KWANT CONTROLS
sneek-holland

R/I converters

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Quality in command

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R/I Converters

These DIN rail mounted electronic modules have been designed to convert the position of a lever, tiller, steering wheel or azimuth control head into industry standard 4-20mA current signals.

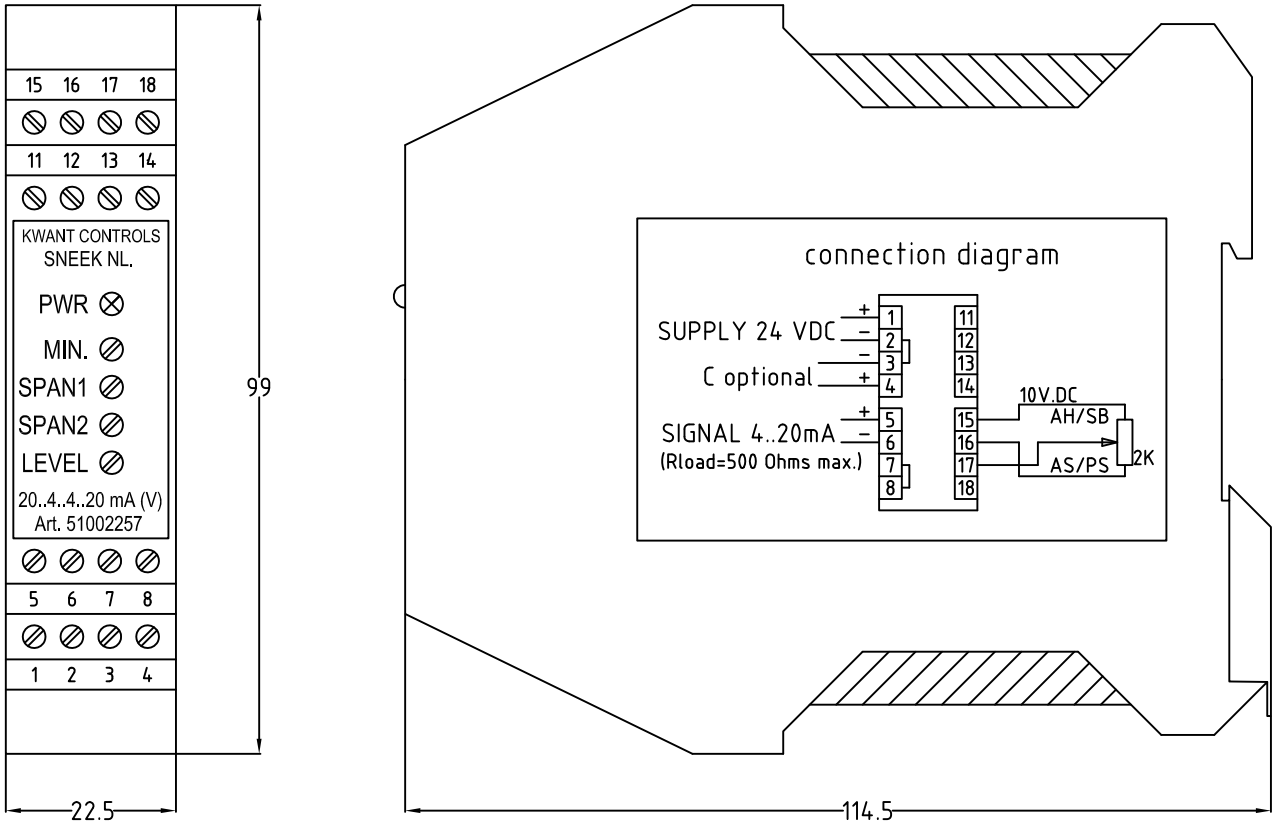
Common features are:

- Adjustable R/I-conversion circuit with span- and offset level calibration.
- 10 Volts reference voltage to power the potentiometer.
- The output signal is isolated from the power supply.
- Large power supply range (24VDC±30%)
- 'Power-on' indication (green LED).
- Mounted on a DIN-rail according to EN50022.
- CE-approved according to EN60945.

They come in a number of executions:

Part no:	Datasheet:	Application:
51001907	4A0107073	350° potentiometer with the standard 280° (80%) rotation angle.
51001917		355° potentiometer, single output for 360° control head.
51002257		V-shaped 20-4-4-20mA or 20-4-20mA for governor control.
51002927		As the 51001907 for wider input ranges of 50-85%.
51002997	4A0110799	Twin wiper 360° potentiometer, dual output with 90° offset.

A	ST.NR.	CE MARKING ADDED	12-11-99	TTW
E		Version 2 removed, covered by version 4	29-10-04	TTW
F		Part number on the dimensional drawing changed	26-4-2006	NJV
G		358° changed to 356°	10-01-2011	TTW



PWR = LED-lamp indicating the presence of the supplyvoltage
MIN = setpoint for adjusting the minimum outputsignal (e.g. for creating a flat in a 20..4..20 mA signal)
SPAN1 = setpoint for adjusting the required span (range) in the 'Ahead/Starboard'-sector
SPAN2 = setpoint for adjusting the required span (range) in the 'Astern/Portside'-sector (for 20..4..20mA signals)
LEVEL = setpoint for adjusting the signallevel in the 'Stop/Midship'-leverposition (e.g. 12mA)

Note: the module is clipped on a mountingrail size 35/7,5mm (acc. to EN 50 022)

ELECTRICAL SPECIFICATIONS
- Supplyvoltage: 24 V.DC (-20% ... +30%)
- Powerconsumption: approximately 1 W.
- Operating temperature range: -25° ... +70°C.
- Loadimpedance: 0 ... 500 Ohm

The powersupply input is protected against voltage transients and wrong polarity connections. The power supply is isolated from the outputsignal (500VDC).

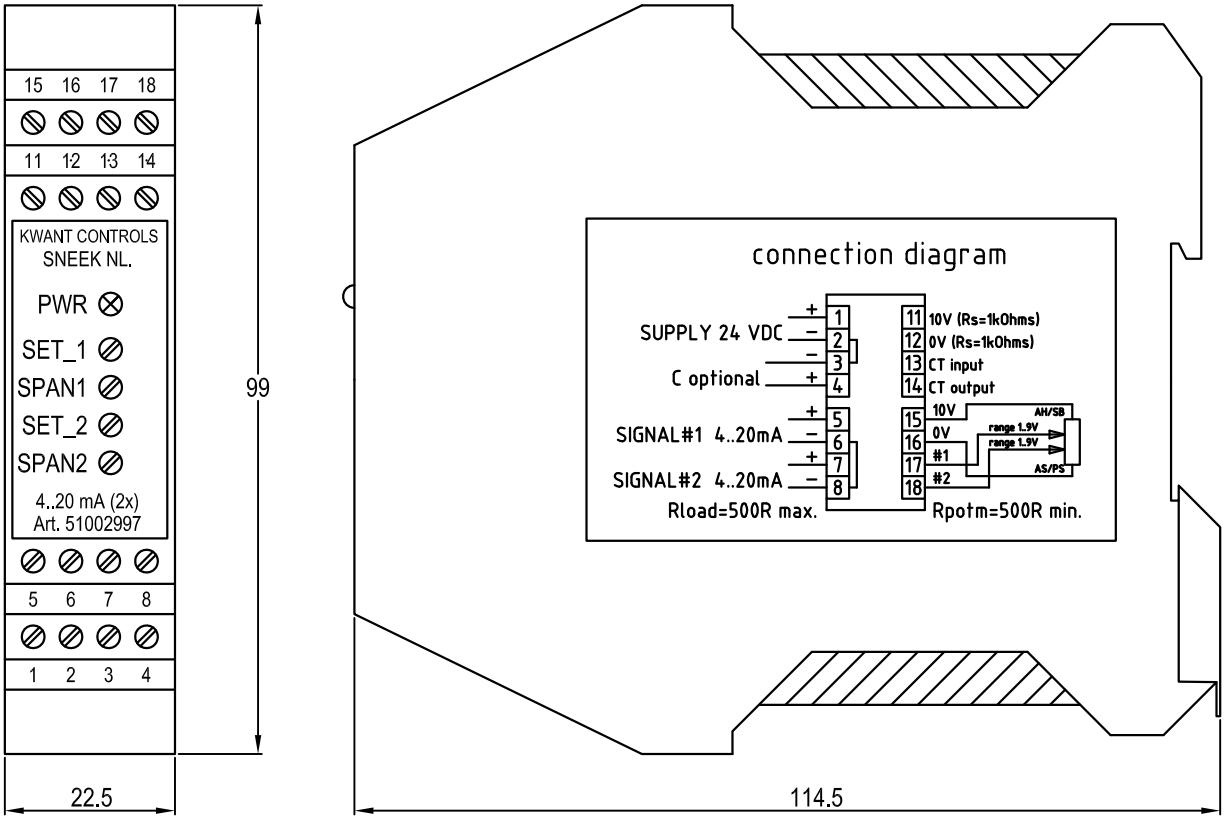
The mA-transmitter has been CE-approved according to EN60945:1997, as laid down in certificate nr. 96122-KRQ/EMC 99-4555.

CE

The mA-transmitter can be supplied in the next versions:
1. Type 51001907 = the **standard 4 ... 20 mA** signaltransmitter for normal applications with an input-range of 80%.
3. Type 51001917 = a **continuous 4 ... 20 mA** signaltransmitter for use in 360°-systems. A special 356°-potentiometer is used; when the wiper is in the remaining 4°-contactless area the outputsignal will remain at 4 or at 20 mA depending on the last contact.
4. Type 51002257 = a **V-shaped signal (20..4..20 mA)** used for direct signaltransmission to e.g. a governor.The signallevel around the 'Stop/Neutral' position can be flattened in order to activate the clutches before changing the motor speed.
6. Type 51002927 = the **4 ... 20 mA** signaltransmitter for normal applications with an adjustable inputrange of 50 to 85%.

MODULE mA-TRANSMITTER	4 A0107073	PROJ. METHODE
KWANT CONTROLS KWANT CONTROLS B.V. SNEEK HOLLAND	WIJZ. G	
	GET. NJV D.D. 20-09-99 GEZ.	
	SCHAAL: 1:1 BLAD. 1	

LET.	ST.NR.	WIJZIGING	D.D.	NAAM



PWR = LED-lamp indicating the presence of the supply voltage
SET_1 = setpoint for adjusting the signal level at the 'Neutral/Midship'-position for output 1
SPAN1 = setpoint for adjusting the required span (range) in the 'Ahead/Starboard'-sector for output 1
SET_2 = setpoint for adjusting the signal level at the 'Neutral/Midship'-position for output 2
SPAN2 = setpoint for adjusting the required span (range) in the 'Ahead/Starboard'-sector for output 2
Note: the module is clipped on a mountingrail size 35/7,5mm (acc. to EN 50 022)

ELECTRICAL SPECIFICATIONS

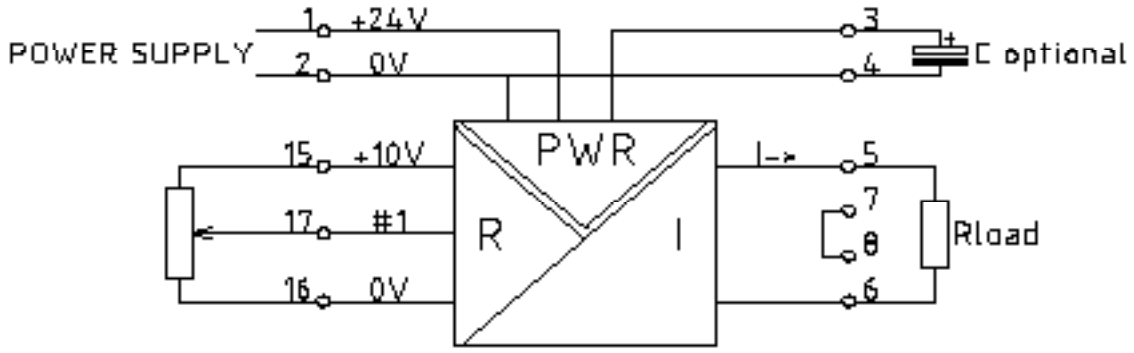
- Supplyvoltage: 24 V.DC (-30...+30%)
- Powerconsumption: approximately 2 W.
- Operating temperature range: -25° ... +71°C.
- Loadimpedance: 0 ... 500 Ohm

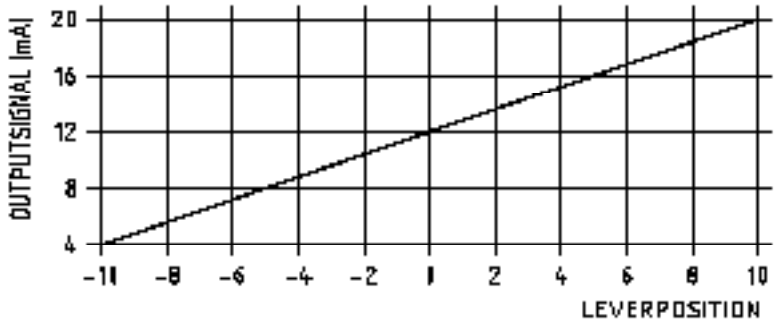
The powersupply input is protected against voltage transients and wrong polarity connections. The power supply is isolated from the outputsignal (500VDC).

MODULE DOUBLE R/I-CONVERTER	4 A 0110799	PROJ. METHODE
KWANT CONTROLS KWANT CONTROLS B.V. SNEEK HOLLAND	WIJZ.	
HET AUTEURSRECHT WORDT VOORBEHOUDEN OVEREENKOMSTIG DE WET	GET. NJV D.D. 27-11-2002 GEZ.	
	SCHAAL: 1:1 BLAD.	

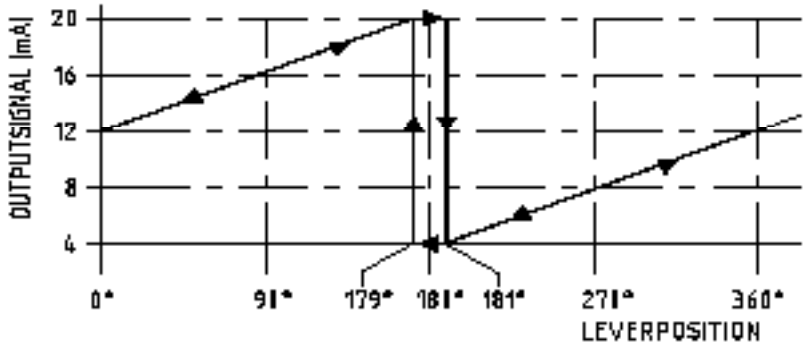
Models 51001907 - 51001917

Electrical data:		Physical data:	
Power supply voltage:	24VDC±30%	Ambient temperature:	-25/+71 °C
Max supply current:	50mA@24VDC	Heat dissipation:	1.5W
Potentiometer:	1-10KΩ	Ingress protection grade:	IP20
Span adjustment:	+/-2%	Dimensions [w x h x d]	22.5 x 98 x 114.5 mm
Offset adjustment:	0-8mA	Weight:	130 g
Load resistance:	<500Ω		
Temp. Coeff.	<50ppm/°C		
X2 cap (prim-sec)	22nF / 275VAC		





In/output characteristic of the SK51001907



In/output characteristic of the 51001917

Model 51002257

The electronic module 51002257 is specially designed to convert the position of a potentiometer to a V-shaped 0-20 or 4-20mA signal. This signal is used for speed control purposes.

FEATURES

· Adjustable R/I-conversion circuit with span- and offset and minimum level calibration.

· Seperate span adjustment for both directions.

· Minimum level adjustment around the mid position.

· 10 Volts reference voltage to power the potentiometer.

· The output signal is isolated from the power supply.

· Large power supply range (24VDC±30%).

· 'Power-on' indication (green LED).

· Optionally an external capacitor (e.g. 1000µF/40V) can be connected to smoothen the power supply voltage.

· The module is mounted on a DINrail according to EN50022.

· CE-approved according to EN60945.

FUNCTIONAL DESCRIPTION

This module converts the position of a potentiometer to a V-shaped output signal of 20-4(0)-20mA. For this purpose it is equipped with a adjustable R/I-converter circuit. A stable 10 VDC voltage regulator is powering the potentiometer. The output of this precision voltage source is current limited.

The module 51002257 is designed for potentiometers with a wiper range of 10% to 90% of the track, this is the standard for Kwant Controls control units (other ranges are optional).

The spans of the 'forward' - and 'reverse' direction are adjustable with the trimmers 'SPAN1' and 'SPAN2' respectively. The common point on the Y-axis is determined by the trimmer 'LEVEL'. Finally the minimum level of the output signal can be preset with the trimmer 'MIN'. This can be used to create a flat section in the output signal. Please refer to the next page for a complete adjustment procedure.

For output signals with a sharp v-output signal from 4 to 20 ma:

1. Put the lever in the ‘0’-position = ‘0 (zero).
2. Turn MIN and LEVEL counter clockwise until the output signal is 0 mA.
3. With the lever in the ‘0’-position, turn LEVEL clockwise until the output signal is 4mA.
4. Put the lever to ’10-Ahead’, adjust with SPAN1 until the output signal is 20 mA.
5. Put the lever to ’10-Astern’, adjust with SPAN2 until the output signal is 20 mA.
6. Repeat the readjusting from step 3 until the values are correct.

For output signals with a flat around the ‘0’-position:

1. Put the lever in the ‘0’-position = ‘0 (zero).
2. Turn MIN and LEVEL counter clockwise until the output signal is 0 mA.
3. Determine on which point the current should be rising.
   The formula is: 20 – 10/(10-x)*16 (where x is the mark on the scale of 0 to 10).
   For example with lever in ‘1’, the formula will be: 20 - 10/9 * 16 = 2.22 mA.
4. Put the lever in the ‘0’-position, turn LEVEL clockwise until the output signal is 2.22mA.
5. Put the lever to ’10-Ahead’, adjust with SPAN1 until the output signal is 20 mA.
6. Put the lever to ’10-Astern’, adjust with SPAN2 until the output signal is 20 mA.
7. Repeat the readjusting from step 4 until the values are correct.
8. Put the lever in the ‘0’-position, adjust MIN clockwise to an output signal of 4 mA.
9. Put the lever in position ‘1-Ahead’ or ‘1-Astern’ and check if this is still 4 mA.
10. Moving the lever position to ’10-Ahead’ or ’10-Astern’, the output signal should increase directly after position 1.

Alternative procedure (without calculation):

1. Put the lever in the ‘0’-position = ‘0 (zero).
2. Turn MIN and LEVEL counter clockwise until the output signal is 0 mA.
3. Determine the point on the scale from where the output signal should start rising.
   For example the lever in ‘1-Ahead’.
4. Put the lever in ‘1-Ahead’, turn LEVEL clockwise until the output signal is 4 mA.
5. Put the lever to ’10-Ahead’, adjust with SPAN1 until the output signal is 20 mA.
6. Put the lever to ’10-Astern’, adjust with SPAN2 until the output signal is 20 mA.
7. Repeat the readjusting from step 4 until the values are correct.
8. Put the lever in the ‘0’-position, adjust MIN clockwise to an output signal of 4 mA.
9. Put the lever in position ‘1-Ahead’ or ‘1-Astern’ and check if this is still 4 mA.
10. Moving the lever position to ’10-Ahead’ or ’10-Astern’, the output signal should increase directly after position 1.

(Please note that the procedure as shown above uses the standard values; other values are possible as long as they are in the operating range of the converter).

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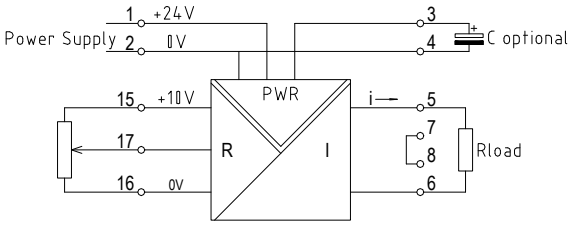
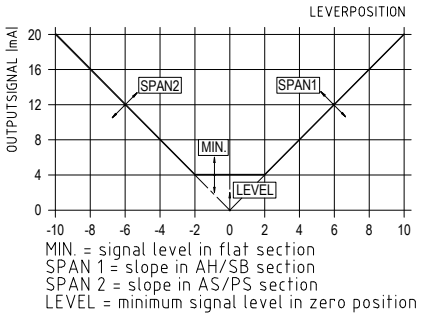
Electrical data

Power supply voltage:	24VDC±30%
Max supply current:	50mA@24VDC
Total potentiometer resistance:	1000-10000 Ω
Span adjustment:	+/-8mA
Offset level adjustment:	0-8 mA
Output current:	0/4-20 mA
Load resistance (each output)	0-500 Ω
Temperature coefficient:	<50ppm/ºC
X2-capacitor (prim-sec):	22nF/275VAC

Environmental Specifications

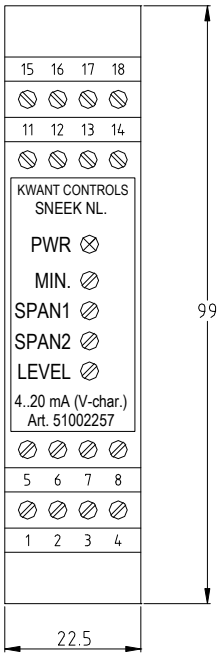
Ambient temperature:	-25/+71 °C
Heat dissipation:	1.5 W
Protection Standard:	IP20
Dimensions (LxWxH):	99x22.5x114,5mm
Weight:	130 g

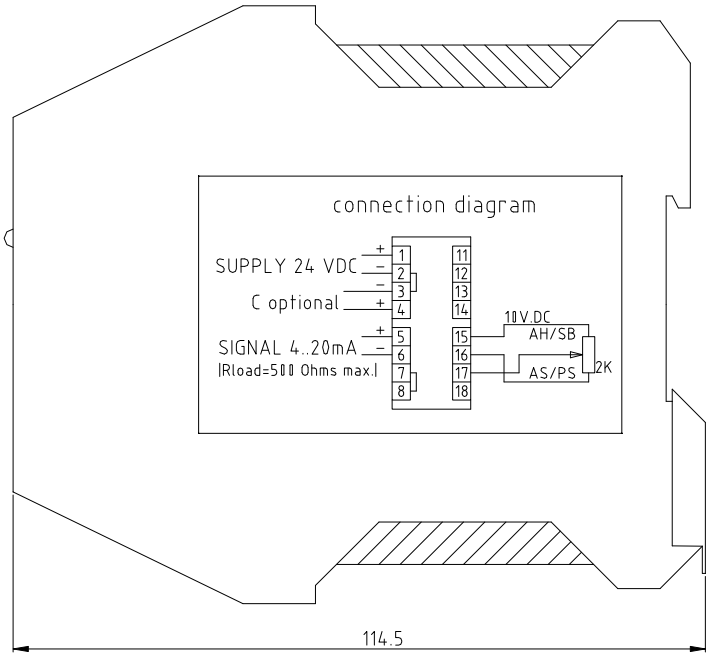




MIN. = signal level in flat section
SPAN 1 = slope in AH/SB section
SPAN 2 = slope in AS/PS section
LEVEL = minimum signal level in zero position

In/output characteristic of the SK51002257





Physical dimensions

Part Numbers

51002257

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Model 51002997

The electronic module 51002997 is designed to convert the position of one double- or two single wiper potentiometers into two 4-20 mA signals.

Features

- Two separately adjustable R/I-conversion circuits with span- and offset calibration
- One common 10 VDC reference voltage to power the potentiometer(s)
- Wiring faults of the potentiometer(s) will result in a 0 mA output signal
- Wide input range of the potentiometer signal from 10% up to 80%
- Two internal series resistors of 1000Ω each to connect 360° potentiometers
- High side output drivers allow signals with a common ground
- The output signals are isolated from the power supply
- Large power supply range (24VDC±30%)
- 'Power-on' indication (green LED)
- Optionally an external capacitor (e.g. 1000µF/40V) can be connected to smoothen the power supply voltage
- The module is mounted on a DIN-rail according to EN50022
- Tested according to ABS, BV, CCS, DNV, LRS, Class NK, RINA, RMRS.

Functional description

This module made by Kwant Controls converts the position of a double wiper potentiometer to a corresponding output signal of 4 … 20 mA. For this purpose it is equipped with two separately adjustable R/I-converter circuits that share the same reference voltage. The outputs are current sourcing and have a common return connection.
A stable 10 VDC voltage regulator is powering the potentiometer(s). When this output is overloaded, both output signals will be disabled. The signal inputs are limited to an input voltage of 1 to 9 Volts. In case the wiper signal exceeds these limits, the corresponding output signal will also be disabled. In order to connect a 360° potentiometer directly to the module, two series resistors of 1000Ω have been integrated in the electronics to prevent that the signal input will exceed the above mentioned limits.

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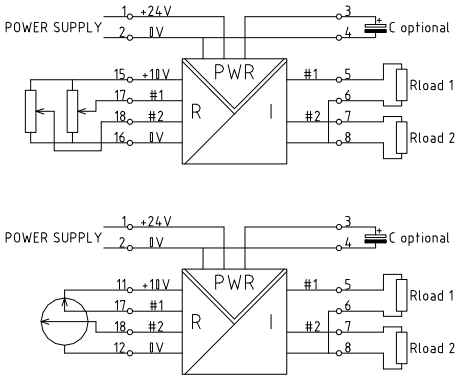
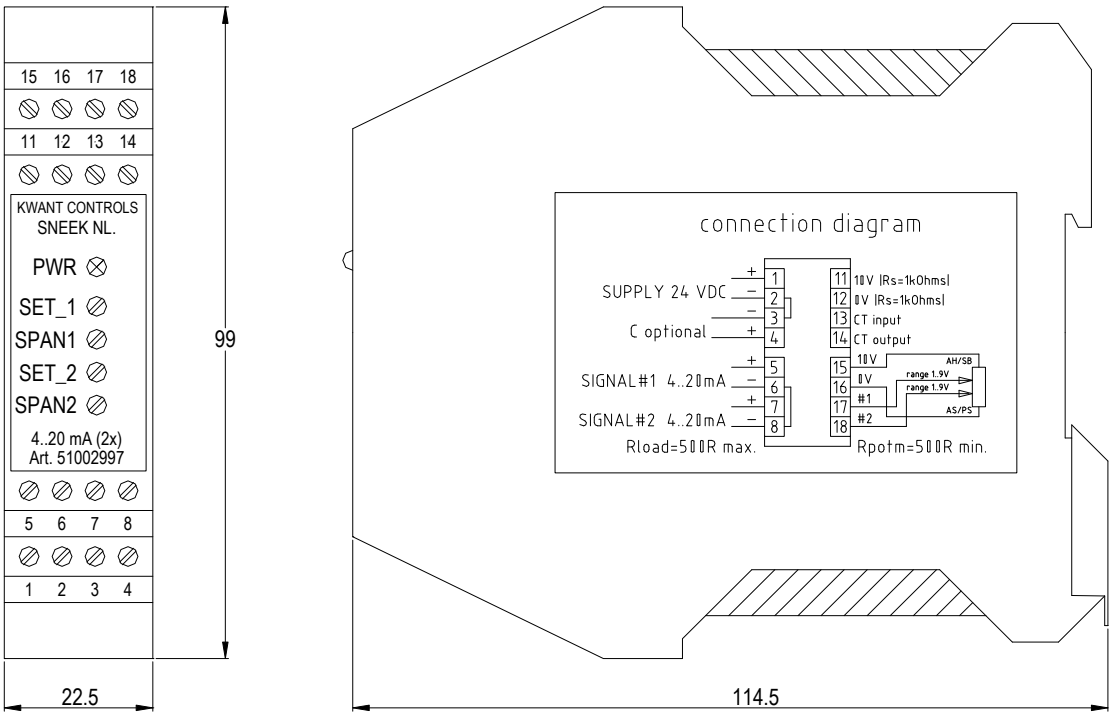
Electrical data

Power supply voltage:	24 VDC ±30%
Power consumption:	70 mA (@24VDC)
Total potentiometer resistance:	500 ... 10000 Ω
Input voltage range:	1 … 9 VDC
Span adjustment:	10 … 80%
Offset adjustment:	0 … 20 mA
Output current:	0/4 … 20 mA
Load resistance (each output)	0 … 500 Ω
Temperature coefficient:	typ. <2µA /ºC
X2-capacitor (prim-sec):	22nF / 275VAC



Environmental Specifications

Ambient temperature:	-25 ... +71 °C
Heat dissipation:	2 W
Protection Standard:	IP20
Dimensions (LxWxH):	99x22.5x114,5mm
Weight:	141g



Physical dimensions

Part Number
51002997

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Adjustment procedure for limited angle application

Channel 1

1) Make sure the potentiometer is connected to terminals 15 (+10V), 16 (0V) and 17 (wiper #1). Put the operating lever of the control unit in the neutral/zero position.
2) Check the voltage on terminals 16(-) and 17(+), it should be exactly 5VDC.
3) Adjust the SET_1 trim potentiometer until the output current at terminals 5-6 is 12mA.
4) Put the lever in the Full Ahead/Max position.
5) Adjust the SPAN1 trim potentiometer until the output current at terminals 5-6 is 20mA.
6) Put the operating lever of the control unit in the neutral/zero position.
7) Readjust (if necessary) the SET_1 trim potentiometer until the output current at terminals 5-6 is 12mA.
8) Put the lever in the Full Ahead/Max position.
9) Readjust (if necessary) the SPAN1 trim potentiometer until the output current at terminals 5-6 is 20mA.
10) Repeat steps 6 to 9 until no readjusting is necessary.
11) Put the lever in the Full Astern/Min position.
12) Adjust the lever end stop in such a way that the output current at terminals 5-6 is 4mA.

Channel 2

1) Make sure the potentiometer is connected to terminals 15 (+10V), 16 (0V) and 18 (wiper #2). Put the operating lever of the control unit in the neutral/zero position.
2) Check the voltage on terminals 16(-) and 18(+), it should be exactly 5VDC.
3) Adjust the SET_2 trim potentiometer until the output current at terminals 7-8 is 12mA.
4) Put the lever in the Full Ahead/Max position.
5) Adjust the SPAN2 trim potentiometer until the output current at terminals 7-8 is 20mA.
6) Put the operating lever of the control unit in the neutral/zero position.
7) Readjust (if necessary) the SET_2 trim potentiometer until the output current at terminals 7-8 is 12mA.
8) Put the lever in the Full Ahead/Max position.
9) Readjust (if necessary) the SPAN2 trim potentiometer until the output current at terminals 7-8 is 20mA.
10) Repeat steps 6 to 9 until no readjusting is necessary.
11) Put the lever in the Full Astern/Min position.
12) Adjust the lever end stop in such a way that the output current at terminals 7-8 is 4mA.

Note:
This procedure is also valid for the 1-channel limited angle converter (51001907). In that case the SET potentiometer is called LEVEL.

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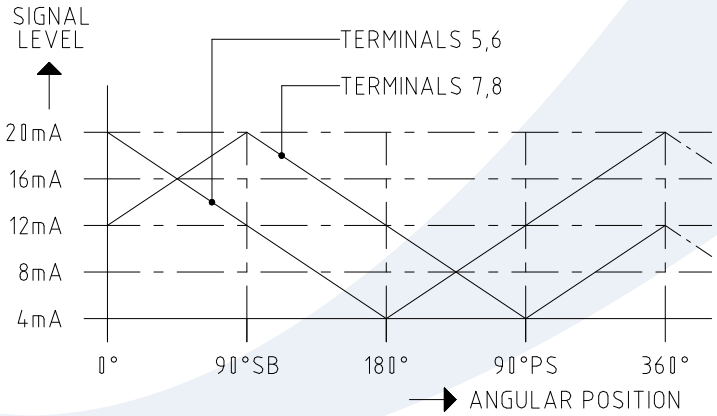
Adjustment procedure for 360° application

A 360° dual wiper potentiometer (drw. 4A0110738) can be connected to produce two 4-20mA signals that are 90° out of sync. These potentiometers are often referred to as sine/cosine even if the output signals themselves are in fact linear:



Calibration of the output current at terminals 7-8 ("sine" function):

1) Position the thruster/azimuth head in the 0-degrees position.
2) Manually rotate the transmitter potentiometer until the voltage difference between terminal 18 and 14 is minimal (less than 0.1 V).
3) Adjust the SET_2 trim potentiometer until the output current at terminals 7-8 is 12mA.
4) Position the thruster/azimuth head in the 90-degrees position.
5) Adjust the SPAN2 trim potentiometer until the output current at terminals 7-8 is 20mA.
6) Position the thruster/azimuth head in the 0-degrees position.
7) Readjust (if necessary) the SET_2 trim potentiometer until the output current at terminals 7-8 is 12mA.
8) Position the thruster/azimuth head in the 90-degrees position.
9) Readjust (if necessary) the SPAN2 trim potentiometer until the output current at terminals 7-8 is 20mA.
10) Repeat steps 6 to 9 until no readjusting is necessary.

Calibration of the output current at terminals 5 - 6 ("cosine" function):

11) Position the thruster/azimuth head in the 90-degrees position.
12) Check that the voltage difference between terminal 17 and 14 is minimal (less than 0.1 VDV).
13) Adjust the SET_1 trim potentiometer until the output current at terminals 5-6 is 12mA.
14) Position the thruster/azimuth head in the 0-degrees position.
15) Adjust the SPAN1 trim potentiometer until the output current at terminals 5-6 is 20mA.
16) Position the thruster/azimuth head in the 90-degrees position.
17) Readjust (if necessary) the SET_1 trim potentiometer until the output current at terminals 5-6 is 12mA.
18) Position the thruster/azimuth head in the 0-degrees position.
19) Readjust (if necessary) the SPAN1 trim potentiometer until the output current at terminals 5-6 is 20mA.
20) Repeat steps 16 to 19 until no readjusting is necessary.