

Operating instructions

English

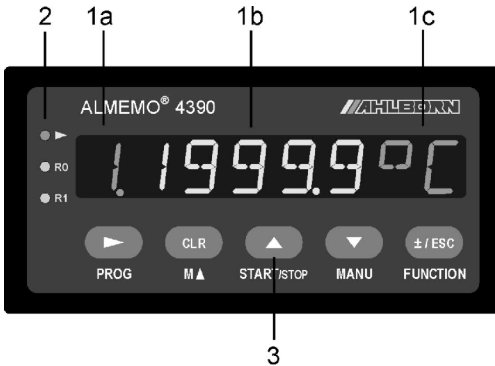


Precision panel meter ALMEMO® 4390-2

V1.1
23.09.2009

1. OPERATING CONTROLS

Front view



(1) LED display

- (a) Measuring point, port
- (b) Measured value, parameter
- (c) Units, function

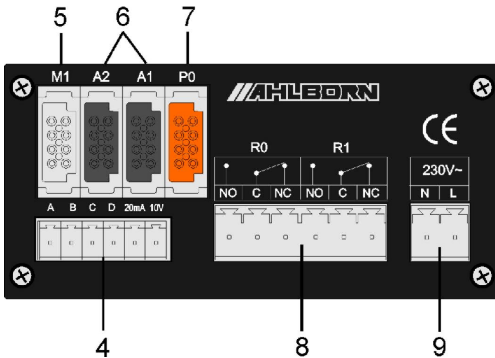
(2) Signal lights

- ▶ Start measuring
- R0 Relay R0 active
- R1 Relay R1 active

(3) Operating keys

- PROG** Programming
- M▲** Meas. point selection
- START/STOP** Start / stop measuring
- MANU** Manual measuring
- FUNCTION** Function selection
- ▶, ▲, ▼ Cursor keys
- CLR** To cancel the function
- ±/ESC** Arithmetic sign, cancel

Rear view



(4) Measuring input M0

- M0** Clamp connector for sensors with free ends
- M1, M2, M3** 3 additional channels

(5) or Measuring input M1

- M0** for all ALMEMO® sensors
- M1, M2, M3** 3 additional channels

(6) Outputs A1, A2

- A1** Interface USB (ZA 19019-DKU)
- RS 232 (ZA 1909-DK5)
- LWL (ZA 1909-DKL)
- Ethernet (ZA 1945-DK)
- RS 422 (ZA 5099-NVL/NVB)
- A2** Network cable (ZA1999-NK5/NKL)
- Trigger input (ZA 1000-ET/EK)
- Relay outputs (ZA 1006-EAK)

(7) Analog outputs P0 (option R02)

- P0** ALMEMO® connector (ZA 1000-KS)

(8) Relays R0, R1

- R0** Switch (NO, C, NC)
- R1** Switch (NO, C, NC)

(9) Power supply

- 230V** Mains connector (90..250V AC)
- 12V** 10..30V (option U)

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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 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 to carefully read these operating instructions and the appropriate sections in the ALMEMO® Manual. This is necessary in order to avoid operating and measuring errors and to prevent damage to the device. To help you find answers to your questions as quickly and easily as possible there is a comprehensive index at the end of these instructions and at the end 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 14, "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 circumstances :

- The customer attempts any form of unauthorized tampering and alteration inside the device.
- The device is used in environments or conditions for which it is not suited.
- The device is used with an unsuitable power supply and / or in conjunction with unsuitable peripheral equipment.
- 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 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 Standard delivery

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

Panel meter ALMEMO® 4390-2, These operating instructions
ALMEMO® Manual, CD with 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



This symbol means that the product is subject to the European Union's segregated waste disposal regulations. 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.

Batteries and rechargeable battery packs are special waste and must not be discarded as normal domestic waste.

Please dispose of packaging materials, plastics, and electronic components separately and in the proper manner.

4. SAFETY PRECAUTIONS



CAUTION This sign is intended to warn the user of a situation that risks damaging the device.

The user should carefully read the operating instructions in order to avoid possible errors, damage to equipment, and even the risk of personal injury. The device may only be opened by duly authorized and qualified service technicians.



WARNING This sign is intended to warn the user of a possibly life-threatening situation with risk of fatal injury through high voltage. Please note that connections to the 230 V mains should be set up by a qualified electrician.

Before connecting any equipment to the power supply always ensure that the operating voltage is correct.

Before attempting to install a sensor or other peripheral equipment always first disconnect the device from the power supply.

Please note that the device may be susceptible to damage 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. Be sure to observe the maximum load capacity of the sensor power supply!

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.

5. INTRODUCTION

Panel meter ALMEMO® 4390-2 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, operating instructions, 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

Panel meter ALMEMO 4390-2 has one ALMEMO® measuring input for all ALMEMO® sensors or one input for directly connecting your own sensors each with 4 channels. For operating purposes the panel meter incorporates a keypad with 5 keys and an 8-character alphanumeric LED display. There are more than 40 functions available - all easily accessible via the menu system. The panel meter is equipped with a real-time clock and a 128-KB EEPROM sufficient to record up to 25000 measured values. This capacity can be further extended as required by means of an external memory connector with a multimedia card (MMC). Internally the device has 2 freely configurable relays as standard and 2 universal analog outputs available as option. There are also two output sockets which can be used to connect any of the ALMEMO® output modules, e.g. digital interface, trigger input, or universal interface adapter. Power can be supplied either via one of the highly efficient AC/DC modules (90 to 250 VAC) or via DC/DC converter (10 to 30 VDC). 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, via the ALMEMO® connectors on the sensors. However, the user can easily supplement or modify this programming via the keypad or via the interface.

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 needing to reset.

Function channels

Maximum, minimum, and differential values of certain measuring points can be programmed as function 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 adjustment and gain adjustment can be performed at the touch of a button. Sensors with multi-point calibration can also be connected; (see Manual 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 an alarm contact is actuated by the internal relays; these can be allocated individually to specific limit values. Hysteresis is set by default to 10 digits; however, it can be adjusted to any value between 0 and 99 digits. The exceeding of a limit value can also be used to automatically start or stop measured value recording.

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 operation

Up to 4 measuring channels are available per transducer; i.e. it is also possible to evaluate double sensors, individually scaled sensors, and sensors with function channels. The user 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 (5 mops); 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 support high-speed sensors the measuring rate for a particular measuring point can be raised as far as 400 mops.

Measured values

The measured value for the selected measuring point is shown continuously with automatic zero-point correction 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 (10 V or 20 mA). At the two analog outputs (option) the device can output the measured value from any measuring point or a programming 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 O₂ sensors.

Measured value smoothing

Meas. values of an unstable or strongly fluctuating nature can be smoothed by taking 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.

5.1.3 Process control

To record the measured values from the 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 keypad or 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. The real-time clock is buffered for a matter of years by means of a lithium battery.

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 restrict data output from particular channels; this may prove 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

For measuring point scans the measuring rate can be set from 2.5 up to 400 measuring operations per second (mops). Recording can be accelerated if all measured values are also output to memory or via the interface at the measuring rate.

Control outputs

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

Measured value memory

All measured values can be saved to an EEPROM either manually or automatically per cycle. Standard memory capacity is 128 KB - sufficient for up to 25000 measured values. The memory can be organized and configured in linear or ring form. Output is via the interface. Selection can be specified according to time span.

Memory capacity can be increased substantially by means of an external memory connector with a multi-media memory card. With an external memory

connector (available as an accessory) files can be read out very quickly via any standard card reader.

Output

All data logs, measured values, and programming parameters can be output to any peripheral equipment. Using the appropriate interface cables RS232, RS422, USB, and Ethernet interfaces are available. 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 for longer distances via 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 operate 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. PUTTING INTO SERVICE

1. Connect the power supply at the terminals provided (9); the power supply required will depend on the variant (see rating plate) and be either 90 to 230 VAC mains or 10 to 30 VDC. see 7
2. Connect sensor with ALMEMO® connector at socket M1 (5) or sensor with free ends at clamp connector M0 (4) see 8. In this last case program the measuring range (menu 'SENSOR', function 'RANGE').
3. Selecting and programming the functions see 9.3; 9.4

To select a menu press (3)

FUNCTION, **▲** / **▼**

To select a function press

▶, **▲** / **▼**

To display parameters press

▶, **▲** / **▼**

To enter parameters press

▶, **▲** / **▼**, **▶**, **▲** / **▼**...

4. Displaying measured values

To select the 'MEASURED VALUE' function

M▲ / **CLR**

s. 10.1.1

and the measuring channel press

Read out the measured value

5. Displaying maximum value and minimum value

Select the 'MEASFUNCT' menu and then the

'MAXVALUE' or 'MINVALUE' function

PROG, **CLR**

6. To set the measured value to zero

select the 'ZERO' function and press

PROG, **▶**, **▶** s. 10.2.1

To perform zero-point adjustment

select the 'ADJUST' function and press

PROG, **▼**, **▶**, **▶** s. 10.2.2

To adjust a special sensor

select the 'ADJUST' function and press

PROG, **▶**, **▶** s. 10.2.5

To clear sensor correction press

PROG, **▲** / **▼**, **CLR**

7. Limit value monitoring

Select the 'SENSOR' menu and then function 'LIMIT-HI' or 'LIMIT-LO' s. 9.3,

Entering limit values s. 11.3,

To configure relays select the function 'OUTPUT' and then 'PORTS' s. 13.2.1,

Connect alarm device at clamp connector (8)

8. Saving measured values cyclically

To program select the menu 'DEVICE' and then the function 'CYCLE' s. 9.3, 9.4

To return to the 'MEASURED VALUE' function press

M▲ / **CLR**

To start / stop measuring press

START/STOP and **START/STOP**

9. Data output via the interface

Connect the computer via interface cable to socket A1 (6) (see Man., Sec. 5.2).

Start supplied software AMR-Control (note the baud rate).

'Search for connected devices', Click on 'Devices', 'Measured value

memory', 'Read out memory', memory range and output format as required

It is possible to import 'Table' output format into MS-Excel

7. POWER SUPPLY



Before connecting any equipment to the power supply always ensure that the operating voltage is correct; check the rating plate.

7.1 Mains operation

The mains power supply, 90 to 230 VAC at 50-60 Hz, must be connected via the screw terminal of socket (9) on the rear of the device.



Please note that connections to the 230 V mains should be set up by a qualified electrician.

7.2 DC voltage supply

For an electrically isolated 10 to 36 VDC power supply option U is needed. This voltage too must be connected via the screw terminal of socket (9) on the rear of the device (taking particular care to observe correct polarity).

7.3 Sensor supply

At the terminals + (plus) and - (minus) in the ALMEMO® connector there is a configurable sensor supply voltage available (self-healing fuse, 500 mA). Instead of the standard 9 V (150 mA) it is also possible, depending on sensor requirements, to use either 6 V (200 mA) as an energy-saving alternative or if necessary 12 V (100 mA); this can be programmed in the menu 'DEVICE' and function 'U-SENSOR'; (see 12.10). Other voltages (12 or 15 V or references for a potentiometer and strain gauge) can be obtained using special connectors; (see Manual 4.2.5 and 4.2.6).

7.4 Reinitialization

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

7.5 Data buffering

The sensor's programming is stored in the EEPROM on the sensor connector; the device's calibration and programmed parameters and all recorded measured values are stored in the EEPROM on the instrument itself - all on a fail-safe basis. Date and time-of-day are buffered by a dedicated lithium battery; this data is retained intact for years - even when the device is switched off.

8. CONNECTING THE SENSORS / TRANSDUCERS

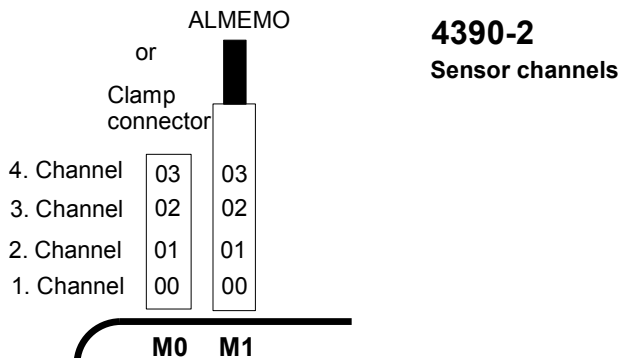
Any ALMEMO® sensor can be connected at ALMEMO® input socket M1 (5). Your own sensors with open ends can be clamped directly onto terminal strip(4) or onto an equivalent ALMEMO® connector.

8.1 Sensors / 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.

8.2 Measuring inputs and additional channels

On the ALMEMO® 4390-2 either ALMEMO® socket M1 (5) or clamp connector M0 (4) can be used as measuring input. When connecting an ALMEMO® sensor at socket M1 the programming is taken automatically from the connector; this can handle up to four measuring channels (M0 to M3). The additional channels can be used in particular for humidity sensors with 4 measurable 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 two or three sensors, if pin assignment so permits, can be combined in a single connector (e.g. rH / NTC, mV / V, mA / V, etc.). If the ALMEMO® connector is withdrawn then 4 channels are available for the clamp connector; however, these must be programmed via the measuring instrument. On the measuring instrument this gives the following channel assignment :



8.3 Sensor connected via clamp connector

A wide variety of passive sensors not powered from the device can be connected to the clamp connector, terminals A, B, C, D. The pin assignment is shown in the Manual. Ch. 4.1. For all sensors connected via the clamp connector the appropriate measuring ranges must be programmed on measuring channel M00 (s. 11.7).

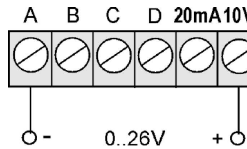
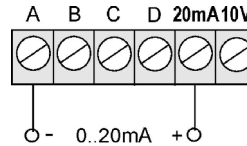
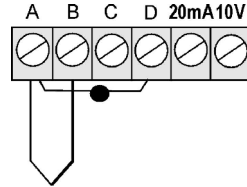
For thermocouples there is a special clamp connector available with integrated cold junction temperature sensor. The thermocouples themselves are, as normal, connected to terminals A and B (see Manual 4.2.1) and the measuring range is programmed on M00. The NTC sensor is configured as cold junction sensor at the same time automatically on M01.

For the purposes of measuring the current a 2 Ω shunt is incorporated between terminals 20 mA and A. This is where the current signal should be connected. As measuring ranges 'mA' and '%' are provided.

For measuring a voltage up to maximum 26 V a voltage divider is provided. A voltage signal of this nature should be connected to terminals 10V and A. As measuring range 'U26V' must be programmed.

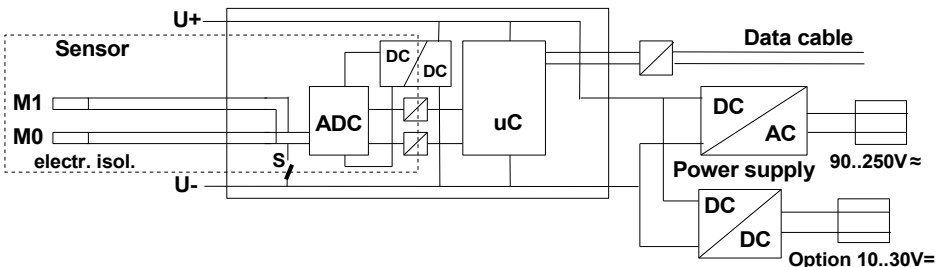


Since there are two connection possibilities but only one input, this input must not be used simultaneously for an ALMEMO® connector and a sensor with clamp connector.



8.4 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 measuring inputs are electrically isolated from the power supply by means of optocouplers. The power supply itself is also electrically isolated up to 50 V by means of the AC/DC module or the DC/DC converter (OA4390-U). The voltage at the measuring inputs themselves (between B, C, D and A or -) must not exceed 12 volts.

The 2 inputs, just like sensors combined within one connector, are electrically interconnected and must therefore be operated in isolation. For sensors with integrated power supply $\pm U$ the electrical isolation must be disabled by means of switch S (see above) or wire jumper; some inputs would otherwise be left without reference potential; (see Manual 6.10.3, Configuration with element flag 5 'ISO OFF'; this is usually set automatically the first time connected). With certain connectors (especially divider connectors without power supply) element flag 5 should be checked and if necessary corrected.





The internal analog outputs (OA 4390-R02) are also electrically isolated by means of a DC/DC converter.

Data and trigger cables are also isolated by means of optocouplers.

9. DISPLAY AND KEYPAD







9.1 Display

Panel meter ALMEMO® 4390 incorporates an 14-segment 8-digit LED display (1). This can display the measured value with measuring channel and units, menu and menu function in normal text, and the programming functions with channel and abbreviation, e.g.:

Measured value	
Menu	
Menu function	
Parameter	




To improve the clarity of the display the channel, units, and abbreviation are slightly dimmed; channel 0 is not displayed at all.

Special operating states and faults

Segment test for display	This is performed automatically each time the device is switched ON	
Checksum error during device calibration		
Non-connected sensors, deactivated measuring points		
Measuring range / function not permitted		
Sensor breakage		Abbreviation flashes
Measuring range undershot, CJ compensation or CJ compensation breakage		(Cold junction)flashes
Value range overshoot (>65000)		flashes
Measuring range overshoot	Maximum value flashes	
Measuring range undershot	Minimum value flashes	
Limit value overshoot	LED's R0, R1 active If so configured	

9.2 Keypad

To operate the device a keypad with 5 keys is provided (3). Each of these keys initially has the function indicated below it.

Function	Normal	Entry
Programming	PROG	
Measured value, measuring point selection	M▲	CLR
Start/stop measuring	START/STOP	
Manual measuring point scan	MANU	
Selection of functions	FUNCTION	±/ESC

After the key **PROG** or **FUNCTION** is pressed the white label on the keys apply.

9.3 Function selection and function activation

Panel meter ALMEMO® 4390-2 provides over 40 different functions for controlling measuring sequences, for acquiring, averaging, monitoring, and saving measured values, for outputting this data to various peripheral equipment, and for scaling, adjusting, and correcting sensors, etc. For the sake of clarity and easy access, functions are displayed in normal text, divided up into five menu blocks, and activated on an application-specific basis. If you want to have all functions activated for a limited period, press the **FUNCTION** key and hold it down for longer than one second.

A function is selected step-by-step using the cursor keys and the selection key right through to the actual parameters. These are displayed together with measuring point, functional value, and a 2-character abbreviation, as follows:

To select the 5 menu blocks press

FUNCTION,  / 

To activate all functions press

FUNCTION Press and hold down

1. Measuring functions

MEASFCT

2. Memory

MEMORY

3. Sensor programming

SENSOR

4. Device programming

DEVICE

5. Output modules

OUTPUT

To select menu function press

,  / 

To select parameters press

, ( / )

To return to measured value from any level press

CLR

To return to measured value step-by-step press

±/ESC

9. Display and keypad

Functions

Measuring functions menu

▶ MaxValue (Hi)	MAX VALUE
▼ MinValue (Lo)	MIN VALUE
▼ Average value	AVERAGE
▼ Number of averaged values	COUNTS
▼ Averaging mode	AV-MODE
▼ Smoothing	DAMPING
▼ Diameter standardized	DIAMETER
▼ Cross-section area	CR-SECT
▼ Atmospheric pressure	ATMPRESS
▼ Temperature compensation	T-COMPEN

Menufunctions Parameter Abbreviation activation

MEASFCT

1. 127.3 MH	Standard
1. 23.4 ML	Standard
1. 13.24 AV	Averaging mode > 0
1. 1234 C	Averaging mode > 0
1. Cont AM	Standard
10 DP	FUNCTION lang
1. 150. DM	Measuring range 'Flow'
1. 75. CS	Measuring range 'Flow'
1013 mb	Measuring range with PC
1. 23.4 TC	Measuring range with TC

Menu SAVE

▶ Memory capacity free	MEM FREE
▼ Memory time	MEM TIME
▼ Start time	STARTTIM
▼ Start date	STARTDAT
▼ End time	END TIME
▼ End date	END DATE

MEMORY

113.24M MF	Standard
2T16.34 MT	Press and hold down FUNCTION
10.00.00 ST	Press and hold down FUNCTION
02.10.03 SD	Press and hold down FUNCTION
17.00.00 ET	Press and hold down FUNCTION
02.10.03 ED	Press and hold down FUNCTION

Menu SENSOR

▶ Locking mode	LOCKMODE
▼ Measuring range	RANGE
▼ Units	DIM
▼ Limit value, maximum	LIM-HI
▼ Relay, maximum	REL-HI
▼ Limit value, minimum	LIM-LO
▼ Relay, minimum	REL-LO
▼ Analog start	AN-START
▼ Analog end	AN-END
▼ Analog type	AN-TYPE
▼ Base value	BASE
▼ Factor	FACTOR
▼ Exponential	EXPONENT
▼ Zero-point correction	ZEROCORR
▼ Gain correction	SLOPECOR

SENSOR

1. 0005 LM	Standard
1. NiCr R	Standard
1. °C DI	Locking<3
1. 123.0 LH	Locking<7
1. R00 RH	Press and hold down FUNCTION
1. -10.0 LL	Locking<7
1. R-- RL	Press and hold down FUNCTION
1. 000.0 AS	Locking<6
1. 123.4 AE	Locking<6
1. 4-20 mA	Locking<6
1. ---- BA	Locking<5
1. ---- FA	Locking<5
1. 0 EX	Locking<5
1. ---- ZC	Locking<4
1. ---- SC	Locking<4

Menu DEVICE

- ▶ Cycle
- ▼ Measuring rate
- ▼ Measuring duration
- ▼ Measuring time
- ▼ Time-of-day
- ▼ Date
- ▼ Baud rate, output format
- ▼ Device address
- ▼ Language
- ▼ Brightness / contrast
- ▼ Hysteresis
- ▼ Sensor voltage

<u>DEVICE</u>
CYCLE
CONVRATE
MEASDUR
MEASTIME
TIME
DATE
BAUDRATE
DEV-ADDR
LANGUAGE
CONTRAST
HYSTERES
U-SENSOR

00.15.00	CY	Standard
10	CR	Standard
01.00.00	MD	Press and hold down FUNCTION
01.23.45	MT	Press and hold down FUNCTION
12.34.56	TM	Press and hold down FUNCTION
01.12.01	DA	Press and hold down FUNCTION
Un 9600	BR	Press and hold down FUNCTION
00	DA	Press and hold down FUNCTION
EN	LA	Press and hold down FUNCTION
50	CO	Standard
10	HY	Press and hold down FUNCTION
9V	US	Press and hold down FUNCTION

Menu OUTPUT

- ▶P0: Relays, all channels, inverted
- ▲P1: Relays, all max. values, inverted
- ▲P6: Analog output, modes **MX/B2/COM**
Type: **10V/20mA**
- ▲A1: Data cable V5
- ▲P27: Analog output at A2, driven

PORTS

PO.ALL -	RE	Standard
P1.MAX-	RE	
P6. B2	AA	FUNCTION press and release
P6.20mA	AA	Press and hold down FUNCTION
A1	DK	
27.COM	AA	

In the function **MEASURED VALUE** some adjustment functions can be activated by pressing



Functions

- Measured value
- ▶ Set to zero
- ▼ Zero-point adjustment
- Two-point adjustment
- ▼ Setpoint adjustment, factor
- Setpoint adjustment, gain

Menufunctions

- ZERO
- ADJUST
- ADJUST
- SETPOINT
- SETPOINT

Parameter Abbreviation activation

1.123.45	°C	
1. 0.00	CL	
1. 0.00	AJ	
1. 4.00	AJ	Special sensors only
1. 5.00	S4	Locking=4
1. 5.00	S3	Locking=3

Activation conditions

- Standard Function is always active.
- Averag. mode >0 Function is active if averaging mode is programmed in the meas. channel.
- Meas. range 'Flow' Function is active if the range 'Flow' is programmed.
- Meas. range with TC Function is active for ranges with temperature compensation.
- Meas. range with PC Function is active for ranges with pressure compensation.
- Press and hold down **FUNCTION** Function is active if the **FUNCTION** key is initially pressed and held down.
- Locking <= Function is active if the locking condition is met

9.4 Data entry

Parameters can be programmed as follows :

To select parameters press	FUNKTION , ▲, ▼, ▶ ...
To start programming press	PROG
The front digit flashes and can now be changed.	'0'000.0°C
To increment the digit press	▲ ...
If you overshoot the highest value, you start again at zero.	
To decrement the digit press	▼ ...
If you go below zero, you start again at the highest value.	
To change the arithmetic sign for the first digit or to cancel this input with effect from the second digit press	±/ESC
To move forwards to the next digit press	▶
To move back to the previous digit press and hold down	▶ lang
To terminate programming	
After setting the last digit again press	▶
To delete measured values and reset the programming press	PROG , CLR

When entering certain parameters, e.g. measuring range, relay variant, etc. this procedure can be used to select and program not only digits but also characters, symbols, and whole designations

10. MEASURING OPERATIONS

Panel meter ALMEMO® 4390-2 offers all the possibilities associated with measured data acquisition.

1. Semi-continuous scanning of all active measuring points see 12.2

Display of any selected measuring point

Measured value sent to an analog output see 13.2.2

2. Measuring point scan and output, once-only see 10.4.1 and Manual 6.5.1.1

3. Measuring point scan and output, cyclic see 10.4.2 and Manual 6.5.1.2

4. Measuring point scan and output, continuous see Manual 6.5.1.3.

To completely delete all measured values

With each new START of a measuring operation all maximum, minimum, and average values for all channels are deleted automatically. see Manual 6.5.1.3

10.1 Measured value

After switching ON first of all a segment test is performed; then the measuring point is displayed with the measured value and appropriate units. All special operating states possible for the measured value are explained in Section 9.1.

If another function is selected, the measured value will appear automatically after 1 minute if no key is pressed or immediately if you press :

1. 25.37°C

M▲

10.1.1 Selecting a measuring point

To select one after the other all active measuring points and have the current measured value displayed for each press the M▲ key. To move back to the previous channel press and hold down the M▲ key.

To increment the measuring channel press

To decrement the measuring channel press and hold down

M▲
M▲

When switching between channels the measuring range abbreviation is briefly displayed. see 11.7.1

10.1.2 Double display

If a double sensor for temperature and humidity is connected at socket M1, the display can be switched to a double display showing both variables. To obtain a double display, select channel M1 for humidity and press and hold down the PROG key. With the same key combination this function can also be reset.

Select the humidity channel

1. 47.5%
H

For double display press and hold down PROG

25.3°C 47.5%

10.1.3 Maximum and minimum value memories

From the measured values acquired per measuring point the highest and lowest values are determined and saved for each. To display these extremes first the desired channel must be set and then, in the menu 'MEASFNCT', the function 'MAXVALUE' or 'MINVALUE' selected.

MaxValue function 'MH' and **MinValue** function 'ML'

1. 123.4MH

To select a function press see 9.3

FUNCTION, ▲/▼, ►, ►

To clear the maximum / minimum values press

PROG, CLR

As soon as the saved maximum / minimum value has been deleted, the current measured value appears again immediately. The maximum / minimum values are also automatically cleared with each start (see 10.F) or whenever the measuring range is changed (see 11.7).

10.2 Measured value correction and compensation

For differential measuring operations based on a reference value, for measured value correction based on sensor errors, and for scaling processes, there are five programmable parameters available, namely zero-point correction 'ZC', gain correction 'SC', base value 'BA', factor 'FA', and decimal point setting 'EX'; (see Manual 6.3.10). These parameters can either be programmed (see 11.4, 11.5) or be calculated automatically in the MEASURED VALUE function in a sub-menu with special functions:

Function	Select	Display	Key	Display	Key
To select meas. value and meas. point	M ▲			1. 12.34 °C	
To set the meas. value to zero see 10.2.1	PROG	ZERO	►	1. '00.00'CL	►
Zero-point adjustment see 10.2.2	▼	ADJUST	►	1. '00.00'AJ	►
Setpoint input see 10.2.3	▼	SETPOINT	►	1. '15.00'S4	►
For dynamic pressure sensors and chemical probes (see 10.2.5):					
Zero-point adjustment, gain adjustment	PROG	ADJUST	►	1. '00.00'AJ	►



So long as the measuring point is locked at level ≥ 6 (see 11.2) this menu cannot be accessed.

10.2.1 To set the measured value to zero

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 can be accessed in the 'MEASURED VALUE' function by means of the following key sequence :

To select the zero-setting function 'ZERO' press

PROG

Display

ZERO

To open zero-setting press

►

The measured value is displayed, flashing, '0000' with abbreviation 'CL'

1.'00.00'CL

To set the measured value to zero press



To cancel this function press

±/ESC



If only a 'C' appears as abbreviation, this means that the measuring point is locked at level 5 or above. see 11.2

In this case the measured value is saved as base value in the RAM; i.e. once the device is switched off, then the next time it is switched on, this will be restored to its original value.

To clear the zero-point shift again

Select the function 'ZERO' (see above and 10.2):

ZERO

Press

CLR

10.2.2 Zero-point adjustment

Many types of sensor need to be adjusted at least once or at regular intervals to compensate for various instabilities. For sensors which are scaled or whose correction values are to be locked there is special zero-point adjustment. In this function scaling is not affected; the zero-point error is saved as zero-point correction. see 11.4. If the function is locked at level >3, it can be temporarily enabled just for adjustment purposes.

To access zero-point adjustment select the 'ADJUST' function and press

PROG , ▾

Display

ADJUST

To perform zero-point adjustment press



If this function is locked at level >3, the locking level is displayed with the abbreviation 'FREE'.

VM5 FREE

To temporarily unlock to level 3 press



To cancel zero-point adjustment press

±/ESC

If this is OK, the display flashes, '0000' or the negative base value with abbreviation 'AJ'

1.'00.00'AJ

To perform zero-point adjustment press



To cancel this function press

±/ESC

Clearing correction values In the 'ADJUST' function see 10.2

ADJUST

Press

CLR

If this function is locked, the locking level is displayed with the abbreviation 'FREE'.

VM5 FREE

To temporarily unlock to level 3 press



To cancel press

±/ESC

10.2.3 Setpoint input

If you set up a 2nd calibration value other than the zero-point, you can, by entering the setpoint, correct a measured value, including gain. On ALMEMO® force transducers an appropriate calibration resistance is automatically activated for the purposes of final value correction. Depending on the locking status either the factor (locking level 4) or gain correction (locking level 3) is calculated and saved to the connector.

To ensure that two-point adjustment is correct, the zero-point should have been adjusted first. see 10.2.2.

1. Select measured value and set up the calibration value (e.g. boiling water)

1. 97.34 °C

2. To select the setpoint function press see 10.2

PROG, ▼ / ▲, ►

Display

SETPOINT

If this function is locked at level =5, the locking level is displayed with the abbreviation 'FREE'.

VM5 FREE

To temporarily unlock to level 3 press

►

To cancel setpoint adjustment press

±/ESC

If this function is locked at level ≤3, the function 'S3' is displayed with the measured value flashing.

1. '97.34'S3

If this function is locked at level =4, the function 'S4' is displayed with the measured value flashing.

1. '97.34'S4

3. Enter setpoint until last digit flashes. see 9.4

100.0'0'S4

4. To perform adjustment again press

►

With 'S3' the correction factor is saved as gain correction; with 'S4' it is saved as factor.

Clearing the correction value In the 'SETPOINT' function see 9.4

SETPOINT

Press

CLR

10.2.4 Sensor adjustment for dynamic pressure probes

With dynamic pressure probes FDA602Sx (range L840 and L890 and units m/s or Pa) zero-point adjustment must be performed before each measuring operation - by pulling off the hoses. The zero-point error is always written to the calibration offset - irrespective of locking level; it is only saved temporarily, i.e. until the device is next switched off; this ensures that linearization is not falsified.

To select the 'Measured value' function press

M▲

The measured value is displayed with units 'm/s' or 'Pa'.

1. 0.34 ms

To select the 'ADJUST' function press

PROG

'ADJUST' is displayed.

ADJUST

To perform the 'Adjust' function press



The measured value is displayed, flashing, '0000' with abbreviation 'AJ'.

1. '0.00'AJ

To perform zero-point adjustment press



The measured values from dynamic pressure probes depend heavily on air temperature and atmospheric pressure. (see Manual 3.5.3) It is recommended therefore in the event of deviation from standard values to perform compensation of these variables (see 10.2.7, 10.2.8)

10.2.5 Sensor adjustment for chemical sensors and probes

Many types of sensor need to be adjusted at least once or at regular intervals to compensate for various instabilities. With the following chemical probes automatic two-point adjustment can be performed:

Probe	Type	Zeropoint	Gain
pH-Probe	ZA 9610-AKY:	7.00	4.00 pH or 10.00 pH
	FY A641-LF:	0.0	2.77 mS/cm
Conduktivität:	FY A641-LF2:	0.0	147.0 uS/cm
	FY A641-LF3:	0.0	111.8 mS/cm
	FY A640-O2:	0	101 %

Two-point adjustment is performed in 2 steps:

1. Zero-point adjustment

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

- Immerse pH probe in a buffer solution, pH 7.0.
- withdraw conductivity probe from the liquid and dry.
- Hold the O₂ probe for water in a zero solution.

The measured value is displayed (e.g.)

1. 7.34 PH

To select the 'ADJUST' function press

PROG

'ADJUST' is displayed.

ADJUST

To perform the 'Adjust' function press



If the correction values are locked at level >3, the locking level is displayed with the abbreviation 'FREE'. (s. 11.2)

VM5 FREE

To temporarily unlock press



To cancel sensor adjustment press

±/ESC

10. Measuring operations

If this is OK, the display shows
'7.00' with abbreviation 'AJ'.

1. '7.00'AJ

To perform adjustment and save again press



The display shows the corrected measured value.

1. 7.00 PH

2. Gain adjustment

For the purposes of gain adjustment the gain calibration resource must first be set up (as per Table). Gain adjustment is performed in exactly the same way as zero-point adjustment.

The display shows the corrected measured value, e.g:

1. 4.00 PH

Clearing adjustment values

If a pH probe is incorrectly adjusted these adjustment values can be deleted and the default values (base value 7.00, gain -0.1689) can be restored.

Adjustment is performed as described above.

PROG

'ADJUST' is displayed.

ADJUST

To delete adjustment values press

CLR

The display shows the unchanged, incorrect measured value.

1. 7.34PH



The measured values from pH probes depend heavily on air temperature; the measured values from O₂ probes depend heavily on atmospheric pressure; (see Manual 3.5.3). It is recommended therefore in the event of deviation from standard values to perform compensation of these variables. (see 10.2.7, 10.2.8)

10.2.6 Cold junction compensation

Cold junction compensation for thermocouples is normally performed automatically by means of an NTC sensor in measuring socket M1. This sensor can be substituted with an external measuring sensor; (see Manual 6.7.3). For especially exacting requirements (e.g. for extreme temperature gradients in the device) special connectors are available, each with its own integrated temperature sensor (ZA-9400-FSx) for cold junction compensation. These can be used for all thermocouple types; however, they require 2 measuring channels. '#J' is programmed in the designation; this ensures that the temperature sensor integrated in the connector is used for cold junction compensation.

10.2.7 Atmospheric pressure compensation

Some measured variables depend on the ambient atmospheric pressure; large deviations from standard pressure (1013 mbar) may lead to measuring errors. (see 11.7.1 Measuring range list 'with PC').

e.g. error per 100 mbar

Relative humidity, psychr.	approx. 2%
Mixture ratio, capacitive	approx. 10 %
Dynamic pressure	approx. 5%
O ₂ saturation	approx. 10%

Compensation range

500 to 1500 mbar
Vapor pressure (VP) up to 8 bar
800 to 1250 mbar (error < 2%)
500 to 1500 mbar

It is important therefore, especially when working at significant heights above sea level, to take due account of the atmospheric pressure (approx. -11 mbar per 100 meters above mean sea level MSL). This can be programmed in the 'ATMOSPHERIC PRESSURE' function 'mbar', which is activated automatically for the listed sensors in the 'MEASFUNCT' menu (see 5.2).

'ATMOSPHERIC PRESSURE' function 'mbar'

1013 mb

Select see 9.3; Entry in mbar see 9.4

With each reset the atmospheric pressure is set to 1013 mbar. It can be set to the current value by means of the usual data entry process. see 9.4.

10.2.8 Temperature compensation

Sensors whose measured values depend heavily on the temperature of the measuring medium usually incorporate their own temperature sensor and the device performs temperature compensation automatically. (see 11.7.1 Measuring range list 'with TC'). However, dynamic pressure probes and pH probes are also available without their own integrated temperature sensor. If the temperature of the medium deviates from 25 °C the following measuring errors may occur:

e.g. errors per 10 °C

Dynamic pressure	approx. 1.6%
pH probe	approx. 3.3%

Compensation range

-50 to 700 °C
0 to 100 °C

Sensor

NiCr-Ni
Ntc or Pt100

For **temperature compensation** of these sensors there are 2 possibilities

1. Enter the compensation temperature in the 'T-COMPEN' function:

TEMPERATURE COMPENSATION function 'TC'

25.0 TC

Select see 9.3; Entry in °C see 9.4

2. Continuous temperature compensation with external temperature sensors can be activated either via the reference channel of the sensor to be compensated or by configuring any temperature sensor as reference sensor with a '*T' in the designation; (see Manual 6.3.4).

10.3 Averaging

The average value for a measured value is needed for various applications.

z.B. Smoothing a widely fluctuating measured value (e.g. wind, pressure, etc.)

Average flow velocity in a ventilation conduit

Hourly or daily average values for weather data (temperature, wind, etc.)

Also for consumption values (electric current, water, gas, etc.)

The average value \bar{M} of a measured variable is obtained by adding together a series of measured values (M_i) and then dividing this total by the number of measured values used (N):

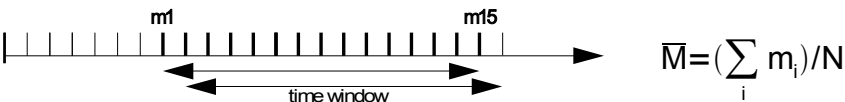
$$\text{Average value } \bar{M} = \left(\sum_i M_i \right) / N$$

The ALMEMO® 4390-2 offers several different averaging modes.

These include measured value smoothing for the selected channel with a sliding averaging window, averaging over individual measuring operations selected by place or time (also networked measuring as per VDE), averaging over the full measuring time, over cycles, or over specified measuring points.

10.3.1 Smoothing meas. val. by means of a sliding average

The first method for averaging applies exclusively to the measured value of the displayed channel; it is used to smooth measured values of an unstable or strongly fluctuating nature, e.g. especially turbulent flows, by means of a sliding average over a specified time frame. The level of smoothing can be set in the 'MEASFNCT' menu, 'SMOOTHING' function; here you specify the number of measured values to be averaged (possible range 2 to 99). The smoothed measured value will then apply for all subsequent evaluation functions. Smoothing can thus also be used in a combination with averaging over individual measured values (see 10.3.3).



Measured value smoothing over e.g. 15 values

'DAMPING' function 'DP' Select all functions see 9.3; Entry see 9.4

To clear smoothing press



In semi-continuous measuring point scans the time constant (s) = smoothing / measuring rate * 2

10.3.2 Averaging mode

All averaging operations, except when smoothing a measured value, are specified in the 'AVERAGING MODE' function 'AM'; the average value appears in the 'AVERAGE VALUE' function 'AV'; the number of averaged values appears in the 'COUNTS' function 'C'. The 'AVERAGE MODE' function 'AM' in menu 'MEASFUNCT' is by default activated; the last two functions 'AV' and 'C' are activated automatically as and when the averaging mode is programmed.

Averaging mode function 'AM' Select functions see 9.3; Entry see 9.4

To clear the averaging mode press

1. ContAM

PROG , CLR

If the measuring point has been appropriately programmed the following modes can be set :

No averaging

1. ----AM

Averaging from start to stop see 10.3.4

Or over a series of individual measuring operations see 10.3.3

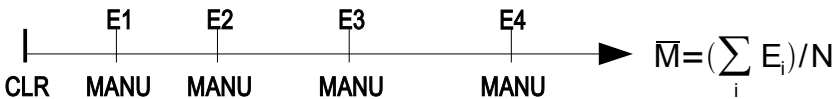
1. ContAM

Averaging per cycle see 10.3.5

1. CYCLAM

10.3.3 Averaging over manually set individual meas. operations

To obtain the average over individual measuring operations at particular locations or times individual measuring point scans 'E_i' must be set manually. At all measuring points where measured values are to be averaged the averaging function must be switched on with 'CONT' mode.



1. To stop measuring (if it has been started) press

START/STOP

2. To set the averaging mode press see 10.3.2

1. ContAM

To smooth a measured value (if required) select smoothing. see 10.3.1

1. 15 DP

3. To clear the average value after selecting it press

PROG , CLR

The 'Average value' function displays

1. ----AV

The 'Count' function displays

1. 0000 C

4. To acquire individual measured values 'Ex' manually press

MANU

The 'Average value' function displays

1. 12.34AV

10. Measuring operations

The 'Count' function displays

1. 0001 C

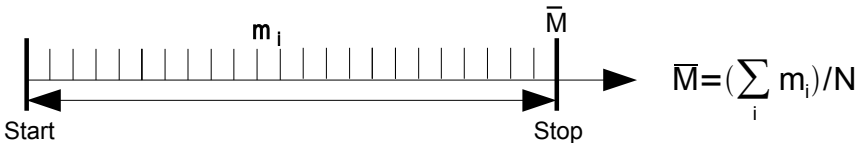
5. Repeat step 4 for each measuring point.



With the function channels for average value 'M(t)' and number 'n(t)', all function values used in averaging can be output via the interface or saved.

10.3.4 Averaging over time

To calculate the average value of all measured values acquired at the measuring rate over a certain period of time the averaging mode for the required measuring channel must be set to 'CONT'. Averaging can be performed either with or without the cycle. A measuring point scan is always performed at start and stop in order to record the start value and end value each with the applicable time-of-day. In order to record average value \bar{M} a function channel M(t) is required. (see 11.7.1)



Set averaging mode, continuous see 10.3.2

1. ContAM

To clear the average value after selecting it press see 9.3 (or clear the average value automatically at start)

PROG , CLR

The 'Average value' function displays

1. ----AV

To start averaging press

START/STOP

To stop averaging press

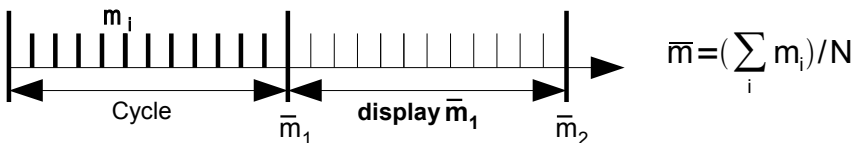
START/STOP

Read out average value in the 'Average value' function

1. 12.34AV

10.3.5 Averaging over the cycle

To acquire average values at cyclic intervals over these cycles the averaging mode 'CYCL' must be used. This ensures that the average value, maximum value, and minimum value are cleared after each cycle but continue to appear in the display throughout the following cycle.



Set averaging over a cycle see 10.3.2

1. CYCLAM

Program the cycle see 12.1

00.15.00CY

Select the average value function and clear

1. ---AV

To start averaging press (LED '▶' lights up)

START/STOP

To stop averaging press (LED '▶' goes out again)

START/STOP

Read out average value / cycle in the 'Average value' function

1. 12.34AV

Averaging over manually set periods of time:

Using the same averaging mode but without the cycle the average value can also be obtained over the period of time from one manual measuring point scan to the next:

Delete the cycle see 12.1

00.00.00CY

To start averaging press (LED '▶' lights up)

START/STOP

To manually set a measuring point scan press

MANU

Read out average value / period in the 'Average value' function

1. 12.34MW



With the function channels for average value 'M(t)' and number 'n(t)', all function values used in averaging can be output via the interface or saved.

10.3.6 Volume flow measurement

To determine the volume flow 'VF' in ventilation conduits multiply the average flow velocity \bar{v} by the cross-section area 'CS'.

$$VF = \bar{v} \cdot QF \cdot 0.36$$

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

To calculate **average flow velocity** \bar{v} from approximate air volume measurements at air vents and gratings **time-based averaging** should be used. (see 10.3.4 and Manual 3.5.5)

Apply the rotating vane at one end, start averaging, and proceed uniformly over the whole cross-section; when you reach the other end of the cross-section stop averaging.

Alternatively the average flow velocity can also be determined by **single array measurements** as per VDI/VDE 2640, i.e. individual measuring operations performed manually at defined points (e.g. 13.24 m/s). (see 10.3.3 and Manual 3.5.5)

Continuous volume flow measurement can also as a special case be performed by means of pure center point measurement. Averaging over several points can thus be omitted. Volume flow calculation is then based automatically on the measured value only. Measured value smoothing is definitely advisable.

see 10.3.1. The K factor for correcting the flow profile, as factor for the volume flow channel, should be set to 0.8; (see below).

Volume flow function channel

To show the volume flow data a function channel is required whose reference channel is aligned to the flow measuring point and / or to the appropriate average value channel M(t). (see Man. 6.3.4) The easiest way to do this is to program the measuring range 'Flow' on the 2nd or 3rd channel of the flow sensor.



If this channel has not yet been activated, it must be selected in the 'RANGE' function by pressing and holding down the 'Ms' key and programming the measuring range 'Flow'. see 11.7.1 The reference channel is automatically set to the 1st channel 'Flow'.

Programming example for a rotating vane as flow sensor:

- | | | |
|---------------------------------|--------------------|-----------------------------------|
| 1. Channel e.g. meas. point M00 | Meas. range 'S220' | Averaging mode 'Cont' |
| 2. Channel e.g. meas. point M01 | Meas. range 'Flow' | Cross-section 175 cm ² |

Entering the cross-section

The cross-section area CS can be entered in the 'Flow' channel either directly in the 'CS' function up to a maximum of 32000 cm² or as diameter in the 'DM' function up to a maximum of 2000 mm. (see 5.4) When the function channel 'Flow' is selected both these functions are activated automatically.

CROSS-SECTION function 'CS' Select see 9.3

Entry in cm² see 9.4

1. 175.CS

DIAMETER function 'DM' Select see 9.3

Entry in mm see 9.4

1. 150.DM



With some cross-sections or arrangements (see Manual 3.5.5) a correction factor K is necessary; this can be easily programmed as a factor in the 'Flow' channel; (see Section 7.5).

Displaying the volume flow

The total air volume flow is the product obtained by multiplying average velocity \bar{v} and cross-section area CS. This volume flow is calculated automatically in the function channel 'Flow' and displayed as the measured value in m³/h.

VOLUME FLOW in the function channel 'Flow'

To select press key M▲ Display in m³ / hour

1. 834.mh

Converting to standard conditions

With all flow sensors it is possible to convert the actual measured values to standard conditions, i.e. temperature = 20°C and atmospheric pressure = 1013 mbar. To do so the actual measured values for temperature and atmospheric pressure must be entered in the functions 'temperature compensation' and 'pressure compensation' and '#N' must be programmed in the designation via the interface - either in the velocity channel or in the volume flow channel; this then automatically produces the standard volume flow. (see 6.3.5)

10.4 Measuring point scans and data output

Measuring point scans can be used to acquire and then evaluate data from all active measuring points at particular times (for the purposes e.g. of averaging, outputting to the interface, or saving to memory). A measuring point scan can be initiated at any time-of-day either manually or automatically by a cycle. Each measured value is then saved to the integrated memory and output to the interface in the selected output format. (see Manual 6.5.5) (for print layouts, see Manual 6.6.1).

10.4.1 Measuring point scan, once-only

Once-only manual measuring point scans for acquiring the current measured values from the active measuring points can be initiated in the 'MEASURED VALUE' function by pressing the **MANU** key. (see also Manual, Section 6.5.1.1) The LED '▶' should light up briefly. Each time the key is pressed again after this the measured values are processed accordingly. If the actual time-of-day is to be indicated as measuring time, this needs to be entered first. see 12.4.

Measuring point scan, once-only

In function MEASURED VALUE press the key:

MANU

10.4.2 Measuring point scan, cyclic

For cyclic measuring point scans and outputs the output cycle can be set in menu 'DEVICE', function 'CYCLE', 'CY'. (see also Manual 6.5.1.2).

CYCLE function 'CY' Select see 9.3

Entry see 9.4

Enter in 6-character format e.g. 15 minutes

To clear the cycle press keys. This terminates any cyclic scan currently still running.

00.15.00CY

hh . mm . ss

PROG , **CLR**

The cyclic measuring operation is started by pressing the **START/STOP** key; the LED '▶' should light up continuously. If a peripheral device is connected, the measured values are output cyclically

To start a **cyclic measuring point scan** press: **START/STOP**

To stop automatic measuring point scanning again press **START/STOP**

The current measured values are saved to memory again. The LED '▶' should go out again.

To stop a cyclic measuring point scan press :

START/STOP

10.5 Measured value memory

The measured value memory is used to record measured values acquired from all measuring points by once-only or cyclic measuring point scans. see 10.4. You can use either the internal EEPROM data memory or an external memory connector with MMC. (see Manual 6.5).

10.5.1 Internal data memory

The ALMEMO® 4390-2 incorporates an internal 124-KB EEPROM with sufficient capacity for 16000 to 24000 measured values (depending on the number of channels). This memory is configured by default as ring memory with a cycle of 1 minute; however, it can be reconfigured as linear memory. (see Manual 6.10.13.2) For the fundamentals of saving data in ALMEMO® devices please see the description in the Manual, Section 6.9. In the event of a failure in the supply voltage both measured data and time-of-day are retained intact.

PLEASE NOTE ! The first time the device is started only one sensor configuration is saved to the internal memory. However, if other sensors are connected the memory must be read out and then cleared before the next recording session!

10.5.2 Memory connector with multimedia card

If extra memory capacity is required or if data needs to be moved elsewhere for evaluation, memory connector ZA 1904-MMC can be used; this additional external memory is a conventional multi-media flash memory card, available from our range of accessories. The memory card should preferably be RS form (reduced size), half size, 32 to 512 MB; measured data is written to it via the memory connector in table mode and in standard FAT16 format. The MMC can be formatted and its contents can be read out or deleted on any standard PC using any standard card reader. Measured data can be imported into MS-Excel or into Win-Control. The memory connector with the memory card can be connected at socket A2 (6); it is recognized automatically. You can check this in the 'MEMORY FREE' function by the now increased memory capacity in MB. see 10.5.3

If the external memory is connected at the start of any measuring operation, it will be used. However, it must not, in the course of measuring, be unplugged; this would cause temporarily buffered measured values to be lost.

Before starting any measuring operation you can enter an 8-character file name via the interface (e.g. with the AMR-Control software). In the absence of a user-defined file name, the default name 'ALMEMO.001' or the name most recently used will be suggested automatically. So long as the connector configuration is not altered, any number of measuring operations can be saved - either manually or cyclically - all in the same file.

If, however, the connector configuration has been changed since the last mea-

suring operation, a new file will be created; and, if no new file name has been programmed, the index in the file name extension will automatically be incremented by 1, e.g. 'ALMEMO.002'. Similarly, if the file name now entered already exists, a new file will be created with the same file name prefix but with a new index.



The ring memory mode is not supported with external storage!

10.5.3 Memory functions

Memory capacity display

In the 'MEMORY' menu, function 'MEMORY FREE' 'MF', the available memory capacity can be seen (internal memory in KB, MMC in MB). If the memory is full, the display will read 0.0; if the memory is configured in linear mode no further measured values will be saved; if it is configured in ring mode old values will be overwritten by new.

'Memory free' function 'MF' Select see 9.3

```
124.0K MF
PROG , CLR
'SCLr'MF
±/ESC
```

To clear the memory press keys

In the display 'SCLr' flashes.

To cancel deleting press



In the case of a multimedia card clearing the memory has the effect of reformatting the entire card, thus deleting all files !

Memory time

You can, in the 'Memory time' function 'MT', display the amount of time available for saving measured data to the remaining free memory (see above). This time depends not only on the memory capacity but also on the number of measuring channels, on the cycle, and even, in certain operating modes, on the conversion rate.

Fun'MEM TIME' function 'MT' Select
see 9.3

```
1T18.40MT
```

Format: ttttThh.mm

10.5.4 Measured value acquisition

All once-only and all cyclic measuring point scans are generally saved to memory. (see 10.4) A new feature is that all measured data is also saved whenever a measuring operation stops - even if no cycle has been programmed. It is thus possible e.g. to log the results of a simple start - stop - averaging operation including volume flow calculation.

Start date and time, end date and time

A measuring series can be started and stopped automatically at specified ti-

10. Measuring operations

mes. For this purpose the start date and time-of-day and the end date and time-of-day must be programmed. If no date has been programmed, the measuring operation will be performed every day within the set period. The current time-of-day must have been programmed. see 12.4

‘Start time’ function ‘ST’ Select see 9.3

12.40.00ST

Entry in hh:mm:ss see 9.4

‘Start date’ function ‘SD’ Select see 9.3

01.02.08SD

Entry in dd:mm:yy see 9.4

‘End time’ function ‘ET’ Select see 9.3

12.40.00ET

Entry in hh:mm:ss see 9.4

‘End date’ function ‘ED’ Select see 9.3

01.02.08ED

Entry in dd:mm:yy see 9.4

To clear start time / end time press keys

PROG , CLR

Other ways of starting and stopping measured value recording, i.e. by means of limit values, external triggering, or interface command, are described in the Manual, Section 6.6.

10.5.5 Memory output

The measured value memory can only be output via the serial interface.

(see Manual 6.9.3) It is possible to specify certain sections of the memory for output - by stipulating the start time and end time of the measuring operations in question. With each output from the internal memory any one of the three output formats may be used “list”, “columns”, or “table”.

With external MMC memory cards there is usually only one option available, namely output in table mode of all the measured data contained in the file most recently used. (see 10.5.2)

The most sensible approach is to remove the memory card and copy the files via a USB card reader directly onto the PC. These can then be imported either into MS-Excel or into Win-Control (as of V.4.8.1).

During memory output, the function ‘Memory free’ ‘MF’, jumps to function ‘Memory output’ ‘MO’; this displays the amount in KB still to be output. see 10.5.3.

‘Memory - remaining’ function ‘MO’

14.2K MO

Select see 9.3,10.5.3

11. SENSOR PROGRAMMING

Since on ALMEMO® devices all sensor programming is stored in the ALMEMO® connector itself, the user will not normally need to reprogram each time. Programming will only be necessary in certain circumstances, e.g. to correct sensor errors, to scale your own sensors, or to stipulate certain limit values; in these circumstances there are comprehensive programming functions available. Please note that series sensors by default have the locking mode enabled to protect them against unintended alteration; if modification really is required this locking mode must first be lowered to an appropriate level. (see 11.2)

All parameters can be entered and modified easily and conveniently via the keypad - providing this function is activated and the appropriate sensor connector is plugged in. (see 9.3)

On the clamp connector unfortunately this automatic programming feature is not supported. Each measuring point must first be activated with a measuring range according to the sensor type. (see 11.7)

All the possibilities offered by the ALMEMO® connector system will then be available. However, as and when the sensor is changed, reprogramming will be required.

11.1 Measuring point selection

To view or to edit a sensor's parameters, first of all in the 'MEASURED VALUE' function select the appropriate measuring point by pressing M▲.

To increment the measuring channel press

To decrement the measuring channel press and hold down



When switching between channels the measuring range abbreviation is briefly displayed see 11.7.1.

11.2 Locking the sensor programming

The functional parameters for each measuring point are protected by means of the locking mode; this can be set to the desired locking level (see Manual, Section 6.3.12) Before programming the locking mode must be lowered to an appropriate level. If you see a dot in the display after the locking mode, this means that this cannot be modified.

Locking level Locked functions

- | | |
|---|--|
| 0 | None |
| 1 | Measuring range, element flags |
| 2 | Measuring range, zero-point correction, gain correction |
| 3 | Measuring range, units |
| 4 | plus zero-point correction and gain correction |
| 5 | plus base value, factor, exponential |
| 6 | plus analog output, start and end, and zero-point adjustment |
| 7 | plus limit values, maximum and minimum |

11. Sensor programming

Locking mode function 'LM' Select see 9.3 Entry see 9.4 'OF MX EF LM'

1. 0005LM

In the display, in front of the locking mode, you should see the output function, multiplexer position, and element flags - assuming these have been programmed. (see Manual 6.10.2/3/4) These can be selected and programmed by pressing and holding down the **PROG** key

11.3 Limit values

Two limit values (MAXIMUM and MINIMUM) can be programmed per measuring point. Exceeding one of these limit values can be reported as a fault via signal lamp R0 or R1 to one of the integrated relays (in the same way as exceeding a measuring range limit or as sensor breakage). The behavior of these relays in the event of alarm can be configured in the 'OUTPUT' menu; the associated lamps indicate their activation status. (see also Manual 6.3.9)

To assign these relays to particular measuring points the functions 'REL-HI' 'RH' and 'REL-LO' 'RL' should be used

Limit value function 'LIM-HI' 'LH' Select see 9.3 Entry see 9.4

1. 25.0LH

Relay assignment function 'REL-HI' 'RH' Select see 9.3; Entry see 9.4

1. R00 RH

Limit value function 'LIM-LO' 'GL' Select see 9.3 Entry see 9.4

1. 15.0LL

Relay assignment function 'REL-LO' 'RL' Select see 9.3; Entry see 9.4

1. R-- RL

To clear limit values and relay assignment press keys

PROG , **CLR**



If additional limit values are required, e.g. as advance alarm, these can be implemented by activating an extra function channel 'Meas' (see 11.7).

11.4 Correction values

Sensors can be corrected in terms of zero-point and gain by means of the correction values 'ZERO-POINT' and 'GAIN'. (see Man. 6.3.10, 7.7.1 Multi-point calibration)

Corrected measured value = (measured value - ZERO-POINT) x GAIN.

ZERO-POINT CORRECTION function 'ZC' Select see 9.3; Entry see 9.4

1. 1.2ZC

GAIN correction function 'SC' Select see 9.3 Entry see 9.4

1.0.1230SC

To clear the correction values press keys

PROG , **CLR**

Sensor adjustment

To simplify the zero-point and gain correction of sensors, the 'MEAS VALUE' function includes special functions which perform this adjustment automatically. see 10.2.1, 10.2.3. For this purpose the locking mode must be set to level 3.

11.5 Scaling, decimal point setting

To display the electrical signal of a sensor as measured value in its physical size it is nearly always necessary to perform decimal point shift, zero-point correction, and multiplication by a factor. To perform these steps the functions 'EXPONENT' 'EX', 'BASE' 'BA', and 'FACTOR' 'FA' are provided. For a detailed description of scaling, with an example, please refer to the Manual, Section 6.3.11. **Displayed value** = (corrected measured value - BASE) x FACTOR.

Decimal point setting

First of all the position of the decimal point should be checked; if necessary this should, using the 'EXPONENT' function, be adapted to the desired resolution and to units appropriate to the sensor. Using the 'EXPONENT' function 'EX' the decimal point can be shifted as far to the left (-) or to the right (+) as display and printer permit.

Example: Force transducer with output 0.2 to 2.2000 V should indicate 1000.0N. The decimal point must be shifted three positions to the right with exponential 3. From the new actual values 200.0 N and 2200.0 N and using the formulae (Manual, Section 6.3.11) it is now easy to calculate the base value (200.0) and the factor (0.5).

EXPONENT function 'EX' Select see 9.3

Entry see 9.4

1. 3EX

BASE VALUE function 'BA' Select see 9.3

Entry see 9.4

1. 200.0BA

FACTOR function 'FA' Select see 9.3

Entry see 9.4

1. 0.5FA

To clear the scaling values press keys

PROG , CLR



The scaling values can also be specified automatically by means of two-point adjustment. First of all, in the MEASURED VALUE function, the measured value is set to its zero state (e.g. pressure transducer unpressurized, etc.) (see 10.2.1) and then, with a defined value (e.g. reference resistance connected), the setpoint is entered (see 10.2.3).

11.6 Changing the units

For each measuring channel the default units for the measuring range can be replaced with any two-character units. (see also Manual 6.3.5)

All upper-case and lower-case letters, special characters °, °, Ω, %, [,], *, -, =, ~, and space () can be used. To modify the units use the function 'DIM' 'DI'

DIM function 'DI' Select see 9.3

Entry see 9.4

1. %H DI



When entering units you can switch between upper-case / lower-case / and special characters by pressing and holding down the keys ▲ and ▼.

If you enter '°F' as units the temperature value will be converted automatically from degrees Celsius to degrees Fahrenheit.

If you set character '°C' or '°F', cold junction compensation will be disabled.

11.7 Selecting the measuring range

If you want yourself to program a sensor on the clamp connector (4) you will have to clear the locking mode for the measuring point in question (see 11.2); please note also that for certain transducers a special connector or plug will be required (e.g. thermo, shunt, divider, etc., see the table, 8.3). To modify the measuring range you must first set the measuring point. see 11.1

To select the measuring range use the 'RANGE' function 'R'.



If the desired measuring point has not yet been activated, then in the 'RANGE' function 'BE' press and hold down the key **M▲**. In this way you can select all channels (including unprogrammed ones).

RANGE function 'BE' Select see 9.3

Entry see 9.4

To clear the range and thus also the channel press the keys

1. NiCrBE

PROG, **CLR**

To reactivate the channel press the keys

PROG, **PROG**

11.7.1 Measuring ranges

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

Sensors / transducers	Connector / cable / sensor	Measuring range	Units	Display
Pt100-1 ITS90	ZA 9000-FS	-200.0... +850.0	°C	P104
Pt100-2 ITS90	ZA 9000-FS	-200.00...+400.00	°C	P204
Pt1000-1 ITS90 (Element flag 1)	ZA 9000-FS	-200.0... +850.0	°C	P104
Pt1000-2 ITS90 (Element flag 1)	ZA 9000-FS	-200.00...+400.00	°C	P204
Pt1000-3 ITS90	ZA 9000-FS	0.000...+65.000	°C	P304
Ni100	ZA 9000-FS	-60.0... +240.0	°C	N104
NiCr-Ni (K) ITS90	ZA 9020-FS	-200.0...+1370.0	°C	NiCr
NiCr-Ni (K) ITS90 **	ZA 9020-SS2	-100.00...+500.00	°C	NiC2
NiCroSil-NiSiil (N) ITS90	ZA 9020-FS	-200.0...+1300.0	°C	NiSi
Fe-CuNi (L)	ZA 9021-FSL	-200.0... +900.0	°C	FeCo
Fe-CuNi (J) ITS90	ZA 9021-FSJ	-200.0...+1000.0	°C	IrCo
Cu-CuNi (U)	ZA 9000-FS	-200.0... +600.0	°C	CuCo
Cu-CuNi (T) ITS90	ZA 9021-FST	-200.0... +400.0	°C	CoCo
PtRh10-Pt (S) ITS90	ZA 9000-FS	0.0...+1760.0	°C	Pt10
PtRh13-Pt (R) ITS90	ZA 9000-FS	0.0...+1760.0	°C	Pt13
PtRh30-PtRh6 (B) ITS90	ZA 9000-FS	+400.0...+1800.0	°C	EL18

Sensors / transducers	Connector / cable / sensor	Measuring range	Units	Display
Au-FeCr	ZA 9000-FS	-270.0... +60.0	°C	AUFE
W5Re-W26Re (C) **	ZA 9000-SSC	0.0...+2320.0	°C	WR26
Ntc type N	ZA 9000-FS	-50.00...+125.00	°C	Ntc
Ntc type N **	ZA 9040-SS3	0.000...+45.000	°C	Ntc3
Ptc type Kty84 **	ZA 9040-SS4	-0.0...+200.0	°C	KTY
Millivolt 1	ZA 9000-FS	-26.000...+26.000	mV	mV 1
Millivolt	ZA 9000-FS	-10.000...+55.000	mV	mV
Millivolt 2	ZA 9000-FS	-260.00...+260.00	mV	mV 2
Volts	ZA 9000-FS	-2.6000...+2.6000	V	Vol1
26 volts (range B67)	ZA 9602-FS	-26.000...+26.000	V	U26V
Difference Millivolt 1	ZA 9000-FS	-26.000...+26.000	mV	D 26
Difference Millivolt	ZA 9000-FS	-10.000...+55.000	mV	D 55
Difference Millivolt 2	ZA 9000-FS	-260.00...+260.00	mV	D260
Difference Volts	ZA 9000-FS	-2.6000...+2.6000	V	D2.6
Sensor voltage	any	0.00...20.00	V	BAtt
Milliampere	ZA 9601-FS	-32.000...+32.000	mA	mA
Percent (4-20mA)	ZA 9001-FS	0.00... 100.00	%	%
Ohms	ZA 9000-FS	0.00... 400.00	Ω	Ohm
Ohms **	ZA 9003-SS3	0.000... 50.000	Ω	Ohm1
Frequency	ZA 9909-AK	0... 25000	Hz	FREQ
Pulses	ZA 9909-AK	0... 65000		Pu1s
Digital input	ZA 9000-EK2	0.0... 100.0	%	Inp
Digital interface	ZA 9919-AKxx	-65000... +65000		DIGI
Flügelrad Normal 20	FV A915-S120	0.30... 20.00	m/s	S120
Rotating vane, normal 40	FV A915-S140	0.40... 40.00	m/s	S140
Rotating vane, micro 20	FV A915-S220	0.50... 20.00	m/s	S220
Rotating vane, micro 40	FV A915-S240	0.60... 40.00	m/s	S240
Rotating vane, macro	FV A915-MA1	0.10... 20.00	m/s	L420
Water turbine, micro	FV A915-WM1	0.00... 5.00	m/s	L605
Dyn. press., 40m/s with TC, PC	FD A612-M1	0.50... 40.00	m/s	L840
Dyn. press., 90 m/s with TC, PC	FD A612-M6	1.00... 90.00	m/s	L890
Flow sensor SS20 **	ZA9602-SSS	0.50... 20.00	m/s	L920
Rel. atm. humidity	FH A646	0.0... 100.0	%H	°o rH
Rel. atm. humidity with TC	FH A646-C	0.0... 100.0	%H	HcrH
Rel. atm. humidity with TC	FH A646-R	0.0... 100.0	%H	H rH
Humid temperature HT	FN A846	-30.00...+125.00	°C	P HT
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/l	O2-C
Function channels				
* Mixture ratio with PC	FH A646	0.0 ... 500.0	g/kg	H AH

11. Sensor programming

Sensors / transducers	Connector / cable / sensor	Measuring range	Units	Display
* Dew-point temperature	FH A646	-25.0... 100.0	°C	H DT
* Partial vapor pressure	FH A646	0.0...1050.0	mbar	H VP
* Enthalpy with PC	FH A646	0.0 ... 400.0	kJ/kg	H En
* Rel. humidity, psychr. with PC	FN A846	0.0 ... 100.0	%H	P RH
* Mixture ratio with PC	FN A846	0.0 ... 500.0	g/kg	P AH
* Dew-point temp. with PC	FN A846	-25.0 ... +100.0	°C	P DT
* Partial vapor press. with PC	FN A846	0.0 ...1050.0	mbar	P VP
* Enthalpy with PC	FN A846	0.0 ... 400.0	kJ/kg	P En
Measured value (Mb1)	any		f(Mb1)	MESS
Difference (Mb1 - Mb2)	any		f(Mb1)	DIFF
Maximum value (Mb1)	any		f(Mb1)	MAX
Minimum value (Mb1)	any		f(Mb1)	MIN
Average value over time (Mb1)	any		f(Mb1)	M(t)
Number of val. averaged (Mb1)	any			n(t)
Total number of pulses (Mb1)	ZA 9909-AK	s.Man. 6.7.1 0..65000		S(t)
Number of pulses/print cycle Mb1	ZA 9909-AK	s.Man. 6.7.1 0..65000		S(P)
Alarm value (Mb1)	any	s. Man.6.10.4 0/100	%	Alrm
Cold junction temperature	any	s.10.2.6	°C	CJ
Volume flow m ³ /h Mb1 · Q	any	s. 10.3.6	m ³ /h	Flow
Timer	any	s. 12.3 0..65000	s	TIME
Temperature, refrigerant R22 °	FDA602Lx	-90.0...+79.0	°C	R22
Temperature, refrigerant R23 °	FDA602Lx	-100.0...+26.0	°C	R23
Temperature, refrigerant R134a °	FDA602Lx	-75.0...+101.0	°C	R134
Temperature, refrigerant R404a °	FDA602Lx	-60.0...+65.0	°C	R404
Temperature, refrigerant R407c °	FDA602Lx	-50.0...+86.0	°C	R407
Temperature, refrigerant R410 °	FDA602Lx	-70.0...+70.0	°C	R410
Temperature, refrigerant R417a °	FDA602Lx	-50.0...+70.0	°C	R417
Temperature, refrigerant R507 °	FDA602Lx	-70.0...+70.0	°C	R507

TC = Temperature compensation; PC = Pressure compensation; Mbx = Reference channels

* Humidity variables; (Mb1 = temperature, Mb2 = humidity / humid temperature)

++ Only via special connectors with internal characteristic; (see 11.7.2, others available on request)

° 8 measuring ranges for refrigerants - only with device option R (Mb1 = pressure in mbar)

At the end of the table of measuring ranges and units (see above) under the sub-heading 'Function channels' there is a group of ranges that can be used to represent function parameters for measured value processing or for calculated results obtained by linking certain measured values on measuring channels. (see Manual 6.3.4) Reference to the actual measuring channels is provided by one or two reference channels. For default reference channel Mb1 (= 1st channel in the same connector) programming is not necessary.

11.7.2 Special meas. ranges, linearization, multi-point calibration

Thanks to the new ALMEMO® special connectors with extra memory for additional data (bigger EEPROM, code E4) the following tasks can now be performed for the first time with great elegance :

1. Provision of special measuring ranges with internal characteristic (see 11.7.1)
2. Linearization of signals for voltage, current, resistance, or frequency - set by the user
3. Multi-point calibration of all sensors

The ALMEMO® 4390 as standard can evaluate all appropriately programmed connectors. On leaving the factory any device as of ALMEMO® 2690-8 with the special KL variant can, using the AMR-Control software, program measuring signals as per a characteristic of up to 36 support values to the EEPROM on the ALMEMO® connector. During a measuring operation the measured values between these points are interpolated on a linear basis. When correcting non-linear sensors (e.g. with Pt100 or thermocouple sensors) initially the original characteristic is considered; and only then are the deviations interpolated on a linear basis and inserted.

If a channel with a characteristic is deactivated or programmed with a different range, the characteristic can subsequently be reactivated by restoring the special range with abbreviation 'Lin' using the keypad or command 'B99'.

11.8 Analog output, start and end

To output measured values in analog form preferably the electrically isolated, internal analog output (option OA 4390-R02) should be used. In most cases it is advisable to spread the partial measuring range used over the standard output signal 10 V or 20 mA. You can do this by simply stipulating the start value and end value in functions 'AN start' 'AS' and 'AN end' 'AE'. For 20 mA analog outputs you can also choose, in function 'mA', the output type, 0-20 mA or 4-20 mA.

Analog output start function 'AS' Select see 9.3

Entry see 9.4

Analog output end function 'AE' Select see 9.3

Entry see 9.4

To clear the scaling values press keys

Analog output type function 'mA' Select see 9.3

Entry see 9.4

Example

1. -20.0AS

1. 50.0AE

PROG , CLR

1. 4-20mA

Range -20.0 to 50.0 °C

Analog type 4-20mA

These parameters, "Analog output start", "Analog output end", and "Analog output type" are also saved in the sensor EEPROM and can thus be individually programmed per channel; i.e. when channels are switched through manually each measurable variable can be individually scaled.

12. DEVICE PROGRAMMING

All sensor parameters are saved in the sensor connector; certain other parameters are stored in the device itself. These include device address, baud rate, language, display contrast, hysteresis, sensor supply voltage, and times and cycles used for process control. These can be programmed in the 'DEVICE' menu.

12.1 Cycle

To specify that measured values be saved and output to the interface on a cyclic basis use the 'CYCLE' function. s. 10.4.2

Cyclic saving, i.e. recording data to memory per cycle, is by default activated; however, it can be deactivated via the interface as and when required.

'CYCLE' function 'CY' Select see 9.3

Entry in 'hh:mm:ss' see 9.4

To clear the cycle press keys. This terminates any **PROG** , **CLR** cyclic scan currently still running.

00.15.00CY

12.2 Measuring rate

As and when necessary the measuring rate (conversion rate) for measuring point scans can be raised in the 'CONVRATE' function from 2.5 to 10, 50, or 100 mops (measuring operations per second). (see Manual 6.5) There is also an option (SA0000-Q4) for setting the measuring rate to 400 mops - for just one measuring point.

'CONVRATE' function 'CR' Select see 9.3

Entry see 9.4

10 CR



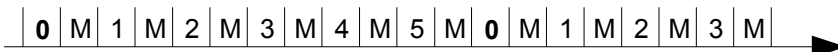
It should be noted, however, when selecting the measuring rate, that the higher the measuring rate so the lower the measuring quality and, conversely, the lower the rate, the higher the quality.

At measuring rates above 10 mops mains hum suppression is not possible; as a result accuracy may be adversely affected by interference over the connection lines; (wherever possible use twisted wires).

At 100 or 400 mops saving to memory is only possible using the multimedia card (not with the internal EEPROM).

Semi-continuous measuring point scan

The measuring rate for measuring points is by default semi-continuous; i.e. all measuring points are continuously scanned but the selected measuring point is assigned preferred status and is rescanned every 2nd time. This ensures a constant scanning rate (= half the measuring rate) irrespective of the number of measuring channels; this is an advantage for analog output or measured value smoothing; all other channels are always included.



Continuous measuring point scan

If continuous measuring point scanning is set (only possible via the interface), all active measuring channels are scanned equally often at the chosen measuring rate, uninterruptedly one after the other; the results can also be output to the interface or saved to memory at the same rate. (see Manual 6.5.1.3).

12.3 Measuring time, measuring duration, timer

For averaging over time (see above) and for many other measuring operations the actual measuring time, from start to stop, is required. To continuously monitor the measuring time without clearing the real time use the function 'MEASTIME' in the 'DEVICE' menu. If the function 'Clear measured values at start of measuring operation' is activated in the operating parameters the measuring time will also be cleared automatically at each start-up.

'MEASTIME' function 'MT' Select see 9.3

Display in 'hh:mm:ss' see 9.4

To clear the measuring time press keys
(or automatically on each start)

01.23.45MT
PROG , CLR

Measuring duration

If you want to stop a measuring operation or an averaging process after a certain length of time, you can program the measuring duration in the function 'MEAS DUR'.

Measuring duration function 'MD' Select see 9.3

Entry in 'hh:mm:ss' see 9.4

To clear the measuring duration press keys

01.30.00MD
PROG , CLR



When recording to memory use a programmed measuring duration to ensure that recording does not abort prematurely!

Timer as function channel

Measuring times can be output and saved by means of the function channel "Time"; the format is "sssss" or "ssss.s". (see 11.7.1) The resolution can be set to 0.1 seconds by programming the exponent to -1. At a count of 60000 the timer is reset and starts again at 0. All the normal start / stop functions can be used; in addition, the start, stop, output, and zero-setting of the timer can also be triggered by actions in the event of limit values being exceeded. (see Manual, Section 6.6.3).

12.4 Date and time-of-day

The ALMEMO® 4390-2 incorporates an integrated real-time clock with date and time-of-day for logging measuring times. This real-time clock is buffered by means of a lithium battery with the effect that date and time-of-day are retained even after switching off.

12. Device programming

'TIME' function 'TM' Select see 9.3

Entry see 9.4

Enter in 6-character format e.g. 12:34:56

'DATE' function 'DA' Select see 9.3

Entry see 9.4

Enter in 6-character format e.g. 01.Feb.2008

To clear date or time-of-day press keys

12.34.56TM

hh . mm . ss

01.02.08DA

TT . MM . JJ

PROG , **CLR**

12.5 Baud rate, data format

Via the serial interface you can program the device and sensors or view the current programming status. (see Manual, Chapter 6)

You can also (as described in 10.4.1 and 10.4.2) output manual and cyclic measuring operations either online or after recording (see 10.5.5) offline to a printer or computer. The various interface modules are plugged into socket A1 (6). Connection to the devices is described in the Manual, Section 5.2. Modules for networking the devices are described in the Manual, Section 5.3.

On leaving the factory the baud rate for all interface modules is programmed to 9600 baud. In order to avoid unnecessary problems when networking several devices together the baud rate should not be altered; rather the computer or printer should be set to match. If this is for some reason not possible, then in the BAUD RATE function 'BR' (for activation, see Section 5.2), using the keypad, enter the values 150, 300, 600, 1200, 2400, 4800, 9600 baud, and 57.6 or 115.2 kbaud (paying attention not to exceed the maximum baud rate for the interface module!).

'BAUD RATE' function 'BR' Select see 9.3

Entry see 9.4

Example

Un9600BR

'S': Output to memory

'n': Format 'columns'

Baud rate 'BR' 9600 baud

The baud rate is saved to the EEPROM on the interface module and thus applies when any other ALMEMO® device is used. The output format can only be set via the interface. (see Manual 6.5.5)

Data format : Cannot be changed; 8 data bits, 1 stop bit, no parity

12.6 Device address and networking

All ALMEMO® devices can 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)

To communicate with networked devices it is absolutely essential that each device should have 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 / numbers. To do so use the 'DEV-ADDR' function 'DA'. The devi-

ce number (factory default setting is usually 00) can be modified as desired by entering the appropriate data as usual.

'DEV-ADDR' function 'GA' Select see 9.3

Entry see 9.4

01DA

Example

Adresse 01



In network operation consecutive numbers between 01 and 99 should be used; this ensures that device 00 is not addressed unnecessarily in the event of interruption to the power supply.

12.7 Language

In the function 'LANGUAGE' you can choose between German 'DEU', English 'ENG', and French 'FRA' as language for the menus and functions.

'LANGUAGE' function 'SP' Select see 9.3

Entry see 9.4

ENG LA

12.8 Display contrast

The brightness and contrast of the LED display can be set in the 'CONTRAST' function to any one of 10 levels (from 10 to 100 %).

'CONTRAST' function 'CO' Select see 9.3

Entry see 9.4

50 CO

12.9 Hysteresis

The hysteresis for an alarm triggered in the event of a limit value being exceeded can be set generally for all sensors from 0 to 99 digits (default 10 digits) in the 'Hysteresis' function. (see 11.3 and Manual 6.2.7).

'HYSTERESIS' function 'HY' Select see 9.3

Entry see 9.4

10 HY

12.10 Sensor supply voltage

The power supply voltage for sensors can be set in the 'U-SENSOR' function to approx. 6, 9, or 12 V. With sensors that draw a lot of current but manage with relatively low voltage, a carefully chosen sensor voltage can save a considerable amount of energy.

'U-SENSOR' function 'US' Select see 9.3

Entry see 9.4

9V US

13. OUTPUT MODULES

Almost all ALMEMO® devices have two output sockets A1 and A2; these can output measured values in either analog or digital form. It is also possible to initiate various functions by means of trigger pulses. To cover all possibilities while also keeping the hardware needed to a minimum the necessary interfaces have been integrated in our ALMEMO® output cables or output modules. The numerous connection possibilities are described in detail in the Manual, Chapter 5.

The panel meter incorporates two more internal relays as standard; a double analog output is available as option R02 (socket P0).

To ensure that all elements can be addressed, each of these sockets has been assigned 10 port addresses pp:

Socket Connection	Port
P0 Internal relays / analog outputs (option)	P0,P1/P6,P7
A1 V6 output modules	10..19
A2 V6 output modules	20..29

These output modules, just like the sensors themselves, are recognized automatically and listed in the 'OUTPUT' menu. All V6 interface elements (relays, trigger input, or analog output) can be individually configured in all their function variants. see 13.2.3

Activating the function 'PORTS' displays a list of all ports that can be accessed by means of keys ▲ or ▼.

13.1 V5 output cables

V5 output cables can still be used at sockets A1 and A2; these appear under the abbreviations 'A1' and 'A2'.

13.1.1 Data cables

Via the serial interface you can output measured values or cyclic data logs and all the programming details for the device and for the sensors to a printer or computer. All ALMEMO® data cables (e.g. RS232, RS422, optic fiber, USB, Ethernet, Radio, etc.) and the various connections to the devices are described in the Manual Section 5.2. Other modules for networking the devices are described in detail in the Manual, Section 5.3. All available interface modules are connected to socket A1 (6); this is with the exception of cable ZA 1999-NK which is used for networking a further device; this must be connected to socket A2. The V5 output cable at A1 appears under port A1:

Function port 'A1', variant, type, data cable 'DK'
Select see 9.3; Entry see 9.4

A1. DK

13.1.2 Analog modules

For the purposes of analog recording of measured values it is still possible, at sockets A1 and / or A2 (6) to connect V5 output modules with an analog out-

put, e.g. recording cable ZA1601-RK. (see Manual 5.1.1)

This gives, depending on the analog output, the following output signals :

Voltage output	-1.2 ... +2.00 V	0.1mV/Digit
Voltage output	-6.0 ... +10.0 V	0.5mV/Digit
Current output	0.0 ...20.0 mA	1µA/Digit

Function port 'A2', mode, type, recording cable 'RK'

Select see 9.3; Entry see 9.4

A2. M1 RK

The following output modes can be programmed as variants:

0: Measured value for the selected measuring channel Mx

Mx, **PROG**, **CLR**

2: Measured value for a programmable channel Bx

Bx, **PROG**, **▲▼**, **▶**

8: Programmed analog output (see below)

EXT

Mode 8 'Programmed analog output' is activated automatically on entering output values via the interface. see Manual 6.10.7.

13.2 V6 interface elements

The internal elements appear as V6 interface elements under abbreviation 'Px', and the elements of V6 output modules at sockets A1 and A2 under addresses '1x' and '2x'. The element type is displayed with the last two characters grayed out.

13.2.1 Relays

The device incorporates two changeover relays R0 and R1, which for various purposes can be configured individually as ports P0 or P1.

Function port 'P0', variant, inverted, relay 'RE'

Select see 9.3; Entry see 9.4

P0.MAX-RE

After selection the relay switching mode can be configured to the following variants:

0: Alarm if any one channel is faulty

ALL

2: Alarm for an internal channel

INT

3: Alarm if one maximum limit value of all is overshoot

MAX

4: Alarm if one minimum limit value of all is undershoot

MIN

8: Relay externally driven via interface

EXT



If you assign relays to certain limit values (see 11.3), variant 2 'internal' will be set automatically.

Power failure can be detected more easily if relay activation is inverted; i.e. in the absence of current (power failure) the relay drops out, the contacts close, and an alarm is triggered automatically. All function variants are therefore also provided on an inverted basis. e.g. **ALL-**

Standard setting for the two relays R0 and R1 is **MAX-** and **MIN-**

13.2.2 Analog outputs

On option OA4390-R02 two configurable analog outputs 'AA' are available as ports P6 and P7 at socket P0 (7), either 0 to 10 V or 0 to 20 mA.

Choose analog type '10 V' or '20 mA', e.g. at port 'P6', by pressing and holding down the **FUNCTION** key see 9.3 Entry see 9.4

P6.10V AA

Choose output mode, e.g. 'Mx' at port 'P6', by pressing the **FUNCTION** key Select see 9.3 Entry see 9.4

P6. M1 AA

The following output modes can be programmed as variants:

0: Meas. value for the selected meas. channel Mx

Mx, **PROG**, **CLR**

2: Measured value for a programmable channel Bx

Bx, **PROG**, **▲** / **▼**, **▶**

8: Programmed analog output (see below)

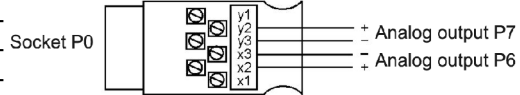
EXT

Mode 8 'Programmed analog output' is activated automatically on entering output values via the interface. see Manual 6.10.7

These two analog outputs are connected to the evaluating unit via a clamp connector ZA1000-KS as follows:

Clamp connector ZA1000KS

To display the measuring channels with 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 11.8, Manual 6.10.7.



13.2.3 Relay trigger analog modules

If a combined V6 input / output cable (ZA 1006-EAK) or a relay trigger analog adapter (ZA 8006-RTA3) is connected at one of the output sockets A1 or A2, then up to 10 elements will appear under addresses 10 to 19 (A1) or 20 to 29 (A2). The various possibilities regarding the display and programming of relays and analog outputs are described in 13.2.1 and 13.2.2.

Trigger inputs are the third feature; their functions too can be programmed:

Function port 'P9', mode 1, trigger input 'TR'
Select see 9.3; Entry see 9.4

P9. 1 TR

The following trigger functions can be programmed as mode variants:

0: Start / stop measuring Edge-controlled

SS F

1: Once-only manual measuring point scan

MANU

2: Clear all maximum / minimum values

CMAX

3: Print

PRNT

4: Start / stop measuring Level-controlled

SS P

8: To set the measured value to zero

CLRM

-5..-9: Macros see Manual 6.6.5

MAK5. 9

14. TROUBLE-SHOOTING

The ALMEMO® 4390 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; usually the cause 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. If necessary re-initialize. see 7.4

Error: Measured values are incorrect.

Remedy: Switch the device OFF and back ON again. Via the interface check the channel programming very carefully (especially the base value and zero-point).

Error: Measured values fluctuate unexpectedly or the system hangs in mid-operation.

Remedy: Check the cabling for any inadmissible electrical connections. Unplug the sensor. In its place connect a hand-held sensor in air or phantom sensor (for thermocouples short-circuit A-B, for Pt100 sensors use 100-Ω resistor) and check. Reconnect the sensor and recheck. If a fault persists for any one connection, check all wiring. If necessary, insulate the sensor and eliminate interference by using shielded or twisted wiring.

Error: Error message "CALErr" 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 our factory.

Error: Data transmission via the interface does not function.

Remedy: Check the interface module, connections, and settings. Ensure that both devices are set to the same baud rate and transmission mode. Ensure that the correct COM interface on the computer is 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 these LEDs light up green, whereas the handshake lines DSR, DTR, RTS, CTS carry positive voltage of approx. +9V and these LEDs light up red. For the duration of data transmission the data LEDs should flash red. Test 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)

If the computer is in the XOFF status. enter <ctrl Q> for XON. Check the programming by means of 'P15'. (see Manual 6.2.3)

Test the transmit line by selecting a measuring point with command 'Mxx' and checking 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. Check that all network distributors are 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, accompanied by an explanatory note, error description, and if available test printouts. see 17.1

With the AMR-Control software you can print out screen-shots showing the relevant programming and save and / or print out a comprehensive 'Function test' in the device list or terminal operations.

15. DECLARATION OF CONFORMITY

Ahlborn Mess- und Regelungstechnik GmbH declares herewith that measuring instrument ALMEMO® 4390-2 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	IEC 61010-1:2001
EMC:	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 61000-4-4: 1995+A1:2000 2kV
	IEC 61000-4-3: 1995+A1:1998+A2:2000 3V/m
	IEC 61000-4-5: 1995+A1:2000
	IEC 61000-4-6: 1996+A1:2000
	IEC 61000-4-11: 1994+A1:2000



In case of a product modification not agreed with us, this declaration becomes void.

When positioning the sensor 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.

16. APPENDIX

16.1 Technical data (s. Man. 2.3)

Measuring inputs	1 ALMEMO® socket suitable for all ALMEMO® sensors 1 screw terminal socket for sensors with open ends
Measuring channels	4 channels per socket for double sensors, function channels
A/D converter	Delta - sigma, 24 bit, electrically isolated, adjustable 1 to 100
Conversion rates	2.5 / 10 / 50 / 100 / 400 (mops)
Sensor power supply	6V 0.4A / 9V 0.3A / 12V 0.2A settable
Outputs	2 ALMEMO® output sockets suitable for all output modules
Output relays	2 mechanical changeover relays Load capacity 2 A, 50 V
Option OA 4390-R02	2 analog outputs, electr. isolated, integrated, socket P0 -4.0 to +10.0 V Load >100 kΩ 0.0 to +20.0 mA Load <500 Ω Resolution 15 bit Accuracy ± 0.1% of final value Time constant 100 μs Temperature drift 10 ppm/K
Standard equipment	
LED display	14-segment 8-character LED display, 10 mm, 3 LEDs
Operation	5 membrane keys
Memory	128-KB EEPROM (16000 to 25000 measured values)
Date and time-of-day	Real-time clock, buffered with a lithium battery
Power supply	
Mains operation	100 to 240 VAC, 50/60 Hz, 5 W
DC voltage (option U)	10 to 30 VDC, 5 W
Housing	Plastic case, 96 x 48 mm; Mounting depth 112 mm
Panel opening	90 x 42.5 mm
Suitable conditions	
Operating temperature	-10 to +50 °C Storage temperature -20 to +60 °C
Ambient relative humidity	10 to 90 % RH (non-condensing)

16.2 Product overview

Precision panel meter ALMEMO® 4390-2	Order no.
1 measuring input via ALMEMO® socket or clamp connector	
14-segment 8-character LED display, 5 keys; Measured value memory	
2 relays; 2 ALMEMO® output sockets A1, A2; for data cable RS232, USB, Ethernet	
Analog cable, Trigger cable	MA 4390-2
Options	
DC power supply, electrically isolated, 10 to 30 VDC, 1000 mA	OA 4390-U
2 analog outputs, integrated 0 to 10 V or 0 to 20 mA Clamp connector	OA 4390-Rx2
Accessories	
ALMEMO® data cable, with USB interface, el. isol., max. 115.2 kbaud	ZA 1919-DKU
ALMEMO® data cable, with V24 interface, el. isol., max. 115.2 kbaud	ZA 1909-DK5
ALMEMO® data cable, Ethernet interface, el. isol., max. 115.2 kbaud	ZA 1945-DK
ALMEMO® network cable, electrically isolated, maximum 115.2 kbaud	ZA 1999-NK5
ALMEMO® V6 i/o cable, with trigger and 2 semiconductor relays	ZA 1006-EAK
ALMEMO® V6 relay-trigger adapter (4 relays, 2 trigger inputs)	ZA 8006-RTA3

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17.1 Your contact partner

