

ALMEMO®



V5



Operating Instructions

Multifunctional Measuring Instruments ALMEMO® 2290-2/3 V5

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Operating Instructions

Multifunctional Measuring Instruments ALMEMO[®] 2290-2 and -3

For Reference with the ALMEMO[®] Manual

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1. INTRODUCTION

The multifunctional measuring instruments ALMEMO® 2290-2/3 *Version 5* are instruments 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 is necessary 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 multifunctional measuring instrument ALMEMO® 2290-2 has one measuring input with 4 channels for more than 65 measuring ranges, the ALMEMO® 2290-3 has two electrically isolated measuring inputs with up to 8 measuring and two differential channels. Two output sockets allow for connecting any ALMEMO® output modules, for example, the analogue output, digital interface, trigger input or alarm contacts. Several devices can be networked by a simple connection between the devices. For easy operation it is equipped with a keyboard and an 8½-digit LCD display.

The instruments provide many functions for an optimal evaluation of all sensors, for a flexible process control and for a universal data output. To avoid a complicated handling, which could be caused by functions that are not required, these functions can be activated automatically or manually when required. A few special functions can only be accessed via 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 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 interface and given on the printout or display if evaluations are 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. By setting to zero and entering the nominal value the scaling values can be automatically calculated.

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 data logging.

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 four 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 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).

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 O₂ sensors. With infrared sensors the parameters zero point and slope correction are used for background temperature and emissivity factor.

Difference

The ALMEMO 2290-3 provides two differential measuring channels for both electrically isolated measuring inputs. If such a channel is selected, the measured values of both sensors are continuously determined and the difference is indicated and, if available, provided to an analogue output.

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).

Memory for Momentary Values

The measured value can be frozen by the push of a button (hold function).

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.

Average Value of a Channel

A manual averaging over a particular period or over single measurements is available for the selected channel.

Volume Flow Measurement

Apart from the averaging functions, all flow probes provide functions for entering the cross section area or diameter of air vents and calculating the volume flow. The average flow velocity can be roughly determined by measuring the whole cross section area or by accurate net measurements according to DIN. For dynamic pressure probes a temperature and an atmospheric pressure compensation is available. With corresponding environmental conditions these values can be entered manually or automatically measured.

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, interface, external trigger signal, 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.

Print Cycle

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

Print Cycle Factor

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

Measuring Cycle

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

Average Value over Measuring Point Scans

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

Conversion Rate

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

Control Outputs

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

Output

All measuring and programming data is accessible by means of the LCD display. RS232, RS422, RS485 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.

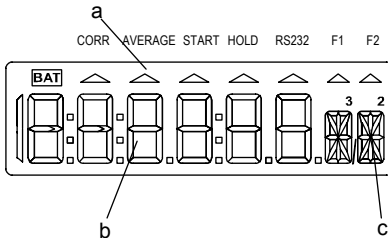
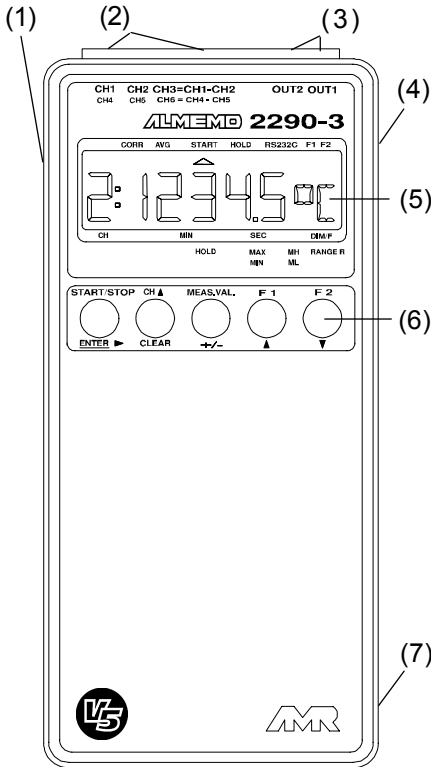
Networking

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

Software

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

1.2 Operating Controls



(1) ON/OFF switch

up ON
down OFF

(2) Meas. Inputs M1, (M2 2290-3)

CH1, (CH2) f. all ALMEMO® sensors
CH2 to CH4 additional channels
(CH3 to CH11 additional channels 2290-3)
(CH3, CH6 differential channels 2290-3)

(3) Output Sockets OUT1, OUT2

OUT1 RS232 Interface (ZA 1909-DK)
RS232 Fiber Opt. (ZA 1909-DKL)
Centronics (ZA 1936-DK)
RS 422 (ZA 5099-NVB)
RS 485 (ZA 5085-NV)
Analogue output 1 (ZA 1601-RK)
OUT2 Network cable (ZA1999-NK)
Trigger input (ZA 1000-ET)
Relay outputs (ZA 1000-EGK)
Analogue output 2 (ZA 1601-RK)

(4) DC Socket

Mains adapter (ZB 2290-NA, 12V, 200mA)
Connector cable (ZB 5090-EK, 7-13V DC)
Cable, electr. isol. (ZB 2290-UK, 10-30V)

(5) LCD Display

(6) Function Keys

(7) Battery Box (back of unit)

Alkaline mangan. battery 9V (6F22)
Space for spare battery

(5) LCD Display

(a) Symbols for operating modes

BAT U battery < 7 V
▲ CORR Correction of meas. val.
▲ AVERAGE Averaging
▲ START Measuring point scan
▲ HOLD Memory for moment. val.
▲ RS232 Output of meas. val.
▲ F1 Measuring function
▲ F2 Programming function

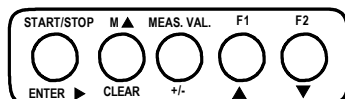
(b) 6½ x 7 Segment Display for:

Meas. point, meas. val., meas. range, meas. and progr. values, cycles, time, date

(c) 2 x 16 Segment Display for:

Dimension of the measured value, Abbreviation for additional functions

(2) FUNCTION KEYS



INPUT, +/-, ▲▼, ►	for entering programming values
INPUT, CLEAR	clear data, set measured value to zero
INPUT, +/-	calibrate measured value
START/STOP	cyclic measuring point scan
CH ▲	select measuring point
MEAS.VAL.	select measured value, hold
F1	select measuring functions

Max value (Hi)	MH	●
Min value (Lo)	ML	●
Average Value	AV	+
Number of averaged values	C	+
Volume flow	VF	+
Print cycle	PC	*
Meas. cycle	MC	*
Time	TM	*
Date	DA	*

F2

Select Programming Functions

Range	R	●
Limit value Max (Hi)	LH	
Limit value Min (Lo)	LL	
Zero point correction	ZC	"
Slope correction (gain)	SC	"
Ambient temperature	AT	^
Emissivity factor	EF	^
Base value	BA	
Factor	FA	
Exponent	EX	
Averaging mode	AM	+
Cross section area	CS	+
Diameter normalised	DN	+
Atmospheric pressure	mb	~
Temperature compensation	TC	"
Analogue output-start	AS	
Analogue output-end	AE	
Baud rate	BR	*
Device address	A	*
Locking mode	LM	

Functions will be activated by:

All by switch-on with key ENTER or RS232 command

- Reinitialisation Switch-on with key CLEAR
- * Interface modules
- + Flow sensors
- ^ Infrared sensors
- " pH probes
- ~ Humidity, dynamic pressure and O₂ sensors

2. INITIAL OPERATION

1. Connect **transducers** to the sockets CH1 (and CH2) (2), see 4.
2. Ensure **power supply** with 9V battery or mains adapter, see 3.1, 3.2.
3. **For switching on** move the slide switch (1) on the left side of the unit up, see 3.3.
4. **For displaying** the measured values,
select function MEAS. VALUE by using the key **MEAS.VAL.** (6),
use key **CH▲** to select the measuring channels, read meas. values,
see 7.1.1
5. **Cyclic output of measured values** to printer or computer
Connect peripheral device via interface cable to socket OUT1,
see manual 5.2.
Set 9600 bd, 8 data bits, 1 stop bit, no parity at peripheral device, see 9.1.
Enter time and date, as required, see 7.3.3.
Use key **F1** to select function PRINT CYCLE 'PC' and program the print cycle, see 7.3.1.
Use key **START/STOP** to start and stop the cyclic meas. point scan, see 7.3.
6. **Monitoring of limit values**
Enter limit values, see 6.4.
Use key **F1** to select function MEAS. CYCLE 'MC' and program the measuring cycle, see 7.3.2.
Connect alarm device with alarm module to socket OUT2,
see manual 5.1.2/5.1.3.
If required, use an interface cable to connect the printer or computer for an alarm list output to the socket OUT1, see manual 5.2.
Set 9600 bd, 8 data bits, 1 stop bit, no parity at peripheral device, see 9.1.
Use key **START/STOP** to start and stop the cyclic meas. point scan, see 7.3.
7. **Evaluation of the measurement**
Select function MAX VALUE 'MH' or MIN VALUE 'ML' by using key **F1** and query the maximum and minimum values, see 7.1.4.

3. POWER SUPPLY

The following options are available for the power supply of the instrument:

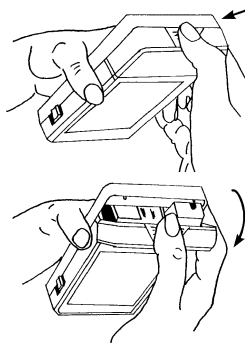
- 9V battery IEC 6 F22 ZB 2000-B9
- 9V rechargeable battery,
as above with charger unit integrated in plug ZB 2000-A9, ZB 2000-LS
- Mains adapter 12V/200mA ZB 2290-NA
- External power supply, connecting cable ZB 2290-UK

Our product line includes corresponding accessories.

3.1 Operation with Battery and Rechargeable Battery

Only use type IEC 6 F22 alkaline manganese batteries. At a current consumption of approximately 7mA, they last for an operating time of 50 hours. The operating time will be shortened if sensors or modules are connected that consume additional current.

Inserting Batteries:



The battery box (7) is located at the underside of the instrument.

1. Press the area that is marked with the arrow and, at the same time, pull as marked by the arrow, as illustrated left.
2. Use the connector clip to connect the battery. The connector shape prevents from confusing the poles.
3. Use the second battery box to store a spare battery.

Battery Control:



If the battery warning symbol is illuminated in the display the battery will still operate for approx. 5 hours (supply voltage <7V)



If the battery voltage drops below 6 volts 'LobAt' will be indicated on the display.

The battery should be immediately removed. Leakage of the battery and damage to the instrument can then be avoided.



The actual battery voltage can be accurately monitored with an own measuring channel U_{bat} and the remaining battery life can be estimated accordingly.

Tips regarding correct handling of batteries:

- Do not leave used batteries in the instrument!
- Remove batteries from the instrument if it is not used for a long period.
- Risk to health and instrument failure can result from leaking batteries! Therefore, only use leak-proof batteries.
- Used batteries are hazardous waste and must be disposed in an environmentally friendly way! Return them to the dealer or dispose of them in a battery storage container.

Operation with Rechargeable Batteries

Rechargeable batteries can be used instead of normal batteries. Due to their smaller capacity of 110mAh they only reach an operating time of 16 hours. The operating time will be shortened if sensors or modules are connected that consume additional current. It is recommended to use the 9V rechargeable battery with plug-integrated charger unit ZB 2000 LS, which is included in the range of accessories.

Tips regarding correct handling of rechargeable batteries:

- The rechargeable batteries supplied are not charged when delivered!
- If NiCD cells are only partly discharged, the full capacity cannot be reached by a normal recharging.
- Therefore, use the instrument until the rechargeable batteries are completely discharged.
- Completely recharge the rechargeable batteries afterwards.
- As a result, the life of the rechargeable batteries is significantly increased.
- Completely recharged batteries will slowly discharge during storage.

3.2 External Voltage Supply

For an external voltage supply the connector socket (4) is located at the right side of the device. The range of accessories includes the mains adapter ZB 2290-NA (12V/200mA). However, any other DC voltage source (7 to 13V) can also be used. The connection is performed by a low-voltage connector (NES1 according to DIN 42323, centre pin to negative).

The electrically isolated supply cable ZB 2290-UK must be used if an **electrical isolation** between power supply and transducers is required or if a larger input voltage range is required. It allows to operate the measuring instrument with 12V or 24V mains supply.



If a battery is used in addition it will take over the power supply if the voltage drops under 9V.

3.3 Switch On/Off, Reinitialisation

The ON/OFF switch (1) on the left side of the device has two positions:

- up: ON
- down: OFF

For **switch-on** the slide switch (1) on the left side must be moved upwards.

The device is **switched off** when the slide switch is moved to the lower position. Time and date will be lost after switching off. However, all programmed parameters stored in the EEPROMS will be maintained.

If the device shows an irregular behaviour due to interference influences (e.g. electrostatical charging or wrong connection of peripheral devices) or if incorrect programming must be avoided, the device can be completely reinitialised.

The **reset** can be achieved if the key **CLEAR** is pressed during switch-on. Apart from the measuring data, the time and date and all internal data such as cycles, conversion rate and atmospheric pressure and the settings for the function keys will be cleared or set to their default values. However, the device configuration and the sensor programming within the ALMEMO® connectors will not be affected by the reset.

4. CONNECTION OF THE TRANSDUCERS

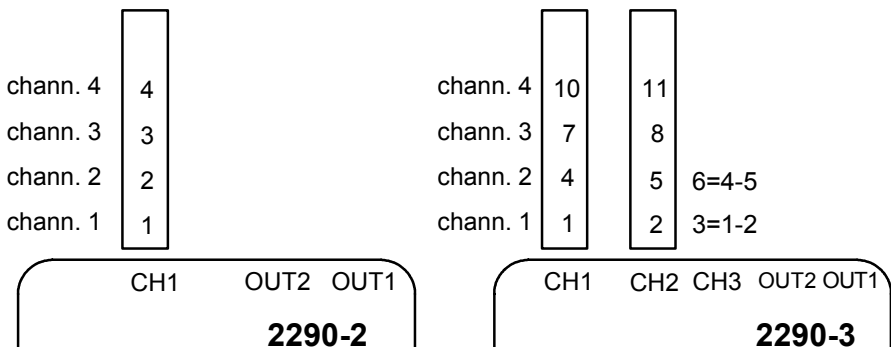
Any ALMEMO® sensors can be connected to the ALMEMO® input sockets (2) CH1 and CH2 of the measuring instrument. For connecting existing sensors it is only necessary to connect a corresponding ALMEMO® connector.

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® 2290-2 has 1 input socket (2), the ALMEMO® 2290-3 has 2 input sockets CH1 and CH2, and additionally a differential channel CH3 (CH1-CH2). However, ALMEMO® sensors can, if required, provide up to 4 channels. 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, a 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 located on the next higher level. The following channel occupancy is valid for both measuring instruments.





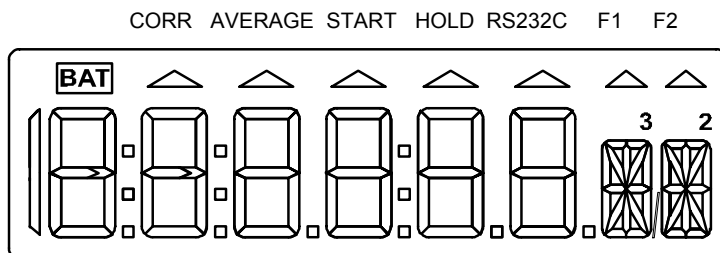
The 5 analogue inputs are electrically isolated by using photovoltaic relays and a potential difference of 50V DC or 60V AC, at maximum, is permissible between them. However, sensors combined within one connector and sensors with an own power supply are electrically connected to each other and must, 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 CH1 of the device.

5. DISPLAY AND KEYBOARD

5.1 Display and Function Selection

The display (5) of the measuring device ALMEMO® 2290-2/3 consists of an LCD module with six and a half 7-segment digits, two 16-segment digits, and a battery symbol and seven arrows for indicating the operating status.



Special Operating Conditions

Segment test of the display

Supply voltage: lower than 7V:

automatically after switch-on.

BAT symbol illuminated

lower than 6V:

1: L o b A t

Sensors that are not connected,
deactivated measuring points,
cleared programming values.

1: - - - - XX

Sensor correction or scaling

arrow **CORR** illuminated.

Measuring point scan in progress

arrow **START** illuminated.

Memory for momentary values

arrow **HOLD** illuminated.

Measuring point scan with output

arrow **V24** illuminated.

Measuring function selected

arrow **F1** illuminated.

Programming function selected

arrow **F2** 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

Exceeding of limit value:

measured value flashes

Overshooting of measuring range:

maximum value flashes

Undershooting of measuring range:

minimum value flashes

Undershoot. of meas.range of CJ comp. or

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 Selecting and Activating Functions

After a reinitialisation (see 3.3), the functions Max and Min Value are only available at first by using the key F1 and the measuring range by using key F2. Further to these basic functions, the instruments ALMEMO® 2290-2/3 also provide a large number of additional functions for an optimal support of various sensors, for example for highest accuracy, implementing an automatic measuring point scan and also for providing data to any peripheral devices.

As certain functions are only necessary for certain sensors, and other functions are only needed for data output etc. the functions will usually only be activated when they are required. This should ensure a quick access by using the keys F1 and F2 and should reduce the risk of incorrect entries. However, in certain cases, to keep all functions directly available, it is possible to temporarily activate all functions, i.e. until the next switch-off:

Activate all functions by switching on with key  **held pressed.**

The functions can be selected by repeatedly pressing the keys F1 and F2. If the key is pressed for longer than one second the previous function can be recalled. The functions can be identified by a two-digit abbreviation that is displayed in place of the dimension, as given in the table below:

MEAS.VALUE	F1 (Meas.Functions)	F2 (Programm. Values)
Meas. Val., Dim	Max Value (Hi) MH	Range R
HOLD	Min Value (Lo) ML	limit value Max (Hi) LH
	+ average value AV	limit value Min (Lo) LL
	+ numb. of averag. val. C	" zero point correction ZC
	+ volume flow VF	" slope (gain) correction SC
	* print cycle PC	^ ambient temperature AT
	* meas. cycle MC	^ emissivity factor EF
	* time TM	base value BA
	* date DA	factor FA
		exponent EX
		+ averaging mode AM
		+ cross-sectional area CS
		+ diameter, normalized DN
		~ atmospheric pressure mb
		° temperature compens. TC
		analog output-start AS
		analog output-end AE
		* baud rate BR
		* device address A
		locking mode LM

Automatic activation of the functions by:

- * interface modules
- + flow sensors
- ° probes for dyn. press and pH

- ^ infrared sensors
- " pH probes
- ~ humidity, dyn. press. and O₂ sensors

The abbreviation for the function is indicated at the right side of the value. If sensor parameters are involved the number of the channel is also indicated:

Meas. Val.:	chann.	-	meas. value	dimension	11: 2.1 2 3 4 mV
Range:	chann.		short name	R	1: N i C r R
Parameter:	chann.	-	value	function	1: 1 2 3.4 MH
Cycles:	hours	minutes	seconds	function	0 0:1 5:0 0 PC
Times:	hours	minutes	seconds	TM	1 2:3 4:5 6 TM
Date:	day	month	year	DA	0 1.0 1.9 9 DA
Baud rate:	outp.chan.	format	baud	BR	U n 9 6 0 0 BR

The devices can also be individually configured for each application by setting the key functions via interface (AMR-Control) (see manual 6.10.13.3). Even storing a configuration in an ALMEMO® configuration connector is possible, i.e. the functions can also be activated by the formerly required programming modules.

The additionally activated functions can be **cleared** by pressing the key **CLEAR** when switching the device on.

5.3 Keyboard

The keyboard (6) has the following functions that are displayed above the keys:

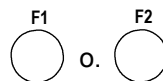
Function	Normal	Enter
Start and stop of meas. point scans	START/STOP	<u>ENTER</u> ►
Selecting the measuring points	CH ▲	CLEAR
Meas. value	MEAS. VAL.	+/-
Selecting the measuring functions	F1	▲
Selecting the programming functions	F2	▼

If the key ENTER ► is pressed for longer than one second a digit or an abbreviation is flashing in the display indicating that the device is in the edit mode and that the **red** designations below the keys are valid. The keys +/-, ▲, ▼ are then available for altering the input figure, the key ENTER ► operates as cursor key and **CLEAR** is available for clearing parameter data. The input is complete when the last digit has been confirmed with operating the key ENTER ►

5.4 Data Entry

The programming of numeric parameters is performed as follows:

The desired function can be selected by using keys **F1** or **F2**...



The **programming is started** by long pressing the key **ENTER** ►

The first digit flashes
and can be altered.



The digit can be **increased** using the key ▲ .

After exceeding the maximum value the cycle restarts from zero.



The digit can be **decreased** using the key ▼ .

After falling below zero the maximum value follows (9 or 5).



The **sign can be changed** using the key ± .



A switch the next digit is performed using the key **ENTER** ► .



To switch back to the previous digit by long pressing **ENTER** ► .

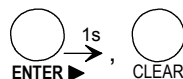


The **programming process** is complete

after setting the last digit and again operating the key **ENTER** ►



Programming and measured values can be cleared using





6. SENSOR PROGRAMMING

As all ALMEMO® instruments contain the whole sensor programming stored in the ALMEMO® 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 using the key CH▲. If this is performed within any programming 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:  $\xrightarrow{1s}$ press and hold (approx. 1 sec)

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 'BE'. 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 long pressing the key ENTER ► the abbreviation for the measuring range flashes in the display. The keys ▲ and ▼ 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 RANGE ' R '

Select by using the key F2...

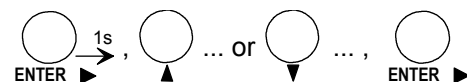


1: NiCr R

Example:

chan. CH1, range NiCr-Ni

Changing the meas. range:



Transducer	Connector / Cable / Sensor	Meas. Range	Dim.	Display
Pt100-1	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
NiCr-Ni (K)	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
Ntc type N	ZA 9000-FS	-30.00...+125.00	°C	Ntc
Millivolt 1	ZA 9000-FS	-26.000...+26.000	mV	U 26
Millivolt	ZA 9000-FS	-10.000...+55.000	mV	U 55
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
Milliampere	ZA 9601-FS	-32.000...+32.000	mA	I032
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
Infrared 1	ZA 9000-FS	0.0... +200.0	°C	Ir 1
Infrared 2	ZA 9000-FS	0.0... +800.0	°C	Ir 2
Infrared 3	ZA 9000-FS	-30.0... +70.0	°C	Ir 3

Transducer	Conn. / Cable	Meas. Range	Dim.	Display
Infrared 4	ZA 9000-FS	-30.0... +100.0	°C	Ir 4
Infrared 6	ZA 9000-FS	0.0... +500.0	°C	Ir 6
Snap-on head Normal 20	FV A915-S120	0.30... 20.00	m/s	\$120
Snap-on head Normal 40	FV A915-S140	0.40... 40.00	m/s	\$140
Snap-on head Micro 20	FV A915-S220	0.50... 20.00	m/s	\$220
Snap-on head Micro 40	FV A915-S240	0.60... 40.00	m/s	\$240
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
Relative air humidity cap.	FH A646	0.0... 100.0	%H	°orH
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
Conductivity probe w. TC	FY A641-LF	0.0 ... 20.000	mS	LF
CO ₂ sensor	FY A600-CO2	0.0 ... 2.500	%	CO2
O ₂ saturation w. TC a. PC	FY A640-O2	0 ... 260	%	O2-S
O ₂ concentration w. TC	FY A640-O2	0 ... 40.0	mg/l	O2-C

Function Channels

Difference	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
Wet bulb globe temp.	ZA 9000-FS		°C UbGt

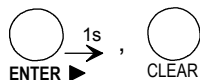
TC Temperature Compensation, PC Atm. Pressure Compensation, * 2290-3 only

The **use of function channels** for the output of measured and calculated data with corresponding reference channels is described in the man. sect. 6.3.4.

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

Function: RANGE ' R'

Keys:

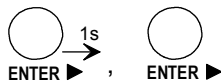


After switch-off the measured value is no longer indicated, queried, or provided as output. However, the programming is still maintained.

Re-activation of the measuring channel:

Function: RANGE ' R'

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 , Ω , $\%$, $[\square]$, $*$, $-$, $=$, \sim and spaces (\square) 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 MEAS. VALUE by pressing the key ENTER . The first character of the dimension will flash in the display. It can then be changed by using the keys \blacktriangle and \blacktriangledown . When the first character is selected the key ENTER should be pressed 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 .

Function: MEAS. VAL.



When the dimension $^{\circ}\text{F}$ 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 $\square^{\circ}\text{C}$ or $\square^{\circ}\text{F}$.

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



6.4 Limit Values

Two limit values (MAX, MIN) can be programmed for a measuring channel. An exceeding of limit values is handled as fault, similar to an exceeding of measuring range limits or sensor breakage. The measured value will flash on the display, alarm relays will respond and alarm values will be output during a measuring cycle (s.man. 6.3.9). Activation of the functions 'LH' and 'LL', s. 5.2.

Function LIMIT VALUE HIGH 'LH' and LIMIT VALUE LOW 'LL'

Select by using the key **F2**...  ...

Programming: Input according to 5.4

Switch-off:  ^{1s}  **CLEAR**

1: 1 2 3.0 LH


1: - - - - LH

6.5 Correction Values

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

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

Function ZERO POINT CORRECTION 'ZC'

Select by using the key **F2**...  ...

Programming: Input according to 5.4

Clearing with the keys: ENTER ► long, **CLEAR**

1: 0 0 3.2 ZC

1: - - - - ZC

Function SLOPE CORRECTION: 'SC'

Select by using the key **F2**... Input according to 5.4

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 slope (gain), a key combination for an automatic adjustment is available in the function **MEAS. VALUE** (see 7.1.4). If the function zero point correction is activated (s. 5.2) the corrected measured value is stored as zero point correction and will be set to zero. However, the base value will be maintained.

Function selection MEAS.VAL.  Adjustment with keys:  ^{1s}  **+/-**

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

1. With **pH probes**, if the two keys **START/STOP** and **F2** are pressed during switch-on, the locking is only temporary, i.e. until the device is switched off and set to 3. An undesired adjustment can then be avoided.
2. **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 being written into the internal calibration offset until the switch-off is performed.
3. With the following sensors, a **slope adjustment** is performed in the same way for the corresponding calibration value:

pH probe:	pH4 or pH10
Conductivity:	2.77mS/cm (FY A641-LF) or 147µS/cm (FY A641-LF2)
O ₂ saturation:	101% (FY A640-O2)

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** 'BA', **FACTOR** 'FA' and **EXPONENT** 'EX' 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.

Function **BASE VALUE** 'BA'

Select by using the key **F2**... Input see 5.4

1: - 7.0 0 BA

Function **FACTOR** 'FA'

Select by using the key **F2**... Input see 5.4

1: -.1 6 3 8 FA

Function **EXPONENT** 'EX'

Select by using the **F2**... Input see 5.4

1: 2 EX

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 **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**. The function **EXPONENT** 'EX' allows to shift the decimal point to the left (-) or right (+) as far as it can be indicated

on the display or printer. An exponential representation of measured values is not possible.

Two-Point Adjustment

The scaling values can be automatically determined by using a two-point adjustment. First, the measured value is, at its 'zero state' (ice water, unpressurized etc.), set to zero within the function MEAS. VALUE by using the keys **ENTER** ► **long**, **CLEAR** (see 7.1.7).

The sensor is then brought to a defined nominal value (boiling water, known weight etc.) and the nominal value is entered. For this purpose the key **EINGABE** ► must be pressed two times **long** (approx. 1s) within the function MEAS. VALUE until the first digit of the measured value flashes. Then, by entering the nominal value (see 5.4), the scaling value is calculated and the measured value is indicated accordingly.




The functions base value 'BA' and factor 'FA' must be activated and unlocked! (see 6.7)

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'

Select using the key **F2**...  ... Input see 5.4

1:0 0 0 5 LM



From function 'R' press **F2** one time long (reverse).

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).

7. MEASUREMENT

The instruments ALMEMO® 2290-2 and 2290-3 provide the following options for the acquisition of measuring data:

1. Continuous measurement of a selectable meas. point, s. 7.1 and man. 6.4.
Output of measuring data to the analogue output, see 8. and manual 5.1.1.
2. Single measuring point scan, see 7.2 and manual 6.5.1.1.
3. Cyclic measuring point scan, see 7.3 and manual 6.5.1.2.
4. Continuous measuring point scan, see 7.3.2 and manual 6.5.1.3.

Total Clearing of all Measured Values

On START of every cyclic measurement all max, min and average values of all channels are automatically cleared. This function can be switched off if not desired (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 3.3) only the measured value of a selected measuring point, which is at first CH1, is continuously acquired with the specified conversion rate (see 6.5.4). This is the best operating mode for a registration with the analogue output.

7.1.1 Selecting the Measured Value and Measuring Point

After switch-on the function MEAS. VALUE is automatically set and the measuring point CH1 of the first sensor is selected, i.e. the measured value M1 is indicated on the display. After activating other functions by operating the keys F1 and F2 the measured value which was indicated before can be recalled by using the key MEAS.VAL.

Within the function MEAS. VALUE, the key CH▲ allows to successively select all measuring points and indicate the actual measured value. If the key CH▲ 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.

	MEAS.VAL.	
Selecting the measured value:		1: 2 3.4 °C
	CH▲	
Increase measuring channel with key:		2: 5 1.8 %H
	CH▲	
Decrease measuring channel with key:		1s ➔ press and <u>hold</u> (approx. 1s)

7.1.2 Memory for Momentary Values

If a measured value shall be frozen at any point in time, for an easier evaluation, the key **MEAS.VAL.** must be operated again within the function **MEAS.VALUE.**

This hold function is indicated by an arrow 'HOLD' in the display.

The clearing of the memory for momentary values can be performed by pressing the key **MEAS.VAL.** once again or by selecting another function.

7.1.3 Differential Measurement (only ALMEMO 2290-3)

A true differential measurement between the inputs CH1 and CH2 or CH4 and CH5 is possible by activating the measuring channels CH3 or CH6. For this purpose, the function RANGE 'BE' must be selected by using the key **F2** and the key **CH▲** must be used to select the channel 3 or 6. After holding down the key **ENTER** ► the symbol "d1-2" or "d4-5" starts flashing, and by pressing the key **ENTER** ► once again the differential function can be activated. In this function, the measured values of both sensors involved are determined and the arithmetic difference is indicated on the display and provided as output to the analogue output.




The difference is only available if both sensors have the same measuring range (e.g. NiCr-Ni).

7.1.4 Memory for Peak Values

From the measured values that are obtained from each measuring point the maximum and minimum value is determined and stored each time. For displaying the peak values the function MAX VALUE or MIN VALUE must be selected by using the key **F1** and the required channel must be set.



Function MAX VALUE 'MH' and MIN VALUE 'ML'

Select by using the key **F1**...


...

1: 1 2 3.4 MH

Clear Max Val, Min Val:


1s


1: - - - - MH

If the cleared channel is also the selected measuring channel, the actual measured value will be immediately displayed after the clearing process.

The peak values are also cleared when a total clearing (see 7.) or a change of the measuring range is performed (see 6.2).

7.1.5 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.)


The average value of a measured value results when a number of measured values M_i are added together and then divided by the number N of the measured values:

$$\text{Average Value } \bar{M} = (\sum M_i) / N$$

For using the average value three functions are available, **AVERAGING MODE** 'AM', **AVERAGE VALUE** 'AV' and **COUNT** 'C' (function activation, see 5.2).

The type of averaging is set via the averaging mode 'MM' and can be recalled with using the key F2.

Function AVERAGING MODE 'AM'

Select by using the key F2...  ...

1:S t S t P AM

The following modes can be set with using the keys ENTER ► long, ▲ ▼, ENTER ► if a sensor with an ALMEMO® connector is plugged in:

Function

No averaging:

Display

- - - -

Averaging over Measuring Point Scans:

Continuous averaging over all cycles:

C o n t

Averaging over all measuring cycles of a print cycle:

C Y C L

Manual Averaging over Measured Values of a Channel:

Continuous average value from start to stop via keyboard

S t S t P

Aver. val. over single measurements that are captured via 'hold'

S i n g L

Manual Averaging

In this section manual averaging over measured values of the selected channel will be described. The averaging over measuring point scans can be found in the manual section 6.7.4.

Averaging over Time

To obtain the average value of all measured values of a measuring channel over a specified time period, the averaging mode 'StStP' must be set for the selected measuring channel. For example, by uniformly scanning an area, this mode also allows to determine the average flow velocity in an air vent (see manual 3.5.5). For distinguishing between the manual and the cyclic averaging the following requirements must be met:

- averaging mode of the selected channel 'StStP'
- no cyclic measuring point scan (cycles stopped)
- no continuous measuring point scan (no C in conversion rate)

1. Select the function AVERAGE VALUE 'AV' with using the key F1.

2. Clear the average value with using the keys

ENTER ► long, CLEAR

1: - - - - AV

3. The averaging can be started with the key **START/STOP**. The arrow 'AVERAGE' will then be indicated in the display.

4. The averaging can be stopped by operating the key **START/STOP** once again. The arrow 'AVERAGE' clears again and the average value can be read.

1: 1 2.3 4 AV

Averaging over a Number of Single Measurements

For an averaging of isolated measurements at certain points or times (e.g. net measurements) the averaging mode 'SinGL' must be used. In this case corresponding requirements must also be met:

- Averaging mode of the selected channel 'SinGL'
- No cyclic measuring point scan (cycles stopped)
- No continuous measuring point scan (no C in conversion rate)

1. Before each measurement the average value must be cleared in the function AVERAGE VALUE by using the keys ENTER ► long, CLEAR.

2. In the function MEAS. VALUE the single values are captured in the memory for instant values by pressing the key **MEAS.VAL**. The arrow 'HOLD' appears in the display.

3. If the value is correct, it can be transferred into the memory for average values by operating the key **START/STOP**. The arrow 'HOLD' will then turn off.

4. If the value is not correct, it can be rejected by operating the key **MEAS.VAL** once again, i.e. the arrow 'HOLD' turns off and the current value is indicated.

5. To acquire more values, the steps 2 to 4 can be repeated.

6. To **indicate the average value** the function AVERAGE VALUE 'AV' must be selected with using the key F1.

7. With operating the key F1 once again, the **count N of averaged values** can be obtained within the function 'C'.

Function COUNT 'C'



Select by using the key F1... ..

Display:

1: 0 1 2 3 C

7.1.6 Volume Flow Measurement

For determining the volume flow in VF in ventilating channels the average flow velocity \bar{V} is multiplied with the cross section area CS:

$$VF = \bar{V} \cdot CS \cdot 0.36$$

$$VF = m^3/h, \bar{V} = m/s, CS = cm^2$$

The **average flow velocity** \bar{V} can be determined by a **time-based averaging** with rough air volume measurements at air vents (see 7.1.5 and man. 3.5.5). The rotating vane is properly placed at one end and the averaging is started. The whole cross section is uniformly measured and, when reaching the other end, the averaging is stopped again.

Alternatively, the average flow velocity can be determined by **single net measurements** according to VDI/VDE 2640 (see 7.1.5 and man. 3.5.5) (e.g. 13.24 m/s).

Function **AVERAGE VALUE** 'AV'

Select by using the key F1...

Display \bar{V} m/s:

1: 1 3.2 4 AV

Entering the Cross Section Area

The cross section area CS can either be directly entered within the function CS, with 32000cm² at maximum, or within the function DN via the diameter, with 2000mm at maximum (see 5.4).

Function **CROSS SECTION AREA** 'CS'

Select by using the key F2...

Input cm², see 5.4

1: 0 1 7 5.CS

Function **DIAMETER** 'DN'

Select by using the key F2...

Input mm, see 5.4

1: 0 1 5 0.DN

Indication of the Volume Flow

The result of the multiplication of the average velocity and the cross section area CS is the air volume. This volume flow VF is automatically calculated and is displayed in m³/h in function 'VF'.

Function **VOLUME FLOW** 'VF':

Select by using the key F1...




Display VF m³/h:

1: 0 8 3 4.VF

7.1.7 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 to check the deviation from the reference value. The indicated measured value is, by the following key combination, stored as base value and set to zero.

Function: MEAS. VAL. with key  Zero setting:  ^{1s} 



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

If the function 'BA' is activated the new base value is stored in the EEPROM of the connector (see 6.6). If not, the previous value will be indicated again when switching the instrument off and on.




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. If the function 'BA' is not activated, a switch-off of the system (see above) is sufficient. However, if the function 'BA' is available, is selected with using the key **F2** and the base value is cleared by using the keys ENTER ► long, **CLEAR**.

Function: BASE 'BA' with key  .. Clear base:  ^{1s} 

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). The zero point correction is performed using the following keys:

Function: MEAS. VAL.  Zero point adjustment:  ^{1s} 



The function zero point adjustment is only available if the function zero point correction is activated (s. 5.2) and if the locking mode is set below 4 (see 6.7).

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

7.1.8 Atmospheric Pressure Compensation

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


For example, error per 100 mbar:

Compensation Range:

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

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 ATMOSPHERIC PRESSURE 'mb'

Select by using the key  ... Input mbar, see 5.4

1 0 1 3 m b

With each reset the atmospheric pressure is set to 1013mb. It can be set to the actual value by the usual data entry (see 5.4).

7.1.9 Temperature Compensation

Sensors with measured values that are strongly depending on the temperature of the measuring medium are, in most cases, equipped with a specific temperature sensor and the instrument will automatically perform a temperature compensation (see measuring range list 6.2 'w. TC'). However, dynamic pressure probes and pH probes are also available without a temperature sensor. If the temperature of the medium deviates from 25°C the following measuring errors must be considered:

For example, error per 10 °C:

Compensation Range:

Dynamic pressure	ca. 1.6%	-50 to 700 °C
pH probe	ca. 3.3%	0 to 100 °C

The temperature compensation can also be performed with external temperature sensors by using the reference channel, or within the function 'TC' by entering the temperature manually:

Function TEMPERATURE COMPENSATION 'TC'

Select by using the key  ... Input °C, see 5.4

1: 1 8 0.0 T C

Display when autom. temp. compensation is selected:

1: A u t o T C

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. If an interface module is connected to the socket OUT1 the functions PRINT CYCLE 'PC', MEAS.CYCLE 'MC', TIME 'ZT' and DATE 'DA' will automatically be activated for key F1, and the BAUD RATE 'BR' and DEVICE ADDRESS 'A' for key F2. As long as no print cycle and no measuring cycle has been programmed (e.g. after a reinitialisation, see 3.3) the key **START/STOP** can be used to start single measuring point scans for acquiring the momentary measured values of all active measuring points. These values are sequentially indicated on the display for approx. 1.5 seconds. During this process the arrow 'START' is displayed and then turns off again. If the time was cleared before, it will be started. If a peripheral device (e.g. printer) is connected (see man. 5.2) the measured values are provided for one time as an output via interface and, in addition, the arrow 'RS232' is indicated (print output, see manual 6.6.1). With each press of the key the measured values are correspondingly processed. If the true daytime has to be indicated as the measuring time, it must first be set (see 7.3.3).

Single Measuring Point Scan: Key:  (cycles 00:00:00)

7.3 Cyclic Measuring Point Scan (see manual 6.5.1.2)

For cyclic measuring point scans the measuring or print cycle (s. 7.3.1/2) must be programmed. The measurement is started with the key **START/STOP** and the arrow 'START' is continuously displayed. If a peripheral device is connected, the measured values are provided as a cyclic output and the arrow 'V24' is indicated. Different output formats are available (s. 9.1). The measurement must be started in the function RANGE 'R' 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 measuring point scan: Key:  (cycle programmed)

Stopping of the automatic measuring point scan can be achieved by operating the key **START/STOP** once again. The indications 'START', 'RS232' and 'MEMORY' will disappear.

Stop cyclic measuring point scan: Key: 

7.3.1 Print Cycle

For cyclic measuring point scans and outputs the print cycle can be set in the function PRINT CYCLE 'PC'.

Function PRINT CYCLE 'PC'

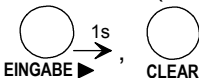
Select by using the key F1...



0 0:3 0:0 0 PC

6-digit programming in format hh:mm:ss (s. 5.4). *Example:* print cycle 30 min

Clear print cycle with keys:



0 0:0 0:0 0 PC

A running cyclic scan is terminated by this.

7.3.2 Measuring Cycle

The measuring cycle can be used, either for cyclic averaging (see man. 6.7.4) or for monitoring the measured values and performing an alarm list output when limit values have been exceeded. For indicating the measuring cycle (hh:mm:ss) the function MEAS.CYCLE 'MC' must be activated using key F1.

Function MEAS. CYCLE 'MC'

Select by using the key F1...



0 0:0 1:0 0.MC

6-digit programming in format hh:mm:ss (s. 5.4). *Example:* meas.cycle 1min

The continuous conversion rate can be switched on or off by using the key CH▲ (s. man. 6.5.1.3). For control a dot is indicated following the measuring cycle. The measuring cycle can be cleared or stopped using the keys ENTER ► long, CLEAR.

7.3.3 Time and Date

The ALMEMO® 2290-2/3 is equipped with a clock with date function. As it is not battery-backed, time and date are cleared when the device is switched off.

Function TIME 'TM'

Select by using the key F1...

1 2:3 4:5 6 TM

6-digit programming in format hh:mm:ss (see 5.4).

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

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

Function DATE 'DA'

Select by using the key F1...

0 1:0 5:9 9 DA

Example: date 1st May 1999

6-digit programming in format dd.mm.yy (see 5.4). 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 ► long, CLEAR.

8. 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 OUT1 or OUT2.

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 -10.0 to +50.0°C). To achieve this the **analogue output-start** and the **analogue output-end** of the desired measuring range must be entered within the functions 'AS' and 'AE' (see also man. 6.10.7). If the initial value is zero it will remain cleared. For activating the functions 'AS' and 'AE', see 5.2.

Analogue Output-Start:

Select by using the key F2... Input, see 5.4

1: - 1 0.0 A S

Analogue Output-End:

Select by using the key F2... Input, see 5.4

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

If the measuring points are being continuously scanned, two analogue outputs can be connected simultaneously. The measured value of the selected channel is available at the OUT2 output. The measured value of the selected sensor of the first channel is available at the output of OUT1 (see also man. 6.10.7).

9. DIGITAL DATA OUTPUT

Via serial interface the instrument and the sensor can be completely programmed, the programming can be queried (see man. sect. 6) or, as described in sections 7.2 and 7.3, manual and cyclic measurements can be provided as output to a printer or computer. The different interface modules can be connected to socket OUT1 (3). The connection to the instruments is described in the manual section 5.2. Other modules for networking the instruments follow in the manual section 5.3.

The output of all single values and of the programming of the instrument is only possible by using interface commands or an additional trigger cable (see 9.3).

9.1 Baud Rate, Data Format, Output 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 57600 bd can be set within the function BAUD RATE 'BR' via keyboard.

The input is started with long pressing 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 'BR'

Select by using the key **F2**:

U n 9 6 0 0 BR

Example: Output to interface 'U', format 'column', 9600 bd

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

Output Formats (see man. 6.5.5 and 6.6.1)

The output format determines the print output at measuring point scans. 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).


The **output format** is indicated by a letter between the output channel 'U' and the baud rate. The key **CH▲** can be used to successively select the following options.

Output Format	Format	Baud Rate
measured values in a list	U	9 6 0 0 BR
n measured values in columns	U n	9 6 0 0 BR
t meas. val. in spreadsh. format	U t	9 6 0 0 BR

9.2 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 can be performed by using the function **DEVICE ADDRESS 'A'**. It can be selected with the key **F2** and the currently set device number is displayed, which is usually factory-set to 00. It can then be modified by normal data entry (see 5.4).

Function DEVICE ADDRESS 'A'

Select by using the key **F2**:  ... Input, see 5.4



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.

9.3 Manual Data Output

Using the keyboard of the instrument, only manual and cyclic measuring point scans can be provided as output to a printer or computer. When starting from the function **RANGE 'R'**, a header with the programming is also available. All other functions that have been selected by using the keys **F1** or **F2** can either be printed out using interface commands, or via an additional trigger cable (accessory ZA 1000-ET, variant 3, see man. 6.10.9).

The trigger cable can be connected to socket OUT1 and the external key can be used to trigger the following print outputs:

Function	Ab	Ke	Print Output
MEAS. VAL.			12:34:00 01: +0023.5 °C
MAX VALUE			MAXIMUM: 01: +0020.0 °C
MIN VALUE			MINIMUM: 01: -0010.0 °C
AVERAGE V.			AVERAGE VAL: 01: +0017.8 °C
COUNT	AM	F	CH MEAS.VAL MAXIMUM MINIMUM AVG COUNT
all meas. values	C	F,	01:+0023.0 +0025.0 +0019.0 +0022.0 99999 s. man. 6.4.4
		F	
VOLUME FLOW	V	F1	VOLUME: 01: 00419 m3/h
PRINT CYCLE	PC	F1	PRINT CYCLE: 00:06:00
MEAS. CYCLE	MC	F1	MEAS. CYCLE: 00:01:30
TIME	T	F1	TIME: 12:34:00
	M		
DATE	DA	F1	DATE: 01.02.99
RANGE	R	F2	01:NiCr +0123.4 -0012.0 +0000.0 °C 1.0000 E+0 - - -
LV MAX	LH	F2	LIM-MAX: 01: -0100.0 °C
LV MIN	LL	F2	LIM-MIN: 01: +0020.0 °C
ZERO POINT	ZC	F2	ZERO CORR: 01: -0000.7 °C
SLOPE	SC	F2	SLOPE CORR: 01: +1.0013
BASE	BA	F2	BASE VAL: 01: -0273.0 °C
FACTOR	FA	F2	FACTOR: 01: +1.0350E-1
EXPONENT	EX	F2	FACTOR: 01: +1.0350E-1
AVG MODE	AM	F2	01:NiCr +0123.4 -0012.0 +0000.0 °C 1.0000 E+0 STSTOP
CROSS SECTION	CS	F2	CROSS SECT: 01: 00078 cm2 DIAMETER: 00100 mm
DIAMETER	DN	F2	CROSS SECT: 01: 00078 cm2 DIAMETER: 00100 mm
ANALOG. START	AS	F2	ANALOG START:01: +0000.0 °C
ANALOG. END	AE	F2	ANALOG END: 01: +0100.0 °C
ATM. PRESSURE	mb	F2	DEVICE: G00 M11 A01 P03/11/00
DEVICE ADDR.	A	F2	A.PRESSURE: +01013. mb
(Dev.Programming)			CJ-TEMP: +0023.5 °C
			U-SENSOR: ! 12.5 V
			HYSTERESIS: 10
			CONFIG: FC-DA--- -L--
			ALARM: -1-3
			A1: DK0 Un
			A2: AK1
			s. man. 6.2.5
BAUD RATE	BR	F2	AMR ALMEMO 2290-2
(Sensor			
Programming)			CH RANGE LV-MAX LV-MIN OFFSET D FACTOR EXP AVG COMMENT
			01:Ntc +040.00 - - - - - °C 1.0123 E+0 - - - Temperature
			02:°o H +0060.0 +0020.0 - - - %H - - - E+0 - - - Humidity
			MEAS CYCLE: 00:00:30 W010 C--U-
			PRINT CYCLE: 00:10:00 Un 9600 bd
LOCKING	LM	F2	CH 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
			s. man. 6.10.1

10. TROUBLESHOOTING

The data logger ALMEMO® 2290-2/3 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: No display data or all display segments are permanently illuminated.

Remedy: Check power supply, recharge battery, switch off and on again, reinitialise (see 3.3)

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 external power supply and output modules.

Disconnect all suspicious sensors and replace them by hand-held sensors operated in air or by dummies (short circuit AB at thermocouples, 100Ω at Pt100 sensors).

If the error is corrected by this, 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 9.1)?

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 **START/STOP** 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 $y \text{ CR LF}$.
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 loggers ALMEMO® 2290-2/3 meet 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 products:

EN 50081-1:1992

EN 50082-1:1992

IEC 801-2 8kV, IEC 801-4 1kV

IEC 801-3 3V/m: deviation < 100 μ V

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

Technical Data (see manual 2.2)

Measuring Inputs:	2290-2: 1 ALMEMO® socket for ALMEMO® flat connector 2290-3: 2 ALMEMO® sockets for ALMEMO® flat connector
Measuring channels:	2290-2: 1 primary channel 3 add. chann. for double sensors and function chann. 2290-3: 2 primary channels, electrically isolated 6 add. chann. for double sensors and function chann. 2 differential measuring channels
Sensor voltage supply:	battery: 7 to 9V, max. 100mA mains adapter: ca. 12V, max. 100mA
Outputs:	2 ALMEMO® sockets for all output modules
Equipment:	
Display:	6½ digit 7-segment, 2 digit 16-segment, 12mm
Keyboard:	5 keys
Time and date:	not buffered
Microprocessor:	HD 6303 Y
Voltage Supply:	7 to 13V DC not electrically isolated
Mains adapter:	ZB 2290-NA 230V AC to 12V DC, 200mA electr. isol.
Adapter cable electr. isol.:	ZB 2290-UK 10 to 30V DC to 12V DC, 250mA
Current consumption:	2290-2: approx. 5.5 mA (without I/O modules) 2290-3: ca. 7 mA (see above)
Housing:	180x85x33mm, ABS high impact strength (70°C max)
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® 2290-2/3 Operating Instructions ALMEMO® 2290-2/3 ALMEMO® Manual incl. software AMR-Control

Product Overview

Multifunctional Measuring Instrument ALMEMO® 2290-2

1 input, 4 channels max., 5 keys,
RS232 interface that can be cascaded

Order No.

MA 2290-2

Multifunctional Measuring Instrument ALMEMO® 2290-3

2 inputs, 10 channels max., 5 keys,
RS232 interface that can be cascaded

MA 2290-3

Mains Adapter 12V DC, 200mA

ZB 2290-NA

DC Adapter Cable 9 to 30V DC, 12V/250mA electr. isol.

ZB 2290-UK

ALMEMO® Recording Cable -1.25 to 2.00 V, 0.1mV/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



