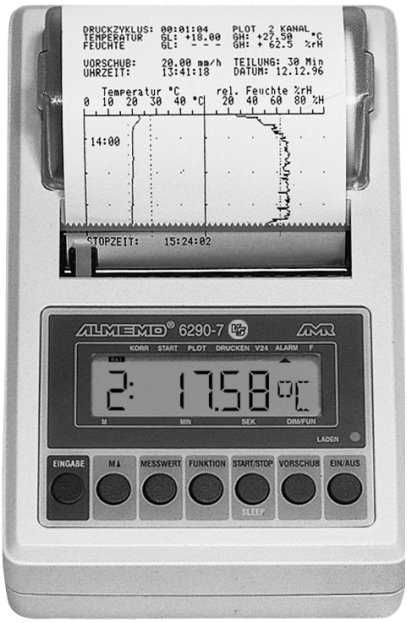
AHLBORN

Operating Instructions



Measuring Instrument
with Built-In Printer
ALMEMO® 6290-7B V5

V1.3
18.03.2004

Operating Instructions

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ALMEMO® 6290-7B V5

For Reference with the ALMEMO® Manual

Table of Contents

		Page
1	**INTRODUCTION**	**4**
1.1	Function Range	4
1.2	Front Operating Controls	9
1.3	Rear Operating Controls	11
2	**INITIAL OPERATION**	**12**
3	**POWER SUPPLY**	**13**
3.1	Rechargeable Battery Operation	13
3.2	Mains Operation	13
3.3	External Power Supply	13
3.4	Switch On/Off, Reinitialisation	14
3.5	Data Buffer	14
4	**CONNECTION OF THE TRANSDUCERS**	**15**
4.1	Transducers	15
4.2	Measuring Inputs and Additional Channels	15
5	**DISPLAY AND KEYBOARD**	**17**
5.1	Display	17
5.2	Selecting and Activating Functions	18
5.3	Keyboard	19
5.4	Data Input	20
5.5	Keyboard Lock	20

		Page
6	**SENSOR PROGRAMMING**	**21**
6.1	Selecting the Input Channel	21
6.2	Selecting the Measuring Range	21
6.3	Changing the Dimension	24
6.4	Limit Values	25
6.5	Correction Values, Sensor Adjustment	25
6.6	Scaling, Decimal Point Setting	26
6.7	Locking the Programming of the Sensor	27
7	**MEASUREMENT**	**28**
7.1	**Continuous Measurement of a Measuring Point**	**28**
7.1.1	Selecting the Measuring Point	28
7.1.2	Memory for Peak Values	29
7.1.3	Setting the Measured Value to Zero, Zero Point Correction	29
7.1.4	Atmospheric Pressure Compensation	30
7.2	**Measuring Point Scan**	**31**
7.2.1	Single Measuring Point Scan	31
7.2.2	Cyclic Measuring Point Scan	31
7.2.3	Print Cycle	32
7.2.4	Time and Date	32
7.2.5	Sleep Mode	33
8	**DIGITAL DATA OUTPUT**	**34**
8.1	**Output Mode**	**34**
8.2	**Built-In Printer**	**34**
8.3	**Print**	**35**
8.3.1	Programming	35
8.3.2	List of Measured Values	35
8.3.3	Measured Values and Max and Min Values	36
8.4	**Plot**	**36**
8.4.1	Plot Range	37
8.4.2	Paper Feed	38
8.4.3	Line Plot	38
8.5	**Output via Serial Interface**	**39**
8.5.1	Baud Rate, Data Format	39
8.5.2	List of Measured Values, Output Formats	39
8.5.3	Manual Data Output	40
8.5.4	Device Address and Networking	41
8.6	**Data Memory (Option S)**	**42**
8.6.1	Memory Functions	42
8.6.2	Memory Output	44

		Page
9	**TROUBLESHOOTING**	**45**
10	**ELECTROMAGNETIC COMPATIBILITY**	**46**
	APPENDIX	**47**
	Technical Data	47
	Product Overview	48
	Your Contacts	49

1. INTRODUCTION

The new measuring instrument with built-in printer ALMEMO® 6290-7B *Version 5* is an 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® instruments in the same way. The operation and programming is identical with all units. Therefore, all ALMEMO® measuring system items listed below are described, in detail, in a separate ALMEMO® manual supplied with each 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 analogue 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, the sections dealing with the system control via keyboard will only often provide a note referring to a more detailed description within the manual (manual section x.x.x).

1.1 Function Range

The ALMEMO® 6290-7B instrument with built-in printer allows for acquiring measured values from 2 sensors and up to 8 channels and, optionally, for an alphanumerical printout or line plot. With option S (memory), data can be recorded and reproduced in any form. The integrated rechargeable batteries offer a sleep mode operation allowing for long term recording that is independent from mains supply. All ALMEMO® output modules, e.g. analogue output, digital interface, trigger input or alarm contacts can be connected to the 2 output sockets. Several devices can be easily networked by simply connecting them. For easy operation it is equipped with a keyboard and an 8½ digit LCD display. The many functions for optimal evaluation of all sensors, for flexible process control and data output, are automatically activated or can be configured as required. Some special functions are only available via interface.

SENSOR PROGRAMMING

The measuring channels are automatically programmed by the ALMEMO® connectors of the sensors. 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 voltage, current and resistance ranges with individual scaling in the connector. Existing sensors can be used without problems. ALMEMO® connectors are available for this purpose and only have to be connected using the screw 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 and can be processed and printed like normal measuring junctions. Furthermore, function channels for special measuring tasks are provided to determine temperature coefficient $Q/\Delta t$ and wet bulb globe temperatures.

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.

Correction of Measured Values

For correcting measured values a zero point and slope (gain) 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 (gain) 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 measured value of each measuring channel for zero point and slope (gain). The decimal point position can be set by the exponent.

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

Plot Range
For accurate graphical outputs the plot range can be programmed for each channel with plot range start and plot range end.

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.

MEASUREMENT
Up to 4 measuring channels are available for each transducer, i.e. it is also possible to evaluate double sensors, individually scaled sensors, or sensors with function channels. The measuring channels can be successively selected forwards or backwards via keyboard. The selected measuring point can be scanned with a conversion rate of 2.5 or 10 measurements/second. The measured value is calculated and indicated on the display or, if available, provided on the analogue output.

Measured Value
A continuous presentation of measuring data from the selected measuring point is provided and also includes automatic zero point correction and optional correction of the measured value or new scaling.
A sensor breakage condition is, with most sensors, automatically detected (exception: connectors with shunts, dividers or additional electronics).

Measuring Functions
Special measuring functions are required for some sensors in order to achieve an optimal acquisition of measuring data. 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 O_2 sensors. With infrared sensors the parameters zero point and slope correction are used for background temperature and emissivity factor.

Analogue Output and Scaling
By means of analogue start and analogue end the indicated measured value can be scaled so that the resulting measuring range covers the full analogue output range (2V, 10V or 20mA).

Maximum and Minimum Value
Each measurement involves an acquisition and storing of the maximum and minimum value. These values can be displayed, printed or cleared.

PROCESS FLOW PROGRAMMING
A cyclic measuring point scan with a time-based process flow control is required to register the measuring data of all connected sensors. For this purpose, the real time clock, the print cycle and the paper feed are available. If fast processing is required, the data can be recorded according to the conversion rate. 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 date function or the pure measuring time are used for an accurate recording of any measurement.

Output Mode
The setting of the output mode determines whether the plot presents the measured values in one diagram, or in two diagrams (side by side), or alphanumerically, to a printer or interface.

Paper Feed
When plotting, the required measuring rate is determined by the available adjustment of the paper feed.

Print Cycle
The print cycle is programmable between 1s and 59h/59min/59s and provides a cyclic output of measured values to the interfaces.

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

Conversion Rate
With ALMEMO® *V5* devices, all measuring points can be continuously scanned with the conversion rate (2.5 or 10 meas./s). It is also possible to provide all measured values as an output via interface.

Control Outputs
The interface allows to individually trigger up to four output relays and one analogue output.

PRINTER OUTPUT
All measuring and programming data are, firstly, accessible via LCD display. In addition, the measuring instrument has an integrated thermal printer with graphic capabilities, which allows for, either, a line plot with 280 dots, or to print 40 characters/line alphanumerically. In plot mode 4 channels can be optionally presented with individual scaling in one channel or two channels in two

diagrams. The limit values are drawn as a line. The print mode allows for the output of the measured values in a list format, or an output of the maximum and minimum values or of the entire programming.

MEMORY (Option S)
The instrument is, optionally, available with 500 kB memory for 100000 measured values. All data of a measurement are, in addition, stored in a buffered RAM and can be subsequently reproduced in any form. The storage organisation can be configured as linear or ring memory. The output can be carried out via the built-in printer or the interface. A selection with respect to time intervals or alarm values is available. The following functions are temporarily available for the corresponding control of the data output:

Output mode plot, print and interface output
Plot range start and **plot range end** for each channel
Start/end time and **start/end date**

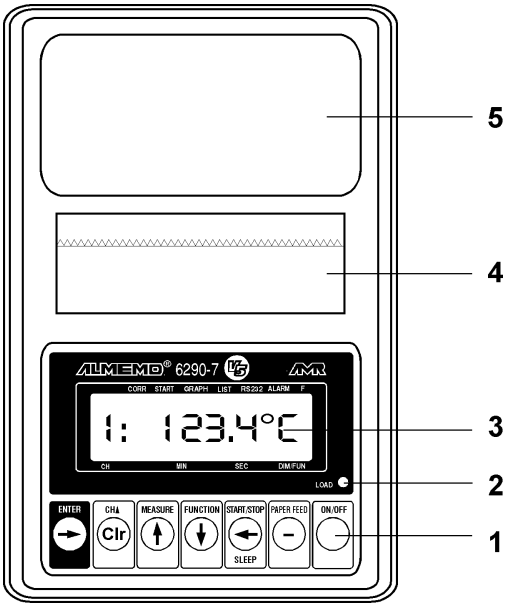
INTERFACE FUNCTIONS
By using different interface cables an RS232, RS422, RS485 or Centronics interface is also available. All measurement records and all stored measuring and programming values can be output to any peripheral device. The output of measuring data can be selected in list format, columns 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. The baud rate is programmed and stored in the connector plug and is automatically recognised.

Name of Measured Values
Sensors can be identified by a 10 digit alphanumeric designation. It is entered via the interface and appears on the printout or display if the evaluation is done via PC.

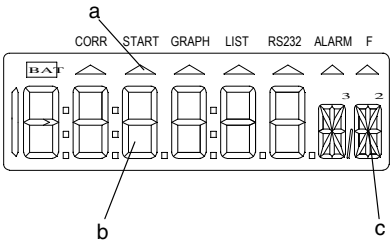
Networking
All ALMEMO® devices can be addressed and can be easily networked by a simple connection with network cables or network junctions for longer distances.

Software
The AMR-Control software, which allows for the entire programming of the sensors and for the configuration of the measuring instrument is supplied with each ALMEMO® manual. The integrated terminal also allows for online measurements. The WINDOWS® software packages, Win-Control and DATA-Control, are available for data acquisition of networked devices, graphical presentation and complex data processing. The software LogCel is provided for an online import of data into MS-Excel®.

1.2 Front Operating Controls



(3) **LCD Display**



(a) Symbols for Operating States

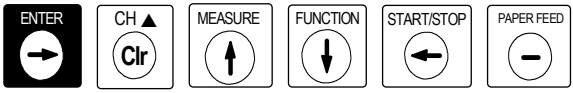
BAT	Batt. soon empty, charge
▲ CORR	Correction of meas. val.
▲ START	Measurement in progress
▲ GRAPH	Output graphic plot
▲ LIST	Output list print
▲ RS232	Output interface
▲ ALARM	Exceeding of limit value
▲ F	Programming function

(b) 6½ x 7 segment display for:
Meas. point, meas. val., meas. range, meas. values, programming values cycles, times, date

(c) 2 x 16 segment display for:
Dimension of the measured value, Abbrev. for additional functions

(2) **CHARGING** Charge Control Lamp

illuminated: battery is recharging
flashing: battery is recharged



(1) FUNCTION KEYS

ENTER, ▫, ⇧⇩,⇨,⇦ for entering programming values
ENTER, Clr clear data, set meas. value to zero
ENTER, ▫ adjust measured value

CH▲ select measuring point

MEASURE select measuring functions

measured value	Dim
maximum value (Hi)	MH
minimum value (Lo)	ML
memory (option)	MY

FUNCTION select programming function

output mode	OM
paper feed	PF
or print cycle	PC
time	TM
date	DA
range	R
plot range start	PS
plot range end	PE
limit value high	LH
limit value low	LL

Activation by:

+ Switch-on with **ENTER** or V24 command	+	locking mode	LM
	+	base	BA
	+	factor	FA
	+	exponent	EX
" pH probes	+"	zero point correction	ZC
	+"	slope (gain) correction	SC
^ infrared sensors	^	ambient temperature	AT
	^	emissivity factor	EF
* interface cable	*	baud rate	BR
	*	device address	A
~ humidity, dyn. pressure, O_2	~	atmospheric pressure	mb

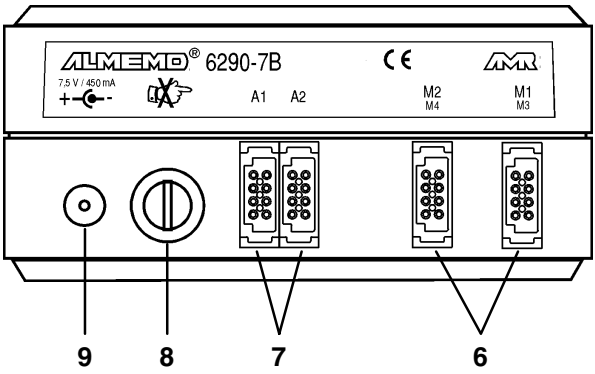
START/STOP start/stop measurement
PAPER FEED line feed of the built-in printer
ON/OFF switch on/off of the instrument

(4) PRINTER

built-in thermal printer:
alphanumerical 40 char./line
graphical 280 dots/line

(5) PAPER COMPARTMENT for temperature-sensitive paper with cover

1.4 Rear Operating Controls



(6) **MEASURING INPUTS**

M1, M2	2 ALMEMO® sockets for all ALMEMO® sensors
M3 to M8	addition. channels for double sensors and function channels

(7) **OUTPUT SOCKETS**

A1	RS232 interface cable (ZA 1909-DK)
	RS232 cable with fiber optics (ZA 1909-DKL)
	Centronics interface cable (ZA 1936-DK)
	RS 422 network branch box (ZA 5099-NVB)
	RS 485 network branch box (ZA 5085-NV)
	analogue output 1 (ZA 1601-RK)
A2	network cable (ZA1999-NK)
	trigger input (ZA 1000-ET)
	relay outputs (ZA 1000-EGK/EAK)
	analogue output 2 (ZA 1601-RK)

(8) **KEY SWITCH**

keyboard locking

(9) **POWER SUPPLY SOCKET**

7.5V	mains adapter ZB 6290-NA 7.5V DC, 450 mA
	supply cable ZB 6290-UK 10 to 30V, electr. isol., 250 mA

2. INITIAL OPERATION

1. Connect the **transducers** to the ALMEMO® sockets M1/M3 and M2/M4 (6), s. 4.
2. For battery charging connect mains adapter ZB6290-NA to socket (9), s.3.2.
3. Use key **ON/OFF** to **switch the instrument on**, see 3.4.
   Attention! The keys might be locked by the key switch (8)!
4. **Displaying Measured Values**
   Select function MEASURE by using the key **MEASURE**,
   select measuring channel by using the key CH▲, read meas. value, s.7.1.1.
   Scan all measuring points automatically by using key **START/STOP**, see 7.2.1.
5. **Print Measured Values**
   Select function output mode ´OM´ by using the key **FUNCTION.**
   Set output mode ´dr´ by using the keys ENTER, ⇧⇩,⇨, see 8.1.
   Select function print cycle ´PC´ by using the key **FUNCTION**.
   Enter print cycle, see 7.2.3.
   Enter correct time and date, as required, see 7.2.4.
   Start/stop measurement by using the key **START/STOP**, see 8.3.2.
6. **Plot Measured Values**
   Set output mode ´PL 1´ or ´PL 2´ in function ´OM´, see 8.1, 8.4.
   Select the functions ´PS´ and ´PE´ successively by using the key **FUNCTION** and enter the plot range start and range end for all plot channels (s. 8.4.1).
   Select function paper feed ´PF´ by using the key **FUNCTION**,
   enter paper feed in mm/h, see 8.4.2.
   Start/stop measurement by using the key **START/STOP**, see 8.4.3.
7. **Memory Output to Printer or Computer** (with option S only)
   Connect peripheral device, via interface cable, to socket A1, see man. 5.2.
   Set peripheral device to 9600 bd, 8 data bits, 1 stop bit, no parity.
   Enter output mode ´U´ in function ´OM´ (see 8.1) and use the key **CH▲** for setting the output format ´n´ or spreadsheet (table) ´t´, see 8.5.2.
   Select function MEMORY ´MY´ by using the key **MEASURE**
   Start memory output by using the key **START/STOP,** see 8.6.2.
   Clear the memory in function ´MY´ by using the keys ENTER, Clr, see 8.6.1.
8. **Display Max and Min Values**
   by using the key **MEASURE** in function ´MH´ or ´ML´, see 7.1.2.

3. POWER SUPPLY

3.1 Rechargeable Battery Operation and Voltage Control

For power supply 4 rechargeable NiCd batteries (4.8V/800mAh) are integrated in the instrument. They have a current consumption of ca. 11mA and last, without printing, for an operating time of ca. 90 hours. During continuous operation as a printer, one battery charge lasts ca. 5000 print lines (cycles), ca. 15000 cycles can be reached in plot mode. The instrument must be operated in sleep mode (see 7.2.5) to reach the above values during long term operation. When ca. 10% capacity is reached, the BAT symbol appears in the display. The built-in printer will stop its operation after printing the following:

```
STOP TIME:     hh:mm:ss
Battery discharged
```

All other instrument functions remain available. If the option 'Memory' is available the data logging is also still continued. If the rechargeable battery is completely discharged, the instrument will switch off. However, measuring data and time will be maintained in the battery buffered memory (see 3.5). Generally, the batteries should be recharged, at latest, when the symbol BAT is displayed, using the supplied mains adapter ZB 6290-NA, otherwise the batteries can suffer damage from deep discharge. Rechargeable batteries must always be charged beforehand if the instrument has been out of operation for a few months.

3.2 Mains Operation

For external supply of the instrument and for recharging the batteries the supplied mains adapter ZB 6290-NA (7.5V/450mA) must be connected to the rear socket (9). After plugging in, the small lamp ´LOAD´ is illuminated and indicates that the batteries are being recharged. The batteries are recharged after 4 hours, at maximum, and the small lamp starts to flash, i.e. the charger circuitry has switched to trickle charge. The mains adapter can, offering a buffer operation, stay continuously connected to the measuring instrument.

3.3 External Voltage Supply

It is also possible to connect another DC voltage, 7.5V ± 5% (450mA), to the socket (9). The connection is performed by using a low voltage connector (NES1 according to DIN 42323), centre pin to negative. However, the electrically isolated supply cable ZB 6290-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 mains supply.

3.4 Switch On/Off, Reinitialisation

The instrument can be switched on by using the key ON/OFF. The instrument can be switched off by using the same key or automatically when the rechargeable battery is discharged. However, the real time clock continuous its operation and all stored data remains available by a buffer battery (see 3.5). To avoid the instrument being unintentionally switched on or off, the user operation can be blocked by using the key switch on the back.

If the device shows an irregular behaviour due to interference influences (e.g. electrostatic charging or discharged buffering battery) or if incorrect programming must be avoided, the device can be reinitialised.
The **reset** can be achieved if the key Clr is pressed during switch-on. All internal data such as maximum and minimum values and the data memory will be cleared. Furthermore, cycles, time, date and device address are set to zero and the conversion rate and atmospheric pressure will be set to the standard values. However, the device configuration and the sensor programming within the ALMEMO® connectors will not be affected by the reset.

3.5 Data Buffer

The sensor programming is stored in the EEPROM of the sensor connector, the calibration of the instrument is fail-safe stored in the EEPROM of the instrument. The instrument, measuring data, as well as the time and date are buffered by the lithium battery so that storage of the data is also guaranteed when the device is switched off or when the batteries are discharged.

4. CONNECTION OF THE TRANSDUCERS

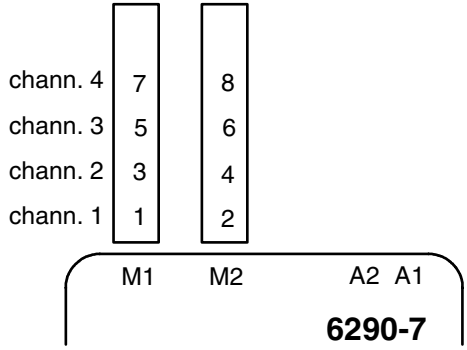
Any ALMEMO® sensors can be connected to the ALMEMO® input sockets M1 and M2 of the measuring instrument (6). For connecting existing sensors it is only necessary to connect a corresponding ALMEMO® connector.

4.1 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.

4.2 Measuring Inputs and Additional Channels

The ALMEMO® 6290-7B measuring instrument with built-in printer has two input sockets, M1 and M2. However, ALMEMO® connectors can, if required, provide up to 4 channels. 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 scalings 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 located one level higher. As a result, the measuring instruments have the following channel occupancy.



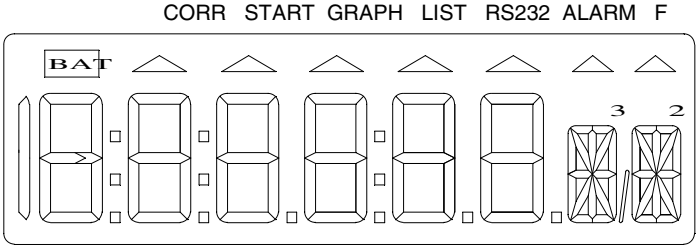
The 2 analogue inputs are electrically isolated by using photovoltaic relays and a potential difference of 50V DC or 60V AC, at maximum, is permissible between them. However, sensors combined within one connector and sensors with an own power supply are electrically connected to each other and must, therefore, be operated in isolation. The voltage applied to the measuring inputs must not exceed ±5V (between B,C,D and A or - respectively).

The cold junction compensation for thermocouple measurement is integrated in socket M1 of the device.

5. DISPLAY AND KEYBOARD

5.1 Display

The display of the measuring device ALMEMO® 6290-7B consists of an LCD module with six and a half 7-segment digits, two 16-segment digits, and a battery symbol and seven arrows for indicating the operating status.



Special Operating Conditions

Segment test of the display	automatically after switch-on.
Batt. almost discharged, no print operation:	BAT symbol illuminated
Batt. discharged, device switches off:	1:L o b A t
Sensors that are not connected, deactivated measuring points, cleared programming values.	1: - - - -
Sensor correction or scaling	arrow **CORR** illuminated
Measurement in progress	arrow **START** illuminated
Output as graphic plot	arrow **GRAPH** illuminated
Output as list print	arrow **LIST** illuminated
Output to RS232 interface	arrow **RS232** illuminated
Function selected	arrow **F** illuminated
Memory function selected (option S)	arrow **F** flashes

Alarm Conditions

are displayed as follows and cause an alarm (see manual 6.3.9):

Sensor breakage:	1: N i C r °C abbr. flashes
Overshooting of measuring range:	maximum value flashes
Undershooting of measuring range:	minimum value flashes
Exceeding of limit value:	arrow **ALARM** illuminated
Undershoot. of meas. range CJ compens. or meas. without ext. CJC or CJC break.	1: C J (cold junction) flashes
Exceeding of range of values (>65000):	1:6 5 0 0 0 flashes

5.2 Selecting and Activating Functions

After a reinitialisation (see 3.4) the basic functions (bolded in table) for operating the instrument with built-in printer are available by using the keys **MEASURE** and **FUNCTION**. More functions are available and can automatically or manually be activated, as required, for correcting measured values and for data transfer. This provides fast access and a reduced risk of incorrect entries. However, to have any function available in case it is required, all functions can be temporarily activated, i.e. until the instrument is switched off again:

Activate all functions by switching on with the key 

pressed and held.

The functions can be activated by repeatedly operating the keys **MEASURE** or **FUNCTION**. If a key is pressed and held for longer than one second the previous function can be selected again. The functions are identified by a two digit abbreviation instead of the dimension. In the display the abbreviation for the function follows the value of the function. In the case of sensor parameters the channel number is also included:

MEAS. VALUE	
Meas. Functions	**Abbrev.**
Meas. value	1: 114.3 °C
Max value (Hi)	1: 123.4 MH
Min value (Lo)	1: 023.4 ML
Memory (option S)	1: 113.2 MY
↓	
FUNCTION	
Memory functions	
Pplot range - start	1: 000.0 PS
Plot range - end	1: 100.0 PE
Free memory	126.1 FR
Output mode	PL 2 OM
Start time	10:00:00 ST
End time	10:30:00 ET
Start date	01.05.99 SD
End date	01.05.99 ED

FUNCTION	
ProgrammingFunctions	**Abbrev.**
Output mode	PL 2 OM
Paper feed	320.00 PF
or **print cycle**	00:15:00 PC
Time	12:34:56 TM
Date	31.12.99 DA
Range	1: NiCr R
Plot range - start	1: 000.0 PS
Plot range - end	1: 100.0 PE
Limit value Max (Hi)	1: 123.0 LH
Limit value Min (Lo)	1:-010.0 LL
Locking mode	1: 0005 LM
Base value	1: ---- BA
Factor	1: ---- FA
Exponent	1: 0 EX
" Zero point correction	1: ---- ZC
" Slope (gain) correction	1: ---- SC
^ Ambient temperature	1: 250.0 AT
^ Emissivity factor	1: 0.950 EF
* Baud rate	9600 BR
* Device address	00 A
˜ Atmosph. pressure	1013 mb

Automatic activation of the functions by:

* interface modules ^ infrared sensors
" pH probes ˜ humidity, dynam. press. and O_2 sensors

For a data output starting from the measuring function ´MY´ the key **FUNCTION** can be used to call various **memory functions**, which are entirely independent

from those used for the recording of measuring data (see 8.6.1) if a **data memory** has been integrated (option S).

The instruments can be individually configured for any application by setting the functions of the key FUNCTION via interface (AMR-Control) (see man. 6.10.13.3). For this purpose, this key corresponds to the key **F**. Even the storage of a configuration in an ALMEMO® configuration connector is possible, i.e. the functions can then also be activated by programming modules that were formerly required.

The additional activated functions are **cleared** by operating the key CLEAR during the switch-on.

5.3 Keyboard

The keyboard (6) has the following functions that are displayed above the keys:

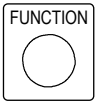
Function	Normal	Enter
Programming of Parameters	**ENTER**	⇨
Selecting Measuring Points	**CH ▲**	Clr
Selecting Measuring Functions	**MEASURE**	⇧
Selecting Programming Functions	**FUNCTION**	⇩
Start and Stop of Measurements	**START/STOP**	⇦
Line Feed	**PAPER FEED**	▫

When the key ENTER is operated a digit or an abbreviation is flashing in the display, i.e. the instrument is in edit mode and the white designations on the keys are valid. The keys ▫, ⇧ and ⇩ are then available for altering the input figure, ⇨, ⇦ operate as cursor keys and the key Clr is available for clearing parameter data. The input is complete, when the last digit has been confirmed with operating the key ⇨.

5.4 Data Entry

The programming of numeric parameters is carried out as follows:

Select the function by using the key **FUNCTION ...**



The programming is started by using the key ENTER.
The first digit flashes
and can be altered.

The digit can be **increased** using the key ⇧ .
After exceeding the maximum value the cycle restarts from zero.

The digit can be **decreased** using the key ⇩ .
After falling below zero the maximum value follows (9 or 5).

The sign can be changed using the key ▫ .

A switch to the next digit is performed using the key ⇨ .

To switch back to the previous digit press the key ⇦ .

The programming process is complete
after setting the last digit and again operating the key ⇨ .

Programming and measured values can be cleared using

, Clr

5.5 Keyboard Lock

To protect all settings during a measurement against unauthorised alteration the keyboard can, in addition to the sensor locking (see. 6.7), be locked by using a key switch (6) that is located at the back of the unit.

6. SENSOR PROGRAMMING

As all ALMEMO® instruments contain the whole sensor programming stored in the ALMEMO® connector plug, the user does not usually 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. 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 (see 6.7). All parameters can easily be entered or changed via keyboard when the corresponding sensor connector is connected and the function activated (see 5.2).

6.1 Selecting the Input Channel

To query or to program the parameters of a sensor the corresponding input channel must be selected within the desired function using the key CH▲. If this is performed within any programming function, i.e. not with the rotary switch moved to function MEASURE, only the input channel will be changed but not the selected measuring channel, i.e. the measurement is not being interrupted.

Increase the input channel by: 

(programmed channels only)

Decrease the input channel by: 

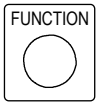
press and hold (approx. 1s)

6.2 Selecting the Measuring Range

If users want to program the connectors on their own or frequently change the measuring range, it is necessary that the locking is cleared (see 6.7) and special connectors may be required for some transducers (e.g. thermo, shunt, divider etc., see table).

The selection of the measuring range is performed within the function RANGE ´R´. For activating a channel that has not yet been programmed the locking of the 1st channel must be cleared for the corresponding sensor. After selecting the input channel and pressing the key ENTER the abbreviation for the measuring range flashes in the display. The keys ⇧ and ⇩ allow to select all available ranges in the sequence given below. If the key ENTER is pressed and held it is possible to jump from group to group (group ranges bolded in table). If the desired range is displayed the programming can be completed by pressing ENTER once again and the data is transmitted to the connector. All programming values of the input channel are then cleared.

Function RANGE ´R´

Selection with key: 

... 1: NiCr °C

Example: channel M1, range NiCr, dimension °C

Change meas. range: 

,  ... or  ... , 

Transducer	Connector / Cable / Sensor	Meas. Range	Dim.	Display
Pt100-1	ZA 9000-FS	-200.0... +850.0	°C	P104
Pt100-2	ZA 9000-FS	-200.00...+200.00	°C	P204
Ni100	ZA 9000-FS	-60.0... +240.0	°C	N104
NiCr-Ni (K)	ZA 9020-FS	-200.0...+1370.0	°C	NiCr
NiCroSil-NiSil (N)	ZA 9020-FS	-200.0...+1300.0	°C	NiSi
Fe-CuNi (L)	ZA 9000-FS	-200.0... +900.0	°C	FECO
Fe-CuNi (J)	ZA 9000-FS	-200.0...+1000.0	°C	IrCo
Cu-CuNi (U)	ZA 9000-FS	-200.0... +600.0	°C	CUCO
Cu-CuNi (T)	ZA 9000-FS	-200.0... +400.0	°C	CoCo
PtRh10-Pt (S)	ZA 9000-FS	0.0...+1760.0	°C	Pt10
PtRh13-Pt (R)	ZA 9000-FS	0.0...+1760.0	°C	Pt13
PtRh30-PtRh6 (B)	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**	U 26
Millivolt	ZA 9000-FS	-10.000...+55.000	mV	U 55
Millivolt 2	ZA 9000-FS	-260.00...+260.00	mV	U260
Volt	ZA 9000-FS	-2.6000...+2.6000	V	U2.60
Differential-Millivolt 1	ZA 9050-FS	-26.000...+26.000	mV	d 26
Differential-Millivolt	ZA 9050-FS	-10.000...+55.000	mV	d 55
Differential-Millivolt 2	ZA 9050-FS	-260.00...+260.00	mV	d260
Differential-Volt	ZA 9050-FS	-2.6000...+2.6000	V	d2.60
Sensor Voltage	ZA 9000-FS	0.00...20.00	V	UbAt
Milliampere	ZA 9601-FS	-32.000...+32.000	mA	I032
Percent (4-20mA)	ZA 9000-FS	0.00... 100.00	%	P420
Ohm	ZA 9000-FS	0.00... 400.00	Ω	Ohn
Frequency	ZA 9909-AK	0... 25000	Hz	FrEq
Pulses	ZA 9909-AK	0... 65000		PULS
Digital input	ZA 9000-EK2	0.0... 100.0	%	Inp
Digital interface	ZA 9919-AKxx	-65000... +65000		diGi
Infrared 1	ZA 9000-FS	0.0... +200.0	°C	Ir 1
Infrared 2	ZA 9000-FS	0.0... +800.0	°C	Ir 2

Transducer	Conn./Cable	Meas. Range	Dim	Display
Infrared 3	ZA 9000-FS	-30.0... +70.0	°C	Ir 3
Infrared 4	ZA 9000-FS	-30.0... +100.0	°C	Ir 4
Infrared 6	ZA 9000-FS	0.0... +500.0	°C	Ir 6
Snap-on head Normal 20	FV A915-S120	0.30... 20.00	m/s	S120
Snap-on head Normal 40	FV A915-S140	0.40... 40.00	m/s	S140
Snap-on head Micro 20	FV A915-S220	0.50... 20.00	m/s	S220
Snap-on head Micro 40	FV A915-S240	0.60... 40.00	m/s	S240
Macro	FV A915-MA1	0.10... 20.00	m/s	L420
Water-Micro	FV A915-WM1	0.00... 5.00	m/s	L605
Dyn.press. 40m/s w. TC a. PC	FD A612-M1	0.50... 40.00	m/s	L840
Dyn.press. 90m/s w. TC a. PC	FD A612-M6	1.00... 90.00	m/s	L890
Rel. air humidity cap.	FH A646	0.0... 100.0	%H	°orH
Rel. air humidity cap. w. TC	FH A646-R	0.0... 100.0	%H	H rH
Mixture ratio w. 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 UP
Enthalpy w. PC	FH A646	0.0 ... 400.0	kJ/kg	H En
Humid temperature	ZA 9000-FS	-30.00 ... +125.00	°C	P Ht
Rel. humidity psychr. w. PC	ZA 9000-FS	0.0 ... 100.0	%H	P RH
Mixture ratio w. PC	ZA 9000-FS	0.0 ... 500.0	g/kg	P AH
Dew point temperature w. PC	ZA 9000-FS	-25.0 ... +100.0	°C	P dt
Partial vapour press. w. PC	ZA 9000-FS	0.0 ...1050.0	mbar	P UP
Enthalpy w. PC	ZA 9000-FS	0.0 ... 400.0	kJ/kg	P En
Conductivity probe w. TC	FY A641-LF	0.0 ... 20.000	mS	LF
CO_2 sensor	FY A600-CO2	0.0 ... 2.500	%	CO2
O_2 saturation w. TC a. PC	FY A640-O2	0 ... 260	%	O2-S
O_2 concentration w. TC	FY A640-O2	0 ... 40.0	mg/l	O2-C

Function Channel

Difference	any			diFF
Maximum value	any			Hi
Minimum value	any			Lo
Average value over time	any			A[t]
Average value over junctions	any			A[n]
Sum over junctions	any			S[n]
Total number of pulses	ZA 9909-AK2	0... 65000		S[t]
Pulses/print cycle	ZA 9909-AK2	0... 65000		S[P]
Alarm value	any			Alrm
Wet bulb globe temp.	ZA 9000-FS		°C	UbGt

The **use of the function channels** for the output of measuring and calculated variables with the corresponding ref. channels is described in man. sect. 6.3.4.

Switch-off, i.e. deactivation of a programmed measuring channel

Function: RANGE ´R´ **Keys:** 

, 

After switch-off the measured value is no longer indicated, queried, or provided as output. However, the programming is still maintained.

Re-activation of the measuring channel:

Function: RANGE ´R´ **Keys:** 

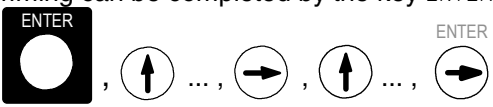
, 

If the channel was previously activated, the channel will be re-activated with all programming values. However, if the channel is already active, all programming values will be cleared by operating the above key combination (corresponds to selecting a measuring range).

6.3 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 the space `_´ are available. The dimension is displayed by two 16-segment characters that are following the measured value.

The **change of the dimension** can be performed within the function MEASURE by pressing the key ENTER. The first character of the dimension will flash in the display. It can then be changed by using the keys ⇧ and ⇩. When the first character is selected the key ENTER should be pressed and the same procedure will be performed for the second character. When the desired dimension has been set the programming can be completed by the key ENTER.

Function: MEASURE 

When the dimension °F is entered a temperature value in degrees Celsius will be converted into degrees Fahrenheit.

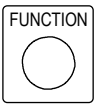
The cold junction compensation can be switched off by using the character °C or °F.

The dimension ms is indicated on the display as m/s, and mh as m^3/h.

6.4 Limit Values

Two limit values (MAX and MIN) can be programmed for each measuring channel. The exceeding of the limit values is handled as a fault, similar to the exceeding of the measuring range limits and sensor breakage. The arrow ALARM will appear in the display and the alarm relays will respond (see manual 6.3.9). An exceeding can also be used to start or stop a measuring point scan (see manual 6.6.3).

Function LIMIT VALUE HIGH ´LH´ and **LIMIT VALUE LOW** ´LL´

Selection with key: 

... 1: 1 2 3.0 LH

Programming: Input according to 5.4

Switch-off: 

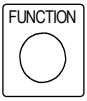
, Clr 1: - - - - LH

6.5 Correction Values

The correction values ZERO POINT and SLOPE allow for correcting sensors with regard to zero point and slope (gain) (see manual 6.3.10).

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

Function ZERO POINT CORRECTION ´ZC´

Selection with key: 

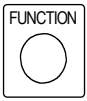
... 1: 0 0 3.2 ZC

Programming: Input according to 5.4

Clear: 

, Clr 1: - - - - ZC

Function SLOPE CORRECTION (GAIN): ´SC´

Selection with key: 

... 1:1.5 0 0 0 SC

Programming: Input according to 5.4

If correction values are programmed and, as a result, the measured value is corrected, the arrow **CORR** will be indicated in the display.

Sensor Adjustment

To simplify the correction of sensors for the zero point and, possibly, also the slope (gain), a key combination for an automatic adjustment is available in function **MEASURE** (see 7.1.3). The corrected measured value is stored as zero point correction and will be set to zero. However, the base value will be maintained.

Function MEASURE: Adjustment with keys: 

For some sensors **special functions** are available in this context:

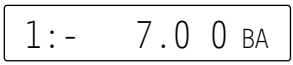
1. **Dynamic pressure probes** are very delicate and should be adjusted in an unpressurized state before each use (i.e. disconnected hoses or Pitot tube out of flow). The correction value must be entered before the conversion 'pressure-to-velocity' is performed. For the ranges L840 and L890 an adjustment is possible even if the channel is locked. The zero point error is temporarily written in the calibration offset until the switch-off is performed.
2. With the following sensors, a **slope adjustment** is performed in the same way for the corresponding calibration value:
   pH probe: pH4 or pH10
   Conductivity: 2.77mS/cm (FY A641-LF) or 147µS/cm (FY A641-LF2)
   O_2 saturation: 101% (FY A640-O2)

6.6 Scaling, Decimal Point Setting

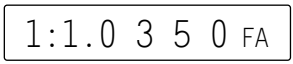
For indicating the electrical signal of a sensor as a measured value of a physical variable it is, in most cases, necessary to set a zero point shift and to perform a multiplication with a certain factor. The functions BASE and FACTOR and EXPONENT are available for this. A detailed description of the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

Indicated value = (corrected measured value - BASE) x FACTOR.

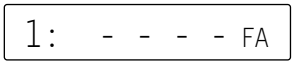
Function BASE VALUE ´BA´

Selection with key **FUNCTION**... Input accord. to 5.4 

Function FACTOR ´FA´

Selection with key **FUNCTION**... Input accord. to 5.4 

Clear with keys: 

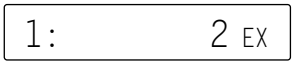


Decimal Point Setting

The FACTOR can be programmed in the range -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 function EXPONENT ´EX´ 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 representation of measured values is not possible.

Function EXPONENT ´EX´

Selection with key **FUNCTION...** Input see 5.4



If scaling values are programmed and, as a result, the measured value is corrected, the arrow **CORR** will be indicated in the display.

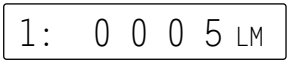
6.7 Locking the Programming of the Sensor (man. 6.3.12)

The function parameters of each measuring point are protected by the locking mode up to an adjustable locking level. 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	measuring range + element flags
2	measuring range + zero point and slope correction
3	measuring range + dimension
4	+ zero point and slope correction
5	+ base value, factor, exponent
6	+ analogue output, start and end
7	+ limit values, max and min

Function LOCKING MODE ´LM´

Selection with key **FUNCTION...**



Programming Input according to 5.4

If programmed, the element flags and the multiplexer settings are indicated on the display next to the locking mode (see manual 6.10.2/3).

Keyboard locking and a locking code can be used to protect against unauthorised modification (see 5.5) during a measurement and to protect the programming and the process control.

7. MEASUREMENT

The measuring instrument with built-in printer ALMEMO® 6290-7B provides the following options for the acquisition of measuring data:

1. Continuous measurement of a selectable measuring point, see manual 6.4. Output of measuring data to the analogue output see manual 5.1.1.
2. Single measuring point scan, see manual 6.5.1.1.
3. Cyclic measuring point scan, see manual 6.5.1.2.
4. Continuous measuring point scan, see manual 6.5.1.3.

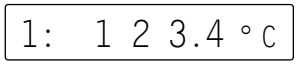
7.1 Continuous Measurement of a Measuring Point

As long as no cycle and no continuous measuring point scan have been programmed (e.g. after a reinitialisation, see 3.4) only the measured value of a selected measuring point, which is at first M0, is continuously acquired with the specified conversion rate (see 6.5.4) (optimal for analogue output).

7.1.1 Selecting the Measuring Point

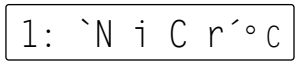
With the rotary switch moved to position MEASURE, the key **CH▲** allows to successively select all measuring points and indicate the actual measured value. If the key **CH▲** is pressed and held (approx. 1s) the previous channel is again indicated. By selecting the measuring channel the input channel is, at the same time, also selected (see 6.1). If the measuring range changes when switching over, the abbreviation of the measuring range is indicated first.

Increase measuring channel with key: 



Decrease measuring channel with key: 

press and hold (approx. 1s)

In case of a sensor breakage the abbreviation for the meas. range flashes instead of the meas. val. (s. 6.2): 

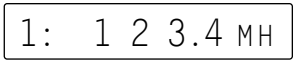
The arrow ´CORR´ is illuminated in the display if the measured value is corrected by scaling or correction values (see 5.1).

7.1.2 Memory for Peak Values

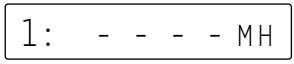
From the acquired measured values of each measuring point the highest and lowest value is determined and stored. For indicating the peak values the function MAX VALUE or MIN VALUE must be selected with the key **MEASURE** and the desired channel must be set.

Function MAXIMUM VALUE ´MH´ and **MINIMUM VALUE** ´ML´

Selection with key **MEASURE...**



Clear Max and Min values: ENTER , Clr



The peak values are also cleared if a change of the measuring range (see 6.2) is carried out.

7.1.3 Setting Measured Value to Zero, Zero Point Correction

Setting the Measured 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. The indicated measured value is, by the following key combination, stored as base value and, as a result, set to zero.

Function MEASURE: MEASURE Zero setting by keys: ENTER , Clr

Please note that this function is only available if the locking code is set below 5 (see 6.7).

If the function ´BA´ is activated, the new base value is stored in the EEPROM of the connector (see 6.6). If not, the original value is inserted again when the instrument is switched off and on.

The arrow **CORR**. appears in the display as long as the deviation from the base value is indicated, but not the actual measured value.

The base value must be cleared in order to obtain the actual measured value (see 6.6). If the function BASE ´BA´ is not activated, switching off the device is sufficient (see above). However, if the function is available it has to be selected by using the key **FUNCTION** and the base value has to be cleared by using the keys ENTER, Clr.

Function BASE: FUNCTION ... Clear base value: ENTER , Clr

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 Measured Value to Zero´ mentioned above, as some sensors require an additional scaling (e.g. pH probes). In this function the zero point error is not stored as base value but as zero point correction (special cases and slope correction, see 6.5). In this case, the locking mode must be set below 4 (see 6.7). The zero point correction is performed using the following keys:

Function MEASURE: 

Zero point adjustment: 

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

7.1.4 Atmospheric Pressure Compensation

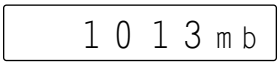
Some measuring variables depend on the environmental atmospheric pressure (see 6.2 measuring range list ´w. PC´). As a result, higher deviations from the normal pressure of 1013mbar can cause corresponding measuring errors:

e.g. error per 100mbar:	rel. humidity psychrometer	approx. 2%
	dynamic pressure	approx. 5%
	O_2 saturation	approx. 10%

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 or measured with a sensor (see manual 6.7.2).

Function ATMOSPHERIC PRESSURE ´mb´

Selection with key: 

... Input mbar, see 5.4 

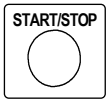
With each reset the atmospheric pressure is set to 1013mb. It can be set to the actual value by the usual data entry.

7.2 Measuring Point Scan (see also manual section 6.5)

Measuring point scans can be used to acquire, indicate and, in most cases, to document data from the selected measuring point and also from other measuring points. During a measuring point scan the measuring inputs of the active measuring points are, via photovoltaic relays and with the conversion rate, switched to the measuring circuit. The measured value is acquired, with exceeding of limit values being monitored, and successively indicated for a duration of approximately 1.5s on the display. Furthermore, the maximum and minimum values are updated.

7.2.1 Single Measuring Point Scan (see also manual 6.5.1.1)

Single measuring point scans for acquiring the momentary measuring values of all active measuring points are triggered by the key **START/STOP** as long as no print cycle has been programmed.

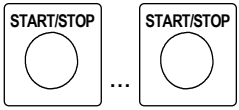
Single Measuring Point Scan: Key: 

(cycle 00:00:00)

While the measured value is displayed the arrow ´START´ is illuminated and then turns off again. If the time had been cleared, it will be re-started. The measured values are automatically stored if the option 'Memory' is used. The measured values are provided as output depending on the output mode (see 8.). With each further pressing the key the measured values are equally processed with the corresponding measuring time. The real time must first be entered before it can be displayed (see 7.2.4).

7.2.2 Cyclic Measuring Point Scan (see also manual 6.5.1.2)

The print cycle (see 7.2.3) must be programmed for cyclic measuring point scans with list output. The measurement is activated by using the key **START/STOP** and the arrow ´START´ is continuously illuminated. The measured values are automatically stored if the option 'Memory' is used. The measured values are provided as output depending on the output mode (see 8.).

Starting and stopping cyclic measuring point scans: 

Stopping of the automatic measuring point scan can be achieved by operating the key **START/STOP** once again. The arrow ´START´ will then turn off again.

7.2.3 Print Cycle

At all measurements the print cycle causes a cyclic measuring point scan of all active measuring points and an output of the measured values to a display, printer, memory (option) or interface. The time can be set between 1s and 12h.

The print cycle cannot be accessed in PLOT mode. It is set by entering the paper feed in function ´PF´ (see 8.4.2), i.e. only if the output mode is set to ´dr´, ´U´ or ´S´ the function print cycle ´PC´ can be selected by using the key **FUNCTION**.

Function PRINT CYCLE ´PC´

Selection with key: 

... 0 0:3 0:0 0.PC

Example: print cycle 30 min.

The print cycle is programmed using the 6-digit format hh:mm:ss (see 5.4).

The key **CH▲** can be used to switch the **continuous conversion rate** (see manual 6.5.1.3) on or off. For control purposes a dot is displayed following the print cycle.

Clear print cycle: 

0 0:0 0:0 0 PC

A running cyclic scan is terminated by this.

7.2.4 Time and Date

For recording the measuring time a real time clock with date function has been integrated into the ALMEMO® 6290-7B. It is equipped with a lithium battery allowing for time and date to be maintained when the unit is being switched off.

Function TIME ´TM´

Selection with key **FUNCTION**... 1 2:3 4:5 6 TM

The input format for time and date is hh:mm:ss (see 5.4).
The clock can be stopped/set to zero by using the keys ENTER, Clr.
The clock can be started in any switch position by operating key **START/STOP**.

Function DATE ´DA´

Selection with key **FUNCTION**... 0 1:0 5:9 9 DA

Example: date 1st May, 1999

The input format for the date is dd.mm.yy (see 5.4). The year number can also be provided as output with 4 digits (see manual 6.10.13) via interface.

The date can be cleared by using the keys ENTER, Clr.

7.2.5 Sleep Mode

As one completely recharged battery only allows for an operating time of 90 hours at maximum (even with large print cycles) it is possible to operate the instrument with the built-in printer in sleep mode for long-term monitoring.
Within this power saving mode the device will switch off after each measuring point scan and will automatically switch on for the next measuring point scan after the cycle time has expired.
As a result, it is possible to acquire up to 5,000 cycles in print mode and up to 15,000 cycles in plot mode. The print cycle must be set to more than 1 minute. The cyclic output is, at first, started as usual (see 7.2.2).

The following steps must be performed for an **operation in sleep mode**:

1. A print cycle with a duration of 1 minute at minimum must be entered.
2. The measurement is started using the key **START/STOP** within the function MEASURE.
3. **Switch-over to sleep mode**
   in function MEASURE by using the keys ENTER, ⇦ (SLEEP).

   Sleep Mode: 

   Before the instrument will automatically switch off, the display will indicate ´SLEEP ON´ for one second when it has been programmed properly.

   If the programming is not correct, the display will indicate ´SLPErr´ and corresponding error messages will be provided as output to the printer:

   ```
   Sleep mode is not possible:
   Cycle is not started.
   Cycle must be longer or equal to 1 minute.
    or Paper feed must be less than 20mm/h.
   ```

4. Within the set cycle the instrument will automatically switch on,
   perform a measuring point scan,
   display ´SLEEP ON´ and the measured values,
   and then switch off.
5. **Switch-over to active operation**
   The instrument must be switched on again by using the key ON/OFF.
   After a measuring point scan the measurement will be continued in normal mode.
6. Terminate the measurement by using the key **START/STOP**.

8. DIGITAL DATA OUTPUT

For data output the ALMEMO® 6290-7B measuring instrument with built-in printer has, at first, the integrated thermal printer and then also a serial interface. During a measurement the measured values of all connected sensors are scanned in cycles and, according to the output mode, provided as output (see 8.1). The built-in printer can present the measured values as a list or a line plot. The output via interface is available with three format options. Optionally, the measured values can be buffered in the instrument and can later be represented in any output format. As the measured values are being logged with the date and time, these parameters should be programmed accordingly (see 7.2.4). Apart from the measured values, it is also possible to provide an output of the programming of the sensors and of the instrument.

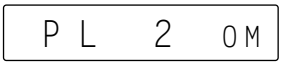
8.1 Output Mode

The following output options can be set by using the output mode in function ´OM´:

Display	Printout	Function
dr	PRINT	list output to the built-in printer
Pl 1	PLOT 1	line plot in 1 diagram on the built-in printer
Pl 2	PLOT 2	line plot in 2 diagrams on the built-in printer
U	U	list output to the serial interface
S	-	storing of the measured values only (option S)

Function OUTPUT MODE ´OM´

Selection with key **FUNCTION**...



After operating the key ENTER the output mode flashes and can be altered by using the keys ⇧ and ⇩. The selected output mode is accepted by pressing the key ENTER once again. During PRINT mode the arrow ´LIST´, and during PLOT mode the arrow ´GRAPH´, and in case of an output to the serial interface the arrow ´RS232´, is indicated for control.

8.2 Built-in Printer

The measuring instrument with built-in printer is generally equipped with a dot-matrix thermal printing unit that can either print 40 alphanumerical characters per line or 280 x 8 pixels graphically. Two operating modes PRINT and PLOT are available and can be set by selecting the output mode. In both modes the measured values are collected in a cycle and are provided accordingly. In addition, it is also possible to print the programming or all maximum and minimum values.

Loading the Temperature-Sensitive Paper
Only the temperature-sensitive paper that is specified for this printer must be used to ensure high quality printing and safe operation. To remove the cover, pressure must be applied to the grooved surfaces on both sides and the cover must be pulled upwards. The temperature-sensitive paper must be cut straight before insertion. It must then be pushed into the slot at the front side of the paper compartment and the key **PAPER FEED** must be pressed until the paper is coming out from the print head. To protect the paper roll from falling out and from contamination, the cover must be mounted and locked by pressing on the side surfaces. A red stripe will appear on the paper to indicate that the paper is running out. The remaining paper should be pulled out and replaced with a new paper roll.

8.3 Printing

For alphanumerical printouts the output mode ´OM´ must be set to PRINT ´dr´ (see 8.1).

8.3.1 Programming

The key **START/STOP** can be used to start two control printouts for the programming:
Within the function output mode ´OM´ or baud rate ´BR´:
Sensor programming and process control (see program header, 8.3.2),
Within the function device address ´ A´ or atmospheric pressure ´mb´:
Programming of the instrument (see 8.5.3).

8.3.2 List of Measured Values

If, within function MEASURE and with the output mode set to ´dr´ , a measuring point scan is started by using the key **START/STOP** (see 7.2), a list of measured values with time and all measured values is printed out.

If the print cycle is cleared (00:00:00 PC) only the values of one **single measuring point scan** are available. Up to 2 channels are printed in columns in each line. If there are more channels, they will be printed below.

Printout of one single measuring point scan:

```
12:50:05  1: + 29,31 °C  2: + 965.7 mb
          3: +  51,8 %H
```

If the print cycle is programmed (see 7.2.3), a list of measured values from the **cyclic measuring point scan** is available.

As the built-in printer needs almost 2 seconds for printing a line with 2 measuring points the print cycle must be selected accordingly (at min 2 sec. for 2 meas. points, at min. 4 sec. for 4 meas. points etc.).

If the function RANGE ´R´ is selected during start, a header with the programming will be printed at the beginning. It is also possible to provide an individual designation in the header (see manual 6.2.4).

Printout for cyclic measuring point scan with output of the header:

```
ALMEMO 6290-7              5.50   1899     header
CH RANGE  LV MAX  LV MIN  D COMMENT        programming
1: NiCr  +  80.0 +  75.0 °C Temperature
3: °orH    - - -   - - - %H Humidity
PRINT CYCLE: 00:00:10    PRINT             print cycle, output mode
DATE:       01.01.99
12:50:05  1: +  78.3 °C  3: +  51.8 %H     measured values
12:50:15  1: +  79.2 °C  3: +  51.1 %H
12:50:25  1:!+  80.5 °C  3: +  50.4 %H     overshooting of limit value
12:50:35  1:!+  73.8 °C  3: +  49.7 %H     undershooting of limit value
12:51:45  1:  - - -  °C  3: +  48.1 %H     sensor breakage
```

To stop the automatic printout the key **START/STOP** must be pressed.

8.3.3 Measured Values and Max and Min Values

If the key **START/STOP** is operated in function Max Value ´MH´ or Min Value ´ML´ a list of the current measured, maximum and minimum values of all connected sensors are printed.

Printout:

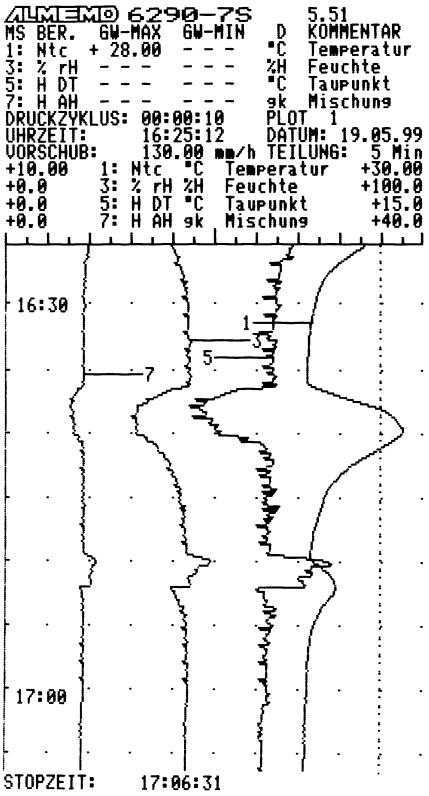
```
CH MEAS.VAL MAX.VAL MIN.VAL DIM
01:+0023.0 +0025.0 +0019.0 °C
03:+0028.1 +0034.5 +0029.9 %H
```

8.4 Plot

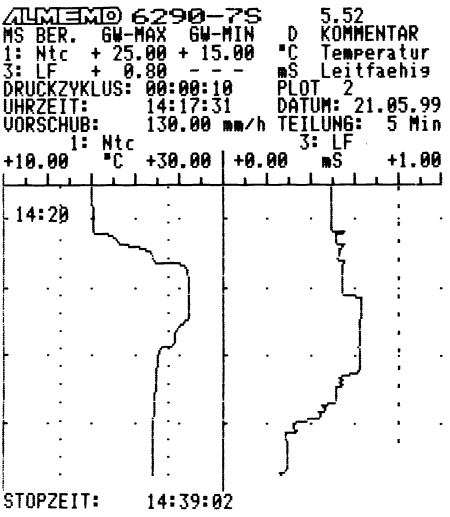
As an alternative for the list of measured values the measured values can also be printed as a line plot. By using the output mode PLOT 1 ´PL 1´ up to four measuring points will be printed in a diagram using the entire printing width. In output mode PLOT 2 ´Pl 2´ two measuring points will be printed in two separate diagrams, side by side, with half of the printing width. In both cases, only the active channels providing a programming for plot start and plot end will be considered so that unwanted channels can be masked.

For monitoring the exceeding of limit values or for a better orientation, a dotted reference line is printed in addition to each measuring point. For identification of the channels the lines will be provided with the number of the measuring point after each printout of the time.

PLOT 1 (1 diagram with 4 chann. at max.):



PLOT 2 (2 diagrams side by side):



8.4.1 Plot Range

The plot range must be specified for each channel that has to be plotted, i.e. the start of the plot range must be programmed in function ´PS´ and the end of the plot range must be programmed in function ´PE´. If more channels are programmed than can be plotted, only the first 4 or 2 will be considered.

Start of plot range: Selection with key **FUNCTION**... | 1: 000.0 PS |

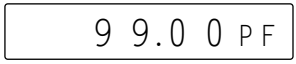
End of plot range: Selection with key **FUNCTION**... | 1: 100.0 PE |

During input (see 5.4) it must be considered that the plot range end is always larger than the plot range start.
The plot range limits can be cleared by using the keys ENTER, Clr.

8.4.2 Paper Feed

If the output mode is set to PLOT the paper feed speed can be programmed in the range of 0.03 to 640 mm/h.

Paper Feed: Selection with key **FUNCTION**...



The input is carried out within function ´PF´, in mm/h, according to section 5.4.

From the paper feed velocity an internal print cycle can be automatically calculated (see 7.2.3) where the measured values are scanned:

Print Cycle: PC [s] = 1280 / PV [mm/h]

If the conversion does not provide a print cycle in even numbered seconds, the paper feed will correct itself during the input accordingly.

If the print cycle is not sufficient for printing one line (1.8 s) and measuring all channels, it will increase automatically.

The scaling of the time axis results from the print cycle. The time intervals of the scale lines are listed in the header as SCALE DIVISION in minutes or hours. The time hrs:min will be printed after every 6 lines and will also be printed when the date changes.

8.4.3 Line Plot

The plotter can be started by using the key **START/STOP** if the output mode, plot range and paper feed are properly set. Corresponding error messages will be printed if this is not the case:

Start not possible:	
Channel not existing	no measuring points activated
Error Plot range start/end	plot range not correct progr.

If the programming, including the limit values, has to be printed at the beginning, the start must be performed within the function RANGE ´R´. In all other functions only the data required for the evaluation of the diagram will be printed, such as TIME, DATE, FEED and DIVISION. In addition, the RANGE, DIMENSION and COMMENT, including the end values of the PLOT RANGE, as well as a scale with 20 scale lines, will be printed for each channel (see print examples). This scaling is repeated after 24 time-slot patterns.

After the start the arrow ´START´ will be illuminated in the display.

The first line plot is only provided after eight print cycles have expired because eight rows of dots are printed in one line and each measuring point scan is only presented in one row.

The output can be stopped by operating the key **START/STOP** once again. The arrow ´START´ in the display will then turn off. In addition, the latest measured values that have been acquired will be provided, along with the end time.

8.5 Output via Serial Interface

As an alternative to the built-in printer the measuring data, as well as the entire programming, can also be provided as an output via serial interface to a printer or computer. The necessary interface modules and the connection of the devices are described in the manual section 5.2. The commands for the programming of the instrument, the sensors and the data output via serial interface can also be found in the manual section 6.

In this case the output mode ´OM´ must be set to ´U´ (see 8.1). Three formats (list, columns, spreadsheet/table) are available for the output of the measuring point scans (see 8.5.2). The corresponding printouts are listed in section 6.6.1 of the manual.

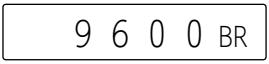
8.5.1 Baud Rate, Data Format

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 150, 300, 600, 1200, 2400, 4800, 9600 bd or 57.6 kbd can in function BAUD RATE ´BR´ be set via keyboard.

The input is started with the key ENTER. Then the value indicated on the display is flashing and can be altered using the keys ⇧ and ⇩. When the desired transmission rate has been selected the programming can be terminated by operating the key ENTER once again. 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 ´BR´

Selection with key **FUNCTION**... *Example:* 9600 bd



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

8.5.2 List of Measured Values, Output Formats

If measuring point scans (see 7.2) or memory outputs (see 8.6.2) are started when the output mode is set to ´U´, the lists of all measured values with time will be provided via serial interface. For this purpose the user can select from three different output formats (see manual 6.6.1). Apart form the standard list format with all measured values provided as a list, the output in columns, **side by side**, provides a clear and space-saving printout. A printer will automatically switch to the condensed character mode. The **spreadsheet format** is provided for further processing in spreadsheet applications (see manual 6.1).

The **output format** can also be set in the function output mode ´OM´. The three options can be selected by using the key CH▲. For identification purposes the abbreviations ´n´ or ´t´ follow the output channel ´U´:

Abbr.	Output Format
U	measured values in list format
Un	measured values in column format, side by side
Ut	measured values in spreadsheet (table) format

8.5.3 Manual Data Output

In addition to the list of measured values data such as max/min values, the sensor and instrument programming can, similar to an output via built-in printer, be provided as output via interface by using the key **START/STOP** (s.8.3).

All other function values that have been selected by using the keys **MEASURE** or **FUNCTION** can be either printed out by using interface commands, or by using an additional trigger cable (accessory ZA 1000-ET, variant 3, see man. 6.10.9). The trigger cable must be connected to socket A1 and, with the external key, the outputs providing the following printouts can be triggered.

The following functions can also be output by using the key **START/STOP**:

Function	Ab	Ky	Printout	
OUTPUT MODE	OM	**F**	AMR ALMEMO 6290-7	see man. 6.2.3
BAUD RATE (sensor programming)	BR	**F**	CH RANGE LIM-MAX LIM-MIN BASE D FACTOR EXP AVG COMMENT 01:NiCr +0123.4 - - - - - - °C 1.0350 E+0 - - - Designation 02:NiCr - - - +0012.0 - - - °C - - - E+0 CONT Water MEAS. CYCLE: 00:00:30 S S0501.3 F0204.7 AR W010 C--U- PRINT CYCLE: 00:10:00 Un 9600 bd	
ATM. PRESSURE	mb	**F**	DEVICE: G00 M11 A01 P03/11/00	see man. 6.2.5
DEVICE ADDRESS (instrument programming)	A		A.PRESSURE: +01013. mb CJ-TEMP: +0023.5 °C U-SENSOR: ! 12.5 V HYSTERESIS: 10 CONFIG: FCRD-S-- -L-- ALARM: -1-3 A1: DK0 Un A2: AK1	
MAX/MIN VALUE	MH	**CH**	CH MEAS.VAL MAXVAL MINVAL AVG COUNT	
(all meas. values)	ML		01:+0023.0 +0025.0 +0019.0 - - - - - - -	s. man. 6.4.4
MEMORY	MY	**CH**	MEMORY: - - - - -	see man. 6.9.2

The following functions can only be output with the trigger cable:

MEAS. VALUE	Dim	**CH**	12:34:00 01: +0023.5 °C
PRINT CYCLE	PC	**F**	PRINT CYCLE: 00:06:00
PAPER FEED	PF	**F**	FEED: 130.00mm/h DIVISION: 5 min
TIME	TM	**F**	TIME: 12:34:00
DATE	DA	**F**	DATE: 01.02.99
RANGE	R	**F**	01:NiCr +0123.4 -0012.0 +0000.0 °C 1.0000 E+0 - - -

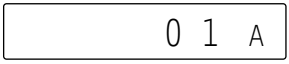
Function	Ab	Ky	Printout
PLOT START	PS	**F**	ANALOG START:01: +0000.0 °C
PLOT END	PE	**F**	ANALOG END: 01: +0100.0 °C
LIMIT VALUE, MAX	LH	**F**	LV MAX: 01: -0100.0 °C
LIMIT VALUE, MIN	LL	**F**	LV MIN: 01: +0020.0 °C
LOCKING	LM	**F**	CH ZEROPT SLOPE LM K FUNC EOFSET EFACT ANA-ANF ANA-END B1 MX EF AH AL ZF UMIN 01:+0000.0 +1.0000 5. 1 MEAS +00000 32000 +0000.0 +1000.0-01 M1 -- S- E2 05 12.0
			see man. 6.10.1
BASE	BA	**F**	BASE VAL: 01: -0273.0 °C
FACTOR	FA	**F**	FACTOR: 01: +1.0350E-1
EXPONENT	EX	**F**	FACTOR: 01: +1.0350E-1
ZERO POINT	ZC	**F**	ZEROPT: 01: -0000.7 °C
SLOPE	SC	**F**	SLOPE: 01: +1.0013
Memory Functions:			
MEMORY FREE	MF	**F**	MEMORY: S0501.2 F0234.5 AR
START TIME	ST	**F**	START TIME: 07:00:00
STOP TIME	ET	**F**	END TIME: 17:00:00
START DATE	SD	**F**	START DATE:01.02.99
END DATE	ED	**F**	END DATE: 02.02.99

8.5.4 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 each device has its own 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. The function DEVICE ADDRESS ´ A´ is available for this purpose. It can be selected with the key **FUNCTION** and, at first, the currently set device number, which is normally factory-set to 00, is displayed. It can then be modified by a normal data input (see 5.4).

Function DEVICE ADDRESS ´ A´

Selection with key: 



Example: Address 01:

During network operation only consecutive numbers between 01 and 99 should be entered so that the device 00 is not addressed unjustifiably in case of a power interruption.

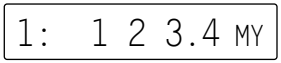
8.6 Data Memory (Option S)

With the option S the measuring instrument with built-in printer is equipped with a 500kB data memory for ca. 100,000 measured values. The basic principles for storing data in ALMEMO® devices are described in section 6.9 of the manual. The memory organisation can be selected as linear or ring memory (standard) (see manual 6.10.13.2). Ring memory means that old measured values are overwritten when the memory space is occupied. In principle, all measured values that are acquired during a measuring point scan are stored. If the data should only be stored and not be provided online, the output mode ´S´ must be set (see 8.1). The stored data can be completely retrieved offline at a later point in time or just an extract can be retrieved with any output format.

8.6.1 Memory Functions

For implementing the above options, special memory functions are available that allow (only with regard to the memory output) for setting the output mode, plot and time range. The functions do not have any influence on the device or sensor programming. For this purpose, it is necessary to firstly select the function MEMORY ´MY´ by using the key MEASURE The display will indicate the previously stored measured value. By using the key CH▲ the other channels of the previous measuring point scan are also accessible.

Function MEMORY: Selection with key **MEASURE** ...



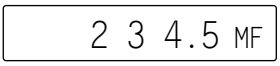
Clear memory with the keys ENTER, Clr:

If then, from the function MEMORY ´SP´, the key **FUNCTION** is operated, the following memory functions are available.

MEAS.VALUE			**FUNCTION**	**F**
Meas. Functions	**Abbrev.**			▲ flash.
Meas. value	Dim			
Max value	MH			
Min value	ML		**Memory Functions**	**Abbrev.**
Memory	MY	➔	memory free	MF
			output mode	OM
			start time	ST
			end time	ET
			start date	SD
			end date	ED
			plot range start	PS
			plot range end	PE

For separating between memory functions and normal functions the arrow ´F´ is indicated in the display.

In **function MEMORY FREE** ´MF´ the free memory space is indicated in kilobytes.



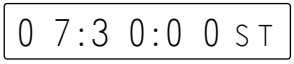
By selecting the **OUTPUT MODE** ´OM´ (see 8.1) every data log can be subsequently output in any output format. Furthermore, the memory function ´OM´ provides the option ´dr AL´ that allows to only print out the alarm values from one entire measurement.

Display	Printout	Function
dr	PRINT	list output to the built-in printer
Pl 1	PLOT 1	line plot in 1 diagram to the built-in printer
Pl 2	PLOT 2	line plot in 2 diagrams to the built-in printer
U	U	list output to serial interface
dr AL	PRINT	list output alarm values only to the built-in printer

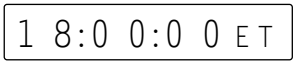
The parameters **PLOT RANGE BEGIN** ´PS´ and **PLOT RANGE END** ´PE´ are first received from the sensor programming for each channel (see 8.4.1). However, they can be altered, as required, for the output. This allows for a new channel selection and, along with the time interval, also for zooming in any direction.

The functions **START TIME** ´ST´ and **END TIME** ´ET´ and **START DATE** ´SD´ and **END DATE** ´ED´ allow for a selection and output of an extract from any part of the memory area. The data input corresponds to the input of the time and date (see 7.2.4).

Start time ´ST´ Selection with key **FUNCTION..**

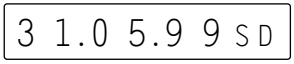


End time ´ET´ Selection with key **FUNCTION..**

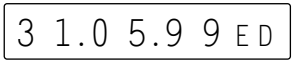


Programming in format hh:mm:ss according to 5.4.

Start date ´SD´ Selection with key **FUNCTION..**



End date ´ED´ Selection with key **FUNCTION..**



Programming in format dd:mm:yy according to 5.4.

The values can be cleared by using the keys ENTER, Clr.

If another function is selected in function MEMORY ´MY´ by using the key MEASURE, the normal functions are available again when using the key FUNCTION (see 5.2).

8.6.2 Memory Output

When all parameters of the memory output have been set according to section 8.6.1 the output can be started by using the key **START/STOP**. The printouts correspond, depending on the output mode of the list of measured values (see 8.3.2), to the line plots (see 8.4) or to the interface logs (see man. 6.6.1). The memory can be recalled as often as desired and in any format and scaling. During the memory output ´S Out ´ is indicated in the display and the following key functions are available:

START/STOP	Stop of the automatic memory output
MEASURE	Output of individual measured values
FUNCTION	Start of the automatic memory output
CH▲ / Clr	Termination of the automatic memory output

Special Functions

During interface operation the measuring instrument with built-in printer also supports the identification of measurements with a number, as well as the selective memory output corresponding to these numbers (see man. 6.8 and 6.9.2.3). For example, a barcode reader can be used locally for the input of a number (see manual 5.2.4).

With a corresponding configuration the measuring instrument with built-in printer can also record individual measuring points at a rate of 10 measurements/second (see man. 6.5.1.3) and can plot the measurement at a later point in time.

9. TROUBLESHOOTING

The ALMEMO® 6290-7B measuring instrument with built-in printer 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 data or all display segments permanently illuminated.
Remedy: Check power supply, recharge battery, switch off and on again, reinitialise (see 3.4)

Error: False measured values.
Remedy: Thoroughly check the programming of the channel (especially base and zero point), query the entire programming by means of the software AMR-Control or the terminal and command `P15` (see manual 6.2.3) and `f1 P15` (see manual 6.10.1)

Error: Varying meas. values, segment test or blockage during operation.
Remedy: Check cabling for inadmissible electrical connection.
Disconnect the external power supply and output modules,
disconnect suspicious sensors and replace them by hand-held sensors held in the air or by dummies (short circuit AB at thermocouples, 100Ω at Pt100 sensors).
If the fault is eliminated by that, check the wiring,
isolate the sensor if necessary, use an electrically isolated power supply, prevent influences from disturbances by shielding or twisting.

Error: Data transmission via interface does not function.
Remedy: Check interface module, connections and settings:
Are both devices set to the same baud rate and transmission mode (see 8.5.1)?
Is the correct COM interface addressed at the computer?
Is the output channel set to ´U´ (see 8.1)?
Is the printer set to 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 diodes 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 lines must flash red).

Test the data transmission by using a terminal (AMR-Control, WIN-Control, DATA-Control, WINDOWS Terminal):
Address the device with its device number Gxy (see manual 6.2.1), query the programming by P15 (see manual 6.2.3),
only check the sending line by cycle input via command Z123456 and control in the display.
Test the receiving line with key **START/STOP** and monitor control.

Error: Data transmission within network does not function

Remedy: Check that all devices are set to different addresses.
Address 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 devices separately at the data cable of the computer (see above).
Check the wiring for a 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. The software AMR-Control allows to print the monitor pages including the programming and also to save the terminal operation and to print it out.

11. ELECTROMAGNETIC COMPATIBILITY

The ALMEMO® 6290-7B measuring instrument with built-in printer meets the electromagnetic compatibility (EMC) safety requirements specified in the relevant CE directive, issued by the council for the alignment of legal regulations of the member states (89/336/EWG).

The following standards have been applied for the evaluation of the product:

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

The following 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.

Technical Data (see also manual 2.2)

Measuring Inputs:	2 ALMEMO® sockets for ALMEMO® connector
Meas. channels:	2 primary chann. electr. isol., max. 6 addit. channel for double sensors and function channels
Sensor voltage supply:	8 to 10V, max. 70mA
Equipment:	
Display:	6½ digit 7-segment, 2 digit 16-segment, 12mm
Keyboard:	7 keys with key switch
Memory (Option S):	500 kB (100000 meas.val.), buff. w. rech. lithium batt.
Time and date:	real time clock, buffered with recharg. lithium battery
Microprocessor:	HD 6303 Y
Built-in Printer:	
Print mechanism:	thermal, dot matrix (7x5)
Character size:	2.4 x 1.1 mm
Number of columns:	40 characters/line
Print speed:	0.6 lines / s
Paper:	Jujo Paper Co. TP50K5-A roll width 80mm, diameter 40mm
Outputs:	2 ALMEMO® sockets for all output modules
Voltage Supply:	4 NiCd batteries, 4.8V, 0.8Ah with quick charge circ.
Mains adapter:	ZB 6290-NA 7.5 V, 450 mA, recharge time: ca. 3h
Adapter cable, electr. isol.:	ZB 6290-UK 9 to 30V DC to 7.5V DC, 250mA
Current consumption:	switched off: approx. 0.04mA switched on without printing: approx. 11mA switched on with printing: approx. 500mA
Operating time, normal:	90h without printing
in sleep mode:	alphanumerical: 5,000 cycles graphical: 15,000 cycles
Supply voltage control:	automatic, with optical alarm
Housing:	plastics (180 x 115 x 70 mm)
Operating temperature:	0 to +40 °C
Storage temperature:	-10 to +60 °C
Humidity of ambient air:	10 to 75 % rH non-condensing
Extent of the Delivery:	Measuring Instrument ALMEMO® 6290-7B 2 Rolls temperature-sensitive paper Mains Adapter ZB 6290-NA 7.5V/ 450mA Operating Instructions ALMEMO® 6290-7B ALMEMO® Manual incl. software AMR-Control

Product Overview

	Order No.
Measuring Instrument with Built-In Printer ALMEMO® 6290-7B 2 inputs, max. 8 channels, real time clock, 7 keys, sleep mode, built-in thermal printer, interface that can be cascaded, rechargeable batt 4.8V, 0.8 Ah, 2 rolls temperature sensitive paper, mains adapter 7.5V/450mA	MA 6290-7B
Option S Data Memory 500kB (100000 measured value)	OA 6290-S
Option TA Date Printout at date change	OA 6290-TA
Roll temperature sensitive paper, 80mm wide, 20m long	ZB 1040-TP
DC Adapter Cable 10 to 30V DC, 12V/250mA electr. isolated	ZB 6290-UK
ALMEMO® Recording Cable -1.25 to 2.00 V, 0.1 mV/digit	ZA 1601-RK
ALMEMO® Data Cable V24 Interface, electr. isolated	ZA 1909-DK
ALMEMO® Data Cable Centronics Interface, electr. isolated	ZA 1936-DK
ALMEMO® Network Cable Current Loop, electr. isolated	ZA 1999-NK
ALMEMO® I/O Cable for Triggering and Limit Value Alarm	ZA 1000-EGK

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