Energetyka

MUPASZ 901

smart energy management

Bay control unit

Technical documentation

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Symbols

Electrical warning symbol indicates the presence of hazardous energy circuits or electric shock hazards.

The warning symbol indicates the important information related to the threat to life and health.

The information symbol indicates the clarification of relevant features and parameters of the device.

Safety information

The case must be properly grounded.

Dangerous voltages can occur on the connectors, even though the auxiliary voltage has been disconnected.

National and local electrical safety regulations must always be followed.

Whenever changes are made in the device, measures should be taken to avoid inadvertent tripping.

Exploration of damaged device can result in malfunction of protected object and result in threat to life and health.

Comments

We reserve the right to modify the device.

Device is an industrial monitoring and control instrument.

Remaining user documentation can be downloaded from energetyka.itr.org.pl

The device meets requirements of the of the European Directive ROHS 2011/65/EU

The device after use is electrical and electronic waste, recyclable accordance with European Directive 2012/19/EU (WEEE) on waste electrical and electronic equipment.
The device contains a Li or Li-SOCl2 battery, which is subject to selective collection accordance with European Directive 2013/56/EU.

Contents:

1. General information

1.1 Destination of the equipment

MUPASZ 901 is designated for protecting incoming and outgoing feeder bays in low and medium voltage grids. It may provide full protection against interphase or ground faults.

Fig. 1.1.1 The view of MUPASZ 901 device

The MUPASZ 901 bay controller may have up to 3 bay types (profiles) implemented which may be freely modified and adapted to the user's requirements. Logic function simulator is included. The user may also redesign implemented bay views and usage of 6 signaling diodes.

MUPASZ 901 works with ELF application used to design individual bay operation logic, parameterization of protections, configuration, to read measurements and events, and to control device operation in service mode.

2. Functional tests

2.1 EC directives and harmonized standards

EU Directive applies to:

- on the harmonisation of the laws of the Member States relating to electromagnetic compatibility (EMC) 2014/30/EU;
- on the harmonisation of the laws of the Member States relating to the making available on the market of
- electrical equipment designed for use within certain voltage limits (LVD) 2014/35/EU
- on the restriction of the use of certain hazardous substances in electrical and electronic equipment 2011/65/EU

Tab. 2.1.1 Harmonized standards:

No. standards	Title of the standard
PN-EN 60255-1:2010	Measuring relays and protection equipment - Part 1: Common requirements
PN-EN 60255-26:2014	Measuring relays and protection equipment - Part 26: Electromagnetic compatibility requirements
PN-EN 60255-27:2014	Measuring relays and protection equipment - Part 27: Product safety requirements
PN-EN 60529:2003	Degrees of Protection Provided by Enclosures (IP Code)
PN-EN 50581:2013-03	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

2.2 Electromagnetic compatibility

Table 2.2.1 Emission tests

Port	Frequency range	Limits	Basic standard
Enclosure port	30 MHz – 230 MHz	40 dB(µV/m) quasi peak at 10 m	CISPR 11
	230 MHz – 1000 MHz	47 dB(µV/m) quasi peak at 10 m	
Auxiliary power supply port	0.15 MHz – 0.5 MHz	79 dB(µV) quasi peak	CISPR 22
		66 dB(µV) average	
	0.5 MHz – 30 MHz	73 dB(µV) quasi peak	
		60 dB(µV) average	

2.2.1 Immunity

Table 2.2.1.1 Communication ports

Environmental phenomena	Test specification	Description	Basic standard	Acceptance criteria
Conducted disturbance induced by radio-frequency fields	Frequency sweep		PN-EN 61000-4-6	A
	0,15-80 MHz	Frequency range		
	10 V	r.m.s.		
	80 %AM (1kHz)	Amplitude Modulated		
	150 Ω	Source impedance		
	Spot frequencies			
	27 MHz, 68 MHz	Frequencies		
	10 V	r.m.s.		
	80 %AM (1kHz)	Amplitude Modulated		
	150 Ω	Source impedance		
	100 %	Duty cycle		
Fast transient – Zone A	5/50 ns	Tr/Th	PN-EN 61000-4-4	B
	5 kHz	Repetition frequency		
	2 kV	Peak voltage		
Slow damped oscillatory wave	1 MHz	Voltage oscillation frequency	PN-EN 61000-4-12	B
	75 ns	Tr - Voltage rise time		
	400 Hz	Repetition frequency		
	200 Ω	Output impedance		
	0 kV	Differential mode - peak voltage		
	1 kV	Common mode - peak voltage		
Surge - Zone A	1,2/50 (8/ 20) µs	Voltage (current) rise time / time to half value Tr /Th	PN-EN 61000-4-5	B
	4 kV	Line-to-earth		
	2 Ω	Source impedance		

Table 2.2.1.2 Input and output ports (including measuring ports)

Environmental phenomena	Test specification	Description	Basic standard	Acceptance criteria
Conducted disturbance induced by radio-frequency fields	Frequency sweep		PN-EN 61000-4-6	A
	0,15-80 MHz	Frequency range		
	10 V	r.m.s.		
	80 %AM (1kHz)	Amplitude Modulated		
	150 Ω	Source impedance		
	Spot frequencies			
	27 MHz, 68 MHz	Frequencies		
	10 V	r.m.s.		
	80 %AM (1kHz)	Amplitude Modulated		
	150 Ω	Source impedance		
	100 %	Duty cycle		
Fast transient – Zone A	5/50 ns	Tr/Th	PN-EN 61000-4-4	B
	5 kHz	Repetition frequency		
	4 kV	Peak voltage		
Slow damped oscillatory wave	1 MHz	Voltage oscillation frequency	PN-EN 61000-4-12	B
	75 ns	Tr - Voltage rise time		
	400 Hz	Repetition frequency		
	200 Ω	Output impedance		
	1 kV	Differential mode - peak voltage		
	2,5 kV	Common mode - peak voltage		
Surge - Zone B	1,2/50 (8/ 20) µs	Voltage (current) rise time / time to half value Tr /Th	PN-EN 61000-4-5	B
	1 kV	Line-to-line		
	2 kV	Line-to-earth		
	2 Ω	Source impedance		
Power frequency - Zone B (concerns only binary inputs)	Differential mode 100 V	Test voltage (r.m.s.) - Line-to-line	PN-EN 61000-4-16	A
	Common mode 300 V	Test voltage (r.m.s.) - Line-to-earth		

Table 2.2.1.3 Auxiliary power supply port

Environmental phenomena	Test specification	Description	Basic standard	Acceptance criteria
Conducted disturbance induced by radio-frequency fields	Frequency sweep		PN-EN 61000-4-6	A
	0,15-80 MHz	Frequency range		
	10 V	r.m.s.		
	80 %AM (1kHz)	Amplitude Modulated		
	150 Ω	Source impedance		
	Spot frequencies			
	27 MHz, 68 MHz	Frequencies		
	10 V	r.m.s.		
	80 %AM (1kHz)	Amplitude Modulated		
	150 Ω	Source impedance		
	100 %	Duty cycle		
Fast transient – Zone A	5/50 ns	Tr/Th	PN-EN 61000-4-4	B
	5 kHz	Repetition frequency		
	4 kV	Peak voltage		
Slow damped oscillatory wave	1 MHz	Voltage oscillation frequency	PN-EN 61000-4-12	B
	75 ns	Tr - Voltage rise time		
	400 Hz	Repetition frequency		
	200 Ω	Output impedance		
	1 kV	Differential mode - peak voltage		
	2,5 kV	Common mode - peak voltage		
Surge - Zone A	1,2/50 (8/ 20) µs	Voltage (current) rise time / time to half value Tr /Th	PN-EN 61000-4-5	B
	2 kV	Line-to-line		
	4 kV	Line-to-earth		
	2 Ω	Source impedance		
A.C. and D.C. voltage dips and voltage interruption 0% corresponds to the complete reduction of supply voltage	0 %	during ≤ 0,5 i 1 periods A.C. or ≤ 50 ms D.C.	PN-EN 61000-4-11 PN-EN 61000-4-29	A
	40 %	during ≤ 10 periods A. C. or ≤ 200 ms D.C.		C (for time longer than specified)
	70 %	during ≤ 25 periods A. C. or ≤ 500 ms D.C.		

Table 2.2.1.4 Enclosure port

Environmental phenomena	Test specification	Basic standard	Acceptance criteria
Radiated radiofrequency electromagnetic field	80-1000 MHz 10 V / m (r.m.s.) 80% AM (1 kHz)	IEC 61000-4-3	A
Electrostatic discharge	contact discharge 6 kV (charge voltage) air discharge 8 kV (charge voltage)	IEC 61000-4-2	B
Power frequency magnetic field	50 Hz or 60 Hz frequency 30 A (r.m.s.) / m - continuous 300 A (r.m.s.) / m - 1 to 3 s	IEC 61000-4-8	A B

2.3 Product safety requirements

Voltage test of solid insulation and insulation resistance measurements for auxiliary power supply, inputs, outputs, communication and measuring circuits:

Table 2.3.1 Product safety

Type of insulation test	Value	Basic standard
Dielectric voltage test 50 Hz or 60 Hz	2,2 kV/AC 1 minute or 3,1 kV/DC 1 minute	PN-EN 60255-27
Peak impulse voltage test	5 kV pulse 1,2/50 µs; 0,5 J	
Insulation resistance	>100 MOhm 500 VDC	

2.4 Climatic environmental tests

Table 2.4.1 Climatic environmental test

Test	Standard	Description
Cold tests	PN-EN 60068-2-1:2009	Minimum operational temperature -20˚C/16 hours Minimum storage temperature -30˚C/16 hours
Dry - heat tests	PN-EN 60068-2-2:2009	Maximum operational temperature +55˚C/16 hours Maximum storage temperature +70˚C/16 hours
Damp - heat tests	PN-EN 60068-2-78:2013-11	+40˚C; 95% rh /10 days

2.5 Mechanical tests

Table 2.5.1 Mechanical tests

Test	Standard	Class
Sinusoidal vibration	PN-EN 60255-21-1:1999	2
Single and multiple shocks and bumps	PN-EN 60255-21-2:2000	2
Seismic	PN-EN 60255-21-3:1999/Ap1:2002P	0

2.6 Degree of protection

Table 2.6.1 Degree of protection

Test	Description	Standard	Degree of protection
Degrees of protection provided by enclosures (IP Code)	Front panel side	PN-EN 60529:2003	IP 65
	Connector side without connectors		IP 20
	Connector side with connectors plugged		IP 30

2.7 Installation requirements

Table 2.7.1 Installation requirements

Definition	Reguirements
Class equipment	1
Overvoltage category	III
Pollution degree	2
Electrical environment	B

3. Technical parameters

3.1 Input circuits

3.1.1 Current input circuits

Number of inputs	3
Rated current In (2 versions)	1 A or 5 A
Long term current-carrying capacity	5 I_n
1-second current-carrying capacity	60 I_n
Dynamic current-carrying capacity	250 I_n
Power consumption at rated current	< 0,6 VA / fazę
Measurement range	≤ 60 I_n
Frequency measurement range based on I1 phase current	43,0 Hz...57,0 Hz

3.1.2 Zero sequence current input circuits

Number of inputs	1
Rated current I0n (6 versions)	0.02 A/ 50 Hz 0.05 A/ 50 Hz 0.1 A/ 50 Hz 0.2 A/ 50 Hz 0.5 A/ 50 Hz 1.0 A/ 50 Hz
Long term current-carrying capacity	5 I0n
1-second current-carrying capacity	50 I0n
Power consumption at rated current	<0.2 VA
Measurement range	5 I0n

3.1.3 Voltage input circuits

Number of inputs	4
Rated voltage Un	100/√3 V
Rated voltage U0n	100 V
Withstand voltage	< 2.5 Un
Power consumption at rated voltage	< 0.2 VA
Measurement range Un	up to 2 Un
Measurement range Uon	up to 2 U0n

3.1.4 Binary inputs

Maximum number of inputs	16
Nominal voltage (5 versions)	DC 24 V DC 48 V DC 110 V DC 220 V AC 230 V

Nominal voltage DC 24 V

Minimum excitation voltage	DC 18 V
Maximu de-excitation voltage	DC 13 V
Current consumption before excitation	< 11 mA
Current consumption after excitation	≤ 5 mA

Nominal voltage DC 48 V	
Minimum excitation voltage	DC 38 V
Maximu de-excitation voltage	DC 26 V
Current consumption before excitation	< 6 mA
Current consumption after excitation	≤ 4 mA

Nominal voltage DC 110V	
Minimum excitation voltage	DC 83 V
Maximu de-excitation voltage	DC 52 V
Current consumption before excitation	< 4 mA
Current consumption after excitation	≤ 2 mA

Nominal voltage DC 220 V	
Minimum excitation voltage	DC 150 V
Maximu de-excitation voltage	DC 92 V
Current consumption before excitation	< 2 mA
Current consumption after excitation	≤ 1 mA

Nominal voltage AC 230 V	
Minimum excitation voltage	AC 134 V
Maximu de-excitation voltage	AC 78 V
Current consumption before excitation	< 2 mA
Current consumption after excitation	≤ 1 mA

3.2 Output circuits

3.2.1 Binary outputs

Maximum number of outputs	6
including relay – semiconductor outputs (high rated power)	3
Relay – semiconductor outputs (high rated power)	
Switching capability at resistance load	DC 250 V; 2A; 0,5 kW AC 380 V; 8A; 2 kVA
Switching rate at maximum contact load	maks. 10/ min.
Contacts material	AgCdO; AgCu/Au; 0,2mm

Relay outputs	
Switching capability AT resistance load	DC 250 V; 0,4 A; 75 W AC 380 V; 8 A; 2000 VA
Switching rate at maximum contact load	maks. 10/ min
Contacts material	AgCdO

3.3 Power supply

Nominal voltage (5 versions)	DC 24 V -20% +10% DC 48 V -20% +10% DC 110 V -20% +10% DC 220 V -20% +10% AC 230 V -20% +10%
Power consumption	<7 W / VA

3.4 Clock

Clock error	≤1,5 min/ month

3.5 Environmental conditions

Temperature operational	-20˚C … +55˚C
Temperature storage	-30˚C … +70˚C
Air humidity	lack of condensation and frost deposition

3.6 Protection level

At front panel side	IP67
At connectors side	IP20
At connectors side with connectors mounted	IP30

3.7 Connectors

Power supply, measurements and communication	WAGO 734-124
Inputs/outputs	Wago 231-114/037-000
Connection wire cross-section area	0.08...2.50 mm^2

3.8 Communication – port COM1

Protocols	MODBUS RTU MODBUS-TCP CANBUS-PPM2
RS485	
Bit rate	9600 bit/s … 230 kbit/s
Parity	none or parity even or parity odd
Stop bit	1bit or 2 bits
Number of bits	8 bit
Optical fiber	
Connector	ST
Fiber	62.5/125 um
Bit rate	9600 bit/s … 1,22 Mbit/s
Parity	none/even/odd
Stop bits	1 or 2
Number of bits	8 bits
Ethernet twisted pair	
Connector	RJ45
Bit rate	10/100 Mb/s

3.9 Engineering port

Connector	USB mini B - hermetic

3.10 Mass and dimensions

Mass	~1.0 kg
Dimensions (width, height, depth)	170/110/103 mm
Dimensions with connectors plugged-in (width, height, depth)	170/110/120 mm
Cut-out dimensions (width, height)	160/100 mm

3.11 Reset to pickup ratios

Reset to pickup ratio for excess protections	0.98
Reset to pickup ratio for under protections	1.02

3.12 Protections accuracy

Protections internal delay	<35 ms
Protections accuracy	5%

3.13 Measurement accuracy

Current measurement accuracy	
current transducer 1 A lub 5 A (0,2 … 8 In)	1%
current transducer 1 A lub 5 A (8 … 60 In)	2%
Zero sequence current measurement accuracy (0,2…5 I_{0n})	1%
Voltage measurement accuracy (0,1 … 2 U_n)	1%
Voltage measurement accuracy (0,1 … 2 U_{0n})	1%
Frequency measurement accuracy (43…57 Hz)	0,01 Hz

3.14 HMI - user interface

Color LCD display	320 x 240 pixeli
ignalling diodes	5 pcs
User programmed diodes (three color)	6 pcs
Buttons (keyboard)	9 pcs
Connection to the control software	See Engineering port

3.15 Control software

Logic Functions Editor	The installation version can be found at: energetyka.itr.org.pl

4. Functional versions

4.1 Nominals

Tab. 4.1.1 Nominals

Nominals			
Name	**Range**	**Default**	**Description**
Current circuits	• I1,I2,I3 • I1,I3 • I1	I1,I2,I3	The parameter telling the numer and installation method of voltage transformers.
Voltage circuits	• U1, U2, U3 • U12, U23 • U12	U1, U2, U3	The parameter telling the numer and installation method of voltage transformers.
In [A]	10 … 10000	100	Primary side nominal current value (upper side of the current transformer).
Ib [A]	10 … 10000	500	The base current value defined as a nominal current for, e.g. motor, generator or transformer.
Un [V]	100… 36000	6000	Phase to phase nominal voltage value at the primary side of voltage transformers.
I0 ratio [A/A]	10 … 250	100	The transformer ratio for zero sequence current.

4.2 Algorithms

Table 4.2.1 Protections and control systems in MUPASZ M900

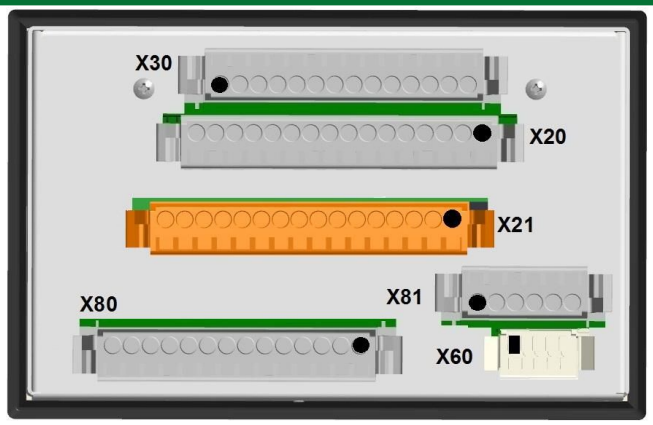
Protections			
Name	**Symbol**	**ANSI**	**Description**
I>	A_IGT	50/51/67/50V/51V 67V/50F/51F/67F	Phase overcurrent, level I
I>>	A_IGT2	50/51/67/50V/51V 67V/50F/51F/67F	Phase overcurrent, level II
I<	A_ILT	37	Phase undercurrent / Loss of the load
IDMT	A_IDMT	51/67	Overcurrent dependent
I0>	A_EF	50N/51N	Overcurrent earth fault, level I
I0>IDMT	A_EFIDMT	51N	Dependent earth fault
I0>dir	A_EFD	67N	Directional earth fault
Y0>	A_Y0GT	21N	Admittance / Conductance / Susceptance
U<	A_ULT	27	Undervoltage
U>	A_UGT	59	Overvoltage
U0>	A_U0GT	59N	Zero sequence overvoltage
Tech	A_DIP	62	Technological working on the binary inputs
Universal	A_UNIVERSAL		Universal working on the binary inputs
Bay ready	A_READY_BAY		Controls bay state
Control and monitoring systems			
Circuit Breaker	A_BREAKER	-	State monitoring system - circuit breaker
Disconnector	A_CONECTOR	-	Control and monitoring system – disconnector
Earthing switch	A_EARTHING	-	Control and monitoring system – earthing switch
Disconnector-earthing switch	A_DISCONNECTOR_EARTHING	-	Control and monitoring system – disconnector-earthing switch
Truck	A_TRUCK	-	Control and monitoring system – truck
Automatics			
OPZ	A_OPZ	-	Reconnected delay

4.3 Measurements

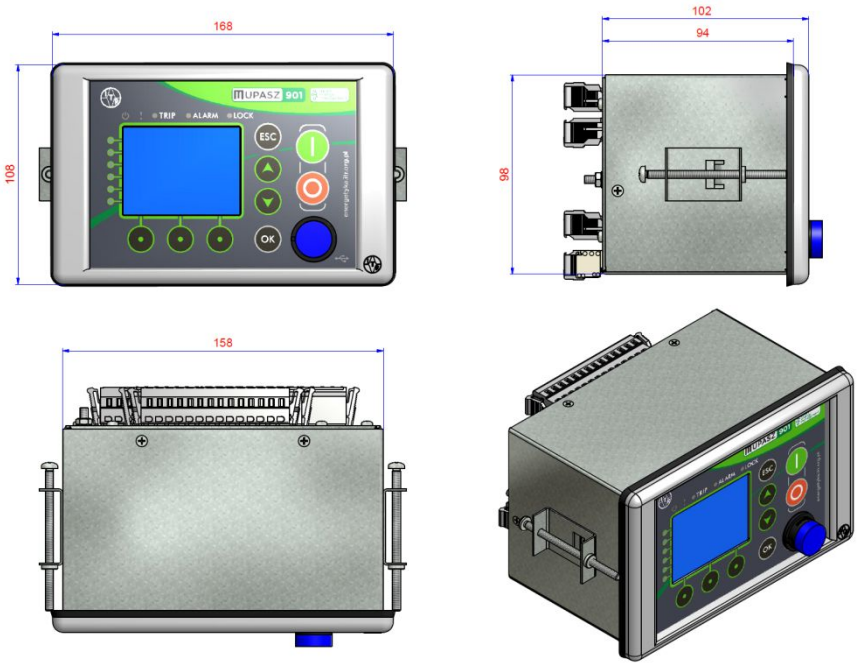
Table 4.3.1 Device measurements

Voltage measurement values	
Measurement value name	**Reference**
RMS value of phase L1 voltage	U1 [V]
RMS value of phase L2 voltage	U2 [V]
RMS value of phase L3 voltage	U3 [V]
RMS value of zero component voltage	U0 [V]
Current measurement values	
RMS value of phase L1 current	I1 [A]
RMS value of phase L2 current	I2 [A]
RMS value of phase L3 current	I3 [A]
RMS value of zero component current	I0 [A]
Power, power factor and frequency measurement values	
Apparent power	S [VA]
Active power	P [kW]
Reactive power	Q [kVar]
Frequency	f [Hz]
Power factor	Cos ϕ
Angle values	
Angle between zero component voltage and current	∡ (U0,I0) [°]
Angle between voltage U1 and current I1	∡ (U1,I1) [°]
Angle between voltage U2 and current I2	∡ (U2,I2) [°]
Angle between voltage U3 and current I3	∡ (U3,I3) [°]
Angle between voltage U1 and U2	∡ (U1,U2) [°]
Angle between voltage U3 and U1	∡ (U3,U1) [°]
Energy, cumulated current, working time meters	
Working time	Tp [h:m]
Active energy negative value	Ec- [kWh]
Active energy positive value	Ec+ [kWh]
Reactive energy negative value	Eb- [kVarh]
Reactive energy positive value	Eb+ [kVarh]
Accumulated current of phase L1 main line	Σ I1 [MA]
Accumulated current of phase L2 main line	Σ I2 [MA]
Accumulated current of phase L3 main line	Σ I3 [MA]

5. Case sizes and sockets placement

Sockets view	Reference	Use
 The view of sockets (16 inputs variant)	X20	8 insulated binary inputs
	X21	8 insulated binary inputs
	X30	6 insulated binary outputs
	X60	RS 422/485 interface
	X80	Power supply and voltage U1, U2, U3, U0 and zero sequence current I0 analogue measurement inputs
	X81	Currents I1,I2 and I3 measurement inputs

Black dot designates pin No. 1



Rys. 5.1 Case dimensions

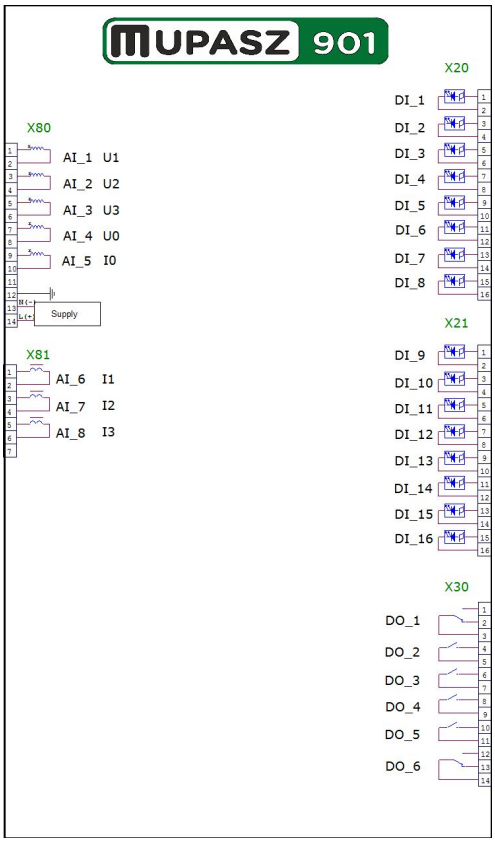


Fig. 5.2 Socket assignment example (8 binary inputs version)

5.1 Schematy aplikacyjne

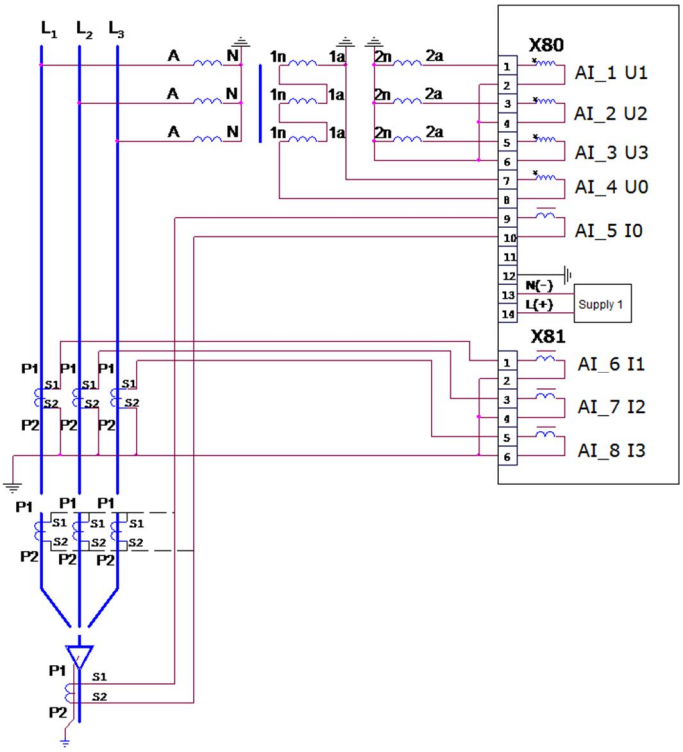


Fig. 5.1.1 Current and voltage transducer connection

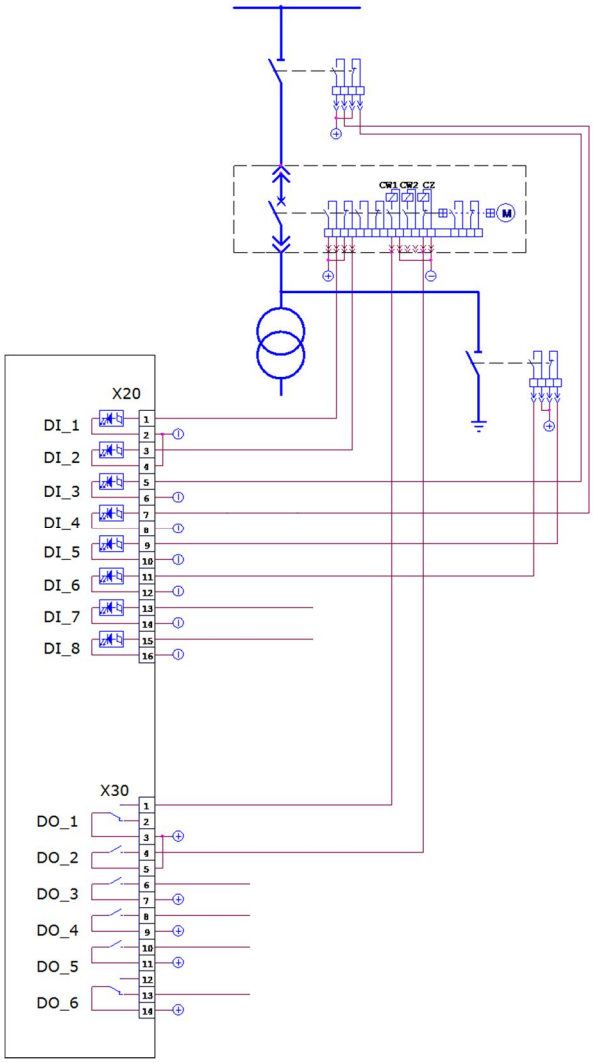


Fig. 5.1.2 State control and breaker control signals

6. Ordering information

	A	B	C	D	E	F
Supply voltage						
DC 24 V	1					
DC 48 V	2					
DC 110 V	3					
DC 220 V	4					
AC 230 V	5					
Binary inputs nominal voltage						
DC 24 V		1				
DC 48 V		2				
DC 110 V		3				
DC 220 V		4				
AC 230 V		5				
Zero sequence current circuits						
0,02 A			1			
0,05 A			2			
0,1 A			3			
0,2 A			4			
0,5 A			5			
1,0 A			6			
Number of binary inputs						
4				1		
6				2		
8				3		
16				4		
Communication port COM						
none					0	
RS485, MODBUS RTU					1	
Fiber optic, MODBUS RTU					2	
Ethernet, MODBUS TCP					3	
2 x RS485 CANBUS; PPM2[1)]					4	
Versions						
Standard version						0
Phase current input nominal value I=1,0 A						1

1) Excludes option D-4

Example:

	Supply voltage	Binary inputs nominal voltage	Zero sequence current circuits	Number of binary inputs	Communication port COM	Version
M901	**A**	**B**	**C**	**D**	**E**	**F**
	1	1	6	1	0	0

MUPASZ 901:

A-1 supply voltage: DC 24 V

B-1 binary inputs nominal voltage: DC 24 V

C-6 zero sequence current circuits: 1,0 A

D-1 number of binary inputs: 4

E-0 communication port: none

F-0 version: standard

7. Contact

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