Transmitters with PWM output - type RW1

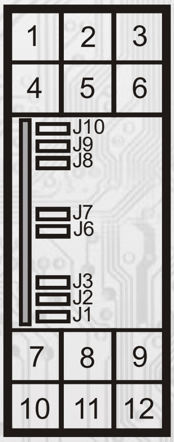
- PWM output 0÷100%
- PWM freqency ,4Hz÷10kHz
- Input selection: (Pt100, Pt1000, Ni 1000, 0÷100Ω, 0÷1000Ω, 0÷5V, 0÷10V, 4÷20mA, 0÷20mA)
- Configuration using PC (the MBSet program)
- Modbus RTU communication over RS485 line

Description:

The transmitters type RW1 are intended for signal conversion from resistive temperature sensors Pt100, Pt500, Pt1000, Ni1000, Ni10000 and active signals 4 to 20mA or 0 to 10V to the output PWM.

Basic technical parameters

Arrangement of jumpers and connectors



jumper J1÷J3 … konfigurace vstupu
jumper J6 . povolení zápisu konfiguračních hodnot
jumper J7 . definice diagnostického síťového módu
jumper J8…definice klidového stavu (vodič A),
jumper J9…definice klidového stavu (vodič B),
jumper J10…zakončovací rezistor 120R

Svorka 1... kladná svorka napájení (Ucc)
Svorka 2... záporná svorka napájení (GND)
Svorka 3... výstup PWM signálu
Svorka 4... RS485 - A
Svorka 5... RS485 - B
Svorka 6... GND
Svorky 7÷12... vstupní signál (obr.3)

Supply voltage (Ucc)	12 to 30 VDC
Current consumption	max. 40 mA (Rz ≥ 10 kΩ)
Type of input signal (max- temperature range)	Ni1000/5000ppm (-50 ÷ 200°C) Ni1000/6180ppm (-50 ÷ 200°C) Pt1000/3850ppm (-50 ÷ 400°C) Pt100/3850ppm (-50 ÷ 400°C) 0 ÷ 1000Ω (max.1700Ω) linear 0 ÷ 100Ω (max.170Ω) linear 0 ÷ 10V linear 0 ÷ 5V linear 4 ÷ 20mA linear 0 ÷ 20mA linear
Input resistance	input signal voltage: 130 kΩ input signal current: 120 Ω
Max. measurement current	Ni1000, Pt1000, 0 ÷ 1000Ω: 100μA Pt100, 0 ÷ 100Ω: 1 mA
Output	PWM 0 ÷ 100 %
PWM frequency	1,4 Hz ÷ 10 kHz
Resolution PWM/PWM frequency	16 bits / 1,4Hz÷366Hz 8 bits / 366Hz÷10kHz
Voltage output level	Hi ≈ Ucc, Lo ≈ 0V
Max. output curent	100 mA
Output rezistance	≈ 220 Ω
Load resistance Rz	≥ 10 kΩ
Galvanic separation of PWM output	no
Communication	RS485, protocol ModBus RTU
Communication speed	1200 ÷ 19200 Bd
Configuration program (freeware)	www.regmet.cz, REGMET MBSet
Galvanic separation of RS485	no
Range of recommended working temp	-30 ÷ 50 °C
Range of recommended storage temp.	-30 ÷ 70 °C
Relative humidity	< 80 %
Protection type of terminals	IP20
Terminal board	wires max. 2,5 mm²
Dimension	85 x 22,5 x 65 mm

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Function description

Input signal measurement and conversion to PWM signal:
The input signal is evaluated by the electronics, which converts this value to the PWM output signal as per the parameters set in **EXTENDED REGISTERS - viz Map X RAM (EXTENDED REGISTERS)**.

The current temperature value is sent over the RS485 line in the form of a 16-bit number with a signed integer multiplied by a constant 10.

Properties of the communication protocol
Protocol Modbus RTU with adjustable Baud rate 1200 - 57600 Bd, 8 bits, no parity, 1 stop bit, line RS485, half-duplex operation

Description of data registers
Reading of these registers is done using **command 03**. (0x03 Read Holding Registers).

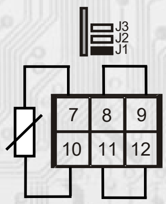
Registr 0x0001 ** : current input value. Range is 2 bytes, for temperature sensors form of number with sign (signed integer) multiplied by the constant 10 ((0x0001 = 0,1°C, 0xFFFF = -0,1°C). In case of fault of the analogue input (short circuit or interruption of the temperature probe), the sensor transmits the value 0x7FFF = 32767dek.

Input HW configuration:

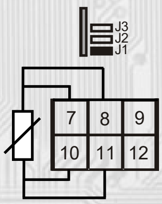
is done with jumpers J1 and J3, which are accessed by removing the front panel:

input signal \ jumper	J1	J2	J3
Ni1000, Pt1000, 0 ÷ 1000Ω, Pt100, 0 ÷ 100Ω	**ON**	OFF	OFF
0 ÷ 10V, 0 ÷ 5V	OFF	OFF	**ON**
4 ÷ 20mA, 0 ÷ 20mA	**ON**	**ON**	**ON**

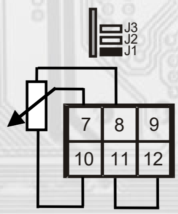
Input signal connection (fig.3):



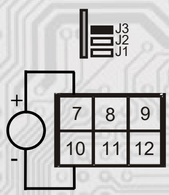
Ni1000,Pt1000,Pt100,
0 ÷ 100Ω, 0 ÷ 1000Ω
Two-wire connection



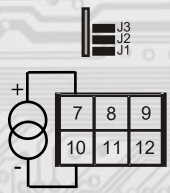
Ni1000,Pt1000,Pt100,
0 ÷ 100Ω, 0 ÷ 1000Ω
Connection with compensative loop



0 ÷ 100Ω, 0 ÷ 1000Ω
Three-wire connection



0 ÷ 10V, 0 ÷ 5V



4 ÷ 20mA, 0 ÷ 20mA

Input SW configuration:

is done with command 16 (0x10 Preset Multiple Registers) when J6 and J7 are short (accessible after removing the front panel).
In this case the transmitter has the address 255 and communication speed 19200Bd.

Map X RAM (EXTENDED REGISTERS):

EXTENDED REGISTERS can only be modified if the J6 jumper (enabling writing the configuration values) and J7 jumper (setting the fixed sensor address to 255 and setting the baudrate to 19 200 Bd - these network variables are reserved for configuration only and, therefore, if the required sensor address of 255 is set, the sensor modifies to 254 automatically) are inserted. In case only the J7 jumper is inserted, it is possible to use a fixed address and baudrate without the risk of overwriting the configuration parameters.
The configuration is carried out by command 16 (multiple register preset 0x10). The changes are written and configuration is finished by extracting the J6 and J7 jumpers. No reset is necessary for proper function.
X Reg = 8 bytů, ie 4 registry MODBUS

Obsah X Reg								Rozsah adres X Reg **	
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	[hex]	[dek]
F_BIT	-	ZD_TEXT/0	ZD_TEXT/1	ZD_TEXT/2	ZD_TEXT/3	ZD_TEXT/4	ZD_TEXT/5	0x2001 ÷ 0x2004	8193 ÷ 8196
ZD_TEXT/6	ZD_TEXT/7	ZD_TEXT/8	ZD_TEXT/9	-	ZD_INT	ZD_OFF/Hi	ZD_OFF/Lo	0x2005 ÷ 0x2008	8197 ÷ 8200
SK_ADR	SK_SPD	AU_I1/Hi	AU_I1/Lo	AU_I2/Hi	AU_I2/Lo	-	AU_TB	0x2009 ÷ 0x200C	8201 ÷ 8204
-	-	AU_SP/Hi	AU_SP/Lo					0x200D ÷ 0x2010	8205 ÷ 8208

** During the transfer the register addresses are indexed from zero, i.e. register 0x2001 is physically sent through the busbar as 0x2000 (8193dek jako 8192dek)(zero based addressing)

F_BIT

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	-	-	P_INV	PWM16

P_INV This defines the direction of increments of the PWM output signal: 0 = PWM output signal increases with increasing input signal;
1 = PWM output signal decreases with increasing input signal

PWM16 This defines the resolution of PWM signal: 0 = 8bit – i.e. 256 levels of PWM period in range $2{,}73.10^{-3} \div 0{,}107.10^{-3}$ with (366 ÷ 9375 Hz)
1 = 16 bits, ie 65536 levels for the PWM period in the range of $0.7 \div 2.73.10^{-3}$ s (1.4 ÷ 366 Hz)

ZD_TEXT The custom text field,range is 10 bytes. It is determined for the client´s identification of the device.

ZD_INT Type of temperature sensor, The range is 1 byte. Takes the value 0 to 255. The number format is 16-bit unsigned integer

value ZD_INT [hex]	0x00	0x01	0x02	0x03	0x10	0x11	0x30	0x31	0x40	0x41
value ZD_INT [dek]	0	1	2	3	16	17	48	49	64	65
sensor type	Ni 1000/5000ppm	Ni 1000/6180ppm	Pt 1000/3850ppm	Pt 100/3850ppm	0 ÷ 1000Ω	0 ÷ 100Ω	0 ÷ 10V	0 ÷ 5V	4 ÷ 20mA	0 ÷ 20mA

Pozn.: Rozsahy pro lineární odpory (odporové vysílače) 0÷1000Ω resp. 0÷100Ω jsou schopny měřit hodnoty v rozsahu 0 až 1700Ω resp. 0 až 170Ω a z nich vyplývajících kalibračních bodů rozsahů.

ZD_OFF Correction of temperature. Range is 2 bytes, form of number with sign (signed integer) multiplied by the constant 10.
0x0001 = 0,1°C, 0xFFFF = -0,1°C.

SK_ADR Network address. range 1 byte, It acquires the values 0 ÷ 255 dek, whereas the address 0 is reserved for the broadcast and the sensor does not respond to it, the address 255 is reserved for the controller configuration. Thus the range of available addresses is 1 ÷ 254. The number format is unsigned integer.

SK_SPD Baud rate. range is 1 byte, It acquires the values 0 ÷ 4. The number format is unsigned integer.

value SK_SPD [hex]	0x00	0x01	0x02	0x03	0x04
value SK_SPD [dek]	0	1	2	3	4
speed [Bd]	1200	2400	4800	9600	19200

AU_I1 Initial value of the input range temperature for PWM 0 or 100% (according to P_INV setting). It acquires the values -3276,7 to 3276,6°C. Range is 2 bytes, form of number with sign (signed integer) multiplied by the constant 10.
0x0001 = 0,1°C, 0xFFFF = -0,1°C.

AU_I2 Ended value of the Input range temperature limit for PWM 0 or 100% (according to P_INV setting). It acquires the values -3276,7 to 3276,6°C. Range is 2 bytes, form of number with sign (signed integer) multiplied by the constant 10.
0x0001 = 0,1°C, 0xFFFF = -0,1°C

AU_TB Period (frequency) of PWM signal. The range is 1 byte. Takes the value 0 to 255.
The number format is 16-bit unsigned integer. If the entered value of 16-bit, then the upper byte is ignored.

$$T = \frac{1}{24 \cdot 10^6} \cdot (256 - AU\_TB) \cdot N \qquad AU\_TB = 256 - \left(\frac{T}{N} \cdot 24 \cdot 10^6 \right)$$

T… Periode of ouput signal PWM
N… Number of levels (resolution) of PWM output signal, i.e. 256 / 65536 (depending on F_BIT: PWM16)
AU_TB… Value for definition of period (frekvency) of output PWM signal [bit]

AU_SP Output value in case of fault of the temperature probe. This value determines the temperature, which replaces the incorrect value from the probe for calculation of the PWM output signal. It takes values of -3,276.7 to 3,276.6 ° C. Range is 2 bytes, form of number with sign (signed integer) multiplied by the constant 10. 0x0001 = 0,1°C, 0xFFFF = -0,1°C.

Examples of communication

Command 03 (0x03): Read Holding Registers:

```
Master:   02 03 00 00 00 01 Crc Crc
          │  │  │  │  └  └ Number of read registers (1 registers)
          │  │  └  └ Address of initially read register (0x0001**)
          │  └ Command (Read Holding Registers)
          └ Address of device (device with address 2)

Slave:    02 03 06 00 FF Crc Crc
          │  │  │  └  └  Data from register (0x00FF)
          │  │  └ Number of bytes (2)
          │  └ Command (Read Holding Registers)
          └ Address of device (device with address 2)
```

The address of initial register is 0x0001** which is the address of measured temperature register. Thus: the measured temperature 0x00FF = 25,5° C. In the case of linear input signals, it depends on the AU_I1 and AU_I2 settings.

Command 16 (0x10) Write Multiple

```
Master:
  FF 10 20 08 00 01 02 09 04 Crc Crc
  │  │  │  │  │  │  │  └  └ Registered data (0x0904)
  │  │  │  │  │  │  └ Number of bytes (2)
  │  │  │  │  └  └ Number of registered registers (1)
  │  │  └  └ Address of first registered register (0x2009**)
  │  └ Command ( Preset Multiple Registers )
  └ Address of device (with inserted jumper "servs" J6 - address 255)
Slave:
  FF 10 20 08 00 01 Crc Crc
  │  │  │  │  └  └ Number of registered registers (1)
  │  │  └  └ Address of first registered register (0x2009**)
  │  └ Command (Preset Multiple Registers)
  └ Address of device (with inserted jumper "servs" J6 - address 255)
```

With writing of the value 0x0904 in register 0x2009** the address 9 is set and the Baud rate 19 200 Bd is set.

** During the transfer the addresses of registers are indexed from zero, i.e. register 0x0005 is physically sent through the bus bar as 0x0004... (zero based addressing).

Example of calculation of AU-TB value for definition of PWM signal period (frequency):

The value AU_TB in the EXTENDED REGISTERS defines the period (frequency) of the PWM output signal.
The value AU_TB is calculated from the required PWM signal period/frequency using the following formula:

$$AU\_TB = 256 - \left(\frac{T}{N} \cdot 24 \cdot 10^{6}\right)$$

The actual PWM signal period/frequency (depending on the resolution set in F_BIT: PWM16) is calculated using the following formula:

$$T = \frac{1}{24 \cdot 10^{6}} \cdot (256 - AU\_TB) \cdot N$$

f… PWM output signal frequency [Hz] f = 1/T
T… Periode of ouput signal PWM
N… Number of levels (resolution) of PWM output signal, i.e. 256 / 65536 (depending on F_BIT: PWM16)
AU_TB… Value for definition of period (frekvency) of output PWM signal [bit]

For *f* = 100 Hz:	*T* = 0,01s	F_BIT: PWM16 = 1	*AU_TB* = 252
For *f* = 700 Hz:	*T* = 1,429 ms	F_BIT: PWM16 = 0	*AU_TB* = ≈122
For *f* = 10 kHz:	*T* = 0,1 ms	F_BIT: PWM16 = 0	*AU_TB* = ≈246

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Installation and connection:

The transmitter has to be fastened with the the help of a holder on the mounting bar DIN EN50022.
The signal terminals A and B on the transmitter are connected to the serial line as per the rules for connection of devices in RS485 serial lines (Fig. 2). The use of A, B, ZAK. jumpers is subject to general rules for communication through RS485 lines (note: at end points of the RS485 line, it is necessary to connect a terminating resistor through the ZAK. jumper). The transmitters are supplied from a single 12 to 30 VAC power supply, while the supply voltage is connected to the terminals marked by Ucc and GND (Fig. 2).
It is recommended to interconnect the devices using a multi-core shielded cable, which hosts data as well as power supply wires. The cable shield must be interconnected between individual segments of the line and only connected to the lowest potential (PE terminal) in the switchboard. First we set the upper mandrel of transmitter box holder on the upper bar edge and with the help of a screwdriver push out the lower arrestment mandrel lock. We pull the lower box part to the bar and then free the lock. The transmitter is fastened now. We connect the inputs, outputs and power supply into the respective clamps (see fig. 1 and 2). We recommend the connecting cable with the wires cross section 0,35...2 mm 2 , for the active signals with the screening mantle.

Example of wiring the sensors in the system