Operating instruction

Universal transmitter ALMEMO® 8390-2

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Operating istruction

Universal transmiter

ALMEMO® 8390-2

With supplementary reference to the ALMEMO® Manual

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1. INTRODUCTION

The universal measuring instrument ALMEMO® 8390-2 is a new member in our family of unique measuring devices - all equipped with Ahlborn GmbH'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 on the connector itself; repeat programming is thus no longer necessary.

All sensors and output modules can be connected to all ALMEMO® measuring instruments - all in the same way. Programming and functioning are identical for all units. The following points apply to all devices in the ALMEMO® measuring system and are described in detail in the ALMEMO® Manual supplied with each device.

- Detailed description of the ALMEMO® system (Manual, Chapter 1)
- Overview of the device functions and measuring ranges (Manual, Chapter 2)
- Basic principles, operating instructions, and technical data for all sensors (Manual, Chapter 3)
- Options for connecting your own existing sensors (Manual, Chapter 4)
- All analog and digital output modules (Manual, Section 5.1)
- Interface modules RS-232, optic fiber, Centronics, Ethernet (Man., Sec. 5.2)
- The entire ALMEMO® networking system (Manual, Section 5.3)
- All functions and their operation via the interface (Manual, Chapter 6)
- Complete list of interface commands with all the printouts (Man., Chapter 7)

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

1.1 Functions

Universal measuring instrument ALMEMO® 8390-2 has one measurement input for all ALMEMO® sensors. The measuring possibilities are virtually unlimited; there are 4 channels in the sensor connectors - with some 70 measuring ranges. The ALMEMO® output modules, analog output, and digital interfaces can be connected to the output socket. Either one or two integrated analog outputs are available as options. Several devices can be networked together via ALMEMO® network distributors or an RS-485 interface (option). The measuring instrument incorporates a keypad and an 8½-character LCD. A wide range of functions can be activated either automatically or individually, e.g. for evaluating all sensors, for process control, and for universal data output. There is also a range of special functions accessible only via the interface.

SENSOR PROGRAMMING

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

Function channels

Maximum, minimum, and average values, differential measured values, volume flow, and wet bulb globe temperature (WBGT) can be programmed as function channels and further processed and printed out just 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 and °F is performed automatically.

Measured value designation

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

Measured value correction

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 (expansion, force, pH) can be freely interchanged. Zero-point correction and, partly at least, gain adjustment can be performed at the touch of a button.

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. By setting to zero and entering the nominal value the scaling values can be calculated automatically.

Limit values and alarm
Per measuring channel two limit values can be set (1 maximum and 1 minimum). In the event of one of these limit values being exceeded relay output modules actuate the appropriate alarm contacts. Hysteresis is set by default to 10 digits but can also be adjusted. The exceeding of a limit value can also be used to start or stop measured value recording and data logging.

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

MEASUREMENT
For each transducer up to four measuring channels are available; i.e. it is also possible to evaluate double sensors, individually scaled sensors, and sensors with function channels. It is possible using the keypad to move from one measuring channel to the next successively forwards or backwards. The selected measuring point is scanned at a conversion rate of 2.5 or 10 measuring operations per second; the measured value is calculated and output to the display and, if available, to an analog output.

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

Measuring functions
With some sensors, in order 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. On infrared sensors the parameters for zero-point correction and gain correction are used as the background temperature and the emissivity factor.

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

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, printed

out, or deleted from memory.

Average value of a channel
Averaging can be performed per selected channel for the purposes of signal smoothing, either over a certain period or over single measurements.

Volume flow measurement
For all flow sensors not only the functions for averaging are provided but also functions for entering the cross-section and diameter of ventilating channels and for calculating the volume flow. The average flow velocity can be determined roughly by scanning the whole cross-section or exactly by means of network measurements according to DIN. For dynamic pressure probes both temperature compensation and atmospheric pressure compensation are provided. Under the appropriate environmental conditions these values can be either entered manually or measured automatically.

PROCESS FLOW PROGRAMMING
To record the measured values from all connected sensors in digital form a cyclic measuring point scan with a time-based process flow control is required. This feature involves the real-time clock, the print cycle, and, if high-speed processing is required, the conversion rate itself. The measuring operation can be started and stopped via the keypad, the interface, an external trigger signal, or by exceeding a specified limit value.

Date and time-of-day
Each measuring operation can be logged either using the real-time clock with the date and time-of-day function or purely in terms of the actual measuring time.

Print cycle
The print 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 the average and sum of values.

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

Averaging over measuring point scans
The measured values obtained by scanning measuring points can be averaged either over a number of measuring points or over one particular measuring point either for the total measuring time or over the print cycle time. Function channels are provided for the cyclic output of such average values.

Conversion rate
With ALMEMO® devices all measuring points can be continuously scanned with

a conversion rate of either 2.5 or 10 measuring operations per second. It is also possible to output all measured values to the interface.

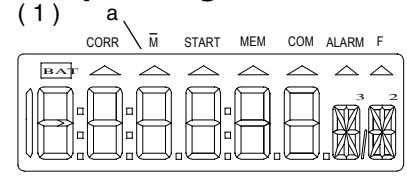
Control outputs
It is possible via the interface to individually address up to four external output relays and one analog output.

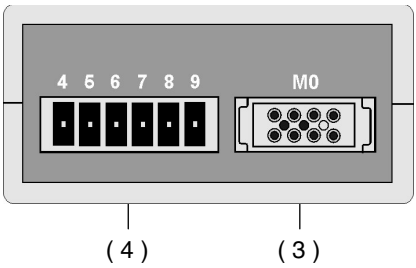
Output
All measured values and programming parameters can be accessed via the LCD. Interfaces for RS-232, RS-422, Centronics, and Ethernet are provided via the appropriate interface cables. All data logs, saved measured values, and programming parameters can be output to any peripheral equipment. Measured 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 specifically to the company or application.

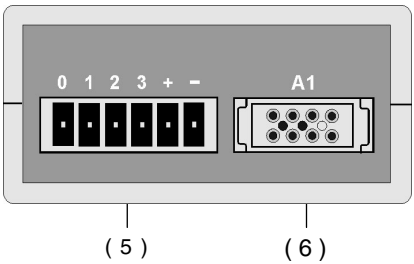
Networking
The measuring instrument is addressable and can be networked - even over long distances - via ALMEMO® network distributors.

Software
Each instrument is accompanied by the AMR-Control software package, which can be used to configure the measuring instrument and to program the sensors. It is also possible using the integrated terminal to perform measuring operations online and to save the measured values to PC. The WIN-Control software package for WINDOWS® is provided for the purposes of measured value acquisition via networked devices, for graphical presentation, and for more complex data processing.

1.2 Operating controls







Front:

(1) LCD display

(a) Symbols for operating states

BAT	Battery voltage < 7 V
▲ CORR	Measured value correct.
▲	Averaging
▲ START	Measuring operat. started
▲ COM	Measured value output
▲ ALARM	Limit value exceeded
▲ F	Function

(b) 6½ x 7 segment display for: measuring point, measured value, measuring range, measured values, programming parameters, cycles, date, time-of-day

(c) 2 x 16 segment display for: units for measured value, function abbreviations

(2) Function keys (see below)

Left side:

(3) Measuring input M0

M0	for all ALMEMO-sensors
M1..M3	Additional channels

(4) Socket for clamp connectors

6 7 1. Analog output A-, A+
0..10V option R2/R22
0/4..20mA option R3/R32

4 5 2. Analog output A-, A+
0..10V option R22
0/4..20mA option R32

Right side:

(5) Socket for clamp connectors

+ - **Power supply** with mains adapter(ZB1012-NA1,12V/0.2A)

RS485 interface (OA 8390-I)

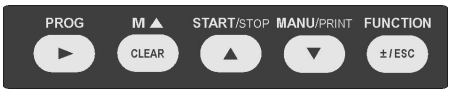
0 1 input RX+, RX-

2 3 output TX+, TX-

(6) Output socket A1

A1 V24-interface (ZA 1909-DK5/DKL)
RS 422 (ZA 5099-NVB)
Ethernet (ZA 1945-DK)
Centronics (ZA 1936-DK)
Analog output (ZA 1601-RK)

(2) FUNCTION KEYS



PROG,	**+/-, ▲ ▼, ▶**	Input of programming parameters
PROG,	**CLEAR**	Clear data, set measured value to zero
PROG,	**▼, PROG**	Adjust measured value
M ▲		Select measured value, measuring point
START/STOP		Start and stop a measuring operation
MANU/PRINT		Manual measuring point scan, data output
FUNCTION		Select function(s)

Functions are activated by:

All functions are activated by **FUNKTION** pressing and holding down the **FUNCTION** key; each function can be activated individually by interface command.

- • Standard (switch ON with CLEAR key)
- * Locking mode (not locked)
- + Averaging mode programmed
- ° Measuring range ´Flow´
- ^ Infrared sensors (IR-flag)

Maximum value (Hi)	MH	•
Minimum value (Lo)	ML	•
Average value	AV	+
Number of average value	C	+
Averaging mode	AM	•
Level of smoothing	DG	
Diameter standardized	DN	°
Cross-section area	CS	°
Atmospheric pressure	mb	
Temperature compensation	TC	
Cycle	CY	•
Time-of-day	TM	
Date	DA	
Baud rate, output format	BR	
Device adress	A	
Range	R	•
Locking mode	LM	•
Maximum limit value (Hi)	LH	*
Minimum limit value (Lo)	LL	*
Analog output - start	AS	*
Analog output - end	AE	*
Base value	BA	*
Factor	FA	*
Exponent	EX	*
Zero piont correction	ZC	*
Gaint correction	SC	*
Ambient temperature	AT	^
Emissivity factor	EF	^
Display mode (language)	DM	

2. PUTTING INTO SERVICE

1. Connect **transducer** to socket M0 (3); (see Section 4).
2. Ensure the **power supply** is connected via the mains adapter; (see Sections 3.1, 3.2).
3. **Displaying** the measured values
   Select MEASURED VALUE function by pressing the key **M▲** (2).
   Select measuring channels by pressing key **M▲**, read out the measured values; (see Section 6.1.1).
4. Connect the **cyclic measured value output** to the printer or to the computer.
   Connect the peripheral device via interface cable to socket A1; (see Manual, Section 5.2).
   On the peripheral device set 9600 bauds, 8 data bits, 1 stop bit, no parity; (see Section 9.2).
   If necessary enter the current date and time-of-day; (see Section 9.1).
   Select CYCLE function ´ZY´ by pressing the**FUNCTION** key and program the cycle; (see Section 6.3.2).
   Select the output format in the BAUD RATE function ´BR´ by pressing the keys **PROG, ▲.., PROG, ESC**; (see Section 6.3.3).
   Start and stop cyclic measuring point scanning by pressing the **START/STOP** key; (see Section 6.3.2).
5. **Evaluating a measuring operation**
   Select the function MAXWERT ´MH´ or MINWERT ´ML´ by pressing the **FUNCTION** key and call up the maximum and minimum values; (see Section 6.1.3).

For the available **options** and the appropriate pin assignment please see the rating plate located on the bottom of the device !

3. POWER SUPPLY

As power supply there are the following possibilities :

- Mains adapter 12 V / 200 mA ZB 1012-NA1
- DC voltage supply, 7 to 13 V DC
- DC voltage supply, 9 to 30 V DC, electrically isolated OA 8390-U

3.1 Power supply via the mains adapter

On the rear of the device there is the socket (5) for connecting an external power supply. Here by default mains adapter ZB 1012-NA1 (12 V / 200 mA) is connected to the + and - terminals by means of the clamp connector. Or, alternatively, you can use some other DC power source (7 to 13 V).
If, however, the power supply has to be electrically isolated from the transducers, then option U is required.

3.2 DC voltage supply (option U)

Option U (OA 8390-U) provides an electrically isolated DC voltage supply with a wide input voltage range, 9 to 30 V. The voltage must also be connected to the clamp / screw terminal of socket (5) on the device using the clamp connector. It will then be possible to use the measuring instrument in a 12-volt or 24-volt on-board supply system.

3.3 Sensor supply

Whatever the power supply, a sensor supply voltage of approx. 12 V DC is available on the + and - terminals of the ALMEMO® connector. With special connectors, 15 V or 24 V DC or reference voltages of 5 V and 2.5 V are also available. It is important to ensure that the total current consumed by the sensors does not exceed 70 mA ! The sensor voltage can be monitored using the measuring channel ´UbAt´.

3.4 Data safeguarding, reinitialization

Sensor programming is saved in the connector itself; calibration and device configuration data is saved in an EEPROM in the device; in the event of an interruption to the power supply this data is retained intact; only the date and time-of-day are lost and as and when power is restored these are reset (to 01.01.00 00:00:00). If you wish to reset the device parameters to their default values, then, when switching on, press the **CLEAR** key.

4. CONNECTING THE TRANSDUCER

Virtually any ALMEMO® sensor can be connected to the ALMEMO® input sokket M0 (3). To connect your own existing sensors you simply need the appropriate ALMEMO® connector.

4.1 Transducers

The ALMEMO® Manual includes detailed descriptions of the comprehensive range of ALMEMO® sensors (see Manual, Chapter 3) and of how to connect your own existing sensors to ALMEMO® instruments (see Manual, Chapter 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. Each ALMEMO® connector also incorporates 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.

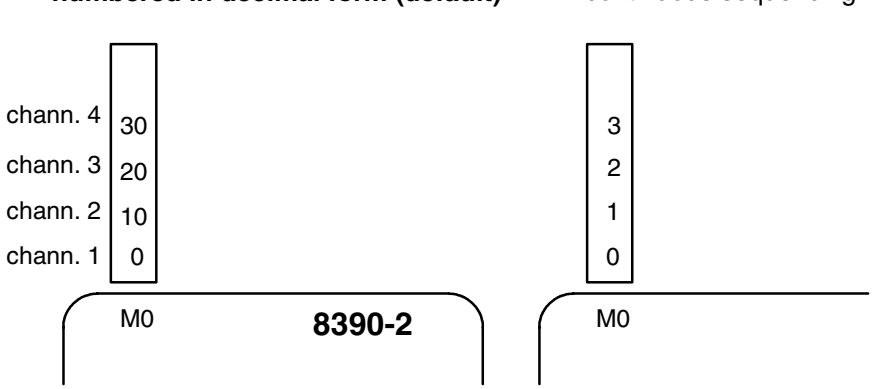
4.2 Measuring inputs and additional channels

Measuring instrument ALMEMO 8390-2 incorporates an input socket M0 (1), to which initially measuring channel M0 is assigned. ALMEMO® sensors can, however, if necessary, provide up to four channels. The additional channels can be used in particular for humidity sensors with four measuring variables (temperature / humidity / dew point / mixture ratio) or for function channels. Each sensor can if necessary be programmed with several measuring ranges or scaling settings; and 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.).

Measuring point numbering

Each additional measuring channel in a connector lies one level higher. In this new series the levels are now numbered in standard decimal form, i.e. the front digit indicates the level. The measuring point number (and thus also the programmed reference channels) for all devices with 1, 2, 3, 5, or 10 inputs thus always remains the same. This means, however, that, with effect from measuring channel number 20, the measured value resolution in the display is limited. If this proves to be a serious problem, it is possible, by holding down the **MANU** key when switching ON, to change to continuous sequencing (and, by means of the same key, to change back again).

On the measuring instrument this gives the following channel assignment :



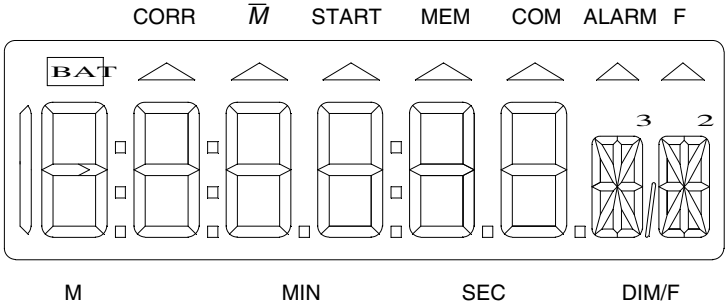
Sensors combined within one connector and sensors with their own power supply, however, are electrically interconnected and must therefore be operated in isolation. The voltage applied to the measuring inputs themselves must not exceed ±5 volts (between B, C, D, A and -).

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

5. DISPLAY AND KEYPAD

5.1 Display

The display (1) on measuring instrument ALMEMO® 8390-2 comprises an LCD with 6½ x 7-segment characters, two 16-segment characters, a battery symbol, and seven arrows to indicate the operating status.



Measured value display

The first thing to appear after switching ON is the measured value display with measuring point (M) and units (DIM) as used for the channel most recently selected.

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

Function display (see Section 5.2)

Measuring point, function value, function: 0: 29.7 MH

Double display for temperature and humidity

If a double sensor for temperature and humidity is connected at socket M0, the display can be switched to a double display showing both variables. To obtain a double display, channel M2 must be selected for humidity and the **PROG** key must be pressed and held down for longer than one second. With the same key combination this function can also be changed back again.

Selecting the humidity channel: M▲ → 2: 34.5 %H

double display by pressing key: PROG, 1s → 23.4 °C 34.5 %

Even if other channels or function values are selected in standard format, the double display will continue to apply as and when you return to channel M2.

Special operating states

Segment test for display — This is performed automatically each time the device is switched ON.

Supply voltage: below 7 volts: **BAT** symbol lights up

below 6 volts: 1:L o b A t

Checksum error during device calibration: C A L E r r

Non-connected sensors, deactivated measuring points, deleted programming values: 1: - - - - XX

Non-permitted measuring range: 1: E r r

Sensor correction or scaling — **CORR** arrow lights up
Measuring point scan in progress — **START** arrow lights up
Averaging in progress — **M̄** arrow lights up
Measuring point scan with output — **COM** arrow lights up
Function selected — **F** arrow lights up
If all functions are activated, the — **F** arrow flashes

Malfunctions

Malfunctions are displayed as follows and trigger an alarm; (see Manual, Section 6.3.9):

Sensor breakage: 1: N i C r °C flashes

Limit value exceeded: **ALARM** arrow lights up
Measuring range overshot: Maximum value flashes
Measuring range undershot: Minimum value flashes

1: C J

Measuring range undershot for cold junction compensation, or measuring without external cold junction compensation, or cold junction compensation breakage 1: C J flashes

Values range overshot (>65000): 1:6 5 0 0 0 flashes

5.2 Function selection and function activation

Measuring instrument ALMEMO® 8390-2 provides a wide variety of functions for controlling measuring sequences, for acquiring, averaging, monitoring, and saving measured values, for outputting data to various peripheral equipment, and for scaling, adjusting, and correcting sensors, etc.. Since these functions will not be needed by the normal user all at once, they can be activated in various ways on an application-specific basis.

After reinitialization (see Section 3.4) the **FUNCTION** key will initially have only the following functions assigned : maximum value, minimum value, cycle, measuring range, locking mode, and averaging mode. Appropriate additional functions will then be activated depending on the sensor programming (i.e. locking mode, averaging mode, etc., see below). Any further functions that you frequently require can be enabled via the interface. This approach is intended to maintain rapid access via the **FUNCTION** key and to minimize the risk of accidentally entering incorrect information.

If it suddenly becomes necessary to have all functions activated for a limited period, then the first time you press the **FUNCTION** key you must hold it down for longer than one second. To verify that this has succeeded the ´F´ arrow in the display flashes.

The active functions can be selected by repeat-pressing the **FUNCTION** key. To revert to the previous function arrangement press and hold down the **FUNCTION** key again. If a function is selected instead of a measured value, the ´F´ arrow in the display lights up.

Functions are shown in the display as a function value followed in the units position by a two-character abbreviation (as listed in the following table); in the case of sensor parameters, the channel number will also be shown.

Functions	**Value Abbrev.**	**Activation**	**Memory**
Maximum value (Hi)	1: 127.3 MH	Default	Device
Minimum value (Lo)	1: 023.4 ML	Default	Device
Average value	1: 13.24 AV	Averaging mode >0	Device
Number of averaged values	1: 1234 C	Averaging mode >0	Device
Averaging mode	1: Cont AM	Default	Sensor
Smoothing	00 DG	Hold down **FUNCTION** key first time it is pressed	Sensor
Diameter standardized	1: 0150. DN	Measuring range ´Flow´	
Cross-section area	1: 0175. CS	Measuring range ´Flow´	Sensor
Atmospheric pressure	1013 mb	Hold down **FUNCTION** key first time it is pressed	Device
Temperature compensation	1: 023.4 TC	Hold down **FUNCTION** key first time it is pressed	Device
Cycle	00:15:00 CY	Default	Device
Time-of-day	12:34:56 TM	Hold down **FUNCTION** key first time it is pressed	Device

Functions	Value	Abbrev.	Activation	Memory
Date	01.12.99	DA	Hold down **FUNCTION** key first time it is pressed	Device
Baud rate, output format	Un 9600	BR	Hold down **FUNCTION** key first time it is pressed	Device
Device address	00	A	Hold down **FUNCTION** key first time it is pressed	Device
Range	1: NiCr	R	Default	Sensor
Locking mode	1: 0005	LM	Default	Sensor
Maximum limit value (Hi)	1: 123.0	LH	Locking mode level <7	Sensor
Minimum limit value (Lo)	1: -010.0	LL	Locking mode level <7	Sensor
Analog end	1: 123.4	AE	Locking mode level <6	Sensor
Analog start	1: 000.0	AS	Locking mode level <6	Sensor
Base value	1: ----	BA	Locking mode level <5	Sensor
Factor	1: ----	FA	Locking mode level <5	Sensor
Exponent	1: 0	EX	Locking mode level <5	Sensor
Zero-point correction	1: ----	ZC	Locking mode level <4	Sensor
Ambient temperature	1: 250.0	AT	Elementflag = IR	Sensor
Gain correction	1: ----	SC	Locking mode level <4	Sensor
Emissivity factor	1: 0.950	EF	Element flag = IR	Sensor
Display mode (sleep / language)	--- d	DM	Hold down **FUNCTION** key first time it is pressed	Device

Activation via interface

The default functions can, if necessary, be specified via the interface (e.g. AMR-Control); (see Manual, Section 6.10.13.3, key F2).

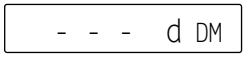
Language setting

The function abbreviations can be shown in any one of three languages. You can switch between languages in the DISPLAY MODE ´DM´ function, which can be activated as and when necessary by holding down the **FUNCTION** key the first time it is pressed; (see above).

Function DISPLAYMODE:

Enter with **PROG**, **▲▼..**, **PROG**

The letter indicates the language setting :



e.g. : German

d = Deutsch (German)
E = English
F = French

Function designations in the interface protocol are always in English; (see Section 6.3.4).

5.3 Keypad

Each of the keys (2) initially has the normal function noted above it :

Function	Normal	Eingabe
Programming	**PROG**	▶
Select measured value and measuring point	**M** ▲	CLEAR
Start and stop measuring point scanning	**START** / **STOP**	▲
Manual measuring point scanning, data output	**MANU** / **PRINT**	▼
Function selection	**FUNCTION**	± / ESC

If you press the **PROG** key, a digit or an abbreviation flashes in the display; i.e. the device is in input mode and now the **red** lettering below the keys applies. In this mode the following keys are available : ±, ▲, ▼ for changing the input digit, the ▶ key as cursor key, and CLEAR for deleting the parameters. Input is completed as soon as the last digit has been confirmed by means of the ▶ key or input has been cancelled by means of the ESC key.

5.4 Data input

Numeric parameters are programmed as follows :

Select the desired function by pressing the **FUNCTION** key

Start programming by pressing the **PROG** key.
The front digit flashes and can now be changed.

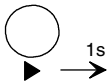
Increment the digit by pressing the ▲ key.
If you overshoot the highest value, you start again at zero.

Decrement the digit by pressing the ▼ key.
If you go below zero, you start again at the highest value (9 or 5).

To change the arithmetic sign press the ± / ESC key at the first digit.
or cancel this input with effect from the second digit

To move forwards to the next digit press the ▶ key.

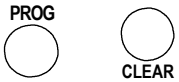
To move back to the previous digit, press the ▶ key and hold down



To terminate programming

After setting the last digit press the ▶ key again.

To delete measured values and reset the
programming press the keys PROG and CLEAR.



6. MEASURING OPERATIONS

Measuring instrument ALMEMO® 8390-2 provides the following options for measured data acquisition :

1. Continuous measuring point scanning of all active measuring points
   (see Section 6.1 and Manual, Section 6.5.1.3)
   Representation of a selectable measuring point in the display
   Measured value output to an analog output (see Chapter 8).
2. Once-only measuring point scan and output (s. Sec. 6.3.1; Man., Sec. 6.5.1.1)
3. Cyclic measuring point scan and output; (s. Sec. 6.3.2 and Man., Sec. 6.5.1.2)

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.

6.1 Measuring point scanning and meas. point display

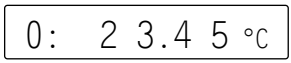
The ALMEMO® 8390-2, unlike previous instruments, is set by default to continuous measuring point scanning; i.e. all measuring points are continuously scanned and the measured values thus acquired can be called up at any time, even if they depend on other channels (e.g. function channels, temperature compensation, etc.).

6.1.1 Selecting the measured value and the measuring point

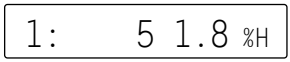
After the device is switched on, the MEASURED VALUE function is set automatically and the measured value of the selected measuring point is displayed together with the appropriate units. After activating other functions by pressing the **FUNCTION** key, you can return to the measured value display by pressing the **M▲** key.

In the MEASURED VALUE function it is also possible, by pressing **M▲** key, to successively select all other active measuring points and have the current measured value of each one displayed. If key **M▲** is pressed and held down (for approx. 1 second), the previous channel is displayed again. When a measuring channel is selected the associated input channel is also selected at the same time. If, when switching channels, the measuring range changes, the abbreviation for the measuring range is displayed for a moment first; (see table in Section 7.7).

MEASURED VALUE function by key: **M▲**



Increment the meas. channel by key: **M▲**



Decrement the meas. channel by key: **M▲**  **1s** → and hold down (appr. 1 s)

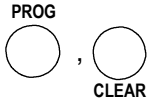
6.1.2 Maximum and minimum value memories

From the measured values acquired per measuring point the highest and the lowest values are determined and saved for each. To display these extremes first the desired channel must be set and then the MAXIMUM VALUE or MINIMUM VALUE function selected by pressing the **FUNCTION** key.

max. value function ´MH´ und **minimum value function** ´ML´

Select by the **FUNCTION** key 

... 1: 1 2 3.4 MH

delete the max./min. by keys: 

1: - - - - MH

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 Chapter 6) or whenever the measuring range is changed (see Section 7.7).

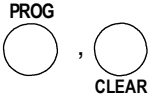
6.2 Measured value correction and compensation

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, Section 6.3.10). These parameters can either be programmed (see Sections 7.4, 7.5) or be automatically calculated in a sub-menu in the MEASURED VALUE function including a few special functions (see Sections 6.2.1/2).

Function	**Select**	**Display**	**Execute**
Select meas. value and meas. point	**M▲**	1: 12.34 °C	
Set measured value to zero (-> base)	**PROG**	1: `00.00´ CL	**CLEAR**
Zero-point correction (-> zero-point)	▼	1: `00.00´ AJ	**PROG**
or gain correction (-> gain)		1: `10.00´ AJ	**PROG**
Enter setpoint values (-> factor / gain)	▼	1: `12.34´ S4	**PROG, ▲/▼..**
Enter the units	▼	*1: 12.34 `°C´*	***PROG, ▲/▼..***

6.2.1 Setting the measured value to zero,

It is possible - a very useful function - to zero the measured value at certain locations or at certain times in order then to observe the deviation from this reference value. This function can be activated in the MEASURED VALUE function by means of the following key combination :

Set function to zero by keys: 

1: `0 0 0.0´CL

When the PROG key is pressed in function ´CL´ the measured value 000.0 flashes; when the **CLEAR** key is then pressed, the measured value is saved as base value and set to zero.

So long as the deviation from the base value is shown (rather than the actual measured value), the **CORR** arrow appears in the display.

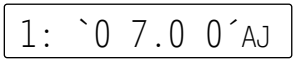
- If only a ´C´ appears as function, this means that the base value function is locked at level 5 or above; (see Section 7.2). In this case the new base value is not saved to the connector's EEPROM but only to the RAM; i.e. once the device is switched off, then the next time it is switched on, this will be restored to its original value.
- If you prefer to have the new zero-point saved more permanently, then, before zero-setting, briefly and temporarily lower the locking mode to level 3 by switching on the device with the **PROG** and **FUNCTION** keys held down. When you switch off, the base value will then be retained; (the locking mode, however, will be restored to its original level).

In order to obtain the actual measured value again the base value must be cleared. If the ´BA´ function is not currently activated, you need only to switch off and on again; (see above). If the ´BA´ function is available, it can be selected by pressing the **FUNCTION** key; the base value can then be cleared by pressing key combination **PROG**, **CLEAR**; (see Section 7.5).

6.2.2 Sensor adjustment, zero-point, and gain

Many types of sensor need to be adjusted at least once or at regular intervals to compensate for various instabilities. There is, for this purpose, in addition to the above-mentioned procedure for "setting the measured value to zero", a specific zero-point adjustment, which does not affect scaling with base value and factor (e.g. pH probes). This function does not save the zero-point error as base value but as a zero-point correction. Zero-point adjustment is executed by pressing the following key combination :

Zero-point adjustment: 

e.g. 

In the ´AJ´ function the measured value appears in the display, initially flashing; this should be the measured value expected after adjustment, i.e. either the normal 0.0 or a scaled value, e.g. 7.00 for pH probes.

So long as the corrected measured value is shown (rather than the actual measured value), the **CORR** arrow appears in the display.

- If only an ´A´ appears as function, this means that the zero-point correction function is locked at level 4 or above; (see Section 7.2).

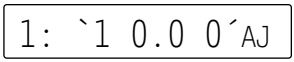
In this case the corrected value is not saved to the connector's EEPROM but only to the RAM; i.e. once the device is switched off, then the next time it is switched on, this will be restored to its original value.

- If you prefer to have the new zero-point saved more permanently, then, before zero-setting, briefly and temporarily lower the locking mode to level 3 by switching on the device with the PROG and FUNCTION keys held down. When you switch off, the corrected value will then be retained; (the locking mode, however, will be restored to its original level).
- In the case of dynamic pressure probes the zero-point error is generally saved to the calibration offset only temporarily (i.e. until you switch off) - irrespective of whether locking applies.

Gain adjustment can be performed for the following sensor types using the same function, assuming the appropriate calibration value is available :

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

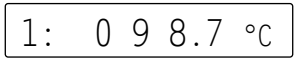
Gain adjustment e.g. pH10: 

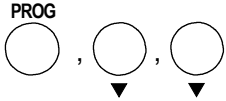


6.2.3 Entering a setpoint

A setpoint can be entered in much the same way as gain adjustment (described in the previous section). If you save defined calibration values other than the zero-point, you can, by entering the setpoint, automatically correct or scale a measured value. On ALMEMO® force transducers an appropriate calibration resistance can be selected for the purposes of final value correction. The factor or gain correction is calculated, depending on the locking state, and saved to the connector. To ensure that two-point adjustment is correct, the zero-point should have been adjusted previously.

1. Set the locking mode to level 4 or 3 (e.g. by switching on with the **PROG** and **FUNCTION** keys held down, see above)
2. Select meas. value and apply the calibration value (e.g. boiling water)



3. setpoint function by keys: 

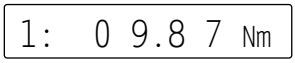
   Function ´S3´, if locking level 3: Correction factor is saved as gain correction

   Function ´S4´, if locking level 4: Correction factor is saved as factor

4. Enter setpoint (see Section 5.4)

Zur Endwertjustage von ALMEMO-Kraftaufnehmern kann man einen einge-
To perform final value adjustment on ALMEMO force transducers, select an integrated calibration resistance; in the MEASURED VALUE function, press and hold down the **PROG** key. If the ´CORR´ arrow flashes, this has succeeded..

Select calibration resistance by key: 



and holding down for one second

setpoint function by pressing: 

and enter the setpoint s. 5.4

Deactivate calibration resistance : 

CORR arrow stops flashing

6.2.4 Cold junction compensation

Cold junction compensation for thermocouples is normally performed automatically by means of an NTC sensor in measuring socket M0. This sensor can be substituted with an external measuring sensor; (see Manual, Section 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 two measuring channels. ´#J´ is programmed in the comments; this ensures that the temperature sensor integrated in the connector is used for cold junction compensation.

6.2.5 Atmospheric pressure compensation

Some measured variables depend on the ambient atmospheric pressure (see Section 7.7, measuring range list ´with PC´) with the effect that pronounced deviations from normal pressure (1013 mbar) may lead to measuring errors.

e.g. error per 100 mbar:		**Compensation range:**
Rel. humidity psychrometer	approx. 2%	500 to 1500 mbar
Mixture ratio, capacitive	approx. 10 %	Vapor pressure VP up to 8 bar
Dynamic pressure	approx. 5%	800 to 1250 mbar (error < 2%)
O2 saturation	approx. 10%	500 to 1500 mbar

Account should be taken, therefore, especially when working at significant heights above sea level, of the atmospheric pressure (approx. -11 mbar per 100 meters above mean sea level MSL). This can either be programmed or measured directly with a sensor (see Manual, Section 6.7.2).

The ATMOSPHERIC PRESSURE function ´mb´ is only activated as and when necessary for sensors of the types mentioned above (see Section 5.2) by holding down the **FUNCTION** key the first time it is pressed.

ATMOSPHERIC PRESSURE function ´mb´

Select by key ... and enter mba s. 5.4

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 Section 5.4).

6.2.6 Temperature compensation

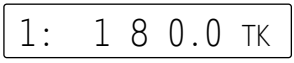
Sensors whose measured values depend heavily on the temperature of the measuring medium usually incorporate their own temperature sensor; such devices perform temperature compensation automatically; (see Section 6.2, measuring range list ´with TC´). However, dynamic pressure probes and pH probes are also available without their own temperature sensor. If the temperature of the medium deviates from 25 °C the following measuring errors may occur :

e.g. error per 10 °C :	**Compensation range :**	**Sensor :**
Dynamic pressure app. 1.6%	-50 to +700 °C	NiCr-Ni
pH probe approx. 3.3%	0 to +100 °C	Ntc or Pt100

Temperature compensation can also be performed using the reference channel and external temperature sensors; or it can be performed manually by entering the temperature in the ´TC´ function (reference channel = measuring channel).

TEMPERATURE COMPENSATION function ´TC´

Select by pressing key FUNCTION ◯ Enter °C as per S.5.4



6.3 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. If a peripheral device (e.g. printer) is connected (see Manual, Section 5.2), each measured value is output to it via the interface in the output format set (see Section 6.3.3) (printout, see Section 6.6.1). In time-critical applications it may be preferable to activate continuous measuring point scanning (see Manual, Section 6.5.1.3); scanning all measuring points in continuous mode takes only half as long as in semi-continuous mode; (see Section 6.1, default setting ´continuous´ off).

6.3.1 Once-only measuring point scan (see Manual, Section 6.5.1.1)

A once-only manual measuring point scan for acquiring instantaneous measured values from all active measuring points can only be initiated in the MEASURED VALUE function by pressing the MANU/PRINT key. The ´START´ arrow lights up briefly; and if the interface is connected, the ´COM´ arrow should also appear. With the "S" option the measured values are saved and the ´MEM´ arrow lights up. 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 Section 9.1).

Once-only measuring point scan

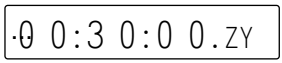
The MEASURED VALUE function by :

6.3.2 Cyclic measuring point scan (see also Manual, Section 6.5.1.2)

For cyclic measuring point scans and outputs the output cycle can be set in the CYCLE function ´CY´.

CYCLE function ´CY´

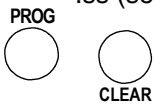
Select by pressing the **FUNCTION** key



Enter the time in the 6-character format hh:mm:ss (see Section 5.4).

Example : print cycle 30 minutes

Delete cycle by pressing the keys:



This terminates any cyclic scan currently still running.

The cyclic measuring operation is started by pressing the**START/STOP** key; the ´START´ arrow should light up continuously. If a peripheral device is connected, the measured values are output cyclically and the ´COM´ arrow should appear. There is a wide variety of output formats available (see Section 6.3.3).For the associated printouts please refer to the Manual Section 6.6.1

To start a cyclic measuring point scan: key: START/STOP (cycle programmed)

To stop automatic measuring point scanning press the START/STOP key again. The ´START´, ´COM´, and ´MEM´ lights go out again..

To stop a cyclic measuring point scan : key: START/STOP

6.3.3 Output formats for measured value lists

Both for manual and for cyclic measuring point scans (see Sections 6.3.1/2) the measured values are output as measured value lists in a wide variety of output formats (see Manual, Sections 6.5.5, 6.6.1). There is the standard format in which all the measured values are listed one below the other; there is also the column format listing them next to one another; this printout is clear, easy-to-understand, and space-saving. For **this latter format** the printer is switched over automatically to compressed character mode. There is also the table format which is intended for further processing using spreadsheet programs (see Manual, Section 6.1).

The output format is indicated in the baud rate function ´BR´ by means of a letter placed between the output channel ´U´ and the baud rate.

Format	**Printout**	**Display**
List	Measured values are listed one below the other	U 9600 BR
"n" = next to one another	Measured values are listed in adjacent columns	U n 9600 BR
"t" = table	Measured values are listed in table format	U t 9600 BR

To change these settings the **output format** must first of all be selected by pressing the **PROG** key and then set, as usual, by pressing the keys **▲▼...** Programming is terminated by pressing the keys **PROG, ESC**, or **PROG, PROG**.

6.3.4 Manual data output

In all functions selected by pressing the **FUNCTION** key, the function values can, by pressing the **MANU/PRINT** key, be output to a printer or computer, partly as tables and with the following printout formats :

Function	Abb	Printout	V24
MAXIMUM VALUE	MH	MAXIMUM: 01: +0020.0 °C	P02
MINIMUM VALUE	ML	MINIMUM: 01: -0010.0 °C	P03
AVERAGE VALUE	AV	AVERAGE VAL: 01: +0017.8 °C	P14
COUNT (all meas. values)	C	CH MEAS.VAL MAXIMUM MINIMUM AVG.VAL COUNT 01: +0023.0 +0025.0 +0019.0 +0022.0 99999 s. Hb. 6.4.4	P18
AVERAG. MODE	AM	01:NiCr +0123.4 -0012.0 +0000.0 °C 1.0000 E+0 CONT	P00
SMOOTHING	DG	TIME CONST: 01: 10	P32
DIAMETER	DN	CROSS SECT: 01: 00078 cm2 DIAMETER: 00100 mm	P26
CROSS SECTION	CS	CROSS SECT: 01: 00078 cm2 DIAMETER: 00100 mm	P26
TEMP. COMP.	TC	COMPENSATION 01: 025.0 °C	P44
CYCLE	CY	PRINT CYCLE: 00:06:00	P11
TIME	TM	TIME: 12:34:00	P10
DATE	DA	DATE: 01.02.99	P13
BAUD RATE (Senor programming)	BR	AMR ALMEMO 2390-5 s. Hb. 6.2.3 CH RANGE LIM-MAX LIM-MIN BASE D FACTOR EXP AVG COMMENT 01:Ntc +040.00 - - - - - - °C 1.0123 E+0 - - - Temperature 02:°o H +0060.0 +0020.0 - - - - - - %H - - - E+0 - - - Humidity MEAS:CYCLE: 00:00:00 S0251.9 F0104.7 E W010 ----- PRINT CYCLE: 00:10:00 Un 9600 bd	P15
ATMOSPHERIC PRESSURE	mb	MODULE: G00 M11 A01 P03/11/00 A.PRESSURE:+01013. mb	P19
DEVICE ADDRESS (Device programming)	A	CJ-TEMP: +0023.5 °C U-SENSOR: ! 12.5 V HYSTERESIS:10 CONFIG: -------- ---- ALARM: ---- A1: DK0 Un A2: AK1 s. Hb. 6.2.5	
RANGE	R	01:NiCr +0123.4 -0012.0 +0000.0 °C 1.0000 E+0 - - -	P00
LOCKING (extended sensor programming)	LM	CH ZERO SLOPE LM P FUNC CALOFS CALFA A-START A-END B1 MX EF AH AL ZF UMIN 01:+0000.0 +1.0000 5. 1 MESS +00000 32000 +0000.0 +1000.0 0-01 M1 -- S- E2 05 12.0 s. Hb. 10.1	f1 P15
LIMIT VALUE HI	LH	LIMIT MAX: 01: -0100.0 °C	P08
LIMIT VALUE LO	LL	LIMIT MIN: 01: +0020.0 °C	P09
ANALOG START	AS	ANALOG START:01: +0000.0 °C	P16
ANALOG END	AE	ANALOG END: 01: +0100.0 °C	P17
BASE	BA	BASE: 01: -0273.0 °C	P06
FACTOR	FA	FACTOR: 01: +1.0350E-1	P07
EXPONENT	EX	FACTOR: 01: +1.0350E-1	P07
ZERO CORRECT.	ZC	ZERO CORR: 01: -0000.7 °C f1	P06
SLOPE CORRECT	SC	SLOPE CORR: 01: +1.0013 f1	P07

The column on the right lists the interface commands to initiate output.

6.4 Averaging

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

e.g. the average flow velocity in a ventilation channel
smoothing of a widely fluctuating measured value (e.g. wind, pressure etc.)
hourly or daily average values of weather data (temperature, wind etc.)
as above, for consumption values (current, water, gas, etc.)

The average value of a measured value $\overline{M}$ is obtained by adding together a series of measured values M_i and then dividing this sum by the number N of measured values in the series : Average valuet $\overline{M} = (\sum_i M_i)/N$

6.4.1 Smoothing out meas. val. by means of a sliding average

When measuring values of an unstable or strongly fluctuating nature, e.g. particularly turbulent flows, it is an advantage to smooth the values by means of continuous averaging. The level of smoothing can be set, via the ´Smoothing level´ function ´DG´, within a range of 0 to 99 (see Section 5.2). This level specifies the number of measuring operations at the selected measuring point from which the sliding average is to be taken. The smoothed measured value can then be read out in the MEASURED VALUE function; this will also apply for all subsequent evaluation functions. Smoothing can thus also be used in conjunction with averaging (see Section 6.4.3) e.g. for network measurements.

SMOOTHING LEVEL function ´DG´

Select by key: FUNCTION ... 1: 1 0 DG

Enter as per Section 5.4

Measured value smoothing is only possible for the selected channel. When a large number of measuring points is involved, continuous measuring point scanning should be switched off; otherwise the filter effect may be substantially restricted.

6.4.2 Averaging mode

All averaging operations, except when smoothing a measured value, are specified via AVERAGING MODE ´MM´; the average value appears in the AVERAGE VALUE function ´MW´; the number of averaged values appears in the NUMBER function ´C´. As and when the averaging mode is programmed, these last two functions ´MW´ and ´C´ are activated automatically. Averaging mode is activated by default and is selected by pressing the **FUNKTION** key.

AVERAGING mode function ´MM´

Select by key: FUNCTION ... 1: C o n t MM

If a sensor with an ALMEMO® connector is connected, the following modes can be set by pressing keys **PROG**, ▲ ▼, **PROG** :

Function	**Display**
No averaging:	- - - -
Continuous averaging from start to stop (see Section 6.4.3) or over single measurements, if not started (see Section 6.4.4):	C o n t
Averaging over each cycle (see Section 6.4.6):	C Y C L

Averaging has become much more straightforward and effective compared with previous models - thanks to the following measures :

1. Averaging is always performed by means of on-going semi-continuous or continuous measuring point scanning. A measuring cycle is thus no longer necessary for this purpose; if an averaging mode has been programmed then all measuring points will always be considered for all actions (start, stop, manual).
2. With semi-continuous measuring point scanning (default setting), the selected measuring point is always scanned at exactly half the measuring rate.
3. With the function channels for average value ´M(t)´, number ´n(t)´, and volume flow ´Flow´ all function values used in averaging can be output via the interface.
4. It is now also possible for averaging purposes to start and stop measuring operations without a cycle; all measured values and function values at start and stop are acquired.
5. For all continuous averaging operations the averaging mode is ´Cont´. How this functions depends completely on the following :
   Start - Stop by pressing the **START/STOP** key Single measurements by pressing the **MANU** key
6. The **START/STOP** key function is available in all functions.
7. The average values for all channels are normally deleted with each new start.

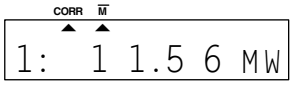
6.4.3 Averaging over the time from start to stop

To acquire the average of all measured values for a measuring channel over a certain period or for the surface area of a ventilating channel (see Manual, Section 3.5.5) or for a whole measuring operation (also with cyclic scanning), the averaging mode to be set is ´Cont´ (see Section 6.4.2).

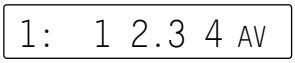
1. Select the AVERAGE VALUE function ´MW´ by pressing the **FUNCTION** key.

The averaging start and stop can if necessary also be selected in any other function (e.g. MEASURED VALUE) !

2. **Start** averaging by pressing the **START/STOP** key The average value is automatically deleted with each new start ! In the display the ´START´ and ´´ arrows light up. All measured data can be saved to memory or output



3. **Stop** averaging by pressing the **START/STOP** key again; the ´START´ and ´´ arrows go out. The average value can now be read out.

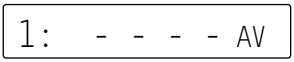


4. For further measuring operations repeat steps 2 and 3 only.

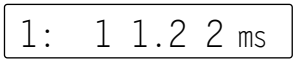
6.4.4 Averaging over single measurements

To determine the average of single isolated measurements at certain locations or certain times (e.g. network measurements) the averaging mode ´Cont´ is used. Measured value smoothing can be programmed (see Section 6.4.1)

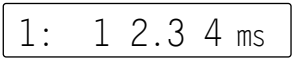
1. If the ´START´ arrow lights up, stop the current meas. operation by pressing the **START/STOP** key.
2. Select the AVERAGE VALUE function ´AV´ by pressing the **FUNCTION** key.
3. Delete the average value before starting each measuring series by pressing the keys **PROG**, **CLEAR**; (this does not happen automatically) !



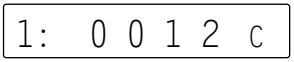
4. Select MEASURED VALUE function by pressing M▲ key.



5. Start manual single measurements by pressing the **MANU** key. In the display the arrow appears briefly.
   All measured data can be saved to memory (option “S”) or output.
6. By pressing the **FUNCTION** key once, the average value can be displayed.



7. By pressing the **FUNCTION** key again, the **count of values averaged** in the function ´C´ can be displayed.



8. You can return to the average value display by pressing the **FUNCTION** key and holding it down for a while.
9. For further measuring series repeat steps 3 to 8.

6.4.5 Volume flow measurement

To determine the volume flow VF in ventilating channels multiply average flow velocity $\bar{v}$ by cross-section area CS.:

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

For approximate air volume measurements at air vents and gratings the average flow velocity can be determined by means of time-based averaging. Or alternatively the average flow velocity can also be determined by single network measurements as per VDI/VDE 2640 with manual single measurements at defined points (e.g. 13.24 m/s) (see 6.4.3 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 (see Section 6.4.1) is definitely advisable. 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 Manual, Section 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 M▲ key and programming the measuring range ´Flow´ (see Section 7.7). The reference channel is automatically set to the 1st channel, Flow.

Programming example for a rotating vane as flow sensor:

1st channel	e.g. measuring point M01	Measuring range ´S220´	Averaging mode ´Cont´
2nd channel	e.g. measuring point M11	Measuring 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 ´DN´ function up to a maximum of 2000 mm; (see Section 5.4). When the function channel ´Flow´ is selected both these functions are activated automatically.

CROSS-SECTION AREA function ´CS´
Select the **FUNCTION** key .... Enter cm^2 (s 5.4)

11: 0 1 7 5.CS

DIAMETER function ´DN´
Select the **FUNCTION** key... Enter mm s. 5.4

11: 0 1 5 0.DN

With some cross-sections or arrangements (see Manual, Section 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

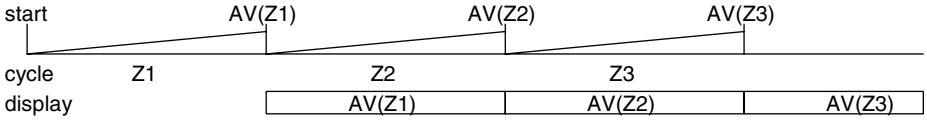
The product obtained by multiplying average velocity $\bar{v}$ by cross-section area CS is the air volume. This volume flow is calculated automatically in the function channel ´Flow´ and displayed as the measured value in m^3/h.

VOLUME FLOW in the function channel ´Flow´:
Select by **M▲** key Display in m^3/hour:

11: 0 8 3 4.mh

6.4.6 Cyclic averaging

If you require average values periodically always over the same periods of time (hours or days), set the cycle to this time (see Section 6.3.2) and set the averaging mode to ´CYCL´. In this mode average value AV is formed after the start of a measuring operation at the measuring rate; it is deleted internally each time cycle "Z" expires. However, average value MW for the last cycle completed remains in the display for the duration of the whole current cycle.



You can, with the aid of the print cycle factor, extend the period for particular measuring points; (see Section 6.10.6)

7. SENSOR PROGRAMMING

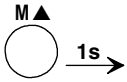
Since on ALMEMO® devices all sensor programming is stored in the ALMEMO® connector, the user will not normally need to reprogram. Programming will only be necessary e.g. if sensor errors are corrected, if your own sensors are scaled, or if certain limit values are stipulated; in these circumstances there are comprehensive programming functions available. Please note that series sensors featuring the locking mode can be protected against unintended alteration and that if modification is required then the locking mode must first be lowered to an appropriate level; (see Section 7.2). All parameters can be entered and modified easily and conveniently via the keypad - providing this function is activated (see Section 5.2) and the appropriate sensor connector is plugged in.

7.1 Selecting a measuring point

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

To increment the measuring channel press key:
(applies to programmable channels only)

To decrement the measuring channel press key:
and hold down (for approx. 1 second)



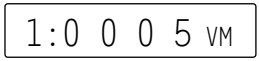
7.2 Locking the sensor programming (see Manual, Sec. 6.3.12)

The functional parameters for each measuring point are protected by means of the locking mode; this can be set to the desired locking level. Before programming the locking mode must be lowered to an appropriate level. You can briefly and temporarily lower the locking mode to level 3 by switching on the device with the **PROG** and **FUNCTION** keys held down; (after switching off it will be restored to the level programmed in the connector). If in the display you see a dot after the locking mode, this means that this cannot be modified.

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

Locking mode function ´LM´

Select by pressing key: FUNCTION ... Enter as per Sec. 5.4



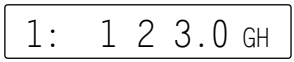
In the display, in front of the locking mode, you should see output function, element flags and multiplexer position - assuming these have been programmed (see Manual, Section 6.10.2/3/4). These can be programmed by pressing and holding down the **PROG** key.

7.3 Limit values

Two limit values (MAX and MIN) can be programmed per measuring channel. Exceeding one of these limit values is treated as a fault, i.e. in the same way as exceeding a measuring range limit or as sensor breakage. In the display the ´ALARM´ arrow appears and the alarm relays are triggered; (see Manual, Section 6.3.9). Activation of functions ´GH´ and ´GL´, see Section 5.2.

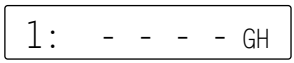
limit value Max function ´LH´ and **limit value Min function** ´LL´

Select by pressing key: FUNCTION ...



Programming: Enter as per Sec. 5.4

Switch off by keys: PROG , CLEAR



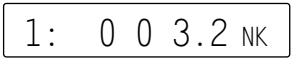
7.4 Correction values

Sensors can be corrected by means of the correction values ZERO-POINT and GAIN; (see Manual, Section 6.3.10).

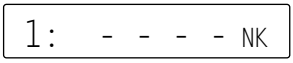
Corrected measured value = (measured value - zero-point) x gain.

ZERO-POINT CORRECTION function ´ZC´

Select by key: **FUNCTION...** Enter as per Sec. 5.4

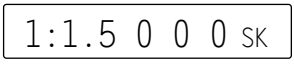


Delete by keys: **PROG**, **CLEAR**



GAIN correction function ´SC´

Select by key: **FUNCTION...** Enter as per Sec. 5.4



Once the correction values have been programmed and the measured value thus duly modified, the ´CORR´ arrow appears in the display.

Sensor adjustment

To simplify the correction of sensors for zero-point and if necessary also for gain, the MEASURED VALUE function includes a special function which performs this adjustment automatically (see also Section 6.2.2).

7.5 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 with a factor. To perform these steps the functions EXPONENT ´EX´, BASIS ´BA´, and FACTOR ´FA´ are provided. For a detailed description of scaling, with an example, please refer to the Manual, Section 6.3.11.

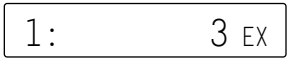
Displayed value = (corrected measured value - BASIS) x FACTOR.

Decimal point setting

First of all the position of the decimal point should be checked and if necessary adapted, using the EXPONENT function, to the desired resolution and to the 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 the display and printer permit.

Function EXPONENT ´EX´

Select by key: **FUNKTION...** Enter as per Sec. 5.4

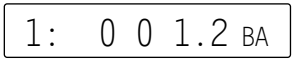


Example: Force transducer with output 2.0000 V should indicate 1000.0 N.

The decimal point must be shifted three positions to the right by means of exponent 3. From the new actual values 0.0 N and 2.000.0 N it is now easy to calculate the necessary factor 0.5. The base value will probably only be needed for the purposes of zero-point correct.

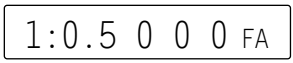
BASE VALUE function ´BA´

Select by key: **FUNCTION**... Enter as per Sec. 5.4



FACTOR function ´FA´

Select by key: **FUNCTION**... Enter as per Sec. 5.4



Once the scaling values have been programmed and the measured value thus duly modified, the ´CORR´ arrow appears in the display.

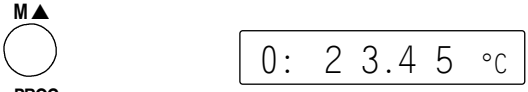
The scaling values can also be specified automatically by means of two-point adjustment. First of all, in the MEASURED VALUE function, the measured value is set to its zero state (icy water, unpressurized, etc.) (see Sections 6.2.1/2) and then, with a defined value, the setpoint (boiling water) is entered (see Section 6.2.3).

7.6 Changing the units

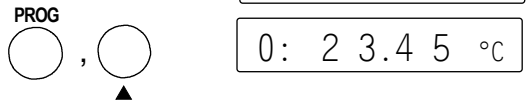
Per measuring channel the default units for the measuring range in question can be replaced with any two-character units; (see also Manual, Section 6.3.5). All upper-case and lower-case letters, special characters °, °, Ω, %, [,], *, -, =, ~, and space (_) can be used. The units are shown as two 16-segment characters after the measured value or programming value.

To **modify the unit**s go to the menu (see Section 6.2) in the MEASURED VALUE function and press the keys **PROG** and then ▲; this will only work if the lokking mode is set to lower than level 4 (see Section 7.2). The units currently set should then appear in the display and start flashing. If you press the **PROG** key again, the first character in the units starts flashing; this can now be changed by pressing the keys ▲ and ▼. To proceed to the second character press the ▶ key; you can change this in the same way (see Section 5.4).

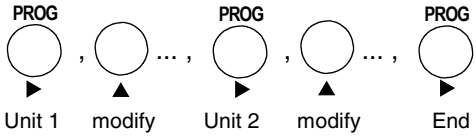
Select the MEASURED VALUE / measuring point function :



Enter units function:



Enter units:



If you enter ºF as units the temperature value will be converted automatically from degrees Celsius to degrees Fahrenheit (ºF). With character ºC or ºF cold junction compensation is disabled. The units “measuring operations per second” are displayed as “m/s”; the units “cubic meters per hour” are displayed as “ m³/h.

7.7 Selecting the measuring range

If you want to program the connector yourself or if you often need to change the measuring range, then please note that the locking mode for the connector should be cleared (see Section 7.2) and that for some transducers a special connector is required (e.g. thermo, shunt, divider, etc., see table).

To modify the measuring range you must first set the measuring point (see Section 7.1). To select the measuring range press the Function key and select the RANGE function ´R´.

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

After pressing and holding down the PROG key for a short while the abbreviated designation for the measuring range appears in the display and starts flashing. Now, by pressing keys ▲ und ▼, all possible measuring ranges can be selected in the order listed in the table below. Once the desired measuring range appears in the display, programming can be completed by pressing the **PROG** key again and this data is transferred and saved to the connector. All programming values for this measuring point are deleted.

RANGE function ´R´

Select by pressing key: FUNCTION ... 1: NiCr R

Example: Channel M1, range NiCr-Ni

modify the meas. range: PROG , ▲ ... or ▼ ... , PROG

Transducer	**Sensor / connector**	**Measuring range**	**Units**	**Display**
Pt100-1 (ITS90)	ZA 9000-FS	-200.0... +850.0	°C	P104
Pt100-2 (ITS90)	ZA 9000-FS	-200.00...+300.00	°C	P204
Ni100	ZA 9000-FS	-60.0... +240.0	°C	N104
NiCr-Ni (K) (ITS90)	ZA 9020-FS	-200.0...+1370.0	°C	NiCr
NiCroSil-NiSil (N) (ITS90)	ZA 9020-FS	-200.0...+1300.0	°C	NiSil
Fe-CuNi (L)	ZA 9000-FS	-200.0... +900.0	°C	FECO
Fe-CuNi (J) (ITS90)	ZA 9000-FS	-200.0...+1000.0	°C	IrCo
Cu-CuNi (U)	ZA 9000-FS	-200.0... +600.0	°C	CUCO
Cu-CuNi (T) (ITS90)	ZA 9000-FS	-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
Au-FeCr	ZA 9000-FS	-270.0... +60.0	°C	AUFE
Ntc type N	ZA 9000-FS	-50.00...+125.00	°C	Ntc
Millivolt 1	ZA 9000-FS	-26.000...+26.000	mV	U 26
Millivolt	ZA 9000-FS	-10.000...+55.000	mV	U 55
Millivolt 2	ZA 9000-FS	-260.00...+260.00	mV	U260
Volts	ZA 9000-FS	-2.0000...+2.6000	V	U2.60
Difference - millivolt 1	ZA 9050-FS	-26.000...+26.000	mV	d 26
Difference - millivolt	ZA 9050-FS	-10.000...+55.000	mV	d 55
Difference - millivolt 2	ZA 9050-FS	-260.00...+260.00	mV	d260
Difference - volt	ZA 9050-FS	-2.0000...+2.6000	V	d2.60
Sensor voltage	ZA 9000-FS	0.00...20.00	V	UbAt
Milliampere	ZA 9601-FS	-32.000...+32.000	mA	I032
Percent (4-20 mA)	ZA 9001-FS	0.00... 100.00	%	P420
Ohms	ZA 9000-FS	0.00... 500.00	Ω	Ohn

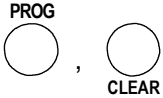
Transducer	Sensor / connector	Measuring range	Units	Display
Frequency	ZA 9909-AK	0... 25000	Hz	FrEq
Pulses	ZA 9909-AK	0... 65000		PULS
Digital input	ZA 9000-EK2	0.0... 100.0	%	Inp
Digital interface	ZA 9919-AKxx	-65000... +65000		diGi
Infrared 1	ZA 9000-FS	0.0... +200.0	°C	Ir 1
Infrared 2	ZA 9000-FS	0.0... +800.0	°C	Ir 2
Infrared 3	ZA 9000-FS	-30.0... +70.0	°C	Ir 3
Infrared 4	ZA 9000-FS	-30.0...+100.0	°C	Ir 4
Infrared 6	ZA 9000-FS	0.0... +500.0	°C	Ir 6
Snap-on head, normal 20	FV A915-S120	0.30... 20.00	m/s	S120
Snap-on head, normal 40	FV A915-S140	0.40... 40.00	m/s	S140
Snap-on head, micro 20	FV A915-S220	0.50... 20.00	m/s	S220
Snap-on head, micro 40	FV A915-S240	0.60... 40.00	m/s	S240
Macro	FV A915-MA1	0.10... 20.00	m/s	L420
Water micro	FV A915-WM1	0.00... 5.00	m/s	L605
Dyn. press., 40 m/s TC and PC	FD A612-M1	0.50... 40.00	m/s	L840
Dyn. press., 90 m/s TC and PC	FD A612-M6	1.00... 90.00	m/s	L890
Rel. air humidity, capacitive	FH A646-x	0.0... 100.0	%H	°orH
Rel. air humidity, capacitive, TC	FH A646-Cx	0.0... 100.0	%H	HcrH
Rel. air humidity, capacitive, TC	FH A646-R	0.0... 100.0	%H	H rH
Mixture ratio, with PC	FH A646	0.0 ... 500.0	g/kg	H AH
Dew-point temperature	FH A646	-25.0... 100.0	°C	H dt
Partial vapor pressure.	FH A646	0.0 ...1050.0	mbar	H UP
Enthalpy, with PC	FH A646	0.0 ... 400.0	kJ/kg	H En
Humid temperature	ZA 9000-FS	-30.00 ... +125.00	°C	P Ht
Rel. humidity, psychrom. PC	ZA 9000-FS	0.0 ... 100.0	%H	P RH
Mixture ratio, with PC	ZA 9000-FS	0.0 ... 500.0	g/kg	P AH
Dew-point temperature, with PC	ZA 9000-FS	-25.0 ... +100.0	°C	P dt
Partial vapor pressure, with PC	ZA 9000-FS	0.0 ...1050.0	mbar	P UP
Enthalpy, with PC	ZA 9000-FS	0.0 ... 400.0	kJ/kg	P En
Conductivity probe, with TC	FY A641-LF	0.0 ... 20.000	mS	LF
CO sensor	FY A600-CO2	0.0 ... 2.500	%	CO2
O saturation, with TC and PC	FY A640-O2	0 ... 260	%	O2-S
O concentration, with TC	FY A640-O2	0 ... 40.0	mg/l	O2-C
Function channels				
Differential channels Mb1-Mb2	any			diFF
Maximum value of channel Mb1	any			Hi
Minimum value of channel Mb1	any			Lo
Average val. M(t) over time of Mb1	any			A[t]
Average val. M(n) of Mb2 to Mb1	any			A[n]
Sum S(n) of Mb2 to Mb1	any			S[n]
Total pulses S(t) of Mb1	ZA 9909-AK2	0... 65000		S[t]

Transducer	Sensor / connector	Measuring range	Units	Display
Pulses / print cycle of Mb1	ZA 9909-AK2	0... 65000		S[P]
Alarm value of channel Mb1	beliebig			Alrn
Therm. coeff. M(Mb1)/M(M03)	ZA 9000-FS		W/m²K	q/dt
Wet bulb globe temperature	ZA 9000-FS		°C	UbGt
Measured value of Mb1	any			MESS
Cold junction temperature	any		°C	CJ
Number of averaged val. of Mb1	any			n(t)
Volume flow m³/h M(Mb1) * Q	any		mh	FLou

TC = Temp. compensation, PC = pressure compensation, Mb1/Mb2 = Reference channels

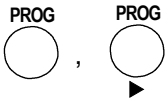
The use of function channels to output measured values and operands using the appropriate reference channels Mb1 (normally 1st channel in connector) and Mb2 (normally M00) is described in the Manual, Section 6.3.4..

Switching off, i.e. deactivating a programmed measuring channel

Function: RANGE ´R´ **keys:** 

The measured value is then no longer displayed, scanned, and output but the programming is retained intact.

Reactivating the measuring channel:

Function: RANGE ´R´ **keys:** 

If the channel was previously deactivated, then it is now reactivated with all programming values intact. However, if the channel is already active, then with this key combination all its programming values are deleted (i.e. as per selecting the measuring range).

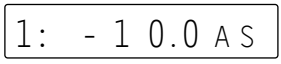
8. ANALOG OUTPUT

For the analog registration of the selected measuring point you can, to socket A1, connect either an analog output cable ZA 1601-RK (see Manual, Section 5.1.1) without electrical isolation or a relay trigger analog adapter ZA 8000-RTA (see Manual, Section 5.1.3) with electrically isolated analog output. If the device incorporates integrated analog outputs (option Rxx), the analog signals are present at terminals 6, 7 of the socket (4) in the case of a single output - and at terminals 4, 5 and 6, 7 in the case of dual output for double sensors.

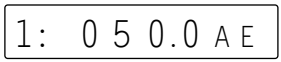
8.1 Skalierung

It is possible to spread any partial measuring range over the standard output signal in the three possible variants 0-2 V, 0-10 V, 0/4-20 mA, providing it comprises at least 100 digits (e.g. 0-20 mA for -10.0 to +50.0 °C). To do so, enter, in the functions ´AS´ and ´AE´, the analog output start and the analog output end of the desired measuring range (see also Manual, Section 6.10.7). If the start value is zero, this will simply be deleted. To activate the ´AS´ and ´AE´ functions see Section 5.2..

Analog output start function ´AS´
Select by the **FUNCTION** key Enter as per Section. 5.4



Analog output end function ´AE´
Select by the **FUNCTION** key Enter as per Section. 5.4



for example: Measuring range -10.0 to 50.0 °C

These two parameters, “analog output start” and “analog output end”, are also saved in the sensor EEPROM and can thus be individually programmed for each channel; i.e. when channels are switched through manually each measurable variable can be individually scaled.

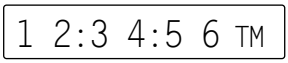
9. DEVICE PROGRAMMING

All sensor parameters are saved in the sensor connector; certain other parameters are stored in the device itself. These include the real-time clock and date, scanning cycle and output format (see Sections 6.3.2/3), device address (see Section 9.3), atmospheric pressure (see Section 6.2.5), and user interface language (see Section 5.2); they also include the device designation (see Manual, Section 6.2.4), and hysteresis (see Manual, Section 6.2.7). The last two in this list are only accessible via the interface. The baud rate is saved in the data cable (see Section 9.2).

9.1 Date and time-of-day

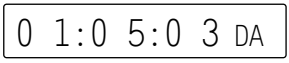
The ALMEMO 8390-2 incorporates an integrated clock with date and time-of-day for logging measuring times. This clock is not buffered, with the effect that date and time-of-day must be set anew each time you switch on.

Time function ´TM´
Select by pressing the key: FUNCTION ◯ ...



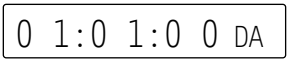
Program the time in the 6-character format hh:mm:ss (see Section 5.4).
The clock can be set to zero by pressing the keys **PROG**, **CLEAR**.

Date function ´DA´
Select by pressing the key: FUNCTION ◯ ...



Program the date in the 6-character format dd:mm:yy (see Section 5.4)
e.g. date 1st May 2003

The date can be cleared by the keys **PROG**, **CLEAR**



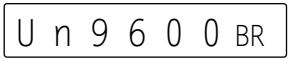
9.2 Baud rate, data format

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 Sections 6.2 and 6.3) output manual and cyclic measuring operations either online or after recording (see Section 6.4) 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 Manual, Section 5.3.
The baud rate for all interface modules is programmed on leaving the factory 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 !).

BAUDRATE function ´BR´

Select by pressing the **FUNCTION** key



For example : Output to interface ´U´, in ´side-by-side´ format, 9600 baud

To enter this information press the **PROG** key twice, then set the baud rate by means of the ▲ and ▼ keys, and then program by pressing the **PROG** key once more. The baud rate is saved to the EEPROM in the interface module and thus applies whenever any other ALMEMO® device is used. The procedure for setting the output format is described in Section 6.3.3.

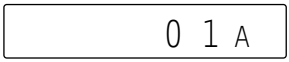
Data format : 8 data bits, 1 stop bit, no parity (settings cannot be changed)

9.3 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, Section 5.3). To communicate with networked devices it is absolutely indispensable that each device should have its own dedicated address; this is because only one device should respond per command. Before starting network operation therefore ensure that all the measuring instruments involved are assigned different device numbers. This is the purpose of the DEVICE ADRESS function ´A´. This function is selected after activation (see Section 5.2) by pressing the **FUNCTION** key; first of all the device number currently set should appear; the factory default setting is usually 00.This can now be modified as desired by means of the usual data entry procedure (see Section 5.4)

DEVICE ADRESS function ´A´

Select by the **FUNCTION** key Enter as per Section 5.4.



example : Address 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.

10. TROUBLE - SHOOTING

ALMEMO® 8390-2 measuring instruments can be configured and programmed in many versatile ways. These measuring instruments are suitable for connecting a wide variety of very different sensors, additional measuring instruments, alarm signaling devices, and peripheral equipment. Given these numerous possibilities the devices may in certain circumstances not behave quite as expected. The cause of such unexpected behavior is only very rarely a device defect; more usually it is incorrect operation by the user, an invalid setting, or unsuitable cabling. In such event try to pinpoint and clear the problem with the aid of the following tests :

Error : Either no display or all display segments light up continuously.

Remedy : Check the power supply; switch off and then on again; if necessary re-initialize (see 3.3) !

Error : Measured values are incorrect.

Remedy : Check the channel programming very carefully (especially the base value and zero point); check the entire programming using the AMR-Control software or terminal and command P15 (see Manual, Section 6.2.3) and f1 P15 (see Manual, Section 6.10.1) !

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

Remedy : Check the cabling for any inadmissible electrical connections; disconnect the external power supply and the output modules; unplug any suspicious sensors and replace with hand-held sensors in air or phantoms (for thermocouples short-circuit A-B, for Pt100 sensors use 100-Ω resistor) !

If these steps succeed in clearing the error, then check all wiring, if necessary, insulate the sensors, use an electrically isolated power supply, eliminate interference by using shielded or twisted wiring !

Error : Data transmission via the interface does not function.

Remedy : Check interface module, connections, and settings :

Are both devices set to the same baud rate and transmission mode (see Section 9.2) ?

Is the correct COM interface on the computer being addressed ?

Is the printer in the ONLINE status ?

Are the handshake lines DTR and DSR active ?

To check the data flow and the handshake lines a small interface tester with LEDs comes in very handy; (in ready-to-operate status the data lines TXD, RXD carry negative potential of approx. -9V and the LEDs light up green, whereas the handshake lines DSR, DTR, RTS, CTS carry approx. +9V positive voltage and the LEDs light up red. For the duration of data transmission the data line LEDs must 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, Section 6.2.1), Check the programming by means of P15 (see Manual, Section 6.2.3), Test the transmit line by entering a cycle with command ´Z123456´ and check in the display. Test the receive line by pressing the **MANU/PRINT** key and check in the display

Error : Data transmission in the network does not function.

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

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

11. Electromagnetic compatibility (EMC)

ALMEMO® measuring instrument 2390-5 complies in full with the safety requirements specified in the EU directive on the harmonization of laws in EU member states relating to electromagnetic compatibility (EMC) (89/336/EWG).

The following standards have been applied in evaluating the product :

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

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

1. If the standard sensor is extended (1.5 meters) care must be taken to ensure that the measuring lines are not laid together with high-voltage power cables or that they are properly shielded so as to prevent spurious interference from being induced in the system.
2. Using the device in strong electromagnetic fields may aggravate measuring errors (<50 µV at 3 V/m and 1.5 meters thermocouple sensor). After exposure to such irradiation ceases, the device will again operate within its technical specifications.

Technical data (see also Manual, Section 2.2)

Measuring inputs :	1 ALMEMO® socket for ALMEMO® flat connector
Channels :	4 channels / sensor maximum (measuring and function channels, depending on sensor type)
A/D converter :	delta-sigma, 16-bit resolution
Measuring rate :	2.5 / 10 measuring operations per second continuous on all channels
System accuracy :	±0.05% of measured value ±2 digits
Temperature drift :	0.01% / K
Cold junction compensation :	± 0.2 K ±0.01 K / °C (-30 to +80 °C)
Sensor power supply :	Mains adapter:approx. 12 V, maximum 70 mA
Outputs :	1 ALMEMO® socket for analog module or interface
Option OA 8390-I	RS-485 interface, electrically isolated, integrated Signals : RX+, RX-, TX+, TX-, line, max. 1 km
Option OA 8390-Rx	Analog output R2 : 0 to 10 V, R3: 0/4 to 20 mA, electrically isolated Accuracy : ±0.1% ± 6 digits, resolution : 15 bits Temperature drift : 1 digit / K
Option OA 8390- Rx2	2 analog outputs R22 : 0 to 10 V, R32: 0/4 to 20 mA, electrically isolated Accuracy : ±0.1% ± 1 digit, resolution : 12 bits Temperature drift : ± 0.005 % / K
Equipment	
Display :	6½-digit 7-segment, 2-digit 16-segment, 12 mm
Keypad :	5 membrane keys
Date and time-of-day :	not buffered
Microprocessor :	NEC 78F0078
Power supply :	7 to 13 V DC, not electrically isolated
Mains adapter :	ZB 1012-NA, 230 V AC to 12 V DC, 200 mA,
electrically isolated	
Option OA 8390-U	9 to 30 V DC electrically isolated
Current consumption	Without input and output modules : approx. 6 mA With analog output option : approx. 50 mA + 2.5 x actually analog current
Housing	108 x 60 x 29 mm, polystyrene
Operating temperature	-10 to +60 °C
Storage temperature	-30 to +60 °C
Ambient relative humidity :	10 to 90 % (non-condensing)
Delivery includes :	Measuring instrument ALMEMO® 8390-2 Operating instructions ALMEMO® 8390-2 ALMEMO® Manual AMR-Control software on CD

Product overview

	Order No.
Universal measuring instrument ALMEMO® 8390-2	
1 input, maximum 4 channels, with LCD and 5 keys, output for interface or analog output	MA 8390-2
Option HS: Adapter for top-hat rail mounting	OA 2290-HS
Option U : DC voltage supply, electrically isolated, 9 to 30 V DC	OA 8390-U
Option I: RS-485 interface, electrically isolated (including option U)	OA 8390-I
Option R2: Single analog output, 0 to 10 V, 15 bit, electr. isolat.	OA 8390-R2
Option R3: Single analog output, 0/4 to 20 mA, 15 bit, electr. isolat.	OA 8390-R3
Option R22: Double analog output, 0 to 10 V, 12 bit, electr. isolat.	OA 8390-R22
Option R32: Double analog output, 0/4 to 20 mA, 12 bit, electr. isolat.	OA 8390-R32

Accessories

Mounting plate with 2 clips	ZB 8390-H
Mains adapter 12 V / 200 mA	ZB 1012-NA1
ALMEMO® analog output cable, - 1.25 to 2.00 V, 0.1 mV / digit	ZA 1601-RK
ALMEMO® V24 data cable, electrically isolated, maximum 115.2 kbaud, <1 mA	ZA 1909-DK5
ALMEMO® V24 data cable, optic-fiber, maximum 115.2 kbaud, <4 mA	ZA 1909-DKL
ALMEMO® data cable, Ethernet interface (10/100 base-T), electrically isolated	ZA 1945-DK
ALMEMO® RS-422 network distributor, electrically isolated, maximum 115.2 kbaud, approx. 30 mA	ZA 5099-NVB
ALMEMO® data cable, Centronics interface, electrically isolated	ZA 1936-DK
ALMEMO® input / output cable for triggering and limit value alarm	ZA 1000-EGK

Software :

Measured value acquisition software WIN-Control	SW 5500-WCx
Software option for connecting via Ethernet (not WC3)	SW 5500-WC06
Software option AMR2ips for several devices connected via Ethernet	SW 5500-C22

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