

4. Connecting your own sensors and electrical signals

To connect your own sensors / transducers you will need the appropriate ALMEMO® connector. For each measuring range programmed ALMEMO® connectors are available, as listed in the overview table in Chapter 3. These provide 6 screw terminals with measuring inputs A, B, C, D, and 2 power supply terminals (+ and -). For many signals additional components or even extra evaluation electronics will be needed. For this purpose special connectors and input modules are provided; (see Section 4.2).

Sensor power supply

For the purposes of supplying power to the sensor 'Normal' on the connector accepts operating voltage via the device (usually 9 V with battery or 12 V with mains adapter) (maximum load capacity 50 mA). On the new devices 2690-8 and 2890-9 the voltage can be programmed.

7..12V Standard connector 'Normal'

ZA 9000-FS

For other sensor supply voltages the following special-purpose connectors are available:

2.5V Stable, for voltage dividers, potentiometers ZA 9025-FS3 s. 4.2.4

5V Stable, with differential amplifier
for measuring bridges ZA 9650-FS s. 4.2.5

12V DC/DC converter, not regulated ZA 960x-FSxV12 s. 4.2.6
15V voltage is also possible on request.

Certain connectors can be used for higher voltages and / or higher currents; for this purpose a cable port for the appropriate external voltage sources or mains units is available (option OA9000V).

The pin assignment for the various sensors is described in the following section.

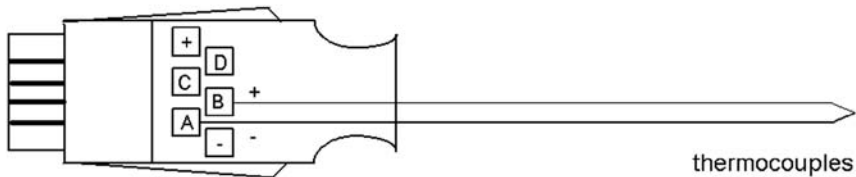
4.1 Using the standard connector

All connection variations described in this Chapter are based on the standard connector 'Normal' ZA 9000-FS. The connector numbers indicated refer only to the corresponding measuring range programming. This programming can be performed by the users themselves at any time. On V6 devices the only things that the user cannot program are the special measuring ranges with linearization in the connector (ZA 9xxx-SS); (see 6.3.13).

4.1.1 Connecting thermocouples

Standard connector ZA 9000-FS can, with appropriate programming, be used for connecting noble-metal thermocouples (types S, B, R) because these have no electromagnetic compatibility (EMC) requirements in the ambient temperature range. With certain base-metal thermocouple types, however, in the event of a temperature difference between terminal and socket, measuring errors may occur. For thermocouple types K, N, T, J, and L, therefore, special-purpose connectors made from thermo material are available; (see Section 4.2.1).

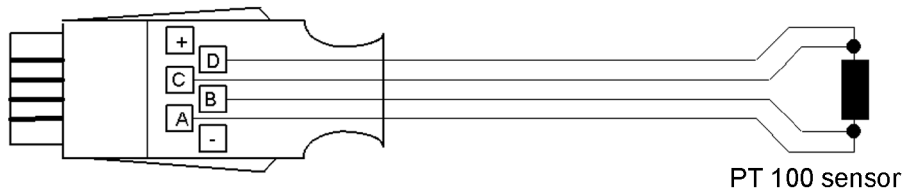
Ranges: PtRh-Pt (S,R,B), AuFe-Cr, W5Re-W26Re (ZA9000-SSC)



4.1.2 Connecting resistance sensors

In order to use your own Pt100 or Ni100 sensors the appropriately programmed connectors ZA9030-FS1,2,3 are available. Resistances up to 500 Ω can be connected via connector ZA9003-FS either in 4-conductor configuration or in 2-conductor configuration with jumpers A-B and C-D. For Pt1000 or Ni1000 sensors and for a 5000 Ω measuring range, connectors ZA9030-FS4,5,6, and ZA9003-FS2 are available (switchover to 1/10 measuring current by means of element flag); (see Section 6.10.3). 50 Ω and 100 k Ω measuring ranges can be set up using special-purpose connectors; (see 4.1.3).

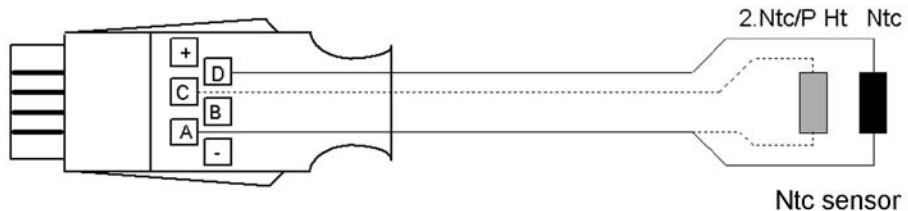
Ranges: Pt100-1, Pt100-2, Ni100, Ohm, Ohm3 (50 Ω ZA9003SS3)



4.1.3 Connecting NTC and PTC sensors

NTC sensors FN Axxx or corresponding NTCs (10 k Ω at 25 $^{\circ}\text{C}$) are connected in connector ZA 9040-FS as follows. With the measuring range for humid temperature or with multiplexer switchover (see Section 6.10.2) a second sensor can be used on the 2nd channel (connector for 2 NTCs, ZA 9040-FS2).

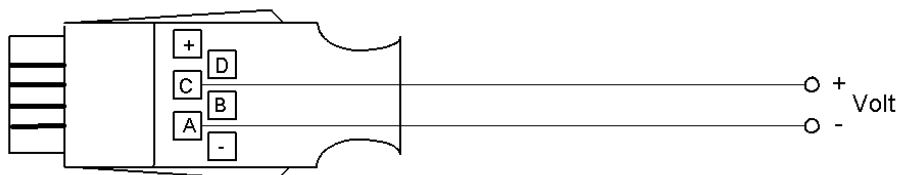
Ranges: Ntc, Ntc 0.001 $^{\circ}\text{C}$ (ZA 9040-SS3), KTY84 (ZA 9040SS4), 100k Ω (ZA 9003-SS4), 2nd NTC or humidity temperature P HT



4.1.4 Voltage measurement

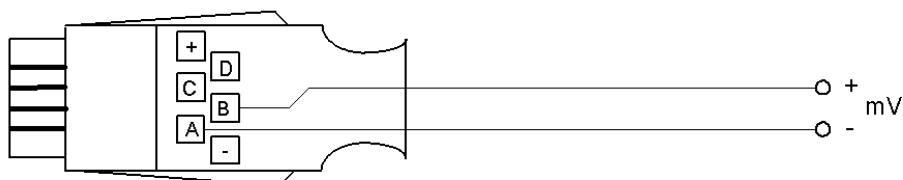
For voltage measurement in the ± 2.6 volts range standard connector ZA 9000-FS3 is used.

Ranges: 2.6 Volt



For smaller voltages the appropriately programmed connectors ZA 9000-FS0 (55 mV), -FS1 (26 mV), -FS2 (260 mV) are available.

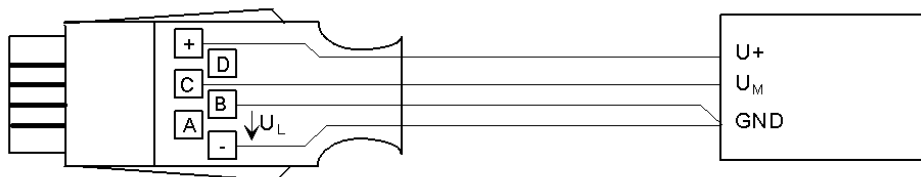
Ranges: 26 mV, 55 mV, 260 mV



4.1.5 Differential voltage measurement for sensors with power supply

Sensors or transmitters (e.g. pressure sensors) which are powered via the device itself are particularly susceptible to voltage drop U_L on the grounding conductor;; in such cases differential voltage measurement is advisable in order to eliminate this. This is performed by connecting the sensor via connector ZA 9000-FS0D/-FS1D/-FS2D/-FS3D in 4-conductor configuration and tapping output signal UM directly via the differential input, pin C and pin B. For signals with a high common-mode part (e.g. measuring bridges) connector ZA 9650-FS should be used (see Section 4.2.5) and for those with a high supply voltage, ZA 960x-FSxV12 (see Section 4.2.6).

Ranges: Differential voltage 26 mV, 55 mV, 260 mV, 2.6 V



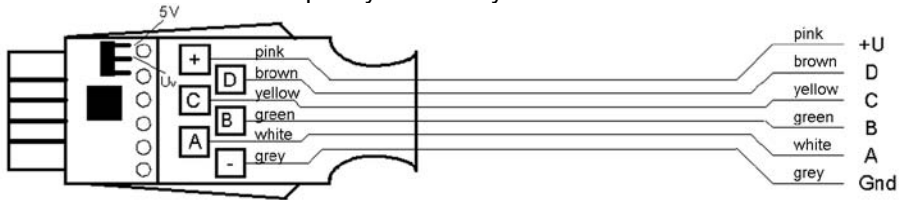
4.1.6 ALMEMO® adapter cable ZA 9000-AK

ALMEMO® universal connector ZA 9000-FS is also available with connecting cable and free ends as adapter cable ZA 9000-AK.

Sensor supply	On all ALMEMO® connectors with screw terminals the terminal +U by default carries a sensor supply voltage of 9 to 12 V or the mains unit voltage.
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The regulated 5V voltage via the ALMEMO® connector (maximum load capacity 50 mA) is available as an option

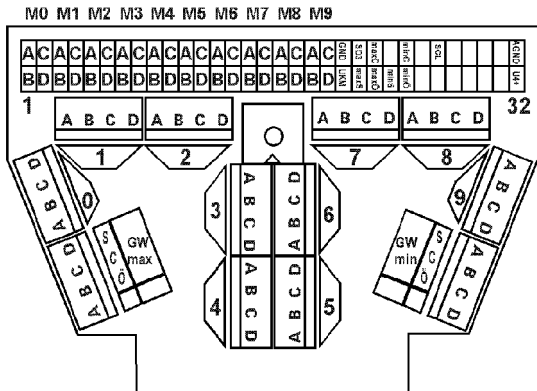
Connecting cable 8-wire, 8 x 0.14 mm², black, length 1,5 meters The wiring diagram and color code of the wires are consistent for all ALMEMO® sensors and cables, so that any pin assignment can be quickly and easily identified.



4.1.7 ALMEMO® 10x MU connector ZA 5590MU

The ALMEMO® 5690 measuring systems may (as an alternative to the plug-in boards for ALMEMO® single connectors) employ plug-in board ES 5690-UMU with 10 inputs in the form of a 64-pin socket strip. Sensors are connected via a 10-fold connector (ZA 5690-MU) each with four screw terminals A, B, C, D - in

the same way as each individual ALMEMO® standard connector ZA9000FS (see Sections 4.1.1 to 4.1.4). Sensors requiring a power supply or an ALMEMO® connector with special interface circuitry (e.g. humidity sensors, rotating vanes, etc.) cannot be connected in this way. Each sensor can be programmed individually but all sensor programming data is saved together in a shared EEPROM located in the connector.



The previous connector generation ZA 5590-MU can still be used with the new 5690 systems (but only with 10 channels); however, the new ZA 5690-MU cannot be used with 5990 systems.

Ranges: NiCr-Ni, Fe-CuNi (L, J), Cu-CuNi (U,T), PtRh-Pt (S, R, B),
Pt100-1, Pt100-2, Ni100, Ohm, Ntc, 2,6V, 26 mV, 55 mV, 260 mV

4.2 Special-purpose connectors

4.2.1 Thermal connectors for thermocouples

For the most frequently used thermocouples the following ALMEMO® connectors (no thermo-electric transition) are available:

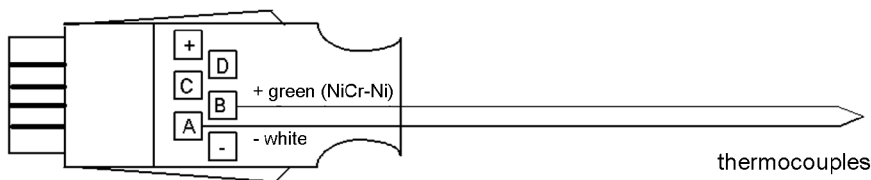
ZA 9020-FS für NiCr-Ni (type K), NiSiI (type N), ZA9020SS2 for NiCr-Ni 0.01°C

ZA 9021-FSL für Fe-CuNi (type L)

ZA 9021-FSJ für Fe-CuNi (type J)

ZA 9021-FST für Cu-CuNi (type T)

Ranges: NiCr-Ni (type K), NiSiI (type N), Fe-CuNi (type L,J) Cu-CuNi (type T)



For especially exacting measuring operations, requiring a high level of precision, using several sensors, and performed under relatively unfavorable conditions (e.g. subject to thermal irradiation), the ALMEMO® ZA9400-FSx connector is available, with its own integrated temperature sensor for cold junction compensation. This connector is suitable for all types of thermocouple but it needs two channels. Having "J" programmed in the first two positions in the designation for the thermocouple ensures that the temperature sensor integrated in the connector is indeed used for cold junction compensation.

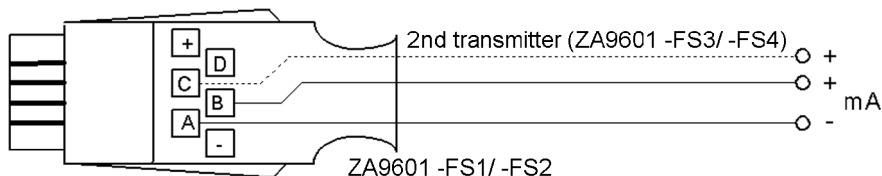
For temperature measurement with NiCr-Ni at high voltage potential the electrically isolated measuring module ZA9950AB is available; (see Section 4.2.8.3).

4.2.2 Shunt connector for current measurement

Current measurement in the range ± 32 mA requires connector ZA9601-FS1 and in the range 0 to 100 % (4 to 20 mA) requires connector ZA9601-FS2 with an integrated 2 ohms shunt. This shunt is adjusted before leaving the factory. Or, as an alternative, it is also possible of course to use a standard connector with a 2Ω 0.1% shunt connected externally to screw terminals A and B. If 2 current signals have a common ground, both can be acquired via just one connector ZA 9601-FS3/-FS4.

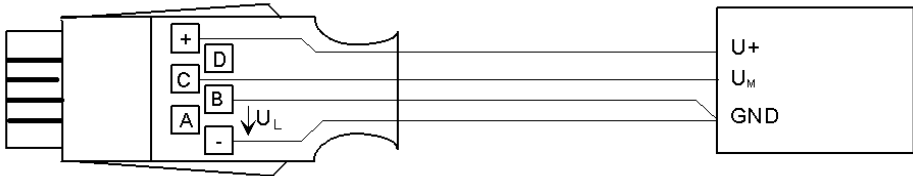
Accuracy : $\pm 0.1\%$ of measured value.

Ranges: Milliampères, percent (4 to 20 mA)

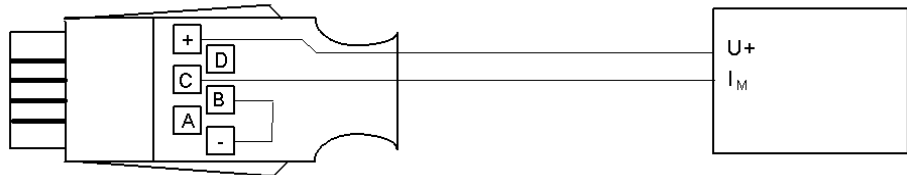


Connectors for sensors powered via the device

Sensors powered with the current output from the device are even more susceptible to the problem of voltage drop on the grounding conductor than sensors with their own integrated voltage output; (see Section 4.1.5). The solution to this problem is similar but it requires connector ZA9601-FS5/-FS6 with a shunt between C and B and a change in the multiplexer position to C-B; (see Section 6.10.2).



In this way 2-conductor transmitters can be connected (jumper between - and B).



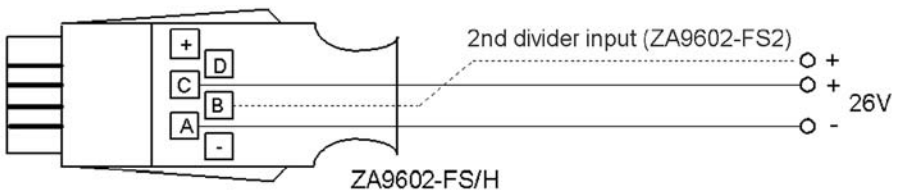
For sensors requiring a supply voltage of at least 12 V the connector series ZA 960x-FSxV12 is available; (see 4.2.6).

4.2.3 Divider connector for voltage measurements up to 26 VDC

For measuring voltages up to ± 26 volts there is connector ZA 9602-FS/H incorporating a 100:1 voltage divider. This is adjusted and programmed with the appropriate decimal point. For two signals with a common ground there is also connector ZA 9602-FS2/H incorporating two voltage dividers.

Accuracy $\pm 0.1\%$ of measured value.

Range: 260 mV



Connectors for sensors powered via the device

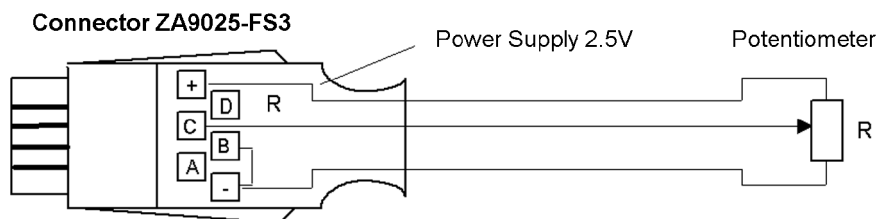
Sensors with higher current consumption which are therefore powered via the device itself are also susceptible to voltage drop on the grounding conductor; (see 4.1.5). This problem can be solved by using connector ZA 9602-FS3 with a divider between C and B and changing the multiplexer position to C-B; (see 6.10.2).

For sensors requiring a supply voltage of at least 12 V the connector series ZA 960x-FSxV12 is available; (see 4.2.6).

4.2.4 Evaluation of potentiometer sensors

Potentiometer sensors for measuring length and angle can be evaluated via connector ZA 9025-FS3. The potentiometer is connected to an internal supply voltage of 2.5 V (maximum 50 ppm/K) and the tapping is recorded in measuring range 2.6 V.

Range: Differential voltage 2.6 V

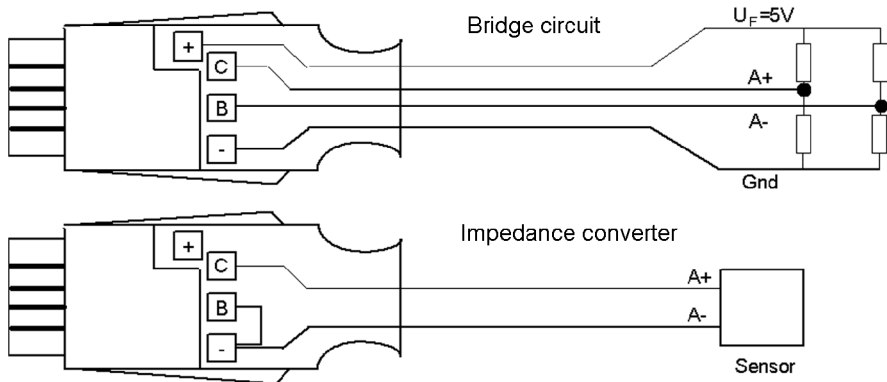


4.2.5 Connectors for measuring bridges with a stable 5V supply

1. With differential amplifier

For all sensors with a bridge circuit (e.g. force transducer, wire strain gauge, etc.) that need a stable supply or have a high common-mode part or for high-impedance sensors that need an impedance converter there is connector ZA 9650-FSx. This connector incorporates a 5V voltage regulator and a differential amplifier with or without amplification. Zero-point and gain adjustment can be stored in the connector's EEPROM.

Pin assignment:



Differential voltage connector ZA9650-FSx

Technical data

Sensor supply

Sensor supply voltage (U_F)

$5 \pm 0.05 \text{ V}$

Temperature coefficient

$< 50 \text{ ppm} / ^\circ\text{C}$

Output current

maximum 100 mA

Amplifier

Input voltage range (common-mode)

$-3.0 \text{ to } +3.5 \text{ V}$

Offset voltage

$400 \mu\text{V} (V=1), 225 \mu\text{V} (V=10)$

Offset voltage drift

maximum $1 \mu\text{V} / ^\circ\text{C}$

Input current

0.5 nA

Current consumption

approx. 2 mA

Connector with amplifier and 5V supply

Differential voltage connector 55 mV

ZA 9650FS0

Differential voltage connector 26 mV ($V=10$)

ZA 9650FS1V

Differential voltage connector 260 mV ($V=10$)

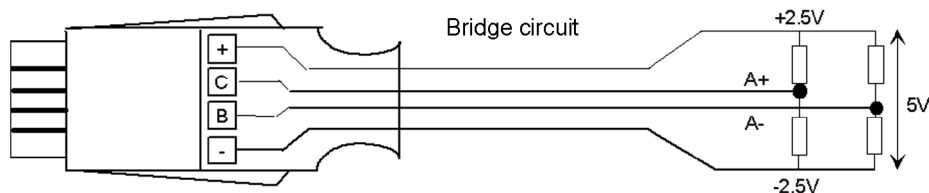
ZA 9650FS2V

Differential voltage connector 2.6 V

ZA 9650FS3

2. Connectors with symmetrical supply and power saving system

With measuring bridges the new connector series ZA 9105-FSx dispenses with the differential amplifier by using a zero-symmetrical voltage supply of ± 2.5 V (and thus avoids the associated drift and noise). Also, so long as the measuring point is not selected, the supply remains switched off. When a large number of measuring bridges are involved this relieves the power supply.



Connectors for measures bridges ZA9105-FSx

Technical data

Sensor supply

Sensor supply voltage (U_F)

5 ± 0.05 V

Temperature coefficient

< 50 ppm / $^{\circ}\text{C}$

Output current

maximum 100 mA

Quiescent current

approx. 3 mA

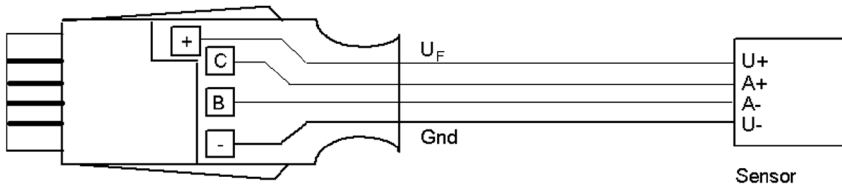
Bridge connector with symmetrical 5V supply

Type	Measuring range	Resolution	Order no.
55 mV	-10 to +55 mV	1 μV	ZA 9105FS0
26 mV	-26 to +26 mV	1 μV	ZA 9105FS1
260 mV	-260 to +260 mV	10 μV	ZA 9105FS2
2.6 V	-2.6 to +2.6 V	0.1 V	ZA 9105FS3

4.2.6 Connector with 12V supply

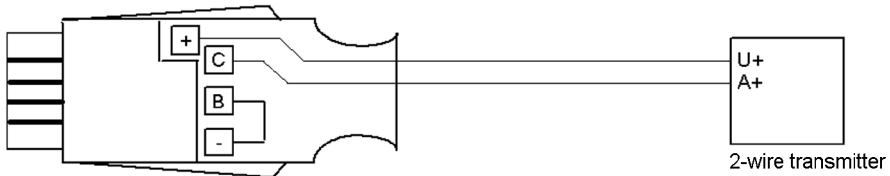
For sensors or transmitters needing a supply of minimum 12 VDC there is connector series ZA960x-FSxV12. This connector series incorporates a voltage converter for converting lower battery voltage to 12 V. 15 V voltage is also possible on request. For signals up to 26 V there is connector ZA 9602-FS3V12/H incorporating a 100:1 divider. Differential evaluation eliminates the line voltage drop.

Pin assignment



Differential current / voltage connector ZA960xFSxV12
with 12V supply

For 2-wire transmitters or sensors with current output there is connector ZA 9601-FSxV12 with an integrated 2-ohm shunt.



Differential current connector ZA9601FSxV12
with 12V supply

Technical data

Device voltage (U_G)	7 to 12 V
Sensor supply voltage (U_F)	13.5 ± 0.5 V
Output current	100 mA at $U_G = 12$ V
	50 mA at $U_G = 9$ V
	20 mA at $U_G = 7$ V
Accuracy	$\pm 0.1\%$ of measured value

Connector with 12V supply

Differential voltage connector 55 mV	ZA 9600FS0V12
Differential voltage connector 26 mV	ZA 9600FS1V12
Differential voltage connector 260 mV	ZA 9600FS2V12
Differential voltage connector 2.6 V	ZA 9600FS3V12
Differential voltage connector 26 V	ZA 9602FS3V12/H
Differential current connector 32 mA	ZA 9601FS5V12
Differential current connector % (4 to 20 mA)	ZA 9601FS6V12

4.2.7 AC voltage module for AC signals

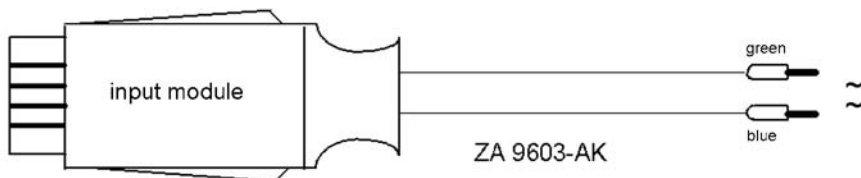
For measuring AC voltages there is ALMEMO® adapter cable ZA 9603-AK with a TRMS converter integrated in the ALMEMO® connector. This converter is supplied via an electrically isolated, integrated DC/DC converter; in this way several signals with varying potentials can all be recorded in the range of maximum ± 50 V.



Once a channel has been selected, the measuring input is electrically connected to measuring instrument ground. Under no circumstances therefore should any voltage above 50 V be applied (extremely dangerous!).

Since on the other hand all signals are present in parallel, measuring point scans can be performed very easily. Given the settling time involved operation in sleep mode is by default not envisaged..

Ranges 260mV, 2.6Volt



Technical data

	Meas. range	Resolution	Internal resistance
Type ZA9603-AK1:	260 mV _{rms}	0.1 mV	Ri = 100 kΩ
Type ZA9603-AK2:	2.60 V _{rms}	0.001 V	Ri = 1 MΩ
Type ZA9603-AK3:	26.0 V _{rms}	0.01 V	Ri = 10 MΩ
Frequency range	50 Hz to 10 kHz		
Accuracy	±0.2% of final val. ±0.5% of meas. val. (40 Hz to 2 kHz sinusoidal)		
Crest factor	3 (additional error 0.7 %) 5 (additional error 2.5 %)		
Current consumption	approx. 5 mA		

4.2.8 Electrically isolated high-voltage measuring modules for AC and DC signals and thermocouples

Safety instructions

So long as the measuring module is used exactly as intended the safety of both device and user are ensured. If, however, it is ever used in any way other than intended this safety cannot be guaranteed.

Please read therefore - carefully and completely - the following safety directives - in order to avoid the risk of fire, of damage to the measuring module or measuring instrument, and of injury to operating personnel.

If operation ever involves voltages above 50 V, personnel must receive appropriate instruction - above all regarding the dangers of mains voltages.

- Switch OFF before plugging a measuring module into the measuring instrument.
- The various measuring modules, depending on type, are suitable for measuring voltage, current, or thermocouples at potentials above 50 V. When operating a measuring module - and especially when connecting it, you must be extremely careful not to touch any parts carrying high voltage.
- With the measuring module for thermocouples, you must, before connecting the temperature sensor, disconnect the operating voltages for all devices involved.
- With the measuring module for AC/DC signals you must use the supplied safety-screened test cable (or an approved equivalent).
- The measuring module for DC signals may only be used in conjunction with DC or DC voltage within the measuring range marked by a cross on the rating plate.
- Please note in particular that current modules must not be connected directly to the voltage source but always in series to the load, i.e. switched via one feed line.
- The measuring instrument and measuring module must not be operated in a wet or damp environment.
- The plastic housing must be protected against open flames and hot surfaces (e.g. hot-plates).
- As soon as a measuring module shows any sign of external damage or if, as a result of incorrect connection, it ceases to function properly, it must no longer be used.
- If the measuring module is operated incorrectly or used for any purpose other than that intended, the manufacturer will not accept liability for any resulting damage.

Safety symbols



Important note

To avoid danger to life and limb and the risk of damage to equipment please ensure that you comply with all advisory notes thus marked in the instructions.



Warning

Touching or coming into contact with any such part carrying high voltage might result in electric shock. To avoid risk of electric shock, you must always be extremely careful not to touch any exposed parts or connectors.

4.2.8.1 High-speed ALMEMO® DC measuring module

DC voltage ZA9900-AB
Direct current (DC) ZA9901-AB



Introduction

ALMEMO® measuring module ZA 9900/1-AB, operating at a sampling rate of 1 kHz, on receipt of a DC or DC voltage signal, records momentary, maximum, minimum, and average values and, with each measuring point scan, transfers these four values to the ALMEMO® device. Measured data is transferred to the measuring instrument in purely digital form. Connection on the module is 4 kV, electrically isolated, and protected against overvoltage. The measuring module can thus be plugged into any ALMEMO® measuring input, i.e. several modules on one ALMEMO® device.

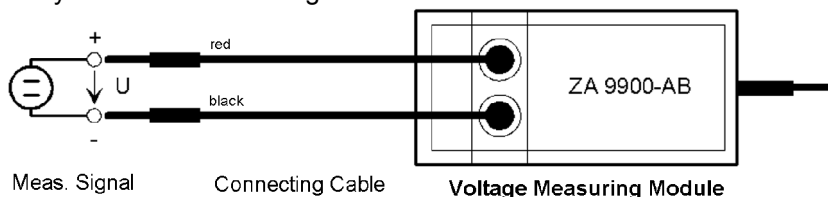
Connecting a measuring module



Be sure, whenever you connect a measuring module, to observe the measuring range marked by a cross on the rating plate. Switch OFF before plugging a measuring module into the measuring instrument.

Measuring a voltage using module ZA 9900-ABx

To measure a voltage the input sockets on the measuring module must be connected directly to the terminals of the voltage source using the supplied safety-screened connecting cable.

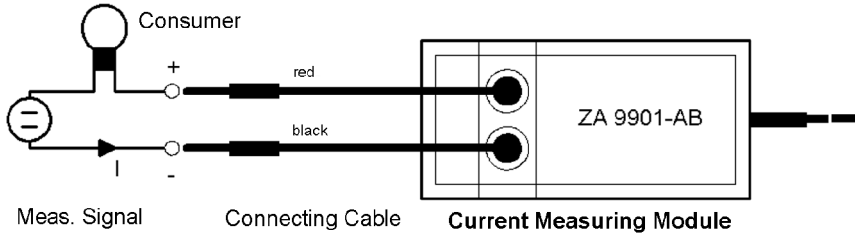


**Warning !**

With voltages above 50 V it is absolutely vital that cabling work be performed with all equipment disconnected and at zero voltage and that the voltage only be (re)connected after such work has been completed. To avoid risk of electric shock, you must always be extremely careful not to touch any exposed parts or connectors.

Measuring a current using module ZA 9901-ABx

To measure a current the measuring module must be switched into the connecting line of a load using the supplied safety-screened connecting cable.

**Warning !**

With voltages above 50 V it is absolutely vital that cabling work be performed with all equipment disconnected and at zero voltage and that the voltage only be (re)connected after such work has been completed. To avoid risk of electric shock, you must always be extremely careful not to touch any exposed parts or connectors.

Important note !

The measuring module for current must not be connected directly to the voltage source without a load; failure to heed this point might destroy the module and incur the risk of fire through overheating. The measuring ranges for current can be overloaded for very brief periods; however, the device is not protected by fuse.

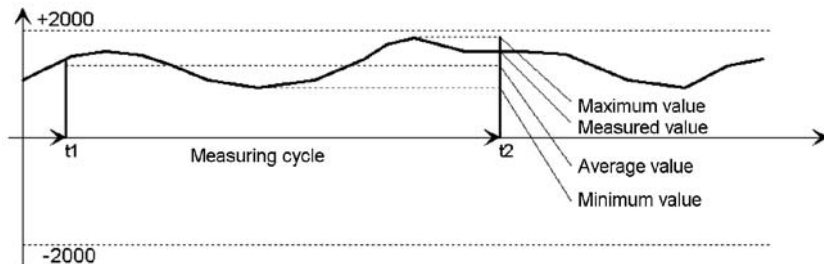
**Connecting a measuring module to an ALMEMO® device**

The ALMEMO® connector on the measuring module can be plugged into any sensor socket Mxx on any ALMEMO® measuring instrument with the 'DIGI' measuring range (i.e. models made since around May/1998). The power for the measuring module is supplied by the ALMEMO® measuring instrument via a DC/DC converter (insulation voltage, minimum 4 kV / second, 1 kV continuous). The power supply to the measuring instrument is thus charged with approx. 40 mA; i.e. for prolonged operation a mains supply unit is necessary. Data is transferred to the measuring instrument every 0.5 seconds opto-isolated and digital.

Measured data acquisition

The measuring signal is continuously sampled at 1 kHz and from this the maximum value, minimum value, and average value are calculated. On completion of each manual or cyclic measuring point scan the measured values obtained since the last measuring point scan, i.e. the maximum, minimum, and average values (but not the momentary value) are output via the 4 channels on the ALMEMO®

connector and then deleted.



If one of the measuring channels (maximum value, minimum value, or average value) is selected, the associated value is called up at the conversion rate (2.5 or 10 mops) and then deleted. If this is not required, the 1st channel on the measuring module or some other sensor must have been selected. If more than 100 consecutive measured values lie outside the measuring range, the measured value display flashes to indicate that the measuring range has been overshoot/undershot.

Programming the ALMEMO® connector

Channel	Measuring function	Range	Resolution	Locking
1st channel	Measured value	DIGI	1/2000 of range	5.00
2nd channel	Maximum value	DIGI	1/2000 of range	5.00
3rd channel	Minimum value	DIGI	1/2000 of range	5.00
4th channel	Average value	DIGI	1/20000 of range	5.00



The measuring range adjustment is stored together with the gain correction data. Before locking can be set below level 4, you should note the adjustment value so that you can enter this again in the event of accidental deletion when programming or as a result of incorrect operation.

Technical data

Meas. module	Meas. range	Overload	Internal resistance
ZA 9900-AB1 ⁺	±200.0 mV	±40 V	50 kW
ZA 9900-AB2	±2.000 V	±400 V	800 kW
ZA 9900-AB3	±20.00 V	±500 V	1 MW
ZA 9900-AB4	±200.0 V	±500 V	1 MW
ZA 9900-AB5	±400. V	±1000 V	4 MW
ZA 9901-AB1	±20.00 mA	±0.1 A*	10 W
ZA 9901-AB2	±200.0 mA	±1 A*	1 W
ZA 9901-AB3	±2.000 A	±10 A*	0.1 W
ZA 9901-AB4	±10.00 A	±20 A*	0.01 W

⁺ Only for current measurement with external shunt

* The measuring ranges for current can be overloaded for very brief periods (1 minute); however, the device is not protected by fuse.

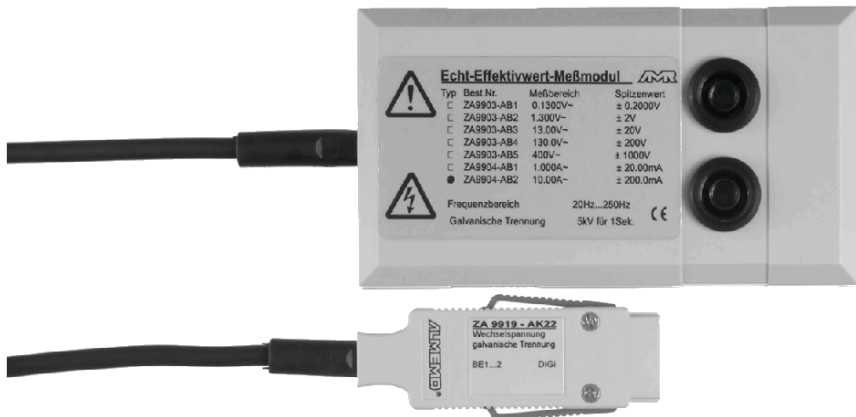
Accuracy	0.1% of final value ± 2 digits
Sampling rate	1 kHz
Resolution	12 bit, ± 2048 digits
Measuring period / settling time	0.1 seconds
Measuring cycle, maximum	14 hours
Electrical isolation	1 kV permanent, 4 kV for 1 second
Housing	polystyrene, (LxWxH) 100 x 54 x 31 mm
Sockets	Sockets, 4 mm, safety-screened
Operating voltage	6 to 14 V via ALMEMO® device
Current consumption	<40 mA (connector and module)

Standard delivery

Measuring module with ALMEMO® connecting cable
 2 test cables with safety-screened banana plugs
 Operating instructions

4.2.8.2 High-speed ALMEMO® TRMS AC measuring module

AC voltage ZA 9903-AB
 Alternating current (AC) ZA 9904-AB



Introduction

ALMEMO® AC measuring modules ZA 9903-AB and ZA 9904-AB automatically record in purely digital form the TRMS value (true root-mean-square) of an AC variable; i.e. the measuring signal with any curve form is digitized at 1 kHz and the TRMS is calculated. The frequency can be called up on the 2nd channel. Data is sent to the measuring instrument in purely digital form. Connection on the module is 4 kV, electrically isolated and protected against overvoltage. The measuring module can thus be plugged into any measuring input on any ALMEMO® measuring instrument, i.e. several modules on one ALMEMO® device.

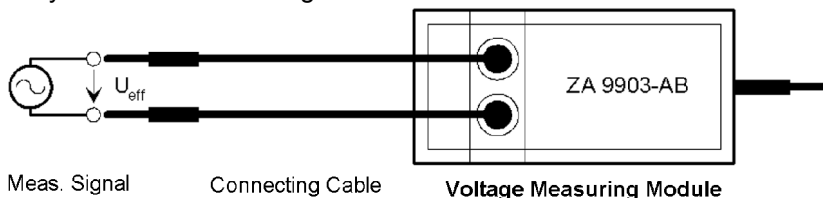
Connecting a measuring module



Be sure, whenever you connect a measuring module, to observe the measuring range marked by a cross on the rating plate. Switch OFF before plugging a measuring module into the measuring instrument.

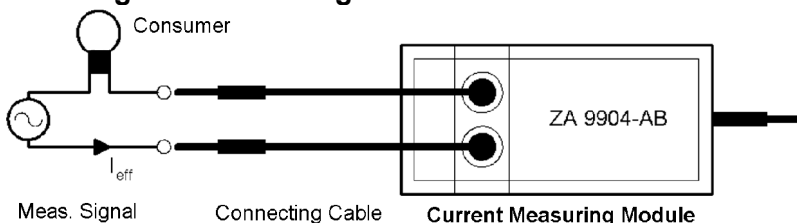
Measuring a voltage using module ZA 9903-ABx

To measure a voltage the input sockets on the measuring module must be connected directly to the terminals of the voltage source using the supplied safety-screened connecting cable.



Warning! With voltages above 50 V it is absolutely vital that cabling work be performed with all equipment disconnected and at zero voltage and that the voltage only be (re)connected after such work has been completed. To avoid risk of electric shock, you must always be extremely careful not to touch any exposed parts or connectors.

Measuring a current using module ZA 9904-ABx



To measure a current the measuring module must be switched into the connecting line of a load using the supplied safety-screened connecting cable.



Warning! With voltages above 50 V it is absolutely vital that cabling work be performed with all equipment disconnected and at zero voltage and that the voltage only be (re)connected after such work has been completed. To avoid risk of electric shock, you must always be extremely careful not to touch any exposed parts or connectors.



Important note ! The measuring module for current must not be connected directly to the voltage source without a load; failure to heed this point might destroy the module and incur the risk of fire through overheating. The measuring ranges for current can be overloaded for very brief periods; however, the device is not protected by fuse.

Connecting a measuring module to an ALMEMO® device

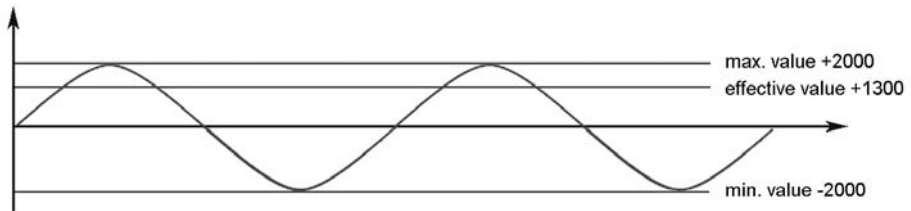
The ALMEMO® connector on the measuring module can be plugged into any sensor socket Mxx on any ALMEMO® measuring instrument with the 'DIGI' measuring range (i.e. models made since around May/1998). This is with the following exception : The measuring module is not designed for operation with selector switch board ES5590MF. The power for the measuring module is supplied by the ALMEMO® measuring instrument via a DC/DC converter (insulation voltage, minimum 4 kV / second). The power supply to the measuring instrument is thus charged with approx. 40 mA; i.e. for prolonged operation a mains supply unit is necessary. Data is transferred to the measuring instrument every 0.5 seconds opto-isolated and digital.

Measuring the TRMS (true root-mean-square)

The AC voltage signal is sampled continuously at 1 kHz and every 0.5 seconds the total root-mean-square value is calculated from the DC voltage and AC voltage parts.

$$V_{\text{rms}} = \sqrt{V_{\text{AC}}^2 + V_{\text{DC}}^2}$$

For a measuring range of 1300 digits for sinusoidal signals the total measuring range is ± 2000 digits.



4

If more than 10 of the 500 measured values lie outside the measuring range, the measured value display flashes to indicate that the measuring range has been overshoot/undershot. To measure frequency the amplitude must be at least 10% of the final value.

Programming the ALMEMO® connector

Channel	Measuring function	Range	Units	Resolution	Locking
1st channel	AC rms	DIGI	V~	1/1300 of range	5.00
2nd channel	Frequency	DIGI	Hz	0.1 Hz	5.00



The measuring range adjustment is stored together with the gain correction data. Before locking can be set below level 4, you should note the adjustment value so that you can enter this again in the event of accidental deletion when programming or as a result of incorrect operation.

Technical data

Measuring module	Meas. range	Resolution	Peak value	Overload	Internal resistance
AC voltage	U_{rms} sinus		U_{ss}	U_{ss}	R_i
ZA 9903-AB1	130.0 mV _{rms}	0.1 mV	±0.2 V	±400 V	0.5 MΩ
ZA 9903-AB2	1.300 V _{rms}	1 mV	±2 V	±400 V	0.8 MΩ
ZA 9903-AB3	13.00 V _{rms}	10 mV	±20 V	±500 V	1 MΩ
ZA 9903-AB4	130.0 V _{rms}	0.1 V	±200 V	±500 V	1 MΩ
ZA 9903-AB5	400. V _{rms}	1 V	±1000 V	±1000 V	4 MΩ
Alternating current	I_{rms} sinus		I_{ss}		
ZA 9904-AB1	1.000 A _{rms}	1 mA	±2 A	±10A*	0.10 Ω
ZA 9904-AB2	10.00 A _{rms}	10 mA	±20 A	±20A*	0.01 Ω

* The measuring ranges for current can be overloaded for very brief periods (1 minute); however, the device is not protected by fuse.

	TRMS	Frequency
Accuracy	0.1% of final value ±2 digits	±0.1 Hz
Sampling rate	1 kHz	-
Resolution	12 bit, ± 2048 digits for U _{pp}	0.1 Hz
Sensitivity	-	10% of final value
Frequency range	20.0 to 250 Hz	20.0 to 250 Hz
Meas. period / settling time	0.5 seconds	0.5 seconds
Electrical isolation	1 kV permanent, 4 kV for 1 second	
Housing	polystyrene, dim. (LxWxH) 100 x 54 x 31 mm	
Sockets	Sockets, 4 mm, safety-screened	
Operating voltage	6 to 14 V via ALMEMO® device	
Current consumption	<40 mA (connector and module)	

4.2.8.3 Electrically isolated ALMEMO® D measuring modules for thermocouples NiCr-Ni (type K), FeCuNi(typeJ), Cu-CuNi(typeT)

Description

To measure temperatures at high potential (up to 1000 V) the new digital ALMEMO® D measuring modules can be used (ZAD950-ABK/J/T, types K/J/T). These measuring modules - electrically isolated - measure and record the temperature of a thermocouple and continuously transfer this measured value in purely digital form to the ALMEMO® device. The measuring module can thus be plugged into any ALMEMO® measuring input, i.e. several modules on one ALMEMO® device.



ALMEMO® D measuring modules have two digital interfaces (one I²C and one serial); these open up completely new possibilities; (see Section 3.01):

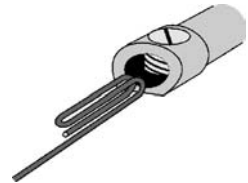
1. Standard use as digital sensor on any ALMEMO® measuring instrument
2. Interference-proof extension up to 1 kilometer by means of intelligent extension cable
3. Use as stand-alone data acquisition system connected directly to a PC or in an ALMEMO® network without additional measuring instrument.

Connecting a measuring module



Beware - High voltage ! With potentials above 50 V it is absolutely vital that cabling work be performed with all equipment disconnected and at zero voltage and that the voltage only be (re)connected after such work has been completed. The measuring module must not be operated in the range within which contact is considered dangerous. At all points beyond the sensor terminals responsibility for safety lies with the user.

Please ensure that the sensor is only connected using the supplied safety-screened high-voltage connectors ! Wire less than one millimeter thick may in certain circumstances have to be bent over several times to ensure a firm grip in the screw terminal.



The ALMEMO® connector on the measuring module can be plugged into any sensor socket Mxx on any ALMEMO® measuring instrument with the 'DIGI' measuring range (i.e. models made since around May/1998). The power for the measuring module is supplied by the ALMEMO® measuring instrument via a DC/DC converter (insulation voltage, minimum

4kV / second). The measuring instrument must provide a sensor supply voltage of 7 to 12 V, approx. 20 mA; i.e. usually a mains unit is required. Data is transferred to the measuring instrument at a measuring rate of 2.5 Hz opto-isolated and digital.

Programming the ALMEMO® connector

1. Channel Measuring range DIGI Locking mode 5

Technical data

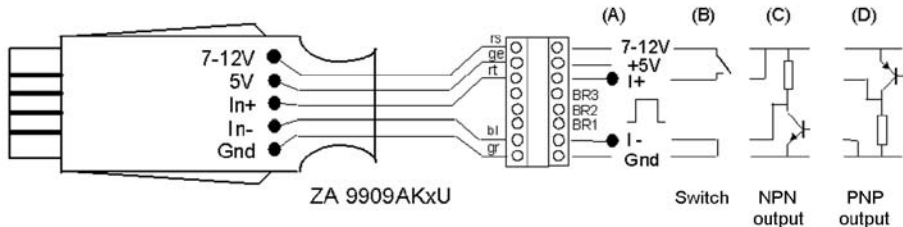
Sensor	Thermocouple
Measuring ranges	ZAD950 ABK NiCrNi (K) -200.0 to +1370.0 °C ZAD950 ABJ Fe-CuNi (J) -200.0 to +1000.0 °C ZAD950 ABT Cu-CuNi (T) -200.0 to +400.0 °C
Measuring rate	2.5 mops
Linearization accuracy	±0.05 K ±0.05% of measured value
System accuracy	0.1% of measured value ±3 digits, 0.01% / K
Electrical isolation	1 kV permanent, 4 kV for 1 second
Housing	ABS (acrylonitrile butadiene styrene), (LxWxH) 127 x 83 x 38 mm
Sensor connection	Banana sockets and plugs, 4 mm, safety-screened
Connecting cable	1.5 meters, with ALMEMO® connector
Operating voltage	7 to 12 V via measuring instrument or mains unit required
Current consumption	<20 mA (connector and module)

4.2.9 Frequency measuring module - for frequency and pulse signals

Frequency measuring module ZA 9909-AKU registers digital pulses; it counts pulses using an integrated miniature microcontroller in its sensor connector and as and when requested transfers the count to the measuring instrument. Signals are still registered even if the particular measuring channel is not selected; it is thus possible to have several frequency measuring modules connected to one device and interrogate these by measuring point scans.

The input of **new universal module ZA 9909-AKU** incorporates optocouplers which can be driven either electrically isolated by means of active voltage signals of 4 to 24 V (A) or directly. To supply passive floating switch contacts (B) the device's supply voltage is also available at other ports. Turbines or photoelectric pulse generators can also be supplied by the module (maximum 50 mA). The optocoupler must be wired according to the output driver (NPN:C) or (PNP:D). If the device voltage is not sufficient, the connector is also available with a voltage transformer for 12-13 volts (option V12).

Range Frequency, pulses



For frequency measuring or pulse measuring the measuring range can be programmed accordingly. To measure speed a module with its own programming is required.

ZA 9909-AK1U: Frequency measurement

Measuring range Frequency 0 to 15000 Hz Range Freq

The frequency module counts pulses per second and outputs this frequency value continuously.



Resolution can be raised to 0.1 Hz by inserting a wire jumper between terminals BR1 and +5V. For measuring range 0 to 3200.0 Hz the decimal point shift must be programmed !

ZA 9909-AK2U: Pulse measurement

Measuring range Pulses 0 to 65000 Range PULSE

Pulse measuring is intended for signals with a low repetition rate that are to be acquired over a fairly long period. The frequency module counts the pulses between two measuring point scans (manual or cyclic) but it only outputs the pulse count with each new measuring point scan; i.e. during the cycle the value displayed does not change. If a measuring cycle of 1 minute is programmed the number of pulses per minute will be displayed each minute. By summing together over the print cycle using function channel S(P) it is also possible to

determine the pulse count over a longer period (e.g. 1 hour).



Bouncing contacts can be digitally suppressed by inserting wire jumpers between terminals BR1, BR2, and +5V, and applying a time constant of 5 ms.

ZA 9909-AK4U: Speed measurement

Measuring range Revolutions per minute (rpm) 8 to 32000 rpm Range Freq
The speed module measures the time between two pulses and from this calculates the rpm.

Frequency module, technical data

Frequency range	0 to 15000 Hz (resolution 1 Hz), gate 4 x 0.5 s 0 to 3200.0 Hz (0.1 Hz), gate 0.5 s + 1 edge
Speed range	8 to 32000 rpm (resolution 1 rpm)
Maximum pulse count	65000
Pulse length	> 50 µs (5 ms with contact bounce)
Input voltage range	4 to 40 V, square wave
Cable length	1.5 meters
Sensor supply	7 to 9 V (12 V with mains adapter or option V12)
Current consumption	3 mA
Temperature range	-10 to +60 °C

4.2.10 Digital input cable

With digital input cable ZA 9000-EK2 four digital states (electrical voltage levels) can be acquired and monitored per measuring input. Each input is programmed as a channel with the range “Inp” and with each new measuring point scan its state appears in the print protocol as either 0.00% or 100.00%. It is thus also possible, by applying a limit value of e.g. 50.00%, to set up an alarm value printout.



If you are interested in the percent ratio of in / out state over a cyclic period or in the total value, this variable can be determined quickly and easily by averaging (cyclic or continuous); (see Section 6.7.4). The highest resolution can be obtained by means of continuous measuring point scans.



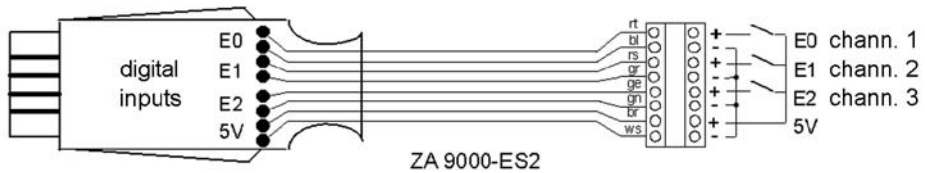
The digital inputs are optocouplers; when a voltage of approx. 4 to 30 VDC is applied these change state from Low (0% = 0 to 1 VDC) to High (100% = 4 to 30 VDC).

To monitor floating (potential-free) contacts the appropriate external voltages must be provided. Digital input cable ZA 9000-ES2 provides a 5V auxiliary

voltage for this purpose but has only 3 digital inputs available. The contacts must be connected to the 5V as per the circuit diagram in such a way that they drive the optocouplers.

4.2.11 Interface adapter cable

Using interface adapter cable ZA 9919-AKx up to maximum 4 measured values from any third-party device with a serial interface (RS232, TTL, etc.) can be integrated in measured data acquisition on the ALMEMO® device. For purposes of electrical isolation optocouplers are provided. The microcontroller integrated in the ALMEMO® connector must have been programmed with the protocol used by the third-party device. This programming is subject to once-only software costs. Several such adapters can be used in conjunction with one device.



Range: DIGI

Technical data:

Display range

65000 digits

Interface

Asynchronous 7/8 data bits, 1/2 stop bits,
electrically isolated

