Interface converters/isolation amplifiers

Overview

In automation and control engineering it will always be necessary to work with analog signals. The interfaces for analog signals that have established themselves as the standard are 0 to 10 V and 0/4 to 20 mA.

Interface converters perform the coupling function for analog signals on both the input side and the output side. They are indispensable when processing analog values with electronic controls. Under harsh industrial conditions in particular, it is often necessary to transmit analog signals over long distances. This means that galvanic isolation is essential due to the different supply systems. The resistance of the wiring causes potential differences and losses which must be prevented. Electromagnetic disturbance and overvoltages can affect the signals on the input side in particular or even destroy the analog modules. All terminals of the 3RS17 interface converters are safe up to a voltage of DC 30 V and protected against switching poles. Short-circuit protection is an especially important function for the outputs.

The devices are EMC-tested according to

- EN 61000-6-4 (basic technical standard for emitted interference),
- EN 61000-6-2 (basic technical standard for immunity to interference).

The analog signals comply with

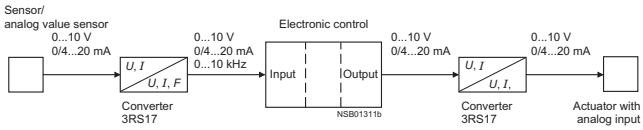
- IEC 60381-1/2.

Area of application

Converters are used in analog signal processing for

- Galvanic isolation
- Conversion of normalized and non-normalized signals
- Matching of gain and impedances
- Conversion to a frequency for processing by a digital input
- Overvoltage and EMC protection
- Short-circuit protection of the outputs
- Potential multiplication.

Application example:
Interface converter in analog signal evaluation



3RS17 25 manual/automatic converter

For special applications in which analog signals have to be simulated, or during plant commissioning when the actual process value is not yet available, the 3RS17 25 devices feature an adjustable potentiometer for entering setpoints manually and a manual/automatic switch.

The potentiometer for the 3RS17 25 devices is used to simulate analog output signals when the changeover switch is set to "Manual" and the control supply voltage is applied, without the need for an analog input signal; and the scale ranges from 0 % to 100 %.

Example:
When it is set for an output of 4 mA to 20 mA, the 0 % scale value on the potentiometer represents an output current of 4 mA and the 100 % scale value represents an output current of 20 mA. In the "Auto" switch position, the output signal follows the input signal proportionally regardless of the potentiometer setting.

Technical specifications

Type 3RS17				24 V AC/DC	24 ... 240 V AC/DC
General data					
Operating range of the supply voltage					
• DC				0.7 ... 1.25 × U_n	0.7 ... 1.1 × U_n
• AC				0.8 ... 1.2 × U_n	0.8 ... 1.1 × U_n
Rated power (own requirements)			W	typically 0.3	typically 0.75
Electrical isolation input/output				Active disconn.: 1500 V, 50 Hz, 1 min Passive disconn.: 500 V, 50 Hz, 1 min	4000 V, 50 Hz, 1 min
Rated insulation voltage Pollution degree 2 Overvoltage category III to DIN VDE 0110			V	50	300
Ambient temperature	during operation		°C	– 25 ... + 60	
	during storage		°C	– 40 ... + 85	
Conductor cross-sections					
Screw-type connections					
• Conductor cross-section					
- solid			mm^2	1 × (0.25 ... 4)	
- finely stranded with or without end sleeve			mm^2	1 × (0.5 ... 2.5)	
• Terminal screws				M 3	
Spring-loaded terminal					
• Solid or finely stranded			mm^2	1 × (0.08 ... 2.5)	
• Finely stranded with end sleeve			mm^2	1 × (0.25 ... 1.5)	
Degree of protection	Enclosure acc. to EN 60529			IP30	
	Terminals acc. to EN 60529			IP20	
Permissible mounting position				any	
Mounting onto standard rail EN 50022			mm	35	
Vibration resistance IEC 60068-2-6			Hz/mm	10-55/0,35	
Shock resistance IEC 60068-2-27			*g*/ms	15/11	
Input					
Impedance	Voltage inputs		kΩ	330	
	Current inputs, active		Ω	100	
Input voltage max.	Voltage inputs		V	AC/DC 30	
	Current inputs, active		V	AC/DC 30	
Response current	Current inputs, passive		µA	100/250 (6.2 mm width)	
Voltage drop	Current inputs, passive		V	2.7 at 20 mA	
Output					
Impedance	Voltage output, 0 ... 10 V		Ω	55	
Output load, max.	• Current 0/4 ... 20 mA, active		Ω	400	
	• Current 0 ... 20 mA, passive		Ω	1000 at 20 mA, 400 at 20 mA (6.2 mm width)	
	• Frequency			2400	
Output current, max.	• Voltage output, 0 ... 10 V		mA	21	
for supply voltage	• Frequency		mA	10	
Short-circuit current	• Voltage output, 0 ... 10 V		mA	40	
	• Current output, 0 ... 20 mA, passive		mA	corresponds to the input current	
	• Frequency		mA	15	
Protection of the outputs				short-circuit resistant	
Max. overvoltage at output			V	30	
Accuracy					
Total errors at 23 °C	• Active discon.	Frequency	%	0.1	
		U, I	%	0.1[1])	
Linearity error	• Active discon.	Frequency	%	0.02	
		U, I	%	0.02	
Deviation through ambient temperature	• Active disconnector	Frequency		0 ... 50 Hz: 7.5 mHz/K; 0 ... 100 Hz: 15 mHz/K; 0 ... 1 kHz: 0.15 Hz/K; 0 ... 10 kHz: 1.5 Hz/K	
		U, I		0 ... 10 V: 1.5 mV/K; 0/4 ... 20 mA: 3 µA/K	
	• Passive disconnector			6.2 mm width: 100 ppm/K of measured value	
				12.5 mm width: with load < 600 Ω: < 50 ppm/K of measured value; with load ≥ 600 Ω: < 175 ppm/K of measured value	
Transmission error	• Passive discon.		%	0.1	
Measured value load error			%/Ω	0.06/100	
Limit frequency at 3 dB	• Active discon.	Frequency	Hz	30	
		U, I	Hz	30	
	• Passive discon.		Hz	50	
Rise time (10 to 90 %)	• Active discon.	Frequency		10 + 1 period	
		U, I	ms	10	
Settling time at 1 % accuracy	• Active discon.	Frequency		30 + 1 period	
		U, I	ms	30	
Remaining ripple	• Active discon.	U, I	mV_{eff}	< 5	
	• Passive discon.		mV_{eff}	< 8	

The accuracy refers to the measurement range end value if not otherwise stated.

1) For 3RS17 06: 0.1 % for selected output 4 ... 20 mA;
0.3 % for selected output 0 ... 20 mA or 0 ... 10 V.

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Interface converters/isolation amplifiers

Selection and ordering data

Screw-type connection and spring-loaded terminals

All converters except the passive single interface converters have a yellow LED for indicating "Power on".

Input	Output	Width	Supply voltage	Electrical isolation	DT	**Screw-type connection**	PS*	Weight per PU approx.	DT	**Spring-loaded terminal**	PS*	Weight per PU approx.
		mm	V			Order No.		kg		Order No.		kg
Single interface converters, active												
												
0 ... 10 V:	0 ... 10 V:	6,2	AC/DC 24	2 paths	A	**3RS17 00-1AD00**	1 unit	0.053	A	**3RS17 00-2AD00**	1 unit	0.047
0 ... 10 V:	0...20 mA	6.2	AC/DC 24	2 paths	A	**3RS17 00-1CD00**	1 unit	0.052	A	**3RS17 00-2CD00**	1 unit	0.047
0 ... 10 V:	4...20 mA	6.2	AC/DC 24	2 paths	A	**3RS17 00-1DD00**	1 unit	0.052	A	**3RS1 700-2DD00**	1 unit	0.047
0...20 mA	0 ... 10 V:	6.2	AC/DC 24	2 paths	A	**3RS17 02-1AD00**	1 unit	0.052	C	**3RS17 02-2AD00**	1 unit	0.047
0...20 mA	0...20 mA	6.2	AC/DC 24	2 paths	A	**3RS17 02-1CD00**	1 unit	0.052	A	**3RS17 02-2CD00**	1 unit	0.045
0...20 mA	4...20 mA	6.2	AC/DC 24	2 paths	A	**3RS17 02-1DD00**	1 unit	0.052	A	**3RS17 02-2DD00**	1 unit	0.048
4...20 mA	0 ... 10 V	6.2	AC/DC 24	2 paths	A	**3RS17 03-1AD00**	1 unit	0.052	A	**3RS17 03-2AD00**	1 unit	0.047
4...20 mA	0...20 mA	6.2	AC/DC 24	2 paths	A	**3RS17 03-1CD00**	1 unit	0.052	C	**3RS17 03-2CD00**	1 unit	0.049
4...20 mA	4...20 mA	6.2	AC/DC 24	2 paths	A	**3RS17 03-1DD00**	1 unit	0.053	A	**3RS17 03-2DD00**	1 unit	0.047
Switchable multi-range converters, active												
												
0...10 V 0...20 mA 4...20 mA, switchable	0...10 V 0...20 mA 4...20 mA, switchable	6.2	AC/DC 24	2 paths	A	**3RS17 05-1FD00**	1 unit	0.053	A	**3RS17 05-2FD00**	1 unit	0.048
		17.5	AC/DC 24 ... 240	3 paths	A	**3RS17 05-1FW00**	1 unit	0.099	A	**3RS17 05-2FW00**	1 unit	0.092
0...10 V 0...20 mA 4...20 mA, switchable	0...50 Hz 0...100 Hz 0...1 kHz 0...10 kHz switchable	6.2	AC/DC 24	2 paths	A	**3RS17 05-1KD00**	1 unit	0.053	C	**3RS17 05-2KD00**	1 unit	0.047
		17.5	AC/DC 24 ... 240	3 paths	A	**3RS17 05-1KW00**	1 unit	0.099	A	**3RS17 05-2KW00**	1 unit	0.092
Switchable universal converters, active												
												
0...60 mV 0...100 mV 0...300 mV 0...500 mV 0...1 V 0...2 V 0...5 V 0...10 V 0...20 V 2...10 V 0...5 mA 0...10 mA 0...20 mA 4...20 mA +/-5 mA +/-20 mA switchable	0...10 V 0...20 mA 4...20 mA, switchable	17.5	AC/DC 24	2 paths	A	**3RS17 06-1FD00**	1 unit	0.082	A	**3RS17 06-2FD00**	1 unit	0.078
				3 paths	A	**3RS17 06-1FE00**	1 unit	0.082	A	**3RS17 06-2FE00**	1 unit	0.077
			AC/DC 24 ... 240	3 paths	A	**3RS17 06-1FW00**	1 unit	0.099	A	**3RS17 06-2FW00**	1 unit	0.094
Switchable multi-range converters, with manual/automatic switch and setting potentiometer as manual analog signal transmitter, active												
												
0...10 V 0...20 mA 4...20 mA, switchable	0...10 V 0...20 mA 4...20 mA, switchable	17.5	AC/DC 24	2 paths	A	**3RS17 25-1FD00**	1 unit	0.085	A	**3RS17 25-2FD00**	1 unit	0.078
			AC/DC 24 ... 240	3 paths	A	**3RS17 25-1FW00**	1 unit	0.102	A	**3RS17 25-2FW00**	1 unit	0.095

Input	Output	Width	Number of channels	Electrical isolation	DT	**Screw-type connection**	PS*	Weight per PU approx.	DT	**Spring-loaded terminal**	PS*	Weight per PU approx.
		mm				Order No.		kg		Order No.		kg
Single interface converters, passive												
												
0/4...20 mA	0/4 ... 20 mA:	6.2	1-channel	2 paths	A	**3RS17 20-1ET00**	1 unit	0.049	A	**3RS17 20-2ET00**	1 unit	0.044
0/4...20 mA	0/4 ... 20 mA:	12.5	1-channel	2 paths	A	**3RS17 21-1ET00**	1 unit	0.059	A	**3RS17 21-2ET00**	1 unit	0.057
0/4...20 mA	0/4 ... 20 mA:	12.5	2-channel	2 paths	A	**3RS17 22-1ET00**	1 unit	0.070	A	**3RS17 22-2ET00**	1 unit	0.066

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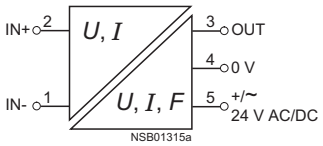
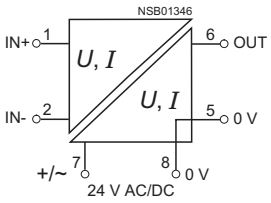
*** This quantity or a multiple thereof can be ordered.**

Circuit diagrams

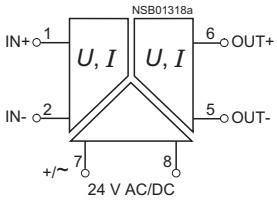
3RS17 00-..D..
3RS17 02-..D..
3RS17 03-..D. .
3RS17 05-..D..



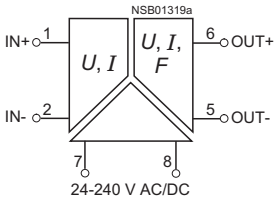
3RS17 06- . FD00



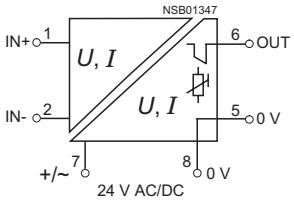
3RS17 06-.FE00



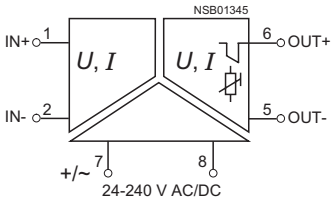
3RS17 0.-..W00



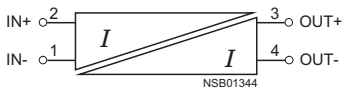
3RS17 25-.FD00



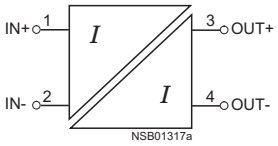
3RS17 25-.FW00



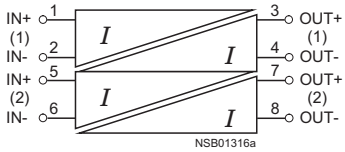
3RS17 20-.ET00



3RS17 21-.ET00



3RS17 22-.ET00



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Interface converters/isolation amplifiers

Further information

Configuration

Active interface converters

Active interface converters provide maximum flexibility for the application by the use of an external supply voltage. Configuration with active interface converters is extremely easy because input and output resistances and voltage drops are compensated by the auxiliary supply. They support complete voltage isolation as well as conversion from one signal type to another or amplification. The load of the measured value transmitter is negligible.

Passive interface converter

Passive interface converters do not require an external supply voltage. This advantage can only be used by current signals that are converted 1:1. Amplification or conversion is not possible. The converters are used for complete galvanic isolation of current signals and to protect the inputs and outputs. Passive isolators do not operate reaction-free, any load on the output produces an equal load on the input. When the passive converter is to be used, the output performance of the sensor and the input resistance of the analog input must be analyzed. This technique is being increasingly implemented in the case of pure current signals.

Calculation guide for passive converter

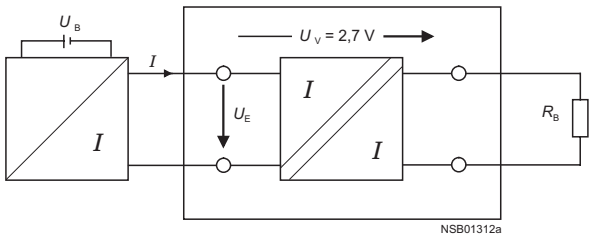
Important: please note the following when using passive isolators:

When the output is open, the input becomes high-resistant and the current-driving voltage of the measuring transducer U_E must be sufficient to drive the maximum current of 20 mA over the passive isolator with a voltage loss of U_V = 2.7 V and the load R_B.

This means that:

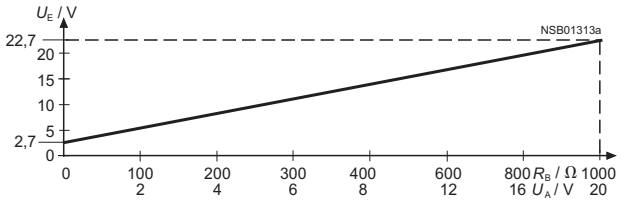
$U_B \geq U_E = 2.7\ V + 20\ mA \times R_B$

Distribution of the voltages in the case of passive isolators



Input voltage depending on the load at
I_a = 20 mA

The following diagram shows the input voltage U_E as a function of the load R_B taking into account the voltage loss U_V. If the load is known, the y-axis shows the minimum voltage that has to be supplied by the current source in order to drive the maximum current of 20 mA over the passive isolator and load.



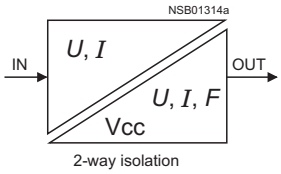
Current carrying capacity of the outputs

A maximum output resistance is specified for current signals. This resistance value specifies how large the input resistance of the next device connected in series can be as a result of the power of the converter.

For voltage signals, the maximum current that can be drawn from the output is the decisive factor.

2-way isolation

In the case of 2-way isolation, the input is galvanically isolated from the output. The "null potential" of the supply voltage is the same as the reference potential for the analog output signal.



3-way isolation

For the 3-path isolation, each circuit is electrically isolated from the other circuits i.e. input, output, and supply voltage do not have a potential connection.