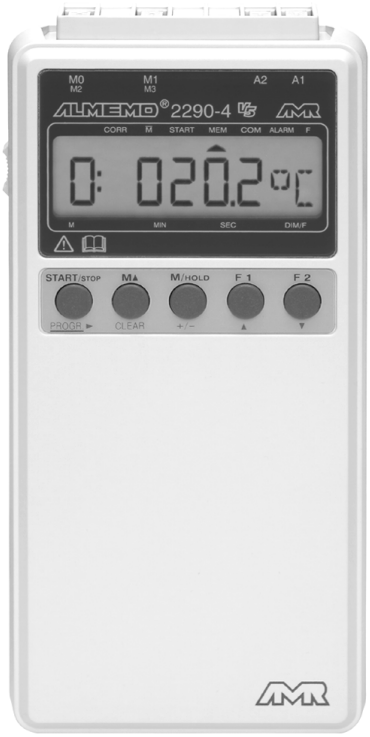

Operating Instructions

Multifunctional Measuring Instruments

ALMEMO® 2290-4 V5

with Option Data Logger

V1.3
04.12.2003

Operating Instructions

Multimeter
ALMEMO® 2290-4 V5

with Option Data Logger

For reference with the ALMEMO® Manual

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1. INTRODUCTION

The multimeter ALMEMO® 2290-4 *V5* 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 multimeter ALMEMO® 2290-4 has two electrically isolated measuring inputs with 8 channels for more than 65 measuring ranges. Two output sockets allow for connecting any ALMEMO® output modules, for example, the analogue output, digital interface, trigger input or alarm contacts. By simply connecting devices using network cables, several devices can be networked. For easy operation a keypad and an 8½-digit LCD display has been integrated. A data logger function with an internal 30kB memory or with external connectors up to 256kB (50,000 measured values) is available.

The measuring instruments have many functions for an optimal evaluation of all sensors, flexible process control and universal data output. To avoid a difficult operation resulting from functions that are not required, it is possible to automatically or individually activate functions, as required. A range of special functions can only be accessed via the interface.

SENSOR PROGRAMMING

The measuring channels are automatically programmed by the ALMEMO® connectors of the sensors. However, the user can easily complete or modify the programming via keypad 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, a function channel for special measuring tasks is provided to determine the wet bulb globe temperature.

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 4 measuring channels are available for each transducer, i.e. it is also possible to evaluate double sensors, individually scaled sensors, or sensors with function channels. The measuring channels can be successively selected forwards or backwards via keyboard. The selected measuring point can be scanned with a conversion rate of 2.5 or 10 measurements/second. The measured value is calculated and indicated on the display or, if available, provided on the analogue output.

Measured Value
A continuous presentation of measuring data from the selected measuring point is provided and also includes automatic zero point correction and optional correction of the measured value or new scaling.
A sensor breakage condition is, with most sensors, automatically detected (exception: connectors with shunts, dividers or additional electronics).

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

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

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

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

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

Volume Flow Measurement
Apart from the averaging functions all flow sensors also provide functions for the input of the cross-sectional area or diameter of ventilating ducts and for calculating the volume flow. The average flow velocity can be roughly determined by proceeding uniformly over the whole cross-sectional area or by exact net measurements according to DIN. Both, a temperature and atmospheric pressure compensation are available for dynamic pressure probes. In case of corresponding environmental conditions the values can be manually entered or automatically measured.

PROCESS FLOW PROGRAMMING
A cyclic measuring point scan with a time-based process flow control is required to digitally register measuring data of all connected sensors. For this purpose, a 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 is used for the recording of any measurement.

Print Cycle
The print cycle is programmable between 1s and 59h/59min/59s. It provides a cyclic storing and output of measured values to the interfaces as well as 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.

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 also possible to store all measured values in the memory and/or to perform an output via the interface.

Data Memory (Option S)
All measured values or alarm values only can manually, cyclic or by using the conversion rate be stored in a 30kB internal, buffered RAM, which is sufficient for 6000 measured values. The memory organisation can be configured as linear or ring memory. External ALMEMO® connectors with 128kB (25,000 meas. values) or 256kB (50,000 meas. values) EEPROM memory are available as alternative storage options. The measurement can be automatically stopped and started with time and date. The individual connectors allow for an easy management of different records and, if required, for readout from a computer when using a separate readout interface. A selection referring to a time interval or alarm value is possible when data is output via interface.

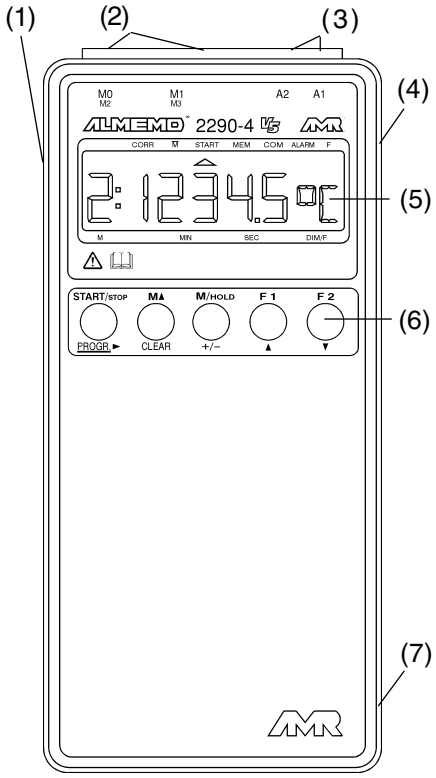
Control Outputs
The interface allows to individually trigger up to four external output relays and one analogue output.

Output
All measuring and programming data is accessible by means of the LCD display. RS232, RS422, RS485 and a Centronics interface are available by using different interface cables. All data logs, measured values and programmed parameters can be provided as output to any peripheral equipment. The output of measuring data can be selected in list format, columns or spreadsheet format. Files in spreadsheet format can be processed by each spreadsheet software. The print header can be programmed specifically to the company or application.

Networking
All ALMEMO® devices can be addressed and 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 with data storage in the computer. 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 ON
down OFF

(2) Measuring Inputs M0, M1
M0, M1 for all ALMEMO® sensors
M2 to M7 additional channels

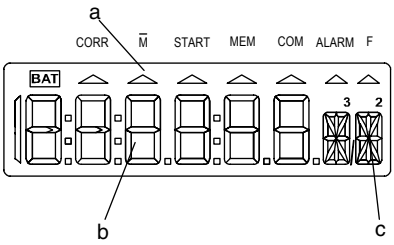
(3) Output Sockets A1, A2
A1 V24 Interface (ZA 1909-DK5)
V24 Fiber Optics (ZA 1909-DKL)
Ethernet (ZA 1945-DK)
Centronics (ZA 1936-DK)
RS 422 (ZA 5099-NVB)
Relay Trigger Cable (ZA 1000-EAK)
Analogue Output 1 (ZA 1601-RK)
A2 Memory Connector (ZA 1904-SS)
Network Cable (ZA1999-NK5)
Trigger Input (ZA 1000-ET)
Relay Outputs (ZA 1000-EGK)
Analogue Output 2 (ZA 1601-RK)

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

(5) LCD Display

(6) Function Keys

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



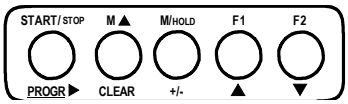
(5) LCD Display

(a) Symbols for operating conditions

BAT	U battery < 7 V
▲ CORR	Correction of meas. value
▲ $\overline{M}$	Averaging
▲ START	Measuring point scan
▲ MEM	Data Memory
▲ COM	Output of meas. value
▲ ALARM	Exceeding of limit value
▲ F	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, abbreviation for functions



(2) FUNCTION KEYS

PROGR, +/-, ▲ ▼, ▶ for entering programming values
PROGR, CLEAR clear data, set meas. value to zero
PROGR, +/- calibrate measured value
START/STOP cyclic measuring point scan
M ▲ select measuring point
M/HOLD select measuring point, hold
F1 select measuring functions

max value (Hi)	MH	•
min value (Lo)	ML	•
free memory	MF	#
print cycle	PC	*
average value	AV	+
number of averaged values	C	+
time constant	s	+
volume flow	V	+
time	TM	*
date	DA	*
start time	ST	#
start date	SD	#
end time	ET	#
end date	ED	#

F2 selecting programming functions

display mode	DM	•
range	R	•
averaging mode	AM	+
cross-sectional area	CS	+
diameter, normalized	DN	+
atmospheric pressure	mb	~
temperature compensation	TC	"
locking mode	LM	
limit value Max (Hi)	LH	
limit value Min (Lo)	LL	
zero point correction	ZC	"
slope (gain) correction	SC	"
ambient temperature	AT	^
emissivity factor	EF	^
base value	BA	
factor	FA	
exponent	EX	
analogue output start	AS	
analogue output end	AE	
baud rate, output format	BR	*
device address	A	*

Functions are activated by:
All by switch-on with key PROGR
Groups via display mode
Individually by interface command

- • Switch-on with key CLEAR
- # Option S Data Logger
- * Interface module
- + Flow sensors (Dim=m/s)
- ^ Infrared sensors (IR-Flag)
- " pH probes (Dim=pH)
- ~ Humidity, dynam. pressure, O_2 sensors

2. INITIAL OPERATION

1. Connect **transducers** to the sockets M0 and M1 (2), see 4.
2. Ensure **power supply** with 9V battery or mains adapter, see 3.1, 3.2.
3. **For switching on** move the slide switch (1) on the left side of the unit to the upper position, see 3.3.
4. For **displaying** the measured values:
   select function MEAS. VALUE with key **M/HOLD** (6),
   select the measuring channels with key **M▲**, read the meas. values, s. 7.1.1.
5. For **cyclic output of measured values** to printer or computer:
   connect peripheral device via interface cable to socket A1, see man. 5.2,
   set 9600 bd, 8 data bits, 1 stop bit, no parity at peripheral device, see 9.1,
   enter correct time and date, as required, see 7.3.2,
   use the key **F1** to select the function PRINT CYCLE ´PC´ and program the print cycle, see 7.3.1,
   use key **M▲** to select the output format in function BAUDRATE ´BR´, s. 9.2,
   use key **START/STOP** to start and stop the cyclic measuring point scan, s. 7.3.
6. For **storing the measured values** (only with option S):
   use the key **F1** to select the function PRINT CYCLE ´PC´ and program the print cycle, see 7.3.1,
   enter correct time and date, as required, see 7.3.2,
   use key **START/STOP** to start and stop the recording of measuring data, s. 7.3.
   For **output of memory data to printer or computer**:
   connect peripheral device via interface cable to socket A1, see man. 5.2,
   set 9600 bd, 8 data bits, 1 stop bit, no parity at peripheral device, see 8.1,
   use key **M▲** to select the output format in function BAUDRATE ´BR´, s. 9.2,
   use key **START/STOP** to output measured values in function ´MF´, see 7.4.3.
7. For **evaluating the measurement**:
   use key **F1** to select the function MAX VAL ´MH´ or MIN VAL ´ML´ and recall the max and min values, s. 7.1.3.

3. POWER SUPPLY

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

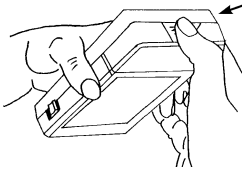
- 9V battery IEC 6 F22 ZB 2000-B9
- 9V rechargeable battery, as above with charger unit integrated in plug ZB 2000-A9, ZB 2000-LS
- Mains adapter 12V/200mA ZB 2290-NA
- External power supply, connecting cable ZB 2290-UK

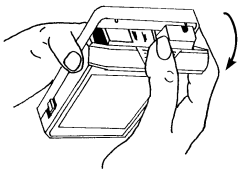
Our product line includes corresponding accessories.

3.1 Operation with Battery and Rechargeable Battery

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

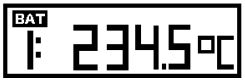
Inserting Batteries:





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

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



Battery Control:

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

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

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

The actual battery voltage can be accurately monitored with an own measuring channel 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 16 hours. The operating time will be shortened if sensors or modules are connected that consume additional current. It is recommended to use the 9V rechargeable battery with plug-integrated charger unit ZB 2000 LS, which is included in the range of accessories.

Tips regarding correct handling of rechargeable batteries:

- The rechargeable batteries supplied are not charged when delivered! Therefore, they must at first be charged.
- If NiCd cells are only partly discharged, the full capacity cannot be reached by a normal recharging. Therefore, use the instrument until the rechargeable battery is almost completely discharged and then completely re-charge the battery again. As a result, the life of the rechargeable batteries is significantly increased.
- Completely recharged batteries will slowly discharge when they are not being used and during storage. Therefore, they should be checked at least once per month so they cannot suffer damage from deep discharge.

3.2 External Voltage Supply

For an external voltage supply the connector socket (4) is located at the right side of the device. The range of accessories includes the mains adapter ZB 2290-NA (12V/200mA). However, any other DC voltage source (7 to 13V) can also be used. The connection is performed by a low-voltage connector (NES1 according to DIN 42323, centre pin to negative).
The electrically isolated supply cable ZB 2290-UK must be used if an **electrical isolation** between power supply and transducers is required or if a larger input voltage range is required. It allows to operate the measuring instrument with 12V or 24V mains supply.

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

3.3 Switch On/Off, Data Storage, Reinitialisation

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

- up: ON
- down: OFF

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

The device is **switched off** when the slide switch s moved to the lower position.

Data Storage

When the instrument is switched off the real time clock continues its operation and the stored data is maintained as long as the available voltage of the 9V battery is above 6V. When changing the battery the residual voltage is sufficient for at least one minute. If the new battery is connected within that period no data will be lost. Otherwise, a reinitialisation must be performed.

Reinitialisation

If the battery supply has been interrupted or if the device is not functioning properly due to disturbances (e.g. electrostatic charging or wrong connection of peripherals) or if incorrect programming must be avoided, the instrument can be reinitialised.

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

4. CONNECTION OF THE TRANSDUCERS

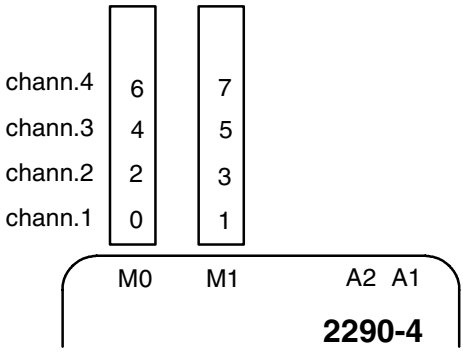
Any ALMEMO® sensors can be connected to the ALMEMO® input sockets (2) M0 and M1. For connecting existing sensors it is only necessary to connect a corresponding ALMEMO® connector.

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® 2290-4 has 2 input sockets (2), M0 and M1 that the measuring channels M0 and M1 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 located one level higher each. As a result, the following channel assignment is available.



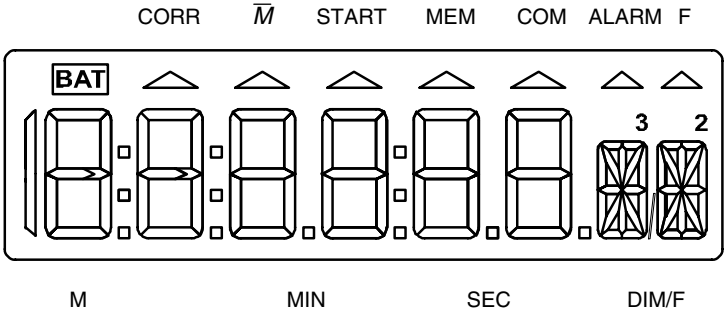
Both analogue inputs of the ALMEMO® 2290-4 are electrically isolated by using photovoltaic relays and a potential difference of 50V DC or 60V AC, at maximum, is permissible between them. However, sensors combined within one connector and sensors with an own power supply are electrically connected to 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 M0 of the device.

5. DISPLAY AND KEYPAD

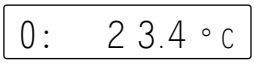
5.1 Display

The display (5) of the instrument ALMEMO® 2290-4 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.



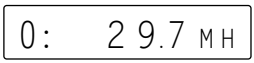
Measuring Data Display

After switching on, the measured value is indicated with the measuring point M and the dimension DIM of the previously selected channel.

Meas. point, meas. value and dimension: 

Function Display

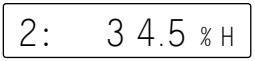
The keys **F1** and **F2**, depending on their activation, can be used to select various function parameters (see 5.2).

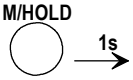
Channel, function value, function: 

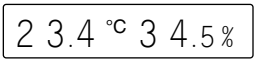
Double Display for Temperature and Humidity

If a double sensor for temperature and humidity is connected to socket M0 the display can be switched to display both variables. To achieve this, the channel M2 for humidity must be selected and key **M/HOLD** must be pressed longer than one second. The same keys are also used to undo the function again.

Select humidity channel: 

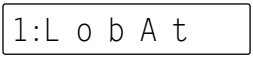
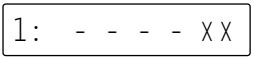


Double display with key: 



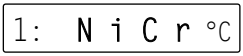
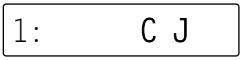
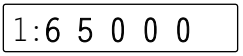
The double display will be maintained when returning to channel 2 and also when other channels or function parameters are selected in standard format.

Special Operating Conditions

Segment test of the display		automatically after switch-on.
Supply voltage:	lower than 7 V:	BAT symbol is illuminated
	lower than 6 V:	
Sensor that are not connected, deactivated measuring points, cleared programming values.		
Sensor correction or scaling		arrow **CORR** illuminated
Measuring point scan in progress		arrow **START** illuminated
Averaging in progress		arrow **M̄** illuminated
Data memory active		arrow **MEM** illuminated
Measuring point scan with output		arrow **COM** illuminated
Function selected		arrow **F** illuminated

Alarm Conditions

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

Sensor breakage:	 abbr. flashes
Exceeding of limit value:	arrow **ALARM** is illuminated
Overshooting of measuring range:	maximum value flashes
Undershooting of measuring range:	minimum value flashes
Undershoot. of meas. range CJ compens.	 (cold junction)
Meas. without ext. CJC or CJC breakage:	flashes
Exceeding of range of values (>65000):	 flashes

5.2 Function Selection and Activation

After a reinitialisation (see 3.3) the function group 1 is selected (see below) and, at first, the functions max value and min value are available with key **F1**, and the measuring range is available with key **F2**. However, in addition to these basic functions the instrument ALMEMO® 2290-4 also provides a large number of further functions for scaling and correcting sensors, implementing automatic measuring point scans, averaging, monitoring, storing and also providing outputs of measured values to peripheral devices.

However, as it is usually not necessary to have all functions available but some with certain sensors and others only for data outputs etc., the functions can be activated for specific applications by different methods. They can be automatically activated via sensors or output modules (see below) or activated individually by selecting a function group in display mode or via interface. This ensures a quick access by using the keys **F1** and **F2** and it reduces the risk of incorrect inputs.

The active functions are selected by repeatedly operating the keys **F1** or **F2**. If the key is pressed for longer than one second it is possible to switch back to the previous function. The functions can be identified by a 2-digit abbreviation in place of the dimension, as follows:

F1 Meas.Functions		Function Access									
Function Group:		0	1	2	3	4	5	6	7	8	9
Max Value (Hi)	MH										
Min Value (Lo)	ML										
Memory Free	MF	#	#	#	#	#	#				
Print Cycle	PC		* #		* #						
Average Value	AV		+	+							
Count of Avg. Val.	C		+	+							
Time Constant	s		+	+		+	+				
Volume Flow	V		+	+	+	+	+				
Time	TM		*								
Date	DA		*								
Start Time	ST						#			#	#
Start Date	SD						#			#	#
End Time	ET						#			#	#
End Date	ED						#			#	#

F2 Programming Values		Function Access									
		0	1	2	3	4	5	6	7	8	9
Display Mode	DM	0	1	2	3	4	5	6	7	8	9
Range	R										
Averaging Mode	AM			+	+						
Cross-Sectional Area	CS			+	+	+	+	+			
Diameter, Normalized	DN			+	+	+	+	+			
Atmospheric Pressure	mb			~	~	~	~	~			
Temp. Compensation	TC			°	°	°	°	°			°
Locking Mode	LM										
Limit Value Max (Hi)	LH										
Limit Value Min (Lo)	LL										
Zero Point Correction	ZC			"		"	"				
Slope (Gain) Correction	SC			"		"	"				
Ambient Temperature	AT				^			^		^	^
Emissivity Factor	EF				^			^		^	^
Base Value	BA										
Factor	FA										
Exponent	EX										
Analog Output-Start	AS										
Analog Output-End	AE										
Baud Rate,Output Format	BR			*	*	*	*	* #		* #	* #
Device Address	A										

Automatic Activation by:

Option S Data Logger
* Interface Modules
^ Infrared Sensors (Elementflag = Ir)
+ Flow Sensors (Dim = m/s)
" pH Probes (Dim = pH)
° Probes for Dyn. Pressure and pH
~ Humidity, Dyn.Press., O_2 Sensors

Activation of Function Groups

As shown in the previous table it is possible to set 10 different function groups that release the corresponding functions (grey background). The applications range from an almost entirely locked instrument to the release of all functions.

F Group	Application MEASUREMENT:
0	Locked: no input, only single measuring point scan, Meas. value without hold, max/min without clear, range indication
1	Basic Setting: Start/stop, meas.val./hold, max/min, range usually locked Option S: memory, print cycle
2	Man. meas., as above, with zero-setting and sensor adjustment
3	Man. averaging (for sensors without dimension m/s)
4	Cyclic measurement with averaging, limit value monitoring
5	as above, with sensor adjustment Option S: start/stop with start/end time/date
6	only functions that have been defined by the user via interface
	Application PROGRAMMING:
7	Sensor/connector programming
8	Device programming
9	All functions

After a reinitialisation (key **CLEAR** must be pressed when switching on) the function group 1 is selected. The selection of another function group can be performed in the function display mode. The (slightly difficult to access) DISPLAYMODE ´DM´ can be accessed by using the key **F2** to select the function RANGE ´R´ and once again by pressing the key **F2** for a longer period.

Function DISPLAYMODE ´DM´

Input, see 5.4 *Example:* German - Function Gr.1

The letter that precedes the function group indicates the language setting:
d = **G**erman, E = **E**nglish, F = **F**rench

Activation via Interface

In function group 6, it is possible to use the interface (e.g. AMR-Control) for allocating the required functions, as required, and without an automatic activation to the keys **F1** and **F2**. As a result, the key assignment can be completely configured (see man. 6.10.13.3).

Furthermore, it is also possible to temporarily activate all functions by pressing the key **PROGR** during switch-on.

In the display the function value is indicated next to the function abbreviation. If sensor parameters are indicated the channel number will also be included:

Meas. Functions	**F1**	**Abbr.**
Max Value (Hi)	1: 127.3	MH
Min Value (Lo)	1: 023.4	ML
Memory (Option S)	01:113.2	MF
Print Cycle	00:15:00	PC
Average Value	1: 13.24	AV
Count of Avg. Val.	1: 1234	C
Time Constant	00	ZC
Volume Flow	1: 0834.	V
Time	12:34:56	TM
Date	01.12.99	DA
Start Time	10:00:00	ST
Start Date	01.12.99	SD
End Time	17:00:00	ET
End Date	02.12.99	ED

Programm. Functions	**F2**	**Abbr.**
Display Mode	d-1	DM
Range	1: NiCr R	
Averaging Mode	1:StStP	AM
Cross-Sectional Area	1: 0175.	CS
Diameter, normalized	1: 0150.	DN
Atmospheric Pressure	1013	mb
Temperature Compens.	1: 023.4	TC
Locking Mode	1: 0005	LM
Limit Value Max (Hi)	1: 123.0	LH
Limit Value Min (Lo)	1: -010.0	LL
Zero-Point Correction	1: ----	ZC
Ambient Temperature	1: 250.0	AT
Slope (Gain) Correction	1: ----	SC
Emissivity Factor	1: 0.950	EF
Base Value	1: ----	BA
Factor	1: ----	FA
Exponent	1: 0	EX
Analogue End	1: 123.4	AE
Analogue Start	1: 000.0	AS
Baud Rate	Un 9600	BR
Device Address	00	A

5.3 Keypad

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

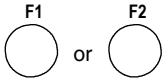
Function	**Normal**	**Input**
Start and stop of meas. point scans	**START** / **STOP**	PROGR ▶
Selection of measuring points	**M** ▲	CLEAR
Measured value	**M** / **HOLD**	+/-
Selection of the measuring functions	**F1**	▲
Selection of the programming functions	**F2**	▼

If the key PROGR ▶ is pressed for longer than one second a digit or an abbreviation will flash in the display, i.e. the instrument is in edit mode and the red designations below the keys are valid. Then, the keys +/-, ▲, ▼ are available for changing the input digit, the key PROGR ▶ operates as cursor key and CLEAR is available for clearing the parameters The data input is finished when the last digit has been confirmed by operating the key PROGR ▶ .

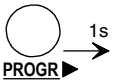
5.4 Data Entry

The programming of numeric parameters is performed as follows:

Selection of the function by using the function keys **F1** or **F2...**



The programming is started by long pressing the key PROGR ▶ . The first programmable digit flashes and can be altered.



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

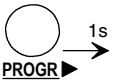
The digit can be **decreased** using the key ▼ .
After falling below zero the maximum value follows (9 or 5).

The sign can be changed using the key ± .

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

To switch back to previous digit the key PROGR ▶ must

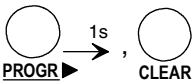
be pressed long.



The programming process is complete

after setting the last digit and again operating the key PROGR ▶

Programming and measured values can be cleared using



6. SENSOR PROGRAMMING

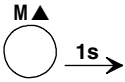
As all ALMEMO® instruments contain the whole sensor programming stored in the ALMEMO® connector plug, the user does not usually need to perform any programming. Only if, for example, sensor errors must be corrected or existing sensors must be scaled or limit values need to be specified the comprehensive programming options have to be used. It must be considered that standard sensors are, by a locking mode, protected against unintentional modification and that the locking level must first be reduced before desired changes can be performed (see 6.7). All parameters can easily be entered or changed via keyboard if the function is activated (see 5.2) and 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 M▲. If this is performed within any programming function, i.e. not in function 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).

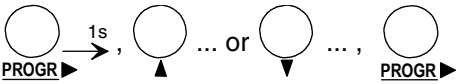
The selection of the measuring range is performed within the function RANGE ´R´. For activating a channel that has not yet been programmed the locking of the 1st channel must be cleared for the corresponding sensor. After selecting the input channel and long pressing the key PROGR ▶ the abbreviation 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 PROGR ▶ 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 PROGR ▶ once again and the data is transmitted to the connector. All programming values of the input channel are then cleared.

Function RANGE ´BE´

Selection by key **F2...** 

... 1: NiCr R

Example : chann. M1, range NiCr-Ni

Change meas. range: 

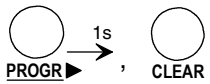
Transducer	Connector / Cable / Sensor	Meas. Range	Dim	Display
Pt100-1	ZA 9000-FS	-200.0... +850.0	°C	P104
Pt100-2	ZA 9000-FS	-200.00...+200.00	°C	P204
Ni100	ZA 9000-FS	-60.0... +240.0	°C	N104
NiCr-Ni (K)	ZA 9020-FS	-200.0...+1370.0	°C	NiCr
NiCroSil-NiSil (N)	ZA 9020-FS	-200.0...+1300.0	°C	NiSi
Fe-CuNi (L)	ZA 9000-FS	-200.0... +900.0	°C	FECO
Fe-CuNi (J)	ZA 9000-FS	-200.0...+1000.0	°C	IrCo
Cu-CuNi (U)	ZA 9000-FS	-200.0... +600.0	°C	CUCO
Cu-CuNi (T)	ZA 9000-FS	-200.0... +400.0	°C	CoCo
PtRh10-Pt (S)	ZA 9000-FS	0.0...+1760.0	°C	Pt10
PtRh13-Pt (R)	ZA 9000-FS	0.0...+1760.0	°C	Pt13
PtRh30-PtRh6 (B)	ZA 9000-FS	+400.0...+1800.0	°C	EL18
Au-FeCr	ZA 9000-FS	-270.0... +60.0	°C	AUFE
Ntc type N	ZA 9000-FS	-30.00...+125.00	°C	Ntc
Millivolt 1	ZA 9000-FS	-26.000...+26.000	mV	U 26
Millivolt	ZA 9000-FS	-10.000...+55.000	mV	U 55
Millivolt 2	ZA 9000-FS	-260.00...+260.00	mV	U260
Volt	ZA 9000-FS	-2.6000...+2.6000	V	U2.60
Differential Millivolt 1	ZA 9050-FS	-26.000...+26.000	mV	d 26
Differential Millivolt	ZA 9050-FS	-10.000...+55.000	mV	d 55
Differential Millivolt 2	ZA 9050-FS	-260.00...+260.00	mV	d260
Differential Volt	ZA 9050-FS	-2.6000...+2.6000	V	d2.60
Sensor Voltage	ZA 9000-FS	0.00...20.00	V	UbAt
Milliampere	ZA 9601-FS	-32.000...+32.000	mA	I032
Percent (4-20mA)	ZA 9000-FS	0.00... 100.00	%	P420
Ohm	ZA 9000-FS	0.00... 400.00	Ω	Ohn
Frequency	ZA 9909-AK	0... 25000	Hz	FrEq
Pulses	ZA 9909-AK	0... 65000		PULS
Digital input	ZA 9000-EK2	0.0... 100.0	%	Inp
Digital interface	ZA 9919-AKxx	-65000... +65000		diGi
Infrared 1	ZA 9000-FS	0.0... +200.0	°C	Ir 1
Infrared 2	ZA 9000-FS	0.0... +800.0	°C	Ir 2
Infrared 3	ZA 9000-FS	-30.0... +70.0	°C	Ir 3

Transducer	Conn. / Cable	Meas. Range	Dim	Display
Infrared 4	ZA 9000-FS	-30.0... +100.0	°C	Ir 4
Infrared 6	ZA 9000-FS	0.0... +500.0	°C	Ir 6
Snap-on head Normal 20	FV A915-S120	0.30... 20.00	m/s	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
Rel. air humidity cap.	FH A646	0.0... 100.0	%H	°orH
Rel. air humidity cap. w. TC	FH A646-R	0.0... 100.0	%H	H rH
Mixture ratio with 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	ZA 9000-FS	-30.00 ... +125.00	°C	P Ht
Rel. humidity psychr. w. PC	ZA 9000-FS	0.0 ... 100.0	%H	P RH
Mixture ratio w. PC	ZA 9000-FS	0.0 ... 500.0	g/kg	P AH
Dew point temperatur w. PC	ZA 9000-FS	-25.0 ... +100.0	°C	P dt
Partial vapour pressure w. PC	ZA 9000-FS	0.0 ...1050.0	mbar	P UP
Enthalpy w. PC	ZA 9000-FS	0.0 ... 400.0	kJ/kg	P En
Conductivity probe w. TC	FY A641-LF	0.0 ... 20.000	mS	LF
CO_2 sensor	FY A600-CO2	0.0 ... 2.500	%	CO2
O_2 saturation w. TC a. PC	FY A640-O2	0 ... 260	%	O2-S
O_2 concentration w. TC	FY A640-O2	0 ... 40.0	mg/l	O2-C
Function Channels:				
Difference	any			diFF
Maximum value	any			Hi
Minimum value	any			Lo
Average value over time	any			A[t]
Average value over junctions	any			A[n]
Sum over junctions	any			S[n]
Total number of pulses	ZA 9909-AK2	0... 65000		S[t]
Pulses/print cycle	ZA 9909-AK2	0... 65000		S[P]
Alarm value	any			Alrm
Wet bulb globe temperature	ZA 9000-FS		°C	UbGt

TC=Temperature Compensation, PC=Air Pressure Compensation

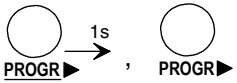
The **use of the function channels** for the output of measuring and calculated variables with the corresponding reference channels is described in the manual section 6.3.4.

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

Function: RANGE ´R´ **Keys:** 

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

Re-activation of the measuring channel:

Function: RANGE ´R´ **Keys:** 

If the channel was previously deactivated, it will be re-activated with all programmed values. However, if the channel is already active then 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 replacing 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 by long pressing the key PROGR ▶. 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 PROGR ▶ 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 PROGR ▶ .

Function: MEAS.VAL. 

1st dim change 2nd dim change end

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 characters □C or □F.
The dimension ms is indicated on the display as m/s, and mh as m^3/h.

6.4 Limit Values

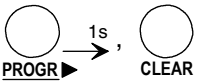
Two limit values (MAX and MIN) can be programmed for each meas. channel. An exceeding of limit values is handled as a fault, similar to an exceeding of meas. range limits and sensor breakage. The arrow ALARM will appear in the display and the alarm relays respond and, in format alarm printout, the alarm values will be output (s. man. 6.3.9). Activation of functions ´LH´ and ´LL´ s. 5.2.

Function LIMIT VALUE MAX ´LH´ and **LIMIT VALUE MIN** ´LL´

Selection with key **F2...** 

... 1: 1 2 3.0 LH

Programming: Input according to 5.4

Switch-off: 

1: - - - - LH

6.5 Correction Values

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

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

Function ZERO POINT CORRECTION ´ZC´

Selection with key **F2...** 

... 1: 0 0 3.2 ZC

Programming: Input according to 5.4

Clear with keys: PROGR ▶ long, CLEAR 1: - - - - ZC

Function SLOPE CORRECTION: ´SC´

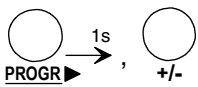
Selection with key **F2...** Input according to 5.4 1:1.5 0 0 0 SC

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

Sensor Adjustment

To simplify the correction of sensors for the zero point and, possibly, also the slope (gain), a key combination for an automatic adjustment is available in the function **MEAS.VAL.** (see 7.1.7). If the function zero point correction is activated (see 5.2) the corrected measured value is stored as zero point correction and, as a result, set to zero. However, the base value will be maintained.

Function selection MEAS.VAL. 

Adjustm. 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 decimal point shift, a zero point shift and to perform a multiplication with a factor. The functions EXPONENT ´EX´, BASE´BA´ and FACTOR ´FA´ are available for this. A detailed description of the scaling, including an example, can be found in the manual section 6.3.11.

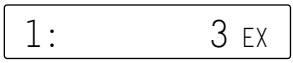
Indicated value = (corrected meas. value - BASE) x FACTOR.

Decimal Point Setting

At first, the position of the decimal point should be checked and, by using the EXPONENT, be adjusted to the required resolution and dimensioning of the sensor, as required. The function EXPONENT ´EX´ allows for shifting the decimal point as far to the left (-) or right (+) as it can be indicated on the display.

Function EXPONENT ´EX´

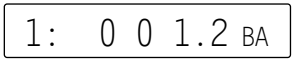
Selection with key **FUNCTION...** Input see 5.4



Example: A force transducer with a 2.0000 V output should indicate 1000.0 N. The decimal point must, via exponent 3, be shifted by 3 digits to the right. The additionally required factor 0.5 can easily be calculated from the new actual values 0.0 N and 2000.0 N. In this case, the base value might only be required for a zero point correction.

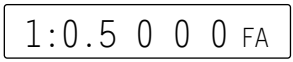
Function BASE VALUE ´BA´

Selection with key **F2**... Input see 5.4



Function FACTOR ´FA´

Selection with key **F2...** Input see 5.4



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

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 **PROGR** ▶ long, **CLEAR** (see 7.1.7).

The sensor is then brought to a defined nominal value (boiling water, known weight etc.) and the nominal value is entered. For this purpose the key PROGR ▶ must twice be pressed long (approx. 1 sec.) until the first digit of the measured value flashes. Then, by entering the nominal value (see 5.4), the scaling value is calculated, stored as FACTOR and the measured value is indicated accordingly.

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

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

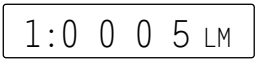
The function parameters of each measuring point are protected by the locking mode up to an adjustable locking level. Before any programming is performed the locking mode must be correspondingly lowered. If a dot is indicated following the locking mode on the display then a modification is not possible.

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´

Selection with key **F2...** 

... Input see 5.4



If programmed, the output function, element flags and multiplexer setting will be indicated next to the locking mode (see man. 6.10.2/3/4).

7. MEASUREMENT

The measuring instruments ALMEMO® 2290-4 provides the following options for the acquisition of measuring data:

1. Continuous measurement of a selectable meas. point, see 7.1 and man. 6.4. Output of measuring data to the analogue output, see 8. and man. 5.1.1.
2. Single measuring point scan, see 7.2 and manual 6.5.1.1.
3. Cyclic measuring point scan, see 7.3 and manual 6.5.1.2.
4. Continuous measuring point scan, see 7.3.1 and manual 6.5.1.3.

Total Clearing of All Measured Values

All max, min and average values of all channels are automatically cleared at the START of each cyclic measurement. This function can be switched off if not required (see man. 6.10.13.2).

7.1 Continuous Measurement of a Measuring Point

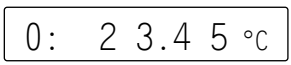
As long as no cycle and no continuous measuring point scan have been programmed (e.g. after a reinitialisation, see 3.3) only the measured value of a selected measuring point, which is at first M0, is continuously acquired with the specified conversion rate (see man. 6.5.4). This is the optimal operating mode for data recording with analogue output.

7.1.1 Selecting the Measured Value and Measuring Point

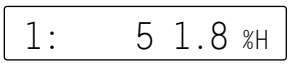
After switch-on the function MEAS.VALUE and the measuring point M0 of the first sensor are automatically selected, i.e. the measured value M0 will be indicated in the display. After selecting other functions using the keys **F1** and **F2** it is possible to return to the display of the measured value by using the key **M/HOLD**.

In function MEAS. VALUE, the key **M▲** allows to successively select all measuring points and indicate the actual measured value. If the key **M▲** is pressed longer (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.

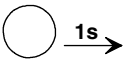
Selecting the measured value: **M/HOLD**



Increase measuring channel with key: **M▲**



Increase measuring channel with key: **M▲**



press and hold (approx. 1s)

7.1.2 Memory for Momentary Values

For fixing a measured value at a certain point in time, e.g. for an easier evaluation, the key **M/HOLD** must be operated again in function MEAS.VALUE. This hold function is indicated in the display by an arrow ´MEM´.
The memory for momentary values can be cleared by pressing the key **M/HOLD** again or by selecting another function.

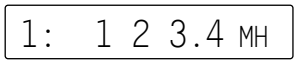
7.1.3 Memory for Peak Values

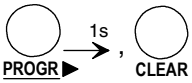
From the acquired measured values of each measuring point the highest and lowest value is determined and stored. For indicating the peak values the function MAX VALUE or MIN VALUE must be selected with the key F1 and the desired channel must be set.

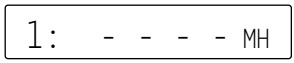
Function MAX VALUE ´MH´ and **MIN VALUE** ´ML´

Selection with key **F1...** 

...



Clearing max and min val.: 



If the cleared channel is the selected measuring channel, the measured value will be indicated immediately after the clearing.

The peak values are cleared if a total clearing (see 7) or change of the range (see 6.2) is carried out.

7.1.4 Smoothing by Sliding Averaging

In case of unstable measured values, e.g. when measuring turbulent flows it is beneficial to smoothen the measured values by a continuous averaging. The level of smoothing can be adjusted from 0 to 25s by means of the time constant in function TIME CONSTANT ´s´ (see 5.2). It specifies the time period that is applicable for the smoothened averaging of the measuring point. The smoothened measured value can be read in function MEAS. VALUE and will also be used for all subsequent evaluation functions. The smoothing can also be used in a combination with the averaging (s.7.1.5), e.g. for net measurements.

Function TIME CONSTANT ´s´

Selection with the key **F1...** 

Input according to 5.4.

The amount of averaged values depends on the conversion rate. The continuous measuring point scan should be switched off as for many measuring points the filtering effect could become too strongly limited.

7.1.5 Averaging

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

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

The average value of a measured value $\overline{M}$ results when a number of measured values M_i are added together and then divided by the number N of measured values:

$$\text{Average Value } \overline{M} = (\sum_i M_i)/N$$

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

The type of averaging is determined by the averaging mode ´AM´ and can be selected with the key **F2**.

Function AVERAGING MODE ´AM´

Selection with the key **F2...** 

... 1:S t S t P AM

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

Function	Display
No averaging:	- - - -
Averaging over Measuring Point Scans:	
Continuous averaging over all measuring point scans:	C o n t
Averaging over all measurements of a print cycle:	C Y C L
Manual Averaging over Measured Values of a Channel:	
Continuous average value from start to stop via keyboard	S t S t P
Aver. val. over single measurements that are captured via 'hold'	S i n G L

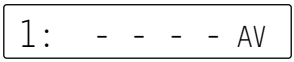
In this section manual averaging over measured values of the selected channel will be described. The averaging over measuring point scans can be found in the manual section 6.7.4.

Averaging over Time

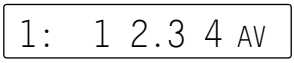
To obtain the average value of all measured values of a measuring channel over a specified time period, the averaging mode ´StStP´ must be set for the selected measuring channel. For example, by uniformly scanning an area, this mode also allows to determine the average flow velocity in a ventilating 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. Select function AVERAGE VALUE ´AV´ with key **F1**.
2. Clear average value using the keys PROGR ▶ long, CLEAR



3. Start the averaging with key **START/STOP**, then the arrow ´$\overline{M}$´ will be on in the display.
4. Stop the averaging by operating the key **START/STOP** again. The arrow ´$\overline{M}$´ disappears again and the average value can be read.



Averaging over a Number of Single Measurements

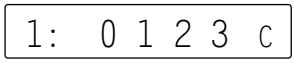
For an averaging of isolated measurements at certain points or times (e.g. net measurements) the averaging mode ´SinGL´ must be used. In this case corresponding requirements must also be met:

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

1. Before each measurement the average value must be cleared in the function AVERAGE VALUE by using the keys PROGR ▶ long, CLEAR.
2. In the function MEAS. VALUE the single values are captured in the memory for instant values by pressing the key **M / HOLD**. The arrow ´HOLD´ appears in the display.
3. If the value is correct, it can be transferred into the memory for average values, by operating the key **START/STOP**. The arrow ´MEM´ disappears again.
4. If the value is not correct, it can be rejected by operating the key **M / HOLD** once again, i.e. the arrow ´MEM´ disappears and the momentary 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 VALUE ´AV´ must be selected with key **F1**.
7. By operating the key **F1** again, the **count C of averaged values** can be obtained within the function ´ C´.

Function COUNT ´ C´

Selection with key **F1...** ... Display:



7.1.6 Volume Flow Measurement

For determining the volume flow VF in ventilating ducts, the average flow velocity $\bar{v}$ must be multiplied with the cross-sectional area CS:

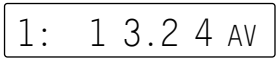
$VF = \bar{v} \cdot CS \cdot 0.36$ $VF = m^3/h$, $\bar{v} = m/s$, $CS = cm^2$

For all sensors with the dimension ´m/s´ the functions for averaging, cross-sectional area or diameter of the duct and the volume flow will be automatically activated (see 5.2).

The average flow velocity $\bar{v}$ can be determined by **time-based averaging** (s. 7.1.5 and man. 3.5.5) for estimated air volume measurements at ventilating gratings. The rotating vane must be applied at one end, the averaging has to be started and it is necessary to proceed uniformly over the whole cross-sectional area and to stop the averaging when the other end of the cross-sectional area is reached.

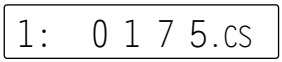
Alternatively, the average flow velocity can be determined by **individual net measurements** according to VDI/VDE 2640 (see 7.1.5 and man. 3.5.5) (e.g. 13.24 m/s).

Function AVERAGE VALUE ´AV´
Selection with key **F1...** Display $\bar{v}$ m/s:



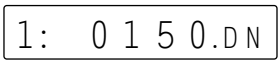
Input of the Cross-Sectional Area

The cross-sectional area CS can be either directly entered in the function ´CS´ with 32,000 cm^2 at max. or via the diameter in function ´DN´ with 2000 mm at max (see 5.4).



Function CROSS-SECTIONAL AREA ´CS´
Selection with key **F2...** Input cm^2, see 5.4

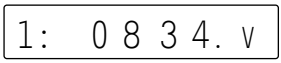
Function DIAMETER ´DN´
Selection with key **F2...** Input mm, see 5.4



Indication of the Volume Flow

The product of average velocity $\bar{v}$ and cross-sectional area CS leads to the air volume. This volume flow VF is automatically calculated and displayed in function ´V´ in m^3/h.

Function VOLUME FLOW ´V´:
Selection with key **F1...** Display VF m^3/h:

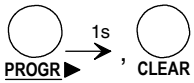


7.1.7 Set Meas. Val. to Zero, Zero Pt Corr., Sensor Adjustmt

Setting Measured Value to Zero

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

Function: MEAS.VAL. with key 

Zero setting: 

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

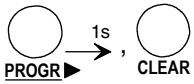
If function ´BA´ is activated the new base value will be stored in the EEPROM of the connector (see 6.6). If not activated, the original value will be inserted again after switching off and on.

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

To return to the original value again, the base value must be cleared. If function ´BA´ is not activated a switch-off of the instrument is sufficient (see above). However, if the function ´BA´ is activated, it can be selected with the key **F2** and the base value can be cleared with the keys PROGR ▶ long, CLEAR.

Function: BASE ´BA´ with key 

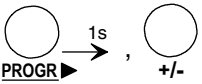
..

Clear base: 

Zero Point Adjustment

Many sensors must be adjusted at least once or at regular intervals to compensate for instabilities. For this purpose and in addition to the ´Set Measured Value to Zero´ mentioned above, a specific **zero point adjustment** is available, which has no effect to a scaling with base and factor (e.g. pH probes). In this function the zero point error is not stored as base value but as zero point correction. The zero point correction is performed with the following keys:

Function: MEAS.VALUE 

Zero point adjustment: 

The function zero point adjustment is only available if the function zero point correction has been activated (see 5.2) and if the locking mode has been set to a lower level than 4 (see 6.7).

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

Sensor Adjustment

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

1. With **pH probes**, if the two keys **START/STOP** and **F2** are pressed during switch-on, the locking is only temporary, i.e. until the device is switched off and set to 3. An undesired adjustment can then be avoided.
2. **Dynamic pressure probes** are very delicate and should be adjusted in an unpressurized state before each use (i.e. disconnected hoses or Pitot tube out of flow). The correction value must be entered before the conversion 'pressure-to-velocity' is performed. For the ranges L840 and L890 an adjustment is possible even if the channel is locked. The zero point error is temporarily being written into the calibration offset until the switch-off is performed.
3. With the following sensors the same key combination as for the zero point adjustment can be used to automatically perform a **slope adjustment** if not the zero value but the calibration value mentioned below is present:

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

7.1.8 Atmospheric Pressure Compensation

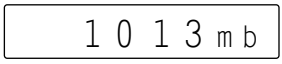
Some measuring variables depend on the environmental atmospheric pressure (see 6.2 measuring range list ´w. PC´). As a result, higher deviations from the normal pressure of 1013mbar can cause corresponding measuring errors:

e.g. Error per 100 mbar:		**Compensation Range:**
Rel. humidity psychrometer	approx. 2%	500 to 1500 mbar
Mixture ration, cap.	approx. 10 %	vapour pressure VP up to 8 bar
Dynamic pressure	approx. 5%	800 to 1250 mbar (error < 2%)
O_2 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 (s. man. 6.7.2). The function ATM.PRESS. ´mb´ will be automatically activated under the key F2 for the sensors mentioned (see 5.2).

Function ATM.PRESS. ´mb´

Selection with key F2 ... Input mbar, see 5.4



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

7.1.9 Temperature Compensation

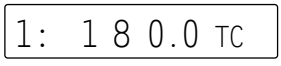
Sensors with measured values that are strongly depending on the temperature of the measuring medium are, in most cases, equipped with a specific temperature sensor and the instrument will automatically perform a temperature compensation (see measuring range list 6.2 ´w. TC´). However, dynamic pressure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

Examples, error per 10°C:	**Compensation Range:**	**Sensor:**
Dyn. pressure:ca. 1.6%	-50 to 700 °C	NiCr-Ni
pH probe: ca. 3.3%	0 to 100 °C	Ntc or Pt100

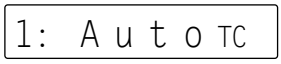
The temperature compensation can also be performed with external temperature sensors by using the reference channel, or within the function ´TC´ by entering the temperature manually:

Function TEMPERATURE COMPENSATION ´TC´

Selection with key F2 ... Input °C, see 5.4



Display when autom. temp. compensation is selected:



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 meas. point and also from other meas. points. If an interface module is connected to socket A1 the functions PRINT CYCLE ´PC´, TIME ´TM´ and DATE ´DA´ will be automatically activated under key **F1** and BAUD RATE ´BR´ under key **F2**. As long as no cycle has been programmed (e.g. after a reinitialisation, s. 3.3) the key **START/STOP** triggers single measuring point scans to acquire the momentary measuring values from all active measuring points. These values are sequentially indicated in the display for approx. 1.5 sec while the arrow ´START´ is on and then disappears again. The time is started if it has been previously cleared. If a peripheral device (e.g. a printer) is connected (see man. 5.2) the measured values are provided one time as an output via interface (printout s. man. 6.6.1) and the arrow ´COM´ also appears in addition. With the option S the measured values are stored and the arrow ´MEM´ will be on. With each press of the key the measured values are equally processed. If true time has to be indicated as measuring time, it must be set beforehand (see 7.3.2).

Single meas. point scan: Key: START/STOP (Cycles 00:00:00)

7.3 Cyclic Measuring Point Scan (see manual 6.5.1.2)

For cyclic measuring point scans the print cycle must be programmed (s. 7.3.1/2). The measurement is started with the key **START/STOP** and the arrow ´START´ will be continuously on. If a peripheral device is connected, the measured values are provided as a cyclic output and, in addition, the arrow ´COM´ is indicated. Different output formats are available (see 9.2). The measurement must be started in the function RANGE ´R´ if the programming is to be indicated before the measured values. The corresponding print outputs can be found in manual section 6.6.1

Start cyclic measuring point scan: Key: START/STOP (cycle is programmed)

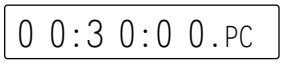
Stopping of the automatic measuring point scan can be achieved by operating the key **START/STOP** once again. The indications ´START´ and ´COM´ will turn off again.

Stop cyclic measuring point scan: Key: START/STOP

7.3.1 Print Cycle, Continuous Measuring Point Scan

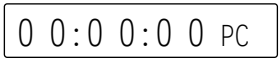
For cyclic measuring point scans and outputs the print cycle can be set in function PRINT CYCLE ´PC´. For activation of functions please refer to section 5.2.

Function PRINT CYCLE ´PC´
Selection with key **F1...** F1 ...



Input 6-digit in format hh:mm:ss (see 5.4), *Example:* print cycle 30 min

Clear print cycle with the keys: PROGR ▶ (1s) , CLEAR



A running cyclic scan is terminated by this.

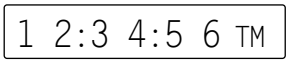
The **continuous measuring point scan** can be switched on and off using the key **M▲** (see man. 6.5.1.3). For control purposes a dot occurs next to the print cycle.

The function **measuring cycle** is, for an easier operation, no longer activated as standard. However, it is still available via the interface and can also be activated in display mode 6. The continuous measuring point scan provides a higher resolution for averaging. For an alarm output the output format ´ALARM´ is available (see 9.2). The measuring cycle is only required for pulse measurements with a cyclic summation.

7.3.2 Time and Date

The ALMEMO® 2290-4 is equipped with a real time clock with date function for recording the measuring time. It has a device battery so the time and date are maintained after a switch-off.

Function TIME ´TM´
Selection with key **F1...**

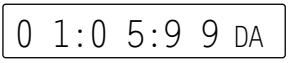


Programming 6-digit in format hh:mm:ss (see 5.4).

Stopping and zero setting of the clock with the keys **PROGR** ▶ long, **CLEAR**.

Operate the key **START/STOP** to start the clock in any switch setting.

Function DATE ´DA´
Selection with key **F1...**



Example: date 1 May 1999

Programming 6-digit in format dd.mm.yy (see 5.4). The year number can also be provided with 4 digits via interface (see manual 6.10.13).

Clear the date by using the keys **PROGR** ▶ long, **CLEAR**

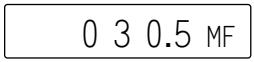
7.4 Data Memory (Option S)

Optionally, the instrument ALMEMO® 2290-4 can be configured ex factory or subsequently by means of a memory connector with option 2290-4S, as a data logger. The basic principles for data storage in ALMEMO® devices are described in the manual section 6.9. The internal data memory of the ALMEMO® 2290-4 has a capacity of 30 Kbytes, which is sufficient for approx. 6000 measured values. The memory organisation can be reconfigured from linear to ring memory (see man. 6.10.13.2).

Display of Memory Capacity

If the measuring instrument has been equipped with the option data logger (OA 2290-4S) the key **F1** can be used to select the function **Memory Free** ´MF´ and to monitor the free memory space (in Kbytes). If the **memory is full** the display turns to 0.0 and no further measured values will be stored if the linear memory has been selected. If ring memory has been selected, old measured values will be overwritten.

Function MEMORY FREE ´MF´



7.4.1 Memory Connector

The ALMEMO® 2290-4 is the first 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.

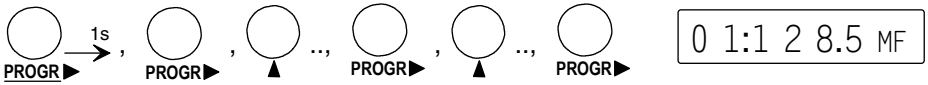
Retrofitting the Data Logger Function

If the measuring instrument has been purchased without the option OA 2290-4S and the device needs to be retrofitted for use as a data logger, a memory connector with option OA 2290-4S must be purchased and connected to the socket A2 of the measuring device. The memory functions (e.g. display of memory capacity ´MF´, see above) will automatically be activated, an ´S´ will be indicated at the revision output next to the type of data, and the data recording can be immediately started. After removing the memory connector the internal memory is also available for data storage.

Application

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 as follows. After a long press of the key **PROGR** ▶ , the message ´SCLr´ will start flashing and when the key **PROGR** ▶ is operated again, the first digit of the number will flash and can be edited as described in 5.4.

Input of the connector number:



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.

7.4.2 Data Acquisition

All single measuring point scans and all measuring point scans that are performed in the print cycle are generally stored in the memory. If only alarm values (e.g. exceeding of limit values) should be stored, the output format alarm ´UA´ or ´SA´ must be set in function ´BR´ (s. 9.2). Data storage in meas. cycle or using the conversion rate is described in the manual (man. 6.5.3, 6.5.4).

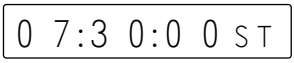
Manual Starting and Stopping

For **starting the cyclic storage** the key **START/STOP** must be operated. For control purposes the arrow ´MEM´ will be on and indicate that measured values are being continuously stored during automatic scans (see 7.3) or only during the scan when a manual scan is performed (see 7.2).
The storage can be stopped by operating the key **START/STOP** again.

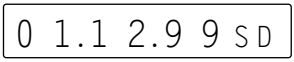
Start and Stop with Start Time/Date and End Time/Date

A set of measurements can be automatically started and stopped at certain points in time. For this purpose the start time and date and the end time and date can be programmed, if the functions are activated (see 5.2). If no date has been specified the measurement will be performed every day at the same time. The current time of day must be already programmed.

Function START TIME ´ST´
Selection with key **F1...**
Input of the time in format hh:mm:ss (see 5.4):



Function START DATE ´SD´
Selection with key **F1...**
Input of the date in format dd:mm:yy (see 5.4):

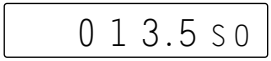


End time and date can be programmed the same way in **function END TIME** ´ET´ and **function END DATE** ´ED´ (see 5.4).

More methods to start and stop a record using limit values, external triggering or the interface are described in the manual section 6.6.

7.4.3 Output of Measuring Data

The content of the memory can, as with the online data output, be provided as often as desired and in all output formats (see 9.2) to a printer or computer (see also man. 6.6.1). The output can be started by operating the key **START/STOP** in function Memory Free ´MF´. During the output of measuring data the display will firstly indicate ´S Out´ and then the function abbreviation ´SO´ is used to continuously indicate the remaining memory content in Kbytes to be provided as output.

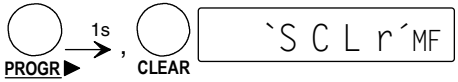


The following key functions are available during the output:

START/STOP	Stop of the automatic memory output
M/HOLD	Output of individual measured values
START/STOP	Start of the automatic memory output
M▲ / CLEAR	Cancelling the automatic memory output

Clear Memory

After pressing the key **PROGR** the message ´SCl r´ will flash in the display. Only if the key **Clr** is then pressed the memory will be deleted, otherwise not.

Memory can be cleared using the keys: 

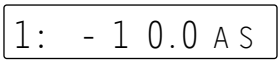
8. ANALOGUE OUTPUT

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

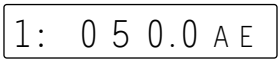
8.1 Scaling

It is possible to spread any partial range to the standard output signal of the three available options 0-2V, 0-10V, 0/4-20mA if the partial range covers at least 100 digits (e.g. 0-20mA for -10.0 to +50.0°C). To achieve this the **analogue output-start** and the **analogue output-end** of the desired measuring range must be entered within the functions AS and AE (see manual 6.10.7). If the initial value is zero it will remain cleared. For activating the functions ´AA´ and ´AE´, see 5.2.

Function Analogue Output-Start ´AS´
Selection with key **F2...** Input see 5.4



Function Analogue Output-End ´AE´
Selection with key **F2...** Input see 5.4



Example: meas. range -10.0 to 50.0 °C

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

If the measuring points are continuously scanned it is even possible to connect two analogue outputs at the same time. At the output of A2 the measured value of the selected channel is present and at the output of A1 the measured value of the first channel of the selected sensor is present (see also man. 6.10.7).

9. DIGITAL DATA OUTPUT

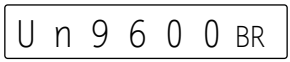
The serial interface can be used to completely program the instrument and sensors or to query the programming (see man. 6.). Furthermore, it is possible, as described in sections 7.2 and 7.3, to provide outputs of manual and cyclic measurements online, or offline after a recording (see 7.4), to a printer or computer. The various interface modules can be connected to socket A1 (3). The connection to the devices is described in the manual section 5.2. Modules for networking the devices follow in section 5.3.

9.1 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 bd and 57.60 or 115.2 kBd can via keypad be entered in function BAUD RATE ´BR´.
The input can be started by a long press of the key **PROGR ▶** . 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 **PROGR ▶** . The baud rate setting will be stored in the EEPROM of the interface module and will then be valid for use with all other ALMEMO® devices.

Function BAUD RATE ´BR´

Selection with key **F2**:



Example: Output to interface ´U´, format ´columns´, 9600 bd

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

To change the baud rate for a quicker readout of a memory connector, via readout cable ZA 1409-SLK, the memory connector must be plugged into socket A1 and the baud rate must be programmed as shown above.

9.2 Output Formats for Lists of Measuring Data

For measuring point scans (s. 7.2/3) the measured values can be provided in different output formats (s. man. 6.5.5, 6.6.1). 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 (s. man. 6.1). If only alarm values shall be printed at a cyclic measuring point scan, the format **Alarm** must be set.

The output format is indicated in function baud rate ´BR´ by a letter between the output channel ´U´ and the baud rate. The key **M▲** can be used to successively select the following options.

Format		Printout	Display
	List	measured values in a list	U 9600 BR
n	Columns	measured values in columns	U n 9600 BR
t	Spreadsheet	meas. values in spreadsheet format	U t 9600 BR
A	Alarm	alarm values only, as a list	U A 9600 BR
as above without data cable:		save alarm values only	S A - - - - BR

9.3 Manual Data Output

If the key **START/STOP** is not required for process control of the measurement, it can also be used to provide function values, which have been selected with the keys **F1** or **F2**, or even data tables as output to a printer or computer. The other functions (marked with *) can be either printed out using interface commands, or via an additional trigger cable (accessory ZA 1000-ET, variant 3, see man. 6.10.9). This trigger cable is plugged into socket A2 and the outputs are triggered using the external key.

Depending on the selected function the following printouts are available:

Function	Ab	Ke	Printout	
MEAS.VAL. *	Dim	**M**	12:34:00 01: +0023.5 °C	
MAX VALUE	MH	**F1**	MAXIMUM VALUE: 01: +0020.0 °C	
MIN VALUE	ML	**F1**	MINIMUM VALUE: 01: -0010.0 °C	
MEMORY	MF	**F1**	MEMORY: - - - -	s. 7.4.3
TIME CONSTANT	s	**F1**	TIMECONST: 10	
AVERAGE VAL *	AV	**F1**	AVG VALUE: 01: +0017.8 °C	
COUNT (all meas. values)	C	**F1**	MS MEASVAL MAXVAL MINVAL AVGVAL COUNT 01:+0023.0 +0025.0 +0019.0 +0022.0 99999	s. man. 6.4.4
VOLUME FLOW	V	**F1**	VOLUME: 01: 00419 m3/h	
PRINT CYCLE *	PC	**F1**	PRINT CYCLE: 00:06:00	
TIME	TM	**F1**	TIME: 12:34:00	
DATE	DA	**F1**	DATE: 01.02.99	
RANGE *	R	**F2**	01:NiCr +0123.4 -0012.0 +0000.0 °C 1.0000 E+0- - -	
LIM. VAL. MAX	LH	**F2**	LIM VAL MAX: 01: -0100.0 °C	
LIM. VAL. MIN	LL	**F2**	LIM VAL MIN: 01: +0020.0 °C	
ZERO POINT	ZC	**F2**	ZERO POINT: 01: -0000.7 °C	
SLOPE (GAIN)	SC	**F2**	SLOPE: 01: +1.0013	
BASE	BA	**F2**	BASE VAL: 01: -0273.0 °C	
FACTOR	FA	**F2**	FACTOR: 01: +1.0350E-1	
EXPONENT	EX	**F2**	FACTOR: 01: +1.0350E-1	

Function	Ab	Ke	Printout
AVERAG. MODE	AM	**F2**	01:NiCr +0123.4 -0012.0 +0000.0 °C 1.0000 E+0 STSTOP
CROSS SECTION	CS	**F2**	CROSS SECT: 01: 00078 cm2 DIAMETER: 00100 mm
DIAMETER	DN	**F2**	CROSS SECT: 01: 00078 cm2 DIAMETER: 00100 mm
ANALOG START	AS	**F2**	ANALOGSTART:01: +0000.0 °C
ANALOG END	AE	**F2**	ANALOGEND: 01: +0100.0 °C
ATM. PRESSURE	mb	**F2**	DEVICE: G00 M11 A01 P03/11/00
DEVICE ADDR. (device programming)	A	**F2**	ATM PRESS: +01013. mb CJ TEMP: +0023.5 °C U SENSOR: ! 12.5 V HYSTERESIS: 10 CONFIG: FC-DA--- -L-- ALARM: -1-3 A1: DK0 Un A2: AK1 s. man. 6.2.5
BAUD RATE (sensor programming)	BR	**F2**	AMR ALMEMO 2290-4 s. man. 6.2.3 MS RANGE LVMAX LVMIN BASE D FACTOR EXP AVG COMMENT 01:Ntc +040.00 - - - - - °C 1.0123 E+0 - - - Temperature 02:°o H +0060.0 +0020.0- - - %H - - - E+0 - - Humidity MEASCYCLE: 00:00:00 S0251.9 F0104.7 E W010 C--U- PRINTCYCLE: 00:10:00 Un 9600 bd
LOCKING (extended sensor programming)	LM	**F2**	MS ZEROPT SLOPE VM K FUNC EOFSET EFACT ANA-ST ANA-END B1 MX EF AH AL ZF RPM 01:+0000.0 +1.0000 5. 1 MESS +00000 32000 +0000.0 +1000.0-01 M1 -- S- E2 05 12.0 s. man. 6.10.1

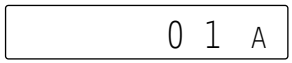
9.4 Device Address and Networking

All ALMEMO® instruments can be very easily networked to centrally acquire the measured values of several instruments that are located at different places (s. man. 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. The function DEVICE ADDRESS ´A´ is used for this purpose. It can be selected with the key **F2** and, at first, 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 (s. 5.4).

Function DEVICE ADDRESS ´A´

Selection with key **F2**: 

... Input see 5.4



Example: Address 01

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

10. TROUBLESHOOTING

The measuring instruments ALMEMO® 2290-4 can be configured and programmed in many different ways. They allow 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, they do not perform as the user would expect. In most cases this will not be related to a defective device but to operating errors such as wrong settings or an inadmissible wiring. The following tests should be performed to correct or to correctly identify the error.

Error: No display data or all display segments are permanently illuminated.
Remedy: Check power supply, recharge battery, switch off and on again, reinitialise (see 3.3)

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

Error: Varying meas. values, segment test or blockage during operation.
Remedy: Check cabling for inadmissible electrical connection,
Disconnect external power supply and output modules,
disconnect suspicious sensors and replace them by hand-held sensors in air or connect dummies and check (short circuit AB at thermocouples, 100Ω at Pt100 sensors).
If the error is corrected by this, check the wiring,
isolate the sensor if necessary, use electrically isolated power supply, prevent influences from disturbances by shielding or twisting.

Error: Data transmission via interface does not function.
Remedy: Check interface module, connections and settings:
Are both devices set to the same baud rate and transmission mode (see 9.1)?
Is the correct COM interface addressed at the computer?
Is the 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 **START/STOP** and monitor control.

Error: Data transmission within network does not function

Remedy: Check that all devices are set to different addresses,
address devices individually via terminal and command 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 measuring instrument ALMEMO® 2290-4 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 manual 2.2)

Measuring Inputs:	2 ALMEMO® sockets for ALMEMO® flat connector
Measuring channels:	2 primary channels, electrically isolated, 6 addit. chann. for double sensors and funct. chann.,
Sensor voltage supply:	Battery: 7...9V, max. 70mA Mains adapter: approx. 12V, max. 100mA
Outputs:	2 ALMEMO® sockets for all output modules
Equipment:	
Display:	6½ digits 7-segment, 2 digits 16-segment, 12mm
Keypad:	5 keys
Time and date:	buffered by device battery
Memory (Option S):	30 kB (6000 meas. val.) buffered by device battery
Microprocessor:	HD 6303 Y
Voltage Supply:	7 to 13V DC not electrically isolated
Mains adapter:	ZB 2290-NA 230V AC to 12V DC, 200mA electr. isol.
Adapter cable, electr. isolated:	ZB 2290-UK 10...30V DC to 12V DC, 250mA
Current consumption:	approx. 7 mA (without I/O modules)
Housing:	180x85x33mm, ABS high impact strength (max. 70°C)
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® 2290-4 Operating Instructions ALMEMO® 2290-4 ALMEMO® Manual incl. software AMR-Control

Product Overview

	Order No.
Multimeter ALMEMO® 2290-4	
2 inputs, 8 channels at max., 5 keys, interface that can be cascaded	MA 2290-4
Option S: data memory 30kB internal or memory connector external	OA 2290-4S
ALMEMO® memory connector with 128kB EEPROM (ca. 25,000 val.)	ZA 1904-SS4
ALMEMO® memory connector with 256kB EEPROM (ca. 50,000 val.)	ZA 1904-SS8
V24 adapter cable for direct readout of memory connector via PC, max. 115200 bd	ZA 1409-SLK
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, 0.1mV/digit	ZA 1601-RK
ALMEMO® V24 Data Cable, electr. isolated, max. 9600 bd, 1-4 mA	ZA 1909-DK
ALMEMO® V24 Data Cable, electr. isolated, max. 115200 bd, 10-14mA	ZA 1909-DK2
ALMEMO® Data Cable Centronics Interface, electr. isolated	ZA 1936-DK
ALMEMO® Network Cable Current Loop, electr. isolated	ZA 1999-NK
ALMEMO® I/O Cable for Triggering and Limit Value Alarm	ZA 1000-EGK