Operating instructions

Universal measuring instruments
ALMEMO® 2490-1, 2490-2

V2.5
04.11.14

1. OPERATING CONTROLS

(1) Measuring inputs M0 and M1
M0 ... M1 for all ALMEMO® sensors
M2 Function channel, differential
M10...M32 9 additional channels

(2) Analog outputs P0 (option)
P0 Clamp connector (ZA 1000-KS)

(3) Outputs A1, A2
A1 Interface USB (ZA 19019-DKU)
RS 232 (ZA 1909-DK5)
Optic fiber (ZA 1909-DKL)
Ethernet (ZA 1945-DK)
RS 422 (ZA 5099-NVL/NVB)
2nd analog output (ZA 1601-RK)
A2 Network cable (ZA1999-NK5/NKL)
Trigger input (ZA 1000-ET/EK)
Relay outputs (ZA 1006-EAK)
1st analog output (ZA 1601-RK)

(4) Connection DC 12V (not type L)
Mains adapter (ZA1312-NA1, 12V, 0.2A)
Cable, electr. isol. (ZA2690-UK, 10-30V)
RS485 (option I) (ZA1000-FSV)

(5) LCD
(a) Function
(b) Measuring point, 2nd meas. value
(c) Units for 2nd measured value
(d) Units for 1st measured value
(e) 1st measured value
(f) Operational states
LOBAT Battery voltage <3.3 V
FREE Unlocked for adjust. purposes
CORR Measured value corrected
REL Relative measuring

(6) Operating keys
ON OFF Switch the device on
To switch device OFF, press and hold down
M▲, **M▼** Meas. point selection
MAX, **MIN** Max. / min. value
clear: press and hold down
MEM Measured value memory
press and hold down: value displaying
CLR Relative measuring
Sensor adjustment
cancel: press and hold down

Rear of device

(7) Battery compartment
3 AA alkaline-manganese batteries

2. CONTENTS

3. GENERAL

Congratulations on your purchase of this new and innovative ALMEMO® measuring instrument. Thanks to the patented ALMEMO® connector the device configures itself automatically; its operation should be fairly straightforward. The device can, however, be used with such a wide range of sensors and peripherals and offers many different special functions. You are advised therefore to properly familiarize yourself with the way the sensors function and with the device's numerous possibilities and take the time to carefully read these operating instructions and the appropriate sections in the ALMEMO® Manual. This is absolutely necessary to avoid operating and measuring errors and to prevent damage to the device. To help you find the answers to your questions quickly and easily there is a comprehensive index at the end both of these instructions and of the Manual.

3.1 Warranty

Each and every device, before leaving our factory, undergoes numerous quality tests. We provide a guarantee, lasting two years from delivery date, that your device will function trouble-free. Before you send your device to us, please observe the advisory notes in Chapter 13. Trouble-shooting In the unlikely event that the device proves defective and you need to return it please wherever possible use the original packaging material for dispatch and enclose a clear and informative description of the fault and of the conditions in which it occurs.

This guarantee will not apply in the following cases :

- The customer attempts any form of unauthorized tampering and alteration inside the device.
- The device is used in environments and conditions for which it is not suited.
- The device is used with unsuitable power supply equipment and / or peripherals.
- The device is used for any purpose other than that for which it is intended.
- The device is damaged by electrostatic discharge or lightning.
- The user fails to observe and comply with the operating instructions.

The manufacturer reserves the right to change the product's characteristics in the light of technical progress or to benefit from the introduction of new components.

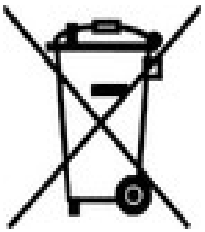
3.2 Scope of delivery

When you unpack the device check carefully for any signs of transport damage and ensure that delivery is complete.

Measuring instrument ALMEMO® 2490 with 3 AA alkaline batteries
These operating instructions
ALMEMO® Manual
CD with the AMR-Control software and various useful accessories

In the event of transport damage please retain the packaging material and inform your supplier immediately.

3.3 Waste disposal



The pictogram showing a waste bin crossed through means that the product is subject to European Union regulations on segregated waste disposal. This applies both to the product itself and to any accessories marked with the same symbol. Disposal of any such item as unsorted domestic waste is strictly forbidden

- Please dispose of all packaging materials according to the applicable national waste management regulations.
- Please dispose of cardboard boxes, protective plastic packaging materials, and all preservative substances separately and in the proper manner.
- The disposal of the device itself (also of device parts, accessories, and consumables) is subject to the applicable national and local waste management regulations and to the environmental protection legislation in force in the country of use.
- Please dispose of all waste in the proper manner;
  this applies in particular to all parts and substances that constitute a hazard for the environment. This includes inter alia plastics, batteries, and rechargeable battery packs .
- When disposing of goods, please wherever possible use the original packaging materials.

4. SAFETY INSTRUCTIONS

DANGER **Danger to life and limb, risk of damage to equipment**

Read the instructions carefully before starting to operate the device.

Please ensure that you comply with all general safety advice and the special safety instructions included in other chapters.

Such risks may occur in the following circumstances :

- Failure to heed the operating instructions and all the safety notes these contain
- Any form of unauthorized tampering or alteration inside the device
- Use of the device in environments or conditions for which it is not suited
- Use of the device with an unsuitable power supply and / or in conjunction with unsuitable peripheral equipment
- Use of the device for any purpose other than that for which it is intended
- Damage caused by electrostatic discharge or lightning.

DANGER **Risk of fatal injury caused by dangerously high voltage**

Such risks may occur in the following circumstances :

- Use of the device with an unsuitable power supply and / or in conjunction with unsuitable peripheral equipment
- Damage caused by electrostatic discharge or lightning
- Do not run sensor lines in the vicinity of high-voltage power cables.
- Before you touch any sensor lines, ensure that all static electricity has been discharged.

DANGER **Warning - explosive atmospheres or substances**

In the vicinity of various fuels or chemicals there is a risk of explosion.

Do not use the device in the close vicinity of blasting work or filling stations!

4.1 Special notes on use

- If the device is brought into the work-room from a cold environment there is a risk that condensation might form on the electronics. In

measuring operations involving thermocouples pronounced changes in temperature may cause substantial measuring errors. You are advised therefore to wait until the device has adjusted to the ambient temperature before starting to use it.

- Before using the mains adapter make sure that the mains voltage is suitable.
- Be sure to observe the maximum load capacity of the sensor power supply.
- Sensors with their own integrated power supply are not electrically isolated from one another

4.2 Handling batteries / rechargeable batteries correctly

When inserting batteries / rechargeable batteries ensure that these are correctly polarized.

If the device will probably not be needed for a relatively long period of time or if the batteries are empty, remove the batteries; this will prevent battery acid leaking onto the device and damaging it.

Rechargeable batteries should be recharged as and when necessary.

You should never attempt to recharge an ordinary (non-rechargeable) battery; it may explode !

Batteries / rechargeable batteries must never be short-circuited or thrown onto the fire.

Batteries / rechargeable batteries are special waste and must not be discarded together with normal domestic waste.

5. INTRODUCTION

The ALMEMO® 2490 is a new member in our family of unique measuring devices - all equipped with Ahlborn's patented ALMEMO® connector system. The intelligent ALMEMO® connector offers decisive advantages when connecting sensors and peripherals because all parameters are stored in an EEPROM located on the connector itself; repeat programming is thus no longer necessary. All sensors and output modules can be connected to all ALMEMO® measuring instruments in the same way. Programming and functioning are identical for all units. The following points apply to all devices in the ALMEMO® measuring system; these are described in detail in the ALMEMO® Manual which is included in delivery with each device.

Detailed explanation of the ALMEMO® system (Manual Ch 1)
Overview of the device functions and measuring ranges (Manual Ch 2)
Basic principles, operation, and technical data for all sensors (Manual Ch 3)
Options for connecting your own existing sensors (Manual Ch 4)

All analog and digital output modules (Manual Section 5.1)
Interface modules USB, RS232, optic fiber (Manual Section 5.2)
The whole ALMEMO® networking system (Manual Section 5.3)
All functions and their operation via the interface (Manual Ch 6)
Complete list of interface commands with all the printouts (Manual Ch 7)

The operating instructions you are now reading cover only those features and controls that are specific to this device. Many sections therefore also refer to the more detailed description in the Manual; (see Manual, Section xxx).

5.1 Functions

The ALMEMO® 2490-1 has one electrically isolated measuring input suitable for all ALMEMO® sensors; the 2490-2 has two such measuring inputs. The measuring possibilities are virtually unlimited; there are 4 channels per sensor connector and 4 device-internal function channels (type -2 only) - with over 70 measuring ranges. For operation purposes the device incorporates a large LCD display and a keypad. An option is available with an internal electrically isolated analog output including a DC socket for a mains adapter (socket P0). The standard version with interface has three output sockets, namely A1 and A2, suitable for all ALMEMO® output modules, e.g. analog outputs, digital interfaces, trigger and relay cables, plus a DC socket for a mains adapter. Several devices can be networked by simply linking them together via cable.

5.1.1 Sensor programming

The measuring channels are programmed, completely and automatically, by the ALMEMO® connectors. The user can freely supplement or modify this programming; this applies to the interface version only. However, devices without the interface also behave according to all the programmed parameters.

Measuring ranges

Appropriate measuring ranges are available for all sensors with a non-linear characteristic, e.g. 10 thermocouple types, NTC and PT100 probes, infrared sensors, and flow transducers (rotating vanes, thermoanemometers, Pitot tubes). For humidity sensors additional function channels are available for calculating humidity variables such as dew point, mixture ratio, vapor pressure, and enthalpy. Even complex chemical sensors are supported. Measured values from other sensors can also be acquired using the voltage, current, and resistance ranges with individual scaling in the connector. Existing sensors can also be used - so long as the appropriate ALMEMO® connector is connected via its screw terminals. For digital input signals, frequencies, and pulses, adapter connectors are available with an integrated microcontroller. It is thus possible to connect virtually any sensor to any ALMEMO® measuring instrument and to change sensors without the need for any extra settings.

Function channels

Maximum, minimum, average, and differential values from certain measuring points can be programmed as function channels, also internal channels, and can be processed and printed out like normal measuring points.

Units
The 2-character units display can be adapted for each measuring channel so that both the display and the printout always indicate the correct units, e.g. when a transmitter is connected. Conversion between °C (Centigrade) and °F (Fahrenheit) is performed automatically.

Measured value designation
Each sensor is identified by means of a 10-character alphanumeric name. This name is entered via the interface and will appear in the printout or on the computer display.

Correction of measured values
The measured value on each measuring channel can be corrected both in terms of zero-point and gain; this means that even sensors usually requiring initial adjustment (e.g. expansion, force, pH) can be freely interchanged. Zero-point correction and, partly at least, gain adjustment can be performed at the touch of a button. Sensors with multi-point calibration can also be connected; (see Manual Section 6.3.13).

Scaling
The corrected measured value on each measuring channel can also be further scaled in terms of zero-point and gain - using the base value and factor. The decimal point position can be set by means of the exponent function.

Limit values and alarm
Per measuring channel two limit values can be set (1 maximum and 1 minimum). In the event of one of these limit values being exceeded relay output modules actuate the associated alarm contacts; these can be allocated individually to specific limit values. Hysteresis is set by default to 10 digits but this can be adjusted to any number between 0 and 99. The exceeding of a limit value can also be used to start or stop measured value recording automatically.

Sensor locking
All sensor data stored in the connector EEPROM can be protected by means of a graduated locking function against undesired access.

5.1.2 Measuring operations

For each transducer up to 4 measuring channels are available; i.e. it is also possible to evaluate double sensors, individually scaled sensors, and sensors with function channels. You can move forwards or backwards from one measuring channel to the next using the keypad. The selected measuring point is by default assigned preferred status and is scanned at half the measuring rate; all other active channels are also scanned but in the background (semi-continuous mode). The data is output on the display and, if available, to an analog output. To shorten the response time when there are several measuring points the measuring rate can be set to continuous and increased accordingly.

Measured values
The measured value for the selected measuring point is shown continuously with autozero and, as and when necessary, with measured value correction.
With most sensors, sensor breakage is detected automatically (except for connectors with shunt, dividers, or additional electronics).

Analog output and scaling
Each measuring point can be scaled by means of analog start and analog end in such a way that the measuring range thus defined covers the full range of the analog output (2 V, 10 V, or 20 mA). At the analog output the device can output the measured value from any measuring point or a programmed value.

Measuring functions
With some sensors, to achieve optimal measured value acquisition, certain special measuring functions are required. Cold junction compensation is provided for thermocouples; temperature compensation is provided for dynamic pressure, pH, and conductivity probes; and atmospheric pressure compensation is provided for humidity sensors, dynamic pressure sensors, and O_2 sensors.

Measured value smoothing
Measured values of an unstable or strongly fluctuating nature can be smoothed by means of a sliding average over a number of values programmable from 2 to 99.

Maximum and minimum values
For each measuring operation the maximum value and minimum value are acquired and saved to memory. These values can then be displayed, output, or deleted from memory.

Measured value memory
Up to 100 measured values can be saved manually. This data can then be shown on the display or output via the interface.

Differential measurement
It is possible, by setting the measured value to zero, to perform relative measuring operations with respect to a reference value; with 2 sensors and the same measured variables genuine differential measuring operations can be performed.

5.1.3 Process control (interface functions, see Manual Ch 6, not type L)

To record the measured values from all connected sensors in digital form measuring point scanning is performed continuously with measured value output according to a time-based process control. This may be per cycle or, if really rapid results are required, at the measuring rate itself. The measuring operation can be started and stopped via the interface by means of an external trigger signal or by a specified limit value being exceeded.

Date and time-of-day
Date and time-of-day can be freely set and then used in the logging of measuring operations. When the batteries are replaced these date and time-of-day settings are lost and have to be reset.

Cycle
The cycle can be programmed to any value between 00:00:01 (1 second) and 59:59:59 hh:mm:ss. This function permits cyclic output of measured values to the interfaces and cyclic calculation of average values.

Print cycle factor
The print cycle factor can be used to limit data output from particular channels; this may be necessary in order to reduce excessive data flow especially while data is being saved.

Averaging over measuring point scans
The measured values from measuring point scans can be averaged either over the whole measuring duration or over the specified cycle. These average values can then be output and saved on a cyclic basis to function channels provided for this purpose.

Measuring rate
All measuring points are scanned at the measuring rate (2.5 or 10 mops). To accelerate recording it is also possible to output all measured values at this measuring rate via the interface.

Control outputs
Output relays and analog outputs can be individually addressed via the interface.

Output
All data logs, measured values, and programming parameters can be output to any peripheral equipment. RS232, RS422, USB, and Ethernet interfaces are available using the appropriate interface cables. Measured data can be output in list, column, or table format. Files in table format can be processed directly using any standard spreadsheet software. The print header can be programmed to refer specifically to your company or to your application.

Networking
All ALMEMO® devices can be addressed and can be easily networked by simply linking them together via network cable or over longer distances via an internal RS485 interface (option) or RS422 network distributors.

Software
Each ALMEMO® Manual is accompanied by the AMR-Control software package, which can be used to configure the measuring instrument, to program the sensors, and to read out from the measured value memory. Using the integrated terminal, measuring operations can also be performed online. The WINDOWS® software package WIN-Control is provided for the purposes of measured value acquisition via networked devices, for graphical presentation, and for more complex data processing.

6. INITIAL COMMISSIONING

1. **Connect sensor** to socket **M0** (1); see 8.
2. **Ensure that the power supply** is provided via 3 AA batteries or mains adapter;
3. **Switch ON** by pressing key ON (6) ; see 7.5.
4. **Select measuring channels** by pressing key M▲ (6), read out measured values (5e); see 10.1.1.
5. **Save the measured value** by pressing key MEM (6) see 10.3.
6. **Relative measuring** with respect to a reference value or **sensor adjustment** by pressing key CLR (6); return to normal measured value by pressing and holding down key CLR see 10.4.
7. **Differential measurement** (2490-2 only), plug 2 sensors of same type into sockets M0 and M1 and then select measuring point **M2**; see 10.6
8. **Evaluating a measuring operation**
   Call up maximum / minimum values by pressing keys MAX / MIN (6)
   To delete max. / min. value(s) press and hold down key MAX or MIN ; s. 10.2.
9. **Programming** or **data output** via interface (not type L)
   Connect computer via interface cable to socket A1; see Manual 5.2.
   Activate supplied software AMR-Control.
   Via 'Setup interface' set the COM port and transmission rate to 9600 bauds.
   Program the sensors via 'Program measuring point list'.
   Measured value display and sensor adjustment via ´Measuring points - Measured values´
   Data logging on the computer :

Program the cycle via ´Devices - Programming´
Open the terminal window via ´File - Terminal´
´File - Terminal - Open log ´, enter file name, ´Save´
Start the measuring operation by click ´Start´
Stop the measuring operation by click ´Stop´
´File - Terminal - Close log´
Activate file e.g. from MS-Excel and import using ´;´ as separator;

7. POWER SUPPLY

Power can be supplied to the measuring instrument in any of the following ways : 3 AA alkaline batteries (included in delivery)

Mains adapter 12V, 0.2A with ALMEMO® connector	ZA1312-NA1
Electrically isolated power supply cable (10 to 30 VDC, 0.25 A)	ZA2690-UK
12V DC clamp connector to socket DC (options U and I)	ZA1000-FSV

Our product spectrum includes all the appropriate accessories.

7.1 Battery operation and supply voltage monitoring

Power is supplied to the measuring instrument as delivered by 3 AA batteries. At a current consumption of approx. 16 mA the operating time will be approx. 150 hours. The current operating voltage is displayed each time the the device is switched on; this gives you a basis for estimating the remaining operating time. When the remaining battery capacity drops to approx. 10 percent, the LO-BAT arrow will appear in the display. If the batteries are completely discharged the device will switch off. To replace old batteries first unscrew the battery compartment cover (7) on the rear of the device.

7.2 Mains operation

The ALMEMO® 2490 can be supplied with power from an external source preferably using mains adapter ZA 1312-NA1 (12 V / 0.2 A) via the DC socket (4). Please ensure that the mains voltage is correct.

7.3 External DC voltage supply

The DC socket (4) can also be used to connect another DC voltage, 10 to 30 V (minimum 200 mA). This is via an ALMEMO® connector (ZA1000-FSV). If, however, the power supply has to be electrically isolated from the transducers, then option U (OA 2490-U) is needed or electrically isolated supply cable ZA 2690-UK must be used. It will then be possible to use the measuring instrument in a 12-volt or 24-volt on-board supply system.

7.4 Sensor supply

At the terminals + (plus) and – (minus) in the ALMEMO® connector there is a 9-volt sensor supply voltage available (maximum 150 mA) (self-healing fuse, 500 mA). Other voltages (12, 15, or 24 V or references for a potentiometer and strain gauge) can be obtained using special connectors; (see Manual 4.2.5 and 4.2.6).

7.5 Switching ON / OFF, reinitialization

To switch the device **ON** briefly press and release the key ON OFF (6) in the middle of the keypad; to switch the device **OFF** press and hold down the key ON OFF. After the device is switched off all saved values and settings are retained intact; (see 7.6).

If interference (e.g. electrostatic) or a malfunction (e.g. battery failure) causes the device to behave abnormally, the device can be reinitialized. To activate **RESET** press and hold down the key CLR when switching on. This will restore all settings - except the device designation - to the factory default status. Only the programming of the sensors in the ALMEMO® connectors remains unaffected.

7.6 Data buffering

The sensor's programming is stored in the EEPROM on the sensor connector and the device's calibration and programmed parameters are stored in the EEPROM on the instrument itself, both on a fail-safe basis. Date and time-of-day are retained intact if the device is just switched off but are lost when the batteries are replaced.

8. CONNECTING THE TRANSDUCERS

Virtually any ALMEMO® sensor can be connected to ALMEMO® input socket M0 (and / or M1 on version 2490-2) on the measuring instrument (1). To connect your own existing sensors you simply need the appropriate ALMEMO® connector.

8.1 Transducers

The ALMEMO® Manual includes detailed descriptions of the comprehensive ALMEMO® range of sensors (see Manual Ch 3) and instructions for connecting your own existing sensors to ALMEMO® instruments (see Manual Ch 4). All standard sensors with an ALMEMO® connector usually have the measuring range and units already programmed and can thus be connected to any input socket without further adjustment. A mechanical coding system ensures that sensors and output modules can only be connected to the correct sockets. All ALMEMO® connectors incorporate two snap-lock levers; these snap into position as soon as the connector is inserted into the socket, thus preventing unintended disconnection if the cable is accidentally pulled. To withdraw the connector, both these levers must be pressed in at the sides.
For the ALMEMO® 2490 version with the optional seal new specially designed sensors are available with spray-coated ALMEMO® connectors incorporating a double sealing lip to protect the socket unit against the effects of splashing water. For any unused sockets protective stoppers are available.

8.2 Measuring inputs and additional channels

The ALMEMO® 2490-1 has 1 input socket, version 2490-2 has 2 input sockets (1); to these initially measuring channels M0 (and M1) are assigned. ALMEMO® sensors can, however, if necessary, provide up to 4 channels. The

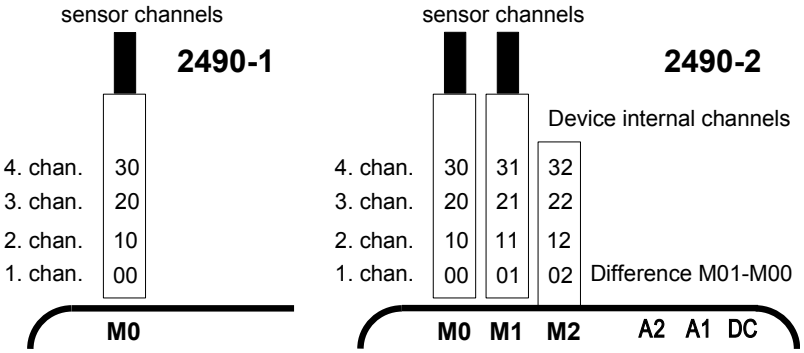
additional channels can be used in particular for humidity sensors with 4 measuring variables (temperature / humidity / dew point / mixture ratio) or for function channels. Each sensor can if necessary be programmed with several measuring ranges or scaling settings; and 2 or 3 sensors, if pin assignment so permits, can be combined in a single connector (e.g. rH / NTC, mV / V, mA / V, etc.). The additional measuring channel numbers per connector go up in steps of 10 (e.g. the first sensor has channels M0, M10, M20, M30, the second sensor has channels M1, M11, M21, M31 etc.).

Device-internal channels (2490-2 only)

A further innovation on this device is its four additional device-internal channels. The first of these M2 is programmed by default as differential channel M1 – M0. This only applies, however, if there are two sensors with the same units and same decimal point position connected at measuring points M0 and M1. However, all 4 channels can be programmed with any other function channels (e.g. U-Bat, cold junction compensation, averages, etc.); (see Manual, Section 6.3.4). The reference channels are by default Mb1 = M1 and Mb2 = M0.

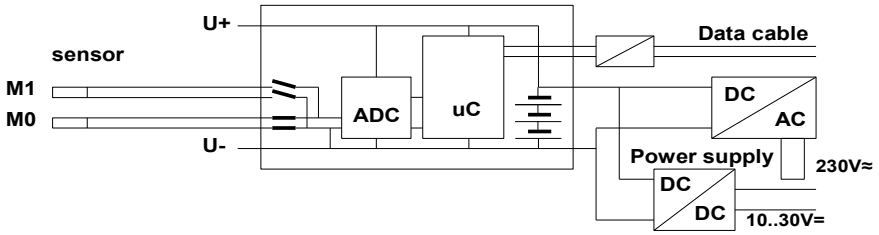
The **advantage** of device-internal channels is that when using several sensors for the same application these sensors do not have to be reprogrammed and can be exchanged without losing the function channels. However, if the whole application operates with just one sensor, then programming the function channels on the sensor itself makes more sense.

On the measuring instrument this gives the following channel assignment :



8.3 Potential separation

When organizing a properly functioning measuring setup it is very important to ensure that no equalizing current can flow between sensors, power supply, and peripherals. All points must therefore lie at the same potential and / or any unequal potentials must be electrically isolated.



The 2 inputs on version 2490-2 are electrically isolated by means of photovoltaic relays and a potential difference of maximum 50 VDC or 60 VAC is permissible between them. Sensors combined within one connector and sensors with their own power supply, however, are electrically interconnected and must therefore be operated in isolation. The voltage at the measuring inputs themselves must not exceed 5 volts (between B, C, D, A and -).
The power supply is isolated by the transformer in the mains adapter or by a DC/DC converter (OA2490-U or ZA2690-UK). Data and trigger cables are equipped with optocouplers. If analog output cables are not electrically isolated the recording device or the sensors must be zero-potential.

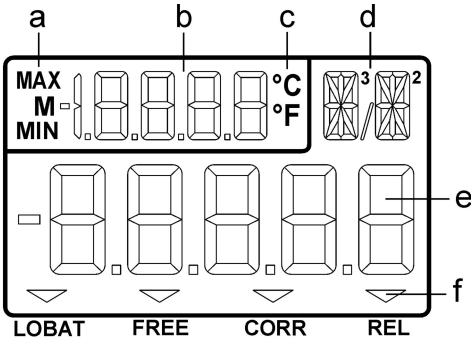
9. DISPLAY AND KEYPAD

9.1 Display

The display (5) on the ALMEMO® 2490 measuring instrument is a 2-row LCD arrangement; the main field comprises 5x 7-segment digits (e) plus 2x 16-segment digits (d) for depicting the measured value;,the function field comprises 41/2x 7-segment digits (b) for depicting various measuring functions (a); there are also 4 arrows (f) for depicting the operating status.

Function field

Main field



Display of measuring functions in the function field

Measuring point	M 0
Maximum value	MAX 36.5
Minimum value	MIN 17.3
Saved value	M 36.2
Memory capacity	P01
Temperature value from double sensors	26.5 °C
Configuration of device address	Adr
Configuration of analog reference channel	ACh1
Configuration of locking	Loc
Configuration of automatic OFF	AOFF

Special operating states and faults

Display segment test : runs automatically after switch ON

Supply voltage Display after segment test

Under 3.6 V : **LOBAT** arrow lights up.

Relative measuring with respect to a reference value : **REL** arrow lights up.

Sensor correction or scaling : **CORR** arrow lights up.

Unlocked to enable sensor adjustment : **FREE** arrow lights up.

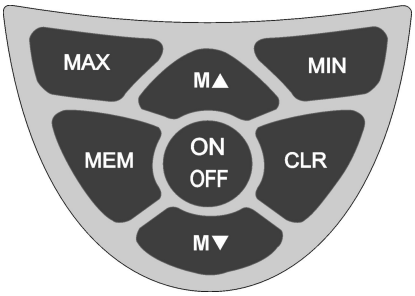
Checksum error in device calibration :	CALEr	
Non-connected sensors, deactivated measuring points :	-----	
Measuring range / function not permitted :	Err	
Sensor breakage :	NiCr	flashes
Outside of measuring range, undershoots cold junction compensation or cold junction compensation breakage :	CJ	flashes
Overshoots values range (>65000) :	65000	flashes

Overshoots measuring range : Maximum value flashes

Undershoots measuring range : Minimum value flashes

9.2 Keypad

To operate the device a keypad with 7 keys is provided :



Function :	Key
To switch ON the device : (see Section 7.5)	ON OFF
To switch OFF the device :	ON OFF must be pressed and held down

Function :	Key
Measuring points selection (see Section 10.1.1)	M▲ or M▼
Displaying the maximum value : (see Section 10.2) To delete press and hold down	MAX
Displaying the minimum value : (see Section 10.2) To delete press and hold down	MIN
Zero-setting the measured value : (see Section 10.4) To delete press and hold down	CLR
Saving the measured value : (see Section 10.3)	MEM
Displaying the battery voltage :	ON OFF

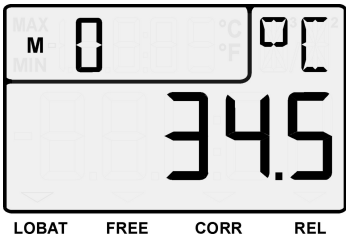
10. MEASURING OPERATIONS

With measuring instrument ALMEMO® 2490 all available measuring channels are scanned by default semi-continuously; this permits continuous differential measurements and ensures continuous temperature compensation for dynamic pressure probes or chemical probes; (see Manual, Section 6.5.1.3).
Up to 4 or 12 measuring channels (type 2) can be displayed; see 8.2-
A measured value can be sent to an analog output; (see 11.2, Manual 5.1.1).

10.1 Measured value

After switching ON first of all a segment test is performed; then the battery voltage appears and if the batteries are almost empty (<3.6 V) the LOBAT arrow also appears.

The measured value is then displayed with the appropriate units in the main field and the measuring point is displayed in the function field. All special operating states possible for the measured value are explained in Section 9.1.



10.1.1 Selecting a measuring point

By pressing key M▲ you can select one after the other all active measuring points and have the current measured value displayed for each. By pressing key M▼ you can return to the previous channel.

To increment the measuring channel press key : M▲

To decrement the measuring channel press : M▼

When switching between channels the abbreviation for the measuring range is briefly displayed; (see 10.1.2).

10.1.2 Measuring ranges

With each channel switchover or sensor breakage the abbreviation for the measuring range appears in the display. For identification purposes the following table lists all possible measuring ranges.

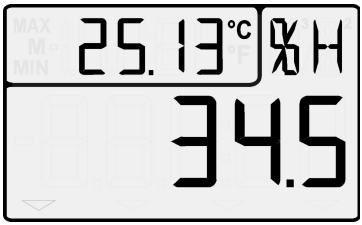
Transducers	Sensor / connector	Measuring range	Units	Abbreviation
Pt100-1	FP Axxx	-200.0... +850.0	°C	P104
Pt100-2	FP Axxx	-200.00...+400.00	°C	P204
Ni100	ZA 9030-FS3	-60.0... +240.0	°C	N104
NiCr-Ni (K)	FT Axxx	-200.0...+1370.0	°C	NiCr
NiCroSil-NiSil (N)	ZA 9020-FSN	-200.0...+1300.0	°C	NiSi
Fe-CuNi (L)	ZA 9000-FSL	-200.0... +900.0	°C	FECO
Fe-CuNi (J)	ZA 9000-FSJ	-200.0...+1000.0	°C	IrCo
Cu-CuNi (U)	ZA 9000-FSU	-200.0... +600.0	°C	CUCO
Cu-CuNi (T)	ZA 9000-FST	-200.0... +400.0	°C	CoCo
PtRh10-Pt (S)	FS Axxx	0.0...+1760.0	°C	Pt10
PtRh13-Pt (R)	ZA 9000-FSR	0.0...+1760.0	°C	Pt13
PtRh30-PtRh6 (B)	ZA 9000-FSB	+400.0...+1800.0	°C	EL18
Au-FeCr	ZA 9000-FSA	-270.0... +60.0	°C	AUFE
Ntc Typ N	FN Axxx	-30.00...+125.00	°C	Ntc
Millivolt	ZA 9000-FS0	-10.000...+55.000	mV	U 55
Millivolt 1	ZA 9000-FS1	-26.000...+26.000	mV	U 26
Millivolt 2	ZA 9000-FS2	-260.00...+260.00	mV	U260
Volt	ZA 9000-FS3	-2.0000...+2.6000	V	U2.60
Difference millivolt	ZA 9000-FS0D	-10.000...+55.000	mV	d 55
Difference millivolt 1	ZA 9000-FS1D	-26.000...+26.000	mV	d 26
Difference millivolt 2	ZA 9000-FS2D	-260.00...+260.00	mV	d260
Difference volt	ZA 9000-FS3D	-2.0000...+2.6000	V	d2.60

Transducers	Sensor / connector	Measuring range	Units	Abbreviation
Sensor voltage	any	0.00...20.00	V	UbAt
Milliampere	ZA 9601-FS1	-26.000...+26.000	mA	I032
Percent (4-20mA)	ZA 9601-FS2	0.00... 100.00	%	P420
Ohm	ZA 9003-FS	0.0... 500.0	Ω	Ohn
Frequence	ZA 9909-AK1	0... 32000	Hz	FrEq
Pulse	ZA 9909-AK2	0... 65000		PULS
Digital input	ZA 9000-EK2	0.0... 100.0	%	Inp
Digital interface	ZA 9919-AKxx	-65000... +65000		diGi
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
Dynamic press., 40 m/s with TC and PC	FD A612-M1	0.50... 40.00	m/s	L840
Dynamic press., 90 m/s with TC and PC	FD A612-M6	1.00... 90.00	m/s	L890
Relative air humidity, capacitive	FH A646	0.0... 100.0	%H	°orH
Relative air humidity, cap., TC	FH A646-C	0.0... 100.0	%H	HcrH
Relative air humidity, cap., TC	FH A646-R	0.0... 100.0	%H	H rH
Mixture ratio, capacitive with PC	FH A646	0.0 ... 500.0	g/k	H AH
Dew-point temperature, cap.	FH A646	-25.0... 100.0	°C	H dt
Partial vapor pressure, cap.	FH A646	0.0 ...1050.0	mb	H UP
Enthalpy, capacitive with PC	FH A646	0.0 ... 400.0	kJ	H En
Humid temperature	FN A846	-30.00 ... +125.00	°C	P Ht
Relative humidity, psychr. with PC	FN A846	0.0 ... 100.0	%H	P RH
Mixture ratio, psychrometric with PC	FN A846	0.0 ... 500.0	g/k	P AH
Dew-point temp., psychrometric with PC	FN A846	-25.0 ... +100.0	°C	P dt
Partial vapor pressure, psychr. with PC	FN A846	0.0 ...1050.0	mb	P UP
Enthalpy, psychrometric with PC	FN A846	0.0 ... 400.0	kJ	P En
Conductivity probe, with TC	FY A641-LF	0.0 ... 20.000	mS	LF
CO_2 sensor	FY A600-CO2	0.0 ... 2.500	%	CO2
O_2 saturation with TC and PC	FY A640-O2	0 ... 260	%	O2-S
O_2 concentration with TC	FY A640-O2	0 ... 40.0	mg	O2-C
Function channels:				
Differential channels Mb1 - Mb2	any			diFF
Maximum value of channel Mb1	any			Hi
Minimum value of channel Mb1	any			Lo
Av. val. M(t) over time of Mb1	any			A[t]
Av. value M(n) of Mb2 to Mb1	any			A[n]
Sum S(n) of Mb2 to Mb1	any			S[n]
Total pulses S(t) of Mb1	ZA 9909-AK2	0... 65000		S[t]
Pulses / print cycle of Mb1	ZA 9909-AK2	0... 65000		S[P]

Transducers	Sensor / connector	Measuring range	Units	Abbreviation
Alarm value of channel Mb1	any			Alrn
Wet bulb globe temperature	ZA 9030-FS		°C	UbGt
Measured value of Mb1	any			MESS
Cold junction temperature	any		°C	CJ
Number of av. values of Mb1	any			n(t)
Volume flow m^3/h $\overline{M}$ (Mb1)*Q	any		mh	FLou
Timer	any		s	tinE

TC = Temperature compensation PC = Air pressure compensation

10.1.3 Double display



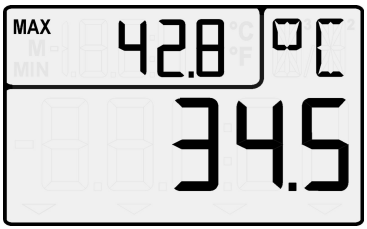
On all double sensors incorporating a temperature sensor on the 1st channel the temperature value can at the same time be displayed in the function field.

Select 2nd channel

Activate temperature display Press and hold down M▲

Return to channel display Press and hold down M▲

10.2 Peak value memory



From the measured values acquired for each measuring point the highest and the lowest values are continuously recorded. To display these high / low peak values first the desired channel must be set (see Section 7.1) and then the MAX or MIN key must be pressed. As a check the display also includes the associated symbol.

To display the maximum value press key : MAX.

To display the minimum value press key : MIN.

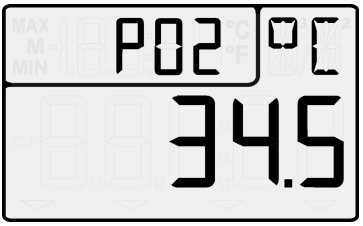
To delete the maximum value press and hold down key : MAX .

To delete the minimum value press and hold down key : MIN .

To return to the measuring point display press key : M▲.

As soon as you clear the memory, the current measured value will appear (because measuring is continuous).

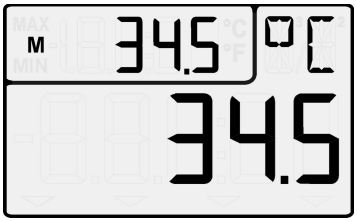
10.3 Measured value memory



The ALMEMO® 2490 can save 99 measured values in memory locations P01 to P99. The measured data can be shown on the display or output via the interface.

To save each such measured value press key : MEM .

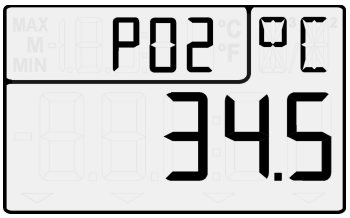
The function field will show the memory location for about one second
e.g.: P02



The value most recently saved then appears in the function field preceded by the symbol ´M´

To return to the channel display press key : M▲.

To **display all memory data** press and hold down key : MEM .



The function field displays the last memory location; the main field displays the measured value.

To select the first memory location press : MIN
To select the last memory location press : MAX
To increment the memory location press : M▲
To decrement the memory location press : M▼
To clear the memory press : CLR
To terminate memory display press : MEM

Interface commands

Saving a measurement value S-4
Output of the memory data : P-04

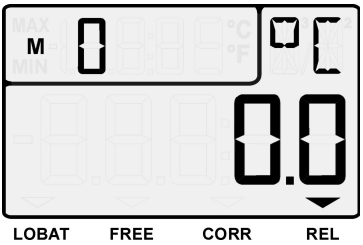
```
Memory :
P01: 00: +022.12 °C
P02: 00: +022.12 °C
P03: 10: +0039.9 %H
P04: 10: +0039.9 %H
P05: 20: +0007.6 °C
P06: 20: +0007.5 °C
```

Clearing the memory : C-04

10.4 Relative measuring

One very useful function is to zero the measured value at certain locations or at certain times as a reference value in order then to observe only the subsequent deviations. This function is independent of the locking status and does

not modify the programming parameters in the connector. (Special cases, see 10.5 and Locking, see 12.4).



To zero-set the measured value press key : **CLR**

To display relative measuring with arrow : **REL**.

Return to normal measured value by pressing and holding down key : **CLR** .

Setting to zero automatically deletes the maximum and minimum values for this channel. The **MAX**, **MIN**, and **MEM** functions are thus also available for relative measurement.

10.5 Sensor adjustment

Many types of sensor need to be adjusted at least once or at regular intervals to compensate for various instabilities. With **dynamic pressure probes** (ranges L840 and L890, units Pa) the zero-point must be temporarily adjusted by pressing key **CLR** , i.e. until switching off, even if the channel is locked.

With the following **chemical probes** automatic **two-point adjustment** can be performed :

Probe	Type	Zero point	Gain
pH probe	ZA 9610-AKY:	7.00	4.00 pH or 10.00 pH
Conductivity	FY A641-LF:	0.0	2.77 mS/cm
	FY A641-LF2:	0.0	147.0 uS/cm
	FY A641-LF3:	0.0	111.8 mS/cm
O_2 saturation	FY A640-O2:	0	101 %

1. Open locking

For adjustment purposes, since these sensors are by default locked, locking must be temporarily deactivated. To do so when switching ON press and hold down the two keys **MAX** and **MIN** . The arrow **FREE** should then light up indicating that adjustment is now possible. After the device is switched off the sensor will be locked again as normal.

2. Zero-point adjustment

To perform **zero-point adjustment** the measured value must first be physically set to zero, i.e.

- pH probe must be immersed in a buffer solution pH 7.0.
- Conductivity probe must be withdrawn from the liquid and dried.
- O_2 probe for water must be held in a zero solution.

Zero-point adjustment is performed in 2 steps :

The 1st time key **CLR** is pressed the setpoint flashes in the display.

The 2nd time key CLR is pressed, adjustment is performed.
To cancel adjustment press key M▲

3. Gain adjustment

For **gain adjustment** the **gain calibration resources must be provided** (see Table). **Gain adjustment** is then performed by pressing key CLR in exactly the same way as for zero-point adjustment.

If correction val. have been programmed, the CORR arrow lights up.

4. Deleting adjustment values

Adjustment values can be cleared by pressing and holding down the key CLR. On pH probes you can thus restore the default values, base value 7.00 and gain -0.1689.

Temperature compensation

On conductivity probes and O_2 probes with an integrated temperature sensor temperature compensation is performed automatically. For pH probes a temperature sensor can be specially configured for this purpose; (see Man. 6.2.6).

10.6 Differential measurement

On version 2490-2, if two sensors with the same units and same decimal point position are connected at measuring points M0 and M1, the difference M1 - M0 appears automatically below the measuring point M2. The sensors are electrically isolated by means of photovoltaic relays. If the differential channel is not required, it must be cleared via the interface. If further differential channels are needed, these can also be created via the interface using the appropriate reference channels; (see Manual, Section 6.3.4).

11. OUTPUTS

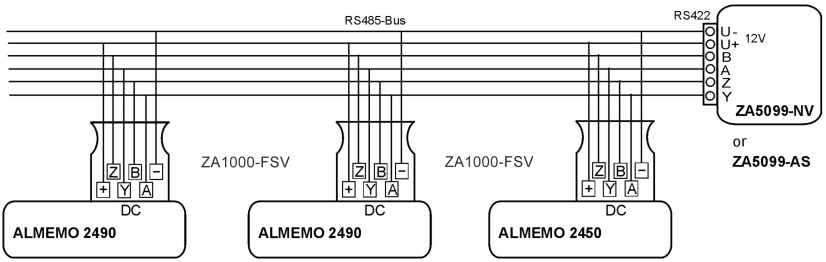
The following interfaces corresponding accessories or options either are necessary. (see 14.2).

11.1 Interface

The ALMEMO® 2490 version with the interface can not only be completely programmed via the computer thus enabling the user to read out all acquired data (see Manual Ch 6) but also be networked together very easily thus enabling the user to centrally acquire and record measured values from several measuring instruments - even if these are located far apart (see Manual 5.3) . The data cables required for this purpose (see Manual 5.2) are plugged into socket A1. The baud rate for all data cables is is programmed on leaving the factory to 9600 baud; this setting should not be altered.

As alternative option I is available with an integrated **RS485 interface**. Via 6-pin ALMEMO® clamp connector ZA1000-FSV these devices can be connected directly either to network distributor ZA5099-NVL or to bus driver ZA5099-AS. The transmit and receive lines must be crossed once-only. Up to 32 other devices can then be wired in parallel with line lengths up to 1 km. As with all net-

worked devices each one must be set to a different device address; (see

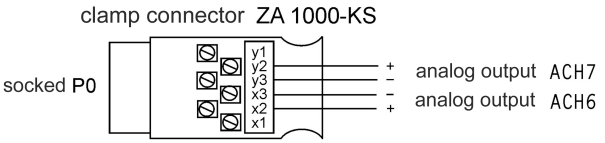


12.1).The power supply also takes place with 12V DC over the bus.

11.2 Analog outputs

An analog output cable ZA 1601-RK (0 to 2 V) can be connected at socket(s) A2 and / or A1 (3) without electrical isolation; (see Manual 5.1.1). In ´Device configuration´ the functions ´ACH1 A2´ or ´ACH2 A1´ should now appear (see Chapter 12); here the reference channels for the corresponding analog outputs and the scaling requirements can be entered.

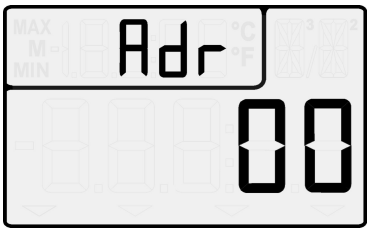
Or, alternatively, there are variants 2490-xR02 with 2 integrated electrically isolated analog outputs (see Section 15.2); these can be configured as 0 to 10 V, 0 to 20 mA, or 4 to 20 mA. These appear in ´Device configuration´ as ´ACH6 PO´ and ´ACH7 PO´ because they occupy ports 6 and 7 of socket P0 (2) (port addresses 06 and 07). These two are connected to the evaluating unit via a clamp connector as follows :



Which measuring channel is output via which analog output can be configured via the display (see 12.2) or via the interface (see Manual 6.10.7). To achieve the best possible resolution the partial measuring range used can be spread over the full output range (0 to 10 V or 0/4 to 20 mA); (see 12.2, Manual 6.10.7).

On devices with option R02 (integrated analog outputs) and option U (electrically isolated power supply) battery operation is no longer possible.

12. DEVICE CONFIGURATION



On the ALMEMO® 2490 measuring instrument a number of parameters can be configured. To do so when switching ON press and hold down key **MEM** . The function field should then show an abbreviation for the parameter and the main field should show the value currently set.

To select from all possible parameters,
if any are available, press keys : **M▲** or **M▼**.

Device address; see 12.1 — Adr

Locking the **CLR** key: see 12.4 — Loc

Reference channel and scaling for
1st analog output (at socket A2): see 12.2 — ACh1

Reference channel and scaling for
2nd analog output (at socket A1): see 12.2 — ACh2

Reference channel and scaling for
Analog output P0-6 (option);: see 12.2 — ACh6

Reference channel and scaling for
Analog output P0-7 (option);: see 12.2 — ACh7

Automatic switch OFF time in minutes: see 12.3 — AOFF

Air pressure for measuring value compensation — mb 1013

To enter a value first press : **ON** and the value starts flashing.
To modify the value press keys : **M▲** or **M▼**
To delete parameters press : **CLR**
select the next digit or entry is completed : **ON**
To terminate or cancel configuration : **MEM**

12.1 Device address and networking

To communicate with networked devices it is absolutely indispensable that each device should have its own baud rate (standard 9600 bd) setting and its own dedicated address; this is because only one device should respond per command. Before starting network operation ensure therefore that all the measuring instruments involved are assigned different device addresses. This is the purpose of the afore-mentioned ´Adr´ parameter.

12.2 Analog output

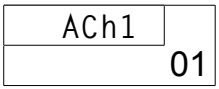
By default the 1st analog output (cable at A2) is used to output the measured value for the selected measuring point and the 2nd analog output (cable at A1) is

used to output the measured value for the 1st channel of the selected sensor; (see Manual 6.10.7). The internal analog outputs P0-6, P0-7 initially behave adäquat (see 11.2).

Selecting the reference channel
Which channel is in fact to be output via which analog output can also be stipulated by the user. To do this the parameters ´ACh1´, ´ACh2´, ´ACh6´, or ´ACh7´ must be configured as previously described.

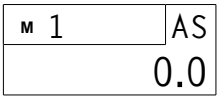
Scaling the analog output
The output signal from each analog output variation (0 to 2 V, 0 to 10 V, 0 to 20 mA, 4 to 20 mA) can be set for each sensor to any partial range (e.g. 4 to 20 mA for -30.0 to +120.0 °C). For the previously specified reference channel, the values for analog output start and analog output end plus analog output type (0 to 20 mA or 4 to 20 mA) can all be programmed.

First the analog output must be selected and then the reference channel can be programmed (e.g. M01) :

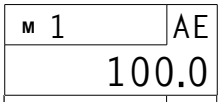


To select other parameters :

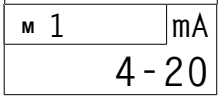
Analog output start by pressing : MIN
(minimum value in measuring range)



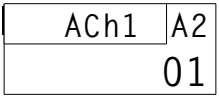
Analog output end by pressing : MAX
(minimum value in measuring range)



Analog output type by pressing key : CLR
(0-10V, 0-20mA or 4-20mA)



To return to the reference channel press key: M▲



To enter a value first press : ON and the 1st digit starts flashing.
Each digit can be changed by pressing keys : M▲ or M▼.
To use negative values below zero press: M▼
To delete parameters press : CLR
To select the next digit, and terminate entry : ON ....
To cancel or terminate configuration press: MEM

12.3 Automatic switch OFF

In menu item ´AOFF´ the device can be programmed to switch OFF automatically if no key is touched for a certain settable number of minutes; this will help save the batteries. This automatic device switch OFF will not take effect if the setting is ´- -´ or if a mains adapter or interface cable is connected. If the device is powered from an external supply manual switch OFF can be prevented by selecting the setting ´noOFF´. To switch OFF in this case the external power supply would have to be unplugged.

12.4 Device locking

The measured value in the main field of the display can be manipulated by pressing key CLR and setting it to zero. This function can be evaluated in different ways or even switched off in cases where there is a risk of accidentally activating relative measuring by zero-setting the measured value.

Loc **parameter :**

0 The offset is saved in RAM, base or zero-point - depending on locking
1 The offset is saved in RAM only.
2 Relative measuring is locked

12.5 Atmospheric pressure compensation

Measured variables dependent on the ambient atmospheric pressure (see Manual 6.3.3 Measuring range list ´with PC´) may, in the event of large deviations from normal pressure (1013 mbar), involve certain measuring errors.

e.g. Error per 100 mbar	**Compensation range**	
Rel.humidity psychrometer	approx. 2%	500 to 1500 mbar
Mixture ratio, capacitive	approx. 10 %	Vapor pressure VP up to 8 bar
Dynamic pressure	approx. 5%	800 to 1250 mbar (error < 2%)
O_2 saturation	approx. 10%	500 to 1500 mbar

It is advisable therefore, especially when taking measurements at appreciable heights above sea level to take due account of the atmospheric pressure (approx. -11 mbar / 100 meters above mean sea level, MSL).
The appropriate atmospheric pressure can be entered in parameter 'mb' either in device programming or it can be measured using an atmospheric pressure sensor (reference sensor with designation ´*P´, see Manual 6.7.2).

13. TROUBLE-SHOOTING

The ALMEMO® 2490 measuring instrument can be configured and programmed in many versatile ways. It is suitable for connecting a wide variety of different sensors, additional measuring instruments, alarm signaling devices, and peripheral equipment. Given these numerous possibilities the device may in certain circumstances not behave quite as expected. The cause of such unexpected behavior is only very rarely a device defect; more usually it is incorrect operation by the user, an invalid setting, or unsuitable cabling. In such event try to pinpoint and clear the problem with the aid of the following tests.

Error: No display, display malfunction, keys do not react

Remedy: Check the power supply; replace the batteries; switch off and then on again; if necessary re-initialize (see 7.5).

Error: Measured values are incorrect.

Remedy: Switch Device OFF / ON, press key and hold **CLR**. Check all the channel programming very carefully, especially the base value and zero-point.

Error: Fluctuating measured values or the system hangs in mid-operation.

Remedy: Check the cabling for any inadmissible electrical connections,
Unplug any suspicious sensors.
Connect hand-held sensors in air or phantoms (for thermocouples short-circuit AB, for PT100 sensors use 100Ω) and check.
Connect the sensors again one at a time and check successively.
If a fault persists for any one connection, then check all wiring; if necessary, insulate the sensor and eliminate interference by using shielded or twisted wiring.

Error: ´CALEr´ is displayed when the device is switched on.

Remedy: The calibration of a measuring range may have become misadjusted. The device must be recalibrated at the factory.

Error: Data transmission via the interface does not function.

Remedy: Check interface module, connections, and settings.
Are both devices set to the same baud rate and transmission mode ?
Is the correct COM interface on the computer being addressed ?
To check the data flow and the handshake lines a small interface tester with LEDs comes in very handy; (in ready-to-operate status the data lines TXD, RXD carry negative potential of approx. -9V and the LEDs light up green, whereas the handshake lines DSR, DTR, RTS, CTS carry approx. +9V positive voltage and the LEDs light up red. For the duration of data transmission the data LEDs should flash red. Check data transmission by means of a terminal (AMR-Control, WIN-Control, WINDOWS-Terminal).
Address the device using its assigned device number´Gxy´ (see Manual 6.2.1).
Enter <ctrl Q> for XON, if the device is in the XOFF status.
Check the programming by means of ´P15´ (see Manual 6.2.3).

Test the transmit line only by selecting a measuring point using command ´Mxx´ and check in the display.

Error: Data transmission in the network does not function.

Remedy: Check to ensure that all devices are set to different addresses.
Address all devices individually via the terminal using command ´Gxy´.
Addressed device is OK if at least ´y CR LF´ is returned as echo.
If transmission is still not possible, unplug the networked devices.
Check all devices individually on the data cable to the computer; (see above).
Check the wiring for short-circuit or crossed wires.
Are all network distributors supplied with power ?
Network the devices again one at a time and check successively; (see above).

If, after performing the above-listed checks and remedial steps, the device still fails to behave as described in the operating instructions, it must be returned to our factory in Holzkirchen (see 14.4), accompanied by an explanatory note, error description, and if available test printouts. With the AMR-Control software you can print out screen-shots with the relevant programming and save and / or print out a comprehensive ´Function test´ in the device list or terminal operation.

14. DECLARATION OF CONFORMITY

Ahlborn Mess- und Regelungstechnik GmbH declares herewith that measuring instrument ALMEMO® 2490 carries the CE label and complies in full with the requirements of EU directives relating to low voltage and to electromagnetic compatibility (EMC) (89/336/EWG).

The following standards have been applied in evaluating the product.

Safety / security:	EN 61010-1:2001
EMC:	EN 61326: 2006

CE

If a product is modified in any manner not agreed with us in advance, this declaration becomes void.

When using the sensor with an extension care must be taken to ensure that wiring is not laid alongside or close to high-voltage power cables and that it is, if necessary, properly shielded so as to prevent spurious interference being induced in the system.

The following advisory notes must be observed when operating the device :

Using the device in strong electromagnetic fields may aggravate measuring errors (<50 µV at 3 V/m and 1.5 meters thermocouple sensor). After exposure to such irradiation ceases, the device will again operate within its technical specifications..

15. APPENDIX

15.1 Technical data

(see Manual 2.3)

Measuring inputs :

2490-1	1 ALMEMO® socket suitable for all ALMEMO® sensors
2490-2	2 ALMEMO® sockets, electrically isolated, suitable for ALMEMO® sensors
Measuring channels:	4 channels / socket for double sensors, function channels
2490-2	4 internal additional channels
A/D converter :	Delta - sigma, 16-bit, 2.5 / 10 mops, adj. 1 to 100
Sensor power supply :	9 volts, max. 400 mA (with OA2450-U only 80 mA)
Outputs :	2 ALMEMO® sockets suitable for all output modules
RS485 interface, integrated:	OA 2490-I, electr. isol., integrated, socket DC
Signals :	RX+, RX-, TX+, TX-, line, maximum 1 km
Analog output, integrated:	electrically isolated, socket P0
Variants:	2490-1R02, 2490-2R02
Outputs, options:	0.00 V ...+10.0 V 0.5 mV/digit Load > 100kΩ 0.0 mA ...+20.0 mA 1 µA/digit Load < 500Ω
Accuracy:	± 0.1% of measured value, ± 0.1% of final value
Temperature drift:	10 ppm / K
Time constant:	100 us

Standard equipment :

LCD :	Measured value : 5x 7-segment 15 mm, 2x 16-segment 9 mm
	Function 4½ x 7-segment 9 mm, 9 symbols
Operation :	7 silicone keys
Memory	99 measured values on the RAM
Date and time-of-day	Software clock, buffered by battery supply

Power supply :

Batteries :	3 AA alkaline batteries
Current consumption :	approx. 16 mA (without input and output modules)
With double analog output:	approx. 90 mA + 3.5 x I_{OUT}
External :	ALMEMO® socket DC
Clamp connectors	ZA1000-FSV 10 to 30 VDC
Mains adapter :	ZA 1312-NA1 230 VAC to 12 VDC, 0.2 A
Adapter cable, electr. isolated	ZA 2690-UK 10 to 30 VDC to 12 VDC, 0.25 A
Option U, electr. isolated	OA2490-U 10 to 30 VDC, 0.1A
Housing :	(LxWxH) 127 x 83 x 42 mm ABS (acrylonitrile butadiene styrene), weight : approx. 260 g

Suitable conditions

Operating temperature :	-10 ... +50 °C (storage temperature : -20 ... +60 °C)
Ambient relative humidity :	10 to 90 % rH (non-condensing)

15.2 Product overview

Universal measuring instrument ALMEMO® 2490-1	**Order no.**
1 measuring input , 2-row LCD, 7 keys, measured value memory with 99 locations, battery supply 3 ALMEMO® output sockets, A1, A2 for cables RS232, USB, Ethernet, analog, trigger, relay, DC socket for mains adapter	MA 2490-1
Same but with internal double analog output 0 to 10 V / 0 to 20 mA Connection at socket P0, clamp connector	MA2490-1R02
Universal measuring instrument ALMEMO® 2490-2L	
2 measuring inputs, electrically isolated, 2-row LCD, 7 keys, measured value memory with 99 locations, battery supply 3 ALMEMO® output sockets, A1, A2 for cables RS232, USB, Ethernet, analog, trigger, relay, DC socket for mains adapter	MA 2490-2
Same but with internal double analog output 0 to 10 V / 0 to 20 mA Connection at socket P0, clamp connector	MA2490-2R02

Options

Measuring ranges for temperature display of 10 refrigerants	SB 0000-R
DC power supply, electr. isol.,10 to 30 VDC, 10 mA, clamp connectors	OA 2490-U
RS485 interface, integrated, including option U, socket DC, clamp connectors	OA 2490-I
Top hat rail mounting	OA 2490-HS

Accessories

Mains adapter with ALMEMO® connector, 12 volts, 1 A	ZA 1312-NA8
DC adapter cable, 10 to 30 V DC, 12 V / 0.25 A, electrically isolated	ZA 2690-UK
ALMEMO® connector 10 to 30V DC and RS485 (option I)	ZA 1000-FSV
ALMEMO® data cable, with USB interface, electr. isol., max. 115.2 KB	ZA 1919-DKU
ALMEMO® data cable, with V24-interface, electr. isol., max. 115.2 KB	ZA 1909-DK5
ALMEMO® data cable, with Ethernet interface, electr. isol., maximum 115.2 KB	ZA 1945-DK
ALMEMO® network cable, electrically isolated, maximum 115.2 KB	ZA 1999-NK5
ALMEMO® recording cable, -1.25 to 2.00 V	ZA 1601-RK
ALMEMO® V6 input / output cable with trigger and 2 semiconductor relays	ZA 1006-EAK
ALMEMO®-V6 relay-trigger adapter (4 relays, 2 trigger inputs)	ZA 8006-RTA

15.3 Index

15.4 Your contact

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Even the greatest possible care cannot exclude the possibility of inaccuracies.
We reserve the right to make technical changes without advance notice.