Operating Instructions

Data Logger
ALMEMO® 2690-8

V1.0
29.06.04

1. OPERATING CONTROLS

Back of unit:

(8) Battery box
3 Mignon Alkaline Batteries
or 3 Mignon NiCd/NiMH Accumulators

(9) Stand for stand and hang up
(for opening out from 90° to 180°
please press the stand together!)

(1) Meas. inputs M0 to M4
M0 ... M4 for all ALMEMO-Sensors
M10...M34 15 additional channels

(2) Output sockets A1, A2
A1 Interface V24 (ZA 1909-DK5)
Fiber optics V24 (ZA 1909-DKL)
Ethernet (ZA 1945-DK)
Centronics (ZA 1936-DK)
RS 422 (ZA 5099-NVL/NVB)
Analog output 1 (ZA 1601-RK)
A2 Network cable (ZA1999-NK5/NKL)
Trigger input (ZA 1000-ET/EK)
Relay outputs (ZA 1000-EGK)
Analog output 2 (ZA 1601-RK)

(3) Connector socket DC 12V
Mains adapter(ZA 2690-NA, 12V, 0.2A)
Charging adapter (ZA 2690-LA, 12V)
DC-Cable isolat. (ZB 2690-UK, 10-30V)

(4) Sleep-LED

(5) LCD display
Status line:

C	Cont. measuring point scan
▶, II	Measurement Start, Stop
REC	Memory record
COM	Output of meas. values
I▶, ▶I	Meas. start, end programmed
R01	Alarm relay status
✳, ✳	Light on, pause
▭	Battery operation/charge status

13 lines for functions
Function of keys F1, F2, F3, F4

(6) Control keys

ON, <POFF>	Switch device on, off
▲, ▼, ▶	Function selection
F1 ... F4	Function keys (soft keys)
PROG	Programming
▲, ▼, ▶	Data input
<ESC>	Function abort
◀	Last measuring menu

(7) Rubber shock absorber

2. TABLE OF CONTENTS

3. GENERAL

Congratulations for buying this innovative ALMEMO® data logger. By means of the patented ALMEMO® connectors the device configures itself and with the help of menus and help windows the operation should not be too difficult. However, the device allows the connection of a great variety of sensors and peripherals with many special functions. For getting to know the function range of the sensors and the diverse possibilities of the device, you really should read these operating instructions and the corresponding chapters of the ALMEMO® manual. This is the only way to avoid operating and measuring errors as well as damages of the device. For a quick answer to all questions, a detailed keyword index is provided at the end of the instructions and of the manual.

3.1 Guarantee

Every device has to pass through several quality tests before leaving the works. For a perfect function, a guarantee of two years from the delivery date is granted. Before sending back the device, please pay attention to the indications in chapter 11. Troubleshooting. Should there actually be a defect, please use the original packing material for depatch if possible and enclose an expressive description of the trouble in connection with the corresponding circumstances.

In the following cases a guarantee benefit is excluded:

- After forbidden operations and changes in the device by the client
- Operating in surrounding conditions that are not valid for this product
- Using unsuitable power supply and peripherals
- Using the device in a way it is not determined for
- Damages through electrostatic discharge or flash of lightning
- Not paying attention to the operating instructions

Changes in the product features in favour of technical progress or due to new components are reserved to the producer.

3.2 Extent of the Delivery

While unwrapping the delivery, pay attention to damages of the device and to its completeness:

Measuring device ALMEMO® 2690-8 with 3 alkaline-mignon-batteries,
Rubber shock absorber with a stand,
these operating instructions,
ALMEMO® Manual,
CD with Software AMR-Control and useful accessories

In case of a transportation damage, the packing material is to be kept and the supplier is to be informed immediately.

3.3 Handling Batteries or Accumulators

When putting in the batteries/accumulators the right pole is to be considered.

Remove the batteries from the device when they are empty or when the device is not used for a long time in order to avoid damages through running out cells. Accumulators should correspondingly be charged in time.

Batteries are not to be charged, danger of explosion!

Pay attention to batteries/accumulators not being short-circuited or thrown into the fire.

Batteries/accumulators are special refuse and must not be thrown in the dustbin!

3.4 Special Operating Instructions

- When the device is brought from cold surroundings into the work room, there can appear some kind of dew on the electronic. At thermocouple measurements and high changes in temperature, greater measuring errors are additionally possible. Therefore, please wait until the device is adapted to the ambient temperature before operating with it.
- When connecting mains adapters the mains voltage is to be considered
- Pay attention to the maximum capacity of the power supply of the sensors
- Sensors with supply are not electrically isolated from each other.
- Do not lay the sensor cables near power lines.
- Mind the diversion of statical electricity before touching the sensor cables.
- Opening out the stand **(9)** at the back of the rubber shock absorber **(7)** you can bring the device in a sloping position for a better legibility. When you press the stand together, it can also be folded up over the stop in order to hang up the device on corresponding gadgets.

4. INTRODUCTION

The data logger **ALMEMO®** 2690-8 is a new instrument from the unique product range of measuring devices that are all equipped with the ALMEMO® connector system, which has been patented by Ahlborn GmbH. The intelligent ALMEMO® connector provides important advantages with regard to the connection of sensors and peripherals as all parameters are stored in an EEPROM within the connector. As a result, the programming that usually has to be performed for the connection is not required. All sensors and output modules can be connected to all ALMEMO® measuring devices in the same way. The operation and programming is identical with all units. Therefore, all of the ALMEMO® measuring system items listed below are described, in detail, in a separate ALMEMO® manual that is supplied with every device:

Detailed description of the ALMEMO® system (manual section 1)
Overview of the device functions and measuring ranges (manual section 2)
All sensors with basic principles, operation, technical data (man. section 3)
The options for connecting existing sensors (manual section 4)
All analog and digital output modules (manual section 5.1)
The interface module RS232, fiber optics, Centronics (manual section 5.2)
The entire ALMEMO® networking system (manual section 5.3)
All functions and their control via the interface (manual section 6)
A complete interface command list with all print outputs (manual section 7)

These operating instructions only cover features and controls that are specific for a certain device. As a result, many sections will often provide a note referring to the more detailed description within the manual (man. sect. x.x.x).

4.1 Function Range of the ALMEMO 2690-8

The ALMEMO® 2690-8 data logger has 5 electrically isolated measuring inputs for all ALMEMO® sensors. Over 20 channels in the sensor connectors and 4 device internal function channels with more than 70 measuring ranges are provided with unlimited measuring possibilities. The device can be operated by means of the LCD graphic display and a softkey keypad with cursor block. User menus can be configured to adapt the display for any application. The data logger function is carried out by a real time clock and a 512kB EEPROM memory for approximately 100000 measured values. Two output sockets allow for connecting any ALMEMO® output modules, for example, the analogue output, digital interface, trigger input or alarm contacts. Several devices can be networked by simply connecting them with network cables.

4.1.1 Sensor Programming

The measuring channels are automatically programmed by the ALMEMO®

connectors. However, the user can easily complete or modify the programming via keyboard or via interface.

Measuring Ranges

There are corresponding measuring ranges for sensors with a non-linear characteristic such as 10 thermocouple types, Ntc and Pt100 sensors, infrared sensors, and flow sensors (rotating vanes, thermoanemometers, pitot tubes). Humidity sensors are available with function channels that also calculate humidity data such as dew point, mixture ratio, vapour pressure and enthalpy. Even complex chemical sensors can be used. The acquisition of measured data from other sensors is easily possible by using the voltage, current and resistance ranges with individual scaling in the connector. Existing sensors can be used without problems. Only the corresponding ALMEMO® connector has to be connected using its terminals. Furthermore, there are adapter connectors with an own microcontroller for digital signals and for measuring frequencies and pulses. This way, nearly all sensors can be connected to any ALMEMO® measuring instrument and are interchangeable without requiring any settings.

Function Channels

Maximum, minimum, average values and differences of certain measuring junctions can be programmed as function channels, also in device internal channels, and can be processed and printed like normal measuring junctions. Furthermore, function channels for special measuring tasks are provided to determine the temperature coefficient Q/ΔT and wet bulb globe temperature.

Dimension

The 2 digit dimension can be altered for each measuring channel so that the display and the printout will always indicate the correct dimension, for example when a transmitter is connected. The conversion from °C to °F is automatically performed according to the dimension.

Name of Measured Values

For identification of the sensors a 10-digit alphanumeric name is provided. It is entered via the keypad or the interface and appears on the display, the printout or the computer display.

Correction of Measured Values

For correcting measured values a zero point and slope correction can be applied to the measured value of each measuring channel. This also allows for sensors to be interchanged that usually, at first, require an adjustment (expansion, force, pH). The zero point and the slope correction are virtually performed by the push of a button.

Scaling

The base value and the factor allow for a further scaling of the corrected mea-

sured value of each measuring channel for zero point and slope. The decimal point position can be set by the exponent. By setting to zero and entering the nominal value the scaling values can be automatically calculated.

Limit Values and Alarm
Two limit values (1 max and 1 min) can be set for each meas. channel. If a limit value is exceeded alarm contacts, that can be individually allocated to limit values, are provided by means of relay output modules. As a standard, the hysteresis is set to 10 digits; however, it can also be adjusted between 0 and 99 digits. Furthermore, limit value exceeding can also be used to start or stop a data logging.

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

4.1.2 Measurement

A total of up to 20 meas. channels are available for 5 transducers, i.e. it is also possible to evaluate double sensors, individually scaled sensors, or sensors with function channels. The meas. channels can be successively selected forwards or backwards via keypad. Normally, the selected meas. point is favoured, but all active meas. channels are also scanned in the background (halfcontinously) with the conversion rate and output to the display or, if available, to the analog output. To increase the response speed at many measuring points, the conversion rate can be increased and set to continuous scan.

Measured Values
The measured values of 1 to 20 measuring points can be indicated on the display in different menus (that can also be configured) in three font sizes, as bar graph or as line chart. They are automatically acquired with auto zero and self calibration and can also be arbitrarily corrected and scaled as required. A sensor breakage condition is, with most sensors, automatically detected.

Analog Output and Scaling
By means of analog start and analog end any measuring point can be scaled so that the resulting measuring range covers the full range of the bar graph or line chart or of an analog output (2V, 10V or 20mA). The measured value of any measuring point as well as a programmed value can be output to the analog output

Measuring Functions
Special measuring functions are required for some sensors to achieve an optimal data acquisition. The cold junction compensation is available for thermocouples, a temperature compensation for dynamic pressure and pH and conductivity probes, and an atmospheric air pressure compensation for humidity sensors, dynamic pressure sensors and O2 sensors. With infrared sensors the parameters zero point and slope correction are used for background temperature and emissivity factor.

Max and Min Value
Each measurement involves an acquisition and storage of the Max value and the Min value including the time and date. The values can be displayed, printed or cleared.

Average Value
A manual averaging over a particular period, cycle or over single measurements is available for every channel.

4.1.3 Process flow control

A continuous measuring point scan with a time-based process flow control for the output of measuring valures is required to register the measuring data of all connected sensors. For this purpose, an output cycle is available and, if fast processing is required, the conversation rate is available. The measurement can be started and stopped by using the keyboard, the interface, an external trigger signal, the real time clock or an exceeding of limit values.

Time and Date
The real time clock with data function or the pure measuring time are used for an accurate recording of any measurement. Start and end time/date can be programmed in order to start or stop a measurement.

Cycle
The Cycle is programmable between 1 s and 59 h, 59 min and 59 s and provides a cyclic output of measured values to the interfaces or memories and also provides a cyclic averaging.

Print Cycle Factor
If necessary, the print cycle factor allows for limiting the data output of particular channels so that an excessice data flow can be limited, especially during data storage.

Average Value over Measuring Point Scans
The measured values resulting from scanning measuring junctions can be averaged as desired either over the total measuring time or over the cycle time. Function channels are available for a cyclic output and storage of these average values.

Conversion Rate
With the ALMEMO® 2690-8 all measuring points can be continuously scanned with the conversion rate (2.5;10 or 50 M/s). To realize a high recording speed it is possible to store all measured values in the memory and/or to perform an output via the interface.

Data Memory
During the cycle, all measured values can be manually or automatically stored in an EEPROM. The memory capacity is, as standard, 512 Kilobyte, which allows up to 100.000 measured values. The memory organisation can be configured as linear or ring memory.The output can be carried out via the display or

the interface. It is possible to specify a selection according to a time interval or number.

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

Control Outputs
Via keyboard and interface allows to individually trigger up to 4 output relays and one analog output.

Operation
All measuring and function values can be displayed in different menus on the dot matrix LCD display. 3 user menus can be individually configured from nearly 50 functions for your specific applications. Using texts, lines and blank lines allows to format the printout in an application-specific style. Nine keys (four of them are soft keys) can be used to operate the device. This also allows you to fully program the sensors, the device and the process control.

Output
All data logs, menu functions and stored measured values and programmed parameters can be provided as output to any peripheral equipment. Various interface cables can be used to provide a RS232, RS422, Centronics or Ethernet interface. The output of measuring data can be selected in list format, columns or spreadsheet format. Files in spreadsheet format can be processed by each spreadsheet software. The print header can be programmed specifically to the company or application.

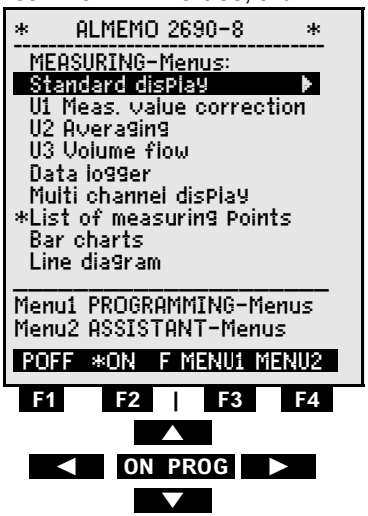
Networking
All ALMEMO® devices can be addressed and can be easily networked by simply linking them using network cables, or RS422 network distributors for longer distances.

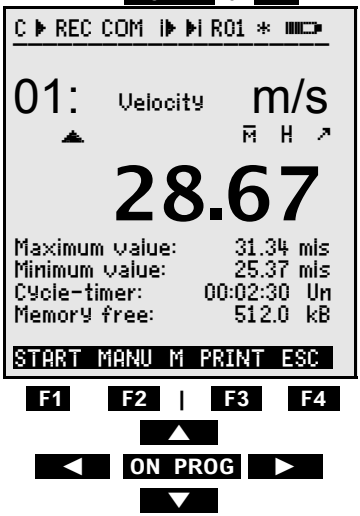
Software
The AMR-Control software, which allows for the entire programming of the sensors, the configuration of the measuring instrument, of the user menus and the read-out of the data memory is supplied with each ALMEMO®manual. The integrated terminal also allows for online measurements. The WINDOWS® software WIN-Control is available for data acquisition of networked devices, graphical presentation and complex data processing.

5. INITIAL OPERATION

Sensor connection Connect transducers to the sockets **M0** to **M4** (1), s. 7.
Power supply with batteries/accumulators or mains adapter on **DC (3)** s. 6.1, 6.3
Switch-on Press key **ON / PROG** (6), s. 6.6

Automatical display of the last measuring menu, s. 9. **keys:**
Menu selection MEAS.-Menus: call up with key: < ESC > or F4
e.g. select menu StandardDisPlay , s. 8.1 ▲ / ▼ ... (F)
Call up the menu with key: ▶
Select meas. point (s. 9.1.1) with keys: ▲ / ▼ ... (M)
Select function Max/MinVal (s. 8.4) with: PROG , ▼ ...
Clear max/min values, s. 9.1.2 < CLR > or F1





Output of measuring data or memory via interface:
- Connect peripheral device, via data cable, to socket **A1** (2), s. man. 5.2
- Set 9600bd, 8 data bits, 1 stop bit, no parity at peripheral device

Single output/storage, s. 9.3.1 < MANU > or F2
Cyclic measurement: Select Cycle-Timer : PROG , ▼ ...
Enter cycle (hh:mm:ss) s. 8.5 Cycle-Timer: 00:05:00Sn
Output format list ´ ´, columns ´n´, table ´t´ < FORM> or F3 ...
Stop programming < ESC> or F4
Start/stop the cyclic measurement, s. 9.3.2 <START> , <STOP> or F1

Output of memory data to printer or computer:
Select the function Memory Free with: PROG , ▼ ...
Memory data output, s. 10.2.5 < PRINT> or F3
Clear memory, s. 10.2.5 < CMEM >

6. POWER SUPPLY

The following options are available for the power supply of the instrument:

3 alkaline-mignon batteries (type AA) in the extent of the delivery	
Mains adapter 12V, 0.2A with ALMEMO® connector	ZB 2690-NA
3 NiMH-accumulators (type AA) with charging adapter 12V,1A	ZB 2690-AS
Electr. isol. power supply cable (10..30V DC, 0.25A)	ZB 2690-UK

Our product line includes corresponding accessories.

6.1 Battery operation and Supply Voltage Control

3 mignon batteries are used as the standard power supply of the device. At a current consumption of approx. 30 mA, they last for an operating time of about 100 hours. If the illumination is constantly switched on, this operating period is reduced to approx. 20 to 50 hours (depending on the lightness). To extend the operating time for long term recording it is possible to operate the device in sleep mode (s. 10.2.4). The current operating voltage can be called up in menu Power supply (s. 10.7) in order to assess the remaining operating time. When a remaining battery capacity of approx. 10% is reached, the symbol will be indicated in the status line of the display. If the battery is completely discharged, the device will switch off. However, measuring data and time will be maintained (s. 6.7). To change the batteries, the sensors must be taken off, the rubber protection (7) be removed and the battery cover (8) at the back of the device has to be unscrewed and stripped off in the direction of the arrow.

6.2 Accumulator operation

The batteries can also be replaced by 3 NiMH accumulators. In the accessory, there is a corresponding accumulator set with charging adapter (ZA 2690-AS). As the capacity of the accumulator is only about the half of the alkaline-manganese batteries, the operating times get half as long as well. The charging adapter is to be connected between mains adapter and measuring device. It discerns the maximum current of the mains adapter and correspondingly adjusts the charging time. Maximum current, charging current and charging time can be controlled in the menu Power supply (s. 10.7). If the accumulators are completely charged, the charging adapter switches to trickle charge. Therefore, it can stay continuously connected to the measuring device without overcharging the accumulators.

6.3 Mains Operation

For external supply of the device the mains adapter ZA 2690-NA (12V/0.2A) must be connected to the socket DC (3). Pay attention to the mains voltage! Operating with accumulator, the stronger mains adapter ZA 2690-NA2 (12V/0.8A) allows an especially fast charging of the accumulators in 1 hour.

6.4 External DC Voltage Supply

It is also possible to connect another DC voltage, 6..12V (min. 200mA), to the socket **DC** (3).The connection is performed by using an ALMEMO® connector. However, the electrically isolated supply cable ZB 2690-UK must be used if an electrical isolation between power supply and transducers is required or if a larger input voltage range 10...30V is required. It allows to operate the measuring instrument with 12V or 24V DC on-board supply systems.

6.5 Sensor Supply

A configurative sensor supply voltage is provided at the clips – and + in the ALMEMO® connector (self-repairing fuse 500 mA). Instead of the 9V (150mA) as a standard, it is possible to program 6V (200mA) for power saving or 12V (100mA) if necessary, in the menu Power Supply (s. 10.7), according to the demand of the sensors. Other voltages (12V, 15V, 24V or references for potentiometer and strain ganges) are also available with special connectors (s. man. 4.2.5/6).

6.6 Switch On/Off, Reinitialisation

To **switch on** the device press the key **ON PROG** **(6)** in the middle of the cursor block. There always appears the last called up meas. menu first in the display.
To **switch off** the device leave a working menu with **<ESC>** and press the softkey **<P-OFF>** in the menu selection. After switch-off the real time clock continues its operation and all stored data remains available (s. 6.7).

If the device shows an irregular behaviour due to interference influences (e.g. electrostatic charging or battery failure), the device can be reinitialised. The **reset** can be achieved if the key **F1** is pressed during switch-on. If the complete device programming with times, terms of device, user menus etc. is to be set to the delivery defaults, the key **F4** must be pressed during switch-on. Only the sensor programming within the ALMEMO® connectors will not be attached by this reset.

6.7 Data buffering

The sensor programming is stored in the EEPROM of the sensor connector, the calibration and the programmed parameter of the device is fail-safe stored in the EEPROM of the device. Time and date are buffered by a lithium battery so that storage of the data is also guaranteed without batteries and when the device is switched off.

7. CONNECTION OF THE TRANSDUCERS

Any ALMEMO® sensors can be connected to the ALMEMO® input sockets M0 to M4 of the measuring instrument (1). For connecting existing sensors it is only necessary to connect a corresponding ALMEMO® connector.

7.1 Transducers

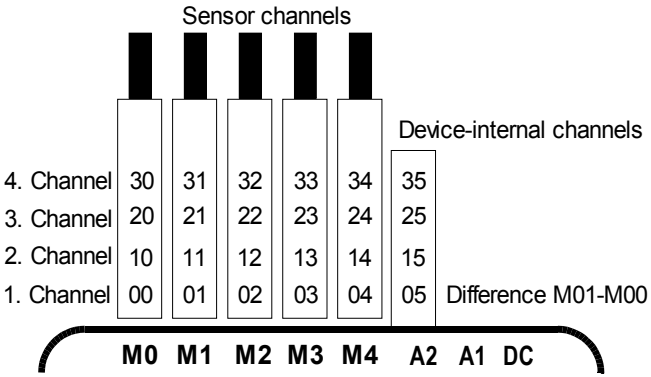
A detailed description of the comprehensive ALMEMO® sensor range (see manual section 3) and the connection of existing sensors (see manual section 4) to the ALMEMO® instruments are provided in the ALMEMO® manual. All standard sensors with ALMEMO® connector usually have the measuring range and dimension already programmed and can be immediately connected to any input socket. A mechanical coding ensures that sensor and output modules can only be connected to the correct sockets. Furthermore, each ALMEMO® connector has two locking levers that snap in when the insertion into the socket is established and that prevent a disconnection caused by pulling the cable. Both levers must be pressed on the sides for disconnecting the connector.
Especially for the device ALMEMO® 2690-8, new sensors with ready-made ALMEMO® connectors are available. They offer a splash-proof enclosure for the sockets due to their double sealing lips. For unused sockets there are dummy connectors.

7.2 Measuring inputs and Additional Channels

The measuring instrument ALMEMO 2690-8 has 5 input sockets (1) that the measuring channels M0 to M4 are initially allocated to. However, ALMEMO® sensors can, if required, provide up to 4 channels so that 20 channels are available with 5 input sockets. The additional channels can be especially used with humidity sensors with 4 measuring variables (temperature/humidity/dew point/mixture ratio) or used for function channels. If required, the sensor can also be programmed with several ranges or scaling or, depending on the pin assignment, 2 or 3 sensors can be combined in one connector (e.g. rH/Ntc, mV/V, mA/V etc.). The additional measuring channels of a connector are increased in steps of 10 (e.g. the first sensor has the channels M0, M10, M20, M30, the second sensor has the channels M1, M11, M21, M31 etc.).

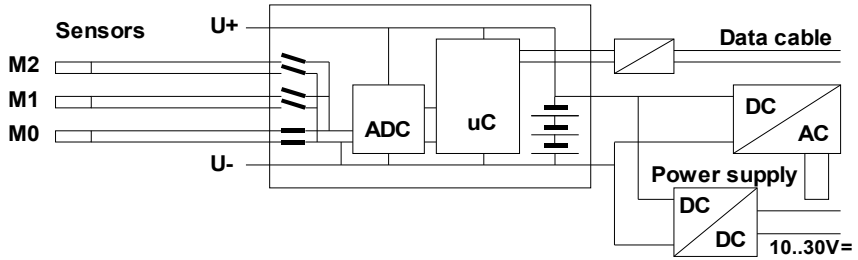
Device-internal channels:
An innovation on this device is its four extra additional channels. The first of these M5 is programmed by default as differential channel M1 – M0. This only happens, however, if there are two sensors with the same units and same decimal point position connected at measuring points M0 and M1. However, all four channels can be programmed with any other function channels (e.g. U-Bat, CJ, average, volume flow, etc.); (s. 10.3.10, man. 6.3.4). Mb1 = M1 and Mb2 = M0 are always used as reference channels by default.

Advantage of the device-internal channels: If several sensors are being used for the same application, they do not have to be reprogrammed and can be freely exchanged without losing their function channels. If, however, the whole application operates with just one sensor, then programming in the sensor itself makes more sense.
On the measuring instrument this gives the following channel assignment:



7.3 Isolation

When building up a working measuring arrangement, it is very important that there cannot flow any compensation currents between sensors, power supply and peripherals. This is the case when all measuring points are on the same potential or when unequal potentials are electrically isolated.

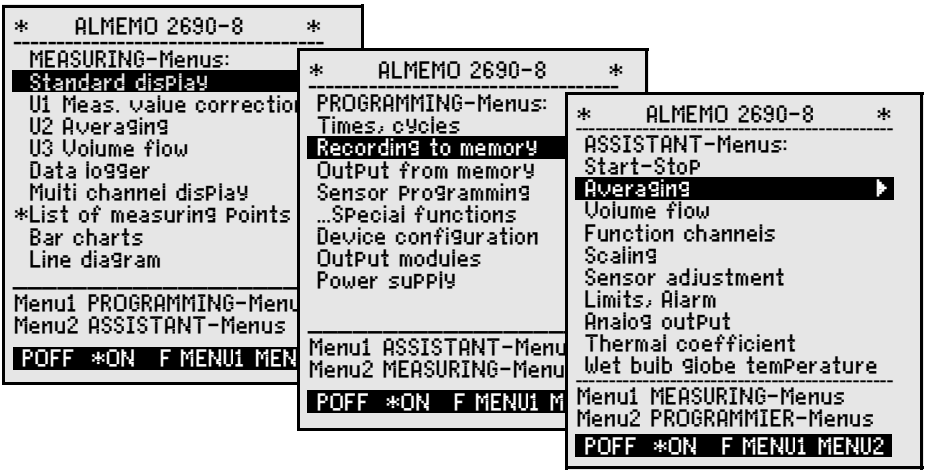


The 5 analog inputs are electrically isolated by photovoltaic relais and between them a potential difference of at most 50 V DC or 60V AC is permitted. However, combined sensors within one connector and sensors with power supply are elelctrically connected; therefore they must be operated isolatedly. The voltage at the measuring inputs (between B,C,D and A or -) must not exceed 12V! The power supply is isolated by the transformer of the mains adapter or by the DC/DC-converter in the adapter cable ZA2690-UK. Data and trigger cables are equipped with optocouplers. At electrically not isolated cables of the analog output, the registration device or the sensors have to be potential free.

8. DISPLAY AND KEYPAD

8.1 Display and Menu Selection

The display (5) of the measuring instrument ALMEMO 2690-8 consists of a dot matrix LCD display with 128x128 dots, or 16 lines with 8 dots. For the acquisition of measuring data with the required functions and for the programming of the process control, the sensors and the device parameters, 3 categories of menus are available: Measuring-Menus (s. 9), Programming-Menus (s. 10) and Assistant-Menus, which can be called up over corresponding selecting menus. Of the 9 measuring menus, there are 3 ´user´ menus U1, U2, U3, which are freely definable by the user (s. 9.7).



If necessary, call up the menu selection using the key: **<ESC>**

If necessary, select the desired menu selection with key: **<MENU1>** o. **<MENU2>**

Switch on the **Display Lighting** in 3 levels (s. 10.5.5) **< ✳ ON >**

Switch off the device with key: **<P-OFF>**

Select the menus using the keys: ▲ or ▼ ...

Call up the selected menu with key: ▶ or **PROG**

Back to the last meas. menu using the key once: ◀

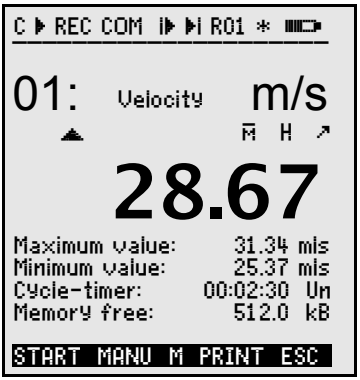
Back to the last programming menu using the key again: ◀

Back to the menu selection with key: **<ESC>**

The device designation in the header line can be as easily programmed(s. 10.5.1) as the menu titles of the user menus (s. 9.7).

8.2 Function Keys

The function of the keys **F1** to **F4** **(6)** can be different in the various menus. It is indicated by abbreviations in the bottom line of the display (soft keys). In the manual the soft key abbreviations are set in angle brackets, e.g. **<START>**.



Next to the meas. value, control symbols for the meas.value are displayed (s. below).

The following keys are available in the `Standard display` (s.r.) :

Selection of measuring points with the cursor keys **(6)**	▲ o. ▼ ...
Starting a cyclic measurement	<START> or F1
Stopping a cyclic measurement	< STOP > or F1
Single **manual output**/storage of all measured values	< MANU > or F2
Output of menu functions via the interface	< PRINT > or F3
Returning back to the menu selection	< ESC > or F4

8.3 Control Symbols

Symbols for monitoring the state of the device in the status line:

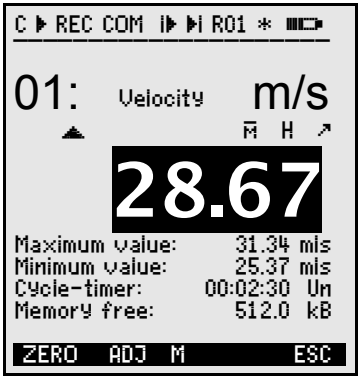
Continuous measuring point scan:	C
Measurement stopped or started:	▮▮ or ▶
Measuring point scan started including storing:	REC
Measuring point scan started incl. output via interface:	COM
Start/end time of measurement is programmed:	▮▶ or ▶▮
Relay status (external output module) off or on:	R-- or R01
Display illumination switched on or pause:	✱ or ✱
Batt./accumulator charge state:100% charged, 50% charged, discharged:	▮▮▮▮ , ▮▮▮ , ▮ flashes

Symbols for checking the measured value (see above)

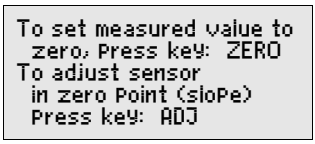
No sensor, measuring point deactivated:	´-----´
Measured value altered by sensor correction or scaling:	↗
Averaging in progress:	M
Output function altered (s. 10.4.5):	D , H , L , M , A
Exceeding of limit value Max or Min:	▲ or ▼ flashes
Exceeding of measuring range: display of max. value	O flashes
Undershooting of meas. range: display of min. value	U flashes
Sensor breakage sensor voltage Lo :display ´-.-.-´	B flashes / L flashes
Supply voltage too low for measurement:	display switched off

8.4 Function Selection

Each menu consists of a number of functions that, possibly, have to be used or programmed during operation.



Help window at function selection:



Selection of the functions.

First changeable parameter is highlighted	PROG
as inverse coloured font on a black bar:	Velocity
In the middle of the softkey line appears for control:	F
Switching to the next function:	▼ or ▲ ...
Depending on the functions, the keys F1 or F3 provide corresponding functions, e.g. MaxValue Clear	<CLR>
Meas. value Set to zero, Meas. value Adjust	<ZERO> / <ADJ>, PROG
Memory data output	<PRINT>
Memory Clear	<CMEM>

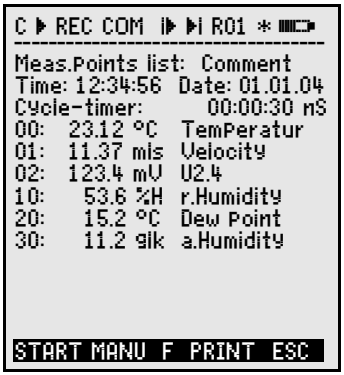
8.5 Data Entry

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

Clearing the programmed values	< CLR >
For programming, press the key	PROG
Then you are in the **input mode**	P in the middle of the softkey line
the cursor flashes below the first cursor position	Cycle-Timer: 00:00:00
Increasing the selected number with	▲ ...
Decreasing the selected number with	▼ ...
Changing the sign of numerical values	< +/- >
Selecting the next position	▶
the cursor flashes below the second digit	Cycle-Timer: 00:00:00
Switching back to the previous digit	◀
Each digit is programmed analogously to the first one	▲ / ▼ ..., ▶
Quitting the data entry	PROG
Cancelling the programming process	<ESC>

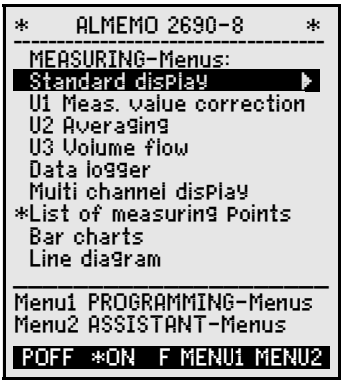
The input of letters, measuring ranges etc. can be carried out accordingly.

9. MEASURING USING MEASURING-MENUS



After the first switch-on, the device shows the menu **Meas. Points list** (s. 9.5.3). It offers a good overall view over the whole measuring system. This is also where to control, if time and date are right. If not, there is the possibility to programm them immediately (s. 8.4 and 8.5). Additionally, you can already see continuously the measured values of all connected sensors and measuring channels. It is even possible to assign extra additional functions like comment, range, max values and limits with the cursor keys ▲ or ▼. If you programm the cycle timer (s. 9.3.2) you can start the first measurement with the key **<START>** and cyclically record the measured values. If a printer or terminal is connected, all values are also put out online. After selecting the channels, it is also possible to programm measuring points. To select other measuring menus, press key **<ESC>**.

Menu selection



The data logger 2690-8 provides a series of prefabricated measuring menus for a best possible display of the measured values and corresponding function values. They are called up in the selection **MEASURING-Menus** and differ in the number of measuring points (1 to 20), in the display of measured values in different sizes of the digits (4, 8, 12 mm) or as bar or line chart and in the arrangement of functions. If this does not come up to your expectations you can arrange the 3 user menus U1 to U3 yourself from over 50 functions (s. 9.7).

Call up the menu selection with key: **<ESC>**

Select a menu with keys: ▲ or ▼ ...

Call up the selected menu with key: ▶

The most important functions for controlling the measuring operation are already available in the measuring menus and can be programmed there directly.

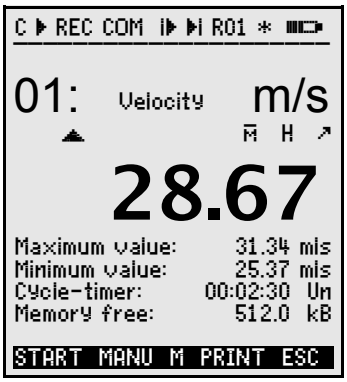
For a special programming of the sensors or the device, there are extra **PROGRAMMINIG -Menus** and for special functions **ASSISTANT-Menus** .

They are selected with the keys: **<MENU1>** or **<MENU2>** .

9.1 Measuring with one Measuring Point

Standard display

The menu Standard display shows a measuring point in the largest display with measuring point, comment and dimension. Some symbols serve for the control of the status of measured values (s. 8.3). The functions maximum and minimum value are described in 9.1.2, cycle timer in 9.3.2 and memory free in 9.3.3.



9.1.1 Selecting the Measuring Point

The key ▲ allows for successively selecting all active meas. points including the display of the current meas. value(M in the middle of the softkey line). If the key ▼ is pressed, the previous channel is again indicated. By selecting the meas. channel the input channel is, at the same time, also selected.

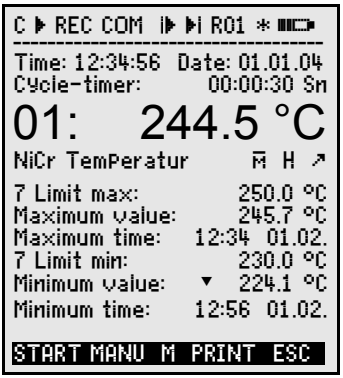
Increasing the meas. channel using the key: ▲

Decreasing the meas. channel using the key: ▼

9.1.2 Peak Value Memory with Time and Date

The highest and lowest value, including the time and date, will each time be determined and stored from the acquired measured values of each measuring point. The functions listed below are available to display these values, function channels are available put them out (s. 10.3.10).

The software AMR-Control can be used to easily load or configure the menu Monitoring with Max/Min times (illustrated on the right) as a user menu (s. 9.7).



Function Maximum Value:

Function Minimum Value:

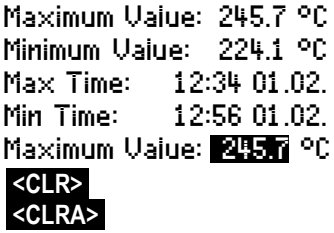
Function Time and Date of Maximum Value:

Function Time and Date of Minimum Value:

To clear, select function (s. 8.4):

Clear single value wich key:

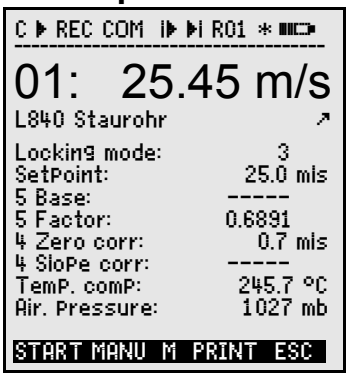
Clear Max, Min and Avg. Values of all channels:



Due to the continuous measurement the current measured value will be immediately displayed after the clearing process. Furthermore, the peak values are cleared at each start of a measurement, if the device has been correspondingly configured (standard setting, s. 10.5.8).

9.2 Correction of the Meas. Value and Compensation

To achieve a maximum accuracy of measurements it is possible to correct the zero point of the sensores in all menus by pushing a button. Additional correction functions are provided in the ´User Menu´ `U1 Meas. Correction` (selection s. 8.1). By entering a setpoint the correction value will be automatically calculated and stored in the sensor connector. A corresponding compensation is provided for sensors, which are affected by the ambient temperature or the atmospheric pressure.



9.2.1 Setting the Meas. Value to Zero

The user can zero the measured value at certain locations or at certain times in order to check the deviation from this reference value. After selecting the function Meas. Value (s. 8.4) in any menu, a help window shows you all possibilities of correction of the measured value. The keys **<ZERO>** , **PROG** can be used to store the displayed measured value as base value and, as a result, to set it to zero.

Function select **Measuring Value**: 00: 23.4 °C

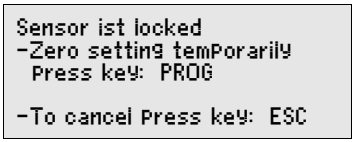
Function **Set Measuring Value to Zero:** **<ZERO>**

Carry out with key: **PROG**

Measuring Value: 00: 00.0 °C ↗

Base Value: Base: 23.4 °C

If the function is locked (s. 10.3.4), the base value is not stored in the connector, but only temporarily in the RAM until switch-off.



As long as the deviation from the base value is indicated (instead of the actual measured value) the symbol ↗ appears in the display.

The base value must be cleared in order to re-obtain the actual measured value (s. 10.3.6).

9.2.2 Zero Point Adjustment

Many sensors must be adjusted at least once or at regular intervals to compensate for instabilities. For this purpose, a specific **zero point adjustment** is available, in addition to the ´Set Meas. Value to Zero´ mentioned above, for not influencing the scaling. In this function the zero point error is not stored as base but as **zero point correction** (s. 10.3.7).

Select function **Measuring Value**: 00: 01.2 °C

Function **Zero Point Adjustment** using the key: <ADJ>

Carry out with key: PROG

Meas. Value: 00: 00.0 °C ↗

Zero Point: Zero Point: 01.2°C

If the function is locked more than 3 (s. 10.3.4), a help box announces that the function can only be unlocked momentarily for adjustment, for a permanent storage of the correction values in the connector.

```
Sensor ist locked
-Zero setting temporarily
 Press key: PROG

-To cancel Press key: ESC
```

Unlock momentarily for adjustment with key: <FREE>

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 temporarily (i.e. until you switch off) to the calibration offset - even if the channel is locked.

9.2.3 Sensor Adjustment in the case of chemical sensors

In the case of the following sensors, with <ADJ> (s. 9.2.2), you get automatically from the function measured value to the assistant menu `Sensor adjustment`, for a **two-point adjustment** of **zero point** and **slope**. The corresponding callibration value setpoints are already entered, but can also be changed:

Probe:	Type:	Zero Point	Slope
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 %

If required, temperature and air pressure can also be entered here for compensation.

```
SENSOR ADJUSTMENT
-------------------------------
Select measuring channel:
01:   7.23 PH  PH-Wert
TemP.ComPensation:   25.0 °C
Air Pressure         1013. mb
Zero Point:
SetPoint 1:            7.00 PH
01:   7.00 PH  PH-Wert
SloPe:
SetPoint 2:           10.00 PH
01: 10.00 PH  PH-Wert
SloPe error:          -10.8 %
START MANU M  PRINT ESC
```

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

Select function **Setpoint 1**: SetPoint 1: 07.00 pH

Zero point adjustment with key: <ADJ>

The adjustment meas. value is recorded: 00: 07.00 pH ↗

In the case of pH probes, the standard values, base value 7.00 and slope -0.1689, can be restored by pressing the key <CLEAR>.

2. Setting up a means of calibration for the slope:

Select function **Setpoint 2**: SetPoint 2: 10.00 pH

Slope adjustment with key: <ADJ>

The adjustment meas. value is recorded: 00: 10.00 pH ↗

The slope shows approximately: SloPe: -0.1689

The **slope error** shows the deviation from the nominal value and therefore the state of the probe: SloPe error: 9 %

If the sensors are locked, they can be momentarily unlocked by pressing the key <FREE>.

9.2.4 Two-point Adjustment with Setpoint Entry

In the menu U1 Meas.Correction a two-point adjustment is also possible for other sensors. Additionally to the zero point adjustment 9.2.2 , the slope can be corrected with a second measuring point using the function SetPoint . Pressing a button, the correction factor is automatically determined and stored in the sensor connector.

1. Zero point adjustment

Set sensor to the **zero state**
(ice water, unpressurized etc.),
Set the meas. value to zero by using (s. 9.2.2). <ZERO> / <ADJ> , PROG

2. Final value adjustment

Put sensor to a defined **setpoint** 00: 098.7 °C
((boiling water, known weight etc.)

At **ALMEMO force transducers,** switch on/off
the calibration resistor (s. man. 3.6.2) with: <ON> or <OFF>

Enter the **setpoint** in function ´Setpoint´: SetPoint: 100.0 °C

Calibrate the meas. value in function ´Setpoint´: <ADJ>

Afterwards, the meas. val. should indicate the set point. 00: 100.0 °C

If the sensor is locked with 4 or momentarily unlocked with the key <FREE>, the correction factor is programmed as ´factor´. If the locking level is set <= 3, the correction factor is programmed as slope correction (s. 10.3.7).

9.2.5 Temperature Compensation

Sensors with measured values that are strongly depending on the temperature of the measuring medium are, in most cases, equipped with a specific temperature sensor and the instrument will automatically perform a temperature compensation (s. 10.3.9 measuring range list ´w. PC´). However, dynamic pressure probes and pH probes are also available without a temperature sensor. If the temperature of the medium deviates from 25°C the following measuring errors must be considered:

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

The temperature compensation can either be performed automatically using the reference channel and external temperature sensors or manually by using the function `TemP ComP` e.g. in the menu `Meas.Correction` and entering the temperature:

Entering the compensation temperature in the function: `TemP ComP: 31.2°C`

9.2.6 Atmospheric Pressure Compensation

Some measuring variables depend on the environmental atmospheric pressure (s. 10.3.9 measuring range list ´w. PC´). As a result, higher deviations from the normal pressure of 1013mbar can cause corresponding measuring errors:

e.g. error per 100 mbar:		**Compensation range:**
Rel. humidity psychrometer	approx. 2%	500 to 1500 mbar
Mixture ratio, cap.	approx. 10%	vapour pressure VP to 8 bar
Dynamic pressure	approx. 5%	800 to 1250 mbar (error < 2%)
O_2 saturation	approx. 10%	500 to 1500 mbar

Therefore, the atmospheric pressure should be considered (approx. -11mb/ 100m over mean sea level, MSL) especially during use in a corresponding height above sea level. It can either be programmed (s. 10.5.6) or measured with a reference sensor (reference sensor marked with comment ´*P´ s. man. 6.7.2).

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

Entering the atm. pressure in function ´Atm. Press.´: `AtmPress: 1013. mb`

With each reset the atmospheric pressure is set to 1013mb. It can be set to the current value by the usual data entry (s. 8.5). If it is measured, the measured value will be displayed.

Please note that the last measured value will be retained when a reference sensor is being disconnected.

9.2.7 Cold Junction Compensation

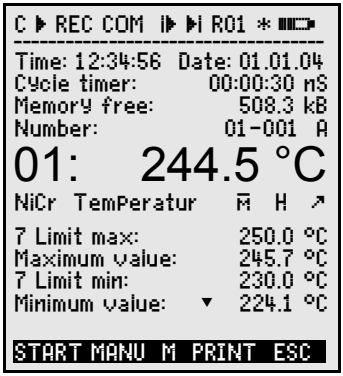
Cold junction compensation for thermocouples is normally performed automatically by means of an NTC sensor in measuring socket M2. The Cold junction temperature is displayed as an operating parameter in the device configuration (s. 10.5.8) It can be incorporated if necessary in measured data acquisition as a device temperature with function channel "CJ" (s. 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, section 6.7.3); this must be positioned upstream from the thermocouples and "*J" must have been programmed in the first two positions in the comments (s. 10.3.2).

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) there are special connectors available for cold junction compensation each with its own integrated temperature sensor (ZA-9400-FSx). These can be used for all thermocouple types; however, they require two measuring channels. Having "#J" programmed in the first two positions in the comments for the thermocouple ensures that the temperature sensor integrated in the connector is indeed used for cold junction compensation.

9.3 Measuring point scans and Output

Measuring point scans can be used to acquire the measured values of all measuring points at particular times, either manually or cyclically over a period of time, which means to store or to record on printer or computer (s. man. 6.5).

For this purpose, the menu `Data logger`, e.g., is available:



9.3.1 Single Output / Storage of all Measuring Points

Single manual measuring point scans for acquiring the momentary measured values of all active measuring points (s.man. 6.5.1.1) can be triggered by the key **<MANU>**. If the true time of day has to be indicated, it must first be set (s. 10.1.1). The output format can be set in the function `Cycle Timer` (s. 9.3.2).

Single manual measuring point scan: **<MANU>**

The following symbols will, **for a short period,** be indicated in the **status line**:

The start arrow will light up and then go off again	´▶´
Lightening up in case of data output via interface	´COM´
Indicated when measured values are being stored (s. 10.1.2)	´REC´

Each time the key is pressed again after this, the measured values are equally processed with the corresponding measuring time.

9.3.2 Cyclic Output / Storage of all Measuring Points

For cyclic outputs of measured values (s. man. 6.5.1.2) and recording, the cycle and the output format have to be programmed. The measurement can be **started** by pressing the key **<START>** and **stopped** with the key **<STOP>**. At each start of a measurement the max, min and average values of all measuring points are cleared, if the device has been correspondingly configured (standard setting, s. 10.5.8).

The function `Cycle Timer` indicates the cycle as long as a measurement has not been started. After selecting the function (s. 8.4), the cycle can be entered immediately (s. 8.5). After starting a measurement you can see the timer counting down to the next cycle.

Function `Cycle Timer`: `Cycle Timer: 00:02:00 S`

Cycle (hh:mm:ss), Memory On, Format List

The key **<FORM>** can be used as the quickest way to set the required Output Format (printouts s. man. 6.6.1).

Change format:	**<FORM>**
Format columns next to each other ´n´:	Cycle Timer: 00:02:00Sn
Change format:	**<FORM>**
Format table ´t´:	Cycle Timer: 00:02:00St

Starting a cyclic measuring point scan: **<START>**

For control purposes the following symbols will **continuously**, i.e. for the whole meas.period, be indicated in the **status line**:

The start arrow lights up	´▶´
Lightening up in case of a data output via interface	´COM´
Indicated when measured values are being stored (s. 10.1.2)	´REC´
Stopping a cyclic measuring point scan : **<STOP>**	´II´

9.3.3 Memory space, Memory Output, Clearing the Memory

The function MemoryFreei allows, during recording of measuring data, to continuously monitor the available memory space. By selecting this function, two soft keys are available for a direct output and clearing of the memory. The output format corresponds to the setting in the cycle (s. 9.3.2 and 10.1.2)

Function MemoryFree e.g.:	MemoryFree: 0378.4 kB
Memory data output (s. 10.2.5):	**<PRINT>**
Clear memory:	**<CMEM>**

9.3.4 Output of Menu Functions

Each data menu, together with all displayed functions, can be output via interface to a printer or computer (connection of peripheral devices, see manual 5.2). If you have selected the standard display, pressing the key **<PRINT>** leads to a printout of the following listing:

Print data menu: **<PRINT>**

Meas. point, meas. value, designation:

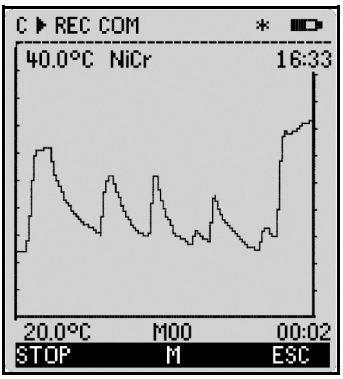
```
01:+0023.5 °C Temperature
MAXIMUM:    01:+0020.0 °C
MINIMUM:    01:-0010.0 °C
PRINTTIMER:   00:01:23
```

Total memory capacity, free mem. in kB

```
MEMORY: S0512.1 F0324.4 A
```

The listing of the individual functions is given in section 6.6.1.

9.3.5 Displaying Measured Values as a Line Diagram



When using the menu `Line diagram` the meas. value of the selected channel is indicated as a line chart with 100x200 dots as soon as a measurement is started. The curve continuously moves from the right to the left, the time resolution is determined by the **cycle**, each scan involves one point (dot). Therefore, time data for the whole t axis is given as (days) hours:minutes in the bottom right corner. In the upper right corner the time of day is indicated. In this mode, the curve is also updated during an active measurement, if the user leaves the menu (in this case, do not change the meas. point!).
Limits, if activated, are entered as dotted lines.

The functions **Analog Start** and **Analog End** of the menu `Special functions` (s. 10.4.4) can be used to set the display range of the y-axis. They can also be entered directly at the axis using the key **PROG**.

Displaying a measured value as line chart:

Enter the cycle in the menu `Times - Cycles`.	Cycle: 00:00:05
Time axis 120 x 5s = 10min:	00:10
Select meas. channels using the keys:	▲ or ▼ ...
Scaling the y-axis with key:	**PROG**
Analog end at the upper end:	40.0 %H
Change value (s. 8.5) with the keys:	**PROG**, ▲ / ▼..., ▶...
Analog start at the lower end as above.:	▼ 20.0 %H
Stop input:	**<ESC>**
Start measurement:	**<START>** ´▶´
Stop measurement:	**<STOP >** ´ii´

Channel switching is blocked during the measurement!
At each start and at each channel switching the line chart will be cleared!

9.4 Averaging

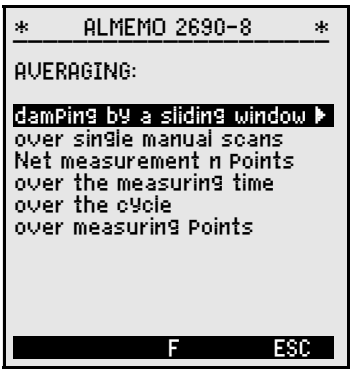
The **average value** of the measured value is required for various applications:

e.g. Smoothing of a largely varying measured value (wind, pressure etc.).
The average flow velocity in a ventilating channel.
Hourly or daily average values of weather data (temp., wind etc.).
As above, of consumption values (current, water, gas etc.).

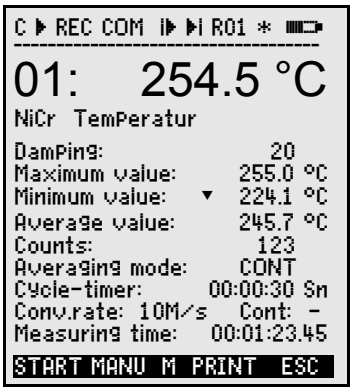
The average value $\overline{M}$ of a measured value results when a number of measured values M_i are added together and then divided by the number N of the measured values:

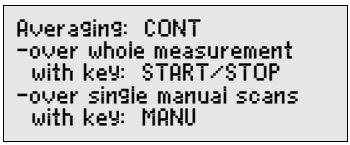
Average value $\overline{M} = (\sum_i M_i)/N$

There are several different averaging modes in the ALMEMO 2690-8:
Attenuation of measured values of the selected channel with a sliding averaging window, averaging over single measurements of place or time (also as net measurement according to the guidelines from VDE), averaging over the whole measuring time, over cycles or over several measuring points.
You can call up an own assistant menu for all modes to put in the necessary parameters and to learn the operation by help windows.



Measuring menu Average Value :
However, most of the averaging functions can also be carried out directly in a measuring menu, e.g. the ´User menu´ U2 Averaging . The operation of the different modes is explained with help windows during the programmation of the averaging mode, e.g.

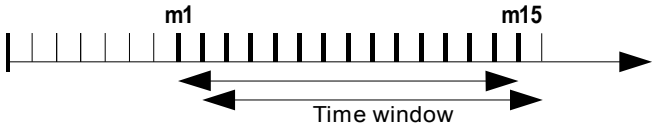




To calculate the volume flow from average velocity and cross-section of a flow conduit, there is a ´User meas. menu´ U3 Volume flow (s. 9.4.9) as well as a assistant menu Volume flow .

9.4.1 Damping of Meas. values by a Sliding averag. window

The first possibility of averaging concerns only the measured value of the indicated channel and helps to damp measured values of an unstable or strongly fluctuating nature, e.g. particular turbulent flows by means of sliding averaging over a time window. The **Level of damping** can be set via the function `DamPing` over the number of the respective taken values within the range of 0 to 99. The smoothed measured value also applies for all subsequent evaluation functions. Damping can thus also be used in conjunction with averaging over single measured values (s. 9.4.3) or at net measurements (s. 9.4.4) .



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

Meas. value damping over e.g. 15 values with: `DamPing: 15`

Continuous scanning should be switched off, because otherwise the conversion rate would be reduced too much with many measuring points: `Conv.rate: 10M/s Cont: -`

9.4.2 Averaging Mode

A detailed description of averaging over measuring point scans is given in the manual section 6.7.4. The type of averaging is determined through the function `Averaging Mode`. With the averaging mode and the corresponding operation the following modes can be set:

Function no averaging: `Averaging Mode: -----`

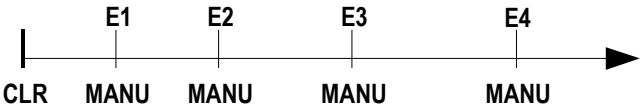
Averaging over single measurements with MANU or all measured values from START to STOP: `CONT`

Averaging over all measured values of a cycle: `CYCL`

Lightening up for control purposes if averaging is in progress: $\overline{M}$

9.4.3 Averaging over Manual Single Measurements

Single manual meas. point scans E_i are performed for an averaging of isolated measurements at certain points or times. At all measuring points where measured values must be averaged the averaging must be switched on by using the averaging mode ´CONT´, a measurement in progress must be stopped.



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

1. Stop measurement, if it is started: **<STOP>**
2. Set the averaging mode (s. 8.5):
   For smoothing a meas. value select damping:
   Switch the continuous scanning off, if required:

```
Averaging mode:  CONT
Damping:         20
Conv. rate:10M/sCont: -
```

3. Clear avg. value by selecting it (s. 8.4) and using: **<CLR>**
   Function ´Average value´ displays:
   Function ´Counts´ displays:

```
Average val:  ----- mls
Counts:       00000
```

4. Manual scans Ex of single measurements: **<MANU>**
   Function ´Average value´ displays:
   Function ´Counts´ displays:

```
Average val:  12.34 mls
Counts:       00001
```

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

9.4.4 Net Measurement

Especially when determining the average velocity in a flow conduit according to the guidelines VDI/VDE 2640, measurements are to be carried out in a net of individual points in a cross-section which is placed vertically with respect to the flow direction (s. man. 3.5.5). A special menu for net measurements is available to record all single values or to have the possibility to repeat error measurements. It can be selected in the function ´Average value´, using the key **<ARRAY>**. The menu can be used for other point measurements, too, of course.

```
Net measurement  Points:  5
01:  11.43 mls
02:  12.51 mls
03:  19.71 mls
04:  --.-- mls
05:  --.-- mls

Avarage value:   14.51mls
STOP  CLEAR  F          ESC
```

1. The Averaging mode is not important:
   For smoothing a meas. value select damping:
2. Select function average value:
3. Select menu net measuremet using the key: **<ARRAY>**
4. For data recording, press the key: **PROG**
5. Set the number of points:
   A cleared array appears:
6. Select a measuring point using the key: **▼**
7. Start the measurement with key: **<START>**
8. Stop the measurement with key: **<STOP>**
9. Record all points according to steps 6 to 8:
10. Clear the array and new measurement with key: **<CLEAR>**
11. Back to the measuring menu: **<ESC>**

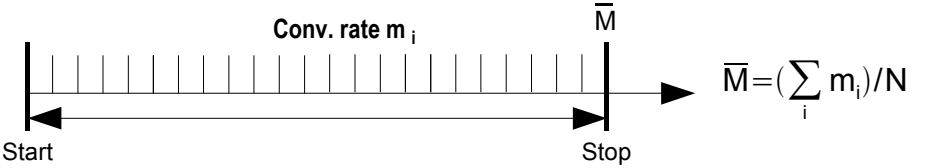
```
AveragingMode:   ----
Damping:         20
AverageValue:    -----
```

```
Net measurement  Points: 5
01:  --.-- mls
```

```
01:  --.-- mls
01:  11.22 mls
01:  11.43 mls
```

9.4.5 Averaging over the Measuring Time

To determine the average value of all meas. values, that were acqired over the conversion rate, over a defined period, the averaging mode ´CONT´ must be set for the required measuring channel. Averaging can be carried out with or without cycle. A measuring point scan will be performed in any case on start and stop allowing to record the start and end values including the time of day. A function channel M(t) is required for the recording of the average value $\overline{M}$ (s. 10.3.9, 10.3.10).



Set the averaging mode: Averaging Mode: CONT

Automatic clearing of average val. on start (s. 10.5.8) or, after selecting the average value, by using: Check: <CLR>

Starting the averaging using the key: <START> ▶ M

Reading the meas. time (s. 9.4.6) in function: Meas.Time: 00:01:23.40

Stopping the averaging using the key: <STOP> ii

Reading the average value in function: Average value: 13.24°C

Output of all function values of the menu by using: <PRINT>

9.4.6 Measurement Time

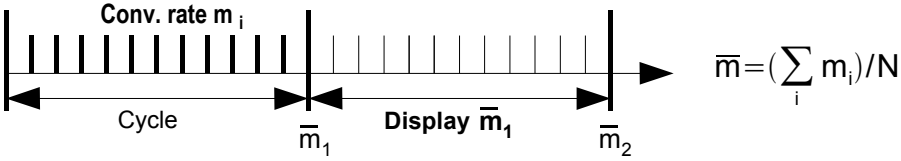
For the averaging over time (see above) and for many other measurement experiments, in many cases, the actual measurement time, from start to stop, is required. The function ´Measuring time´ has a resolution of 0.10s and is available to allow a continuous monitoring of the measurement time without clearing the real time. If the function ´Clear Meas. Values On Start of a Measurement´ is activated within the operating parameters (s. 10.5.8), the measurement time will also be automatically cleared on each start.

Function measuring time: Measuring time: 00:00:00.00

Clearing the measuring time by using: <CLR>

9.4.7 Averaging over the Cycle

The averaging mode ´CYCL´ must be used if average values have to be acquired in cyclic periods over these periods. This ensures, that the average value is cleared after each cycle, but appears in the display during the next cycle.



Setting the averaging over cycles: Averaging mode: CYCL
Programming the cycle (s. 10.1.2): Cycle: 00:15:00

		Check:
Start measurement, averaging in progress:	<START>	▶ m̄
Stop measurement:	<STOP>	ii
Reading the average value/cycle in function:		Average value: 13.24°C
Output of all function values of the menu by using:	<PRINT>	

Average value over manual periods:
It is also possible to determine the average value over periods from one manual measuring point scan to the next with the same averaging mode, but without cycle:

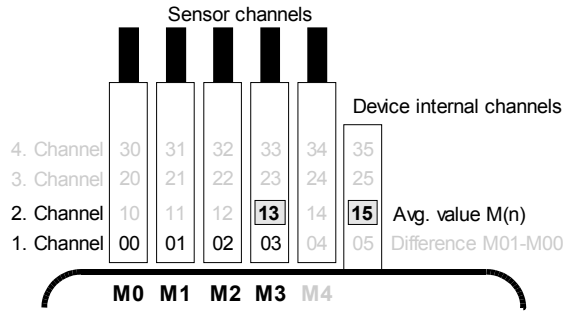
Setting the averaging over cycles: Averaging mode: CYCL
Select and clear cycle using the key: <CLR>
Cycle timer: 00:00:00

		Check:
Start measurement, averaging in progress:	<START>	▶ m̄
Manual measuring point scan:	<MANU>	▶ ...
Average value from one scan to the next scan:		Average value: 13.24°C

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

9.4.8 Averaging over several 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 meas. range `M(n)` must be available (s. 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) (s. 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 (s. 10.4.6). The function channel can be configured quickly and easily by means of the help menu for `Averaging`.



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

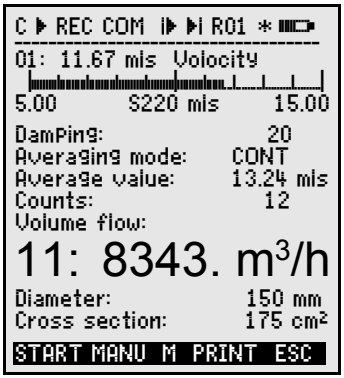
Example:

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

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

If the sensors are to stay untouched, the function channel can also be programmed to the device internal channels (e.g. M15) (s. 10.3.10). The standard reference channels are here M0 to M1.

9.4.9 Volume Flow Measurement



The **volume flow** in flow channels can be calculated by multiplying the average flow velocity $\overline{v}$ and the cross-section surface. The functions needed for this purpose can be accessed via the ´User menu´ U3 Volume flow (see on the right); these are a flow channel with averaging, the functions ´diameter´ and ´cross-section´, and a function channel for volume flow (s. 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, please refer to the help menu Volume flow .

As unstable measured values can be easier read out when an analog display is used, this menu, besides a small digital display, also provides a **bar chart**.

The display range of the bar chart can be set by using the functions ´**Analog Start**´ and ´**Analog End**´ in the menu ´Special Functions´ (s. 10.4.4). The values can also be edited directly below the scale, when programming.

Volume flow VF = average flow velocity $\overline{v}$ • cross section area CS:

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

For rough air volume measurements at air vents the **average flow velocity** $\overline{v}$ can be determined by a **time-based averaging** (s. 9.4.5 a. man. 3.5.5).The rotating vane must be applied at one end, the averaging has to be started and it is necessary to proceed uniformly over the whole cross-sectional area and to stop the averaging when the other end of the cross-sectional area is reached.

Alternatively, the average flow velocity can also be determined by single **net measurements** according to VDI/VDE 2640 (s. 9.4.4 and manual 3.5.5) (e.g. 13.24 m/s).

The average velocity $\overline{v}$ is displayed in function: Average value: 13.24m/s

Input of the diameter in mm (max. 2000): Diameter: 0150 mm

Input of the cross section area CS directly in cm^2: (max. 32000 cm^2) CrossSection: 0175cm²

Display of the volume flow VF in a function channel in m^3/h:

Volume flow:
11: 834.m³/h

Output of all function values of the menu by using: **<PRINT>**

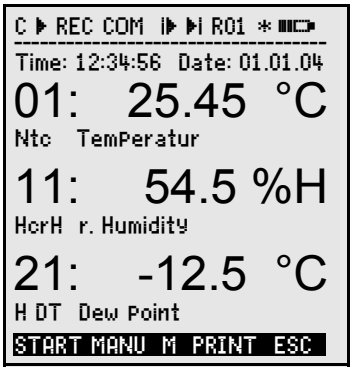
For outputting and storing the number of measuring operations, the function channel ´n(t)´ is provided (s. 10.3.9, 10.3.10).

9.5 Display of Several Measuring Points

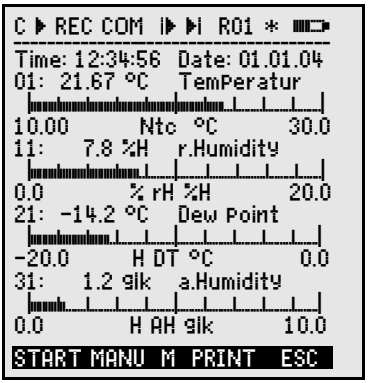
The already mentioned measuring menus allow, on principle, only the selection and display of one measuring point. This chapter provides a description on how you can get several measuring points with your selection of functions simultaneously on the display.

9.5.1 Menu Multi Channel Display and Bar chart

After the first call the menu **Multi Channel Display** indicates the measured value of the first three active channels in average scale. But they can be programmed as required:



In the menu **Bar Chart** the first four active channels will be displayed with measured value and bar chart:



Measuring point selection:

The first measuring channel is always the selected measuring point.

This can be selected directly by means of: ▲ or ▼ ...

To change the other channels, the measuring point must be selected as function, by means of keys: **PROG** and ▲ or ▼ ...

The channel can now be changed by means of: **<M▲>** , **<M▼>** ...

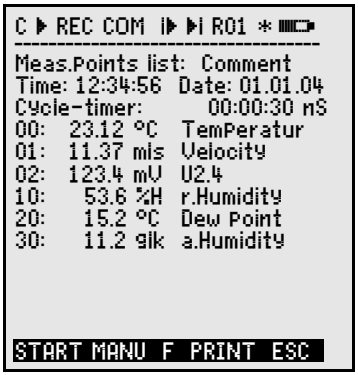
The channel selection is terminated with key: **<ESC>**

9.5.2 Differential Measurement

If there are two sensors with the same dimensions and same decimal point position connected at measuring points M0 and M1, the difference M1-M0 appears automatically at the device-internal measuring point M5 (s. 7.2). If the differential channel is not required, it must be explicitly deleted (s. 10.3.9). If further differential channels are needed, these can be created using the appropriated reference channels (s. 10.4.6).

9.5.3 Menu List of Measuring Points

The best overview of the meas. system incl. all meas. values, time of day, date and cycle is obtained with the menu `Meas.Point list`. From here, it is also possible to get to the `Sensor Programming` of all measuring points.



This menu cannot be individually configured, it can only be combined with some selected functions:

At first call a list with max 20 meas. pts is displayed:
MeasPtsList: 20 Meas.v.
00: 23.12°C ...

Functions can be allocated to a meas. value with: ▲ or ▼ ...
This reduces the max. number of channels to 10.

Select the following function with: ▲

Measured value including **comment:**
MeasValList: Comment
00: 23.12°C TemPerature

Measured value including **maximum value:**
MeasValList: Max value
00: 23.12 °C 32.67 °C

Measured value including **minimum value:**
MeasValList: Min value
00: 23.12 °C 19.34 °C

Measured value including **average value:**
MeasValList: Avg. value
00: 23.12 °C 25.45 °C

Measured value including **limit value max:**
MeasValList: Limit max
00: 23.12 °C 32.67 °C

Measured value including **limit value min:**
MeasValList: Limit min
00: 23.12 °C 19.34 °C

Measuring range only (again max. 20 channels):
MeasValList: Range
00: NTC °C

The programming functions can be accessed as follows: PROG , ▲ / ▼ ...

9.6 Assistant-Menus for Special Meas. 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 assistant menu for each.

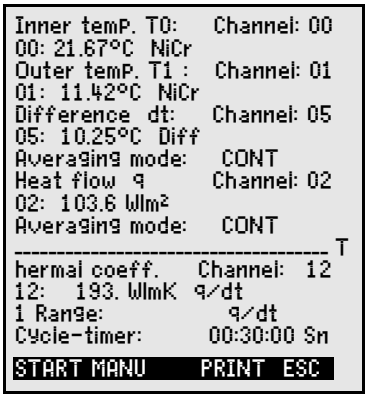
9.6.1 Thermal Coefficient

To determine the thermal coefficient $\overline{q}/\overline{(T1-T0)}$ the two temperature sensors are connected as required (see manual, section 3.2) to channels M0 and M1, and the heat flow plate to M2. The temperature difference T(M1)-T(M0) is obtained automatically on channel M5.

For this measuring operation the following programming steps are needed :

Averaging mode on M5 : CONT or CYCL
Averaging mode on M2: CONT or CYCL
Range on M12: q/dt
Enter the cycle by means of: Cycle timer
Start measuring by means of: <START>
Stop measuring by means of: <STOP>

Assistant-Menu Thermal Coefficient:



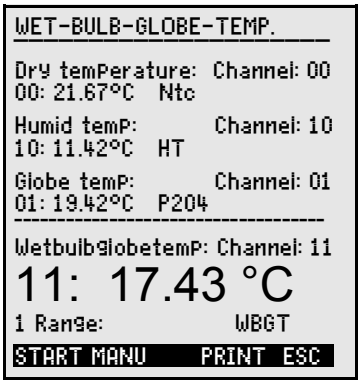
9.6.2 Wet Bulb Globe Temperature

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=0.1TT + 0.7HTN + 0.2GT (s.man. 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 and a Pt100 globe thermometer is connected to socket M1. The output on channel 11 is programmed to WBGT; (for this device the factor 0.2 must not be programmed !).

Assistant-Menu Wet Bulb Globe Temperature:



9.7 User Menus

When studying the measurement menus you may have noticed that the display of the meas. value and the combination of functions does not always match your applications in an optimum way. Therefore, you can freely configure the three user menus **U1** to **U3**, in addition to the standard measuring menus using the software AMR-Control. You can use the following list of functions to individually place the functions you require, in any sequence, on your display up to the available space of 13 lines. There is no limit in the number of measuring points, as it is at the ALMEMO® 2590-9. In addition to the meas. functions that have been described before, it is possible to use times and cycles for the process control (s. 10.1.) and most of the sensor programming functions (s. 10.3).

9.7.1 Functions

Functions:	Display:	Keys:		Command:
Meas.value small	00: 234.5°C TemPerature	ZERO	ADJ	o 15
Meas. value medium 3 lines	00: 1234.5 °C	ZERO	ADJ	o 16
Meas. value large 7 lines	00: TemPerature °C 1234.5	ZERO	ADJ	o 17
Meas. value bar chart 2 lines	5.0 $220 mis 15.00			o 34
Limit value Max (s. 10.3.5)	Limit Max: 1234.5°C	OFF	ON	o 00
Limit value Min:	Limit Min: -0123.4°C	OFF	ON	o 01
Base value (s. 10.3.6)	Base: ------	OFF	ON	o 02
Factor:	Factor: 1.12345	OFF	ON	o 03
Zero point corr. (s. 10.3.7)	Zero correction: ------	OFF	ON	o 04
Slope correction:	Slope correction: ------	OFF	ON	o 05
Analog start (s. 10.4.4)	Analog-start: 0.0°C	OFF	ON	o 06
Analog end:	Analog-end: 100.0°C	OFF	ON	o 07
Range (s. 10.3.9)	Range: NiCr			o 08
Maximum value (s. 9.1.2)	Maximum value: 1122.3°C	CLR	CLRA	o 09
Minimum value:	Minimum value: 19.3°C	CLR	CLRA	o 10
Average value(s. 9.4.5)	Average value: ------	CLR	CLRA	o 11
Cycle (s. 10.1.2)	Cycle: 00:00:00Un	CLR	FORM	o 12
Time, date (s. 10.1.1)	Time:12:34:56 Date:01.02.00	CLR		o 14
Averaging mode (s. 9.4.2)	Averaging mode: CONT	CLR		o 18
Conv. rate: (s. 10.1.3)	Conv.rate: 10M/s Cont: -	OFF	ON	o 19
Cycle Timer: (s. 9.3.2)	Cycle-timer: 00:00:00Un	CLR	FORM	o 20
Averaging Counts (s. 9.4.3)	Counts: 00000.			o 22

Number (s. 10.2.2)	Number: 123-56	OFF	ON	o 23
Range, comment:	NiCr TemPerature M H ↗			o 24
Diameter mm (s. 9.4.9)	Diameter: 0000 mm	CLR		o 25
Cross section cm^2 (s. 9.4.9)	Cross-section: 0000 cm^2	CLR		o 26
Max-time-date (s. 9.1.2)	Max Time: 12:34 01.02.			o 28
Min-time-date	Min Time: 13:45 01.02.			o 29
Blank line:				o 30
Line:	————————			o 31
Smoothing (s. 9.4.1)	DamPinG: 10	CLR		o 32
Memory free (s. 9.3.3)	MemoryFree: 502.1kB	CMEM	PRINT	o 33
Device designation (s.10.5.1)	SamPleMan CorPoration	CLR		o 36
Text1: (s. 9.7.4)	1: CommentLine	CLR		o 37
Text2:	2: CommentLine	CLR		o 38
Text3: (s. 9.7, 9.7.4)	U1 MenuTitle	CLR		o 39
Text4:	U2 MenuTitle	CLR		o 40
Text5:	U3 MenuTitle	CLR		o 41
Locking (s. 10.3.4)	LockinG: 5	CLR		o 42
Atm. Pressure (s. 10.5.6)	Atm.Pressure: 1013mb	CLR		o 43
TemperatureComp(s. 9.2.5)	TemP.comPens.: 25.0°C	CLR		o 44
Setpoint (s. 9.2.4)	SetPoint: 1100.0°C	OFF	ADJ	o 45
Meas. time: (s. 9.4.6)	Meas. Time: 00:00:00.00	CLR		o 46
End of menu:				o 99

9.7.2 Configuration of the menus

Select one user menu U1, U2 or U3 from the measuring menus you do not need at the moment:

MEAS.Menus:

▲ / ▼ ..., ▶

Please connect the device for configuration via data cable with your PC and call up the delivered **Software AMR-Control**.

With one click on: Network scanning

you get to the: Device list

Select the device and press: Program user menus

Pull the functions from the left side to the menu window on the right with the drag and drop function.

At all functions containing a measured value (e.g. max, average value, also bar display) you have to put in the measured value of the measuring point first, afterwards the corresponding functions!

Put in an expressive menu title: User menu title

Store the finished menu in the device on Ux with: Menu store, Ux, OK

All menus can also be stored in the PC and be reloaded, if required!

9.7.3 Function Printouts

The functions of all measurement menus can be printed out in the listed sequence by using the key: **<PRINT>** (s.a. 9.3.4)
The print format of the individual functions is given in the following table:

Funktion	Ausdruck	Befehl
Meas. Values all	01: +0023.5 °C Temperatur	P35
Maximum Value	MAXIMUM: 01: +0020.0 °C	P02
Maximum Time	MAX-TIME: 01: 12:32 01.02	P28
Minimum	MINIMUM: 01: -0010.0 °C	P03
Minimum Time	MIN-TIME: 01: 12:32 01.02	P29
Average Value	AVERAGE VAL.:01: +0017.8 °C	P14
Averaging Mode	AVERAGEMODE: 01: CONT	P21
Averaging Count	AVERAGECOUNT:01: 00178.	P22
Memory Free	MEMORY: S0512.1 F0324.4 A	P33
Number	NUMBER: 01-012	P23
Range (Comment)	RANGE: 01: NiCr	P24
Limit Max	LIMIT MAX: 01: -0100.0 °C	P08
Limit Min	LIMIT MIN: 01: +0020.0 °C	P09
Base	BASE: 01: -0273.0 °C	P06
Factor	FACTOR: 01: +1.0350E-1	P07
Zero Point Correction	ZERO CORR: 01: -0000.7 °C	f1 P06
Slope Correction	SLOPE CORR: 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
Time, Date	TIME: 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
Satrt Date	START DATE: 01.02.04	f1 P13
End Date	END DATE: 02.02.04	f2 P13
Measuring Time	MEASURETIME: 00:00:00.00	P46
Damping	DAMPING: 01: 10	P32
Diameter	DIAMETER: 01: 00100 mm	P25
Cross section	CROSS SECT: 01: 00078 cm2	P26
Atm. pressure	A.PRESSURE:+01013.mb	P43
Temp. compensation	COMPENSATION:01: 25.0°C	P44
Setpoint	SET POINT: 01: 1100.0°C	P45
Device designation	Fa.Ahlborn,Holzkirchen	P36

Line	----------	P31
Blank line		P30
Text1	Comment Text 1	P37
Text2	Comment Text 2	P38
Text3	Menu Title U1	P39
Text4	Menu Title U2	P40
Text5	Menu Title U3	P41
Locking	LOCKING MODE: 5	P42

9.7.4 Programming via the Serial Interface:

Apart from the output errors mentioned above, only new commands, which are not covered by the manual section 6, will be listed in the following.

Selecting the menu line xx:		ixx
Selection of menu u and function yy:		fu oyy
Entering the texts:	Text 1:	f5 $Text1
	Text 2:	f6 $Text2
	Text 3=MenuTitle U1:	f7 $Text3
	Text 4=MenuTitle U2:	f8 $Text4
	Text 5=MenuTitle U3:	f9 $Text5
Output of the texts 1 to 5:		f5 P20 Text1 etc.
Output of the menu configurations:		fu P20
Menu title of the menu u		U1:MenuTitle U1
In line 00: function yy		00:30
In line 01: function yy		01:39
....		02:16 03:24 04:30 ...
Output of all functions of the selected menu (print format see above):		P20
Menu title		MeasCorrection
Meas. value average		00: +025.67 °C
		RANGE: 00: Ntc
Blank line		
		LOCKING:0. SETPOINT: 00: +0000.0øC COMPENSATION:00:+0000.0øC ATM.PRESSURE: +01013. mb
Input of the cross-section for the inp.channel in cm²:		Qxxxxx (max. 32000, s. 9.4.9)
Input of the smoothing for the input channel:		f1 zxx (s. 9.4.1)
Input of temperature compensation in 0.1 °C:		f1 gxxxxx (f1 g00150=15.0°C)
Input of setpoint at input channel:		f2 gxxxxx
Setpoint adjustment (VM=4 Factor, VM≤3 Slope):		f2 C01

10. PROGRAMMING WITH PROGRAMMING-MENUS

Apart from the measuring functions you have already get to know some functions for process control and sensor programming in the measuring menus.

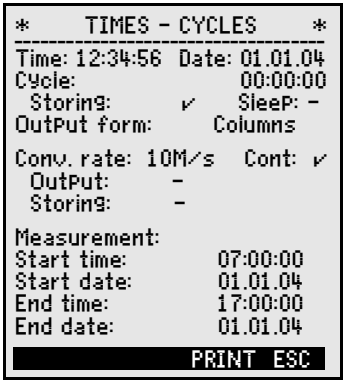
Here in the PROGRAMMING Menus you find a complete and systematic list of all programming functions.

From the measuring menu, you reach the selection menu using the key: **<MENU1>**

For some programming function, there are additional ASSISTANT Menus.

10.1 Times and Cycles

All time functions for measurement, process control and recording are combined in the programming menu Times - Cycles and can also be programmed there.



10.1.1 Time and Date

The ALMEMO 2690-8 is equipped with a real time clock with date function for recording the measuring time. It has a lithium battery so the time and date are also maintained after battery change. By selecting the function (s. 8.4) the time can be programmed in the specified format in the first line on the left side and the date on the right side (s. 8.5).

Function Time and Date: Time: 12:34:56 Date:01.05.00

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

10.1.2 Cycle with Storage Activation and Output Format

The Cycle is used for cyclic storage and outputs of measuring data on the interface (it corresponds to the print cycle of other ALMEMO® devices, the measuring cycle is no longer implemented). The storage activation in the cycle, i.e. the cyclic recording of data in the memory is automatically switched on after a reinitialisation but it can also be switched off, if required.

The **output format** (see manual 6.6.1) determines the print format at measuring point scans and at the memory output. It is programmed by using the function `OutPut form`. Apart from the standard format ´List´ with all measured values given in a list, the output format ´Columns´ allows for a clear and space-saving printout in columns. For this purpose, a printer will automatically switch to the condensed character mode. The **format** ´Table´ is available to further process measuring data by means of spreadsheet applications (s. print images man. 6.1).

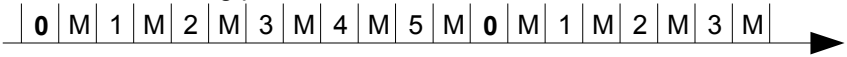
Function **Cycle** (format hh:mm:ss)**:**	`Cycle: 00:15:00`
Clear cycle, terminate current scan:	`<CLR>`
Function **Storage actication in cycle:**	`Storing: -  SleeP: -`
Switch on storing (basic setting):	`<ON> ✓`
Switch off storing:	`<OFF> -`
Switch on function **sleepmode** s. 10.2.4:	`<ON> SleeP: ✓`
Output format ´ ´ measured values in list format:	`OutPut form: List`
Output format ´n´ columns side by side:	`OutPut form: Columns`
Output format ´t´ table with semicolon separation:	`OutPut form: Table`
In the meas. menus the format abbreviations ´n´ or ´t´ and ´S´ (with storage activation) or ´U´ (without storage activation) are displayed next to the cycle :	`Cycle: 00:15:00 Sn`

10.1.3 Conversion Rate, Continuous Measuring Point Scan

If required, for measuring point scans the conversion rate can in function `Conv. rate` be increased from 2,5 up to 10M/sec or 50M/sec (s. man. 6.5).

Half-continuous measuring point scan

The possibility to record only the selected measuring point (not continuous) is not intended anymore, because errors are easily made when corresponding sensors are not recorded. However, it can be useful, especially with many sensors, to treat the selected measuring point in a favoured way and to replace the measured value once in a while, e.g. at analog output or smoothing of the measured value. Therefore, by default the not continuous meas. point scan was replaced by the **half-continuous meas. point scan**, i.e. all measuring points are continuously recorded, but every second measurement records the selected measuring point.

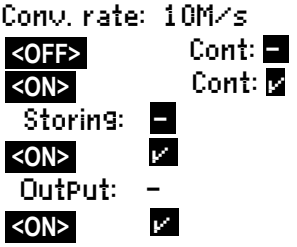


Continuous measuring point scan

If the **continuous measuring point scan** is switched on, all active measuring channels will be continuously and successively scanned by the conversion rate and all measured values are always up-to-date (s. man. 6.5.1.3). The output and storage of all measured values is also possible.

The continuous storage and the continuous output of the measured values can be activated with the conversion rate using the following two functions.

Function Conversion rate: Input s. 8.5



half-continuous measuring point scan (basic setting): <OFF>
continuous measuring point scan: <ON>
continuous storage off:
activate continuous storage: <ON>
continuous output off:
activate continuous output: <ON>

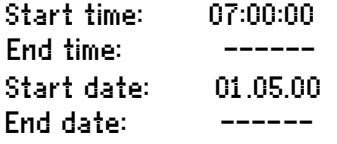
At a conversion rate of 50 measurements/sec. the following limitations due to shortened analysation times are to be considered:

1. The increased conversion rate only takes effect after the start of a measurement, before the device works with 10 measurements/sec.
2. During the measurement with high measuring rate, a supervision of the ALMEMO® connectors is no longer possible, i.e. the connector configuration can only be changed when the measuring is stopped.
3. If the conversion rate is over 10 measurement/sec, a suppression of mains frequency noise is normally not possible. Therefore, the accuracy can be additionally disturbed by irradiations in the connection cables (twist, if possible!).

10.1.4 Time and Date of Start, Time and Date of End

A sequence of measurements can, at certain points in time, be automatically started and stopped. For this purpose the start time and date and the end time and date can be programmed. If a date has not been specified the measurement will be performed every day in the defined period. The current time must be programmed beforehand.

Function Start Time (format `hh:mm:ss`):
Function End Time (format `hh:mm:ss`):
Function Start Date (format `dd:mm:yy`):
Function End Date (format `dd:mm:yy`):



To clear values, select function and then use: <CLR>

If the start time of a measurement has been programmed, the status line will show the symbol: ´i▶´

If the end time of a measurement has been programmed, the status line will show the symbol: ´▶i´

10.2 Data Memory

The basic information with regard to data storage in ALMEMO® devices is given in the manual section 6.9. The internal data memory of the ALMEMO 2690-8 is a 512kByte EEPROM with capacity sufficient for 64.000 to 100.000 measured values (depending on the channel number). In the event of a failure in the supply voltage the measured data is retained. The EEPROM can be configured either as linear memory or ring memory (s. man. 6.10.13.2).

10.2.1 Data Acquisition

Most of the parameters, which are required for the **recording** of measuring data, have already been described in the menu `Times - Cycles` (s. 10.1).

1. Time and date
2. Cycle, storage activation, sleep mode
3. Conversion rate with storage activation
4. Time of start and end of a measurement

The menu `Recording to memory` can be used for an especially simple recording to memory.

Additionally, there are extra assistant menus for the various possibilities to start and stop the measurement! (s. 10.2.3)

Attention: One sensor configuration is only stored during the first start, additional sensors are completed at the next start. If other sensors are connected, memory must be readout and cleared before the next recording!

Menu `Recording to memory`:

Internally available memory capacity: Memory internal: 512.0 kB
Available free memory space: Memory free: 217.5 kB
Linear memory without overwriting of data: Ring memory: -
Activate **ring memory** with overwriting of data: <ON> ✓
Nb of act. channels to calculate the storing time: Meas.chann: 24 active: 05
Input of **cycle** (s. 8.5, format hh:mm:ss): Cycle: 00:01:00
Minimal cycle with 50M/s corresp. to active channels: <MIN> 00:00:00.12
Cycle without storing and without sleepmode: Storing: - Sleep: -
Select and switch on **storing** using the key: <ON> ✓ Sleep: -
Switch on **sleepmode** (s. 10.2.4) using the key: <ON> Sleep: ✓
Storing time from cycle and channel number: StoringTime: 24d 13h
Meas.duration, after start automatic stop after: Meas.duration: 00:10:00
Number: e.g. room 12, meas. point 1 s. 10.2.2 Number: 12-001 A

10.2.2 Numbering of measurements

For the identification of measurements or series of measurements it is possible to individually enter a number before starting. With the next measuring point scan it will be output or stored, respectively. This allows to also assign single measurements during a read-out to specific measurement locations or measuring points (s. manual 6.7).

After selecting the function `Number` the 6-digit number is entered in the usual way (s. 8.5). In addition to the figures 0 to 9 the characters A,F,N,P,- or _ (space) can be used. After the input the number is activated and next to it an ´A´ will be indicated until the next cyclic or manual measurement will be stored.

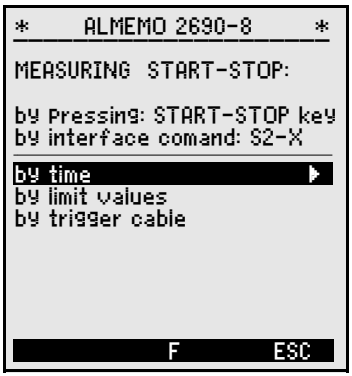
Function **Number:** (e.g. room 12, meas. point 1) NUMBER: 12-001 A
Zero setting and deactivating the number with key: <CLR>
Activating and **deactivating** the number with key: <ON>, <OFF>
Incrementing and **activating** the number with: < +1 >

10.2.3 Starting and Stopping of measurements

Additionally to starting and stopping of the measurement with the keys, there are even more possibilities, concretely conveyed by the assistant menu `START-STOP`.

The operation via interface is described in the manual section 6.6.

The function of start time and end time is described here in section 10.1.4, the limit value responses in section 10.4.3 and the varieties of relais and trigger in section 10.6.2.



10.2.4 Sleepmodus

For long term monitoring with larger cycles it is possible to operate the measuring device in sleep mode. Within this power saving mode the device will be switched off after each measuring point scan (this is to be considered using sensors with power supply!) and will be automatically switched on for the next measuring point scan after the cycle time has expired. This procedure allows, with one set of battery/accumulators to perform more than 15000 measuring point scans. At 10 minutes for one cycle this results in a total measuring time of more than 100 days.

The following steps must be carried out in the menu `Recording to memory` to perform a **data recording in the sleep mode**:

1. Enter a cycle with a min. duration of 2 minutes: Cycle: 00:05:00
2. Switch on the storage activation in the cycle: Storing: ☑ Sleep: -
3. Select the sleep mode: Storing: ✓ Sleep: ■

4. Switch on the sleep mode using the key: **<ON>** SleeP: ☑
5. Start the measurement in a meas. menu with key: **<START>**
   The device announces in the display, SleeP On
   then it switches off, for control purposes only a red lamp flashes regularly on the upper window frame. LED ´**SLEEP**´ (4) flashes
6. Within the set cycle the device switches automatically on, performs a measuring point scan, and then switches off again.
7. Terminate sleep mode using the key: **<ON>**
8. Terminate measurement using the key: **<STOP>**

The start or stop through start and end time or through limit values is, on principle, not possible in sleep mode and, therefore, must be switched off!

10.2.5 Memory Output

The content of the data memory can, completely or in parts, be output to the serial interface. For each output one of the three available output formats ´List´, ´Columns´ or ´Table´ can be used. The option to specify partial ranges is available as it is possible to set the start and end time of measurements and also possible to select the number of corresponding identified measurements.

```
*  OUTPUT FROM MEMORY  *
-------------------------
Memory Internal:   512.0 kB
Memory free:       125.8 kB
Residual output:    12.5 kB
Output form:       Columns
Number:            01-001 A
Time: 12:34:56  Date: 01.01.04
Time interval:
Start time:        07:00:00
Start date:        01.01.04
End time:          17:00:00
End date:          01.01.04
 ALL   NR   F  TIME   ESC
```

Menu Memory OutPut :

Setting the **output format**: OutPut form: List

In case of **selecting a numbered measurement:** NUMBER: 12-001 A

In Function Number select number with keys: **<FIRST>**, **<NEXT>**..., **<LAST>**

To **select a time interval:**

Enter the start time using the format ´hh:mm:ss´: Start time: 07:00:00

Enter the end time using the format ´hh:mm:ss´: End time: 17:00:00

Enter the start date using the format ´dd:mm:yy´: Start date: 01.05.00

Enter the end date using the format ´dd:mm:yy´: End date: 01.05.00

Perform complete output of data memory: **<ALL>**

Output of a numbered measurement: **<NR>**

Output of a time interval from start to end: **<TIME>**

Cancelling the memory output using the key: **<STOP>**

The memory contents will be output with the same print format as with a printer operation, including multiple printouts and different formats (s. man. 6.6.1).
During the output of data memory, the remaining memory content (in kB) to be output is continuously indicated in the function `Residual output`. Time, date and number show the current values .

Remaining memory output:	Residual output: 12.5 kB
current number of memory output:	Number: 01-001A
current time and date of memory output:	Time: 12:34:56 Date: 01.01.04

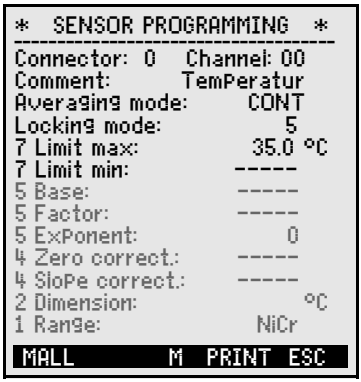
Clear memory

Select function `Memory free` (s. 8.4):	Memory free: 384.5kB
To clear the memory, press the key:	**<CMEM>**
Full memory capacity is indicated in function:	Memory free: 512.0kB
Cancel by using the key:	**<ESC>**

10.3 Sensor Programming

As all ALMEMO® instruments contain the whole sensor programming stored in the ALMEMO® connector plug, the user, usually, does not need to perform any programming. Only if, for example, sensor errors must be corrected or existing sensors must be scaled or limit values need to be specified the comprehensive programming options have to be used.

If the corresponding sensor connector is connected all parameters of a channel can be checked and entered or changed via keypad in the menu SENSOR PROGRAMMING. It must be considered that standard sensors are, by a locking mode, protected against unintentional modification and that the locking level must first be reduced before desired changes can be performed (s. 10.3.4). The functions are only selectable as far as the locking mode allows, the rest appears in grey.



Output of the sensor programming of all active measuring points (command P15 s. man. 6.2.3) with key: **<PRINT>**

10.3.1 Selecting the Input Channel

To query or to program the parameters of a sensor, it is first necessary to select the menu SENSOR PROGRAMMING and then to set the required input channel by using the key ▲ or ▼. For this, only connected sensors and activated channels will be considered. To be able to activate new channels, the key **<MALL>** can be used to enable the selection of **all** channels. The key **<MACT>** can be used to reduce the selection back to the **active** channels only. The corresponding connector number will be displayed with each input channel.

Menu SENSOR PROGRAMMING:

Indication of connector number and channel: Connector:0 Channel:00

Selecting the next input channel using the key: ▲

Selecting the previous input channel using the key: ▼

Enabling the selection of all available channels: **<MALL>**

Reducing the selection to all active channels: **<MACT>**

10.3.2 Measuring Point Designation

Each measuring point can be given a 10-digit alphanumeric designation to optimally identify the type of sensor, the measuring location or the purpose of the application. This comment will be indicated with all standard displays of measured values. If it has not been programmed, the abbreviation of the measuring range will be indicated. In case of outputs via interface the measuring point designation appears in the program header as ´COMMENT´ and in the list of measured values (see man. 6.6.1).

Input in function ´Comment´ s. 8.5 Comment: Humidity

It is possible, by means of comment ´*J´, to define temperature sensor (Ntc, Pt100) as external cold junction compensator (s. 9.2.7, man. 6.7.3). It is now also possible (a new feature), by means of comment " #J ", to define, via the reference channel, a specific cold junction sensor (e.g. connector ZA9400-FSx with Ntc) to apply to just one thermocouple (s. 9.2.7).

10.3.3 Averaging Mode

The types of averaging, which are defined through the function Averageing mode are described in section 9.4.2.

Function no averaging: Averaging mode: -----
Averaging over all running measuring point scans: CONT
Averaging over all scans in one cycle: CYCL

10.3.4 Locking the Programming of the Sensor

The function parameters of each measuring point are protected by the locking mode up to an adjustable locking level (s. man. 6.3.12). Before any programming is performed the locking mode must be correspondingly lowered. If a dot is indicated following the locking mode on the display then a modification is not possible.

Locking Level	Locked Functions
0	none
1	Meas.range + element flags + output mode
3	+ Dimension
4	+ Zero point and slope correction
5	+ Base value, factor, exponent
6	+ Analog output, start and end
7	+ Limit values, max and min

Function ´LockingMode´: Locking: 5

In the menu SENSOR PROGRAMMING the functions are arranged from top to bottom so that the locked functions cannot be selected.

10.3.5 Limit Values

Two limit values (MAX, MIN) can be programmed and allocated to each measuring channel. An exceeding of limit values is handled as a fault, similar to an exceeding of meas. range limits and sensor breakage. On the display a corresponding arrow ▲ or ▼ will appear next to the measured value and the alarm relays of a connected relay cable will respond (s. 10.6.2). Relays can also be assigned to limit values (s. 10.4.3). The alarm condition will persist until the measured value has dropped below the limit value by the Hysteresis. Generally, the hysteresis is set to 10 digits, however, it can be adjusted to values between 0 and 99 digits (s. 10.5.7). The exceeding of a limit value can also be used to start or stop a measurement (s. 10.4.3).

Function:

Enter limit value max (s. 8.5): 7 Limit max: 123.4°C

Limit value min: 7 Limit min: -----°C

Switching off the limit value: <OFF>

Switching on the limit value: <ON>

10.3.6 Scaling, Decimal Point Setting

For indicating the electrical signal of a sensor as a measured value of a physical variable it is, in most cases, necessary to set a zero point shift and to perform a multiplication with a certain factor. The functions BASE and FACTOR are available for this. A detailed description of the scaling, including an example, can be found in the manual section 6.3.11.

Indicated value = (Corrected Measured Value - BASE) x FACTOR.

The FACTOR can be programmed in the range from -2.0000 to +2.0000. For factors over 2.0 or under 0.2 a corresponding decimal point setting must be considered by entering the EXPONENT. The EXPONENT allows to shift the decimal point to the left (-) or right (+) as far as it can be indicated on the display and printer. An exponential presentation of the measured values is not possible.

For automatic calculation of the scaling values:

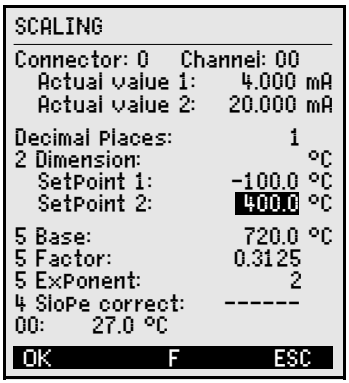
5 Base : ------

5 Factor: ------

5 Exponent: 0

In the ASSISTANT Menus there is an extra menu Scaling consisting of actual and setpoint values.

The correction arrow ↗ will be indicated as status of the measured value (s. 8.3), if scaling values have been programmed and the actual measured value has been altered.



10.3.7 Correction Values

The correction values ZERO CORRECTION and SLOPE CORRECTION allow for correcting sensors with regard to zero point and slope (s. man. 6.3.10).

Corrected Meas. Value = (Meas.Value - ZERO CORR.) x SLOPE CORR.

Function:

Zero point correction: 4 Zero correct.: -----°C

Slope correction: 4 Slope correct.: -----°C

Switch on/off keys: **<OFF>** or **<ON>**

The correction arrow ↗ will be indicated as status of the measured value (s. 8.3), if scaling values have been programmed and the actual measured value has been altered.

10.3.8 Changing the Dimension

Each measuring channel allows to replace the standard dimension of the measuring range by any other dimension that has two digits (see manual 6.3.5). In addition to all capital and normal letters, the characters Ω, %, [,], *, -, =, ~ and spaces (_) are available. The dimension is indicated by two characters that are indicated next to the measuring and programming values.

The **dimension can be changed** using the function: 2 Dimension: °C

When the dimension °F is entered a temperature value in degree Celsius will be converted into degrees Fahrenheit. The cold junction compensation can be switched off by using the characters !C. The following dimensions are automatically generated, entering 2 corresponding characters: m/s at ms, m³/h at mh, W/m² at Wm, g/k at gk.

10.3.9 Selecting the Measuring Range

If users want to program the connectors on their own or if they frequently change the measuring range, it must be considered that the locking must be cleared, i.e. set to zero (s. 10.3.4), and that special connectors may be required for some transducers (e.g. thermo, shunt, divider etc., see table). To activate a new measuring channel, activate all channels by using the key **<MALL>** select the corresponding input channel (s. 10.3.1) and then enter the measuring range. With the input acknowledgement of the new measuring range all programming values of the input channel will be cleared.

Function Meas. Range Selection: 1 RANGE: NiCr

Enabling the selection of all avail. meas. channels: **<MALL>**

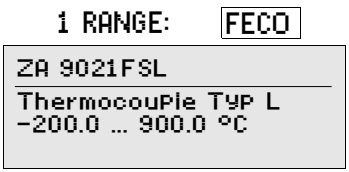
Switch-off, i.e. deactivating a channel: **<CLR>**

Switch-on, i.e. re-activating the channel: **PROG** , **PROG**

Programming of range as with data input, 8.5 **PROG** , **▲** ... , **PROG**

In the input window all abbreviations of the following table are indicated successively

and a corresponding help window to identify the sensors:



Transducer	Conn./Cable/ Sensor	Meas. Range	Dim	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
Ni100	ZA 9000-FS	-60.0... +240.0	°C	N104
NiCr-Ni (K) ITS90	ZA 9020-FS	-200.0...+1370.0	°C	NiCr
NiCroSil-NiSil (N) ITS90	ZA 9020-FS	-200.0...+1300.0	°C	NiSi
Fe-CuNi (L)	ZA 9000-FS	-200.0... +900.0	°C	FeCo
Fe-CuNi (J) ITS90	ZA 9000-FS	-200.0...+1000.0	°C	IrCo
Cu-CuNi (U)	ZA 9000-FS	-200.0... +600.0	°C	CuCo
Cu-CuNi (T) ITS90	ZA 9000-FS	-200.0... +400.0	°C	CoCo
PtRh10-Pt (S) ITS90	ZA 9000-FS	0.0...+1760.0	°C	Pt10
PtRh13-Pt (R) ITS90	ZA 9000-FS	0.0...+1760.0	°C	Pt13
PtRh30-PtRh6 (B) ITS90	ZA 9000-FS	+400.0...+1800.0	°C	EL18
Au-FeCr	ZA 9000-FS	-270.0... +60.0	°C	AuFe
Ntc Type N	ZA 9000-FS	-30.00...+125.00	°C	Ntc
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
Volt	ZA 9000-FS	-2.6000...+2.6000	V	Volt
Differential Millivolt 1	ZA 9000-FS	-26.000...+26.000	mV	D 26
Differential Millivolt	ZA 9000-FS	-10.000...+55.000	mV	D 55
Differential Millivolt 2	ZA 9000-FS	-260.00...+260.00	mV	D260
Differential 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 (4-20mA)	ZA 9001-FS	0.00... 100.00	%	%
Ohm	ZA 9000-FS	0.00... 400.00	Ω	Ohm
Frequency	ZA 9909-AK	0... 25000	Hz	Freq
Pulse	ZA 9909-AK	0... 65000		Puls
Digital input	ZA 9000-EK2	0.0... 100.0	%	Inp
Digital interface	ZA 9919-AKxx	-65000... +65000		DIGI
Infrared 1	ZA 9000-FS	0.0... +200.0	°C	Ir 1
Infrared 4	ZA 9000-FS	-30.0... +100.0	°C	Ir 4
Infrared 6	ZA 9000-FS	0.0... +500.0	°C	Ir 6
Rotating Vanes Normal 20	FV A915-S120	0.30... 20.00	m/s	S120
Rotating Vanes Normal 40	FV A915-S140	0.40... 40.00	m/s	S140

Transducer	Conn./Cable/ Sensor	Meas. Range	Dim	Display
Rotating Vanes Micro 20	FV A915-S220	0.50... 20.00	m/s	S220
Rotating Vanes Mikro 40	FV A915-S240	0.60... 40.00	m/s	S240
Rotating Vanes Macro	FV A915-MA1	0.10... 20.00	m/s	L420
Rotating Vanes Water-Micro	FV A915-WM1	0.00... 5.00	m/s	L605
Dyn.press. 40m/s with TC u. PC	FD A612-M1	0.50... 40.00	m/s	L840
Dyn.press. 90 m/s with TC u. PC	FD A612-M6	1.00... 90.00	m/s	L890
Rel. humidity cap.	FH A646	0.0... 100.0	%H	°o rH
Rel. humidity cap. with TC	FH A646-C	0.0... 100.0	%H	HcrH
Rel. humidity cap. 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 a. 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 s. 10.3.10				
* Mixture ratio wth PC	FH A646	0.0 ... 500.0	g/kg	H AH
* Dew point temperature	FH A646	-25.0... 100.0	°C	H DT
* Partial vapour pressure	FH A646	0.0...1050.0	mbar	H VP
* Enthalpy with PC	FH A646	0.0 ... 400.0	kJ/kg	H En
* Rel. humidity psychr. with PC	FN A846	0.0 ... 100.0	%H	P RH
* Mixture ratio with PC	FN A846	0.0 ... 500.0	g/kg	P AH
* Dew point temperature with PC	FN A846	-25.0 ... +100.0	°C	P DT
* Partial vapour 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
Measuring value (Mb1)	any		f(Mb1)	Mess
Difference (Mb1-Mb2)	any		f(Mb1)	Diff
Maximum value (Mb1)	any		f(Mb1)	Max
Minimum value (Mb1)	any		f(Mb1)	Min
Average value over time (Mb1)	any		f(Mb1)	M(t)
Count of avg. values (Mb1)	any		f(Mb1)	n(t)
Avg.val. over meas.pts (Mb2..Mb1)	any		f(Mb1)	M(n)
Sum over meas. pts (Mb2..Mb1)	any		f(Mb1)	S(n)
Total pulse count (Mb1)	ZA 9909-AK2	0... 65000		S(t)
Pulse count/print cycle (Mb1)	ZA 9909-AK2	0... 65000		S(P)
Alarm value (Mb1)	any		%	Alrm
Thermal coeff. $\overline{q}/(\overline{M01-M00})$	ZA 9000-FS		W/m²K	q/dT
Wet bulb globe temperature	ZA 9000-FS		°C	WBGT
Cold junction temperature	any		°C	CJ
Volume m³/h $\overline{Mb1} \cdot Q$	any		m³/h	Flow

TC = Temperature Compensation, PC = Atmospheric Pressure Compensation, Mbx = Reference channels

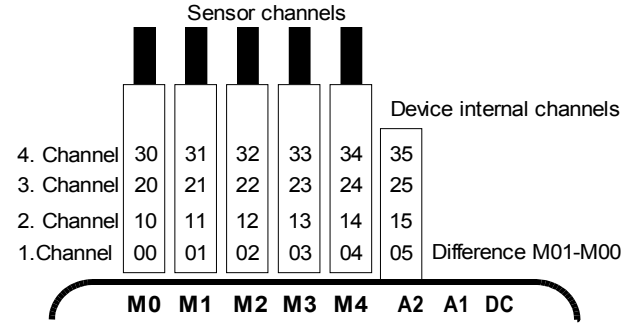
* Calculated variables of humidity (Mb1=Temperature, Mb2=Humidity/Humid temp.)

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 for representing function parameters in measured value processing or calculated results from 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 standard reference channels Mb1 and Mb2.

Function	Function channel	Ref. Channel 1	Ref. Channel 2
* Humidity variables cap.	to 3. or 4.Channel	Mb1=Temperatur	Mb2=Humidity
* Humidity variables psy.	to 3. or 4.Channel	Mb1=TT	Mb2=HT
Function parameters (Mb1)	to 2., 3. or 4.Channel	Mb1= 1.Channel	
Difference (Mb1-Mb2)	to 2., 3., 4.Chan. (Mb1)	Mb1= 1.Channel	Mb2=M00
Avg. value over Mb2..Mb1	to 2., 3., 4.Chan. (Mb1)	Mb1= 1.Channel	Mb2=M00
Sum over Mb2..Mb1	to 2., 3., 4.Chan. (Mb1)	Mb1= 1.Channel	Mb2=M00
$\overline{q/(M01-M00)}$	to 2., 3., 4.Chan. (q)	Mb1= 1.Channel	Mb2=M05
WBGT	to 2.Channel (GT)	Mb1= 1.Channel	Mb2=M00

Arrangement of channels on the connectors :



Once the range has been programmed the standard reference channels can be used (see above). Settings for the reference channels are described in 10.4.6. The best approach is to use the Function channeli assistant.

A new feature is the presence of four device-internal channels:

M5 is programmed by default as differential channel M1-M0; this applies if there are two sensors with the same units and same decimal point position connected at measuring points M0 and M1. However, all four channels can be used in conjunction with any function channels with standard reference channels Mb1=M1 and Mb2=M0 assigned; i.e. if you want to program a function parameter without reference channel on a device-internal basis, the sensor must be connected to M1.

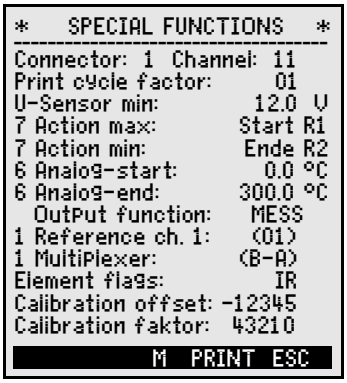
Advantage of device-internal channels:

If several sensors are being used for the same application, they do not have to be reprogrammed and can be freely exchanged without losing their function

channel assignment. However, if the whole application operates with just one sensor, then programming on the sensor itself makes more sense.

10.4 Special Functions

The data logger 2690-8 has a separate menu allowing access to all ALMEMO® special functions, which despite only rarely being required during routine operation, are very useful for some applications (see manual 6.10). These functions can (to a certain extent) be very complex and should only be used if their operation is completely understood.



10.4.1 Print Cycle Factor

For the adaptation of the data recording to the update speed of the individual measuring points it is possible to program a print cycle factor between 00 and 99 to output measuring points less often or not at all (see manual 6.10.6). Only disturbed measuring points, e.g. on exceeding of limit values will always be output. Generally, the print cycle factor of all measuring points is cleared or set to 01, i.e. all activated measuring points will be output at each cycle. If a different factor, e.g. 10 is programmed, the corresponding measuring point will only be put out once in ten times, however, if 00 is programmed it will not be output. The data recording also allows to suppress unnecessary measured values and, as a result, saves memory space.

Enter the print cycle factor (s. 8.5) in function: `Print cycle factor: 01`
Clearing the print cycle factor with the key: **<CLR>**

10.4.2 Minimum Sensor Supply Voltage

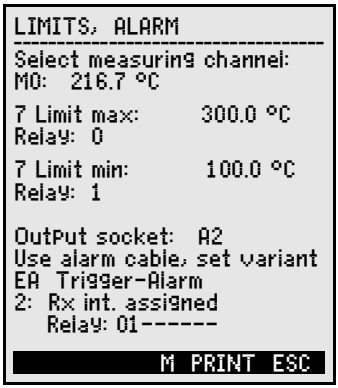
Similarly to all ALMEMO® devices, the sensor supply voltage is also monitored in the 2690-8. It is also displayed in the menu `Power supply` (s. 10.7). However, there are also sensors, which require for a correct operation a supply voltage, which requires a charged accumulator or a power supply unit. To avoid measuring errors, the sensor programming allows to individually program the required minimum sensor voltage for each transducer. In case of falling below this voltage the measured value is treated as sensor breakage (indication L flashes).

Entering the minimum sensor supply voltage: `U-Sensor Min: 12.0 V`
Switching off the voltage control with the key: **<CLR>**
`U-Sensor Min: ---- V`

10.4.3 Limit Value Responses

Relay Allocation

As standard, both limit values of all measuring points of a device are used for fault alarms (s. 10.3.5), i.e. if an exceeding of a limit value occurs at any measuring point, the relay 0 responds if an Alarm Relay Cable or a corresponding Relay Adapter (s. man. 5.2/3) is used. It only opens again, after all measured values have dropped below the limit values by as much as the hysteresis. If a limit value has not been defined, the measuring range limit will be used as limit value. A sensor breakage will always cause a fault alarm.
To distinguish between max value exceeding and min value undershooting the alarm signal generators can be re-programmed to variant 1 (s. 10.6.2, man. 6.10.9).
If it is necessary to selectively identify and evaluate faults, the function `Action Max`, `Action Min` or the assistant menu `LIMITS, ALARM` can be used to allocate individual relays to the limit values. It is also possible to allocate several limit values to one relay. For this purpose the relay cables provide 2 relays (0 and 1) and the relay adapter (ZA 8000-RTA) provides 4 relays (0 to 3). This mode also has to be set as variant 2 in the output module (s. 10.6.2, man. 6.10.9).



`Output socket: A2`
Setting the relay module to variant 2:
(relay int. allocated)
Activating relay x at limit value exceeding Max:
Activating relay y at limit value undershooting Min:
Clearing the relay allocation using the key:

`EA Trigger-Alarm`
`2: Rx int. allocated`
`7 Action max: ----- Rx`
`7 Action min: ----- Ry`
`<CLR>`

Starting and Stopping a Measurement

Exceeding of limit values can not only be used for fault alarms but also to start or stop a measurement (s. man. 6.6.3). The start command or stop command is assigned to a limit value - also by means of the functions `Action max` and `Action min`.

Starting the measurement at exceeding of limit max: `7 Action max: Start--`
Stopping measurement at undershooting of limit min: `7 Action min: Stop--`
Clear response by using the key: `<CLR>`

Printing the sensor programming (s. man. 6.10.1), there appears a composed code for start/end `S/E` (s. man. 6.6.3) and relay allocation `x` (s. man. 6.10.8) in the actions Max (AH) and Min (AL).

10.4.4 Analog Output Start and End

In most cases the analog output of measured values to the analog output modules (see manual 5) or the display as bar or line chart must be scaled to a specified sub-range. For this, it is just necessary to specify the start and end value of the display range required by you. This range is then mapped to the analog range 2V, 10V, 20mA or, for the display, to 100 dots.

Programming the **analog output start**: `6 Anaiog start: 0.0°C`
Programming the **analog output end**: `6 Anaiog end: 100.0°C`

These two parameters, analog output start and analog output end, are also stored in the EEPROM of the sensor and can, therefore, be individually programmed for each channel, i.e. during a manual switch through the channels an individual scaling is available for each measuring variable.
The flag for switching over from 0-20mA to 4-20mA can be programmed through the element flags (s. 10.4.8).
There is the assistant menu `Anaiog outPut` (s. 10.6.3) to programm all parameters of an analog output.

10.4.5 Output Function

If not the real measured value but only the Max, Min, Average or Alarm value is required, then this function can be programmed as output function (see manual 6.10.4). As a result, only the corresponding function value will be considered for storing and analog or digital output. For control of the changed output function the symbol below is displayed next to the measured value (s. 8.3).

Examples:

1. If meas. values are averaged over the cycle only the average value is relevant as output value, but not the last measured value. This way, memory space can be saved in a data logger.
2. The analog measured value of the dew sensor FH A946-1 has no meaning. If the limit value Max is set to approximately 0.5V, and the measuring function ´Alarm Value´ is programmed only the relevant values 0.0% for dry and 100.0% for ´dew´ will be displayed.

Output Function	**Control Symbol**	**Menu**
Measuring 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: Alrm`

10.4.6 Reference Channel 1

The arithmetic functions of the function channels, generally, refer to a particular measuring channel (or 2 meas. channels) (s. 10.3.10, man. 6.3.4). During the programming of a function channel the first channel of the corresponding sensor connector Mxx1 is automatically set as reference channel Mb1. The 2nd reference channel Mb2 (for difference, average value M(n) etc.) is, initially, the measuring point M00. In function `Reference ch. 1` it is possible to set other measuring points as reference channel, either absolutely by specifying a particular measuring point or by specifying the ´distance´ referred to the function channel (e.g. -01 identifies the channel preceding the function channel).

Programming of the ref. channel 1 absolute:	`1 RefChannel 1: 01`
Programming of the ref. channel 1 relative:	`1 RefChannel 1: -10`

10.4.7 Reference Channel 2 or Multiplexer

In case of function channels, which require a second reference channel (s. above), the function `Reference channel 2` will automatically be displayed in the line after `Reference channel 1`. In all other cases it is possible to change the pin assignment in the connector by changing the input multiplexer with the function `MultiPlexer` (s. manual 6.10.2).

Programming of the ref. channel 2 absolute:	`1 RefChannel 2: 00`
Programming of the ref. channel 2 relative:	`1 RefChannel 2: -01`
Measuring inputs B+ and A-, GND-referred	`1 MultiPlexer: B-A`
Measuring inputs C+ and A-, GND-referred	`1 MultiPlexer: C-A`
Measuring inputs D+ and A-, GND-referred	`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

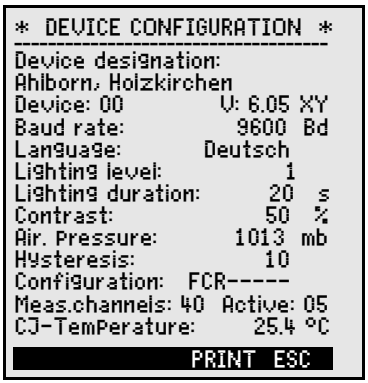
For a realization of sensor-specific additional functions, element flags can be activated at each measuring channel (s. manual 6.10.3)

Measuring current 1/10 for Pt1000, 5000Ω:	`ElementFlags: I 1/10`
Emission and background temp. for IR sensors:	`ElementFlags: IR`
Meas. bridge with switch for final value simulation:	`ElementFlags: Bridge`
(Activation base value:) *	`ElementFlags: Basis`
(Activation of all averaging functions:) *	`ElementFlags: Avg On`
(Element flag 6:) *	`ElementFlags: Flag 6`
Switch-off of the sensor breakage detection:	`ElementFlags: Br Off`
Analog output 4-20mA instead of 0-20mA:	`ElementFlags: A 4-20`

* At the ALMEMO 2690-8 these element flags have no meaning

10.5 Device Configuration

Some fundamental settings can be taken in the menu DEVICE CONFIGURATION. The device designation serves as print header in log printouts and facilitates the assignment within a network. Furthermore, the device address is imperative in a network. The baud rate can be adapted to external devices. Three levels are available for the lighting of the display. The setting of the atmospheric pressure for the compensation of certain sensors is particularly suitable at corresponding altitudes. The standard value of the hysteresis of alarm relays can be changed. For checking the device the channel number and cold junction temperature are indicated.



10.5.1 Device Designation

The function Device designation (s. manual 6.2.4) allows to enter any text with max 40 digits (s. 8.5). The text appears in the main menu, in the print header of a measurement and in device lists (software).

Function Device designation:

Device designation:
Ahlborn, Holzkirchen

10.5.2 Device Address and Networking

All ALMEMO® instruments can be very easily networked to centrally acquire the measured values of several instruments that are located at different places (see manual 5.3). For communicating with networked devices it is mandatory that all devices have the same baud rate and an own individual address as only one device is allowed to respond to each command. Therefore, before any network operation it is necessary that all connected devices are set to different device numbers. For this, the function Device is available. Generally, the device number 00 is set as the factory default value in this function. It can be changed by the usual data entry (s. 8.5). For checking purposes it is followed by the device type, the version number and, possibly, an option code (s. manual 6.10.11).

Device address with type, version, option: Device: 00 2690-8 V:6.05XY

Example: address: 00, type: 2690-8, version: 6.05, option: XY

Only successive numbers between 01 and 99 should be entered for network operation so that the device 00 cannot be falsely addressed in case of a power supply failure.

10.5.3 Baud Rate, Data Format

All interface modules are factory-set and programmed to 9600 baud. To avoid unnecessary problems when networking several devices the baud rate should not be modified but the computer or printer should be set up accordingly. If this is not possible the values 1200, 2400, 4800, 9600bd or 57.6, 115.2 kbd can be entered in the function `Baud Rate` (please consider the max. baud rate of the interface module!). The baud rate setting will be stored in the EEPROM of the interface module and will then be valid for use with all other ALMEMO devices.

Function `Baud Rate`: `BaudRate: 9600bd`

Data Format: unchangeable 8 data bits, no parity, 1 stop bit

10.5.4 Language

The language of the function legend and the printouts can be set to German, French or English. The soft keys are international code and are not meant to be altered:

Language selection in function `Language` s. 8.5: `Language: English`

10.5.5 Lighting and Contrast

The background lighting of the display can be switched on or off in 3 levels in the selection menus by using the key `<* ON>` or in the function `Lighting` of the device configuration (attention, the power consumption is fife times higher in level 3!). If the lighting is switched on when a mains supply adapter is not connected, the lighting will switch off in a configurable lighting time after the last key was operated (pause), and it will switch on again as soon as any key is operated. With the function `Contrast` the contrast of the display can be set to 10 different positions.

Switching on the lighting, level 1 to 3: `Lighting level: 2`
Switching off the lighting, level 0: `Lighting level: 0`
Entering the lighting time from 20sec to 10 min: `Lighting time: 20s`

If the **lighting is switched on**,
the status line provides the symbol: `*` Lighting on
If it is temporarily switched off, lights up: `*` Pause
Switch-on **without** function by using the key: `<ESC>`
Setting the contrast (10 to 100%) s. 8.5: `Contrast: 50%`

10.5.6 Atmospheric Pressure

For compensation of various sensors the atmospheric pressure can be entered (s. 9.2.6). If it is measured, it will also be indicated in this function:

Entering the atmospheric pressure in function: `Atm. Pressure 1013mb`

10.5.7 Hysteresis

In case of an exceeding of limit values the hysteresis of an alarm condition can, generally for all sensors, be set in the function `Hysteresis` (s. 10.3.5 and manual 6.2.7) within the range from 0 to 99 digits (standard setting is 10 digits).

Change hysteresis (0 to 99) s. 8.5: `Hysteresis: 10`

10.5.8 Operating Parameters

Some operating parameters are software options and can be user-configured with the function `Configuration` (s. manual 6.10.13.2).

Mains frequency noise suppression 60Hz instead of 50Hz	`Configuration: F-------`
Clearing all measured values on start of a measurement	`Configuration: -C------`
Ring memory (overwriting of old data when full)	`Configuration: --R-----`
Switching off the signal transmitter	`Configuration: -----S--`

The following parameters can be used to check the device function:

Out of 20 channels 5 are activated: `Meas.Chan:20 active:05`

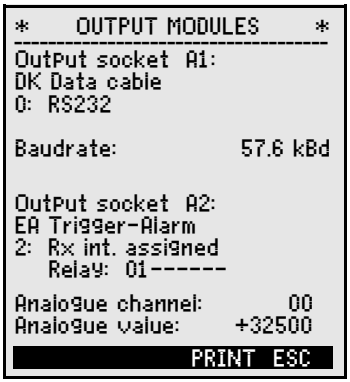
Cold junction temperature = socket temperature: `CJ-Temperature: 25.4°C`

10.6 Output Modules

The data logger ALMEMO® 2690-8 has two output sockets, A1 and A2, to allow an output of the measured values as analog or digital values or as alarm signals. Furthermore, it is possible to trigger various functions through trigger pulses. To suit all possibilities, while keeping the hardware requirements at a minimum, all necessary interfaces have been integrated into the ALMEMO® output connectors.

The output modules, like the sensors, are automatically detected and displayed in the menu `OUTPUT MODULES` so that, generally, no programming is required.

The various connection possibilities are only listed here, but they are concretely described in the manual section 5.



10.6.1 Data cable

The serial interface can be used to output cyclic data logs, all function values of the measuring menus, as well as the whole programming of the sensors and the device to a printer or computer. The ALMEMO® data cables and the connection to the instruments are described in the manual section 5.2. Other modules for networking the instruments follow in the manual section 5.3.
All available interface modules are connected to the socket A1 **(2)**, exception: network cables ZA1999-NK to network a further instrum. are connected to A2.

Under the prevailing socket the menu indicates:

```
Outout Socket A1:
DK Data cable
```

Variant 0: Standard interface always active

```
0: RS232
```

The baud rate is also stored in the cable connector:

```
Baudrate:      9600 Bd
```

10.6.2 Relais Trigger Cable

The combined input and output cables (ZA 1000-EAK) and the relay trigger analog adapter ZA 800x-RTA (see manual 5.1.2/3) provide max. 4 switching contacts for the triggering of peripheral devices and trigger inputs (see manual 6.6.4). They are connected to the output socket A2 **(2)** and their function can be programmed (see manual 6.10.9):

Module	Type	No	Abbrev	Comment
Trigger cable	EK	0	EK0	Start/stop succession with pos. edge/contact
	EK	1	EK1	Single Measuring Point Scan
	EK	2	EK2	Clear Max/Min values
	EK	3	EK3	Print the function
	EK	4	EK4	Start/stop level-triggered
	NK	8	EK8	Setting the measured value to zero
Alarm cable	GK	0	AK0	Relay R0 alarm from all channels
	GK2	1	AK1	Relay R0 alarm Max, R1 alarm Min
	GK3	2	AK2	Relay Rx internally allocated (s. 10.4.3)
	AK	8	AK8	Relay Rx externally triggered
Trigger alarm	EGK	0	EA0	Start/stop, relay R0 alarm from all channels
	EGK	1	EA1	Start/stop, relay R0 alarm Max, R1 alarm Min
	EGK	2	EA2	Start/stop, relay Rx internally allocated
	EAK	8	EA8	Start/stop, relay Rx externally triggered

At socket A2:
a trigger alarm cable is connected,
programmed to variant no. 2,
the relay R1 is activated

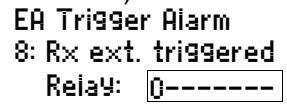
```
OutPut Socket A2:
EA Trigger Alarm
2: Rx int. allocated
   Relay: -1------
```

After the function selection the variant x can be programmed.

The alarm variant no. 2 ´Relay internally allocated´ additionally requires the **allocation of the relays** to particular limit values (s. 10.4.3).

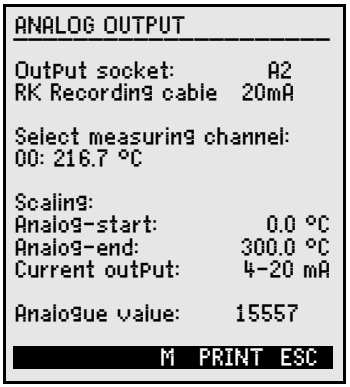
The variant no. 8 ´Externally Triggered´ allows a **manual triggering** of relays through the keypad or via the interface (see manual 6.10.10.).

Trigger alarm cable
programmed to variant no.8
Programming of the relay state, s. 8.5



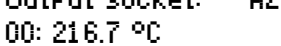
10.6.3 Analog Output

For analog acquisition of the selected measuring point either an analog output cable ZA 1601-RK (see manual 5.1.1) without electrical isolation or a relay trigger analog adapter ZA 8000-RTA (see manual 5.1.3) with electrically isolated analog output can be connected to the sockets A1 and/or A2 **(2)**. All parameters for configuration of the analog ouputs are available in the assistant menu `Analog Output`.
The functions `Analog-start and -end` for scaling have already been described in the menu `SPeciaI functions` (s. 10.4).



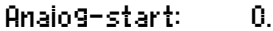
Selection of the output socket A1 or A2:

Selection of the measuring channel,
which is to be output using the key:



Scaling of the analog output:

Programming the analog output start:
Programming the analog output end:

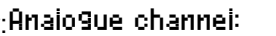


Only for 20mA analog outputs:
Selection between 0-20mA and 4-20mA output:

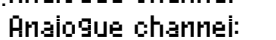
Analog channel

In the menu `Output moduls`, the measuring point, which is output to the analog output to socket A2, is displayed as analog channel. Without programming, this is the selected channel Mxx. This adjustment in connection with a half-continuous conversion rate (s. 10.1.3) is the most favourable, because in this way, the analog output is operated with most frequently. However, any measuring point can be determined for the analog output via programming (see above).

Analog output of the selected meas. channel Mxx:



Analog output of the programmed meas. chann. yy:



Programmed analog output (see below):

Programmed Analog Value Output

The analog value (Output to A1) can also be programmed, manually or via interface, in a range from -12000...+20000 digits (see manual 6.10.7). Depending on the analog output the following output signals are available:

Voltage output	-1.2 ... +2.0 V	0.1mV/Digit
Voltage output	-6.0 ... +10.0 V	0.5mV/Digit
Current output	0.0 ...20.0 mA	1µA/Digit

Set analogue channel to programmed output with: **<CLR>**

```
Analogue channel: M--
```

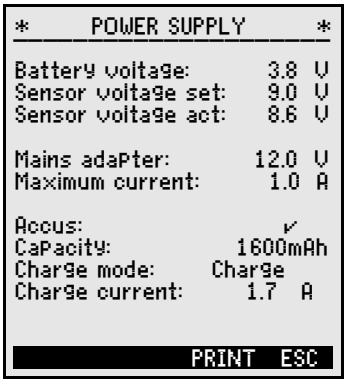
Output of 2.5V using the 10V output = 5000 digits:

```
Analogue value:+05000
```

switching back to the meas. channel by using the key: **<OFF>**

switching back to the previous programming value: **<ON>**

10.7 Menu Power Supply



Power for the measuring instrument is normally supplied from three AA battery cells, either standard or rechargeable. The POWER SUPPLY menu provides an estimation of the battery's remaining operating time in the form of a current voltage display. At 3.5 volts the battery symbol in the status line starts to flash and at 3.1 volts the device switches off automatically. The current charge status cannot be displayed more exactly than this because of the different types of battery cell available.

To power the sensors a selectable sensor voltage is generated (approx. 6, 9, or 12 volts). With sensors that draw a lot of current but manage with relatively low voltage, the ideal sensor voltage selection can save a lot of energy.

Setting the desired Sensor Voltage:

```
Sensor voltage set: 9.0 V
```

Display of actual sensor voltage:

```
Sensor voltage act: 9.1 V
```

If a mains adapter is connected, the sensor voltage will always be over 9V:

```
Mains adapter: 9.3 V
```

The max. admissible current is also displayed:

```
Maximum current: 1.0 A
```

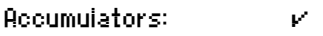
Our range of accessories includes a rechargeable battery set ZA2690-AS, comprising three NiMH 1.6-Ah accumulators and an intelligent charge adapter. These rechargeable batteries are coded in such a way that they can be recognized and correctly recharged in the device. They can be charged up quickly and easily irrespective of their current charge status at any time. The charge adapter regulates the charging current according to the maximum admissible current of the mains adapter and the capacity of the rechargeable batteries in such a way that the recharging process can be completed as quickly as possible. However, in normal operating conditions the current is reduced in order to

reserve sufficient current for the measuring instrument and sensors and to avoid adversely affecting measuring quality.
With our two mains adapters (accessories) the following recharge times are needed:

Order-No.	Max. current	Device status	Charge current	Charge time
ZA2690-NA	200mA	switched off	400mA	approx. 4h
		in operation	160mA	approx. 10h
ZA2690-NA2	800mA	switched off	1600mA	approx. 1h
		in operation	400mA	approx. 2.5h

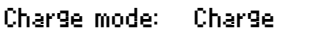
For the duration of the charging phase the green LED on the adapter remains lit continuously; as soon as the battery is fully charged, the adapter switches over to trickle charge and the LED starts flashing.

If the accumulators are discerned (contact), there appears in the display:



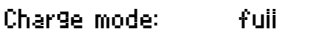
The accumulator capacity must be programmed:

In charging mode the charge status is displayed:



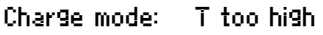
The charging current is set automatically:

As soon as the accumulator is fully charged, charging status displays:

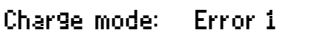


the charge current switches over to trickle charge:

If the battery temperature is either too high or too low for charging or if the mains adapter is too weak etc., the charging mode displays, e.g.:



or a numbered error mistake:



11. TROUBLESHOOTING

The data logger ALMEMO 2690-8 can be configured and programmed in many different ways. It allows for a connection of many different sensors, additional measuring instruments, alarm signalisers and peripheral devices. Due to the large variety of options it is possible that, under certain conditions, it does not perform as the user would expect. In most cases this will not be related to a defective device but to operating errors such as wrong settings or an inadmissible wiring. The following tests should be performed to correct or to correctly identify the error.

Error: No display at all or faulty display, no key response

Remedy: Check power supply, recharge battery, switch off and on again, reinitialise, if required (see point 6.6)

Error: Incorrect measured values

Remedy: Thoroughly check the entire programming of the channel, particularly base and zero point (menu ´Sensor Programming´ and ´Special Functions´)

Error: Varying meas. values or blockage during operation

Remedy: Check cabling for inadmissible electrical connection,
disconnect all suspicious sensors,
connect hand-held sensors and operate them in air or connect dummies (short circuit AB at thermocouples, 100 Ω at Pt100 sensors) and check,
then reconnect sensors successively and check.
If an error occurs with one sensor, check the wiring, isolate the sen sor if necessary, prevent influences from disturbances by shielding or twisting.

Error: Data transmission via interface does not function

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

A small interface tester with LEDs is very useful for checking the data flow and the handshake lines (during standby mode the data lines TXD and RXD are on a negative potential of approximately -9V and the LEDs are illuminated green. The handshake lines DSR, DTR, RTS and CTS have a positive voltage of approximately +9V and the LEDs are illuminated red. During the data transmission the data LEDs must flash red).

Test the data transmission by using a terminal (AMR-Control, WIN-Control, WINDOWS Terminal):

Select output channel interface U by using the command ´A1´,
Address the device with its device number ´Gxy´ (s. man. 6.2.1),
if the computer is in XOFF state, enter <Strg Q> for XON,
query the programming through ´P15´ (s. man. 6.2.3),
Only check the sending line by cycle input via command ´Z123456´ and control in the display
Test the receiving line with the key **<PRINT>** and by monitor control.

Error: Data transmission within the network does not function.

Remedy: Check that all devices are set to different addresses, address all devices individually via terminal and command ´Gxy´.
Addressed device is OK when the feedback is at least ´y CR LF´.
If data transmission is still not possible, disconnect networked devices, check all devices separately using the data cable of the computer (see above),
check the wiring regarding short circuit or twisting.
Are all network distributors supplied with power?
Network and check the devices successively again (see above).

If the device is, after the above inspections, still not performing as specified in the operating instructions, it must be sent to the factory in Holzkirchen, Germany, including a short report and, possibly, control printouts. Additionally, the software AMR-Control allows to print the monitor pages including the programming and also to save an extensive ´function test´ in the device list or the terminal operation and to print it out.

12. ELECTROMAGNETIC COMPATIBILITY

The data logger ALMEMO 2690-8 meets the essential electromagnetic compability safety requirements issued in the relevant CE directive 89/336/EWG.

The following standards have been applied for the evaluation of 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 3V/m

The following notes must be observed when operating the instrument:

1. If the standard sensor cables (1.5m) are extended it must be considered that the measuring lines are not guided together with power mains and that they are appropriately shielded to protect against any coupling of disturbance signals.
2. If the instrument is operated within strong electromagnetic fields an additional measuring error must be expected (<50µV at 3V/m and 1.5m thermocouple transducers). After the irradiation the device operates again within the specified technical data.

13. APPENDIX

13.1 Technical Data (see manual 2.3)

Measuring inputs:	5 ALMEMO® sockets for ALMEMO® flat connectors
Meas. channels:	5 primary channels el. isol., max. 19 add. channels for double sensors and function channels
AD-converter:	Delta-sigma >16bit, 2.5, 10, 50 M/s, amplific. 1..100
Sensor voltage supply:	6V 0.2A, 9V 0.15A, 12V 0.1A (mains adapter: ≥9V)
Outputs:	2 ALMEMO® sockets for all output modules
Equipment:	
Display:	graphics 128x128 dots, 16 lines à 4mm
Operation:	9 keys (4 softkeys)
Memory:	512kB EEPROM (approx. 100000 Meas.values)
Time and Date:	real time clock buffered with Lithium battery
Microprocessor:	M16C62P
Power supply:	ext. 6...13V DC
Batteries:	3 Alkaline Mignon type AA or 3 Accumulators NiMH-Mignon type AA 1.6 Ah
Mains adapter standard:	ZA 2690-NA 230V AC to 12V DC, 0.2 A
for fast accumulator charging:	ZA 2690-NA2 230V AC to 12V DC, 0.8 A
Adapter cable electr. isolated:	ZA 2690-UK 10...30V DC to 12V DC, 0.25 A
Current consumption without input and output modules:	active mode: approx. 30 mA with lighting: approx. 50..150 mA sleep mode: approx. 0.05 mA
Housing:	L204 x B109 x H44 mm, ABS, weight: 550g
Operation conditions:	
Operating temperature:	-10 ... +50 °C (storage temperature: -20 ... +60 °C)
Humidity of ambient air:	10 ... 90 % rH (non-condensing)

13.2 Product overview

Data logger ALMEMO 2690-8	**Order No.**
5 inputs, max. 24 channels, 2 outputs, cascadable interface, 9 keys, LCD graphics display, real time clock, 512kB EEPROM memory	MA 2690-8
Mains adapter with ALMEMO connector 12V, 0.2 A	ZA 2690-NA
Mains adapter with ALMEMO connector 12V, 0.8 A	ZA 2690-NA2
Accumulator set with 3 NiMH-Mignon cells 1600 mAh coded and fast charging adapter for 3-9 NiCd- or NiMH cells, 12V, max. 2A	ZA 2690-AS
DC Adapter cable 10 to 30V DC, 12V/0.25A electr. isolated	ZA 2690-UK
ALMEMO® Recording cable -1,25 to 2,00 V	ZA 1601-RK
ALMEMO® Data cable V24 Interface, electr. isolated, max. 115.2kB	ZA 1909-DK5
ALMEMO® Network cable, electr. isolated, max. 115.2kB	ZA 1999-NK5
ALMEMO® I/O cable for triggering and limit value alarm	ZA 1000-EGK

13.3 Keyword index