AHLBORN
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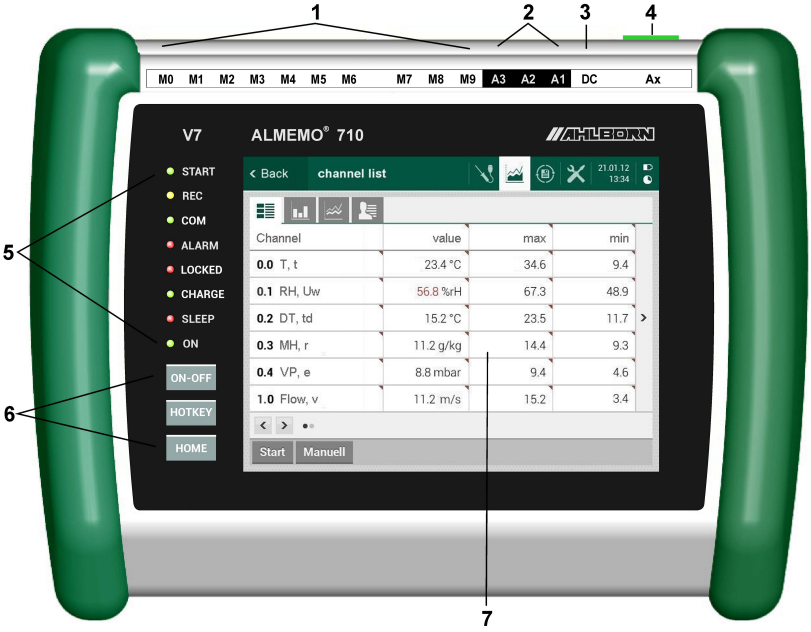
Operating instructions

Data logger
V7 ALMEMO® 710

V1.6
13.07.2015

1. OPERATING CONTROLS



(1) Measuring sockets M0 to M9

M0 ... M9 for all ALMEMO sensors

M0.0...M9.9 for up to 100 meas. channels

(2) Output sockets A1, A2, A3

A1 USB Interface (ZA1919-DKU)
RS 232/LWL (ZA1909-DK5/DKL)
RS 422 (ZA 5099-NVL/NVB)
Ethernet (ZA 1945-DK)
Analog output 2 (ZA 1601-RK)

A2 Network cable (ZA1999-NK5/NKL)
Trigger input (ZA 1000-ET/EK)
Relay outputs (ZA 1006-EGK)
Relay trigger adapter (ZA 8006-RTA)
Analog output 1 (ZA 1601-RK)

A3 SD card connector (ZA1904-SD)

(3) Socket, DC 12V

DC Mains adapter (ZA1312NA9, 12V, 2.5A)
Cable, el. isol. (ZA 2690-UK2, 10-30V)

(4) Ax **Emergency switch**, hidden

(5) Status LEDs

START	Meas. operation is running.
REC	Data is being saved.
COM	Data is being output.
ALARM	Limit value infringement.
LOCKED	Block function is active.
CHARGE	Battery is being charged.
SLEEP	Sleep mode
ON	Device is switched ON.

(6) Touchtasten

ON-OFF	To switch ON / OFF.
HOTKEY	To call up a desired menu.
HOME	Start screen

(7) Touchscreen

Zurück	return to the last meas. menu
	Sensor menu
	Measured value display
	Data logger
	Settings
21.01.12	Date, time-of-day
	Battery charge status, Memory

2. TABLE OF CONTENTS

3. GENERAL

Congratulations on your purchase of this latest V7-generation ALMEMO® data logger. Thanks to the patented ALMEMO® plug the device configures itself automatically and thanks to the self-explanatory touchscreen its operation should be fairly straightforward. The device can, however, be used with such a wide range of sensors and peripherals and offers many different special functions. You are advised to take the time to carefully read these operating instructions and the relevant sections in the ALMEMO® Manual and to properly familiarize yourself with the way the new D7 sensors function and with the extended range of features the V7 device can now provide. This is the best way to avoid operating and measuring errors and prevent damage to the device. To help you find answers to your questions as quickly and easily as possible a comprehensive index is provided at the end of these instructions and at the end of the Manual.

3.1 Warranty

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

This manufacturer's guarantee will not apply in the following circumstances :

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

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

3.2 Standard delivery

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

- Measuring instrument ALMEMO® 710
- with 2 rechargeable battery packs and folding stand
- Mains adapter
- These operating instructions
- ALMEMO® Manual
- CD with ALMEMO® Control software and various useful accessories

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

3.3 Waste disposal

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

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

4. SAFETY INSTRUCTIONS

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

Before starting to operate the device, please read the instructions carefully.

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

Such risks may occur in the following circumstances :

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

DANGER **Risk of fatal injury through exposure to dangerously high voltage.**

Such risks may occur in the following circumstances :

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

DANGER **Warning - explosive atmospheres or substances.**

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

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

4.1 Special notes on use

- If the device is brought into the work-room from a cold environment there is a risk that condensation might form on the electronics. In measuring operations involving thermocouples pronounced changes in temperature may cause substantial measuring errors. You are advised therefore, before starting to use the device, to wait until it has adjusted to the ambient temperature.
- Before using the mains adapter make sure that the mains voltage is suitable.
- Measuring operations with thermocouples using the device-internal cold junction temperature should wherever possible be performed subject to the following operating parameters.
  - Running on rechargeable batteries
  - Display brightness level 1 (i.e. lowest level)

  Performing measuring operations with thermocouples in any mode other than this may involve a higher risk of measuring errors.
- Be sure to observe the maximum load capacity of the sensor power supply.
- Sensors with their own integrated power supply are not electrically isolated from one another. (see 8.5)
- Located on the rear of the device is a folding stand; when this is folded out the device can be positioned at an angle for better readability.

4.2 How to deal with rechargeable batteries

Usually when the device is delivered the battery pack is not fully charged. First of all therefore the battery should be charged using the mains adapter provided; continue until the LED '**CHARGE**' goes out.
Rechargeable batteries should be recharged as and when necessary.
A rechargeable battery pack must never be mechanically damaged, short-circuited, or thrown on the fire.
Rechargeable batteries are special waste and must not be discarded as normal domestic waste.

5. INTRODUCTION

The V7 data logger ALMEMO® 710 is a brand new member in our family of unique measuring instruments - all equipped with Ahlborn GmbH's patented ALMEMO® plug system. The ALMEMO® plug offers - and has offered for the last 20 years - decisive advantages when connecting sensors and peripherals because all parameters are stored in an EEPROM located on the connector itself; repeated programming is thus no longer necessary. All sensors and output modules can be connected to all ALMEMO® measuring instruments in the same way.
However, the new generation of intelligent digital ALMEMO® D7 sensors, operating in conjunction with our V7 measuring instruments, overcomes all limitations to which the system was previously subject. These sensors, irrespective of the device's measuring ranges and operating as an autonomous measuring system with up to 10 channels, offer completely new measurable variables with any necessary control functions, calculating functions, or compensation values and cover a range of values up to 8 digits and a speed of up to 1 kHz. What is so special about this new generation is that, thanks to individual sampling rates, high-resolution variables, both quick and slow, can now very easily be measured and recorded together. Individual sensor functions can be parametrized via a menu stored in the plug. To facilitate identification the quantity abbreviations and units have been extended to 6 digits and channel designation to 20 characters. All sensors belonging to the preceding V5, D6 generations can be used on V7 devices but the new D7 sensors are not compatible with V6 devices. However, they can be operated directly on the PC via the serial interface and an adapter cable. What is completely new on V7 devices is the channel numbering system. Sensors and sockets are counted from 0 to 9; this is followed by the channels counted as decimals also from 0 to 9; i.e. the first sensor has channels 0.0 to 0.9, the second has 1.0 to 1.9, etc. . However, programming and functioning are virtually identical for all units. The following points apply to all devices in the ALMEMO® measuring system; these are described in detail in the ALMEMO® Manual which is included in delivery with each device :

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

The operating instructions you are now reading cover only those features and controls that are specific to this device. Many sections refer to more detailed descriptions in the Manual; (see Manual X.X.X).

5.1 Functions of the ALMEMO 710

The ALMEMO® 710 data logger has 10 electrically isolated measuring inputs - suitable for all ALMEMO® sensors. Given the large portfolio of already existing standard sensors and now the new, innovative D7 sensors measuring possibilities are virtually limitless. The V7 device is operated by means of its 5.7-inch TFT touchscreen and its 3 touchkeys. The measured value display initially includes measured value lists, individual values, bar charts, and line graphs - but this can be adapted via configurable user menus to provide any function required for any application. The data logger function is implemented with an extremely accurate real-time clock (2 ppm) and a high-speed 8-MB flash memory sufficient for over 1.5 million measured values. There are three output sockets which can be used to connect any ALMEMO® output modules, e.g. digital interface, analog output, trigger input, memory card, or alarm contacts. Several devices can be networked by simply connecting them via network cables.

5.1.1 Sensor programming

The measuring channels are programmed, completely and automatically, via the ALMEMO® plugs. However, the user can easily supplement or modify this programming as and when necessary via the touchscreen or via the interface.

Measuring ranges

Appropriate measuring ranges are available for all sensors with a non-linear characteristic, e.g. 10 thermocouple types, NTC and Pt100 probes, infrared sensors, and flow transducers (rotating vanes, hot-wire 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 plug itself. Existing sensors can also be used - so long as the appropriate ALMEMO® plug is connected via its screw terminals. For digital input signals, frequencies, and pulses, adapter plugs are available with an integrated microcontroller. The new autonomous D7 sensors - not only now but also in the future - herald as yet unimagined possibilities in data acquisition though digital and analog sensors with all manner of data formats. It will even be possible to control the measuring system. It is thus possible to connect an increasing range of sensors to the ALMEMO® V7 measuring instrument and to change sensors without needing to reset.

Function channels

The maximum, minimum, average, and differential values of certain measuring channels can be programmed as function channels and can be processed and printed like normal measuring channels. There are also function channels available for special measuring tasks, e.g. to determine thermal coefficient Q/ΔT and the wet-bulb globe temperature.

Units

The units display (V5 2 characters, D7 up to 6 characters) can be adapted for

each measuring channel in such a way that both the display and the printout always indicate the correct units, e.g. when a transmitter is connected. Conversion between °C (Centigrade) and °F (Fahrenheit) is performed automatically.

Measured value designation

To help identify sensors an alphanumeric designation is also provided (V5 - 10 characters, D7 - up to 20 characters). This designation appears in each measured value display, in the printout, or on the computer screen.

Correction of measured values

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

There is also the possibility of performing multi-point adjustment or user-defined linearization.

Scaling

The corrected measured value on each measuring channel can also be further scaled in terms of zero-point and gain based on the base value and factor. The decimal point position can be set by means of the ´Exponent´ function. Scaling values can be calculated automatically by setting to zero and entering the nominal setpoint or by using the scaling wizard.

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 infringed an alarm signal is output and relay output modules actuate the associated alarm contacts; these can be allocated individually to specific limit values. Hysteresis is set by default to 10 digits; however, this can be adjusted to any value between 0 and 99 digits. A limit value infringement can also be used to automatically start or stop measured value recording or via macros to control device functions in any way required.

Sensor locking

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

5.1.2 Measuring operation

With standard up to 40 measuring channels are available for 10 sensors; i.e. it is thus also possible to evaluate double sensors, individually scaled sensors, and sensors with function channels. All activated default standard channels are scanned continuously at the conversion rate and the data acquired is shown in the display. A D7 sensor has up to 10 channels and a sampling rate corresponding to each individual measuring speed; this sampling rate can be applied individually over the new scan cycle.

Measured values

All measured values can be shown in the display in various configurable

menus as measured value list, single display, bar chart, or line graph. Measured values are acquired automatically with auto-zero and self-calibration; however, they can also be corrected and scaled as and whenever required. With most sensors a sensor breakage is detected automatically.

Analog output and scaling

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

Measuring functions

To achieve optimal measured value acquisition some sensors require certain special measuring functions. 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, dynamic pressure, and O2 sensors. With digital D6 and D7 sensors these various compensation measures are performed in the sensors themselves.

Measured value smoothing

With standard sensors measured values of an unstable, fluctuating nature can be smoothed by taking a sliding average over a number of values programmable from 2 to 99. The averaging period will depend on the conversion rate and the number of active channels. However, D7 sensors are assigned their own averaging period for all primary channels; this can be set via the sensor menu.

Maximum and minimum values

Each measuring operation acquires and stores the maximum and minimum values with date and time-of-day. These values can then be displayed, printed out, or deleted from memory.

Average value

Measured values can be expressed as a continuously smoothed sliding average or as the average obtained over a particular period or cycle or over a series of specified measuring operations.

5.1.3 Process control

In order to record the measured values from all connected sensors in digital form measuring channel scanning must be performed continuously with measured value output according to a time-based process control. The measuring operation can be started and stopped by means of the keypad, the interface, an external trigger signal, the real-time clock, or by a specified limit value infringement. The standard cycle, settable from 1 second up, ensures even, cyclic output. If a higher speed is required, standard sensor values can be output at the conversion rate; however, all sensors can now use the new scan cycle, which obtains measured values from each channel individually according to its own actual measuring duration.

Date and time-of-day
Each measuring operation can be accurately logged using the real-time clock in terms either of date and time-of-day or purely by actual measuring duration. For the purposes of starting / stopping a measuring operation, the start / stop date and time-of-day can be programmed.

Output cycle
The output cycle can be programmed to any value between 1 second and 59 hours, 59 minutes, 59 seconds. This function permits cyclic output of measured values to the interfaces or to the memory and provides cyclic calculation of the average value.

Cycle factor
The cycle factor can be used to restrict data output from particular channels; this may prove necessary in order to reduce excessive data flow especially while measured data is being saved.

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

Conversion rate
All standard channels are scanned continuously at the conversion rate (2.5 / 10 / 50 / 100 measuring operations per second).

Scan cycle
With the ALMEMO® 710 there is also the superordinate scan cycle, which acquires all standard and D7 channels whenever these deliver a new current measured value. Recording can be accelerated if measured values thus acquired are stored to memory and / or output via the interface immediately.

Measured value memory
All measured values can be saved to a flash memory either manually or automatically per cycle or scan cycle. Memory capacity is 8 MB, sufficient for between 400,000 and over 1.5 million measured values. This memory can be organized and configured in either linear or ring form. All measuring operations found to have a modified sensor configuration are assigned a new numeric file name. Each measuring operation can also have a comments text attached; this can be up to 64 characters in length. Output is via the interface. Selection can be made according to file name, number, or date.
Memory capacity can be increased substantially by using an external memory connector with a micro SD memory card. With an external memory connector (available as an accessory) files can be read out very quickly via any standard card reader.

Numbering of measuring operations
By entering a 6-digit number single scans or entire series of measuring operations can be identified and selectively read out from memory.

Control inputs and outputs

Up to 10 output relays or 4 analog outputs can be addressed individually via the touchscreen or via the interface with a relay trigger adapter . Via the trigger inputs it is also possible for external events to influence the measuring sequence.

Operation

All measured values and function values can be displayed in different menus on the touchscreen. For your individual applications user menus can be configured independently. The device can be operated via its state-of-the-art touch display. Sensors, device, and process control can thus be fully programmed.

Output

All measured data and programming parameters can be output to any peripheral equipment. The header can be programmed to refer specifically to your company or to a specific application. USB, RS-232, and Ethernet interfaces are available via the appropriate interface cables. To accommodate the variable data quantities and certain new parameters for operating D7 sensors the interface protocol has been changed so that data is now output in table format only; this can then as required be processed directly using any standard spreadsheet program.

Networking

All ALMEMO® devices can be addressed and can be easily networked by simply linking them together via network cable or Ethernet adapter or, for longer distances, via RS-422 network distributors. However, given the modified protocol, older V5 / V6 devices and V7 devices must now be operated via separate interfaces.

Software

Each ALMEMO® Manual is accompanied by the ALMEMO® Control software package, which can be used to configure the measuring instrument, to program the sensors, and to read out from the measured value memory. Using the integrated terminal, measuring operations can also be performed online. The WINDOWS® software package WIN-Control for measured value acquisition from networked devices, for graphical presentation, and for more complex data processing tasks is now available in a new version; this can be used to operate V5 / V6 devices and V7 devices via separate interfaces.

6. PUTTING INTO SERVICE

Sensor connection Connect sensors to sockets **M0** to **M9 (1)**. see 8
Power supply Via rechargeable battery or charge adapter connected at socket **DC (3)** see 7.1, 7.2
To switch ON Press and hold down touchkey ON-OFF **(6)** . see 7.5
Automatic display of last measuring menu see 11

To select data logger menu using tab:

Once-only output see 10.4 Manual
Cyclic measuring Enter save-to-memory cycle:
Output cycle (hh:mm:ss) with saving see 9.7
or scan cycle (hh:mm:ss.sss) with saving
To start cyclic measuring Start see 10.4

To select measured value display

1. To select **channels list**

see 9.2

Display of **max. / min.** values in channels list
To **delete** touch on appropriate **max. / min. field.**

For single display select the required channel from list, e.g.

2. To select **bar chart**

3. To select **line graph**

4. To select **user menu**

To stop measuring Stop

To **output from memory** to printer or to computer

Memory output via interface
- Connect peripheral equipment via data cable to socket **A1 (2)** (see Man. 5.2)
- On the peripheral device set 9600 baud, 8 data bits, 1 stop bit, no parity.

To select data logger menu

To select memory output see 10.6

To start output Start output
To delete memory content Delete memory

7. POWER SUPPLY

Power can be supplied to the measuring instrument in any of the following ways :
Integrated lithium-ion battery pack, 4.2 V / 15.6 Ah as standard
Mains adapter / charge adapter, 12 V, 2.5 A ZA 1312-NA9
Power supply cable, electrically isolated (10 to 30 VDC, 1 A) ZB 2690-UK2
Our product spectrum covers all the appropriate accessories.

7.1 7.1 Rechargeable battery operation and supply voltage monitoring

This device is normally powered by a rechargeable lithium-ion battery pack with 15.6 Ah. At a current consumption of approx. 500 mA the operating time with full illumination will be approx. 25 hours. If illumination is usually kept dimmed, the operating time can, depending on the brightness used, be extended up to 50 hours. To prolong the operating time for the purposes of long-term recording the device can be left in SLEEP mode. (see 10.3) Operating voltage and remaining battery capacity can be checked in the ´Power supply´ menu; this gives a basis for estimating the remaining operating time. (see 13.8) As soon as the remaining battery capacity drops to approx. 10%, the battery symbol  will appear in the status bar of the display. Now - at the very latest - the batteries must be recharged using supplied mains adapter ZA 1312-NA9 (12 V / 2.5 A); this will save the measuring operation from being interrupted. (see 7.2) Thanks to the intelligent charge circuitry, the batteries can in fact be recharged at any time and in any charge status. If the batteries are completely discharged, the device will switch off but measured data and the time-of-day will be saved intact. (see 7.6)

7.2 Mains operation

To power the device from an external source or to recharge the batteries, mains adapter ZB 1312-NA (12 V / 2.5 A) should be connected at socket DC (3). When the mains adapter is plugged in, the green ´**CHARGE**´ LED lights up indicating that the batteries are being recharged. Batteries that have been switched off will take approx. 3 hours to be recharged; after this the LED goes out again and the charge circuitry switches to trickle charge. Batteries that remain in use will take longer to be recharged because of normal consumption and the reduced charging current. The mains adapter can in fact be left permanently connected to the device in buffer mode without risk of overcharging the batteries.

7.3 External DC voltage supply

The **DC** socket (3) can also be used to connect another DC voltage, 12 V. It can be connected using ALMEMO® plug ZA 1312-FS9 (12V, 2.5A). If, how-

ever, the power supply has to be electrically isolated from the transducers or if a larger input voltage range (10 to 30 V) is required, then electrically isolated supply cable ZA 2690-UK2 (12V, 1A) must be used. It will then be possible to use the device in a 12-volt or 24-volt on-board supply system; however, the battery will slowly be recharged.

7.4 Sensor supply

At the terminals + (plus) and - (minus) in the ALMEMO® plug there is a configurable sensor supply voltage available (self-healing fuse, 500 mA). This voltage is derived automatically from the minimum sensor supply voltage for all sensors; however, this can be replaced as and when required with a higher voltage. It can be programmed in the menu ´**Settings** > Power supply > Sensor voltage setpoint´. (see 13.8)
In mains operating mode the sensor voltage is set automatically to 12 V. Other voltages (12 / 15 / 24 V or references for a potentiometer and strain gauge) can also be obtained using special plugs. (see Manual 4.2.5/6).

7.5 Switching ON / OFF, reinitialization

To switch the device ON / OFF press and hold down the touchkey ON-OFF **(6)**.
The measuring menu most recently selected always appears in the display first.
After the device is switched off the real-time clock continues to run and all saved values and settings are retained intact. (see XREF)
If interference (e.g. electrostatic) or a malfunction (e.g. battery failure) causes the device to behave abnormally, it can, by means of a slide switch located under the rubberized cover Ax **(4)** on the rear of the device, be switched off and then back on again. A **reset** is performed as follows : shortly after switching on with the slide switch, also press the HOME key. This will have the effect of deleting all device programming and user menus; only the time-of-day, memory, device designation, device adjustment, and sensor programming in the ALMEMO® plugs remain intact.

7.6 Data buffering

The sensor's programming is stored in the EEPROM in the sensor plug; the device's calibration and programmed parameters are stored in the EEPROM on the device itself; and all recorded measured values are stored in the device's integrated flash memory - all on a failsafe basis. Date and time-of-day are buffered by a dedicated lithium battery; this data is retained intact for years - even if the device is kept switched off and the batteries are empty.

8. SENSOR CONNECTION

Virtually any ALMEMO® sensor can be connected at any of ALMEMO® input sockets M0 to M9 (standard so-called V5 sensors and newer D6 and D7 digital sensors included). The ALMEMO® Manual includes detailed descriptions of the comprehensive ALMEMO® range of sensors (see Manual Ch. XREF) and instructions for connecting your own existing sensors to ALMEMO® instruments (see Manual Ch. 3). To connect your own existing sensors you simply need the appropriate ALMEMO® plug. All standard sensors with an ALMEMO® plug usually have the measuring range and units already programmed and can thus be connected to any input socket without further adjustment. A mechanical coding system ensures that sensors and output modules can only be connected to the correct sockets. All ALMEMO® plugs incorporate two snap-lock levers; these snap into position as soon as the plug is inserted into the socket, thus preventing unintended disconnection if the cable is pulled accidentally. To withdraw the plug both these levers must first be pressed in at the sides.

8.1 Standard sensors (V5), V6

ALMEMO® standard sensors (V5) are housed in a light-gray case. The exclusive source of their intelligence is an 2-KB EEPROM integrated in the sensor plug, in which all channel settings are stored; the device is thus programmed completely as soon as such a sensor is connected. With the newer V6 version incorporating a 4-KB EEPROM (E4) multi-point calibration can be performed on the sensors. Passive analog sensors are electrically isolated from one another by means of photovoltaic relays; all signals in the device are converted analog-to-digital. Digital sensors used for the quantities - frequency, pulse, or DIGI - contain a microcontroller, which transfers digital signals to the device via an I2C bus. Measured values are processed in synchrony with the conversion rate (maximum 100 measuring operations per second) and at a resolution of maximum ±65000 all in the device including linearization and various forms of compensation.

8.2 D6 sensors

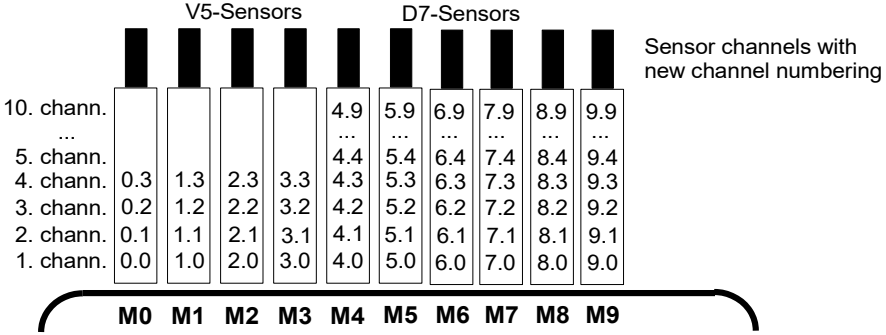
ALMEMO® D6 sensors are housed in a partly light-gray, partly dark-gray case; they are completely autonomous measuring modules not only for digital but also for analog sensors; they can, independently of the device, handle new measuring ranges with special measured value processing and various forms of compensation. As regards measured value processing D6 sensors are fully compatible with standard sensors (except for multi-point calibration and damping); however, quantity configuration and parametrization can only be performed via special menu ´Sensor configuration´ and using an adapter cable, the serial interface, and a PC - or using a new V7 device. (see 13.1).

8.3 D7 sensors

ALMEMO® D7 sensors are housed in a dark-red case; they too are completely autonomous measuring modules for digital and for analog sensors - but offer substantially enhanced properties. The conversion rate can be set from 1 millisecond up to several minutes with a resolution up to 8 digits. The number of channels has, thanks to a new numbering scheme, been extended up to 10 per sensor and up to 10000 per device. Channel designations can be up to 20 characters and units up to 6 characters in length. With D7 sensors up to 4 primary channels can also at the same time be smoothed internally over the averaging period. For the purpose of setting individual parameters (e.g. quantities, averaging period) a special menu ´Sensor configuration´ is provided by the sensor itself. (see 13.1) All measured value processing is performed in the sensor itself; the resulting data is no longer transferred via an I2C bus but via the serial interface alone. For this reason and because of the expanded data format D7 sensors can only be operated in conjunction with a V7 device or directly on a PC.

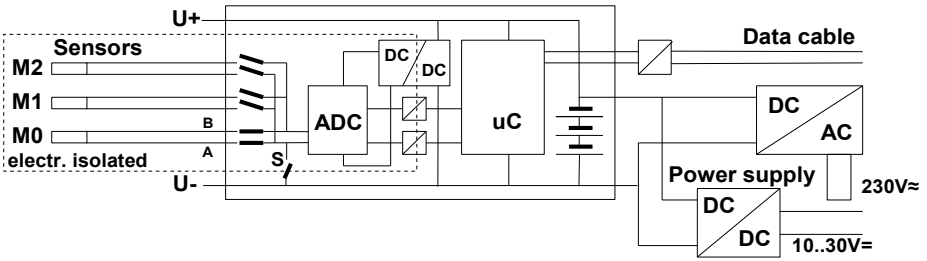
8.4 Measuring inputs, additional channels

Measuring instrument ALMEMO® 710 incorporates 10 input sockets M0 to M9 (1); to these, under the new channel numbering scheme, measuring channels M0.0 to M9.0 are initially assigned. Whereas standard sensors can if necessary provide up to 4 channels (M0.0 to M0.3, M1.0 to M1.3, etc.), D7 sensors can provide up to 10 (M0.0 to M0.9, M1.0 to M1.9, etc.). The additional channels can be used in particular for humidity sensors with 4 measurable variables (temperature / humidity / dew point / mixture ratio) or for function channels. Each sensor can if necessary be programmed with several quantities or scaling settings; 2 or 3 sensors, if pin assignment so permits, can be combined in a single plug (e.g. RH / NTC, mV / V, mA / V, etc.). This device does not incorporate any internal channels. On the measuring instrument this gives the following channel assignment :



8.5 Potential separation

When organizing a properly functioning measuring setup it is very important to ensure that no equalizing current can flow between sensors, power supply, and peripherals. All measuring points must therefore either be insulated (e.g. by air spacing) or lie at the same potential - and any unequal potentials that do exist must be electrically isolated.



The 10 analog inputs on this device are electrically isolated from one another by means of photovoltaic relays. A new feature is the additional separation of the measuring inputs from the CPU and power supply. However, for some analog sensors this electrical isolation may have to be disabled again by means of relay S (see above) or a wire jumper; some inputs would otherwise be left without reference potential. The first time any such sensor is connected this relay is set automatically by means of element flag 5 'ISO OFF'.(see Manual 6.10.3).

However, with certain connectors (especially divider connectors without power supply) element flag 5 should be checked and if necessary corrected. Between all inputs and outputs (even those analog output cables not electrically isolated) the maximum potential difference permitted is 50 V. The voltage at the measuring inputs themselves (between B, C, D, and A) must not exceed 12 V.

However, some components are not electrically isolated, namely all sensors connected to the common internal power supply ±U (including all D6 and D7 sensors) and sensors combined within one connector. No such problems affect sensors without any conductive connection (D6). For D7 sensors (in particular electrical measuring connectors, conductivity probes) an adapter cable ZAD700-GT is available; this provides electrical isolation for the power supply and data lines. Non-insulated sensors can be sufficiently protected by electrically isolating the power supply (battery, mains adapter, or connecting cable with DC/DC converter).

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

9. DISPLAY AND KEYPAD

The operator interface **(7)** on data logger ALMEMO® 710 is a state-of-the-art capacitive touchscreen; the display comprises five 7" TFT LCDs (VGA resolution 640 x 480 pixels); there are also 3 additional touchkeys **(6)**.

9.1 Touchkeys

The touchkeys **(6)** operate independently of the touchscreen.

ON-OFF	To switch ON / OFF press and hold down.
HOTKEY	To call up a desired menu press and hold down. To select touch on appropriate field.
HOME	To return to the HOME screen.

9.2 Displaying and selecting an application

When the device is switched on for the first time, the HOME screen is displayed. In this screen any of the main applications displayed can be selected by simply touching the appropriate field.

Sensor with all its assigned measuring channels and parameters

Display with channels list, bar chart, line graph, user menus

Data logger with the process control, memory management

Settings for all applications

Wizards to help with complex applications

Block function for individual access locking

General device settings for setting the date, time-of-day, language, and display brightness

You can at any time toggle back and forth between the first 4 main applications and their respective current status by touching the appropriate tabs located along the top edge of the screen.

To return to the screen previously viewed toucht

9.3 Function keys

For the purpose of controlling measuring operations there are just a few super-ordinate keys located along the bottom edge of the screen.

To start a cyclic measuring operation see 10.4

To stop a cyclic measuring operation

Once-only **manual** output / saving of all measured values

Call up **settings** for local menu

key in the menu

If applications occupy more than one page, the arrow keys can be used to access the current page.

9.4 Status LEDs

The status LEDs **(5)** report the current device status as follows :

ON		Device is switched ON.
SLEEP	flashes briefly just once	Device is in sleep mode.
CHARGE		Device's batteries are being recharged.
START	is lit continuously	Cyclic measuring has started.
	lights up briefly	Once-only measuring channel scan
REC	is lit continuously	Cyclic measuring channel scan with data saving This also lights up during output from memory.
	flashes	Data saving at scan cycle
	lights up briefly	Once-only measuring channel scan with data saving
COM	is lit continuously	Cyclic measured value transmission to PC
	flashes	Measured value transmission to PC at scan cycle
	lights up briefly	Once-only measuring channel scan transmits data to PC
ALARM		Limit value infringement or sensor breakage
ALARM	flashes	Supply voltage to device too low
LOCKED		Key operation is restricted by block function.

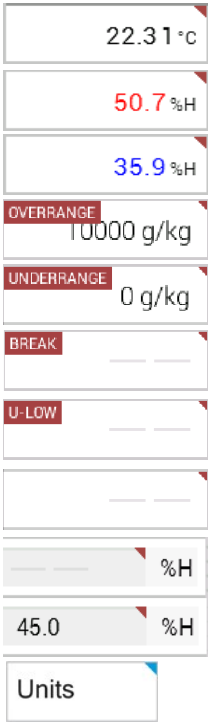
9.5 Status symbols

Battery status and memory status are displayed on the far right of the top line.

Battery charge status full/normal/almost empty/being recharged
Memory status empty / normal / almost full
By touching on the appropriate symbol the exact status can be viewed in the associated menu..

9.6 List of parameters

All measured values and parameters are shown in fields in various ways together with additional symbols.



Measured value

Limit value overshoot in red

Limit value undershoot in blue

Measuring range overshot OVERRANGE flashes

Measuring range undershot UNDERRANGE flashes

Sensor breakage BREAK flashes

Sensor voltage too low U-LOW flashes

A red triangle in the top right corner indicates that by touching on it a further menu can be called up.
The parameters in this menu are not yet programmed but they can be programmed.

Parameters are programmed.

A blue triangle in the top right corner indicates that by touching on it a help text can be called up.

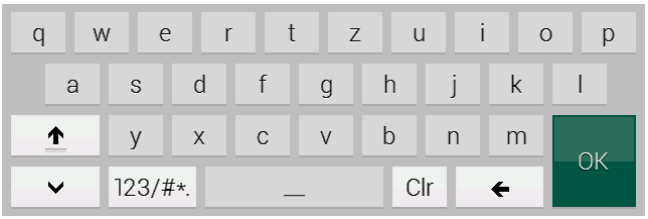
9.7 Entering data

First touch on the parameter in question and then use the numerical keypad to enter data.

To delete a parameter	Clr
To delete a character to the left	←
To change the arithmetic sign	±
To abort without saving	⌄
To save and quit	OK

Enter alphanumeric designations using the alphanumeric keypad.

e.g. Measuring channel designation



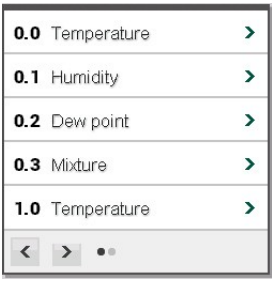
For upper-case letters ↑
For numbers and special symbols 123/#*.

For letters only ABC

Some device settings can only be used on a temporary basis; others can be permanently saved.

Other data that can be entered

Selection box

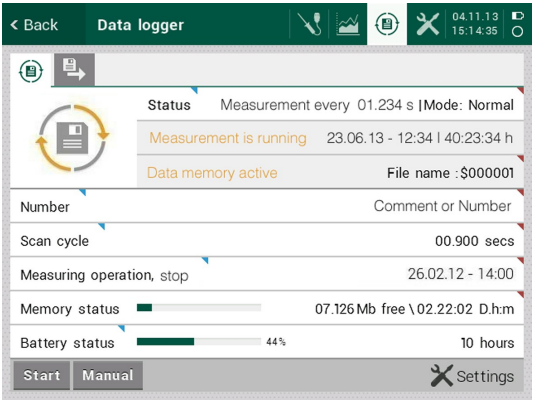


Quasi-analog values (display brightness)

ON / OFF switch for functions

Activation of functions

10. DATA LOGGER



Normally the function of this measuring instrument is, using suitable sensors, to acquire specified measured values in a specified chronological sequence and to save these to a specified storage medium. Since these sensors are normally already fully programmed by the ALMEMO® system and thus ready-to-operate, only the process control needs to be configured . To do this select the ´Data logger´ application by touching on tab .

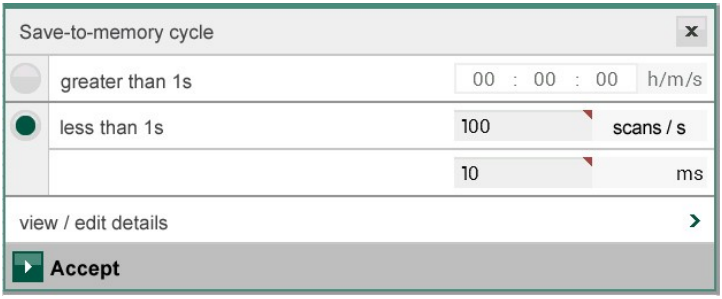
The menu functions show the data logger status; settings can now be entered by touching on the appropriate field.

Time-of-day	Call up the date and time-of-day by touching on the tab in the top line.
Status	Cycle, scan mode (normal, sleep, monitoring, failsafe)
Measuring operation	Stopped / running, since starting time, actual measuring duration since start
Data memory	Active / inactive as per activation with save-to-memory cycle, file name
Comments text	Comments text or number for measuring operation
Save-to-memory cycle	Scan cycle or output cycle with saving-to-memory activated
Measuring start / stop	Key, start / stop time, fixed measuring period, limit value action
Memory status	Remaining memory capacity, remaining save-to-memory time, delete memory content
Battery status	Charge status, estimated remaining operating time
Start / stop, manual	Manual key operation for measured value acquisition / output

10.1 Measured value acquisition / output

Measuring channel scans are needed for the following purposes - to continuously acquire and monitor measured values from all measuring channels, to record maximum / minimum values, and to detect limit value infringements, and then to save all this data in the device. With standard sensors this is still performed as previously at the conversion rate but with new D7 sensors a superordinate scan cycle has been added. Output to a specified storage medium or via the interface to a PC can be performed in synchrony either with this new scan cycle or, for greater cyclic intervals, with the output cycle. Or, as an alternative, with some applications outputs can also be performed manually at specific times. (see Manual 6.5) The ALMEMO® 710 incorporates as standard an internal 8-MB flash memory. To handle larger data quantities or to transport data quickly and easily an external memory connector with a micro-SD card (ZA 1904-SD) can be used.

If the user touches on the button ´Save-to-memory cycle´ and then selects ´greater than 1s´ or ´less than 1s´ this is usually equivalent to choosing between the output cycle and the scan cycle.



Or, instead of the scan cycle, the user can enter the desired scans per second directly. The scan cycle and the associated conversion rate are then calculated automatically. In straightforward cases the user can simply accept this setting ´as is´ by means of ´Apply´; in special cases it is better to check by means of ´Display / edit details´. These settings ´Data logger 1/4´ can also be accessed directly on the data logger via the option ´Settings´ in the bottom line.

10.1.1 Conversion rate

All active standard sensors (analog, DIGI, D6) are scanned continuously one after the other at the conversion rate of the A/D converter. This conversion rate can be 2.5 / 10 / 50 / 100 measuring operations per second (mops) (see Manual XREF); the desired rate can be set via the option ´Settings´ in the bottom line and the selection box ´Conversion rate´. The scan time for all standard sensors currently connected is continuously calculated and displayed.

The rate is set by default to 10 mops. It should be noted, however, when selecting the conversion rate, that the higher the rate so the lower the measuring quality and, conversely, the lower the rate, the higher the quality.

The physical response speed of the sensors must also be considered; ignoring this may produce a lot of irrelevant junk data.

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

10.1.2 Scan cycle with output

With the new intelligent D7 sensors the minimum actual measuring duration is stored in the sensor plug itself; depending on the sensor this may be from 1 millisecond up to several minutes; it is listed in the sensor overview. To scan all the measuring channels of standard or D7 sensors a new scan cycle has been introduced; this scans only those measured values that have been up-

dated since the last scan; i.e. in a short scan cycle only high-speed sensors will appear for most of the time, the slower ones being added at larger intervals. This method ensures that the measuring instrument can adapt to a wide variety of sensors - without duplicating a lot of unwanted data.
The device can be further adapted to the specific needs of the user's own applications by selecting the most suitable output cycle.
The device will automatically offer its own suggestions in a selection box; (D7 options are only available if a D7 sensor is connected).

D7 minimum time	By selecting the minimum time a high-speed D7 sensor can be scanned at maximum speed (total sampling rate up to 4000 measuring operations per second). If even more measured values occur per second, the scan cycle will be prolonged automatically in increments of 1 ms and some of the high-speed measuring points may be omitted.
D7 optimum time	Optimum time is the shortest cycle that can, with the current sensor configuration, always be sustained.
Conversion time	This scan cycle corresponds to the conversion time for one channel; i.e. normally with each cycle one V5 channel and all updated D7 channels will be scanned and assigned a time-stamp. However, as soon as all V5 channels have been scanned at least one special measuring operation is performed to allow the A/D converter to self-calibrate. If thermocouples are connected, two additional internal cold junction measuring operations will also be required.
Scan time	The scan time is the scan cycle for all standard sensors at the conversion rate including one special measuring operation and possibly two cold junction measuring operations (see above).
D7 maximum time	This is the shortest scan cycle in which all measuring channels are always scanned and displayed.

Output per scan cycle

All measured values acquired in a scan cycle can also be output and / or saved to memory immediately. Both these functions can be activated separately as and when required via the menu (see man. 6.5.1.3)

Save in scan cycle 

Output in scan cycle 

10.1.3 Output cycle

Measured values can be saved and / or output via the interface on a cyclic basis using the ´Output cycle´ in the format h/m/s.

If a channel is programmed to averaging mode CYCL, average, maximum, and minimum values are all deleted with each cycle.

After a reinitialization **activation of saving-to-memory** with each cycle or manual scan, i.e. cyclic saving of data to memory, is automatically enabled; however, it can be disabled if so required.

Save with output cycle or manually

There is no longer a choice of **output formats** (see Manual 6.6.1) because the expanded range of values can only be expressed in table format. This format is now used for both the output and saving of measured values; it is, as always, ideally suitable for further processing with any standard spreadsheet program; (see screenshots, Manual 6.1).

10.1.3.1 Cycle factor

To adapt data recording to the speed of change on each individual measuring channel certain measuring channels can still be programmed with a cycle factor between 00 and 99 which will cause them to be output less frequently or not at all. (see Manual 6.10.6) This cycle factor is by default completely disabled or set to 01 for all measuring channels; i.e. all activated measuring channels are output in each cycle. If factor 10 is entered, the measuring channel in question will only be output every 10th cycle; if 00 is entered it will not be output at all (effective cycle). With data saving, similarly, it is possible to suppress measured values that are unnecessary and to thus save on memory capacity.
This channel function can be programmed via
Settings > Channel functions > Measured value output > Cycle factor.

10.1.4 Memory, internal

The internal 8-MB flash memory is sufficient for between 0.5 and 1.5 million measured values (depending on the number of channels). In the event of a failure in the supply voltage the measured data is retained intact. The data format, here too, has been changed to table format and now, whenever the sensor configuration is changed, a new configuration file is saved; its file name, a 6-digit number, is incremented each time.
All parameters concerning the memory can be accessed by touching on ´Memory status´ or ´Settings´ > ´Memory´.
Changing the memory organization to ring memory (in which old data will be overwritten) is only possible for the internal memory. (see Manual 6.10.13.2).

Memory total	8000.0 KB internal
Memory free	5234.5 KB memory free, sufficient for 018.00:23 D-h-m
Activate ring memory	
Delete memory content	Delete memory content

☞ A user requesting memory content to be deleted is asked to confirm; if confirmed, it is always the entire content of the memory that is deleted, together with all files and all configurations.

10.1.5 Memory connector with memory card

If memory capacity proves insufficient or if data needs to be moved elsewhere for evaluation, you can, as additional external memory, use memory connector ZA 1904-SD (off R 3.11), available from our range of accessories, with an industrial-standard micro-SD memory card. Measured data is written to this memory card via the memory connector; this data is in standard FAT16 table format. The SD card can be formatted and its contents can be read out or deleted- using virtually any SD card adapter on any standard PC equipped with a card reader. This data can also be imported into MS-Excel or into WinControl.

The memory connector with the memory card can be connected at socket A3 (2); it will be recognized automatically. The increased memory capacity shown in the menu ´Data logger´ (see 10) and function ´Memory status´ shows that it has indeed been recognized. If the external memory is connected at the start of any measuring operation, it will be used. In the course of a measuring operation the external memory must not be unplugged; all temporarily buffered measured values would be lost.

To check that the memory connector is functioning properly there is an LED incorporated in the end of the handle; this indicates the following states :

- No memory card is detected. LED flashes once long and then three times short.
- Data is being recorded. LED flashes in the same rhythm as the cycle.
- Data is being read out. LED lights up continuously for the duration of data output.

☞ Please ensure, when plugging in the connector, that the card remains latched in position.
Memory cards do not support ring memory mode.

Here too the parameters ´Memory total´ and ´Memory free´ and the function ´Delete memory content´ can all be accessed via ´Memory status´.

☞ Here too a user requesting memory content to be deleted is asked to confirm; if confirmed, the entire card is reformatted and all files will be deleted. Selective deletion of individual files is only possible on the computer.

10.1.5.1 File name

Before starting any measuring operation you can, in the ´File name´ function, enter an 8-character file name. In the absence of a user-defined file name, the default ´ALMEMO.001´ or the name most recently used will be suggested automatically. So long as the connector configuration is not altered, any number of measuring operations can be saved - either manually or cyclically, also with number codes, all in the same file. (see 10.1.6)

If, however, the **connector configuration has been changed** since the last

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

10.1.6 Numbering of measuring operations

To identify each measuring operation or each series of measuring operations it can be assigned a unique number before starting - via ´Settings´ > ´Data logger 2/4´. This number will be output and / or saved with the start of the next measuring channel scan. When reading out individual measuring operations these can thus be attributed to certain measuring locations or measuring points. (see Manual 6.7)
A 6-digit number can be entered via the function ´Number´. (see 9.7)
The number is activated as soon as it has been entered; it will then be followed in the data logger menu by the letter ´A´ until the next cyclic or manual measuring operation is saved.

To deactivate / delete a number

Number (active) 120001 A

Number (deleted) — —

10.2 Memory - comments text

Before starting a measuring operation, an ´Comments text´ can be entered; this can be up to 64 characters in length and is used to denote its location, time, and / or subject. This will be saved in the memory configuration and will appear in the data logger main menu as an alternative to the number (if no number has been activated).

10.3 Scan mode

Menu ´Data logger´ > menu ´Settings - data logger 2/4´ via function ´Status´ or via ´Settings´ (page 2) Here in the function ´Scan mode´ you can choose between 4 different modes with autonomous operation or computer scanning via a selection box.

Normal Internal cycle or cyclic scanning by the computer
Monitor Internal cycle, not disturbed by computer scans
Failsafe Cyclic scanning by the PC; in the event of PC failure, internal cycle
Sleep Internal cycle only, automatically switching off for long-term monitoring.

Monitor mode

Monitor mode should be used when a data logger, being operated on a cyclic basis, is to be monitored occasionally by the computer. Internal cyclic scanning is not influenced in any way by software scanning; (in WinControl ´Safe initialization´ must be switched off). The internal output cycle is started as soon as the software starts; it may also have been started previously. When scanning

with the internal cycle no data is output to the interface. In order to record data the memory must have been activated.
In menu ´Data logger 2/4´ select scan mode ´Monitor´.

Failsafe mode
Failsafe mode is suitable when scanning is purely software-based; it merely ensures, in the event of computer failure, that scanning will continue on an internal cyclic basis. In this mode the cycle programmed in the device must be longer than that needed for software scanning. Software scanning keeps resetting the internal cycle with the effect that this cycle is only actually used in the event of the software scan failing; (in WinControl “safe initialization” must be switched off). The internal output cycle is started as soon as the WinControl software starts; it may also have been started previously. When scanning with the internal cycle no data is output to the interface. In order to record data the memory must have been activated.
In menu ´Data logger 2/4´ select scan mode ´Failsafe´.

Sleep mode
Sleep mode is suitable for long-term monitoring involving the device long measuring cycles. In energy-saving sleep mode the device switches off completely after each measuring channel scan (sensors with their own power supply) and switches on again automatically after the cycle expires - ready for the next measuring channel scan. In this way with just one battery recharge over 100,000 measuring channel scans can be performed; for a cycle lasting 10 minutes this in theory represents an available runtime of over 2 years.
If in menu ´Data logger 2/4´ the scan mode ´Sleep´ is selected, this will automatically activate ´Save per output cycle´ and automatically deactivate ´Save per scan cycle´ and ´Output´. If the output cycle is less than 2 minutes, it will be reset to this. To ensure that lower-speed sensors also have time to settle and deliver correct measured values, a sleep delay time will be set - normally automatically; this parameter must also be saved in the sensor connector.
To enable **data recording in sleep mode** the following parameters must be set :
1. In menu ´Data logger 2/4´ select scan mode ´Sleep´,
2. In menu ´Data logger 1/4´ enter output cycle of at least 2 minutes,
4. In a measurements menu, start measuring by pressing START
The device then switches itself off and as a check the red LED “SLEEP“ (5) starts to flash.
5. In the specified cycle the device switches on automatically, performs one measuring channel scan, and then switches off again.
6. To terminate sleep mode simply switch on ON
7. To stop measuring operation STOP

10.4 Starting and stopping measuring operations

In addition to starting / stopping a cyclic measuring operation by means of the Start / Stop keys or via the interface (see Manual 6.6) there are several other methods, e.g. start time and end time, fixed measuring period, or limit value actions.

Once a measuring operation has started (LED ´START´ lights up) no programming is permitted. Similarly, once a measuring operation has started, sensors must not be exchanged; a sensor connected in mid-operation will not be recognized or evaluated.

The function ´**Measuring start**´ gives access to menu ´Settings´ > ´Data logger 3/4´; here the ´**Start mode**´ can be set as manual or by start time. (see 10.4.1) To have the maximum / minimum / average values of all measuring channels deleted each time a measuring operation is started, this can activated in the next line (default). The ´**Stop mode**´ similarly can be set as manual or by stop time or after a fixed measuring period. (see 10.4.2). To start / stop a measuring operation as the result of a limit value infringement, ´**Limit value actions**´ (s. 13.2.8) must be called up or the trigger variants listed in Chapter 13.5.2.

As soon as a measuring operation starts, the data logger display changes.

LED´s :

- START
- REC
- COM

Status Measuring operation in save-to-memory cycle | Scan mode
Measuring operation running since start time | Actual measuring duration since start

A measuring operation **without memory activation** will be as follows:

LED´s :

- START
- COM

Once-only output / saving of all measuring channels

A once-only, manual measuring channel scan to acquire the current measured values from all active measuring channels (see Manual 6.5.1.1) can be performed by pressing the key Manual. The results will be saved if the memory is activated per scan cycle or per output cycle,
LEDs ´START´, ´REC´, ´COM´ light up briefly just once.

10.4.1 Start date and time, Stop date and time

A measuring operation can be started / stopped automatically at specified times. ´**Start date**´, ´**Start time**´ and ´**Stop date**´, ´**Stop time**´ can be programmed via menu ´Settings´ > ´Data logger 3/4´; this can be reached via the function ´**Measuring start**´ in menu ´Data logger´. If no date has been programmed, the measuring operation will be performed every day within the period set. This is assuming of course that the current time-of-day has been programmed. Or, alternatively, instead of specifying the stop time, the fixed measuring period itself can be programmed. (see 10.4.2)
The start and stop times can also be viewed in the main menu ´Data logger´ in function ´Measuring start / stop´.

10.4.2 Fixed measuring period

To have a measuring operation stop after a certain period elapses it is also possible, instead of programming the stop time, to program the ´**Fixed measuring period**´ itself - in menu ´Settings´ > ´Data logger 3/4´.
After the measuring operation starts, the remaining time can be viewed in the main menu ´Data logger´ in function ´**Measuring stop**´.
Measuring stop in 01:23:45 h/m/s

When recording to memory be sure to check whether a fixed measuring period has been programmed to ensure that this does not inadvertently cause recording to abort prematurely.

10.5 Memory status, delete memory content

While measured values are being recorded the memory capacity still available is continuously displayed in the menu ´Data logger´ in function ´**Memory status**´. By selecting this function in menu ´Settings - Data logger 4/4´ all memory data can be viewed.
´**Memory total**´ indicates the total memory size - in KB for internal or in MB for external (memory card).
´**Memory free**´ indicates the remaining memory capacity - in KB for internal and in MB for external (memory card) - and the memory time - in the format D.hh:mm - still available in the current scan cycle.
´**Ring memory**´ can only be activated for an internal memory; recording will then be unrestricted in terms of time. If the memory is full the oldest measuring operations will be overwritten.
There is also the function ´**Delete memory content**´.
However, before memory content is actually deleted, a confirmation window will open; confirming will clear the storage medium completely; i.e. all files will be deleted.

10.6 Memory output

The contents of the internal measured value memory can be output via the serial interface either selectively by touching on individual files or in excerpts. For outputs only table format is now available, as mentioned previously. Certain sections of the memory can be specified for output - either by stipulating ´**Start time**´ to ´**Stop time**´ or by selecting the ´**Number**´ defining the measuring operations in question.

In menu ´Data logger´ using tab  select ´**Memory output**´ and then one of the options ´**Read out file**´, ´**Read out time frame**´, or ´**Read out number**´, and then enter the parameters required.

Start output with key Start output

With **external SD memory** cards (see 10.1.5) the only option available is to output in table format all the measured data contained in the file most recently used.

The most sensible approach in these circumstances is to remove the memory card and copy all the files needed via a USB card reader directly onto the PC. These can then be imported either into MS-Excel or into WinControl (as of V.4.9).

Delete memory content

The button for deleting memory content is located in the bottom line. Delete memory However, before memory content is actually deleted, a confirmation window will open; confirming will clear the storage medium completely; i.e. all files will be deleted.

11. MEASURED VALUE DISPLAY

Having configured the time-based process control in menu ´Data logger´ we recommended that you display the measured values from your own application in the most suitable way possible. First select in the top line with tab :

measured value display options, then choose the most suitable display

channels list for all connected measuring channels (see 11.1)

bar chart for up to 4 selectable measuring channels (see 11.2)

line graph for up to 4 selectable measuring channels (see 11.3)

user menus configured according to your own requirements (see 11.4)

All measured value displays offer in the bottom line, just like the data logger, the buttons Start / Stop und Manual for controlling the measuring channel scan.

11.1 Channels list

The best overview of the measuring system with all measured values and the parameters for all channels can be obtained via the menu ´Channels list´. This first displays the measuring channel, channel designation, and the current measured value and maximum / minimum values. The arrows > and < can be used to access further columns; additional parameters can be programmed via the field in the top line. All parameters can be selected, edited, and implemented. Via the fields in the column ´Channel´ the user can also access a ´Measuring channel´ directly and have this displayed (see 12.1). Here all channel functions can be programmed (see 13.2).
In the ´Dual display´ option twice as many channels can be listed - but with just channel number, designation, and measured value; default display mode can be restored by means of ´Normal display´.

11.2 Bar chart

In the menu ´**Bar chart**´ the first 4 active channels are displayed, each with its respective channel designation and measured value and also a bar chart with automatic scaling.
Via selection box ´Channels´ or using the button ´Settings´ > ´Select channels´ any 4 channels, from all those available, can be selected for display.
On the next two pages the ´**Scaling mode**´ can be changed from ´Automatic´ to ´Fixed range´ with ´Maximum´ and ´Minimum´.
To have these settings saved permanently please use the key Save settings

11.3 Line graph

Via the menu ´**Line graph**´ and selection box ´Channels´ any five channels from all those available can be selected for graphical display . Before starting recording either via another menu or automatically as a result of a starting time or limit value action the channel must have been selected and settings must have been made.

The channels, their respective designations, and the units for the axes can be selected and if necessary modified by simply touching on them. Or, alternatively, the ´Settings´ button gives access to the page ´**Line graph - scales and channels**´. Here, similarly, via ´Select channels´ the units for the Y axes left and right and the colors for the channels can be defined.

On the next page ´**Axis scaling - left, right, and time axis**´ the scaling mode for the two **measured value axes** can be set.

´**Automatic**´ depending on the maximum and minimum of the measured value
´**Fixed range**´ with defined maximum and minimum
´**Fixed scaling**´ with a defined incremental step for scaling

For the time axis the following selections can be made :

The ´**Display cycle** ´ is the write time from pixel to pixel.

The scaling mode with **time axis** offers the following possibilities:

1. ´**Total measuring operation**´
   If writing is no longer possible because the graphic window is full, all values are compressed by 50% (maximum and minimum retained intact) and writing can continue albeit at a reduced rate (display cycle).
2. ´**Fixed range**´ with adjustable time frame
   If writing is no longer possible because the graphic window is full, all values are shifted by 50% to the left out of the window and writing can continue at an unaltered rate.

On the third page ´**Display options**´ the grid can be activated on a horizontal / vertical basis and the limit value lines of a selectable curve can be added.

Measured value acquisition

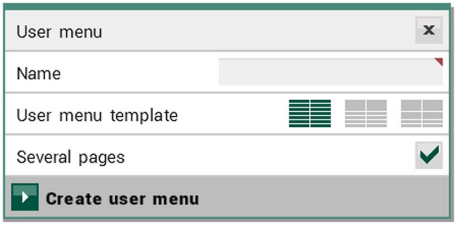
As soon as a **new measuring operation starts** any existing line graph in the graphics menu is deleted.

The measured values of the selected channels are then written per display cycle pixel by pixel from left to right as a line graph with 540 x 265 pixels. Maximum and minimum values within the display cycle are recorded and shown as vertical lines. The curve is updated continuously throughout the active measuring operation - even if the user leaves the menu.

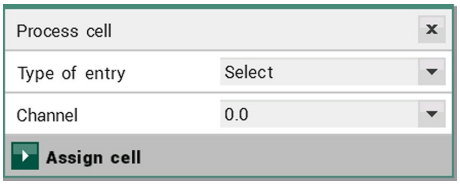
The device can save altogether up to 120 graphic windows, after which old data is overwritten (ring memory). On completion of a measuring operation the whole graphics buffer can be displayed in both scaling modes with different time axes; (for quick access use the tabs ´Settings´ and ´Line graph´).

11.4 User menus

Looking at the standard measuring menus you might conclude that the display of measured values and the various function combinations are not always ideally suited to the requirements of your particular applications. In addition to all the standard menus you can also call up a number of user menus; there are 3 user menus already preconfigured; other user menus can be freely configured, saved, and reloaded as you require. When the application ´User menus´ is selected, an overview of all existing user menus appears plus the further option ´Add user menu´. If you touch on this option a window appears for entering the name, menu template, and whether the menu is to be assigned more than one page. The template proposes an arrangement of function cells.



2 x 8 small cells
2 x 5 small cells and 2 large cells or
2 x 2 small cells and 4 large cells
Then an empty menu appears. You can select all the functions you require from the following functions list and the associated channels and, by touching on the individual cells, allocate these in any arrangement you want. For several fields it is possible, instead of the fixed channel assignment, to set the ´Selected channel´; this can then be confirmed in the course of normal operation via a selection box in the top line.



11.4.1 Functions

Measured value
Smoothing (see 13.2.2)
Channel designation (see 13.2.1)
Max. value, min. value (see 13.2.3)
Max., min., date, time-of-day (s. 13.2.3)
Average value (see 14.4.2)
Number (see 14.4.1)
Averaging mode (see 13.2.4)
Atmospheric pressure (see 12.2.6)
Temp. compensation (see 12.2.5)
Setpoint (see 12.2.4)
Conversion rate (see 10.1.1)
Scan cycle (see 10.1.2)
Output cycle (see 10.1.3)
Cycle factor (see 10.1.3.1)
Effective cycle
Actual measuring duration (see 13.4.2.1)
Start time / stop time (see 9.4.1)
Fixed measuring period (see 9.4.2)
Locking level (see 12.2.6)
Quantities (see 12.2.13)
Limit value, max. / min. (see 12.2.7)
Limit value actions, max. / min. (see 12.2.8)
Base value, factor, exponential (see 12.2.11)
Zero-point, gain (see 12.2.10)
Analog output - start / end (see 12.2.9)
Number (see 9.1.6)
File name (see 9.1.5)
Memory free (see 10.5)
Device designation (see 12.6.6.1)
Cross-section area in cm2 (see 13.5)

Once all functions have been entered, the menu can be saved under the chosen name by pressing the ´ Settings ´ key and the cells are populated with he current values. The functions can be programmed by touching on them in the usual way. Measured value scanning is controlled by means of keys ´ Start and Manual .
The menu can be modified at any time via option ´Edit user menu´. The content of a populated cell can be deleted by touching on the waste bin; a new function can then be assigned to it.

Backup and recovery

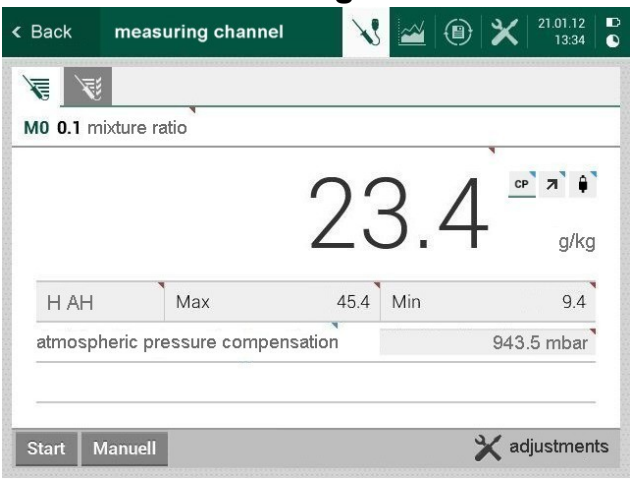
In the ALMEMO®-Control software the user menus can be saved and if necessary restored - via ´Device list´ and the ´File´ menu.

12. SENSORS

The ´Sensors´ application, accessible via the tab, is dedicated exclusively to the organization and functioning of individual sensors (see 9.2).
The first page provides a ´Sensor overview´ listing all connected sensors together with socket, sensor number, sensor designation, and minimum actual measuring duration of each one, plus a symbol 4 indicating the number of channels assigned (see 10.1.2).
A sensor can be selected by means of field > this provides a display of all ´**Sensor channels**´ with channel number, channel designation, measured value, and maximum and minimum values. The measured value functions can be accessed by touching on them; all other sensors can also be selected directly via the socket number in the header. Selecting ´**Settings**´ gives access to the special ´**Sensor settings**´, which can be used to configure the sensor channels and the D6 and D7 sensors and to manage the calibration data.
Here too by means of field > a ´**Measuring channel**´ can be selected for further processing.

12.1 Measuring by means of a measuring channel

The menu ´Measuring channel´ can be accessed by selecting a channel from the channels list; this displays a measuring channel in the largest available format with channel number, designation, and units.



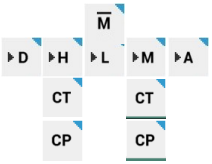
M0 0.1 Mixture — Selecting a different measuring channel

To check measured value status there are various **symbols** available; when one of these is touched on, an explanatory text gives its meaning.

Measured value smoothed (see 13.2.2)

REL — Relative value with respect to a reference value

Measured value modified with sensor correction or scaling



Averaging in progress

Output function active: **D**iff, **H**i, **L**o, **M**(t), **A**larm (s. 13.2.5.1)

Temp. compensation **CT** active: Value, fixed, measured

Atm. pressure compensation **CP** active; Value, fixed, measured

Below the measured value the functions - range, maximum and minimum values (s. XREF) - are still available; and these can also be used. Below the measured value, if it is compensated in terms of some other value, the compensation values in question also appear.

 By means of the ´**Channel parameters**´ tab all the parameters for the channel in question can be viewed over 4 pages and directly modified.

The following table lists the functions and section references:

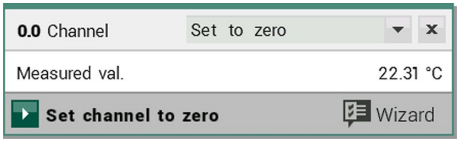
13.2.1	Channel designation
13.2.2	Measured value smoothing
13.2.4	Averaging mode
10.1.3.1	Cycle factor
13.2.13.7	Minimum sensor supply voltage
13.2.6	Locking level
13.2.7	Limit values, maximum and minimum
13.2.8	Actions, maximum and minimum
13.2.8	Relays, maximum and minimum
13.2.9	Analog output start / end
13.2.11	Base value, factor, decimal point shift
13.2.10	Zero-point and gain
13.2.12	Units
13.2.5.1	Output function
13.2.13	Measuring range with reference channel and multiplexer
13.2.10	Calibration offset and calibration factor

Alternatively, the individual ´**Channel functions**´ (see 13.2) can also be found bottom right via the ´Channel functions´ option and the appropriate heading..

12.2 Measured value correction and compensation

To achieve maximum measuring accuracy the zero-point of the sensors can be corrected in all menus at the touch of a button. By entering a setpoint the correction value will be automatically calculated and stored in the sensor connector. For sensors affected by ambient temperature or atmospheric pressure the appropriate compensation can then be provided.

12.2.1 Set measured value to zero



One very useful function is to zero the measured value at certain locations or points in time as a reference value from which to observe subsequent deviations. For this purpose touch on the measured value in question and confirm via selection box ´**Zero-set**´. The measured value is then saved as **base value** and thus set to zero. To save the relative reference value to RAM on a temporary basis only, option 'Temp. zero-setting' must be used. (**Display 'REL'**)

Whenever, instead of the actual measured value, the display indicates a deviation from the base value, the symbol will appear.
To obtain the actual measured value again the base value must be cleared. (see 13.2.11).

12.2.2 Zero-point adjustment

Many types of sensor need to be adjusted either once or at regular intervals to compensate for various instabilities. This can be done with the above-mentioned ´Set measured value to zero´ - but also with the special **zero-point adjustment**, which does not influence scaling. For this purpose touch on the measured value again and confirm via selection box ´Adjustment´. This ensures that the zero-point error is saved not as base value but as **zero-point correction**. (see 13.2.10) If the function is locked at level 3 or above (see 13.2.6), a help box states that it can be unlocked temporarily; this ensures that the correction values are remain permanently stored on the connector.
As soon as the request is confirmed, adjustment is performed.

If a base value has been programmed, the measured value indicated after adjustment is not zero but the negative base value.
In the case of dynamic **pressure probes** the zero-point error is always written to the calibration offset temporarily (i.e. until you switch off) even if the channel is locked.

12.2.3 Sensor adjustment for chemical sensors and probes

With the following sensors the adjustment (s. 12.2.2) will automatically take the form of a **two-point adjustment**. The appropriate calibration setpoints should already be entered but these can also be modified.

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

With pH probes ´**Zero-set**´ (s. 12.2.1) restores the connector to default programming.

☞ Two-point adjustment with setpoint entry

t adjustment can also be performed on other sensors. After zero-point adjustment (s. 12.2.2) ´**Setpoint adjustment**´ should be selected and the ´**Setpoint**´ entered; the channel will then be adjusted. The correction factor is calculated automatically at the touch of a button and stored as factor on the sensor connector.

1. Zero-point adjustment

Bring sensor to zero status (icy water, unpressurized, etc.),
Zero-set measured value by means of ´Adjustment´. (see 12.2.2)

2. Final value correction

Bring sensor to a defined setpoint (boiling water, a known weight, etc.).
Measured value 0.0 098.7 °C
With **ALMEMO® force transducers** switch the calibration resistor on / off in order to simulate the check value. (see Manual 3.6.2)
Touch on the measured value, in selection box select ´Setpoint adjustment´, enter the setpoint and ´Adjust channel´. Setpoint 100.0 °C
The measured value shown should then be the setpoint. 0.0 100.0 °C

☞ If the sensor is locked at level 4 the correction factor is programmed as ´Factor´; if the sensor is locked at level <= 3 or temporarily unlocked, the correction factor is programmed as gain correction. (see 13.2.10)

For a genuine two-point adjustment involving no zero-point the wizard ´**Two-point adjustment**´ is available. (see 14.3)

12.2.5 Temperature compensation

Sensors whose measured values depend heavily on the temperature of the measuring medium usually incorporate their own temperature sensor and the device performs temperature compensation automatically. (see 13.2.13 Measuring range list ´with TC´)
However, dynamic pressure probes and pH probes are also available without their own integrated temperature sensor. If the temperature of the medium deviates from 25°C the following measuring errors must be considered:

e.g. Errors per 10 °C:		**Compensation range**	**Sensors**
Dyn. pressure:	approx. 1.6%	-50 to 700 °C	NiCr-Ni
pH probe:	approx. 3.3%	0 to 100 °C	Ntc or Pt100

To perform temperature compensation on a probe of this type there are several possibilities.

1. Using an external temperature sensor program control character ´*T´ in the channel designation. (see 13.2.1)

2. Or enter the approximate temperature manually in ´Device settings´ → ´Device compensation´ → ´Temperature´. This value is then used for all sensors with temperature-compensation. This can be checked in ´Settings´ → ´Channel functions´ → ´Channel compensation´. (see 13.2.14)

If temperature compensation is static, this is indicated in the menu ´Measuring channel´ by symbol CT.

If the temperature is measured externally, this is indicated by the symbol CT.

Automatic temperature compensation can be disabled by programming the reference channel for the measuring channel to itself.

12.2.6 Atmospheric pressure compensation

Some measured variables depend on the ambient atmospheric pressure (see 13.2.13, measuring range list ´with PC´) - with the effect that large deviations from normal pressure (1013 mbar) may lead to measuring errors.

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

It is important therefore, especially when working at significant altitudes above sea level, to take due account of atmospheric pressure (approx. -11 mbar / 100 meters above mean sea level, MSL). This device now incorporates - for the first time - a dedicated atmospheric pressure sensor, which is used automatically for all functions requiring pressure compensation. This atmospheric pressure value is also made available in a function channel. (see 13.2.13.1) Alternatively, atmospheric pressure can be measured using an external sensor. If the channel designation has ´*P´ (s. 13.2.1), the measured value concerned will be used for atmospheric pressure compensation for the following channels. However, ´Atmospheric pressure´ can still also be programmed in ´Device settings´ → ´Device compensation´. s. 13.6.4 To resume internal measuring operations this value must be deleted. The atmospheric pressure used for a channel is shown in ´Settings´ → ´Channel functions´ → ´Channel compensation´. (see 13.2.14)

If atmospheric pressure compensation is static, this is indicated in the menu ´Measuring channel´ by symbol CP. If the atmospheric pressure is measured externally, this is indicated by the symbol CP.

12.2.7 Cold junction compensation (CJC)

Cold junction compensation (CJC) for thermocouples is normally performed completely automatically. In order to ensure the highest possible level of accuracy on this device with its 10 sockets - even in difficult thermal conditions (e.g. thermal irradiation) - the socket temperatures are acquired by means of two precision NTC sensors in measuring sockets M0 and M9 and then calculated by linear interpolation separately for each socket. The exact cold junction temperature of each channel is shown in ´Settings´ → ´Channel functions´ → ´Channel compensation´. (see 13.2.14)

However, the cold junction temperature can also be measured using an external measuring sensor (Pt100 or NTC) in an isothermal block (see Manual 6.7.3); this must be located upstream from the thermocouples and the first 2 characters of the channel designation must have been programmed with control code ´*J´ (see 13.2.1). As and when necessary the cold junction temperature can be checked with function channel ´CJ´. This can also be used as device temperature.
For especially exacting requirements (e.g. for thermocouples for which there is no connector with thermo-contacts or for large temperature differences caused by thermal irradiation) special connectors are available, each with its own integrated temperature sensor (ZA-9400-FSx) for cold junction compensation. These can be used for all thermocouple types; however, they require 2 measuring channels. Having ´#J´ programmed in the first two positions of the channel designation for the thermocouple ensures that the temperature sensor integrated in the connector is indeed used for cold junction compensation.

13. SETTINGS

´Settings´ contains all the setting possibilities for the sensors and output modules, for the device itself, for the display and power supply, plus the scaling factors for all measured value displays. ´Settings´ can be accessed directly from the ´Home´ screen or in any display by means of the tab . If you are already in a ´Settings´ menu, you can return to the selection list by pressing this tab again

In der Rubrik ´Einstellungen´ finden Sie alle Einstellmöglichkeiten von Fühlern und Ausgangsmodulen, vom Gerät Anzeige und Stromversorgung, sowie die Skalierungen aller Messwertanzeigen. Aufgerufen werden die ´Einstellungen´ direkt vom Home-Bildschirm aus oder über den Tab in jeder Anzeige. Befinden Sie sich bereits in einem Menü ´Einstellungen´, dann kommen Sie mit einem weiteren Tastendruck auf diesen Tab wieder auf die Auswahlliste:

13.1 Sensor settings

Selecting ´Sensor settings´ opens a further selection list. Here via selection box ´Choose sensor´ you can select the desired sensor and then call up one of the following functions :

Channels / ranges
Sensor configuration (D7)
Calibration data

The item ´**Channels**´ provides an overview of all the channels available to the sensor in question with the activated ones checked with a tick. Here the desired channels can be activated or deactivated as required. The quantity can also, if necessary, be changed on the next page.

The next item ´**Sensor configuration**´ provides a sensor menu for selected D6 or D7 sensors which can be used to access their respective parameters.

The third item ´**Calibration data**´ shows the serial number, the next calibration date, and the calibration interval. If ´Calibration message´ is enabled, the device will issue the appropriate notification.

13.2 Channel functions

Since on ALMEMO® devices all sensor programming is stored in the ALMEMO® connector itself, the user will not normally need to reprogram each time. Programming will only be necessary 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 setting functions available.

Selecting ´Channel functions´ opens a further selection list; here, if the sensor in question is connected, all the parameters listed for a particular channel can be entered and / or modified,. This overview can also be accessed from the menu ´Measuring channel´ by selecting the option ´Settings´. (see 12.1)

13.2.1 Channel designation, function abbreviation
13.2.2 Measured value smoothing
13.2.3 Maximum / minimum values
13.2.4 Averaging functions (average value, mode, number)
13.2.5 Measured value output (output function, cycle factor)
13.2.6 Channel locking (locking level)
13.2.7 Limit values (maximum, minimum, hysteresis)
13.2.8 Actions triggered by limit value infringement (action maximum / minimum, relay maximum / minimum)
13.2.9 Analog output (start / end)
13.2.11 Scaling values (base value, factor, decimal point shift)
13.2.10 Correction values (zero-point, gain)
13.2.12 Units
13.2.13 Quantities Function channels
13.2.13.4 Reference channels, multiplexer
13.2.13.6 Element flags
13.2.13.7 Minimum sensor supply voltage
13.2.14 Channel compensationn

Please note that series sensors by default have the locking mode enabled to protect them against unintended alteration; if modification really is required this locking mode must first be lowered to an appropriate level. (see 13.2.6)

Selecting the input channel

To view or to program a sensor's parameters it is necessary via selection box ´Select channel´ to specify the desired input channel. Only sensors actually connected and channels actually activated can be processed. To activate new channels it is necessary in ´Settings´ → ´Sensor settings´ → ´Quantities´ to activate an inactive channel and, if necessary, change the range.

13.2.1 Channel designation

The first function in this list is ´Channel designation´. Each measuring channel can be assigned a designation; this must be alphanumerical, using any ASCII characters (except ; / | #); for D7 sensors it can be up to 20 characters, otherwise up to 10 characters; it should denote as clearly as possible the type of sensor, measuring location, and / or purpose. This designation is included in all

measured value displays.
Certain **control characters** at the beginning of a channel designation have **special functions**.

´*J´ This denotes a temperature sensor (NTC, Pt100) to be used for external cold junction compensation. (see 12.2.7 Manual 6.7.3)

´#J´ This specifies that an internal cold junction sensor is to be used for a thermocouple. (e.g. connector ZA9400-FSx with NTC) (see 12.2.7, Manual 6.7.3)

´*T´ This denotes a temperature sensor (NTC, Pt100) to be used as reference for temperature compensation. (see 12.2.5)

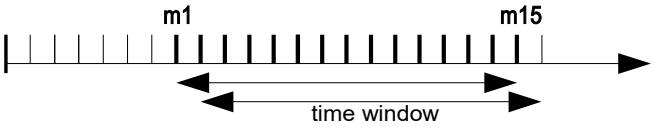
´*P´ This denotes an atmospheric pressure sensor to be used as reference for atmospheric pressure compensation. (see 12.2.6)

´#N´ This denotes that in flow measuring operations the actual measuring conditions for temperature compensation and / or pressure compensation are to be converted to standard conditions. (see 14.5)

The remaining characters can be used for the user's own descriptions.
´!´ at the end automatically indicates a specific user-defined linearization or multi-point calibration. (see 13.2.13.3) This cannot be overwritten.

13.2.2 Measured value smoothing

One method for averaging (see 14.4) applies exclusively to the measured value of the displayed channel (see 12.1); it is used to smooth measured values of an unstable or strongly fluctuating nature, e.g. flow turbulence, by means of a sliding average over a specified time frame. With D7 sensors up to 4 primary channels can be smoothed internally at the same time over the averaging period. (see 8.3)
The function ´Measured value smoothing´ can be set with any number of values to be averaged from 0 to 99. The smoothed measured value will then apply for all subsequent evaluation functions. Smoothing can thus also be used in a combination with averaging over individual measured values. (see 14.4.1)



$$\overline{M} = \left(\sum_{i} m_i\right)/N$$

Time constant (s) = smoothing / conversion rate·(V5 channels +1) is calculated and displayed in the menu ´Smoothing´.

13.2.3 Maximum / minimum values with date and time-of-day

The highest and lowest values are identified from the acquired measured values for each measuring channel and continuously updated to memory together with date and time-of-day. Maximum and minimum values are displayed in the menus ´Sensor channels´, ´Measuring channel´, and ´Channel list´. These can be output via function channels (s. 13.2.13.1) and via the interface.
Touching on these values opens the menu ´**Maximum / minimum values**´, which lists not only the maximum and minimum values themselves but also

their respective date and time-of-day. These values can be deleted individually; or all maximum, minimum, and average values for all channels can be deleted together. This last function is especially advisable whenever a measuring operation is started; it can therefore also be configured here accordingly. (see 13.6.3) Whenever this data is deleted, the current measured value, since measuring is a continuous process, will appear again immediately. Cyclic clearing can be activated by programming the averaging mode ´CYCL´ accordingly. (see 14.4.3).

13.2.4 Averaging mode

The various ways of averaging via measuring channel scans are explained in detail in the help text of the wizard ´Averaging´ (see 14.4); here the chosen mode can be configured and tested. Touching on ´Channel functions´ > ´Averaging functions´ opens the ´**Averaging functions**´ menu. The averaging method can be defined for each channel via the function ´Averaging mode´ and can be set in a selection box from the following modes:

- `---` Function, no averaging
- CONT Averaging over individual measuring operations, either Manual or all measuring channel scans from Start to Stop
- CYCL Averaging over all measuring channel scans in a cycle

This menu displays not only the ´Average value´ of the selected channel but also the ´Number´ of values to be averaged. The average value can be deleted either separately or together with all maximum and minimum values.

For **recording** average values a **function channel** with quantity **M(t)** (see 13.2.13) or the corresponding **output function M(t)** is required - instead of the measured value (see 13.2.5.1).

13.2.5 Measured value output

13.2.5.1 Output function

It is possible, instead of the measured value, to output other measuring functions, e.g. maximum / minimum / average / alarm value. This function can be programmed as ´**Output function**´. (see Manual 6.10.4)
Saving, analog output, digital output need then only process the appropriate function value. As a check on the modified output function the ´Measuring channel´ display will show the following symbols : (see 12.1).

Examples:

1. If measured values are being averaged over a cycle the only output value of interest is the average value itself, not the last measured value. With a data logger this approach saves memory capacity.
2. The analog measured value from dew sensor FH A946-1 is not really significant. If limit value - maximum is set to approx. 0.5 V and the alarm value function is programmed, the only values received are 0.0% for dry and 100.0% for dew.

Output function	Status symbol	Abbrev. in ALMEMO-Control
Measured value (Mxx)		Mess
Differential (Mxx-M00)	D	Diff
Maximum value (Mxx)	H	Max
Minimum value (Mxx)	L	Min
Average value (Mxx)	M	M(t)
Alarm value (Mxx)	A	Alrm

13.2.6 Channel locking

The function parameters of each measuring channel are protected by means of a settable ´**Locking level**´. (see Manual 6.3.12)
Before programming can take place locking must first be lowered to an appropriate level. If the display shows a dot after the locking level, this means that modification is not permitted.

Locking	Locked functions
0	None
1	Measuring range + element flags + output mode
3	+ units
4	+ zero-point correction and gain correction
5	+ base value, factor, exponential
6	+ analog output, start / end, zero-point adjustment. temporary
7	+ limit values, maximum and minimum

In menu ´Channel parameters´ each function is shown with the locking level at which it will in fact be locked, i.e. not be programmable. Given the inconvenience of having to lower the locking level each time before programming and the risk of forgetting to restore locking to its correct level afterwards, this device will open a check-box, which indicates that locking is in force but - subject to deliberate confirmation - will still permit programming to be performed.

13.2.7 Limit values

Two limit values, ´**Limit value maximum**´ and ´Limit value minimum´, can be programmed for each measuring channel. Overshooting / undershooting a limit value (like exceeding a measuring range limit and sensor breakage) is treated as a fault; the red alarm LED lights up and the built-in beeper sounds. In the display the measured value is highlighted - in red if MAX is overshot or in blue if MIN is undershot - and the appropriate alarm relay (connected via relay cable) is triggered (see 13.5.2). Since the maximum and minimum values are displayed in a different color, it is also possible - on completion of a measuring operation - to see whether a limit value has been infringed. All limit values can also have relays assigned to them separately (see 13.2.8). The alarm status will remain in effect until the measured value returns to within the prescribed limit values by the amount set as hysteresis. ´Hysteresis´ is set by default to 10 digits for all

channels but this can be adjusted to any number of digits between 0 and 99 (see 13.2.7.1). A limit value infringement can also be used to start or stop a measuring operation (see 13.2.8).

13.2.7.1 Hysteresis

The hysteresis for canceling an alarm triggered in the event of a limit value infringement can be set generally for all sensors to any number between 0 and 99 digits (default 10 digits) in the ´**Hysteresis**´ function. (see 13.2.7 and Manual 6.2.7).

13.2.8 Actions triggered by limit value infringement

Relay assignment

As ´Limit value actions´ in the event of a limit value infringement each limit value can, for the purpose of reporting the alarm, be assigned a ´**Relay - maximum**´ or ´**Relay - minimum**´ on relay adapter ZA 8006-RTA3; this does not apply to general alarms. The relay remains energized until the measured value returns to within the prescribed limit values by the amount set as hysteresis. (see 13.2.7) If no limit value has been set the measuring range limit is used as limit value. A sensor breakage always triggers an alarm.
A relay can have more than one limit value assigned to it. For this purpose the relay cables offer 2 relays (0 and 1); the relay adapter (ZA 8006-RTA3) offers from 4 to 10 relays. (see 13.5.2, Manual 6.10.9).

Controlling a measuring operation

A limit value infringement can be used not only to report an alarm but also to control a measuring operation. (see Manual 6.6.3) Commands can be assigned to a limit value maximum or limit value minimum via functions ´**Action maximum**´ and ´**Action minimum**´. These functions can, by means of a selection box, have the following actions assigned to them : To delete a setting, ´Alarm only´ should be selected again.

Alarm only
Start measuring
Stop measuring
Individual meas. operation, ´Manual´
Set timer 2 to zero
Macros 5 to 9

13.2.9 Analog output

Analog output of measured values to analog output modules (see Manual 5) must usually be scaled to a certain sub-range. The display range can be specified in menu ´**Analog output**´ by entering ´**Analog start**´ and ´**Analog end**´. This sub-range is then mapped to analog range 2 V, 10 V, 20 mA.
These two parameters, are also saved in the sensor's EEPROM and can thus be individually programmed per channel; i.e. when channels are switched through manually each measurable variable can be individually scaled. Switchover from 0-20 to 4-20 mA can also be activated in this menu. (Element flags, see 13.2.13.6).

13.2.10 Correction values

Correction values ´**Zero-point**´ and ´**Gain**´ can be used to correct sensors with regard to their zero-point and gain. (see Manual 6.3.10)

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

Once the correction values have been programmed and the actual measured value has been thus modified, the correction arrow appears beside the measuring channel display (see 12.1) to show the measured value status.

For the purpose of automatically calculating any two-point adjustment a dedicated ´Two-point adjustment´ wizard is provided. (see 14.3)

To reach maximum accuracy multi-point calibration of sensors is now also possible - with option KL. (see XREF)

On many sensors, for adjustment on leaving our factory, the variables ´Calibration offset ´ and ´Calibration factor´ are used. These work like correction values; in the same menu these can be checked - but not changed.

13.2.11 Scaling values

To display a sensor's electrical signal as a measured value with a physical quantity it is nearly always necessary to perform a zero-point shift and multiplication by a factor. To perform these steps the functions ´**Base value**´ and ´**Factor**´ are provided. For a detailed description of scaling, with an example, please refer to the Manual 6.3.11.

Displayed value = (corrected measured value - base value) x factor

The ´Factor´ can be programmed within the range -2.0000 to +2.0000. For factors below 0.2 or above 2.0 the decimal point setting should be adjusted by entering the ´**Exponential**´. Using the ´Exponential´ function the decimal point can be shifted as far to the left (-) or to the right (+) as the display and the printer permit. With standard sensors an exponential view of measured values is not supported.

For automatic calculation from the actual value and the setpoint value a dedicated ´Scaling´ wizard is provided. (see 14.2)

Once the scaling values have been programmed and the actual measured value has been thus modified, the correction arrow appears beside the measuring channel display (see 12.1) to show the measured value status .

13.2.12 Units

For each measuring channel the default units for the measuring range can be replaced with any other units - with D7 sensors 6 characters, otherwise 2 characters. (see Manual 6.3.5)

Not only upper and lower case letters but also a number of special characters are available (excluding ; / | #). The units are shown after the measured value or programming value in question.

If ´°F´ is entered as units the temperature value will be converted automatically from degrees Celsius to degrees Fahrenheit. If ´!C´ is entered cold junction compensation will be disabled. Entering the ap-

propriate two characters will automatically generate the following units : ´m/s´ from ´ms´, ´m³/h´ from ´mh´, ´W/m²´ from ´Wm´, ´g/kg´ from ´gk´, ´l/m´ from ´lm´.

13.2.13 Quantities

Normally, on leaving our factory, all sensor plugs are ready-to-operate. However, if a measuring range stored in the plug needs to be modified or newly programmed, the appropriate channel must be selected and, via selection box ´Quantity´, the required range must be programmed. With V5 sensors / connectors the choice is as per the following list. A new measuring channel can only be activated in ´Sensor settings´ → ´Channels, Quantities´. Please note that with certain sensors a special plug type is required (e.g. thermal, shunt, divider, etc.). When the new measuring range is entered, default units and multiplexer are set automatically but all programming values for the channel in question are deleted. With D7 sensors a separate list of quantities is displayed. D6 and D7 sensors can be fully configured in ´Sensor settings´ → ´Sensor configuration´.

Sensor	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...+400.00	°C	P204
Pt1000-1 ITS90 (Element flag 1)	ZA 9000-FS	-200.0... +850.0	°C	P104
Pt1000-2 ITS90 (Element flag 1)	ZA 9000-FS	-200.00...+400.00	°C	P204
Pt1000-3 ITS90	ZA 9000-FS	0.000...+65.000	°C	P304
Ni100	ZA 9000-FS	-60.0... +240.0	°C	N104
NiCr-Ni (K) ITS90	ZA 9020-FS	-200.0...+1370.0	°C	NiCr
NiCr-Ni (K) ITS90 ++	ZA 9020-SS2	-100.00...+500.00	°C	NiC2
NiCroSil-NiSil (N) ITS90	ZA 9020-FS	-200.0...+1300.0	°C	NiSi
Fe-CuNi (L)	ZA 9021-FSL	-200.0... +900.0	°C	FeCo
Fe-CuNi (J) ITS90	ZA 9021-FSJ	-200.0...+1000.0	°C	IrCo
Cu-CuNi (U)	ZA 9000-FS	-200.0... +600.0	°C	CuCo
Cu-CuNi (T) ITS90	ZA 9021-FST	-200.0... +400.0	°C	CoCo
PtRh10-Pt (S) ITS90	ZA 9000-FS	0.0...+1760.0	°C	Pt10
PtRh13-Pt (R) ITS90	ZA 9000-FS	0.0...+1760.0	°C	Pt13
PtRh30-PtRh6 (B) ITS90	ZA 9000-FS	+400.0...+1800.0	°C	EL18
Au-FeCr	ZA 9000-FS	-270.0... +60.0	°C	AuFe
W5Re-W26Re (C) ++	ZA 9000-SSC	0.0...+2320.0	°C	WR26
Ntc Typ N	ZA 9000-FS	-50.00...+125.00	°C	Ntc
Ntc Typ N ++	ZA 9040-SS3	0.000...+45.000	°C	Ntc3
Ptc Typ Kty84 ++	ZA 9040-SS4	-0.0...+200.0	°C	KTY
Millivolt 1	**ZA 9000-FS**	**-26.000...+26.000**	**mV**	mV 1
Millivolt	ZA 9000-FS	-10.000...+55.000	mV	mV
Millivolt 2	ZA 9000-FS	-260.00...+260.00	mV	mV 2

Sensor	Sensor / connector	Measuring range	Units	Display
Volts	ZA 9000-FS	-2.0000...+2.6000	V	Volt
Difference - millivolt 1	ZA 9000-FS	-26.000...+26.000	mV	D 26
Difference - millivolt	ZA 9000-FS	-10.000...+55.000	mV	D 55
Difference - millivolt 2	ZA 9000-FS	-260.00...+260.00	mV	D260
Difference - volt	ZA 9000-FS	-2.6000...+2.6000	V	D2.6
Sensor voltage	beliebig	0.00...20.00	V	Batt
Milliampere	ZA 9601-FS	-32.000...+32.000	mA	mA
Percent (4 to 20 mA)	ZA 9001-FS	0.00... 100.00	%	%
Ohms	ZA 9000-FS	0.00... 400.00	Ω	Ohm
Ohms ++	ZA 9003-SS3	0.000... 50.000	Ω	Ohm1
Frequency	ZA 9909-AK	0... 25000	Hz	Freq
Pulses	ZA 9909-AK	0... 65000		Puls
Digital input	ZA 9000-EK2	0.0... 100.0	%	Inp
Digital interface	ZA 9919-AKxx	-65000... +65000		DIGI
Infra-red 1	FI A628-1/5	0.0... +200.0	°C	Ir 1
Infra-red 4	FI A628-4	-30.0... +100.0	°C	Ir 4
Infra-red 6	FI A628-6	0.0... +500.0	°C	Ir 6
Rotating vane Normal 20	FV A915-S120	0.30... 20.00	m/s	S120
Rotating vane Normal 40	FV A915-S140	0.40... 40.00	m/s	S140
Rotating vane Micro 20	FV A915-S220	0.50... 20.00	m/s	S220
Rotating vane Micro 40	FV A915-S240	0.60... 40.00	m/s	S240
Rotating vane Macro	FV A915-MA1	0.10... 20.00	m/s	L420
Water turbine Micro	FV A915-WM1	0.00... 5.00	m/s	L605
Dyn. press. 40 m/s with TC and PC	FD A612-M1	0.50... 40.00	m/s	L840
Dyn. press. 90 m/s with TC and PC	FD A612-M6	1.00... 90.00	m/s	L890
Flow sensor SS20 ++	ZA9602-SSS	0.50... 20.00	m/s	L920
Rel. atm. humidity, capacitive	FH A646	0.0... 100.0	%H	°o rH
Rel. atm. humidity, cap. with TC_{int}	FH A646-C	0.0... 100.0	%H	HcrH
Rel. atm. humidity, cap. with TC_{int}	FH A646-R	0.0... 100.0	%H	H rH
Humid temperature HT	FN A846	-30.00...+125.00	°C	P HT
Conductivity probe with TC_{int}	FY A641-LF	0.0 ...20.000	mS	LF
CO_2 sensor	FY A600-CO2	0.0 ... 2.500	%	CO2
O_2 saturation with TC_{int} and PC	FY A640-O2	0 ... 260	%	O2-S
O_2 concentration with TC_{int}	FY A640-O2	0 ... 40.0	mg/l	O2-C
Function channels see 13.2.13.1				
* 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 VP
* Enthalpy with PC	FH A646	0.0 ... 400.0	kJ/kg	H En
* Rel. humidity, psychrom. with PC	FN A846	0.0 ... 100.0	%H	P RH
* Mixture ratio with PC	FN A846	0.0 ... 500.0	g/kg	P AH

Sensor	Sensor / connector	Measuring range	Units	Display
* Dew-point temperature with PC	FN A846	-25.0 ... +100.0	°C	P DT
* Partial vapor pressure with PC	FN A846	0.0 ...1050.0	mbar	P VP
* Enthalpy with PC	FN A846	0.0 ... 400.0	kJ/kg	P En
Measured value (Mb1)	any		f(Mb1)	Mess
Differential (Mb1-Mb2)	any		f(Mb1)	Diff
Maximum value (Mb1)	any		f(Mb1)	Max
Minimum value (Mb1)	any		f(Mb1)	Min
Average value over time (Mb1)	any		f(Mb1)	M(t)
Number of averaged val. (Mb1)	any			n(t)
Av.erage val. over meas. points (Mb2,.Mb1)	any		f(Mb1)	M(n)
Total from meas. points (Mb2,.Mb1)	any		f(Mb1)	S(n)
Total number of pulses (Mb1)	ZA 9909-AK	s.Hb.6.7.1 0..65000		S(t)
Pulses / print cycle (Mb1)	ZA 9909-AK	s.Hb.6.7.1 0..65000		S(P)
Alarm value (Mb1)	any	s. 13.2.5.1 0/100	%	Alrm
Thermal coefficient $\overline{q}/(\overline{M01-M00})$	ZA 9000-FS	s. 14.6	W/m²K	q/dT
Wet-bulb globe temperature	ZA 9000-FS	s. 14.7	°C	WBGT
Cold junction temperature	any	s. 13.6.6.3	°C	CJ
Volume flow m³/h $\overline{Mb1} \cdot Q$	any	s. 14.5	m³/h	Flow
Timer	any	s.13.2.13.2 0..65000	s	Time
Atmospheric pressure	any	300.0...1100.0	mb	AP
Temperature, refrigerant R22 °	FDA602Lx	-90.0...+79.0	°C	R22
Temperature, refrigerant R23 °	FDA602Lx	-100.0...+26.0	°C	R23
Temperature, refrigerant R134a °	FDA602Lx	-75.0...+101.0	°C	R134
Temperature, refrigerant R404a °	FDA602Lx	-60.0...+65.0	°C	R404
Temperature, refrigerant R407c °	FDA602Lx	-50.0...+86.0	°C	R407
Temperature, refrigerant R410 °	FDA602Lx	-70.0...+70.0	°C	R410
Temperature, refrigerant R417a °	FDA602Lx	-50.0...+70.0	°C	R417
Temperature, refrigerant R507 °	FDA602Lx	-70.0...+70.0	°C	R507

TK Temperature compensation, PC Pressure compensation, Mbx Reference channels

* Calculated humidity quantities according to the new formulas of Dr. Sonntag (Mb1 = temperature, Mb2 = humidity / humid temperature / dewpoint)

++ Only via special connectors with internal characteristic (see 13.2.13.3) (others available on request)

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

13.2.13.1 Function channels

At the end of the table of quantities and units (see above) under the sub-heading ´**Function channels**´ there is a group of ranges that can be used to represent function parameters for measured value processing or for calculated results obtained by linking certain measured values on measuring channels. (see Manual 6.3.4)

Reference to the actual measuring channels is provided by one or two refer-

ence channels. For all function channels the default reference channels Mb1 and Mb2 are available on the appropriate connector; these do not need programming.

Function	Function channel	Reference channel 1	Reference channel 2
* Humidity variables, capacitive	on channel 3 or 4	Mb1 = temperature	Mb2 = humidity
* Humidity variables, psychr.	on channel 3 or 4	Mb1 = Dry temp.	Mb2=Humid temp.
Function parameter (Mb1)	on channel 2, 3, or 4	Mb1 = channel 1	
Difference (Mb1 - Mb2)	on channel 2, 3, 4 (Mb1)	Mb1 = channel 1	Mb2=M0.0
Average value over Mb2 to Mb1	on channel 2, 3, 4 (Mb1)	Mb1 = channel 1	Mb2=M0.0
Sum of Mb2 to Mb1	on channel 2, 3, 4 (Mb1)	Mb1 = channel 1	Mb2=M0.0
$\overline{q}/(M01-M00)$	on channel 2, 3, 4 (q)	Mb1 = channel 1	Mb2=M1.1
WBGT	on channel 2 (GT)	Mb1 = channel 1	Mb2=M0.0

Arrangement of channels on the connectors
Once the quantity has been programmed the default reference channels can be used (see above). Settings for the reference channels are described in 13.2.13.4.

13.2.13.2 Timer as function channel

Actual measuring durations can be output and saved by means of the function channel ´Time´; the format is ´sssss´ or ´ssss.s´. (see 13.2.13) The resolution can be set to 0.1 seconds by programming the exponent to -1. At a count of 60000 the timer is reset and starts again at 0. All the normal start / stop functions can be used; the start, stop, output, and zero-setting of the timer can also be set as actions triggered by limit value infringement. (see 13.2.8).

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

Thanks to the ALMEMO® V6 standard connector with its 4-KB EEPROM (code E4) the following tasks can be performed with a certain elegance :

1. Provision of special measuring ranges with internal characteristic
   (see 13.2.13, quantities list, code ++)
2. Linearization of signals for voltage, current, resistance, or frequency - set by the user
3. Multi-point calibration of all V6 and V7 sensors

The ALMEMO® 710 can as standard evaluate all appropriately programmed ALMEMO® connectors. With special variant KL it is also possible to convert measuring signals into equivalent display values based on a characteristic of up to 30 support values. These support points are programmed to the EEPROM in the ALMEMO® connector using the ALMEMO® Control software. During a measuring operation the measured values between these points are interpolated on a linear basis. When correcting non-linear sensors (e.g. with Pt100 or thermocouple sensors) initially the original characteristic is considered; and only then are the deviations interpolated on a linear basis and inserted. If a channel with a characteristic is deactivated or programmed with a different quantity, the characteristic can subsequently be reactivated by programming the special range ´Lin´ either via the keypad or command ´B99´.

13.2.13.4 Reference channel 1

The calculating functions of the function channels usually refer to one (or two) particular measuring channel(s). (see 13.2.13.1, Manual 6.3.4)
When programming a function channel the 1st channel Mx.0 on sensor plug Mx.x is set automatically as reference channel Mb1. The 2nd reference channel Mb2 (for differential value, average value M(n), etc.) is provided initially by measuring channel M0.0. However, in the function ´**Reference channel 1**´ it is also possible, via a selection box, to set any other suitable measuring channel as reference channel.

These reference channels are entered in the new V7 channel numbering system but saved, wherever possible, in V5 format; this permits operation on both old and new devices alike.

13.2.13.5 Reference channel 2 or multiplexer

With those function channels needing a 2nd reference channel (see above) ´Reference channel 1´ is followed automatically in the next line by the function ´**Reference channel 2**´ where an appropriate setting can be entered.

In all other cases in the function ´Multiplexer´ it is possible, via a selection box, to change the input multiplexer and thus also the pin assignment in the connector. (see Manual 6.10.2).

Multiplexer

Measuring inputs B+ and A-, with respect to ground	B - A
Measuring inputs C+ and A-, with respect to ground	C - A
Measuring inputs D+ and A-, with respect to ground	D - A
Differential measuring inputs C+ and B-	C - B
Differential measuring inputs D+ and B-	D - B

13.2.13.6 Element flags

For certain quantities so-called element flags that help implement sensor-specific additional functions are activated or can be activated. (see Manual 6.10.3)

Measuring current 1/10 for Pt1000, Ni1000, 5000 Ω instead of Pt100, Ni100, 500 Ω: I 1/10	
(Flag 2:) *	IR
Bridge switch for final value simulation, can be activated	Bridge
Scan - only in cycle for sensors / ranges with cyclic calculations	Cyclic
Electrical isolation - disable if differential inputs have no ground (see 8.5)	Iso Off
(Flag 6:) *	Flag 6
Sensor breakage detection - disable for high-impedance sources	Br Off
Analog output 4 to 20 mA instead of 0 to 20 mA	A 4-20

* With the ALMEMO® 710 this element flag has no significance.

13.2.13.7 Minimum sensor supply voltage

Normally, for each ALMEMO® sensor, a ´Minimum sensor supply voltage´ is specified; it needs this to operate properly. If the actual sensor supply voltage drops below this value the measured value will be treated as a sensor break-

age and display U-LOW flashes. The actual sensor supply voltage of the device is formed automatically based on the ´Minimum sensor supply voltage´ needed for all sensors; in the menu ´Settings´ → ´Power supply´ it can be checked and also raised to a higher value.

13.2.14 Channel compensation

In the menu ´Channel functions´ - ´Channel compensation´ all forms of compensation, e.g. temperature compensation (see 12.2.5), atmospheric pressure compensation (see 12.2.6), cold junction compensation (see 12.2.7) are listed for each channel with the appropriate values which are used for calculating the measured value. These can be programmed or internally measured values (see 13.6.4) or also externally measured values (see 12.2.5, 12.2.6, 12.2.7).

13.3 Display settings

Certain settings, especially scaling, are required for bar chart and line graph displays. These settings have already been described in 11.2 and 11.3. However, they can also be accessed here.

13.4 Data logger settings

The settings for the data logger have already been described in Chapter 10. However, they can also be accessed here via ´Settings´.

13.5 Output modules

Data logger ALMEMO® 710 has three output sockets, A1, A2, A3 (2); these can be used to output measured values in analog or digital form or as an alarm signal. It is also possible to initiate various functions by means of trigger pulses. To cover all possibilities while also keeping the required hardware to a minimum all necessary interfaces have been integrated in the ALMEMO® output connectors or output modules.
These output modules and a mains adapter connected at the DC power supply socket are automatically recognized, just like the sensors, and are initially displayed as a list in the menu ´**Output modules**´.
With the relay trigger analog modules certain function variants can be configured (see 13.5.2), relays can have certain limit values assigned to them (see 7.5), and analog outputs can be assigned to certain measuring channels. In subsequent menus all ports can be selected and configured accordingly. The connection possibilities are described in the instructions for the output module concerned.

13.5.1 Data cables

Via the serial interface it is possible to output cyclic data logs, all the function values from the measuring menus, and all the programming details for the device and for the sensors to a printer or computer. The various ALMEMO® data

cables and their connection to devices are described in detail in the Manual 5.2. Other modules for networking the devices are described in detail in the Manual 5.3. All available interface modules can be connected to socket A1 **(2)**; this is with the exception of cable ZA 1999-NK, which is used for networking extra devices; this must be connected to socket A2. In the menu under the socket concerned e.g.: A1 ZA1909DK (data cable)

Variant	RS232	Serial standard interface always active
Baud rate	9600 baud	Also saved in the cable connector

The baud rate can also be modified here via a selection box.

13.5.2 Relay trigger modules

Whereas, for the purpose of addressing peripheral devices for relays and trigger inputs (see Manual 5.1.2/3), old V5 modules (ZA1000-EAK) offer only one function variant (see Manual 6.6.4), the new V6 relay trigger cables and the relay trigger analog adapter (ZA 8006-RTA3) offer up to 10 relays or options with 2 trigger inputs or up to 4 analog outputs. Relays, trigger inputs, or analog outputs can be individually configured regarding their function variant. These modules can be connected at any of output sockets A1 to A3 **(2)**. To ensure that all elements can be addressed, each of these sockets has been assigned 10 port addresses.

Socket	Connection	Port addresses
A1	V6 output modules at socket A1	10..19
A2	V6 output modules at socket A2	20..29

In the menu ´**Output modules**´ first the desired output module is selected; this gives access to ´**Port list**´ and ´**Port settings**´. Here the elements can be individually selected and their functions programmed. (see Manual 6.10.9)

Relay addressing

On leaving our factory **relays** are set basically as follows :

Semiconductor	0.5 A	Normally open relay (NO)
Semiconductor	0.5 A	Normally closed relay (NC)
Semiconductor	0.5 A	Changeover relay

Relay addressing can be configured to the following **variants** :

Total alarm	Alarm - one or more channels of all
Assigned	Alarm - a programmable channel
Total alarm Max	Alarm - one or more limit value maximum of all
Total alarm Min	Alarm - one or more limit value minimum of all
Driven	Relay driven via interface or keypad

When **relays are assigned** to limit values the variant ´Assigned´ is configured automatically. (see 13.2.8). **Power failure** can be detected more easily if relay addressing is inverted; i.e. in the absence of current (power failure) the relay drops out, the contacts close, and an alarm is triggered automatically.

Relay addressing - inverted

Inverting	activate

The **activation mode** and the actual **contact status** resulting from the relay type and addressing mode are displayed in the next lines.

Status	active / inactive
Contact	open / closed

Via the keypad or the interface relays can be **manually activated** to relay variant ´Driven´. (see Manual 6.10.10)

Relay 

Trigger inputs

For the purpose of controlling the measuring sequence two trigger inputs are provided at ports 8 and 9 (keypad or optocoupler).

The trigger sources ´Key´ and / or ´Optocoupler´ can be defined directly in the RTA3 by selecting the trigger port and then using keys PROG, PROG, ▲ / ▼... and PROG or the trigger function can, for safety reasons, be disabled altogether by means of ´Off´.

The **following trigger functions** can be programmed as variants :

Start / stop	Start / stop a measuring operation, edge-controlled
Manual	Once-only manual measuring channel scan
Delete Max / Min	Delete all maximum / minimum values
Print the function	Print the measured value
Start / stop, level-triggered	Start / stop a measuring operation, level-controlled
Set measured value to zero	Set measured value to zero

If these standard functions prove insufficient, it is also possible to enable ´Macro execution´; any one of the 5 available macros can then be selected and, in the last line of the macro, interface commands can be entered as required, separated by ´|´. (see Manual 6.6.5).

Macro 5	Execute macro 5
Macro 6	Execute macro 6
Macro 7	Execute macro 7
Macro 8	Execute macro 8
Macro 9	Execute macro 9

13.5.3 Analog output

At sockets A1 and / or A2 it is possible to use not only relays and trigger inputs but also analog outputs, either as optional ports (4 to 7) with V6 relay trigger adapter ZA 8006-RTA3 or separately as V5 recording cable ZA 1601-RK. (see Manual 5.1.1) They provide the following output signals :

Recording cable ZA1601-RK	Voltage -1.2 to +2.0 V	0.1 mV / digit
Relay trigger adapter ZA8006-RTA3	Voltage 0 to 10 V	0.5 mV / digit
or optionally	Current 0 to 20 mA	1 µA / digit

Various configurations are also possible with analog outputs in the menu ´Output

modules´. **Output type** 0-10 V or 0-20 mA can only be selected with the relay trigger adapter.

The **following output variants** can normally be programmed:

Measuring channel	Output of the measured value from the measuring channel
Assigned, reference channel	Output of the measured value from a reference channel
Driven	Programmed analog output (see below)

In this menu the **measuring channel** can be set; however, it can be changed in the menu ´Measuring channel´ or via the interface.
In the second variant ´Assigned´ the analog output is assigned to a specific reference channel. This can be specified via the function ´**Channel**´.
With the driven analog output any output value can be specified via the keypad or the interface. (see Manual 6.10.7)
In the function ´**Analog output**´ it is always the current analog output value that is shown.

Scaling the analog output

When configuring a measured value output it is also possible, in the same menu, by means of the functions ´Analog start´ and ´Analog end´, to have the measuring range actually used for the measuring channel spread over the full 10 V or 20 mA. (see 13.2.9)
The output range 4-20 mA can only be enabled for the 20 mA analog outputs.

13.6 Device settings

The menu item ´Device settings´ leads to a further selection list with the following device functions:

132.6.1 Communication (device address, baud rate)
13.6.2 Macros
13.6.3 Operating parameters
13.6.4 Device compensation values
13.6.5 Calibration data
13.6.6 General device settings (language, time-of-day, display)

13.6.1 Communication

All ALMEMO® devices can be networked together very easily via the serial interface, thus enabling the user to centrally acquire and record measured values from several measuring instruments - even if these are located far apart. (see Manual 5.3) To communicate with networked devices interconnected via serial interface it is absolutely essential that all the devices concerned have the same baud rate setting but that each have its own dedicated address; this ensures that only one device responds per command. Before starting network operation therefore it is important to ensure that all measuring instruments involved are set to the same baud rate but that each is assigned its own unique device address.
When connecting V5/V6 and V7 devices to the same PC at the same time a separate interface is required for each group; this is because of the different

protocols involved.

It should also be noted, given the different protocols, that V7 devices must be operated separately from V5 / V6 devices via their own dedicated interface.

13.6.1.1 Device address and networking

on leaving our factory, in the function ´Device address´, the number is normally set to 00. This can be modified as desired by entering the appropriate data as usual. (see 9.7).

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.

13.6.1.2 Baud rate, data format

On leaving our factory the baud rate for all interface modules is programmed to 9600 baud. In order to avoid unnecessary problems when networking several devices together the baud rate should not be altered; rather the computer or printer should be set to match. If this is for some reason not possible, you can, in the function ´**Baud rate**´, via a selection box, choose from the values 600 / 1200 / 2400 / 4800 / 9600 baud or 57.6 / 115.2 / 230.4 / 460.8 / 921.6 kbaud (taking care not to exceed the maximum baud rate for the interface module). The baud rate setting is saved to the EEPROM on the interface module and thus applies when any other ALMEMO® device is used.
Data format 8 data bits, 1 stop bit, no parity (cannot be changed)

13.6.1.3 Output per scan cycle

In the course of a measuring operation measured data is output to the interface by default per output cycle. However, by enabling the option ´Output per scan cycle´ data can also be output directly per scan cycle; this is usually quicker. (see 10.1.2).

13.6.1.4 Allow oversampling of data output

With this option all standard channels being scanned at the conversion rate are always output - even if they have not yet been measured again.

13.6.2 Macros

In this menu 5 macros can be entered and saved, i.e. a list of serial commands that can be executed either as trigger events or as limit value actions. (see Manual 6.6.5) The individual commands are listed in the Manual Ch. 6 or 7; they are separated one from the other by the pipe character ´|´.
The menu ´Macros´ lists all 5 macros that have been set and / or modified by normal entry. (see 9.7).

13.6.3 Operating parameters

In the menu ´Operating parameters´ some functions can still be configured even if they have already been executed elsewhere. (see Manual 6.10.13.2)
Mains hum suppression 60 Hz instead of 50 Hz
When a measuring operation starts, delete maximum / minimum / average values. (see 10.4)
Enable / disable beeper
Hysteresis (see 13.2.7.1)

13.6.4 Device compensation values

The menu ´**Device compensation**´ lists three compensation values, which can be either measured or specified by programming.
On this device the ´**Atmospheric pressure**´ is measured by an integrated sensor; this value is used for all sensors requiring atmospheric pressure compensation. (s. 12.2.6 and quantities list ´With PC´ 13.2.13)
Here, if compensation is to be disabled standard atmospheric pressure 1013 mbar can be entered; if pressure on the device does not match atmospheric pressure at the measuring point, (e.g. in pipes), any other pressure can also be specified. To return to using a measured value the programmed value must be deleted.
Here the ´**Temperature**´ used to compensate sensors can be entered. (as per quantities list ´With TC´ 13.2.13) (see 12.2.5)
To disable compensation the value must be simply deleted, i.e. set to 25.0 °C.
The ´**CJC** (cold junction compensation) **temperature**´ is normally measured by two high-precision NTCs at sockets M0 and M9 and interpolated on a linear basis for use by all thermocouples as cold junction temperature..

13.6.5 Calibration data

The menu ´**Calibration data**´ lists the device's serial number and calibration data. Here, the date of the next calibration can be entered. If ´Calibration message´ is activated then, as soon as the next calibration is due, a message to this effect will appear when the device is switched on.

13.6.6 General device settings

13.6.6.1 Device designation

The device designation helps identify the device and facilitates its assignment in a network. In the ´Device designation´ function (see Manual 6.2.4) any text can be entered as designation up to maximum 40 characters in length (see 9.7). This text will then appear in the ´Home´ menu in the top line and in device lists (software).

13.6.6.2 Language

In the function ´**Language**´ the user can, via a selection box, choose between German / English / French as the interface language in which the functions are labeled in the display; (other languages are also available as options). If German is not set as the language, outputs via the interface will appear in English.

13.6.6.3 Date and time-of-day

For the purpose of logging actual measuring durations this device incorporates a real-time clock with date and time-of-day; this clock is very precise (2 ppm, equivalent to maximum 0.2 s/day). It is powered by a lithium battery ensuring that date and time-of-day are retained intact even if the battery pack is completely discharged. Date and time-of-day are always visible in the top line. Selecting this field calls up a menu in which the date can be programmed in the format d.m.y and the time-of-day in the format h:m:s.

13.6.6.4 Illumination

The display can be brightly lit but using this illumination can be very power-consuming. If the ambient light is sufficient ´**Display brightness**´ can be substantially dimmed without adversely affecting legibility. This saves energy and makes for a much longer ´Operating time´ when the device is run in battery mode. It is also possible to program a period of time, after which, if the device has not been used, it will automatically switch to ´Energy-saving mode´ and reduce its ´Display brightness´ even further. It is also possible by means of 'Energy-saving mode' to disable the display completely. It will return to normal display brightness as soon as any key is pressed.

13.7 Blocking function

To protect the device against unauthorized use and generally to facilitate normal operation it is possible in the menu ´Block function´ to enable / disable access to a particular menu or functions by simply clicking on it.

In the functions ´Configure menu block´ and ´Configure function block´ the desired enable / disable setting can then be entered quickly and easily. These settings can be activated by means of ´Activate block configuration´. The user will now be asked to set up a password, which will have to be entered again at the same juncture in the function ´Deactivate block configuration´ in order to deactivate the block. So long as a block configuration is active, the yellow LED ´LOCKED´ (5) will remain lit. (see 9.4)

In the main menu by means of the function ´Select block configuration´ any of the 5 standard block configurations ´Lock1´ through to ´Lock5´ can be called up. When one of these is called up it can be suitably renamed in .

13.8 Power supply

Power for the measuring instrument is supplied by two rechargeable lithium-ion battery packs with '**battery capacity**' 15.6 Ah. In the 'power supply' menu, the '**battery voltage**' display provides an estimate of the battery's remaining operating time. At 3.6 V the battery symbol in the status bar starts to flash and at 3.4 V the device switches off automatically. In '**charge / discharge current**' charging can be set to 'off', 'slow', 'normal', 'fast', or 'automatic'.

Providing the device is switched off, 'automatic' can be selected; standard mains adapter ZA1312-NA9 (12 V, 2.5 A) is used; fast charging the batteries will then take about four hours.

However, while the device is switched on, 'normal' should be selected; charging will then be at a lower current; this ensures that measuring conditions, especially with thermocouples, are not adversely affected by heat that might otherwise be generated. In these circumstances it is possible to force fast charging - but only with the appropriate settings (3). The other two options restrict possible heating even further. If the mains unit proves to be too weak, one of these will be selected automatically. The heating risk can also be reduced by adjusting the brightness of the display lighting.

The '**charge / discharge current**' is monitored continuously and from this the '**remaining battery capacity**' and the '**probable operating time**' are calculated.

For the purpose of powering the sensors the '**sensor voltage - setpoint**' of 6 / 9 / 12 V is derived automatically from the minimum sensor supply voltage for all sensors; however, this can if so required be replaced with a higher value. With sensors that draw a lot of current but cope with relatively low voltage, a carefully chosen sensor voltage can help save a considerable amount of energy. The actual value '**sensor voltage - actual**' is measured internally and is also displayed.

If a mains adapter is connected, the sensor voltage will always be set to 12 V. The mains adapter data is displayed in '**mains adapter voltage**' and '**mains adapter current**'. For the duration of the charging phase the green LED 'CHARGE' (5) remains continuously lit; as soon as the battery is fully charged, the adapter switches over to trickle charge and the LED goes out.

13.9 Memory

´Settings´ > ´Memory´ provides data referring to the memory. (see XREF)

´**Memory status**´ gives a graphical display of the memory's utilization level.

´**Memory total**´ indicates the total memory size - in KB for internal or in MB for external (memory card).

´**Memory free**´ indicates the remaining memory capacity - in KB for internal and in MB for external (memory card) - and the memory time - in format D.hh:mm - still available in the current scan cycle with the current sensor configuration.

´**File name**´ is the name of the current file.

There is also the function ´**Delete memory content**´. However, before mem-

ory content is actually deleted, a confirmation window will open; confirming will clear the storage medium completely; i.e. all files will be deleted.

13.10 About the device

This menu item provides ´**Device information**´ referring to the individual device. ´Type´ with number 710 may if appropriate be extended by an option code. (see Manual 6.10.11) This is followed by the serial number. There are two different software versions - one for the ´Measuring section´ and one for the ´User interface´. This is followed by various information, e.g. how to contact us by telephone or via the Internet.

14. WIZARDS

Some applications depend on such an array of parameters that one or two may easily be overlooked; some applications need additional calculation processes; others may need specially adapted menus. With this in mind we have created a number of ´Wizards´; these can be accessed directly from the ´Home´ screen.

14.1 Data logger
14.2 Scaling
14.3 Two-point sensor adjustment
14.4 Averaging (sliding, over time, over a cycle, over manually selected individual measuring operations, or over measuring channels)
14.5 Volume flow
14.6 Thermal coefficient
14.7 Wet-bulb globe temperature

14.1 Data logger

The principal task of data logger 710 is data acquisition. To perform this task and exploit the many possibilities offered by this device you are invited to carefully work through these wizards and process all the items requested.
On **page 1** we check all the general conditions, e.g. whether date and time-of-day are set correctly, whether the memory and battery capacity are sufficient, and whether the correct sensors are connected and functional.
On **page 2** we set the conversion rate (see 10.1.1), with which generally all standard ALMEMO® sensors operate (V5, DIGI, D6).
On **page 3** we select the scan cycle (see 10.1.2) for scanning all those measuring channels that provide an updated measured value - either at the conversion rate or, in the case of D7 sensors, according to their own respective actual measuring duration. All others are omitted. In order to set this important parameter to best suit the application's needs a number of suggestions reflecting the properties of the channels in question are listed in a selection box.
The next important decision is whether this scanning rate, very efficiently adapted to the sensors' requirements, should also be used for saving data to memory.

On **page 4** we are offered, as alternative, the option of using the output cycle (see 10.1.3) for recording data to memory. This will be used to always output all channels - unless the cycle is prolonged by the cycle factor (see 10.1.3.1) or certain channels are even deactivated.
On **page 5** we are offered the option of sleep mode for long-term recording; in this mode the device is switched off completely between cyclic scans, thus ensuring a much longer operating time per battery charge. To ensure that lower-speed sensors also have time to settle and deliver correct measured values, a sleep delay time will be set - normally automatically; this parameter is also saved in the sensor connector.
On **page 6** the display shows the remaining memory capacity, the probable memory time, and the battery operating time subject to the present configuration.
If the remaining memory capacity is insufficient, either the memory can be switched to ring mode or an external memory connector with an SD card can be used.
If the remaining battery capacity is insufficient, the battery must be fully charged or the mains adapter must remain connected or sleep mode with its longer cycle must be used.
On **pages 7 and 8** we can set 2 limit values (see 13.2.7) per measuring channel and choose from various actions (see 13.2.8) to be triggered in the event of these limit values being infringed. A limit value infringement can be used not only to issue an alarm report or alarm message but also to start / stop an entire measuring operation. Via macros the device's whole command repertoire can be used.
On **page 9** we are offered further possibilities for starting / stopping a measuring operation. The necessary control signals include not only keys, times, limit values but also mechanical or electrical events received via trigger modules.
Finally we may need at a later date or time to identify, locate, and interpret some previously recorded data. With this in mind on page 10 we can enter a comprehensive comments text describing the particular measuring location, purpose, task. Certain measured values or certain series within a measuring operation can also be assigned a number on the basis of which they can subsequently be called up very quickly.
On the last page we are given an overview of all the most important parameters.

14.2 Scaling

To display the electrical signal of a sensor as a measured value with a physical quantity it is usually necessary to perform scaling with a zero-point shift and factor and often a decimal point shift as well. (see 13.2.11)
To help calculate all the necessary parameters we have the ´Scaling´ wizard.
Here you should enter 2 corresponding points as actual value and setpoint and select the desired decimal position and the units.

The function ´Calculate´ produces the result, displayed on the next page.
Base value, factor, exponent, and in special cases also zero-point and gain are used.

14.3 Two-point adjustment

Two-point adjustment without a zero-point is not exactly straightforward. However, we have the ´Two-point adjustment´ wizard to help.

1. Set up calibration resources for setpoint 1.

Enter setpoint 1	Setpoint 1	07.00	pH
Either enter measured value in **actual value 1** or			
transfer measured value to **actual value 1**	Actual value 1	07.32	pH

2. Set up calibration resources for setpoint 2.

Enter setpoint 2	Setpoint 2	10.00	pH
Either enter measured value in **actual value 2** or			
transfer measured value to **actual value 2**	Actual value 2	09.87	pH

The function ´Calculate´ produces the result, displayed on the next page.

Zero point	-0.32
Gain	-0.1689

With pH probes you can by pressing the ´Clr´ key restore the default values, namely base value 7.00 and gain -0.1689. If a sensor is locked it can be temporarily unlocked using the help box.

14.4 Averaging

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

e.g. Smoothing a widely fluctuating measured value (e.g. wind, pressure, etc.)
Average flow velocity in a ventilation conduit
Hourly or daily average values for weather data (temperature, wind, etc.)
Also for consumption values (electric current, water, gas, etc.)

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

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

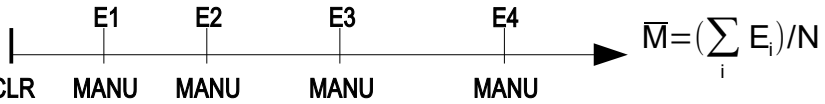
ALMEMO® devices offer several different averaging modes.
These include measured value smoothing per selected channel with a sliding averaging window, averaging over individual measuring operations selected by location or by time, averaging over the full actual measuring duration, over a cycle, or over specified measuring channels.
Users can, using the ´Averaging´ wizard, try all these modes in order to familiarize themselves with the parameters required by each and the operating methods. There is also the ´Volume flow´ wizard, which can be used to calculate volume flow from the average velocity and the cross-section of a flow channel.

When you call up the ´Averaging´ wizard, you will first be faced with a list of available averaging modes.

13.2.2 Measured value smoothing (see channel functions)
14.4.1 Averaging over manually selected individual measuring operations
14.4.2 Averaging over the full actual measuring duration
or the fixed measuring period
14.4.3 Averaging over a cycle
14.4.4 Averaging over measuring channels

14.4.1 Averaging over manually selected individual measuring operations

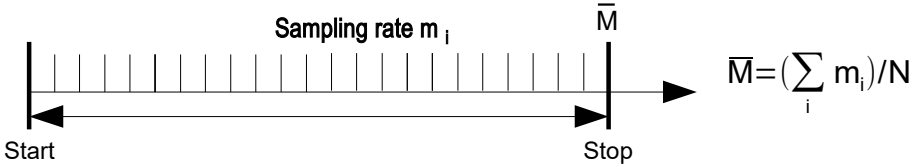
To obtain the average over individual measuring operations at particular locations or times individual measuring channel scans ´E_i´ must be performed manually. At all measuring channels whose measured values are to be averaged averaging must be switched to ´**CONT**´ (continuous) mode.



1. To stop a measuring operation if it has been started	Stop	
2. To set the averaging mode (see 9.7)	Averaging mode	CONT
To smooth a measured value (if required) select smoothing.	Smoothing	20
3. To delete the average value		
The ´Average value´ function displays	Average value	— —
The ´Number´ function displays	Number	0
4. To scan individual measured values ´Ex´ manually	Manual	
The ´Average value´ function displays	Average value	12.34 m/s
The ´Number´ function displays	Number	1

14.4.2 Averaging over the full actual measuring duration or the fixed measuring period

To calculate the average value of all measured values acquired at the scan cycle over a certain period of time the averaging mode for the required measuring channel should be set to ´**CONT**´.
Averaging can be performed either with or without a cycle.
At the start and stop of any measuring operation a measuring channel scan is always performed; this ensures that the start value and end value are always recorded each with the applicable time-of-day. In order to record average value $\overline{M}$ a function channel **M(t)** is required. (see 13.2.13).



To set the averaging mode	Averaging mode	CONT
To delete the average value automatically on start (s. 13.6.3) or with function ´Delete average value´		
To start averaging	START	
Read out the actual measuring duration (s. 14.4.2.1)	Measuring duration	00:01:23.4
To stop averaging	STOP	
For a fixed averaging period there is the function	Fixed measuring period	00:02:00
Read out average value in function	Average value	13.24 m/s

14.4.2.1 Actual measuring duration, fixed measuring period

For averaging over time (see above) and for many other measuring operations the actual measuring duration, from start to stop, or a programmable fixed measuring period is required. To continuously monitor the actual measuring duration the function ´**Actual measuring duration**´ is provided; this has the format ´hh:mm:ss.x´ and a resolution of 0.1 seconds; this is also used in the process of data recording. (see 10.4)

If in the operating parameters the function ´Delete measured values on start of measuring operation´ is activated (see XREF), the actual measuring duration will also be deleted automatically on each start.

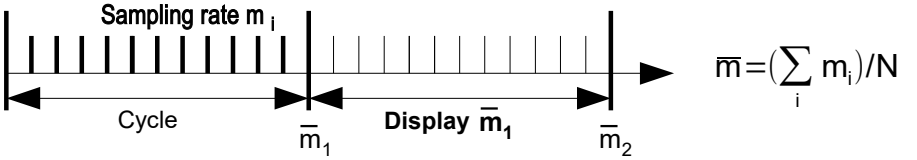
We are already familiar with the function ´**Fixed measuring period**´ from the data logger. (see 10.4.2)

It is used to stop a measuring operation on expiry of a fixed period of time.

Please note that, for data recording, the function channel or fixed measuring period, programmed here purely for test purposes, may have to be deleted again !

14.4.3 Averaging over a cycle

To acquire average values at cyclic intervals using the output cycle the averaging mode ´CYCL´ must be set. This mode ensures that on completion of each cycle the average, maximum, and minimum values are displayed and output via function channels to memory or to the interface and are then deleted.



Set averaging over a cycle	Averaging mode	CYCL
Program the output cycle (see 10.1.3)	Output cycle	00:15:00
Start measuring operation, averaging in progress	START	
Stop the measuring operation	STOP	
Read out average value / cycle in the function	Average value	13.24 m/s

Averaging over manually set periods of time

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

Set averaging over a cycle	Averaging mode	CYCL
Select the cycle and delete by pressing	Clr	
	Cycle timer	00:00:00
Start measuring operation, averaging in progress	START	
Manual measuring channel scan	Manual	

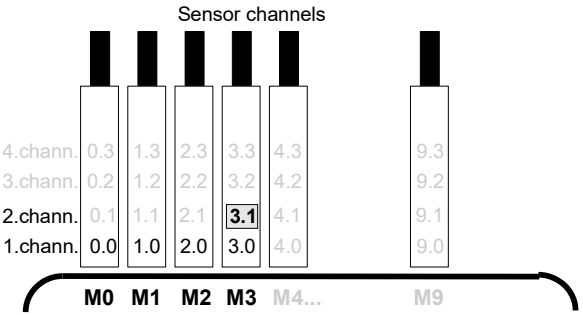
Average value over time from one measuring channel scan to the next Average value 12.34 ms

For recording average values an additional **function channel** with the quantity M(t) or the corresponding **output function** M(t) is required - instead of the measured value. (see 13.2.5.1, Manual 6.10.4).

14.4.4 Averaging over measuring channels

In all measuring channel scans the average value can also be determined over a number of associated measuring channels. However, for this average value a function channel with the measuring range **M(n)** must be available. (see 13.2.13) If you do not wish to program reference channels and the measuring channels to be averaged begin with M0.0, you need simply to program the function channel **M(n)** to the 2nd channel of the last connector (e.g. M3.1). (see 13.2.13.1) This will then refer automatically to the series from reference channel 2 (M0.0) through to reference channel 1 (M3.0 = 1st channel). Other measuring channel ranges can be activated by programming the reference channels accordingly. (see 13.2.13.4).

Via ´Select channel´ select	average value for meas. channel	0.0
In the next line enter	up to measuring channel	4.0
Freely selectable channel for the	function channel ´Average value´ M(n)	4.1
Here the average value M(n) appears	e.g. average value	10.78 m/s



$$\overline{M} = \left(\sum_{i=Bk2}^{n=Bk1} M_i \right) / N$$

Example

$$M3.1 = \left(\sum_{i=M0.0}^{n=M3.0} M_i \right) / N$$

M3.1= $\overline{M}$ von M0.0 .. M3.0

14.5 Volume flow measurement

To determine the **volume flow** in flow channels multiply together the average flow velocity $\overline{v}$ and the cross-section area

The ´**Volume flow**´ wizard contains all the necessary functions.

1. An average value has been obtained using a flow probe (units m/s) based on a previous averaging process. (see 14.4)
2. Functions for calculating the cross-section, i.e. ´diameter´, ´length´, ´width´
3. A function channel for the volume flow (see 13.2.13.1).
4. Calculation of the standard volume flow at 20 °C ambient temperature and 1013 mbar atmospheric pressure

Volume flow VS = average flow velocity $\overline{v}$ • cross-section area QF:

$VS = \overline{v} \cdot QF \cdot 0.36$ $\quad VS = m^3/h,\ \overline{v} = m/s,\ QF = cm^2$

To calculate average flow velocity $\overline{v}$ from approximate air volume measurements at air vents and gratings the **time-based averaging mode** can be used (see 14.4.2 and Manual 3.5.5). Apply the rotating vane at one end, start averaging, and proceed uniformly over the whole cross-section; when you reach the other end of the cross-section stop averaging.

With Pitot tubes, in order to calculate actual velocity, both **temperature compensation and atmospheric pressure compensation** are required. (see 12.2.5, 12.2.6).

Select Measuring channel	Flow	0.0
Select Function channel ´Average value´	Function channel ´Average value´	0.1
Display Average velocity $\overline{v}$	Average value	13.24m/s
Select channel type	Channel type	Tubular
Enter diameter in mm	Diameter	0150 mm
Volume flow, display	0.2 Volume flow	834.m3/h

For the calculation, display, output, and saving of the volume flow the function channel ´**Flow**´ is provided. (see 13.2.13).

Converting to standard conditions
With all flow sensors it is possible to convert the measured values obtained under the actual measuring conditions to standard conditions (i.e. temperature = 20 °C and atmospheric pressure = 1013 mbar). The actual measuring conditions, i.e. temperature and atmospheric pressure, are determined using the same device settings that may already have been set for temperature compensation and pressure compensation.
By select the function `Standardized volume flow` and entering the temperature and atmospheric pressure in the measurement the **standard volume flow** is calculated accordingly.

To ensure that output data at the interface is converted in this way, ´#N´ must be programmed in the channel designation either already in the velocity channel or in the volume flow channel. (see 13.2.1).

14.6 Thermal coefficient

To determine the thermal coefficient $\bar{q}/(T1-T0)$ the two temperature sensors are connected as required (see Manual 3.2) to channels M0.0 and M1.0 and the heat flux plate to M2.0. Temperature difference T(M1)-T(M0) is acquired on channel M1.1 as ´**Diff**´ and calculated on channel M2.1 as thermal coefficient.
For this measuring operation the following programming is required:

Quantity for M1.1:	Diff
Averaging mode for M1.1:	CONT or CYCL
Averaging mode for M2.0:	CONT or CYCL
Quantity for M2.1:	q/dt
Default reference channels	Mb1 = q = M2.0
	Mb2 = Diff = M1.1
Enter cycle in	Output cycle
Start measuring by pressing	START
Stop measuring by pressing	STOP

14.7 Wet-bulb globe temperature

The stress caused in heat-exposed workplaces can be evaluated in terms of their wet-bulb globe temperature calculated according to the following formula :
WBGT=0.1DT + 0.7HTN + 0.2GT (see Manual 3.1.4)
To measure the dry temperature (DT) and the natural humid temperature (HT) a psychrometer (FN A848-WB) with turn-off motor is connected at socket M0.0. A Pt100 globe thermometer is connected at socket M1.0. The wet-bulb globe temperature is calculated on channel M1.1 as quantity WBGT.

15. TROUBLE-SHOOTING

The ALMEMO® 710 data logger can be configured and programmed in many different ways. It is suitable for connecting a wide variety of different sensors, additional measuring instruments, alarm signaling devices, and peripheral equipment. Given these numerous possibilities the device may in certain circumstances not behave quite as expected. The cause of such unexpected behavior is only very rarely a device defect; usually the cause is incorrect operation by the user, an invalid setting, or unsuitable cabling. In such event try to pinpoint and clear the problem with the aid of the following tests.

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

Remedy Check the power supply. Charge the batteries. Switch OFF and then back ON again. If necessary reinitialize. (see 7.5)

Error Measured values are incorrect.

Remedy Check all the channel programming very carefully, especially the base value and zero-point (menu ´Display´ > ´Channels list´ > ´Measuring channel´ > ´Channel parameters´)

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

Remedy Check the cabling for any inadmissible electrical connections. Unplug any suspicious sensors. Connect a hand-held sensor in air or a phantom sensor (for thermocouples short-circuit A-B, for Pt100 sensors use 100 Ω) and check. Connect the sensors again one at a time and check successively. If a fault persists for any one connection, check all wiring. If necessary, insulate the sensor and eliminate interference by using shielded or twisted wiring.

Error Data transmission via the interface does not function.

Remedy Is the USB driver installed correctly? Check the interface module, connections, and settings. Ensure that both devices are set to the same baud rate and transmission mode. (see 13.6.2.1) Is the correct COM port on the computer being addressed ? Test data transmission by means of a terminal (ALMEMO® Control, WinControl). Address the device using its assigned device number ´Gxy´. (see Manual 6.2.1) If the computer is in XOFF status. enter <ctrl Q> for XON. Check the programming by means of ´P15´. (see Manual 6.2.3F) Test the transmit line only by entering a cycle using command ´Z123456´ and check in the display. Test the receive line by pressing the manual 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; then address devices individually via the terminal with command ´Gxy´. Addressed device is OK if at least ´y CR LF´ is returned as echo. If

transmission is still not possible, unplug all networked devices and check all devices individually using 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, a device still fails to behave as described in the operating instructions, it must be returned to our factory in Holzkirchen, accompanied by a brief explanatory note, error description, and if available test printouts. With the ALMEMO® Control software you can print out screenshots showing the relevant programming details and save and / or print out a comprehensive ´Function test´ in the device list or terminal mode.

16. DECLARATION OF CONFORMITY

Ahlborn Mess- und Regelungstechnik GmbH declares herewith that measuring instrument ALMEMO® 710 carries the CE label and complies in full with the requirements of EU directives relating to low voltage and to electromagnetic compatibility (EMC) (89/336/EWG).
The following standards have been applied in evaluating this product.

Safety EN 61010-1:2011
Electromagnetic compatibility (EMC) EN 61326-1:2013

CE

If a product is modified in any manner not agreed with us in advance, this declaration becomes void.
When using the sensor with an extension care must be taken to ensure that wiring is not laid alongside or close to high-voltage power cables and that it is if necessary properly shielded so as to prevent spurious interference being induced in the system.
The following advisory notes must be observed when operating the device :
Using the device in strong electromagnetic fields may aggravate measuring errors. After exposure to such irradiation ceases, the device will again operate within its technical specifications..

17. ANNEX

17.1 Technical data (s. Manual 2.3)

Measuring inputs	10 ALMEMO® sockets Mx, suitable for ALMEMO® flat connectors
Measuring channels	Maximum 40, electrically isolated, up to 100 function channels
A/D converter	Delta - sigma, 24-bit, 2.5 / 10 / 50 / 100 mops, amplification 1 to 100
Sensor power supply	6 / 9 / 12V, 0.4 A (with mains adapter 12 V)
Outputs	3 ALMEMO® sockets, A1 to A3, for all output modules
Standard equipment	
Display	5.7-inch TFT LCD graphical display, VGA 480 x 640
Operation	Capacitive touchscreen, 3 touchkeys
Memory	8-MB flash memory (sufficient for 400,000 / 1,500,000 values)
Date and time-of-day	Real-time clock (accurate to 4.7 ppm) buffered by a lithium battery
Power supply	External, 9 to 13 VDC, via ALMEMO® DC socket
Rechargeable battery pack	2 rechargeable lithium-ion batteries, 15.6 Ah
Mains adapter	ZB 1312-NA9, 230 VAC to 12 VDC, 2.5A
Current consumption without input and output modules	with illumination approx. 250 / 700 mA Sleep mode approx. 0.25 mA
Housing	222 x 169 x 61 mm (WxDxH) ABS / TPE (acrylonitrile-butadiene styrene / thermoplastic elastomer)
Weight	1.2 kg
Operating conditions	
Operating temperature	-10 to +50 °C Storage temperature -20 to +60 °C
Ambient atm. humidity	10 to 90 % RH (non-condensing)

Product overview

V7 data logger ALMEMO® 710	**Order no.**
10 inputs, 3 outputs, Cascadable interface, 5.7-inch TFT LCD graphical display, Touchscreen, Real-time clock, 8-MB flash memory	MA 710
Options	
Sampling rate 500 mops for a V5 measuring channel	SA 0000-Q5
Measuring ranges for temperature display for 8 refrigerants	SB 0000-R
Sensor linearization, multi-point calibration,	OA 710-KL
Accessories	
Memory connector including micro SD card (at least 512 MB) and reading device	ZA 1904-SD
Mains adapter with ALMEMO® plug, 12 V, 2.5 A	ZA 1312-NA9
ALMEMO® connector for external power supply 12V, 2.5A	ZA 1312-FS9
DC adapter cable, 10 to 30 VDC, 12 V / 1 A, electrically isolated	ZA 2690-UK2
ALMEMO® recording cable, -1.25 to 2.00 V	ZA 1601-RK
ALMEMO® data cable with USB interface, electrically isolated, maximum 115.2 kbaud	ZA 1919-DKU
ALMEMO® data cable with V24 interface,	

electrically isolated, maximum 115.2 kbaud	ZA 1909-DK5
ALMEMO® data cable, with Ethernet interface, electrically isolated, maximum 115.2 kbaud	ZA 1945-DK
ALMEMO® network cable, electrically isolated, maximum 115.2 kbaud	ZA 1999-NK5
ALMEMO®-D7 adapter cable, electrically isolated, length 25 cm	ZA D700-GT
ALMEMO®-D7 extension cable, not electrically isolated, length xx cm	ZA D700-VKxx
ALMEMO® input / output cable for triggering and limit value alarm	ZA 1006-EGK
ALMEMO® relay trigger analog adapter (4 relays, 2 trigger inputs)	ZA8006-RTA3
Option R02: Double analog output, electrically isolated, 10 V or 20 mA	OA 8006-R02

17.2 Index

17.3 Your contact partner(s)

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We take every possible care but the risk of inaccuracy can never be altogether excluded.
We reserve the right to make technical changes without advance notice.