AHLBORN

Operating instructions

Universal measuring instrument
ALMEMO® 2390-3

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Operating instruction

Universal Measuring Instrument ALMEMO® 2390-3

With supplementary reference to the ALMEMO®-Manual

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1. INTRODUCTION

The universal measuring instrument ALMEMO® 2390-3 is member of a truly unique product family - all equipped with the ALMEMO® connector system, patented by Ahlborn Mess- und Regelungstechnik GmbH. The intelligent ALMEMO® connector offers decisive advantages when connecting sensors and peripherals because all parameters are stored in an EEPROM on the connector itself; repeat programming is thus no longer necessary. All sensors and output modules can be connected to all ALMEMO® measuring devices - all in the same way. Programming and functioning are identical for all units. The following points apply to all devices in the ALMEMO® measuring system; they are described in detail in the ALMEMO® Manual supplied with each device :

- Detailed description of the ALMEMO® system (Manual, Section 1)
- Overview of the device functions and measuring ranges (Manual, Section 2)
- Basic principles, operating instructions, technical data for all sensors (Manual, Section 3)
- Options for connecting your own existing sensors (Manual, Section 4)
- All analog and digital output modules (Manual, Section 5.1)
- Interface modules RS232, optic fiber, Centronics (Manual, Section 5.2)
- The entire ALMEMO® networking system (Manual, Section 5.3)
- All functions and their operation via the interface (Manual, Section 6)
- Complete list of interface commands with all the print outputs (Manual, Section 7)

These operating instructions only cover features and controls that are specific to this device. Sections dealing with operation via the keypad often refer therefore to a more detailed explanation in the Manual (Manual, Section x.x.x).

1.1 Functions

Universal measuring instrument ALMEMO® 2390-3 has two electrically isolated measuring inputs for all ALMEMO® sensors. The measuring possibilities are virtually unlimited; there are 8 channels in the sensor connectors and 4 device-internal function channels - with over 65 measuring ranges including genuine differential measurement. The ALMEMO® output modules, analog output, and digital interface, can be connected to the output socket. In the absence of address setting, however, networking possibilities are limited. For the purposes of operating the measuring functions the instrument incorporates a keypad and an 8½-character LCD. However, sensor programming and instrument configuration for data output are only possible via the interface.

SENSOR PROGRAMMING

The measuring channels are automatically and completely programmed by the ALMEMO® sensor connectors. Programming can, however, be modified or supplemented, as and when necessary, via the interface.

Measuring ranges

For all sensors with a non-linear characteristic, e.g. 10 thermocouple types, Ntc and Pt100 sensors, infrared sensors, and flow sensors (rotating vanes, thermoanemometers, Pitot tubes), the appropriate measuring ranges are available. For humidity sensors, additional function channels are available that also calculate 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 without difficulty - so long as the appropriate ALMEMO® connector is connected via its screw terminals. For digital input signals and frequencies, adapters are available with an integrated microcontroller. It is thus possible to connect virtually any sensor to any ALMEMO® measuring instrument and to interchange these without the need for any extra settings.

Function channels

Maximum, minimum, and average values and differences at certain measuring points can be programmed as function channels and further processed and printed just like normal measuring points. There is also a function channel available for special measuring tasks, for determining the wet-bulb-globe temperature.

Units

There are two 16-segment displays; these always indicate the physically correct units for the ALMEMO® sensor in question. For your own already existing sensors the correct units can also be individually programmed. Conversion between °C and °F is performed automatically.

Names of measured values

Each sensor is identified by means of a 10-character alphanumeric name. This name, entered via the interface, will subsequently appear in the printout or, when evaluated by PC, on the screen.

Correction of measured values

The measured value on each measuring channel can be corrected in terms both of zero point correction and slope (gain) correction; this means that even sensors usually requiring initial adjustment (expansion, force, pH) can be freely interchanged. Zero point correction and partly also slope (gain) correction can be performed at the touch of a button.

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

Limit values and alarm
Per measuring channel two limit values can be set (1 maximum and 1 minimum). In the event of either one of these limit values being overshot, an alarm arrow appears in the display.

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

MEASUREMENT
For each transducer up to four measuring channels are available; i.e. it is also possible to evaluate double sensors, individually scaled sensors, and sensors with function channels. The selected measuring point is scanned at a conversion rate of 2.5 measuring operations per second; the measured value is calculated and output to the display and, if available, to an analog output.

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

Measuring functions
With some sensors, to achieve optimal data acquisition, special measuring functions are required. Cold junction compensation is available for thermocouples; temperature compensation is available for dynamic pressure, pH, and conductivity probes. With infrared sensors the parameters for zero point and slope correction are used as the background temperature and emissivity factor.

Analog output and scaling
The displayed measured value can, by means of analog start and analog end, be scaled in such a way that the associated measuring range covers the full analog output range (2 V, 10 V, or 20 mA).

Data memory
At the touch of a button the measured value can be frozen in the display.

Maximum and minimum values
For each measuring operation the maximum value and minimum value are acquired and saved. These values can be scanned and, as and when necessary, deleted.

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

PROCESS FLOW PROGRAMMING
To digitally record the measured values of all connected sensors a cyclic measuring point scan using data acquisition software or an internal time-based process flow control is required. For this purpose a software clock and the print cycle are available. The measuring operation can be started and stopped via the interface.

Time and date
When the device is switched off, the date and time-of-day are lost. For the purposes of logging a measuring operation these must be reset.

Print cycle
The print cycle can be programmed to any value between 00:00:01 seconds and 59:59:59 hh/mm/ss. The print cycle permits cyclic output of measured values to the interface.

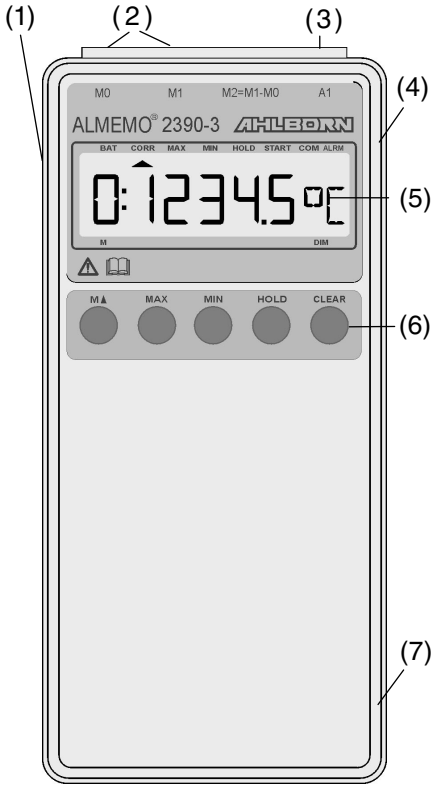
Print cycle factor
To avoid excessive data flow the data output of certain channels can, as and when necessary, by means of the print cycle factor, be restricted or altogether disabled. It is also possible to summate pulses over longer cycles.

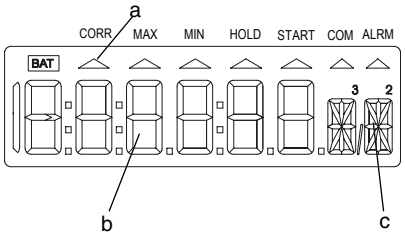
Output
All measured values and programming values are accessible via various interface cables with RS232, RS422, or optic fiber interface. The output of measured data can be selected in a list, in columns, or in spreadsheet format. Files in spreadsheet format can be processed by any standard spreadsheet software. The print header can be programmed specifically to the company or application.

Networking
The normal networking possibilities of ALMEMO® devices are restricted in this case because the device address 0 cannot be modified.

Software
Each ALMEMO® Manual is accompanied by the AMR-Control software package, which can be used to configure the measuring instrument and to program the sensors. Measuring operations can also be performed online using the integrated terminal. The WINDOWS® software package, WIN-Control, can be used for data acquisition with graphical presentation and complex data processing.

1.2 Operating controls





(1) ON/OFF switch
up : ON
down : OFF

(2) Measuring inputs M0, M1, M2
M0, M1 for all ALMEMO® sensors
M2 Function channel, difference
M10 - M32 Additional channels

(3) Output socket A1
Analog output (ZA 1601-RK)
V24 interface (ZA1909-DK5/L)

(4) Socket DC
Mains adapter(ZB 2290-NA, 12 V, 200 mA)
Connecting cable (ZB2290-EK,7-13V DC)
Cable, electrically isolated
(ZB 2290-UK, 10-30 V)

(5) LCD-display

(6) Function keys

M▲	Meas. value, meas. point
MAX	Call up maximum value
MIN	Call up minimum value
HOLD	Freeze measured value
CLEAR	Set measured value to zero Delete Max, Min, Hold

(7) Battery compartment (rear of dev.)
9-volt alkaline-manganese battery (6F22) Space for reserve battery

(5) LCD-display

(a) Symbols for operating states

BAT	Battery voltage < 7 V
▲ CORR	Correction of meas. val.
flashes	Reference measurement
▲ MAX	Maximum value
▲ MIN	Minimum value
▲ HOLD	Measured value frozen
▲ START	Measuring point scan
▲ COM	Measured value output
▲ ALRM	Limit value exceeded

(b) 6 x 7-segment display for:
measuring point, measured value

(c) 2 x 16-segment display for:
units for measured value

2. PUTTING INTO SERVICE

1. **Connect transducer** to socket M0 (2); see 4.

2. Provide **power supply** via 9-volt battery or mains adapter; see 3.1, 3.2.

3. **To switch on**, push the slide switch (1) located on the left side of the device upwards; see 3.3; then read measured value; see 7.1.

4. **To display** measured values, return from **MAX**, **MIN**, or **HOLD** by pressing **M▲** key; select measuring channels by pressing **M▲** key (6); then read measured values; see 7.1.

5. **To freeze** measured value, press **HOLD** key (6); see 7.3.

6. For **reference measurement** to a reference value or for sensor adjustment : press **CLEAR** key (6); return to normal measured value by pressing and holding down **CLEAR** key (6); see 7.4.

7. For **differential measurement**, insert two identical sensors in sockets M0 and M1 and then select measuring point M2; see 7.5.

8. **Evaluating a measuring operation** :
   call up maximum / minimum values by pressing **MAX** or **MIN** key (6);
   delete maximum and / or minimum values by pressing **CLEAR** key; see 7.2.

9. **Programming** or **data output** via interface :
   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 sensors via ‘Program measuring point list’ :
   Measured value display and sensor adjustment via ‘Measuring points - Measured values’ Data logging in the computer :
   - program the print cycle via ‘Devices - Programming’;
   - open the terminal window via 'File - Terminal';
   - open file via ‘File - Open’ and enter file name;
   - start measuring operation by means of command button ‘Start’;
   - stop measuring operation by means of command button ‘Stop’;
   - close file via ‘File - Close’.

3. POWER SUPPLY

As power supply there are the following possibilities :

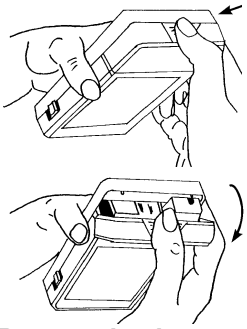
- 9-volt batteries IEC 6 F22 — ZB 2000-B9
- 9-volt rechargeable battery pack, with charger integrated — ZB 2000-A9/-LS
- mains adapter 12 V / 200 mA — ZB 2290-NA
- external power supply cable, 10 to 36 V DC, elect. isol. — ZB 2290-UK

Our product spectrum includes all the appropriate accessories.

3.1 Battery / rechargeable battery operation

Use only alkaline-manganese batteries, type IEC 6 F22. At a current consumption of around 4.5 mA, these last for an operating time of approx. 80 hours. If sensors or modules also requiring power are connected, the operating time will be accordingly shorter.

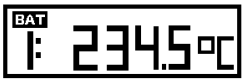
Inserting the batteries:



The battery compartment (7) is located underneath the device.

1. Press on the spot marked with the arrow and at the same time pull in the direction shown by the arrow (as shown in the illustrations).
2. Connect the battery using the clip. Accidental reverse polarity is prevented by the shape of the connections.
3. Use the second battery compartment to store a reserve battery.

Battery check:



If the battery symbol in the display lights up, this means that the battery will last for approximately another 5 hours. (Supply voltage <7 V)

In the event of the battery voltage falling below 6 volts, the display shows the message ´ LobAt ´. In this event the battery must be removed immediately. This prevents the battery from leaking and thus damaging the device

The current battery voltage can be checked by applying a measuring channel with 'Battery voltage' set as range.

Tips on the correct handling of batteries:

- Never leave used dead batteries in the device !
- If the device is likely to be unused for a relatively long time, remove the batteries !
- A leaking battery represents a health hazard and may also destroy the device. Use only leak-proof batteries !

- Spent batteries are special waste and must be disposed of in an environmentally acceptable way. Take spent batteries back to your dealer or dispose of them in your local battery collection container !

Rechargeable battery operation:
Instead of the standard batteries you can use rechargeable battery packs. Rechargeable batteries are of lower capacity, 110 mAh, and provide an operating time of only 25 hours. If sensors or modules also requiring power are connected, the operating time will be accordingly shorter. From our range of accessories we recommend the 9-volt rechargeable battery with a charger integrated in the connector, ZB 2000 LS.

Tips on the correct handling of rechargeable batteries:

- The rechargeable batteries supplied are not usually charged when delivered.
- If NiCd cells are only partly discharged, normal recharging will not restore them to full capacity.
- For this reason use the device until the batteries are nearly totally discharged and then recharge them completely.
- This will significantly prolong the life of your rechargeable batteries.
- Even fully charged batteries discharge in storage without being used.

3.2 External voltage supply

On the right side of the device there is a socket (4) for connecting an external power supply. In our range of accessories we offer a mains adapter ZB 2290-NA (12 V / 200 mA). Or, alternatively, you can use some other DC power source (7 to 13 V). The power source is connected by means of a low-voltage connector (NES1 as per DIN 42323), center pin to minus.
If, however, the power supply has to be electrically isolated from the transducers or if a larger input voltage range (10 to 36 V DC) is required, electrically isolated supply cable ZB 2290-UK must be used. It will then be possible to operate the measuring instrument using a 12- or 24-volt on-board supply system.

If a battery is connected, this will, in the event of a voltage drop below 9 volts, take over as power supply.

3.3 Switching ON and OFF

The slide switch (1) on the left side of the device has two switch positions :

up :	ON	i.e. to switch ON
down :	OFF	i.e. to switch OFF

Certain device parameters, e.g. print cycle (00:00), analog reference channel (measuring channel), temperature compensation (25 °C), air pressure (1013 mbar), and hysteresis (10 digits) can be permanently programmed via the interface. To reset these parameters to their default values (shown in brackets), keep the **CLEAR** key pressed down when switching ON.

4. CONNECTING THE SENSORS

Any ALMEMO® sensors can be connected to ALMEMO® input sockets M0 and M1 (2). To connect your own existing sensors you simply need the appropriate ALMEMO® connector.

4.1 Sensors

The ALMEMO® Manual includes detailed descriptions of the comprehensive ALMEMO® sensor range (see Manual, Section 3) and of how to connect your own existing sensors to ALMEMO® instruments (see Manual, Section 4). All standard sensors with an ALMEMO® connector usually have the measuring range and units already programmed and can thus be immediately connected to any input socket.

A mechanical code system ensures that sensors and output modules can only be connected to the correct sockets. Each ALMEMO® connector also incorporates two locking levers; these snap into position as soon as the connector is inserted into the socket, thus preventing disconnection if the cable is pulled. To withdraw the connector, both these levers must be pressed in at the sides.

4.2 Measuring inputs and additional channels

Measuring instrument ALMEMO® 2390-3 has two input sockets M0 and M1 (2) to which, initially, measuring channels M0 and M1 are allocated. ALMEMO® sensors can, however, if necessary, provide four channels. Additional channels are available primarily for humidity sensors (temperature / humidity / dew point / mixture ratio) or flow probes and chemical probes incorporating a temperature sensor. A single sensor can be programmed, if necessary, with several ranges or scaling processes; similarly, if pin assignment permits, two sensors can be combined on one connector (e.g. rH/Ntc, mV/V, mA/V, etc.).

Measuring point numbering:

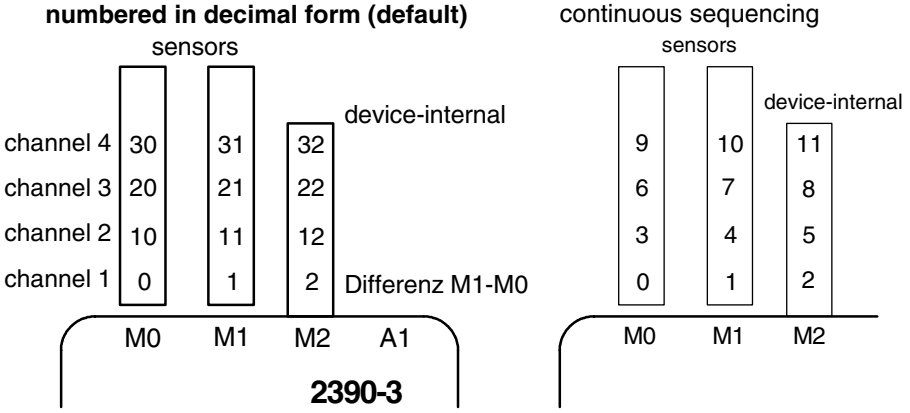
Each additional measuring channel in a connector lies one level higher. In this new series the levels are now numbered in default decimal form, i.e. the front digit indicates the level. In this way the measuring point number (and thus also the programmed reference channels) for all devices with 1, 2, 5, or 10 inputs always remains the same. This means, however, that, with effect from measuring channel number 20, the measured value resolution in the display is limited. If this proves to be a serious problem, it is possible to revert to continuous sequencing - by holding down th eM▲ key when the device is switched on.

Device-internal channels:

A further innovation on this device is its four extra additional channels. The first of these is programmed by default as differential measuring channel M1 - M0. This only appears, however, if there are two sensors with the same units and same decimal point position connected at measuring points M0 and M1.

The other channels can be programmed via the interface optionally with measuring ranges 'U-BAT' (Battery voltage), 'VC' (cold junction compensation), or other function channels; (see Manual, Section 6.3.4).

On the measuring instrument this gives the following channel assignment:

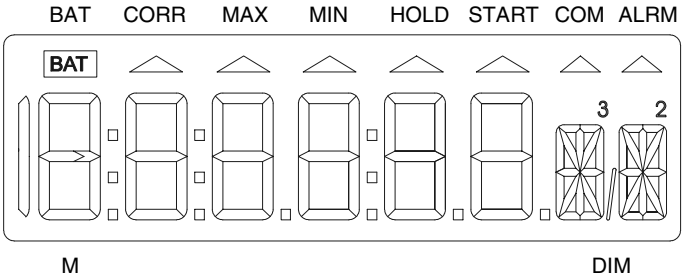


The two analog inputs on the measuring instrument are electrically isolated by means of photovoltaic relays; the maximum potential difference permitted between them is 50 V DC or 60 V AC. However, sensors combined within one connector and sensors with their own power supply are electrically interconnected and must therefore be operated in isolation. The voltage applied to the measuring inputs themselves must not exceed ±5 volts (between B, C, D, and A or -).

The cold junction compensation for thermocouple measurement is integrated in socket M0 on the device.

5. DISPLAY

The display (5) on measuring instrument ALMEMO® 2390-3 comprises an LCD with six 7-segment digits, two 16-segment characters, a battery symbol, and arrows to indicate the operating status.



Measured value display

Measuring point, measured value, units: `0: 23.4 °C`

Special operating states and faults

Segment test for display: automatic - each time the device is switched on.

Voltage supply : below 7 V: **BAT**-symbol llights up

below 6 V: `LobAt`

Checksum error during device calibration: `CALErr`

Non-connected sensors,, deactivated measuring points: `0: ----`

Non-permitted measuring range: `0: Err`

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

Reference measurement: **CORR** arrow flashes

Limit value exceeded: **ALRM** arrow lights up

Sensor breakage : `0: `NiCr´ °C` flashes

Measuring range overshot: Maximum value flashes

Measuring range undershot: Minimum value flashes

Measuring range undershot for cold junction compensation or breakage: `0: `CJ´°C` (Cold junction) flashes

Values range overshot (>65000): `0:`65000´XX` flashes

6. SENSOR PROGRAMMING

Since on ALMEMO® devices all sensor programming is stored in the ALMEMO® connector, you can connect any ALMEMO® sensor without needing to reprogram. To connect certain sensors you can even order ALMEMO® connectors that have already been appropriately programmed. If, however, you wish to create or scale your own sensors or if sensor errors have to be continually corrected, you can do the programming via the serial interface using the AMR-Control software; (see Manual, Section 6.3).

6.1 Measuring ranges

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

Sensors	Sensor/connector	Meas. range	Units	Display
Pt100-1	FP Axxx	-200.0... +850.0	°C	P104
Pt100-2	FP Axxx	-200.00...+300.00	°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 type 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	-260.0...+260.0	mV	U260
Volt	ZA 9000-FS3	-2.0000...+2.6000	V	U2.60
Difference millivolt	ZA 9050-FS0	-10.000...+55.000	mV	d 55
Difference millivolt 1	ZA 9050-FS1	-26.000...+26.000	mV	d 26
Difference millivolt 2	ZA 9050-FS2	-260.0...+260.0	mV	d260
Difference volt	ZA 9050-FS3	-2.0000...+2.6000	V	d2.60
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
Ohms	ZA 9003-FS	0.0... 500.0	Ω	Ohn
Frequency	ZA 9909-AK1	0... 32000	Hz	FrEq
Impulse	ZA 9909-AK2	0... 65000		PULS
Digital input	ZA 9000-EK2	0.0... 100.0	%	Inp

Sensors	Sensor/connector	Meas. range	Units	Display
Digitale interface	ZA 9919-AKxx	-65000... +65000		diGi
Infrared 1	FI A628-1/5	0.0... +200.0	°C	Ir 1
Infrared 4	FI A628-4	-30.0... +100.0	°C	Ir 4
Infrared 6	FI A628-6	0.0... +500.0	°C	Ir 6
Snap-on head, normal	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.pressure 40m/s w. TC	FD A612-M1	0.50... 40.00	m/s	L840
Dyn.pressure 90m/s w. TC	FD A612-M6	1.00... 90.00	m/s	L890
Relative air humidity, cap	FH A646	0.0... 100.0	%H	°orH
Relative air humidity, w. TC	FH A646-R	0.0... 100.0	%H	H rH
Mixture ratio, cap	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, cap	FH A646	0.0 ... 400.0	kJ	H En
Humid temperature	FN A846	-30.00 ... +125.00	°C	P Ht
Relative humidity, psychr	FN A846	0.0 ... 100.0	%H	P RH
Mixture ratio, psychr	FN A846	0.0 ... 500.0	g/k	P AH
Dew-point temperature, psychr	FN A846	-25.0 ... +100.0	°C	P dt
Partial vapor pressure, psychr	FN A846	0.0 ...1050.0	mb	P UP
Enthalpy, psychr	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	FY A640-O2	0 ... 260	%	O2-S
O_2-concentration with TC	FY A640-O2	0 ... 40.0	mg	O2-C
Function channels:				
Maximum value	any			Hi
Minimum value	any			Lo
Alarm value	any		%	Alrm
Total number of pulses	ZA 9909-AK2	0... 65000		S[t]
Pulses / print cycle	ZA 9909-AK2	0... 65000		S[P]
Wet bulb globe temp. meas.	ZA 9000-FS		°C	UbGt
The following ranges are not supported				
Average value over time	any			A[t]
Average value of meas. points	any			A[n]
Sum of measuring points	any			S[n]

TC = Temperature compensation

6.2 Units

The units are shown after the measured value as two 16-segment characters. Depending on the programming (see Manual, Section 6.3.5) units other than the standard units can be stipulated per measuring range; (see Man. Sec. 6.1).

For degrees Fahrenheit °F the temperature value is converted from degrees Celsius. With the character °C or °F, cold junction compensation is disabled.
The units ms are displayed as m/s and mh as m^3/h.

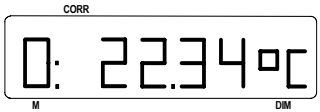
7. MEASURING OPERATIONS

With measuring instrument ALMEMO® 2390-3 all available measuring channels are scanned 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 12 measuring points can be displayed; (see Section 7.1).
A measured value can be sent to an analog output; (see Manual, Sec. 5.1.1)

7.1 Selecting the meas. value and the measuring point

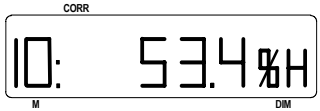
After the device is switched on, the **MEASURE** function is set and measuring point M0 for the first sensor is selected automatically; i.e. measured value M0 is shown in the display. After calling up other functions you can revert to the **MEASURE** function by means of key **M▲** (6) .

Measure - measuring point M0

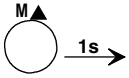


In the **MEASURE** function it is also possible, by means of key **M▲**, to successively select all other active measuring points and have the current measured value of each one displayed. If keys **M▲** is pressed and held down (for approx. 1 second), the previous channel is displayed again.

Increase the meas. channel :



Decrease the meas. channel :



Press and hold down (for appr. 1 s)

If, when switching measuring channels, the measuring range changes, the abbreviation for the measuring range is displayed for a moment first; (see Section 6.1).This abbreviation also flashes in the event of sensor breakage - instead of the measured value:

Display of the meas. range:

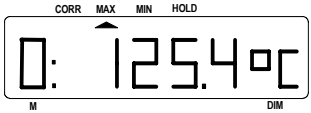
If the actual measured value changes as a result of programmed scaling or correction values (see Manual, Section 6.3.10/11), then the ´CORR´ arrow lights up in the display.

7.2 Maximum and minimum values

From the continuous measured values per measuring point the highest and the lowest values are determined and stored for each. To display these high/low peak values the desired channel must be set (see Section 7.1) and then the **MAX** or **MIN** key must be pressed. An arrow should appear in the display below the appropriate symbols.

The MAX VALUE function

Select the maximum value :



The MIN VALUE function

Select the minimum value:

Delete the max. / min. values:

Return to the MEASURE function :

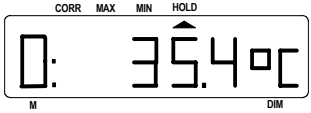
7.3 Current measured values memory

To freeze a measured value at any particular time, e.g. to facilitate evaluation, the **HOLD** key must be pressed.

HOLD status is indicated by means of an arrow below the ´HOLD´ symbol in the display.

HOLD function

Freeze a measured value :



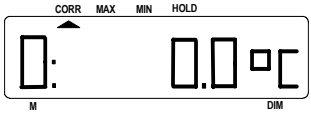
Each time the **HOLD** key is pressed, the current measured value appears in the display.

To obtain a continuous display of the current measured value, return by pressing either the **CLEAR** or the **M▲** key. The ´HOLD´ arrow should go out again.

7.4 Reference measurement and correction of measured values

In the **MEASURE** function by pressing the **CLEAR** key you can set the current measured value temporarily to zero (if the channel is locked at level ? 5). The current measured value is saved as reference value and the difference with respect to this reference value is displayed; it is thus possible e.g. to read out at random points the respective difference with respect to the reference point. To indicate that this differential mode is activated, the 'CORR' arrow flashes.

Set measured value to zero :



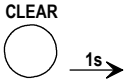
Setting to zero automatically deletes the maximum and minimum values for this channel. The **MAX**, **MIN**, and **HOLD** functions are also available in conjunction with reference measurement.

The way in which the zero-setting function operates depends on the locking mode for the measuring point in question (Man. Sec. 6.3.12).
If the locking mode is set to level 5 or higher, the reference value will be lost when the device is switched OFF.
If the locking mode is set to level 4, the reference value will be saved as base value in the connector EEPROM.
If the locking mode is set to level 3 or low, the sensor will be adjusted and the correction values will be saved in the connector EEPROM; see below..

Deleting the reference value

The reference value for a channel can be deleted by pressing and holding down the **CLEAR** key - even in the course of normal operation; (this does not apply with dynamic pressure); (and this is only if also unlocked in the EEPROM, see below). The maximum and minimum values are deleted and the 'CORR' arrow should stop flashing.

Return to normal measured values:



Press and hold down (appr. 1 s)

Sensor adjustment

Many types of sensor have to be adjusted relatively often to compensate for various instabilities. If the sensors are scaled with the base value and factor or if the correction has to be saved ?*? more permanently, then **zero-point adjustment** must be performed using the **zero-point correction function**; (see Manual, Section 6.3.10). On probes with scaling the base value is thus retained; i.e. a pH probe (base value 7.00) after adjustment will show not 0.00 but 7.00 pH. This function is activated automatically if the locking mode is set to level ? 3 (see above). You can **briefly and temporarily lower the locking mode down to level 3** by switching the device ON with the **M▲** and **CLEAR** keys held down; after switching OFF the locking mode will be restored to the level originally programmed.

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

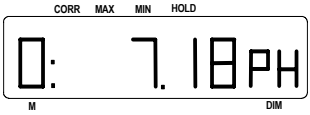
- Temperature sensors must be placed in icy water.
- pH probes must be immersed in a buffer solution pH 7.0.
- Conductivity probes must be withdrawn from the liquid and dried.
- O_2 probes for water must be held in a zero solution.

Zero-point adjustment can also be activated by pressing the **CLEAR** key.
Gain adjustment can be performed for the following sensor types using the same function, assuming the appropriate calibration value is available :

pH-probe	FY A8PH-xx:	pH 4.00 or pH 10.00
Conductivity	FY A641-LF:	2.77 mS/cm
or	FY A641-LF2:	147.0 uS/cm
or	FY A641-LF3:	111.8 uS/cm
O_2-saturation	FY A640-O2:	101 %

Example pH-probe:
Zero-point adjustment in a buffer solution of 7.00 pH :

Measured value :



Zero-point adjustment :

Gain adjustment in a buffer solution of 4.00 pH:

Measured value :

Gain adjustment :

7.5 Differential measurement

If there are two sensors with the same units and same decimal point position connected at measuring points M0 and M1, the difference M1 - M0 appears automatically below 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 to be created, this is also possible via the interface using the appropriate reference channels; (see Manual, Section 6.3.4).

8. TROUBLE-SHOOTING

Measuring instrument ALMEMO® 2390-3 can have a great many different sensors and peripherals connected to it. 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 incorrect setting, or incorrect cabling. In such event try to pinpoint and clear the problem with the aid of the following tests :

Error : Either no display or all display segments light up continuously.
Remedy : Check the power supply, switch off and then on again !

Error : Measured values are incorrect.
Remedy : Check the channel programming exactly (especially, if the ´**CORR**´ arrow lights up, the base and zero point); scan the entire programming using AMR-Control, or terminal and command P15 (see Manual, Sec. 6.2.3) and f1 P15 (see Manual, Sec. 6.10.1) !

Error : Fluctuating measured values or segment test or the system hangs in mid-operation.
Remedy : Check the cabling for inadmissible electrical connections, disconnect the external power supply and the analog output, unplug the sensor and replace with a hand-held sensor and operate them in air or dummies (for thermocouples short-circuit A-B, for Pt100 sensors, 100-Ω resistor); if these steps succeed in clearing the error, then check all wiring, if necessary, insulate the sensor, use an electrically isolated power supply, eliminate interference by using shielded or twisted wiring.

Error : ´CALErr´ is displayed when device is switched on.
Remedy : The calibration of a measuring range may have become misadjusted; the device must be recalibrated at the factory.

If, after performing the above-listed checks and remedial steps, the device still fails to behave as described in the instructions, it must be returned to our factory in Holzkirchen, accompanied by a explanatory note and error description. Complaints not accompanied by explanation and error description cannot be processed

9. ELECTROMAGNETIC COMPATIBILITY

ALMEMO® measuring instrument 2390-3 complies in full with the safety requirements specified in the EU directive on the approximation of Member States' laws relating to electromagnetic compatibility (EMC) (89/336/EEC).

The following standards have been applied in evaluating the product :

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

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

1. If the standard sensor is extended (1.5 meters) care must be taken to ensure that the measuring lines are not laid together with high-voltage power cables and that they are properly shielded so as to prevent spurious interference from being induced in the system.
2. Using the device in strong electromagnetic fields may aggravate measuring errors (<50 uV 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.

Technical data (see also Manual, Section 2.2)

Measuring inputs:	two ALMEMO® socket for ALMEMO® sensors
Channels :	4 channels / sensors maximum (measuring and function channels, depending on sensor type) 4 function channels in device
Sensor power supply :	Battery : 7 to 9 V, max. 100 mA Mains adapter : approx. 12 V, max. 100 mA
Measuring rate :	2.5 measuring operations per second , continuous
System accuracy :	±0.05% of measured value ±2 digits
Temperature drift :	0.01% / K
Cold junction compens. :	± 0.2 K ± 0.01 K /ºC (-30 to +80 ºC)
Outputs :	1 ALMEMO® socket for analog output module or interface cable
Equipment :	
Display :	6.5-digit 7-segment, 2-digit 16-segment, 12 mm
A/D converter :	delta-Sigma ± 15/16 bit 2.5 measuring operations per second
Microprocessor :	NEC 78F0078
Power supply :	7 to 13 V DC, not electrically isolated
Mains adapter :	ZB 2290-NA, 230 V AC to 12 V DC, 200 mA, electrically isolated
Adapter cable, el. isol. :	ZB 2290-UK, 10 - 30 V DC. to 12 V DC, 250 mA
Current consumption :	approx. 4.5 mA (without input and output modules)
Housing :	180 x 85 x 33 mm, ABS (acrylonitrile butadiene styrene) high impact resistance (max. 70 °C)
Operating temperature :	-10 ... +60 ºC
Storage temperature :	-30 ... +60 ºC
Ambient rel. humidity :	10 to 90 % (non-condensing)
Delivery includes :	Measuring instrument ALMEMO® 2390-3 Operating instructions ALMEMO® 2390-3 ALMEMO® Manual plus AMR software on CD

Product overview	**Order no.**
Universal measuring instrument ALMEMO® 2390-3	
2 inputs, 12 channels, LCD, and 5-key keypad, connection for mains supply unit, analog output, interface	MA 2390-3
Mains adapter, 12 V DC, 200 mA	ZB 2290-NA
DC adapter cable, 10 to 30 V DC, 12 V / 250 mA, electrically isolated	ZB 2290-UK
ALMEMO® V24 data cable, electrically isolated, maximum 115.2 kbaud, 1 mA	ZB 1909-DK5
ALMEMO® analog output module - 1.25 to 2.00 V, 0.1 mV / digit	ZA 1601-RK

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