LABOR – ASTER

INDUSTRIAL AUTOMATION

Certyfikat nr QS/14/07

AC 083
QMS

THERMOCOUPLES SIMULATOR, REPEATER type S2-RT, DUPLICATOR type S2-RTp

- **Thermocouple input ⇒ thermocouple output**
  Thermocouple input ⇒ two separated thermocouple outputs
- **Input 0/4÷20mA, 0÷10V ⇒ thermocouple output**
- **Input, output and supply circuits mutually separated**
- **Supply 24Vdc. When no power supply output circuits are opened.**

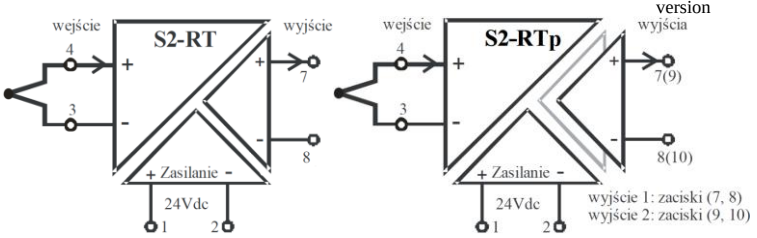
Duplicator version — One-channel version

APPLICATION:

Simulator type **S2-RT** is designed to repeat on its outputs voltages of any ordered thermocouple. Any thermocouple can be connected to the input and the voltage of this thermocouple can be repeated on each of the outputs. There is an option with one thermocouple output and on the other output can be any analog signal e.g. 0/4…20mA, 0…10V.

It is possible to convert the analog input signal e.g. 0/4…20mA, 0…10V to the simulated thermocouple voltage. For example for version 0…10V to thermocouple J 0…400°C for 0V on the output is 0mV and for 10V is 21,85mV, but the characteristic is linear.

According to the principle of operation of thermocouple connected to the input of a device voltage on the terminals has value corresponding to the difference of the temperature of the tip of the thermocouple and the temperature of the terminals to which it is connected. The **S2-RTp** does not have cold endings compensation. Its thermocouple output is just realization of a voltage (eg. repetition of the input terminals voltage to which the thermocouple is connected). If inputs of a controller, to which outputs of **S2-RTp** are connected, have automatic cold endings compensation and their terminals are in similar temperature as terminals of **S2-RTp** then whole measurement channel will correctly represent temperature of the thermocouple tip. If these inputs do not have automatic cold endings compensation but the temperature of the input terminals of **S2-RTp** will be known then this temperature can be add up to the measurement and the whole measurement channel will accurately represent temperature of the thermocouple tip.



HOW TO ORDER:

Order code: type S2-RT or S2-RTp (duplicator)
Input: describe thermocouple type and temperature range,
Output: describe kind of output and its ranges.

ORDER EXAMPLE:

Thermocouple duplicator type S2-RTp:
Input – thermocouple K, range 0…400°C
Output 1 – repeater of the input thermocouple,
Output 2 – repeater of the input thermocouple,
Note: output 2 can be any analog signal output e.g. 0/4…20mA, 0…10V representing respectively minimum and maximum thermocouple voltage.

Thermocouple simulator type S2-RT:
Input – thermocouple J, range 0…600°C
Output – repeater of the input thermocouple.

BASIC TECHNICAL PARAMETERS:

Input signal	-	any thermocouple as ordered
input resistance	-	≥1MΩ
Output signals:		
one output	-	repeater of input thermocouple voltage
two outputs	-	repeater of input thermocouple voltage on both outputs
	-	option: first output as repeater of input thermocouple voltage, second output as any analog signal e.g. 0/4…20mA, 0…10V
Class	-	0.1 %
Nonlinearity	-	± 0.05%
Error due to Rload changes in case of 2nd output as analog signal	-	- 0.05% / 750Ω
Temperature drift	-	± 0.01%/°C
Time constant	-	0.1s or other as ordered 0.01÷1s
Power supply	-	24Vdc (21...28 Vdc) / 50mA
Galvanic separation	-	all circuits mutually separated
capacity between circuits	-	< 10pF
isolation test voltage	-	2kV, 50Hz or equivalent
Housing		
duplicator version	-	22,5mm width, IP20
one channel version	-	12,5mm width, IP20
mounting	-	universal rail clamp

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Issue 01/2024

The S2-RTp simulator converters the input voltage from the thermocouple into an output voltage simulating a thermocouple with the class and nonlinearity given in the technical parameters of the device. The S2-RTp analog output (if ordered) may be confusing. Please remember that the characteristics of a thermocouple (voltage versus temperature) is non-linear. The S2-RTp simulator processes the measurements linearly. For the output simulating a thermocouple there is no problem because the voltage is reproduced 1:1. However, in the case of an analog output, e.g. 4-20mA, there may be a problem with the interpretation of the current signal.

Example for input in the range 0…600°C thermocouple J, output 4-20mA

According to the thermocouple J table 0°C is 0mV – for such an input voltage the output is set to 4mA.
According to the thermocouple J table 600°C is 33.102mV – for such an input voltage the output is set to 20mA.
The correct reading of the tip of the thermocouple requires taking into account the temperature of the cold endings of the thermocouple. The S2-RTp simulator does not do this compensation. The output current is converted according to formula:
Iout = ((T_thermocouple - T_ambient) / (Tmax - Tmin) * 16mA) + 4mA
Where:
T_thermocouple is the temperature of the tip of the thermocouple
T_ambient is the temperature of the S2-RTp converter terminals
Tmin is the lower temperature range of the S2-RTp converter, in this example 0°C
Tmax is the upper temperature range of the S2-RTp converter, in this example 600°C

For correct calculation of the temperature of the thermocouple tip the user must know the ambient temperature of the S2-RTp converter terminals and make a correction in the output current interpretation by adding this temperature according to the following formula:
T_thermocouple = (Iout – 4mA) / 16mA * (Tmax – Tmin) + T_ambient

The simulator calibrated for the thermocouple J in range 0...600°C will act as follows for T_ambient=28°C:

Therm. J tip temp.	0°C	28°C	60°C	300°C	328°C	330°C	600°C	624°C	628°C
Voltage from table	0mV	1.433mV	3.116mV	16.327mV	17.876mV	17.986mV	33.102mV	34.516mV	34.754mV
Output 4-20mA	3.25mA	4mA	4.82mA	11.20mA	11.95mA	12mA	19.32mA	20mA	20.11mA
Output interpretation	0°C	28°C	59°C	298°C	326°C	328°C	603°C	628°C	632°C
Interpretation error	0.00%	0.00%	-0.21%	-0.31%	-0.31%	-0.33%	0.42%	0.67%	0.69%

This error results from the nonlinearity of the thermocouple, which the S2-RTp converter does not take into account.
The nonlinearity of thermocouples for selected temperature ranges is given below. This is more or less error you can expect when using S2-RTp as a converter of thermocouple temperature to analog signal e.g. 4-20mA.

NIELINIOWOŚĆ TERMOPAR

Tab.1 Fe - Ko **Type J**

Range [°C]	Sensor nonlinearity [%]
0....100	- 0.92
0....150	- 1.1
0....200	- 1.15
0....250	- 1.15
0....300	- 1.05
0....400	- 0.90
0....500	- 0.78
0....600	- 0.8
0....800	- 2.3
0....900	- 2.8
50....100	- 0.34
50....200	- 0.6
50....300	- 0.55
100....200	- 0.27
100....300	- 0.22
100....400	- 0.15
100....500	- 0.12
100....600	- 0.52
200....300	+ 0.04
200....350	+ 0.08
200....400	+ 0.12
200....500	+ 0.06
300....400	+ 0.06
300....500	- 0.13
300....900	- 2.8
400....500	- 0.10
400....600	- 0.75
400....800	- 2.5
500....600	- 0.55
680....900	- 0.42

Tab.2 Cu - Ko **Type T**

Range [°C]	Sensor nonlinearity [%]
0.....50	- 1.3
0.....100	- 2.4
0.....150	- 3.25
0.....250	- 4.5
0.....400	- 5.5
100....300	- 2.7
100....400	- 3.4
200....300	- 1.1
200....400	- 1.5

Tab.3 PtRh 10 - Pt **Type S**

Range [°C]	Sensor nonlinearity [%]
0.....1000	- 6
0.....1200	- 6.3
0.....1400	- 6.4
0.....1600	- 6.4
500.....1400	- 2.85
600.....1400	- 2.4
700.....1600	- 1.8
800.....1200	- 1.3
800.....1400	- 1.2
900.....1500	- 1.0
1000...1600	- 0.48
1200...1600	+ 0.25
1300...1600	+ 0.32

Tab.4 PtRh 13 - Pt **Type R**

Range [°C]	Sensor nonlinearity [%]
0.....1750	- 7.8
600.....1000	- 1.5
800.....1400	- 1.82
1000...1600	- 0.7
1300...1750	- 0.78

Tab.5 PtRh 30 - Pt **Type B**

Range [°C]	Sensor nonlinearity [%]
0.....1800	- 22
600.....1200	- 6.5
800.....1400	- 4.75
1000...1600	- 3.25
1400...1750	- 0.43
1500...1800	+ 0.15