5. ALMEMO® Output Modules

A modern measuring instrument must be able to communicate with its environment, i.e. transmitting measuring data to analog and digital peripheral equipment, running the commands of a computer, triggering alarm signals or responding to switching pulses. To suit all possibilities, while keeping the hardware requirements at a minimum, all necessary interfaces have been integrated into the ALMEMO® output connectors. This concept enables the user of digital transmission, depending on the task, to freely select between RS232, RS422, RS485, Current Loop, Centronics interface, wire connection, fiber optic or radio transmission. For connection of the modules almost all ALMEMO® devices are equipped with two output sockets A1 and A2, which also allow for 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 Modules

5.1.1 Analog Output Cable

For data registration with a recorder or similar equipment the analog output module ZA 1601-RK can be connected to the socket A1 or A2. The connector plug contains a converter that transforms the pulse-interval-modulated signal of the measuring instrument into a voltage (-1.25 to +2.0 V), which corresponds to the linearised measured value of the selected channel. The output voltage corresponds 0.1mV/digit, and 0.1mV/2 digit in the measuring range 55mV. The conversion rate must be set to 10M/s if a high response speed needs to be achieved.
During a cyclic scan of measuring points the analog output retains the latest value of the selected channel. In case of a sensor breakage the output voltage turns to zero.
The output signal can be scaled as desired over the analog start and analog end (see 6.10.7) if the amount totals more than 100 digits (e.g. 0 to 2V for -30.0 to 120.0°C).
Two analog output modules and two different channels can be output at the two sockets A1 and A2 of hand-held devices if true double sensors are used or when a continuous scan of measuring points is performed. Usually, the 1st channel and the selected measuring channel is used in a sensor. Any other channel can be programmed instead of the measuring channel (see 6.10.7).

Technical Data:

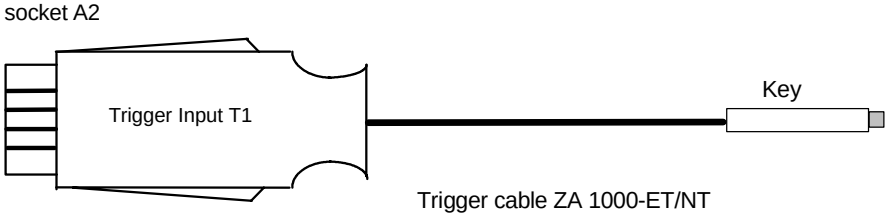
Output voltage:	-1.250 to 2.000V not electrically isolated
Gain:	0.1mV/digit
Residual ripple:	< 2 digit
Load:	> 100kΩ
Accuracy:	± 0.1% ±6 digit
Temperature drift:	1digit / K
Time constant:	100ms
Current consumption:	approximately 3mA

5.1.2 Relay Trigger Cable and Relay Adapter

Cables with integrated semiconductor relays are available for alarm messages when limiting values are exceeded (see 6.4.5) and for triggering peripheral equipment (see 6.10.8). For remote control of the devices (see 6.6.4) trigger cables and a combination of trigger cables and cables with integrated semiconductor relays are available. The variants of the trigger function can only be programmed at the actual trigger cables (see 6.6.4, 6.10.9).

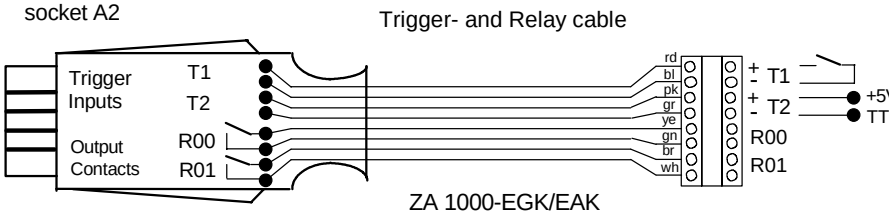
ZA 1000-EK Trigger cable with an optocoupler and 2 banana plugs,
ZA 1000-ET Trigger cable with one key,
ZA 1000-NT Zero cable with one key,
ZA 1000-GK Alarm cable with 1 relay and 2 banana plugs*,
ZA 1000-EGK Trigger and alarm cable with 2 relays*,
ZA 1000-EAK Trigger and output cable with 2 relays**

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



Trigger cable ZA 1000-ET/NT

The **trigger input T1** is triggered by a floating contact, the **trigger input T2** is triggered by an electrical signal. This can be a voltage of 4 to 30V DC that must drive an optocoupler (in case of TTL signals triggering in negative logics T2+ to 5V, T2- to output).



ZA 1000-EGK/EAK

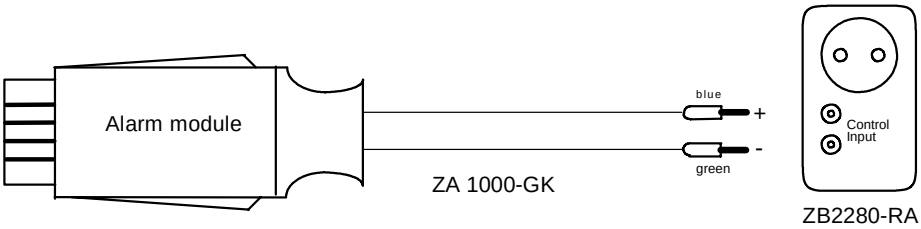
At the alarm cable ZA1000-EGK the relay contacts R00 and R01 respond separately if the Max and Min limiting values are exceeded. The variants for the relay triggering are programmable for all output modules (see 6.10.9).

Technical Data:

Trigger input T1:	not electrically isolated for floating switch contact, Ri > 50kΩ
Trigger input T2:	optocoupler 4 ... 30V DC, Ri > 3kΩ
Output relay:	semiconductor relay 1Ω without polarity, power dissipation: 50V, 300mA
Current consumption:	3mA

Relay Adapter

The relay adapter ZB 2280-RA is used to switch mains operated devices. It can be easily connected between the mains socket and the alarm device and is triggered through a relay cable (ZA1000-GK) , i.e. in case of an alarm it will be switched on.



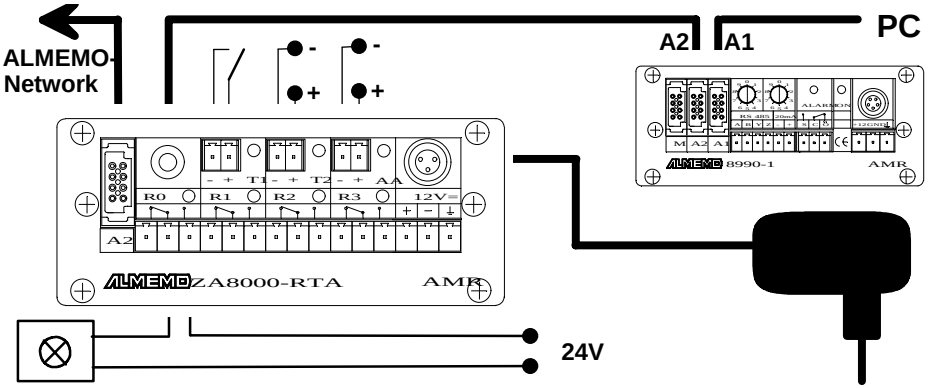
Technical Data:

Trigger input:	for optocoupler output or switch contact R < 10kΩ
Switch relay:	mechanical relay, power-handling capacity: 250V, 6A Non-operated: OFF, Alarm condition: ON

5.1.3 Relay Trigger Analog Adapter RTA

The relay trigger analog adapter ZA 8000-RTA represents a universal trigger output interface with 4 mechanical output relays, two trigger inputs and one analog output for all ALMEMO® devices. The adapter is connected to socket A2 of the ALMEMO® device. As the adapter also provides a socket A2, networking with network cables is still possible.

The power supply for the relay triggering can be provided either with 8-12V DC (200mA), 12V power supply adapter plug.



In case of alarms the 4 **output relays** can be automatically triggered in any way via interface commands (see 6.10.10) or from the measuring instruments. The function can be set by programming the EEPROM or it can be ordered as an option

(see6.10.9). The allocation of the limiting value to the relay can be programmed as desired (see 6.10.8).
The relay control can be configured via jumper settings so that the relays pick up normally and drop-out in case of alarm or power failure (JP1 open). At each switch-on a beep sounds (JP2 open). The switch status is indicated by 4 LEDs.

The **trigger input** T1 can be triggered from a floating switch contact, T2 can be triggered by an optocoupler with voltage levels between 0 and 5/24V. With all ALMEMO® devices the triggering generally causes the start or stop of a cyclic scan or the start of a single scan of measuring points (see 6.6.4).

As an option, the relay trigger adapter can also be equipped with an electrically isolated **analog output** that can provide the following signals:

Option	**Output Signal**	**Gain**
OA 8000-R1	-1.2500V ... +2.0000V	0.1mV/digit
OA 8000-R2	-6.0000V ...+10.0000V	0.5mV/digit
OA 8000-R3	0.000mA ...+20.000mA	1µA/digit

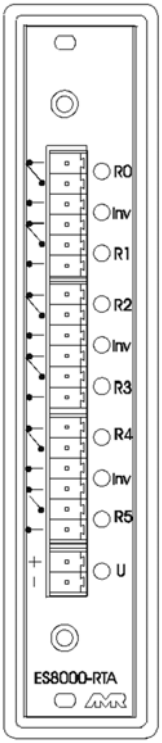
The above gain is related to 2 digits for the measuring range 55mV. The output value usually corresponds to the linearised measured value. Alternatively, the analog value can also be given via interface as control value (see 6.10.7). A recording device can be connected by a screw terminal connector to the terminals AA + and -. The output signal of the three options is programmable as a standardised output of 0 to 2V, 0 to 10V, 0 to 20mA or 4 to 20mA for any partial measuring ranges (see 6.10.7), if the extent totals more than 100 digits (e.g. 0 to 20mA for -30.0 to 120.0°C).

Technical Data:

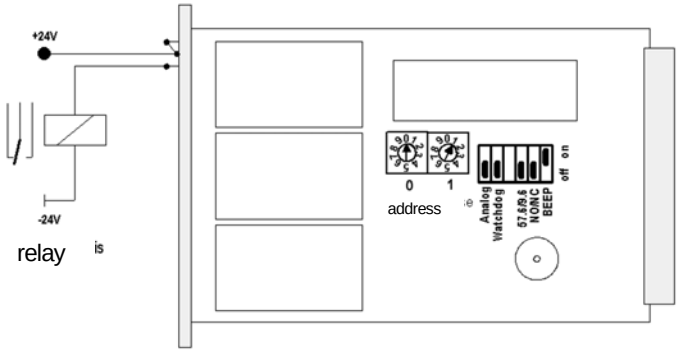
Trigger input T1:	not electrically isolated for switch contact, Ri > 50kΩ		
Trigger input T2:	optocoupler 4 to 30V, Ri > 3kΩ		
Output relay:	mechan. relay, power-handling capacity:50V, 2A		
Supply voltage:	8-12V DC (mains adapter ZB 3090-NA)		
Current consumption:	max. 200mA		
Analog output:	electrically isolated		
OA 8000-R1	-1.25V ... +2.0V	0.1mV/digit	load > 100kΩ
OA 8000-R2	-6.00V ...+10.0V	0.5mV/digit	load > 100kΩ
OA 8000-R3	0.0mA ...+20.0mA	1µA/digit	load < 500Ω
Residual ripple:	< 2 digit		
Accuracy:	± 0.1% ± 6 digit		
Temperature drift:	1 digit / K		
Time constant:	100ms		

5.1.4 Relay trigger analog adapter RTA2

The plug-in ES 8000-RTA2 gives ALMEMO® data acquisition systems 5590-1 / 5990-1 a universal output interface with six computer-driven semiconductor relays and with an optional analog output; (with 5590-2 systems not intended for multiple active modules, an internal interface driver must be retrofitted). This plug-in device is a stand-alone module - each with its own address. This address must be set - before the device is put into service - by means of two code switches on the card in such a way that it is one higher than the most recent address. The interface connection and power supply are via the system. The baud rate is set by default to 9.6 kbaud but can be modified by means of jumper “Mode4” to 57.6 kbaud.



If the power supply is in order, green LED “U” should light up.
The relay analog adapter is also available in version ZA 8000-RTA2 with its own housing. It can be connected via an ALMEMO® socket and used in conjunction with a network distributor anywhere in an ALMEMO® network. In order to set the address the screws on the front panel must be loosened and the plug-in device must be withdrawn. For the power supply an external voltage of 12 to 24 V DC or AC (200 mA) is needed. For this purpose connector network adapter ZB 1012-NA1 (12 V, 200 mA) with free ends is available. This is connected to clamp connector “U”. If this is in order, green LED “U” should light up.
The main board is fitted by default with three modules each with two photo semiconductor relays (change-over contacts). It is also available as an option fitted with fewer modules or with an analog output instead of the third relay module. If the current or voltage capacity of the relays is not sufficient, appropriate relay modules (e.g. Phoenix nos. 2967219 and 2961105, 250V 6A) can be fitted downstream; (see above).



Relays

Output relays R0 to R5 can be driven as and when required by means of interface commands; (see Manual, Section 6.10.10).

Functions	**Commands**
Energizing contact Rx :	R0x
De-energizing contact Rx :	R-0x
Calling up the relay status via	P19
Device configuration (see Manual, Section 6.2.5) :	ALARM: 01---5
This also displays the number of relays involved.	
Row A2 displays the setting	
NO (normally open) or NC (normally closed)	A2: EA8 NO WWA

and the module types : W = change-over contact, A = analog output

Safety functions

For safety-critical applications the relay switching mode can be configured by means of the jumper “NO/NC” (normally open / normally closed) in such a way that relays are closed in their idle status (NC) and open as and when they are energized or in the event of power failure. In this intrinsically safe inverse operating mode all three yellow LEDs "Inv" are continuously lit, indicating that the switching mode as imprinted on the front panel is currently inverted. Whenever the device is switched on, a beep sounds. This can be deactivated by means of the jumper “Beep off”.

It is also possible by means of the jumper ´Watchdog´ to ensure that the relays release if, with a timeout set to 1 minute, there is no energizing pulse received via the interface. This alarm status, in which no further commands are accepted, is indicated by the LED ´U` flashing; this alarm can be reset either by switching off and then on again.

Analog output

The relay adapter can also be fitted - as an option - with an electrically isolated analog output; this can output the following signals, as selected.

Option	**Output signal**	**Gain**
OA 8000-R1	-1.2500 V ... +2.0000 V	0.1 mV/digit
OA 8000-R2	-6.0000 V ...+10.0000 V	0.5 mV/digit
OA 8000-R3	0.000 mA ...+20.000 mA	1 µA/digit

The analog value is preset as actuating variable via the interface; (see Manual, Section 6.10.7). A recording device can be connected via a screw / clamp connector to terminals AA + and - (instead of R5).

Funktions	**Commands**
Analog output of xxxxx digits	f9 a±xxxxx
e.g. voltage (2 V) -0.5 V	f9 a-05000
voltage (10 V) +6.40 V	f9 a12800
current (20 mA) + 19.0 mA	f9 a19000

Calls up the analog output value via	P19	
Device configuration (see Section 6.2.5):	CONFIG:	xxxxxx-- -x-- B-1 a+12345
If there is no analog output:	CONFIG:	xxxxxx-- -x--

Technical data:

19" plug-in device :	Width 4 DU	
Main board :	Baud rate :	9600, 57600 baud
	Current consumption :	max. 10 mA
Semiconductor relays :	Power-handling capacity :	50 V, 0.1 A
	nternal resistance :	prox. 11 ohms
	current consumption :	max 5mA / module, internal
Voltage supply :	ES 8000-RTA2 :	bus : 9V DC
	ZA 8000-RTA2 :	external : 12 to 24 V DC or AC
Mains adapter :	ZB 1012-NA1 :	12 V DC, 200 mA

Analog output: electrically isolated

OA 8000-R1	-1.25 V ... +2.0 V	0.1 mV/digit	Load > 100kΩ
OA 8000-R2	-6.00 V ...+10.0 V	0.5 mV/digit	Load > 100kΩ
OA 8000-R3	0.0 mA ...+20.0 mA	1 µA/digit	Load < 500W
Residual ripple:	< 2 digits		
Accuracy:	± 0.1% ± 6 digits,		
Temperature drift:	1 digit / K		
Time constant:	100 ms		
Current consumption:	max. 60 mA		

Product overview:	**Order no.**
Relay adapter as plug-in unit for data acquisition systems with 6 photo semiconductor relays (change-over contacts 50 V / 0.1 A)	ES 8000-RTA2H
as above, device can be networked, desktop version	ZA 8000-RTA2H
Relay adapter as plug-in unit, main board without modules	ES 8000-RTA2G
as above, device can be networked, desktop version	ZA 8000-RTA2G
Option RWH2 :	
Two semiconductor relays (change-over contacts 50 V / 0.1 A)	OA 8000-WH2
Option R1 : Analog output -1.25 to +2.0 V	OA 8000-R1
Option R2 : Analog output -6.00 to +10.0 V	OA 8000-R2
Option R3 : Analog output 0.00 to +20.0 mA	OA 8000-R3
Network adapter 12 DC (200 mA), connection with free ends	ZB 1012-NA1
RS422 network distributor, connection via optic fiber	ZA 5099-NVL

5.2 ALMEMO® Interface Modules

Four interface cables, each having the necessary interface integrated in the connector, are available for data transmission from ALMEMO® devices to a computer or peripheral equipment.

ZA 1909-DK5: RS232 interface, electrically isolated for printer and computer connection via DSUB socket

ZA 1909-DKL: RS232 interface with fiber optic technology for printer or computer connection via DSUB socket

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

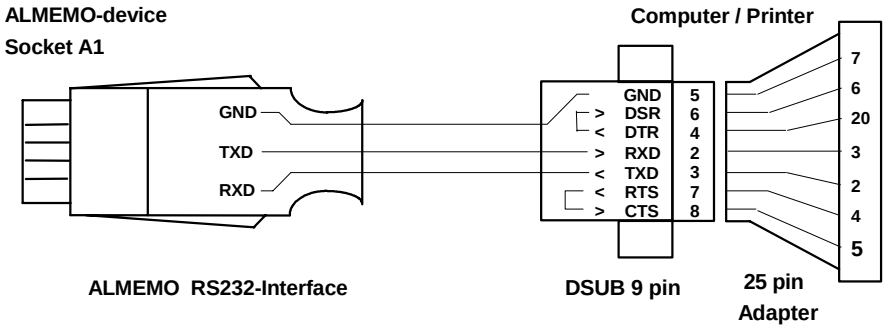
ZA1709-BTx: Bluetooth modules class 1 or class 2 for USB and RS232 (s. 5.3.4)

The interface cables are connected to the output socket A1 and are automatically detected by the measuring instrument as all transmission parameters are stored in the connector plugs. The operator can use different cables to connect several peripheral devices such as printer, terminal or computer with different parameters to a measuring instrument without requiring any settings. Additional network cables and RS422/485 network drivers and network distributors that are required for larger distances are available for networking several ALMEMO® devices.

5.2.1 RS232 Data Cable

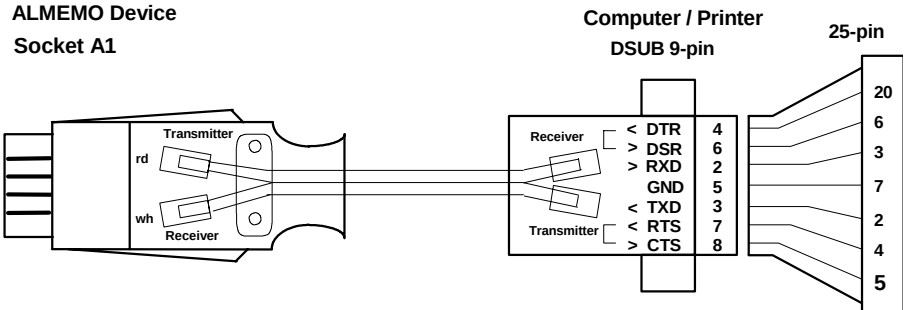
Computers with 9-pin plugs can be directly connected to the measuring instrument via the electrically isolated interface cable ZA 1909-DK5. For devices with a 25-pin plug or socket (printer) a corresponding adapter must be interconnected. The current consumption is approximately 1mA, the maximum baud rate is 115.2 kbd. Hardware handshake is no longer supported; support is provided for XON-XOFF.

Wiring of the RS232 interface cable ZA 1909-DK5:



5.2.2 RS232 Data Cable with Fiber Optics

The transmission of digital data via fiber optic provides a number of significant advantages compared to a wire-based data transmission. There are no EMC problems as no electric or magnetic fields influence the cabling, i.e. a safe data transmission is also possible in industrial environments with high noise levels. Due to the total electrical isolation of the individual devices it is also possible to bridge potential differences. Even an extensive lightning protection is achieved.
Compatible with the RS232 data cable ZA 1909-DK5 the fiber optics data cable ZA 1909-DKL is available. This cable allows for a transmission over a length up to 50m at a baud rate up to 115.2 kbd (as far as the devices allow for this),, the hardware handshake is not supported.



ALMEMO Fiber Optics Data Cable

5.2.4 Barcode Reader

Instead of a computer or a terminal, a barcode reader (accessory ZA 7909-BCL) can be used as input device and can be connected to an ALMEMO® device. In principle, all interface commands can be read from paper and can be transmitted to the devices. This method is particularly suitable for identifying measuring points. At data loggers the numbers that unambiguously identify the subsequent measurements, and later allow for a selective memory read-out (see 6.8), can be entered at any stage of the measuring process. If the measuring locations are identified with a 6-digit number as a barcode, the allocation can be easily and quickly performed.
A further reasonable application is the local application-specific programming of devices without operating controls.
The barcode reader can be set to all standard formats so that existing barcode printers can still be used. Furthermore, a print software for computers with a Windows operation system is available for printing barcodes.

Technical Data:

Baud rates:	150, 300, 600, 1200, 2400, 4800, 9600, 19200
Data formats:	7 or 8 bit data, parity, stop
Output formats:	CODABAR, code 3 out of 9, INTERLEAVED 2 out of 5 2 out of 5, code 11, code 93, code 128, matrix 2 out of 5 UPC A and E, EAN/JAN-8 and -13
Signalisation:	flash or tone signal on switch-on and code recognition

5.2.5 Data Transmission via Modem

For a remote control and remote configuration of ALMEMO® devices within the range of the terrestrial phone network our delivery program provides ready configured modems for both, analog and digital connections (ISDN). For reasons of compatibility it is recommended to use pairs of devices. For this purpose it must be considered that for use with the ALMEMO® device the analog modem (ZA1709-MK) has another setup than the modem on the PC side (ZB1709-M).

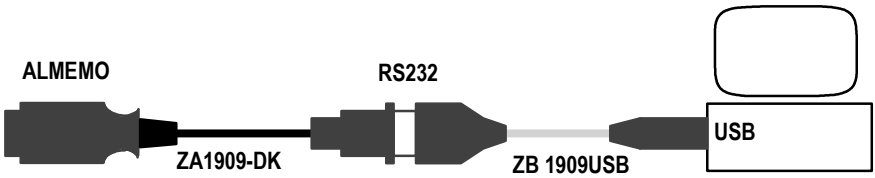
For applications remote from the terrestrial phone network, the GSM modem ZA1709-GSM is available. A mobile radiocommunication data contract (for Germany: D1 network) is required for this and can be signed with us or with other providers. In this case, an analog modem (ZB1709-M) is used as counterpart on the PC end.

When connecting the ALMEMO® device it is mandatory that the supplied additional adapter ZA1709-AS is connected between the data cable and the modem. It exchanges once more the data lines and switches the communication during the intialisation phase off. It is possible that an additional adapter from 9-pin to 25-pin DSUB connector may be required.

It is probably possible to use own modems with the adapter mentioned above, however, due to the large number of types available on the market it is not possible to provide support regarding the configuration and initial operation.

5.2.6 USB-RS232 converter

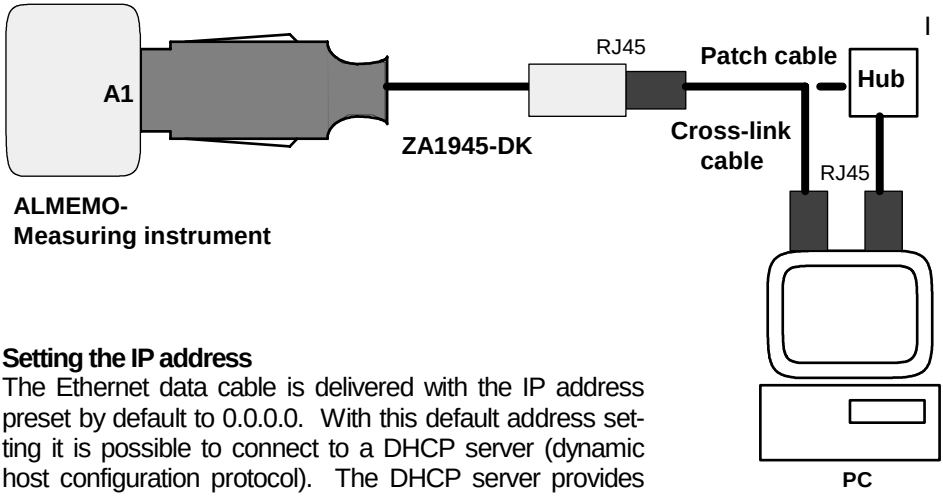
Many computers on the market nowadays do not have an RS232 interface - only USB interfaces. To connect ALMEMO® measuring instruments to such computers a USB - RS232 converter is needed (ZB 1909-USB). With this converter plugged into a USB socket on the computer any ALMEMO® data cable or any network driver can then be connected to the DSUB connector.



To set up the necessary additional COM port, the WINDOWS driver (provided on the enclosed CD) must be installed, in the usual manner. The virtual COM port thus generated can be used in conjunction with all programs, at all the usual baud rates, without any restrictions.

5.2.7 Ethernet ALMEMO® data cable

Using Ethernet ALMEMO® 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 via a cross-link cable; a switch or hub can be connected via a patch cable.
Putting into service and terminal operation are now also possible using our AMR-Control software (version 5.0 and above), available free-of-charge.
Having an Ethernet module integrated in measured value acquisition is the default setting in the Win-Control WC3 software package; if this is not the case, option WCO6 is required. With additional software AMR2ips SW5500-C22 it is possible to operate several Ethernet modules simultaneously.



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.
n networks without DHCP server a permanent IP address must be set manually in the Ethernet data cable.
The necessary XPort-Installer software and the instructions for using it are provided on the AMR-CD in the directory
Accessories / Ethernet / XPort-Installer.

Status LEDs

Two additional LEDs are provided for the purposes of monitoring the status of the Ethernet connection.

Left LED :	10 MHz	Right LED :	100 MHz
OFF	No connection		
Orange	Half duplex	Green	Full duplex
Continuously lit	Connection is established	Flashing	Data transmission

Technical data

Ethernet	Socket RJ45 (10/100 base-T) autom. switchover 10 / 100 MHz
ALMEMO®	ALMEMO® connector for socket A1, baud rate : standard 9600 baud, maximum 115.2 kbaud (modification via XPort-Installer and browser)
Power supply	7 to 12 volts DC via measuring instrument (suitable mains supply unit recommended)
Current consumption	<60 mA (10 MHz), <90 mA (100 MHz)

Product overview	Order number
Ethernet data cable RJ45 socket on ALMEMO® connector	ZA 1945-DK
Patch cable RJ45, plug / plug, 2 meters	ZB 1904 PK2
Additional software AMR2ips for operating several Ethernet modules with Win-Control software	SW5500-C22

5.3 Networking Measuring Devices

Decentralised data acquisition' has become a keyword that can be consistently realised with ALMEMO® devices. Measuring data is locally obtained using short sensor cables and small modular measuring instruments, which are networked via fail-safe digital circuits and, therefore, can be centrally analysed via PC. This helps to minimise both, wiring efforts and EMC problems. The use of equipment is flexible and can very easily be adapted to any measuring task.

All ALMEMO® devices can be individually addressed. They all operate with the same protocol and, therefore, can be totally networked. In addition, a small network distributor has been integrated that allows one further device to be connected to each device by using a pre-assembled network cable. This method allows for a connection of up to 100 devices to one serial interface of a PC. Alternatively, fiber optic cables can be easily used in environments with high noise levels. A transmission using an RS422 interface should be used for installations that are distributed over larger areas. Special drivers and electrically isolated network branch boxes are available for each device. The protocol is based on simple ASCII communication instead of a complex 7-layer

type. Consequently, data of each measuring instrument can be read out in plain text format via any terminal. A data flow control is only available through a software handshake (XON/XOFF). Software packages are available for automating the scanning of measuring points within the network and provide a graphical output and analysis of the measured data. All measuring devices must be set to different device numbers before any network operation is started. The numbers can be programmed via keyboard for devices with a display and via code switches for transmitters and plug-in units (see device manuals). The arrangement of the devices and the sequence of the addresses can be chosen in any order but there must not be any spaces.

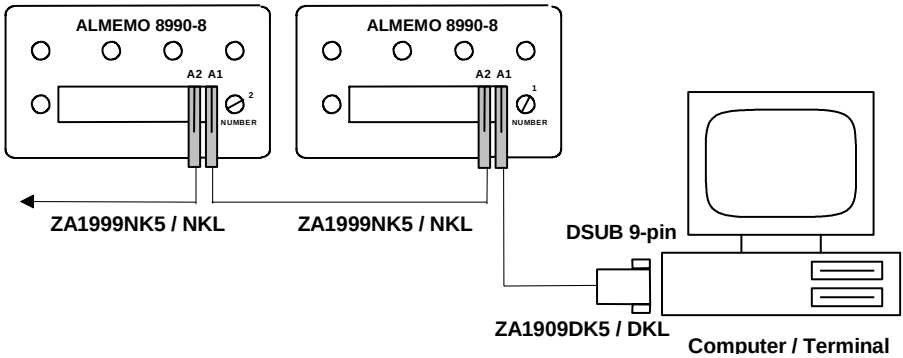
Only successive numbers between 01 and 99 should be used for network operation to ensure that the device 00 is not mis-addressed in case of a power interruption.

5.3.1 Network Cable

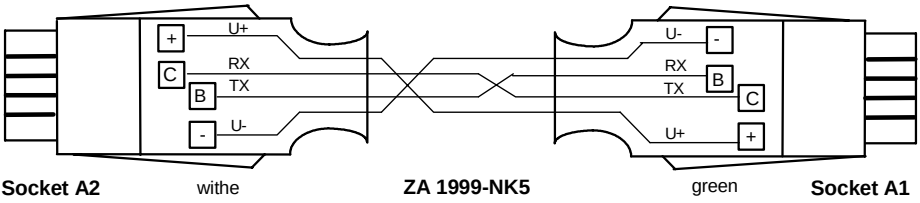
An RS232 interface (ZA1909DK5) or **an Ethernet interface (ZA1945DK)** that is connected to socket A1 of the ALMEMO® measuring instrument can, by means of network interface cables (ZA1999NK5), be cascaded to socket A2. As a result, 99 additional ALMEMO® measuring instruments can be connected to the first measuring instrument.The commands sent to the first device are, as buffered data, also transmitted to all other devices. The responses from these are provided with an OR operation, therefore, they are also available at the output of the first device.

Advantages:
1. Devices can be quickly and easily networked.
2. Low power consumption as no additional power supply is required.

Disadvantages:
1. The device network will be blocked if a power failure occurs at the measuring instrument.
2. Socket A2 is used and occupied.

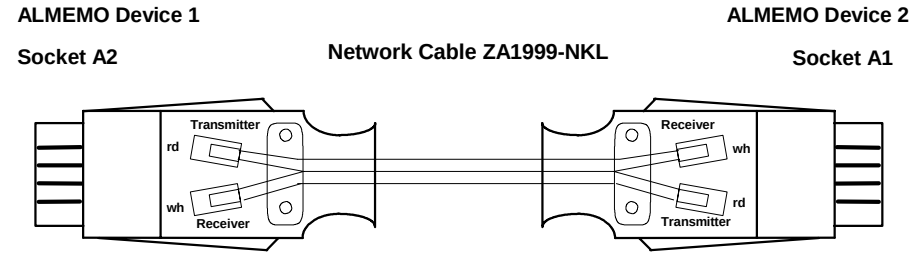


The network cable ZA1999NK5 can be easily assembled using 2 single connectors and one four-wire cable of up to 50m length.



5.3.2 Network Cable with Fiber Optics

The network cable is also available as ZA 1999-NKL in fiber optic technology. It consists of two ALMEMO® fiber optic converters ZA 1999-FSL and 1.5m two-layer plastic fiber optic cable. The fiber optic cable can have a length of up to 50m and the converters can be easily connected by the user. However, the cable attenuation limits the number of network cables that can be cascaded (to approximately 10 cables at 9600bd, 57.6kb is not possible). The power supply is provided by the devices that are connected.



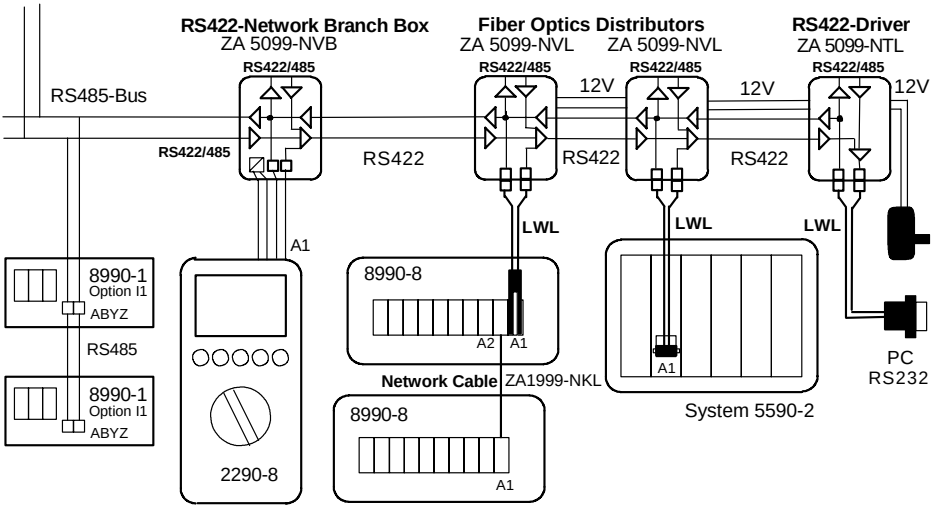
Assembly

For assembling a data cable the fiber optic cable must firstly be cut at a right angle, to the desired length, by means of a sharp knife (do not use cutting pliers). The double conductor must then, at both ends and over a length of 1cm to 2cm, be split into single wires. If ALMEMO® converters are used the two single wires should be inserted into both photo elements (after removing the cover) and fastened using the pull relief. Ensure that each of the two wires are guided from the transmitter to the receiver when connecting the second converter. The transmitting wire can be easily identified during data flow because visible red light is used for the data transmission.

5.3.3 Data Transmission via RS422 Interface

The data transmission should be performed using RS422 interfaces if the measuring instruments are located in distances of more than 50m from each other or when a star network cannot be avoided. Unlike RS232, where data transmission is earth-related, the data transmission and analysis via RS422 interface is based on voltage differences. By this method, common-mode interferences in the transmission line can be largely suppressed so that wire lengths of 1000m and more are possible. The RS232 signal can simply be converted into a RS422 signal or a fiber optic signal and vice versa.

For networking purposes the ALMEMO® system provides two network distributors, which simultaneously transmit the commands from the computer to all devices and then only transmit the answer of the addressed device back. The network distributors are generally connected via RS422 interfaces and, therefore, can span large distances.



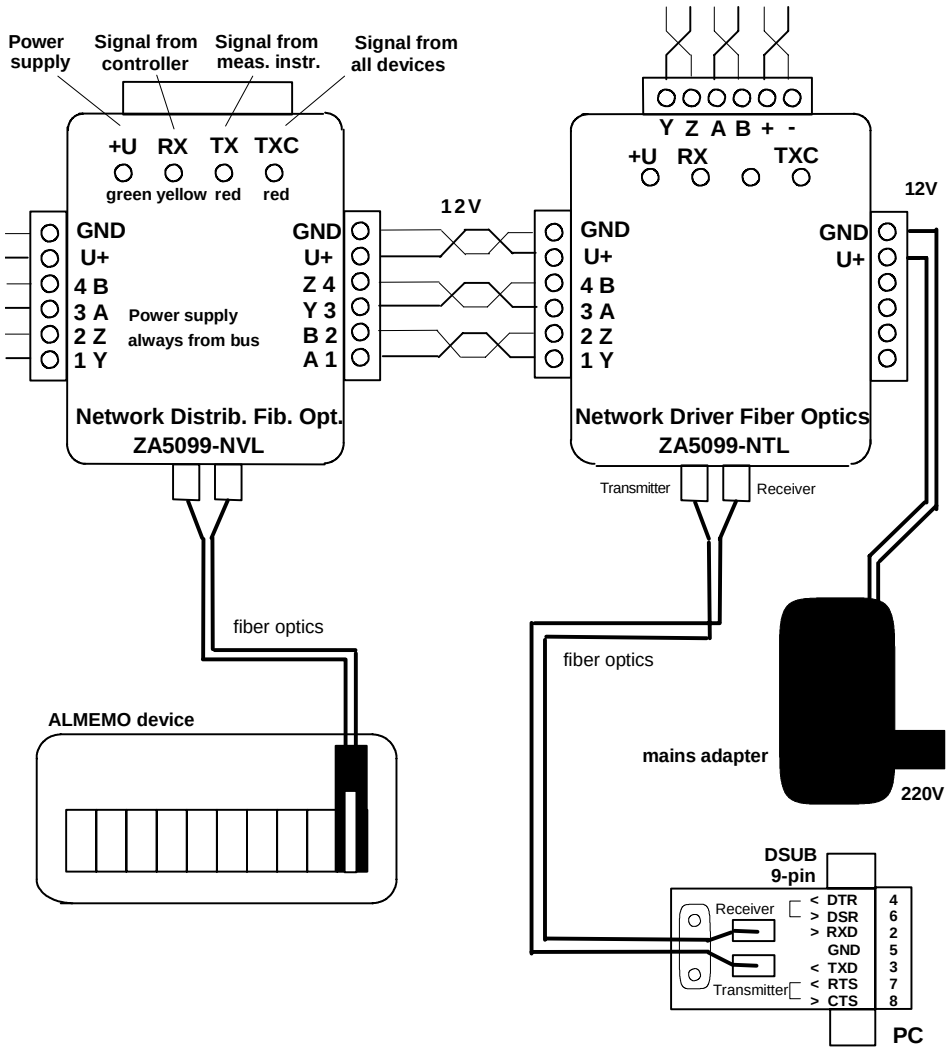
For the **network distributor ZA 5099-NVL** the connecting line to the measuring instrument consists of a **fiber optic cable** and, as a result, provides a high interference immunity. In this case the connection between the distributors must run over 6-wire or 8-wire RS-422 data cables, with 4 wires for the data line, 2 wires for the power supply line, 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 the wire-based **network distributor ZA 5099-NVB** is used the distributor is electrically isolated supplied via DC/DC converter from the device. In this case, a 4-wire data line is sufficient to connect the distributors.
The simple plug-on converter ZA 5099-AS from RS232 to RS422 without electrical isolation can be used as **driver** for the RS422 network, or, which is also recommended, the driver **ZA 5099-NTL** with fiber optics can be used for an optimal separation from the computer. 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 fiber optics

The network driver ZA 5099-NTL with fiber optics is recommended to protect the computer against line overvoltages and to minimize voltage transients being coupled into the system. It consists of a RS232 fiber optics converter, 1.5m fiber optics cable and RS485 bus drivers. As a result, the RS232 COM interface of the computer is completely electrically isolated from the network. The wiring from the driver to the distributor is parallel (wire transposition of AB and YZ by arrangement of connection). The network must be supplied through a 12V power supply unit.

5.3.3.2 Network Distributor RS422 and Device Connection with Fiber Optics

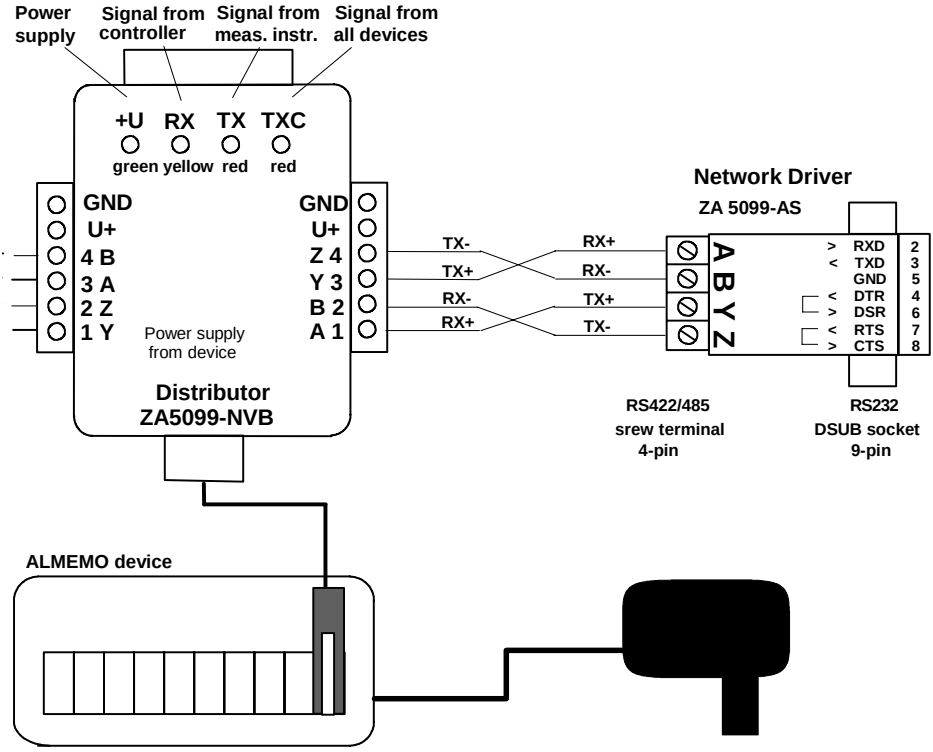
As illustrated in the previous figure the ALMEMO® devices are connected to the network by using corresponding RS422 network distributors. The most noise resistant version is the ZA 5099-NVL with fiber optic connection. Even the failure of a measuring instrument will not disturb the function of the network. The fiber optic cable for the connection of the ALMEMO® device can be up to 50 m long. If the network is to be branched as a star network from one device into two directions it is possible to connect an additional branch to the second output. Each RS422 output can be also used as a RS485 driver for transmitters with a RS485 interface. However, a further RS422 network branch box must not be connected to this type of RS485 branch! In case of the fiber optic network distributors 2 supply lines must be wired in parallel in addition to the data lines (if longer cable lengths are required, the power supply line must be duplicated and run over 2 x 2 wires) (the wire transposition of inputs and outputs is ensured through the arrangement of connections). The 12V power supply unit can be connected at any point within the network, in case of large networks in the centre, when



possible, to keep the voltage drop low. The housing with mounting straps for surface mounting and the screw terminal plugs allow for easy installation. Even several network branch boxes can be directly connected. Data cables that are twisted in pairs must be used for longer lines.

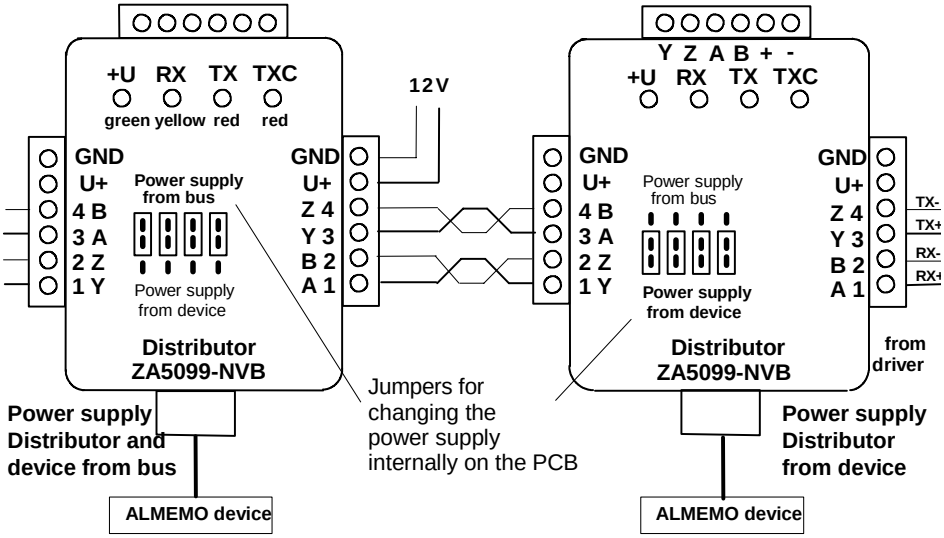
5.3.3.3 Network Driver RS232-RS422/485 without Electr. Isolation

The following combination of network driver and distributor works with a 4-wire wiring and does not require an additional power supply. The adapter connector ZA 5099-AS is provided as a RS422/485 bus driver to be plugged onto the RS232 COM interface of a computer. This allows to directly connect a RS422 network distributor, or a RS485 transmitter. Between the bus driver and the first device the transmitting lines Y, Z must be connected to the receiving lines A, B and vice versa. 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.



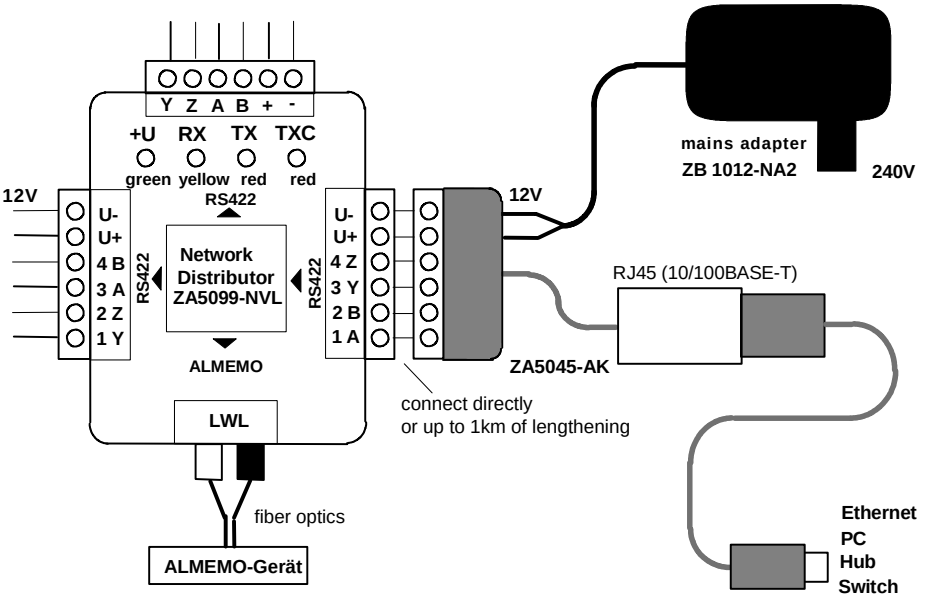
5.3.3.4 Network Distributor RS422 w. DC/DC Converter and Cable Connection

The network distributor ZA 5099-NVB includes a cable connection to the measuring instrument and a DC/DC converter for the power supply of the distributor through the measuring instrument. The electrical isolation is established through optocouplers. A 4-wire data line is, therefore, sufficient for connecting the distributor. However, if the power supply fails for one of the devices the entire net will be blocked! In exceptional cases these distributors alternatively provide the option to supply the distributors centrally from a power supply (distance less than 50m). For this purpose the supply can be reversed on the PCB of the distributor. This can be performed by using 4 jumpers, which must be inserted to the position ´Power Supply from Bus´. For the power supply it is then necessary to re-wire all 6 lines and to centrally connect a 12V power supply adapter. (if longer cable lengths are required, the power supply line must be duplicated and run over 2 x 2 wires) With regard to the power consumption, the current consumption of the network branch box (approx. 25mA), the measuring instruments and the sensor power supply must be considered (ZB 1012-NA1: 200 mA, ZB 1012-NA2: 800 mA). In this operating mode it is not possible to switch the measuring instruments off any more.



5.3.3.5 Network Distributor RS422

Using the 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 this 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.



Two additional LEDs are provided for the purposes of monitoring the status of the Ethernet connection.

Left LED :	10 MHz	Right LED :	100 MHz
OFF	No connection		
Orange	Half duplex	Green :	Full duplex
Continuously lit	Connection is established	Flashing	Data transmission

The steps involved in connecting ALMEMO® measuring instruments and in operating an ALMEMO® network are described in the ALMEMO® Manual.

Having an Ethernet network distributor integrated in measured data acquisition is the default setting in the Win-Control software; with additional software AMR2ips

SW5500-C22 it is possible to operate several Ethernet network distributors simultaneously by redirecting to COM interfaces.

Setting the IP address

The Ethernet network distributor 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 network distributor 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 in the Ethernet network distributor.
The necessary XPort-Installer software and the instructions for using it are provided on the AMR-CD in the directory \Accessories \ Ethernet \ XPort-Installer.

Technical data

Ethernet	Socket RJ45 (10/100 base-T) automatic switchover 10 / 100 MHz
RS-422	6-contact screw terminal connector 4-wire TX+, TX-, RX+, RX-, and supply +12 volts, -12 volts Line length between driver and distributor : maximum 1 kilometer Baud rate : maximum 115.2 kbaud
Power supply	9 to 12 volts DC, <60 mA (10 MHz), <90 mA (100 MHz)

Product overview	Order number
Ethernet network driver RJ45 auf RS-422, 4-wire	ZA 5045-AK
Mains adapter, 12 volts DC, 800 mA, with free ends, also for supplying other network distributors via the bus	ZB 1012-NA2
Patch cable RJ45, plug / plug, 2 meters	ZB 1904 PK2
Optic fiber network distributor RS-422 on ALMEMO® optic fiber and 2 x RS-422	ZA 5099-NVL
Additional software AMR2ips for implementing TCP-IP modules on COM ports	SW5500-C22

5.3.3.6 Connection of Devices with RS485 Interface

The RS485 interface is a bus-enabled RS422 interface, which allows for networking up to 32 devices in parallel without additional distributors. A RS485 interface is optionally available for the ALMEMO® 8990-1 / -2 transmitters. They can be directly connected to any RS422 output of the distributors, but no further RS422 distributors can then be connected to them.

5.3.3.7 Start-Up

After wiring the bus drivers and all network distributor and the measuring instruments are connected, a check should be performed to confirm that all measuring devices or modules provide a consistent sequence of different addresses. The measuring instruments can then be switched on and the supply voltage for the network distributor can be applied. The operation of the network distributors and branch boxes can be checked by the integrated LEDs. The green LED ´+U´ should be illuminated at all branch boxes/distributors, which indicates that the power supply is correct.

If no data is being transmitted, none of the remaining LEDs should be on (except DTR at ZA 5085-NV of the addressed device, see 5.3.3.4). If one or more of the remaining LEDs are on, then the wires are confused or shorted. The wiring in the branch with the faulty distributor must be re-checked.

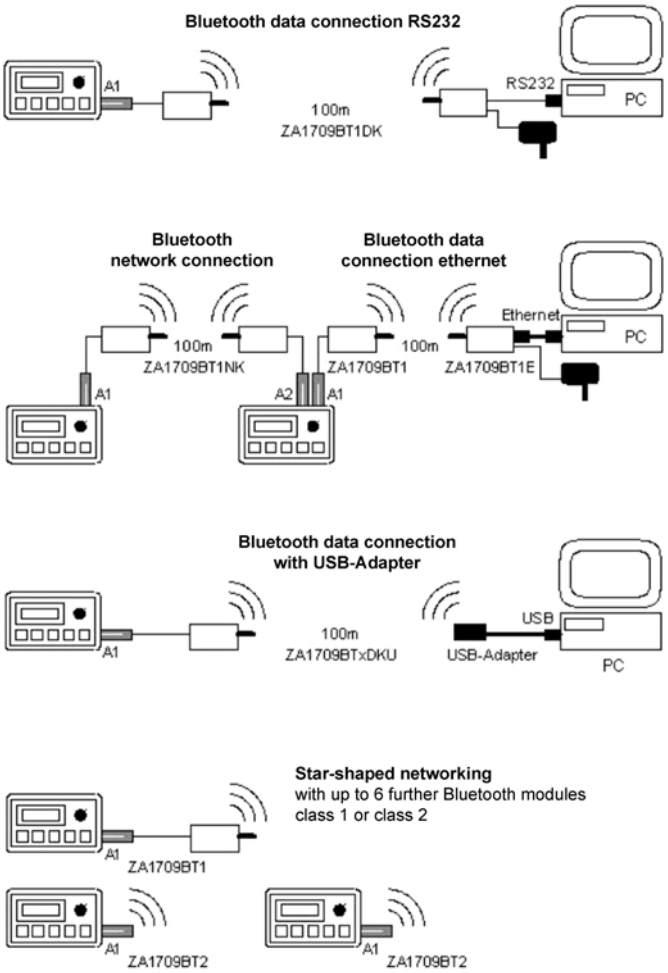
The actual network check is performed by the network software, AMR-Control, or by successively addressing the devices individually with a terminal. The software uses the same method and displays which devices and addresses were detected in the network.

In principle, the yellow LEDs ´RX´ must flash in all network branch boxes during data output from the controller. On response the red LED ´TX´ of the addressed device is illuminated first. Furthermore, the data will be indicated by the LED ´TXC´ of all network distributors that have been passed through by the data. The tracking of data is difficult when only single commands are entered via terminal as the LEDs flash for a very short moment. In case of problems a key (e.g. ´X´) can be pressed continuously. If certain devices do not respond at all, the power supply of the device and the address that has been set must be re-checked.

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 can be operated via 7 virtual COM ports. All these ports can be evaluated together using our Win-Control data acquisition software with the AMR2ips add-on.



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.) are provided with mains unit ZA2290-NA; this must be connected as power supply. If the power supply is functioning properly, the green LEDs on the end of the modules light up. If the wireless connection is functioning properly, the yellow LEDs light up for class 1 and the blue LEDs for class 2. 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. Whatever else happens the configuration is retained.
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 connection should as far as possible be kept in view).
The AHLBORN Bluetooth - USB adapter ZA1709BT1U can be used to generate 7 virtual COM ports for a total of 7 wireless modules ZA1709-BT1 or -BT2. All these ports can be evaluated together using our Win-Control data acquisition software with the AMR2ips add-on.
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).

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 kilobaud (irrespective of the ALMEMO baud rate)
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 connector 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 volts, 30 mA at 7 volts
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 (up to 200 meters free field using ZB1709BTx) (with antenna ZB1709BT1A in each case)
Bluetooth device names	"ALMEMO xxx"
Current consumption	approx. 25 mA at 9 to 12 volts, 40 mA at 7 volts
Operative range	-10 to +60 °C
Housing	(LxWxH) 108 x 60 x 29 mm, 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 port (standard installation) up to 6 other COM ports possible (extended installation) grouped together using the AMR2ips software SW5500C22

Variants	**Order number**
Wireless data connection: 1 Bluetooth module, class 1, RS232, and 1ALMEMO® Bluetooth module	ZA 1709-BT1DK
Wireless network connection: 2 ALMEMO® Bluetooth modules, class 1	ZA 1709-BT1NK
Wireless data connection: Bluetooth USB stick and ALMEMO® Bluetooth module, class 1	ZA1709-BT1DKU
Wireless data connection: Bluetooth USB stick and ALMEMO® Bluetooth module, class 2	ZA1709-BT2DKU
ALMEMO® Bluetooth connector, class 2	ZA 1709-BT2
ALMEMO® Bluetooth connector, class 2, for Bluetooth printer	ZA 1709-BT2D
Bluetooth module, class 1, with ALMEMO® adapter cable, cable length 1 meter	ZA 1709-BT1
Bluetooth module, class 1, with RS232 - DSUB9 adapter cable, cable length 1 meter	ZB 1709-BT1V
Bluetooth module, class 1, with RS422 adapter cable for ALMEMO® networks, cable length 1 meter	ZB 1709-BT1N
Bluetooth module, class 1, with Ethernet socket RJ45, mains unit 12 volts, 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 of the Interface Modules:

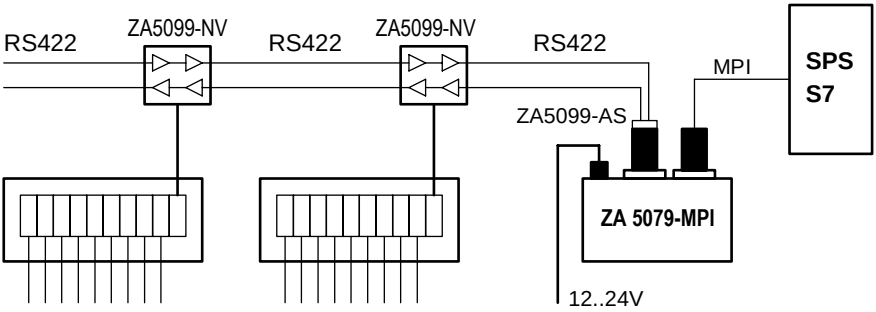
RS232 Interface:	ZA 1909-DK5	RS232 9-pin DSUB, TXD, RXD, DSR, DTR electr. isol. baud rate max. 115.2 kbd, current consumption: approx. 1 mA
RS232 Interface:	ZA 1909-DKL	RS232 9-pin DSUB, TXD, RXD, electr. isol. with fiber optics, baud rate max. 115.2 kbd, current consumption: approx. 4-8 mA
Ethernet interface :	ZA 1945-DK	Ethernet RJ45 (10 / 100 base-T) Baud rate 115.2 kilobaud, current consumption approx. 90 mA
Bluetooth wireless modules :	ZA 1709-BTx	see 5.3.4

Network Components:		baud rate with all, max. 57.6 kbd
Network Cable:	ZA 1999-NK5	ALMEMO® Current-Loop TX+,TX-, RX+,RX- electr. isol. Current consumption: approx. 1 mA, line length max. 50m
Network Cable, Fiber Optics:		ZA 1999-NKL,ALMEMO® TXD, RXD, electr. isol. with fiber optics Current consumption: approx. 4-8 mA, line length max. 50m
RS422 Network Driver:	ZA 5099-AS	1: RS232 9-pin DSUB socket, TXD, RXD, 2: RS422 4-wire TX+, TX-, RX+, RX- without electr. isol. Plastic housing: L 50 x W 33 x H 16 mm
RS422 Network Driver:	ZA 5099-NTL	as above 2x RS422 electr. isol. with fiber optics Plastic housing: L 71.5/90 x W 61.5/95 x H 30 mm
RS422 Network Distributor:	ZA 5099-NVB	1: RS422 4-wire TX+, TX-, RX+, RX- 2/3: RS422 4-wire TX+, TX-, RX+, RX- Device connection: ALMEMO® Current-Loop electr. isol. line length between 2 distributors: approx. 1km Current consumption: without DC/DC: approx. 10-18 mA with DC/DC: approx. 25-35 mA Plastic housing: L 71.5/90 x W 61.5/95 x H 30 mm
RS422 Network Distributor:	ZA 5099-NVL	as above, but device connection with fiber optics line length fiber optic cable: max. 50m
RS-422 Ethernet driver :	ZA 5045AK	1: Ethernet RJ45 (10 / 100 base-T) 2: RS-422, 4-wire, TX+, TX-, RX+, RX- Current consumption, maximum 90 mA
RS-422 data line :	LD0042	Data line, 4 x 2 wires, 0.28 mm2, solid, stranded in pairs to form twin wires, common sheath, type J-Y(St)Y to be laid on a permanent basis
Bluetooth wireless modules :	ZA 1709-BTx	see 5.3.4

5.3.6 Data transmission via field bus coupler (MPI)

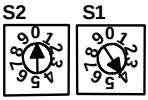
Via field bus coupler ZA 5079 all ALMEMO® devices and thus the comprehensive range of ALMEMO® sensor technology can be connected to a Siemens PLC S7. Measured data can thus be transferred via the MPI (optionally Profibus) in digital form and saved directly to a data component -without any loss in accuracy and without additional programming. It is also possible by means of a 2-byte life counter to continuously monitor that the system is properly functioning. No additional interface card and no special function component are needed for the PLC for this purpose. 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 as required on site.

Schematic diagram showing the network structure:



Putting into service:

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



last device address: **0** **4**

Using a Profibus cable connect the MPI interface on the PLC to the socket “PLC-MPI” (9-contact DSUB connector, RS-485, pin 3+ and 8- 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 ways as to a PC, using a standard data cable or ALMEMO network driver (ZA5099-AS or ZA5099-NTL). Connect the power supply via 24 V DC or 12 V mains supply unit. After switching on, the ALMEMO devices are continuously interrogated and the measured data is transferred to the data component on the PLC. In a second data

component a 2-byte life counter is incremented after each data transfer; this checks that the system is properly functioning.
The status LED on the front panel signals 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. channels / 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).
Procedure:

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; the data is saved after OK.

Functions	**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 meas. channels / device (e.g. 60)	atkan=060 CR	060 CR OK CR
Interrogating each setting e.g.	atkan=? CR	xxx CR OK CR

5. Finally return the code switch to the last device address.
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 / 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 / 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 exceeded
Bit B5-7	000-----	Measured value valid
	001-----	Sensor invalid (comma or dimension incorrect)
	010-----	Measuring range overshot
	011-----	Measuring range undershot
	1xx-----	Measured values invalid: Daten: 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	---	DEC	12500
DB4.DBB 30	---	HEX	B#16#40
DB4.DBW 31	---	DEC	0
// Device 2			
DB4.DBB 60	---	HEX	B#16#00
DB4.DBW 61	---	DEC	2691
DB4.DBB 66	---	HEX	B#16#00
DB4.DBW 67	---	DEC	2701
//Life counter			
DB5.DBW 0	---	HEX	B#16#78
DB5.DBW 1	---	DEZ	2

Technical data:

Housing :	aluminum housing, (HxWxD) 44 x 105.5 x 132 mm
Voltage supply :	9 to 32 V DC
Current consumption :	max. 150 mA
Power connection :	3-pin terminal connector (+, -, ground)
Connection 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
Connection PLC-MPI :	9-contact DSUB socket
Interface: MPI :	187 kbaud