ALMEMO®

Operating Instructions

Data Acquisition System
ALMEMO® 5590-3

V1.1
14.06.2000

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Data Acquisition System
ALMEMO® 5590-3 V5

For Reference with the ALMEMO® Manual

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1. INTRODUCTION

The data acquisition system ALMEMO® 5590-3 *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® 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 analogue and digital output modules (manual section 5.1)
- The interface modules 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 printouts (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, in many cases, only provide a note referring to a more detailed description within the manual (manual section x.x.x).

1.1 Function Range

The universal data acquisition system ALMEMO® 5590-3 can be extended from 10 electrically isolated measuring inputs to 250 inputs by additional passive selector switch boards or active measuring circuit boards. Alternatively, it is also possible to integrate externally networked ALMEMO® devices into the data acquisition. The parallel data acquisition of active measuring circuit boards allows for a high data rate and the large battery-backed memory accepts up to 400,000 measured values. For easy operation the system is equipped with a rotary switch, alphanumerical keyboard and a 24-digit two-line LCD display. Four 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 a simple connection between the devices.

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. 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 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.

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.

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 (1 max, 1 min) can be set for each measuring channel. An alarm value printout can be performed if a limit value is exceeded and, by means of relay output modules, alarm contacts are provided that can be individually allocated to limit values. 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.

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
The standard equipment includes one measuring circuit board with 10 electrically isolated inputs. The number of inputs can be increased in steps of 10 to a maximum of 250 by adding more active measuring circuit boards or up to 8 passive selector switch boards. At the plug-in modules for the ALMEMO® single connectors a maximum of 4 measuring channels are available per sensor, i.e. it is also possible to evaluate double sensors, sensors with different scalings or sensors with a function channel. A cost-effective alternative is available for many standard sensors with the possibility to connect an ALMEMO® 10-fold MU plug. In this plug the data of all sensors is also stored in an EEPROM.
The measuring channels can be successively selected forwards or backwards or by their number 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).

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).

Measuring Functions
Some sensors require special measuring functions 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.

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 measuring cycle are available and, if fast processing is required, the conversion 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 date 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.

Output Cycle

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

Output Cycle Factor

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

Measuring Cycle

The measuring cycle, also programmable between 1s and 59h/59min/59s, is for a cyclic scanning with a display of all measured values, limit value monitoring including alarm message and output of alarm values, averaging and, if necessary, a storage of measured values.

Average Value

The measured values that result from scanning the measuring junctions can be averaged as desired either over the total measuring time or over the print cycle time. Function channels are provided for a cyclic output of average values.

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 possible to store all measured values in the memory and/or to perform an output via the interface.

Storage of Measured Values

During the measuring or print cycle, all measured values or alarm values can be manually or automatically stored in a buffered RAM. The memory capacity is, as standard, 500kB, which allows up to 100,000 measured values. The memory organisation can be configured as linear or ring memory. The output can be optionally performed via interface, analogue output or display. It is possible to select a certain time interval, number or alarm value.

Numbering of Measurements
Single scans or entire series of measurements can be identified and selectively read out from the memory.

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

Keyboard Lock
The keyboard operation can be locked with a key switch.

Output
All measuring and programming data is accessible by means of the LCD display. RS232, RS422, RS485 and a Centronics interface are available by using different interface cables. All data logs, measured values and programmed parameters can be provided as output to any peripheral equipment. 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
ALMEMO® measuring instruments can be easily connected to the system by a simple connection with network cables or RS422/485 network junctions for longer distances or the system can be integrated in a network.

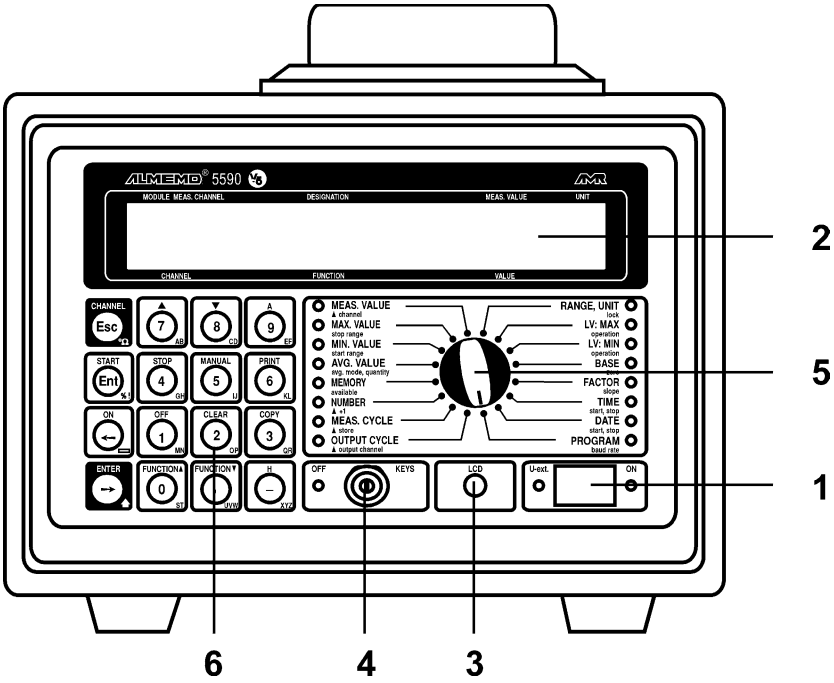
Software
The AMR-Control software, which allows for the entire programming of the sensors, the configuration of the measuring instrument and the read-out of the data memory is supplied with each ALMEMO® manual. The integrated terminal also allows for online measurements. The WINDOWS® software packages,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

OPTION Memory Extension
By using the option S the memory capacity can be quadruplicated to 2Mbytes.

OPTION Rechargeable Battery
By using the option ´Rechargeable Battery´ the data acquisition system can run independently with own power supply for several days. Afterwards the rechargeable battery can be recharged within 2 hours by using a power supply unit. The rechargeable battery can also be used on a long-term base for power failure protection.

OPTION Built-In Printer
The 40-digit built-in thermal printer allows for an independent operation of the data acquisition system including a local log printout.

1.2 Front Operating Controls



(1) **ON SWITCH** rocker switch: for SWITCH-ON of the system
control lamp ON: on when system is switched on
control lamp SUPP: on when power supply is connected
option recharg. batt.: on when battery is being recharged
flashes when battery is recharged

(2) **LCD DISPLAY** 2 lines with 24 characters dot matrix

1st line:	meas. channel	designation	meas. value	dimension
2nd line:	input channel	meas. function	value	dimension
		factor	value	exponent
time(s):	output channel	function	hr : min : sec	
date:		function	day . mth . year	

(3) **LCD** contrast control for LCD display

(4) **KEY SWITCH**
Keyboard locking control lamp OFF: key operation is not possible

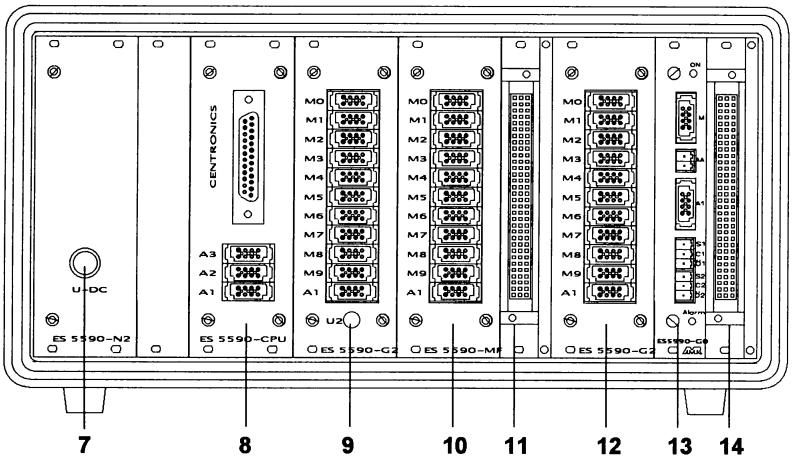
(5) FUNCTION SELECTOR SWITCH 

Function	Add. Function with FUNCTION▲	● Control Lamps
MEAS. VALUE	zeroing -> base	sensor breakage
	zeroing -> zero	
MAX. VALUE	Ana-End	max value > limit value
MIN. VALUE	Ana-Start	min value < limit value
AVG. VALUE	Avg. mode / Count	averaging active
MEMORY	Mem. free	memory active
NUMBER		number active
MEAS. CYCLE	Meas. rate	measuring cycle running
OUTPUT CYCLE	Address:	print cycle running
RANGE, UNIT	Locking	dimension changed
LV: MAX	Action max	exceeding of limit value
LV: MIN	Action min	exceeding of limit value
BASE	Zero corr	zero point changed
FACTOR, exponent	Slope corr	factor/exp changed
TIME	Start / Stop	start/end programmed
DATE	Start / Stop	start/end programmed
PROGRAM, baud rate	Atm.press / hysteresis	

(6) FUNCTION KEYS 

CHANNEL x x	select measuring point/input channel
CHANNEL ⇦ g x x	select meas. module g, meas. point xx
▲	increase meas. point/input channel
▼	decrease meas. point/input channel
START	start measuring point scan
STOP	stop measuring point scan
MANUAL	single measuring point scan
PRINT	data output to output channel
ON	activate programming value
OFF	de-activate programming value
CLEAR	clear programming value / meas. data
COPY	copy programming for meas. point(s)
FUNCTION ▲	next function (add. function)
FUNCTION ▼	previous function (add. function)
ENTER - 1 2 . 3 Ent	input numerical parameters "-12.3"
ENTER ⇧00 9 ⇨ 0 ⇨ 00 ⇨ Ent (big S T e s s t)	input alphanum. designation "Test"
⇨	cursor position to the right
⇦	cursor position to the left
Ent	complete input
Esc	abort input

1.3 Rear Operating Controls



Basic Configuration:

(7) **Plug-In Module ES 5590-N1/2: Power Supply**

Socket U-DC	9..13V DC, for mains adapter ZB 5090-NA3, 12V, 2A
Option A:	12V DC for rech. batt. for mains adapter ZB 5090-NA3
Option V:	10..36V DC electr. isol. with DC/DC converter, 12V, 1A
Option N:	mains socket 90-260V AC 50-60Hz

(8) **Plug-In Module ES 5590-CPU: CPU f. Scan. Active Meas.Circ. Boards**

A1	V24 interface with cable or fiber optics (ZA 1909-DK/L) RS 422 with network distributor ZA 5099-NVB RS 485 with network branch box ZA 5085-NV
A2	network interface for networking the system with more ALMEMO® devices to the computer trigger input with cable ZA 1000-EK/ET alarm relay outputs with ZA 1000-EGK, ZA 8000-RTA
A3	network interface for expanding the system by external ALMEMO® devices
CENTRONICS	Centronics interface for printer

(9) **Plug-In Mod. ES 5590-G2: Active Mast. Meas. Circ. Board** passive ext.

M00 to M09	10 meas. inputs for all sensors with ALMEMO® connect.
M10 to M39	max. 30 add. channels for double sensors and arithmetic chan.
A1	analogue output with cable ZA 1601-RK
A1	2 relay outputs with cable ZA 1000-EGK/EAK

Extension with Passive Selector Switch Boards:

(10) **Plug-In Module ES 5590-MF: Passive Selector Switch Board**

Mx0-Mx9	10 meas. inputs for all sensors with ALMEMO® conn.
Mx0+10 to Mx0+39	max. 30 add. chan. for double sensors and arithmetic chan.
A1	2 alarm outputs with cable ZA 1000-EGK
1 CODE SWITCH	board number 0 to 7 internally on-board

(11) **Plug-In Module ES 5590-MU: Passive Selector Switch Board**

Mx0 to Mx9	10 meas. inputs for analogue sensors without power supply with 10-fold connector ZA 5590-MU
GW max, GW min	2 alarm outputs for all meas.points of plug-in module
1 CODE SWITCH	board number 0 to 7 internally on-board

Extension with Active Meas. Circ. Boards: (passively not extendable)

(12) **Plug-In Module ES 5590-G2: Active Measuring Circuit Board**

M00 to M09	10 meas. inputs for all sensors with ALMEMO® connector
M10 to M39	max. 30 add. channels for double sensors and arithmetic chan.
A1	analogue output with cable ZA 1601-RK 2 relay outputs with cable ZA 1000-EGK 2 relay outputs with cable ZA 1000-EAK
2 CODE SWITCHES	module address 00 to 99 internally on-board

(13) **Plug-In Module ES 5590-G0: Active Measuring Circuit Board**

M00	1 meas. input for all sensors with ALMEMO® connector
M01 to M03	3 add. channels for double sensors and arithmetic chan.
AA	analogue output internally electrically isolated (option R1:2V, R2:10V, R3:20mA)
A1	analogue output not electr. isol. with cable ZA1601-RK
S1 C1 Ö1	alarm contact 1 lim. val. Max, make and break contact (50V, 300mA)
S2 C2 Ö2	alarm contact 2 lim. val. Min, make and break contact (50V, 300mA)
2 CODE SWITCHES	module address 00 to 99 internally on-board

(14) **Plug-In Module ES 5590-G3: Active Measuring Circuit Board**

M00 to M09	10 meas. input for analogue sensors without power supply with 10-fold connector ZA 5590-MU
2 CODE SWITCHES	module address 00 to 99 internally on-board

2. INITIAL OPERATION

1. Connect the **transducers** to the sockets Mxx (9) etc., see 4.
2. Ensure **power supply** by mains adapter connected to socket (7), see 3.1
3. For **switch-on** press the rocker switch (1), so the control lamp is on, s. 3.4
4. For **displaying** the measured values,
   select function MEAS. VALUE by using the rotary switch (5),
   select measuring channel with the key ▲, read the meas. value, see 7.1.1.
5. **For storing** the measured values:
   Use the function MEMORY and keys **ENTER**, **CLEAR** to clear the memory.
   Use MEAS. CYCLE and the key **ON** to activate the memory, see 7.3.2.
   Single storing with using the key **MANUAL,** see 7.2.
   Enter measuring cycle for cyclic storing, see 7.3.2.
   Enter time and date as required, see 7.3.4.
   Enter time and date of start or end of a measurement as required, see 7.3.5.
   Use the keys **START** and **STOP** to start and stop a cyclic storing, see 7.3.
   Output of memory data to printer or computer
   Connect peripheral device via interface cable to socket A1, see manual 5.2.
   Set 9600 bd, 8 data bits, 1 stop bit, no parity at peripheral device.
   Use the key ▲ in function OUTPUT CYCLE to set the output channel ´U´ and, possibly, use the key **MEAS. POINT** to set the output format columns ´n´ or spreadsheet (table) ´t´, see 8.1.
   Use key **PRINT** within function MEMORY to output meas. values, see 7.4.2.
6. **Cyclic output of measured values** to printer or computer
   Connect peripheral device via interface cable to socket A1, see manual 5.2.
   Set 9600 bd, 8 data bits, 1 stop bit, no parity at peripheral device, see 8.2.
   Enter time and date, as required, see 7.3.4.
   Program the print cycle within function OUTPUT CYCLE,
   with key ▲ output channel ´U´ and, if required, with key **MEAS.POINT**
   set output format columns ´n´ or spreadsheet (table) ´t´, see 8.1
   Use the keys **START** and **STOP** to start and stop a cyclic storing, see 7.3.
7. **Monitoring of limit values**
   Enter limit values, see 6.5.
   Program measuring cycle, see 7.3.2.
   Connect alarm device with alarm module to socket A2, see man. 5.1.2/5.1.3
   Use the key ▲ in function OUTPUT CYCLE to activate ´U´ for alarm list output and ´S´ for storing the data of the output channel, see 8.1
   Use the keys **START** and **STOP** to start and stop a cyclic storing, see 7.3.
8. **Evaluation** of the measurement
   Display max and min values within function MAX or MIN VALUE, see 7.1.2.

3. POWER SUPPLY

3.1 Mains Operation

The universal mains adapter ZB 5090-NA3 for 100 to 260V AC to 12V DC, 2A, is generally used for the power supply of the measuring instrument. It is connected to the socket U-DC (7) and is locked by turning it to the right. In addition, the banana plug with the connection for the protective earth conductor must for interference suppression be connected to the bare socket beside.

Only in case of exceptions (e.g. in industrial environments) the protective earth conductor itself can show such high voltage spikes that it is better to avoid its connection.

The option N involves the installation of the plug-in module ES 5590-N1 with an integrated switched-mode power supply that allows for a voltage supply from 90 to 260V AC (50 to 60Hz) via a standard mains cable.

Danger! Mains Voltage! The mains plug must whatever happens be disconnected from the power supply plug-in module ES 5590-N1 before a plug-in module is installed into or removed from the system!

3.2 Operation with Rechargeable Battery (Option A)

With the option A, a 7.2V NiCd rechargeable battery with 1.5 Ah will be installed, which allows, at a current consumption of approximately 21mA, an uninterrupted operating time of approximately 75 hours. The operating time will be shorter if selector switch boards (approx. 12mA) are installed or sensors are connected that require additional current (e.g. humidity sensors FH A646 2mA or rotating vanes approximately 3mA) or if the serial interface (4mA) is used. When the voltage of the rechargeable battery has reached 7V a ▯ symbol starts flashing in the display. An exact determination of the voltage of the rechargeable battery and an estimation of the remaining operating time are available with the measuring channel ´Batt´.

If the device is only operated with the rechargeable battery the green lamp SUPP (1) will not be on at all. For charging the rechargeable battery the 12V mains adapter ZB 5000-NA3 can be used, which also allows for fully recharging an empty rechargeable battery within 2 hours. During this process the green lamp will be continuously on for charge control. When the green lamp flashes, the rechargeable battery is fully recharged and the charge circuitry switches to trickle charge. As a result, the power supply can, during buffer operation, remain connected to the measuring instrument.

3.3 External Power Supply (Option U)

If the instrument is intended to have an external voltage supply the power supply plug-in module with option U (OA 5590-U) and the connecting cable ZB 5090-EK with 2 banana plugs is required. It has a wide input voltage range from 9 to 36V DC and an electrical isolation allowing that the measuring instrument can be operated with 12V or 24V mains supply. Further, the mains adapter ZB 5090-NA3 still allows for operation with mains supply.

3.4 Switch On/Off, Reinitialisation

After the voltage supply has been correctly connected the green control lamp SUPP, located on the front panel (1), will be on. If a rechargeable battery is installed the lamp is used for charge control (see 3.2).

For switching on the device the rocker switch (1) must be operated. Then the red control lamp ON will be on and indicated that the instrument is operational.

When switching off the instrument the red control lamp turns off again. However, the real time clock continues its operation and all stored data remain available (see 3.5).
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 completely reinitialised.

The **reset** can be achieved if the key **CLEAR** is pressed during switch-on. All internal data such as max, min and average 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(r) connectors will not be affected by the reset.

3.5 Data Buffer

For an uninterrupted power supply of the real time clock and the memory a NiCd rechargeable battery (2.4V) for buffering is installed, which ensures that time and date data and all stored values are maintained for several months if the mains supply is not available. However, to prevent the rechargeable battery from completely discharging and to avoid the loss of data, the instrument should be operated with mains supply for a few hours at least once per month.

4. CONNECTION OF THE TRANSDUCERS

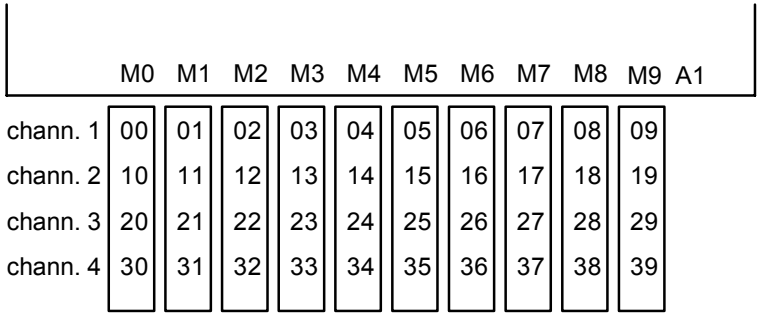
Any ALMEMO® sensors can be connected to the ALMEMO® input sockets Mxx of the plug-in modules (9), (10), (12) and (13). For connecting existing sensors it is only necessary to connect a corresponding ALMEMO® connector.

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 measuring circuit board ES 5590-G2 has 10 input sockets with, at first, the measuring channels M00 to M09 being allocated to them. However, ALMEMO® sensors can, if required, provide up to 4 channels so that 40 channels are available with 10 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 scalings or, depending on the pin assignment, 2 or 3 sensors can be combined in one connector (e.g. TE/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.).



All 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 M3 of the measuring circuit plug-in module.

4.3 Extension of the Measuring Inputs

Several options are available for the **extension of the measuring points**. It is possible to use a total of 8 passive and 99 active modules at maximum.

The first active master measuring circuit board ES 5590-G2 can control up to 8 **passive selector switch boards** each with 10 photovoltaic relays, however, the total number of measuring channels is limited to 98 at maximum. To be able to adapt the number of sensors to the individual requirements, the number of channels of the master measuring circuit board and the selector switch boards can be independently configured to 10, 20, 30 or 40 (s.man. 6.10.13.1). The numbering of measuring points starts and continues from the last measuring point of the master board. The selector switch boards can be coded from 0 to 7 by the on-board code switches. The duration of a measuring point scan increases proportionally to the number of measuring channels. Analogue output cables can only be connected to the master board.

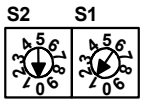
1. With the **passive selector switch boards ES 5590-MF** (10) the number of measuring points is increased in steps of 10 electrically isolated ALMEMO® inputs. Limit value relay cables can be connected to all boards. The plug-in module required 2 PCB slots.
2. The **passive selector switch boards ES 5590-MU** (11) also have 10 inputs, which are guided to a 64-pole socket terminal strip. The connection of the sensors is performed via a 10-fold plug ZA 5590-MU each having 4 screw-type terminals. The programming can be individually entered for each sensor, however, it is stored in a common EEPROM that is located in the connector. The plug-in module requires only one PCB slot and, independent from the configuration of the channel number, 10 channels are only available. For this reason, double sensors and sensors that require a power supply or an ALMEMO® connector with logic control (e.g. humidity sensors, rotating vanes etc.) cannot be connected. Two limit value relays, separately for Max and Min, are already mounted on the board and can be connected via the MU connector.

Extension with Active Measuring Circuit Boards and Devices:

Active measuring circuit boards are independent measuring modules with a microcontroller, ALMEMO®-measuring circuit and own address. All plug-in modules are electrically isolated from each other and it is also possible to connect an analogue output cable or an output relay cable, with the exception of the ES 5590-G3. The measuring point scan of all active boards is performed simultaneously so that the time for scanning all measuring points is significantly reduced. The identification of measuring points is based on the two digit module number and the two digit measuring point number. The module numbers usually start at the master measuring circuit board from 00 and are increased by one for each additional module.

3. Additional **active measuring circuit boards ES 5590-G2** (12) with 10 ALMEMO® sockets each provide 10 to 40 measuring channels for all sensors with an ALMEMO® connector.

   For setting the address two code switches are located on the board. The plug-in module required 2 PCB slots.

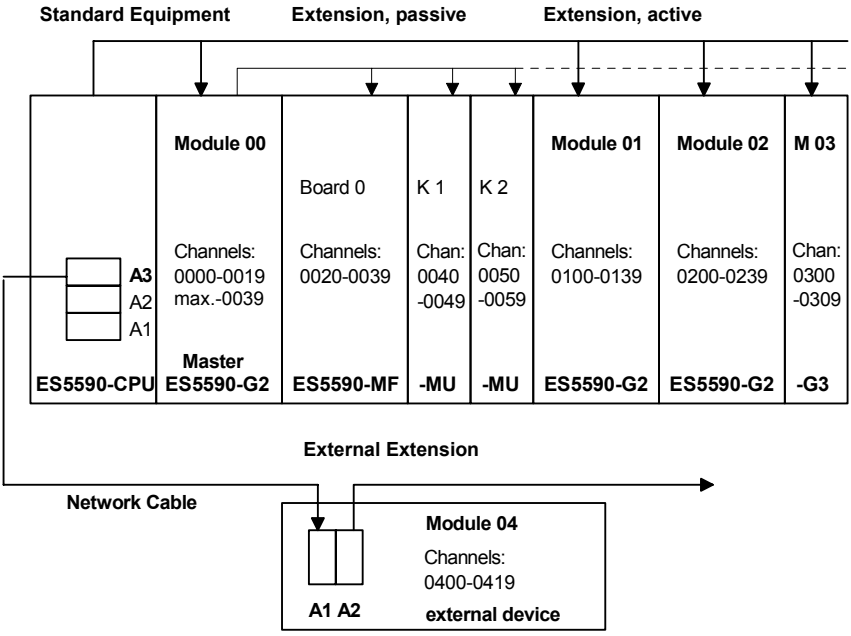
   Example: module address 01 module address **0** **1**

4. Alternatively, the **active measuring circuit board ES5590-G3** (14) with 10 measuring channels and 10-fold connector ZA5590-MU can be used like the selector switch board ES5590-MU. Analogue output and limit value relays are not available here. The plug-in module requires only one PCB slot.
5. Furthermore, the **active measuring circuit boards ES 5590-G0** (13) with ALMEMO® sockets (4 channels) are available. An integrated electrically isolated analogue output (2V, 10V or 20mA) is available as an option. Two limit value relays, separately for Max and Min, are mounted on the board and can be connected via screw clamp connectors. The plug-in module requires only one PCB slot.
6. In addition, the extension of the measuring points is also possible via any **external ALMEMO® device** with serial interface. They are connected to the socket A3 of the CPU ES 5590-CPU via network cables or network distributors (see manual 5.3). It is just necessary to ensure that all active modules of the system and all external devices are set to the baud rate 9600 and that they have different addresses. The addresses must be continuously available, however, their sequence within the network is of no importance.

Initial Operation

At each change of the configuration the system must be switched off and the addresses of the modules and devices must be consistently set (see 8.2.2.3). On initial operation, firstly all external devices and then the system must be switched. During initialisation phase all modules are queried and the configuration is stored in the memory. This process can, for control purposes, be monitored on the display with an indication of all module designations. Devices that have been subsequently connected or switched on will not be recognised anymore. However, sensors that have been subsequently connected will be (depending on the number of channels) automatically detected and evaluated in the selected module after a certain interrogation cycle. New sensors within other modules will only be included from the next following measuring point scan.

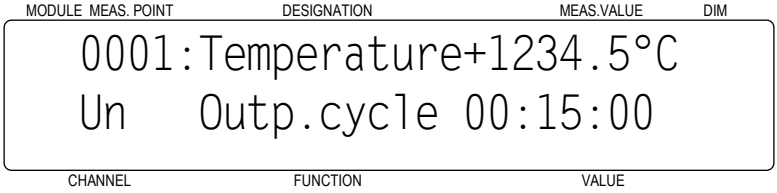
Example for a configuration:



5. DISPLAY AND KEYBOARD

5.1 Display and Function Selection

The display of the system ALMEMO® 5590-3 consists of a LCD dot matrix display with two lines with 24 characters each. The first line always provides the device address (MODULE), the selected measuring point with designation and the current measured value. If no designation is programmed, the measuring range will be displayed. The second line provides the selected function. The input channel for scanning and programming of the functions is independent from the measuring point given in the 1st line.



Special Operating Conditions

Supply voltage: lower than 7 V: symbol flashes in 1st line

lower than 6 V: LoBat in the 2nd line, no other function

Memory output: Output

Sensors that are not connected, de-activated measuring points, cleared programming values: - - -

Alarm Conditions

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

Sensor breakage: NiCr abbr. flashes

Overshooting of measuring range: maximum value is displayed

Undershooting of measuring range: minimum value is displayed

Exceeding of limit value: control lamp is on

Measuring without ext. CJC or CJC break. CJ-Err (cold junction) flashes

Exceeding of range of values (>65000): 65.000

The basic functions are set by the function selector switch (5). The keys FUNCTION▲ and FUNCTION▼ can then be used to select, partly, additional functions. The following table shows how the functions are indicated in the 2nd line of the display and which special key actions are available:

Function		Display	Key	Action
MEAS. VAL.	line 1:	0000:comment 1234.5°C	▲▼	change meas. point
	line 2:	device designation	ENTER ⇦	enter designation
F▲		zeroing-> base	**CLEAR**	set meas. val. to zero
F▲, F▲		zeroing-> zero	**CLEAR**	adjustment meas. value
MAXIMUM VALUE		01:Max.value: 1234.5°C	▲▼	change input channel
F▲		01:Ana-End: 1000.0°C	▲▼	"
MINIMUM VALUE		01:Min.value: -123.4°C	▲▼	"
F▲		01:Ana-Start 200.0°C	▲▼	"
AVERAGE VALUE		01:Avg.value: 333.3°C	▲▼	"
F▲		01:Avg.mode: CONT	▲▼	"
F▲, F▲		01:Count: 11111	▲▼	"
MEMORY		01:Memory: 23.4°C	▲▼	change display channel
F▲		Mem. free: 00501.9kB		
NUMBER		Number: 12-001	▲▼	increment/decrement
MEAS. CYCLE		S Meas.cycle 00:30:00	**ON/OFF**	storing on/off
F▲		Meas.rate: 10/s CSU	**ON/OFF**	storing on/off
OUTPUT CYCLE		U Outp.cycle 01:30:00	▲▼	output channel
		UnOutp.cycle 01:30:00	MEAS.PT.	output format
F▲		Address: 00		
RANGE, DIM		01:Range: NiCr °C	▲▼	change input channel
F▲		01:Locking: 0005	▲▼	"
LIMIT VALUE MAX		01:Limit max: 1000.0°C	▲▼	"
F▲		01:Action max Start	▲▼	"
LIMIT VALUE MIN		01:Limit min: -100.0°C	▲▼	"
F▲		01:Action min - - -	▲▼	"
BASE		01:Base: - - -	▲▼	"
F▲		01:Zero corr: 1.3°C	▲▼	"
FACTOR		01:Factor: - - - E+0	▲▼	"
F▲		01:Slope corr - - -	▲▼	"
TIME		Time 12:34:56	**CLEAR**	meastime:00:00:00
F▲		Start: 07:30:00		
F▲, F▲		Stop: 18:00:00		
DATE		Date: 31.12.99		
F▲		Start: - - -		
F▲, F▲		Stop: - - -		
PROGRAM		Baud rate: 9600 bd		
F▲		Atm.press. 1013mb		
F▲, F▲		Hysteresis 10		

5.2 Control Lamps

Power Supply:	**U-ext.**	external supply is connected
	option A:	continuously on: batt. is being recharged flashing: batt. is recharged
	ON	instrument is switched on
Keyboard Locking:	**KEYS OFF**	keys are locked with key switch
Programming:	**RANGE,UNIT**	dimension deviates from range
	BASE	zero point correction programmed
	FACTOR	factor or exponent programmed
	TIME	start or end time programmed
	DATE	start or end date programmed
Meas. Point Scan:	**MEAS. CYCLE**	meas. point scan active in meas. cycle
	OUTPUT CYCLE	output to output channel active
	MEMORY	memory write process or memory output
	NUMBER	number activated
	AVG. VALUE	averaging active
Alarm Conditions:	**MEAS.VALUE**	sensor breakage
	LV:MAX / LV:MIN	limit value momentarily exceeded
	MAX. VALUE	max, min value higher than limit value
	MIN. VALUE	(limit value was exceeded)

5.3 Keyboard and Locking

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

Selecting the measuring points	MEAS.POINT, ▲, ▼
Control of the meas. point scans	**START**, **STOP**, **MANUAL**
Data output	**PRINT**
Selecting additional functions	**FUNCTION▲**, **FUNCTION▼**
Programming of parameters	ENTER, **ON**, **OFF**, **CLEAR**, **COPY**

After operating the keys MEAS.POINT or ENTER a digit flashes in the display, i.e. the instrument is in the input mode. Then, the white key designations are valid and the numeric keys 0 ... 9, . , - and the cursor keys ⇨, ⇦ are available. The input can be completed with the key Ent or interrupted with the key Esc. If an abbreviation (e.g. range) is flashing, the keys ▲ (7) and ▼ (8) can be used to select the desired function.

To protect the programming of the system against unauthorised access the keyboard can be locked by means of a key switch (4). For this purpose the key must be positioned vertically and then be removed. For control purposes the red lamp **KEYS OFF** will be on. However, the function selector switch (5) remains operational.

5.4 Numeric Data Input

The programming of numeric parameters is performed as follows:

The desired function can be selected using the rotary switch (5)

Additional functions, if required, are selected with key **FUNCTION▲**

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

Input of numbers with the keys 0 . . . 9 .

The **sign can be changed** using the key ▫ .

Changing to the next digit
automatically with every input of a number or with the key ⇨

To switch back to the previous digit press the key ⇦

Decimal point input with using the key .
Number formatting according to decimal point of the meas. range

The programming process can be finished
after setting the last digit, with using the key ⇨
or with the key Ent

Abortion of the programming process with using the key Esc
or by operating the rotary switch

Clearing of programmed and measured values with the key

Switch-off of a programming value by operating the key

Switch-on of a programming value by operating the key

Example: limit value 35.0 key operations: ENTER 3 5 Ent

5.5 Alphanumeric Input

Three functions require not only numbers but also an input of letters:

1. Module designation or individual print header (40/24 characters)
2. Dimension for each measuring point (2 characters)
3. Measuring point designation for each measuring point (10 characters)

These parameters can, as the easiest method, be entered via the serial interface using the AMR Control software or via any terminal (s. man. 6.2.4, 6.3.5, 6.3.6). The keyboard of the instrument can also be used for this. Apart from the numbers printed on the keys, it is also possible to select the letters or characters given at the right bottom by repeatedly operating the keys. The key ENTER has, for upper case letters and special characters (°, Ω, %, !) the function of a SHIFT key ⇧, and, for lower case letters, the function of the key ⇨ for moving the cursor to the next digit.

Individual Print Header / Module Designation (see man. 6.2.4)

With each printout of the programming the following print header will appear:

AMR ALMEMO 5590-3 MODULE:01/00-02 A5590-1 5.12

The three module addresses identify the current module 01 from the available modules 00 to 02. Then, the module type and version follow. It also appears on the display in the function MEAS.VAL. in the 2nd line and can also be replaced by an individual module designation (40/24 characters at max). The following description describes, as an example, the input of the word ´Text´.

Selection of the function  MEAS. VALUE

1. Press key ENTER, 1st digit after measuring point flashes: Input measuring point designation, s. 6.4	0 0 0 0 :`_´_ _ _ _ _ _ _
2. Press key ⇦, then the 1st digit of the device designation flashes in the 2nd line	`_´ _ _ _ _ _ _ _ _ _ _ _ _
3. Hold ENTER for capital letters and press the required key, e.g. **0** $_{ST}$ as often, until the desired character appears:	`T´_ _ _ _ _ _ _ _ _ _
4. When the key ENTER is released the next digit automatically starts flashing.	T`_´_ _ _ _ _ _ _ _ _ _
5. For lower case letters and numbers just press the corresponding key, e.g. **9** $_{EF}$, until the desired character appears:	T`e´_ _ _ _ _ _ _ _ _ _
6. A switch to the next digit is performed using the key ⇨, continue the input until the text is complete.	T e x`t´_ _ _ _ _ _ _
7. Complete the input with the key ⇨ and key Ent or Abort/Cancel with the key Esc	

Clear the designation with the key Ent from the 1st digit.

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 6.8). All parameters can easily be entered or changed via keyboard when the corresponding sensor connector is connected.

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. If this is performed within any programming function, i.e. not with the rotary switch moved to MEAS. VALUE, then only the input channel is changed, but not the selected measuring channel, i.e. the measurement is not interrupted. The selection of a channel, which is not yet programmed, is only possible in the function RANGE, if the locking of the 1st channel has been cleared for the corresponding sensor.

ALL

Enter input channel directly:
(e.g. meas. point 12):

Increase input channel successively:

...

Decrease the input channel:

...

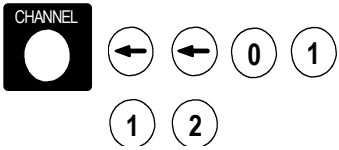
In case of changes the existing channels only will be considered.

As several active modules or devices can be managed within the data acquisition system ALMEMO® 5590-3, it might be necessary to also select the corresponding module when selecting a certain channel. This can be performed with the keyboard, only in switch position **MEAS.VALUE** (see. 7.1):

MEAS.VALUE

module 01 and

select channel 12:



6.2 Selecting the Measuring Range

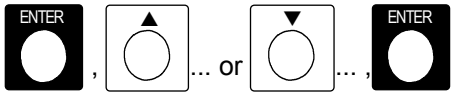
If users want to program the ALMEMO® connectors on their own or frequently change the measuring range, it is necessary that the locking is cleared (see 6.8) and special connectors may be required for some transducers (e.g. thermo, shunt, divider etc., see table).

The selection of the measuring range is performed within the function RANGE. 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 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.

Selection of the Measuring Range:


RANGE Display: 01:Range: `NiCr´°C

Example: chan. M01, range NiCr, dimension °C

Change meas. range using the keys: 

Transducer	Conn./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**	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

Transducer	Conn./Cable	Meas. Range	Dim	Display
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	D2.6
Sensor Voltage	ZA 9000-FS	0.00...20.00	V	Batt
Milliampere	ZA 9601-FS	-32.000...+32.000	mA	mA
Percent (4-20mA)	ZA 9000-FS	0.00... 100.00	%	%
Ohm	ZA 9000-FS	0.00... 400.00	Ω	Ohm
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
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
Relative air humidity cap.	FH A646	0.0... 100.0	%H	% rH
Relat. 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 VP
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 pressure w. PC	ZA 9000-FS	0.0 ...1050.0	mbar	P VP
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

Transducer Function Channel	Conn./Cable	Meas. Range	Dim	Display
Difference	any			Diff
Maximum value	any			Max
Minimum value	any			Min
Average value over time	any			M(t)
Averag. val. over junctions	any			M(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
Thermal coefficient	ZA 9000-FS		W/m^2K	q/dT
Wet bulb globe temp.	ZA 9000-FS		°C	WBGT

The **use of function channels** for the output of measured and calculated data with corresponding reference channels is described in the man. sect. 6.3.4.

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

Function RANGE **key:**

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

Re-activation of the measuring channel:

Function RANGE **key:**

If the channel was previously activated and then deactivated, the channel will be re-activated with all programming values.

6.3 Changing the Dimension

When selecting the measuring range the dimension is also correspondingly set, i.e. for temperatures °C or current mA or %. However, with a transmitter connection it is preferable to adapt the physical variable to the dimension. Therefore, it is possible to enter any 2-digit dimension for each measuring channel (see also manual 6.3.5).

The **change of the dimension** can be performed within the function RANGE by pressing the keys ENTER, ⇦. The first character of the dimension will flash in the display. The input of the two characters can be performed according to 5.5.

When the dimension °F is entered a temperature value in degrees Celsius will be converted into degrees Fahrenheit.
The cold junction compensation of thermocouples can be switched off by the dimensions !C or !F.

6.4 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 designation appears in the 1st line of the display before the measured value:

Meas.Point Designation ´Temperature´ 0001:Temperature

In case of outputs via interface the measuring point designation appears in the program header as ´COMMENT´ and in the list of measured values (man. 6.6.1).

The input is performed within the function MEAS.VALUE with using the key ENTER according to 5.5.

6.5 Limit Value, Hysteresis

Two limit values (Max, Min) can be programmed for a measuring channel. The exceeding of the limit values is, as the exceeding of the measuring range limits and sensor breakage, handled as disturbance (see manual 6.3.9) and the corresponding red control lamps will be on. The control lamps of ✹ MAXIMUM VALUE and ✹ MINIMUM VALUE still indicate the disturbance, even if it has disappeared already. Disturbed measuring channels will be provided as output via the interface during a measuring point scan within a measuring cycle. An exceeding can also be used to start or stop a measuring point scan (s. 7.3.6).
Any disturbances only disappear after the measured value has dropped below the limit value by the hysteresis. The hysteresis is, as standard, set to 10 digits. However, it can, within the function Hysteresis, be set separately for each module from 00 to 99.

Function LIMIT VALUE MAX and LIMIT VALUE MIN:

LIMIT VALUE MAX
LIMIT VALUE MIN

01:Limit max:

Programming: Input according to 5.4

Switch-off: key 

01:Limit max: - - -

Function HYSTERESIS:

PROGRAM 

, 

Hysteresis 10

Programming: Input according to 5.4

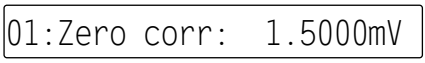
6.6 Correction Value

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.Val. – ZERO POINT) x SLOPE.

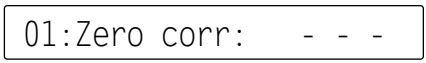
Function ZERO POINT CORRECTION:


BASE key: 



Programming: Input according to 5.4

Switch-off: key: 



Function SLOPE CORRECTION:


FACTOR key: 

Programming: Input according to. 5.4

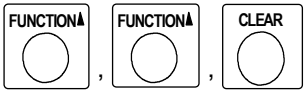
The corresponding control lamps ✹ BASE and ✹ FACTOR will be on if correction values are programmed and, as a result, the measured value is changed.

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 **MEAS.VALUE** (see also 7.1.3).

Press key **FUNCTION▲** twice within function MEAS.VALUE. The meas. value will flash and line 2 of the display will indicate ´zeroing -> zero´. With operating the key **CLEAR** the corrected, non-scaled meas. value will be stored as zero point correction and be set to zero. The base value will be maintained.

Function: zeroing-> zero


MEAS.VALUE 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.

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)

6.7 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.

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.

Function BASE VALUE:


BASE

```
01:Base:  V:-007.00pH
```

Function FACTOR and EXPONENT:


FACTOR

```
01:Factor: 1.0350E+1
```

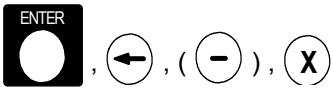
Programming: Input according to 5.4

The corresponding control lamps, ✹ BASE and ✹ FACTOR, will be on if scaling values are programmed and, as a result, the measured value is changed.

Decimal Point Setting

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 representation of measured values is not possible.

For **entering the exponent** within the function FACTOR the keys ENTER, ⇦ must be pressed so that the exponent is flashing. The sign can then be changed by using the key ▫. The numerical value X can be entered with using the numeric keys.

Keys: 

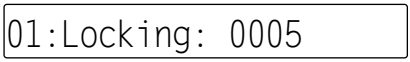
6.8 Locking the Programming of the Sensor (s.man. 6.3.12)

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:


RANGE key: 



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).

The keyboard locking by means of the key switch must be used to protect the programming and the process control during a measurement against unauthorised modification (see 5.4).

7. MEASUREMENT

The instrument ALMEMO® 5590-3 provides the following options for the acquisition of measuring data:

1. Continuous measurement of a selectable meas. point, s. 7.1 and man. 6.4
   Output of measuring data to the analogue output, see 9. and manual 5.1.1.
2. Single measuring point scan, see 7.2 and manual 6.5.1.1
3. Cyclic measuring point scan, see 7.3 and manual 6.5.1.2
4. Continuous measuring point scan, see 7.30,3 and manual 6.5.1.3

Total Clearing of all Measured Values

Previous measuring data should be cleared before a measurement. Max, min, and average values of all channels and the memory can be cleared with the rotary switch in position MEMORY, by using the keys ENTER, ENTER, **CLEAR**.

Key: 

flashes `Clr SP` (clear memory)

flashes `Clr All` (clear memory and meas. values)

`- - -` cleared (not with other key)

For automatic clearing on each START, see manual 6.10.13.2.

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 7.3.3) (optimal for analogue output).

7.1.1 Selecting the Module and Measuring Point

In the switch position **MEAS.VALUE** the display provides the following information. In the first line the combination of module address 00 (see 8.2) and measuring point 12 is displayed. Then, the short name of the measuring range follows (see 6.2) if a measuring point designation has not been entered (see 6.4). At the end the measured value is displayed including the dimension. In the second line the version of the selected module or a programmed module designation (see 5.5) will be displayed.

Function MEAS.VALUE:


MEAS.VALUE

```
0012:  NiCr      123.45°C
A5590-1 5.50
```

Display with measuring point designation and module designation:

```
0012:oiltemp.2  123.45°C
motor-checkbox A6
```

In case of a sensor breakage the short name of the measuring range and the red control lamp ✹ MEAS.VALUE will flash instead of the measured value.

If the actual measured value is changed by scaling or correction values the corresponding yellow lamps, ✹ BASE and ✹ FACTOR will be on. A re-programmed dimension is indicated by the control lamp ✹ RANGE, DIM (see 5.2).

The key 

can be used to query the CPU version in the second line.

Selection of Module and Measuring Point

The measuring points of all measuring modules can, directly or successively, be selected with using the keys ▲ or ▼ and the actual measured value will be displayed. By selecting the measuring channel the input channel is, at the same time, also selected (see 6.1).

Increase measuring channel with key:  (programmed channels only)

Decrease measuring channel with key:  (active channels only)

A **measuring point within the selected module** can via the keyboard be directly entered with two digits:

Enter meas. chan. directly (e.g. meas, point 12): 

, 1 , 2

Selecting a measuring point in another module can be performed by a three-digit or four-digit input, with moving the cursor ⇦ accordingly to the left:

Example: Module 01 and 

, ⇦ ⇦ , 0 , 1

Select channel 12: 1 2

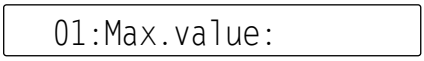
If the module shall be switched only (from the selected channel of one module to the selected channel of the other module) the selection can be finished with using the key Ent after entering the module.

7.1.2 Memory for Peak Values

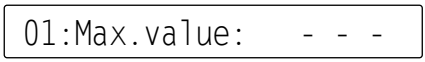
From the measured values that are obtained from each measuring point the maximum and minimum value is determined and stored each time. For indicating the peak values the function MAX VALUE or MIN VALUE must be selected with the rotary switch and the desired channel must be set.

Function MAXIMUM VALUE or MINIMUM VALUE:

MAXIMUM VALUE
MINIMUM VALUE



Clear: Key CLEAR



The peak values are also cleared when a total clearing (see 7.) or a change of the measuring range is performed (see 6.2). If the cleared channel is the selected measuring channel, the measured value will be indicated immediately after the clearing.

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 to check the deviation from the reference value. With the key **FUNCTION ▲** in switch position **MEAS.VALUE** the display will indicate ´zeroing -> base´ and with the key **CLEAR** the displayed measured value will be stored as base value and, as a result, be set to zero.

Function: zeroing -> base

Function:  MEAS.VALUE Set to zero with keys: FUNCTION▲ , CLEAR

Please note that this function is only available if the locking code is set below 5 (see 6.8).

The control lamp BASE will be on as long as the deviation from the base value is indicated, but not the actual measured value.

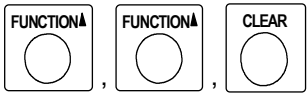
The base value must be cleared in order to obtain the actual measured value (see 6.7). For this purpose the rotary switch must be set to the function BASE and the base value must be cleared with the key **CLEAR**.

Function:  BASE Clear base value: CLEAR

Zero Point Correction

Many sensors must be adjusted at least once or at regular intervals to compensate for instabilities. For this purpose, a specific **zero point correction** 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 6.6). In this case, the locking mode must be set below 4 (see 6.8). The zero point correction is performed using the following keys:

Function: `zeroing-> zero`

Function:  MEAS.VALUE Zero Pt Correct.: 

 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

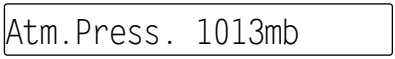
Some measuring variables depend on the environmental atmospheric pressure (see 6.2 measuring range list ´w. PC´) so that corresponding measuring errors will occur in case of larger deviations from the normal pressure 1013 mbar.

For example, 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 or measured with a sensor (see manual 6.7.2).

Function ATMOSPHERIC PRESSURE:

 PROGRAM key: 



With each reset the atmospheric pressure is set to 1013mb. It can be set to the actual value by the usual data entry (see 5.4).

7.2 Measuring Point Scans (see also manual 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 values are acquired, monitored with regard to an exceeding of limit values and successively indicated in the display for 1.5 seconds. Furthermore, the maximum and minimum values are updated. For storing all measuring point scans the memory activation in the measuring cycle can also be used (see 7.3.2). The digital output via the output channels ´serial interface´, ´Centronics´ and ´built-in printer´ and with three output formats is described in chapter 8.1.

7.2.1 Single Measuring Point Scan

Single measuring point scans for acquiring the momentary measuring values of all active measuring points are triggered by the key **MANUAL**.

Single measuring point scan: key: 

 ALL

During the display of the measured value the control lamp ✹ MEAS.CYCLE will be on and then will turn off again. If the time was set to zero before, it will be started. When a peripheral device is connected (e.g. printer) and the output channel is activated (see 8.1) the measured values will be one time provided via the interface and the control lamp ✹ OUTPUT CYCLE will be on. If all measured values also need to be stored, the memory must be activated (see 7.4.1). If this is the case, the control lamp ✹ MEMORY will switch on during the data acquisition.

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 7.3.4).

7.3 Cyclic Measuring Point Scan

For cyclic measuring point scans the measuring or print cycle (s. 7.3.1/2) must be programmed. The measurement is started with the key **START** and the control lamp ✹ MEAS.CYCLE will be continuously on. If a peripheral device is connected the measured values will be provided in cycles and the control lamp ✹ OUTPUT CYCLE will be on. If the memory is active (see 7.4.1) the measured values are stored and, in addition, the control lamp ✹ MEMORY is on.

Start cyclic measuring point scan: key: 

The **automatic measuring point scan can be stopped** by operating the key STOP. The control lamps ✹ MEAS.CYCLE, ✹ OUTPUT CYCLE and ✹ MEMORY turn off.

Stop cyclic measuring point scan: key: 

7.3.1 Output Cycle

The output cycle, the output channel and the output format (s. 8.1) can be set in the function OUTPUT CYCLE for cyclic measuring point scans and outputs.

Function OUTPUT CYCLE:

 OUTPUT CYCLE

```
Un Outp.cycle 00:30:00
```

Example: output channel ´U´ (V24), column format, print cycle 30 min.

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

Clear print cycle and stop the measuring point scan with using the key **CLEAR.**

7.3.2 Measuring Cycle and Memory Activation

The measuring cycle is used for the storage of measured values, for averaging and for the output of alarm values (see also manual 6.5.3).

Function MEAS.CYCLE:

 MEAS.CYCLE

```
S Meas.Cycle 00:02:00
```

Example: storing activated ´S´, meas.cycle 2 min

The meas.cycle is entered with 6 digits and format hh:mm:ss according to 5.4.

Clear meas. cycle and stop the measuring point scan with using the key **CLEAR.**

The **storage activation** for all manual and cyclic measuring point scans (see 7.4.1) can be performed with the key ON.

Storage activation with key: 

Switch-off with key: 

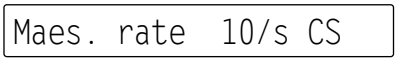
7.3.3 Conversion Rate, Continuous Measuring Point Scan

If required, the conversion rate can be individually increased from 2.5 to 10M/sec for each module (man. 6.5, 6.5.4). For this purpose, with the switch position MEAS.CYCLE, the additional function CONVERSION RATE must be selected with key **FUNCTION▲** and be entered by the keys ENTER, ▲▼, ENTER.

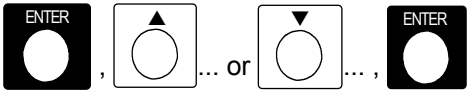
At the same time, the **continuous measuring point scan** can be set with the identification code ´C´, i.e. not only the selected measuring point will be scanned but all active measuring channels will be continuously scanned successively (man. 6.5.1.3). At the system ALMEMO 5590-3 this applies firstly to the individual measuring modules, i.e. compensations of the measured values are performed and, in case of an exceeding of limit values, the alarm modules plugged onto the corresponding module will respond. For the CPU this leads to the advantage that it is no longer necessary to measure the measured values but just to ´pick´ them up. If the **master module** is set to continuous measuring point scan ´C´ and **no measuring cycle** is programmed, the CPU begins **at the start** of a measurement to scan without interruption all modules and evaluates the measured values (fastest meas. cycle). Also in the CPU, all max, min and average values will be updated, the limit values will be centrally monitored and continuous storing of the measured values in the CPU memory will be enabled. During the continuous measurement only the selected meas. point will be indicated in the display and programming is no longer possible as the modules are continuously switched. Furthermore, it is not possible to print cyclic sums (range S(P))!

Function CONVERSION RATE:


MEAS.CYCLE key: 



Example: conv.rate 10M/s, continuously, with storing

Change conv. rate: keys: 

The continuous storing with the identification ´S´ and 0.10s resolution can be activated with using the keys ON and OFF, while the continuous output of the measured values (´U´) can only be activated via the interface (see man. 6.5.4).

Storage activation with the key: 

Switch-off with the key: 

During continuous measurements/outputs the following control lamps will flash:
✹ MEAS.CYCLE and, possibly, ✹ OUTPUT CYCLE, ✹ MEMORY, ✹ AVERAGE VALUE.

7.3.4 Time and Date

For recording the measuring time a real time clock with date function has been integrated into the CPU board. It has a lithium battery so the time and date are maintained after a switch-off.

Function TIME:


TIME

Time:	12:23:45

The time is programmed in the format hh:mm:ss (see 5.4).
The clock can be stopped and set to zero by using the key **CLEAR**.
The clock can be started in any switch position by using the key **START/STOP**.

Function DATE:


DATE *e.g.* 1 May, 1999

Date:	01.05.99

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

Clear the date by using the key **CLEAR**.

7.3.5 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 time and date of the start and the time and date of the end can be programmed. If no date has been specified the measurement is performed daily at the specified time interval. The actual time must be programmed before.

Function TIME OF START:


TIME key: 

Start:	- - -

Programming using the format hh:mm:ss:

Start:	07:30:00

Function TIME OF END:


TIME keys: 

, 

Stop:	18:30:00

Start date and end date are programmed in the same way in the format dd:mm:yy and with the switch positioned on **DATE**.

The data can be activated or deactivated with using the keys **ON** and **OFF.**

7.3.6 Start and Stop by Limit Values

Another possibility for starting or stopping a data logging automatically is the triggering by the exceeding of limit values (see manual 6.6.3). The **allocation of the start or stop command** to a limit value can be performed in switch position LIMIT VALUE MAX or MIN. The additional function `Action Max` or `Action Min` can be activated with using the key **FUNCTION ▲**.

Function ACTION MAX and ACTION MIN:


LV. MAX action cleared:

```
01:Action max - - -
```

The **activation of the actions ´Start´ or ´Stop´** is performed by pressing the key ENTER and selecting with the keys ▲ and ▼.
The symbols `´Start´` or `´Stop´` will start flashing.
The programming can be terminated by the key `ENTER`.

Action START at LV MAX of channel 1:

```
01:Action max  Start
```

7.3.7 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.)
- hourly or daily average values of weather data (temp., wind etc.)
- as above, of consumption values (current, water, gas etc.)

An averaging process for the measured values of measuring point scans can be programmed for each measuring point (manual 6.7.4).

The **average value** can be **indicated and programmed** at switch setting AVERAGE.

Function AVERAGE VALUE:


AVERAGE VALUE

```
01:Avg.value:  173.5°C
```

Average values must be cleared before each measurement and for programming. The **clearing of an average value** is performed after selecting the input channel by using the key **CLEAR** or by a total clearing (see 7.).

The **type of averaging** is determined through the averaging mode:

Function AVERAGING MODE:

key: 

The following modes can be set by using the keys ENTER, ▲▼, ENTER:

Function	Display
No averaging:	- - - -
Continuous averaging:	C o n t
Cyclic averaging:	C Y C L

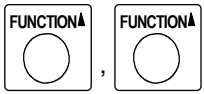
For **averaging single measurements** the averaging mode ´Cont´ must be selected, measuring and print cycle must be cleared and the key **MANUAL** must be pressed each time. In function **AVERAGE** the average value is indicated and can be printed at any time by using the key **PRINT** (see 8.3).

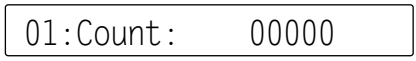
For an **averaging over time** the measuring and, possibly, print cycle must be programmed in addition to the averaging mode.

The averaging can be **started** with operating the key **START** and stopped with operating the key **STOP**. When averaging is activated for a channel, the control lamp ✹ AVERAGE VALUE.

The **count N** of averaged values can be obtained in function Count by operating the key **FUNCTION▲** twice.

Function COUNT:





7.4 Data Memory

The basic principles for storing data in ALMEMO® devices are described in section 6.9 of the manual. The memory organisation can be reconfigured from linear to ring memory (see manual 6.10.13.2).

7.4.1 Data Acquisition

Switch-on of the Data Storing within the Measuring Cycle

If the memory is activated in switch position MEAS.CYCLE (see 7.3.2), each measuring point scan (except ´continuously´) will then be stored. This is applicable for each scan in the measuring cycle, print cycle and a manually started scan (also when the measuring cycle is zero). Outputs to the selected interface are independent from this.

Switch-on of the Data Storing within the Output Cycle

If the output channel, while in position OUTPUT CYCLE, is set to ´S´ by operating the key ▲ (s. 8.1), all measuring point scans which are, usually, provided as output to the interface, will be stored in the memory, i.e. measuring point scans in print cycle or manually, in measuring cycle only the alarm value lists (e.g. exceeding of limit values), if activated (see manual 6.10.13.2).

Switch-on of the Continuous Storing with the Conversion Rate

The highest recording speed can be reached with **storing at continuous measuring point scan** (see 7.3.3 and manual 6.5.1.3).

For **starting a cyclic storing** the key START must be operated. When measured values are stored the control lamp ✹ MEMORY will be on, during automatic scans continuously, in case of manual scans only during the scan. The **storing can be stopped** by operating the key **STOP**, the control lamp ✹ MEMORY, ✹ MEAS.CYCLE and ✹ OUTPUT CYCLE turn off again.

7.4.2 Output of Measuring Data

Displaying the Data Memory:

MEMORY

The display always shows the last stored measured value of the input channel.
Change of the indicated channel with key ▲.

```
01:Memory:   256.7°C
```

On **sensor breakage** the abbreviation of the range:

```
01:Memory:   NiCr
```

When the **memory** is **cleared** the display indicates:

```
01:Memory:   - - -
```

If the **memory** is **full** the display indicates:
With linear memories no further measured values will be stored, with ring memories old values will be overwritten.

```
01:Memory:   FULL
```

The free memory space is displayed in function ´Sp. frei´ in kB by operating the key **FUNCTION▲**:

```
01:Mem. free: 345.6kB
```

The content of the data memory can, using measuring points, be provided as output to the display and the analogue output or, using cycles, be provided as output to the serial interface. The output channel is relevant in this context.

Output to the Display and to the Analogue Output

OUTPUT CYCLE select output channel: display: ´–´
analogue output: ´S´

MEMORY
- select the desired measuring point ▲
- obtain first meas. value on the display **PRINT**
- recall individual measured values **MANUAL**
- start automatic output **PRINT**
  - display (´–´): 1 value/s
  - recorder output (´S´): 2 values/s
- cancel automatic output **STOP**
  - recall individual measured values **MANUAL**
  - re-start automatic output **PRINT**
  - cancel automatic output **STOP**

During the memory output the green control lamp ✹ MEMORY will be on for control purposes. At the end a ±20-digit notch is written on a recording device. The output can be repeated for each further measuring point.

Output to the Serial Interface

OUTPUT CYCLE
- select output channel: ´U ´
- set the output format: e.g. ´Un´

MEMORY
- start the automatic output **PRINT**
- cancel automatic output **STOP**
  - recall individual measured values **MANUAL**
  - re-start automatic output **PRINT**
- cancel automatic output **STOP**

During the memory output the display will indicate ´Output´ and the green control lamp ✹ MEMORY will be on. The memory content is provided as output with the same printouts as used for an output via printer and, if necessary, several times and in different formats (see manual 6.6.1).

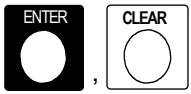
Printout:

```
MEMORY:
NUMBER:     12-001              (when activated)
DATE:       12.03.90
```

List format

```
12:30:00 01: +0012.0 °C NiCr Designation
         02:!+0008.8 °C NiCr Water
         03:>+125.00 °C Ntc  Motor oil
```

Clear Memory

 MEMORY clearing with keys: 

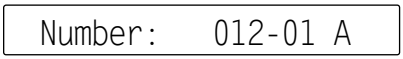
To completely clear all measured values use ENTER, ENTER, **CLEAR** (see 7.).

7.5 Numbering of Measurements

For an identification of measurements or sequences of measurements a number can be entered that will be printed or stored with the next measuring point scan. As a result, individually stored measurements can be allocated to certain measuring locations or measuring points (see manual 6.8).

Function NUMBER:

 NUMBER

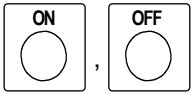


Example: Room No.: 12, meas. point 1, active

Programming of the 6 digit number (see 5.4). Apart from the figures 0 to 9 it is also possible to use the character -. After the input the number output is activated and an ´ A´ will appear in the dimension field.

Increasing the number by 1 and activating by using the key:

Activating and deactivating the number with the keys:



Setting to zero and deactivating the number with the keys:

8. DIGITAL DATA OUTPUT

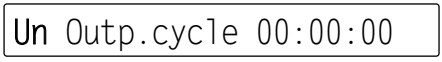
All measured values as well as the complete programming of the sensors and the instrument can be provided as output via the serial interface A1 to a computer, via the Centronics interface to an external printer, or to an internal built-in printer (option D). Three output formats are available for the presentation of the measuring point scans. The system 5590-3 can, by networking, also scan the measured values of external devices.

8.1 Output Channel and Output Format

If the data is not provided via the standard ALMEMO® socket A1 but via the Centronics socket, the built-in printer or just to the memory, the output must be redirected by means of the output channel.

Output Channel and Output Format:

OUTPUT CYCLE



Example: U = output via interface A1, n = column format

The **output channel** is indicated within the function OUTPUT CYCLE in the first digit at ´CHANNEL´ and can be selected with the keys ▲ and ▼.

AK	Output Channel	
-	no output	
U	serial interface A1	all data
C	parallel interface CENTRONICS	all data
P	built-in printer (option)	all data
S	**storing** in print cycle, alarm values in meas. cycle output from memory to recorder	meas. point scans only only 1 channel

Output Format with Lists of Measured Values (see manual 6.6.1)

As described in chapter 7 the measured values will, at all measuring point scans (see 7.2 and 7.3) and memory outputs (see 7.4.2), be provided as list of measured values, including the time of day, to the output channel mentioned above. The lists of measured values can be provided in three different formats. Apart from the standard list format, with all measured values given in a **list**, the **column** output format allows for a clear and space-saving printout in columns. For this purpose, a printer will automatically switch to the condensed character mode. Alarm lists during the measuring cycle are not available for this format. The **spreadsheet** format is available to further process measuring data by means of spreadsheet applications (see manual 6.1).

The information on the **output format** follows after the output channel and can be set with the key **MEAS.POINT**.

Abbr.	Output Format
	measured values with range and comment as list
n	measured values in columns
t	measured values in spreadsheet format
a	only alarm values as list when memory is read

8.2 Serial Interface

The device connection via serial interface and the necessary interface modules are described in the manual section 5.2. Other modules for networking several instruments follow in the manual section 5.3. The commands for the programming of the instrument, the sensors and the data output via serial interface can be found in the manual section 6.

8.2.1 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 or 9600bd can be entered via keyboard if the rotary switch is in position **PROGRAM**.

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:

PROGRAM

Baud rate:9600 bd

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

8.2.2 Networking of Measuring Modules and Instruments

Three types of networking can be distinguished at the data acquisition system ALMEMO 5590-3. The extension of measuring points by internal active measuring circuit boards has already been introduced in section 4.2. This extension can, via socket A3 (externally) and with the same boards, be continued in the system ALMEMO 5590-1 or with other ALMEMO® modules, which will then also be controlled and scanned by the system. On the other hand, the system itself can also be integrated into a network that is controlled via a computer. It is possible to connect a total of up to 99 ALMEMO® devices to a serial interface.

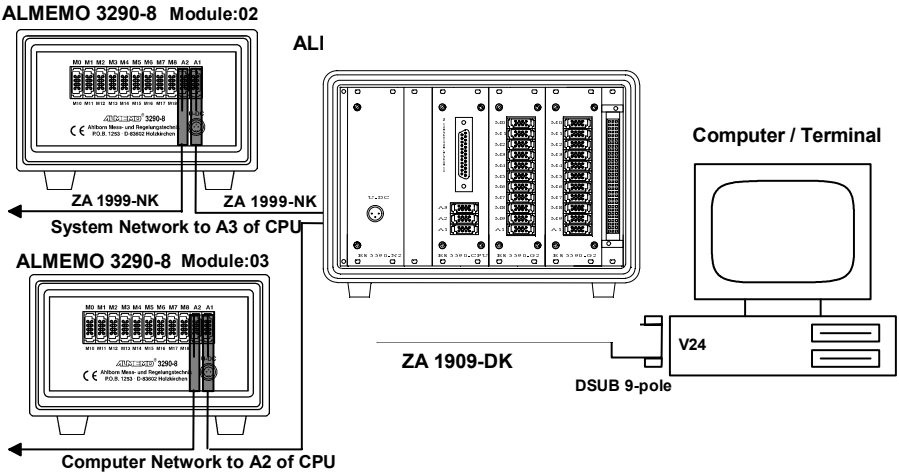
8.2.2.1 Extension of the System with Networked Meas.Instruments

The connection of ALMEMO® devices to socket A3 of the CPU can be performed with network cables ZA 1999-NK (see man. 5.3.1) or, via the network driver ZA 5099-FS, with the RS422/485 network branch box (see man. 5.3.3). All external devices are handled like the internal active measuring circuit boards. The sensors can be programmed and the measured values can be automatically scanned, stored in the system and be provided as output via the output channels.

8.2.2.2 Networking of the System

An interface cable that is connected to socket A1 of the system can also be cascaded by means of the ALMEMO® network components to socket A2. However, ALMEMO® devices that are connected here cannot be controlled by the system but only by a superordinated computer.

Connection Diagram:



8.2.2.3 Setting the Device Addresses

Before any network operation all measuring modules and devices must be set to the same baud rate, 9600bd, but to different device addresses. The address of the system corresponds to the address of the first module and is usually 00. It must be changed, for example, when two 5590-3 systems are networked. If the first system has the modules 00 to 03 and the second system the modules 04 to 07, then the address 04 must be set for the second system. For this purpose, it is necessary to select the function "Address" with the key **FUNCTION▲** in the rotary switch position OUTPUT CYCLE, and to change the set device number accordingly (see 5.4).

Function ADDRESS:

OUTPUT CYCLE KEY:

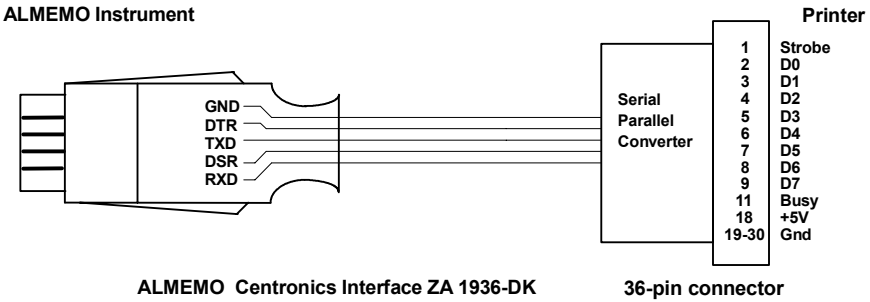

```
0112:  NiCr 123.45°C
Address:       01
```

The addressing of the internal modules with using code switches is described in section 4.3. The addresses of the external devices must continuously follow the internal modules. However, the sequence of the addresses is of no importance. The individual operating instructions provide information on how to set the addresses. The selection of any devices is performed the same way as the module selection (see 7.1.1). On initial operation at first all external devices and then the system must be switched. During initialisation phase all modules are queried and the configuration is stored in the memory. This process can, for control purposes, be monitored on the display with indication of all module designations. Devices that have been switched on afterwards will no longer be recognised.

8.3 Centronics Interface

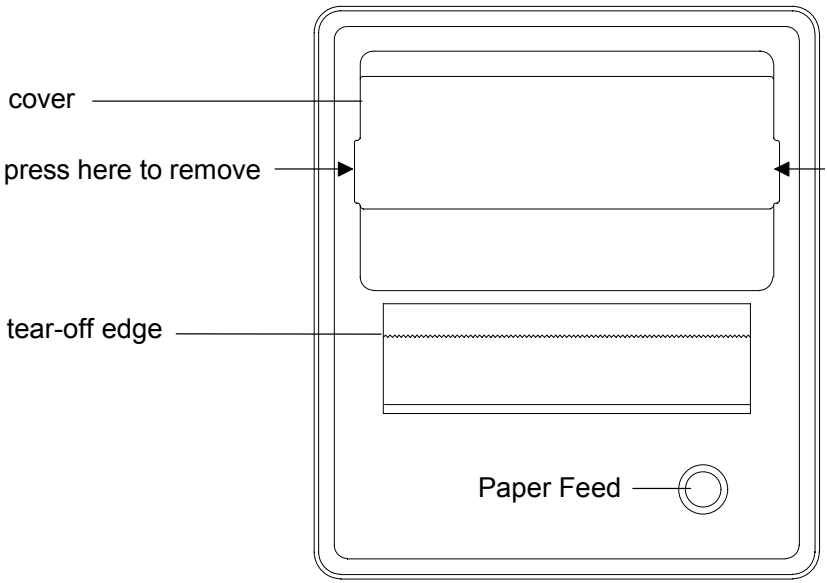
Printers with a Centronics interface can be connected via a standard PC cable to the socket CENTRONICS of the CPU board (8). After selecting the output channel ´C´ all outputs will be performed via the parallel interface. However, it is still possible to enter commands via the serial interface.

If additionally an electrical isolation is required between the CPU and the printer, or if more than 3m have to be bridged, or if you already have an ALMEMO® Centronics cable ZA 1936-DK, then this cable can also be used for connecting the printer. It is plugged into the socket A1 of the CPU (8). The module includes a serial-parallel converter with an electrical isolation so that the Centronics interface must be supplied from the printer (usually provided by pin 18 = + 5V). The baud rate setting must not be altered.



8.4 Built-In Printer (Option D)

The system ALMEMO 5590-3 can be equipped with a built-in printer that allows for all functions of the print operation. The built-in printer is equipped with a 40-digit dot matrix thermal printing system and CMOS interface, which has in standby mode a very low power consumption so that also an operation with the built-in rechargeable battery (option A) is possible. Only in case of frequent printouts the rechargeable battery will be remarkably faster discharged.
Print and programming commands can be entered via both, the keyboard and the serial interface.



Inserting 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 paper feed key 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 paper should then be pulled out and be replaced by a new roll.

8.5 Manual Data Output

The list output with networked modules can be extended as follows:

List	12:30:00 00: +025.67 °C Ntc Temperature
	MODULE:01 00: +0008.8 °C NiCr Water
Column	12:30:00 00: +025.67 °C 10: +0054.6 %H
	MODULE:01 00: +0008.8 °C 01: +02.345 br 02: +0231.6 V~
Spreadsh.	"DATE:";"TIME:";"M00:°C";;"M0100:°C";"M01:br";"M02:V~
	"01.01.2000";"12:30:00";25,67;;8.8;2,345;231,6

Each module can, apart from the lists of measured values, also provide all other measuring and programming values. For the output of data to the interface or to a built-in printer the output channel must be set to ´U´, ´C´ or ´P´ by using the key ▲ to ´U´, ´C´ or ´P´ within the function OUTPUT CYCLE (see 8.1). The output format is of no importance for the manual data output. All function values that have been selected by using the rotary switch and, possibly, with the key **FUNCTION ▲**, can then be printed out with the following printout by using the key **PRINT**:


ALL


... manual data output:


Key	Function	Printout
	MEAS. VALUE	12:34:00 01: +0023.5°C
	MAX VALUE	MAXIMUM: 01: +0020.0 °C
F▲	**Analogue End**	ANALOG END:01:+0100.0 °C
	MIN VALUE	MINIMUM: 01: -0010.0 °C
F▲	**Analogue Start**	ANALOG START 01: +0000.0 °C
	AVERAGE VAL.	AVERAGE VAL: 01: +0017.8 °C

Key	Function	Printout
F▲	**Average Mode**	CH MEAS.VAL MAXIMUM MINIMUM AVG.VAL COUNT s. m. 6.4.4
F▲, F▲	**Count**	01:+0023.0 +0025.0 +0019.0 +0022.0 99999
	NUMBER	NUMBER: 00-123
	MEMORY	MEMORY: - - - - s. 7.4.2
F▲	**Memory free**	MEMORY: S0501.4 F0234.5 A
	RANGE, DIM	01:NiCr +0123.4 -0012.0 +0000.0 °C 1.0000 E+0 - - -
F▲	**Locking**	s. m. 6.10.1
	ext. program	CH ZERO SLOPE LM P FUNC CALOFS CALFA A-START A-END B1 MX EF AH AL CF UMIN 01:+0000.0 +1.0000 5. 1 MESS +00000 32000 +0000.0 +1000.0-01 M1 -- S- E2 05 12.0
	LIM. VAL. MAX	LIMIT MAX: 01: -0100.0 °C
	LIM. VAL. MIN	LIMIT MIN: 01: +0020.0 °C
	BASE	BASE: 01: -0273.0 °C
	FACTOR	FACTOR: 01: +1.0350E-1
F▲	**Zero Point**	ZERO CORR: 01: -0000.7 °C
F▲	**Slope (Gain)**	SLOPE CORR: 01: +1.0013
	TIME	TIME: 12:34:00
F▲	**Start Time**	START TIME: 07:00:00
F▲, F▲	**End Time**	END TIME: 17:00:00
	DATE	DATE: 01.02.99
F▲	**Start Date**	START DATE: 01.02.99
F▲, F▲	**End Date**	END DATE: 02.02.99
	OUTPUT CYCLE	PRINT CYCLE: 00:06:00
	MEAS.CYCLE	MEAS.CYCLE: 00:01:30
	PROGRAM	AMR ALMEMO 5590-3 MODULE:00/00-01 Module Designation 00 s. man.. 6.2.3
	Sensor Programming	CH RANGE LIM-MAX LIM-MIN BASE D FACTOR EXP AVG COMMENT 00:Ntc +025.00 +020.00 - - - °C - - - E+0 - - - Temperature 10:%rH +0050.0 +0020.0 - - - %H - - - E+0 - - -Humidity AMR ALMEMO 5590-3 MODULE:01/00-01 Module Designation 01 CH RANGE LIM-MAX LIM-MIN BASE D FACTOR EXP AVG COMMENT 00:NiCr +0123.4 - - - - - - °C 1.0350 E+0 - - - Water 02:U2.4 - - - +01.000 - - - br - - - E+0 CONT Pressure
	Cycles, Memory	MEAS.CYCLE: **00:00:30 S** **S0501.3 F0204.7 A** W010 **C-SU-** PRINT CYCLE: **00:10:00 U** **9600 bd**
	if programmed	START TIME: **00:07:00** START DATE: **02.01.99** END TIME: **18:30:00** END DATE: **03.01.99**
F▲	**Atm. Press.**	MODULE: G00 M40 A08 P10/20/20 s. man. 6.2.5
F▲, F▲	**Hysteresis**	A.PRESSURE: **+01013. mb**
	Module Pro-gramming	CJ-TEMP: +0023.5 °C U-SENSOR: 12.5 V HYSTERESIS: 10 CONFIG: **FCRDA**--- ---- B02 **a+12345** ALARM: **-1-3** A1: **DK0 Un** A2: **RK**

At the master measuring module the bolded parameters are depending on the data and configuration of the CPU.

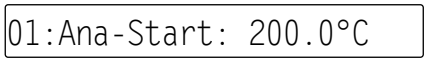
9. ANALOGUE OUTPUT

For analogue acquisition of the selected measuring point of any active module either an analogue output cable ZA 1601-RK (see manual 5.1.1) without electrical isolation or a relay trigger analogue adapter ZA 8000-RTA (see manual 5.1.3) with electrically isolated analogue output can be connected to the socket A1 of the corresponding plug-in module. For external control of an analogue output via the serial interface (see manual 6.10.7) the analogue output module must be connected to the socket A2 of the CPU.

Scaling

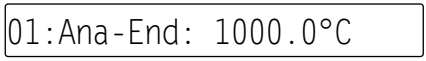
It is possible to spread any partial range to the standard output signal of the three available options 0-2V, 0-10V, 0/4-20mA if the partial range covers at least 100 digits (e.g. 0-20mA for +200.0 to +1.000.0°C). To achieve this the **analogue output-start** and the **analogue output-end** of the desired measuring range must be entered within the functions `Analogue Start` and `Analogue End` (see manual 6.10.7). If the initial value is zero it will remain cleared.

Function ANALOGUE START:



Programming: Input according to 5.4

Function ANALOGUE END:



Example: meas. range 200.0 to 1000.0 °C

These two parameters, analogue output-start and analogue 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.

10. TROUBLESHOOTING

The data logger ALMEMO® 5590-3 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: Switch-on indicator is not illuminated, no display data or all display segments are permanently illuminated.

Remedy: Check power supply, recharge battery, switch off and on again, reinitialise (see 3.4).

Error: Incorrect measured values.

Remedy: Thoroughly check the programming of the channel (especially base and zero point).
Query the entire programming with AMR-Control or via terminal and command `P15` (see man. 6.2.3) and `f1 P15` (see man. 6.10.1).

Error: Varying meas. values, segment test or blockage during operation.

Remedy: Check cabling for inadmissible electrical connection.
Disconnect the output modules, disconnect suspicious sensors and replace them by hand-held sensor operated in air or dummies (short circuit A-B at thermocouples, 100Ω at Pt100 sensors).
If the error is corrected by this, re-connect and check the sensors and modules successively, if an error occurs with one sensor, check the wiring, isolate the sensor if necessary, 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 8.2.1)?
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 (s. man. 6.2.1),
query the programming by P15 (see man. 6.2.3).
Only check the sending line by cycle input via command Z123456 and control in the display.
Test the receiving line by using the key **OUTPUT** 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 network. devices, check devices separately at 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 data acquisition system ALMEMO® 5590-3 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:

EN 50081-1:1992	
EN 50082-1:1992	IEC 801-2 8kV, IEC 801-4 1kV
	IEC 801-3 3V/m: deviation<100uV

The following notes must be observed when operating the instruments:

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 (<50mV at 3V/m and 1.5m thermocouple transducers). After the irradiation the device operates again within the specified technical data.

Technical Data (see manual 2.2)

Measuring Inputs:

Act. Meas.Circ. Board ES 5590-G2 10 ALMEMO® sockets for ALMEMO® connector

Measuring channels:	10 prim. chan. electr. isol., max 30 add. channels for double sensors and function channels
Master board:	triggering of 8 selector switch boards at maximum
Current consumption:	approx. 21 mA without I/O modules
Sensor voltage supply:	mains adapter: approx 12V, max. 100mA rechargeable battery: 7 to 9V, max. 100mA

Extension:

Free plug-in slots, internally:	40DU housing: 3 84DU housing: 14
Max. number of active meas. modules:	50
Maximum number of channels:	250

Select. Switch Board ES 5590-MF 10 ALMEMO® sockets for ALMEMO® connector
10 channels electr. isol., 30 addit. channels, 2 slots

Current Consumption:	approx. 12 mA without input modules

Select. Switch Board ES 5590-MU 10 inputs via 10-fold MU connector
10 channels, 1 slot

Current consumption:	approx. 1 mA

Act. Meas. Circ. Board ES 5590-G0 1 ALMEMO® socket for ALMEMO® connector
4 channels, 1 slot

Sensor voltage supply:	Mains adapter: approx. 12V, max. 100mA rechargeable battery: 7 to 9V, max. 100mA

Act. Meas.Circ. Board ES 5590-G3 10 inputs via 10-fold MU connector
10 channels electr. isol., 1 slot

Equipment:

Display:	LCD dot matrix display 2 lines 24 characters 9mm
Function selection:	16-position rotary switch
Keyboard:	16 keys with key switch
Memory:	500 kB (100000 meas.val.) buff. w. rechar. NiCd batt.
Option S (OA 5590-S3):	2 MB (400000 meas. values)
Time and date:	real time clock buff. with rechargeable NiCd battery
Microprocessor:	HD 6303 Y

Outputs:

CPU:

A1: Serial computer interface	150, 300, 600, 1200, 2400, 4800, 9600 bd 8 data bits, 1 stop bit, no parity
A2: Ext. network connection	as above
analogue output, alarm relay	with ALMEMO output modules
A3: int. network connection	9600 bd, 8 data bits, 1 stop bit, no parity
Centronics interface:	25-pin DSUB socket, 8 data, strobe, busy

Meas. Circuit Boards:	**ES5590-G2/MF**	**ES5590-MU**	**ES5590-G0**
Analogue Output:	A1 (only G2)	-	A1, option Rx
Limit Value Signals:	A1	2 opto relays Max and Min	2 opto relays Max and Min

Built-In Printer (Option D):

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
Current consumption:	standby: ca. 4 mA, when printing: ca. 500 mA

Voltage Supply: 7 to 13V DC not electrically isolated

Mains adapter:	ZB 5090-NA3 100..260V AC, 2A
Option N:	power supply integrated, 90-260VAC to 12VDC, 1A
Option U:	10 to 30V DC electr. isol. to 12V DC, 1A
Option A:	NiCd recharg. batt.: 7.2V, 1.5Ah recharge time: ca. 2h quick and trickle charging

Housing Dimensions:

19" desktop housing 40DU:	W 230 x H 165 x D 270 mm
19" desktop housing 84DU:	W 452 x H 165 x D 270 mm
19" sub rack 84DU:	W 483 x H 132,5 x D 273 mm
Operating/storage temperature:	-10 ... +60 °C / -30 ... +60 °C
Humidity of ambient air:	10 ... 10 to 90 % rH (non-condensing)

Operating Conditions:

Operating Temperature:	-10 to +60 °C (option D: -10 to +40 °C)
Storage Temperature:	-30 to +60 °C
Humidity of Ambient Air:	10 to 90%rH (opt. D): 10 to 75%rH) (non-condens.)

Extent of the Delivery: Measuring Instrument ALMEMO® 5590-3
Mains Adapter ZB 5090-NA2 12V/ 2A
Operating Instructions ALMEMO® 5590-3
ALMEMO® Manual incl. software AMR-Control

Product Overview

	Order No.
Data Acquisition System ALMEMO® 5590-3	
10 electr. isol. inputs for ALMEMO® flat connectors, 40 channels at max., extendable to 250 electr. isol. inputs at max., 250 channels at max., 500 kB memory (100000 meas. val.), real time clock, 16 keys, serial interface that can be cascaded, mains adapter 12V/2A	
19" desktop housing 40 DU, 3 plug-in slots for meas. point ext.	MA 5590-3TG4
19" desktop housing 84 DU, 14 plug-in slots for meas. point ext.	MA 5590-3TG8
19" sub rack 84 DU, 14 plug-in slots for meas. point extension	MA 5590-3BT8
Option S 2 MB (400,000 meas. values)	OA 5590-S3
Option N power supply 90-260V AC	OA 5590-N
Option A rech. batt. 7.2V, 1.5Ah with quick charge in 2h	OA 5590-A
Option U voltage supply 10 to 30V DC not electrically isolated	OA 5590-U
Option D built-in thermo printer, 40 characters/line, 1.2 lines/s	OA 5590-D
incl. a roll with temp. sensitive paper, 80mm wide, 20m long	ZB 1040-TP
Selector Switch Board with 10 electr. isol. inputs for ALMEMO® flat connector, 10 to 40 meas. channels, output socket for alarm cable, space requirement 2 slots	ES 5590-MF
Selector Switch Board with 10 electr. isol. inputs, sensor connection via 64-pin spring contact strip and ALMEMO® 10-fold MU connector, 10 meas. chan. (no frequency/double sensors), alarm contacts Max and Min, space requirement 1 plug-in slot	ES 5590-MU
Active Meas. Circuit Board with 1 input for ALMEMO® flat connector, 4 meas. channels for double sensors and function channels, output socket for analogue output, space requirement 1 plug-in slot	ES 5590-G0
Option S memory 500kB for 100000 meas. values, real time clock	OA 5590-S
Active Meas. Circuit Board with 10 electr. isol. inputs for ALMEMO® flat connector, 10 to 40 meas. channels, output socket for alarm cable, space requirement 2 plug-in slots	ES 5590-G2
Option S memory 500kB for 100000 meas. values, real time clock	OA 5590-S
Active Meas. Circuit Board with 10 electr. isol. inputs, Sensor connection via 64-pin spring contact strip and ALMEMO® 10-fold MU connector, 10 meas. channels (no frequency/double sensors), space requirement 1 plug-in slot	ES 5590-G3
Option S memory 500kB for 100000 meas. values, real time clock	OA 5590-S
ALMEMO® 10-fold MU Connector for connecting 10 sensors and 2 alarm contacts	ZA 5590-MU
ALMEMO® Recording Cable -1.25 to 2.00 V, 0.1mV/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