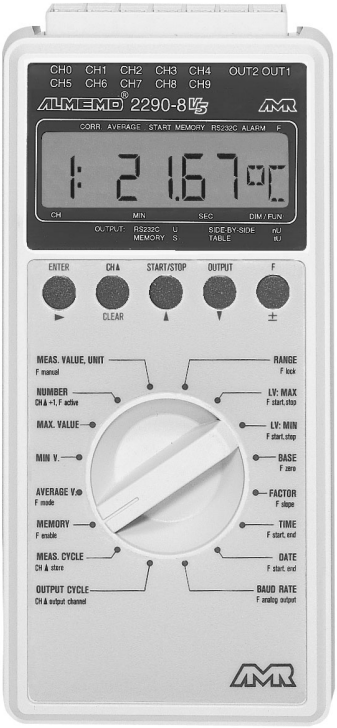


Operating Instructions

Data Logger

ALMEMO® 2290-8 V5

V2.1
04.12.2003

Operating Instructions

Data Logger

ALMEMO® 2290-8 V5

For reference with the ALMEMO® Manual

Table of Contents

1. INTRODUCTION

The new data logger ALMEMO® 2290-8 *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® 2290-8 data logger has five electrically isolated measuring inputs with up to 20 measuring channels for more than 70 measuring ranges, 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. 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
A total of up to 20 measuring channels are available for 5 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_2 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.

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

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 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 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. Deductible ALMEMO® memory connectors are alternative usably. 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.

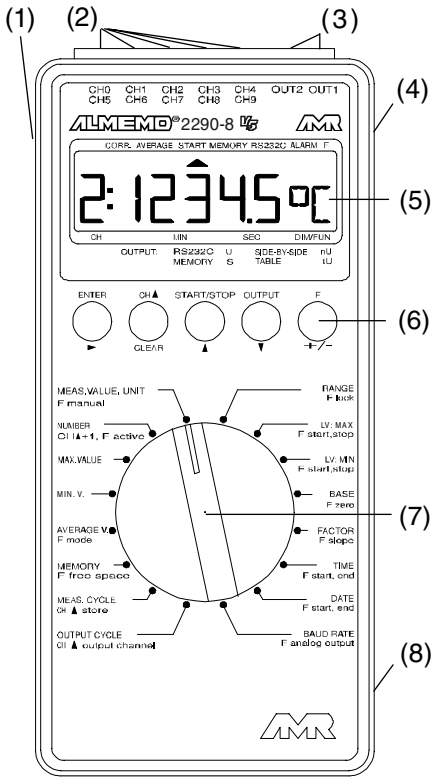
Keyboard Lock
The keyboard operation can be locked with a password.

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

1.2 Operating Controls



(1) ON/OFF switch

up	SLEEP
centre	ON
down	OFF

(2) Measuring Inputs CH0 to CH4
CH0 to CH4 for all ALMEMO® sensor
CH5 to CH19additional channels

(3) Output Sockets OUT1, OUT2

OUT1 Interface RS232 (ZA 1909-DK5)
Fiber Optics RS232 (ZA 1909-DKL)
Ethernet (ZA 1945-DK)
Centronics (ZA 1936-DK)
RS 422 (ZA 5099-NVB)
Analogue Output 1 (ZA 1601-RK)

OUT2 Network Cable (ZA1999-NK5)
Memory connector (ZA1904-SS)
Trigger Input (ZA 1000-ET/EK)
Relay Outputs (ZA 1000-EGK)
Analogue Output 2 (ZA 1601-RK)

(4) DC Socket
Mains Adapter (ZB 2290-NA, 12V, 200mA)
Cable, electr. isol. (ZB 2290-UK, 10-30V)

(5) LCD Display

(6) Function Keys

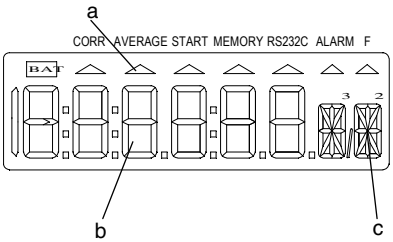
(7) Function Selector Switch

(8) Battery Box (back of unit)
Alkaline mangan. battery 9V (6F22)
Space for spare battery

(5) LCD Display

(a) Symbols for operating modes

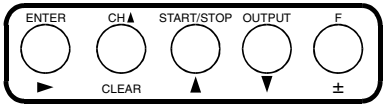
BAT	U battery < 7 V
▲ CORR	Correction of meas. value
▲ AVERAGE	Averaging
▲ START	Measuring point scan
▲ MEMORY	Memory receive, output
▲ RS232C	Output of meas. value
▲ ALARM	Exceeding of limit value
▲ F	Additional function



(b) 6½ x 7 segment display for:
Meas. point, meas. value, meas. range, meas. and progr. values, cycles, time, date

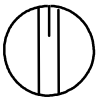
(c) 2 x 16 segment display for:
Dimension of the measured value, Abbrev. for additional functions

(2) **FUNCTION KEYS**



ENTER,	± , ▲ ▼, ▶	for entering programming values
ENTER,	CLEAR	clear data, set meas. value to zero
ENTER,	±	calibrate measured value
M ▲		select measuring point
START/STOP		cyclic measuring point scan
OUTPUT		data output to interface
F		single measuring point scan
		select additional functions

(3) **FUNCTION SELECTOR SWITCH**



Function	**Key**	**Additional functions**	**Abbrev.**
MEAS. VALUE, UNIT	F	single measuring point scan	
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	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	slope (gain) correction	SC
	F	emissivity factor	EF *
MEMORY	F	free memory	FR
MEAS CYCLE	CH▲	store on/off	S
	F	conversion rate	CR
PRINT CYCLE	CH▲	output channel / format	U
	F	device address	A
TIME	F	start time	S
	F,F	end time	E
DATE	F	start date	S
	F,F	end date	E
BAUD RATE	F	atmospheric pressure	mb

* infrared sensors only

2. INITIAL OPERATION

1. Connect **transducers** in the correct order to the sockets CH0 to CH4, 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 to the centre position, see 3.3.
4. **For displaying** the measured values,
   select function MEAS. VALUE by using the rotary switch (7),
   use key **CH▲** to select the measuring channels, read meas. values, see 7.1.
5. **For storing** the measured values, see 7.4.
   Use function MEMORY and keys **ENTER**, **CLEAR** to clear the memory.
   Use MEAS. CYCLE and key **CH▲** to activate the memory ´S´, see 7.3.2.
   Single measuring point scan by key **F** within function MEAS.VALUE, 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, see 8.1.
   Use key **CH▲** within function OUTPUT CYCLE to set the output channel ´ U´ and, possibly, the 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, see 8.1.
   Enter time and date, as required, see 7.3.4.
   Program the print cycle within function OUTPUT 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 OUT2,
   see man. 5.1.2/5.1.3.
   For an alarm print use key **CH▲** within function OUTPUT 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 or MIN VALUE, see 7.1.2.

3. POWER SUPPLY

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

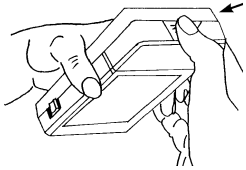
- 9V battery IEC 6 F22 — ZB 2000-B9
- 9V rechargeable battery, as above with charger unit integrated in plug — ZB 2000-A9, ZB 2000-LS
- Mains adapter 12V/200mA — ZB 2290-NA
- External power supply, connecting cable — ZB 2290-UK

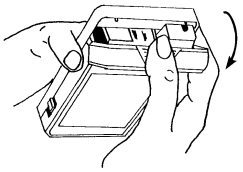
Our product line includes corresponding accessories.

3.1 Operation with Battery and Rechargeable Battery

Only use type IEC 6 F22 alkaline manganese batteries. At a current consumption of approximately 10mA, they last for an operating time of 35 hours. The operating time will be shortened if sensors or modules are connected that consume additional current.

Inserting Batteries:

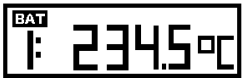




The battery box (8) is located at the underside of the instrument.

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 Ubat 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 11 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 10...30V 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 three positions:

- up: ON sleep mode
- centre: ON normal mode
- down: OFF

To **switch-on** the active measuring mode the slide switch (1) on the left side must be moved one step upwards (centre position).
The second, top position is meant for a power-saving operation when the device is temporarily switched off and afterwards by the real time clock is regularly, in cycles, switched on again for measuring point scans. An automatic query cycle (for at least 2 minutes) must be started (see 7.6) for switching to the sleep mode for long term monitoring.

The device is **switched off** when the slide switch is moved to the lower position. However, the real time clock continues its operation and all stored values will be maintained (see 3.4).

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. 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.

3.4 Battery Buffer

A lithium battery (3V) is integrated in the device and ensures an uninterrupted power supply for the real time clock and memory. As a result, the time and date and all stored data will be maintained if the 9V battery is replaced or if the power fails during operation with mains supply.

4. CONNECTION OF THE TRANSDUCERS

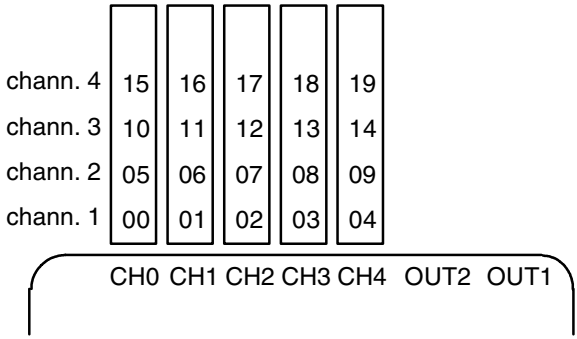
Any ALMEMO® sensors can be connected to the ALMEMO® input sockets CH0 to CH4 of the measuring instrument (2). For connecting existing sensors it is only necessary to connect a corresponding ALMEMO® connector.

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® 2290-8 has 5 input sockets (2) that the measuring channels CH0 to CH4 are initially allocated to. However, ALMEMO® sensors can, if required, provide up to 4 channels so that 20 channels are available with 5 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 5 (e.g. the first sensor has the channels CH0, CH5, CH10, CH15, the second sensor has the channels CH1, CH6, CH11, CH16 etc.).



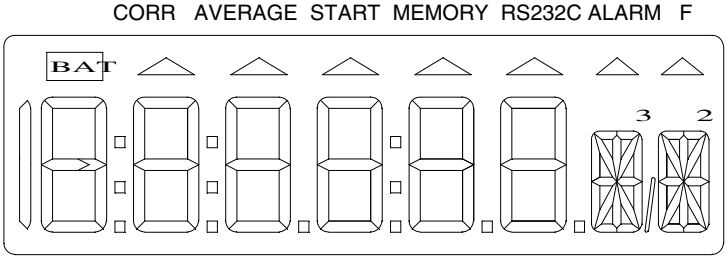
The 5 analogue inputs are electrically isolated by using photovoltaic relays and a potential difference of 50V DC or 60V AC, at maximum, is permissible between them. However, sensors combined within one connector and sensors with an own power supply are electrically connected to each other and must,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

The cold junction compensation for thermocouple measurement is integrated in socket CH0 of the device.

5. DISPLAY AND KEYBOARD

5.1 Display and Function Selection

The display (5) of the measuring device ALMEMO® 2290-8 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.



The basic functions are set by the function selector switch (7). If required, the additional functions can be selected by the key **F**. The presentation of the functions on the display is as follows:

Meas. Val.:	chann. -	meas. value	dimension	19:2.1 2 3 4 mV
Range:	chann.	short name	dimension	1: N i C r °C
Parameter:	chann. -	value	dimension	
	chann. -	factor	exponent	
Number:		value	-/active	N 1 2 - 0 1 A
Cycles:	hours minutes	seconds	output chann.	1 2:3 4:5 6 TM
Times:	hours minutes	seconds	function	
Start:	not activated		function	- - - - - - S
End:	hours minutes	seconds	function	1 8:3 0:0 0 E
Date:	day month	year	function	0 1.0 1.9 6 DA
Baud Rate:		baud	BR	9 6 0 0 BR

Special Operating Conditions

Segment test of the display		automatically after switch-on.
Supply voltage:	lower than 7V:	BAT symbol illuminated
	lower than 6V:	1:L o b A t
Sensors that are not connected, deactivated measuring points, cleared programming values.		1: - - - -
Memory output		S O u t u
Sensor correction or scaling		arrow **CORR** illuminated.
Measuring point scan in progress		arrow **START** illuminated.
Measuring point scan with storing		arrow **MEMORY** illuminated.
Measuring point scan with output		arrow **RS232C** illuminated.
Additional function selected		arrow **F** 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 **ALARM** illuminated
Undershoot. of meas. range CJ compens. Measuring without ext. CJC or CJC break.:	1: C J	(cold junction) flashes
Exceeding of range of values (>65000):	1:6 5 0 0 0	flashes

5.2 Keyboard

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

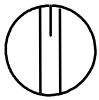
Function	Normal	Enter
Programming of Parameters	**ENTER**	▶
Selecting Measuring Points	**CH** ▲	CLEAR
Start and Stop of Meas. Point Scans	**START/STOP**	▲
Data Output	**OUTPUT**	▼
Selecting Additional Functions	**F**	±

After operating the key **ENTER** a digit or abbreviation is flashes in the display, i.e. the instrument is in edit mode and the red designations below the keys are valid. The keys ±, ▲, ▼ are then available for altering the input figure, the key ▶ 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 ▶ .

5.3 Data Entry

The programming of numeric parameters is performed as follows:

The desired function can be selected using the rotary switch (7).



Additional functions, if required, are selected using the key **F.**

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

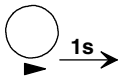
The digit can be **increased** using the key ▲ .
After exceeding the maximum value the cycle restarts from zero.

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 ± .

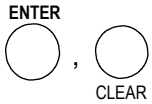
A switch to the next digit is performed using the key ▶ .

To switch back to the previous digit press and hold the key ▶ .



The programming process is complete
after setting the last digit and again operating the key ▶ .

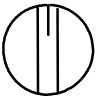
Programming and measured values can be cleared using

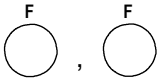


The programming process can be cancelled by operating the rotary switch.

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).

Locking Code (LC):  RANGE

Keys: 

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

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

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 3.3).

6. SENSOR PROGRAMMING

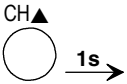
As all ALMEMO® instruments contain the whole sensor programming stored in the ALMEMO® connector plug, the user does not usually need to perform any programming. Only if, for example, sensor errors must be corrected or existing sensors must be scaled or limit values need to be specified the comprehensive 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)

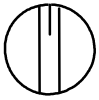
Decrease the input channel by: 

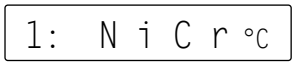
press and hold (approx. 1 sec)

6.2 Selecting the Measuring Range

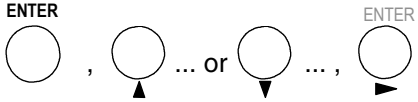
If users want to program the connectors on their own or frequently change the measuring range, it is necessary that the locking is cleared (see 6.7) and special connectors may be required for some transducers (e.g. thermo, shunt, divider etc., see table).

The selection of the measuring range is performed within the function RANGE. 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 ▲ 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 Selection:  RANGE



Example: channel CH1, range NiCr, dimension °C

Meas. Range Selection: 

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

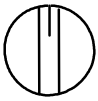
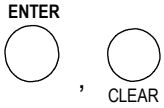
Transducer	Conn. / Cable	Meas. Range	Dim.	Display
Millivolt 2	ZA 9000-FS	-260.00...+260.00	mV	U260
Volt	ZA 9000-FS	-2.6000...+2.6000	V	U2.60
Differential-Millivolt 1	ZA 9050-FS	-26.000...+26.000	mV	d 26
Differential-Millivolt	ZA 9050-FS	-10.000...+55.000	mV	d 55
Differential-Millivolt 2	ZA 9050-FS	-260.00...+260.00	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
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
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	S120
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
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

Transducer Function Channels	Conn. / Cable	Meas. Range	Dim.	Display
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
Thermal coefficient	ZA 9000-FS		W/m^2K	q:dt
Wet bulb globe temp.	ZA 9000-FS		°C	UbGt

TC Temperature Compensation, PC Atmospheric Pressure Compensation

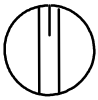
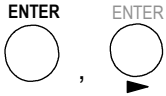
The **use of the function channels** for the output of measuring and calculated variables with the corresponding reference channels is described in the manual section 6.3.4.

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:** 

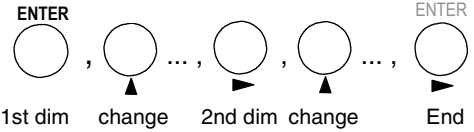
If the channel was previously activated, the channel will be re-activated with all programming values. However, if the channel is already active, all programming values will be cleared by operating the above key combination (corresponds to selecting a measuring range).

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 □, □̲, Ω, %, [,], *, -, =, ~ 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 MEAS. VALUE, DIM 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 ▲ and ▼. When the first character is selected the key ▶ 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., DIM



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 □̲ .

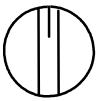
The dimension ms is indicated on the display as m/s, and mh as m³/h.

6.4 Limit Values

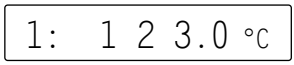
Two limit values (MAX and MIN) can be programmed for each measuring channel. The exceeding of the limit values is handled as a fault, similar to the exceeding of the measuring range limits and sensor breakage. The arrow ALARM will appear in the display and the alarm relays will respond and the alarm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

Function:

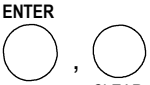
Limit value Max
Limit value Min

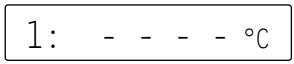


LV MAX
LV MIN



Programming: Input according to 5.3

Switch-off: 



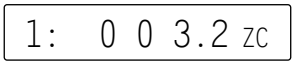
6.5 Correction Values

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.

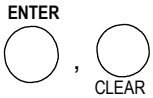
Function:
Zero point correct.
(ZC)

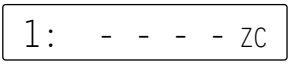
Key:



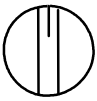
Programming: Input according to 5.3

Clear: Keys:

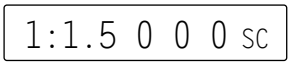




Function:
Slope correction
(SC)



Key:



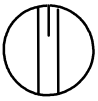
Programming: Input according to 5.3

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

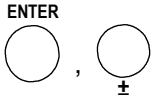
Sensor Adjustment

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 the function **MEAS. VALUE** (see 7.1.4). 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:

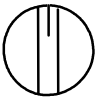


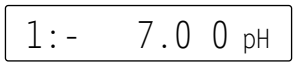
6.6 Scaling, Decimal Point Setting

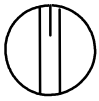
For indicating the electrical signal of a sensor as a measured value of a physical variable it is, in most cases, necessary to set a zero point shift and to perform a multiplication with a certain factor. The functions BASE and FACTOR are available for this. A detailed description of the scaling, including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

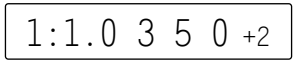
Indicated value = (corrected measured value - BASE) x FACTOR.

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 value  BASE input see 5.3



Function:
Factor,
Exponent  FACTOR input see 5.3

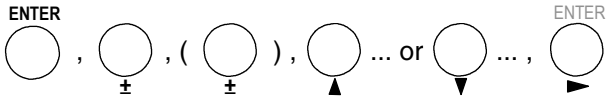


The arrow **CORR** will be indicated in the display if scaling values are programmed and if the measured value is actually modified.

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** within the function FACTOR the keys **ENTER**, ± must be pressed so that the exponent is flashing. The sign can then be changed by using the key ± . The numerical value is set by using the keys ▲ and ▼ and the programming can be completed by using the key **ENTER**.

Input exponent: 

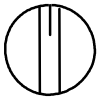
Two-Point Adjustment
The scaling values can be automatically determined by using a two-point adjustment. First, the measured value is, at its 'zero state' (ice water, unpressurized etc.), set to zero within the function MEAS. VALUE by using the keys **ENTER**, **CLEAR** (see 7.1.4).
The sensor is then brought to a defined nominal value (boiling water, known weight etc.) and the nominal value is entered. For this purpose the key **ENTER** must be pressed and held (approx. 1s) within the function MEAS. VALUE until the first digit of the measured value flashes. Then, by entering the nominal value (see 5.3), the scaling value is calculated and the measured value is indicated accordingly.

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

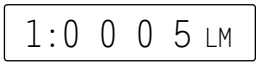
The function parameters of each measuring point are protected by the locking mode up to an adjustable locking level. Before any programming is performed the locking mode must be correspondingly lowered. If a dot is indicated following the locking mode on the display then a modification is not possible.

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)



Key:



Programming: Input according to 5.3

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 .

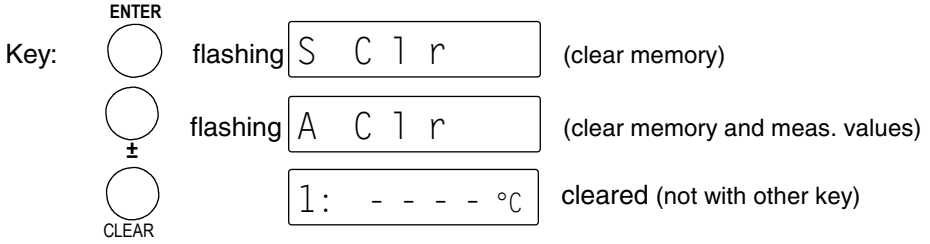
7. MEASUREMENT

The instrument ALMEMO® 2290-8 provides the following options for the acquisition of measuring data:

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

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**, **±**, **CLEAR**.



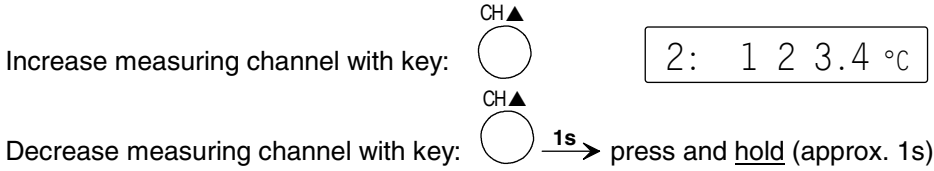
For automatic clearing on each START, see manual 6.10.13.2.

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 3.3) only the measured value of a selected measuring point, which is at first CH0, 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 **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.

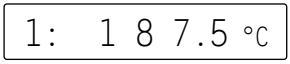


7.1.2 Memory for Peak Values

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. VALUE or MIN V. must be selected with the rotary switch and the desired channel must be set by using the key **CH▲**.

Function:

Peak values:  MAX. VALUE
MIN. V.



Clear: Using the keys **ENTER**, **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 Averaging

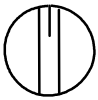
The **average value** of the measured value is required for various applications:

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, $\overline{A}$, results when a number of measured values A_i are added together and then divided by the number N of the measured values:

$$\text{Average Value } \overline{A} = (\sum_{i} A_i)/N$$

Indication and programming of an average value is performed by setting the rotary switch to AVERAGE V. **The type of averaging** is determined through the averaging mode. This function (AM) is activated by key **F**.

Averaging Mode:  AVERAGE V. Key: 

The following modes can be set with the keys **ENTER**, ▲▼, **ENTER**, if a sensor with an ALMEMO® connector is connected:

Function	**Display**
No averaging:	- - - -
<u>Averaging over Measuring Point Scans:</u>	
Continuous averaging over all cycles:	C o n t
Averaging over all measuring cycles of a print cycle:	C Y C L
<u>Manual Averaging over Measured Values of a Channel:</u>	
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

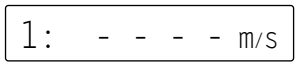
In this section manual averaging over measured values of the selected channel will be described. The averaging over measuring point scans can be found in the manual section 6.7.4.

Averaging over Time

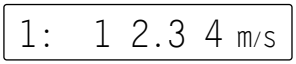
To obtain the average value of all measured values of a measuring channel over a specified time period, the averaging mode ´StStP´ must be set for the selected measuring channel. For example, by uniformly scanning an area, this mode also allows to determine the average flow velocity in a ventilating channel (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. Move rotary switch to the function AVERAGE V.
2. Clear the average value by the keys **ENTER**, **CLEAR**.



3. Start the averaging with the key **START/STOP**, the arrow ´AVERAGE´ will be illuminated in the display.
4. Stop the averaging by operating the same key. **START/STOP**, the arrow ´AVERAGE´ disappears and the average value can be read.



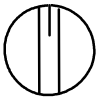
Averaging over a Number of Single Measurements

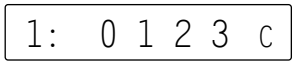
For an averaging of isolated measurements at certain points or times (e.g. net measurements according to VDI/VDE 2640, see manual 3.5.5) the averaging mode ´SinGL´ must be used. In this case corresponding requirements must also be met:

- 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 V. by using the keys **ENTER**, **CLEAR**.
2. In the function MEAS. VALUE the single values are captured in the memory for instant values by pressing the key **START/STOP**. The arrow ´MEMORY´ appears in the display.
3. If the value is correct, it can be transferred into the memory for average values by operating the key **ENTER**. The arrow ´MEMORY´ disappears and the arrow ´AVERAGE´ is now indicated.

4. If the value is not correct, it can be rejected by operating the key **START/STOP** once again, i.e. the arrow ´MEMORY´ disappears and the instantaneous value is indicated again.
5. To acquire more values, the steps 2 to 4 can be repeated.
6. To **indicate the average value** the function AVERAGE V. must be selected.
7. By operating the key **F** twice, the **count C of averaged values** can be obtained within the function ´ C´.

Count N:  AVERAGE V. Keys: F , F



The key OUTPUT allows for a printout of average values, at any time, either as single values or as a list, including the count and max/min values (see 8.3).

7.1.4 Setting Measured Value to Zero, Zero Point Correction

Setting the Measured Value to Zero

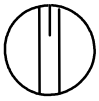
The user can zero the measured value at certain locations or at certain times in order to check the deviation from this reference value. The indicated measured value is, by the following key combination, stored as base value and, as a result, set to zero.

Function:  AVERAGE V. Zero setting by keys: ENTER , CLEAR

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

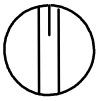
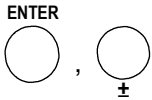
The arrow **CORR**. appears in the display as long as the deviation from the base value is indicated, but not the actual measured value.

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**, CLEAR.

Function:  BASE Clear base value: ENTER , CLEAR

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. With pH probes, if the two keys **ENTER** and **F** 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 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:

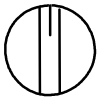
pH-probe:	ZA 9610-AKY:	pH4 or pH10
Conductivity:	FY A641-LF:	2.77 mS/cm,
	FY A641-LF2:	147 uS/cm
	FY A641-LF3:	111.8 mS/cm
O_2 saturation:	FY A640-O2:	101 %

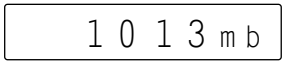
7.1.5 Atmospheric Pressure Compensation

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:		**Compensation range:**
Rel. humidity psychrometer	approx. 2%	500 to 1500 mbar
Mixture ratio, capacitive	approx. 10 %	Vapor pressure VP up to 8 bar
Dynamic pressure	approx. 5%	800 to 1250 mbar (error < 2%)
O2 saturation	approx. 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). The atmospheric pressure is indicated in the function ´mb´.

Atm. Press:  BAUD RATE Key: 

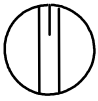


With each reset the atmospheric pressure is set to 1013mb. It can be set to the actual value by the usual data entry (see 5.3).

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 **F** in the function MEAS. VALUE.

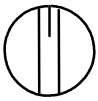
Single Meas. Point Scan: Key: 

 MEAS. VALUE

The measured values are sequentially indicated on the display for approx. 1.5 seconds.(not by continuous measuring point scan) 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, in addition, the arrow ´RS232C´ is indicated (print output, see manual 6.6.1). The output format can be set in the function OUTPUT 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: START/STOP   ALL

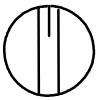
Stopping of the automatic measuring point scan can be achieved by operating the key **START/STOP** once again. The indications ´START´, ´RS232C´ and ´MEMORY´ will disappear.

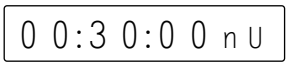
Stop Cyclic Meas. Point Scan: Key: START/STOP 

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 OUTPUT CYCLE for cyclic measuring point scans and outputs.

Function:
Print cycle
Output channel
Output format

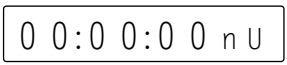
 OUTPUT CYCLE



Example: print cycle 30 min, output channel ´U´, column format ´n´

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

Clear print cycle: Keys: ENTER  ,  CLEAR



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).

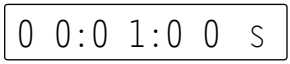
Output channel and output format are displayed in the dimension field. By using the key **CH▲** the following options can be successively selected. By pressing **CH▲** and holding (approx. 1s) a back switch is possible.

Ab.	Designation	Output Format
U	Measured values interface	in a list
n U	Measured values interface	in columns
t U	Measured values interface	in spreadsheet format
a U	Alarms out memory to interface	in a list
S	Meas. values interface and memory	in a list
	Meas. values one channel from memory	to analog output
n S	Meas. values interface and memory	in columns
t S	Meas. values interface and memory	in spreadsheet format

7.3.2 Measuring Cycle and Memory Activation

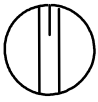
The measuring cycle is used for storing measured values, for cyclic averaging (see manual 6.7.4) or for monitoring the measured values including alarm list output in case of limiting values being exceeded. The display of the measuring cycle has 6 digits (hh:mm:ss) in the function MEAS. CYCLE.

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**, **CLEAR**.
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.

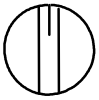
Memory Activation:  MEAS. CYCLE **With key:** 

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 and the additional function CONVERSION RATE ´CR´ must be selected by using the key F and must be set by using the keys **ENTER**, ▲ ▼, **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.

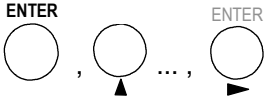
Function:
Conversion Rate (CR)



MEAS. CYCLE Key:

Example: 10M/s, continuous, with saving

Change conversion rate:

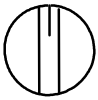


Memory on/off:

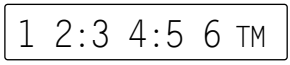
7.3.4 Time and Date

The ALMEMO® 2290-8 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:



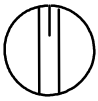
TIME



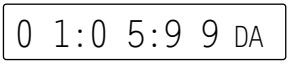
The time is programmed in the format hh:mm:ss (see 5.3).

Stopping the clock and setting it to zero can be performed by using the keys **ENTER**, **CLEAR**.
The clock can be started in any switch position by using the key **START/STOP**.

Function Date:



DATE



Example: date 1st May 1999

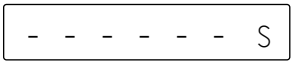
Enter the date in the format dd.mm.yy (see 5.3). The year number can also be provided with 4 digits via interface (see manual 6.10.13).

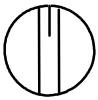
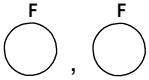
Clear the date by using the keys **ENTER**, **CLEAR**.

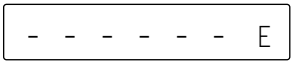
7.3.5 Time and Date of Start, Time and Date of End

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.

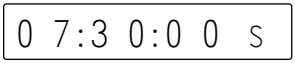
Start Time:  TIME 



End Time:  TIME 



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



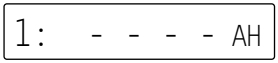
Start date ´ S´ **and end date** ´ E´ are programmed in the same way in the format dd:mm:yy and with the switch positioned on DATE (see 5.3).

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

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 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 **F** 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 ▲ and ▼.

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:

7.4 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.

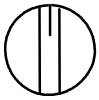
Switch-on of the Storage within the Print Cycle

If the output channel has been set to ´S´ by using the key **CH▲** while in OUTPUT 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.

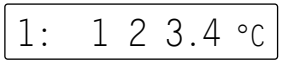
For **starting a cyclic storing** the key **START/STOP** must be operated. If measured values are stored the arrow ´MEMORY´ is indicated for control purposes, e.g. continuously during automatic scans and only during the scan if the scan has been manually started.

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

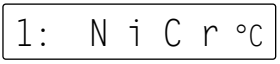
Displaying the Data Memory:


MEMORY

The display shows the last stored measured value of the input channel.
Change of the indicated channel with key **CH▲**.



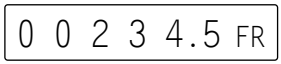
On **sensor breakage** the abbreviation of the range:



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

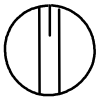
If the **memory is full** the display indicates:
Further measured values will no longer be stored when in the linear memory. Old values will be overwritten when in the ring memory.

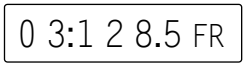
The free memory space is displayed in kB in function ´FR´ by pressing the key **F**:



7.4.2 Memory Connector

The ALMEMO® 2290-8 is the device that allows connecting external ALMEMO® EEPROM Memory Connectors ZA 1904-SS with capacities of 128kB or 256kB (25,000 or 50,000 measured 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 readout of data using the readout interface can be set via the measuring instrument (see 9.1).
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. 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 with keys **ENTER**, ▲▼, ▸ , ▲▼, ▸ .

Function memory free:  MEMORY 



Memory number: 03
Memory free: 128.5 kB

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 **CLEAR** (see 7.4.3). If the data needs to be rescued the connector must be removed again and the data must first be read out.You must not, in the course of a measuring operation, either plug or unplug the connector; the change will not be considered until the measuring operation stops; i.e. if a connector is unplugged during a measuring operation, all subsequent data for that operation will be lost.

7.4.3 Measured values Output

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

OUTPUT CYCLE Select output channel: Display: output channel ´–´
Analogue output: output channel ´S´

Output to the display and to the analogue output is only possible, if the data cable not connected.

MEMORY

Select desired measuring point,	**CH▲**
obtain first meas. value on the display,	**OUTPUT**
recall individual measured values,	**F**
start automatic output	**OUTPUT**
display (´–´): 1 value/s	
recorder output (´S´): 2 values/s	
stop automatic output	**START/STOP**
recall individual measured values	**F**
re-start automatic output	**OUTPUT**
cancel automatic output	**CLEAR**

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

Output to the Serial Interface

OUTPUT CYCLE

Select output channel:	´ U´
(No longer required as of version 5.71)	
Set output format: e.g.	´nU´

MEMORY

Start automatic output:	**OUTPUT**
stop automatic output	**START/STOP**
recall individual measured values	**F**
re-start automatic output	**OUTPUT**
cancel automatic output	**CLEAR**

During the memory output the display indicates ´S Out ´ and the arrow ´**MEMORY**´ is indicated. The memory content is provided as output with the same print output as used for an output via printer and, if necessary, several times and in different formats (see manual 6.6.1).

Print Output:

```
MEMORY:
NUMBER:      12-001              (if activated)
DATE:        12.03.90
12:30:00 01: +0012.0 °C NiCr designation
         02:!+0008.8 °C NiCr water
         03:>+125.00 °C Ntc  motor oil
```

list format

Clear Memory


MEMORY

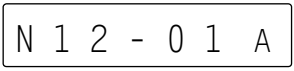
Clear with keys: ENTER , CLEAR

To completely clear all measured values use **ENTER**, **±** , **CLEAR** (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: CH▲

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

Setting to zero and deactivating the number with the keys: ENTER , CLEAR

7.6 Sleep Mode

For long term monitoring with larger measuring cycles it is possible to operate the measuring device in sleep mode. 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 for one battery to perform approximately 7,000 measuring point scans. At 15 minutes for one cycle this results in a total measuring time of more than 70 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. Start measuring point scan using the key **START/STOP**.

   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!

3. **Switch over to sleep mode**
   Move the slide switch (1) to the upper position,
   ´SLEEP ON´will be displayed for a short period,
   and the instrument will be practically switched off.

4. Within the set cycle the instrument will automatically switch on,
   perform a measuring point scan,
   display ´SLEEP ON´ and the measured values,
   and then switch off again.
5. **Switch over to active normal operation:**
   Move the slide switch (1) to the centre position.
6. Terminate the measurement by pressing the key **START/STOP**.

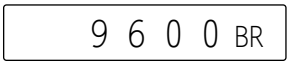
8. DIGITAL DATA OUTPUT

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 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.

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

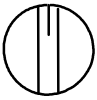


Example: 9600 bd

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 OUTPUT CYCLE. The key **F** 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).


OUTPUT CYCLE Key: F

0 1 A

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 OUTPUT CYCLE (see 7.3.1). The output format is not relevant for the manual data output, with the exception of the read-out of the memory. All function values that have been selected by using the rotary switch and, possibly, with the key F, can be printed out with the next print output by using the key OUTPUT.

Manual data output within each function with key: OUTPUT

Switch	Func	Key	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.			AVEARGE VAL: 01: +0017.8 °C
AVERAGE V.	AM	F	CH MEAS.VAL MAXIMUM MINIMUM AVG. COUNT
all meas. values	N	F, F	01: +0023.0 +0025.0 +0019.0 +0022.0 99999 s. man. 6.4.4
NUMBER			NUMBER: 00-123
MEMORY			MEMORY: - - - - see 7.4.2
MEMORY	FR	F	MEMORY: S0501.3 F0324.6 A
RANGE			01:NiCr +0123.4 -0012.0 +0000.0 °C 1.0000 E+0 - - -
RANGE	LM	F	CH ZERO SLOPE LM P FUNC CALOFS CALFA A-START A-END B1 MX EF AH AL CF UMIN
ext. programm.			01:+0000.0 +1.0000 5. 1 MESS +00000 32000 +0000.0 +1000.0-01 M1 -- S- E2 05 12.0 see manual 6.10.1
LV MAX			LIM-MAX: 01: -0100.0 °C
LV MIN			LIM-MIN: 01: +0020.0 °C
BASE			BASE: 01: -0273.0 °C
FACTOR			FACTOR: 01: +1.0350E-1
BASE	ZC	F	ZERO CORR: 01: -0000.7 °C
FACTOR	SC	F	SLOPE CORR: 01: +1.0013
TIME	TM		TIME: 12:34:00
TIME	S	F	START TIME: 07:00:00

Switch	Func	Key	Print Output
TIME	E	F, F	END TIME 17:00:00
DATE	DA		DATE: 01.02.99
DATE	S	F	START DATE: 01.02.99
DATE	E	F, F	END DATE: 02.02.99
PRINT CYCLE			PRINT CYCLE: 00:06:00
MEAS. CYCL.			MEAS. CYCLE: 00:01:30
BAUD RATE	BR		AMR ALMEMO 2290-8
Sensor Programming			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
if programmed			START TIME: 00:07:00
			START DATE: 02.01.99
			END TIME: 18:30:00
			END DATE: 03.01.99

see manual 6.2.3

BAUD RATE	mb	F	DEVICE: G00 M20 A08 P05/20/00
Device Programming			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

see manual 6.2.5

9. ANALOGUE OUTPUT

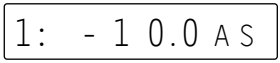
For analogue acquisition of the selected measuring point either an analogue output cable ZA 1601-RK (see manual 5.1.1) without electrical isolation or a relay trigger analogue adapter ZA 8000-RTA (see manual 5.1.3) with electrically isolated analogue output can be connected to the sockets A1(OUT1) or A2(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 +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 AS and AE (see manual 6.10.7). If the initial value is zero it will remain cleared.

Function ANALOGUE OUTPUT-START:

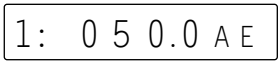
Key: 



Programming: Input see 5.4

Function ANALOGUE OUTPUT-END:

Key: 



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® 2290-8 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: 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 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 Gxy (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 Gxy,
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® 2290-8 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:

EMC: IEC 61326:1997+A1:1998+A2:2000
IEC 61000-6-1:1997
IEC 61000-6-3:1996
IEC 61000-4-2: 1995+A1:1998+A2:2000 8kV
IEC 61000-4-4: 1995+A1:2000 2kV
IEC 61000-4-3: 1995+A1:1998+A2:2000 3V/m

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)

Measuring Inputs:	5 ALMEMO® sockets for ALMEMO® connector
Meas. channels:	5 primary chann. electr. isol., max. 15 addit. chann. for double sensors and function channels
Sensor voltage supply:	battery: 7...9V, max. 100mA mains adapter: approx 12V, max. 100mA
Outputs:	2 ALMEMO® sockets for all output modules
Equipment:	
Display:	6½ digit 7-segment, 2 digit 16-segment, 12mm
Function selection:	16-position rotary switch
Keyboard:	5 keys
Memory:	500 kB (100000 meas.val.) buffered with lithium batt.
Time and date:	real time clock buffered with lithium battery
Microprocessor:	HD 6303 Y
Voltage Supply:	7 to 13V DC not electr. isol.
Mains adapter:	ZB 2290-NA 230V AC to 12V DC, 200mA electr. isol.
Adapter cable electr. isol.:	ZB 2290-UK 10...30V DC to 12V DC, 250mA
Current consumption without input and output modules:	approx. 10mA sleep mode: approx. 20µA
Housing:	180x85x33mm, ABS high impact strength (70°C max)
Operating Conditions:	
Operating temperature:	-10 ... +60 °C
Storage temperature:	-30 ... +60 °C
Humidity of ambient air:	10 ... 90 % rH (non-condensing)
Extent of the Delivery:	Measuring Instrument ALMEMO 2290-8 Operating Instructions ALMEMO 2290-8 ALMEMO® Manual incl. software AMR-Control

Product Overview

	Order No.
Data Logger ALMEMO 2290-8	
5 inputs, 20 channels at maximum, 500 kB memory, real time clock, 5 keys, RS232 interface that can be cascaded, sleep mode	MA 2290-8
Mains Adapter 12V DC, 200mA	ZB 2290-NA
DC Adapter Cable 10 to 30V DC, 12V/250mA electr. isol.	ZB 2290-UK
ALMEMO® Recording Cable -1.25 to 2.00 V	ZA 1601-RK
ALMEMO® Data Cable V24 Interface, electr. isolated	ZA 1909-DK5
ALMEMO® Data Cable Centronics Interface, electr. isolated	ZA 1936-DK
ALMEMO®-Data Cable Ethernet Interface, electr. isolated	ZA 1945-DK
ALMEMO® Network Cable Current Loop, electr. isolated	ZA 1999-NK5
ALMEMO® I/O Cable for Triggering and Limit Value Alarm	ZA 1000-EGK
ALMEMO® Memory Connector 256kB (up to 50000 Meas. values)	ZA 1904-SS8
V24 Adapter Cable to read the memory connector with PC	ZA 1409-SLK