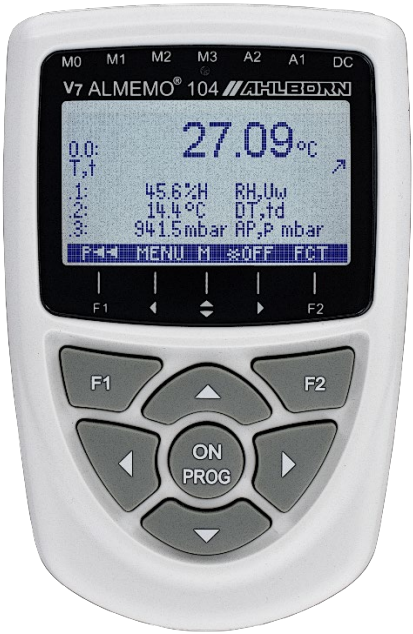
Operating instructions

English



V7 Universal measuring instrument ALMEMO® 104

V1.0
22.10.2024

1. OPERATING CONTROLS

(1) Measuring sockets M0 to M3
M0...M3 for all ALMEMO® sensors
M0.0...M3.9 up to 40 meas. channels

(2) Output sockets A1, A2
A1 USB interface (ZA 1919-DKU)
Optic fiber (ZA1909-DKL)
V24 (ZA1909-DK5)
Ethernet (ZA1945-DK)
Trigger input (ZA1006-ET/EK2)
Relay outputs (ZA1006-EGK)
Analog output 1 (ZA160x-RI/RU)
A2 Network cable (ZA1999-NK5/NKL)
Plug-in memory (ZA1904-SD)
Trigger input (ZA1006-ET/EK2)
Relay outputs (ZA1006-EKG)
Relay trigger adapter (ZA1006-RTA)
Analog output 2 (ZA160x-RI/RU)

(3) Connection socket DC 12V
Mains adapter (ZA1312-NAx,12V, min.1A)
Cable, el. isol. (ZA2690-UK, 10-30V)

(4) LCD graphics display
7 rows for functions
1 row for softkeys F1, ◄, ▲, ►, F2
Shown in brackets: **<MENU>** , **<FCT>**

(5) Operating keys

ON	To switch device ON
To switch device OFF: press and hold down	
F1, **F2**	Function keys (Softkeys)
▲, **▼** ...	**M:** To select a measuring point
▲, **▼**, **►**	**F:** To select a menu
PROG, **▼** ...	**F:** To select a function
◄ ...	Return to menu selection
< M◄◄ >	Go directly to the meas. menu
< F►► >	Go directly to the function menu
PROG	To program
▲, **▼**, **►** ...	To enter data

Rear of device:

(6) Battery compartment
3 AA alkaline-manganese batteries

2. TABLE OF CONTENTS

3. GENERAL

Congratulations on your purchase of this special ALMEMO® measuring instrument from our latest V7 generation. Thanks to the patented ALMEMO® plug the device configures itself automatically and thanks to the menus and context-sensitive help windows its operation should be fairly straightforward. The device can, however, be used with a wide range of sensors and peripherals and offers many different special functions. You are advised 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 17, '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.

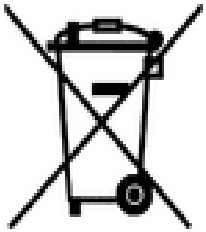
3.2 Standard delivery

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

- Measuring instrument ALMEMO® 104 with three AA alkaline batteries
- These operating instructions

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.
- Be sure to observe the maximum load capacity of the sensor power supply.
- Sensors with their own integrated power supply are not electrically isolated from one another.

4.2 Handling batteries / rechargeable batteries correctly

When inserting batteries / rechargeable batteries ensure that the polarity is correct.

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

Rechargeable batteries should be recharged as and when necessary.

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

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

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

5. INTRODUCTION

The ALMEMO® 104 measuring device is a brand new member of the unique family of measuring devices that are all equipped with the ALMEMO® connector system. The intelligent ALMEMO® plug system - successfully tried and tested for over 20 years - offers decisive advantages when connecting sensors and peripherals; since all parameters are stored in an EEPROM located in the connector itself, there is no need to repeat programming. Any sensor or output module can be connected to any ALMEMO® measuring instrument - all in the same way.

Intelligent digital ALMEMO® sensors of the new D7 generation operating in conjunction with our V7 measuring instruments overcome any lingering limitations that may previously have affected the system - with the one exception that they will not function on old V6 devices. These sensors, irrespective of the device's quantities and ranges, operate as an autonomous measuring system with up to 10 channels covering completely new measurable variables, with all relevant control functions, calculation functions, or compensation values, and ranges up to 8 digits in size and at speeds of up to 1000 measuring operations per second (mops). What is so special about this new generation is that, thanks to individual sampling rates, both quick and slower but high-resolution variables can now very easily be measured and recorded together. Individual sensor functions can be parametrized via a menu stored in the plug itself. To facilitate identification the quantity abbreviations and units have been extended to 6 digits and channel designation to 20 characters. What is completely new on V7 devices is the channel numbering system. Sensors and sockets are counted from 0 to 9; this is followed, after a decimal point, by the channels, likewise counted 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.

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 (Man., Chapt. 1)
- Overview of the device functions and measuring ranges (Man., Chapt. 2)
- Basic principles, operating instructions, and technical data for all sensors (Man., Chapt. 3)
- Options for connecting your own existing sensors (Man., Chapt. 4)
- All analog and digital output modules (Man., Chapt. 5.1)
- Interface modules RS232, USB, Ethernet, optic fiber (Man., Chapt. 5.2)
- The whole ALMEMO® networking system (Man., Chapt. 5.3)
- All functions and their operation via the interface (Man., Chapt. 6)
- Complete list of interface commands with all the printouts (Man., Chapt. 7)
- The new V7 commands are described in a special V7 supplement. manual

The operating instructions you are now reading cover only those features and controls that are specific to this device.

5.1 Functions of the ALMEMO® 104

The ALMEMO® 104 measuring devices have 4 measuring inputs. The measuring possibilities opened up by the new D6 and D7 series of digital sensors are virtually endless. The device can be operated via its integrated softkey keypad with cursor block and its LCD graphics display. The display can be adapted via configurable sensor-specific menus to suit all applications. With the internal 8 megabyte memory or with connected memory plug (SD card) a data logger function is realized. There are two output sockets which can be used to connect ALMEMO® output modules, plug-in memory, analog output, digital interface, trigger input, or alarm contacts. Multiple devices can be networked together 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 via the keypad or via the interface.

Measuring ranges

Corresponding measuring ranges are available for sensors with non-linear characteristics, such as 10 types of thermocouples, Ntc and Pt100 sensors, infrared sensors and flow sensors (impellers, thermoanemometers, pitot tubes). For humidity sensors, there are additional function channels that also calculate the humidity variables dew point, mixing ratio, vapor pressure and enthalpy. Complex chemical sensors are also supported. The measured values of other sensors can be easily recorded via the voltage, current and resistance ranges with individual scaling in the connector. Existing sensors can be used without further ado, simply connect the appropriate ALMEMO® connector via its screw terminals. Adapter plugs with integrated microcontrollers are also available for digital input signals, frequencies and pulses. In this way, almost all sensors can be connected to any ALMEMO® measuring device and exchanged with each other without having to make any settings.

Function channels

Maximum, minimum, and differential values of certain measuring points can be programmed as function channels and can be processed like normal measuring points.

Units

The units display (V5 two characters, D7 up to six characters) can be adapted for each measuring channel in such a way that both the display and via interface 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, via interface and in the software.

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. Sensors with multi-point calibration can also be connected.
(see Manual 6.3.13).

Scaling
The corrected measured value on each measuring channel can also be further scaled in terms of zero-point and gain 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 via the scaling menu.

Limit values and alarm
Per measuring channel two limit values can be set (one maximum and one minimum). In case of one of these limit values being infringed the 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.

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

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

Measured values
The measured values can be shown on the display in various menus in two font sizes. 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 point can be scaled by means of analog start and analog end in such a way that the measuring range thus defined covers the full range of the bar chart or of an analog output (2 V, 10 V, or 20 mA). At the analog output the device can output the measured value from any measuring point or a programmed value.

Measuring functions
To achieve optimal measured value acquisition some sensors require certain special measuring functions. The new intelligent sensors perform atmospheric

pressure compensation and temperature compensation internally and automatically. With infra-red sensors the emissivity factor can be configured and set.

Measured value smoothing
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 sampling rate and the number of active channels. However, most D6 and D7 sensors are assigned their own averaging period for all primary channels; this can be set via the sensor menu.

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

Average value
Manual averaging is available per channel over a particular period or cycle or over a series of individual measuring operations.

Measured value memory
Up to 10 measured values can be saved manually. This data can then be shown on the display or output via the interface.

5.1.3 Process control

To record the measured values from the connected sensors in digital form measuring channel scanning must be performed continuously with measured value output according to a time-based process control. A measuring operation can be started and stopped by means of 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 an even cyclic output. If a higher speed is required, standard sensor values can be scanned and output at the sampling rate; however, all sensors can now use the new scan cycle; this, if set to minimum time, 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 via the interface.

Output cycle
The output cycle can be programmed to any value from 1 second to 24 hours. This function permits cyclic output of measured values to the interface 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 certain channels; this may prove necessary in order to reduce excessive data flow especially while measured data is being saved.

Averaging over measuring point scans
The measured values from measuring point 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.

Sampling rate
The measuring points are continuously scanned at the set measuring rate of 10 measuring operations per second (mops). This rate can also be programmed to 2.5 mops.

Scan cycle
With the ALMEMO® 104 there is also the superordinate scan cycle, which acquires all standard channels and D7 channels whenever one of these delivers a new current measured value. Recording can be accelerated if measured values thus acquired are output via the interface and / or to a plug-in memory immediately.

Measured value memory
With the ALMEMO® 104 data logger, all measured values can be stored manually or automatically in a cycle in an EEPROM. The standard storage capacity is 8 megabytes, sufficient for at least 400,000 measured values. The memory organization can be set as linear or ring memory. Output is via the interface. A selection by time section or number is possible. All devices in the ALMEMO® 104 series can, by fitting an external plug-in memory and micro-SD card, be upgraded to a high-capacity data logger. Using this external memory (available as an accessory) files can be read out very quickly via any standard card reader.

Control ports
A relay trigger analog adapter can be used to provide up to ten output relays, and, as option, up to four analog outputs and two trigger inputs.

Operation
All measured values and function values can be displayed in different menus on the dot-matrix LCD screen. User menus can be individually configured for your specific applications from a range of nearly 50 functions, texts, lines, and empty lines. There are 7 keys (2 of them softkeys) for operating the device. These can also be used to fully program the device, sensors, and process control.

Output
All data logs, menu functions, saved measured values, and stored program parameters can be output to any peripheral equipment. Using the appropriate interface cable any of interfaces RS232, USB, or Ethernet can be used. To accommodate the variable data quantities 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 individually addressed and can be networked together by simply linking them up via network cable. However, old V5 / V6 devices and the new V7 devices use different protocols and must therefore be operated via different COM ports.

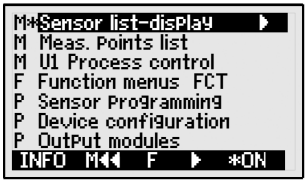
Software
Each ALMEMO® Manual is accompanied by the ALMEMO® Control software package, which can be used to configure the measuring instrument, to program the sensors, and to read out from the measured value memory. Using the integrated terminal, measuring operations can also be performed online. The WINDOWS®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

6. PUTTING INTO SERVICE

Sensor connection Connect sensors to sockets **M0** to **M3** (1) s. 8.
Power supply via batteries or mains adapter at socket **DC** (3) s. 7.1, 7.2
To switch ON Press **ON / PROG** (5) once and release s. 7.5

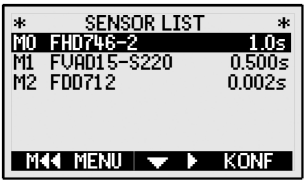
Automatic display of last measuring menu s. 11.

For **menu selection**
press key: **<MENU>**
On / off display illumination: **<✱ON>** / **<✱OFF>**
Select **sensor list** s. 9.1 menu **<F>**: ▲ / ▼ ...
Call up a menu: ▶ or. **PROG**



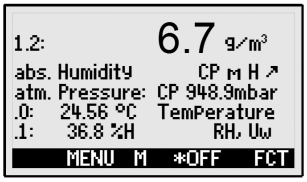
Select a sensor (s. 10) ▲ / ▼ ...

Display sensor: **<M◀◀>**

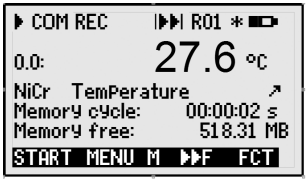


Select a **measuring channel** (s. 11.1.1)
<M>: ▲ / ▼ ...

All channels on the connector or those functions needed for measured value calculation are displayed.



Data logger functions: (s. 11.4)
Select Menu **U2 data logger** : **<MENU>**, ▼.., ▶
Select **memory cycle** **PROG**, ▲ / ▼ ...
Using the scan cycle:
For V6 set 'scan time': **<SCANT>**
For D7 set 'minimum time': **<MIN>**
Return to output cycle (00:01:00): **<RESET>**
Enter the cycle (s. 9.5): **PROG**, ▲ / ▼, ▶
..
Terminate programming mode: **< ESC>**
Start / stop measuring: **<START>** - **<STOP>**



Output via an interface:
- Connect peripheral equipment via data cable to socket **A1** (2) s. Man. 5.2

Select **free memory** : **PROG**, ▼ ...
Output memory s. 13.5.6 **< PMEM>** or command ´P04´ from the computer
Delete memory content s. 13.5.6 **< CMEM >** or command ´C04´ from the computer

7. POWER SUPPLY

Power can be supplied to the measuring instrument in any of the following ways:

Three AA alkaline batteries (included in delivery)	
Mains adapter, 12 V, min. 1 A, with ALMEMO® plug	ZA1312-NAx
Electr. isolated power supply cable with banana plug	ZA2690-UK
USB data / power cable	ZA1919-DKU5

See chapter 'Accessories' in the Ahlborn catalog.

7.1 Battery operation and supply voltage monitoring

The device is normally powered by three AA alkaline batteries. They enable an operating time of approx. 70 hours However, if the display illumination is left switched on, this will be reduced to approx. 35 hours. Since this device operates exclusively with active sensors, their current consumption must also be considered. The current operating voltage can be checked in the **Info** menu; this gives you a basis for estimating the remaining operating time (s. 10). As soon as the remaining battery capacity drops to approx. 10 %, the battery symbol  will appear in the status bar or softkey bar of the display and start to flash. If the batteries discharge completely, the device will switch off automatically as soon as battery capacity drops to approx. 3 V; any parameters set will be saved. (s. 7.6) To replace used batteries first switch the device off and then unscrew the cover of the battery compartment located on the rear of the device. (6) When inserting fresh batteries ensure that their polarity is correct.

7.2 Mains operation

To power this device from an external source preferably use mains adapter ZA-1312-NAx (12 V / min. 1 A); connect this to the DC socket. (3) Please ensure that the mains voltage is correct. The sensor voltage rises to approx. 12 V.

7.3 External DC voltage supply

The **DC** socket can also be used to connect another DC voltage, 6 to 13 V (minimum 200 mA). (3) It can be connected using ALMEMO® plug ZA-1312-FS8. If, however, 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-UK must be used. It will then be possible to use the measuring instrument in a 12-volt or 24-volt on-board supply system. A practical alternative is USB data / power cable ZA-1919-DKU5; this provides simultaneously a data interface to the computer and power supply (not electrically isolated).

7.4 Sensor supply

At the terminals + (plus) and - (minus) in the ALMEMO® plug there is a sensor supply voltage of 6 / 9 / 12 V (self-healing fuse, total current 500 mA); this is set automatically depending on the minimum sensor supply. With a 12 V supply the sensor supply voltage will generally also increase to 12 V.

7.5 Switching ON / OFF, reinitialization

To switch the device ON press and release **ON PROG** located in the middle of the cursor block. (5) The measuring menu most recently selected always appears in the display first. To switch OFF press and hold down the same key(s) **ON PROG**. After the device is switched off the real-time clock continues to run and all saved values and settings are retained intact. (s. 7.6) If interference (e.g. electrostatic, battery failure) causes the device to behave abnormally, it can be reinitialized. To activate a reset press and hold down key **F1** when switching on. To return all device programming (including device designation, user menus, process control, etc.) to the factory default settings press and hold down key **F2** when switching on. In so doing certain parameters will be lost or returned to their defaults: Language: German, Illumination: OFF, Device address: 00, Hysteresis: 10, Sampling rate: 10 mops.

Sensor programming in the ALMEMO® plugs will remain unaffected.

7.6 Data buffering

The sensor's programming is stored in the EEPROM on the sensor plug; the device's calibration values and programmed parameters are stored in the EEPROM on the instrument itself; in the event of failure both will be retained intact. Date and time-of-day settings and the individual value memory are retained intact if the device is just switched off - so long as the batteries have a voltage of approx. 2.7 V.

8. CONNECTING SENSORS / TRANSDUCERS

All ALMEMO® sensors can be connected to the input sockets M0 to M3 (1) of the ALMEMO® 104 measuring device. To connect your own sensors, simply connect a corresponding 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)

ALMEMO® V5 sensors are housed in a light-gray case. The source of their intelligence is a 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 sensor. Digital sensors used for the quantities - frequency, pulse, or DIGI - incorporate a microcontroller, which transfers digital signals to the device via an I^2C bus. Measured values are processed in synchrony with the sampling rate and at a resolution of maximum ±65000 all in the device.

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 smoothing; however, on this V7 device, quantity configuration and parametrization can be performed via the 'Sensor configuration' menu or using a USB adapter cable directly on the PC (s. 14.10).

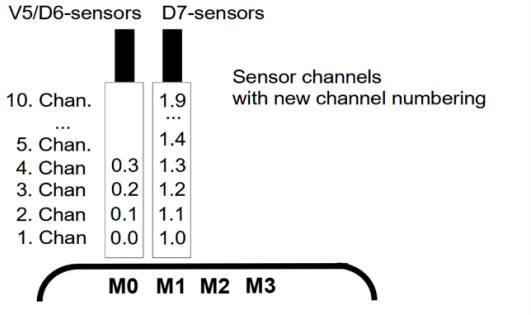
8.3 D7 sensors

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 sampling 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 six characters in length. With D7 sensors up to four primary channels can also be smoothed at the same time 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. (s. 14.10) All measured value processing is performed in the sensor itself; the resulting data is transferred no longer via an I^2C bus but via a serial interface to the device. 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 und additional channels

The ALMEMO® 104 measuring device has 4 input sockets M0 to M3 (1), to which the measuring channels M0.0 to M3.0 are initially assigned according to the new channel numbering. Whereas standard sensors can if necessary provide up to four 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 all the humidity variables (temperature / humidity / dewpoint / mixture ratio) or for function channels. Each sensor can if necessary be programmed with several quantities or scaling settings; and two or three sensors, if pin assignment so permits, can be combined in a single plug. This device does not incorporate any internal channels. On the measuring instrument this gives the following channel assignment:



8.5 Potential separation

The analog inputs are galvanically isolated by photovoltaic relays and a maximum potential difference of 50 V DC or 60 V AC is permitted between them. However, combined sensors within a connector and sensors with power supply are galvanically connected to each other and must therefore be operated in isolation. The voltage at the measuring inputs themselves (between B, C, D and A or -) must not exceed 5V!

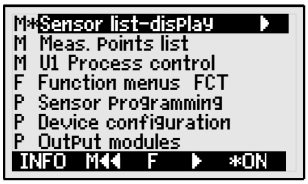
Since also the digital sensors are all operated via the common sensor power supply, they are all electrically interconnected. So long as the sensors are themselves isolated or are operated in isolation, this is not a problem. However, if two electrical signals (current, voltage) are used, adapter cable ZA-D700-GT

can be connected between them to ensure electrical isolation for power supply and data lines.
The power supply is isolated by the transformer in the mains adapter or by a DC/DC converter in connecting cable ZA-2690-UK. Data and trigger cables are equipped with optocouplers. If analog output cables are not electrically isolated the recording device or the sensors must be zero-potential.

9. DISPLAY AND KEYPAD

9.1 Display and menu selection

Measuring instrument ALMEMO® 104 incorporates a display comprising a dot-matrix LCD with 128 x 64 pixels or 8 rows each 8 pixels high **(4)**.



The **menu selection** screen offers the following items (s. 10):

3 meas. menus for acquiring meas. values (s. 11),

Additional function menus (s. 13), also accessible from any measuring menu by pressing key **<FCT>**,

Three programming menus (s. 14) for programming the sensors, device parameters (s. 15), and output modules (s. 16),

´Info´ menu (s. 10) for information regarding the device and the sensors

To call up **menu selection** (depending on the menu) press: ◀ ...or **<MENU>**

To switch **display illumination** ON / OFF (s. 15.4) **< ✱ ON >** / **< ✱ OFF >**

To switch the **device OFF** press: ON and hold down

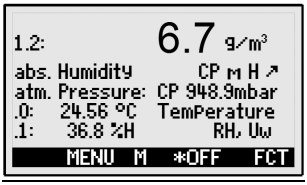
To select menus press: ▲ or ▼ ...

To call up the selected menu press: ▶ or **PROG**

To view the most important device information: **< INFO>**

9.2 Measured value display and status symbols

The sensor menu can be accessed by selecting the corresponding sensor in the sensor list and pressing the **M◀◀** button. The display then shows the selected measuring point, the measured value, and in some cases the functions of importance for this measured value, plus further measuring channels assigned to the connector in question.



For the **measured value** in question a row of **status symbols** is available:

	Symbol:
No sensor, measuring point deactivated	´- - - - -´
Relative measuring with respect to a reference value	**REL**
Meas. value modified with sensor correction or scaling	↗
Averaging in progress	M̄
Output function **D**iff, **H**i, **L**o, **M**(t), **A**larm (s. 14.12.5)	**D**, **H**, **L**, **M**, **A**
C Compensation, **T** Temperature, **P** Atm. pressure	**CT. P.** (**.** flashes)
Limit value infringement	**s** or **t** flashes
Measuring range overshot	**O** flashes

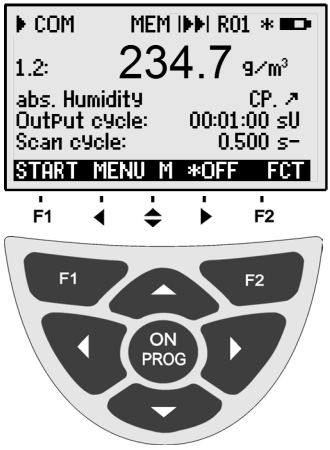
Measuring range undershot — **U** flashes
Sensor breakage / Sensor voltage low: Display ´-.-.-´ — **B** flashes / **L** flashes
Battery voltage <3.4 V, remaining capacity <10% — flashes

In the **process control** or **data logger** menu the top status bar also displays the following symbols for **checking the device status**:

Measurement stopped or started: ii or ▶
Values saved in individual value memory: MEM
Meas. point scan started with data output via interface: COM
Measuring point scan started and data being saved: REC
Start time or end time of meas. operation programmed: i▶ or ▶i
Status of the relays (external output module) open / closed: R-- or R01
Display illumination activated or on pause: ✱ or ✱
Battery status: full / half / empty: , , flashes

9.3 Function keys

The way in which the function keys **F1** , **F2** and the cursor keys ◀ , ▶ operate may vary from menu to menu (5). Their function is indicated as an abbreviation in the bottom line of the display (softkeys). In the instructions and documentation these softkey abbreviations are shown in angle brackets e.g. **<START>**.



In all measuring menus the following function keys are available:

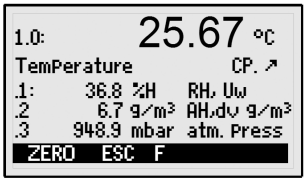
To select the **measuring point** press cursor keys: ▲ or ▼ ...
Softkey symbol which lights up in the middle: <M>
To call up function menu selection: < FCT > or F2
Navigation through several function menus: < ▶ F > or < F ◀ >
Navigation through several programming menus: < ▶ P > or < P ◀ >
To **return to** menu selection: < MENU > or ◀
To **return to** the most recent **M**easuring menu: < M ◀◀ >

The following softkeys only appear when the user selects a function menu or a programming menu (e.g. sensor programming):

To return from the measuring menu to the function menu press: < ▶▶ F > or ▶
To return from the meas. menu to the last programming menu press: < P ◀◀ > or F1

9.4 Function selection

Each menu comprises a number of functions; these may have to be activated or programmed during operation.



In conjunction with certain functions a context-sensitive **help window** will appear.

To **select a function** press: PROG
The first modifiable parameter is highlighted in inverse font: 25.45
Help is provided by the softkey symbol: <F> (for function selection)
To jump forward to the next function press: ▼ or ▲ ...

Depending on function the keys F1 , F2 and ◄ , ► are assigned the desired meaning, e.g.

Set measured value to zero: <ZERO>
Adjust measured value: <ADJ>
Delete the maximum / minimum value: <CLR>
Clear value memory: <CLRM>
Clear memory card: <CMEM>
Set a parameter directly: <SET>
Cancel the function: <ESC>

9.5 To enter data

When a programmable parameter is selected its current value can be cleared or reprogrammed directly (s. 9.4).

To **delete a programmed value** press: < CLR >
To **program** a value press: PROG
You should now be in programming mode: <P> in the middle of the softkey bar
The cursor flashes below the first input position Base value: 0025.0 °C
To **increment** the selected digit: ▲ ...
To **decrement** the selected digit: ▼ ...
To change the arithmetic sign of a numeric value: < +/- >
To move forward to the next position: ►
The cursor now flashes below the second position Base value: 0025.0 °C
To move back to the previous position: ◄
Each position is programmed just like the first ▲ / ▼ ..., ►
To save and exit: PROG
To cancel without saving: <ESC>

When entering a series of **alphanumeric characters** select the appropriate group:

For upper-case characters: **<ABC>**

For lower-case characters: **< abc >**

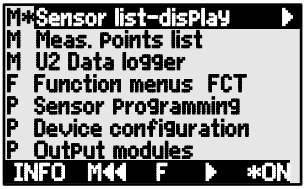
For numbers only: **< 123 >**

For arithmetic sign: **< + - >**

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

10. MENU SELECTION

The menu selection screen offers three **measuring menus** (s. 9.1).

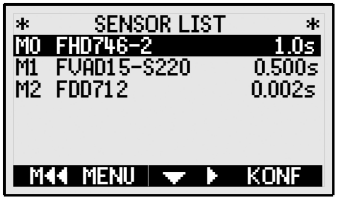


1. **M Sensor list** s. 11.1
2. **M Meas. Points list** s. 11.3
3. **M U2 Data logger** s. 11.4
4. A series of **F Function menus** s. 13
   and **3 Programming menus**:
5. **P Sensor Programming** s. 14
6. **P Device configuration** s. 15
7. **P OutPut modules** s. 16 if available

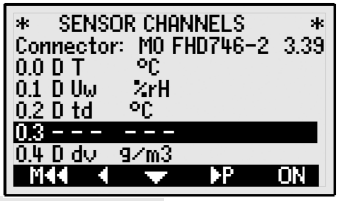
To display the most important information regarding the device **INFO**

Here, when submitting questions, you can find the exact device type together with its firmware version, options, and serial number. Any sensor can be selected by pressing ▲ / ▼ and identified on the basis of its order number (if available). To determine the power supply requirements both the battery voltage and the sensor voltage can be displayed. You can obtain any other help you might need at our WEB address.

Having accessed the **Sensor list** with its display of all connected sensors, you can use keys ▲ / ▼ to select one particular sensor; from here there are three possibilities.



1. With key **<M◀◀>** you can access the universal measuring menu **Sensor display** (s. 11.1).



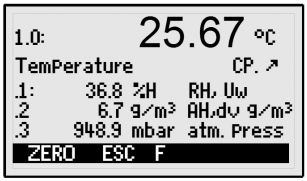
2. With key **<KONF>** you can access the **Sensor configuration** menu, specially provided by the selected D6 or D7 sensor for the purpose of programming its individual measuring ranges and parameters (s. 14.10).

3. With keys **PROG** or ▶ you can open the **Sensor channels** menu with its display of all channels available to the sensor selected. Here, similarly, if a particular channel is selected, you can access the **Sensor display** (with **<M◀◀>**) or sensor programming (with **<P▶▶>**) (s. 14)

11. MEASURING MENUS

The menu **Meas. Points list** provides not only the sensor display (listing all measured values for a particular sensor plus any appropriate compensation values) but also a clear overview of all measuring channels together with the most important data on each (s. 11.3). To output measured values to an interface or memory at a certain scanning rate and output cycle, you can select menu **U2 Data logger**. Each measuring menu can, by means of function menus, also be assigned various functions (s. 13).

11.1 Sensor display menu



Via the sensor list you can access the intelligent **Sensor display** menu. In the first line you will see the measured value (up to seven digits in length, large format), the measuring point, and the units (up to six characters in length, small format). Below this appears the measuring point designation (up to 20 characters in length) and certain symbols for checking the measured value status (s. 9.2). Below this, depending on the quantity and range, it lists all functions of importance for this measured value (e.g. compensation values) plus any further measuring channels assigned to the sensor in question.
Additional measuring functions can be implemented by means of function menus (s. 13). Symbol **<M>** in the middle of the softkey bar indicates that the measuring point can be selected by pressing keys ▲ / ▼.

11.1.1 Measuring channel selection

With key **▲** all active measuring channels can be selected one after the other and the latest measured value of each can be displayed. With key **▼** the previous channel is displayed. When a particular measuring channel is selected the associated input channel is also selected at the same time.

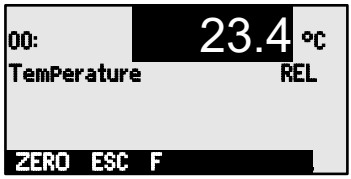
When performing this selection it should be noted that with this V7 device the channel numbering system has been changed; the channels are now numbered per sensor.

To increment the measuring channel:
To decrement the measuring channel:

11.2 Measured value correction and compensation

To achieve maximum measuring accuracy zero-point correction can be performed for sensors as early as the **Sensor display** menu. Universal two-point adjustment can be performed for all sensors via the function menus **Two-Point adjustment** (with two actual values and two setpoint values) and **Scaling** (s. 13.3,13.4). Any D6 or D7 sensor whose measurable variables are affected by ambient temperature or atmospheric pressure is already compensated internally and its associated values are shown in the sensor display (s. 11.2.2).

11.2.1 Setting measured values to zero



One very useful function is to zero the measured value at certain locations or points in time to act as a reference value from which to observe subsequent deviations. Having selected the measured value function the softkey **<ZERO>** will appear. Pressing this key saves the displayed measured value temporarily as **base value** and resets it to zero (s. 14.7).

Select the '**Measured value**' function (s. 9.4): 00: 23.4 °C
To zero the measured value: <ZERO>
The measured value should then show: 00: 00.0 °C and symbol REL
The base value is assigned measured value: Base value: 23.4 °C
To cancel zero-setting, after selecting this function: <ZERO> press and hold down

With standard locking level 5 (s. 14.4), the base value is not stored in the plug, but only **temporarily** in RAM until it is switched off. This status is indicated in the display by the symbol REL; in other cases the symbol ↗ appears. If locking level 3 is set, the value is not saved as a base value but as a zero point correction.

If you prefer to disable the zero-setting function completely, the channel in question must be locked at level 6.

11.2.2 Atmospheric pressure compensation

Measured variables affected by ambient atmospheric pressure may, in the event of substantial deviation from normal pressure (1013 mbar), be subject to certain measuring errors.

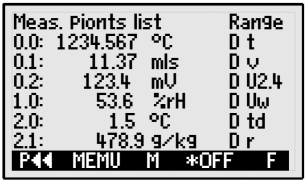
e.g. error per 100 mbar:		**Compensation range**
Rel. humidity psychrometer	approx. 2 %	500 to 1500 mbar
Mixture ratio, cap.	approx. 10 %	Vapor pressure VP up to 8 bar
Dynamic pressure	approx. 5 %	800 to 1250 mbar
O2 saturation	approx. 10 %	500 to 1500 mbar

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).

Any D6 or D7 sensor whose measurable variables are affected by atmospheric pressure incorporates its own atmospheric pressure sensor; this performs atmospheric pressure compensation automatically. This value is normally available as a measuring channel but it is also displayed in the menu Sensor display as atmospheric pressure compensation for appropriate measurable variables.

A measured atmospheric pressure compensation can be displayed in menu CP.

11.3 Measuring points list menu



The best overview of all measuring points with measured values and function values is obtained via the menu **Meas. Points list**.

This menu can be combined with selected functions:

When the list is first called up it appears with maximum six measured values, the units, and measuring range:

Meas. Points list: Range
0.0: 423.12 g/m³ DIGI ...

The measured value can be linked to a series of functions by pressing keys:

<F> , **<F>** ...

Measured value with units (maximum 6 characters) and comments text (maximum 20 characters)

Meas. Points list: Comments text
0.0: 423.12 g/m³
AH, dv abs. humidity

Measured value with maximum value

Meas. Points list: Max value
0.0: 23.12 °C 32.67

Measured value with minimum value

Meas. Points list: Min value
0.0: 23.12 °C 19.34

Measured value with average value

Meas. Points list: Average val.
0.0: 23.12 °C 25.45

Measured value with limit value, maximum

Meas. Points list: LV-Max
0.0: 23.12 °C 30.00

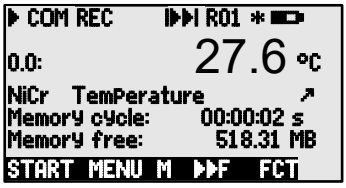
Measured value with limit value, minimum

Meas. Points list: LV-Min
0.0: 23.12 °C 20.00

To select further measuring points press

<M>: **▲** or **▼** ...

11.4 Menu U2 - Data logger



This menu can be used either on its own or just like any measuring menu in conjunction with the function menu **Data logger functions** (s. 13.5).
The device status is displayed by certain symbols in the status bar (s. 9.2). Data acquisition can be set to cyclic via the save-to-memory cycle. The save-to-memory cycle depends on whether in the data logger functions the memory is activated with the output cycle or with the scan cycle (s. 13.5.7). This switchover can also be performed easily and conveniently in this menu using the softkeys. The available memory is displayed in the function **Memory free** (s. 13.5.6).

To set save-to-memory cycle as output cycle with saving: **Memory cycles: 00:00:02 s**
To set V6 to scan cycle as 'scan time': **<SCANT>** s. 15.7.2
To set D7 to scan cycle as 'minimum time': **<MIN>** s. 15.7.2

To return to output cycle (00:01:00):	**<RESET>**	s. 15.7.3
To start a cyclic measuring operation (if cycle >0):	**<START>**	s. 13.5.5
To initiate manual meas. value scanning (if cycle =0):	**<MANU>**	s. 13.5.4

12. MEASURED DATA SCANNING AND OUTPUT

Repeated measuring channel scans are needed in order to continuously monitor and acquire measured values from all measuring channels, to record maximum / minimum values, to detect limit value infringements, and then to output all this data either via the interface or to memory. With standard sensors this is performed at the 'sampling rate' (normally 10 mops, s. 15.7.1). With the new D7 sensors there is also a superordinate 'scan cycle', with which not only standard sensors but also all D7 sensors with their fully individual measuring speeds are acquired (s. 15.7.2). Output can be performed using this 'scan cycle' or at more prolonged cyclic intervals using the 'output cycle' (s. 15.7.3). For certain applications output can also be initiated manually at specifiable points in time.

Cyclic output

For cyclic output via the interface or to memory either the 'output cycle' or the 'scan cycle' must have been programmed and the output configured appropriately (s. 13.5.7). Once cyclic output has started all measured value scans are output cyclically in table format (see Manual 6.5.1.2).

To **start a cyclic measuring point scan** **<START>**

The cycle timer should then be seen counting down until the next cycle.

To stop a cyclic measuring point scan **<STOP>**

Once-only output

If the output cycle is deleted, a once-only measuring channel scan can be initiated by pressing key **<MANU>** (see Manual 6.5.1.1).

Once-only manual measuring point output **<MANU>**

Each time a key is pressed again the measured values will be processed in the same way with the associated actual measuring duration.

13. FUNCTIONS MENUS

To manage individual tasks each measuring menu can be assigned a function menu from the adjacent list. For each measuring operation you can at any time toggle between measuring menu and function menu.

The **Function menu** can be accessed via the menu selection screen or in measuring menus and function menus by means of (s. 10): < FCT >

To access the function menu press: ▼ and ▶ or PROG

The function menu is then saved for quick menu changes.

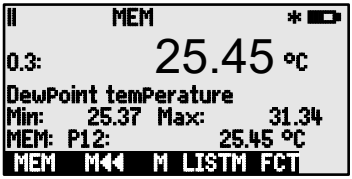
To toggle between function menu and meas. menu: < M◀◀ > and <▶▶F >

Delete saved function menu: < CLR >

Navigation through several function menus: <▶F > or <F◀ >

13.1 Maximum, minimum, individual value memory

The function menu **Max. Min. Individual memory** shows not only the measured value but also the continuously acquired maximum and minimum values for the selected measuring point plus an individual value memory sufficient for 100 individual values.



Maximum value, minimum value

Function **Min** and **Max**: Min: 25.37 Max: 31.34

To clear this memory select the function (s. 9.4): Min: 25.37 Max: 31.34

To clear maximum, minimum, and average values for all channels <CLRA>

Whenever this data is deleted, the current measured value will, since measuring is a continuous process, appear again immediately. These peak values will, if the device has been so configured, be cleared each time a measuring operation starts (default setting, s. 15.9).

Individual value memory

Each measured value of any channel can be saved at the touch of a button. The measured value is displayed in the function **MEM** together with its units and position number and **MEM** is highlighted in the status bar. The user can choose whether to clear the whole memory or just the last value. All data thus saved can be shown in the display or output in list form via the interface.

To continuously save the measured value <MEM>

Memory display with position Memory: P12: 25.45 °C

After selecting this function, to clear the last position <CLRP>

To clear all saved values <CLRM>

To display all saved values <LISTM> and <F▶ > ..

To output all saved values <PRINT>

Interface commands		Response
To save a measured value	S-4	
To output memory data	P-04	Memory: P01: 0.0: +022.12 °C P02: 0.0: +022.12 °C P03: 1.0: +0039.9 %H P04: 1.0: +0039.9 %H P05: 2.0: +0007.6 °C
To clear the memory	C-04	

13.2 Averaging

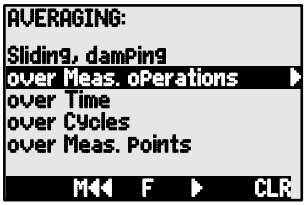
The average of a measured value is needed for various applications.

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 $\bar{M}$ of a measured value 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).

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

If, in function selection, averaging is selected, a new selection menu will appear listing the various averaging modes.

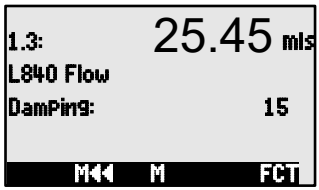


These include measured value smoothing for the selected channel with a sliding average window, averaging over individual measuring operations selected by place or time, averaging over time, over cycles, or over specified measuring points.

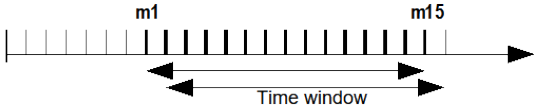
To select an average value menu ▼ and ▶ or PROG

To clear averaging for the selected channel <CLR>

13.2.1 Smoothing meas. values by means of a sliding average



The first averaging method applies exclusively to the measured value of the selected channel; this 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. The **level of smoothing** can be set in the **Smoothing** function by specifying the number of measured values to be averaged (range 0 to 99). The smoothed measured value can thus also be used in all subsequent evaluation functions in combination with averaging over individual measured values (s. 13.2.2).



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

To smooth a measured value over e.g. 15 values **Smoothing: 15**
Sampling rate: 10 M/s

Time constant (s) = Smoothing x Scan time = 3s at a channel

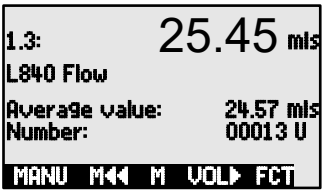
In most D6 and D7 sensors, the moving average is already built into the sensor. It is configured by entering the averaging time in the sensor menu. The damping is no longer available in this case.

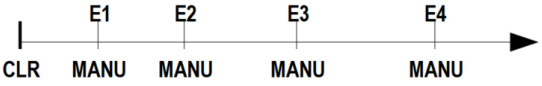
How the averaging menus operate:

The following averaging menus use some of the standard functions such as averaging mode, output cycle, sampling rate - all appropriately reprogrammed. Data output via the interface or to memory is possible but this must be configured. To also display the average value acquired as it is being output a function channel M(t) must be activated on an additional channel for the sensor in question (s. 14.9).

13.2.2 Averaging over manually selected meas. operations

To obtain the average of individual measuring operations at particular locations or times select the menu **Average over meas. oPerations**. Here individual measuring point scans 'E_i' can be initiated manually.





$$\overline{M} = \left(\sum_i E_i\right)/N$$

1. To select and then clear an average value
   The **Average value** function displays
   The **Numberl** function displays

PROG , **<CLR>**
Average value: ----- mls
Number: 00000 U

2. Manually scan individual meas. values Ex.x:
   The **Average value** function displays
   The function **Numberl** displays

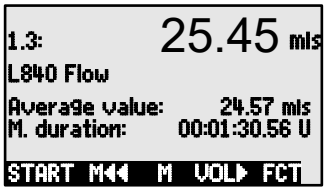
<MANU>
Average value: 12.34 mls
Number: 00001

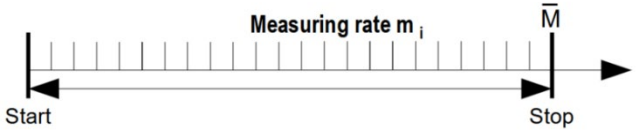
3. Repeat step 2 for each manual measured position.

For flow probes call up the 'volume' menu by pressing: **<VOL▶>** s. 13.2.6

13.2.3 Averaging over time

To determine average values over a certain duration there are two possibilities - either by pressing the 'start' and 'stop' keys accordingly or by entering a duration for averaging which is started manually but will stop automatically. A measuring point scan is always performed at start and stop in order to record the start value, end value, and average value - each with the applicable time-of-day.





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

To delete the average value and actual measuring duration automatically on start (s. 15.9) or on selecting the average value press <CLR>

Read out the measuring duration in the function M. Duration: 01:23.40 U

Start averaging <START> Verification: $\overline{M}$

Stop averaging <STOP>

Or, alternatively

To enter a certain averaging duration in seconds, select and program the function **Meas. Duration**,

The function changes automatically to Aver. duration: 020 U

Start averaging <START> Verification: $\overline{M}$

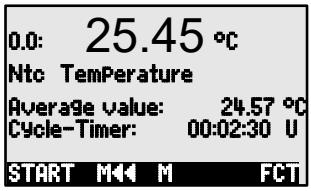
Stop averaging after expiry of averaging duration

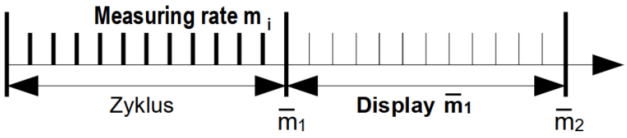
Read out the average value in the function: Aver. Value: 13.24 mls

With flow sensors calculate volume <VOL▶> s. 13.2.6

13.2.4 Averaging over a cycle

To determine hourly or daily average values the average values must be acquired at cyclic intervals. An output cycle is programmed to ensure that the average value, maximum value, and minimum value are cleared after each cycle but continue to appear in the display throughout the following cycle.



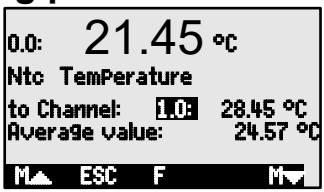


$$\overline{m} = (\sum_{i} m_i)/N$$

Program the output cycle (s. 15.7.3) **Output cycle: 00:15:00 Un**
Start measuring operation, averaging in progress **<START>** Verification: $\bar{M}$
Stop the measuring operation **<STOP>**

Read out the average value of the last cycle in function **Aver. value: 13.24 mls**

13.2.5 Averaging over measuring points



An average value can also be determined over any two measuring points. In the menu **Average over meas. Points** you can set the start channel (reference channel 2) with the measuring point in the first line and, having selected the function to channel also the end channel (reference channel 1). The average value M(n) should be programmed to function channel M1.3. (s. 14.9).
Measuring point scanning is continuous.
Average value M(n) from M0.0
(reference chann. 2) to M1.0 (reference chann. 1)

$$\bar{M} = M1.3 = \left(\sum_{i=Bk2}^{n=Bk1} M_i\right)/N$$

13.2.6 Volume flow measurement

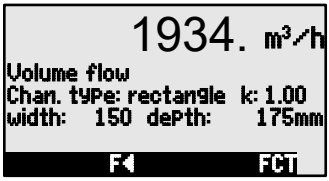
To **determine the volume flow** 'VF' in flow conduits multiply the average flow velocity $\bar{v}$ by the cross-section area 'XS'

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

The average flow velocity $\bar{v}$ can be acquired in the following ways.

1. **Averaging over individual measurements** (s. 13.2.2)
2. **Averaging over time** (s. 13.2.3)

To obtain approximate air volume measurements at air vents and gratings the user should apply the flow sensor at one end, start averaging, and proceed uniformly over the whole cross-section, and, on reaching the other end, stop averaging.



If the average value is assigned m/s as units, the volume flow can be determined by calling up the volume flow menu directly from the average value menu by pressing **<VOL ▶ >**.

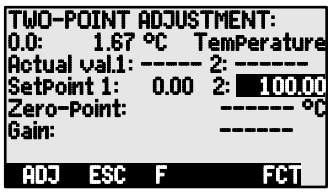
This lists the following functions for calculating the cross-section

Chan. type: Rectangular with width and depth,
Tubular with diameter or
Surface with cross-section
including correction factor 'k'

Chan.type: Tubular k:1.00
Diameter: 00175 mm
Cross-section: 02345 cm²

Display of volume flow m^3/h: **Volume flow 1934. m³/h**

13.3 Two-point adjustment with Setpoint entry



For universal error correction at any two points the function menu **Two-Point adjustment** is provided. If the actual values at two points are known, these can be entered together with the associated setpoints. If not, two setpoint states must be created and adjusted online. Usually, for the first measuring point, a zero-point adjustment is performed; however, any other setpoint is equally possible. For the second measuring point a gain adjustment is performed and all correction values are recalculated (s. 14.6).

Two-point adjustment (actual values are cleared)

1st Measuring point

Place the sensor in **1st status**	0.0: 0.4 °C
(e.g. icy water, unpressurized, etc.),	Actual val.1: -----
Select and enter setpoint 1	SetPoint1: 0.0
Adjust meas. value to setpoint 1 by pressing	<ADJ>
Measured value should now display setpoint 1	0.0: 0.0 °C

2nd Measuring point

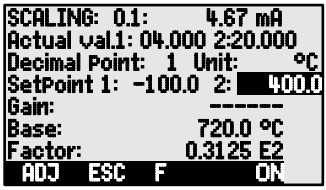
Place the sensor in **2nd status**	0.0: 99.45 °C
(e.g. boiling water, known weight, etc.)	2: -----
For the second meas. point enter setpoint 2	2: 100.0
Adjust gain in function 'setpoint 2' by pressing	<ADJ>
Measured value should now display setpoint 2	0.0: 100.0 °C

Correction value calculation:

Also enter known actual values in function Actual val.1: 0.4 2: 100.0
and calculate correction in function setpoint 2 by pressing <ADJ>

If the sensor is locked, a confirmation request will appear asking whether adjustment should indeed be performed.

13.4 Scaling



Sensors or transmitters with standardized signal output will usually have to be scaled to be able to display the physical variable. If two actual values and 2 setpoints have been entered, the menu **SCALING** will, as in the previous chapter (s. 13.3), perform the task of calculating the scaling values, base value and factor (s. 14.7). The desired units, the decimal point position, and the number of decimal places must also be entered.

Calculating the scaling values

After entering all the necessary parameters the scaling values are calculated in function 'setpoint 2' by pressing <ADJ>

Scaling by means of two-point adjustment
Sensors adjusted via the factor, e.g. force transducers and displacement transducers, can also be adjusted online (as described in 13.3).

1. Simulate, select, and enter **setpoint 1**:
Adjust in **SetPoint1** by pressing

SetPoint1: -100.0
<ADJ>

2. Simulate setpoint 2,
Select and enter setpoint 2

2: 400.0

Two-point adjustment in setpoint 2 by pressing <ADJ>

It is also possible to adjust the end value only - without changing the zero-point.

13.5 Data logger functions

The four function menus can be used to acquire and record measured values from all measuring points either manually at specifiable points in time or cyclically over a specifiable period (s. manual 6.5).

13.5.1 Internal data memory

The data logger ALMEMO® 104 has an internal data memory of 8 MByte EEPROM, sufficient for approx. 400,000 measured values (depending on the number of channels). If the supply voltage fails, the measured data are retained. The total memory capacity and the free memory space can be seen from the two functions Internal memory and Free memory. The organization can be reconfigured from ring to linear memory. The basics for data storage in ALMEMO® instruments are described in the manual chapter 6.9. ATTENTION: Only one sensor configuration is stored in the internal memory at the first start, additional sensors will be added at the next start. However, if other sensors are connected, the memory must be read out and deleted before the next recording is made.

13.5.2 External plug-in memory incorporating Memory card

Measured data is written to the memory card via the plug-in memory connector; this data is saved in standard FAT16 table format. The SD card can be formatted and its contents can be read out or deleted - using the SD card adapter on any standard PC equipped with a card reader. This data can also be imported into MS-Excel or into WinControl. In the course of a measuring operation the plug-in memory and the memory card must not be unplugged; this would cause all temporarily buffered measured values to be lost.

Memory capacity still free

Memory free: 321.75 MB

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_7.001´ 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 (s. 13.5.3).

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_7.002´. 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.

To check that the plug-in memory is functioning properly there is an LED incorporated in the handling end; 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

When inserting the plug-in memory make sure that the card remains latched in position. Memory cards do not support ring memory mode.

13.5.3 Numbering of measuring operations

To identify measuring operations or series of measuring operations these can before starting be assigned unique numbers. This number will be output and / or saved with the start of the next measuring point scan. When reading out individual measuring operations these can thus be attributed to certain measuring locations or measuring points (s. Manual 6.8).

When the **Number** function is selected a 6-digit number is entered as normal (s. 9.5). You can use digits 0 to 9 and characters A, F, N, P, and '_'(space). The number is activated as soon as it has been entered and will be followed by 'A' until the next measuring operation is saved to memory.

Function Number: (e.g. room 12, meas. point 1) **Number:** **12-001 A**
To zero-set and deactivate the number **<CLR>**
To increment and activate the number **< +1 >**

13.5.4 Once-only saving of all measuring points

Once-only manual measuring point scans for saving the current measured values from all active measuring points can be initiated by pressing key **<MANU>**. (see Manual 6.5.1.1).

To initiate a once-only manual measuring point **<MANU>**
Each time a key is pressed again the measured values will be processed in the same way with the associated actual measuring duration.

13.5.5 Cyclic saving of all measuring points

For cyclic measured value recording either the output cycle or the scan cycle must be programmed in the next menu and saving-to-memory must be activated accordingly (see Manual 6.5.1.2). The 'save-to-memory cycle' function will then indicate the cycle being used for data logging (s. 11.4). Having selected this function you can specify the cycle directly (s. 9.5).

Function **Save-to-memory cycle** Memory cycle: 00:02:00 s

The procedure for setting the data and time-of-day is described in Section 15.1.

The measuring operation can be started by pressing <START> and stopped by pressing <STOP>. Each time a measuring operation starts, if the device has been so configured, the maximum, minimum, and average values of all measuring points will be cleared (default, see 15.9).

To **start a cyclic measuring point** scan <START>

The following symbols will be highlighted continuously in the status bar, i.e. so long as the measuring operation is running (s. 9.2).

The START arrow lights up. ´▶´

If data is being output via the interface, ´COM´ will light up.

If measured values are being saved, ´REC´ will light up.

To **stop a cyclic measuring point scan** press <STOP> ´‖´

13.5.6 Memory capacity, memory output and clearing

When measured values are being recorded the 'memory capacity free' function continuously displays the memory capacity still available. Selecting this function enables two softkeys, one for direct memory output and one for memory clearing.

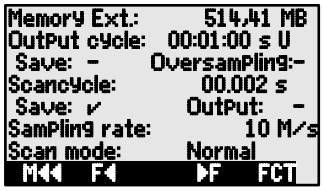
Function **memory capacity free** e.g. Memory free: 238.4 kB

Output memory in table format <PMEM>

Completely delete the memory card's contents <CMEM>

If an SD memory card is being used the device itself can only read out in table mode the measured data contained in the file most recently used (s. 13.5.2). For the duration of memory output the LED on the handling end lights up continuously. The most sensible approach is to remove the memory card and copy the files via the SD card adapter and USB card reader directly onto a PC. These can then be imported either into MS-Excel or into WinControl (as of V.4.8.1).

13.5.7 Scanning configuration



The following menu, accessible by pressing key < ▶ F >, first shows the total memory capacity of the SD card being used. The functions '**Output cycle**' (16.7.3), '**Scan cycle**' (16.7.2), and '**Sampling rate**' (16.7.1) can be used to define exactly how data from standard and D7 sensors should be scanned and saved to memory. Here all settings are listed.
The way in which saving-to-memory is activated will affect the resulting 'save-to-memory cycle' (s. 13.5.5).

Output cycle with save-to-memory activation
For a relatively slow (one second up) cyclic saving of measured values from all sensors the OutPut cycle with saving-to-memory activated should be used. If all channels do not appear every time in the period provided, oversampling can be enabled. As soon as an operation is started the cycle timer should then be seen counting down until the next cycle.

Enter the **cycle** in format ´hh:mm:ss´ s. 15.7.3: OutPut cycle: 00:01:00 s U
Clear the cycle and end current scan <CLR> 00:00:00 s U
Function ' save-to-memory activation' in the output cycle Save: -
Saving to memory activated (default setting): <ON> ✓
Switching off the saving function <OFF> -
Allow oversampling OversamPling:-

For quicker processes, in particular with D7 sensors, saving-to-memory should be activated at the scan cycle. For standard sensors the speed is prescribed by the sampling rate; for D7 sensors it is prescribed via the minimum actual measuring duration.

Select scan cycle s. 15.7.2: Scan cycle: 00.005 s
Switch saving OFF Save: -
Switch saving ON <ON> ✓
Switch output OFF <OFF> OutPut: -
Switch output ON <ON> OutPut: ✓
Enter **sampling rate** s. 15.7.1: SamPling rate: 10 moPs

13.5.8 Scan mode

For automatic data logger operation and / or measured value scanning by the computer there are four scan modes available.

Normal Internal cycle or cyclic scanning by the computer
Sleep Internal cycle only, automatically switching off, for long-term monitoring
Monitor Internal cycle, not disturbed by computer scans
Fail-safe Cyclic scanning by the PC; after any failure, an internal cycle

Function 'scan mode': Scan mode: Normal
Set **scan mode** s. 9.5 or by means of key: <SET>

Sleep mode

Running the device in sleep mode is suitable for long-term monitoring involving long measuring cycles. In energy-saving sleep mode the device switches off completely after each measuring point scan: (for sensors with their own power supply a wakeup delay can be set); sleep mode switches on again automatically after the cycle expires - ready for the next measuring point scan. In this way with just one set of batteries or one battery recharge over 15,000 measuring point scans can be performed; for a cycle lasting 10 minutes this represents an available runtime of over 100 days.

When sleep mode is selected (subject to a check window being confirmed), all necessary parameters can be configured.

For data recording in sleep mode please perform the following steps:

1. Enter a cycle lasting at least two minutes — Cycles: 00:05:00
2. Activate saving to memory in the cycle — Save: ✓ Mode:Normal
3. Select scan mode — Save: ✓ Mode:Normal
4. Program sleep mode s. 9.5 — Mode:
5. In the menu **Data logger** start measuring operation by pressing — <START>
   The device should then display — SleeP On SleeP
   The device then switches off and the only visible activity is the flashing red at the top of the display — LED ´**SLEEP**´ (4) flashes
6. In the specified cycle the device switches on automatically, performs one measuring point scan, and then switches off again
7. To quit sleep mode press — <ON>
8. To terminate the measuring operation press — <STOP>

A measuring operation can be started in sleep mode using the start time; however, in sleep mode it cannot be stopped using the end time and fixed measuring period (s. 13.5.9).

Monitor mode:

The new monitor mode should be used if 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 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 the 'mode' function the 'monitor' variant must be programmed **Mode:Monitor**

Fail-save mode:

Fail-save 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 (e.g. device cycle 20 seconds, software cycle 10 seconds). Software scanning keeps resetting the internal cycle with the effect that this cycle is only used if software scanning fails. (Here, similarly, in WinControl 'safe initialization' must be switched off). The internal 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 the 'mode' function the 'fail-safe' variant must be programmed **Mode:FailSave**

Memory time available

An important parameter for data recording, appearing in the third data logger menu, is the memory time available. This depends on the memory capacity, the number of active measuring channels, the sampling rate, and the actual measuring duration for each D7 sensor.

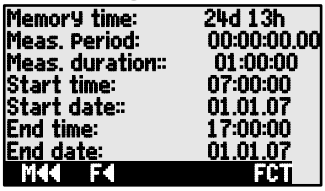
Memory time available **Memory time: 24d 13h**

With the ALMEMO® 104 with internal memory, endless recording is possible if the parameter ring memory is activated. In this mode, when the memory is full, the first data is overwritten and the last data is available (see manual 6.10.13.1).

Linear memory without overwriting data: Ring memory: –

Ring memory: with overwriting of data: <ON> ✔

13.5.9 Starting and stopping measuring operations



A measuring operation can be started and stopped not only by pressing the appropriate keys but also using numerous other methods; these are described in the Manual, Section 6.6.

These operating instructions describe, in Section 14.12.2, the start time and end time, the fixed measuring period, and limit value actions and, in Section 16.2, the relay and trigger variants.

Start date and time-of-day, end date and time-of-day

A measuring series can be started / stopped automatically at specifiable times. For this purpose the **start date** and time-of-day and the **end date** and time-of-day must be programmed. If no date has been programmed, the measuring operation will be performed every day within the period set. Or, alternatively, instead of specifying the end time, the fixed measuring period itself can be programmed. The total actual measuring duration since starting is shown in the ´**actual measuring duration**´ function.

This is assuming of course that the current time-of-day has been programmed. Sleep mode takes no account of end time or fixed measuring period.

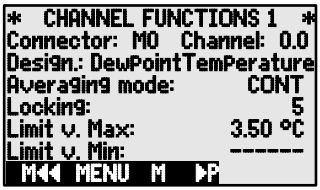
To access the menu press **< ▶F >**

Function Measuring period (Format hh:mm:ss): Meas. Period: 00:10:00
Function Start time (Format hh:mm:ss): Start time: 07:00:00
Function End time (Format hh:mm:ss): End time: ------
Function Start date (Format tt:mm:jj): Start date: 01.05.07
Function End date (Format tt:mm:jj): End date: ------
Meas. duration start (Format hh:mm:ss.hh): Meas. duration: 00:01:23.45

To clear these values, after selecting this function, press **<OFF>**
If the start time-of-day for a measuring operation has been programmed, the following symbol appears in the status bar ´▮▶´
If the end time-of-day or the fixed measuring period for a measuring operation has been programmed, the following symbol appears in the status bar ´▶▮´

14. SENSOR PROGRAMMING

Since on ALMEMO® devices all sensor programming is stored in the ALMEMO® connector itself, the user will not normally need to reprogram each time. Programming will only be necessary e.g. if sensor errors are corrected, if your own sensors are scaled, or if certain limit values are stipulated; in these circumstances there are comprehensive programming functions available.



In the **Channel functions** menus all parameters for a channel can be viewed and checked and (so long as the appropriate sensor is plugged in) can be entered and modified via the keypad. 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 (s. 14.4). Functions can only be selected if the locking mode allows.

To select all four menus for sensor programming **<▶P>** ... and **<P◀>** ...

14.1 Selecting the input channel

To view or edit a sensor's parameters you must first select the menu **Channel functions 1** and then set the required input channel by means of keys **▲** or **▼**; (new V7 channel numbering applies). Only sensors actually connected and channels actually activated can be processed. To activate a new channel key **<MALL>** should first be pressed; this accesses all selectable channels. Then key **<MACT>** should be pressed; this accesses only those that are active. For each input channel the associated connector number is displayed.

Menu **Channel functions 1**:

Display of connector number and channel	**Connector:0 Channel:0.0**
To select the next input channel	**▲**
To select the previous input channel	**▼**
To access all possible channels	**<MALL>**
To access all active channels only	**<MACT>**

14.2 Channel designation

Each measuring channel can be assigned an alphanumerical designation (standard sensors up to 10 characters, D7 sensors up to 20 characters); this should denote as clearly as possible the type of sensor, measuring location, and / or purpose. This designation is included in all standard measured value displays. In the case of a measured value output via the interface this channel designation appears online as soon as a scan starts; in the case of output from memory it appears in the table header as ´COMMENTS TEXT´ (s. Manual 6.6.1).

To enter name in **Designation** function s. 9.5 **Design.: Dew-Point**

'!' at the end of the designation indicates multi-point calibration (s. 14.11).

14.3 Averaging mode

The various averaging modes that can be defined via the **Averaging mode** function are described in 13.2 and in the Manual, Section 6.7.4.

Function - no averaging: **Averaging mode -----**
Averaging - start to stop or over individual measuring operations **CONT**
Averaging - over all scans per output cycle **CYCL**
To set the averaging mode s. 9.5: **Averaging mode CONT**

14.4 Locking the sensor programming

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

Locking level	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 and end
	+ zero-point adjustment, temporary
7	+ limit values, maximum and minimum

Function **Locking mode**: **Locking: 5**

In the **Channel functions** menu the functions are listed from top to bottom and in such a way that the locked functions cannot be selected.

14.5 Limit values

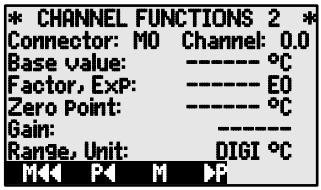
Two limit values (maximum and minimum) can be programmed per measuring channel. Exceeding one of these limit values is treated as a fault (in the same way as exceeding a measuring range limit or as sensor breakage). In the display, in front of the measured value affected, the appropriate arrow ▲ or ▼ appears and the alarm relays connected by relay cable are triggered (s. 16.2). Limit values can also have relays assigned to them (s. 14.12.2). 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 but this can be adjusted to any number of digits between 0 and 99 (s. 15.8). A limit value infringement can also be used to start or stop a measuring operation (s. 14.12.2).

Function:

Enter the limit value, maximum (s. 9.5)	LV Max: 123.4 °C
Enter the limit value, minimum	LV Min: ----- °C
To switch limit value off	<OFF>
To switch limit value on	<ON>

14.6 Correction values

Sensors can be corrected in terms of zero-point and gain by means of the 'zero-point' and 'gain' correction values (see Manual 6.3.10). The corrected values can then also be scaled by means of BASIS and FACTOR (s. 14.7). These functions can be accessed in menu Channel functions 2 by means of key <▶P>.



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

Functions:

Zero-point correction:	Zero Point: ----- °C
Gain correction:	Gain: ----- °C
To switch on and off press	<OFF> or <ON>

Once the scaling values have been programmed and the actual measured value thus modified, the correction arrow appears indicating the measured value status ↗ (s. 9.2).

With option KL sensors can attain maximum accuracy by means of multi-point calibration (s. 14.11).

14.7 Scaling, decimal point setting

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' and 'factor' are provided. For a detailed description of scaling, with an example, please refer to the Manual, Section 6.3.11.

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

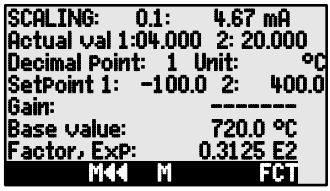
The ´factor´ can be programmed within the range -2.0000 to +2.0000. For factors below 0.2 or above 2.0 the decimal point setting should be specified by entering the 'exponent'. Using the 'exponent' function the decimal point can be shifted as far to the left (-) or to the right (+) as the display and interface permit. An exponential view of measured values is not possible.

Functions:

Base value: ------

Factor,ExP: ------ E0

To calculate the scaling values automatically from the actual value and setpoint the function menus include a special menu Scaling (s. 13.4).



Once the scaling values have been programmed and the actual measured value thus modified, the correction arrow appears indicating the measured value status ↗ (s. 9.2).

14.8 Changing the units

For each measuring channel the default units for the quantity and measuring range can be replaced with any other units, two characters for standard sensors, up to six characters for D7 sensors (see Manual 6.3.5). The units are shown after the measured value or programming value in question.

To change the units use the function: 1 Range, Units: DIGI °C

If °F is entered as units the temperature value will be converted automatically from degrees Celsius to degrees Fahrenheit. Entering the appropriate two characters will automatically generate the following units: for m/s enter ms, for m³/h enter mh, for W/m² enter Wm, and for g/kg enter gk.

14.9 Selecting the measuring range

If you want to program the connectors yourself or have to change the measuring range frequently, make sure that the locking of the connectors is deleted, i.e. set to 0 (s. 14.4) and that a special connector is required for some transducers (e.g. thermo, shunt, divider, etc.). To activate a new measuring channel key <MALL> should first be pressed; this accesses all selectable channels; then select the required input channel, and then enter the measuring range (s. 14.1). When the new measuring range entry is confirmed all programming values for that input channel will be deleted.

Function, select measuring range — Range, Units: DIGI °C

To access all possible measuring channels — <MALL>

To deactivate a channel — <OFF>

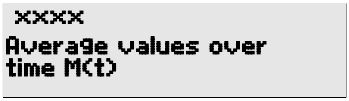
To activate a channel — <ON>

Programming the range is as for data input 9.5 — PROG , ▲ , ▲ , PROG

In the input window all abbreviations appear one after the other, as listed in the following table

Range: DIGI

There is also a help window for identifying the sensor in question.



Depending on the connector (analog, D6, D7), different ranges are available for selection (s. Manual 6.3.3). The individual measuring ranges of the D6 and D7 sensors can only be changed in this device via the sensor configuration menu (s. 14.10).

With the function channels such as maximum value or difference it is possible to represent function parameters from measured value processing or from calculated results obtained by linking certain measured values on measuring channels (s. Manual 6.3.4). Reference to the actual measuring channels is provided by one or two reference channels. For all function channels the default reference channels Mb1 and Mb2 are available on the appropriate plug; these do not need programming.

Function	Function channel	Ref. channel 1	Ref. channel 2
Function parameters (Mb1)	on channel 2, 3 or 4	Mb1= channel 1	
Differential (Mb1-Mb2)	on channel 2, 3 or 4 (Mb1)	Mb1= channel 1	Mb2=M0.0
Average value over Mb2, Mb1	on channel 2, 3 or 4 (Mb1)	Mb1= channel 1	Mb2=M0.0
Total over Mb2, Mb1	on channel 2, 3 or 4 (Mb1)	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 14.12.6.

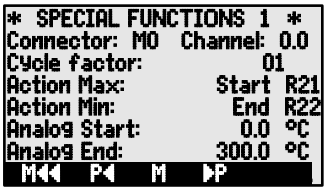
14.10 Sensor configuration

D6 and D7 sensors can be assigned new quantities, measuring ranges, and individual parameters completely unknown to the measuring instrument. Each such sensor must therefore provide its own sensor menu for defining the sensor configuration with all its special settings (i.e. measuring ranges, compensation values, sampling rate, smoothing, etc.). The menu 'sensor configuration' can be accessed by selecting the sensor in question from the 'sensor list' and pressing key <KONF> (see 10). Settable parameters are described in the operating instructions 'Digital ALMEMO® D6 sensors' and 'Digital ALMEMO® D7 sensors'.

14.11 Multi-point calibration

ALMEMO® sensors (analog with identifier E4 or V6, DIGI, D6 and D7 sensors) can be corrected in their characteristics with a multi-point calibration via the ALMEMO® Control software. The sensors allow characteristics with up to 36 support values; with D6 and D7 sensors, each of the 4 primary channels can be corrected. In so doing only the deviations are added to the original characteristics (interpolated on a linear basis); accuracy is thus appreciably improved. This correction process can be performed at our works as part of a factory or DAkkS calibration or with the ALMEMO® 104 if it has option KL enabled.
'!' at the end of the channel designation indicates that the channel is subject to multi-point calibration.

14.12 Special functions



On the ALMEMO® 104 measuring instrument, in the two **Special functions** menus, all sensor parameters can be accessed; these may be needed only occasionally in routine operation but may in many applications be very useful, (see Manual 6.10). Some of these functions are highly complex and should only be considered if the user is fully aware of how they work and what effect they may have.

The two 'special functions' menus can be accessed after sensor programming by means of key <P> ... or ▶ ...

To return to the previous menu <P> ... or ◀ ...

14.12.1 Cycle factor

To adapt data recording on the basis of the output cycle to the speed of change at individual measuring points certain measuring points can 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). Only faulty measuring points, e.g. in the event of a limit value infringement, will always be output. This cycle factor is by default completely disabled or set to 01 for all measuring points; i.e. all activated measuring points are output in each output cycle. If some other factor e.g. 10 is entered, the measuring point in question will only be output every 10th cycle; if 00 is entered it will not be output at all.

Enter the cycle factor in function (s. 9.5) **Cycle factor: 01**

Clear the cycle factor by means of <CLR>

14.12.2 Actions triggered by limit value infringement

Relay assignment

For reporting alarms both limit values are by default used for all a device's measuring points (s. 14.5); i.e. a limit value infringement at any measuring point will trigger any appropriately programmed relay connected via an alarm relay cable or relay adapter (see Manual 5.1). This relay remains energized until all measured values return to within the prescribed limit values by the amount set as hysteresis. If no limit value has been set the measuring range limit is used as limit value. A sensor breakage always triggers an alarm.

To ensure that disturbances can be reliably recognized and selectively evaluated it is possible, in the functions **Action Max** and **Action Min**, to assign individual relays to specific limit values. A relay can have more than one limit value assigned to it. For this purpose the relay cables offer two relays; the relay adapter (ZA-8006-RTA3) offers up to 10 relays. In the output module for the relay the mode should be set to variant 2 (assigned internally) (s. 16.2, Man. 6.10.9).

To activate relay 'xx' in the event of overshooting limit value maximum: Action Max: ----- Rxx

To activate relay 'xy' in the event of undershooting limit value minimum: Action Min: ----- Rxy

To clear relay assignment press <CLR>

To program the output module (s. 16, 17.2): Socket: A2 ZA8006RTA3

To select a relay port Port: 20

Relay: Normally Open 0.5A

To set variant 2 (assigned internally) 2: Assigned internally

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 by means of the functions:

Action Max and Action Min			Rxx
Start meas. operation at limit value, max.:	Action Max:	Start	R--
Stop meas. operation at limit value, min.:	Action Min:	StoP	R--
Manual scan at limit value, maximum:	Action Max:	Manu	R--
Zero-set timer 2 at limit value, maximum:	Action Max:	TZero	R--
Execute macro 5 to 9 at limit value, max.:	Action Max:	Macro5	R--
		....	

To set action press: <SET>

To clear action press: <CLR>

14.12.3 Analog output start / end

The analog output of measured values to the analog output modules or to the display as a bar chart must in most cases be scaled to a particular sub-range (see Manual 5). This can be done by simply stipulating the start value and end value of the range to be displayed. This range will then be mapped to the analog range 2 V, 10 V, 20 mA, or a bar chart display with 100 pixels.

To program the analog output - start 6 Analog Start: 0.0°C

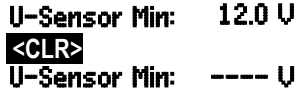
To program the analog output - end 6 Analog End: 100.0°C

These two parameters, 'analog output start' and 'analog output end', are also saved in the sensor EEPROM and can thus be individually programmed per channel; i.e. when channels are switched through manually each measurable variable can be individually scaled. The flag for switching over from 0 - 20 mA to 4 - 20 mA is programmed via the element flags (s. 14.12.7, 16.3).

14.12.4 Minimum sensor supply voltage

As with all ALMEMO® devices the sensor supply voltage on the ALMEMO® 104 is monitored. The sensor supply voltage is displayed in the **INFO** menu (s. 10). Some sensors, however, will only operate properly with their own supply voltage; this may require e.g. a mains unit. To prevent measuring errors the minimum sensor voltage needed by each individual sensor can be entered in 'sensor programming'. If the sensor voltage drops below this value the measured value will be treated as a sensor breakage and display 'L' flashes (see 9.2).

To enter the minimum sensor supply voltage
To disable voltage monitoring, to clear the value



14.12.5 Output function

If the current measured value of measuring point Mx.x is not actually needed but only the maximum, minimum, average, or 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 verification that the output function has been thus changed the measured value is shown with the symbols listed below (s. 9.2).

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. When simply recording data 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**	**Menu**
Measured value (Mxx)		Output function: Mess
Differential (Mxx-M00)	D	Output function: Diff
Maximum value (Mxx)	H	Output function: Max
Minimum value (Mxx)	L	Output function: Min
Average value (Mxx)	M	Output function: M(t)
Alarm value (Mxx)	A	Output function: Alrm

14.12.6 Reference channels

The calculating functions of the function channels usually refer to one (or two) particular measuring channel(s) (s. 14.9, Manual 6.3.4). When programming a function channel the reference channel Mb1 is provided automatically by the 1st channel of associated sensor connector Mxx1.
The 2nd reference channel Mb2 (for differential value, average value M(n), etc.) is provided initially by measuring point M0.0. In the function **Reference channel 1** you can also set another measuring point as reference channel.
Program reference channel 1 **Ref. channel 1:(1.0) 2: - -**
For function channels needing a 2nd reference channel (see above) first enter reference channel 1 and then the 2nd reference channel (see Manual 6.10.2).
Program reference channel 2, absolute **Ref. channel 1:(1.0) 2:(0.0)**

For measuring ranges that do not need any reference channels the display shows only horizontal dashes with the standard channels in brackets (s. 14.9).

14.12.7 Element flags

Element flags are available per measuring channel; these can be activated to implement sensor-specific extra functions (s. Man. 6.10.3).

1. 1/10 Measuring current for Pt1000
3. Measuring bridge with switch for final-value simulation
4. Measuring channel, cyclic evaluation only
7. Sensor breakage detection switch-off
8. Analog output 4 to 20 mA (instead of 0 to 20 mA)

On the ALMEMO® 104 element flags 2, 5, 6 have no function.

Function Element flags **Element flags: 87654321**
To program element flags **PROG** **Element flags: 8-------**
To select element flags ▶ and ◀
To switch element flags ON / OFF ▲ and ▼

15. DEVICE CONFIGURATION

In the **DEVICE CONFIGURATION** menu certain basic settings can be made, e.g. date, time-of-day, language, and illumination. The device designation helps individually identify the device and facilitates its assignment in a network. In network operation the device address is indispensable. The baud rate can be adapted for operation with external devices. The default value for hysteresis for alarm relays can also be modified.

15.1 Date and time-of-day

For logging data recordings a real-time clock with date and time-of-day is provided; this is buffered by means of the device battery. So long as the device is in the switched off status it is possible to change the batteries without date and time-of-day being lost. The first line contains the time-of-day on the left and the date on the right; by selecting this function (s. 9.4) these can be programmed in the format described (s. 9.5).

Function 'time-of-day'	Format hh:mm:ss	**Time:**	**12:34:56**
Function 'date'	Format dd.mm.yy	**Dat.:**	**01.05.14**

15.2 Device designation

In the **Device designation** function (see Manual 6.2.4) any text can be entered up to maximum 40 characters in length (s. 9.5). The entry here of an individual text can help clearly identify the device in the display (device configuration, 'info' menu), or in a software listing (device lists).

Function **Device designation** : **Device designation: Ahlborn, Holzkirchen**

15.3 Language

The user can choose from German / English / French as the language for function labeling and outputs (other languages are available on request). The softkeys are international; these cannot be changed.

To select the desired language press **<SET>** in the function:

Language: English

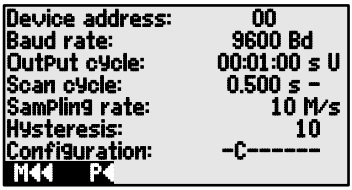
15.4 Illumination and Contrast

Display illumination can be enabled / disabled in the selection menu (and in many other menus) by pressing **<* ON>** or in device configuration in function **Illumination** (please note that enabling will double the current consumption). If illumination is enabled but no mains adapter is connected, it will switch off again automatically as soon as a settable illumination duration expires; this starts with each pause in key operation and restarts as soon as any key is pressed. The display contrast can be set in the **Contrast** function to any one of 10 levels.

Display illumination ON Illumination: ✓
To set the illumination duration (20 seconds to 10 minutes) press
<SET>: Duration: 20sec

If display illumination is enabled,
the following symbol appears in the status bar ✻ Illumination ON
If display illumination has switched off temporarily,
the following will light up. ✻ Pause
To switch ON again without this function press ◀
To set the contrast (5 to 100 %) press <-> and <+>: Contrast: 50%

15.5 Interface, device address and networking



Via the serial interface cyclic data logs and all the programming details for the device and for the sensors can be output to a computer (see Man. Chap. 6). For connecting to the various interfaces we have a series of data cables available (s. 16.1, Manual 5.2). All ALMEMO® devices can be networked together very easily, thus enabling the user to centrally acquire and record measured values from several measuring instruments - even if these are located far apart (see Man. 5.3). To communicate with networked devices it is absolutely essential that all the devices concerned should have the same baud rate setting but that each should have its own dedicated address; this ensures that only one device responds per command. Before starting network operation ensure therefore that all the measuring instruments involved are assigned different and unique device addresses. For this purpose use the **Device address** function. On leaving the factory the device address is normally set to 00. This can be modified as desired by entering the appropriate data as usual (s. 9.5).

15.6 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 should be set to match. If this is for some reason not possible you can, in the **Baud rate** function, choose from the values 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 to all other ALMEMO® devices connected.

To set the baud rate, function (s. 9.5): Baud rate: 9600 bd

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

15.7 Process control

As already described in Chapter 12, maximum and minimum values, limit value infringements, and analog outputs are acquired from standard sensors at the sampling rate and from D7 sensors at the scan cycle. All measuring channels can be output to a computer or saved to memory either simultaneously at this scan cycle or at more prolonged cyclic intervals at the output cycle.

15.7.1 Sampling rate

ALMEMO® standard sensors (DIGI or D6) just like all standard devices on measuring point scans are scanned continuously one after the other at the **sampling rate** (see Manual 6.5.1.3). However, with this device, the sampling rate is not based on the conversion rate of an A/D converter; it has simply been set. This sampling rate thus determines definitively the data acquisition speed of connected standard sensors; it can be set via the **SamPling rate** function to 2.5 or 10 measuring operations per second (mops). The scan time for all standard sensors currently connected, including any special measuring operation, is continuously calculated and displayed in the sensor list (s. 10). The measured values are internally processed with immediate effect and saved to memory (but not output). This can be performed optionally at the quick scan cycle or the slower output cycle.

Function - sampling rate, modify by means of **<SET>** **SamPling rate 10M/s**

15.7.2 Scan cycle

The scan cycle is used for the purpose of acquiring maximum and minimum values, limit value infringements, and analog outputs from the intelligent D7 sensors. In continuous scanning standard sensors supply their values at the sampling rate (s. 15.7.1) and D7 sensors at their own individual actual measuring duration, as saved in the plug (1 millisecond up to several minutes). The actual measuring durations can be found in the sensor list s. 10. The scan cycle can in most cases be set to a minimum time with **<MIN>**; this helps acquire measured values in their full dynamics. However, no unnecessary measured values are produced; only those updated since the previous scan are scanned again; i.e. for a certain period the list includes only quick sensors subject to a short scan cycle and slower sensors only at more prolonged intervals. A special advantage in terms of speed and consistency is that all D7 sensors supply measured values in parallel and simultaneously; they do not have to be measured in sequence one after the other by an A/D converter.

If it is not necessary for many measured values to be saved to memory at high sampling rates, of course a longer scan cycle can be set.

If only standard sensors are connected and all channels are always to appear with the same time-stamp, the scan cycle can be based on the scan time which can be selected directly on entering with softkey **<SCANT>**.

Enter a scan cycle in format ss.sss: Scan cycle: s -
Set scan cycle to minimum time <MIN> 00.001
Set scan cycle to scan time <SCANT> 00.500
Select output in scan cycle ▼ 00.002 s
Activate output <ON> 00.002 s U
Select and activate save-to-memory at the scan cycle in the data logger functions (s. scan configuration 13.5.7).

15.7.3 Output cycle

For measured value output via the interface at a relatively prolonged cycle (> 1 second) 'output cycle' in format hh:mm:ss is provided. The output cycle can also be used for determining cyclic average, maximum, or minimum values.

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

Enter an output cycle in format hh:mm:ss: Output cycle: 00:01:00 s U
Zero-set cycle for manual measuring operation <CLR>
Reset cycle to 1 minute <RESET>

There is no longer a choice of output formats because the expanded range of values can only be expressed in table format (see Man. 6.6.1). This format is, as always, ideally suitable for further processing with any standard spreadsheet program (see Man. 6.1, printouts).

15.8 Hysteresis

The hysteresis for an alarm triggered in the event of a limit value infringement can be set generally for all sensors from 0 to 99 digits (default 10 digits) in the **Hysteresis** function (s. 14.5, Man. 6.2.6).

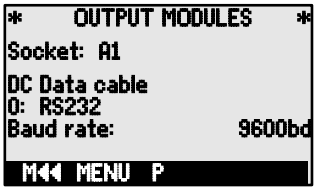
Modify hysteresis (0 to 99) s. 9.5: Hysteresis: 10

15.9 Operating parameters

Certain operating parameters can be configured by the user as software options (s. Manual 6.10.13.1).

Delete all measured values at the start of a measuring operation Configuration: -C------
Immediate output via the interface (oversampling) Configuration: ----A---
Program the configuration PROG Configuration: -C------
Select a parameter ► and ◄
Switch the parameter ON / OFF ▲ and ▼

16. OUTPUT MODULES



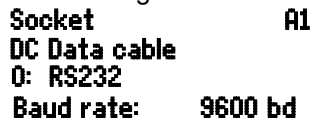
The ALMEMO® 104 measuring instrument has two output sockets, A1 and A2; these can be used to output measured values in analog or digital form or as an alarm signal. It is also possible to initiate various functions by means of trigger pulses. To cover all possibilities while also keeping the required hardware to a minimum all necessary interfaces have been integrated in the ALMEMO® output cables or output modules.

These output modules, just like the sensors themselves, are recognized automatically and listed in the **Output modules** menu. The numerous connection possibilities are described in detail in the Manual, Chapter 5.

16.1 Data cable

All ALMEMO® data cables and their connection to devices are described in detail in the Manual, Section 5.2. Other modules for networking the devices are described in detail in the Manual, Section 5.3. The interface modules are connected to socket A1 (2); this is with the exception of network cable ZA-1999-NK5 which is used for networking a further device; this must be connected to socket A2. In the menu under the socket concerned the following information is displayed:

Variant 0: Serial standard interface always active
The baud rate is saved in the cable connector



16.2 Relay trigger modules

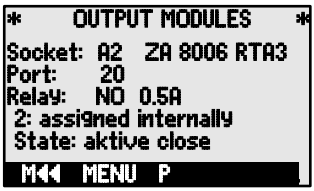
The elements of the V6 relay trigger cables (ZA 1006-ECG) and the relay trigger analog adapters (ZA 8006-RTA3) can have their function variants individually configured.

This offers up to 10 relays or options with 2 of these as trigger inputs or up to 4 as analog outputs. These modules can be connected equally well to output socket A2 or output socket A1 **(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 to 19
A2	V6 output modules at socket A2	20 to 29

In the **Output modules** menu the elements of the output modules can be individually selected and functions programmed as follows (s. Man. 6.10.9).



First select the port
e.g. port 0, socket A2 (port address 20)
This shows the element concerned

<P>: ▲ or ▼
Port: 20

Relays:

Relay type, normally open (NO):
Relay type, normally closed (NC):
Relay type, changeover:

Relay NO
Relay NC
Relay - changeover

Relay addressing can be configured to the following variants s. 9.5:

- 0: Alarm if any one channel is faulty
- 2: Alarm for a programmed channel
- 3: Alarm if one limit value – max. of all is overshot
- 4: Alarm if one limit value – min. of all is undershot
- 8: Relay driven via interface or keypad

0: Summated alarm
2: Assigned internally
3: Summated alarm Max
4: Summated alarm Min
8: Driven externally

Variant 2 'assigned internally' is set automatically if a relay is assigned to a limit value (s. 14.12.2).

Power failure can be detected more easily if relay addressing is inverted; i.e. in the absence of current the relay drops out and an alarm is triggered. All function variants are therefore also provided on an inverted basis.

Relay addressing - inverted:
Variant 2, inverted

-2: assigned int., inverted

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

Activation mode and relay contact **status**

Status active, open

Relay variant 8 'driven externally' permits manual activation of the relays via the keypad or via the interface (see Man. 6.10.10).

Relay variant 8:
For manual activation of relays press

8: driven externally
<ON> or <OFF>

Trigger inputs

For the purpose of controlling the measuring sequence two trigger inputs are provided at ports 8 and 9 (keypad or optocoupler). On the relay trigger analog adapter (ZA-8006-RTA3) the trigger source 'key' and / or 'optocoupler' can be configured by means of keys PROG , ▲ / ▼ and PROG or the trigger function can, for safety reasons, be switched off altogether by means of 'off'.

```
*     OUTPUT MODULES     *
Socket: A2    ZA 8006 RTA3
Port:    8          Adr.:28
Trigger: keaP.+OPtocouPler
 0: Start-StoP
M◀◀ MENU  P
```

The following trigger functions can be programmed as variants:

- 0: Start and stop a measuring operation
- 1: Once-only manual measuring point scan
- 2: Delete all maximum / minimum values

0: Start / StoP
1: Once-only scan
2: Delete all max./min. val.

3: Print the measured value
4: Start / stop a meas. op., level-controlled

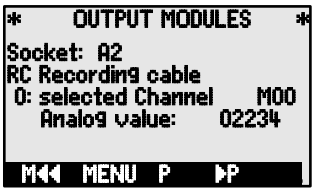
8: Set measured value to zero
-5: Execute macro 5 (s. Man. 6.6.5)
-6: Execute macro 6
-7: Execute macro 7
-8: Execute macro 8
-9: Execute macro 9

3: Print
4: Start/Stop level-controlled
8: Set meas. value to zero
-5: Macro5
-6: Macro6
-7: Macro7
-8: Macro8
-9: Macro9

16.3 Analog outputs

V5 output modules

For the purposes of analog recording of measured values it is still possible, at sockets A1 and / or A2 **(2)** to connect V5 output modules with an analog output driven by the device, e.g. recording cable ZA-1601-RK (s. Manual 5.1.3.1).



To select the socket press <P>: ▲ or ▼

The following output modes can be programmed as variants:

0: Measured value for the selected measuring channel — 0: Selected channel M00
2: Measured value for a programmed channel — 2: Assigned internally M01
8: Programmed analog output (see below) — 8: Driven externally

The analog value appears below this in digits: Analog value: 08345

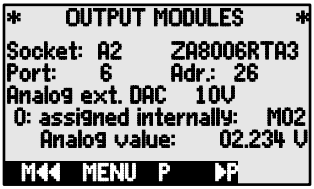
This gives, depending on the analog output, the following output signals.

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

In variant 2 'assigned internally', after selecting the Mxx function, you can program the measuring point to be output 2: assigned internally M

V6 output modules

The new V6 relay trigger analog adapter ZA-8006-RTA3 (s. Man. 5.1.2) offers, at ports 4 to 7, the option of up to four external analog outputs, separately configurable also in the output signal.



ZA1601-RI and ZA1602-RU with up to 2 separately configurable analog outputs.

To select the port <P>: ▲ or ▼
e.g. port 6, socket A2 (port address 26) Port: 26
The analog module appears with type and output signal 10 V or 20 mA.
Analog output (D/A converter, external, in module) Analog ext. DAC 10V
Can be programmed via keypad to Analog ext. DAC 20mA
(not with ZA160x-RI/RU)

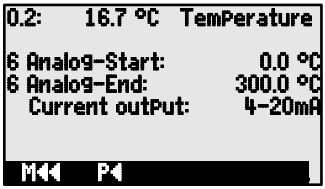
The same output modes can be programmed as variants as with V5.

- 0: Measured value for the selected measuring channel — **0: Selected channel M00**
- 2: Measured value for a programmed channel — **2: Assigned internally M01**
- 8: Programmed analog output (see above) — **8: Driven externally**

With V6 the analog value appears with the appropriate units. **Analog value +08.345 V**

Programmed analog value output (s. Man. 6.10.7)

If the analog value is to be controlled individually either manually or via the interface then variant 8 'driven externally' must be set: **8: Driven externally**
Program the output 2.5 V with 10 V output (s. 9.5): Analog value: **02.500 V**



In a special sub-menu the measuring range assigned to the measuring point concerned and actually being used by the selected channel can, by means of functions **Analog-Start** and **Analog-end**, be spread over the full 10 V or 20 mA (s. 14.12.3).

To program the analog output - start
To program the analog output - end s. 9.5:

6 Analog-Start: 0.0°C
6 Analog-end: 100.0°C

For 20 mA analog outputs only
Output either 0 to 20 mA or 4 to 20 mA:

Current output: **4-20 mA**

17. TROUBLE-SHOOTING

The ALMEMO® 104 measuring instrument can be configured and programmed in many different ways. It is suitable for connecting a wide variety of different sensors, other 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 not usually a device defect; often 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; replace the batteries; switch off and then on again; if necessary re-initialize (see 7.5)

Error: Measured values are incorrect.

Remedy: Check all the channel programming very carefully, especially the base value and zero-point ('sensor programming' menu and 'special functions').

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 (short-circuit for voltages, 100 Ω for Pt100 sensors) and check.
Then reconnect sensors one after the other and check again; if a fault persists for any one connection, check all wiring; if necessary, insulate the sensor concerned and eliminate interference by using shielded or twisted wiring.

Error: Data transmission via the interface does not function.

Remedy: Check the interface module, connections, and settings.
Ensure that both devices are set to the same baud rate and transmission mode. (s. 15.6)
Ensure that the correct COM port on the computer is being addressed. Test data transmission by means of a terminal (ALMEMO® Control, WinControl, WINDOWS Terminal).
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´ (s. Man. 6.2.3)
Test the transmit line only by entering a cycle using command ´Z123456´ and check in the display.
Test the receive line by pressing **<MANU>** and check in the display.

Error: Data transmission in the network does not function.

Remedy: Ensure that V7 devices are connected at their own COM port. Check to ensure that all devices are assigned different addresses.

Address all devices individually via the terminal using command ´Gxy´. Addressed device is OK if at least ´y CR LF´ is returned as echo.

If transmission is still not possible, unplug the networked devices. Check all devices individually on the data cable to the computer (see above).

Check the wiring for short-circuit or crossed wires.

Check that all network distributors are supplied with power.

Network the devices again one after the other 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 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.

18. DECLARATION OF CONFORMITY

AHLBORN

Doc-Nr. CE_MA104_000_20241018_R1.doc

EU-Konformitätserklärung

EU-Declaration of Conformity

nach/*according to* EN 17050-1

Hersteller: *Manufacturer:*	Ahlborn Mess- und Regelungstechnik GmbH
Adresse: *Address:*	Eichenfeldstrasse 1 83607 Holzkirchen Germany

bestätigt, dass das Produkt
declares, that the product

Produktbezeichnung: *Product Name:*	Universalmessgerät Almemo® 104
Produkt Typ: *Product Type:*	MA104
Produkt Optionen: *Product Options:*	Alle/*all*

den nachfolgenden Europäischen Anforderungen und Richtlinien entspricht und folglich das CE Zeichen trägt.
conforms to following European Product Specifications and Regulations and carries the CE marking accordingly.

2014/35/EU	Niederspannungsrichtlinie *Low Voltage Directive*
2014/30/EU	EMV Richtlinie *EMC Directive*
2014/53/EU	R&TTE Richtlinie *R&TTE Directive*
Angewandte harmonisierte Normen und technische Spezifikationen: *Applied harmonised standards and technical specifications:*	Sicherheit *(Safety)* EN 61010-1: 2010+A1 EMV *(EMC)* EN 61326-2-3: 2013 Tabelle 2

Holzkirchen, 21.10.2024
Ort, Datum der Ausstellung
Place, date of issue

R. Prokop
Entwicklungsleitung

Qualitätsmanagement

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19. ANNEX

19.1 Technical data (s. Manual 2)

Measuring inputs	4 ALMEMO® sockets, suitable for ALMEMO® flat connectors (only digital sensors DIGI, D6, D7 sensors)
Measuring channels	2 primary channels, maximum 9 additional channels per input for double sensors and function channels
Sensor power supply	9 / 12 V; 0.4 A (with mains adapter 12 V)
Outputs	2 ALMEMO® sockets, suitable for all output modules
Standard equipment	
Display	Graphics, 128 x 64 pixels, 8 rows of 4 mm
Operation	7 keys (4 softkeys)
Date and time-of-day	Real-time clock, buffered by device battery
Power supply	ALMEMO® DC socket, external 6 to 13 VDC
Batteries	3 AA alkaline batteries
Mains adapter	ZA-1312-NAx, 230 VAC to 12 VDC, min. 1 A
Adapter cable, electr. isol.	ZA-2690-UK, 10 - 30 VDC to 12 VDC, 0.25 A
USB data / power cable	ZA1919-DKU5, 5 V, 0.4 A
Current consumption	(without input and output modules) Active mode approx. 31 mA (at 4.5 V) With illumination approx. 68 mA (at 4.5 V) Sleep mode approx. 0.15 mA
Housing	127 x 83 x 42 mm (LxWxH) ABS (acrylonitrile butadiene styrene)
Weight	approx. 260 g
Operating conditions	
Operating temperature	-10 to +50 °C Storage temp. -20 to +60 °C
Ambient atm. humidity	10 to 90 % RH (non-condensing)

19.2 Product overview

Special measuring instrument ALMEMO® 104 for digital sensors	**Order no.**
4 inputs, maximum 40 channels, 2 outputs, cascadable interface, 7 keys, LCD graphics display, real-time clock	MA 104
Options:	
Multi-point calibration	OA 104-KL
Accessories:	
Plug-in memory including micro SD card and reading device	ZA 1904-SD
Mains adapter with ALMEMO® plug, 12 V, min. 1 A	ZA-1312-NAx
ALMEMO® plug for external power supply, 12 V, 1 A	ZA-1312-FS8
DC adapter cable, 10 to 30 VDC, 12 V / 0.25 A, electrically isolated	ZA-2690-UK
ALMEMO® data cable, with USB interface, el. isol., max. 921.6 kbaud	ZA-1919-DKU
ALMEMO® data / power cable, 5 V, USB interface, max. 921.6 kbaud	ZA-1919-DKU5
ALMEMO® data cable with V24 interface, el. isol., max. 115.2 kbaud	ZA-1909-DK5
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® V6 input / output cable for triggering and limit value alarm	ZA-1006-EGK
ALMEMO® V6 relay trigger adapter (4 relays, 2 trigger inputs)	ZA-8006-RTA3
Option 2, analog outputs, electr. isol. configurable 10 V or 20mA	OA 8006-R02
ALMEMO® analog output cable, electrically isolated, 1 x 20mA	ZA1601-RI
ALMEMO® analog output cable, electrically isolated, 2 x 10V	ZA1602-RU

19.3 Index

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