Energetyka

MUPASZ 101

smart energy management

Bay control unit

Technical documentation

Document version: 01i07
Update: 21/06/2021

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 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.

1.2 Destination of the equipment

MUPASZ 101 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. It works with CR/CRR current transducers (Rogowski coils).

Fig. 1.1.1 The view of MUPASZ 101device

The MUPASZ 101 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 101 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

Table 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 %	during ≤ 0,5 i 1 periods A.C. or ≤ 50 ms D.C.	PN-EN 61000-4-11	A
	40 %	during ≤ 10 periods A. C. or ≤ 200 ms D.C.	PN-EN 61000-4-29	C
	70 %	during ≤ 25 periods A. C. or ≤ 500 ms D.C.		

0% corresponds to the complete reduction of supply voltage				(for time longer than specified)

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 -55˚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 67
	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 Rogowski coils input circuits

Number of inputs	3
Transformation coefficient (sensitivity)	0.5 .. 5 mV/A 50 Hz
Measurement range	~4 mV...10 V

S [mV/A] *conversion factor (sensivity)*	CR 05-55	CR 1-25	CR 1-55	CR 1-78	CR 1-120	CR 2-25	CR 2-55	CR 2-78	CR 3-55	CR 6-55	CRR 1-50
f = 50 Hz	0,520	1,081	1,046	1,039	1,146	2,165	2,098	2,082	3.182	1,046	3.182
f = 60 Hz	0,624	1,298	1,255	1,249	1.375	2,598	2,596	2,498	3.818	1,255	3.818

Further information about CR/CRR transducer is available on energetyka.itr.org.pl

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	do 5 I0n

3.1.3 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	-55˚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 – engineering port

Connector	USB (version 2.0 full speed, miniUSB socket, type B)
Software tool:	Logic Function Editor (ELF2)

3.9 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

3.10 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	
CR/CRR transducer (0,2 … 2 In)	0,5%

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 Algorithms

Table 4.1.1 Protections and control systems in MUPASZ M101

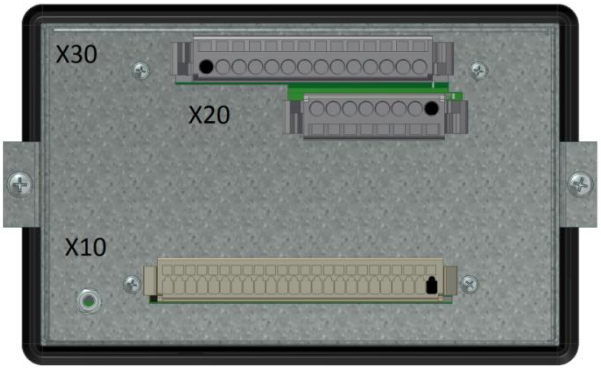
Protections			
Name	**Symbol**	**ANSI**	**Description**
I>	A_IGT	50/51/67/50V/51V 67V/50F/51F/67F	Phase overcurrent, level I
I>>	A_IGT2	50/51/67/50V/51V 67V/50F/51F/67F	Phase overcurrent, level II
I>>>	A_IGT3	50/51	Phase overcurrent, level III
I>IDMT	A_IDMT	51/67	Overcurrent dependent
I0>	A_EF	50N/51N	Overcurrent earth fault, level I
I0>zależne	A_EFIDMT	51N	Dependent earth fault
I2f>	A_TID	-	Magnetizing current detector
Tech	A_DIP	62	Technological working on the binary inputs
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

4.2 Measurements

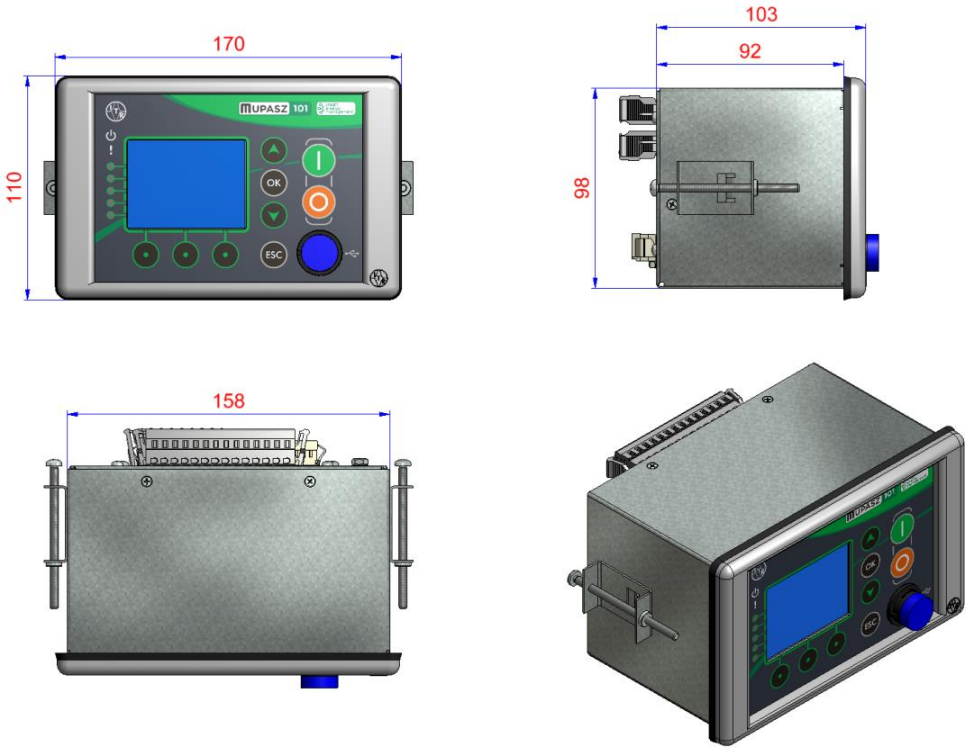
Table 4.2.1 Device measurements

Measurement value name	Reference
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 sequence current	I0 [A]
Counters of energy, accumulated currents and bay operation time	
Bay operation time	Bay work time [h:m]
Main line L1 phase accumulated current	Σ I1 [MA]
Main line L2 phase accumulated current	Σ I2 [MA]
Main line L3 phase accumulated current	Σ I3 [MA]

5. Case sizes and sockets placement

Sockets view	Reference	Use
 8 binary inputs sockets view	X20	4 insulated binary inputs
	X30	6 insulated binary outputs
	X10	Power supply, current and zero sequence current I0 analogue measurement inputs, RS 422/485 interface

Black dot designates pin No. 1



Rys. 5.1 Case dimensions

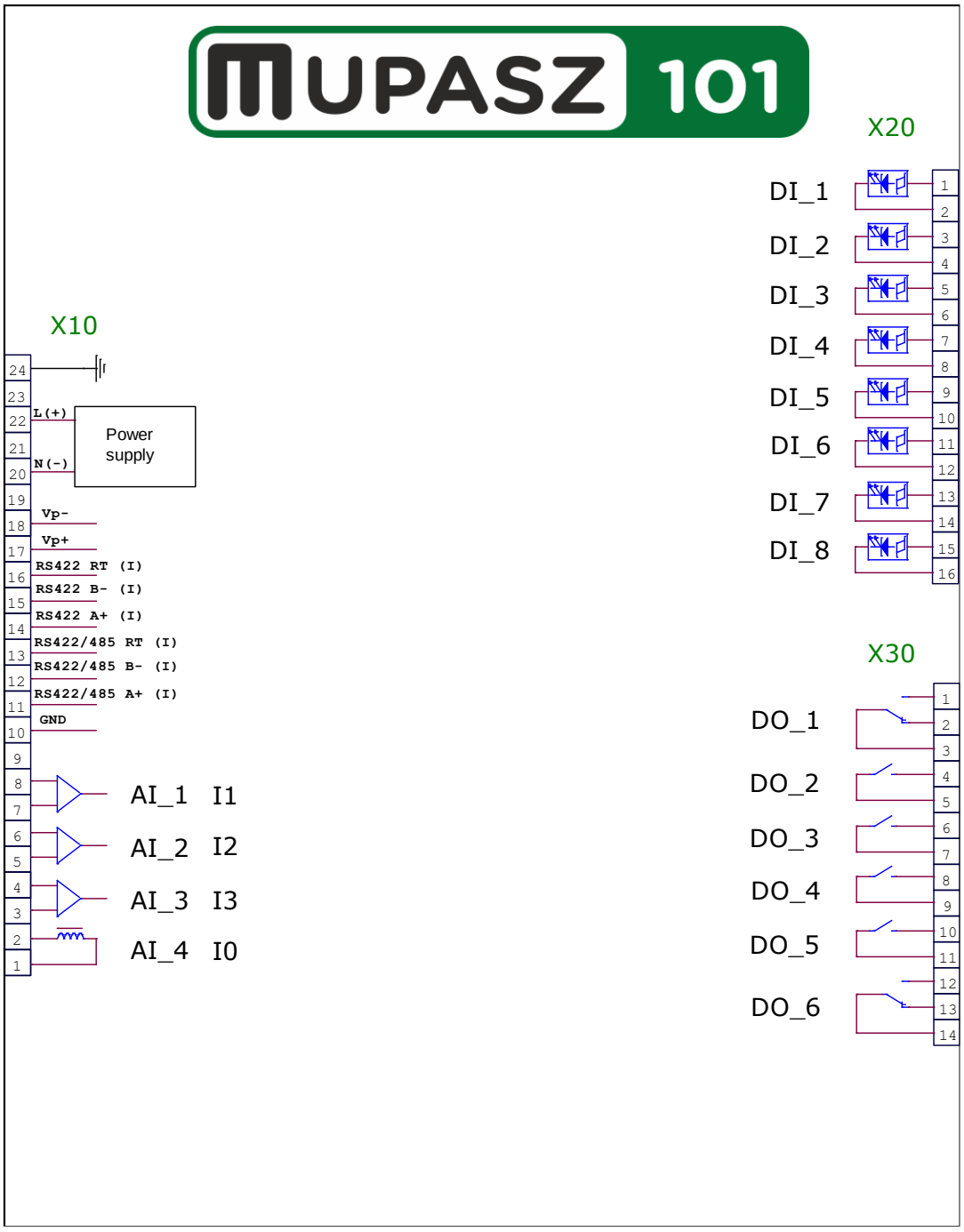


Fig. 5.2 Socket assignment example (8 binary inputs version)

6. Ordering information

	A	B	C	D	E
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			
AV 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	
8				3	
16				4	
Communication port COM					
none					0
RS485, MODBUS RTU					1
Fiber optic, MODBUS RTU					2
Ethernet, MODBUS TCP					3
2xRS485 CANBUS; PPM2[1)]					4
RJ45; DNP3.0					5

1) Excludes the use of 16 binary inputs (option D-4)

Example:

	Supply voltage	Binary inputs nominal voltage	Zero sequence current circuits	Number of binary inputs	Communication port COM	Version
M101	**A**	**B**	**C**	**D**	**E**	**F**
	1	1	6	1	0	0

MUPASZ 101:

A-1 supply voltage: 24 V DC

B-1 binary inputs nominal voltage: 24 V DC

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

D-1 number of binary inputs: 4

E-0 communication port: none

7. Contact

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