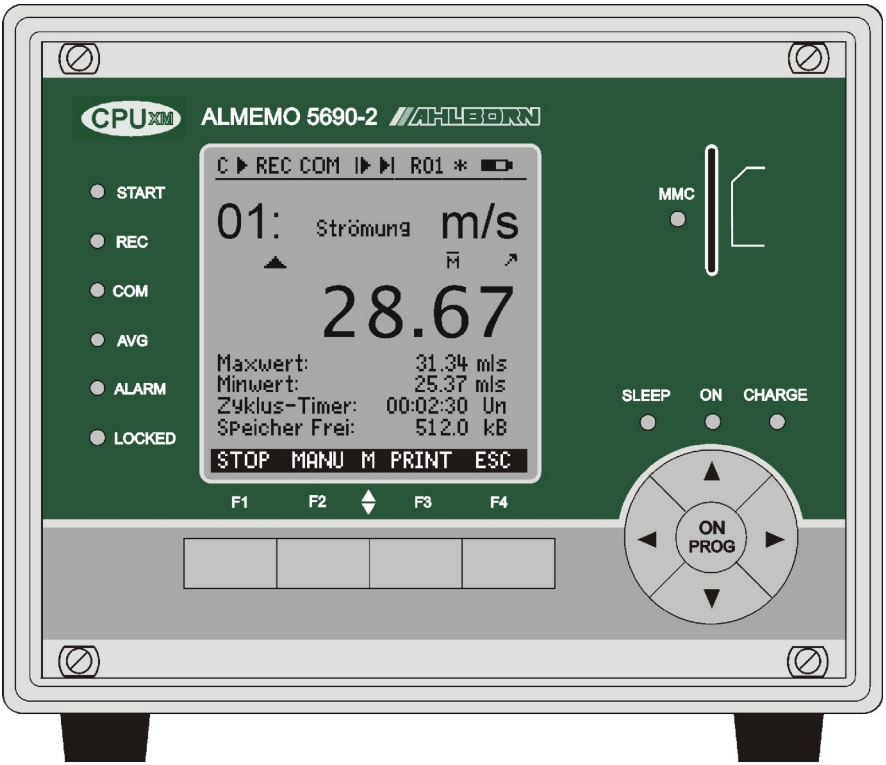
Operating instructions



V6

Data acquisition system ALMEMO® 5690-2CPU

V1.1
10.06.2008

www.ahlborn.com

1. OPERATING CONTROLS

1.1 Front panel

(1) LCD see 8.

Status bar

C	Continuous measuring point scan
▶, ‖	Start / stop measuring
REC	Record to memory
COM	Measured value output
▮▶, ▶▮	Program the start / end of measuring
R01	Alarm relay state
✱, ✱	Illumination ON, pause
	Battery operation / charge status

13 rows for functions

Function of keys F1, F2, F3, F4

(2) Status LEDs

START	Measuring operation started
REC	Measuring with results saved
COM	Measuring with output
AVG	Averaging
ALARM	Limit value overshoot Sensor breakage, LoBat
LOCKED	Keys locked

(2) Status LEDs

ON	Device is switched ON.
SLEEP	Flashes in sleep mode.
CHARGE	Rechargeable battery is being charged. Goes out as soon as fully charged.

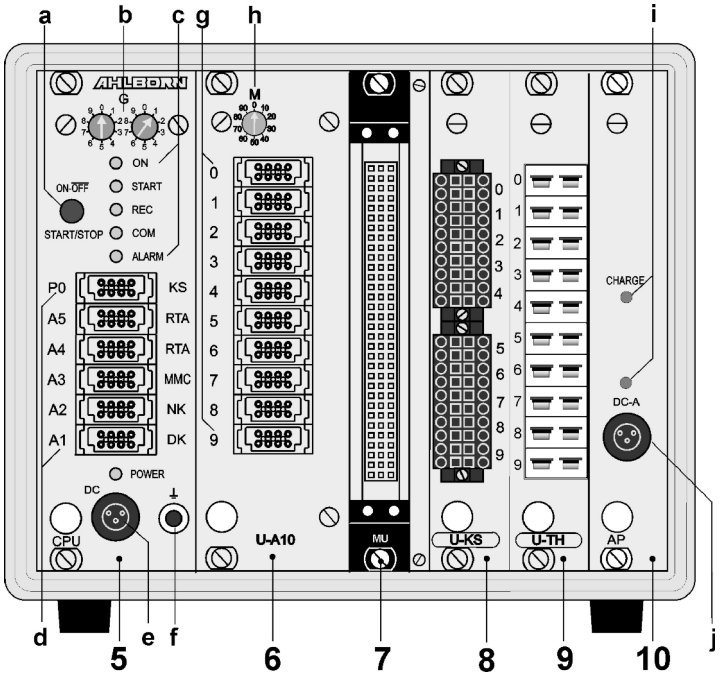
(3) Keypad see 8.

F1 to F4	Function keys (soft keys) Cursor block
ON PROG	Switch on Program To switch OFF press and hold down
▲, ▼, ▶	Function selection, input
◀	Most recent menu

(4) Slot, multimedia card

MMC	Slot for MMC see 10.2.1

1.2 Rear view



(5) Plug-in CPU module CPU measuring circuit

(a) Pushbutton No function

(b) Code switches see 10.5.2

G Device address 00 to 99
With option XU or XM
3 addresses are occupied.
Device address 0 to 7 only

(c) Status LEDs

ON Device is switched ON.
START Measuring operation started
REC Measuring with results saved
COM Measuring with output
ALARM Limit value overshoot
Sensor breakage,
LoBat (flashes)

(d) Output sockets see 10.6.

A1 Interface / optic fiber (ZA1909-DK5/L)
USB interface (ZA1919-DKU)
RS 422 (ZA 5099-NVL/NVB)
Ethernet (ZA 1945-DK)
A2 Network cable (ZA1999-NK5/NKL)
Analog output (ZA 1601-RK)
V5 / V6 periphery (ZA 8000/6-RTA)
A3 V6 periphery (ZA 8006-RTA3)
A4 V6 periphery (ZA 8006-RTA3)
A5 V6 trigger input (ZA 1006-ET/EK)
P0 option Relay trigger, analog, internal

(e) DC connection socket see 6.

Mains adapter (ZB 1212-NA6, 12 V, 3 A)
Cable, el. isol.(ZB 3090-UK2, 10 to 30 V, 1.2 A)

Status LED

POWER Mains supply, present

(f) Ground socket

Extension of measuring points with selector switch boards see 7.3:

(6) Plug-in module U-A10 : Selector switch board for 10 ALMEMO sockets

(g)	**Measuring inputs 0 to 9**	x0 to x9	for any 10 ALMEMO sensors
		x+10 to x+39	maximum 30 additional channels
(h)	**Code switches M**	Measuring point x	10 to 90

(7) Plug-in module U-MU : Selector switch board for 10x MU connector

Measuring inputs	x0 to x9	for 10 sensors without their own power supply
	x+10 to x+39	maximum 30 additional channels
Code switch, internal	Measuring point x	10 to 90 on board

(8) Plug-in module U-KS : Selector switch board for 2 clamp connectors

Measuring inputs	x0 to x9	for 10 sensors without their own power supply
	x+10 to x+39	maximum 30 additional channels
Code switch, internal	Measuring point x	10 to 90 on board

(9) Plug-in module U-TH : Selector switch board with 10 thermal sockets

Measuring inputs	x0 to x9	for 10 sensors with miniature thermal connectors
	x+10 to x+39	maximum 30 additional channels
Code switch, internal	Measuring point x	10 to 90 on board

Active selector switch boards with their own measuring circuit (option 5690-M) are labeled with **M** instead of **U**. **M-A10**, **M-MU**, **M-KS**, **M-TH**

(10) Plug-in module AP : Rechargeable battery (option, see 6.3)

(i)	**Connection socket**	**DC-A**	Mains adapter 12 V (ZB 1212-NA6, 12 V, 5 A)
(j)	**Status LEDs**	**DC-A**	Mains supply, present
		CHARGE	Batteries are being charged.

2. TABLE OF CONTENTS

3. GENERAL

Congratulations on your purchase of this new and innovative ALMEMO® data acquisition system. Thanks to the patented ALMEMO® connector the device configures itself automatically and thanks to the supplied AMR-Control software its operation should be fairly straightforward. The device can, however, be used with such a wide range of sensors and peripherals and offers many different special functions. You are advised therefore to properly familiarize yourself with the way the sensors function and with the device's numerous possibilities and to carefully read these operating instructions and the appropriate sections in the ALMEMO® Manual. This is absolutely necessary to avoid operating and measuring errors and to prevent damage to the device. To help you find the answers to your questions quickly and easily there is a comprehensive index at the end both of these instructions and of the Manual.

3.1 Warranty

Each and every device, before leaving our factory, undergoes numerous quality tests. We provide a guarantee, lasting two years from delivery date, that your device will function trouble-free. Before you return your device to us, please observe the advisory notes in Chapter 11 Trouble-shooting. In the unlikely event that the device proves defective and you need to return it please wherever possible use the original packaging material for dispatch and enclose a clear and informative description of the fault and of the conditions in which it occurs.

This guarantee will not apply in the following circumstances :

- The customer attempts any form of unauthorized tampering and alteration inside the device.
- The device is used in environments and conditions for which it is not suited.
- The device is used with an unsuitable power supply and / or in conjunction with unsuitable peripheral equipment.
- The device is used for any purpose other than that for which it is intended.
- The device is damaged by electrostatic discharge or lightning.
- The user fails to observe the operating instructions.

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

3.2 Standard delivery

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

Measuring instrument ALMEMO® 5690-2C
Multimedia card and USB card reader
Mains adapter ZB 1212-NA6 12 V, 3 A
These operating instructions
ALMEMO® Manual
CD with the AMR-Control software and various useful accessories

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

3.3 How to deal with rechargeable batteries (option)

Usually when the device is delivered the batteries have not yet been charged. First of all therefore the batteries should be charged using the mains adapter provided; continue charging until the **CHARGE** LED goes out.

Rechargeable batteries must never be short-circuited or thrown on the fire.

Rechargeable batteries are special waste and must not be discarded together with normal domestic waste.

3.4 Special notes on use

- If the device is brought into the work-room from a cold environment there is a risk that condensation might form on the electronics. In measuring operations involving thermocouples pronounced changes in temperature may cause substantial measuring errors. You are advised therefore to wait until the device has adjusted to the ambient temperature before starting to use it.
- 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.
- 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.

4. INTRODUCTION

The data acquisition system ALMEMO® 5690-2CPU is a new member in our family of unique measuring devices - all equipped with Ahlborn's patented ALMEMO® connector system. The intelligent ALMEMO® connector offers decisive advantages when connecting sensors and peripherals because all parameters are stored in an EEPROM located on the connector itself; repeat programming is thus no longer necessary. All sensors and output modules can be connected to all ALMEMO® measuring instruments in the same way. Programming and functioning are identical for all units. The following points apply to all devices in the ALMEMO® measuring system; these are described in detail in the ALMEMO® Manual which is included in delivery with each device :

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

The operating instructions you are now reading cover only those features and controls that are specific to this device. Many sections therefore also refer to the more detailed description in the Manual; (see Manual, Section xxx).

4.1 How the system functions

The ALMEMO® 5690-2CPU system has a CPU measuring circuit board for over 70 measuring ranges without their own measuring inputs. These are implemented in the form of various selector switch boards. The 84-DU housing can accommodate up to 190 electrically isolated inputs (maximum 250 channels) - for all ALMEMO® sensors (U-A10) but also for sensors with thermal connectors (U-TH) or free ends (U-MU or U-KS). High scanning rates can be achieved thanks to the active selector switch boards with their own measuring circuit (option 5690-M). To accommodate these various expansion stages the desktop housing is available in 32-DU / 84-DU sizes and a 19-inch rack is available. For operation purposes the device incorporates an illuminated LCD graphics display and a soft-key keypad with cursor block. The display can be adapted by means of configurable user menus to suit any application. For the purposes of recording and logging data the device incorporates a 2-MB battery-buffered RAM (or non-volatile FeRAM, available as an option) with capacity for some 400,000 measured values. With the standard memory connector and multimedia card storage capacity is virtually unlimited. There are 6 output sockets which can be used to connect any ALMEMO® output modules, e.g. analog output, digital interfaces, trigger input, or alarm contacts. Several devices can be networked by simply linking them together via cable. The system is fed by default via a 12-V mains adapter. There is also the option of using a rechargeable battery module.

4.1.1 Sensor programming

The measuring channels are programmed, completely and automatically, by the ALMEMO® connectors. However, the user can easily supplement or modify this programming via the keypad or via the interface.

Measuring ranges

Appropriate measuring ranges are available for all sensors with a non-linear characteristic, e.g. 10 thermocouple types, NTC and Pt100 probes, infrared sensors, and flow transducers (rotating vanes, thermoanemometers, Pitot tubes). For humidity sensors additional function channels are available for calculating humidity variables such as dew point, mixture ratio, vapor pressure, and enthalpy. Even complex chemical sensors are supported. Measured values from other sensors can also be acquired using the voltage, current, and resistance ranges with individual scaling in the connector. Existing sensors can also be used - so long as the appropriate ALMEMO® connector is connected via its screw terminals. For digital input signals, frequencies, and pulses, adapter connectors are available with an integrated microcontroller. It is thus possible to connect virtually any sensor to any ALMEMO® measuring instrument and to change sensors without the need for any extra settings.

Function channels

Maximum, minimum, and differential values of certain measuring points can be programmed as function channels and can be processed and printed like normal measuring points. There are also function channels available for special measuring tasks, e.g. to determine volume flow, temperature coefficient Q/ΔT, and wet bulb globe temperature, etc..

Units

The 2-character units display can be adapted for each measuring channel so that both the display and the printout always indicate the correct units, e.g. when a transmitter is connected. Conversion between °C (Centigrade) and °F (Fahrenheit) is performed automatically.

Measuring point designation

Each sensor is identified by means of a 10-character alphanumeric name. It is entered via the keypad or the interface and appears in the display, in the printout, or on the computer screen.

Correction of measured values

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

Scaling

The corrected measured value on each measuring channel can also be further scaled in terms of zero-point and gain - using the base value and factor. The decimal point position can be set by means of the exponent function. The 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 (1 maximum and 1 minimum). In the event of one of these limit values being exceeded two internal relays (option) or external relay output modules actuate the alarm contacts; these can be allocated individually to specific limit values. Hysteresis is set by default to 10 digits; however, it can be adjusted to any value between 0 and 99 digits. The exceeding of a limit value can also be used to automatically start or stop measured value recording or to initiate other specified action.

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

4.1.2 Measuring operations

Up to 4 measuring channels are available per transducer; i.e. it is also possible to evaluate double sensors, individually scaled sensors, and sensors with function channels. All activated measuring points are normally scanned continuously one after the other at the selected measuring rate (standard 10 mops, maximum 100 mops). Data is output, if available, to the interface, to a measured value memory, or to an analog output. A higher scanning rate of up to 400 mops can be achieved by using active selector switch boards (option 5690-M); these operate in parallel and are scanned via a high-speed bus. In this mode semi-continuous measuring point scanning is no longer supported.

Measured values
The measured values of 1 to 20 measuring points can be indicated on the display using a variety of menus, some user-configurable, in three font sizes, and in the form of a bar chart or line graph. Measured values are acquired automatically with auto-zero and self-calibration; however, they can also be corrected and scaled arbitrarily as 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 line graph 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
With some sensors, to achieve optimal measured value acquisition, certain special measuring functions are required. Cold junction compensation is provided for thermocouples; temperature compensation is provided for dynamic pressure, pH, and conductivity probes; and atmospheric pressure compensation is provided for humidity sensors, dynamic pressure sensors, and O_2 sensors.

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

Average value
Measured values can be expressed as a sliding average obtained by continuous automatic smoothing or manually averaged over a certain period or cycle or over a series of individual measuring operations.

4.1.3 Process control

To record the measured values from all connected sensors in digital form measuring point scanning is performed continuously with measured value output according to a time-based process control. This may be per output cycle or, if really rapid results are required, at the measuring rate itself. The measuring operation can be started and stopped by means of the keyboard, the interface, an external trigger signal, the real-time clock, or by a specified limit value being exceeded.

Date and time-of-day
All measuring operations can be accurately logged using the real-time clock with date function or in terms of the pure measuring time. For the purposes of automatically starting / stopping a measuring operation, the start / stop date and time-of-day can be programmed.

Cycle
The cycle can be programmed to any value between 00:00:01 (1 second) and 59:59:59 (hh:mm:ss). This function permits cyclic output of measured values to the interfaces or to the memory and provides cyclic calculation of the average value.

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

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

Measuring rate
The possible measuring rates are 2.5 / 10 / 50 / 100 mops (measuring operations per second) and on just one channel even 400 mops. Recording can be accelerated if all measured values are saved to memory and / or output to the interface at the full measuring rate.

Measured value memory
To save measured values there are 3 methods.
As standard the device incorporates a 2-MB battery-buffered RAM; this provides sufficient storage capacity for up to 400,000 measured values. For higher reliability for applications conducted over long periods a non-volatile FeRAM is available as an option. Both memory types can be organized and configured in either linear or ring form. Output is via the interface. Selection can be specified according to a time interval or number.
Or alternatively a multimedia memory card can be used as storage medium. This

solution offers a virtually limitless memory capacity. From the memory card files can be read out very quickly via the standard card reader. However, ring memory and selective readout are not possible.

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

Control outputs
Up to 90 output relays or analog outputs in appropriate external adapters (ZA8006-RTA3) or on plug-in boards can be individually addressed.

Operation
All measuring and function values can be displayed in different menus on the dot matrix LCD screen. Three user menus can be individually configured for your specific applications from a range of nearly 50 functions. You can use texts, lines, and blank lines to arrange and format the layout in a style suited to your application. Nine keys (four of them soft keys) can be used to operate the device. Sensors, device, and process control can thus be fully programmed.

Output
All data logs, all saved measured values, and all programming parameters can be output to any peripheral equipment. An RS232 / RS422 / USB / Ethernet interface is available using the appropriate interface cable. Wireless communication is also possible via Bluetooth. Measured data can be output in list format / column format / table format. Files in table format can be processed directly using any standard spreadsheet software or the Win-Control software package. The print header can be programmed to refer specifically to your company or to your application.

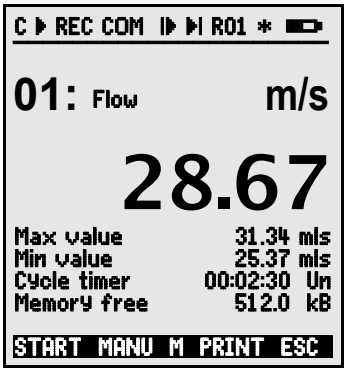
Networking
All ALMEMO® devices can be addressed and can be easily networked by simply linking them together via network cable or for longer distances via RS422 network distributors. The CPU with option XU or XM occupies 3 addresses because each address can manage only 100 measuring channels.

Software
Each ALMEMO® Manual is accompanied by the software package AMR-Control; this can be used to configure the measuring instrument and user menus, 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 software package WIN-Control is also available; this can be used for the purposes of measured value acquisition via networked devices, for graphical presentation, and for more complex data processing.

5. COMMISSIONING

Sensor connection Connect sensors to sockets **M0** to **Mxx** (6g). see 7.
Power supply With mains adapter connected to socket **DC** (5e) see 6.3, 6.1
Switching ON Press **ON PROG** (3) key (3) on front panel see 6.5.

	Keys
Automatic display of last measuring menu see 9.	
Menu selection MEASURING menus Activate by pressing	<ESC> or F4
e.g. select menu Standard display see 8.1	▲ / ▼ ... (F)
To call up the menu press	▶
Select measuring point (see 9.1.1) by pressing keys	▲ / ▼ ... (M)
Select function maximum / minimum value (see 8.4)	PROG , ▼ ...
Clear maximum / minimum values see 9.1.2	< CLR > or F1



F1 F2 | F3 F4 ▲ ◀ PROG ▶ ▼

F1 F2 | F3 F4 ▲ ◀ PROG ▶ ▼

Output of measured values or memory via interface
- Connect peripheral device via data cable to socket **A1** (5d). see Manual 5.2.
- On the peripheral device set 9600 baud, 8 data bits, 1 stop bit, no parity.

Once-only output / saving see 9.3.1	< MANU > or F2
Cyclic measuring Select cycle timer	PROG , ▼ ...
Enter cycle (hh:mm:ss) see 8.5	Cycle timer 00:05:00 Sn
Output format List ´ ´, Columns ´n´, Table ´t´	< FORM> or F3 ...
Terminate programming	< ESC> or F4
Start / stop cyclic measuring see 9.3.2	<START> , <STOP> or F1

Output from memory to the printer or to the computer

Function To select free memory press	PROG , ▼ ...
Output memory see 10.2.6	< PRINT> or F3
Clear the memory see 10.2.6	< CMEM >

6. POWER SUPPLY

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

Mains adapter 12 V / 3A	ZB 1212-NA6
Electrically isolated power supply cable, 10 to 30 VDC, 1.25 A	ZB 3090-UK2
Rechargeable battery module, NiMH 9.6 V / 1600 mAh	ES 5690-AP

See product overview, Annex 14 and the following chapters.

6.1 Mains operation

To power the device from the mains use the mains adapter provided, 12 V / 3A (ZB 1212-NA6). Thus must be connected to the DC socket (5e) and locked by twisting to the right.

If necessary the device can be grounded via the bare socket (5f) (e.g. protective ground connector).

6.2 External DC voltage supply

The **DC** socket (5e) can also be used to connect another DC voltage, 10 to 13 V (minimum 200 mA). For this connection use a cable with 2 banana plugs (ZB 5090-EK). 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 an electrically isolated supply cable must be used, either ZB 3090-UK or, for the rechargeable battery module, ZB 3090-UK2. It will then be possible to use the measuring instrument in a 12-volt or 24-volt on-board supply system.

6.3 Operation with rechargeable battery (only with ES5690-AP)

For mains-independent operation the system must be equipped with module AP (10) with eight NiMH rechargeable batteries (9.6 V / 1600 mAh). With passive selector switch boards and at a current consumption of approx. 40 mA this will give an operating time of approx. 40 hours. With active selector switch boards current consumption increases by 30 mA; operation with a rechargeable battery then only makes sense in the event of power failure. To prolong the operating time for the purposes of long-term recording the device can be left in SLEEP mode; (see 10.2.5). The operating voltage can be checked in the menu **" Power supply"** (see 10.7); this gives you a basis for estimating the remaining operating time. When the remaining battery capacity drops to approx. 10%, the ▭ symbol in the status bar of the display will start flashing; as soon as this happens the batteries must be recharged. If the batteries are completely discharged the device will switch off to avoid the risk of critically low discharge. The measured data and time-of-day will, however, be retained; see 6.6. The NiMH rechargeable batteries can in fact be recharged at any time and in any charge status using the intelligent charge circuitry. To charge the batteries the mains adapter ZB 1212-NA6 (12 V / 2 A) must be connected to socket **DC-A** (10j). The LED "**CHARGE**"(10i) should then light up indic-

ating that the batteries are being recharged. After approx. 3.5 hours the batteries should be fully recharged and the LED goes out again. After a certain period the batteries are then recharged again; the charge circuitry then switches over to trickle charge. The mains adapter can thus be left permanently connected to the measuring instrument in buffer mode without risk of overcharging the batteries. If you prefer not to recharge the batteries at the moment, e.g. to prevent the device from warming up during thermocouple measurement, you can connect the mains unit to the **DC** socket (5e).

If you intend to replace the rechargeable batteries yourself please be absolutely sure that you change all of them and that the new batteries provide the same capacity; failure to heed this advice may cause high-speed charging to malfunction and the batteries may be damaged.

6.4 Sensor supply

At the terminals + (plus) and – (minus) in the ALMEMO® connector there is, for mains operation, a sensor supply voltage available, approx. 12 V (maximum 400 mA / plug-in module) (self-healing fuse 500 mA); the total current requirement (device, sensors, output modules) is limited to approx. 1 A. During battery operation the battery voltage is available, 9 to 11 V. Other voltages (12, 15, or 24 V or references for a potentiometer and strain gauge) can be obtained using special connectors; (see Manual 4.2.5 and 4.2.6).

6.5 Switching ON / OFF, reinitialization

To switch the device **ON** press the **ON - PROG** key (3); if all is in order the "**ON**" LED lights up.

To switch the device **OFF** press the **ON - PROG** key and hold down for approx. 1 second. After the device is switched off the real-time clock continues to run and all saved values and settings are retained intact; (see 6.6).

If the device behaves abnormally as the result of interference (e.g. electrostatic or mains failure), you are advised to try clearing the problem first of all by simply reinitializing, i.e. switching off and then on again.

If this does not help then you can reinitialize the device. You can activate this **reset** by pressing key **F1** when switching on. You can restore all device programming (including times, device designation, user menus, etc.) to the factory default settings by pressing key **F4** when switching on. Only the programming of the sensors in the ALMEMO ® connectors remains unaffected.

6.6 Data buffering

The sensor's programming is stored in the EEPROM on the sensor connector and the device's calibration and programmed parameters are stored in the EEPROM on the instrument itself, both on a fail-safe basis. The data in the standard RAM and the date and time-of-day are buffered by a dedicated lithium battery; all

this data is retained intact for years - even when the device is switched off and even in the absence of charged batteries. In the event of the lithium battery starting to weaken this will be indicated by a flashing ALARM LED. This still leaves enough time to read out and save the data stored in the memory. The plug-in CPU module can then be pulled out and the lithium battery replaced by a new one. If you have the option with the non-volatile FeRAM or you use the memory connector with the multimedia card then there is no risk of data being lost.

7. CONNECTING THE SENSORS / TRANSDUCERS

The **measuring inputs** are implemented by means of various passive and active selector switch boards with 10 inputs each; these are switched by photovoltaic relays; 7.37.3). The number of plug-in modules is only limited by the size of the housing and the number of available slots; however, the maximum number of channels is around 250. At over 100 measuring channels (requires option XU or XM) the system behaves like 3 devices with addresses as follows. To program and scan measuring points each hundreds group must be addressed with the device address and measuring point number. If only **passive selector switch boards** are being used, all measured values are acquired one after the other by the CPU measuring circuit; the time taken for a measuring point scan increases in proportion to the total number of active measuring channels. To determine the scan time more exactly one special measuring operation and where thermocouples are involved up to 2 cold junction compensation measurements / board are required.

A **higher measuring rate** of up to 220 mops can be obtained by means of **active selector switch boards** with integrated measuring circuit (requires option M); these - all simultaneously - acquire their measuring points themselves and are then quickly scanned by the CPU via the bus (requires option XM). The scanning rate is stipulated by the board with the most measuring points. It is advisable therefore to have the measuring channels distributed as evenly as possible over all selector switch boards.

At this higher measuring rate sensor presence is no longer checked during the measuring operation. Sensors must not be added or removed therefore during the measuring operation.

7.1 Sensor / transducer

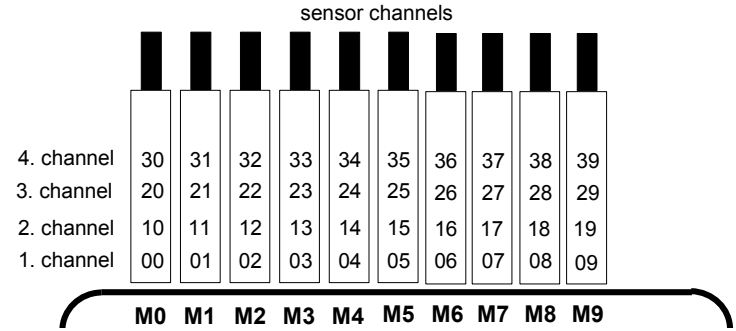
At the ALMEMO® input sockets on the plug-in ALMEMO® modules, types U-A10 or M-A10 (2), any ALMEMO® sensor can simply be plugged in. The ALMEMO® Manual includes detailed descriptions of the comprehensive range of ALMEMO® sensors (see Manual, Chapter 3) and of how to connect your own existing sensors to ALMEMO® instruments (see Manual, Chapter 4). All standard sensors with an ALMEMO® connector usually have the measuring range and units already programmed and can thus be connected to any input socket without further adjustment. A mechanical coding system ensures that sensors

and output modules can only be connected to the correct sockets. All ALMEMO® connectors incorporate two snap-lock levers; these snap into position as soon as the connector is inserted into the socket, thus preventing unintended disconnection if the cable is accidentally pulled. To withdraw the connector, both these levers must be pressed in at the sides. To connect your own existing sensors you simply need the appropriate ALMEMO® connector.

7.2 Measuring inputs and additional channels

A selector switch module usually incorporates 10 inputs (6g) to which initially measuring channels M0 to M9 are allocated. However, each such input can if necessary provide up to 4 channels; 10 such inputs can thus provide a total of 40 channels. The additional channels can be used in particular with ALMEMO® humidity sensors for 4 measurable variables (temperature / humidity / dew point / mixture ratio) or for function channels. Each sensor can if necessary be programmed with several measuring ranges or scaling settings; and 2 or 3 sensors, if pin assignment so permits, can be combined at just one connector (e.g. RH / NTC, mV / V, mA / V, etc.) but these will not be electrically isolated. The additional measuring channel numbers per connector go up in steps of 10 (e.g. the first sensor has channels M0, M10, M20, M30, the second sensor has channels M1, M11, M21, M31 etc.).

On the 1st selector switch board this gives the following channel assignment :

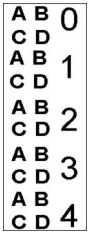


7.3 Selector switch boards

The **CPU measuring circuit board CPU** (1) manages all the selector switch boards and the data of all the measuring channels. The numbers of sensors and channels of each module can be adapted to individual requirements by configuring the measuring point numbering and thus the channel number of the modules by means of a code switch (2i) in the plug-in module. This code switch defines the measuring point number of the first measuring point of each module and thus also the number of channels of the previous module. The 1st plug-in module always begins at 0 (zero). The measuring point number of the next module - logically - must be set between 10 and 40 measuring points higher than the previous module and accordingly the number of channels of

the previous module will be limited to 10 to 40 measuring points Multi-channel sensors should therefore be collected as far as possible in one module. At over 100 channels the measuring point numbering starts all over again with M00; the hundreds group is determined automatically from the overall order.

1. Each **selector switch board U-A10** (6) provides 10 electrically isolated ALMEMO® inputs for all ALMEMO® sensors. In the housing each module occupies 2 plug-in slots. For the purposes of thermocouple measurement each module is equipped with 2 cold junction sensors whose values are interpolated for each measuring point. If thermocouples are involved the measuring time for this will affect the total sampling rate.
2. **Selector switch board U-MU** (7) has 10 inputs led out to a 64-contact socket strip. Sensors are connected via a 10x connector (ZA 5690-MU) each with 4 screw terminals A, B, C, D - in the same way as any standard ALMEMO® connector; (see Manual 4.1). Sensors requiring a power supply or an ALMEMO® connector with special interface circuitry (e.g. humidity sensors, rotating vanes, etc.) cannot be connected in this way. The new connector ZA 5690-MU with a larger EEPROM now permits 4 channels per sensor, i.e. 40 channels altogether; on the old connector ZA 5590-MU there are only 10 channels available. Measuring point numbering, however, is as described above, namely by means of code switches internally on the board. For this purpose the module must be withdrawn and the number on the switch multiplied by 10 (4 = measuring point 40). Each sensor can be programmed individually but all sensor programming data is saved together in a shared EEPROM located in the connector. A cold junction sensor is also provided for thermocouples.
3. **Selector switch board U-KS** (8) also has 10 inputs; these are led directly onto two 20-contact plug connectors with terminals. Sensors can be connected via terminals A, B, C, D, with the usual wiring arrangement; (see label on the side of the connector, example on the right). In order to feed in the wires the outside connectors must be opened by inserting a narrow screw-driver in the inside holes. These boards are also available with shunts for 20-mA signals (terminals A and B for units "mA" or "% ") and with dividers for 10-V signals (terminals A and C for units "mV 2"). A module is only suitable for thermocouples if these are connected using copper wires via an isothermal block with integrated cold junction sensors; (see Manual 6.7.3). Automatic sensor recognition is not possible with this plug-in module; the sensor data is saved to an EEPROM on the board and must be programmed depending on sensor type e.g. using the AMR-Control software. In the newest version (5.13) this several sensors can be programmed at the same time. Measuring point numbering is by means of the code switch internally on the board (see above). This module, similarly, occupies 1 plug-in slot only.



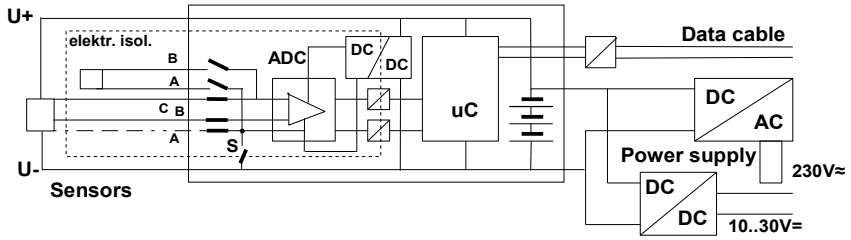
4. **Selector switch board U-TH** (9) has 10 inputs for thermocouples with

miniature thermal connectors. The sensor data is saved to an EEPROM on the board; this means that individual programming is required; (see above). This module occupies only 1 plug-in slot but if arranged in a series a dummy panel must be inserted between in order to operate the connectors. Measuring point numbering is by means of the code switch internally on the board (see above).

5. **Active selector switch boards M-A10, M-MU, M-TH, M-KS** with integrated measuring circuit (all option M) can be scanned more rapidly (up to 220 mops); otherwise they have the same characteristics as passive selector switch boards.

7.4 Potential separation

When organizing a properly functioning measuring setup it is very important to ensure that no equalizing current can flow between sensors, power supply, and peripherals. This will be the case so long as all points lie at the same potential or any unequal potentials are electrically isolated.



The analog inputs are electrically isolated from one another by means of photovoltaic relays. A new feature on this device is the additional separation of the measuring inputs from the CPU and power supply. Between all inputs and outputs (even the analog output cables which are not electrically isolated) the maximum potential difference permitted is 50 V. The voltage at the measuring inputs themselves must not exceed 12 V (between B, C, D, and A).

However, some components are not electrically isolated, namely all sensors connected to the common internal power supply ±U. If a sensor of this type has no connection to pin A, it must be electrically isolated by means of relay S (see above) or even be bridged by a wire jumper because otherwise the inputs would have no reference potential. The relay is set automatically by means of element flag 5 **"ISO OFF"** the first time it is connected; (see Manual 6.10.3). However, with certain connectors (especially divider connectors without power supply) element flag 5 should be checked and if necessary corrected. Sensors with their own integrated power supply must themselves be isolated or the device must be operated with an electrically isolated power supply (mains adapter or connecting cable ZB 3090-UK2 with DC/DC converter).
Data and trigger cables are also isolated by means of optocouplers.

8. DISPLAY AND KEYPAD

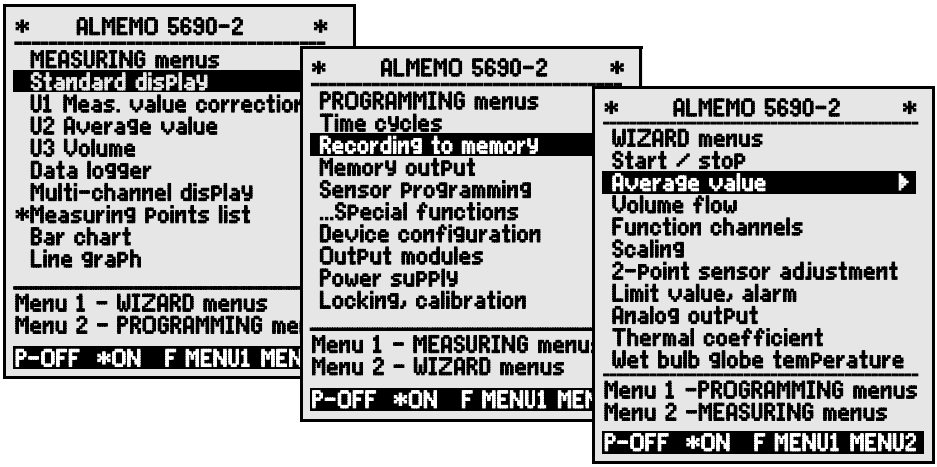
8.1 Display and menu selection

In the graphics display (1) three selection menus are available :

1.Measuring menus see 9. There are 9 measuring menus; these list the measuring and function values in various ways. There are 3 user menus (U1, U2, and U3); these can be freely configured by the user (see 9.7).

2.Programming menus see 10. Here you can program the settings needed on the device and on the sensors and the process control for the data logger.

3.Wizards These will help when it comes to programming and measuring for special applications.



To display menu selection press	<ESC>
To select desired menu selection press	<MENU1> or <MENU2>
Display illumination can be switched on in 3 levels; (10.5.5)	< * ON > ...
To switch off the device in the menu selection press	<P-OFF>
or at any junction press and hold down	ON
To select menus press :	▲ or ▼ ...
To call up the selected menu press :	▶ or PROG
To return to the measuring menu last used press	◀
To return to the programming menu last used press	◀ again.
To return to menu selection press	<ESC>

You can program the device designation in the header line (see 10.5.1) and the titles of the user menus (see 9.7).

8.2 Status symbols in the display and status LEDs

Checking the device status	Status bar	LEDs
Continuous measuring point scan	C	
Measuring operation stopped or started	ii or ▶	START
Measuring point scan started with data saving	REC	REC
Measuring point scan started with data output via interface	COM	COM
Start time or end time of measuring operation programmed	i▶ / ▶i	
Status of the relays (external output module) open / closed	R-- or R01	
Keypad operation restricted by locking		LOCKED
Display illumination activated or on pause	✱ or ✱	
Battery charge status : full / half / empty	, ,	

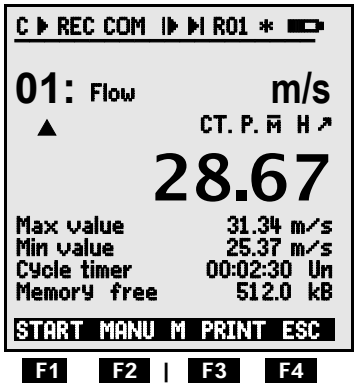
Symbols indicating the measured value status (see above)

No sensor, measuring point deactivated	´-----´	
Measured value modified with sensor correction or scaling	↗	
Averaging in progress	M̄	AVG
Output function **D**iff, **H**i, **L**o, **M**(t), **A**larm (see 10.4.5):	D, H, L, M, A	
Compensation **C**: **T** Temperature, **P** Pressure, **.** continuous	CT. P. (. flashes)	
Limit value exceeded, maximum or minimum	▲ or ▼ flashes	
Overshooting the measuring range Display for maximum value	O flashes	ALARM
Undershooting the measuring range Display for minimum value	U flashes	ALARM
Sensor breakage / sensor voltage Lo : Display ´-.-.-´	B flashes/L flashes	ALARM

8.3 Function keys

The function of keys F1 to F4 (3) may differ per menu. This 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>.

Various status symbols are displayed next to the measured value; (see below).
In the standard display (shown on the right) the following keys are available :

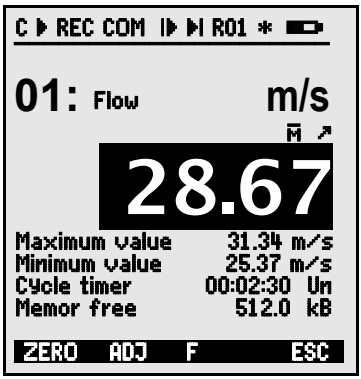


Measuring point selection by means of cursor keys (3) (**M** in the middle) ▲ or ▼ ...

To start a cyclic measuring operation	<START> or F1
To stop a cyclic measuring operation	< STOP > or F1
Once-only **manual output / storage** of all measured values	< MANU > or F2
To output the menu functions via the interface	< PRINT > or F3
To return to menu selection	< ESC > or F4

8.4 Function selection

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



Help window for selecting functions:

```
Set measured value to zero
  Press  ZERO
Sensor adjustment
  with zero-Point (gain)
  Press  ADJ
```

Selection of functions , PROG ,
The first changeable parameter is highlighted in inverse 28.67
font on a black background.
A character should appear in middle of the soft-key bar F
- as verification
To jump forward to the next function press ▼ or ▲ ...
Depending on function the keys F1 to F3
are assigned the desired meaning, e.g. Clear maximum <CLEAR>
Set measured value to zero Adjust measured value <ZERO> / <ADJ> , PROG
Output memory <PRINT>
Clear memory <CMEM>

8.5 Data entry

If a programmable parameter is selected (see 8.4) you can enter or clear the value.

Clearing programmable values <CLEAR> , <OFF>
To program press PROG
You should now be in **programming mode** ;P appears middle
The cursor blinks below the first input position. of softkey bar

Cycle timer 00:00:00

Increment the selected digit by pressing ▲ ...
Decrement the selected digit by pressing ▼ ...
Change arithmetic sign of numeric values < +/- >
Select next position ▶

Cycle timer 00:00:00

To move back to the previous digit, press ◀
Each position is programmed like the first. ▲ / ▼ ..., ▶
To complete data input PROG
To cancel programming <ESC>

9. MEASURING WITH THE MEASURING MENUS

When the device is switched on for the first time it displays the menu **Measuring Points list** (see 9.5.3). This provides a clear overview of the whole measuring system. Here you can check whether the date and time-of-day are correctly set. If they are not you can enter the correct values now; (see 8.4 and 8.5). You are also shown a continuous display of the measured values for all connected sensors and measuring channels. You can also, by means of cursor keys ▲ or ▼ , even assign other additional functions such as designation, range, maximum value, and limit values. If you program the cycle timer (see 9.3.2), you can, by pressing <START> , start the first measuring operation and record measured values cyclically. If a printer or a terminal is connected then all values can also be output online. Having selected the channels you can then program the measuring points. To select other measured value menus press <ESC>.

Menu selection

To ensure that measured values and the associated functional values are acquired and displayed in your application in the clearest possible way the 5690-2 system incorporates a series of preconfigured measuring menus. These can be selected from the range of **measuring menus**; they differ from one another in the number of measuring points (1 to 20), in the font size used to display measured values (4, 8, 12 mm), in the choice of bar chart or line graph, and in the grouping of functions. If these preconfigured menus do not completely meet your requirements, you can assemble your own 3 user menus (U1, U2, U3) from a range of over 50 functions; (see 9.7).

To activate menu selection press <ESC>

To select a menu press ▲ or ▼ ...

To call up the selected menu press : ▶ or PROG

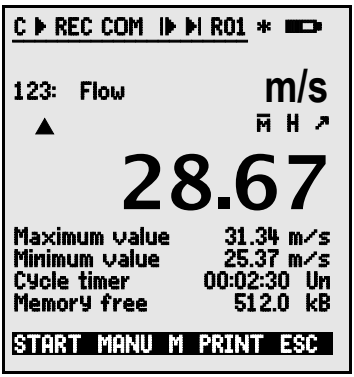
The most important functions for controlling the measuring sequence are already included in and can also be directly programmed in the measuring menus. The system also provides special **PROGRAMMING menus** for the purposes of programming the sensors and the device and **WIZARD menus** for particular functions.

These can be selected by pressing <MENU1> or <MENU2> .

9.1 Measuring with a measuring point

Standard display

The menu **Standard display** shows a measuring point in the largest size with (maximum 3 digits) measuring point, designation, and units. Symbols indicate the status of the measured value; (see 8.2). The maximum and minimum functions are described in Section 9.1.2, the cycle timer in Section 9.3.2, and saving to memory in Section 9.3.3.



9.1.1 Selecting a measuring point

By pressing ▲ you can select one after the other all active measuring points and have the current measured value displayed for each (M in the middle of the softkey bar). By pressing ▼ you can move back to the previous channel. When a particular measuring channel is selected the associated input channel is also selected at the same time.

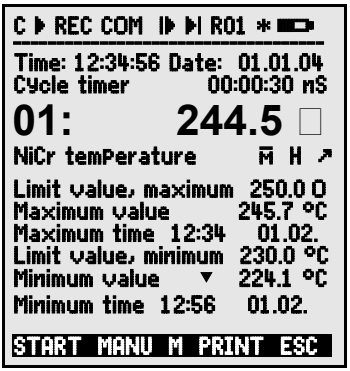
The measuring channel can be incremented by 1 by briefly pressing the key ▲ and by 10 by pressing and holding it down.

The measuring channel can be decremented by 1 by briefly pressing the key ▼ and by 10 by pressing and holding it down.

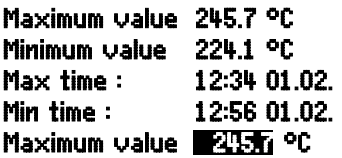
9.1.2 Peak value memory with date and time-of-day

The highest and lowest values are identified from the acquired measured values for each measuring point and continuously updated to memory together with date and time-of-day. To display these values use the functions listed below; to output them use the function channels; (see 10.3.10).

In the AMR-Control software the **Monitoring** menu including the maximum / minimum times (as shown on the right) can be loaded and easily configured as a user menu (see 9.7).



Function, maximum value
Function, minimum value
Function Date and time-of-day of maximum value :
Function Date and time-of-day of maximum value :
To clear memory select the function (see 8.4):

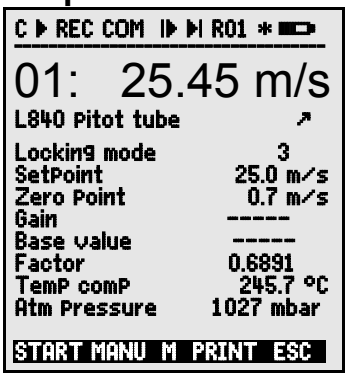


To clear each individual value press **<CLEAR>**
To clear maximum, minimum, and average values for all channels press **<CLRA>**

As soon as you clear the memory, the current measured value will appear (because measuring is continuous). Each time a measuring operation starts, if the device has been so configured, the peak values will be cleared ; (for default setting see 10.5.8). Cyclic clearing can be activated by programming the averaging mode CYCL; (see 9.4.7).

9.2 Measured value correction and compensation

To achieve maximum measuring accuracy the zero-point of the sensors can be corrected in all menus at the touch of a button. More correction functions are provided in the user menu **U1 Measured value correction** (selection, see 8.1). By entering a setpoint the correction value will be automatically calculated and stored in the sensor connector. For sensors affected by ambient temperature or atmospheric pressure the appropriate compensation can then be provided.

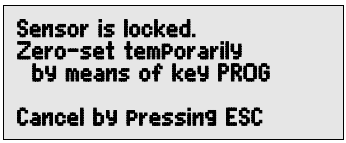


9.2.1 Set measured value to zero

One very useful function is to zero the measured value at certain locations or at certain times as a reference value in order then to observe only the subsequent deviations. Having selected the measured values function in any menu (see 8.4) you will be shown a help window listing all the possibilities for measured value correction. If you press **<ZERO>** , **PROG** , the displayed measured value will be saved as **base value** and thus set to zero.

To select the **measured value** function press — 00: 23.4 °C
To zero the **measured value function :** — <ZERO>
To execute press — PROG
Measured value — 00: 00.0 °C ↗
Base value — Base value 23.4 °C

If the function is locked (see 10.3.4), the base value is not saved on the connector but only **temporarily** to RAM where it is retained until the device is next switched off. This function can be blocked by using locking level 6.



Whenever the display indicates a deviation from the base value (instead of the actual measured value) the symbol ↗ will appear.
To obtain the actual measured value again the base value must be cleared; (see 10.3.6).

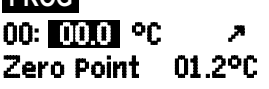
9.2.2 Zero-point adjustment

Many types of sensor need to be adjusted at least once or at regular intervals to compensate for various instabilities. This can be done with the above-mentioned ´Set measured value to zero´ - but also with the special **zero-point adjustment**, which does not influence scaling. If this function is used, the zero-point error is not stored as base value but as **zero-point correction**; (10.3.7).

To select the **measured value** function press
Function **Zero-point adjustment** by means of key

To execute press

Measured value
Zero point



If the function is locked at level 3 or above (see), a help box states that it can only be unlocked temporarily for adjustment purposes; this ensures that the correction values are remain permanently stored on the connector.

To adjust temporarily unlock by pressing

If a base value has been programmed, the measured value indicated after adjustment is not zero but the negative base value.

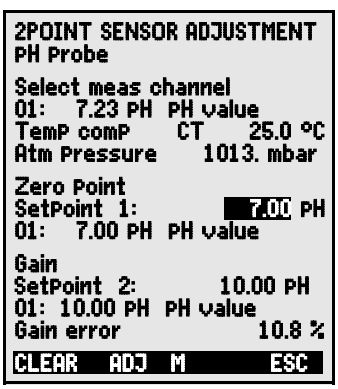
In the case of **dynamic pressure probes** the zero-point error is always written to the calibration offset temporarily (i.e. until you switch off) even if the channel is locked.

9.2.3 Sensor adjustment for chemical sensors and probes

With the following sensors in the measured value function press <ADJ> (9.2.2) to automatically reach the **sensor adjustment** wizard for **two-point adjustment** of the zero-point and **gain**. The appropriate calibration setpoints should already be entered but these can also be modified.

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

Temperature and atmospheric pressure can also be entered here if necessary for compensation purposes (see 9.2.5, 9.2.6).



1. Setting up a means of calibration for the zero point

Function **To select setpoint 1** — SetPoint 1 07.00 pH
Zero-point adjustment by means of key — <ADJ>
Adjustment value is retained — 00: 07.00 pH ↗

In the case of pH probes you can by pressing <ZERO> restore the default values, base value 7.00 and gain -0.1689.

2. Setting up a means of calibration for the gain

Function **To select setpoint 2** — SetPoint 2: 10.00 pH
Gain adjustment by means of key — <ADJ>
Adjustment value is retained — 00: 10.00 pH ↗
Gain shows approx. — Gain -0.1689
The **gain error** shows deviation from rated value and thus the status of the probe — Gain error 9 %

If sensors are locked they can be temporarily unlocked by pressing <FREE> . Locking at level 6 permits adjustment only and thus prevents operating errors by pressing <ZERO>.

9.2.4 Two-point adjustment by entering setpoint

In menu U1 Measured value correction two-point adjustment can also be performed for other sensors. In addition to zero-point adjustment9.2.2 gain is also corrected in the SetPoint function by means of a second measuring point. The correction factor is calculated automatically at the touch of a button and stored as factor on the sensor connector.

1. Zero-point adjustment

Put sensor in its **zero status**
(icy water, unpressurized, etc.)
Set measured value to zero (see 9.2.2) by pressing <ZERO> / <ADJ>, <PROG>.

2. Final value correction

Adjust sensor to a defined **setpoint** — 00: 098.7 °C
(boiling water, known weight, etc.)
With **ALMEMO force transducers** activate / deac- <ON> / <OFF>
tivate calibration resistance (see Manual 3.6.2)
Setpoint entered in function ´Setpoint´ — SetPoint 100.0 °C
Measured value adjusted in function ´Setpoint´ — <ADJ>
The measured value shown should then be the setpoint. — 00: 100.0 °C

If the sensor is locked at level 4 the correction factor is programmed as ´Factor´; if the sensor is locked at level <= 3 or temporarily unlocked by pressing <FREE> , the correction factor is programmed as gain correction (see 10.3.7).

9.2.5 Temperature compensation

Sensors whose measured values depend heavily on the temperature of the measuring medium usually incorporate their own temperature sensor and perform temperature compensation automatically; (see 10.3.9 Measuring range list ´with TC´). However, dynamic pressure probes and pH probes are also available without their own temperature sensor. If the temperature of the medium deviates from 25°C the following measuring errors must be considered :

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

Compensation at constant temperature can be activated via the **'TemPerature comPensation' function** , e.g. in the **'Measured value correction'** menu.

Enter the compensation temperature in the function **TemPerature comPensation CT 31.2°C**

Continuous temperature compensation using external temperature sensors can be activated either via the reference channel of the sensor to be compensated or by configuring any temperature sensor as reference by means of a ´*T´ in the designation.

While the temperature is being measured, point T flashes. **TemPerature comPensation CT. 23.5°C**

Automatic temperature compensation can be switched off by programming the reference channel for the measuring point to itself.

9.2.6 Atmospheric pressure compensation

Some me measured variables depend on the ambient atmospheric pressure (see 10.3.9 Measuring range list ´with PC´) with the effect that large deviations from normal pressure (1013 mbar) may lead to measuring errors.

e.g. error per 100 mbar		**Compensation range**
Relative humidity psychrometers	approx. 2%	500 to 1500 mbar
Mixture ratio, capacitive	approx. 10 %	Vapor pressure VP up to 8 bar
Dynamic pressure	approx. 5%	800 to 1250 mbar (error < 2%)
O_2 saturation	approx. 10%	500 to 1500 mbar

It is advisable therefore, especially when taking measurements at appreciable heights above sea level to take due account of the atmospheric pressure (approx. -11 mbar / 100 meters above mean sea level, MSL). This can be programmed (see 10.5.6) or it can be measured using a suitable sensor (reference sensor with designation ´*P´), (see 10.3.2, Manual 6.7.2).

The function **AtmosPheric Pressure** can be integrated into any user menu or be set in the standard menu **Device Configuration** .

Enter atmospheric pressure in the function Atmospheric pressure **AtmosPheric Pressure CP. 1013. mbar**

The atmospheric pressure is set to 1013 mbar with each reset. It can be set to the current value by means of the usual data entry process; (see 8.5). If atmospheric pressure is being used for compensation in a measuring menu the symbol ´**CP**´ is displayed; if atmospheric pressure is itself being measured the measured value is displayed and a dot flashes after ´**CP**´.

Please note that as soon as a reference sensor is disconnected normal pressure, 1013 mbar, is used.

9.2.7 Cold junction compensation

Cold junction compensation (VK) for thermocouples is normally performed completely automatically. On this device, with 9 sockets, to ensure the highest possible degree of accuracy - even in difficult thermal conditions (e.g. thermal irradiation) - the socket temperatures are acquired by means of two precision NTC sensors in measuring sockets M0 and M8 and then calculated by linear interpolation. The mean cold junction temperature is displayed in the device configuration as an operating parameter (see 10.5.8). This can if necessary be incorporated in measured data acquisition as device temperature with function channel ´CJ´ (see 10.3.10).

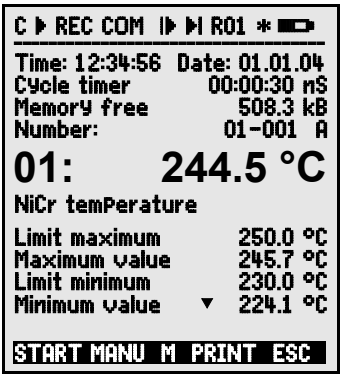
Instead of this form of cold junction temperature measurement it is also possible to use an external measuring sensor (Pt100 or NTC) in an isothermal block (see Manual 6.7.3); this must be positioned upstream from the thermocouples and ´*J´ must have been programmed in the first two positions in the designation (see 10.3.2). In this mode the device is switched over automatically to ´continuous measuring point scan´.

For especially exacting requirements (e.g. for thermocouples for which there is no connector with thermo-contacts or for large temperature differences caused by thermal irradiation) special connectors are available, each with its own integrated temperature sensor (ZA-9400-FSx) for cold junction compensation. These can be used for all thermocouple types; however, they require 2 measuring channels. Having ”#J” programmed in the first two positions in the designation for the thermocouple ensures that the temperature sensor integrated in the connector is indeed used for cold junction compensation.

9.3 Measuring point scan and output

Measuring point scanning is used to acquire measured values from all measuring points either manually at certain times or cyclically over a specified period; these values can be saved on the computer or output to the printer; (see Manual 6.5).

This can be performed e.g. in the **Data logger** menu.



9.3.1 Once-only output / saving of all measuring points

Once-only manual measuring point scans for acquiring the current measured values from all active measuring points (see Manual 6.5.1.1) can be initiated by pressing **<MANU>** . If the time-of-day is required in the display, it must first be set (10.1.1). The output format can be set in the **Cycle timer** function (9.3.2).

Once-only manual measuring point scan : **<MANU>**

The following symbols will be displayed briefly - as verification - in the **status bar**.

The start arrow will light up briefly and then go out again ´▶´

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

If measured values are being saved (see 10.1.2) the following will appear ´REC ´

Each time the key is pressed again after this the measured values will be processed with the associated measuring time.

9.3.2 Cyclic output / saving of all measuring points

For cyclic recording and output of measured values (see Manual 6.5.1.2) the cycle and the output format must be programmed accordingly. The measuring operation can be started using the key **<START>** and stopped using the key **<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 (for default setting see 10.5.8).

So long as no measuring operation has been started the **Cycle timer** function displays the cycle. Once the function has been selected (see 8.4) the cycle can be entered directly (see 8.5). Once started the timer counts down to the next cycle.

Function **Cycle timer** : **Cycle timer** 00:02:00 S

Cycle (hh:mm:ss), Saving ON, List format

The quickest way to set the required output format is by pressing **<FORM>** ; (for printouts see Manual 6.6.1).

Change format	**<FORM>**
Format, adjacent columns ´n´:	Cycle timer 00:02:00 Sn
Change format	**<FORM>**
Format, table ´t´:	Cycle timer 00:02:00 St

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

In the **status bar** - as verification - the following symbols will be displayed continuously, i.e. so long as the measuring operation is running.

The start arrow lights up	´▶´
If data is being output via the interface the following symbol will light up	´COM´.
If measured values are being saved (see 10.1.2) the following will appear	´REC ´
To stop a cyclic measuring point scan press	**<STOP>** ´Ⅱ´

9.3.3 Memory capacity, Memory output, clearing the memory

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. The output format is as set in the cycle (see 9.3.2 and 10.1.2).

Function **Memory capacity free** e.g.	Memory free 0378.4 kB
To output the memory (see 10.2.6) :	**<PRINT>**
Clear the memory	**<CMEM>**

9.3.4 Output menu functions

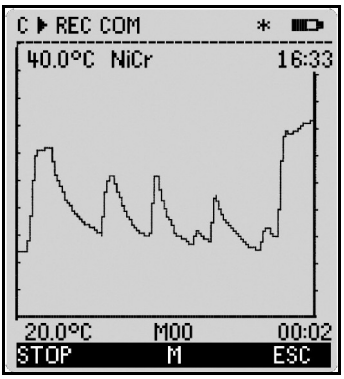
Each measured value menu, together with all its displayed functions, can be output via the interface to a printer or computer; (for connection of peripheral devices, see Manual 5.2). If you have selected the standard display, pressing the key **<PRINT>** will initiate a printout of the following protocol.

Print measured value menu **<PRINT>**

```
Measuring point, measured value, designation 01: +0023.5 °C temperature
                                              Maximum value 01:+0020.0 °C
                                              Minimum value 01:-0010.0 °C
                                              Print timer  00:01:23
Memory capacity - total / free in KB          MEMORY S0512.1 F0324.4 A
```

The protocols for individual functions is listed in Section 6.6.1.

9.3.5 Displaying measured values as a line graph



In the **Line graPh** menu the measured value of the selected channel is displayed, as soon as a measuring operation starts, as a line graph with 100 x 120 pixels. The curve is continuously updated from right to left according to the time resolution defined by the **cycle**; each scan affects one pixel. The resulting time data for the whole t axis is displayed as (days) hours : minutes in the bottom right corner. In the top right corner the time-of-day is displayed. The curve is updated throughout the active measuring operation - even if the user leaves the menu (so long as the selected measuring point is not changed).
Limit values, if activated, are displayed as dotted lines.

To set the display range in the y-axis the functions **Analog start** and **Analog end** in the **SPecial functions** menu should be used; (see 10.4.4). These functions can also be entered directly on the axis by pressing **PROG** .

Displaying a measured value as line graph

In menu **Times - cycles** enter cycle.	Cycle : 00:00:05
Time axis 120 x 5 secs = 10 mins :	00:10
To select the measuring channel press	▲ or ▼ ...
To scale the y axis press	PROG
Analog end at top	40.0 %H
Change value (see 8.5) by pressing	PROG , ▲ / ▼ ..., ▶ ...
Analog start at bottom, ditto	▼ 20.0 %H
To terminate the input	<ESC>
To start a measuring operation	<START> ´▶´
To stop a measuring operation	<STOP > ´⏸´

During a measuring operation the channel switching function is blocked.
Each time a measuring operation starts and each time the channel is switched the line graph will be cleared.

9.4 Averaging

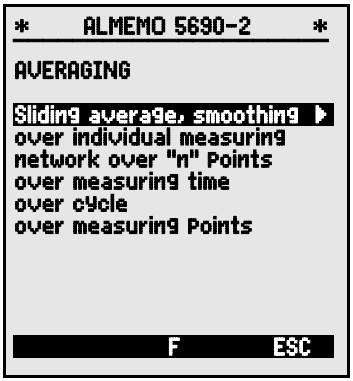
The **average value** for a measured value is needed for various applications.

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

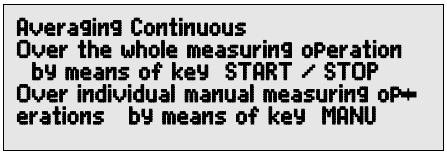
The average value $\overline{M}$ for a measured variable is obtained by totaling a whole series of measured values M_i and then dividing by the number of measured values N.

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

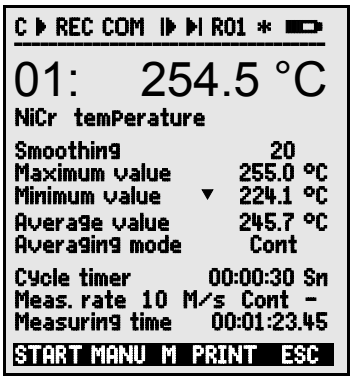
The ALMEMO 5690-2C offers several different averaging modes.
These include measured value smoothing for the selected channel with a sliding averaging window, averaging over individual measuring operations selected by place or time (also networked measuring as per VDE), averaging over the full measuring time, over cycles, or over specified measuring points.
For all these modes you can call up the special **Averaging** wizard to help you enter the necessary parameters with help windows that will teach you how best to proceed.



Measuring menu **Average value** :
Most averaging functions can also be performed directly in a measuring menu, e.g. ´User menu´ **U2 Average value** . Help windows explaining the various averaging modes are available in the programming stage, e.g.

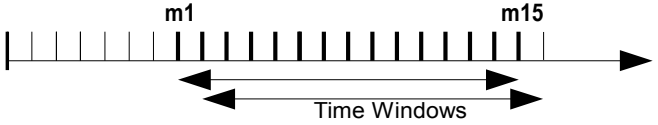


To calculate volume flow from the average velocity and the cross-section of a flow conduit you can use either the ´User measuring menu´ **U3 Volume flow** (see 9.4.9) or the **Volume flow** wizard.



9.4.1 Smoothing meas. values by means of a sliding average

The first method for averaging applies exclusively to the measured value of the displayed channel; it is used to smooth measured values of an unstable or strongly fluctuating nature, e.g. especially turbulent flows, by means of a sliding average over a specified time frame. The **level of smoothing** can be set in the **Smoothing** function; here you specify the number of measured values to be averaged (possible range 0 to 99). The smoothed measured value will then apply for all subsequent evaluation functions. Smoothing can thus also be used in a combination with averaging over individual measured values (see 9.4.3) or for networked measuring (see 9.4.4).



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

Measured value smoothing over e.g. 15 values : **Smoothing 15**

When a large number of measuring points is involved, continuous measuring point scanning should be switched off; the measuring rate might otherwise be substantially reduced. **Measuring rate 10 M/s Continuous -**

Time constant (s) = smoothing / (measuring rate · measuring points +1) is calculated and displayed by the averaging wizard.

9.4.2 Averaging mode

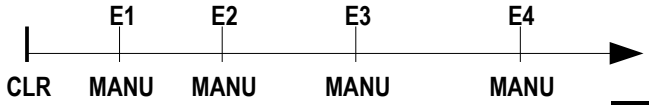
For a detailed description of averaging over measuring point scans see the Manual 6.7.4.. The averaging method is defined for each channel in the **Averaging mode** function. Below are the methods available, shown with averaging mode and operation :

Function - no averaging	**Averaging mode -----**
Averaging over individual measuring operations by **MANU** or over all measured values from **START** to **STOP**:	**Averaging mode CONT**
Averaging over all measured values in a cycle	**CYCL**
If averaging is in progress - the following symbol lights up	$\overline{M}$
Display of average value in	**Average value 12.34 m/s**

For **recording** average values you will need a **function channel** with range M(t) (see 10.3.9/10) or the corresponding **output function** M(t) instead of the measured value (see 10.4.5).

9.4.3 Averaging over individual manual meas. operations

To obtain the average of individual measuring operations at particular locations or times individual manual measuring point scans E_i must be performed. At all measuring points where measured values are to be averaged averaging must be switched on with ´CONT´ mode.



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

1.If a operation has been started stop it by pressing **<STOP>**
2.Set averaging mode (see 8.5)
If necessary, select Smoothing
If necessary, switch continuous measuring off

```
Averaging mode    CONT
Smoothing          20
Measuring rate: 10 M/s
Cont:
```

3.After selection (see 8.4) to clear average value press **<CLEAR>**
Function average value shows
Number function shows :

```
Average value  ----- mls
Number         00000
```

4.Acquire individual measured values Ex manually **<MANU>**
Function average value shows
Number function shows

```
Average value   12.34 mls
Number          00001
```

5.Repeat step 4 for each measuring point.
6.Output all function values for the menu by pressing **<PRINT>**

9.4.4 Networked measuring

Average velocity in a flow channel is calculated as per VDI/VDE 2640, namely by performing measuring operations at particular networked points in a cross-section vertical to the pipe axis (see Manual 3.5.5). To log all the individual values or to be able to repeat incorrect measuring operations a special menu is provided for networked measuring. This special menu can be accessed via the Average value function by pressing **<ARRAY>** . This menu can also be used of course for other point measuring operations.

```
Networked          measuring
Points  5
01: 11.43 mls
02: 12.51 mls
03: 19.71 mls
04: 12.51 mls
05: --.-- mls

Average value  14.51mls
STOP CLEAR F          ESC
```

1.The averaging mode is not significant.
For meas. value smoothing, if necessary, select Smoothing

```
Averaging mode     ----
Smoothing          20
Average value:     -----
```

2.Select Average value function :
3.To select the networked measuring menu press **<ARRAY>**
4.For data acquisition press **PROG**
5.Enter number of points
A deleted array appears

```
Network meas.  Points 5
01: --.-- mls
```

6.To select a measuring point press ▼
7.Start the measuring operation by pressing **<START>**

```
<START> 01: 11.22 mls
```

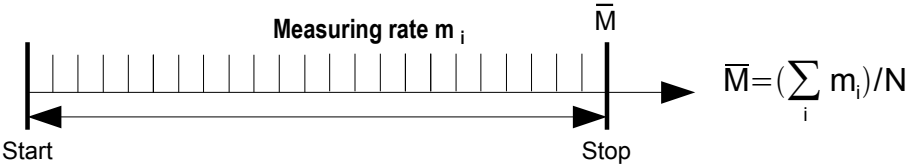
8.Stop the measuring operation by pressing **<STOP>**

```
<STOP> 01: 11.43 mls
```

9.Acquire all points as per steps 6 to 8.
10.To delete the array and new measuring operation press **<CLEAR>**
11.To return to the measuring menu **<ESC>**

9.4.5 Averaging over the meas. time or measuring duration

To calculate the average value of all measured values acquired at the measuring rate over a certain period of time the averaging mode for the required measuring channel must be set to ´CONT´. Averaging can be performed either with or without the cycle. A measuring point scan is always performed at start-up and stop in order to record the start value and end value each with the applicable time-of-day. $\overline{M}$ In order to record the average value a function channel M(t) is required; (see 10.3.9, 10.3.10).



Set averaging mode	Averaging mode Cont
Clear average value automatically at start-up (see 10.5.8)	Verification
or, after selecting the averaging value, press	<CLEAR>
Start averaging by pressing	<START> ▶ M
Read out the measuring time (see 9.4.6) in function	Meas. time 00:01:23.40
Stop averaging by pressing	<STOP> ‖
For a fixed average time the following function can be used.	Meas duration 00:02:00
Read out average value in function	Average value : 13.24mls
Output all function values for the menu by pressing	<PRINT>

9.4.6 Measuring time, Measuring duration, Timer

For averaging over time (see above) and for many other measuring operations the actual measuring time, from start to stop, is required. For continuously monitoring the measuring time - without clearing the real time - the Measuring time function is provided; this has the format hh:mm:ss.xx with a resolution of 0.10 seconds. If the function ´Clear measured values at start of measuring operation´ is activated in the operating parameters (see 10.5.8) the measuring time will also be cleared automatically at each start-up.

Measuring time function	Measuring time 00:00:00.00
To clear the meas. time in Meas. time function press	<CLEAR>

Measuring duration

If you want to stop a measuring operation or an averaging process (see above) after a certain length of time, you can program the measuring duration in the menu Times - Cycles (see 10.1.4) or in a user menu; (this function is displayed in the status bar as ´▶‖´).

Measuring duration function Measuring duration 00:00:00

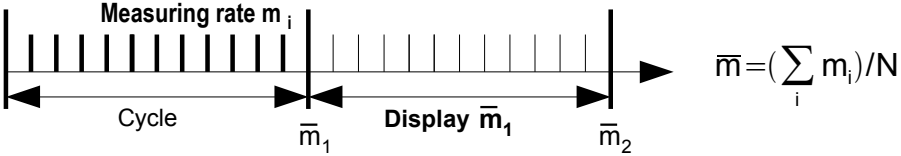
When recording to memory use a programmed measuring duration to ensure that recording does not abort prematurely.

Timer as function channel

Measuring times can be output and saved via the function channels ´Time´ in the format ´sssss´ or ´ssss.s´ (see 10.3.9). The 2nd timer with 0.1 seconds resolution can be obtained by programming the exponent to -1. At a count of 60,000 the timer is reset and starts again at 0. All the normal start / stop functions can be used; in addition, the start, stop, output, and zero-setting of the 2nd timer can also be triggered by actions in the event of limit values being exceeded; (see 10.4.3).

9.4.7 Averaging over the cycle

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



Set averaging over a cycle	**Averaging mode CYCL**
To program the cycle (see 10.1.2):	**Cycle 00:15:00**
	Verification
Start measuring operation, averaging in progress	**<START>** ▶ m̄
To stop a measuring operation	**<STOP>** ‖
Read out average value / cycle in average value function	**Average value 13.24 ms**
Output all function values for the menu by pressing	**<PRINT>**

Average value over manually set periods of time

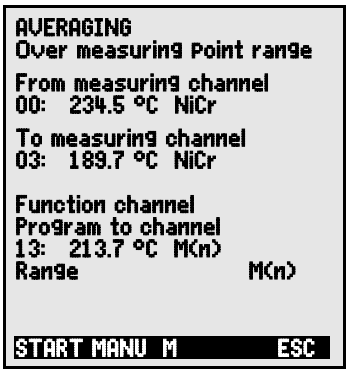
Using the same averaging mode but without the cycle the average value can also be obtained over the period of time from one manual measuring point scan to the next measuring point scan.

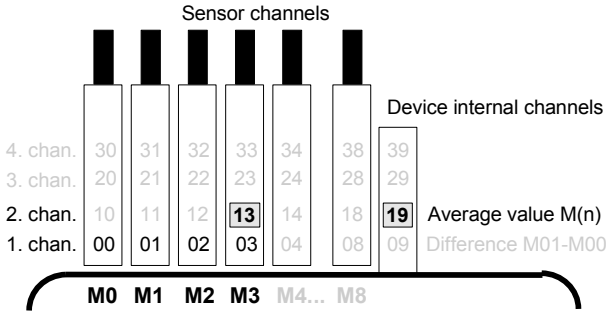
Set averaging over a cycle	**Averaging mode CYCL**
Select the cycle and clear by pressing	**<CLEAR>**
	Cycle timer 00:00:00
	Verification
Start measuring operation, averaging in progress	**<START>** ▶ m̄
Manual measuring point scan	**<MANU>** ▶ ...
Average value from one meas. point scan to the next :	**Average value 12.34 ms**

For recording average values an additional **function channel** with range M(t) (see 10.3.9, 10.3.10) or the corresponding **output function** M(t) is required - instead of the measured value (see 10.4.5, Manual 6.10.4).

9.4.8 Averaging over measuring points

In all measuring point scans the average value can also be determined over a number of associated measuring points. However, for this average value a function channel with the measuring range M(n) must be available (see 10.3.9). If you do not wish to program reference channels and the measuring points to be averaged begin with M0, you need simply to program the function channel M(n) to the 2nd channel of the last connector (e.g. M13) (see 10.3.10). This will then refer automatically to the series from reference channel 2 (M0) through to reference channel 1 (M3 = 1st channel). Other ranges of measuring points can be activated by programming the reference channels accordingly (see 10.4.6). The function channel can be configured quickly and easily by means of the **Averaging** wizard.





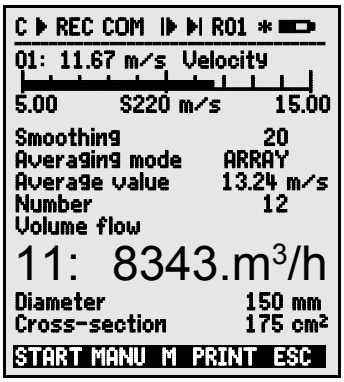
$$\overline{M} = \left(\sum_{i=Bk2}^{n=Bk1} M_i \right) / N$$

Example

$$M13 = \left(\sum_{i=M0}^{n=M3} M_i \right) / N$$

M13= $\overline{M}$ from M0 to M3

9.4.9 Volume flow measuring



The **volume flow** in flow channels can be calculated by multiplying the average flow velocity and the cross-section area. $\bar{v}$ The functions needed for this purpose can be accessed via the user menu U3 **Volume flow** (see right). These are a flow channel with averaging, the functions 'diameter' and 'cross-section', and a function channel for volume flow (10.3.10). If the volume flow channel has not yet been programmed or if other functions are needed, e.g. factor or length and width for rectangular cross-sections, you can use the **Volume flow** wizard. **Volume flow** Volume flow VF = average flow velocity $\bar{v}$ • Cross-section area CS

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

$\bar{v}$ For rough air volume measurements at air vents and gratings the average flow velocity can be determined by means of **time-based averaging** (see 9.4.5 and Manual 3.5.5). You apply the rotating vane at one end, start averaging, and proceed uniformly over the whole cross-section; when you reach the other end of the cross-section stop averaging. Or alternatively the average flow velocity can also be determined by means of **single networked measuring operations** as per VDI/VDE 2640 (see 9.4.4 and Manual 3.5.5) (e.g. 13.24 m/s).

To display, output, and / or save the number of measuring operations a special function channel ´n(t)´ is available (see 10.3.9, 10.3.10).

With Pitot tubes, in order to calculate actual velocity, both **temperature compensation and atmospheric pressure compensation** are required (see 9.2.5, 9.2.6).

$\bar{v}$ The average velocity is shown by the function	Average value 13.24 m/s
Enter the diameter in mm (maximum 4000):	Diameter: 0150 mm
Enter the cross-section area directly in cm^2	Cross-section: 0175 cm²
Display the volume flow in a	volume flow
Function channel in m^3/h	11: 8343.m³/h
Output all function values for the menu by pressing	<PRINT>

Converting to standard conditions

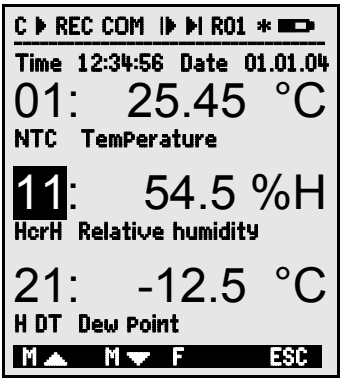
With all flow sensors that acquire actual ambient conditions with both temperature compensation and atmospheric pressure compensation (see 9.2.5) it is possible to convert the actual measured values to standard conditions, i.e. temperature = 20°C and atmospheric pressure = 1013 mbar. To do this ´#N´ must be programmed in the designation either in the velocity channel or in the volume flow channel only (see 10.3.2); this then automatically produces the **standard volume flow**.

9.5 Display of several measuring points

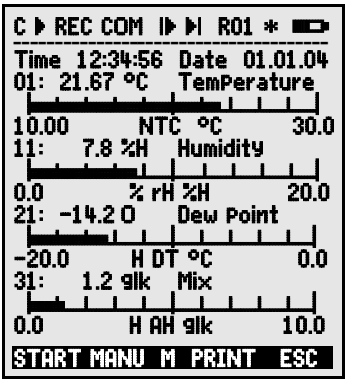
The measuring menus described so far are used for selecting and displaying one measuring point only. In this Chapter we explain how several measuring points can be displayed at the same time combined with the functions of your choice.

9.5.1 Menu Multi-channel display and bar chart

The menu **Multi-channel display** initially shows the measured values of the first three active channels in medium size. However, these can be programmed in numerous ways.



In the menu **Bar chart** the first four active channels are displayed with measured value and bar chart.



Measuring point selection

The 1st measuring channel is always the selected measuring point.

This can be selected directly, in any menu, by means of ▲ or ▼ ...
To change the other channels, the measuring point must be selected as function by pressing PROG and ▼ ...
The selected measuring point can now be changed by means of key(s) <M▲> , <M▼> ...
The process of measuring point selection is terminated by pressing key <ESC>

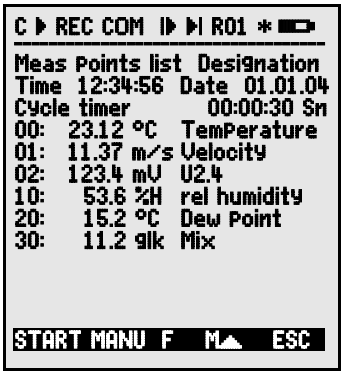
To **set the display range** for the bar chart the functions **Analog start** and **Analog end** in the **Special functions** menu should be used (see 10.4.4). Having selected these functions they can also be entered directly on the appropriate axis by pressing PROG and ▼ (see 8.5).

9.5.2 Differential measurement

To display the difference between two measuring points a function channel (see 10.3.10) must be programmed with the appropriate reference channels (see 10.4.6). Both sensors must be set with the same decimal point and units.

9.5.3 Menu Measuring points list

The best overview of the measuring system with all measured values, date, time-of-day, and cycle can be obtained via the **Measuring Points list** menu. From the measuring points you can also reach **Sensor Programming** for the measuring points.



This menu cannot be configured by the user; it can only be combined with certain selected functions.

Initially the list appears with maximum 20 entries.

Measuring Points list 20 measured values
00: 23.12°C ...

Measured values

To select further measuring points lists press

M▲

or

PROG , M▲ ... / M▼ ...

At over 100 measuring points the hundreds group / device address is displayed in the 1st line.

M100-M199:

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

▲ or ▼ ...

This reduces the maximum number of channels to 10.

To advance to the next function press

▲

Measured value with **designation** :

Meas. Points list - Comment
00: 23.12°C Temperature

Measured value with **maximum value** :

Meas. Points list Max value
00: 23.12 °C 32.67 °C

Measured value with **minimum value** :

Meas. Points list Min value
00: 23.12 °C 19.34 °C

Measured value with **average value** :

Meas. Points list Aver. value
00: 23.12 °C 25.45 °C

Measured value with **limit value, maximum** :

Meas. Points list Limit value, maximum
00: 23.12 °C 32.67 °C

Measured value with **limit value, minimum** :

Meas. Points list Limit value, minimum
00: 23.12 °C 19.34 °C

Measuring range only (also maximum 20 channels)

Meas. Points list Range
00: NTC °C

Functions can be selected for programming

PROG , ▲ / ▼ ... , PROG

9.6 Wizards for special measuring operations

Special measuring operations, i.e. thermal coefficient or wet bulb globe temperature, require a series of sensors in a particular arrangement and function channels programmed for calculating the required variables. To ensure that these two special measuring operations can be performed quickly and easily there is a special wizard menu for each.

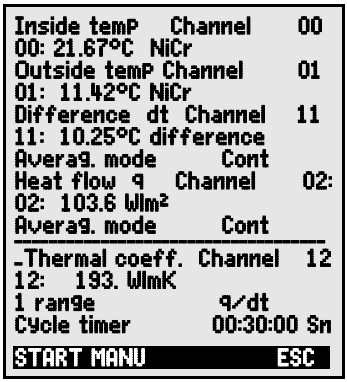
9.6.1 Thermal coefficient

$\bar{q}/(\overline{T1-T0})$ To determine the thermal coefficient the two temperature sensors are connected as required (see Manual 3.2) to channels M0 and M1 and the heat flow plate to M2. The temperature difference T(M1)-T(M0) requires a function channel ´Diff´ on M11.

For this measuring operation the following programming steps are needed :

Averaging mode on M11	**CONT** or **CYCL**
Averaging mode on M2	**CONT** or **CYCL**
Range on M11	**Diff**
Range on M12	**q/dt**
Enter the cycle by means of	**Cycle timer**
Start measuring by pressing	**<START>**
Stop measuring by pressing	**<STOP>**

Thermal coefficient wizard



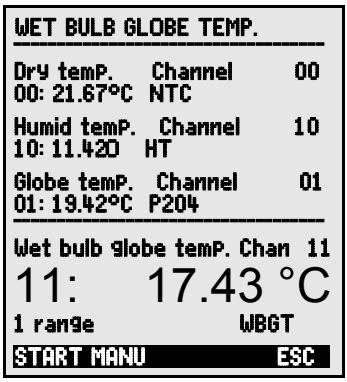
9.6.2 Wet bulb globe temperature

The stress caused in heat-exposed workplaces can be evaluated in terms of their wet bulb globe temperature calculated according to the following formula :

WBGT = 0.1 DT + 0.7 HT + 0.2 GT (see Manual 3.1.4)

To measure the dry temperature (DT) and the natural humid temperature (HT) a psychrometer (FN A848-WB) with turn-off motor is connected to socket M0. A Pt100 globe thermometer is connected to socket M1. Channel 11 is programmed for WBGT; (for this device the factor 0.2 must not be programmed).

Wizard for wet bulb globe temperature



9.7 User menus

Looking at the standard measuring menus you might conclude that the display of measured values and the combination of functions are not always ideally suited to the requirements of your particular applications. You are provided therefore not only with the standard measuring menus but also with three user menus **U1** to **U3** which you can freely configure using the AMR-Control software. You can choose the functions you require from the following list and arrange these on the display exactly as you wish; the only restriction is the available space, namely 13 rows. You can use not only the various measuring functions already described but also various timers for sequence control (see 10.1) and most of the sensor programming functions (see 10.3).

9.7.1 Function range

Functions:	Display	Keys		Command
Measured value - small	00: 234.5Ω temPerature	ZERO	ADJ	o 15
Measured value, medium 3 rows	00: 1234.5 °C	ZERO	ADJ	o 16
Measured value - large 7 rows	00: TemPerature °C 1234.5	ZERO	ADJ	o 17
Measured value, bar chart 2 rows	5.0 $220 m/s 15.00			o 34
Limit value, max. (see 10.3.5)	Limit value, max 1234.5°C	OFF	ON	o 00
Limit value, minimum	Limit value, min -0123.4°C	OFF	ON	o 01
Base value (see 10.3.6)	Base value -------°C	OFF	ON	o 02
Factor	Factor 1.12345	OFF	ON	o 03
Exponent	ExPonent 0	OFF	ON	o 48
Zero point (see 10.3.7)	Zero Point -------°C	OFF	ON	o 04
Gain	Gain -------	OFF	ON	o 05
Analog start (see 10.4.4)	Analog start 0.0°C	OFF	ON	o 06
Analog end	Analog end 100.0°C	OFF	ON	o 07
Range (see 10.3.9)	Range NiCr	CLR		o 08
Maximum value (see 9.1.2)	Max value 1122.3°C	CLR	CLRA	o 09
Minimum value	Min value 19.3°C	CLR	CLRA	o 10
Average value (see 9.4.5)	Average value -------	CLR	CLRA	o 11
Cycle (see 10.1.2)	Cycle 00:00:00Un	CLR	FORM	o 12
Date, time-of-day (see 10.1.1)	Time 12:34:56 Date 01.02.00	CLR		o 14
Averaging mode (see 9.4.2)	Averag. mode Cont	CLR		o 18
Measuring rate (see 10.1.3)	Meas. rate 10 M/s Cont	OFF	ON	o 19
Cycle timer (see 9.3.2)	Cycle timer 00:00:00Un	CLR	FORM	o 20

Mean Number (see 9.4.3)	Number 00000			o 22
Number (see 10.2.3)	Number 123-56	OFF	ON	o 23
Range, designation	NiCr Temperature M H ↗			o 24
Diameter, mm (see 9.4.9)	Diameter 0000 mm	CLR		o 25
Cross-section cm^2 (see 9.4.9)	Cross-section 0000 cm^2	CLR		o 26
Max, date and time-of-day	Max time 12:34 01.02.			o 28
Minimum, date and time-of-day	Min time 13:45 01.02.			o 29
Empty line				o 30
Line	————————————			o 31
Smoothing (see 9.4.1)	Smoothing 10	CLR		o 32
Memory available (see 9.3.3)	Memory free 502.1 KB	CMEM	PRINT	o 33
Device designation (see 10.5.1)	Company name - A Specimen	CLR		o 36
Text 1	1: Designation line	CLR		o 37
Tex t 2	2: Designation line	CLR		o 38
Tex t 3	Menu title U1	CLR		o 39
Text 4	Menu title U2	CLR		o 40
Text 5	Menu title U3	CLR		o 41
Locking (see 10.3.4)	Locking 5	CLR		o 42
Atmospheric pressure (10.5.6)	Atm Pressure 1013 mbar	CLR		o 43
Temp. compensation (see 9.2.5)	Temp comp CT 25.0°C	CLR		o 44
Setpoint (see 9.2.4)	SetPoint 1100.0 °C	OFF	ADJ	o 45
Measuring time (see 9.4.6)	Meas time 00:00:00.00	CLR		o 46
Measuring duration (see 10.1.4)	Meas duration 00:00:00	CLR		o 47
Menu end				o 99

9.7.2 Configuring the menus

From the measuring menu choose a user menu **U1**, **U2** or **U3**, that you do not need at the moment

MEASURING menus

▲ / ▼ ..., ▶

To configure this please connect the device via a data cable to your PC and start the supplied **AMR-Control software**.

Click once with the mouse on — Search the network
You then reach — Device list
Select the device and press — Program the user menus
Choose the desired functions on the left side and drag-and-drop into the menu window on the right.

For all functions concerning measured values (e.g. maximum, average value, bar chart) you must in each case enter the measured value of the measuring point first and then the associated functions.

You are advised to use a meaningful menu title — User menu title
Once completed save the menu in the device as Ux — Save menu, Ux, OK
You can also save all your menus on the PC and reload these as and when required.

9.7.3 Function printouts

You can print out the functions of all measuring menus in the order displayed by pressing <PRINT> (see 9.3.4).

The various functions are listed in the following table :

Function	Printout	Command
Measured value, all formats	01: +0023.5 °C temperature	P35
Maximum value	Maximum value 01: +0020.0 °C	P02
Maximum time	MAX TIME 01: 12:32 01.02	P28
Minimum value	MIN VALUE 01: -0010.0 °C	P03
Minimum time	MIN TIME 01: 12:32 01.02	P29
Average value	AVERAGE VALUE 01: +0017.8 °C	P14
Averaging mode	AVERAGING MODE 01: Continuous	P21
Number of averaged values	NUMBER OF AVERAGED VALUES 01 : 00178	P22
Memory capacity free	MEMORY S0512.1 F0324.4 A	P33
Number	NUMBER 01-012	P23
Range (designation)	RANGE 01: NiCr	P24
Limit value, maximum	LIMIT VALUE - MAX 01: -0100.0 °C	P08
Limit value, minimum	LIMIT VALUE - MIN 01: +0020.0 °C	P09
Base value	BASE VALUE 01: -0273.0 °C	P06
Factor	FACTOR 01: +1.0350E-1	P07
Zero-point correction	ZERO-POINT 01: -0000.7 °C	f1 P06
Gain correction	GAIN 01: +1.0013	f1 P07
Analog start	ANALOG START 01:+0000.0 °C	P16
Analog end	ANALOG END 01: +0100.0 °C	P17
Cycle	PRINT CYCLE 00:06:00	P11
Cycle timer	PRINT TIMER 00:06:00	f1 P11
Date, time-of-day	TIME-OF-DAY 12:34:00 01.02.04	P10, P13
Start time	START TIME 07:00:00	f1 P10
End time	END TIME 17:00:00	f2 P10
Start date	START DATE	f1 P13
End date	END DATE 02.02.04	f2 P13
Measuring time	MEASURING TIME 00:00:00.00	P46
Measuring duration	MEASURING DURATION 00:00:00	P47
Smoothing	SMOOTHING 01: 10	P32
Diameter	DIAMETER 01: 00100 mm	P25
Cross-section	CROSS-SECTION 01: 00078 cm2	P26
Atmospheric pressure	ATMOSPHERIC PRESSURE +01013 mbar	P43
Temperature compensation	COMPENSATION 01: 25.0°C	P44
Setpoint	SETPOINT 01: 1100.0 °C	P45
Device designation	Ahlborn, Holzkirchen	P36
Line	----------	P31
Empty line		P30
Text 1	Designation text 1	P37
Tex t 2	Designation text 2	P38
Tex t 3	Menu title U1	P39
Text 4	Menu title U2	P40
Text 5	Menu title U3	P41
Locking	Locking 5	P42

10. PROGRAMMING VIA THE PROGRAMMING MENUS

So far in looking at the measuring menus you have got to know not only the various measuring functions but also a series of functions for process control and sensor programming.

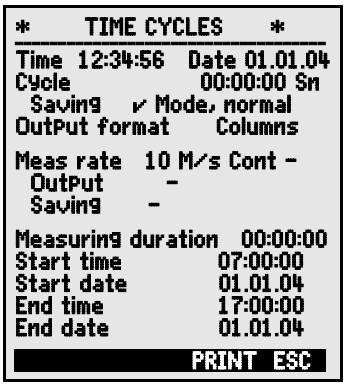
A comprehensive and systematic list of all programming functions is provided here in our description of the **PROGRAMMING menus**.

The selection menu can be accessed from the measuring menu selection by pressing **<MENU1>**.

For certain programming functions there are also **WIZARD menus** available.

10.1 Times and cycles

All time functions used for measuring, process control, and logging purposes can be collated and programmed in the programming menu **Times - cycles** .



10.1.1 Date and time-of-day

The ALMEMO 5690-2 incorporates an integrated real-time clock with date and time-of-day for logging measuring times. This is fitted with a lithium battery ensuring that date and time-of-day are retained intact even when the device battery has to be replaced. The first line contains the date on the right and the time-of-day on the left; by selecting this function (see 8.4) these can be programmed in the format indicated (see 8.5).

Function, date and time-of-day **Time 12:34:56 Date 01.05.00**

Format of time-of-day and date hh:mm:ss dd.mm.yy

10.1.2 Cycle with memory activation and output format

To have measured values saved cyclically and output via the interface **Cycle must be used** ; (this corresponds to the print cycle with other ALMEMO ® devices; the measuring cycle is no longer implemented). Saving per cycle, i.e. cyclic recording of data to the memory, is automatically activated after each

reinitialization but can be deactivated as and when required.

The **output format** (see Manual 6.6.1) defines the print layout for measuring point scans. This output format can be programmed in the function **Output format** . There is the default format ´List´ in which all measured values are listed one below the other; there is also the ´Columns´ format listing them next to one another; this provides a clear, easy-to-understand, and space-saving printout. For this latter format the printer is switched over automatically to compressed character mode. There is also the ´Table´ format which is suitable for further processing using a spreadsheet program; (see print layouts, Manual 6.1). For memory output with the CPU system only Table format is available.

Function, cycle (format hh:mm:ss)**:** Cycle 00:15:00

To clear the cycle and end the current scan press <CLR>.

Function, memory activation in the cycle Saving - Mode, normal

Saving to memory ON (default setting) <ON> ✔

Saving to memory OFF <OFF> -

Function Scanning mode e.g. Sleep (see 10.2.5) Mode, sleeP

Output format ´ ´ List of measured values one below the other Output format List

Output format ´n´ Columns of meas. values next to one another Output format Columns

Output format ´t´ Table of meas. values, semi-colon separated Output format Table

After the cycle, memory activation ON is indicated by ´S´ and OFF by ´U´. The format is indicated by abbreviation ´n´ or ´t.´: Cycle 00:15:00 Sn

10.1.3 Measuring rate , Continuous measuring point scan

As and when necessary the measuring rate (conversion rate) for measuring point scans can be changed, via the **Measuring rate** function, from its standard setting of 10 mops to 2.5 / 50 / 100 mops (see Manual 6.5).

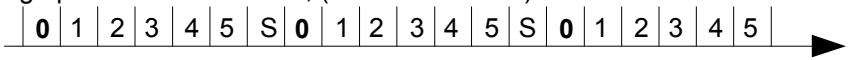
There is also an option (SA0000-Q4) for setting the measuring rate to 400 mops but this is only possible for passive selector switch boards and only for 1 measuring point at a time.

Semi-continuous measuring point scan

The option of scanning only the selected measuring point (non-continuous) is no longer provided because ignoring all the other sensors may easily lead to errors. However, it may be useful, especially when numerous sensors are being used, to assign preferred priority to the selected measuring point and update its measured value more frequently, e.g. for the purposes of analog output or measured value smoothing. The default setting is therefore now no longer the ´**non-continuous**´ but the ´**semi-continuous**´ **measuring point scan**, i.e. all measuring points are continuously scanned but the selected measuring point M is scanned in each 2nd measuring operation. This reduces the total sampling rate otherwise required with continuous measuring point scanning by half. This mode is not available for active selector switches with measuring circuit.

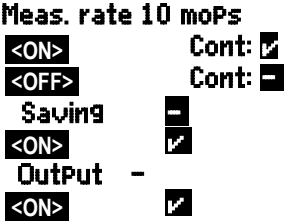
0	M	1	M	2	M	3	M	4	M	5	M	**0**	M	1	M	2	M	3	M

Continuous measuring point scan
In the default setting **continuous measuring point scanning** all active measuring channels are scanned uninterruptedly one after the other and equally often at the chosen measuring rate; at the end of this process a special measuring operation S is inserted; (see Manual 6.5.1.3).



With both the following functions **continuous saving to memory** and **continuous output** of measured values can be activated at the measuring rate.

Function, measuring rate Enter, see 8.5
Continuous measuring point scan (default)
Semi-continuous measuring point scan
Continuous saving to memory, OFF
Continuous saving ON
Continuous output OFF
Continuous output ON



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

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

When acquiring measured values at a rate of 100 mops we recommend that in mains operation the ground socket on the device be connected to protective ground because measuring errors might otherwise occur.

Scan time and total sampling rate

With passive selector switches the **scan time** for a measuring point scan depends directly on the number of activated measuring points.

Scan time = (measuring points + 1 special measuring operation + cold junction compensation measurements) / measuring rate

Only with thermocouple measuring operations are 1 or 2 additional cold junction compensation measurements required per plug-in module (see 7.3).

Example 6 selector switches with 10 sensors (of which 2 with thermocouples)
Scan time at 10 mops = (60 +1 + 2x2) / 10 mops = 65 / 10 = 6.5 seconds
Scan time at 50 mops = (60 +1 + 2x2) / 50 mops = 65 / 50 = 1.3 seconds

In the case of active selector switches with measuring circuit all plug-in modules measure in parallel; only the plug-in module with the most sensors (including cold junction compensation measurements) determines the scan time. The more measuring circuit boards there are, the more measuring points are acquired in the same time. However, the total sampling rate is limited, by the processing speed and the display communications of the CPU, to 220 mops.

Example 6 selector switches with 10 sensors (of which 2 with thermocouples)
Scan time at 10 mops = (10 +1 + 2x2) / 10 mops = 15 / 10 = 1.5 seconds
Scan time at 50 mops = (10 +1 + 2x2) / 50 mops = 15 / 50 = 0.3 seconds
Total sampling rate = 65 measuring operations / 0.3 s = 216 mops
but Scan time with 10 selector switches, 50 mops = 105 measuring operations / 220 mops = 0.5 seconds

10.1.4 Start time Start date End time End date Meas. duration

A measuring series can be started and stopped automatically at specified times. For this purpose the start time and start date, and the end time and end date must be programmed. If no particular date has been programmed, the measuring operation will be performed every day within the set period. This is assuming of course that the current time-of-day has been programmed. Or, alternatively, instead of specifying the end time-of-day the measuring duration itself can be programmed; (see 9.4.6, 10.2.2).

Function, measuring duration (Format hh:mm:ss): Meas duration 00:00:00
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 dd:mm:yy): Start date 01.05.00
Function, end date (Format dd:mm:yy): End date --.--.--

These values can be cleared by selecting the function and pressing <OFF>
If the start time for a measuring operation has been programmed, the following symbol appears in the status bar
If the end time or the measuring duration for a measuring operation has been programmed, the following symbol appears in the status bar

10.2 Measured value memory

The CPU measuring circuit board is equipped as standard with a 2-MB RAM: this is sufficient for 250000 to 400000 measured values (depending on the number of channels). This RAM is buffered by means of a lithium battery, just like the real-time clock. For critical applications conducted over long periods non-volatile FeRAMs are also available as an option. How this measured value memory is organized and how data is recorded to it and output from it are described in the Manual, Section 6.9. It can be configured either as linear memory or ring memory; (see Manual 6.10.13.2). For memory output with the CPU system only table format is available. As on all other ALMEMO data loggers the internal memory supports the following functions :

Recording to ring memory, sleep mode
Selective data output according to date and time-of-day
Selective data output by number
However, only one connector configuration is possible.

Or, alternatively, a multimedia card can be used in slot (4).

10.2.1 Memory with multimedia card

Normally a conventional multimedia flash memory card can be used as external memory . This offers virtually unlimited memory capacity and the data can be evaluated elsewhere as and when required. The memory card should preferably be RS form (reduced size), half size, 32 to 512 MB; measured data is written to it in table mode and in standard FAT16 format. The MM card can be formatted and its contents can be read and deleted via any normal PC using any card reader. Measured data can be imported into MS-Excel or into Win-Control.

Functions of the MMC memory

Virtually unlimited memory capacity
With each new connector configuration a new file is created.
No recording to ring memory
Sleep mode is possible.
Data can be evaluated using any reader on site or elsewhere.
Very high-speed data transfer via the reader
Data recording and output in table format only
Via the ALMEMO device itself only the last file can be read.
No selective data output according to date and time or by number

The memory card is inserted in slot (4) on the front panel; it is recognized automatically. You can verify this in the menu **Record to memory** (see 10.2.2) in the function **External memory** by the increased memory capacity and the file name in the function **File name**. If the external memory is connected at the start of any measuring operation, it will be used. In the course of the measuring operation it must not be unplugged; this would cause temporarily buffered measured values to be lost.

Memory capacity available, external	**External memory 64.00 MB**
Memory capacity still free	**Memory capacity free 21.75 MB**
File name (maximum 8 characters)	**File name ALMEMO.001**

Before starting any measuring operation you can, in the function **File name**, enter an 8-character file name. In the absence of a user-assigned file name, the default name ALMEMO.001 or the name most recently used will be suggested automatically. So long as the connector configuration is not altered, you can save several measuring operations, either manually or cyclically, also with numerical assignment, all in the same file (see 10.2.3).

If, however, the **connector configuration** has been changed since the last measuring operation and if no new file name has been programmed, then a new file is always created and in so doing the index in the file name extension is automatically incremented by 1, e.g. ´ALMEMO.002´. Similarly, if the file name entered already exists, then a new file will be created with the same file name prefix but with a new index.

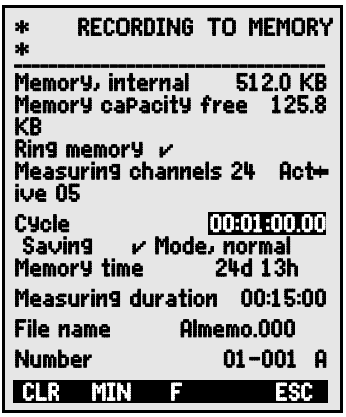
10.2.2 Measured data recording

Most of the parameters needed for the **recording of measured values** have already been examined in our description of the menu **Times - cycles** (see10.1).

1. Date and time-of-day
2. Cycle, memory activation, sleep mode
3. Measuring rate with memory activation
4. Start time and end time for a measuring operation

The preparations for recording to memory can be made most easily using the menu **Recording to memory**.

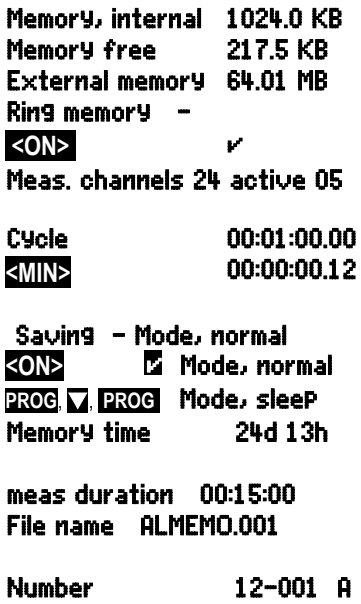
There are numerous methods available for starting and stopping a measuring operation, some also with their own wizards (see 10.2.4).



PLEASE NOTE ! The first time the device is started only one sensor configuration is saved to the internal memory; however, with effect from the next start this can be supplemented by additional sensors. However, if other sensors are connected the memory must be read out and then cleared before the next recording session.

Menu **Recording to memory**:

Memory capacity available, internal
Memory capacity still free
Memory capacity available, external
Linear memory, data is not overwritten
Ring memory, data is overwritten
Active channels for minimum cycle and available memory time
Enter cycle (see 8.5, format hh:mm:ss.cc)
Minimum cycle with 50 mops, depending on number of channels
Cycle without saving in normal mode
To select and activate saving to memory press
To activate sleep mode (see 10.2.5) press
Available memory time from the cycle and the number of channels
Measuring duration after start; automatic stop after
File name with memory connector (maximum 8 characters)
Number e.g. room 12, measuring point 1 (see 10.2.3)



10.2.3 Numbering of measuring operations

To identify measuring operations or series of measuring operations these can be individually numbered before starting. This number is output or saved when the next measuring point scan starts. In this way individual measuring operations can when read out be assigned to certain measuring locations or measuring points (see Manual 6.7).

After selecting the function **Number** the 6-digit number is entered as normal (see 8.5). You can use digits 0 to 9 and also the characters A, F, N, P, and - or _ (space). The number is activated as soon as it has been entered; it will then be followed by the letter ´A´ until the next cyclic or manual measuring operation is saved.

Function, number (e.g. room 12, measuring point 1) NUMBER: 12-001 A
To zero-set and deactivate the number press PROG , <CLEAR>
To **activate** and **deactivate** the number press <ON>, <OFF>
To **increment** and **activate** the number press < +1 >

10.2.4 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 provided in the **START - STOP** wizard.

Operation via the interface is described in the Manual, Section 6.6.

The function using a start time and end time or measuring duration is described in Section 10.1.4; limit value actions are described in Section 10.4.3; and the relay and trigger variants are described in Section 10.6.2.

10.2.5 Scanning mode

For autonomous operation and / or for scanning by computer there are 4 scanning 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 scanning
Fail-safe	Cyclic scanning by the PC; after any failure, internal cycle

Sleep mode:
For long-term monitoring involving large measuring cycles the device can also be operated in sleep mode. In energy-saving sleep mode the measuring instrument is completely switched off after each measuring point scan (please note when using sensors with own power supply) and switched on again automatic-

ally after the cycle expires ready for the next measuring point scan. In this way, depending on the number of channels, it is possible, with just one set of batteries, to perform up to 15000 measuring point scans; with a cycle lasting 10 minutes this represents a measuring duration of up to 100 days.

For **data recording in sleep mode** go to the menu **Recording to memory** and take the following steps :

1. Enter a cycle lasting at least two minutes.
2. Activate saving to memory in the cycle.
3. To select scan mode
4. To activate sleep mode press
5. In a measurements menu, start meas by pressing
   The device should then display
   The display then switches off; as verification the LED ´**SLEEP**´ (2) flashes rhythmically on and off.
6. In the specified cycle the instrument switches on automatically, performs one measuring point scan, and then switches off again.
7. To terminate sleep mode press
8. To terminate the measuring operation press

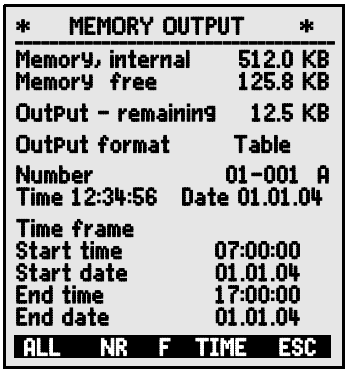
Cycle 00:05:00 S
Saving ☑ Mode: normal
Saving ✓ Mode: normal
PROG ▼ PROG Mode: :sleeP
<START>
SleeP ON
LED ´**SLEEP**´ (2) flashes
<ON>
<STOP>

Stopping based on the end time or according to limit values is not possible in sleep mode; this must be switched off.

Monitor mode :
This new ´monitor mode´ should be used when a data logger, being operated on a cyclic basis, is to be monitored occasionally by computer. Internal cyclic scanning is not influenced in any way by software scanning; (in Win-Control ´safe initialization´ must be switched off).
The internal cycle is started as and when 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 program the **Monitor** variant **Mode: monitor**

Fail-safe mode :
The fail-safe mode is suitable when scanning is purely software-based; it merely ensures, in the event of computer failure, that scanning will continue on an internal cyclic basis. In this mode the cycle programmed in the device must be longer than that needed for software scanning. Software scanning keeps resetting the internal cycle with the effect that this cycle is only actually used as and when software scanning fails; (in Win-Control “safe initialization” must be switched off).
The internal cycle is started as and when the Win-Control 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 program the **Fail-safe** variant **Mode: fail-safe**

10.2.6 Memory output



The **internal measured value memory** can be output via the serial interface in the ´Table´ output format either completely or in excerpts. Certain sections of the memory can be specified for output by stipulating the start time and end time or by selecting the number or range of numbers defining the measuring operations.

With **external MMC memory cards** (see 10.2.1) there is only one option available, namely output in table format of all the measured data contained in the file most recently used (even if over 100 measuring points). For this purpose simply press **PRINT** in the **Memory free** function in the **Memory output** menu or in certain measuring menus. The most sensible approach is to remove the memory card and copy all the files via a USB card reader directly onto the PC. These can then be imported either into MS-Excel or into Win-Control (as of V.4.9).

Menu **Memory output** :

Output format cannot be changed : **Output format Table**

To select a numbered measuring operation : **Number 12-001**

In the **Number** function select the number by pressing **<FIRST>**, **<NEXT>**..., **<LAST>**

To select a time frame :

Enter the start time in the format ´hh:mm:ss´	**Start time 07:00:00**
Enter the end time in the format ´hh:mm:ss´	**End time 17:00:00**
Enter the start date in the format ´dd:mm:yy´	**Start date 01.05.00**
Enter the end date in the format ´dd:mm:yy´	**End date 01.05.00**

To output the measured value memory in full **<ALL>**

To output a measuring operation with its number **<NR>**

To output the time frame from start to end **<TIME>**

To abort memory output press **<STOP>**

The memory content is always output in table format (see Manual 6.6.1).

During memory output, in the **Output - remaining** function, the amount still to be output is continuously updated and displayed in KB. The current values for time-of-day, date, and number are also shown.

Memory output, remaining	**Output - remaining 12.5 KB**
Current number of memory output	**Number 01.01.01**
Current date and time-of-day of memory output	**Time 12:34:56 Date 01.01.04**

Clear the memory

Select the **Memory capacity free** function (see 8.4): Memory free 384.5KB

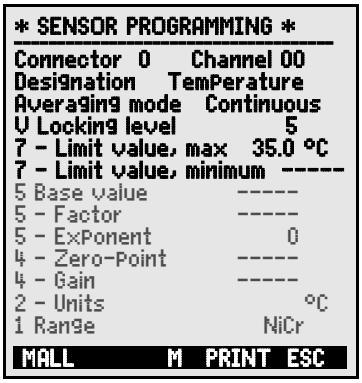
To clear the memory press <CMEM>

PLEASE NOTE If a memory card is being used, the card will be reformatted and all files will be deleted.

The full capacity will be shown as available memory. Memory free 512.0 KB

To cancel press <ESC>

10.3 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 **SENSOR PROGRAMMING** menu all parameters for a channel can be entered, viewed, checked, and modified via the keypad - providing the appropriate sensor connector is plugged in. Please note that series sensors featuring the locking mode can be protected against unintended alteration; therefore, if modification is required this locking mode must first be lowered to an appropriate level (see 10.3.4). Functions can only be selected if the locking mode allows; all other functions remain grayed out.

To output sensor programming of all active measuring points (command P15, see Manual 6.2.3) press <PRINT>

10.3.1 Selecting the input channel

To view or edit a sensor's parameters you must first of all select the menu **SENSOR PROGRAMMING** and then set the required input channel by pressing ▲ or ▼. Only sensors actually connected and channels actually activated can be processed. To activate new channels first press the key <MALL> to select **all** channels. Then press <MACT> to reduce this selection again to only those that are **active**. For each input channel the associated connector number is displayed.

Menu **SENSOR PROGRAMMING** :

Display of connector number and channel	**Connector 0 Channel:00**
To select the next input channel press	▲
To increment the input channel by tens press and hold down key	▲ .
To select the previous input channel press	▼
To decrement the input channel by tens press and hold down key	▼ .
To accept the selection of all possible channels press	<MALL>
To reduce selection to all active channels press	<MACT>

10.3.2 Measuring point designation

Each measuring point can be assigned a 10-character alphanumerical designation (all ASCII characters) denoting as clearly as possible the type of sensor, measuring location, and / or purpose. This designation is included in all standard measured value displays. In an output via the interface the measuring point designation appears in the program header as ´DESIGNATION´ and also in the measured value list (see Manual 6.6.1).

Entry in function ´Designation´ see 8.5 **Designation TemPerature**

Certain **control characters** at the beginning of the designation have **special functions** :

´*J´ defines a temperature sensor (NTC, Pt100) as reference for external cold junction compensation (see 9.2.7, Manual 6.7.3).

´#J´ means that an internal cold junction sensor is to be used with a thermocouple (e.g. connector ZA9400-FSx with NTC); (see 9.2.7, Manual 6.7.3).

´*T´ defines a temperature sensor (NTC, Pt100) as reference for temperature compensation (see 9.2.5).

´*P´ defines an atmospheric pressure sensor as reference for atmospheric pressure compensation (see 9.2.6).

´#N´ ensures that values on flow sensors are converted to standard conditions; (see 9.4.9)

The remaining 8 characters can be used for the user's own descriptions.

´!´ at the end automatically indicates a specific user-defined linearization or calibration (see 10.3.11). This cannot be overwritten.

10.3.3 Averaging mode

The various averaging methods can be defined via the **Averaging mode** function;these are described in Section 9.4.2.

Function - no averaging	**Averaging mode -----**
Averaging over all active measuring point scans	**Cont**
Averaging over all measuring point scans in a cycle	**CYCL**

10.3.4 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). Before programming you must lower the locking mode to an appropriate level. If you see a dot in the display after the locking mode, this means that this cannot be modified.

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

Function Locking mode: `Locking 5`

Clear locking by pressing `<CLEAR>`

In the `SENSOR PROGRAMMING` menu the functions are listed from top to bottom in such a way that the locked functions cannot be selected.

10.3.5 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). If any of the channels is faulty, an arrow appears in the display in front of the measured value (▲ or ▼), an alarm signal sounds (to switch this off, see 10.5.8), and alarm relay R00 (option) in socket P0 (5d) is triggered (see 10.6). Limit values can also have relays in adapters assigned to them (see 10.4.3). This alarm status remains effective until the measured value returns within the prescribed limit value by the amount set as hysteresis. Hysteresis is set by default to 10 digits but this can be adjusted to any number between 0 and 99 (see 10.5.7). The event of a limit value being exceeded can also be used to start or stop a measuring operation or for other actions (see 10.4.3).

Function

Enter limit value, maximum (see 8.5): `7 Limit value, maximum 123.4°C`

Limit value, minimum `7 Limit value, minimum -----°C`

To switch off limit value `<OFF>`

To switch on limit value `<ON>`

10.3.6 Scaling, Decimal point setting

To display the electrical signal of a sensor as a measured value in its physical size 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

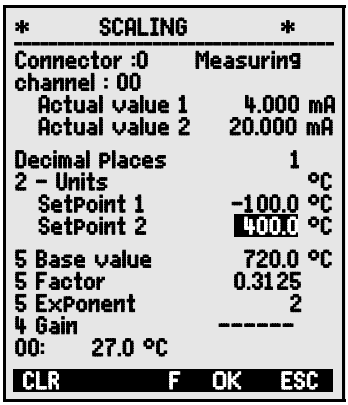
The FACTOR can be programmed within the range -2.0000 to +2.0000. For factors below 0.2 or above 2.0 the decimal point setting should be specified by entering the EXPONENT. Using EXPONENT the decimal point can be shifted as far to the left (-) or to the right (+) as the display and printer permit. An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

To calculate the scaling values automatically

5 Base value : ------
5 Factor: ------
5 ExPonential : 0

from the actual values and setpoints the **WIZ+ ARDs** include the menu **Scaling**.

Once the scaling values have been programmed and the actual measured value thus modified, the measured value status (see 8.2) is indicated by the correction arrow ↗.



10.3.7 Correction values

Sensors can be corrected by means of the correction values ZERO-POINT and GAIN; (see 9.2.4, Manual 6.3.10).

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

Function

Zero-point correction: 4 Zero-Point -----°C
Gain correction: 4 Gain -----°C
To switch on and off press <ON> or <OFF>

Once the scaling values have been programmed and the actual measured value thus modified, the measured value status (see 8.2) is indicated by the correction arrow ↗.

To reach maximum accuracy multi-point calibration of sensors is now also possible - with option KL (see 10.3.11).

10.3.8 Change the units

For each measuring channel the default units for the measuring range can be replaced with any two-character units; (see Manual 6.3.5). All upper-case and lower-case letters, special characters °, W, %, !, [,], *, -, =, ~ and space (_) can be used. The units are shown as two characters after the measured value or programming value. To **change the units** use the function: **2 Units °C**

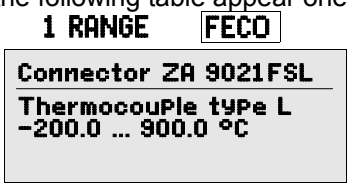
If you enter **°F** as units the temperature value will be converted automatically from degrees Celsius to degrees Fahrenheit. If you enter **!C** cold junction compensation will be disabled. If you enter the appropriate two characters the following units are generated automatically : **m/s** for **ms**, **m³/h** for **mh**, **W/m²** for **Wm**, **g/k** for **gk**.

10.3.9 Selecting the measuring range

If you want to program the connectors yourself or if you often need to change the measuring range you will have to disable the locking mode for the connectors in question by setting the locking level to 0 (see 10.3.4); please note also that for certain transducers a special connector is required (e.g. thermo, shunt, divider, etc., see the table). To activate a new measuring channel first press **<MALL>** to activate all channels, then select the required input channel (see 10.3.1), and then enter the measuring range. When the input for the new measuring range is confirmed all programming values for that input channel will be deleted.

Function, Measuring range selection	**1 RANGE NiCr**
To accept the selection of all possible meas. channels press	**<MALL>**
To deactivate a channel press	**<OFF>**
To reactivate a channel press	**PROG** , **PROG**
Programming the range is as for data input (see 8.5	**) PROG** , **▲** ... , **PROG**

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



and an appropriate help window for identifying the sensors

Sensor / transducer	Connector / cable / sensor	Measuring range	Units	Display
Pt100-1 ITS90	ZA 9000-FS	-200.0... +850.0	°C	P104
Pt100-2 ITS90	ZA 9000-FS	-200.00...+400.00	°C	P204
Pt1000-1 ITS90 (Element flag 1)	ZA 9000-FS	-200.0... +850.0	°C	P104
Pt1000-2 ITS90 (Element flag 1)	ZA 9000-FS	-200.00...+400.00	°C	P204
Pt1000-3 ITS90	ZA 9000-FS	0.000...+65.000	°C	P304
Ni100	ZA 9000-FS	-60.0... +240.0	°C	N104
NiCr-Ni (K) ITS90	**ZA 9020-FS**	**-200.0...+1370.0**	**°C**	NiCr
NiCr-Ni (K) ITS90 ++	ZA 9020-SS2	-100.00...+500.00	°C	NiC2
NiCroSil-NiSil (N) ITS90	ZA 9020-FS	-200.0...+1300.0	°C	NiSi
Fe-CuNi (L)	ZA 9021-FSL	-200.0... +900.0	°C	FeCo
Fe-CuNi (J) ITS90	ZA 9021-FSJ	-200.0...+1000.0	°C	IrCo
Cu-CuNi (U)	ZA 9000-FS	-200.0... +600.0	°C	CuCo
Cu-CuNi (T) ITS90	ZA 9021-FST	-200.0... +400.0	°C	CoCo
PtRh10-Pt (S) ITS90	ZA 9000-FS	0.0...+1760.0	°C	Pt10
PtRh13-Pt (R) ITS90	ZA 9000-FS	0.0...+1760.0	°C	Pt13
PtRh30-PtRh6 (B) ITS90	ZA 9000-FS	+400.0...+1800.0	°C	EL18
Au-FeCr	ZA 9000-FS	-270.0... +60.0	°C	AuFe
W5Re-W26Re (C) ++	ZA 9000-SSC	0.0...+2320.0	°C	WR26
NTC type N	**ZA 9000-FS**	**-30.00...+125.00**	**°C**	NTC
NTC type N ++	ZA 9040-SS3	0.000...+45.000	°C	NTC3
PTC type Kty84 ++	ZA 9040-SS4	-0.0...+200.0	°C	KTY
Millivolt 1	**ZA 9000-FS**	**-26.000...+26.000**	**mV**	mV 1
Millivolt	ZA 9000-FS	-10.000...+55.000	mV	mV
Millivolt 2	ZA 9000-FS	-260.00...+260.00	mV	mV 2
Volts	ZA 9000-FS	-2.6000...+2.6000	V	Volts
Difference - millivolt 1	ZA 9000-FS	-26.000...+26.000	mV	D 26
Difference - millivolt	ZA 9000-FS	-10.000...+55.000	mV	D 55
Difference - millivolt 2	ZA 9000-FS	-260.00...+260.00	mV	D260
Difference - volt	ZA 9000-FS	-2.6000...+2.6000	V	D2.6
Sensor voltage	any	0.00...20.00	V	Batt
Milliampere	**ZA 9601-FS**	**-32.000...+32.000**	**mA**	mA
Percent (4 to 20 mA)	ZA 9001-FS	0.00... 100.00	%	%
Ohms	ZA 9000-FS	0.00... 400.00	Ω	Ohms
Ohms ++	ZA 9003-SS3	0.000... 50.000	Ω	Ohm1
Frequency	ZA 9909-AK	0... 25000	Hz	Freq

Sensor / transducer	Connector / cable / sensor	Measuring range	Units	Display
Pulses	ZA 9909-AK	0... 65000		Pulse
Digital input	ZA 9000-EK2	0.0... 100.0	%	Input
Digital interface	ZA 9919-AKxx	-65000... +65000		DIGI
Infrared 1	FI A628-1/5	0.0... +200.0	°C	Ir 1
Infrared 4	FI A628-4	-30.0... +100.0	°C	Ir 4
Infrared 6	FI A628-6	0.0... +500.0	°C	Ir 6
Rotating vane, normal 20	**FV A915-S120**	**0.30... 20.00**	**m/s**	S120
Rotating vane, normal 40	FV A915-S140	0.40... 40.00	m/s	S140
Rotating vane, micro 20	FV A915-S220	0.50... 20.00	m/s	S220
Rotating vane, micro 40	FV A915-S240	0.60... 40.00	m/s	S240
Rotating vane, macro	FV A915-MA1	0.10... 20.00	m/s	L420
Water turbine, micro	FV A915-WM1	0.00... 5.00	m/s	L605
Dyn. pressure, 40 m/s with TC and PC	FD A612-M1	0.50... 40.00	m/s	L840
Dyn. pressure, 90 m/s with TC and PC	FD A612-M6	1.00... 90.00	m/s	L890
Flow sensor SS20 ++	ZA9602-SSS	0.50... 20.00	m/s	L920
Rel. atmospheric humidity, capacitive	**FH A646**	**0.0... 100.0**	**%H**	°o rH
Rel. atm. humidity, capacitive, with TC	FH A646-C	0.0... 100.0	%H	HcrH
Rel. atm. humidity, capacitive, with TC	FH A646-R	0.0... 100.0	%H	H rH
Humid temperature HT	FN A846	-30.00...+125.00	°C	P HT
Conductivity probe with TC	**FY A641-LF**	**0.0 ...20.000**	**mS**	LF
CO_2 sensor	FY A600-CO2	0.0 ... 2.500	%	CO2
O_2 saturation with TC and PC	FY A640-O2	0 ... 260	%	O2-S
O_2 concentration with TC	FY A640-O2	0 ... 40.0	mg/l	O2-C
Function channels (see 10.3.10)				
* Mixture ratio, with PC	FH A646	0.0 ... 500.0	g/kg	H AH
* Dew-point temperature	FH A646	-25.0... 100.0	°C	H DT
* Partial vapor pressure	FH A646	0.0...1050.0	mbar	H VP
* Enthalpy with PC	FH A646	0.0 ... 400.0	kJ/kg	H En
* Rel. humidity, psychrometric, with PC	FN A846	0.0 ... 100.0	%H	P RH
* Mixture ratio, with PC	FN A846	0.0 ... 500.0	g/kg	P AH
* Dew-point temperature, with PC	FN A846	-25.0 ... +100.0	°C	P DT
* Partial vapor pressure, with PC	FN A846	0.0 ...1050.0	mbar	P VP
* Enthalpy with PC	FN A846	0.0 ... 400.0	kJ/kg	P En
Measured value (Mb1)	any		f(Mb1)	Meas
Difference (Mb1 - Mb2)	any		f(Mb1)	Diff
Maximum value (Mb1)	any		f(Mb1)	Max
Minimum value (Mb1)	any		f(Mb1)	Min
Average value over time (Mb1)	any		f(Mb1)	M(t)
Number of values averaged (Mb1)	any			n(t)
Average value, meas. points (Mb2..Mb1)	any		f(Mb1)	M(n)
Total from measuring points (Mb2..Mb1)	any		f(Mb1)	S(n)

Sensor / transducer	Connector / cable / sensor	Measuring range	Units	Display
Total number of pulses (Mb1)	ZA 9909-AK	Man. 6.7.1 0..65000		S(t)
Number of pulses / print cycle (Mb1)	ZA 9909-AK	Man 6.7.1 0..65000		S(P)
Alarm value (Mb1)	any	(see 10.4.5) 0/100	%	Alarm
Thermal coefficient $\overline{q}/(\overline{M01-M00})$	ZA 9000-FS	(see 9.6.1)	W/m²K	q/dT
Wet bulb globe temperature (WBGT)	ZA 9000-FS	(see 9.6.2)	°C	WBGT
Cold junction temperature	any	(see 9.2.7)	°C	CJ
Volume flow m³/h $\overline{Mb1} \cdot Q$	any	(see 9.4.9)	m³/h	Flow
Timer	any	(s9.4.6) 0...65000	s	Time
Temperature, refrigerant R22 °	FDA602Lx	-90.0...+79.0	°C	R22
Temperature, refrigerant R23 °	FDA602Lx	-100.0...+26.0	°C	R23
Temperature, refrigerant R134a °	FDA602Lx	-75.0...+101.0	°C	R134
Temperature, refrigerant R404a °	FDA602Lx	-60.0...+65.0	°C	R404
Temperature, refrigerant R407c °	FDA602Lx	-50.0...+86.0	°C	R407
Temperature, refrigerant R410 °	FDA602Lx	-70.0...+70.0	°C	R410
Temperature, refrigerant R417a °	FDA602Lx	-50.0...+70.0	°C	R417
Temperature, refrigerant R507 °	FDA602Lx	-70.0...+70.0	°C	R507

TC = temperature compensation, PC = pressure compensation, Mbx = reference channels

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

++ Only via special connectors with internal characteristic (see 10.3.11, others by request)

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

10.3.10 Function channels

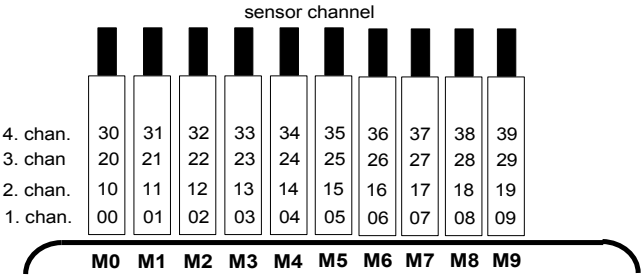
At the end of the table of measuring ranges and units (see above) under the sub-heading **function channels** there is a group of ranges that can be used to represent function parameters for measured value processing or for calculated results obtained by linking certain measured values on measuring channels (see Manual 6.3.4). Reference to the actual measuring channels is provided by one or two reference channels. For all function channels there are preferred channels on the appropriate connector; reference channel programming is not required because these values are referred to by default reference channels Mb1 and Mb2.

Function channels and reference channels must be arranged in a hundreds group.

Function	Function channel	Reference channel 1	Reference chan. 2
* Humidity variables, capacitive	on channel 3 or 4	Mb1 = temperature	Mb2 = humidity
* Humidity variables, psychrometric	on channel 3 or 4	Mb1 = Dry temp.	Mb2 = Humid temp.
Function parameter (Mb1)	on channel 2, 3, or 4	Mb1 = channel 1	
Difference (Mb1 - Mb2)	on channel 2, 3, 4 (Mb1)	Mb1 = channel 1	Mb2=M00
Average value over Mb2...Mb1	on channel 2, 3, 4 (Mb1)	Mb1 = channel 1	Mb2=M00
Total value of Mb2...Mb1	on channel 2, 3, 4 (Mb1)	Mb1 = channel 1	Mb2=M00
$\overline{q}/(\overline{M01-M00})$	on channel 2, 3, 4 (q)	Mb1 = channel 1	Mb2=M11
WBGT	on channel 2 (GT)	Mb1 = channel 1	Mb2=M00

Arrangement of channels on the connectors

Once the range has been programmed the default reference channels can be used (see above). Settings for the reference channels are described in Section 10.4.6. The best approach is to use the **function channels** wizard.



10.3.11 Special measuring ranges, linearization, multi-point calibration

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

1. Provision of special measuring ranges with internal characteristic (see 10.3.9)
2. User-defined linearization of non-linear signals for voltage, current, resistance, or frequency characteristics
3. Multi-point adjustment of all sensors
4. Serial number and calibration data management in the sensor

The 5690-2CPU system can, as a standard feature evaluate all appropriately programmed connectors on all selector switch boards. **Multi-point adjustment** of temperature sensors or pressure sensors can be performed as part of a factory or DKD calibration (KA9001DW) (DKD = Deutscher Kalibrier-Dienst = German calibration service). With option KL you can also, using the AMR-Control software, program a characteristic of up to 35 support values in the EEPROM on the ALMEMO® connector. During a measuring operation the measured values between these are interpolated on a linear basis. When correcting non-linear sensors (e.g. with Pt100 or thermocouple sensors) initially the original characteristics are considered; only then are the deviations interpolated on a linear basis and inserted.

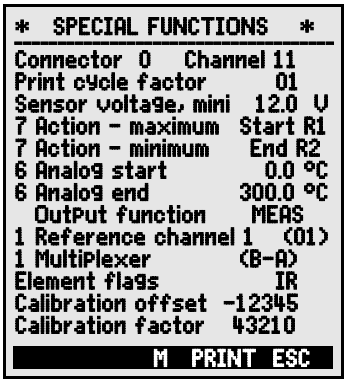
Code for special linearization / calibration Designation with '!' **TemPeratu!**

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

Other information that can be entered in the extended connector includes the order number, the serial number, the date of the next calibration, and the calibration interval. In internetworked systems this permits automatic monitoring of the calibration intervals; (see Manual 7.4.4).

10.4 Special functions

On the 5690-2 data acquisition system all ALMEMO® special functions can be accessed via a special menu; these special functions may be needed only occasionally in routine operation but may be very useful in many applications (see Manual 6.10). Some of these functions are highly complex and should only be used if you are fully aware of how they work and what effect they have.



10.4.1 Print cycle factor

To adapt data recording to the speed of change at individual measuring points a print cycle factor can be programmed to between 00 and 99; this will cause certain measuring points to be output less frequently or not at all (see Manual 6.10.6). This print 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 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. With data saving similarly it is possible to suppress measured values that are unnecessary and to thus save on memory capacity. With cyclic functions (e.g. averaging) larger superordinate cycles can thus be implemented.

Enter print cycle factor (see 8.5) in function — **Print cycle factor : 01**

Clear print cycle factor by pressing — **<CLEAR>**

10.4.2 Sensor supply voltage, minimum

As with all ALMEMO® devices the sensor supply voltage on this device is monitored. The sensor supply voltage is displayed in the **Power supply** menu (see 10.7). Some sensors, to operate properly, need their own supply voltage and this must be provided by a rechargeable battery or via a mains unit. To prevent measuring errors the minimum sensor voltage needed by each individual sensor can be entered in the **Special functions** menu. If the voltage drops below this value the measured value will be treated as a sensor breakage (display ´L´ flashes) .

To enter the minimum sensor supply voltage — **Sensor voltage, min : 12.0 V**

To disable voltage monitoring, to clear the value — **<CLEAR>**

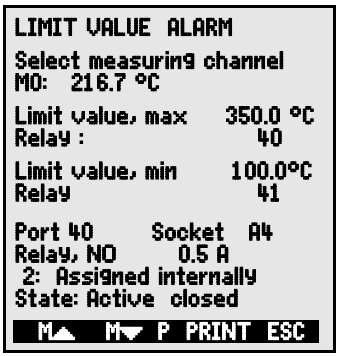
Sensor voltage, min ---- V

10.4.3 Actions in the event of a limit value being exceeded

Relay assignment

Alarms in the event of a limit value being exceeded can be reported internally by the two relays, or externally by alarm relay cables, or by the new V6 relay adapters. These relays can be configured individually - as total alarm or separately as maximum / minimum alarm - or they can have individual limit values assigned to them (see 10.6).

If disturbances need to be selectively detected and evaluated, one can simply specify the limit values in the wizard **Limit value alarm** and assign these to individual relays; (see Manual 6.10.8). It is also possible to have a number of limit values assigned to the same relay. If the relay adapter is connected the corresponding relay will automatically be set to variant 2 (Assigned internally). If not, it must be configured to this variant later.



Or alternatively in the programming menu **Special functions** there are the functions **Action - Max**, **Action - Min** .

To activate relay "xx" in the event of overshooting limit value maximum: **7 Action, max ----- xx**

To activate relay "yy" in the event of undershooting limit value minimum: **7 Action, min ----- yy**

To clear relay assignment press: **<CLEAR>**

The relay configuration can be checked in menu **Output modules**.

Set port 20 on socket A2
a normally open semiconductor relay
to variant 2 (relay assigned internally)

Port 20 Socket A2
Relay Normally open, 0.5 A
2: assigned internally

Controlling a measuring operation

The exceeding of a limit value can be used not only for reporting an alarm but also for controlling 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 measuring operation at limit value, maximum	7 Action, max Start	--
Stop measuring operation at limit value, minimum	7 Action, min StoP	--
Manual inquiry at limit value, maximum	7 Action, max Manu	--
Zero-set timer 0.1s at limit value, maximum	7 Action, max TZero	--
Execute macro 5 to 9 at max. limit value (s. Man.I 6.6.5) :	7 Action, max Macro 5	--

To clear action press: **<CLEAR>**

10.4.4 Analog output start / end

The analog output of measured values to the analog output modules (see Manual Ch 5) or to the display as bar chart or line graph must in most cases be scaled to a particular sub-range. You can do this by simply stipulating the start value and end value of the range you want displayed. This range will then be mapped to the analog range 2 V, 10 V, 20 mA or for the 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 for each 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 (see 10.4.8).

All parameters are best programmed when configuring the analog output (see 10.6.2).

10.4.5 Output function

If the current measured value 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, and digital output will then only process the appropriate function value. As verification for the output function being thus changed the measured value is displayed with the status symbol shown below (see 8.2).

Examples

1. If measured values are being averaged over the cycle the only output value of interest is the average value itself, not the last measured value. With a data logger this 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		Output function Meas
Difference	D	Output function Diff
Maximum value	H	Output function Max
Minimum value	L	Output function Min
Average value	M	Output function M(t)
Alarm value	A	Output function Alarm

10.4.6 Reference channel 1

The calculating functions of the function channels usually refer to one (or two) particular measuring channel(s) (see 10.3.10, Manual 6.3.4). When programming a function channel the reference channel Mb1 is provided automatically by the 1st channel of the associated sensor connector Mxx_1. The 2nd reference channel Mb2 (for differential value, average value M(n), etc.) is provided initially by measuring point M00. In the function **Reference channel 1** you can also set another measuring point as reference channel - either one specified measuring point or an unspecified measuring point chosen according to the distance relative to the function channel (where -01 is the channel in front of the function channel).

Programming reference channel 1, absolute	**1 Reference channel 1 01**
Programming reference channel 1, relative	**1 Reference channel 1 -10**

10.4.7 Reference channel 2 or multiplexer

With those function channels needing a 2nd reference channel (see above) **Reference channel 1** is followed automatically by the function **Reference channel 2**. In all other cases the **MultiPlexer** function can be used to change the input multiplexer and thus the pin assignment in the connector (see Manual 6.10.2).

Programming reference channel 2, absolute	**1 Reference channel 2 00**
Programming reference channel 2, relative	**1 Reference channel 2 -01**
Meas. inputs B+ and A-, with respect to ground	**1 MultiPlexer B - A**
Meas. inputs C+ and A-, with respect to ground	**1 MultiPlexer C - A**
Meas. inputs D+ and A-, with respect to ground	**1 MultiPlexer D - A**
Differential measuring inputs C+ and B-	**1 MultiPlexer C - B**
Differential measuring inputs D+ and B-	**1 MultiPlexer D - B**

10.4.8 Element flags

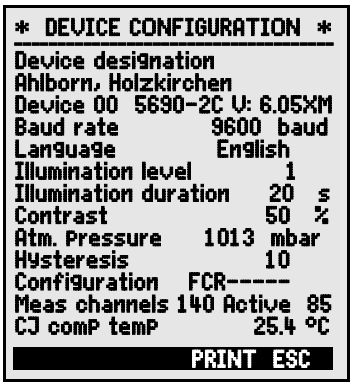
Element flags are available per measuring channel; these can be activated to implement sensor-specific extra functions (see Manual 6.10.3).

Measuring current 1/10 for Pt1000, 5000 Ω:	**Element flags I 1/10**
(Flag 2:) *	**Element flags IR**
Measuring bridge with switch for final-value simulation	**Element flags Bridge**
Digital channel, cyclic evaluation only	**Element flags Cyclic**
To deactivate electrical isolation (see 7.4)	**Element flags Iso OFF**
(Flag 6:) *	**Element flags Flag 6**
To deactivate sensor breakage detection	**Element flags Br OFF**
To switch analog output from 0-20 mA to 4-20 mA	**Element flags A 4-20**

* With the ALMEMO 5690-2C this element flag has no significance.

10.5 Device configuration

In the **DEVICE CONFIGURATION** menu certain basic settings can be made. The device designation can be used as print header in a log printout or to facilitate assignment in a network. In network operation the device address is indispensable. The baud rate can be adapted for interoperation with external devices. The display illumination can be set to any one of three levels. The atmospheric pressure setting can be adjusted to compensate certain sensors in particular at different altitudes. The default value for hysteresis for alarm relays can also be modified. The number of channels and the cold junction temperature are displayed for the purposes of device monitoring.



10.5.1 Device designation

In the **device designation FUNCTION** (see Manual 6.2.4) you can enter any text up to maximum 40 characters in length (see 8.5). This text will then appear in the main menu, in the print header for a measuring operation, and in device lists (software). Function **Device designation**:

Device designation
Ahlborn, Holzkirchen

10.5.2 Device address and networking

All ALMEMO® devices can be networked together very easily thus enabling the user to centrally acquire and record measured values from several measuring instruments - even if these are located far apart (see Manual 5.3). To communicate with networked devices it is absolutely essential that all the devices concerned should have the same baud rate setting but that each have its own dedicated address; this is because only one device should respond per command. Before starting network operation ensure therefore that all the measuring instruments involved are assigned different device addresses. The device address for this system is set by means of a **code switch** (5b) located on the rear of the device.

The **Device** function in the **DEVICE CONFIGURATION** menu displays the device address setting, then the device type and version number, and then if applicable an option code (see Manual 6.10.11).

Device address with type, version, option **Device 00 5690-2C V:6.05XM**

Example Address 00, Type 5690-2, Version 6.05, Option XM

With option XU or XM permitting up to 250 measuring channels the system occupies altogether three device addresses. The start address of the CPU must not be higher than value 7. It is important to remember this when setting the addresses for subsequent devices. The measuring point hundreds groups must each be programmed and scanned just like separate devices (except for the purposes of memory output).

10.5.3 Baud rate, Data format

On leaving the factory the baud rate for all interface modules is programmed to 9600 baud. In order to avoid unnecessary problems when networking several devices together the baud rate should not be altered; rather the computer or printer should be set to match. If this is for some reason not possible you can, in the **Baud rate** function, enter the values 1200, 2400, 4800, 9600 baud or 57.6, 115.2 kbaud (paying attention not to exceed the maximum baud rate for the interface module). The baud rate setting is saved in the EEPROM on the interface module and thus applies when used with any other ALMEMO device.

Function **Baud rate**: **Baud rate 9600 baud**

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

10.5.4 Language

The user can choose between German / English / French as the interface language in which the functions are labeled in the display; (other languages are also available as options). The soft-keys are international; these cannot be changed. If German is not set as the language outputs via the interface will appear in English.

To select the language go to the **Language** function (see 8.5): **Language German**

10.5.5 Illumination and contrast

Display illumination can be enabled in the selection menus by pressing **<* ON>** ; it can be disabled or set to any one of three levels in device configuration with the **Illumination** function; (please note : illumination level 3 more than doubles the power consumption). If display illumination is switched on but no mains adapter is connected, the backlighting will go out again automatically after a settable illumination duration starting as soon as the current key operation has been completed (pause) and will go on again as soon as any key is pressed. The **Contrast** function can be used to set the contrast of the display to any one of 10 levels.

To switch display illumination on at level 1 to 3 : **Illumination level: 2**

To switch display illumination OFF (level 0) : **Illumination level : 0**

To enter illumination duration, 20 seconds to 10 minutes : **Illumination duration : 20s**

If display illumination is switched on, the status bar will display the symbol : * Illumination ON

If display illumination is temporarily disabled, the status bar will display : * rest

To switch back ON again **without** this function press **<ESC>**

Set the contrast (10 to 100%) see 8.5: **Contrast: 50%**

10.5.6 Atmospheric pressure

The atmospheric pressure can be set to compensate certain sensors (see 9.2.6). If atmospheric pressure is measured it will appear in this function.

Enter atmospheric pressure in the function Atmospheric pressure : `Atmo-sPheric Pressure : CP. 1013 mbar`

10.5.7 Hysteresis

The hysteresis for an alarm triggered in the event of a limit value being exceeded can be set generally for all sensors from 0 to 99 digits (default 10 digits) in the **Hysteresis** function (see 10.3.5 and Manual 6.2.7).

To modify hysteresis (0 ... 99) see 8.5: `Hysteresis : 10`

10.5.8 Operating parameters

Certain operating parameters can be configured by the user as software options in the **Configuration** function (see Manual 6.10.13.2).

Mains frequency noise suppression 60 Hz instead of 50 Hz	`Configuration F-------`
Delete all meas. values at the start of a meas. operation	`Configuration -C------`
Ring memory (values are overwritten if memory full)	`Configuration --R-----`
Immediate output via the interface, oversampling	`Configuration ----A---`
Switch signal transmitter OFF	`Configuration -----S--`

The following parameters can be used to check proper device functioning :

Of 60 possible channels 25 are activated :	`Meas. channels :60 active:25`
Sensor supply voltage 11.7 V = mains operation :	`Sensor voltage :11.7 V`
Cold junction temperature : = socket temperature :	`CJ temPerature : 25.4°C`

10.6 Output modules

The CPU system 5690-2CPU provides not only the usual output sockets A1 and A2 for data cables, network cables, and output modules (see Manual Ch 5) but also 4 additional sockets A3, A4, A5, and P0 (5d), so that the many possibilities of the ALMEMO® periphery can all be used simultaneously. For this purpose socket P0 has two integrated elements as option and new V6 output modules with which each element (relay, trigger input, or analog output) can be individually configured in all function variants. To ensure that all elements are addressed, each of these sockets has been assigned 10 port addresses pp.

Socket	Connection	Port
P0	internal elements (relay, trigger, or analog output)	00 to 09
A1	V5 output cables or V6 output modules	10..19
A2	V5 output cables or V6 output modules	20..29
A3	V6 output modules (relay, trigger, analog output)	30..39
A4	V6 output modules (relay, trigger, analog output)	40..49
A5	V6 output modules (relay, trigger, analog output)	50..59
B6	V6 plug-in output module (relay, trigger, analog output)	60..69 :

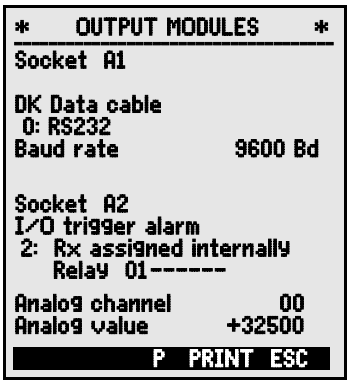
When using V5 and V6 output modules please note the following :

- All old output cables (V5) can only be used at sockets A1, A2 and using the old protocol.
- However, old output cables (V5) can be recoded to the V6 format.
- V6 output cables can be used on all sockets A1 to A5.
- Only V6 trigger cables can be used to execute command macros. (Man. 6.6.5)
- For internal elements only a clamp connector (ZA 1000-KS) is needed.

The V6 output modules can be configured comprehensively; new commands are available. see Manual 6.10.9.2.

All output modules, just like the sensors themselves, are recognized automatically and listed in the menu **OUTPUT MODULES**.

With the relay trigger analog modules certain function variants can be configured (see 10.6.2Fehler: Referenz nicht gefunden), relays can have certain limit values assigned to them (see 6.5), or analog outputs can be assigned to certain measuring channels. In this menu all ports can be selected and configured accordingly. The connection possibilities are described in the instructions for the output module concerned.



10.6.1 Data cables

Via the serial interface you can output cyclic data logs, all the function values from the measuring menus, and all the programming details for the device and for the sensors to a printer or computer. All ALMEMO® data cables (e.g. RS-232, RS-422, optic fiber, USB, Ethernet, Bluetooth, etc.) and the various connections to the devices are described in the Manual Section 5.2. Other modules for networking the devices are described in detail in the Manual, Section 5.3. All available interface modules are connected to socket A1 (5d); this is with the exception of cable ZA 1999-NK which is used for networking a further device; this must be connected to socket A2.

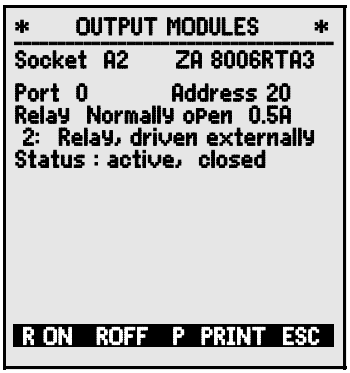
In the menu under the socket concerned the following information is displayed :

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

```
Socket : A1
DK Data cable
 0: RS232
Baud rate   9600 baud
```

10.6.2 Relay trigger adapter, analog

The combined input and output cables (ZA 1000-EAK) and the relay trigger analog adapter ZA 8000-RTA (see Manual 5.1.2 / 5.1.3) provide up to maximum four switch contacts for driving peripheral equipment and one trigger input (see Manual 6.6.4). These V5 output modules are connected to output socket A2 (5d); their functions can only be programmed collectively per type for all elements (see Manual 6.10.9).



V6 output modules are either V5 output modules with a V6 configuration (ZA 1006-EAK) or new modules with up to 10 elements (ZA 8006-RTA3) or as option two elements integrated in the measuring instrument. In the **OUTPUT MODULES** menu all elements can be accessed individually and their function variants programmed.

First **select the socket and port** by pressing : <P>: ▲ or ▼

e.g. port 0, at socket A2 (port address 20) Port 0 Address 20

This shows the element concerned.

1. Relay

Relay type = NO (normally open) Relay Normally oPen

Relay type = NC (normally closed) Relay Normally closed

Relay type = changeover: Relay Changeover

The relay switching mode can be configured to the following **variants**(see 8.5)

0: Alarm if any one channel of all channels is faulty 0: Summated alarm

2: Alarm for a programmed channel 2: Assigned internally

3: Alarm, if one limit value - maximum of all is overshot 3: Summated alarm - max

4: Alarm, if one limit value - minimum of all is undershot 4: Summated alarm - min

8: Relay driven via interface or keypad 8: Driven externally

Variant 2 ´Assigned internally´ also requires the **assignment - relay to limit values** (see 10.4.3).

For the purposes of **detecting power failure** it is an advantage if relays are driven on an inverted basis because in the absence of current an alarm status applies automatically. The function variants are therefore also provided on an inverted basis.

Inverted relay control :

e.g. variant 2 inverted : -2: Assigned internally - 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 Manual 6.10.10).

Relay variant 8	8: Driven externally
For manual activation of relays press	<R ON> or <R OFF>

2. Trigger inputs

The following trigger functions can be programmed as function variants.

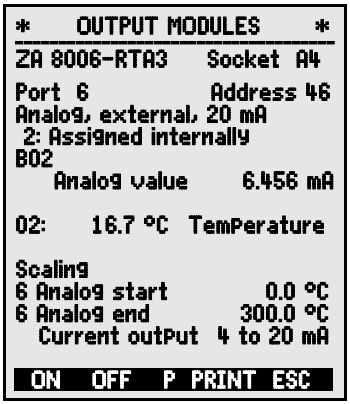
0: Start and stop a measuring operation	0: Start / stoP
1: Once-only manual measuring point scan	1: Once-only scan
2: Clear all maximum / minimum values	2: Delete max/min values
3: Print	3: Print
4: Start/stop a meas. operation on level-controlled basis	4: Start/stoP, level-controlled
8: Set measured value to zero	8: Set meas. value to zero
-5: Execute macro 5	-5: Macro 5
-6: Execute macro 6	-6: Macro 6
-7: Execute macro 7	-7: Macro 7
-8: Execute macro 8	-8: Macro 8
-9: Execute macro 9	-9: Macro 9

3. Analog outputs

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, e.g. recording cable ZA-1601-RK (see Manual 5.1.1).

The new V6 relay trigger analog adapter ZA-8006-RTA3 (see Manual 5.1.3) offers, at ports 4 to 7, the option of up to four separately configurable external analog outputs**.**

New analog modules with high-speed D/A converters can be reprogrammed from ´Analog external DAC 0-10 V´ to ´Analog external DAC 20 mA´.



Analog outputs are available with the following output signals :

Analog, internal 2 V	(PWM in device)	-1.2 ... +2.00 V	0.1 mV / digit
Analog, internal 10V	(PWM in device)	-4.0 ... +10.0 V	0.am / digit
Analog, internal 20mA	(PWM in module)	0.0 ...20.0 mA	1µA / digit
Analog, external 10V	(PWM in module)	-4.0 ... +10.0 V	0.am / digit
Analog, external 20 mA	(PWM in module)	0.0 ...20.0 mA	1 µA / digit
Analog, external DAC 10 V	(DAC in module)	-4.0 ... +10.0 V	0.5 mV / digit
Analog, external DAC 20 mA	(DAC in module)	0.0 ...20.0 mA	1 µA / digit

To select socket and port press <P>: ▲ or ▼

The following output modes can be programmed as variants :

0: Measured value for the selected measuring channel
2: Measured value for a programmed channel
8: Programmed analog output (see below)

```
0: Selected meas. chan.  M00
2: Assigned internally   B01
8: Driven externally
Analog value   12.456 mA
```

Below this appears the **analog value**

The **measured value for the selected measuring channel** Mxx is output in variant 0. This setting together with a semi-continuous measuring rate (see 10.1.3) is the most suitable because in this way the analog output will be processed most frequently.

Assigning an analog output to a measuring point

In variant 2 ´Assigned internally´, after selecting the Bxx function, you can program the measuring point to be output.

```
2: Assigned internally   B 02
```

Scaling the analog output

In this variant that part of 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(see 10.4.4).

To program the analog output start
To program the analog output end see 8.5

```
6 Analog start   0.0°C
6 Analog end     300.0°C
```

For 20 mA analog outputs only
To choose between 0 - 20 mA and 4 - 20 mA output :

```
Current output :  4-20 mA
```

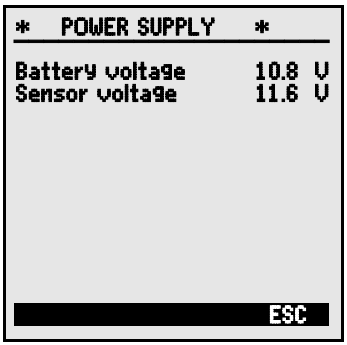
Programmed analog value output (see Manual 6.10.7)

In variant 8 ´Driven externally´ the analog output value can be programmed.

```
8: Driven externally
Analog value   5.000 mA
```

10.7 Power supply menu

The power supply for the measuring instrument is normally derived from mains adapter ZB 1212-NA6 (12V/3A). There is also the option of using module ES 5690-AP with 8 AA NiMH rechargeable batteries. The power supply menu displays the current battery voltage to help you estimate the battery's remaining operating time. At 10.4 V the battery symbol in the status bar starts to flash and at 8.8 V the device switches off automatically. The current charge status cannot be displayed more exactly than this because of the different types of load.



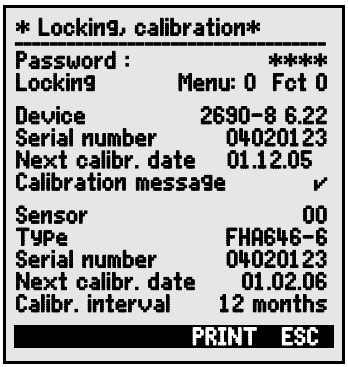
Display of the supply voltage / battery voltage
Display of the actual sensor voltage

```
Battery voltage   10.8 V
Sensor voltage    11.6 V
```

10.8 Locking and calibration menu (option KL)

In the **Locking and calibration** menu you can lock the right-of-access to certain menus and to certain functions. Here you can also see the serial numbers and calibration data for the device itself and for any sensors attached. With option KL it is possible not only to correct the sensor at several points in the connector itself (see 10.3.11) but also to manage the associated calibration data.

The right-of-access to this and certain other menus and to key functions can be stipulated in detail and protected by password. If no password is used and the locking level for the menus (**Menu**) and for the keypad functions (**Fct**) is set to 0, access to all functions will be allowed. The locking levels restricting access to the menus and to the keypad functions are independent of one another; these levels can be selecting separately as listed in the tables below. Having set a locking level this setting can be protected by password.



Device locking

No password, locking with new password: Password ----
Locked with password, enter correct password Password ****
Select locking level, menu, and function : Locking Menu: 0 Fct: 0

Menu	Locking the menus
0	None (calibration menu without option KL)
1	Calibration menu, except password
2	+ programming menus, except recording to memory and output from memory
3	+ recording to memory and output from memory
4	+ wizards
5	+ measuring menus, except user menu U1

Fct	Locking the functions	and keys
0	none	
1	Data input, switching on and off	PROG, ON, OFF, ZERO, ADJ
2	+ clearing measured data	CMEM, CLR, CLRA
3	+ start / stop / output measuring operation	START/STOP, MANU, ARRAY, PRINT
4	+ function selection, measuring point selection	PROG, F▲, M▲

Version and calibration data management

The device type (with version and serial number) and the sensors (with order number and in some cases serial number) are displayed. With option KL you can enter the date of the next calibration and the calibration interval in months. If ´calibration message´ is activated then, as soon as the next calibration is due, a message to this effect will appear when the device is switched on.

11. TROUBLE-SHOOTING

Data acquisition system ALMEMO 5690-2CPU can be configured and programmed in many versatile ways. It is suitable for connecting a wide variety of very different sensors, additional measuring instruments, alarm signaling devices, and peripheral equipment. Given these numerous possibilities the device may in certain circumstances not behave quite as expected. The cause of such unexpected behavior is only very rarely a device defect; usually the cause is incorrect operation by the user, an invalid setting, or unsuitable cabling. In such event try to pinpoint and clear the problem with the aid of the following tests.

Error No display, display malfunction, keys do not react

Remedy Check the power supply, charge the battery, switch off and then on again.
If necessary re-initialize (see 6.5).

Error Measured values are incorrect.

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

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

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

Error Data transmission via the interface does not function.

Remedy Check interface module, connections, and settings.
Are both devices set to the same baud rate and transmission mode (see 10.5.3) ?
Is the correct COM interface on the computer being addressed ?
Is a printer in the ONLINE status ?
Are the handshake lines DTR and DSR active ?

To check the data flow and the handshake lines a small interface tester with LEDs comes in very handy; (in ready-to-operate status the data lines TXD, RXD carry negative potential of approx. -9V and these LEDs light up green, whereas the handshake lines DSR, DTR, RTS, CTS carry positive voltage of approx. +9V and these LEDs light up red. For the duration of data transmission the data LEDs should flash red.

Check data transmission by means of a terminal (AMR-Control, WIN-Control, WINDOWS-Terminal).
Select output channel interface U using command ´A1´,

Address the device using its assigned device number "Gxy" (see Manual 6.2.1).
Enter <ctrl Q> for XON, if the device is in the XOFF status.
Check the programming by means of "P15" (see Manual 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 **<PRINT>** and check in the display.

Error Data transmission in the network does not function.

Remedy Check to ensure that all devices are set to different addresses.
Address all devices individually via the terminal using command "Gxy".
Addressed device is OK if at least "y CR LF" is returned as echo.
With option XU or XM 3 addresses are occupied.
If transmission is still not possible, unplug the networked devices.
Check all devices individually on the data cable to the computer; (see above).
Check the wiring for short-circuit or crossed wires.
Are all network distributors supplied with power ?
Network the devices again one at a time and check successively; (see above).

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

12. ELECTROMAGNETIC COMPATIBILITY

Data acquisition system ALMEMO 5690-2CPU complies in full with the safety requirements specified in the EU directive relating to electromagnetic compatibility (EMC) (89/336/EWG).

The following standards have been applied in evaluating the product.

IEC 61326:1997+A1:1998+A2:2000

IEC 61000-6-1:1997	IEC 61000-4-2: 1995+A1:1998+A2:2000 8kV
IEC 61000-6-3:1996	IEC 61000-4-4: 1995+A1:2000 2kV
	IEC 61000-4-3: 1995+A1:1998+A2:2000 10V/m

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

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

13. APPENDIX

13.1 Technical data (see Manual 2.3 and 2.5)

CPU measuring circuit CPU

A/D converter	Delta - sigma, 24-bit, 2.5 / 10 / 50 / 100 mops, adjustable 1 to 100
Sensor power supply	11.5 V (rechargeable battery 9 to 11.5), current 0.4 A / plug-in module, total 1 A

Measuring inputs:

Selector switch board U-A10:	10 ALMEMO® sockets, suitable for ALMEMO® connectors 10 channels, electrically isolated, 30 additional channels with sensor power supply, 0.4 A, 2 slots
Selector switch board U-MU:	10 inputs, electrically isolated, via 10x MU connector without sensor power supply, 30 additional channels, 1 slot
Selector switch board U-TH:	10 inputs, electr. isolated, via miniature thermal connector Without sensor power supply, 30 additional channels, 2 slots
Selector switch board U-KS:	10 inputs, electrically isolated, via 2 clamp connectors without sensor power supply, 30 additional channels, 1 slot
Option KSU	10 inputs, A - C, with 100:1 divider Accuracy 0.1 % (22 °C), drift 0.003 % / K
Option KSI:	10 inputs, A - B, with shunt, 2 ohms Accuracy 0.1 % (22 °C), drift 0.005 % / K
Option MK:	Dedicated measuring circuit for all selector switch boards
Outputs (see 10.6)	6 ALMEMO® sockets suitable for all output modules
Socket **A1**	Data cable, relay-trigger analog modules, V5 and V6
Socket **A2**	Network cable, relay-trigger analog modules, V5 and V6
Socket **A3**	Relay-trigger analog modules, V6 only
Socket **A4**	Relay-trigger analog modules, V6 only
Socket **A5**	Relay-trigger analog modules, V6 only
Socket **P0**	Relay-trigger analog modules, integrated (option)

Standard equipment :

Display	Graphics 128 x 128 pixels, 16 rows of 4 mm
Operation	9 keys (4 soft-keys and cursor block)
Date and time-of-day	Real-time clock, buffered with lithium battery
Memory, internal	2-MB RAM (250000 to 400000 measured values) buffered
Option SF	2-MB FeRAM, non-volatile
External memory	Multimedia card, drive, and USB card reader

Power supply :	external 10 to 13 VDC
Mains adapter	ZB 1212-NA6 230 VAC to 12 VDC, 3 A
Rechargeable battery in module AP	8 NiMH AA batteries, 9 to 11 V, 1600 mAh
Current consumption Active mode	approx. 37 mA (without input / output modules)
with lighting 1	Level 1 appr. 46 mA, Level 2 appr. 60 mA, Level 3 appr. 75 mA

Sleep mode	approx. 50 uA
Selector switch boards	Passive approx. 5 mA, Active approx. 30 mA

Housing :

19-inch desktop housing, 32 DU	WxHxD 179 x 158 x 232 mm	Polystyrene, shielded
19-inch desktop housing, 84 DU	WxHxD 444 x 158 x 232 mm	Polystyrene, shielded
19-inch sub-rack, 84 DU	WxHxD 483 x 132 x 273 mm	

Suitable conditions :

Operating temperature	-10 ... +50 °C	Storage temperature	-20 ... +60 °C
Ambient relative humidity	10 ... 90 % rH	(non-condensing)	

Order no.

13.2 Product overview

Data acquisition system ALMEMO® 5690-2CPU
Measuring circuit for 100 measuring points with passive selector switch boards,
6 output sockets, cascadable interface,
9 keys, LCD graphics display, real-time clock, 2-MB RAM,
MMC memory, USB card reader, mains adapter 12 V / 3 A

in 19-inch desktop housing, 32 DU, 6 slots	MA 56902CPUTG3
in 19-inch desktop housing, 84 DU, 19 slots	MA 56902CPUTG8
in 19-inch sub-rack, 84 DU, 19 slots	MA 56902CPUBT8

Options : (* only 1 option possible)

SF:	2-MB FeRAM non-volatile, instead of RAM, buffered	OA 5690-SF
XU:	Supports passive selector switches, up to 190 measuring points, 250 channels	OA 5690-XU
XM:	Supports active selector switches with measuring circuit, up to 250 channels	OA 5690-XM
SH2:	2 semiconductor relays, normally open, 1 Ω, 0.5 A, 50 V, internal	OA 5690-SH2*
TR2:	2 optocoupler trigger inputs, internal	OA 5690-TR2*
R22:	2 analog outputs, 10 V, internal	OA 5690-R22*
R32:	2 analog outputs, 20 mA, internal	OA 5690-R32*
KL:	Linearization, multi-point calibration, calibration data management	OA 5690-KL
R:	Measuring ranges for temperature display for 10 refrigerants	SB 0000-R2

Additions

Rechargeable battery module (8 cells, NiMH, 1600 mAh)	ES 5690-AP
Selector switch board U-A10 with 10 inputs, electrically isolated	
for ALMEMO® flat connectors, 10 to 40 channels, 2 slots	ES 5690-UA10
Selector switch board U-MU with 10 inputs, electrically isolated	
Sensor connector with 10x MU connector, 10 to 40 channels, 1 slot	ES 5690-UMU
10x MU connector for 10 sensors, 10 to 40 channels	ZA 5690-MU
Selector switch board U-TH with 10 inputs, electrically isolated	
Sensor connector with thermal connector, 10 to 40 channels, 2 slots	ES 5690-UTH
Selector switch board U-KS with 10 inputs, electrically isolated	
Sensor connector with clamp connector, 10 to 40 channels, 1 slot	ES 5690-UKS

Option KSU Inputs for 10 V with 100:1 divider	OA 5690-UKSU
Option KSI: Inputs for 20 mA with shunt	OA 5690-UKSI
Option with measuring circuit (active selector switch) for all selector switch boards	OA 5690-M

Accessories:

DC power cable, 10 to 30 VDC, 12 V / 1.25A, electrically isolated	ZB 3090-UK2
ALMEMO® data cable with USB interface, electrically isolated, maximum 115.2 kbaud	ZA 1919-DKU
ALMEMO® data cable with V24 interface, electrically isolated, maximum 115.2 kbaud	ZA 1909-DK5
ALMEMO® network cable, electrically isolated, maximum 115.2 kbaud	ZA 1999-NK5
ALMEMO® data cable with Ethernet interface, electrically isolated, maximum 115.2 kbaud	ZA 1945-DK
ALMEMO® V5 recording cable, not electrically isolated, -1.25 to 2.00 V	ZA 1601-RK
ALMEMO® V6 input / output cable for triggering and limit value alarm	ZA 1006-EAK
ALMEMO® V6 relay-trigger adapter (4 relays, 2 trigger inputs)	ZA 8006-RTA3

13.3 Keywords

13.4 Your contact