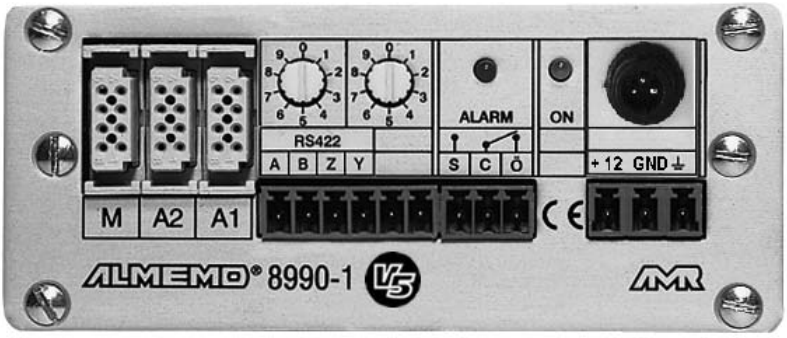

Operating Instructions

Intelligent Transmitter
ALMEMO® 8990-1

V1.0
03.09.1999

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Operating Instructions

Intelligent Transmitter
ALMEMO® 8990-1 V5

For Reference with the ALMEMO® Manual

Table of Contents

1. INTRODUCTION

The transmitter ALMEMO® 8990-1 *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. As a result, the programming that usually has to be performed for the connection is not required.
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 and electr. signals (man.sect. 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 transmitter ALMEMO® 8990-1 has a ALMEMO® measuring input with up to 4 measuring channels. One alarm contact is integrated as standard equipment; one electrically isolated analogue output is available as an option. Furthermore, the two output sockets allow for connecting any ALMEMO® output modules, for example, digital interface, analogue output, trigger input or external relays. Several devices can be networked by a simple connection between the devices via network cable or with an optional RS485 interface. The programming can be performed via the ALMEMO® connectors or serial interface.

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 by using the software AMR-Control, 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 two measuring channels can be programmed as function channels and can be processed and printed like normal measuring points.

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. If a limit value is exceeded a signal lamp will be on and the internal alarm contact responds. The alarm contact can also be individually allocated to the limit values. An alarm value printout can be performed as required. As a standard, the hysteresis is set to 10 digits. However, it can also be adjusted from 0 to 99.

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
Up to 4 measuring channels are available for each transducer, 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 the measured value from the selected measuring point is provided and also includes automatic zero point correction and optional correction of the measured value or new scaling. Most sensors will provide automatic sensor breakage recognition (exception: connectors with shunt, dividers or auxiliary electronics).

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.

ANALOGUE OUTPUT and Scaling
On request the transmitter can be equipped with an electrically isolated analogue output with a 15bit/32,500digit resolution (-1.2500...+2.0000V, -6.250...+10.000V or 0/4.000-20.000mA). By means of analogue start and analogue end the indicated measured value can be scaled so that the resulting measuring range covers the full standard range (0-2V, 0-10V or 0/4-20mA).

PROCESS FLOW PROGRAMMING

A cyclic measuring point scan with a time-based process flow control is required to register the measuring data of all measuring channels. If only one transmitter is available, the measuring point scans can be performed with an own time control. For this purpose the print cycle, measuring cycle and, if fast speed is required, the conversion rate is available. The measurement can be started and stopped by using the interface, an external trigger signal 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 time and date or the pure measuring time is 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.

Measuring Cycle

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

Average Value

The measured values that result from scanning the measuring points 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 output all measured values via the interface.

Control Outputs

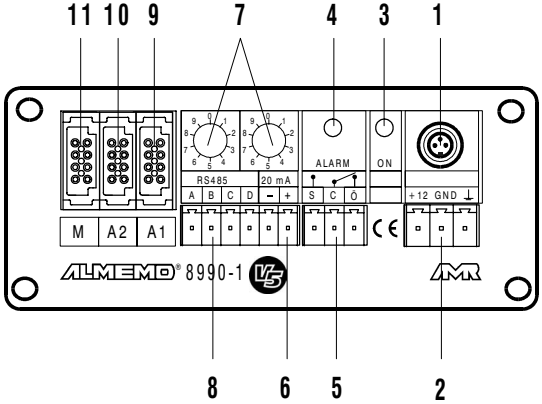
The internal alarm contact or up to 4 external output relays and an analogue output can be individually triggered via the interface.

Output
All data logs and all stored measured values and programmed parameters can be provided as output to any peripheral equipment via interface. Interface cables for RS232 or Centronics interfaces are available. An electrically isolated RS485 interface can be integrated as an option. The output of measuring data can be selected in list format, columns or spreadsheet format. Files in spreadsheet format can be directly 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.

1.2 Operating Controls



POWER SUPPLY (1)

12V miniature socket for 12V plug-in mains adapter ZB 3090-NA

(2) 12V + – option U: terminal connector 10 to 36 V DC electr. isolated
(3) ON control lamp for power supply is available
(4) **ALARM** alarm lamp for ´limit value exceeded´, sensor breakage
(5) S-C-Ö solid-state relay 50V, 100mA (make, common, break)

(6) **ANALOGUE OUTPUT**

2V – + option R1: -1.25 to 2 V electrically isolated
10V – + option R2: -6 or 0 to 10 V electrically isolated
20mA – + option R3: 0 or 4 to 20mA electrically isolated

DIGITAL OUTPUTS

(7) 00 to 99 2 code switches for setting the device address
(8) A B Y Z option I: RS485 interface electrically isolated
(9) A1 ALMEMO® socket for
V24 interface with cable ZA 1909-DK
V24 interface with fiber optics (ZA 1909-DKL)
(10) A2 ALMEMO® socket for
networking with network cable ZA1999-NK
analogue output not electr. isolated with cable ZA 1601-RK
trigger input (ZA 1000-EK/ET)
alarm outputs (ZA 1000-EGK)

MEASURING INPUT

(11) M ALMEMO® socket for all ALMEMO® sensors
M1 to M3 additional channels for double sensors, function channels

2. INITIAL OPERATION

1. Connect the **transducer** to the socket M (11), see 4.
2. **For power supply** connect the mains adapter to socket 12 V (1), see 3.
3. Connect the **recording device** to the analogue output (6).
4. Connect the **alarm device** to the terminal connector (5).
5. **Communication** with a computer
   Connect computer via interface cable to socket A1, see manual 5.2.
   Set interface to 9600 bd, 8 data bits, 1 stop bit, no parity.
   Program the measuring range, see manual 6.3.3.
   Enter the limit values, see manual 6.3.9.
   Set the analogue output range, see manual 6.10.7.
   Scan measured values, see manual 6.5.

3. POWER SUPPLY

3.1 Plug-In Power Supply Unit

As a standard, the power supply is provided via a 12V plug-in power supply unit (ZB 3090-NA). It has to be connected to the 3-pole miniature socket (1) and locked by one rotation. Alternatively, it is also possible to connect another 12V supply to the terminal screw clamp (2).

3.3 DC Voltage Supply (Option U)

The option U (OA 8990-U) is available if an electrically isolated DC voltage supply is required (10 to 36V). The voltage must be connected via a terminal screw clamp to socket (2) of the device. The measuring instrument can be operated with 12V and 24V voltage supply equipment.

3.4 Data Buffer

The programming parameters of the sensors are stored in an EEPROM within the connector. The calibration and the process flow control are stored in an EEPROM within the device and will be buffered when the system is switched off. However, the time and date will always be set to zero when the system is being switched on.

3.5 Sensor Voltage Supply

With all power supplies a sensor voltage supply of 12V DC (70mA at max.) is available at the terminals - and + of the ALMEMO® connector. Only with a few special connectors (e.g. ZA 9050-FSx) this voltage is regulated to 5V.

4. CONNECTION OF THE TRANSDUCERS

Any ALMEMO® sensors can be easily connected to the ALMEMO® input socket M (11). For connecting existing sensors with open ends it is only necessary to connect a corresponding ALMEMO® connector.

The connection of the sensors should be performed very thoroughly as it can have large effects on the electromagnetic compatibility. Although the measuring input is electrically isolated from the outputs, it is advisable to isolate the transducer when installing because the protective earth connection and the housing can often provide high voltage transients in industrial environments. When performing the cabling it must be considered that the leads are not wired near magnetic valves, contactors and motors and that they are not guided together with leads for such devices. The leads should be as short as possible and should have a cross section of 0.5 mm² at minimum (1.0 mm² at max.). Furthermore, electromagnetic influences can be reduced by twisting the lines or by guiding cables in steel tubes. Electrostatic disturbances can be avoided by using shielded cables. The metal braid shield is then connected to the ´-´ terminal of the connector.

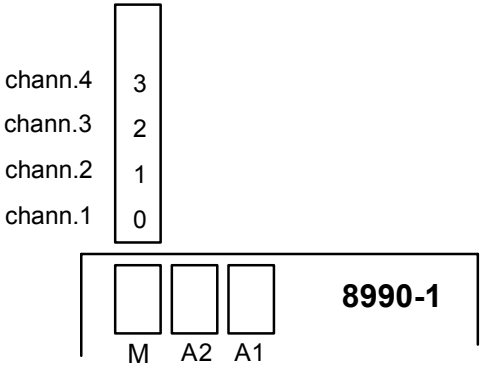
4.1 Transducers

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 transmitter ALMEMO® 8990-1, only be changed via the serial interface (see man. section 6). However, 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 simple commands. Due to the data storage within the connector, it is also possible to perform the programming with any of the ALMEMO® instruments, which are equipped with a 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 transmitter ALMEMO® 8990-1 has one input socket (11) with measuring channel M0. However, ALMEMO® sensors can, if required, provide up to 4 channels so that a total of 4 channels are available. 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 scaling 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.).



Measuring inputs, outputs and power supply are electrically isolated 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 the ALMEMO® socket M.

5. ANALOGUE OUTPUT

For analogue data recording of the selected measuring point three options are available, as follows:

1. Use of an integrated electrically isolated analogue output, which is available as option Rx (see manual 5.1.3).

Option	Output Signal	Slope (Gain)
OA 8990-R1	-1.2500 V ... +2.0000 V	0.1 mV/digit
OA 8990-R2	-6.0000 V ...+10.0000 V	0.5 mV/digit
OA 8990-R3	0.000 mA ...+20.000 mA	1 µA/digit

   The connection of a recording device is performed via a screw terminal connector to the terminals Out + and - (6).
2. Connection of an analogue output cable ZA 1601-RK (-1.25V...2.0V) without electrical isolation to the sockets A1 or A2 (see manual 5.1.1). If an analogue output cable is connected to A2 it is possible to output a second channel by using a second cable to A1 or using the internal analogue output (see manual 6.10.7).
3. Connection of a relay trigger analogue adapter ZA 8000-RTA with electrically isolated analogue output to the sockets A1 or A2 (s. man. 5.1.3).

5.1 Scaling and External Control

A partly range of the measuring signal (e.g. 10 to 50°C) can, by means of analogue start and analogue end, be spread to the full output range (0 to 10V, 0/4 to 20mA). However, the signal can also be controlled via interface (see manual 6.10.7).

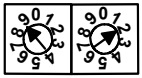
5.2 Response Time

The response time of the analogue signal can be increased accordingly by increasing the conversion rate from 2.5 to 10 measurements/second (see man. 6.5.4).

5.3 Selecting the Measuring Channel

ALMEMO® sensors provide up to 4 measuring channels. For example, channel 2 must be selected if the dew point measured with a humidity sensor should be output to the analogue output. For performing this task without an interface the code switch (7) can be used. The following switch settings are used to set and to continuously store the measuring channel on switch-on; i.e. afterwards, the code switches can be used again for address settings:

Switch position:		channel:
	90	0
	91	1
	92	2
	93	3



chann. select. . . **9** .
meas. chann. 2 . . . . . **2**.

6. DATA ACQUISITION

The transmitter ALMEMO® 8990-1 provides the following options for the acquisition of measuring data:

1. Continuous measurement of a selectable measuring point, see manual 6.4.
2. Output of measuring data to the analogue output see manual 5. and 5.1.1.
3. Single measuring point scan, see manual 6.5.1.1.
4. Cyclic measuring point scan, see manual 6.5.1.2.
5. Continuous measuring point scan, see manual 6.5.1.3.

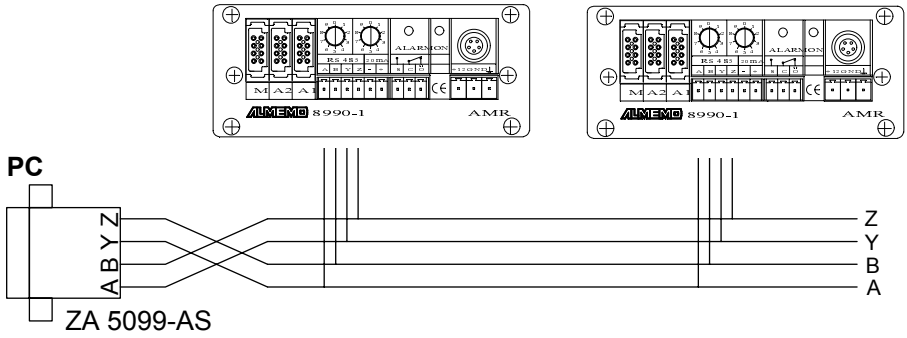
As long as a cycle or continuous measuring point scan has not been programmed, only the measured value of the selected measuring point, at first M0, will be continuously acquired with the set conversion rate (s. man. 6.5.4). This is the best operating mode for a registration with the analogue output.

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 transmitter 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 triggered by means of a trigger cable (s.man. 6.6.4).

6.1 Digital Interfaces

For communication with the transmitter the V24 interface cable ZA 1909-DK is available as an accessory (see man. 5.2.1). In case of environments with particularly high disturbance levels it is also available in fiber optics technology (ZA 1909-DKL).

If the option I, RS485 interface, has been integrated the RS422/485 bus driver ZA 5099-AS is required for the connection of the first device to a computer (see man. 5.3.3.1). For this purpose the transmitting and receiving lines must be crossed once. This allows for an easy networking of up to 32 further devices over large distances (1km at max.) by means of a 4-wire wiring (see manual 5.3.3). Each transmitter must be set to a different device address (see 6.3).



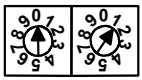
The **programming of the sensors** and the entire transmitter **configuration** is performed via the serial interface, preferably with using the configuration software AMR-Control or with a terminal (PC) (see man. section 6).

6.2 Cyclic Measuring Point Scan of One Device

If only one transmitter is present it can, via print cycle and measuring cycle, independently perform automatic measuring point scans with an own time control and it can output the data via interface (see man. 6.5). 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 starting and stopping can also be performed depending on the exceeding of limit values or via external triggering (see manual 6.6).

6.3 Cyclic Measuring Point Scan of Networked Devices

As with all other ALMEMO® instruments, the transmitters ALMEMO® 8990-1 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 measuring devices be set to different device numbers. For this purpose the ALMEMO® 8990-1 provides two code switches (7), which are located on the front panel.



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

Example: module address 01

For network operation it is necessary that only subsequent addresses between 01 and 89 are used so that the device 00 will not be addressed unjustifiably in case of a power failure. The addresses starting from 90 are reserved for the selection of the measuring channel (see 5.3). The required address must be provided (see man. 6.2.1) before any communication with a device can be started. The addressing of the individual devices can be manually performed via terminal, computer or an AMR data acquisition software.

However, for an automatic measuring point scan of several networked modules a superordinated CPU can be necessary 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.

6.4 Data Acquisition via Software

Alternatively, the transmitters can be operated, individually or networked with other modules, 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.

7. TROUBLESHOOTING

The transmitter ALMEMO® 8990-1 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: Incorrect 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. 6.3),
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 save the data logs during terminal operation and to print them out via the editor.

8. ELECTROMAGNETIC COMPATIBILITY

The transmitter ALMEMO® 8990-1 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<100µV

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 section 2.2)

Measuring Inputs:	1 ALMEMO® socket for ALMEMO® flat connectors
Measuring Channels:	1 primary channel, max. 3 additional channels 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 alarm contact (make, break 1Ω/50V/100mA)
Voltage Supply:	7 to 13V DC not electrically isolated
Mains Adapter:	ZB 3090-NA 230V AC to 12V DC, 0.2A electr. isolal.
Supply Cable, electr. isolated:	ZB 3090-UK 10...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)
Environmental Conditions:	
Operating Temperature:	-10 to +60 °C
Storage Temperature:	-30 to +60 °C
Humidity of Ambient Air:	10 to 90 % rH non-condensing
Extent of the Delivery:	Measuring Instrument ALMEMO® 8990-1 Mains Adapter ZB 3090-NA 12V/200mA Operating Instructions ALMEMO® 8990-1 ALMEMO® Manual incl. Software AMR-Control

Product Overview

		Order No.
Transmitter ALMEMO® 8990-1		
1 input, 4 channels at max, serial interface that can be cascaded, alarm contact, mains adapter 12V/200mA		MA 8990-1
Option U	Power Supply 10-36V DC, electrically isolated	OA 8990-U
Option I	RS 485 Interface, electrically isolated	OA 8990-I
Option H	Holder for Top Hat Rail Mounting	OA 8990-H
Option L	Holding Clips for Device Installation	OA 8990-L
Option R1	Scalable Analogue Output 0-2V, electrically isolated	OA 8990-R1
Option R2	Scalable Analogue Output 0-10V, electrically isolated	OA 8990-R2
Option R3	Scalable Analogue Output 0/4-20mA, electrically isolated	OA 8990-R3
ALMEMO® Network Driver V24/RS485		ZA 5099-AS
ALMEMO® Data Cable V24-Interface, electrically isolated		ZA 1909-DK
ALMEMO® Data Cable V24-Interface, with fiber optics		ZA 1909-DKL
ALMEMO® Data Cable Centronics-Interface, electrically isolated		ZA 1936-DK
ALMEMO® Network Cable Current-Loop, electrically isolated		ZA 1999-NK
ALMEMO® Trigger Cable with Optocoupler (4...30V)		ZA 1000-EK

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