5. ALMEMO® output modules

A modern measuring instrument must be able to communicate with its environment, i.e. transmit measuring data to analog and digital peripheral equipment, run commands from a computer, trigger alarm signals, and respond to switching pulses. To cover all possibilities while also keeping the hardware needed to a minimum all the necessary interfaces have been integrated in our ALMEMO® output connectors or output modules. This concept enables the user for digital transmission purposes to freely select, depending on the desired functions, between the USB, RS232, RS422, or current loop interfaces and between wire, optic fiber, or radio connections. For connection of the modules almost all ALMEMO® devices are equipped with two output sockets A1 and A2, which also allow for the digital networking of the devices. The output modules, like the sensors, are automatically detected so that no programming is required.

5.1 Analog and digital output modules

Most ALMEMO® devices provide an analog output in the form of a PWM (pulse-width modulated) signal at sockets A1 and A2. We offer for this purpose analog output cables or analog output modules which convert the digital signal into analog values 0-2 V, 0-10 V, or 0-20 mA. For the new V6 devices new output modules RTA3, RTA4, and RTA5 have been developed; each such module has its own integrated D/A converter; several analog outputs can thus be provided. It is now also possible, in certain applications, to switch the output type to 0-10V or 0-20 mA. The new modules incorporate up to 10 interface elements with analog outputs, relays and trigger inputs. The functions of each such element can now be individually configured.

5.1.1 Analog output cable

To record measured values using a chart plotter or pen etc. analog output module ZA 1601-RK can be connected to socket A1 or A2. The connector incorporates a converter which converts the PWM signal coming from the measuring instrument into a voltage (-1.25 to + 2.0 V) corresponding to the linearized measured value of the selected channel. The output voltage corresponds to 0.1 mV / digit. To obtain a higher response speed a higher conversion rate must be set.

During a cyclic measuring point scan the analog output gives the most recent value for the selected channel. In the event of sensor breakage the output voltage drops to zero. The output signal can be freely scaled in terms of its analog start and analog end (see Section 6.10.7) if the range covers more than 100 digits (e.g. 0-2V for -30.0 to 120.0°C). With a genuine double-function sensor or a continuous measuring point scan it is possible on hand-held devices via the two sockets A1 and A2 to operate two analog output modules and to output two different channels. Normally this is the 1st channel and the selected measuring channel in a sensor. Instead of the measuring channel any other channel can be programmed; (see Section 6.10.7).

Technical data

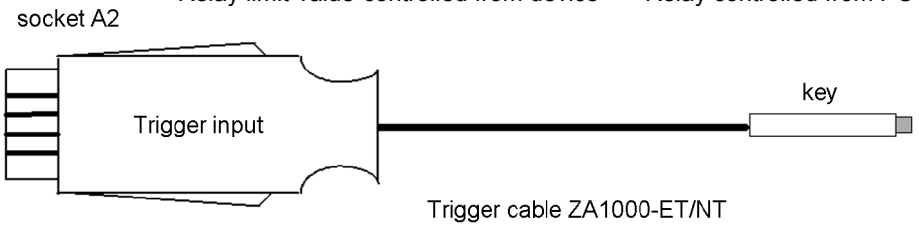
Output voltage	–1.250 to 2.000 V, not electrically isolated
Gain	0.1 mV / digit
Residual ripple	<2 digits
Load	>100 kΩ
Accuracy	± 0.1% ± 6 digits, Drift 1 digit / K
Time constant	100 ms
Current consumption	approx. 3 mA

5.1.2 Relay trigger cable and relay adapter

For reporting alarms in the event of a limit value being exceeded (see 6.3.9) and for driving peripheral devices (see 6.10.8) we offer cables with integrated semiconductor relays; for the remote control of devices (see 6.6.4) we offer trigger cables; combinations of these two are also available. The trigger function variants can only be programmed on pure trigger cables or V6 output modules (see Sections 6.6.4 and 6.10.9); however, the V5 cables listed here can also be reprogrammed to V6 functions using AMR-Control.

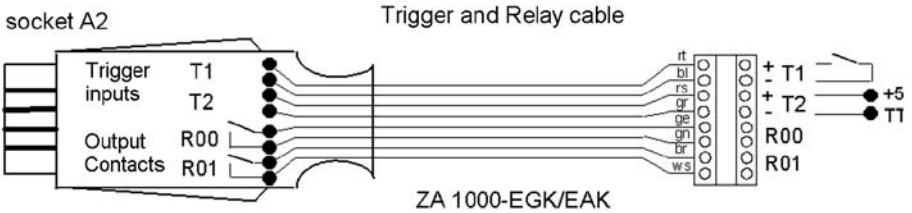
ZA 1000-EK	Trigger cable with 1 optocoupler and 2 banana plugs
ZA 1000-ET	Trigger cable with key
ZA 1000-NT	Zero-setting cable with key
ZA 1000-GK	Alarm cable with 1 relay and 2 banana plugs *
ZA 1000-EGK	Trigger and alarm cable with 2 relays *
ZA 1000-EAK	Trigger and output cable with 2 relays **

* Relay limit-value-controlled from device ** Relay controlled from PC



Trigger cable ZA1000-ET/NT

Trigger input T1 is driven by a zero-potential contact;
trigger input T2 is driven by an electric signal. This signal can be a voltage of 4 to 30 VDC used to drive an optocoupler; (TTL signals in negative logic, T2+ to 5V and T2- to output).



ZA 1000-EGK/EAK

On alarm cable ZA1000-EGK relay contacts R00 und R01 operate separately in the event of limit value MAX overshoot and limit value MIN undershoot. The

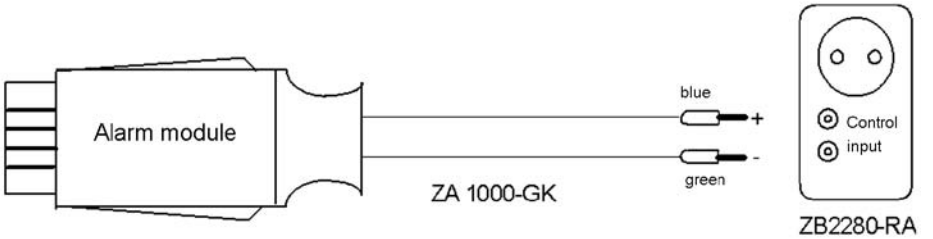
relay operation variants can be programmed for all output modules; (see Section 6.10.9).

Technical data

Trigger input T1	Not electr. isol. for zero-potential switching contact, Ri > 50 kΩ
Trigger input T2:	Optocoupler 4 to 30 VDC, Ri > 3 kΩ
Output relay	Semiconductor relay 1Ω without polarity Load capacity 50 V, 300 mA
Current consumption	3 mA

Relay adapter

For switching mains-powered devices relay adapter ZB 2280-RA is provided. This is simply connected between the mains socket and the alarm device; it is driven via a relay cable (ZA1000-GK), i.e. is activated in the event of an alarm.



Technical data

Trigger input	For optocoupler output or switching contact R < 10 kΩ
Switch relays	Mechanical relay; Load capacity : 250 V, 6 A Quiescent state : OFF; Alarm status : ON

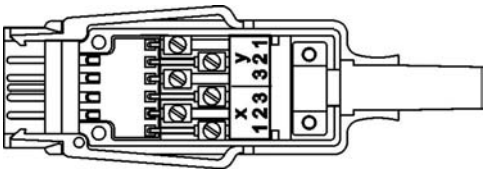
5.1.3 Relay trigger analog adapters

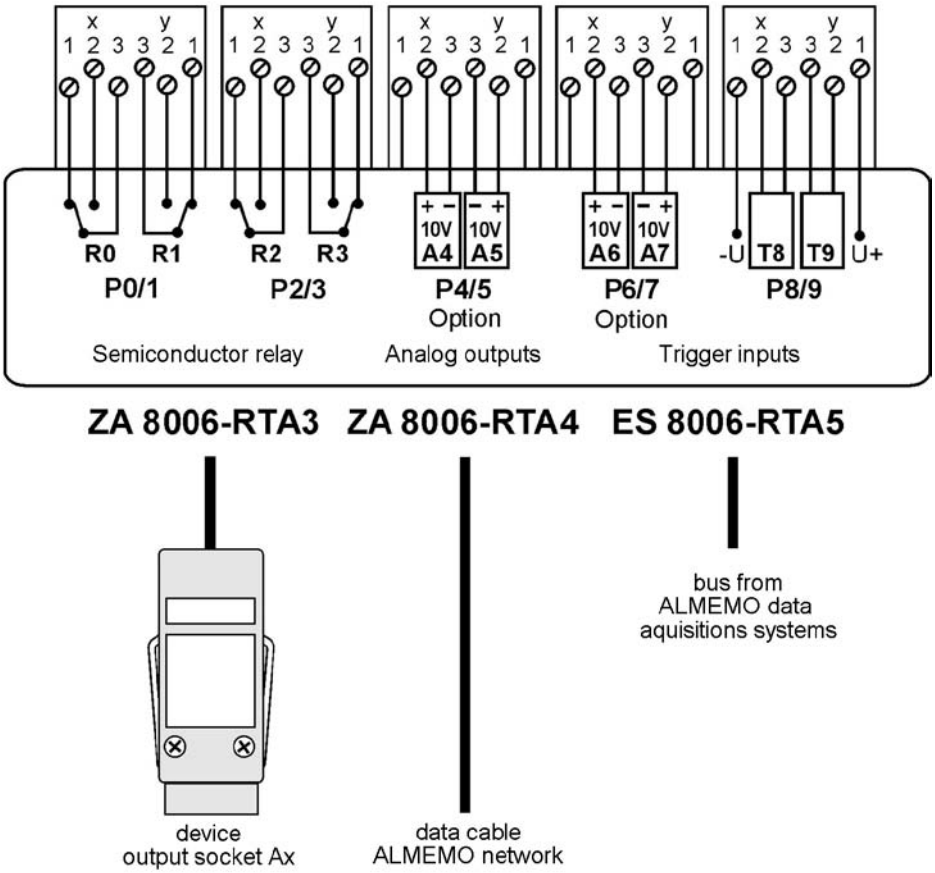
For V6 devices there are 3 different relay trigger analog adapters available :

1. Plug-in output module ZA 8006-RTA3 - suitable for all devices
2. Plug-in module ES 5690-RTA5 - suitable for all 5690 data acquisition systems
3. Stand-alone interface module ZA 8006-RTA4 - in the ALMEMO® network

All have maximum 10 interface elements (semiconductor relays, analog outputs, and trigger inputs). These ports can be individually addressed and configured; (see Section 6.10.9.2). The output relays are driven via the interface, as described in Section 6.10.10; the analog outputs are driven as described in Section 6.10.7.

All elements are connected via orange ALMEMO® clamp connectors.





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The exact components, configuration, and states of these modules can be seen either in diagram form on the graphics display or by interrogating via the interface; (see Section 6.10.9.2). For more detailed information please refer to the device-specific instructions.

Technical data

Relay	Semiconductor relay, 1 ohm; Load capacity 50 V, 0.5 A
Trigger inputs	Optocoupler 4 to 30 V, input current 2 mA
Analog outputs	Double analog output, electr. isolated, maximum 50 V
OA 8006-R22	-4.00 to +10.0 V 0.5 mV / digit Load >100 kΩ
OA 8006-R32	0.0 to +20.0 mA 1 µA / digit Load <500 Ω
OA 8006-R02	-4 to +10 V or 0 to +20 mA, ditto
Accuracy	± 0.1% ± 6 digits
Temperature drift	1 digit / K

5.2 Interface modules

For the purposes of data transmission from an ALMEMO® device to a computer or to some peripheral device there are four interface cables / modules incorporating in the connector the interface needed in each case.

ZA 1909-DK5 RS232 interface, electrically isolated, for connection to a printer or computer via the DSUB socket

ZA 1909-DKL RS232 interface, optic fiber variant, for connection to a printer or computer via the DSUB socket

ZA 1945-DK Ethernet interface for direct connection of an ALMEMO® device to Ethernet (PC network) via RJ45 socket

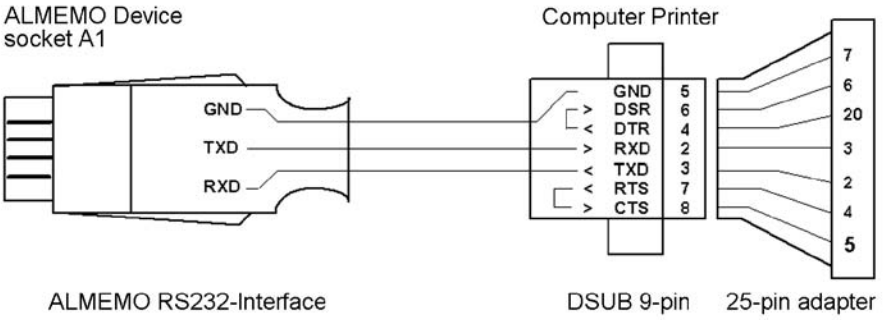
ZA1709-BTx Bluetooth modules class 1 and 2 for USB and RS232 (s. 5.3.4)

Each such interface cable is connected to output socket A1; it is recognized by the measuring instrument fully automatically (because all transmission parameters are stored in the connector). The user can, by choosing the appropriate cable in each case, connect different peripheral devices in turn, such as printer, terminal, or computer, each with different parameters, to one measuring instrument - without having to change any settings. In order to network several ALMEMO® devices together there are special network cables available; to cover large distances there are also RS422 network drivers and ?*? network distributors.

5.2.1 RS232 data cable

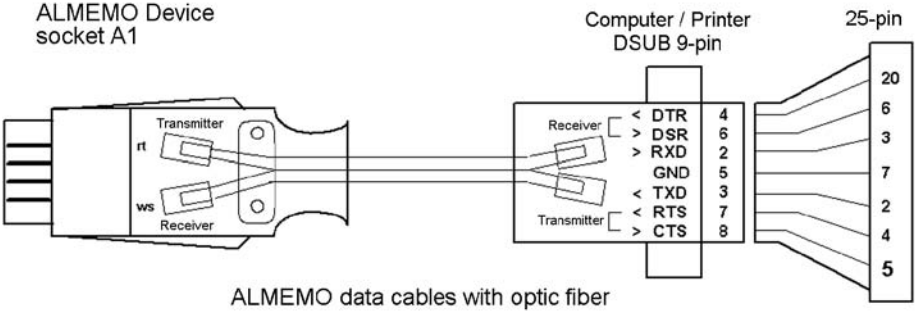
In the case of a computer with a 9-pin plug the measuring instrument can be connected directly via electrically isolated interface cable ZA 1909-DK5. In the case of a device with a 25-pin plug or socket (e.g. printer) an appropriate adapter must be used. Current consumption is approx. 1 mA; maximum baud rate is 115.2 kbaud. Hardware handshake is no longer supported; support is now only provided for XON/XOFF.

RS232 interface cable ZA 1909-DK5



5.2.2 RS232 data cables with optic fiber

Using optic fiber to transmit digital data brings a series of significant advantages compared with conventional wire transmission. Optic fiber is not susceptible to EMC (electromagnetic compatibility) problems (because electrical and magnetic fields have no effect on such cables); i.e. data transmission is safe and reliable even in industrial environments with high levels of interference. Thanks to the absolute electrical isolation between individual devices it is also possible to bridge relatively large differences in potential. Optic fiber even provides substantial protection against lightning.
Optic fiber data cable ZA 1909-DKL is compatible with RS232 data cable ZA 1909-DK5. Optic fiber data cable ZA 1909-DKL can transmit data over distances up to 50 meters at baud rates up to 115.2 kbaud (insofar as the devices themselves permit). This cable does not support the hardware handshake either.



ALMEMO data cables with optic fiber

5.2.3 Data transmission by modem

For the purposes of remote interrogation and remote configuration of ALMEMO® devices within the fixed-line telephone network our product spectrum includes a series of modems pre-configured for analog or for digital (ISDN) connection. For compatibility reasons we recommend using these in pairs. Please note : the setup for the analog modem used in conjunction with the ALMEMO® device (ZA1709-MK) and the setup for the modem on the PC side (ZB1709-M) will not be the same.
For applications outside the fixed-line telephone network we offer the GSM modem ZA1709-GSM. To use this a mobile communications contract with the D1 network is required; we can help you arrange this or you can ask a third party. In this case the partner modem on the PC side will have to be an analog modem (ZB1709-M).
When connecting the ALMEMO® device the supplied adapter ZA1709-AS must always be connected between the data cable and the modem. This crosses the data lines again and for the duration of the initialization phase deactivates communications. A further adapter may, in certain circumstances, be necessary (9-pin to 25-pin DSUB plug).

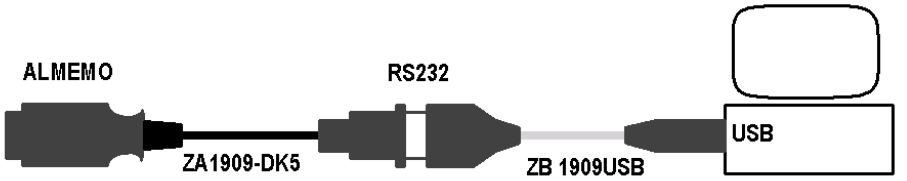
Some third-party modems may work in conjunction with the aforementioned adapter but given the wide variety of types available on the market we cannot offer support in configuring these.

5.2.6 ALMEMO® USB data cables

Many computers on the market nowadays do not have an RS232 interface - only USB interfaces. To connect ALMEMO® measuring instruments to these there are 2 methods.

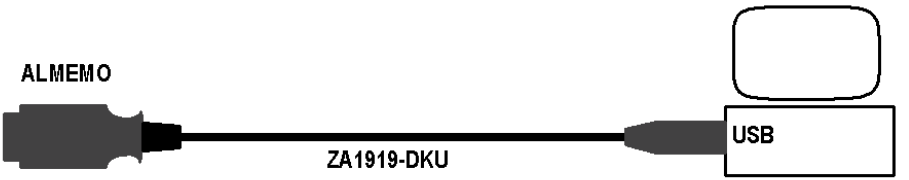
1. Converter from USB to RS232 and ALMEMO® data cable

With converter ZB 1909-USB plugged into a USB socket on the computer any ALMEMO® data cable or any network driver can then be connected via the DSUB connector. An additional virtual COM port is needed; to set this up the WINDOWS driver (provided on the enclosed CD) must be installed in the usual way. This can be used in conjunction with any program, at any usual baud rate, without restriction.



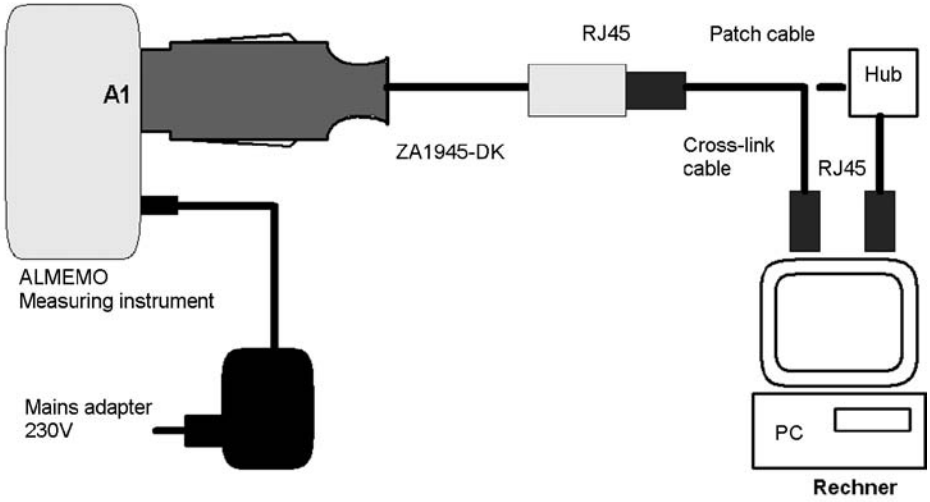
2. ALMEMO® USB data cables

USB data cable ZA 1919-DKU likewise contains a USB-to-RS232 converter. For installation instructions and for the WINDOWS driver needed to set up the virtual COM port please refer to the AMR-Control CD. The advantages of this method are that the cabling is neat and tidy, the device reports with the ALMEMO® signature, and baud rates above 115 kilobaud are supported. Its disadvantages are that it cannot be used with network drivers and that the cable is more or les impossible to extend.



5.2.7 ALMEMO® Ethernet data cable

Using ALMEMO® Ethernet data cable ZA 1945-DK it is possible to connect virtually any ALMEMO® measuring instrument directly to an Ethernet PC network. It is even possible in this way to link up to the Internet. The PC can be connected to the RJ45 (10/100 base-T) socket using a cross-link cable; a switch or hub can be connected using a patch cable.
Putting into service and terminal operation are now also possible using our AMR-Control software (version 5.0 and above); this is available free-of-charge.
Our Win-Control software, as standard with effect from V6.x, supports the integration of an Ethernet module in the process of measured value acquisition.



Setting the IP address

The Ethernet data cable is delivered with the IP address preset by default to 0.0.0.0. With this default address setting it is possible to connect to a DHCP server (dynamic host configuration protocol). The DHCP server provides the Ethernet data cable with a free IP address, a gateway address, and the subnet mask. In networks without DHCP server a permanent IP address must be set manually for the Ethernet data cable.
The necessary XPort-Installer software and the instructions for using it are provided on the AMR-CD in the folder Accessories \ Ethernet \ XPort-Installer.

Status LEDs

Two additional LEDs are provided for monitoring the status of the Ethernet connection (revision R2).

LED on left	Connection	LED on right	Data transmission
OFF	none	OFF	none
Orange	10 MHz	Orange	Half duplex
Green	100 MHz	Green	Full duplex

Technical data (Rev. R2)

Ethernet	Socket RJ45 (10/100 base-T) automatic switchover 10 / 100 MHz
ALMEMO®	ALMEMO® connector for socket A1
	Baud rate Standard 9600 baud, maximum 230.4 kbaud
	(can be changed via XPort-Installer and browser)
Power supply	12 VDC via the measuring instrument
	(suitable mains unit recommended)
Current consumption	approx. 110 mA (at 10 MHz), approx. 95 mA (at 100 MHz)

Product overview	Order no.
Ethernet data cable, RJ45 socket on ALMEMO® connector	ZA 1945-DK
Ethernet network driver, RJ45 socket to RS422, 4-wire (see 5.3.3.5)	ZA 5045-AK
Patch cable RJ45, plug / plug, 2 meters	ZB 1904-PK2

5.3 Networking of measuring instruments

Decentralized measured data acquisition is one of today's buzz words; with ALMEMO® devices it has become a practical reality. Measured data is acquired on site via short sensor leads and miniature modular measuring instruments; these are internetworked via largely interference-proof digital lines, so that the data can be centrally evaluated by computer. This concept helps minimize wiring requirements and significantly reduces EMC problems. Hardware arrangements can be kept flexible and can be adapted to the measuring task on hand. All ALMEMO® devices can be addressed, run the same protocol, and are thus completely network-capable. Each such device incorporates a miniature integrated distributor so that it can even be connected via a standard series-produced network cable to another such device. Up to maximum 100 devices can thus be connected via the computer's serial interface. Or, alternatively, interference-proof optic fiber cables can be used. However, for installations over longer distances, transmission via RS422 interfaces is better. For this purpose we offer drivers and electrically isolated distributors specific to each device. The protocol is not a complex 7-stage model; it is based on a simple ASCII communication; the user can call up via any terminal the measured data from any measuring instrument in normal text. However, data flow can now only be monitored by means of a software handshake (XON/XOFF). There are of course software packages available which automate measuring point scans in a network, evaluate measured data, and display the results in graphics form. Before each network operation all measuring instruments must be set to different device numbers. On display devices this can be done via the key?*? pad, on transmitters and plug-in modules code switches are used; (see device instructions). The arrangement of devices and the order of their addresses is always random but there must not be any gaps.

In network operation consecutive numbers between 01 and 99 should be used; this ensures that device 00 is not addressed unnecessarily in the event of interruption to the power supply.

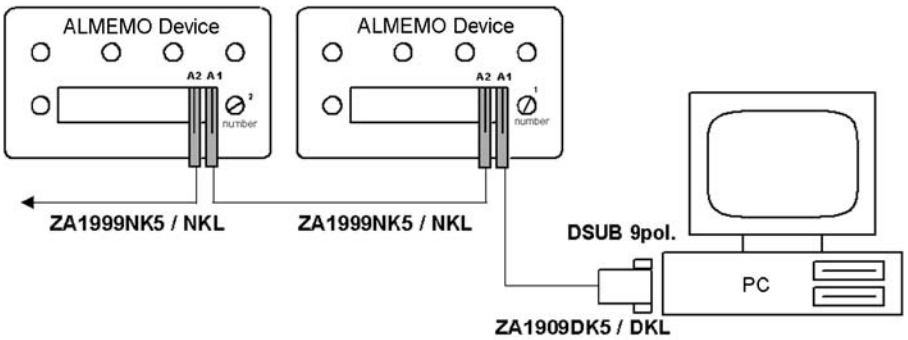
When using indirect connections, e.g. Ethernet, modem, or wireless, where signals are packed in a protocol, substantial signal delays may occur. These delays depend on network utilization level and / or on connection quality e.g. over a wireless link. Especially long delays may occur with Bluetooth networks because successive cascading and the forward and backward movement have the effect of multiplying the times involved. In order in such circumstances to avoid possible data collisions caused by replies from various devices arriving at the receiver simultaneously appropriate delays must be anticipated at device switchover. This is the purpose of the switchover delay parameter in the WinControl data acquisition software.

5.3.1 Network cables

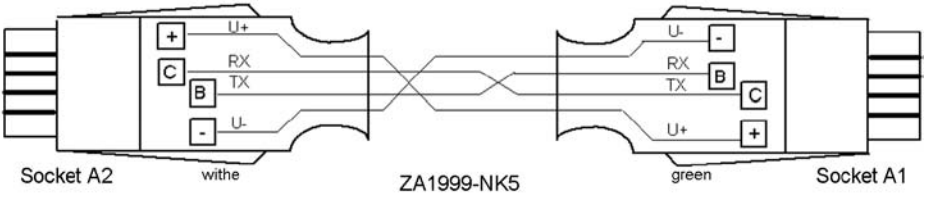
An RS232 interface ZA1909-DK5 **or an Ethernet interface ZA1945DK** connected at socket A1 on the ALMEMO® measuring instrument can be cascaded using network interface cables ZA1999NK5 at socket A2; it is thus possible to connect up to 99 other ALMEMO® devices to the first measuring instrument. Commands to the first device are buffered and transmitted to all the other devices; replies from these other devices are OR'd and thus also appear at the output of the first device.

Advantages
1. Devices can be quickly and easily interconnected and networked.
2. Low power consumption - without additional power supply

Disadvantages
1. In the event of a power failure on the measuring instrument, the mains supply will be interrupted.
2. Socket A2 needs to be occupied.

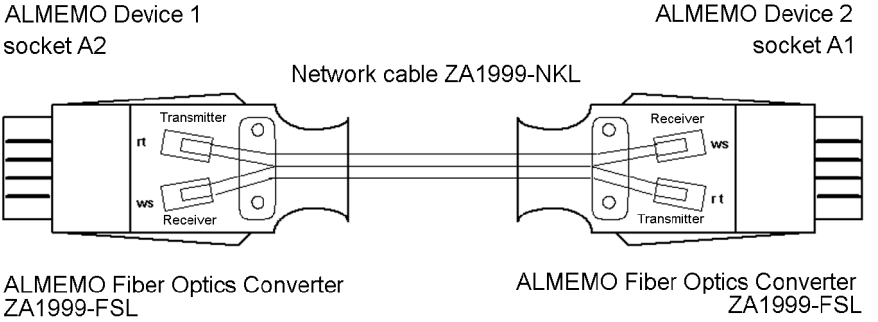


The equivalent of network cable ZA1999NK5 can be easily assembled by the user using just two single connectors ZA1999FS and a four-wire cable up to 50 meters in length.



5.3.2 Network cable with optic fiber

A network cable in optic fiber technology is also available (ZA 1999-NKL). This comprises two ALMEMO® optic fiber converters ZA 1999-FSL and a synthetic duplex optic fiber cable 1.5-meters in length. The optic fiber cable can be up to 50 meters in length; the converters can be easily connected by the user. Power is supplied via the connected devices.



Assembling an optic fiber cable

To assemble a data cable the optic fiber cable must be cut to the desired length (ideally at right angles) using a sharp knife; (do not use side cutters). The conductor pair must be split into separate strands for 1 or 2 cm at each end. On the ALMEMO® converters the cap must be removed and the two strands must be inserted into the two photo-elements and secured in position by means of the strain relief. When connecting the second converter care must be taken to ensure that each strand is correctly led from sender to receiver. Data transmission is with visible red light; thus when data flows the send strand can be easily identified.

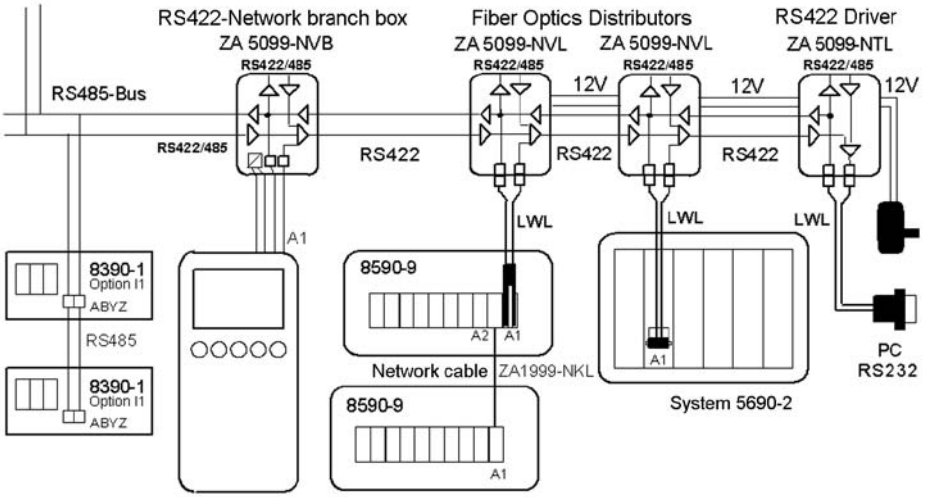
5.3.3 Data transmission via RS422 interface

If the distance between measuring instruments is substantially further than 50 meters or if wiring in star configuration for some reason cannot be avoided, data transmission should be via RS422 interfaces. At the RS422 interface serial data is transmitted and evaluated not with respect to ground as with the RS232 interface but as a voltage difference. Common-mode interference on the transmission line is thus largely suppressed so that line lengths even longer than 1000 meters can be implemented. RS232 signals can simply be converted into RS422 signals or optic fiber signals and vice versa.

For networking purposes the ALMEMO® system offers two network distributors; these transmit commands from the computer simultaneously to all devices and then only return the reply from the device actually addressed. These network distributors are usually connected via RS422 interfaces and can thus bridge fairly long distances.

With network distributor ZA5099-NVL the connection line to the measuring instrument is optic fiber; this ensures a high level of immunity to interference. In this case the connection between the distributors must run over 6-wire or 8-wire RS422 data cables, with 4 wires for data, 2 wires for the power supply, and one central mains supply unit; if longer cable lengths are required, the power supply line must be duplicated and run over 2 x 2 wires (to reduce voltage drop).

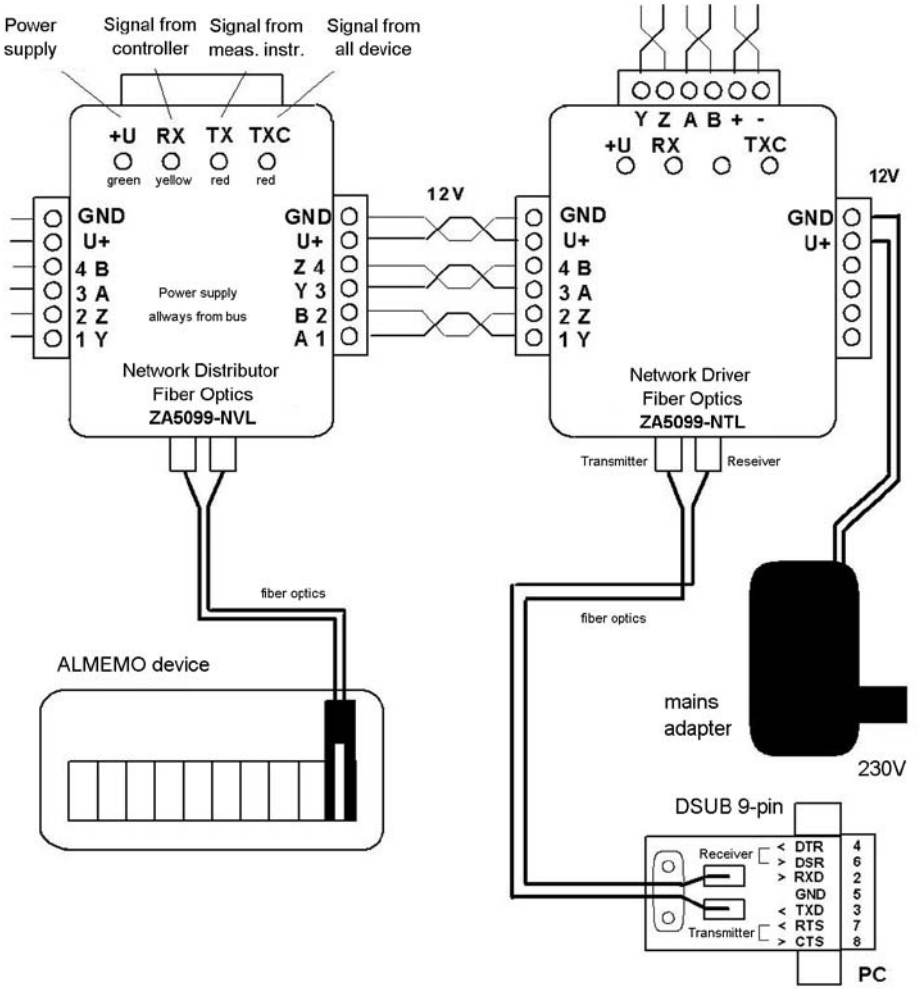
If wired network distributor ZA5099-NVB is used, it must be powered via DC/DC converters and electrically isolated from the device. To connect the distributors in this case a 4-wire data line is enough.



As driver for the RS422 network we offer the simple plug-in converter RS232 to RS422 (ZA5099-AS) without electrical isolation. However, for optimal electrical isolation from the computer we recommend driver ZA5099-NTL with optic fiber. To connect to an Ethernet (PC network) the Ethernet network driver ZA5045AK must be used.

5.3.3.1 Network driver, RS232 - RS422/485, with optic fiber

To protect the computer from overvoltages in the mains supply and to prevent spurious interference being induced in the system we recommend network driver ZA5099-NTL with optic fiber. This comprises an RS232 optic fiber converter, a 1.5 meter optic fiber cable, and RS422 / 485 bus drivers. The RS232 COM interface on the computer is thus electrically isolated completely from the mains supply. The connection from the driver to the distributor is wired in parallel; (the crossing AB and YZ is by means of connection arrangement). The network must be powered by a 12 V mains unit.

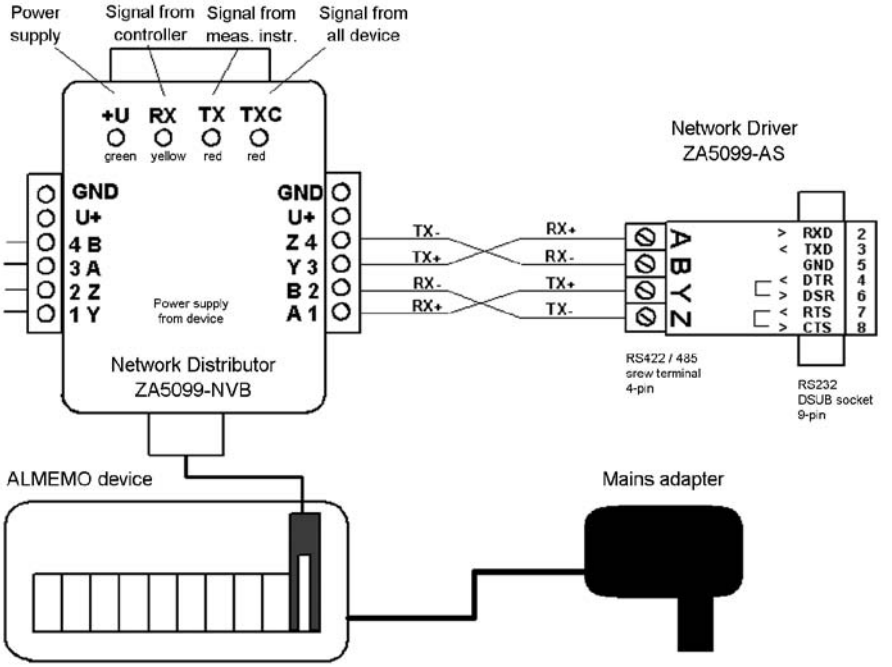


5.3.3.2 Network distributor RS422 and device connection with optic fiber

As illustrated in the previous figure the ALMEMO® devices are connected to the network by using corresponding RS422 network distributors. The most interference-proof variant is ZA 5099-NVL with optic fiber connection. Even the failure of one measuring instrument will not adversely affect the network functioning. The optic fiber cable for connecting the ALMEMO® device can be up to 50 meters in length. If networking is to be branched out from one device in a star configuration in two directions, the second branch can be connected to the second output. Each RS422 output can also be used as an RS485 driver for transmitters with an RS485 interface. However, such an RS485 branch must not have any further RS422 stubs connected to it. With the optic fiber network distributors not only the data lines but also the two power supply lines must be wired in parallel. If longer cable lengths are required, the power supply line must be duplicated and run over 2 x 2 wires; (the crossing of input and output is by means of connection arrangement). The 12 V mains unit can be connected at any point in the network but in large networks this should be as close to the center as possible in order to minimize voltage drop. It can be installed quickly and easily thanks to the surface-mounted housing with its fastening clips and the screw connectors. Several stubs can be connected directly one to the other. If longer lines are required twisted-pair data cables should always be used.

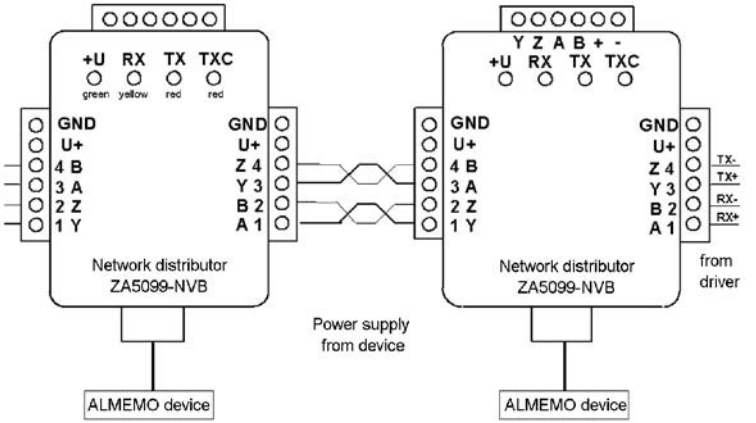
5.3.3.3 Network driver RS232-RS422/485 without electrical isolation

The following combination of network driver and network distributor manages with just 4-wire cabling and without additional power supply. As RS422/485 bus driver we offer plug-in adapter ZA 5099-AS for connection to the RS232-COM interface on a computer. To this adapter an RS422 distributor or an RS485 transmitter can be connected directly. Send lines Y,Z and receive lines A,B between the bus driver and the first device must always be connected. With this driver the network is electrically connected to the PC, but the devices are always isolated from the network by means of the network distributors.



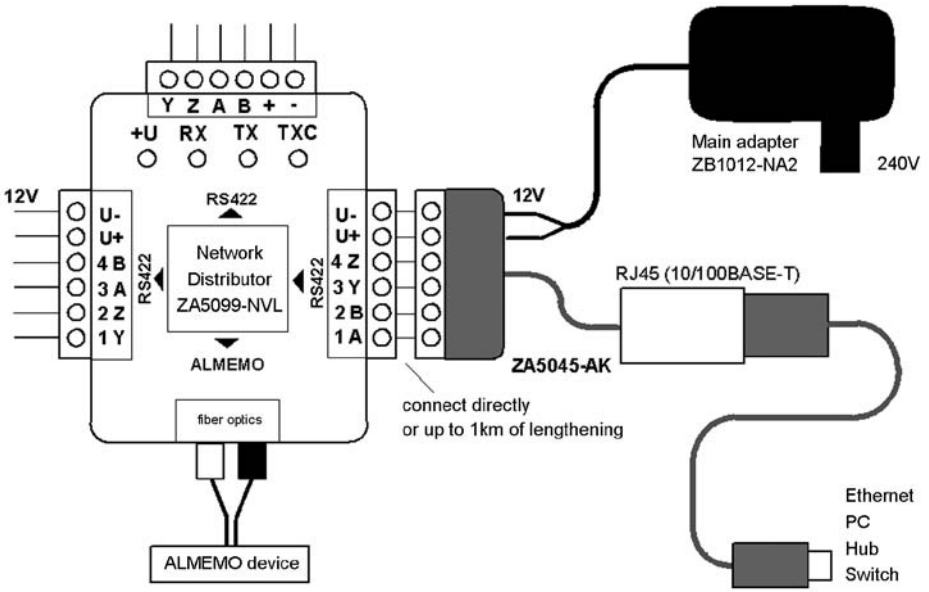
5.3.3.4 Network distributor RS422 with DC/DC converter and cable connector

Network distributor ZA 5099-NVB is fitted with a cable connector for connection to the measuring instrument and an integrate DC/DC converter for the power supply it receives via the measuring instrument. It is electrically isolated by means of an optocoupler. For connecting the distributors a 4-wire data line is therefore usually enough. However, in the event of a failure in the power supply to one device, the whole network may in certain circumstances be blocked



5.3.3.5 Network driver, Ethernet - RS-422

With Ethernet network driver ZA 5045-AK it is possible to connect an ALMEMO® network to an Ethernet PC network. It is even possible in this way to link up to the Internet. Adapter cable ZA 5045-AK, together with network distributor ZA5099-NVL, replaces the previous Ethernet network distributor ZA5099-NVE; however, it is also separately available and can thus be connected to existing networks. The advantage of the new version is that, if the first measuring instrument is a long way from the Ethernet connector, an extension cable can easily be used between the Ethernet adapter cable and the network distributor. The PC can be connected to the RJ45 (10/100 base-T) socket using a cross-link cable; a switch or hub can be connected using a patch cable.



For the IP address setting, the meaning of the two LEDs, and the necessary software please refer to Section 5.2.7.

Technical data

Ethernet	Socket RJ45 (10/100 base-T) automatic switchover 10 / 100 MHz
RS422	6-pin screw connector; 4-wire TX+, TX-, RX+, RX-, and supply +12 / -12 volts Line length between driver and distributor maximum 1 km Baud rate maximum 115.2 kbaud
Power supply	12 VDC via the measuring instrument (suitable mains unit recommended)
Current consumption	approx. 110 mA (at 10 MHz), approx. 95 mA (at 100 MHz)

5.3.3.6 Connection of devices with RS485 interface

The RS485 interface is a bus-capable RS422 interface with the effect that up to 32 devices can be networked in parallel without the need for additional distributors. With ALMEMO® 8390-1/2 transmitters and the new ALMEMO® 2450 and 2490 devices an RS485 interface is available as an option. This can be connected directly to any RS422 output on the distributors; but no further RS422 distributors can then be connected to them.

5.3.3.7 Putting a network into service

Having wired up the network drivers and all the distributors and having connected the measuring instruments, the setup should be checked again to ensure that all measuring instruments and / or measuring modules have been assigned addresses which are unique but together form an unbroken sequence. The measuring instruments can then be switched on and power can be supplied to the network distributors. The distributors should be checked to ensure that they are ready-to-operate; this is indicated by the integrated LEDs. On each distributor the green LED “+U” should light up, indicating that it is receiving power correctly.

No other LED should light up (so long as data is not being transmitted). If any other LED does light up, this indicates that wires may have been inadvertently crossed or short-circuited. The wiring of the branch on the distributor indicating this error must be checked again.

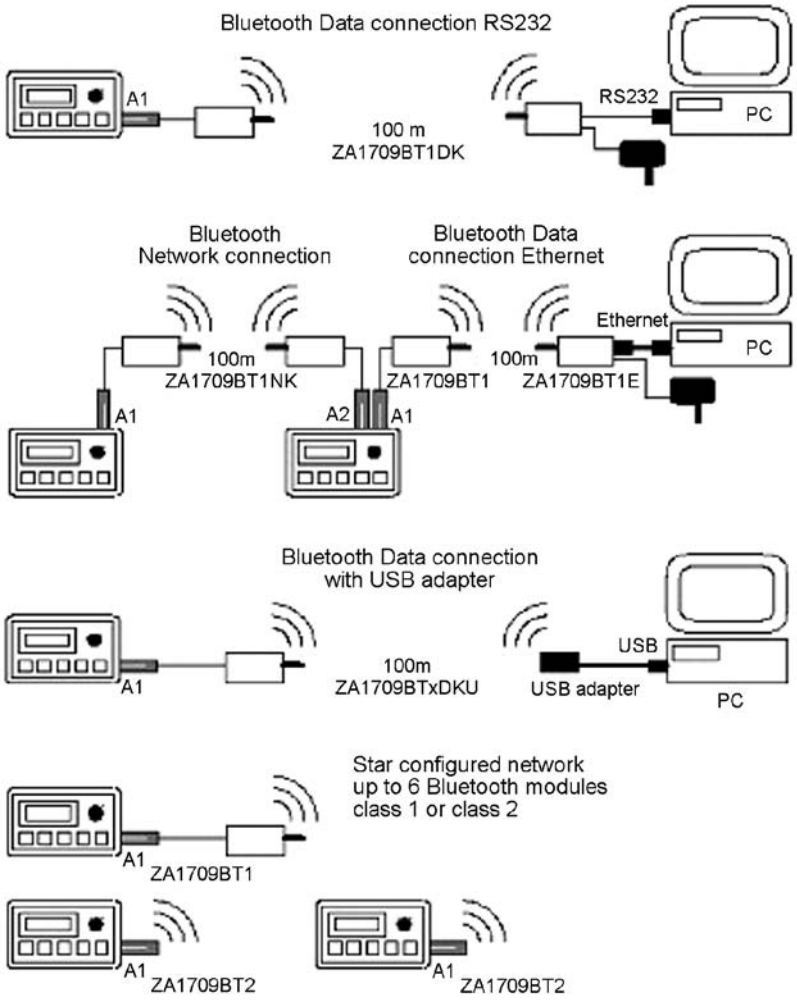
The actual network test is performed using network software or AMR-Control - or by individually addressing each device in turn from a terminal. The software employs the same procedure, i.e. listing all the devices found in the ?*? network and their respective addresses.

As soon as data is output by the controller the yellow LED “RX” should flash in all stubs. When a reply is received the red LED “TX” on the addressed device should light up. LED “TXC” should light up on all distributors through which data flows. If only sporadic commands are being input via the terminal it will be difficult to follow the data flow because the LEDs only flash on very briefly. If necessary the data flow can be made more obvious by pressing a key (e.g. ´X ´) and holding it down for some time. If any device fails to reply, its power supply and its assigned address must be checked again.

5.3.4 Bluetooth wireless modules ZA1709-BT1x and ZA1709-BT2x

Data transmission via Bluetooth technology

Data transmission between ALMEMO® devices and the computer or within a network can also be performed on a wireless basis by means of Bluetooth wireless modules ZA1709BTx. To cover all possible signal paths there are different variants with different operating ranges available (class 1 and class 2, 10 to 200 meters). The number of wireless links that can be operated at the same time is infinite; they cause no mutual interference. Up to 7 wireless modules can be connected to the PC via a Bluetooth - USB adapter; these are operated via 7 virtual COM ports. All these ports can be evaluated together using our Win-Control measured value acquisition software.

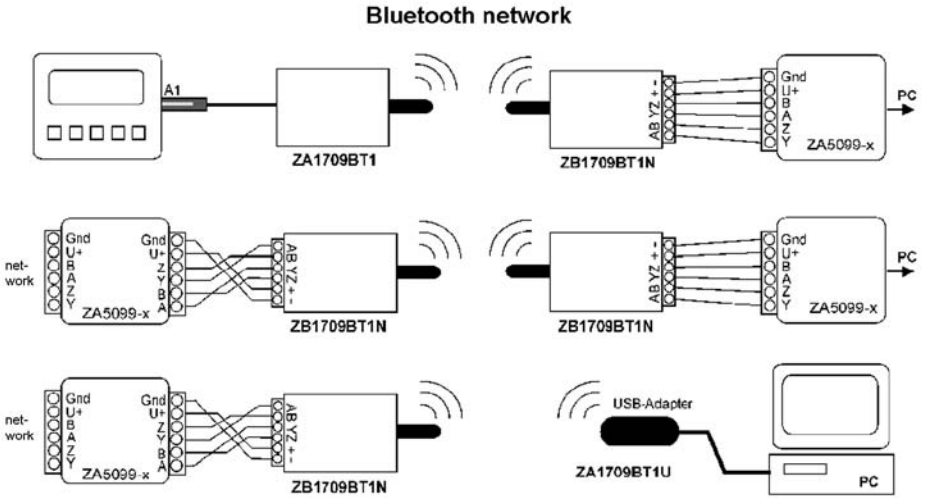


Description

All wireless modules working in pairs as cable substitutes can be simply plugged in and used immediately without needing to be configured. All wireless modules without an ALMEMO® connector (RS232, Ethernet, etc.) come with mains unit ZA 2290-NA, via which power is supplied; those with RS422 are supplied via the mains. If the power supply is functioning correctly, the green LEDs on the end of the modules light up. If the wireless connection is functioning correctly, the yellow LEDs (class 1) or blue LEDs (class 2) also light up. If these LEDs do not light up or go out, this indicates that the operating range has been exceeded; (see technical data); (please note that inside buildings the operating range may be significantly curtailed by walls or other such obstacles).

As soon as two modules affected in this way are brought closer together again, the wireless connection should be restored automatically.
The operating range of class 1 modules can be approximately doubled by using a better antenna, e.g. ZB1709BT1A.

To run wireless links via a Bluetooth - USB adapter the USB adapter must be configured on the PC using the software provided and the two modules must be paired by entering the pin code of the ALMEMO® wireless module; (see the sticker on the USB adapter and the instructions). If at this juncture the connection fails or if the devices are switched off, all that is needed is to reselect the appropriate port using the application software. No matter what happens the configuration will not be lost.
The operating range of the USB adapter can be improved by connecting the USB extension cable provided, thus allowing the adapter to operate in a more favorable position; (this should as far as possible be in the line of sight).
With AHLBORN Bluetooth - USB adapter ZA1709BT1U up to 7 virtual COM ports can be generated - for a total of 7 wireless modules ZA1709-BT1 or -BT2. The Win-Control measured value acquisition software, as standard with effect from V6, evaluates all these interfaces together.
For a detailed description of how to use the Ethernet interface on wireless module ZB1709BT1E please refer to the description of the ALMEMO® Ethernet data cable; (see Manual, Section 5.2.7).
For wireless links in a network wireless module ZB 1709-BT1N is available:



Technical data

Protocol	SPP (sequence packet protocol) (128-bit encryption)
ALMEMO® data rate	9600 baud (can be changed at the factory)
PC data rate	9600 baud to 115 kbaud (irrespective of the ALMEMO® baud rate)
Safety / security	6-character pin needed to enable the connection
Power supply	ZA1709BT2/BT1 via the ALMEMO® device, USB stick via the PC, otherwise via 12-volt mains unit

Bluetooth, class 2

Approval	For all countries worldwide
Operating range	up to 20 meters free field
Bluetooth device names	"Almemo xxx"
Current consumption	approx. 15 mA at 9 to 12 V, 30 mA at 7 V
Operative range	-10 to +55 °C
Housing	ALMEMO® connector

Bluetooth, class 1

Approval	For all countries worldwide - except France
Operating range	up to 100 meters free field (using ZB1709BTx up to 200 meters free field with antenna ZB1709BT1A in each case)
Bluetooth device names	"ALMEMO xxx"
Current consumption	approx. 25 mA at 9 to 12 V, 40 mA at 7 V
Operative range	-10 to +60 °C
Housing	(LxWxH) 108 x 60 x 29 mm, polystyrene (PS)

Bluetooth USB stick, class 1

Approval	For all countries worldwide - except France
Operating range	up to 100 meters free field (USB extension cable recommended)
Driver software	included on CD-ROM
Interfaces	1 virtual COM (standard installation), up to 6 other COMs possible (extended installation), grouped using software WinControl.

Model variants	Order no.
Wireless data link comprising : 1 Bluetooth module, class 1, RS232 and 1 ALMEMO® Bluetooth module, class 1	ZA1709-BT1DK
Wireless network link comprising : 2 ALMEMO® Bluetooth modules, class 1	ZA1709-BT1NK
Wireless network link comprising : 2 ALMEMO® Bluetooth modules, class 2	ZA1709-BT2NK
Wireless data link comprising : Bluetooth USB stick and ALMEMO® Bluetooth module, class 1	ZA709-BT1DKU
Wireless data link comprising : Bluetooth USB stick and ALMEMO® Bluetooth connector, class 2	ZA1709-BT2DKU
ALMEMO® Bluetooth connector, class 2	ZA1709-BT2
Bluetooth module, class 1, with ALMEMO® adapter cable, cable length 1m	ZA1709-BT1

Bluetooth module, class 1, with RS232 - DSUB9 adapter cable, length 1m	ZB1709-BT1V
Bluetooth module, class 1, with RS422 adapter for ALMEMO® network	ZB 1709-BT1N
Bluetooth module, class 1, with Ethernet socket RJ45, mains unit 12 V, 0.2 A	ZB 1709-BT1E
Special antenna for Bluetooth module, class 1 (doubles the operating range)	ZB 1709-BT1A

5.3.5 Technical data, interface modules

RS232 interface	ZA1909-DK5	RS232 9-pin DSUB, TXD, RXD, DSR, DTR, eletr. isolated Baud rate max. 115.2 kbaud; Current consumption approx. 1 mA
RS232 interface	ZA1909-DKL	RS232 9-pin DSUB, TXD, RXD, electr. isolated with optic fiber Baud rate max. 115.2 kbaud; Current consumption approx. 4 to 8 mA
Ethernet interface	ZA1945-DK	Ethernet RJ45 (10 / 100 base-T); Baud rate 115.2 kbaud Current consumption approx. 90 mA
Bluetooth modules	ZA1709BTx	see Section 5.3.4

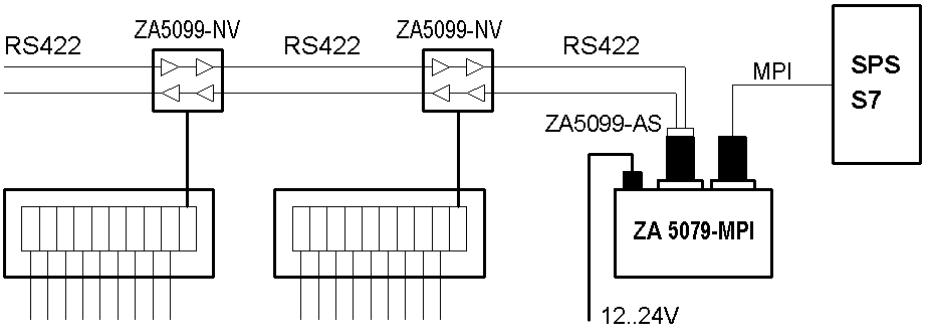
Network components Baud rate for all components, maximum 57.6 kbaud

Network cables	ZA1999-NK5	ALMEMO® current loop TX+, TX-, RX+, RX- electrically isolated Current consumption approx. 1 mA ; Line length maximum 50 meters
Network cable, optic fiber	ZA 1999-NKL	ALMEMO® TXD, RXD, electrically Isolated with optic fiber Current consumption approx. 4 to 8 mA; Line length max. 50 meters
RS422 network driver	ZA 5099-AS	1. RS232 9-pin DSUB socket, TXD, RXD 2. RS422, 4-wire, TX+, TX-, RX+, RX- Plastic housing 50 x 33 x 16 mm (LxWxH)
RS422 network driver	ZA 5099-NTL	ditto, 2 x RS422 electrically isolated with optic fiber Plastic housing 71.5/90 x 61.5/95 x 30 mm (LxWxH)
RS422 network distributor	ZA 5099-NVB	1. RS-422, 4-wire, TX+, TX-, RX+, RX- 2/3 RS-422, 4-wire, TX+, TX-, RX+, RX- Device connection: ALMEMO® current loop, electrically isolated Line length between two distributors approx. 1 km Current consumption: without DC/DC approx. 10 to 18 mA with DC/DC approx. 25 to 35 mA Plastic housing 71.5/90 x 61.5/95 x 30 mm (LxWxH)
RS422 network distributor	ZA5099-NVL	ditto but device connection with optic fiber Line length, optic fiber maximum 50 meters
RS422 Ethernet driver	ZA5045AK	1. Ethernet RJ45 (10 / 100 base-T) 2. RS-422, 4-wire, TX+, TX-, RX+, RX- Current consumption maximum 90 mA
Modem adapter connector	ZA1709AS	9-pin DSUB plug to 9-pin DSUB plug in conjunction with 1909 DK5 / DKL
RS422 data line	LD0042	Data line, 4 x 2 wires, 0.28 square mm, solid, stranded in pairs to form twin wires with common sheath, type J-Y(St)Y, to be laid on a permanent basis
Bluetooth modules	ZA1709BTx	see Section 5.3.4

5.3.6 Data transmission via field bus coupler (MPI)

Via field bus coupler ZA5079 all ALMEMO® devices and thus the comprehensive range of ALMEMO® sensor equipment can be connected to a Siemens PLC S7. Measured data can be transferred via the MPI (Profibus option) and saved directly to a data component all in digital form - without any loss in accuracy and without any additional programming. It is also possible by means of a 2-byte life-counter to continuously monitor that the system is functioning correctly. PLC operation needs no additional interface card and no special functional components. The functions of scanning an ALMEMO® device or any number of networked devices and of transmitting data to the PLC are performed by the field bus coupler. The number of devices in the ALMEMO® network can be set by means of a code switch; it can thus also be modified on site as and when required.

Schematic diagram showing the network structure



Putting into service

On coupler ZA5079-MPI unscrew the front panel, withdraw the plug-in module, and set the last ALMEMO® address (e.g. 04) by means of the two code switches.

Using a Profibus cable connect the MPI interface on the PLC to the socket "PLC-MPI"; (9-pin DSUB connector, RS485, pins 3+ and 8- are wired in parallel). The MPI addresses and the data components are preconfigured before leaving the factory. Connect the ALMEMO® device to the ALMEMO® socket, in the same way as to a PC, using a standard data cable or ALMEMO® network driver (ZA5099-AS or ZA5099-NTL). Connect the power supply via 24 VDC or the 12 V mains supply unit.

When switched on ALMEMO® devices are continuously interrogated and the measured data is transferred to the data component on the PLC. A 2-byte life-counter located in a second data component is incremented after each data transfer; this checks that the system is functioning correctly.

The status LED on the front panel indicates the current operating status:

LED flashing at approx. 2 Hz	Operation is error-free.
LED lit up continuously	Error in reading an ALMEMO® device
LED does not light up at all	On switching on until connection is set up Error in writing to the S7 e.g. incorrect MPI address or data component either incorrect or too small

Standard configuration on leaving the factory (configured in the EEPROM)

MPI partner address	2
MPI gateway station address	5
Data component - life-counter number	5
Data component - measured data number	4
Organization	20 meas. chan. per device, max. 25 devices

User-specific configuration

The user can modify the afore-mentioned standard configuration using a PC and a terminal program (AMR-Control or Hyper-Terminal). For this purpose the ALMEMO® socket on the coupler must be connected to a COM port on the PC using a crossed DSUB cable (socket/socket).

Vorgehensweise:

1. Set the terminal to 9600 baud, 8 data bits, 1 stop bit, no parity.
2. In the coupler set the code switch to 99 .
3. Then switch the coupler on; the firmware version should be displayed.
4. Enter commands as listed in the table; to save data press OK

Function range	Command	Response
MPI partner address (e.g. 2)	atpad=002 CR	002 CR OK CR
MPI gateway station address	atsad=xxx CR	xxx CR OK CR
Data component - for life-counter	atsdb=xxx CR	xxx CR OK CR
Data component - for measured data	atddb=xxx CR	xxx CR OK CR
Number of measuring channels per device	atkan=060 CR	060 CR OK CR
Interrogating each setting, e.g.	atkan=? CR	xxx CR OK CR

5. Finally set the code switch back to the last device address again.
6. Switch the device OFF and back ON again

PLC data component

The data component must be set up by the user.

Size = number of devices x number of measuring channels per device x 3 bytes

The data per measuring channel comprises a 2-byte measured value (16 bits) and one status byte giving a detailed description of the measuring channel's status:

Data format 3 bytes per measuring channel (status byte, high byte, low byte)

Status code EEEGSSS-

Bit B0	-------1	Arithmetic sign
Bit B1-3	----xxx-	Sensor code
Bit B4	---1----	Limit value overshoot
Bit B5-7	000-----	Measured value valid
	001-----	Sensor invalid (comma or units incorrect)
	010-----	Measuring range overshot
	011-----	Measuring range undershot
	1xx-----	Measured values invalid Data 11111111, 11111111
	101-----	Sensor breakage
	110-----	Channel not transmitted, device not responding

The data component life-counter needs 10 bytes (so far only 2 bytes used)

Byte 1	Life-counter	00 to FFH
Byte 2	Address of the device currently selected	

Operand	Symbol	Status format	Status value
// device 1			
DB4.DBB 0	---	HEX	B#16#40
DB4.DBW 1	---	DEZ	12500
DB4.DBB 30	---	HEX	B#16#40
DB4.DBW 31	---	DEZ	0
// device 2			
DB4.DBB 60	---	HEX	B#16#00
DB4.DBW 61	---	DEZ	2691
DB4.DBB 66	---	HEX	B#16#00
DB4.DBW 67	---	DEZ	2701
// life-counter			
DB5.DBB 0	---	HEX	B#16#78
DB5.DBB 1	---	DEZ	2

Technical data

Housing	Aluminum housing, 44 x 105.5 x 132 mm (HxWxD)
Power supply	9 to 32 VDC
Current consumption	maximum 150 mA
Connector for power	3-pin clamp connector (+, -, ground)
Connector for ALMEMO®	9-pin DSUB connector
Data format ALMEMO®	9.6 kbaud, 8 data bits, 1 stop bit, no parity
Last ALMEMO® address	Two code switches
Connector for PLC-MPI	9-contact DSUB socket

MPI interface	187 kbaud