



## Operating Instructions

# Data Logger ALMEMO® 3290-8 VS

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# Operating Instructions

## Data Logger

# ALMEMO<sup>®</sup> 3290-8

For reference with the ALMEMO<sup>®</sup> Manual

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# 1. INTRODUCTION

The new data logger ALMEMO® 3290-8 *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 (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 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 ALMEMO® 3290-8 data logger has nine electrically isolated measuring inputs with up to 36 measuring channels, a real time clock and a 500kB memory for approximately 100,000 measured values. 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. For easy operation it is equipped with a rotary switch, keyboard and an 8½ digit LCD display.

## 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 keyboard or via interface.

## 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, there are adapter connectors with an own microcontroller for digital signals and for measuring 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 display and 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). The zero point and the slope (gain) correction are virtually performed by the push of a button.

## 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. Furthermore, limit value exceeding can also be used to start or stop a measurement.

### **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 measuring channels can be successively selected forwards or backwards via keyboard. The selected measuring point can be scanned with a conversion rate of 2.5 or 10 measurements/second. The measured value is calculated and indicated on the display or, if available, provided on the analogue output.

### **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.

A sensor breakage condition is, with most sensors, automatically detected (exception: connectors with shunts, dividers or additional electronics).

### **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. The cold junction compensation is available for thermocouples, a temperature compensation for dynamic pressure and pH and conductivity probes, and an atmospheric air pressure compensation for humidity sensors, dynamic pressure sensors and O<sub>2</sub> sensors. With infrared sensors the parameters zero point and slope correction are used for background temperature and emissivity factor.

### **Maximum and Minimum 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. For this purpose, the real time clock, the print cycle and the measuring cycle are available and, if fast processing is required, the conversion rate is available. The measurement can be started and stopped by using the keyboard, the interface, an external trigger signal, the real time clock or an exceeding of limit values.

### Time and Date

The real time clock with date function or the pure measuring time are used for an accurate recording of any measurement. Start and end time/date can be programmed in order to start or stop a measurement.

### Print Cycle

The print cycle is also 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 resulting from scanning the measuring junctions can be averaged as desired either over the total measuring time or over the 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 store all measured values in the memory and/or to perform an output via the interface.

### Storage of Measured Values

During the measuring or print cycle, all measured values or alarm values can be manually or automatically stored in a buffered RAM. The memory capacity is, as standard, 500kB, which allows up to 100,000 measured values. The memory organisation can be configured as linear or ring memory. Alternatively are usable also memory connectors. The output can be optionally performed via interface, analogue output or display. It is possible to select a certain time interval, number or alarm value.

### **Numbering of Measurements**

Single scans or entire series of measurements can be identified and selectively read out from the memory.

### **Control Outputs**

The interface allows to individually trigger up to four output relays and one analogue output.

### **Keyboard Lock**

The keyboard operation can be locked with a password.

### **Output**

All measuring and programming data is accessible by means of the LCD display. RS232, RS422 and a Centronics interface are available by using different interface cables. All data logs, measured values and programmed parameters can be provided as output to any peripheral equipment. The output of measuring data can be selected in list format, columns or spreadsheet format. Files in spreadsheet format can be processed by each 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.

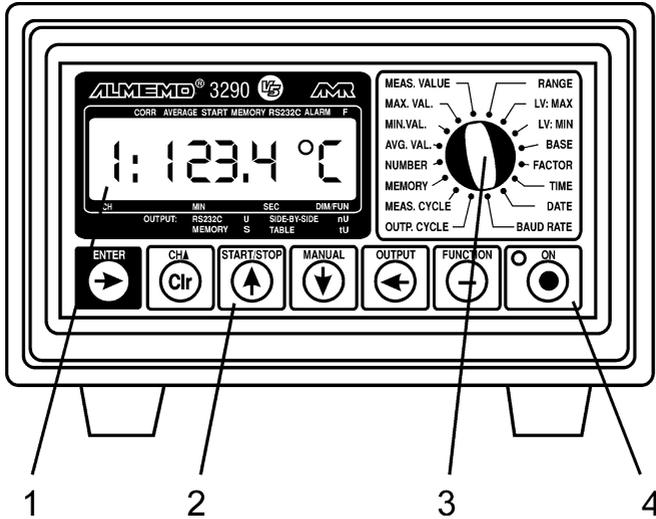
### **Software**

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®.

### **OPTION Rechargeable Battery**

The data logger becomes completely self-sufficient with the option 'rechargeable battery'. Due to the power saving sleep mode, the measuring instrument can, independent from mains supply, record measuring data for weeks. Afterwards the rechargeable battery can be fully recharged within 2 hours by means of a power supply.

# 1.2 Front Operating Controls

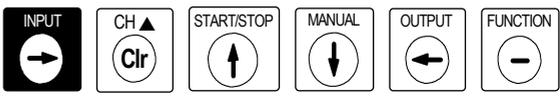


## (1) LCD DISPLAY

1 9:6 4.2 3 4 mv 6½ x 7segment, 2 x 16segment

Measured value:	meas. channel, meas. value, dimension
above -19999	decimal point switch over
Exceed. of range:	max/min value flashes
Exceed. of limit value:	arrow ALARM illuminated
Battery: < 7 V	symbol BAT illuminated
< 6 V	display "LobAt"
Times:	hr : min : sec
Date:	day . mth . year

## (2) FUNCTION KEYS



ENTER, □, ↑↓, ⇄, ⇐	for entering programming values
ENTER, Clr	clear data, set measured value to zero
ENTER, □	calibrate measured value
CH▲	select measuring point
START/STOP	cyclic measuring point scan
MANUAL	single measuring point scan
OUTPUT	data output to interface
FUNCTION	select additional functions



(3) **FUNCTION SELECTOR SWITCH**

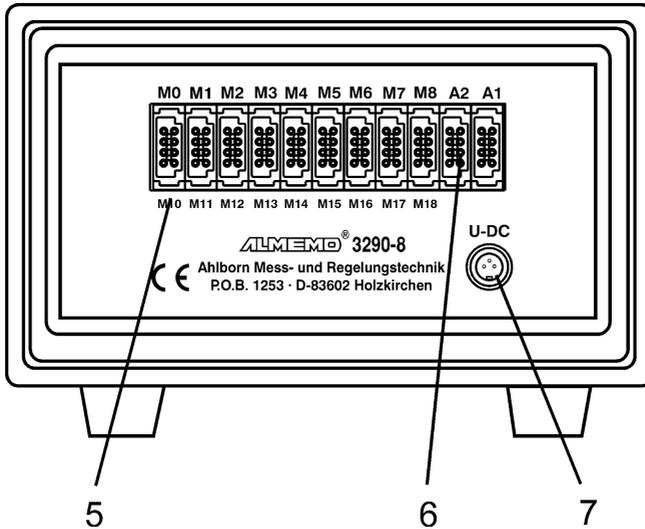


Function	Key	Additional functions	Abbrev.
MEAS. VALUE NUMBER	F	deactivate	A
	CH▲	increase	A
MAX VALUE	F	analogue output-end	AE
MIN VALUE	F	analogue output-start	AS
AVERAGE V	F	averaging mode	AM
	F,F	number of aver. values	C
RANGE, UNIT	F	locking mode	LM
	F,F	locking code	LC
LV MAX	F	action Hi start/stop	AH
LV MIN	F	action Lo start/stop	AL
BASE	F	zero point correction	ZC
	F	* ambient temperature	AT
FACTOR, ± Exponent	F	slopecorrection	SC
	F	* emissivity factor	EF
MEMORY	F	free memory	MF
MEAS CYCLE	CH▲	store on/off	S
	F	conversion rate	CR
PRINT CYCLE	CH▲	output channel	U
	F	device address	A
TIME	F	start time	ST
	F,F	end time	ET
DATE	F	start date	SD
	F,F	end date	ED
BAUD RATE	F	atmospheric pressure	mb
		* infrared sensors only	

(4) **ON/OFF SWITCH**

Lamp green	push button with lamp illuminated: power supply is connected
Option 'recharg. batt.'	illuminated: battery is being recharged flashing: battery is completely recharged
Lamp red	instrument is switched on

## 1.3 Rear Operating Controls



### (5) MEASURING INPUTS

M0 to M9 for all sensors with an ALMEMO® connector  
 M10 to M18/M38 additional channels for double sensors and function channels

### (6) OUTPUTS

A1 RS232 interface cable (ZA 1909-DK),  
 RS232 fiber optic cable (ZA 1909-DKL)  
 RS 422 network branch box (ZA 5099-NVB)  
 Centronics interface cable (ZA 1936-DK)  
 A1 or A2 analogue output with cable (ZA 1601-RK)  
 A2 networking with network cable (ZA1999-NK)  
 Data storage with memory connector (ZA 1904-SS)  
 trigger input with cable (ZA 1000-EK/ET),  
 2 relay outputs with cable (ZA 1000-EGK/EAK)

### (7) CONNECTOR SOCKET

U-DC mains adapter ZB 5090-NA2 12V, 800mA  
 External voltage connector cable ZB 5090-EK for 7-13V DC  
 supply cable electr. isolated ZB 3090-UK for  
 10-30V DC with DC/DC converter, 250 mA

## 2. INITIAL OPERATION

1. Connect **transducers** to the sockets M0 to M8 (5), see 4.
2. Ensure **power supply** by mains adapter connected to socket (7), see 3.1
3. **For switching on** set the push button (4) so the control lamp is on, s. 3.4.
4. **For displaying** the measured values,  
select function MEAS. VALUE by using the rotary switch (3),  
use key **CH▲** to select the measuring channel, read meas. value, see 7.1.
5. **For storing** the measured values:  
Use function MEMORY and keys **ENTER**, **Clr** to clear the memory, s. 7.4.2.  
Use MEAS. CYCLE and key **CH▲** to activate the memory, see 7.3.2.  
Single storing by using the key **MANUAL**, see 7.2.  
Enter measuring cycle for cyclic storing, see 7.3.2.  
Enter time and date, as required, see 7.3.4.  
Enter time and date of start or end of a measurement as required, see 7.3.5.  
Use key **START/STOP** to start and stop a cyclic storing, see 7.3.  
**Output of memory 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.  
Use key **CH▲** in function OUTP. CYCLE to set the output channel 'U' and,  
possibly, output format columns 'nU' or spreadsheet/table 'tU', see 7.3.1.  
Use key **OUTPUT** within function MEMORY to output meas.values, see 7.4.2.
6. **Cyclic output of measured values** 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 7.3.4.  
Program the print cycle within function OUTP. CYCLE,  
use key **CH▲** to set the output channel 'U' and, if required,  
the output format columns 'nU' or spreadsheet/table 'tU', see 7.3.1.  
Use key **START/STOP** to start and stop the cyclic meas. point scan, see 7.3.
7. **Monitoring of limit values**  
Enter limit values, see 6.4.  
Program measuring cycle, see 7.3.2.  
Connect alarm device with alarm module to socket A2, see man. 5.1.2/5.1.3.  
For an alarm print use key **CH▲** within function OUTP. CYCLE to activate  
the output channel 'U', see 7.3.1.  
Use key **START/STOP** to start and stop the cyclic meas. point scan, see 7.3.
8. **Evaluation of the measurement**  
Display max and min values within function MAX.VAL. or MIN.VAL.,  
see 7.1.2.

## 3. POWER SUPPLY

### 3.1 Mains Operation

In general, the mains adapter ZB 5090-NA2 (12V DC, 800mA) is used for the power supply to the instrument. It is connected to the socket U-DC (7) and is locked by turning it to the right.

### 3.2 Operation with Rechargeable Battery (Option A)

With the option A, a 7.2V NiCd rechargeable battery with 1.5 Ah will be installed, which allows, at a current consumption of approximately 15mA, an uninterrupted operating time of 100 hours at minimum. The operating time will be shorter when sensors are connected that require additional current (e.g. humidity sensors FH A646 2mA or rotating vanes approximately 3mA) or the serial interface (4mA). However, the sleep mode is meant for a long term operation of the data logger. It allows for a measurement of approximately 30000 measuring cycles (see 7.6). An exact determination of the voltage of the rechargeable battery and an estimation of the remaining operating time is available with the measuring channel 'Batt'.

The supplied mains adapter ZB 5090-NA2 allows to recharge a discharged battery within 2 hours. During the recharge process the green lamp of the on/off switch (4) is continuously illuminated for charge control. (Attention! Due to the heat build-up in the unit during this process, thermocouple measurements with an internal VC may be erroneous!). If the green lamp flashes, the battery is completely recharged and the charge circuit is switched to trickle charging. As a result, the power supply can, during buffer operation, remain connected to the measuring instrument. If the instrument is operated with the rechargeable battery only, the green lamp in the on/off switch (4) is not illuminated at all.

### 3.3 External Voltage Supply

It is also possible to connect another DC voltage 7...13V to the socket U-DC (7). The cable ZB 5090-EK, fitted with 2 banana plugs, is available for the connection. However, 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.

### 3.4 Switch On/Off, Reinitialisation

If the power supply is properly connected the green lamp in the push button (4) will be illuminated. If a rechargeable battery is installed the lamp is used for charge control (see 3.2).

For **switching on** the instrument, the push button must be pressed. The red control lamp aside will then be illuminated.

The device can be **switched off** by operating the push button once again. The red control lamp will no longer be illuminated. However, the real time clock continues operating and, due to the buffering rechargeable battery, all stored values remain available (see 3.5).

If the device shows an irregular behaviour due to interference influences (e.g. electrostatic charging or discharged buffering battery) or if incorrect programming must be avoided, the device can be completely reinitialised.

The **reset** can be achieved if the key **Clr** is pressed during switch-on. All internal data such as max, min and average values, and the data memory will be cleared. Furthermore, cycles, time, date and device address are set to zero and the conversion rate and atmospheric pressure will be set to the standard values. However, the device configuration and the sensor programming within the ALMEMO® connectors will not be affected by the reset.

### 3.5 Data Buffer

For an uninterrupted power supply of the real time clock and the memory a NiCd rechargeable battery (2.4V) for buffering is installed, which ensures that time and date data and all stored values are maintained for several months if the mains supply is not available. However, to prevent the rechargeable battery from completely discharging and to avoid the loss of data, the instrument be operated with mains supply for a few hours should at least once per month.

## 4. CONNECTION OF THE TRANSDUCERS

Any ALMEMO® sensors can be connected to the ALMEMO® input sockets M0 to M8 of the measuring instrument (5). 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 (see manual section 3) and the connection of existing sensors (see manual section 4) to the ALMEMO® instruments are provided in the ALMEMO® manual. 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.

## 4.2 Measuring Inputs and Additional Channels

The measuring instrument ALMEMO® 3290-8 has 9 input sockets (5) 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. rH/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.).

chann. 4	38	37	36	35	34	33	32	31	30
chann. 3	28	27	26	25	24	23	22	21	20
chann. 2	18	17	16	15	14	13	12	11	10
chann. 1	08	07	06	05	04	03	02	01	00

A1 A2 M8 M7 M6 M5 M4 M3 M2 M1 M0



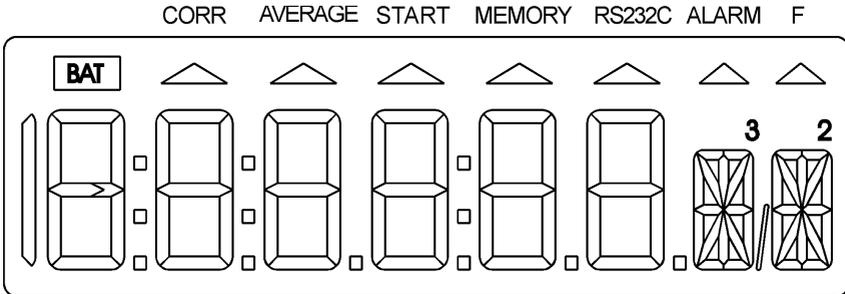
The 9 analogue inputs are electrically isolated by using photovoltaic relays and a potential difference of 50V DC or 60V AC, at maximum, is permissible between them. However, sensors combined within one connector and sensors with an own power supply are electrically connected to each other and must, therefore, be operated in isolation. The voltage applied to the measuring inputs must not exceed  $\pm 5V$  (between B,C,D and A or - respectively).

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

## 5. DISPLAY AND KEYBOARD

### 5.1 Display and Function Selection

The display of the measuring device ALMEMO® 3290-8 consists of an LCD module with six and a half 7-segment digits, two 16-segment digits, and a battery symbol and arrows for indicating the operating status.



The basic functions are set by the function selector switch (3). If required, the additional functions can be selected by the key **FUNCTION**. The presentation of the functions on the display is as follows:

<b>Meas. Val.:</b>	chann.	-	meas. value	dimension	1:2.1 2 3 4 v
<b>Range:</b>	chann.		short name	dimension	1: N i C r °C
<b>Parameter:</b>	chann.	-	value	dimension	
	chann.	-	factor	exponent	
<b>Number:</b>			value	-/active	N 1 2 - 0 1 A
<b>Cycles:</b>	hours	minutes	seconds	output chann.	1 2:3 4:5 6 TM
	Times:	hours	minutes	seconds	function
<b>Start:</b>			not activated	function	- - - - - ST
<b>End:</b>	hours	minutes	seconds	function	1 8:3 0:0 0 ET
<b>Date:</b>	day	month	year	DA	0 1.0 1.9 6 DA
<b>Baud Rate:</b>			baud	BR	I 9 6 0 0 BR

Two digits are required to display the channel with the **additional channels M20 to M38**. The measured value is shifted by one digit to the right if it has more than 4 digits. Another digit is lost if the measured value is negative.

*Example:* channel 20, measured value 2.1234 V: 2 0:2.1 2 3 v

### Special Operating Conditions

Segment test of the display	automatically after switch-on.
Supply voltage: lower than 7V:	<b>BAT</b> symbol illuminated
lower than 6V:	1: L o b A t
Sensors that are not connected, deactivated measuring points, cleared programming values.	1: - - - -
Sensor correction or scaling	arrow <b>CORR</b> illuminated.
Measuring point scan in progress	arrow <b>START</b> illuminated.
Measuring point scan with storing	arrow <b>MEMORY</b> illuminated.
Measuring point scan with output	arrow <b>RS232C</b> illuminated.
Additional function selected	arrow <b>F</b> illuminated.

### Alarm Conditions

are displayed as follows and cause an alarm (see manual 6.3.9):

Sensor breakage:	1: N i C r °C	abbr. flashes
Overshooting of measuring range:		maximum value flashes
Undershooting of measuring range:		minimum value flashes
Exceeding of limit value:		arrow <b>ALARM</b> illuminated
Undershoot. of meas. range CJ compens.	1: C J	(cold junction) flashes
Measuring without ext. CJC or CJC break.:		
Exceeding of range of values (>65000):	1: 6 5 0 0 0	flashes

## 5.2 Keyboard

The keyboard (5) has the following functions that are displayed above the keys:

Function	Normal	Enter
Programming of Parameters	ENTER	⇒
Selecting Measuring Points	<b>CH▲</b>	Clr
Start and Stop of Meas. Point Scans	<b>START/STOP</b>	↑
Single Measuring Point Scan	<b>MANUAL</b>	↓
Data Output	<b>OUTPUT</b>	⇐
Selecting Additional Functions	<b>FUNCTION</b>	□

After operating the key **ENTER** a digit or abbreviation is flashes in the display, i.e. the instrument is in edit mode and the white key designations are valid. The keys □, ↑, ↓ are then available for altering the input figure, ⇒, ⇐ operate as cursor keys and the key **Clr** is used for clearing parameter data. The input is complete when the last digit has been confirmed with operating the key ⇒.

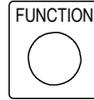
### 5.3 Data Entry

The programming of numeric parameters is performed as follows:

The desired function can be selected using the rotary switch (3)



Additional functions, if required, are selected with key **FUNCTION**.



**The programming is started** by the key **ENTER**,  
The first digit flashes  
and can be altered.



The digit can be **increased** using the key  $\uparrow$  .  
After exceeding the maximum value the cycle restarts from zero.  
The digit can be **decreased** using the key  $\downarrow$  .  
After falling below zero the maximum value follows (9 or 5).



**The sign can be changed** using the key  $\square$  .



**A switch to the next digit is performed** using the key  $\Rightarrow$  .



**To switch back to the previous digit** press the key  $\Leftarrow$  .



**The programming process is complete**  
after setting the last digit and again operating the key  $\Rightarrow$  .

ENTER



**Programming and measured values can be cleared** using

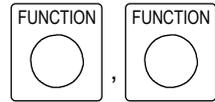


**The programming process** can be cancelled by operating the rotary switch.

### 5.4 Keyboard Lock

To protect all settings during a measurement against unauthorised alteration the keyboard can, in addition to the sensor locking (see. 6.7), be locked by using a locking code (password).

Selecting the Function Locking Code:



If the **locking is switched off**, the display indicates:

O P E N LC

To **lock the access** a four digit number is entered (see 5.3) and the display indicates:

C L O S E d LC

The functions **ENTER**, **START/STOP** and **OUTPUT** are no longer available in this operating stage. However, a reading of all parameters on all channels is still possible. The locking can only be released by re-entering the same locking code. The locking is also cleared when a reinitialisation is performed (see 3.4).

## 6. SENSOR PROGRAMMING

As all ALMEMO<sup>®</sup> instruments contain the whole sensor programming stored in the ALMEMO<sup>®</sup> connector plug, the user does not usually need to perform any programming. Only if, for example, sensor errors must be corrected or existing sensors must be scaled or limit values need to be specified the comprehensive programming options have to be used. It must be considered that standard sensors are, by a locking mode, protected against unintentional modification and that the locking level must first be reduced before desired changes can be performed (see 6.7). All parameters can easily be entered or changed via keyboard when the corresponding sensor connector is connected.

### 6.1 Selecting the Input Channel

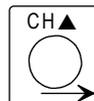
To query or to program the parameters of a sensor the corresponding input channel must be selected within the desired function, i.e. not with the rotary switch moved to MEAS. VALUE, only the input channel will be changed but not the selected measuring channel, i.e. the measurement is not being interrupted.

Increase the input channel by:



(programmed channels only)

Decrease the input channel by:



press and hold (approx. 1s)

## 6.2 Selecting the Measuring Range

If users want to program the connectors on their own or frequently change the measuring range, it is necessary that the locking is cleared (see 6.7) and special connectors may be required for some transducers (e.g. thermo, shunt, divider etc., see table).

The selection of the measuring range is performed within the function RANGE. For activating a channel that has not yet been programmed the locking of the 1st channel must be cleared for the corresponding sensor. After selecting the input channel and pressing the key ENTER the abbreviation for the measuring range flashes in the display. The keys  $\uparrow$  and  $\downarrow$  allow to select all available ranges in the sequence given below. If the key ENTER is pressed and held it is possible to jump from group to group (group ranges bolded in table). If the desired range is displayed the programming can be completed by pressing ENTER once again and the data is transmitted to the connector. All programming values of the input channel are then cleared.

**Function Selection:**  RANGE 1: NiCr °C

*Example :* channel M1, range NiCr, dimension °C

**Change Meas. Range:**  ,  ... or  ... ,  ENTER

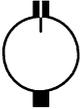
Transducer	Connector / Cable / Sensor	Meas. Range	Dim.	Display
<b>Pt100-1</b>	ZA 9000-FS	-200.0... +850.0	°C	P104
Pt100-2	ZA 9000-FS	-200.00...+200.00	°C	P204
Ni100	ZA 9000-FS	-60.0... +240.0	°C	N104
<b>NiCr-Ni (K)</b>	ZA 9020-FS	-200.0...+1370.0	°C	NiCr
NiCroSil-NiSil (N)	ZA 9020-FS	-200.0...+1300.0	°C	NiSi
Fe-CuNi (L)	ZA 9000-FS	-200.0... +900.0	°C	FECo
Fe-CuNi (J)	ZA 9000-FS	-200.0...+1000.0	°C	IrCo
Cu-CuNi (U)	ZA 9000-FS	-200.0... +600.0	°C	CUCo
Cu-CuNi (T)	ZA 9000-FS	-200.0... +400.0	°C	CoCo
PtRh10-Pt (S)	ZA 9000-FS	0.0...+1760.0	°C	Pt10
PtRh13-Pt (R)	ZA 9000-FS	0.0...+1760.0	°C	Pt13
PtRh30-PtRh6 (B)	ZA 9000-FS	+400.0...+1800.0	°C	EL18
Au-FeCr	ZA 9000-FS	-270.0... +60.0	°C	AUFE
<b>Ntc type N</b>	ZA 9000-FS	-30.00...+125.00	°C	Ntc
<b>Millivolt 1</b>	<b>ZA 9000-FS</b>	<b>-26.000...+26.000</b>	<b>mV</b>	<b>U 26</b>
Millivolt	ZA 9000-FS	-10.000...+55.000	mV	U 55

Transducer	Conn. / Cable	Meas. Range	Dim.	Display
Millivolt 2	ZA 9000-FS	-260.00...+260.00	mV	U260
Volt	ZA 9000-FS	-2.6000...+2.6000	V	U2.60
Differential-Millivolt 1	ZA 9050-FS	-26.000...+26.000	mV	d 26
Differential-Millivolt	ZA 9050-FS	-10.000...+55.000	mV	d 55
Differential-Millivolt 2	ZA 9050-FS	-260.00...+260.00	mV	d260
Differential-Volt	ZA 9050-FS	-2.6000...+2.6000	V	d2.60
Sensor Voltage	ZA 9000-FS	0.00...20.00	V	UbAt
<b>Milliampere</b>	ZA 9601-FS	-32.000...+32.000	mA	<b>I032</b>
Percent (4-20mA)	ZA 9000-FS	0.00... 100.00	%	P420
Ohm	ZA 9000-FS	0.00... 400.00	Ω	Ohn
Frequency	ZA 9909-AK	0... 25000	Hz	FrEq
Pulses	ZA 9909-AK	0... 65000		PULS
Digital input	ZA 9000-EK2	0.0... 100.0	%	Inp
Digital interface	ZA 9919-AKxx	-65000... +65000		diGi
<b>Infrared 1</b>	ZA 9000-FS	0.0... +200.0	°C	<b>Ir 1</b>
Infrared 2	ZA 9000-FS	0.0... +800.0	°C	Ir 2
Infrared 3	ZA 9000-FS	-30.0... +70.0	°C	Ir 3
Infrared 4	ZA 9000-FS	-30.0... +100.0	°C	Ir 4
Infrared 6	ZA 9000-FS	0.0... +500.0	°C	Ir 6
<b>Snap-on head Normal 20</b>	FV A915-S120	0.30... 20.00	m/s	<b>S120</b>
Snap-on head Normal 40	FV A915-S140	0.40... 40.00	m/s	S140
Snap-on head Micro 20	FV A915-S220	0.50... 20.00	m/s	S220
Snap-on head Micro 40	FV A915-S240	0.60... 40.00	m/s	S240
Macro	FV A915-MA1	0.10... 20.00	m/s	L420
Water-Micro	FV A915-WM1	0.00... 5.00	m/s	L605
Dyn.press. 40m/s w. TC a. PC	FD A612-M1	0.50... 40.00	m/s	L840
Dyn.press. 90m/s w. TC a. PC	FD A612-M6	1.00... 90.00	m/s	L890
<b>Relative air humidity cap.</b>	FH A646	0.0... 100.0	%H	<b>°orH</b>
Relat. air humidity cap. w. TC	FH A646-R	0.0... 100.0	%H	H rH
Mixture ratio w. PC	FH A646	0.0 ... 500.0	g/kg	H AH
Dew point temperature	FH A646	-25.0... 100.0	°C	H dt
Partial vapour pressure	FH A646	0.0 ...1050.0	mbar	H UP
Enthalpy w. PC	FH A646	0.0 ... 400.0	kJ/kg	H En
Humid temperature	FN A846	-30.00 ...+125.00	°C	P Ht
Rel. humidity psychr. w. PC	FN A846	0.0 ... 100.0	%H	P RH
Mixture ratio w. PC	FN A846	0.0 ... 500.0	g/kg	P AH
Dew point temperature w. PC	FN A846	-25.0 ... +100.0	°C	P dt
Partial vapour pressure w. PC	FN A846	0.0 ...1050.0	mbar	P UP
Enthalpy w. PC	FN A846	0.0 ... 400.0	kJ/kg	P En
<b>Conductivity probe w. TC</b>	FY A641-LF	0.0 ... 20.000	mS	<b>LF</b>
CO <sub>2</sub> sensor	FY A600-CO2	0.0 ... 2.500	%	CO2
O <sub>2</sub> saturation w. TC a. PC	FY A640-O2	0 ... 260	%	O2-S
O <sub>2</sub> concentration w. TC	FY A640-O2	0 ... 40.0	mg/l	cO2-C

Transducer Function Channels	Conn. / Cable	Meas. Range	Dim.	Display
<b>Difference</b>	any			diFF
Maximum value	any			Hi
Minimum value	any			Lo
Average value over time	any			A[t]
Averag. val. over junctions	any			A[n]
Sum over junctions	any			S[n]
Total number of pulses	ZA 9909-AK2	0 ... 65000		S[t]
Pulses/print cycle	ZA 9909-AK2	0 ... 65000		S[P]
Alarm value	any			Alrm
Thermal coefficient	ZA 9000-FS		W/m <sup>2</sup> K	q:dt
Wet bulb globe temp.	ZA 9000-FS		°C	UbGt

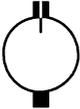
The **use of the function channels** for the output of measuring and calculated variables with the corresponding reference channels is described in the manual section 6.3.4.

### Switch-off, i.e. deactivation of a programmed measuring channel

**Function:**  RANGE **Keys:** , 

After switch-off the measured value is no longer indicated, queried, or provided as output. However, the programming is still maintained.

### Re-activation of the measuring channel:

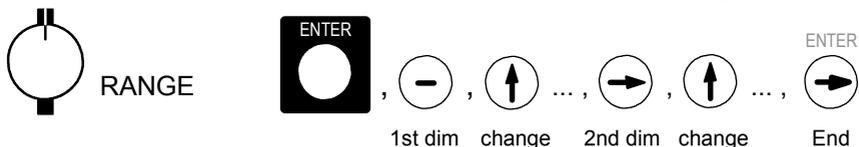
**Function:**  RANGE **Keys:** , 

If the channel was previously activated, the channel will be re-activated with all programming values. However, if the channel is already active, all programming values will be cleared by operating the above key combination (corresponds to selecting a measuring range).

### 6.3 Changing the Dimension

Each measuring channel allows to replace the standard dimension of the measuring range by any other dimension that has two digits (see manual 6.3.5). In addition to all capital and normal letters, the characters  $\square$ ,  $\square$ ,  $\Omega$ ,  $\%$ ,  $[$ ,  $]$ ,  $*$ ,  $-$ ,  $=$ ,  $\sim$  and spaces ( $\_$ ) are available. The dimension is indicated by two 16-segment characters that are indicated following the measuring and programming values.

The **change of the dimension** can be performed within the function RANGE by pressing the key ENTER and  $\square$ . The first character of the dimension will flash in the display. It can then be changed by using the keys  $\uparrow$  and  $\downarrow$ . When the first character is selected the key ENTER should be pressed once again and the same procedure will be performed for the second character. When the desired dimension has been set the programming can be completed by the key ENTER.



When the dimension °F is entered a temperature value in degrees Celsius will be converted into degrees Fahrenheit.

The cold junction compensation can be switched off by using the character  $\square$ .

The dimension ms is indicated on the display as m/s, and mh as m<sup>3</sup>/h.

### 6.4 Limit Values

Two limit values (MAX and MIN) can be programmed for each measuring channel. The exceeding of the limit values is handled as a fault, similar to the exceeding of the measuring range limits and sensor breakage. The arrow ALARM will appear in the display and the alarm relays will respond and the alarm values will be provided as output during the measuring cycle (see manual 6.3.9). An exceeding can also be used to start or stop a measuring point scan (see 7.3.6).

#### Function:

Limit value Max

Limit value Min



LV: MAX

LV: MIN

Programming

Input according to 5.3

1: 1 2 3.0 °C

Switch-off



1: - - - - °C

## 6.5 Correction Values

The correction values ZERO POINT and SLOPE allow for correcting sensors with regard to zero point and slope (see manual 6.3.10).

**Corrected Meas. Value** = (Meas. Value - ZERO POINT) x SLOPE.

### Function:

Zero point correct.  
(ZC)



Key:



Programming:

Input according to 5.3

1: 0 0 3.2 ZC

Clear:



1: - - - - ZC

### Function:

Slope correction  
(SC)



Key:



Programming:

Input according to 5.3

1:1.5 0 0 0 SC

If correction values are programmed and, as a result, the measured value is corrected, the arrow **CORR** will be indicated in the display.

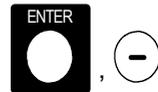
## Sensor Adjustment

To simplify the correction of sensors for the zero point and, possibly, also the slope (gain), a key combination for an automatic adjustment is available in function **MEAS. VALUE** (see 7.1.3). The corrected measured value is stored as zero point correction and will be set to zero. However, the base value will be maintained.

Function:



Adjustment with keys:

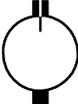


## 6.6 Scaling, Decimal Point Setting

For indicating the electrical signal of a sensor as a measured value of a physical variable it is, in most cases, necessary to set a zero point shift and to perform a multiplication with a certain factor. The functions BASE and FACTOR are available for this. A detailed description of the scaling, including an example, can be found in the manual section 6.3.11.

**Indicated value** = (corrected measured value - BASE) x FACTOR.

The FACTOR can be programmed in the range -2.0000 to +2.0000. For factors over 2.0 or under 0.2 a corresponding decimal point setting must be considered by entering the EXPONENT.

**Function:**  BASE according to 5.3 1:- 7.0 0 pH

**Function:**  FACTOR according to 5.3 1:1.0 3 5 0 +2

The arrow **CORR** will be indicated in the display if scaling values are programmed and if the measured value is actually modified.

### Decimal Point Setting

The EXPONENT allows to shift the decimal point to the left (-) or right (+) as far as it can be indicated on the display and printer. An exponential representation of measured values is not possible.

For **entering the exponent** the keys ENTER,  $\square$  must be pressed so that the exponent is flashing. The sign can then be changed by using the key  $\square$ . The numerical value is set by using the keys  $\uparrow$  and  $\downarrow$  and the programming can be completed by using the key ENTER.

Keys:  ,  , (  ) ,  ... or  ... ,  ENTER

## 6.7 Locking the Programming of the Sensor (man. 6.3.12)

The function parameters of each measuring point are protected by the locking mode up to an adjustable locking level. Before any programming is performed the locking mode must be correspondingly lowered. If a dot is indicated following the locking mode on the display then a modification is not possible.

Locking Level	Locked Functions
0	none
1	measuring range + element flags
2	measuring range + zero point and slope correction
3	measuring range + dimension
4	+ zero point and slope correction
5	+ base value, factor, exponent
6	+ analogue output, start and end
7	+ limit values, max and min

### Function:

Locking mode (LM)



RANGE

Key:



Programming

Input according to 5.3

1:0 0 0 5 LM

If programmed, the element flags and the multiplexer settings are indicated on the display next to the locking mode (see manual 6.10.2/3).

Keyboard locking and a locking code can be used to protect against unauthorised modification (see 5.4) during a measurement and to protect the programming and the process control.

## 7. MEASUREMENT

The instrument ALMEMO® 3290-8 provides the following options for the acquisition of measuring data:

1. Continuous measurement of a selectable measuring point, see manual 6.4.
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.

### Total Clearing of all Measured Values

Previous measuring data should be cleared before a measurement. Max, min, and average values of all channels and the memory can be cleared with the rotary switch in position MEMORY, by using the keys ENTER,  $\ominus$ ,  $\text{Clr}$ .

Key:		flash.	<input type="text" value="S C l r"/>	(clear memory)
		flash.	<input type="text" value="A C l r"/>	(clear memory and meas. values)
			<input type="text" value="1: - - - - °C"/>	cleared (not with other key)

For automatic clearing on each START, see manual 6.10.13.2.

## 7.1 Continuous Measurement of a Measuring Point

As long as no cycle and no continuous measuring point scan have been programmed (e.g. after a reinitialisation, see 3.4) only the measured value of a selected measuring point, which is at first M0, is continuously acquired with the specified conversion rate (see 7.3.3) (optimal for analogue output).

### 7.1.1 Selecting the Measuring Point

With the rotary switch moved to position MEAS. VALUE, the key  $\text{CH}\blacktriangle$  allows to successively select all measuring points and indicate the actual measured value. If the key  $\text{CH}\blacktriangle$  is pressed and held (approx. 1s) the previous channel is again indicated. By selecting the measuring channel the input channel is, at the same time, also selected (see 6.1). If the measuring range changes when switching over, the abbreviation of the measuring range is indicated first.

Increase measuring channel with key: 

Decrease measuring channel with key:  press and hold (approx. 1s)

### 7.1.2 Memory for Peak Values

From the acquired measured values of each measuring point the highest and lowest value is determined and stored. For indicating the peak values the function MAX. VAL. or MIN. VAL. must be selected with the rotary switch and the desired channel must be set.

**Function:**

Peak values:



MAX. VAL.  
MIN. VAL.

Clear:



The peak values are cleared if a total clearing (see 7) or change of the range (see 6.2) is carried out. If the cleared channel is the selected measuring channel, the measured value will be indicated immediately after the clearing.

### 7.1.3 Setting Measured Value to Zero, Zero Point Correction

#### Setting the Measured Value to Zero

The user can zero the measured value at certain locations or at certain times in order to check the deviation from this reference value. The indicated measured value is, by the following key combination, stored as base value and, as a result, set to zero.

Function:



MEAS. VALUE

Zero setting by keys:

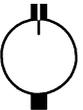


Please note that this function is only available if the locking code is set below 5 (see 6.7).

The arrow **CORR.** appears in the display as long as the deviation from the base value is indicated, but not the actual measured value.

The base value must be cleared in order to obtain the actual measured value (see 6.6). For this purpose the rotary switch must be set to the function BASE and the base value must be cleared with the keys ENTER, Clr.

Function:



BASE

Clear base value:



## Zero Point Adjustment

Many sensors must be adjusted at least once or at regular intervals to compensate for instabilities. For this purpose, a specific **zero point adjustment** is available, in addition to the 'Set Measured Value to Zero' mentioned above, as some sensors require an additional scaling (e.g. pH probes). In this function the zero point error is not stored as base value but as zero point correction (special cases and slope correction, see 6.5). In this case, the locking mode must be set below 4 (see 6.7). The zero point correction is performed using the following keys:

Function:  MEAS. VALUE      Zero point adjustment: , 



If a base value is programmed the measured value is not indicated as zero but as the negative base value after the adjustment.

For some sensors **special functions** are available in this context:

1. **Dynamic pressure probes** are very delicate and should be adjusted in an unpressurized state before each use (i.e. disconnected hoses or Pitot tube out of flow). The correction value must be entered before the conversion 'pressure-to-velocity' is performed. For the ranges L840 and L890 an adjustment is possible even if the channel is locked. The zero point error is temporarily written in the calibration offset until the switch-off is performed.
2. With the following sensors, a **slope adjustment** is performed in the same way for the corresponding calibration value:

pH probe:	ZA 9610-AKY:	pH4 or pH10
Conductivity:	(FY A641-LF)	2.77mS/cm
	(FY A641-LF2)	147µS/cm
	(FY A641-LF3)	111.8mS/cm
O <sub>2</sub> saturation:	(FY A640-O2)	101%

### 7.1.4 Atmospheric Pressure Compensation

Some measuring variables depend on the environmental atmospheric pressure (see 6.2 measuring range list 'w. PC'). As a result, higher deviations from the normal pressure of 1013mbar can cause corresponding measuring errors:

**e.g. error per 100 mbar:**

Rel. humidity psychrometer	approx. 2%	500 to 1500 mbar
Mixture ratio, cap.	approx. 10%	vapour pressure VP up to 8 bar
Dynamic pressure	approx. 5%	800 to 1250 mbar (error < 2%)
O <sub>2</sub> saturation	approx. 10%	500 to 1500 mbar

**Compensation Range:**

Therefore, the atmospheric pressure should be considered (approx. -11mb/100m over mean sea level, MSL) especially during use in a corresponding height above sea level. It can either be programmed or measured with a sensor (see manual 6.7.2).

**Function**

**ATM. PRESS.**

(mb)



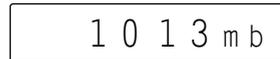
BAUD RATE

Key:



Programming

Input mbar see 5.3



With each reset the atmospheric pressure is set to 1013mb. It can be set to the actual value by the usual data entry.

### 7.2 Single Measuring Point Scan (see manual 6.5.1.1)

Measuring point scans can be used to acquire, indicate and, in most cases, to document data from the selected measuring point and also from other measuring points. Single measuring point scans for acquiring the momentary measuring values of all active measuring points are triggered by the key **MANUAL**.

**Single Meas. Point Scan:**

Key:



ALL

The measured values are sequentially indicated on the display for approx. 1.5 seconds. During this process the arrow 'START' is displayed and then disappears. The time is started if it has been previously cleared. If a peripheral device is connected (e.g. printer) the measured values are provided one time as an output via interface and the arrow 'RS232C' is indicated (print output, see manual 6.6.1). The output format can be set in the function OUTP. CYCLE (see 7.3.1). If all measured values also need to be stored, the memory must be activated (see 7.4.1). If this is the case, the arrow 'MEMORY' also appears during the scan. With each press of the key the measured values are equally processed with the corresponding measuring time. If true time has to be indicated, it must first be set (see 7.3.4).

### 7.3 Cyclic Measuring Point Scan (see manual 6.5.1.2)

For cyclic measuring point scans the measuring or print cycle (see 7.3.1/2) must be programmed. The measurement is started with the key **START/STOP** and the arrow 'START' is continuously indicated. If the memory is active (see 7.4.1) the measured values are stored and the arrow 'MEMORY' is indicated. If a peripheral device is connected, the measured values are provided as a cyclic output and, in addition, the arrow 'RS232C' is indicated. Different output formats are available (see 7.3.1). The measurement must be started in the function RANGE if the programming is to be indicated before the measured values. The corresponding print outputs can be found in manual section 6.6.1.

**Start Cyclic Meas. Point Scan:**

Key:



**Stopping of the automatic measuring point scan** can be achieved by operating the key **START/STOP** once again. The indications 'START', 'RS232C' and 'MEMORY' will disappear.

**Stop Cyclic Meas. Point Scan:**

Key:



#### 7.3.1 Print Cycle, Output Channel, Output Format

The print cycle, the output channel and the output format can be set in the function **OUTP. CYCLE** for cyclic measuring point scans and outputs.

**Function:**

Print cycle

Output channel

Output format



**OUTP. CYCLE**

0 0 : 3 0 : 0 0 n U

*Example:* print cycle 30 min, output channel 'U' (V24), column format.

The print cycle is programmed with 6 digits in the format hh:mm:ss (see 5.3).

Clear print cycle:

Keys:



0 0 : 0 0 : 0 0 n U

A running cyclic scan is terminated by this.

The **output channel** allows to select whether the measured values are provided as output to the interface or to the memory. However, for storing all measuring point scans the memory activation in the measuring cycle can also be used (see 7.3.2).

**Output formats (see manual 6.6.1)**

The output format determines the print output at measuring point scans and at the memory output. Apart from the standard list format, with all measured values given in a list, the column output format allows for a clear and space-saving printout in **columns**. For this purpose, a printer will automatically switch to the condensed character mode. Alarm lists during the measuring cycle are not available for this format. The **spreadsheet format** is available to further process measuring data by means of spreadsheet applications (see manual 6.1).

**Output channel and output format** are displayed in the dimension field. By using the key **CH▲** the following options can be successively selected. By pressing **CH▲** and holding a back switch is possible.

**AK Recording**

- U measured values to interface
- n U measured values to interface
- t U measured values to interface
- a U alarm values from memory to interface
- S meas. values to interface and to memory
- meas. values of a channel from memory
- n S meas. values to interface and to memory
- t S meas. values to interface and to memory

**Output Format**

- as a list
- in columns
- in spreadsheet format
- as a list
- as a list
- to analogue output
- in columns
- in spreadsheet format

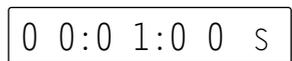
**7.3.2 Measuring Cycle and Memory Activation**

The measuring cycle is used for storing measured values, for cyclic averaging (see manual 6.7.4) or for monitoring the measured values including alarm list output in case of limiting values being exceeded. The display of the measuring cycle has 6 digits (hh:mm:ss) in the function MEAS. CYCLE.

**Function Meas. Cycle:**



MEAS. CYCLE



*Example:* meas. cycle 1 min, memory activated 'S'

The **input** of the measuring cycle has 6 digits and format hh:mm:ss according to 5.3.

The **clearing** of the measuring cycle and, as a result, the switch-off of the automatic scan can be achieved by using the keys ENTER, **Clr**.

The **memory activation** for all manual and cyclic measuring point scans (see 7.4.1) can be performed with the key **CH▲**. An 'S' is indicated on the display following the measuring cycle.

**Memory Activation:**



MEAS. CYCLE

**With key:**



### 7.3.3 Conversion Rate, Continuous Measuring Point Scan

If required the conversion rate can be increased from 2.5 to 10M/sec (see manual 6.5, 6.5.4). The rotary switch must be moved to position MEAS. CYCLE. CYCLE and the additional function CONVERSION RATE 'CR' must be selected by using the key F and must be set by using the keys ENTER,  $\uparrow$   $\downarrow$ , ENTER.

At the same time, the **continuous measuring point scan** (see man. 6.5.1.3) can be set with coding 'C', i.e. not only the selected measuring point but all active measuring channels are scanned successively without interruption. The storage with the conversion rate (coding 'S') can be activated with key CH▲, the output of the measured values 'U' can only be activated via the interface.

#### Function:

Conversion rate  
(CR)



MEAS. CYCLE



1 0 C S CR

Example: 10M/s, continuous, with saving

Change:



...



Memory on/off:



### 7.3.4 Time and Date

The ALMEMO® 3290-8 is equipped with a real time clock with date function for recording the measuring time. It has a lithium battery so the time and date are maintained after a switch-off.

Function Time:



TIME

1 2:3 4:5 6 TM

The time is programmed in the format hh:mm:ss (see 5.3).

Stopping the clock and setting it to zero can be performed by using the keys ENTER, Clr.

The clock can be started in any switch position by using the key START/STOP.

Function Date:



DATE

0 1:0 5:9 9 DA

Example: date 1st May 1999

Enter the date in the format dd.mm.yy (see 5.3). The year number can also be provided with 4 digits via interface (see manual 6.10.13).

Clear the date by using the keys ENTER, Clr.

### 7.3.5 Time and Date of Start, Time and Date of End

A sequence of measurements can, at certain points in time, be automatically started and stopped. For this purpose, the time and date of the start and the time and date of the end can be programmed. If no date has been specified the measurement is performed on a daily basis at the specified time interval. The actual time must be programmed before.

**Start Time:**  TIME 

**End Time:**  TIME , 

Input of time data in the format hh:mm:ss (see 5.3):

**Start date and end date** are programmed in the same way in the format dd:mm:yy and with the switch positioned on DATE (see 5.3).

Clearing of the values is performed by using the keys ENTER, **Clr**.

### 7.3.6 Start and Stop by Limit Values

Another possibility for starting or stopping a data logging automatically is the triggering by the exceeding of limit values (see 6.4 and manual 6.6.3). The **allocation of the start or stop command** to a limit value is performed with the switch in position LV: MAX or LV: MIN. The key **FUNCTION** allows for running the additional function 'AH' or 'AL' (action Hi, Lo).

When the action is cleared the display shows:

The **activation** of the functions 'Start' or 'Stop' is performed by pressing the key ENTER and selecting with the keys  $\uparrow$  and  $\downarrow$ .

The symbol 'S t A r t' or 'S t o P' flashes on the display.

The programming can be terminated by the key ENTER.

Display action measurement START at LV: MAX:

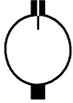
### 7.3.7 Averaging

The **average value** of the measured value is required for various applications:

- e.g. - the average flow velocity in a ventilating channel
- smoothing of a largely varying measured value (wind, pressure etc.)
- hourly or daily average values of weather data (temp., wind etc.)
- as above, of consumption values (current, water, gas etc.)

An averaging process for the measured values of measuring point scans can be programmed for each measuring point (manual 6.7.4). **The average value can be indicated and programmed** at switch setting AVG VAL. Average values must be cleared before each measurement and for programming.

The **clearing of an average value** is performed after selecting the input channel by using the keys ENTER,  or by a total clearing (see 7.).

**Avg. Val:**  AVG VAL. Clear: ,  1: - - - - °C

The **type of averaging** is determined through the averaging mode. This function (AM) is activated by using the key **FUNCTION**.

**Averaging mode:**  AVG VAL.  1: C o n t AM

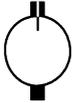
The following modes can be set by using the keys ENTER,  $\uparrow\downarrow$ , ENTER :

Function	Display
No averaging:	- - - -
Continuous averaging:	C o n t
Cyclic averaging:	C Y C L

For **averaging single measurements** the averaging mode 'Cont' must be selected, measuring and print cycle must be cleared and the key **MANUAL** must be pressed each time. In function AVERAGE the average value is indicated and can be printed at any time by using the key **OUTPUT** (see 8.3).

For an **averaging over time** the measuring and, possibly, print cycle must be programmed in addition to the averaging mode. For **starting** the averaging the key **START/STOP** must be operated and for stopping the key **START/STOP** must be operated once again. The arrow 'AVERAGE' will be indicated on the display if a channel is subject to averaging.

The **count C** of averaged values can be obtained in function C by operating the key **FUNCTION** twice.

**Count C:**  AVG. VAL. ,  1: 0 1 2 3 c

## 7.4 Data Memory

The basic information with regard to data storage in ALMEMO® devices is given in the manual section 6.9. The memory organisation can be reconfigured from linear to ring memory (see manual 6.10.13.2).

### 7.4.1 Data Acquisition

#### Switch-on and Switch-off of the Storage within the Measuring Cycle

If the memory has been activated in position MEAS. CYCLE by using the key CH▲ (see 7.3.2) each measuring point scan (exception: continuous) is stored. This is applicable for each scan in the measuring cycle, print cycle and a manually started scan (even when the measuring cycle is zero). Outputs to the selected interface will still be performed.

#### Switch-on of the Storage within the Print Cycle

If the output channel has been set to 'S' by using the key CH▲ while in OUTP. CYCLE (see 7.3.1) all outputs that are normally transmitted to the interface will be stored in the memory, i.e. measuring point scans in the print cycle or manually started scans and also alarm outputs (e.g. exceeding of limit values) in the measuring cycle.

For **starting a cyclic storing** the key START/STOP must be operated. If measured values are stored the arrow 'MEMORY' is indicated for control purposes, e.g. continuously during automatic scans and only during the scan if the scan has been manually started.

**Stopping the storing** is performed by pressing the key START/STOP

again. **Displaying the Data Memory:**

The display shows the last stored measured value of the input channel.

Change of the indicated channel with key CH▲.

On **sensor breakage** the abbreviation of the range:

When the **memory is cleared** the display indicates:

If the **memory is full** the display indicates:

Further measured values will no longer be stored when in the linear memory. Old values will be overwritten when in the ring memory.

**The free memory space** is displayed in kB in function 'MF' by pressing the key FUNCTION:



MEMORY

1: 1 2 3.4 °C

1: N i C r °C

S - - - -

S F U L L

0 0 2 3 4.5 MF

## 7.4.2 Using ALMEMO® Memory Connectors

From version 5.73 it is possible with the data logger 3290-8 to record measured values in removable external ALMEMO® EEPROM Memory Connectors ZA 1904-SS with capacities of 128kB (25,000 meas. values) or 256kB (50,000 meas. values). These memories do not require a battery to keep stored data available. They can be removed, sent away and, independent from the device, they can be evaluated on a computer by means of a readout interface (ZA 1409-SLK). The baud rate for the data can be set via the measuring instrument by connecting the memory connector to socket A1 and entering the baud rate. The function ring memory will not be supported when storing data on the memory connectors.

The memory connector is plugged into socket A2 and will be automatically identified and, as long as it is connected, will be used in place of the internal memory. This will also be visible at the display of the memory capacity 'FR'. Left of the memory space a 2-digit connector number will be indicated. For identification of the connector it can be programmed from 00 to 99 by using the keys ENTER, ↑ ↓, ⇒, ↑ ↓, ⇒ (see 5.3).

**Function Memory Free:**  MEMORY

Connector No. 03  
Free Memory: 128.5kB



If the internal data memory contains data when connecting the memory connector the message 'SCLr' will flash in the display and prompt the user to delete the memory by using the key CLR. If the data needs to be rescued the connector must be removed again and the data must first be read out.



Each cyclic measurement must be terminated by using 'STOP' as the access to a closed set of data is usually not possible. Therefore, the memory connector must not be disconnected when a measurement is running! Single measuring point scans will be immediately (automatically) terminated.



Open data can be rescued by using the command f9 P04 as long as no new measurement has been started. Trigger and relay cables can also be connected to socket A1.

### 7.4.3 Output of Measuring Data

The content of the data memory can, using measuring points, be provided as output to the display and the analogue output or, using cycles, be provided as output to the serial interface. The output channel is relevant in this context.

#### Output to the Display and to the Analogue Output



**OUTP. CYCLE**

Select output channel: Display: output channel ‘-’

Analogue output: output channel ‘S’



The output to the display and to the analogue output is only available via keypad if a data cable is not connected.



**MEMORY**

Select desired measuring point, obtain first meas. value on the display, recall individual measured values, start automatic output

display (‘-’): 1 value/s

recorder output (‘S’): 2 values/s

stop automatic output

recall individual measured values

re-start automatic output

cancel automatic output

**CH▲**

**OUTPUT**

**MANUAL**

**OUTPUT**

**START/STOP**

**MANUAL**

**OUTPUT**

Clr

During the memory output the arrow ‘MEMORY’ is indicated for control purposes, similar to when recording. At the end a  $\pm 20$  digit notch is written on a recording device. The output can be repeated for each further measuring point.

#### Output to the Serial Interface



**OUTP. CYCLE**

Select output channel:

‘U’

Set output format: e.g.

‘nU’



**MEMORY**

Start automatic output:

**OUTPUT**

stop automatic output

**START/STOP**

recall individual measured values

**MANUAL**

re-start automatic output

**OUTPUT**

cancel automatic output

Clr

#### Memory Output including Indication of Remaining Data

During a memory output the arrow ‘MEMORY’ and abbreviation ‘S Out’ will be displayed first. Then, the remaining memory space (in kB) to be output will be

continuously indicated by the abbreviation ‘S0’.

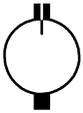
0 1:0 1 7.8 S0

The memory contents will be output with the same printout as with a printer operation, including multiple printouts and different formats (see manual 6.6.1).

**Print Output:** MEMORY:  
 NUMBER: 12-001 (if activated)  
 DATE: 12.03.90  
 list format 12:30:00 01: +0012.0 °C NiCr designation  
 each other 02: !+0008.8 °C NiCr water  
 03: >+125.00 °C Ntc motor oil

The connector number of an ALMEMO® Memory Connector will be printed after each headline 'MEMORY'.

### Clear Memory



MEMORY

Clear with keys:



To completely clear all measured values use ENTER, □, Clr (see 7.).

### 7.5 Numbering of Measurements

For an identification of measurements or sequences of measurements a number can be entered that will be printed or stored with the next measuring point scan. As a result, individually stored measurements can be allocated to certain measuring locations or measuring points (see manual 6.7).

#### Displaying the Number



NUMBER



*Example:* Room No.: 12, Meas. Point 1, active Programming of the 6 digit number (see 5.3). In addition to the figures 0 to 9 the characters A,F,N,P,- or \_ (space) can be used. The characters can be accessed either above 9 or below 0. The numbering output is activated after the input and ' A ' is indicated in the dimension field.

**Increasing** the number by 1 and activating by using the key:



**Activating** and deactivating of the number output by using the key: (identified by ' A ' or ' ')



**Setting to zero** and deactivating the number with the keys:



## 7.6 Sleep Mode

For long term monitoring with larger measuring cycles it is possible to operate the measuring device in sleep mode by using a rechargeable battery (option A) or an external battery. Within this power saving mode the device will be switched off after each measuring point scan and will be automatically switched on for the next measuring point scan after the cycle time has expired. This procedure allows, with one full charged battery to perform approximately 15,000 measuring point scans. At 5 minutes for one cycle this results in a total measuring time of more than 50 days.

The following steps must be performed for an **operation in sleep mode**:

1. Enter a measuring or print cycle of a minimum of 2 minutes.  
If both are programmed the measuring cycle will be ignored.
2. **For starting a measurement in sleep mode:**  
Press key **START/STOP** with key **FUNCTION** held down.

**Start:**  and  must be pressed simultaneously.



The starting and stopping by the start and end time, and also by the limit values, is generally not possible in sleep mode and must, therefore, be switched off!

After the first scan the display indicates:  
and the device will practically be switched off.

S L E E P    O N

3. Within the set cycle the instrument will switch on, perform a measuring point scan, display 'SLEEP ON' and the measured values, and then switch off again.
4. **Switch over to active operation:** Switch the device off and on again.
5. Terminate the measurement by pressing the key **START/STOP**.

## 8. DIGITAL DATA OUTPUT

The entire programming of the sensors and the instrument, as well as all measured values, can be provided as output to a printer or computer via serial interface. The interface modules and the connection to the instruments are described in the manual section 5.2. Other modules for networking the instruments follow in the manual section 5.3.

### 8.1 Baud Rate, Data Format

All interface modules are factory-set and programmed to 9600 baud. To avoid unnecessary problems when networking several devices the baud rate should not be modified but the computer or printer should be set up accordingly. If this is not possible, the values 150, 300, 600, 1200, 2400, 4800, 9600 or 57600bd can be entered via keyboard if the rotary switch is in position BAUD RATE. The input is started with the key ENTER. The display will start to flash and can be modified by using the keys ▲ and ▼. When the desired transmission rate has been selected the programming can be terminated by operating the key ENTER once again. The baud rate setting will be stored in the EEPROM of the interface module and will then be valid for use with all other ALMEMO® devices.

Function:  BAUD RATE

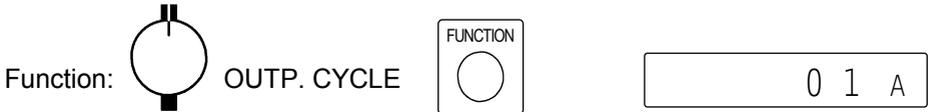
9 6 0 0 BR

*Example:* 9600 bd

**Data format:** unchangeable 8 data bits, no parity, 1 stop bit

## 8.2 Device Address and Networking

All ALMEMO® instruments can be very easily networked to centrally acquire the measured values of several instruments that are located at different places (see manual 5.3). For communicating with networked devices it is mandatory that each device has its own address as only one device is allowed to respond to each command. Therefore, before any network operation it is necessary that all connected devices are set to different device numbers. This is performed with the rotary switch in position **OUTP. CYCLE**. The key **FUNCTION** is used to select the function **DEVICE ADDRESS 'A'** and the currently set device number is displayed, which is usually factory-set to 00. It can then be modified by the normal data entry (see 5.3).



*Example: Address 01*

Only successive numbers between 01 and 99 should be entered for network operation so that the device 00 cannot be falsely addressed in case of a power supply failure.

## 8.3 Manual Data Output

For the output of data to a printer the output channel must be set to 'U' by using the key **CH▲** within the function **PRINT CYCLE** (see 7.3.1). The output format is not relevant for the manual data output, with the exception of the memory. All function values that have been selected by using the rotary switch and, possibly, with the key **FUNCTION**, can be printed out with the next print output by using the key **OUTPUT**.



Switch	Func	Key	Print Output
<b>MEAS. VAL.</b>			12:34:00 01: +0023.5 °C
<b>MAX VALUE</b>			MAXIMUM: 01: +0020.0 °C
<b>MIN VALUE</b>			MINIMUM: 01: -0010.0 °C
<b>AVERAGE V.</b>			AVERAGE VAL: 01: +0017.8 °C
<b>AVERAGE V.</b>	AV	F	MS MEAS. VAL. MAXIMUM MINIMUM AVG COUNT
all meas. values	C	F, F	01: +0023.0 +0025.0 +0019.0 +0022.0 99999 man. 6.4.4
<b>NUMBER</b>			NUMBER: 00-123
<b>MEMORY</b>			MEMORY: - - - - see 7.4.2
<b>MEMORY</b>	MF	F	MEMORY: S0501.3 F0324.6 A

<b>Switch</b>	<b>Func Key</b>	<b>Print Output</b>
<b>RANGE</b>		01:NiCr +0123.4 -0012.0 +0000.0 °C 1.0000 E+0 - - -
<b>RANGE</b> ext. programm.	LM F	MS ZERO SLOPE LM P FUNC CALOFS CALFA A-START A-END B1 MX EF AH AL CF UMIN 01:+0000.0 +1.0000 5. 1 MESS +00000 32000 +0000.0 +1000.0-01 M1 -- S- E2 05 12.0 <b>see manual 6.10.1</b>
<b>LV MAX</b>		LIM VAL MAX: 01: -0100.0 °C
<b>LV MIN</b>		LIM VAL MIN: 01: +0020.0 °C
<b>BASE</b>		BASE VAL: 01: -0273.0 °C
<b>FACTOR</b>		FACTOR: 01: +1.0350E-1
<b>BASE</b>	ZC F	ZERO POINT: 01: -0000.7 °C
<b>FACTOR</b>	SC F	SLOPE: 01: +1.0013
<b>TIME</b>	TM	TIME: 12:34:00
<b>TIME</b>	ST F	START TIME: 07:00:00
<b>TIME</b>	ET F, F	END TIME 17:00:00
<b>DATE</b>	DA	DATE: 01.02.99
<b>DATE</b>	SD F	START DATE: 01.02.99
<b>DATE</b>	ED F, F	END DATE: 02.02.99
<b>PRINT CYCLE</b>		PRINT CYCLE: 00:06:00
<b>MEAS. CYCL.</b>		MEAS. CYCLE: 00:01:30
<b>BAUD RATE</b> Sensor Programming	BR	AMR ALMEMO 3290-8 CH RANGE. LIM-MAX LIM-MIN OFFSET D FACTOR EXP AVG COMMENT 01:NiCr +0123.4 - - - - - °C 1.0350 E+0 - - - Designation 02:NiCr - - - +0012.0 - - - °C - - - E+0 CONT Water MEAS. CYCLE: 00:00:30 S S0501.9 F0304.7 A W010 C-SU- PRINT CYCLE: 00:10:00 U 9600 bd START TIME: 00:07:00 START DATE: 02.01.99 END TIME: 18:30:00 END DATE: 03.01.99 <b>see manual 6.2.3</b>
if programmed		
<b>BAUD RATE</b> Device Programming	mb F	DEVICE: G00 M20 A08 P05/20/00 A.PRESSURE: +01013. mb CJ-TEMP: +0023.5 °C U-SENSOR: ! 12.5 V HYSTERESIS: 10 CONFIG: FCRDAS-- -L-- ALARM: -1-3 A1: DK0 Un A2: AK1 <b>see manual 6.2.5</b>

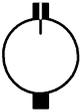
## 9. ANALOGUE OUTPUT

For analogue acquisition of the selected measuring point either an analogue output cable ZA 1601-RK (see manual 5.1.1) without electrical isolation or a relay trigger analogue adapter ZA 8000-RTA (see manual 5.1.3) with electrically isolated analogue output can be connected to the sockets A1 or A2.

### Scaling

It is possible to spread any partial range to the standard output signal of the three available options 0-2V, 0-10V, 0/4-20mA if the partial range covers at least 100 digits (e.g. 0-20mA for +200.0 to +1000.0°C). To achieve this the **analogue output-start** and the **analogue output-end** of the desired measuring range must be entered within the functions AA and AE (see manual 6.10.7). If the initial value is zero it will remain cleared.

#### Function ANALOGUE OUTPUT-START:



MIN. VAL.

Key:

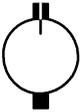


1: - 1 0.0 A S

Programming:

Input see 5.4

#### Function ANALOGUE OUTPUT-END:



MAX. VAL.

Key:



1: 0 5 0.0 A E

*Example:*

Meas. Range -10.0 to 50.0 °C

These two parameters, analogue output-start and analogue output-end, are also stored in the EEPROM of the sensor and can, therefore, be individually programmed for each channel, i.e. during a manual switch through the channels an individual scaling is available for each measuring variable.

## 10. TROUBLESHOOTING

The data logger ALMEMO® 3290-8 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. Due to the large variety of options 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:** Switch-on indicator is not illuminated, no display data or all display segments are permanently illuminated.

**Remedy:** Check power supply, recharge battery, switch off and on again, reinitialise (see 3.4)

**Error:** False measured values.

**Remedy:** Thoroughly check the programming of the channel (especially base and zero point), query the entire programming by means of the software AMR-Control or the terminal and command P15 (see manual 6.2.3) and f1 P15 (see manual 6.10.1)

**Error:** Varying meas. values, segment test or blockage during operation.

**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 with one sensor, 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 interface module, connections and settings:

Are both devices set to the same baud rate and transmission mode (see 8.1)?

Is the correct COM interface addressed at the computer?

Is the output channel set to "U" (see 7.3.1)?

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):

Address the device with its device number  $G_{xy}$  (see manual 6.2.1), query the programming by P15 (see manual 6.2.3), only check the sending line by cycle input via command Z123456 and control in the display.

Test the receiving line by using the key OUTPUT and monitor control.

**Error:** Data transmission within network does not function

**Remedy:** Check that all devices are set to different addresses, address devices individually via terminal and command  $G_{xy}$ , addressed device is OK when the feedback is at least  $y_{CR LF}$ .  
If data transmission is still not possible, disconnect networked devices, check devices separately at data cable of the computer (see above),  
check the wiring regarding 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.

## 11. ELECTROMAGNETIC COMPATIBILITY

The data logger ALMEMO® 3290-8 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 instrument:

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 (< 50µV at 3V/m and 1.5m thermocouple transducers). After the irradiation the device operates again within the specified technical data.

## Technical Data (see also Section 2.2 in Manual)

<b>Measuring Inputs:</b>	9 ALMEMO® sockets for ALMEMO® connector
Meas. channels:	9 primary chann. electr. isol., max. 27 addit. chann. for double sensors and function channels
Sensor voltage supply:	mains adapter: approx 12V, max. 100mA rechargeable battery: 7...9V, max. 100mA
<b>Equipment:</b>	
Display:	6½ digit 7-segment, 2 digit 16-segment, 12mm
Function selection:	16-position rotary switch
Keyboard:	6 keys
Memory:	500 kB (100000 meas.val.) buff. w. rechar. NiCd batt.
Time and date:	real time clock buff. with rechargeable NiCd battery
Microprocessor:	HD 6303 Y
<b>Outputs:</b>	2 ALMEMO® sockets for all output modules
<b>Voltage Supply:</b>	7 to 13V DC not electrically isolated
Mains adapter:	ZB 5090-NA2 230VAC to 12VDC, 0.8A electr. isol.
Adapter cable electr. isol.:	ZB 3090-UK 10...30V DC to 12V DC, 250mA
Option A:	NiCd recharg. batt. 7.2V, 1.5Ah Time for recharging: ca. 2h, quick and trickle charge
Current consumption without input and output modules:	active mode: approx. 15mA sleep mode: approx. 20µA
<b>Housing:</b>	metal housing H86 x W154 x D225mm
Operating temperature:	-10 ... +60 °C
Storage temperature:	-30 ... +60 °C
Humidity of ambient air:	10 ... 90% rH non-condensing
<b>Extent of the Delivery:</b>	Measuring Instrument ALMEMO® 3290-8 Mains Adapter ZB 5090-NA2 12V/ 800mA Operating Instructions ALMEMO® 3290-8 ALMEMO® Manual incl. software AMR-Control

## Product Overview

Order No.

### Data Logger ALMEMO 3290-8

9 inputs, 36 channels at maximum, 500 kB memory, real time clock, 6 keys, RS232 interface that can be cascaded, sleep mode, mains adapter 12V / 0.8A	MA 3290-8
Option A Instr. incl. recharg. batt. 7.2V, 1.6Ah, quick charge within 2h	OA 3290-A
DC Adapter Cable 10 to 30V DC, 12V/250mA electr. isol.	ZB 3090-UK
ALMEMO® Recording Cable -1.25 to 2.00 V, 0.1 mV/digit	ZA 1601-RK
ALMEMO® Data Cable V24 Interface, electr. isolated	ZA 1909-DK
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® Memory Connector with 256kB EEPROM	ZA 1904-SS8
Adapter cable to this output of the memory connectors by the PC	ZA 1409-SLK

