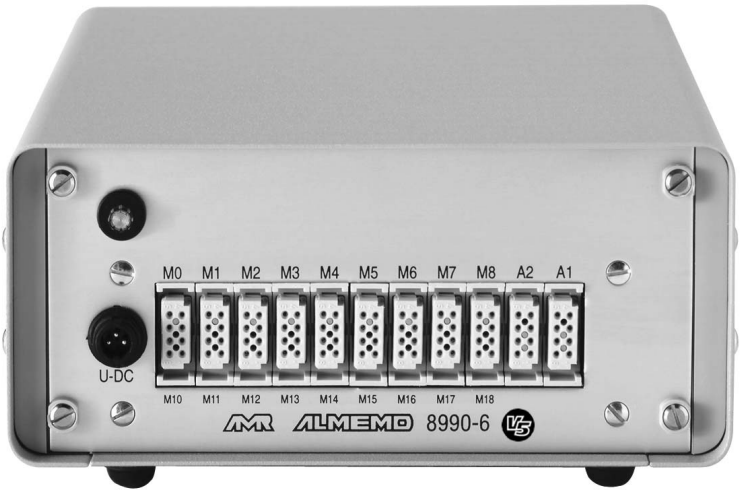

Operating Instructions

Data Acquisition Module
ALMEMO® 8990-6

V1.0
19.08.1999

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Operating Instructions

Data Acquisition Module

ALMEMO® 8990-6 V5

For Reference with the ALMEMO® Manual

Table of Contents

1. INTRODUCTION

The data acquisition module ALMEMO® 8990-6 *Version 5* is an instrument from the unique product range of measuring devices that are all equipped with the ALMEMO® connector system, which has been patented by Ahlborn GmbH. The intelligent ALMEMO® connector provides important advantages with regard to the connection of sensors and peripherals as all parameters are stored in an EEPROM within the connector.
All sensors and output modules can be connected to all ALMEMO® measuring devices in the same way. The operation and programming is identical with all units. Therefore, all of the ALMEMO® measuring system items listed below are described, in detail, in a separate ALMEMO® manual that is supplied with every device:

- Detailed description of the ALMEMO® system (manual section 1)
- Overview of the device functions and measuring ranges (manual section 2)
- All sensors with basic principles, operation, technical data (man. section 3)
- The options for connecting existing sensors (manual section 4)
- All analogue and digital output modules (manual section 5.1)
- The interface module RS232, fiber optics, Centronics (manual section 5.2)
- The entire ALMEMO® networking system (manual section 5.3)
- All functions and their control via the interface (manual section 6)
- A complete interface command list with all print outputs (manual section 7)

These operating instructions, therefore, only cover features and controls that are specific for a certain device. As a result, the sections dealing with the system control via keyboard will only often provide a note referring to a more detailed description within the manual (manual section x.x.x).

1.1 Function Range

The data acquisition module ALMEMO® 8990-6 has 9 electrically isolated measuring inputs with up to 36 measuring channels. Two output sockets allow for connecting any ALMEMO® output modules, for example, the analogue output, digital interface, trigger input or alarm contacts. Several devices can be networked by a simple connection between the devices. The operation can exclusively be performed via serial interface only.

SENSOR PROGRAMMING
The measuring channels are automatically programmed by the ALMEMO® connectors of the sensors. However, the user can easily complete or modify the programming via interface without affecting the measuring process.

Measuring Ranges
There are corresponding measuring ranges for sensors with a non-linear characteristic such as 10 thermocouple types, Ntc and Pt100 sensors, infrared sensors, and flow sensors (rotating vanes, thermoanemometers, pitot tubes). Humidity sensors are available with function channels that also calculate humidity data such as dew point, mixture ratio, vapour pressure and enthalpy. Even complex chemical sensors can be used. The acquisition of measured data from other sensors is easily possible by using voltage, current and resistance ranges with individual scaling in the connector. Existing sensors can be used without problems. Only the corresponding ALMEMO® connector has to be connected using its terminals. Furthermore, adapter connectors with an integrated microcontroller are available for frequencies and pulses. This way, nearly all sensors can be connected to any ALMEMO® measuring instrument and are interchangeable without requiring any settings.

Function Channels
Maximum, minimum, average values and differences of certain measuring junctions can be programmed as function channels and can be processed and printed like normal measuring junctions. Furthermore, function channels for special measuring tasks are provided to determine temperature coefficient $Q/\Delta t$ and wet bulb globe temperatures.

Dimension
The 2-digit dimension can be altered for each measuring channel so that the printout will always indicate the correct dimension, for example, when a transmitter is connected. The conversion from °C to °F is automatically performed according to the dimension.

Name of Measured Values
Sensors can be identified by a 10 digit alphanumeric designation. It is entered via the interface and appears on the printout or display if the evaluation is done via PC.

Correction of Measured Values
For correcting measured values a zero point and slope (gain) correction can be applied to the measured value of each measuring channel. This also allows for sensors to be interchanged that usually, at first, require an adjustment (expansion, force, pH).

Scaling
The base value and the factor allow for a further scaling of the corrected measured value of each measuring channel for zero point and slope (gain). The decimal point position can be set by the exponent.

Limit Values and Alarm
Two limit values (1 Max and 1 Min) can be set for each measuring channel. An alarm value printout can be performed if a limit value is exceeded and, by means of relay output modules, alarm contacts are provided that can be individually allocated to limit values. As a standard, the hysteresis is set to 10 digits, however, it can also be adjusted.

Sensor Locking
All sensor data stored in the EEPROM of the connector can be protected against undesired access by means of a graded locking function.

MEASUREMENT
A total of up to 36 measuring channels are available for 9 transducers, i.e. it is also possible to evaluate double sensors, individually scaled sensors, or sensors with function channels. The selected measuring point can be scanned with a conversion rate of 2.5 or 10 measurements/second and the measured value is provided as output to the analogue output, if available.

Measured Value
A continuous presentation of measuring data from the selected measuring point is provided and also includes automatic zero point correction and optional correction of the measured value or new scaling. Sensor breakage recognition, exception: current measurement.

Analogue Output and Scaling
By means of analogue start and analogue end the indicated measured value can be scaled so that the resulting measuring range covers the full analogue output range (2V, 10V or 20mA).

Measuring Functions
Special measuring functions are required for some sensors in order to achieve an optimal acquisition of measuring data. Cold junction compensation is performed at thermocouples. Temperature compensation is performed at dynamic pressure and pH and conductivity probes and atmospheric air pressure compensation is performed at humidity sensors, dynamic pressure sensors and O_2 sensors. With infrared sensors the parameters zero point and slope correction are used for background temperature and emissivity factor.

Max and Min Value
Each measurement involves an acquisition and storing of the maximum and minimum value. These values can be displayed, printed or cleared.

PROCESS FLOW PROGRAMMING

A cyclic measuring point scan with a time-based process flow control is required to register the measuring data of all connected sensors. If only one module is present, it can perform the measuring point scans with an own time control, print cycle, measuring cycle and, if fast speed is required, with the conversion rate as well. The measurement can be started and stopped by using the interface, an external trigger signal, real time clock or an exceeding of limit values. If several modules or devices are networked, the process control must be performed via an external CPU, which can either be in an ALMEMO® 5590-3 system or a PC with data acquisition software.

Time and Date

The real time clock with date function or the pure measuring time are used for an accurate recording of the measurement.

Print Cycle

The print cycle is programmable between 1s and 59h/59min/59s and provides a cyclic output of measured values to the interfaces or memories and also provides a cyclic averaging.

Print Cycle Factor

If necessary, the print cycle factor allows for limiting the data output of particular channels so that an excessive data flow can be limited, especially during data storage.

Measuring Cycle

The measuring cycle, also programmable between 1s and 59h/59min/59s, is for a cyclic scanning with a display of all measured values, limit value monitoring including alarm message and output of alarm values, averaging and, if necessary, a storage of measured values.

Average Value

The measured values that result from scanning the measuring junctions can be averaged as desired either over the total measuring time or over print cycle time. Function channels are provided for a cyclic output of average values.

Conversion Rate

With ALMEMO® V5 devices, all measuring points can be continuously scanned with the conversion rate (2.5 or 10 meas./s). It is possible to perform an output of all measured values via the interface.

Control Outputs

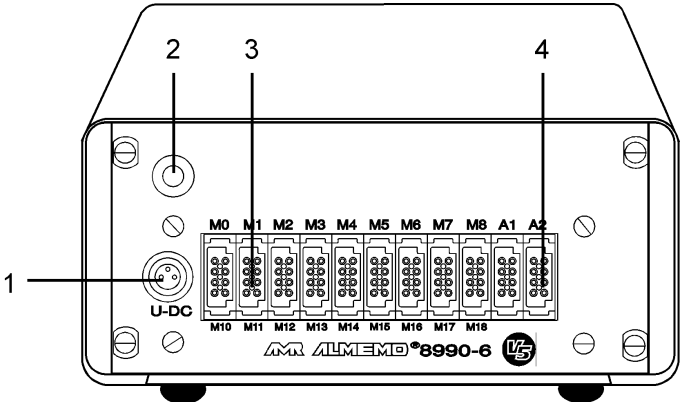
Up to 4 output relays and 1 analogue output can be triggered individually.

Output
All data logs, measured values and programmed parameters can be provided as output to any peripheral equipment via interface. Interface cables for RS232, RS422, RS485 or Centronics interfaces are available. The output of measuring data can be selected in list format, columns or spreadsheet format. Files in spreadsheet format can be processed by any spreadsheet software. The print header can be programmed specifically to the company or application.

Networking
All ALMEMO® devices can be addressed and can be easily networked by a simple connection with network cables or network junctions for longer distances.

SOFTWARE
The AMR-Control software, which allows for the entire programming of the sensors, the configuration of the measuring instrument and the read-out of the data memory is supplied with each ALMEMO® manual. The integrated terminal also allows for online measurements. The WINDOWS® software packages, Win-Control and DATA-Control, are available for data acquisition of networked devices, graphical presentation and complex data processing. The software LogCel is provided for an online import of data into MS-Excel®.

1.2 Operating Controls



(1) **SOCKET** U-DC	Power supply connector for: Mains adapter ZB 3090-NA 12V, 200mA Connector cable ZB 5090-EK 7-13V DC Connector cable ZB 3090-UK 10-30V DC electr. isolated including DC/DC converter		
(2) **ON SWITCH**	not pressed	OFF	lamp off
	pressed	ON	lamp on

(3) **MEASURING INPUTS**

M0 to M8	for all sensors with an ALMEMO® connector
M10 to M38	add. channels for double sensors, funct. chann.

(4) **OUTPUTS**

A1	V24 interface with cable ZA 1909-DK V24 interface with fiber optics ZA 1909-DKL RS 422 network branch box ZA 5099-NVB RS 485 network branch box ZA 5085-NV Centronics with cable ZA 1936-DK
A2	Networking with network cable ZA1999-NK Trigger input with cable ZA 1000-EK/ET 2 relay outputs with cable ZA 1000-EGK/EAK
A1 or A2	Analogue output with cable ZA 1601-RK
CODE SWITCHES	For setting the device address 00 to 99 2 code switches internally on-board

2. INITIAL OPERATION

1. Connect **transducers** to the sockets M0 to M8 (3), see 4.
2. **For power supply** connect the mains adapter to socket U-DC (1), see 3.
3. **For switching on** the pushbutton (2) must be pressed, see 3.4
4. **Output of measuring data** to printer or computer
   Connect peripheral device via interface cable to socket A1, see manual 5.2.
   Set 9600 bd, 8 data bits, 1 stop bit, no parity at peripheral device.
   Enter time and date, as required, see manual 6.2.8.
   Program print cycle, output chann. and output format,
   s.man. 6.2.2/6.5.2/6.5.5.
   For starting or stopping the automatic meas. point scan, see man. 6.6.
5. **Measuring Point Scan** via Computer
   Connect computer via interface cable to socket A1, see manual 5.2.1.
   Set 9600 bd, 8 data bits, 1 stop bit, no parity at peripheral device.
   Call and start the program for the measuring point scan.
6. **Monitoring of Limit Values**
   Enter limit values, see manual 6.3.9.
   Program measuring cycle, see manual 6.5.3.
   Connect alarm device with alarm module to socket A2, see man. 5.1.2/5.1.3
   For starting or stopping the automatic meas. point scan, see man. 6.6.

3. POWER SUPPLY

3.1 Mains Operation

The mains adapter ZB 3090-NA (12V DC, 200mA) is used for the power supply to the instrument. It is connected to the socket U-DC (1) and is locked by turning it to the right.

3.2 External Voltage Supply

It is also possible to connect another DC voltage 7...13V to the socket (1). The cable ZB 5090-EK, fitted with 2 banana plugs, is available for the connection. The electrically isolated supply cable ZB 3090-UK must be used if an electrical isolation between power supply and transducers is required or if a larger input voltage range 10...30V is required. It allows to operate the measuring instrument with 12V or 24V mains supply.

3.3 Switch On/Off

For **switching on** the instrument the push button (2) must be pressed. If the power supply unit is properly connected the green control lamp in the push button will be illuminated. All internal data, e.g. max, min and average values and the process control including cycles, time and date will be cleared when the device is being switched off. However, the device configuration and sensor programming within the ALMEMO® connectors will not be affected by the reset.

4. CONNECTION OF THE TRANSDUCERS

Any ALMEMO® sensors can be connected to the ALMEMO® input sockets M0 to M8 of the measuring instrument (3). For connecting existing sensors it is only necessary to connect a corresponding ALMEMO® connector.

4.1 Transducers

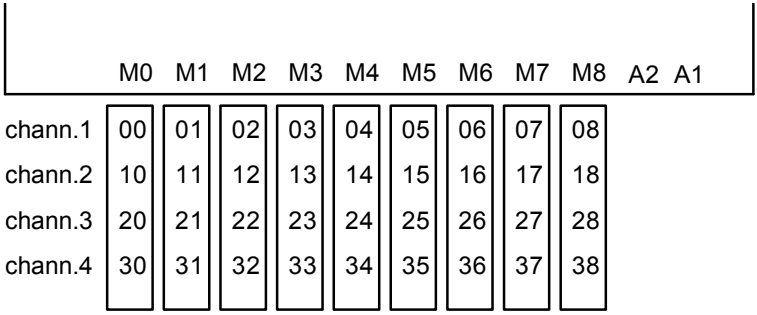
A detailed description of the comprehensive ALMEMO® sensor range and the connection of existing sensors to the ALMEMO® instruments are provided in the ALMEMO® manual (s. man. sect. 3 and 4). All standard sensors with ALMEMO® connector usually have the measuring range and dimension already programmed and can be immediately connected to any input socket. A mechanical coding ensures that sensor and output modules can only be connected to the correct sockets. Furthermore, each ALMEMO® connector has two locking levers that snap in when the insertion into the socket is established and that prevent a disconnection caused by pulling the cable. Both levers must be pressed on the sides for disconnecting the connector.

The **programming of the sensor connectors** can, with the data acquisition module ALMEMO® 8990-6, only be changed via the serial interface (see man. section 6). This can be carried out by using the PC and the configuration software AMR-Control or any terminal application (e.g. Windows Terminal) and using very easy commands. Due to the data storage within the connector, it is also possible to perform the programming with hand-held instruments of the series ALMEMO® 2290 via keyboard. The sensor connector must be connected to the selected channel. When programming, it must be considered that factory-programmed parameters are, by a locking mode, protected against unintentional modification and that the locking level must first be reduced before desired changes can be performed. The connectors ZA 9000-FS are not locked and are, therefore, most suitable for programming by the user.

4.2 Measuring Inputs and Additional Channels

The data acquisition module ALMEMO® 8990-6 has 9 input sockets (3) that the measuring channels M0 to M8 are initially allocated to. However, ALMEMO® sensors can, if required, provide up to 4 channels so that 36 channels are available with 9 input sockets. The additional channels can be especially used with humidity sensors with 4 measuring variables (temperature/humidity/dew point/mixture ratio) or used for function channels. If required, the sensor can also be programmed with several ranges or scalings or, depending on the pin assignment, 2 or 3 sensors can be combined in one connector (e.g. TE/Ntc, mV/V, mA/V etc.).

The additional measuring channels of a connector are increased in steps of 10 (e.g. the first sensor has the channels M0, M10, M20, M30, the second sensor has the channels M1, M11, M21, M31 etc.).



The 9 analogue inputs are electrically isolated by using photovoltaic relays and a potential difference of 50V, at maximum, is permissible between them. However, sensors combined within one connector and sensors with an own power supply are electrically connected to each other and must, therefore, be operated in isolation. The voltage applied to the measuring inputs must not exceed ±5V (between B,C,D and A or - respectively).

The cold junction compensation for thermocouple measurement is integrated in socket M3 of the device.

5. DATA ACQUISITION

The data acquisition module ALMEMO® 8990-6 provides the following options for the acquisition of measuring data:

1. Continuous measurement of a selectable measuring point, see manual 6.4. Output of measuring data to the analogue output see manual 5.1.1.
2. Single measuring point scan, see manual 6.5.1.1.
3. Cyclic measuring point scan, see manual 6.5.1.2.
4. Continuous measuring point scan, see manual 6.5.1.3.

As long as a cycle or continuous measuring point scan has not been programmed, only the measured value of the selected measuring point, at first M0, will be continuously acquired with the set conversion rate (s.m. 6.5.4). This is the best operating mode for a registration with the analogue output.

Measuring point scans can be used to acquire and document data from the selected measuring point and other measuring points. For a measuring point scan the measuring module must, via interface module, usually be connected to an independent data acquisition system ALMEMO® 5590-3 or to a computer (s.man.5.2/3), or be controlled by means of a trigger cable (s.man. 6.6.4).

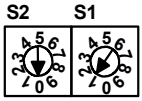
5.1 Automatic Measuring Point Scan of a Device

If only one data acquisition module is present, it can independently perform automatic measuring point scans with an own time control, print cycle and measuring cycle and provide data output via the interface. With terminal software on a PC (AMR-Control or Windows Terminal) it is possible to write the measured values in a file online and evaluate them with spreadsheet software (see man. 6.1).

The **programming of the process flow control** is also performed via serial interface and by using the configuration software AMR-Control or a terminal (PC) (see man. 6.5, 6.6).

5.2 Automatic Measuring Point Scan of Several Devices

As with all other ALMEMO® instruments, the data acquisition modules ALMEMO® 8990-6 can be networked. For communication with networked devices it is mandatory that each device has its own address as only one device is allowed to respond to a command. Therefore, before any network operation, it is necessary that all connected devices be set to different device numbers. For this purpose the ALMEMO® 8990-6 provides two code switches, which are located on-board within the device. For setting the address it is necessary to remove the 4 screws in the upper shell of the housing and to remove it.



Example: module address 01

module address **0** **1**

In the case of a measuring system having several networked modules all measuring points can only be scanned by a superordinated CPU that also performs the addressing of the individual modules. In the ALMEMO® range of measuring instruments the ALMEMO® system 5590-3 provides a CPU that can perform this task. The CPU uses an own real time clock to perform cyclic measuring point scans of all modules and can store the data in its own data memory, if required.

5.3 Data Acquisition via Software

Alternatively, networked modules or devices can be operated on a computer with data acquisition software. Two software packages are available for the cyclic addressing of the modules and scanning of the data:

1. Win-Control (Windows 3.xx, 95, 98 and NT)
2. Data-Control (Windows 3.xx, 95 and 98)

All software packages allow for an online representation of the data as line chart, bar chart or table and for storing the data. Furthermore, the data can be recalled, evaluated and printed, offline.

6. TROUBLESHOOTING

The data acquisition module ALMEMO® 8990-6 can be configured and programmed in many different ways. It allows for a connection of many different sensors, additional measuring instruments, alarm signalisers and peripheral devices. Therefore, it is possible that, under certain conditions, it does not perform as the user would expect. In most cases this will not be related to a defective device but to operating errors such as wrong settings or an inadmissible wiring. The following tests should be performed to correct or to correctly identify the error.

Error: False measured values

Remedy: Thoroughly check the programming of the channel (AMR-Control), query the entire programming by means of the command `P15` (see manual 6.2.3) and `f1 P15` (see manual 6.10.1)

Error: Varying meas. values, cyclic measuring point scan blocked

Remedy: Check cabling for inadmissible electrical connection.
Disconnect all suspicious sensors,
hold hand-held sensors in air or connect dummies and check (short circuit AB at thermocouples, 100Ω at Pt100 sensors)
then reconnect sensors successively and check
if an error occurs at a connection,
check the wiring, isolate the sensor if necessary
prevent influences from disturbances by shielding or twisting.

Error: Data transmission via interface does not function.

Remedy: Check power supply, switch off and on again,
check interface module, connections and settings:
Are both devices set to the same baud rate and transmission mode (see manual 6.10.12)?
Is the correct COM interface addressed at the computer?
Is the printer set to ONLINE mode?
Are the handshake lines DTR and DSR active?

A small interface tester with LEDs is very useful for checking the data flow and the handshake lines (during standby mode the data lines TXD and RXD are on a negative potential of approximately -9V and the diodes are illuminated green. The handshake lines DSR, DTR, RTS and CTS have a positive voltage of approximately +9V and the LEDs are illuminated red. During the data transmission the data lines must flash red).

Test the data transmission by using a terminal (AMR-Control, WIN-Control, DATA-Control, WINDOWS Terminal):
Check module address and code switch position on the PCB (s. 5.2),
Address the device with its device number Gxy (see manual 6.2.1),
query the programming by P15 (see manual 6.2.3),

Error: Data transmission within network does not function

Remedy: Check that all modules are set to different addresses,
address modules individually via terminal and command Gxy,
addressed module is OK when the feedback is at least y CR LF.
If data transmission is still not possible, disconnect external devices,
check devices separately at data cable of the computer (see above),
Check the wiring for a short circuit or twisting.
Are all network distributors supplied with power?
Network and check the devices successively again (see above).

If the device is, after the above inspections, still not performing as specified in the operating instructions, it must be sent to the factory in Holzkirchen, Germany, including a short report and possibly control printouts. The software AMR-Control allows to print the monitor pages including the programming and also to save the terminal operation and to print it out.

7. ELECTROMAGNETIC COMPATIBILITY

The data acquisition module ALMEMO® 8990-6 meets the electromagnetic compatibility (EMC) safety requirements specified in the relevant CE directive issued by the council for the alignment of legal regulations of the member states (89/336/EWG).

The following standards have been applied for the evaluation of the product:

EN 50081-1:1992	
EN 50082-1:1992	IEC 801-2 8kV, IEC 801-4 1kV
	IEC 801-3 3V/m: deviation<100uV

The following notes must be observed when operating the instruments:

1. If the standard sensor cables (1.5m) are extended it must be considered that the measuring lines are not guided together with power mains and that they are appropriately shielded to protect against any coupling of disturbance signals.
2. If the instrument is operated within strong electromagnetic fields an additional measuring error must be expected (<50mV at 3V/m and 1.5m thermocouple transducers). After the irradiation the device operates again within the specified technical data.

Technical Data (see also manual 2.2)

Measuring Inputs:	9 ALMEMO® sockets for ALMEMO® flat connector
Measuring Channels:	9 primary chann. electr. isol., max. 27 addit. chann. for double sensors and function channels
Sensor Voltage Supply:	with mains adapter 12V, 100mA at max.
Equipment:	
Time and Date:	software clock not buffered
Microprocessor:	HD 6303 Y
Outputs:	2 ALMEMO® sockets for all output modules
Voltage Supply:	7 to 13V DC not electrically isolated
Mains Adapter:	ZB 3090-NA 230V AC to 12V DC, 0.2A electr. isol.
Supply Cable, electr. isolated:	ZB 3090-UK 10 to 30V DC to 12V DC, 250mA
Current Consumption:	approx. 15 mA without I/O modules
Housing:	metal housing H63 x W144 x D219 mm (3HU, 6DU)
Operating Conditions:	
Operating Temperature:	-10 ... +60 °C
Storage Temperature:	-30 ... +60 °C
Humidity of Ambient Air:	10 ... 90 % rH non-condensing
Extent of the Delivery:	Measuring Instrument ALMEMO® 8990-6 Mains Adapter ZB 3090-NA 12V/200mA Operating Instructions ALMEMO®8990-6 ALMEMO® Manual incl. Software AMR-Control

Product Overview

	Order No.
Data Acquisition Module ALMEMO® 8990-6	
9 inputs, 36 channels at max, RS232 interface that can be cascaded, mains adapter 12V/200mA	MA 8990-6
DC Adapter Cable 10 to 30V DC, 12V/250mA, electrically isolated	ZB 3090-UK
ALMEMO® Recording Cable without el. isol. (-1.25 to 2.0 V, 0.1 mV/digit)	ZA 1601-RK
ALMEMO® Data Cable V24 Interface, electr. isolated	ZA 1909-DK
ALMEMO® Data Cable V24 Interface with fiber optics	ZA 1909-DKL
ALMEMO® Data Cable Centronics Interface, electr. isolated	ZA 1936-DK
ALMEMO® Network Cable Current Loop, electr. isolated	ZA 1999-NK
ALMEMO® I/O Cable for Triggering and Limit Value Alarm	ZA 1000-EGK
ALMEMO® Relay Trigger Analogue Adapter (4 relays, 2 trigger inputs)	ZA 8000-RTA
Option R1, R2, R3: electr. isol. analogue output 2V, 10V or 20mA	OA 8000-Rx