

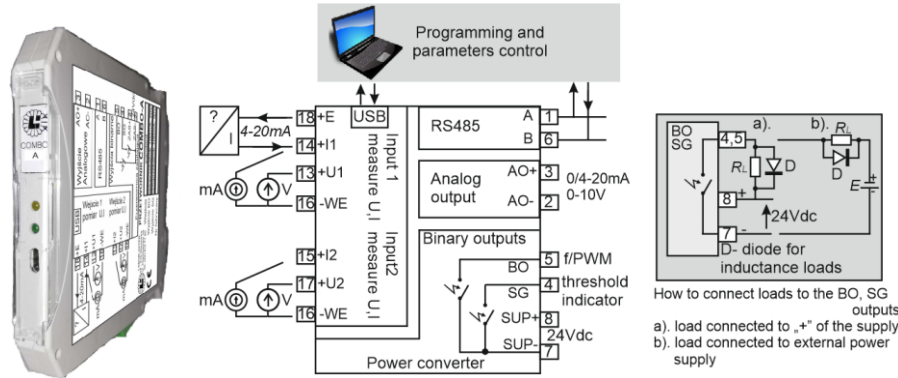
LABOR – ASTER

INDUSTRIAL AUTOMATION



ANALOG CONVERTER, ANALOG SEPARATOR, FREQUENCY CONVERTER, PWM CONVERTER, THRESHOLD INDICATOR

COMBO-A



- Versatility of applications.
- Programming of all functions and measurement range from the “Labor Programmer” program by the user via USB.
- Accurate measurement of two analog values type 0/4...20mA, 0...10V etc.
- Possibility to enter your own tabular approximation (10 points) and use it as a conversion in the characteristics of analog values.
- Reading of two values from other devices with MODBUS (RS485) protocol in any format and using them to control the output signal or indicate exceeding value with the alarm output.
- Control of square wave output frequency and/or PWM duty cycle.
- Input auxiliary power supply for one two-wire transmitter.
- Programmable threshold indicator.
- Galvanic separation between circuits inputs / output / supply / RS485.

APPLICATION EXAMPLES

- Frequency generation from various signal sources.
- PWM generation from various signal sources.
- Simultaneous control of PWM duty cycle and its frequency.
- 2-channel threshold indicator of input signals.
- 2-channel threshold indicator of values read from other devices. Maximum reading frequency every 110ms at a transmission speed of 115200 bd.
- Measurement of 2 analog values and making them available via MODBUS (RS485) and USB.
- Supplier-separator for two-wire transmitter.

And many more within user-defines device resources.

TECHNICAL PARAMETERS

1.	Dimensions	-	12,5 x 99 x 114,5mm
2.	Mounting	-	on TS35 rail
3.	Power supply USB	-	21V±28V / 70mA max 5V (<0.1A)
4.	USB connector	-	USB-B micro
5.	Analog input 1 and 2:	current voltage input measurement class measurement thermal drift sampling frequency	-2...30mA / 50Ω -1...30V / 200kΩ 0,05% 0,002%/°C 0.5 sec
6.	Input current loop supply voltage	-	18V (14V @ 20mA)
7.	Analog output AO (as ordered):	class output thermal drift	- 0,2/4...20mA / ≤600Ω 0,1...10V / ≥2kΩ 0,1% 0,002%/°C
8.	Output response time to input signal jump	-	delay time: 0.5 sec rising time: 0.1 sec (see oscillogram on page 3)
9.	Binary output BO frequency, PWM or threshold indicator	-	Transoptor 50V / 50mA fmax=20kHz if for: E=5V, "0"<3V, "1"=5V: R _L = 2kΩ...20kΩ E=12V, "0"<1V, "1"=12V: R _L = 1kΩ...20kΩ E=24V, "0"<0,5V, "1"=24V: R _L = 1kΩ...20kΩ (for other parameters of BO circuit fmax=20kHz is possible after agreement)
10.	Frequency range	-	Programmable 0,001Hz...fmax [Hz] fmin=fmax/4000
11.	PWM duty cycle range signal reaches 0% and 100% of the duty cycle but correct performing depends on programmed PWM frequency	-	Programmable 0,5...99,5% for f≤10Hz 3...97% for f≤300Hz
12.	Alarm output SG	-	Optorelay 50V / 100mA
13.	Operation indication Transmission indication	-	Green LED Yellow LED
14.	RS485 transmission speed Constant parameters:	-	300...115200 8bit, no parity, 1 stop bit
15.	Cable connectors	-	0,5 ...1,5mm ²
16.	Insulation test voltage	-	2kV
17.	Working conditions:	-	- Ambient temperature - storing: -30°C...+60°C - Ambient temperature - working: -25°C...+60°C - Relative humidity: max 90%, no water vapor condensation - Ambient atmosphere: free from dust and aggressive fumes
18.	EMC requirements Safety requirements	-	PN-EN 61010-1:2002 PN-EN 61326-1

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Edition 07 / 2024

OPERATION DESCRIPTION

The device measures two analog values (U/I) with a very accurate 18-bit Delta-Sigma converter. The method of using the inputs, as well as the measurement subranges, depends on the user's settings. The device has an input auxiliary power supply which can be used to connect one two-wire 4-20mA transmitter.

The device can read two values from other devices in any format using the MODBUS protocol through the RS485 interface.

One of the input value can be processed by 10-point tabular function with linear approximation. Resource usage and conversion parameters are user defined.

The device has two binary outputs. One is universal (threshold indicator, frequency generator, PWM generator) and the other can be used only as threshold indicator.

In addition, the device has one analog current or voltage output. The type of the output is factory set (user cannot change the type).

The signal source for each of the outputs can be any signals measured by this converter or read from other devices. The user decides on the use.

All measured values are available through the RS485 interface using the MODBUS protocol, both in a simplified form (conversion of the input value into a control signal of 0...10000 and made available as a single MODBUS register – a 16-bit integer with a sign) and full (single precision real variables seen as 2 registers according to the standard IEEE764).

The converter can be configured using the "Labor Programmer" program (which is available to download at www.labor-automatyka.pl) directly from the computer via the USB port. To configure the converter, use any PC computer with Windows 7/8/10 and USB port with installed our driver. Configuration can be done without an external 24Vdc power supply, the device can be powered only from USB. In this case, only analog input measurement works.

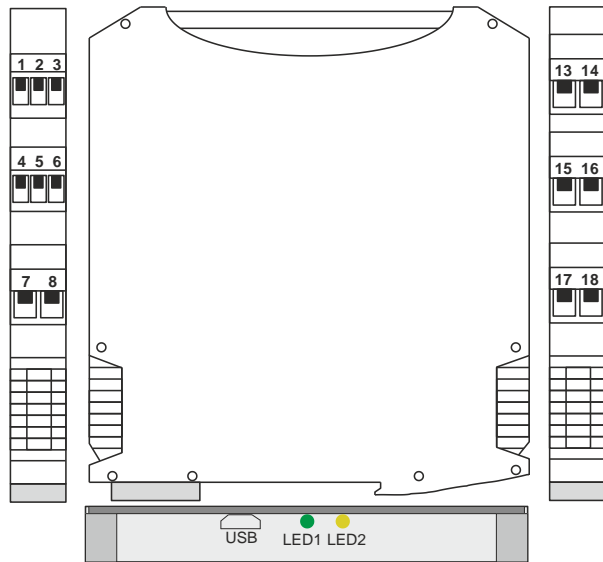
The green LED on the front panel is lit continuously. If the USB interface is connected, this LED starts flashing with a frequency of about 1Hz. This indicates that the programming mode is turned on. In this mode it is possible to program all functions. There is a possibility of tampering with the calibration registers, therefore it is recommended to use the "Labor Programmer" program to set the

operating parameters. If programmed frequency parameters are impossible to implement, the green LED blinks very quickly and the function is not performed.

To connect the USB interface, open the flash and connect the micro USB-B cable to the socket. After connecting, the yellow LED will start flashing for a moment. After a while, the system will show a COM interface called "**Virtual ComPort for Labor**" (if the driver has been installed correctly).

The yellow LED flashes with short pulses in the case of transmission via USB, as well as in the case of transmission via the RS485 interface, both when reading external devices and when reading from this device.

The construction of the converter is suitable for installation on the TS35 mounting rail in a control cabinet.



Placement of the connection terminals.

Map of shared registers

The registers are available both via the USB interface and via the RS485 interface (in "slave" mode).

Register number ^[1]	Format	Description
1	I16 ^[2]	Analog input 1 control signal in [0,01%] i.e. from 0 to 10000. ^[3]
2	I16	Analog input 2 control signal in [0,01%] i.e. from 0 to 10000.
5	I16	Analog output control signal in [0,01%] i.e. from 0 to 10000.
7	I16	Input 1 voltage value in [0,01V].
8	I16	Input 1 current value in [0,01mA].
9	I16	Input 2 voltage value in [0,01V].
10	I16	Input 2 current value in [0,01mA].
11	I16	Read/wrote remote control signal ^[4] channel 1 in [0,01%] i.e. from 0 to 10000.
12	I16	Read/wrote remote control signal channel 2 in [0,01%] i.e. from 0 to 10000.
63,64	F ^[5]	Input voltage measured for analog input 1.
65,66	F	Input current measured for analog input 1.
71,72	F	Precision control of analog input 1.
73,74	F	Input voltage measured for analog input 2.
75,76	F	Input current measured for analog input 2.
81,82	F	Precision control of analog input 2.
115,116	F	Read variable value converted to a single precision real variable input 1.
125,126	F	Read variable value converted to a single precision real variable input 2.

After programming the desired functions it is recommended to reset the device by power supply commutation (disconnect the 24Vdc power supply cable and USB cable for at least 10 sec).

¹ Address of a register is a value sent in the MODBUS protocol. Number of a register is a value greater by 1 than its address. Example: register number 5 has address 4

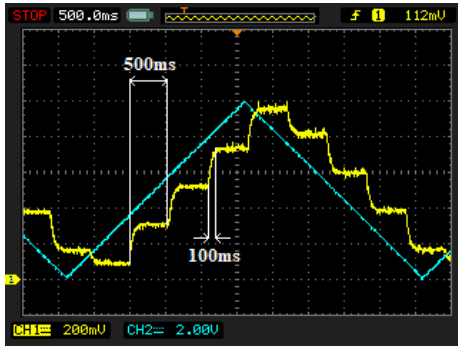
² Signed integer format. Negative values are allowed.

³ Negative scale values are allowed. For example, for the 4-20mA standard, a value below 0 defines an out of range. The control value is limited by software from -100 to 11000. The control value of 0.00% and 100.00% is programmable by the user within the measurement capabilities of the device.

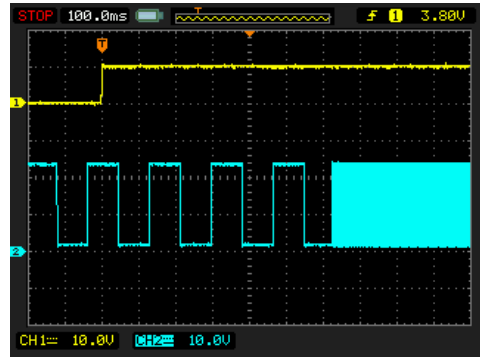
⁴ This value can be write using the RS485 interface with the MODBUS protocol. After writing, it will be converted according to the programmed function.

⁵ Binary format of a single precision floating point number according to the IEEE764 standard. Reading is possible with advanced programs according to the latest MODBUS protocol specifications (standards under development). The order of the bytes in the registers is natural which is from the youngest to the oldest. Register younger address: <LSB><byte1>. Register older address: <byte2><MSB>

Output response to input signal change.



Blue waveform – signal 0...10V from a generator.
Yellow waveform – 4...20mA output from COMBO-A at 50Ω shunt



Yellow waveform – signal 0...10V from a generator.
Blue waveform – frequency output BO from COMBO-A

Below are program windows with all programmable parameters of the device.

Write to device / Read from device

No reading from external devices / Remote reading

9999	[0.01%]	Steering of analog input 1
21,10928	[V]	Input voltage 1
19,99965	[mA]	Input current 1
4999	[0.01%]	Steering of analog input 2
12,66494	[V]	Input voltage 2
11,99895	[mA]	Input current 2
9999	[0.01%]	Steering of analog output
19,9984	[mA/V]	Current/voltage set on analog output
State of BO alarm output (for indicator function)		
State of SG alarm output		
0	[0.01%]	Remote read steering channel 1
0		Remote read value channel 1
0	[0.01%]	Remote read steering channel 2
0		Remote read value channel 2
0		Result of table function
2540	[0.01°C]	Temperature of the device

Remote readout to the device

Zapis do urządzenia / Odczyt z urządzenia

Gold -> Operational parameters of serial interface
Blue -> Readout parameters for channel 1
Red -> Readout parameters for channel 2

65 MODBUS address for readout in slave function
8 bits (default) Length of the word
1 stop bit Number of stop bits slave/master

0 Device address for channel 1
0 Register address (from 0) for readout of channel 1
0 Time for readout

16 bit signed integer Variable format
Transmitted first youngest 16b register Order of the variable
Order in register MSB-LSB Order of the bytes

Test mode enabled (special frame is sent)

Readout with 0x04 (Read Input Register) Readout request
0 Start value for steering 0.00%
0 End value for steering 100.00%

0 Device address for channel 2
0 Register address (from 0) for readout of channel 1
0 Time for readout

16 bit signed integer Variable format
Transmitted first youngest 16b register Order of the variable
Order in register MSB-LSB Order of the bytes

Test mode enabled (special frame is sent)

Readout with 0x03 (Read Holding Register) Readout request
0 Start value for steering 0.00%
0 End value for steering 100.00%

Parameters of analog input and output

Zapis do urządzenia / Odczyt z urządzenia

Red -> Operating parameters of analog input 1
Green -> Operating parameters of analog input 2
Blue -> Operating parameters of analog output

Passive current measurement Analog input 1
20 [V]/[mA] Voltage/current value for steering 100.00%
0 [V]/[mA] Voltage/current value for steering 0.00%

Passive current measurement Analog input 2
20 [V]/[mA] Voltage/current value for steering 100.00%
0 [V]/[mA] Voltage/current value for steering 0.00%

Steering of analog input 1 Source of analog output
2000 [0.01%] Minimum signal (2000 for 4-20mA)
10000 [0.01%] Maximum signal (10000 for 4-20mA)

Selected-output defined
Selected-current output; empty-voltage output

Parameters of binary outputs

Write to device / Read from device

Black -> Operating parameters of BO binary output
Green -> Operating parameters of SG binary output

PWM duty cycle transducer (PWM) Function of BO
Remote read steering channel 1 Source
Steering of analog input 2 Control of PWM frequency
0 Scale: >1 is multiplication, <0 is division

Reversed steering: 100%..0%
Lower threshold on/off (TI)
Upper threshold on/off (TI)
Hysteresis for each threshold on/off (TI)
Minimal output activation time on/off (TI)

4000 [0.01%] Lower threshold (output closed when source value < ...) (TI)
8000 [0.01%] Upper threshold (output closed when source value > ...) (TI)
10 [0.01%] Hysteresis (TI)
5000 [mS][0.01%] Switch-on time (TI) starting duty cycle (F)
100 [Hz][0.01%] Minimal frequency (F/PWM)
0 [10^..] Min frequency exponent (F/PWM)
200 [Hz] Maximal frequency (F/PWM)
0 [10^..] Max frequency exponent (F/PWM)
1000 [0.01%] Minimal duty cycle (PWM)
9000 [0.01%] Maximal duty cycle (PWM)

Threshold indicator Function of SG
Steering of analog input 2 Source

0 Scale: >1 is multiplication, <0 is division
Reversed steering: 100%..0%
Lower threshold on/off
Upper threshold on/off
Hysteresis for each threshold on/off
Minimal output activation time on/off

4000 [0.01%] Lower threshold (output closed when source value < ...)
8000 [0.01%] Upper threshold (output closed when source value > ...)
10 [0.01%] Hysteresis
1000 [mS] Switch-on time

Table function

Write to device / Read from device

This window supports approximation table function.
Values are saved as floating point variables.
On the left is function argument.
On the right is result of table conversion function.

Steering of analog input 1 Source of table function
10 points Number of defined approximation points

Argument p. 1	Argument p. 2	Argument p. 3	Argument p. 4	Argument p. 5	Argument p. 6	Argument p. 7	Argument p. 8	Argument p. 9	Argument p. 10	Result p. 1	Result p. 2	Result p. 3	Result p. 4	Result p. 5	Result p. 6	Result p. 7	Result p. 8	Result p. 9	Result p. 10
1000										100									
2000										200									
3000										300									
4000										400									
5000										500									
6000										600									
7000										700									
8000										800									
9000										5000									
1000										10000									

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ORDERING CODE:

	Output type	Analog input 1	Analog input 2	Analog output	Binary output 1	Binary output 2	Tabular characteristics
CONVERTER COMBO-A	-WY(t)	-AI1(s,r)	-AI2(s,r)	AO(i,s,r)	-SG1(i,m,a,h) -PWM(i,fr,st,en) -F(i,fst,fen,w)	-SG2(i,m,a,h)	-CH((r1,t1)..)

It is necessary to define the type of output. Other parameters are programmable and can be pre-programmed at the customer's request.

Value coding

WY	t	-	Type of output signal sygnału wyjściowego.
	I	-	Current output e.g. 0-20mA, 4-20mA.
	U	-	Voltage output e.g. 0-10V.
AI1(s,r)	s	-	Beginning value of analog input. Specify current or voltage with unit. E.g. 4mA, 0V.
AI2(s,r)	r	-	Ending value of analog input. Specify similar to "s" e.g. 20mA, 10V.
AO(i,s,r)	i	-	Source of control signal of analog output.
	AI1	-	Analog input 1.
	AI2	-	Analog input 2.
	W1	-	Value 1 sent/read to the device from RS485 interface.
	W2	-	Value 2 sent/read to the device from RS485 interface.
	s	-	Beginning value of analog output. Specify current or voltage with unit. E.g. 4mA, 0V.
	r	-	Ending value of analog output. Specify similar to "s" e.g. 20mA, 10V.
SG1(i,m,a,h)			Parameters for threshold indicator 1 on binary output. Alternative to PWM and F .
	i	-	Source of control signal. Similar to AO .
	AI1	-	Analog input 1.
	AI2	-	Analog input 2.
	AO	-	Analog output.
	W1	-	Value 1 sent/read to the device from RS485 interface.
	W2	-	Value 2 sent/read to the device from RS485 interface.
	m	-	Value below which the alarm will be turned ON.
	a	-	Value above which the alarm will be turned ON.
	h	-	Hysteresis of the threshold.
PWM(i,fr,st,en)			Parameters of PWM signal on binary output. Alternative to SG1 and F .
	i	-	Source of control signal. Similar to AO .
	fr	-	Operation frequency in Hz (below 500Hz).
	st	-	Beginning of duty cycle range.
	en	-	Ending of duty cycle range.
F(i,fst,fen,w)			Parameters of frequency signal on binary output. Alternative to SG1 and PWM .
	i	-	Source of control signal. Similar to AO .
	fst	-	Beginning of frequency range (minimal). In case of not specifying or 0 the value is equal to fen/4000.
	fen	-	Ending of frequency range (maximal) (below 500Hz).
	w	-	Duty cycle. Default 50%.
SG2(i,m,a,h)			Parameters for threshold indicator 2 on alarm output. Coding similar as for SG1 .
CH((r1,t1)..)			Input characteristics. Specify minimum 2 points, maximum 10 points.
	r1	-	Current value in mA or voltage value in V. Floating point value.
	t1	-	Result value of the processing in control units (0...10000). Floating point value.
	...	-	Next points (r2,t2)(r3,t3) etc.

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