Draft

Operating Instructions

LM 2000

Meinsberg
PC Laboratory-Multi-Parameter-System

Content

1 Overview

1.1 General aspects to LM 2000

The PC laboratory-multi-parameter-system consists of the basic device with up to 3 intelligent combinable, measuring modules for electrochemical measurements linked with a PC. One module (=transmitter) can be connected with one sensor and Pt 1000. By combination of several LM 2000, applying extension modules, up to 16 measuring points are available.

In connection with the corresponding sensors the modules can determine pH, redox potential, conductivity, dissolved oxygen concentration, ion concentration and temperature. Further parameters can be measured via standardised interface 0…5 V or 0/4…20 mA.

The LM 2000 features automatic module recognition of the connected active modules in plug & play process and enables the configuration and calibration connection with the sensors. Displaying, evaluation, mathematical calculation, saving of measurements and the export of the data are realized and documented easy by PC software. The visualisation program supports a lot of practical relevant algorithms for calibration and methods for compensating temperature as well as GLP-functions.

This PC based measuring system constitutes the toolbox for realisation of a Multi-Parameter System by the user with nearly unlimited possibilities for custom-specific configuration, flexible order and later supplement expansion, by simultaneous high economy, quality just documentation and open system structure for applications in quality control, process supervision, laboratory and technical plants.

Furthermore a module for electrochemical corrosion analyses is also available. This PS 2000 module contains both galvanostat and potentiostat (Refer operation instructions!).

1.2 Design of LM 2000

On the following picture you can see the LM 2000 measuring system. It consists of LM 2000 basic device, sensors and laptop/PC.
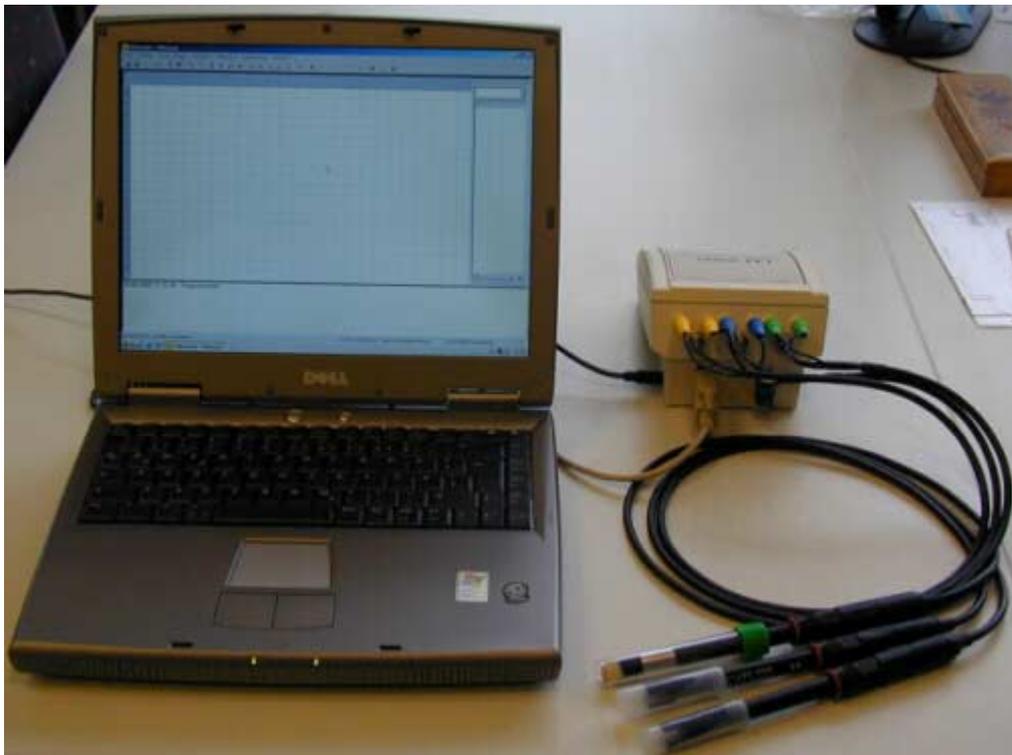
Sensors
A particular feature of the modular PC laboratory-multi-parameter-system (LM 2000) is that conventional electrodes and sensors (pH and redox electrodes, conductivity cells, oxygen sensors, etc.) can be connected without integrated pre-amplifiers or electronic circuit. So the entire range of electrodes, sensors and accessories for connection with the LM 2000 is available. Specific electrically isolated measuring modules with linear transmission characteristics are provided for the connection of sensors with integrated measured value processing.

LM 2000
There are up to 3 modules in the LM 2000 basic device which amplify the measurement signal.
Up to 16 measuring modules in any combination/selection can be connected to an external PC by connecting basic and extension device via bus cable. The plug-in power supply is responsible for power supply for the measuring modules and the PC with the visualisation software recognizes automatically the connected modules.

PC visualisation software (LMremote)
The LMremote PC visualisation software enables the comfortable displaying, configuration and saving of registered measurement values from the measuring modules to a PC.

The following picture shows the connection between basic, extension device and the corresponding sensors.

Electrodes / Sensors
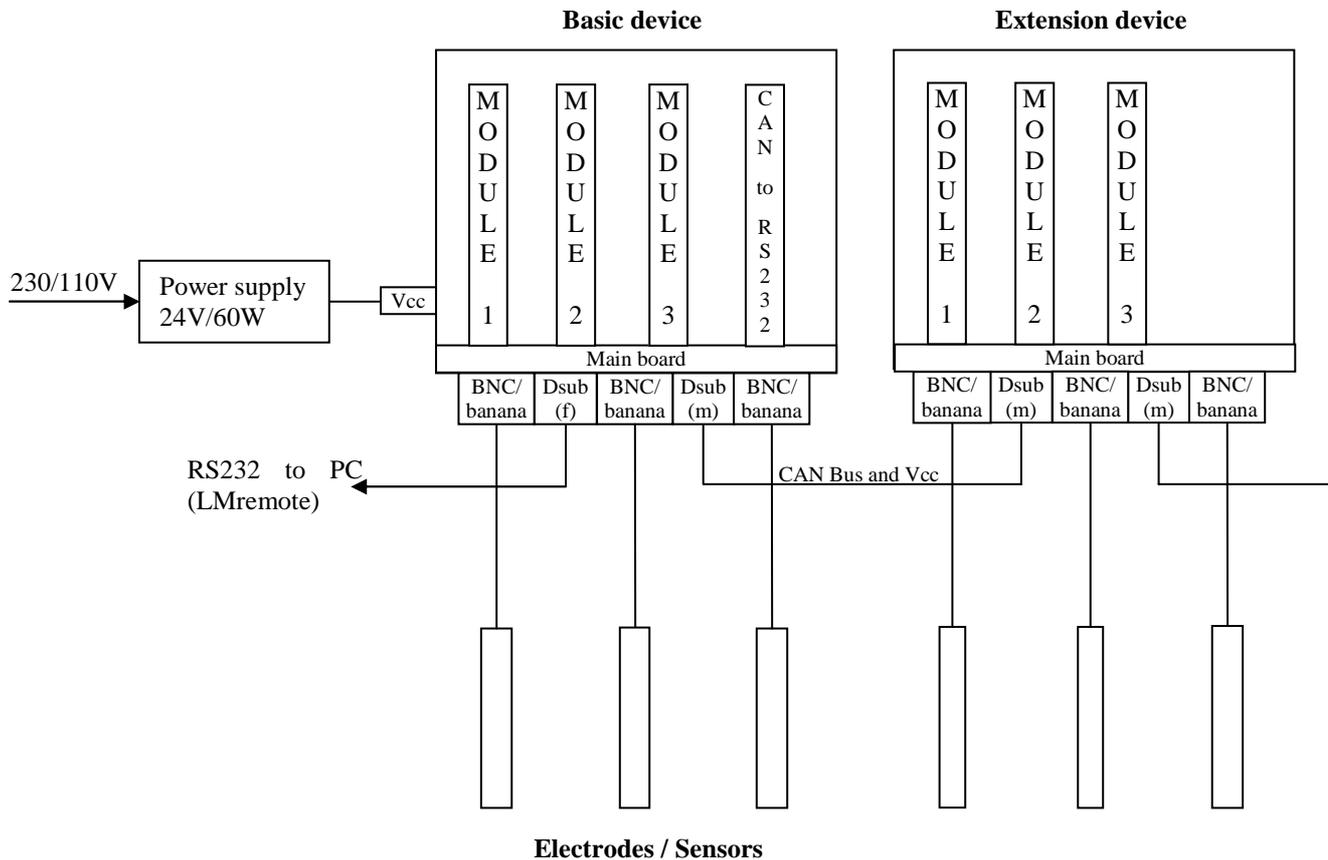
2 Safety

These operating instructions contain fundamental information that should be observed in connection with the installation, start-up, operation and maintenance of the modules. Therefore, it is absolutely vital for the user to read this manual before working with it.

2.1 Proper usage

The components of the PC Laboratory-Multi-Parameter-System are intended for measuring analysis parameters. Considering the 'Technical Data' paragraph operating and using the PC Laboratory-Multi-Parameter-System for this application is the proper usage. Any application beyond this and individual modifications or extensions are improper and will lead to lose warranty. When connecting the modules with electrochemical sensors, always take into account their life and natural wear as this may lead to malfunctioning of the measuring system and the control associated with that. The user must take suitable measures to limit harmful effects of such malfunctioning.

2.2 General safety instructions

All components of the PC Laboratory-Multi-Parameter-System have been manufactured and tested in accordance with the relevant guidelines and standards for electronic measuring equipment. They have left the factory in technically unobjectionable condition.
The proper functioning and the operational reliability of the Measuring System and of the system components will only be guaranteed if the generally usual safety precautions and the specific safety instructions given in these operating instructions and in the operating instructions of the components are observed. If it is assumed that safe operation of the unit or of its components is no longer possible, remove the unit and its components from service and protect it against unintentional operation. Safe operation will no longer be possible if the modules or its components
- show any transport damage.
- has/have been stored under unsuitable conditions for a longer time.
- show any apparent damages.
- does/do no longer work as described in these operating instructions.
If in doubt, please contact your supplier.

User qualification
The modules and the entire measuring system have been designed for analytical multi-parameter measurements. It is assumed that the user/operator and the maintenance staff have the professional skills and experiences to know the specific properties of analytical measuring systems, to master the safe handling of chemicals, for example, in the maintenance of electrodes/sensors, and can assess any dangers and risks resulting from them. The user must ensure that the national legislation and procedures concerning the protection of labour, the prevention of accidents and the handling of chemicals are observed.

Electrical installation work
The components of the PC Laboratory-Multi-Parameter-System are delivered ready for operation and ready for connection to the PC, the plug-in interface converter and the plug-in power supply 230 V AC in accordance with the information of these operating instructions. The plug-in power supply 230 V AC is to check with regard to the existing power supply on the place. It is not allowed to annul the there realized protection functions.
Install the PS 2000 so that the conditions specified under 'Technical Data' will be kept under any circumstances. The enclosures fulfil the IP 41 degree of protection requirements. The correct connection of the PC, malfunction of the PC, effects of malfunctions of the modules and the PC among themselves and each other as well as loss of data and software on the PC are not content of guarantee of the manufacturer from the PC Laboratory-Multi-Parameter-System. Do not use any sensor and bus cables other than recommended by the manufacturer. For the sensors and accessories, the instructions and regulations in the respective operating instructions and specification sheets shall apply.

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3 Start-up

3.1 Delivery volume

Basic equipment:
- 1 LM 2000 basic device with 3 modules in maximum (module type is selectable)
- Sensors with the corresponding measuring cables
- external power supply for LM 2000 basic device
- 1 Interface cable RS 232 (for connecting LM 2000 basic device and laptop/PC)
- 1 Sub-D-end-resistor
- 1 CD-ROM (contains visualisation software „LMremote" German and English)
- 1 operating instructions
- 1 laptop/PC **(no standard part of delivery; deliverable by enquire)**

Extension:
- LM 2000 extension devices
- PS 2000 extension devices
- bus cable (for connecting basic and extension device)

3.2 Connecting the single components

3.2.1 LM 2000 basic device

The connectors of the sensors and bus system are located in the front of the LM 2000.

3 BNC jacks are for the sensors (pH, redox, conductivity, oxygen, ISE) and 3x2 4 mm banana jacks for the corresponding temperature probes Pt 1000. If you have sensors without integrated temperature probe (e. g. redox combination electrodes) you have to adjust a fixed temperature in the visualisation software or connect a separated temperature probe (Refer chapter "temperature compensation"!).

Below the 9 sensor jacks there are a Sub-D-plug and a Sub-D-jack for data transfer. The Sub-D-plug is responsible for power supply and data transfer from basic to extension device. The Sub-D-jack realizes RS 232 data transfer from basic device to laptop/PC.

On the left side of the LM 2000 basic device (considered from the BNC jack side) a jack is located for connecting with a power supply unit.

4 mm banana jack

BNC jack

Sub-D-plug

Sub-D-jack

Power supply

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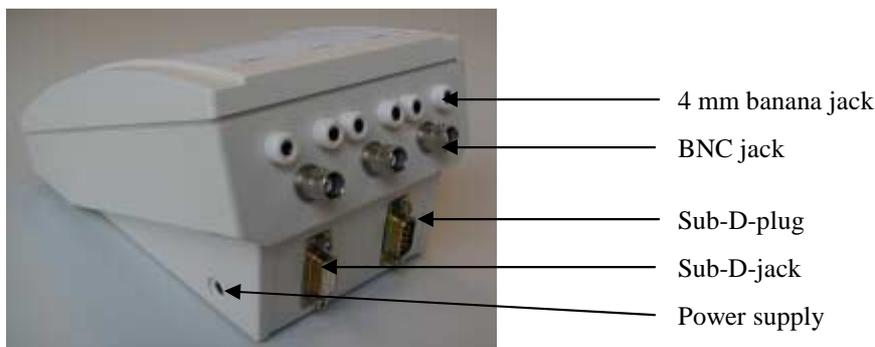
3.2.2 LM 2000 extension device

Basically the extension device is designed like the basic device. However the extension device is not equipped with a power supply because it is realised via basic device. In contrast to basic device the extension device is provided with 2 Sub-D-plugs because data transfer to Laptop/PC is realised via basic device.
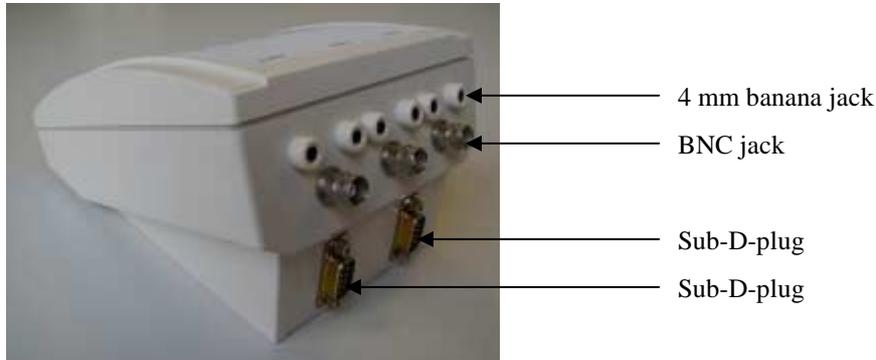
How to realize a measuring system ready for operation?
- Connect sensor (BNC jacks)
- If necessary connect temperature probe Pt 1000 (banana jacks)
- Connect power plug with basic device
- Connect Sub-D-jack (left) with laptop/PC → use Interface cable RS 232
- Complete the LM 2000 with a Sub-D-end-resistor (R=120 Ω)

Pay attention if an extension device is to be integrated in the LM 2000 system:
- Connect basic device (right Sub-D-plug) and extension device (left Sub-D-plug) per bus cable
- Complete the last extension device with a Sub-D-end-resistor (R=120 Ω)

LM 2000 and LM 2000-E

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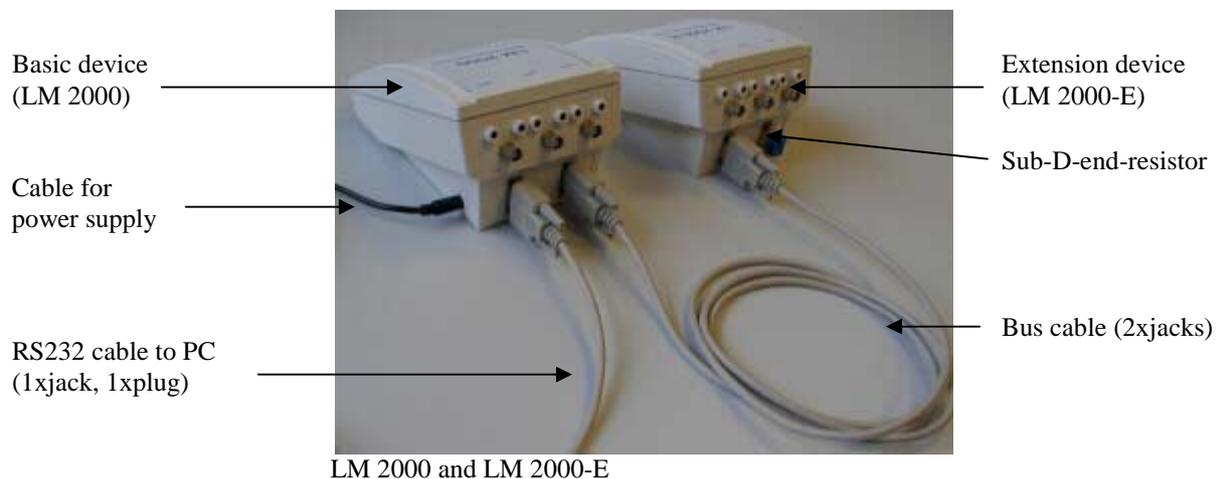
3.3 Software installation

For working with the software LMremote it is necessary to note the recommended PC requirements:

- min. 32 MB RAM and 30 MB HDD
- screen 800 x 600
- free RS232 interface or USB port with adaptor
- MS-Windows 95 or later

For installation of the software insert the data carrier which contains the software LMremote in the appropriate floppy on your PC. Start the installation program "setup.exe" on the data carrier. Now, please follow the installation instructions.

After correct installation of the software, you can start the software via start-program-LMremote or with the desktop icon.
By first starting of the software you have to choose at first the correct interface and you have to configure the program for the data transmission with the modules.
You can adjust the interface via menu point "Setup – RS 232". In the following dialog field you have to choose the correct interface (Refer menu point "Help").
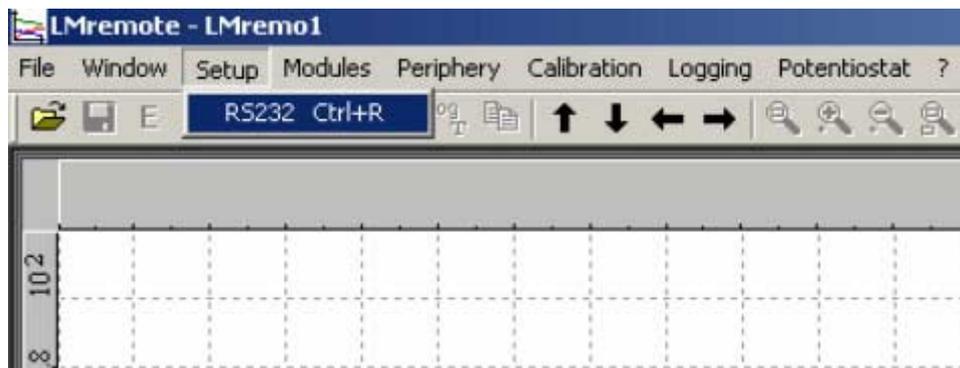
3.4 Release amplifier

After installing software you can release amplifiers. This is the precondition to measure and work with the LM 2000.

The command "Release amplifier" is now described:
- Click the menu point „Modules"
- Choose the command "Release amplifier". Now the field "Release dialog" appears.

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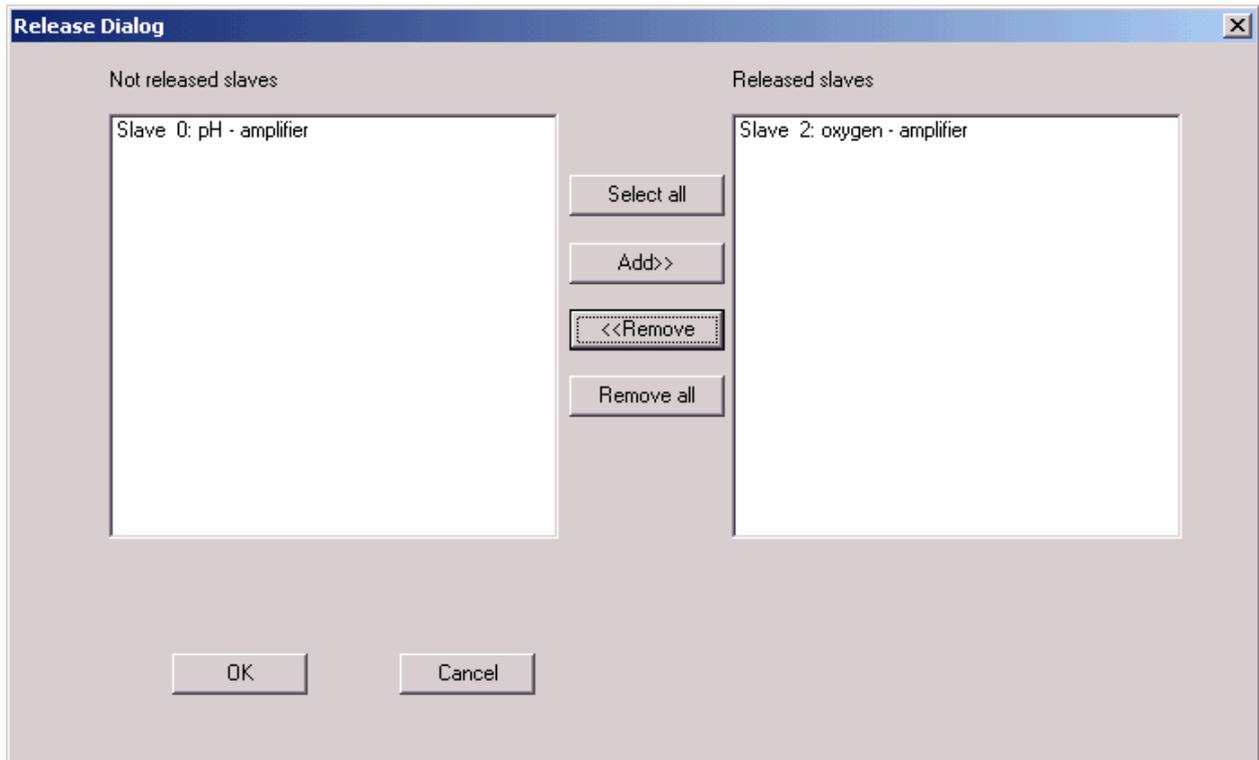
This dialog you need to select the modules for measurement and recording. On the left side listed all modules which are not released. On the right side all released modules are listed. You can swap each module from the released side to the not released side and reverse.

It is possible to select all modules for measurement and plotting but you can also select only the modules you need for a special measurement. So you can save resources of your PC.

- Choose the module (slave) you want to log, click it (left side) and press the button „add".
- Finish the dialog with "OK".

3.5   Command: ID change

Each module has its own slave number (identification number). With this command you can change the number of a released slave. Pay attention that each number is only once on the bus. If a number is double on the bus no correct measurement is possible.

In general changing the ID is not necessary. If you want to extend your LM 2000 with additional modules you can change your ID. It is also possible that the manufacturer or tradesman changed the wished ID number.

If you want to change the ID number pay attention to the following points:

- Choose the menu point „Modules" and click „ID change". With this command you are looking for all modules connected to the bus.
- Choose the slave and enter the new ID number. Confirm with "OK"

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Select module

Please select one slave.

Slave 1: oxygen - amplifier

OK   Cancel
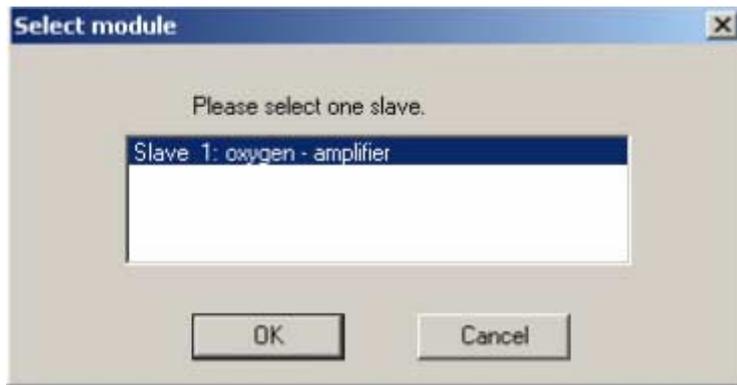
- A warning advice appears. Confirm with "OK".

LMremote

Changing this value can be responsible for measurement errors!

OK

- Enter the new ID and confirm with „OK". Pay attention that each number is only once on the bus.

ID Change

3   Input new ID.

OK   Cancel
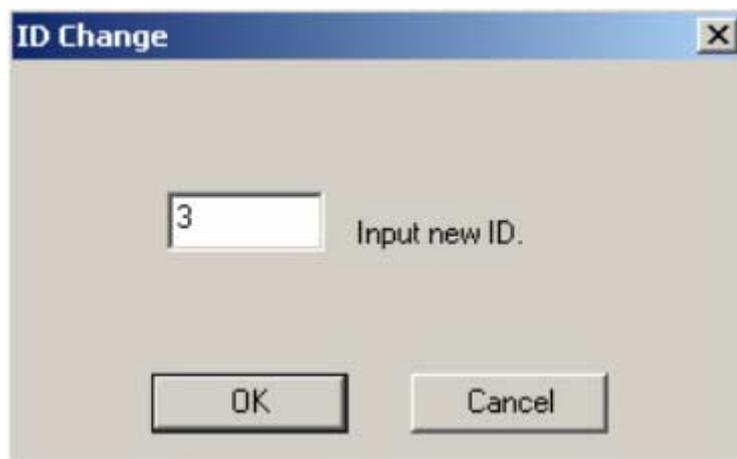
- Now you get the message that the ID change was successful. Confirm with "OK". After changing the number you need a new release of all modules (command "Release amplifiers").

4 General adjustments and options

4.1 Menu point: File

The Menu point „File" contains the following commands:

New	Creates a new document.
Open	Opens an existing document.
Close	Closes an opened document.
Safe	Saves an opened document using the same file name.
Safe us	Saves an opened document to a specified file name.
Export	Export of data in a text/tab- format
Import	Import of xsm- data file from older software MVremote
Print	Prints a document.
Print preview	Displays the document on the screen as it would appear printed.
Print Setup	Selects a printer and printer connection.
Exit	Exits program.

4.2 Menu point: Window

The Window menu offers the following commands, which enable you to arrange multiple views of multiple documents in the application window:

Cascade	Arranges windows in an overlapped fashion.
Tile	Arranges windows in non-overlapped tiles.
Arrange Icons	Arranges icons of closed windows.
Window 1,2, …	Goes to specified window.

4.3 Menu point: help (?)

The Help menu offers the following commands, which provide you assistance with this application.

If you need help for explanation of a special command or keyword read the following points:

- Click „?" in the menu bar.
- Choose the command "Help Topics". Now you are in field "Content".
- If you open the book "Menus" you will find all menus of the software. The menus are listed and explained. If you open the book "Operating instructions" you will see some information to PS 2000.
- If you open the field "Index" you will find an alphabetical index. Here you can jump to the instructions which explain step by step the application of the software "LMremote".

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5 Measuring and logging

The logging menu offers the following commands: Start Measurement, Start Logging, Stop, New Scale.

5.1 Start Measurement

If you start this dialog the measurement windows of the modules are shown to see the active measurement values.
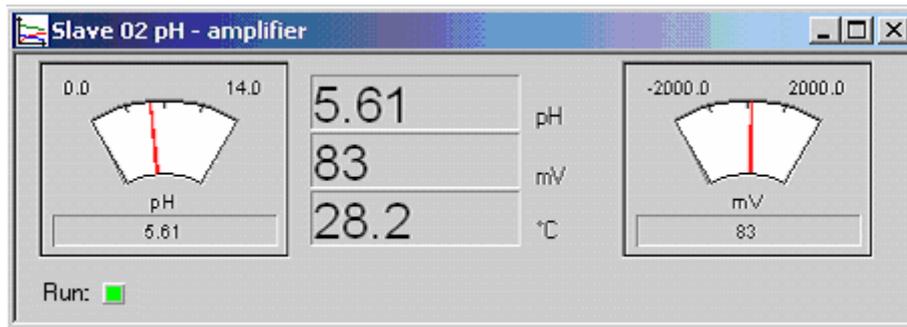
5.2 Start Logging

Use this command to start a data logging on screen.

5.2.1 How to realise a data logging?

Choose or create a file to save your data.

After that the dialog „graphic setup" opens.

With this dialog it is possible to release measurement values for plotting and logging (hook). Also you can define a scaling value for each channel. The interval for data logging and the start area are also to adjust. The button "OK" starts the logging process.

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If you want to make some calculations between different channels you can use 4 additional channels, called "virtual channels". Use therefore the button "virtual Channels" and you get a dialog "adjust virtual channels".

With this dialog you can make a virtual connection by an equation between values of different modules (also temperature values). You have to select the measurement values from the list of released modules and you can input an equation where you use the variable y for measured value slave 1 and variable z for measured value slave 2. To release the plotting don't forget the check in front of the line (hook).

If there is an error in the equation you will get information and you have to change this.

Allowed operations are:
Expression in parentheses: (....)
Operations:

    +   addition

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-	subtraction (or sign)
*	multiplication
/	division
^	power expression/square operation
exp	exponential
ln	natural logarithm
log	logarithm base 10
sin,tan,cos	trigonometrical operations (format RADIAND)
arcsin,arctan,arccos	trigonometrical revers functions (format RADIAND)

Pay attention that errors like division by zero or log of a negative value are not checked in dialog field, because no values are available during input the equation. If there are errors during calculation this values are set to zero.

If all adjustments are finished the measuring values are logged (Refer the following diagram!). On the right of the graph the measuring values are listed.
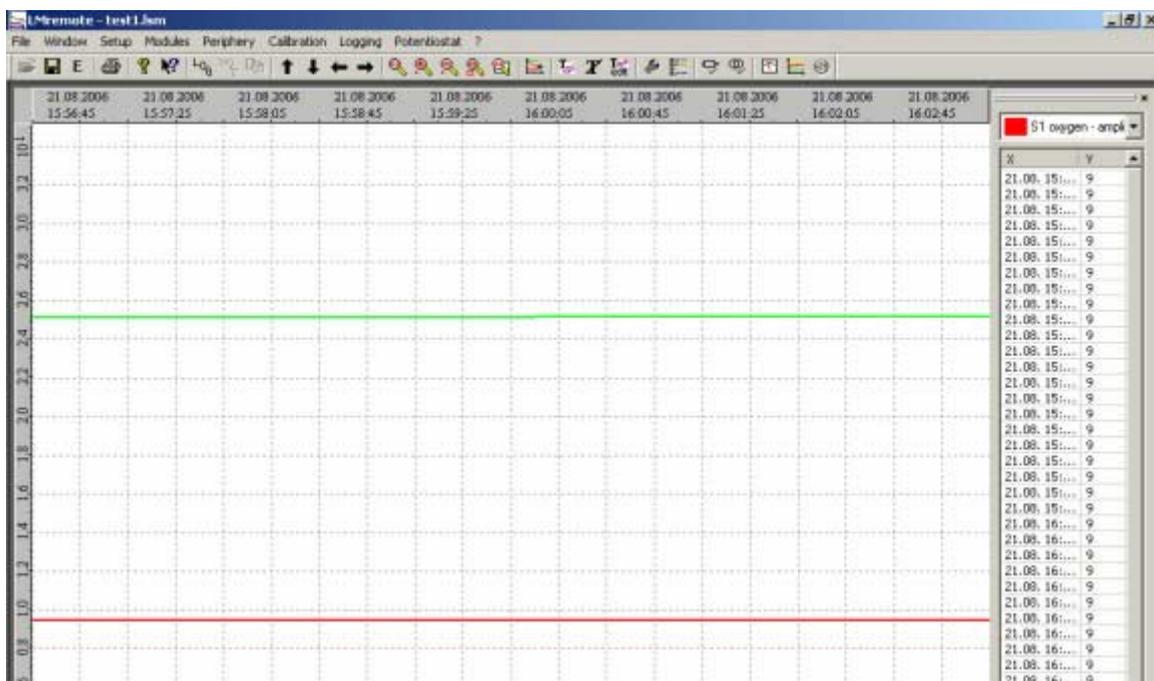
During data logging you can insert a log book (tool „LOG"). Furthermore an individual recording in the log book is also possible (tool "logT").

5.2.2   Graphics edit

5.2.2.1   Toolbar

With the help of tools you can edit graphics. The tools have the following meaning:

	Open an existing document. LMremote displays the Open dialog box, in which you can locate and open the desired file.
	Save the active document or template with its current name. If you have not named the document, LMremote displays the Save As dialog box.
E	Export of data in a text/tab format.
	Print the active document.

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LOG	Insert log book.
log T	Input an individual text in the log book.
	Copy of a selected section from the log book to the clipboard.
↑ ↓ ← →	Move graphic in a direction.
	Adjust graphic on actual graphic window.
	Magnify graphic window.
	Scale down graphic window.
	Redraw graphic window.
	Magnify a selected area of the graphic window.
	Scroll the graphic automatically.
T	Input a text in the graphic window. Right mouse button change the text direction between vertical and horizontal. The cursor fixes the start point of the text.
T	Clear all the text in the graphic window.
T edit	Edit a text in the graphic window. Therefore select the small mark beside the text with the cursor.
	Change the properties of the graphic window (name, colour).
	Select the graphs for drawing.
	Looking for all amplifier modules on the CAN bus.
	Looking for all current output modules on the CAN bus.
	Start measurement and display the value on virtual instruments.
	Start logging of all selected modules.
S	End logging.

5.2.2.2   The graphic command

Furthermore you have the possibility to edit the graphic menu. To get the menu for graphic commands you have to click into the graphic window with the right mouse button.

The Graphic menu offers the following commands:

Point marks	All measurement points are marked with small squares.
Scatter graph	All graphs will be hidden.
Mouse coordinates	In a small window you get the x and y coordinates of the actual mouse position.
Axis	The graphic window is drawn with or without grid.
Fit	Different possibilities for zoom.
Properties	Change properties of graphic window.

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List	On the right site of graphic window all measurement points are listed.
absolute/relative	The time axis is shown with absolute date and time or relative to the start time.

5.3   Stop

You finish data logging with command „Stop".

5.4   New Scale

You change scaling factors with command „New Scale". The graphic is drawn in a new way.

6   Temperature compensation

6.1   General

The LM 2000 measuring system facilitates the automatic temperature compensation of further channels of the measuring system by one temperature measurement. For this purpose, the respective probe and the Pt 1000 temperature sensor must be in the same measuring medium (note the temperature equalisation). If this requirement is met it will be possible to compensate several measured quantities by one single temperature measurement. However, you can also set a fixed compensation temperature for each measuring channel. If a temperature sensor or probe is used for temperature compensation of a different sensor please note that it will also have to be put in the calibration solution in order to facilitate temperature equalisation or compensation during calibration.

6.2   Setting up a temperature measuring channel or a fixed temperature for a measuring point

- Choose the menu „Modules".

- Decide for command „Setup Temperature Channel".

- Now a dialog appears.

With this command you can each released module assign a temperature channel (its own temperature input or a temperature input of another module) for automatic temperature compensation. It is also possible to adjust a fix temperature. For compensation this fixed temperature is used.

Please note that in the virtual instrument regardless of this adjustment always the temperature is displayed which is measured with the module.

7 Calibration

The calibration menu contains the following commands: Temperature, Redox, Dissolved oxygen, pH, Conductivity, Linear, ISE, Turbidity, Chlorine and Protocol. The functions are described on the following sides.

7.1 *Temperature*

Use this command to input an offset for a temperature sensor of a released module. You can compensate an error of the temperature sensor or for long sensor cables.
After using this command you get a list with all measurement modules. Select the module for your adjustment. Now you get the actual measurement values of the selected module. Input in the dialog the correct temperature value and confirm with "OK". The offset will be calculated now and saved in the module.

7.2 *Redox*

If you want to adjust the redox voltage of an electrode you can use this command. Please use therefore a redox buffer solution and specify the offset of the electrode.
If you use this command you get a list with all released redox modules. Select the module for calibration. In a small window you can see the actual values. In the dialog you can input the offset and after pushing the button "calculate" the measurement value with the new offset will displayed. If you want to save this adjustment finish the dialog with "OK".

7.3 *Dissolved oxygen*

Enter the calibration menu and choose „Dissolved oxygen". The Calibration/Dissolved oxygen menu offers the following commands: "Data Input" or "Manual".

7.3.1 Data Input

If you have a sensor with a defined slope value you can input this value direct with this command. Also you can change the values for temperature compensation and salinity. Each sensor model has it's own compensation values. Please contact therefore your dealer.

- Choose the command „Data Input".
- Select the module with the sensor for calibration.
- In a small window you can see the actual values.
- In the dialog you can input the values for slope, temperature compensation and salinity.
- After pushing the button "calculate" the measurement value with the new values will display.
- If you want to save this adjustment finish the dialog with "OK".

7.3.2 Manual

Use this command if you want to calibrate a dissolved oxygen sensor with a comparative value (i.e. of a hand hold meter). For oxygen it is also possible to use the ambient air as calibration solution. Therefore you have to input a value for air saturation of 102%.

- Choose the command „Manual".
- Select the module with the sensor for calibration.
- In a small window you can see the actual values.

- In the dialog you can input the reference value of the solution and after pushing the button "calculate" the measurement value with the new slope will display. Also you can change the values for temperature compensation and salinity.
- If you want to save this adjustment finish the dialog with "OK".
- Please pay attention that a stable temperature is very important for a correct calibration.

7.4 pH

Enter the calibration menu and choose „pH". The Calibration/pH menu offers the following commands: "Data Input", "Automatic" or "Two Point".

7.4.1 Data Input

If you have a sensor with a defined slope and asymmetry value you can input this values direct with this command.

- Choose the command „Data Input".
- Select the module with the sensor for calibration.
- In a small window you can see the actual values.
- In the dialog you can input the values for slope and asymmetry.
- After pushing the button "calculate" the measurement value with the new values will display.
- If you want to save this adjustment finish the dialog with "OK".

7.4.2 Automatic

Use this command if you want to calibrate a pH sensor with defined buffer solutions. The buffer solutions are automatic recognized and the correct buffer value for the measured or fix adjusted temperature is used. It is recommended that the used buffer solutions include the expected measurement values.

- Choose the command „Automatic".
- Select the module with the sensor for calibration.
- The following dialog „Select buffer" lists all saved buffer solutions. Select the correct set of buffer solutions and follow the instruction.


```
Select buffer                              [X]

[                                    ▼]    [  OK  ]

Ingold (2,00/4,01/7,00/9,21)               [ Cancel ]
Labor. (2,00/4,00/7,00/9,00/12,00)
NBS  (1,679/4,006/6,865/9,180/12,454)
Tech. (1,09/3,06/4,65/6,79/9,23)
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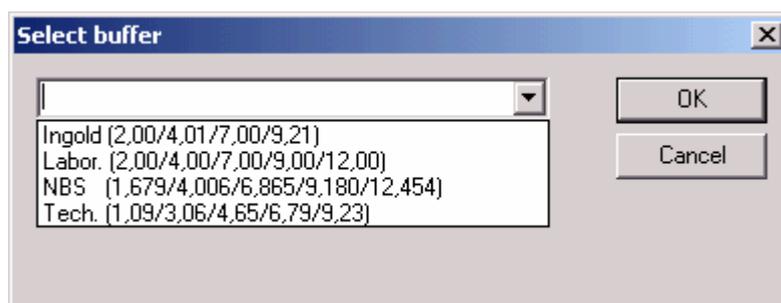
- Now in a small window you can see the actual values. Wait until values are stable and press button OK. You get information about the recognized buffer. The same procedure is to repeat for the second buffer.
- After correct calibration you can decide to save the new values.
- Please pay attention that a stable temperature is very important for a correct calibration.

7.4.3 Two Point

Use this command if you want to calibrate a pH sensor with defined buffer solutions or with comparative values. It is recommended that the used buffer solutions include the expected measurement value.

- Choose the command „Two Point".

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- Select the module with the sensor for calibration. Please follow the instruction.
- Put sensor in first calibration solution.
- In a small window you can see the actual values.
- In a dialog you can input the temperature correct value of the buffer solution. Wait until values are stable and press button OK. The same procedure is to repeat for the second buffer.
- If the calibration is correct finished you get the new calibration values.
- Now you can decide to save the new values or not.
- Please pay attention that a stable temperature is very important for a correct calibration.

7.5 Conductivity

Enter the calibration menu and choose „Conductivity". The Calibration/conductivity menu offers the following commands: "Data Input", "Automatic" or "Manual".

7.5.1 Data Input

If you have a sensor with a defined cell constant value then you can input this value direct with this command. Also you can adjust the temperature coefficient.

- Choose the command „Data Input".
- Select the module with the sensor for calibration.
- In a small window you can see the actual values.
- In the dialog you can input the values for cell constant and temperature coefficient.
- After pushing the button "calculate" the measurement value with the new calibration values will display.
- If you want to save this adjustment finish the dialog with "OK".

7.5.2 Automatic

Use this command if you want to calibrate a conductivity sensor with defined buffer solutions. The buffer solutions are automatic recognized and the correct buffer value for the measured or fix adjusted temperature is used. Two solutions are integrated 0,1N KCL and 0,01N KCL

- Choose the command „Automatic".
- Select the module with the sensor for calibration.
- In a small window you can see the actual values. Wait until values are stable and press button OK.
- The value is set to the temperature compensated value (reference temperature 25°C) of the recognized buffer solution.
- If the calibration was successful you will get information about the new calibration values (cell constant).
- After correct calibration you can decide to save the new values.
- Please pay attention that a stable temperature is very important for a correct calibration.

7.5.3 Manual

Use this command if you want to calibrate a conductivity sensor with defined buffer solutions or with comparative values. It is recommended that the measurement value is near the calibration value.

- Choose the command „Manual".
- Select the module with the sensor for calibration.
- Put sensor in buffer solution or comparative solution which you have determined before calibration.
- In a small window you can see the actual values.

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- In a dialog you can input the temperature correct value of the buffer solution. Pay attention that the temperature coefficient is correct adjusted. Wait until values are stable and press button OK. (If you press button "Calculate" you can see how the value change with your input.)
- If the calibration was successful you will get information about the new calibration value (cell constant).
- After correct calibration you can decide to save the new values.
- Please pay attention that a stable temperature is very important for a correct calibration.

7.6 Linear

Enter the calibration menu and choose „Linear". The Calibration/Linear menu offers the following commands: "Two Point" or "Assign Values".

7.6.1 Two Point

If you want to calibrate a module with linear characteristic curve with two comparative values you can use this command.

- Choose the command "Two Point".
- Select the module with the sensor for calibration.
- Put sensor into first calibration solution or connect the input to the signal.
- In a small window you can see the actual values.
- In a dialog window you can input the value for the first point. Press button "OK" if the value is stable.
- The same procedure you should do for the second point. It is also possible to input a specific unit for the measured value.
- If the calibration was successful you get information about the slope of the linear curve.
- If you want to save this adjustment finish the dialog with "OK".

7.6.2 Assign Values

If you want to calibrate a module with linear characteristic curve by input of defined values you can use this command.

- Choose the command "Assign Values".
- Select the module with the sensor for calibration.
- Input in the following dialog the values for 1 V DC or 4 mA (calibration value 1) and the value for 5 V DC or 20 mA (calibration value 2). That means if you want to measure i.e. a flow rate of 100 l/h and the sensor has a specification of 0 to 20mA correspondingly 0 to 100 l/h you have to input for value 1: 20; value 2: 100.
- If the calibration was successful you get information about the slope of the linear curve.
- If you want to save this adjustment finish the dialog with "OK".

7.7 ISE

Enter the calibration menu and choose „ISE". The Calibration/ISE menu offers the following commands: "Two Point", "Assign Values" or "Standard addition".

7.7.1 Two Point

If you want to calibrate an ISE module with logarithmic characteristic curve with two comparative values you can use this command.

- Choose the command "Two Point".
- Select the module with the sensor for calibration.

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- Put sensor into first calibration solution or connect the input to the signal.
- In a small window you can see the actual values.
- In a dialog window you can input the value for the first point. Press button "OK" if the value is stable.
- The same procedure you should do for the second point. It is also possible to input a specific unit for the measured value.
- If the calibration was successful you get information about the calibration values of the ISE module.
- If you want to save this adjustment finish the dialog with "OK".

7.7.2   Assign Values

If you want to assign calibration values to an ISE module with logarithmic characteristic curve you can use this command.

- Choose the command "Assign Values".
- Select the module with the sensor for calibration.
- Now you can insert the different calibration values. Calibration value 1 stands for the slope (e. g. 59 mV for univalent ions), calibration value 2 stands for the electrode voltage and calibration value 3 stands for the measurement value (e. g. concentration in ppm).
- If the calibration was successful you get information about the calibration values of the ISE module.
- If you want to save this adjustment finish the dialog with "OK".

7.7.3   Standard addition

If you want to assign calibration values to an ISE module with logarithmic characteristic curve you can use this command.
To use this kind of calibration you need at first the determination of the slope for the electrode. With adding the standard the electrode is perfectly calibrated for the sample solution. Pay attention that the standard will not influence the content of the sample solution so much. Therefore use a small volume of standard solution.

- Choose the command "Standard addition".
- Select the module with the sensor for calibration.
- Input all the values into the dialog field.

- Follow all the instructions.
- If the calibration was successful you get information about the calibration values of the ISE module.
- If you want to save this adjustment finish the dialog with "OK".

7.8   *Turbidity*

With this command you can input the values for the turbidity probe. No further calibration is necessary.

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If you select this command you get at first a list with all released turbidity modules. Select the module for calibration and input in the following dialog the correct values which you have got with the probe. Save the new values by using the button „OK".

7.9 *Chlorine*

If you want to calibrate a chlorine sensor please use this command. After execute this command you get a list with all released chlorine sensors. Select the module with the sensor for calibration. The calibration is a single point calibration. Therefore you need a reference meter (i.e. photometer) to determine the content of your solution.
In a small window you can see the actual values. In the dialog you can input the determined value of the solution and after pushing the button "calculate" the measurement value with the new slope will displayed.
If you want to save this adjustment finish the dialog with "OK". Please pay attention that a stable temperature is very important for a correct calibration.

7.10 *Protocol*

This command is useful if you want to know the actual values of the sensor. After execute this command you get a list with all released modules. Select the module for calibration information. Now you get the actual values.

8 Maintenance, disposal

The PC laboratory-multi-parameter-system (LM 2000) is almost maintenance-free. Occasionally wipe the outside of the LM 2000 with a damp, lint-free cloth. Never clean the device with an aggressive detergent which contains solvents (e. g. acetone). Otherwise you will destroy the ABS-case.

8.1 *Maintenance of the sensors*

For maintenance and storing pay attention to the corresponding operating instructions of the sensors.

8.2 *Disposal*

Electrical waste and electronic equipment (WEEE) which was manufactured in Sensortechnik Meinsberg GmbH must not be disposed at the communal collection points.

Instead we offer our customers to take back no longer used instruments produced after 13.08.06 and dispose them free of charge. Instruments for disposal must be sent in with prepaid postage and marked with "zur Entsorgung".

9 Technical Data

Measured parameters	pH-value, redox potential (ORP), conductivity, dissolved oxygen concentration, ion concentration, temperature and more
Temperature compensation	automatical with Pt 1000
Power supply	12 ... 24 V AC/DC plug-in mains unit
Ambient temperature	-10 ... 50 °C
PC-Interface	interface converter CAN/RS-232 for PC-connection
Sensor connection	2x4 mm banana-/BNC-plug per measuring point

Cable connection

pH combination electrodes with integrated Pt 1000	cable Koax 9
redox combination electrodes (without temperature probe)	cable Koax 5
ISE combination electrodes (without temperature probe)	cable Koax 5
conductive 2-electrode cells with integrated Pt 1000	cable Koax 11
dissolved oxygen sensors with integrated Pt 1000	cable Koax 10

Enclosure	ABS-case; IP 41 degree of protection
Weight	0.8 kg
Dimensions	130x100x190 mm (WxHxD)

Measuring modules

MV 2210 L: pH value   pH 0 ... 14, -10 …130 °C
pH combination electrodes with integrated or separated Pt 1000

MV 2215 L: redox potential   -2000 ...+2000 mV, -10 …130 °C
redox combination electrodes; separated Pt 1000

MV 2216 L: ion concentration dependent on ion selective electrode (ISE)
ISE combination electrodes; separated Pt 1000

MV 2220 L: conductivity   0 ... 100 mS/cm auto range; 0 … 80 °C
conductive 2-elektrode cells with integrated Pt 1000

MV 2230 L: dissolved oxygen concentration/saturation
                               0 … 20 (80) mg/l, 0 … 120 %; 0 … 50 °C
amperometric sensors with integrated Pt 1000

MV 2260 L: linear characteristic   adjustable, -10 … 130 °C
sensor/electrode with output 0(4)…20 mA oder 0 … 5(10) V

10 Recommended sensors

The modules for pH and redox potential (ORP) measurement are able to work with nearly all pH/redox electrodes. In connection with the conductivity module conductive 2-electrodes with cell constant 1 cm^{-1} are used. The oxygen module works with dissolved oxygen sensors like MF 41 and MF 39. For other dissolved oxygen sensors contact your dealer. The temperature measurement is made by the temperature probe Pt 1000.

The following table gives an overview about the in connection with the modules recommended electrodes/sensors in application. Please contact the manufacturer if you need a module for special sensors.

	MV 2210 L	**MV 2215 L**	**MV 2220 L**	**MV 2230 L**	**MV 2260 L**
Measured parameter	pH value	redox potential	conductivity	dissolved oxygen concentration/saturation	linear characteristic
Measuring ranges	pH 0 … 14 -10 … 130 ℃	-2000 … 2000 mV -10 … 130 ℃	0 … 100 mS/cm auto range 0 … 80 ℃	0 … 20 (80) mg/l 0 … 120 % 0 … 50 ℃	adjustable -10 … 130 ℃
Sensor/electrode	pH combination electrodes with integrated Pt 1000 EGA 141/Pt 1000 SMEK EGA 142/Pt 1000 SMEK with cable Koax 9	redox combination electrodes EMC 30 I EMC 133 I with cable Koax 5	conductivity cells LTG 1/23 SMEK LTC 1/23 SMEK with cable Koax 11	dissolved oxygen sensors MF 41 SMEK MF 39 SMEK With cable Koax 10	with output 0(4) …20 mA or 0 … 5 (10) V DC
Temperature range	5 … 80 ℃	-5 … 80 ℃	-5 … 100 ℃	-5 … 50 ℃	-10 … 130 ℃
Temperature probe	Pt 1000 separated or integrated in electrode/sensor	Pt 1000 separated	Pt 1000 integrated in measuring cell	Pt 1000 integrated in electrode/sensor	Pt 1000 separated or integrated in electrode/sensor
Sensor connection	BNC and 2x4 mm jack	BNC and 2x4 mm jack	BNC and 2x4 mm jack	BNC and 2x4 mm jack	BNC and 2x4 mm jack