

Operating instruction

English

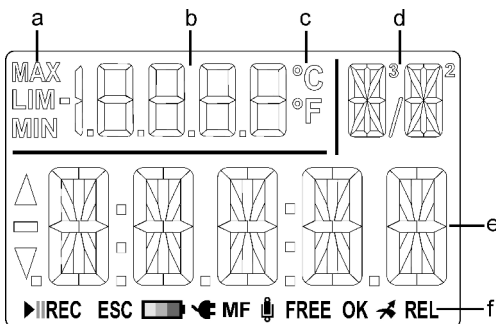


**Universal measuring instruments with
color display ALMEMO® 2470-1S,-1SRH-2,-2S**

V2.0
30.08.2012

1. 1 OPERATING CONTROLS

* only 2470-2, -2S



Back of unit:

(7) Battery box

(1) Meas. inputs M0 und M1*

M0 ... M1* for all ALMEMO sensors

M10..30 3 additional channels

M4* Function channel, differential

M11*..M34* 6 additional channels

(2) Outputs A1*, A2*

A1* USB interface (ZA 19019-DKU)

RS 232 (ZA 1909-DK5)

Ethernet (ZA 1945-DK)

RS 422 (ZA 5099-NVL/NVB)

2. Analog output (ZA 1601-RK)

A2* Network cable (ZA1999-NK5/NKL)

Trigger input (ZA 1000-ET/EK)

Relaisausgänge (ZA 1006-EGK)

1. Analog output (ZA 1601-RK)

(3) DC connector

Mains adapter (ZA1312-NA1,12V,0.2A)

Cable, el. isol. (ZA 2690-UK, 10-30V)

5V and USB (ZA 1919-DKU5)

(4) Sleep LED

(5) LCD

(a) Function

(b) Meas. point, 2nd meas. value, function

(c) Units for 2nd measured value

(d) Units for 1st measured value

(e) 1st measured value

(f) Operating states:

► || REC Measured value memory

■ ■ Battery status : full / empty

☺ Smoothing activated

✂ Meas. value corrected

REL Relative measuring

(6) Operating keys

ON Switch device ON / OFF,
To delete, press and hold down

M▲, M▼ Meas. point selection

MAX, MIN Max. / min. value,

To delete, press and hold down

.. MAX, MIN Max. / min. / limit value

MEM Measured value memory

To display value, press and hold down

FCT Function

PROG Programming:

► Relative meas., adjustment

FCT To cancel

▲, ▼, ►... To enter data

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3. GENERAL

Congratulations on your purchase of this new and innovative ALMEMO® measuring instrument. Thanks to the patented ALMEMO® plug the device configures itself automatically; its operation should be fairly straightforward. The new color display helps show with particular clarity various important operating states, e.g. a limit value being exceeded, etc. The device can, however, be used with a wide range of sensors and peripherals and offers many different special functions. You are advised therefore to take the time to carefully read these operating instructions and the appropriate sections of the ALMEMO® Manual and to properly familiarize yourself with the device's numerous features and with the way the sensors function. This is the best way to avoid operating and measuring errors and prevent damage to the device. To help you find answers to your questions as quickly and easily as possible a comprehensive index is provided at the end of these instructions and at the end of the Manual.

3.1 Warranty

Each and every device, before leaving our factory, undergoes numerous quality tests. We provide a guarantee, lasting two years from delivery date, that your device will function trouble-free. Before returning your device to us, please observe the advisory notes in Chapter 14, 'Trouble shooting'. In the unlikely event that a device does prove defective and you need to return it, please wherever possible use the original packaging materials for dispatch and enclose a clear and informative description of the fault and of the conditions in which it occurs.

This guarantee will not apply in the following circumstances:

- Any form of unauthorized tampering or alteration inside the device
- Use of the device in environments or conditions for which it is not suited
- Use of the device with an unsuitable power supply and / or in conjunction with unsuitable peripheral equipment
- Use of the device for any purpose other than that for which it is intended
- Damage caused by electrostatic discharge or lightning
- Failure to properly observe these operating instructions

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

3.2 Standard delivery

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

- Measuring instrument ALMEMO® 2470-1S with 3 AA batteries
or Measuring instrument ALMEMO® 2470-1SRH with integrated
temperature humidity sensor and atmospheric pressure sensor
and 3 AA batteries
or Measuring instrument ALMEMO® 2470--2 / -2S with 3 AA NiMH
(nickel-metal hydride) rechargeable batteries
- These operating instructions
- ALMEMO® Manual
- CD with AMR-Control software and various useful accessories

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

3.3 Waste disposal



The pictogram showing a waste bin crossed through means that the product is subject to European Union regulations covering segregated waste disposal. This applies both to the product itself and to any accessories marked with the same symbol. Disposal of any such item as unsorted domestic waste is strictly forbidden.

- Please dispose of all packaging materials according to the applicable national waste management regulations.
- Please dispose of cardboard boxes, protective plastic packaging materials, and all preservative substances separately and in the proper manner.
- The disposal of the device itself (also of device parts, accessories, and consumables) is subject to the applicable national and local waste management regulations and to the environmental protection legislation in force in the country of use.
- Please dispose of all waste in the proper manner; this applies in particular to all parts and substances that constitute a hazard for the environment. This includes inter alia plastics, batteries, and rechargeable battery packs.
- For the dispatch of such goods please wherever possible use the original packaging materials.

4. SAFETY INSTRUCTIONS

DANGER



Danger to life and limb, risk of damage to equipment

Before starting to operate the device, please read the instructions carefully.

Please ensure that you comply with all general safety advice and the special safety instructions included in other chapters!

Such risks may occur in the following circumstances:

- Failure to heed the operating instructions and all the safety notes these contain
- Any form of unauthorized tampering or alteration inside the device
- Use of the device in environments or conditions for which it is not suited
- Use of the device with an unsuitable power supply and / or in conjunction with unsuitable peripheral equipment
- Use of the device for any purpose other than that for which it is intended
- Damage caused by electrostatic discharge or lightning.

DANGER



Risk of fatal injury through exposure to dangerously high voltage

Such risks may occur in the following circumstances:

- Use of the device with an unsuitable power supply and / or in conjunction with unsuitable peripheral equipment
- Damage caused by electrostatic discharge or lightning
- Do not run sensor lines in the vicinity of high-voltage power cables.
- Before you touch any sensor lines, ensure that all static electricity has been discharged.

DANGER Warning - explosive atmospheres or substances



In the vicinity of various fuels or chemicals there is a risk of explosion



Do not use the device in the vicinity of blasting work or filling stations

4.1 4.1 Special notes on use

- If the device is brought into the work-room from a cold environment there is a risk that condensation might form on the electronics. In measuring operations involving thermocouples pronounced changes in temperature may cause substantial measuring errors. You are advised therefore, before starting to use the device, to wait until it has adjusted to the ambient temperature.
- Before using the mains adapter make sure that the mains voltage is suitable.
- Be sure to observe the maximum load capacity of the sensor power supply.
- Sensors with their own integrated power supply are not electrically isolated from one another (see 8.3).

4.2 Handling batteries / rechargeable batteries correctly



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

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

Rechargeable batteries should be recharged as and when necessary.

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

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

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

5. INTRODUCTION

The ALMEMO® 2470 is a new member in our family of unique measuring devices - all equipped with Ahlborn's patented ALMEMO® plug system. The intelligent ALMEMO® plug offers decisive advantages when connecting sensors and peripherals because all parameters are stored in an EEPROM located in the plug itself; repeat programming is thus no longer necessary.

All sensors and output modules can be connected to all ALMEMO® measuring instruments in the same way. Programming and functioning are identical for all units. The following points apply to all devices in the ALMEMO® measuring system; these are described in detail in the ALMEMO® Manual which is included in delivery with each device:

- Detailed explanation of the ALMEMO® system (Manual, Chapter 1)
- Overview of the device functions and measuring ranges (Manual, Chap. 2)
- Basic principles, operating instructions, and technical data for all sensors (Manual, Chapter 3)
- Options for connecting your own existing sensors (Manual, Chapter 4)
- All analog and digital output modules (Manual, Section 5.1)
- Interface modules USB, RS232, optic fiber (Manual, Section 5.2)
- The whole ALMEMO® networking system (Manual, Section 5.3)
- All functions and their operation via the interface (Manual, Chapter 6)
- Complete list of interface commands with all the printouts (Man., Chap. 7)

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

5.1 Functions

Measuring instrument ALMEMO® 2470-1S has only one measuring input but special variant 2470-1SRH is also available with an integrated temperature humidity sensor and atmospheric pressure sensor. Types 2470-2/-2S have 2 electrically isolated measuring inputs suitable for all ALMEMO®-sensors.. The measuring possibilities are virtually limitless; there are 4 channels per sensor plug and over 70 measuring ranges. To facilitate operation the device incorporates a keypad and a large illuminated color LCD; this helps show with particular clarity various important operating states, e.g. a limit value being exceeded. All devices incorporate a DC socket for connecting a mains adapter or special interface cable ZA1919-DKU5 with integrated power supply. The ALMEMO® 2470-2/-2S also incorporates output sockets A1 and A2, suitable for all ALMEMO® output modules, e.g. analog outputs, digital interfaces, and trigger and relay cables. Several such devices can easily be networked by simply linking them together via cable.

5.1.1 Sensor programming

The measuring channels are programmed, completely and automatically, via the ALMEMO® plugs. However, this programming can be supplemented or modified via the keypad or via the interface as and when required for measuring purposes.

Measuring ranges

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

Function channels

Maximum, minimum, average, and differential values from particular measuring points can be programmed as function channels, also internal channels, and can be processed and printed out like normal measuring points.

Units

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

Measured value designation

Each sensor is identified by means of a 10-character alphanumeric name. This name is entered via the interface and will appear in the printout or on the computer display.

Correction of measured values

The measured value on each measuring channel can be corrected both in terms of zero-point and gain; this means that even sensors usually requiring initial adjustment (e.g. expansion, force, pH) can be freely interchanged. Zero-point correction and, partly at least, gain adjustment can be performed at the touch of a button. Sensors with multi-point calibration can also be connected. (see Manual, 6.3.13)

Scaling

The corrected measured value on each measuring channel can also be further scaled in terms of zero-point and gain - by means of the base value and factor. The decimal point position can be set by means of the 'EXPONENT' function.

Limit values and alarm

Per measuring channel two limit values can be set (1 maximum and 1 minimum). In the event of one of these limit values being exceeded the beeper sounds and the display backlighting changes from white to red. This alarm status can be cancelled at the touch of a button. The type of measured value error is now shown by its color; red means a limit value overshoot, blue means a limit value undershoot. Various alarm outputs are supported - even in sleep mode. Relay output modules provide the associated alarm contacts; these can be allocated individually to specific limit values. Hysteresis is set by default to 10 digits; however, this can be adjusted to any value between 0 and 99 digits. The exceeding of a limit value can also be used to automatically start or stop measured value recording.

Sensor locking

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

5.1.2 Measuring operation

Up to 4 measuring channels are available per transducer; i.e. it is also possible to evaluate double sensors, individually scaled sensors, and sensors with function channels. The user can move forwards or backwards from one measuring channel to the next using the keypad. The selected measuring point is by default assigned preferred status and is scanned at half the measuring rate; all other active channels are also scanned but in the background (semi-continuous mode). Data is output on the display and also, if available, to an analog output. To shorten the response time when there are several measuring points the measuring rate can be set to continuous and increased accordingly.

Measured values

The measured value for the selected measuring point is shown continuously with zero-point correction and, as and when necessary, with measured value correction.

With most sensors, sensor breakage is detected automatically (except for plugs with shunt, dividers, or additional electronics).

Analog output and scaling

Each measuring point can be scaled by means of analog start and analog end in such a way that the measuring range thus defined covers the full range of the analog output (2 V, 10 V, or 20 mA). At the analog output the device can output the measured value from any measuring point or a programmed value.

Measuring functions

With some sensors, to achieve optimal measured value acquisition, certain special measuring functions are required. Cold junction compensation is provided for thermocouples; temperature compensation is provided for dynamic pressure, pH, and conductivity probes.

Atmospheric pressure compensation is provided for humidity sensors, dynamic

pressure sensors, and O₂ sensors; on this device this is performed automatically by means of an integrated atmospheric pressure sensor.

Measured value smoothing

Measured values of an unstable, fluctuating nature can be smoothed by taking a sliding average over a number of values programmable from 2 to 99.

Maximum and minimum values

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

Individual value memory (2470-2 only)

Up to 99 measured values can be saved manually. This data can then be shown on the display or output via the interface.

Differential measurement (2470-2/2S only)

It is possible, by setting the measured value to zero, to perform relative measuring operations with respect to a reference value; with 2 sensors and the same measured variables genuine differential measuring operations can be performed.

5.1.3 Process control

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

Date and time-of-day

Date and time-of-day can be set and then used for the purpose of logging measuring operations. When batteries are replaced these date and time settings are lost and will have to be reset.

Cycle

The cycle can be programmed to any value between 0:00:01 (1 second) and 9:59:59 hh:mm:ss. This function permits cyclic output of measured values to the interfaces and cyclic calculation of average values.

Print cycle factor

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

Averaging over measuring point scans

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

Measuring rate

All measuring points are scanned at the measuring rate (2.5 or 10 mops). The output of all measured values via the interface can also be performed at the measuring rate; this will accelerate recording.

Measured value memory (2470-1S/2S only)

On data logger 2470-1S or 2470-2S all measured values can be saved to its internal EEPROM either manually or automatically per cycle. Standard memory capacity is 512 KB - sufficient for up to 100 000 measured values. The memory can be organized and configured in linear or ring form. Output is via the interface. Selection can be specified according to time frame or number.

With the ALMEMO® 2470-2S an external memory connector with a multimedia memory card can be plugged onto the device, thus providing much greater memory capacity. Using this external memory connector (available as an accessory) files can be read out very quickly via any standard card reader.

Sleep mode also permits long-term recording and even limit value monitoring with alarm outputs.

Control outputs (2470-2/2S only)

Output relays and analog outputs can be individually addressed via the interface.

Output

In the case of the 2470-1S communication with a PC is only possible via the special USB interface cable ZA1919-DKU5 with integrated power supply. In the case of the 2470-2/2S any of the usual interface cable types can be used (RS232, optic fiber, RS422, USB, or Ethernet).

Measured data can be output in list, column, or table format. Files in table format can be processed directly using any standard spreadsheet software. The print header can be programmed to refer specifically to your company or to your application. All programming functions not accessible via the keypad can be configured via the interface.

Networking

ALMEMO® devices 2470-2/2S can be addressed and can easily be networked by simply linking them together via network cable or for longer distances via RS422 network distributors.

Software

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

6. PUTTING INTO SERVICE

1. **Connect the sensor to socket M0 (1).** see Chapter 8
2. **Power supply** is via batteries, rechargeable battery pack, or mains adapter. see 7.1, 7.3
3. **Switch on** by pressing **ON** (6). see 7.6
4. **Select measuring channels** by pressing key **MA** (6); read out measured values (5e). see 10.2.1
5. For **relative measuring** with respect to a reference value or for **sensor adjustment** press keys **ON**, **▶**. To return to normal measured value press keys **ON**, **FCT**. see 10.5
6. For **differential measurement** (2470-2/2S only), plug 2 sensors of same type into sockets M0 and M1 and then select measuring point **M4**. see 10.8
7. To **save individual measured value** press key **MEM** (6). see 10.4
8. For **manual or cyclic measured value recording** and saving to measured value memory (2470-1S/2S only) press key **MEM**. see 11.2 Select cycle function 'ZY' by pressing key **FCT** and enter cycle by means of keys **PROG**, **▲** / **▼**, **▶**, ... see 9.3
9. **Evaluating a measuring operation:** To call up maximum / minimum values press key **MAX** or **MIN** (6). To delete maximum / minimum value(s) press and hold down key **MAX** or **MIN**. see 10.3

Programming or data output via interface

Connect computer via interface cable to socket A1 or DC. see 12.1

Activate supplied software AMR-Control.

Via 'Setup interface' set the COM port and transmission rate to 9600 bauds.

Program the sensors via 'Program measuring point list'. Measured value display and sensor adjustment via 'Measuring points - Measured values'

Data logging on the computer :

Program the cycle via 'Devices - Programming'.

Open the terminal window via 'File - Terminal'.

'File - Terminal - Open log', enter file name, 'Save'

Start measuring operation by means of command button 'Start'.

Stop measuring operation by means of command button 'Stop'.

'File - Terminal - Close log'

Call up file e.g. from MS-Excel and import using ';' as separator. see Man. 6.4.1

7. POWER SUPPLY

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

3 AA batteries (batteries or rechargeable NiMH batteries included in delivery)

USB interface cable with integrated power supply ZA 1919-DKUV

Mains adapter, 12 V, 1 A, with ALMEMO® plug ZA 1312-NA7

Power supply cable, electrically isolated (10 to 30 VDC, 0.25 A) ZA 2690-UK
 12 VDC via clamp connector at DC socket ZA 1000-FSV
 Our product spectrum includes all the appropriate accessories.

7.1 Rechargeable battery operation and supply voltage monitoring

Power is supplied to measuring instruments 2470-2/2S as standard by 3 AA rechargeable NiMH batteries. With the display always lit and at current consumption of approx. 30 mA a battery set should last for approx. 65 hours. Without display illumination (this can be switched off temporarily, see 12.4) only half the above current is needed and thus double the operating time can be attained. To prolong the operating time for the purposes of long-term recording the device can be left in SLEEP mode. (see 11.2.4) The operating voltage is displayed each time the device is switched on and the status bar shows a battery symbol indicating the battery's approximate charge status. This gives the user a basis for estimating the remaining operating time. As and when the remaining battery capacity drops to approximately 10 percent, the last section in the battery symbol is displayed in red. Now - or at the very latest when the battery symbol is empty and starts to flash - the user should connect mains adapter ZB 1112-NA7 (12 V / 1 A) and recharge the batteries; this will take around 4 hours; any further delay may result in critically low discharge and this may damage the batteries. (see 7.3) The rechargeable NiMH batteries can in fact be recharged at any time and in any charge status, using the intelligent charge circuitry. If the rechargeable batteries are completely discharged the device itself will switch off.

7.2 Battery operation

The ALMEMO® 2470-1 is normally powered by 3 AA alkaline batteries. The 2470-2/2S can also be powered in this way instead of using rechargeable batteries. Standard non-rechargeable batteries have a higher capacity permitting operation of over 100 hours and (without display illumination) of up to maximum 200 hours. In order to replace used batteries, disconnect and remove the sensors, pull off the rubber protection, and open the battery compartment on the rear of the device by undoing the screw and lifting off the battery cover in the direction indicated by the arrow. When inserting new batteries ensure that their polarity is correct. For long-term data logging 1.5 V AA lithium batteries (e.g. Energizer Lithium) are even more suitable because self-discharge is very low.

7.3 Mains operation

To power these devices from an external source preferably use mains adapter ZA 1312-NA7 (12 V / 1 A); connect this to the DC socket (3). Please ensure that the mains voltage is correct. With the ALMEMO® 2470-2/2S devices this mains adapter also charges the rechargeable batteries. As soon as it is connected the device switches on automatically. The battery symbol in the status

bar indicates the approximate charge status. While the 3 green sections flash left to right, the rechargeable batteries are being charged. As soon as all 3 sections remain green, the rechargeable batteries are fully charged; however, the mains adapter can be left connected to the device. If standard non-rechargeable batteries are being used, the battery symbol will, as soon as the mains adapter is connected, flash briefly in red. Standard non-rechargeable batteries must not be subjected to recharging; charging must be terminated immediately by pressing any key; the device will then be powered by mains only.

7.4 External DC voltage supply

The DC socket (3) can also be used to connect another DC voltage, 5 to 13 V (minimum 200 mA). It can be connected using ALMEMO® plug ZA1000-FSV. If, however, the power supply has to be electrically isolated from the transducers, then electrically isolated DC cable ZA 2690-UK must be used. It will then be possible to use the measuring instrument in a 12-volt or 24-volt on-board supply system.

7.5 Sensor supply

At the terminals + (plus) and - (minus) in the ALMEMO® plug there is a configurable sensor supply voltage available (self-healing fuse, 500 mA). The sensor voltage supplied by the device is set automatically, depending on the minimum supply voltage requirements of the sensors, 6V (400 mA), 9 V (300 mA), or 12 V (200 mA). (see Manual, Section 6.10.5) Other voltages (15 V, 24 V, or references for a potentiometer and strain gauge) can also be obtained using special plugs. (see Manual. Sections 4.2.5 and 4.2.6).

7.6 Switching ON / OFF, reinitialization

The **ON OFF** key (6) is located in the middle of the keypad; to switch the device ON press briefly and release; to switch the device OFF press and hold down. When the device switches OFF all saved values and settings are retained intact. (see 7.7) While rechargeable batteries are being charged by a mains adapter the device cannot be switched OFF (display 'noOFF'). To switch OFF in these circumstances the device will have to be disconnected. If interference (e.g. electrostatic) or a malfunction (e.g. battery failure) causes the device to behave abnormally, it can be reinitialized. To activate a reset press and hold down key **FCT** when switching on - without mains adapter connected. This will restore all settings - except the device designation - to factory default status. Programming of sensors in the ALMEMO® plugs will also remain unaffected.

7.7 Data buffering

The sensor's programming is stored in the EEPROM on the sensor plug; the device's calibration and programmed parameters are stored in the EEPROM on the device itself; both are fail-safe. Date and time-of-day settings are retained intact if the device is just switched off but will be lost as and when the batteries are replaced.

8. CONNECTING SENSORS / TRANSDUCERS

Virtually any ALMEMO® sensor can be connected to input sockets M0 / M1 (1) on ALMEMO® measuring instrument 2470-2/2S. To connect your own existing sensors you simply need the appropriate ALMEMO® plug.

8.1 Sensors / transducers

The ALMEMO® Manual includes detailed descriptions of the comprehensive ALMEMO® range of sensors (see Manual, Chapter 3) and instructions for connecting your own existing sensors to ALMEMO® instruments (see Manual, Chapter 4). All standard sensors with an ALMEMO® plug usually have the measuring range and units already programmed and can thus be connected to any input socket without further adjustment. A mechanical coding system ensures that sensors and output modules can only be connected to the correct sockets. All ALMEMO® plugs incorporate two snap-lock levers; these snap into position as soon as the plug is inserted into the socket, thus preventing unintended disconnection if the cable is accidentally pulled. To withdraw the plug both these levers must first be pressed in at the sides.

For the ALMEMO® 2470 series with the optional seal (OA 2479-IP) new specially designed sensors are available with spray-coated ALMEMO® plugs incorporating a double sealing lip to protect the socket unit against the effects of splashing water. For any unused sockets protective stoppers are available.

8.2 Measuring inputs and additional channels

ALMEMO® measuring instruments 2470-1/2 have respectively 1 and 2 input sockets (1); to these input sockets initially measuring channels M0 (and M1) are assigned. However, ALMEMO® sensors can, if necessary, provide up to 4 channels. The additional channels can be used in particular for humidity sensors with 4 measurable variables (temperature / humidity / dew point / mixture ratio) or for function channels. Each sensor can if necessary be programmed with several measuring ranges or scaling settings;

2 or 3 sensors, if pin assignment so permits, can be combined in a single plug (e.g. RH / NTC, mV / V, mA / V, etc.). The additional measuring channel numbers per plug go up in steps of 10 (e.g. the first sensor has channels M0, M10, M20, M30, the second sensor has channels M1, M11, M21, M31 etc.).

Device-internal channels:

The 2470-1SRH and 2470-2/2S incorporate 4 additional channels M4, M14,

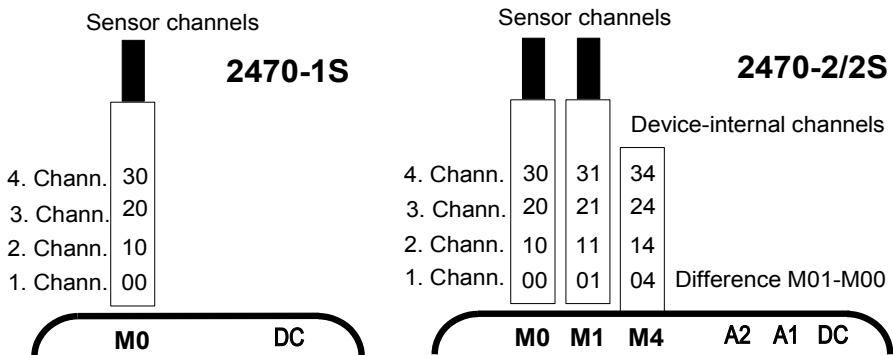
M24, M34. On the 2470-1SRH with its integrated sensors these are used for the channels temperature, humidity, dew point, and atmospheric pressure.

On the other variants M4 is programmed by default as differential channel M1 – M0. This only applies, however, if there are two sensors with the same units and same decimal point position connected at measuring points M0 and M1. However, all 4 channels can be programmed with any other function channels (e.g. battery voltage, atmospheric pressure, cold junction compensation, averages, etc.) (see Manual, 6.3.4)

The reference channels are by default Mb1 = M1 and Mb2 = M0.

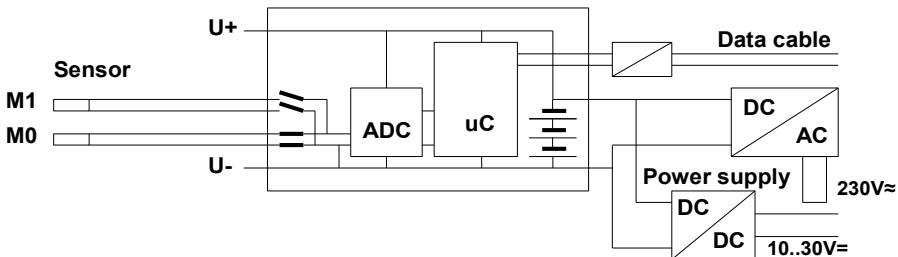
Advantage of device-internal channels : Several sensors being used for the same application do not have to be reprogrammed and can be freely exchanged without losing their function channel assignment. However, if the whole application operates with just one sensor, then programming the function channels on the sensor itself makes more sense.

On the measuring instrument this gives the following channel assignment:



8.3 Potential separation

When organizing a properly functioning measuring setup it is very important to ensure that no equalizing current flow between sensors, power supply, and peripherals. All points must therefore lie at the same potential and / or any unequal potentials that do exist must be electrically isolated.



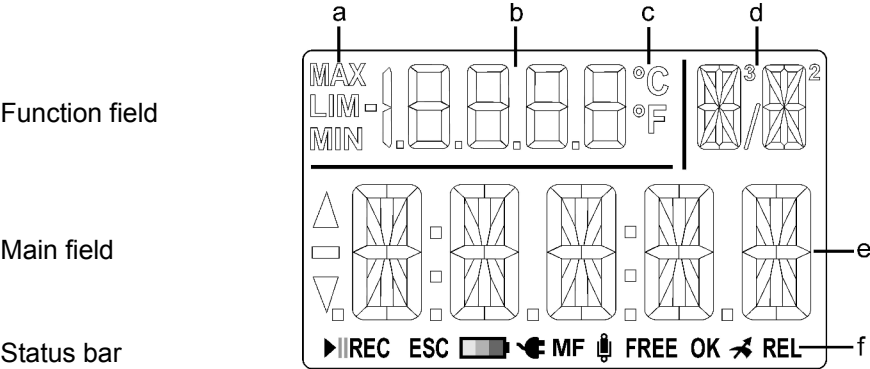
The 2 inputs on version 2470-2 are electrically isolated by means of photovol-

taic relays and a potential difference of maximum 50 VDC or 60 VAC is permissible between them. However, sensors combined within one plug and sensors with their own power supply are electrically interconnected and must therefore be operated in isolation. The voltage at the measuring inputs themselves (between B, C, D and A or -) must not exceed 5 volts. The power supply is isolated by means of DC/DC converter ZA2690-UK. Data and trigger cables are equipped with optocouplers. If analog output cables are not electrically isolated the recording device or the sensors must be zero-potential.

9. DISPLAY AND KEYPAD

9.1 Display

he display on the ALMEMO® 2470 series is an illuminatable 5-color segmented LCD (5); it comprises 5x 16-segment digits (e) for the measured value, 2x 16-segment digits (d) for the units, 4½x 7-segment digits (b) for various measuring functions (a), and a row of symbols (f) for the operating status.



Display of functions in function field

Measuring point

M 0

Maximum / minimum value

MAX 36.5

MIN 17.3

Limit values, maximum and minimum

MAX LIM 35.0

LIM MIN 20.0

Stored individual value

M 36.2

Memory capacity

P01

Temperature value from double sensors

26.5 °C

Configuration - device address

Adr

Configuration - locking

Loc

Configuration - automatic device OFF

A0FF

Configuration - display OFF

d0FF

Special operating states and faults

Segment test for display

This is performed automatically each time the device is switched on.

Supply voltage

Below 3.3 V :

Display after segment test
Battery symbol, empty, flashing

Mains adapter connected



Measured value

M lights up

Function

F lights up

Relative measuring with respect to a reference value REL lights up

Sensor correction or scaling



Correction symbol lights up

Unlocking for sensor adjustment

FREE flashes

Values in individual value memory

REC lights up

Data logger stopped

II Pause symbol

Data logger is started.

►REC Start and recording

Displays in main field

Non-connected sensors,
Deactivated measuring points

Checksum error during
device calibration

CALEr

Function locked

Loc

Switching OFF while charging
not possible

noOFF

Measuring range / function
not possible

Err

Memory configuration altered

Er.MEM

Sensor breakage

NiCr

Abbreviation flashes

Measuring range undershot,
CJ or CJ breakage

CJ

(Cold junction)
flashes

Value range overshoot (>65000):

65000

flashes

Limit value, maximum, overshoot

Measured value turns red, ▲flashes

Limit value, minimum, undershoot

Measured value turns blue, ▲flashes

Measuring range overshoot

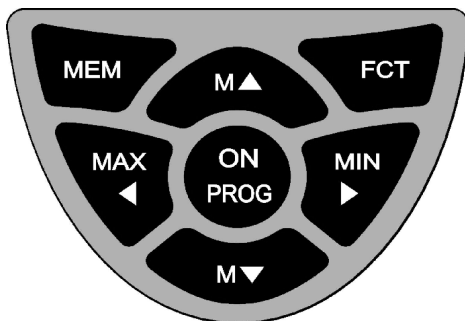
Maximum value flashes

Measuring range undershoot

Minimum value flashes

9.2 Keypad

To operate the device a keypad with 7 keys is provided.



Basic functions

- To switch the device ON (s. 7.6)
- To switch the device OFF
- To select measuring points (s. 10.2.1)
- To display maximum value (s. 10.3)
- To display minimum value (s. 10.3)
- To zero-set the measured value (s. 10.5)
- To save the measured value (s. 10.4)
- To select functions (s. 11)
- To cancel function (ESC):

Key

- ON**
- ON** press and hold down
- M▲** or **M▼**
- MAX** To delete, press and hold down
- MIN** To delete, press and hold down
- PROG** , **▶** To delete **PROG** , **FCT**
- MEM**
- FCT**
- ◀**

9.3 Entering data

When a programmable parameter is selected (see 11, 13) and unlocked (see 13.2) the value can be either deleted or programmed.

To **program** press

You should now be in **programming mode**

To delete the programmed values press:

To change the arithmetic sign.

To **increment** the selected digit press

To **decrement** the selected digit press

To move forward to the next position press

To **move back** to the previous position press

Each position is programmed just like the first

To **save** and exit press

To **cancel** without saving press

To **confirm** this input (OK):

To **cancel** inputs (ESC):

- PROG**
- The input position flashes
- FCT**
- M▼**
- M▲** ...
- M▼** ...
- ▶**
- ◀**
- M▼** / **M▼** ..., **▶** ...
- PROG**
- ◀** ...
- ▶** Input flashes
- ◀** Input flashes

10. MEASURING OPERATIONS

With the ALMEMO® 2470 all available measuring channels are by default scanned continuously; this permits continuous differential measurements and ensures continuous temperature compensation for dynamic pressure probes or chemical probes. (see Manual, 6.5.1.3) Up to 12 measuring channels can be displayed. see 8.2 A measured value can be sent to an analog output. see 12.2 and Manual, 5.1.1

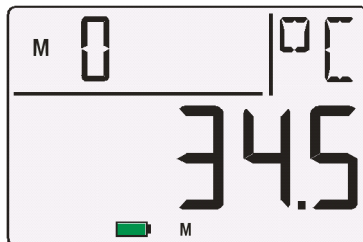
10.1 Battery voltage

As soon as the device is switched on, a segment test is performed; then the battery symbol appears and the available **battery voltage** 'Ubat' is displayed. The battery symbol is an outline containing 3 sections; these indicate the battery status. If the battery is almost empty, the last of these sections will briefly appear in red; then the battery symbol outline will flash (<3.3 V). Now - at the very latest - the rechargeable batteries must be recharged. (see 7.1)



10.2 Measured value

The measured value and its appropriate units are displayed in the main field and the measuring point is displayed in the function field. All special operating states affecting a measured value are explained in 9.1; the special ways of indicating that a limit value has been exceeded are explained in 11.1.3.



10.2.1 Selecting a measuring point

To select one after the other all active measuring points and have the current measured value displayed for each of these press **M▲** To return to the previous channel press **M▼**

To increment the measuring channel



To decrement the measuring channel



The measuring range abbreviation appears briefly in the display. see 10.2.2.

10.2.2 Measuring ranges

Whenever there is a channel switchover or sensor breakage the measuring range abbreviation appears in the display. The following table lists all the measuring ranges possible.

Sensors / transducers	Sensor / plug	Measuring range	Units	Abbreviation
Pt100-1	FP Axxx	-200.0 to +850.0	°C	P104
Pt100-2	FP Axxx	-200.00 to +400.00	°C	P204
Ni100	ZA 9030-FS3	-60.0 to +240.0	°C	N104
NiCr-Ni (K)	FT Axxx	-200.0 to +1370.0	°C	NiCr
NiCroSil-NiSil (N)	ZA 9020-FSN	-200.0 to +1300.0	°C	NiSi
Fe-CuNi (L)	ZA 9021-FSL	-200.0 to +900.0	°C	FeCo
Fe-CuNi (J)	ZA 9021-FSJ	-200.0 to +1000.0	°C	IrCo
Cu-CuNi (U)	ZA 9000-FSU	-200.0 to +600.0	°C	CuCo
Cu-CuNi (T)	ZA 9021-FST	-200.0 to +400.0	°C	CoCo
PtRh10-Pt (S)	FS Axxx	0.0 to +1760.0	°C	Pt10
PtRh13-Pt (R)	ZA 9000-FSR	0.0 to +1760.0	°C	Pt13
PtRh30-PtRh6 (B)	ZA 9000-FSB	+400.0 to +1800.0	°C	EL18
Au-FeCr	ZA 9000-FSA	-270.0 to +60.0	°C	AuFe
NTC type N	FN Axxx	-50.00 to +125.00	°C	Ntc
Millivolt	ZA 9000-FS0	-10.000 to +55.000	mV	mV
Millivolt 1	ZA 9000-FS1	-26.000 to +26.000	mV	mV 1
Millivolt 2	ZA 9000-FS2	-260.00 to +260.00	mV	mV 2
Volts	ZA 9000-FS3	-2.0000 to +2.6000	V	Volt
Difference - millivolt	ZA 9000-FS0D	-10.000 to +55.000	mV	D 55
Difference - millivolt 1	ZA 9000-FS1D	-26.000 to +26.000	mV	D 26
Difference - millivolt 2	ZA 9000-FS2D	-260.00 to +260.00	mV	D260
Difference - volt	ZA 9000-FS3D	-2.0000 to +2.6000	V	D2.6
Sensor voltage	any	0.00 to 20.00	V	Batt
Milliampere	ZA 9601-FS1	-26.000 to +26.000	mA	mA
Percent (4 to 20 mA)	ZA 9601-FS2	0.00 to 100.00	%	%
Ohms	ZA 9003-FS	0.0 to 500.0	W	Ohm
Frequency	ZA 9909-AK1	0 to 32000	Hz	Freq
Pulses	ZA 9909-AK2	0 to 65000		Puls
Digital input	ZA 9000-EK2	0.0 to 100.0	%	Inp
Digital interface	ZA 9919-AKxx	-65000 to +65000		DIGI
Snap-on head, normal, 20	FV A915-S120	0.30 to 20.00	m/s	S120
Snap-on head, normal, 40	FV A915-S140	0.40 to 40.00	m/s	S140
Snap-on head, micro, 20	FV A915-S220	0.50 to 20.00	m/s	S220
Snap-on head, micro, 40	FV A915-S240	0.60 to 40.00	m/s	S240
Macro	FV A915-MA1	0.10 to 20.00	m/s	L420
Water micro	FV A915-WM1	0.00 to 5.00	m/s	L605

Sensors / transducers	Sensor / plug	Measuring range	Units	Abbreviation
Dyn. press., 40 m/s, with TC and PC	FD A612-M1	0.50 to 40.00	m/s	L840
Dyn. press., 90 m/s, with TC and PC	FD A612-M6	1.00 to 90.00	m/s	L890
Rel. atmosph. humidity capacitive	FH A646	0.0 to 100.0	%H	% rH
Rel. atm. humidity capacitive with TC	FH A646-C	0.0 to 100.0	%H	HcrH
Rel. atm. humidity capacitive with TC	FH A646-R	0.0 to 100.0	%H	H rH
Mixture ratio capacitive, with PC	FH A646	0.0 to 500.0	g/k	H AH
Dew-point temperature capacitive	FH A646	-25.0 to 100.0	°C	H DT
Partial vapor pressure capacitive	FH A646	0.0 to 1050.0	mb	H VP
Enthalpy capacitive, with PC	FH A646	0.0 to 400.0	kJ	H En
Humid temperature	FN A846	-30.00 to +125.00	°C	P HT
Rel. humidity psychrometric, with PC	FN A846	0.0 to 100.0	%H	P RH
Mixture ratio psychrometric, with PC	FN A846	0.0 to 500.0	g/k	P AH
Dew-point temp. psychrom., with PC	FN A846	-25.0 to +100.0	°C	P DT
Partial vapor press. psychrom., w. PC	FN A846	0.0 to 1050.0	mb	P VP
Enthalpy psychrometric, with PC	FN A846	0.0 to 400.0	kJ	P En
Conductivity probe with TC	FY A641-LF	0.0 to 20.000	mS	LF
CO ₂ sensor	FY A600-CO2	0.0 to 2.500	%	CO2
O ₂ saturation with TC and PC	FY A640-O2	0 to 260	%	O2-S
O ₂ concentration with TC	FY A640-O2	0 to 40.0	mg	O2-C

Function channels

Differential channels Mb1 - Mb2	any			Diff
Maximum value of channel Mb1	any			Max
Minimum value of channel Mb1	any			Min
Average val. over time, M(t) of Mb1	any			M(t)
Average value M(n) Mb2 to Mb1	any			M(n)
Sum S(n) Mb2 to Mb1	any			S(n)
Total pulses S(t) of Mb1	ZA 9909-AK2	0 to 65000		S(t)
Pulses / print cycle of Mb1	ZA 9909-AK2	0 to 65000		S(P)
Alarm value of channel Mb1	any			Alrm
Wet bulb globe temperature	ZA 9030-FS		°C	UbGt
Measured value of Mb1	any			Mess
Cold junction temperature	any		°C	CJ
Number of averaged val. of Mb1	any			n(t)
Volume flow m ³ /h \bar{M} (Mb1)*Q	any		mh	FLow
Timer	any		s	Time

TC = Temperature compensation; PC = Pressure compensation

10.2.3 Double display

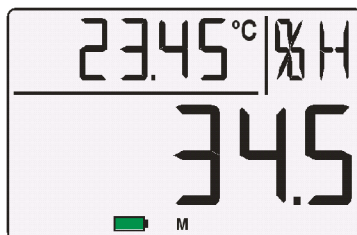
On all double-function sensors incorporating a temperature sensor on the first channel the temperature value can be displayed at the same time in the function field.

Set device locking to 0. (see 13.2)

Select 2nd channel.

To activate temperature display, press and hold down **M▲**

To return to the channel display, press and hold down **M▲**



10.3 High / low peak values memory

From all the measured values acquired for each measuring point the highest and the lowest values are continuously recorded. To display these high / low peak values first the desired channel must be set (see XREF) and then the **MAX** or **MIN** key must be pressed. The display also includes the associated symbol.

To display maximum value press

To display minimum value press

If the maximum value recorded lies above the associated limit value, both values will be displayed in red; if the minimum value recorded lies below the associated limit value, both values will be displayed in blue. (see 11.1.3)

To delete maximum value, press and hold down

To delete minimum value, press and hold down

To return to the measuring point display

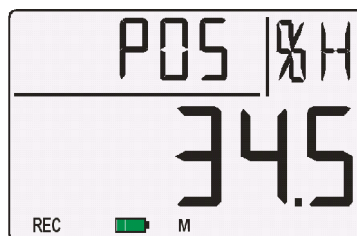
Whenever this memory is cleared, the current measured value will appear (because measuring is continuous).



MAX
MIN

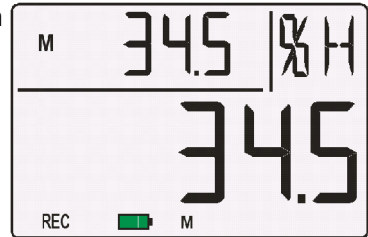
10.4 Individual value memory

The ALMEMO® 2470-2 can save 99 individual values to memory locations P01 to P99. The measured data can be shown on the display or output via the interface. To save each such measured value press **MEM**. The function field will show the memory location for about one second. e.g. P02



The value most recently saved then appears in the symbol 'M'.

To return to the channel display press **M▲**



To display all memory data press and hold down **MEM**

The function field displays the last memory location; the main field displays the measured value.

To select the first memory location press **MIN**

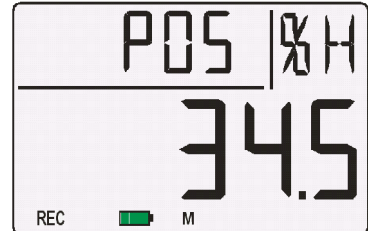
To select the last memory location press **MAX**

To increment the memory location press **M▲**

To decrement the memory location press **M▼**

To clear the memory press **FCT**

To terminate the memory display press **MEM**



Interface commands:

Save a measured value:

S-4

Output of the memory data:

P-04

response :

Memory :

P01: 00: +022.12 °C

P02: 00: +022.12 °C

P03: 10: +0039.9 %H

P04: 10: +0039.9 %H

P05: 20: +0007.6 °C

10.5 Relative measuring

One very useful function is to zero the measured value at certain locations or points in time as a reference value from which to observe subsequent deviations. The offset is saved temporarily, depending on locking level (x), to the RAM (5), the base value (4), or the zero-point (<4). In locking level 6 zero-setting is disabled.

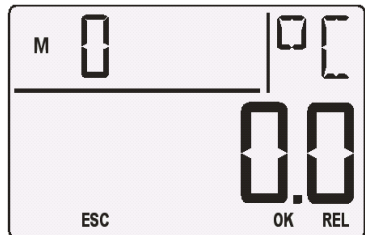
To set the measured value to zero press

To confirm (OK)

To cancel (ESC)

Display of relative measuring with symbol

To return to normal measured value press



PROG 0.0 REL flashes



REL


PROG , **FCT**



Setting to zero automatically deletes the maximum and minimum values for this channel. The MAX, MIN, and MEM functions are thus also available for relative measuring.

10.6 Sensor adjustment

Many types of sensor need to be adjusted either once or at regular intervals to compensate for various instabilities.

With **dynamic pressure probes** (ranges L840 and L890, units Pa) the zero-point must be temporarily adjusted by repeatedly pressing **PROG** ,  , i.e. until switching off, even if the channel is locked.

With the following chemical probes automatic **two-point adjustment** can be performed :

Probe	Type	Zero-point	Gain
pH probe	ZA 9610-AKY	7.00	4.00 pH or 10.00 pH
Conductivity	FY A641-LF	0.0	2.77 mS/cm
	FY A641-LF2	0.0	147.0 uS/cm
	FY A641-LF3	0.0	111.8 mS/cm
O ₂ saturation	FY A640-O2	0	101 %

1. Zero-point adjustment



To perform zero-point adjustment the measured value must first be physically set to zero. i.e.

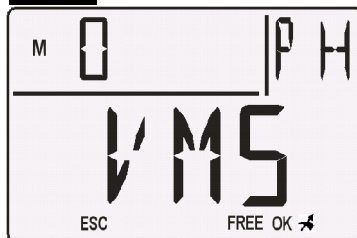
- Immerse pH probe in a buffer solution, pH 7.0.
- Withdraw conductivity probe from the liquid and dry it.
- Hold the O₂ probe for water in a zero solution.

Zero-point adjustment is performed in several steps.

To start the adjustment procedure press



PROG

If the sensor is locked, an abbreviation appears with the locking mode e.g. 'VM5' and the symbol FREE flashes. To temporarily unlock the sensor for the purpose of adjustment, this must either be confirmed by pressing key  (OK) or canceled by pressing key  (ESC).



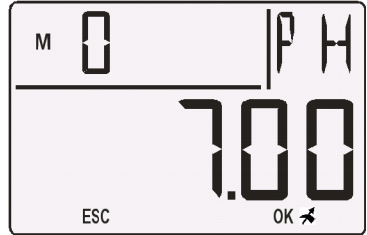
As soon as it has been confirmed the set-


point value flashes in the display with the correction symbol. 

The adjustment itself must now either be confirmed once again by pressing key  (OK) or canceled by pressing key  (ESC).

2. Gain adjustment

For the purposes of gain adjustment the gain calibration resource must first be set up (as per the Table). Gain adjustment is started, similarly, by pressing key **PROG** and performed in exactly the same way as zero-point adjustment.



If correction values have been programmed, the correction symbol  lights up.

4. Deleting adjustment values

Adjustment values can be deleted by pressing key **FCT** in the course of the adjustment procedure. On pH probes the default values can be restored - base value 7.00 and gain -0.1689.

Temperature compensation

On conductivity and O₂ probes with an integrated temperature sensor temperature compensation is performed automatically. On pH probes a temperature sensor can be specially configured for this purpose. (see Manual, 6.2.6)

10.7 Pressure compensation

Some measured variables are affected by the ambient atmospheric pressure (see measuring range list 'with PC'); large deviations from standard pressure at mean sea level (1013 mbar) may lead to measuring errors.

e.g. error per 100 mbar

Rel. humidity, psychrometric

Mixture ratio, capacitive

Dynamic pressure probes

O₂ saturation

Compensation range

approx. 2% 500 to 1500 mbar

approx. 10% Vapor pressure VP up to 8 bar

approx. 5% 800 to 1250 mbar (error <2%)

approx. 10% 500 to 1500 mbar

It is advisable therefore, especially when working at significant altitudes above sea level, to take due account of atmospheric pressure (approx. -11 mbar / 100 meters above mean sea level, MSL).

Atmospheric pressure can be measured using an external sensor. If the designation is programmed to '*P' (see Manual, 6.7.2), the measured value obtained will be used for atmospheric pressure compensation for the following channels. Alternatively, the atmospheric pressure can be programmed as a fixed value in device configuration. (see 13.5)

Special variant 2470-1SRH incorporates an atmospheric pressure sensor; this ensures that all pressure-dependent variables are compensated automatically.

10.8 Differential measurement

On version ALMEMO® 2470-2, if two sensors with the same units and same decimal point position are connected at measuring points M0 and M1, the dif-

ference M1 - M0 appears automatically below the measuring point M4. The sensors are electrically isolated by means of photovoltaic relays. If the differential channel is not required, it can be deleted via the interface. If, on the other hand, further differential channels are needed, these can be created also via the interface using the appropriate reference channels. (see Manual, 6.3.4)

11. FUNCTIONS

The ALMEMO® 2470 series offers a wide range of functions, e.g. battery voltage monitoring, and important sensor programming and data logger functions. To avoid confusion between a programming value and a measured value all functions are shown in pink with code F in the status bar. For all programming steps the device locking level must be set to 0. (see 13.2)

To select a function press

FCT ...

To return to the previous function

FCT press and hold down

To terminate (ESC) and return to the measured value

◀ or **▶**

Abbreviations for the functions appear in the units field or in the function field.

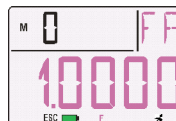
Messfunktion:

Battery voltage 'UBAt' (see 10.1)

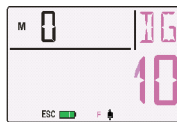


Sensor functions (see 11.1)

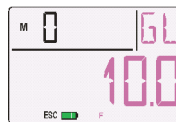
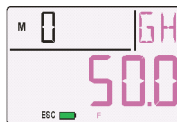
Base value 'BA' und factor 'FA':



Smoothing 'DG':



Limit values 'GH' (high), 'GL' (low)

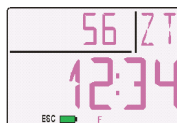


Data logger functions (see 11.2)

Memory capacity 'kB' or 'MB'
and Cycle 'ZY':



Date 'DA' and time-of-day 'ZT'




11.1 Sensor functions

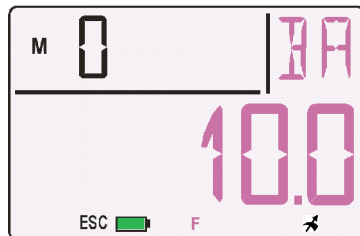
On a number of sensors, e.g. moisture content sensors, it may be necessary before measuring to program correction values, i.e. base value or factor; for measured values of an unstable, fluctuating nature smoothing would be advisable. This device - thanks to the clarity provided by its color display - is ideally suitable for tasks with limit value monitoring. Limit values can also be programmed via the keypad.

11.1.1 Base value and factor

To display the electrical signal of a sensor as a measured value with a physical quantity it is nearly always necessary to perform zero-point shift and multiplication by a factor. To perform these steps the functions BASE and FACTOR are provided. For a detailed description of scaling, with an example, please refer to the Manual, Section 6.3.11.

Displayed value = (measured value - BASE) x FACTOR

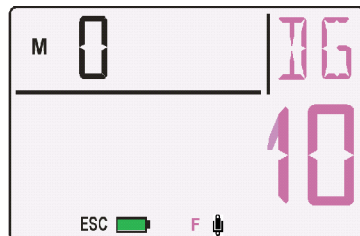
Entering base value 'BA' and factor 'FA' (see 9.3) Once the scaling values have been programmed and the actual measured value thus modified, the correction arrow appears  in the status bar.



11.1.2 Smoothing

Measured values of an unstable or strongly fluctuating nature, e.g. particularly turbulent flows, should preferably be smoothed by means of continuous averaging over a certain time frame. The level of smoothing can be set in the smoothing function 'DG' by specifying the number of measured values to be averaged (range 2 to 99). (see 9.3)

Display with symbol

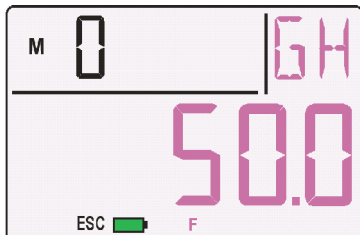


11.1.3 Limit values

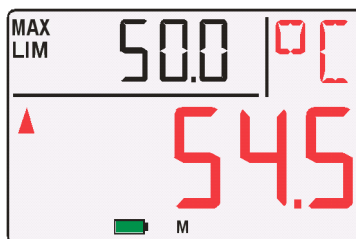
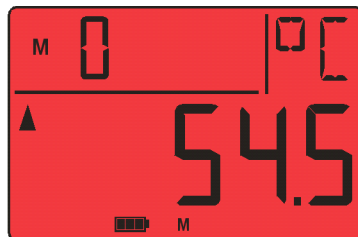
The MAX limit value 'GH' and the MIN limit value 'GL' can be programmed for each measuring channel. (see 9.3) Hysteresis is normally set to 10 digits but this can be adjusted to any number between 0 and 99. (see Manual 6.2.7)

If limit values have been set but not exceeded, the measured value is displayed in green.

Limit value overshoot or undershot



If any measured value overshoots or undershoots its associated limit values, the associated channel is selected automatically, the measured value is displayed on an illuminated red background, and an acoustic alarm is output. Whether the limit value in question is an overshoot MAX or undershoot MIN is indicated by the direction of the flashing arrow ▲ or ▼. The acoustic alarm lasts 10 seconds; the red background can be switched off by pressing any key. The measured value then appears with a flashing arrow either in red (if MAX overshoot) or blue (if MIN undershoot). The function field shows the high / low peak value in the appropriate color. (see 10.3) Here, by again pressing the **MAX** or **MIN** key, the associated limit value can also be displayed with symbol MAX LIM or MIN LIM. The alarm signal can also be forwarded via various relay cables or used to trigger certain actions. (see Manual, 6.3.9) This alarm status remains effective until the measured value returns to within the prescribed limit value by the amount set as hysteresis.



11.2 Data logger functions

The ALMEMO® 2470-1S and 2470-2S are data loggers with an internal EEPROM. On the 2470-2S it is also possible to add a memory connector with a memory card. To control measured value recording 4 additional functions are provided.

Memory capacity display 'FrEE' (see 11.2.3) Cycle 'ZY' (see 11.2.4)

Date 'DA' and time-of-day 'ZT' (see 11.2.5)

For the basic principles of saving data in ALMEMO® devices please see the description in the Manual, Section 6.9.

11.2.1 Internal data memory

The internal 512 KB EEPROM data memory is sufficient for up to 100 000 measured values (depending on the number of channels). In the event of a failure in the supply voltage the measured data is retained intact. The available memory capacity 'FrEE' is displayed in 'KB'. The EEPROM can be reconfigured from ring memory to linear memory. (see Manual, 6.10.13.2)

PLEASE NOTE! The first time the device is started only one sensor configuration is saved to the internal memory; however, with effect from the next start this can be supplemented by additional sensors. If, whenever the device is subsequently started, a different sensor is found to be connected, the display shows 'Er.MEM'. It is now still possible, by pressing 'ESC', to cancel and read out the old measuring operation. If, however, this error message is acknow-

ledged by pressing 'OK', the question 'CMEM' appears. If 'OK' is now pressed the memory content will be cleared and the measuring operation starts. If 'ESC' is pressed instead, the memory content is not cleared and measured value recording is continued - but incorrectly configured (units, measuring range).

11.2.2 External memory connector fitted with a memory card

Memory capacity on the ALMEMO® 2470-2S can be significantly increased by fitting memory connector ZA 1904-SD and a conventional micro SD memory card. Measured data is written to this memory card via the memory connector; this data is in table mode and standard FAT16 format. The SD card can be formatted and its contents can be read out or deleted- using virtually any SD card adapter on any standard PC equipped with a card reader. This data can also be imported into MS-Excel or into Win-Control.

Connecting the memory connector

The memory connector fitted with a memory card can be plugged in at socket A2; it will be recognized automatically. The available memory capacity 'FrEE' is shown in MB. Before the start of any measuring operation an 8-character file name can be entered via the interface (e.g. with the AMR-Control software). In the absence of a user-defined file name, the default 'ALMEM0.001' or the name most recently used will be suggested automatically. So long as the connector configuration is not altered, any number of measuring operations can be saved - either manually or cyclically - all in the same file. If, however, the sensor configuration has been changed since the last measuring operation, a new file will be created; and, if no new file name has been programmed, the index in the file name extension will automatically be incremented by 1, e.g. 'ALMEM0.002'. Similarly, if the file name now entered already exists, a new file will be created with the same file name prefix but with an incremented index.

To check that the memory connector is functioning properly there is an LED incorporated in the end of the handle; this indicates the following states:

- No memory card is detected. LED flashes once long and then three times short.
- Data is being recorded. LED flashes in the same rhythm as the cycle.
- Data is being read out. LED lights up continuously for the duration of data output.



Please ensure, when plugging in the connector, that the card remains latched in position. Memory cards do not support ring memory mode. In the course of a measuring operation the external memory must not be unplugged; all temporarily buffered measured values would be lost.

11.2.3 Memory capacity display

In normal circumstances memory capacity display 'FrEE' shows the still free capacity of the internal memory in KB (kilobyte). However, so long as a memory connector is plugged in, 'FrEE' automatically shows the still free capacity of the memory card in MB (megabyte).

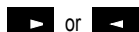
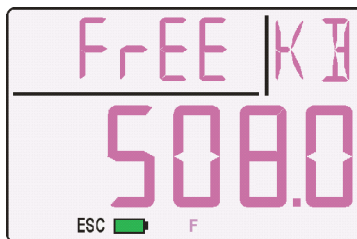
11. Functions

As and when this memory becomes full, the 'FrEE' display will show 0.00; no further measured values will be saved. However, the internal memory can be configured as ring memory. see Manual, 6.10.13.2

To completely delete the memory's contents

PROG CMEM flashes

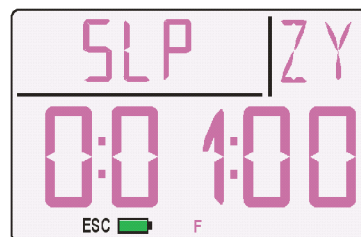
To confirm (OK) or to cancel (ESC) press



11.2.4 Cycle

To have measured values saved cyclically and output via the interface a cycle must be specified. To specify a cycle select the cycle function 'ZY' by pressing **FCT** (see 9.3)

If the cycle is 0, individual measuring operations will be recorded. Saving, i.e. recording data to memory, is activated automatically.



Sleep mode

For long-term recording by cycles lasting longer than 1 minute the device can also be operated in sleep mode. In energy-saving sleep mode the measuring instrument is completely switched off after each measuring point scan (sensors with their own power supply) and switched on again automatically after the cycle expires ready for the next measuring point scan. In this way with just one set of batteries or one battery recharge well over 50 000 measuring operations can be performed; for a cycle lasting 10 minutes this represents an available battery life of over a year.

To adapt the measuring function and the handling of limit value overshoot events as closely as possible to the ambient conditions there are 5 sleep modes with different displays and alarm messages. (see 11.1.3)

To select from among these 5 modes press **MEM** ...

Output formats	SLP	SLPd	LIM SL.d	LIM SL. A	LIM SL.dA
Without limit value overshoot					
Sleep LED flashes.	•	•	•	•	•
The display shows the most recent meas. value		•	•		•
With limit value overshoot					
The red backlighting flashes rhythmically.			•		•
Rhythmic acoustic alarm signal				•	•
Interface commands	o(-)11	f1 o11	f2 o11	f3 o11	f4 o11



Please note that alarm displays will increase current consumption and, depending on the operating period, shorten the battery's useful life. To acknowledge - and thus terminate - alarm display when in sleep mode press the **ON** key. The acoustic alarm signal will end automatically after 10 seconds.

11.2.5 Date and time-of-day

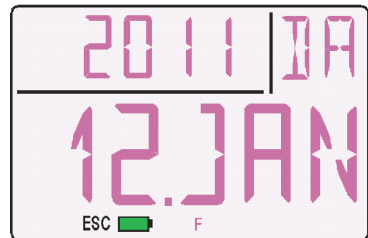
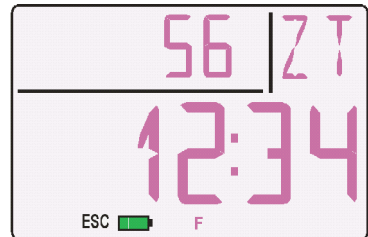
For logging the measuring time a real-time clock with date and time-of-day is incorporated. This real-time clock is buffered by the power supply to the device; in the event of battery replacement date and time-of-day are lost. Having selected the date and time-of-day functions via key **FCT** information is entered in the format specified in Section 9.3.

Function time-of-day 'ZT' (format: hh:mm \ ss)

Function date 'DA' (format: dd.mon \ yyyy)



After a battery change these functions are automatically activated and unlocked for the purpose of entering information.



11.2.6 Measured value recording

Once the cycle, sleep mode (if applicable), and date and time-of-day have been programmed, the measuring operation can be started in the measured value display.

Before it starts the pause symbol is displayed in the status bar.

To start a cyclic measuring operation (cycle > 0) press

The start and save symbols then light up.

In sleep mode 'SLP' briefly appears and the device then switches off automatically. Sleep mode can be terminated at any time by pressing

The current measuring operation continues to run in normal mode.

The measuring operation can always be stopped by pressing

Individual manual measured value scans can be performed if cycle = 0.

In this case the symbol lights up briefly.

II
MEM
➔ **REC**

ON

MEM
➔ **REC**

11.2.7 Reading out the memory

The **internal measured value memory** can only be output via the serial interface - preferably using the AMR-Control software. (see Manual, 6.9.3.2)

With each output from the internal memory any one of the three output formats

may be used “list”, “columns”, or “table”. It is possible to specify certain sections of the memory for output - either by stipulating the start time and end time or by selecting the numbers defining the measuring operations in question.

With **external SD memory cards** the device itself can usually only read out measured data contained in the file most recently used; it does this in table format. (see 11.2.2) For the duration of memory output the LED on the end of the handle lights up continuously. The most sensible approach is to remove the memory card and copy the files via the SD card adapter and USB card reader directly onto a PC. These can then be imported either into MS-Excel or into Win-Control (as of V.4.8.1).

12. OUTPUTS

Output sockets A1 and A2 (2) if available are for a series of peripheral modules and DC socket (3) is for the power supply. (see 7.3) Interface cables and relay, trigger, and analog output modules can be connected. (see Manual, Chapter 5) For this purpose the appropriate accessories are needed. (see 16.2)

12.1 Interfaces

USB data supply cable ZA1919-DKU5 is used as link to the computer; this is especially useful; it serves both as interface and as power supply. Other interfaces can be implemented using the appropriate data cables (see Manual, 5.2); this is only possible at sockets A1 and A2 of measuring instruments ALMEMO® 2470-2/2S. Via all these interfaces devices with sensors can be completely programmed thus enabling the user to read out all acquired data (see Manual, Chapter 6) and also be networked together very easily. (see Manual, 5.3)

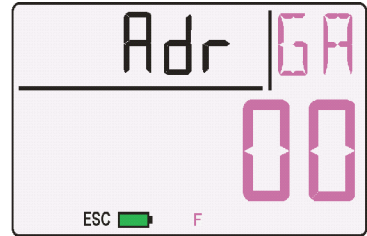
The baud rate for all data cables is programmed on leaving our factory to 9600 baud; this setting should not be altered - especially in networks.

12.2 Relay trigger analog modules

At socket A2 and / or A1 (2470-2/2S only) one can connect analog output cable ZA 1601-RK, 0 to 2 V (see Manual, 5.1.1) without electrical isolation, or relay trigger cable ZA1006-EAK (see Manual, 5.1.2), or the universal relay trigger analog adapter (see Manual, 5.1.3). Alarm relays, analog outputs, and trigger functions can be configured quickly and easily via the interface using the AMR-Control software.

13. DEVICE CONFIGURATION

A number of parameters that need to be modified only very rarely can be specially programmed in 'Device configuration'. When switching ON press and hold down key **MEM**. The function field should then show an abbreviation for the parameter and the main field should show the value currently set.



To select the following parameters again press

Device address

Device locking

Automatic switch OFF time for device in minutes

Automatic switch OFF time for display illumination

Atmospheric pressure for pressure compensation

FCT

Adr	GA
Loc	VC
A0FF	min
d0FF	min
.P	mb

To **enter values**

To **cancel or terminate** configuration press

PROG ... see 9.3



13.1 Device address and networking

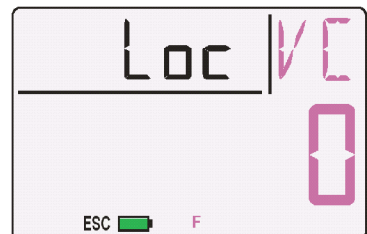
To communicate with networked devices it is absolutely essential that all the devices concerned should have the same baud rate setting (default 9600 baud) but that each should have its own dedicated address; this ensures that only one device responds per command. Before starting network operation ensure therefore that all the measuring instruments involved are assigned different device addresses. This is the purpose of the afore-mentioned 'Adr GA' parameter.

13.2 Device locking

A very useful feature is the ability to lock equipment against undesired reprogramming. Sensor parameters are usually protected by means of sensor locking. (see Manual, 6.3.12)

This status can only be altered via the interface. On this device access to functions and to various programming options is controlled by sensor locking and by the locking code; this

can be configured as and when required via menu item 'Loc VC'. Functions protected by means of sensor locking cannot be selected. All programming options having a long-term effect can only be accessed using locking code 0. In all other cases the following table applies :

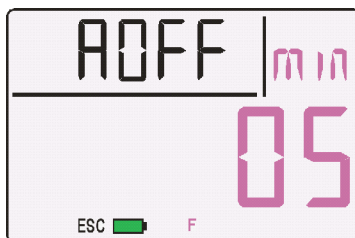


Functions	Locking code VC			
	0	1	2	3
M▲, M▼ Select measuring points, display measured value	●	●	●	●
M▲ <u>press and hold down</u> Program double display	●			
UBat display	●	●	●	● 10s
MAX-MIN-LIM select and display	●	●	●	● 10s
MAX-MIN delete	●	●		
MEM save	●	●	●	
MEM display and delete	●	● 30s		
REL in the RAM	●	●		
REL in the EEPROM as per sensor locking ≤ 4	●			
ADJ in the EEPROM as per sensor locking ≤ 5	●	●		
FCT Display sensor function as per sensor locking and ON	●	●		
FCT Program sensor function as per sensor locking	●			
FCT Display data logger function (with activated memory)	●	●		
FCT Program data logger function (with activated memory)	●			

13.3 Automatic device switch OFF

In menu item 'A0FF' the device can be programmed to switch OFF automatically if no key is touched for a certain settable number of minutes; this will help save the batteries.

This automatic device switch OFF will not take effect if the setting is '- -' or if a mains adapter is connected.

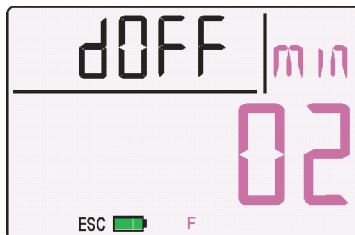


13.4 Display illumination - automatic switch OFF

A characteristic of all illuminated displays is that the illumination consumes a lot of power.

To prolong the device's operating time it is advisable therefore to switch off the illumination either permanently or so long as the device is not being used. The display on this device is a static transfective color segment display; even without illumination it can be clearly read but the characters are only black.

This operating mode is likewise selected when the data logger is in sleep mode 'SLPd'. In normal operating mode, in menu item 'd0FF', the user can program the number of minutes of inactivity after which display illumination is switched OFF automatically. This automatic device switch OFF will not take effect if the setting is '- -' or if a mains adapter is connected.



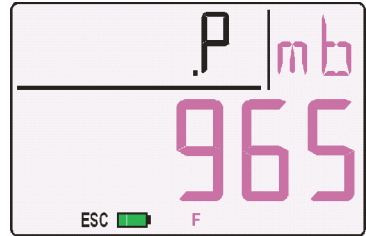
13.5 Atmospheric pressure

To perform pressure compensation on various sensors (see 10.2.2, with PC) the current atmospheric pressure is required. (see 10.7)

The atmospheric pressure can be programmed explicitly in menu item 'P mb'. (see 9.3)

If atmospheric pressure at a measuring point is used for compensation purposes a symbol 'P' is displayed after the measuring point in question; if atmospheric pressure is itself being measured the symbol 'P' is displayed with a dot flashing in front of it.

The default setting on special device 2470-1SRH is to measure atmospheric pressure and use this for compensation.



14. TROUBLE-SHOOTING

The ALMEMO® 2470 measuring instrument can be configured and programmed in many different ways. It is suitable for connecting a wide variety of different sensors, other measuring instruments, alarm signaling devices, and peripheral equipment. Given these numerous possibilities the device may in certain circumstances not behave quite as expected. The cause of such unexpected behavior is only very rarely a device defect; usually the cause is incorrect operation by the user, an invalid setting, or unsuitable cabling. In such event please try to pinpoint and clear the problem with the aid of the following tests.

Error No display, display malfunction, keys do not react.

Remedy Check the power supply; use fresh batteries; switch OFF and then ON again; if necessary re-initialize. (see 7.6)

Error Measured values are incorrect.

Remedy Switch the device OFF and, pressing and holding down key **CLR**, switch ON again; via interface check all the channel programming very carefully, especially the base value and zero-point.

Error Measured values fluctuate or there is no reaction to changes in measured value or to new inputs.

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

Error 'CALEr' is displayed when the device is switched on.

Remedy The calibration of a measuring range may have become misadjusted. The device must be recalibrated at our factory.

Error Data transmission via the interface does not function.

Remedy Check the interface module, connections, and settings. Ensure that both devices are set to the same baud rate and transmission mode. Is the correct COM port on the computer being addressed? To check the data flow and the handshake lines a small interface tester with LEDs comes in very handy; (in ready-to-operate status data lines TXD, RXD carry negative potential of approx. -9V and their associated LEDs light up green whereas handshake lines DSR, DTR, RTS, CTS carry positive voltage of approx. +9V and their associated LEDs light up red. For the duration of data transmission the data LEDs should flash red.

Test data transmission by means of a terminal (AMR-Control, WIN-Control, WINDOWS-Terminal). Address the device using its assigned device number 'Gxy'. (see Manual, 6.2.1) If the computer is in XOFF status. enter <ctrl Q> for XON. Check the programming by means of 'P15'. (see Manual, 6.2.3) Test the transmit line by selecting a measuring point with command 'Mxx' and checking in the display.

Error Data transmission in the network does not function.

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

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

15. DECLARATION OF CONFORMITY

Ahlborn Mess- und Regelungstechnik GmbH declares herewith that measuring instrument ALMEMO® 2470-1S, 2740-2, and 2470-2S all carry the CE label and comply in full with the requirements of EU directives relating to low voltage and to electromagnetic compatibility (EMC) (89/336/EWG).

The following standards have been applied in evaluating these products:

Safety	EN 61010-1: 2001
EMC:	EN 61326: 2006



If a product is modified in any manner not agreed with us in advance, this declaration becomes void.

When using the sensor with an extension care must be taken to ensure that wiring is not laid alongside or close to high-voltage power cables and that it is if necessary properly shielded so as to prevent spurious interference being induced in the system.

16. ANNEX

16.1 Technical data

(see Manual. 2.3)

Measuring inputs	2470-1S	1 ALMEMO® socket M0 for ALMEMO® sensors 4 measuring channels
	2470-1SRH	Same as above, with integrated temperature / humidity sensor and atmospheric pressure sensor 4 additional meas. channels (D °C, D rH, D DT, AP)
Temperature D °C		Measuring range -20.00 to +80.00 °C Accuracy ±0.3 K at +25 °C, otherwise max. ±1.2 K
Relative humidity D rH		Measuring range 5.0 to 98.0 % RH Accuracy ±1.8 % RH at +25 °C within range 20 to 80 % RH Hysteresis ±1.0% RH
Atmospheric pressure AP		Measuring range 300 to 1100 mbar Accuracy ±2.5 mbar (700 to 1100 mbar)
	2470-2/2S	2 ALMEMO® sockets, electrically isolated, suitable for ALMEMO® sensors 4 measuring channels / sockets 4 internal additional channels
A/D converter		Delta - sigma, 16-bit, 2.5 / 10 mops, adjustable 1 to 100
Sensor power supply		6 V 0.4 A / 9 V 0.3 A / 12 V 0.2 A (Mains adapter 12 V / 0.4 A)
Outputs		ALMEMO® DC socket for mains adapter or USB data supply cable
	2470-2/2S	ALMEMO® sockets A1, A2 for all output modules
Standard equipment		
Color segment LCD		Meas. value 5x16-segment 15mm, 2x16-segment 9mm Function 4½ x 7-segment 9 mm, 9 symbols 7 silicone keys
Operation		99 measured values in RAM
Memory, internal	2470-2/2	512-KB EEPROM (up to 100 000 measured values)
	2470-1S/-2S	Software clock, buffered by device power supply
Date and time-of-day		
Power supply		
Internal	2470-1S	3 AA alkaline batteries
	2470-2/2S	3 AA NiMH rechargeable batteries
Current consumption		Without illumination approx. 12 mA
(without input / output modules)		With illumination approx. 29 mA Sleep mode LED approx. 50 µA As above but with display approx. 80 µA
External		ALMEMO® DC socket
Clamp connector		ZA 1000-FSV 10 to 30 VDC
Mains adapter		ZA 1312-NA7 230 VAC to 12 VDC, 1 A
DC / DC cable, electr. isolated		ZA 2690-UK 10 - 30 VDC to 12 VDC, 0.25 A
USB data supply cable		ZA 1919-DKU5 5 VDC, 400 mA
Housing		127 x 83 x 42 mm (LxWxH) ABS (acrylonitrile butadiene styrene) Weight approx. 260g

Suitable conditions

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

16.2 Product overview

Universal measuring instrument ALMEMO® 2470-1S

1 ALMEMO® measuring input, 2-row color segment LCD, 7 keys, 512-KB measured value memory, 1 ALMEMO® DC output socket for mains adapter or USB data supply cable, Battery supply

Order no.

MA 2470-1S

Universal measuring instrument ALMEMO® 2470-1SRH

Like ALMEMO® 2470-1S but with integrated temperature / humidity sensor and atmospheric pressure sensor

MA2470-1SRH

Universal measuring instrument ALMEMO® 2470-2

2 ALMEMO® measuring inputs, electrically isolated, 2-row color segment LCD, 7 keys, 99 measured value memory, 3 ALMEMO® output sockets A1, A2 for data cable RS232, USB, Ethernet, analog cable, Trigger, relay, DC socket for mains adapter or USB data supply cable, Rechargeable battery supply with integrated charge circuitry

MA 2470-2

Universal measuring instrument ALMEMO® 2470-2S

as for ALMEMO® 2470-2 but with 512-KB measured value memory instead of 99 measured value memory

MA 2470-2S

Options

With IP54 protection

OA 2470-IP

Accessories

Rubber guard, gray

ZB 2490-GS2

DIN top hat rail mounting

ZB 2490-HS

Mains adapter with ALMEMO® plug, 12 V, 1 A

ZA 1312-NA7

ALMEMO® DC / DC cable, 10 to 30 VDC, 12 V / 0.25 A, el. isol.

ZA 2690-UK

ALMEMO® power supply plug, 10 to 30 VDC

ZA 1000-FSV

ALMEMO® USB data supply cable, not el. isol., max.115.2 kbaud

ZA 1919-DKU5

ALMEMO® data cable, with USB interface, el. isol., max.115.2 kbaud

ZA 1919-DKU

ALMEMO® data cable, with V24 interface, el. isol., max.115.2 kbaud

ZA 1909-DK5

ALMEMO® data cable, with Ethernet interface, electrically isolated, maximum 115.2 kbaud

ZA 1945-DK

ALMEMO® network cable, el. isol., max.115.2 kbaud

ZA 1999-NK5

ALMEMO® recording cable, -1.25 to 2.00 V

ZA 1601-RK

ALMEMO® V6 input / output cable,

with 2 triggers and 2 semiconductor relays

ZA 1006-EKG

ALMEMO® V6 relay trigger adapter

(4 relays, 2 trigger inputs)

ZA 8006-RTA3

Option for up to 4 analog outputs 10 V / 20 mA

OA 8006-R02

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16.4 Your contact partner

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