



ProLab 5000

THE COMPLETE SYSTEM FOR THE TASKS OF MEASUREMENT, CONTROL AND REGULATION FOR pH, CONDUCTIVITY AND DISSOLVED OXYGEN IN LABORATORY AND TECHNICAL CENTER

SI Analytics

a xylem brand



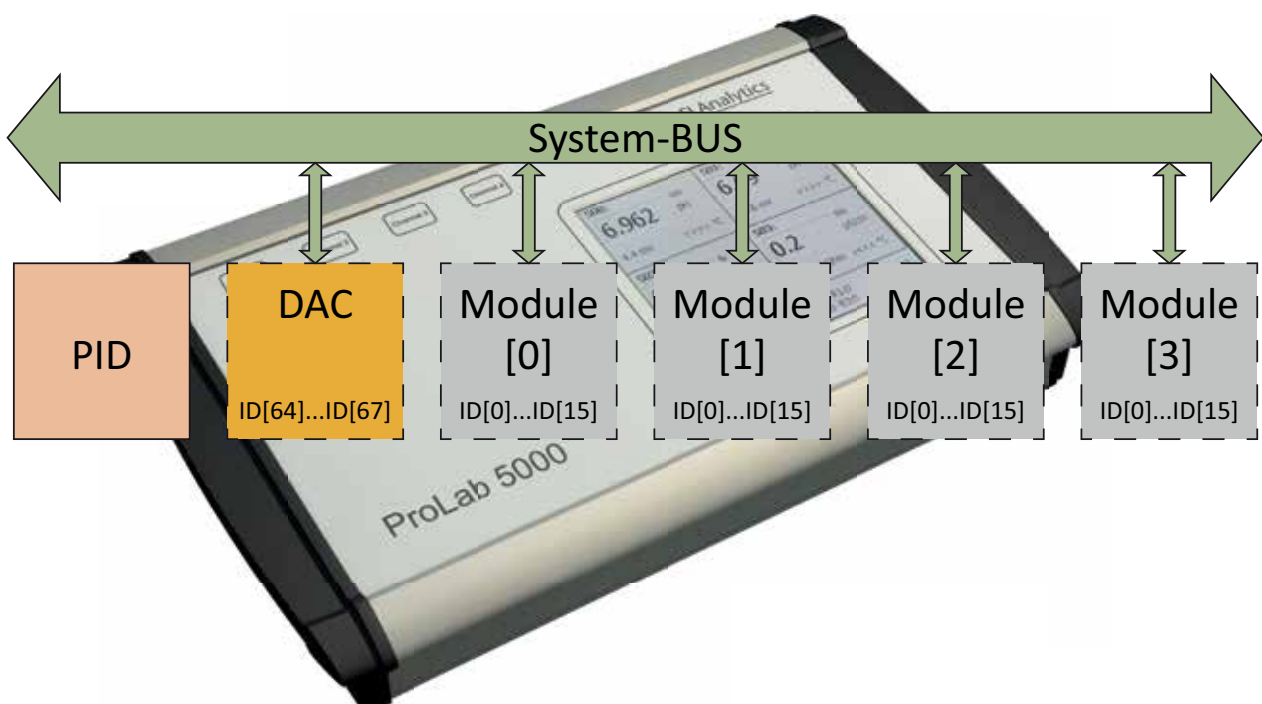
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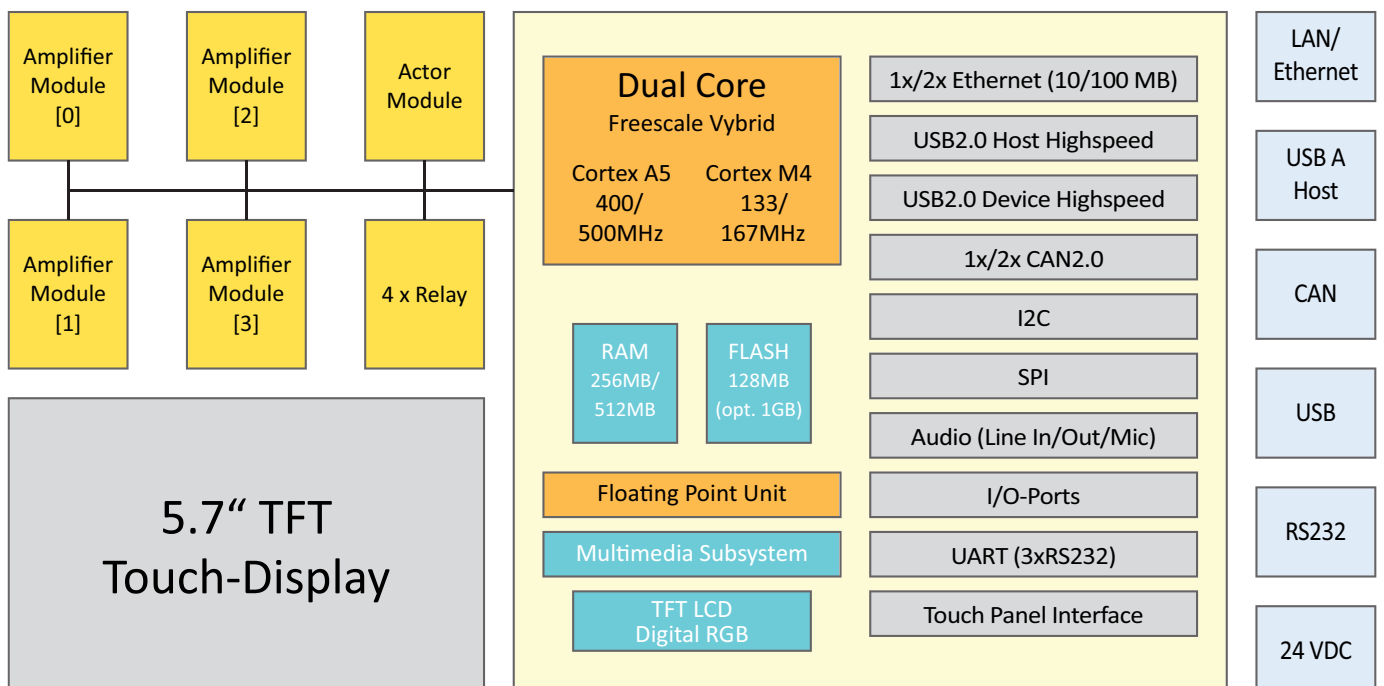
ProLab 5000

The complete system for the tasks of measurement, control and regulation

- ▶ Measurement of pH/ISE/mV, conductivity, and dissolved oxygen
- ▶ Up to 4 measurement modules (inputs) in a variety of configurations
- ▶ 5.7" RGB TFT display with touch control
- ▶ PC software with extensive operating functions
- ▶ Coupling of autosampler and burettes for dosing and automated measurements.
- ▶ Special electrodes test for pH
- ▶ Current outputs for each parameter
- ▶ Additional modules for current output possible
- ▶ Timer function
- ▶ Alarm/threshold function
- ▶ 2 PID regulators
- ▶ Virtual channels to calculate different parameters from the measured value
- ▶ Data storage and data recording
- ▶ Data transfer with RS232/USB or Ethernet
- ▶ Logbook, i.e., documentation of setting changes, for example
- ▶ Access control by password



for pH, conductivity and dissolved oxygen in laboratory and technical center



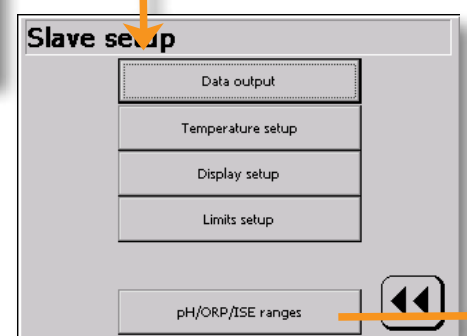
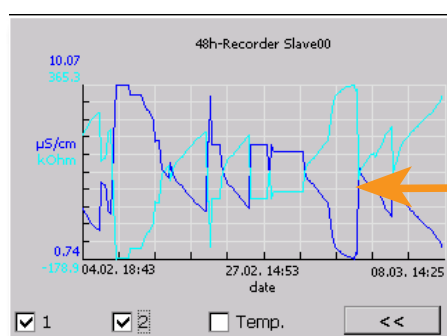
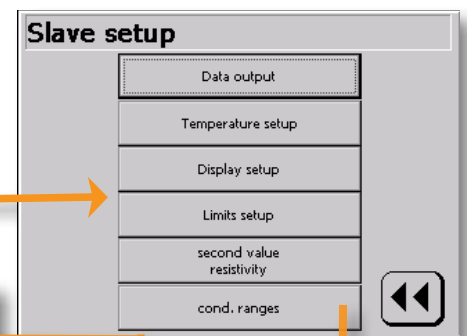
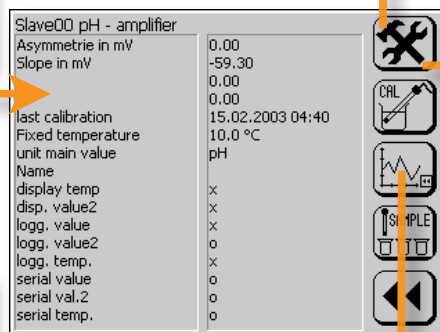
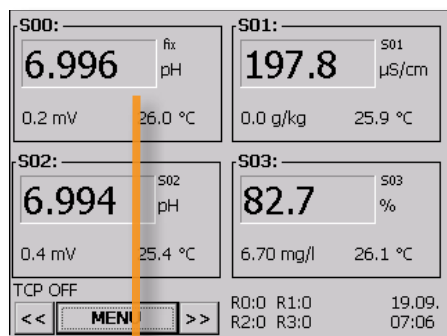
Components of the ProLab 5000

The multiparameter laboratory measuring instrument ProLab 5000 is the complete solution for the tasks of measurement, control and regulation in the laboratory and technical center. Up to 4 measurement modules can determine any combination of pH, conductivity, dissolved oxygen, redox potential, temperature and other parameters. This is based on a modular system structure that links the measurement modules to the central unit and to each other via a bus connection.

The main components of the multiparameter laboratory measurement system ProLab 5000 are:

- ▶ Multiparameter laboratory device ProLab 5000 with power supply, touch screen display, internal modules, data logger and logbook, various digital interfaces such as RS232, USB and Ethernet
- ▶ PC visualization program
- ▶ Measurement modules
- ▶ Sensors
- ▶ Optional samplers, depending on type, up to 72 samples, for example, TW Alpha plus
- ▶ Optional dosing system TITRONIC® 500
- ▶ Optional stirrer

Setting options



Multiparameter laboratory measuring instrument ProLab 5000

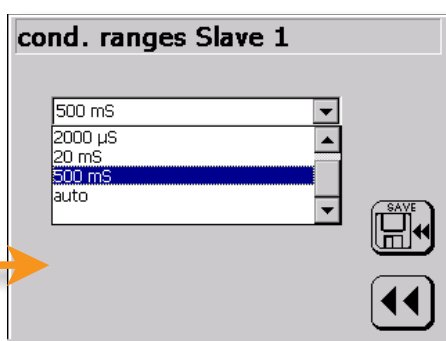
The distinguishing outward feature is the color touchscreen graphic display, which significantly simplifies operation, configuration and calibration of the measurement system. Operation is supported by self-explanatory icons. Only the functions, controls and status information that are relevant to the task at hand are displayed. Up to four measured values with their units, their temperature values, a possible second value as well as an individual name can be presented simultaneously on a display page.

Four integrated threshold relays for simple control, regulation or alarm tasks are standard. The assignment of the contacts to the measured values and to the switching values as well as hysteresis can be adjusted by the user. Two PID-regulators that work independently of each other are available for complex regulation tasks. The regulators can be assigned to any parameter and function as analog, pulse width or pulse frequency regulators using the analog current outputs and the relay outputs of the measuring instrument.

All values can be cyclically output and displayed graphically via the USB interface or Ethernet connected to the PC visualization program ProLab 5000 Pilot. The visualization program ProLab 5000 Pilot simultaneously contains all functions for reading the data logger. The data logger can be used via the USB interface and the data can be transferred directly to a USB stick even without the program ProLab 5000 Pilot. The data logger can be configured as ring storage or finite storage with adjustable sampling time and operates independently of the data output.

The data recorder graphically displays the measured value curve of the parameters of each measurement module over the past 48 hours on the touch screen. This representation gives the operator a quick overview of the measurement progress, indicating the average, maximum and minimum.

Updating the device software through an update represents a great advantage. This can be stored on a USB stick and then transferred via an update function in the device. Thus, the user is able to quickly perform software upgrades himself.



Components of the ProLab 5000

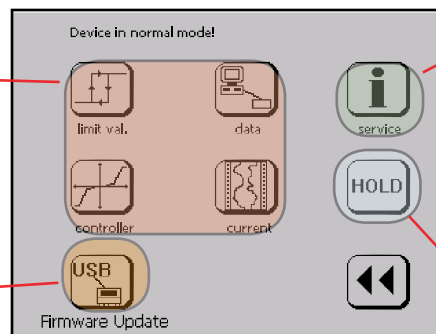
Setup of the ProLab 5000



Possibilities to adjust:

- Limit and alarm outputs by relay
- Timer output by relay
- PID controller
- 0/4-20mA output
- Data logger
- Serial output
- TCP/IP communication

Program a new software

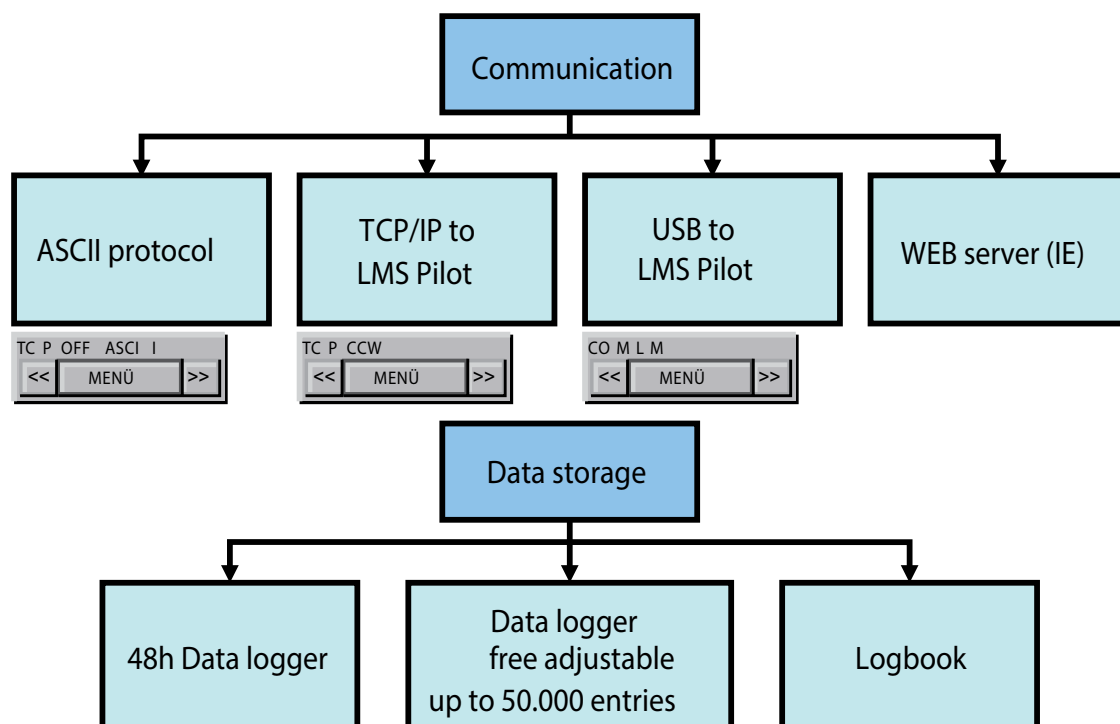


Possibilities to adjust:

- Counts of slaves
- User pH buffer
- Display position for slaves
- Language
- Read logbook
- Store/Read device setup

HOLD to freeze all actor outputs

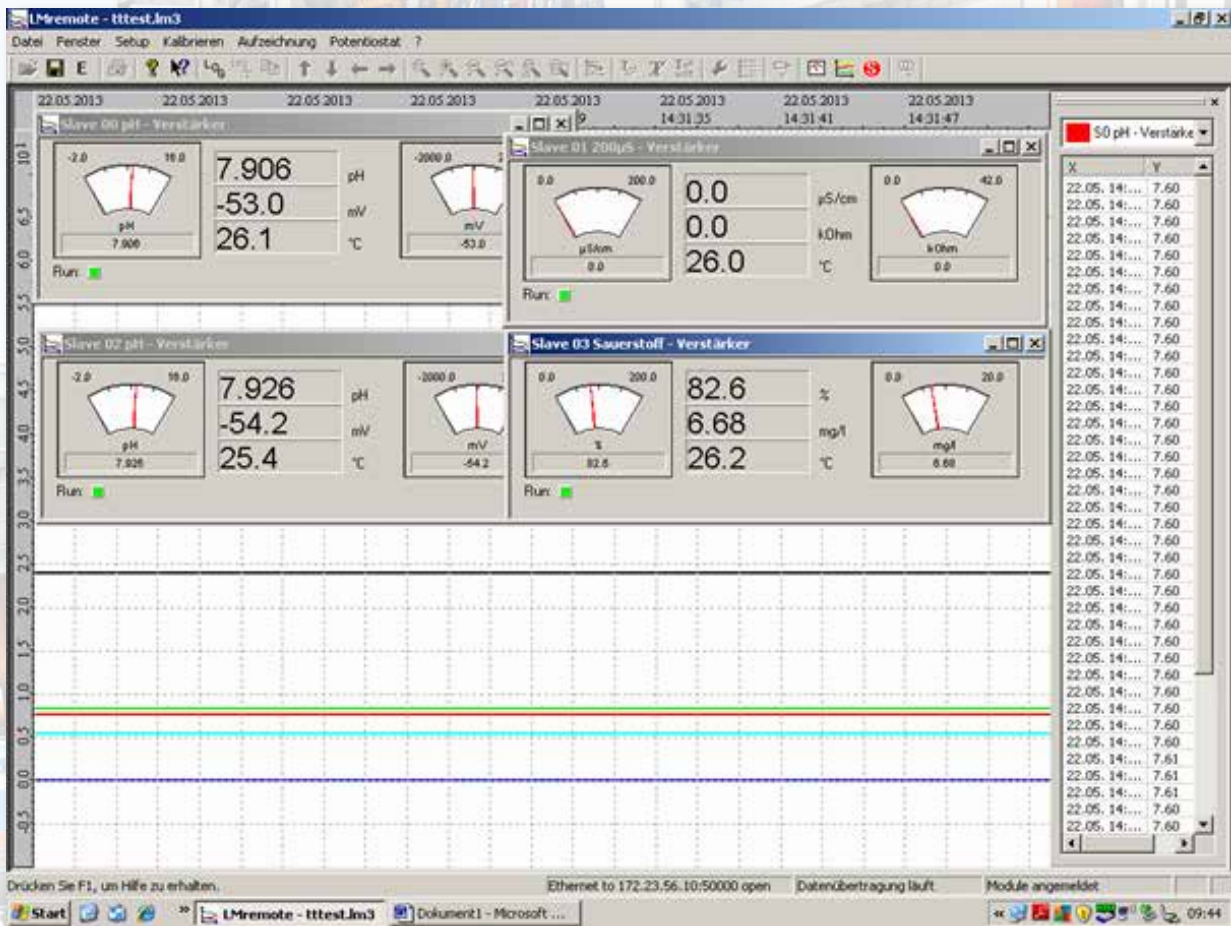
Data and communication management of the ProLab 5000



PC visualization program ProLab 5000 Pilot

ProLab 5000 Pilot allows for convenient presentation, configuration, and storage of measured values on an external PC. The configuration can be made, edited and printed via USB or Ethernet. It is also possible to create, edit and save configurations to the ProLab 5000 independently of a data connection. These configurations can then be transferred to the device via USB stick. In addition, the data logger and logbook can be read and configured.

ProLab 5000 Pilot



Components of the ProLab 5000

Measurement modules

Each measurement module is adapted to detect a main parameter and the temperature. In addition to any main parameter, one or more so-called secondary parameters are calculated or directly measured. These secondary parameters can also be selected and displayed.

Temperature

Each measurement module comes as standard with a separate input for connection to a temperature sensor. This temperature measurement can be used for automatic temperature compensation of the measured parameter or of other measured parameters. The input of an additive linear zero offset is possible when calibrating. The display of the temperature value can be individually set. In principle, the temperature is measured in the range -10 to 130 °C.

pH value and redox potential

The voltage difference between the measuring and reference electrode is displayed directly in the redox potential measurement. The conversion of the redox potential to the potential of the standard hydrogen electrode is provided as a secondary parameter according to DIN 38404 part 6. For this purpose, a temperature input or the use of temperature measurement is required. The input of an additive linear zero offset is possible when calibrating. The width of the input voltage range is ± 2000 mV. The ProLab 5000 supports two-point, three-point or automatic calibration with specifications, or freely selectable and self-configurable pH buffer solutions.

Conductivity

Conductometric four-pole measuring cells are available to measure conductivity. The measurement ranges are 0 to 200 $\mu\text{S}/\text{cm}$, 0 to 2 mS/cm , 0 to 20 mS/cm and 0 to 500 mS/cm . Automatic measurement range switching is also adjustable.

Automatic temperature compensation takes place via the temperature measurement, e.g., with the temperature sensor integrated into the measuring cell. The ProLab 5000 measurement system supports non-linear (nlf) automatic temperature

compensation, linear automatic temperature compensation with adjustable temperature coefficients, both based on the reference temperature of 25 °C, and measurement without temperature compensation. Resistance, salinity and TDS are offered as secondary parameters.

Oxygen content

The oxygen measurement is designed for membrane-covered amperometric sensors with integrated temperature sensor. The measurement signal is the diffusion threshold current of the sensor when applying appropriate polarization. Oxygen partial pressure, percent air saturation (oxygen saturation index according to DIN 38404 part 23) as well as the oxygen content as mass concentration (mg/L) of dissolved oxygen in aqueous media are calculated from the diffusion current. The measurement system ProLab 5000 supports single-point calibration by comparison with known measurements or automatic air calibration.

Examples of measured value displays

Measurement module	Main parameter	Examples of secondary parameters
PL5000pH/ORP/ISE	- pH value - Redox voltage in mV - Ion concentration in concentration units acc. sensor specification (ISE) and calibration	- Chain voltage in mV - Redox voltage in mV relative to the standard hydrogen electrode - Chain voltage of the ISE in mV
PL5000LF	Conductivity in mS/cm, μ S/cm	Resistance value in ohms or salinity in g/kg or TDS in mg/l
PL5000OX	Oxygen saturation in %	Oxygen concentration in mg/l

The image displays four overlapping screenshots of the measurement software interface:

- pH/ORP/ISE ranges Slave 0:** A screen with a dropdown menu showing 'pH', 'ORP', and 'ISE'. Below the menu are 'SAVE' and navigation buttons.
- pH Test information:** A screen displaying test data for 'pH Test LM3000 500000000 19.09.2013 15:26'. It shows 'buffer pH 9.180 @ 26.1°C' and a table of measurements:

time/min	U/mV	drift/mV/min
1 (stirred)	-119.9	0.1
2 (stirred)	-120.9	0.1
3 (stirred)	-119.9	0.0
4	-119.9	0.0

 It also shows 'Response time t(1mV) 0 sec' and 'dU (unstirred - stirred) 0.0 mV'. A 'Copy -> USB' button is at the bottom.
- Slave00 pH - amplifier:** A screen showing amplifier parameters:

Asymmetrie in mV	0.00
Slope in mV	-59.30
	0.00
	0.00
last calibration	15.02.2003 04:40
Fixed temperature	10.0 °C
unit main value	pH
Name	
display temp	x
disp. value2	x
logg. value	x
logg. value2	o
logg. temp.	x
serial value	o
serial val.2	o
serial temp.	o
- pH Test setup:** A screen for configuring the test. It has radio buttons for 'Standard', 'Gel', 'not aqueous', and 'User' (which is selected). To the right are input fields for:

dU[mV]	3.0
drift[mV]	3.0
response time[s]	50.0
slope high[%]	105.0
slope low[%]	90.0
asym high[mV]	20.0
asym low[mV]	-20.0

 A 'START' button and a navigation button are also present.

Components of the ProLab 5000

Sample changer and dosing feeder

The sample changer TW Alpha Plus can be connected to the ProLab 5000 (via 4-pin connector on the rear side of the device). Dosing feeders such as the burette TITRONIC® 500 can be controlled by the connection to this changer.

ProLab 5000 in operation with a sample changer

Slave00 pH - amplifier

Asymmetric in mV	0,00
Slope in mV	-59,30
	0,00
	0,00
last calibration	15.02.2003 04:40
Fixed temperature	10,0 °C
unit main value	pH
Name	
display temp	x
disp. value2	x
logg. value	x
logg. value2	o
logg. temp.	x
serial value	o
serial val.2	o
serial temp.	o

Icons: Settings, Calibration, Graph, Sample, Back

Sampler TW280

Time step controlling

Back

Time step controlling Slave 0

- with stirrer
- Cleaning
- position 1
- pump in position
- pump in position 1
- second value
- with dosing

Speed = 5
Cleaning time = 5 sec
Start position = 2
End position = 4
min. measure time = 10 sec
slave = 1
end move down for = 20 %
TITRONIC 500 = 02
doser volumen = 0,010ml

Buttons: START, SAVE, Back

Time step controlling

3.931	172.8	10.0
pH	mV	°C
197.6	0.0	25.9
µS/cm	g/kg	°C

Measuring sample number 2

Progress bar, Cancel

Time step controlling

3.931	172.8	10.0
pH	mV	°C
197.6	0.0	25.9
µS/cm	g/kg	°C

Cleaning after sample 2

Progress bar

Time step controlling

Time step controlling LM3000 50000000 19.09.2013 12:15 Interv

dosing: 0.010 ml

Num	Temp °C	Last pH	Average pH	Min pH	Max pH
2	10.0	3.931	3.931	3.931	3.931
3	10.0	3.931	3.931	3.931	3.931
4	10.0	3.931	3.931	3.931	3.931

Copy -> USB, Back



The following settings can be made.

With agitator:	Select whether the internal sampler magnetic stirrer is used
Cleaning:	Select whether sensors will be rinsed between measurements
2nd measured value:	Select whether the second sensor will be active
With dosing:	Select whether piston burette is used
Speed:	Setting the speed for internal magnetic stirrer
Cleaning time:	Residence time of the sensors in cleaning solution
Start position:	Position of the 1st measurement
End position:	Position of the last measurement
Min. measuring time:	Residence time of the sensors in the measuring medium
Slave:	Selection of the sensor for 2nd Measured value
Lowering head:	Immersion depth of the sensors
Dosing volume:	Desired dosing quantity
Start	Saves the settings for the sampler and starts the measurement process

mb 5000

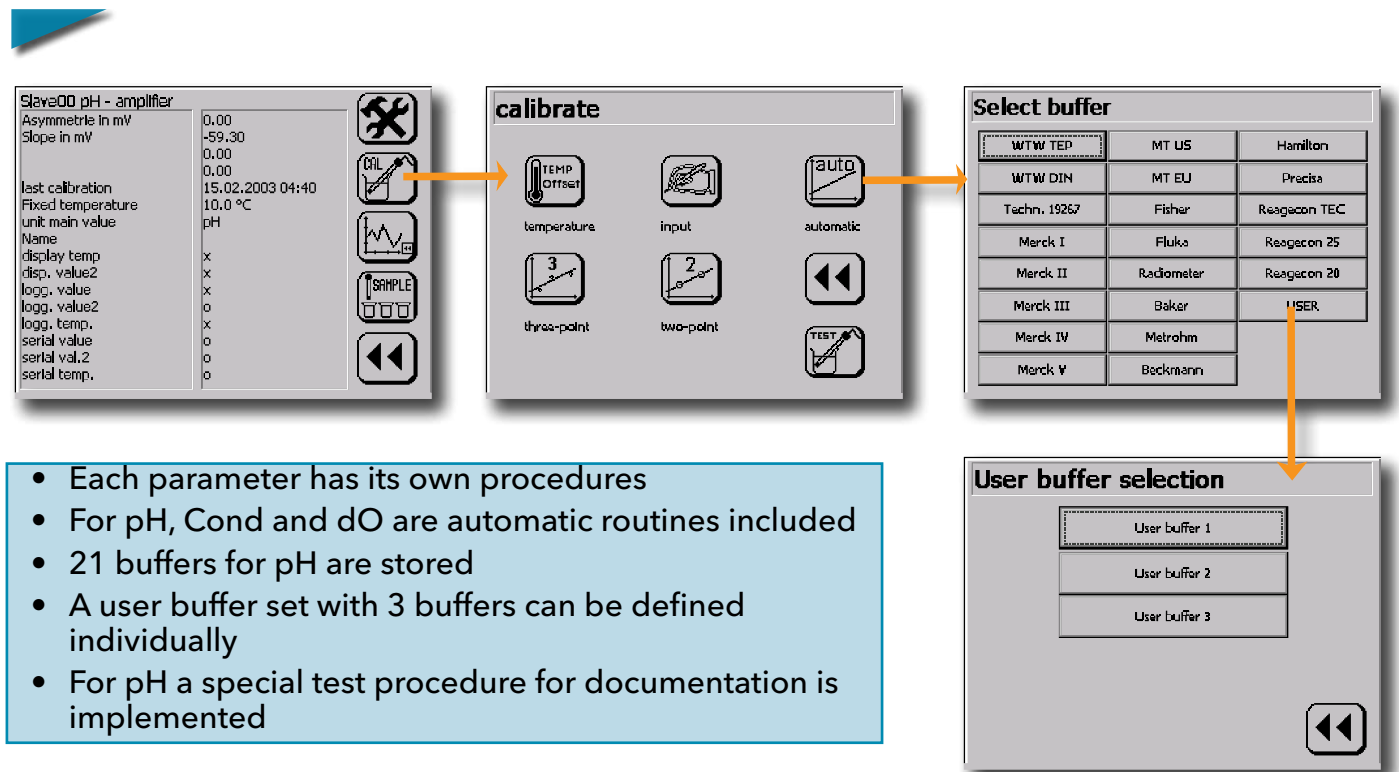
TW Alpha with burette TITRONIC® 500



Calibration

All possible calibration procedures for the respective measurement place type are displayed. Search for your desired calibration procedure by pressing on the corresponding icon.

Possible calibration procedures



- Each parameter has its own procedures
- For pH, Cond and dO are automatic routines included
- 21 buffers for pH are stored
- A user buffer set with 3 buffers can be defined individually
- For pH a special test procedure for documentation is implemented

Choice of buffer sets

The 'Select buffer' screen displays a table of buffer options. The first row, 'SI Analytics TEC', is highlighted with an orange box and an arrow pointing from the right edge of the page.

SI Analytics TEC	MT US	Hamilton
SI Analytics DIN	MT EU	Precisa
Techn. 19267	Fisher	Reagecon TEC
Merck I	Fluka	Reagecon 25
Merck II	Radiometer	Reagecon 20
Merck III	Baker	USER
Merck IV	Metrohm	
Merck V	Beckmann	



Temperature offset

Setting an offset shift for the temperature value is possible with this menu item. The offset can be positive or negative.



Two-point calibration

The sensor is calibrated at two points that differ from one another by means of two defined calibration solutions or known target values. The order of the calibration solutions or target values does not matter.



Three-point calibration

The sensor is calibrated at three points that differ from one another by means of three defined calibration solutions or known target values. The order of the calibration solutions does not matter.



Automatic calibration

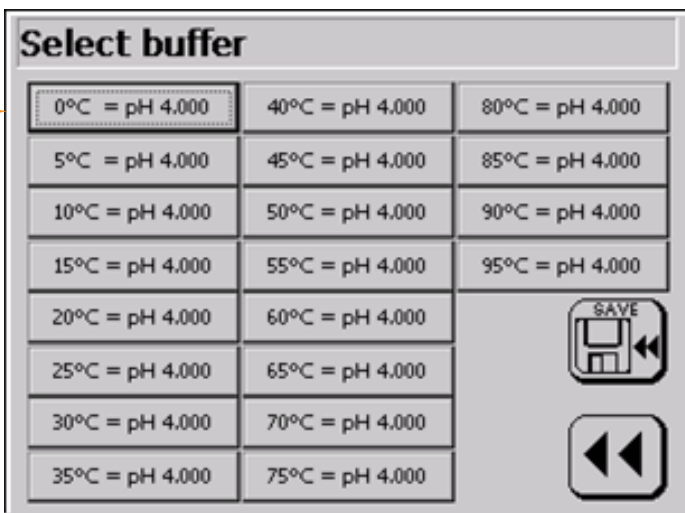
The measuring instrument automatically recognizes the value of the calibration used considering the temperature of the calibration solutions for this calibration. The automatic calibration can be one- or two-point calibration and is limited to the calibration solutions stored in the measuring instrument. This type of calibration is only applied for measurement of the pH, conductivity and dissolved oxygen.

Conductivity

The automatic calibration of the conductivity measurement is a single-point calibration and requires either a 0.01 molar (1.41 mS/cm at 25 °C) or a 0.1 molar (12.9 mS/cm at 25 °C) KCl solution. The temperature range of these two calibration solutions is stored in the device. The device automatically detects which calibration solution is being used (observe measurement range). Other conditions and information are taken from the sensor specification.

pH value

The automatic calibration of the pH measurement is a two-point or three-point calibration and requires knowledge of which buffer solutions you want to use for the calibration. The multiparameter laboratory measuring instrument ProLab 5000 provides for the calibration of the buffer sets listed in the appendix.



Make the selection in the first dialog field. The sequence of buffer solutions does not matter here.

Calibration

Oxygen content

The automatic calibration of oxygen measurement is a single-point calibration of ambient air. The sensor is removed from the measuring medium and exposed to the ambient air.

pH electrode test

A qualification of a pH electrode is determined by compliance with the parameters, slope, response time, drift and flow effect in different buffer solutions. The thresholds are stored in the ProLab 5000; however, your own thresholds can also be defined and stored.



The electrode test is performed with the buffers pH 9, pH 4 and pH 7. The buffers used must be chosen from those stored in the device or self-defined buffer sets. The ProLab5000 recognizes the nearest buffer from the selected buffer set and perform the test with these. A final assessment of the electrode is based on the above-mentioned thresholds. The measured and calculated values are displayed in the device and output as a PDF report. The entire pH electrode test is dialog-driven and can also be performed fully automated in the sample changer. First, the electrode is immersed in buffer pH 9 and its potential measured for 3 minutes while stirring, and then for 1 minute without stirring. The same measurements are repeated with buffers pH 4 and pH 7. The comparison of the measured behavior between stirred and unstirred enables a conclusion about the quality of the electrode. The smaller the difference, the better the electrode. The result of the test is shown on the display and can be saved as a .txt or .pdf file on a USB stick.

	Very good electrode	good electrode	acceptable electrode
Electrode type standard			
Streaming potential dU [mV]	≤ 2.5	≤ 3.0	≤ 4.0
Total Drift [mV]	≤ 2.0	≤ 2.5	≤ 3.0
Slope s [%]	96.5 ≤ s ≤ 101	96 ≤ s ≤ 102	95 ≤ s ≤ 103
Response time [s]	≤ 45	≤ 50	≤ 60
Offset voltage U _{off} [mV]			-15 ≤ U _{off} ≤ 15
Type of electrode gel			
Streaming potential dU [mV]	≤ 3.0	≤ 3.5	≤ 4.5
Total Drift [mV]	≤ 2.5	≤ 3.0	≤ 4.0
Slope s [%]	96.5 ≤ s ≤ 101	96 ≤ s ≤ 102	95 ≤ s ≤ 103
Response time [s]	≤ 60	≤ 75	≤ 90
Offset voltage U _{off} [mV]			-15 ≤ U _{off} ≤ 15
Electrode type non-aqueous			
Streaming potential dU [mV]	≤ 3.0	≤ 4.5	≤ 6.0
Total Drift [mV]	≤ 5.0	≤ 7.0	≤ 9.0
Slope s [%]	88 ≤ s ≤ 120	80 ≤ s ≤ 130	70 ≤ s ≤ 140
Response time [s]	≤ 60	≤ 75	≤ 90
Offset voltage U _{off} [mV]			-10 ≤ U _{off} ≤ 70

Table: Predetermined evaluation criteria for the evaluation of the pH electrode for the test, depending on the type. i.e., whether liquid or gelled electrolyte

Result of the pH tests

Data input

Data input means the entry of the specific characteristics of the connected sensor, e.g., which were previously determined in the laboratory. An input dialog allows for changing the value in the corresponding limits. If these are exceeded, there is an error message that prompts for entering a value within the specified limits.



```
pH Test Gerät 601403002 26.02.2015 10:16
Elektrodentyp: Standard
Puffer: SI Analytics DIN
Slave 0

Puffer pH 9.225 @ 22.2°C
Zeit/min      U/mV      Drift/mV/min
1 (gerührt)   -131.4    0.2
2 (gerührt)   -131.3    0.6
3 (gerührt)   -131.6    1.3
4             -131.5    0.3
Ansprechzeit  t(1mV)    0 sec
dU (ungerührt - gerührt) 0.3 mV

Resultate Puffer 9.225/4.001
Zeit/min      pH(0)     Uoff/mV    Steilheit %
1 (rü)        6.929    -4.1        98.52
2 (rü)        6.931    -4.0        98.52
3 (rü)        6.928    -4.2        98.63
4             6.929    -4.1        98.54
Sensor gut

Auswertung:
dU [mV] sehr gut
Drift [mV] gut
Ansprechzeit [s] sehr gut
Steilheit sehr gut
```

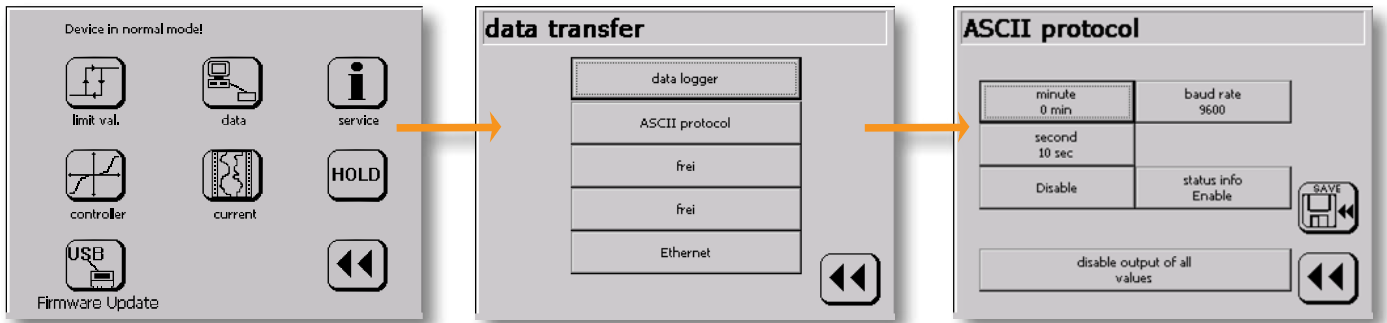


Data communication and data backup

Serial interfaces

The multiparameter laboratory measuring instrument ProLab 5000 has a serial RS-232 interface. A connection to the visualization software ProLab5000 Pilot can be created using the USB special cable Z570. The program ensures the visualization and analysis of the data logger.

Serial data output ASCII



Setup the ASCII protocol for:
 Baud rate: 9600 - 19200-38400
 Time interval: min. 1 second
 Status info: with or without (incl. limit and relay status)

- dd 2 Byte day
- mm 2 Byte month
- yy 2 Byte year
- hh 2 Byte hour
- minmin 2 Byte minute
- EEEE 4 Byte unit to value
- WWWWWWW 6 Byte value
- R 1 Byte status relay
- L 1 Byte status value
- SSSS 4 Byte status device
- R-Status 0: relay contact open
1: relay contact closed
3: Relay is not open for this function
- L-Status 0: value in range
1: value too low
2: value too high
3: slave not available

Description	Start line	Date/time	Value 1	Value 2
Data	0x13 0x10	ddmmyyhhminmin	EEEEWWWWWWWA	EEEEWWWWWWWA
Data length in Byte	2	10	10	10

Start	Status relay	Devider	Status values	Status
STATUS_	RRRRRRRRRRR	_	LLLLLLLLLLLLLLLL	SSSS
7	12	1	16	4

The following settings are made:

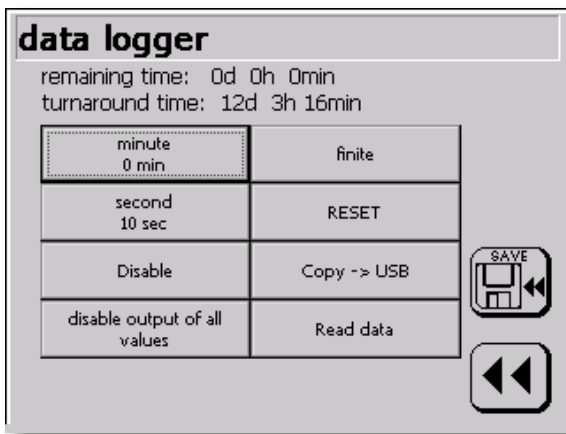
- Minute/second: Setting the transmission interval
- Disable/Enable: Turn ASCII on or off
- Baud rate: Transmission rate
- Status information: When turned on, relay and limit states are transmitted in the protocol
- Output of all values: if disabled, all released data are turned off

Data logger

The data logger stores all measurements released for storage incl. date and time. Approximately 100,000 values can be saved. Retrieving these values can be done in different ways. The easiest option is to transfer the data logger contents to a USB stick, which must be plugged to the USB interface. Another option is to transfer the data to visualization software ProLab5000 Pilot using special USB cable Z570.

Base setting

The sampling time, i.e., the time interval for saving the measured values, is set with the base setting. You specify the time interval for the storage of the measured values. In addition, the type of memory management can still be specified. Ring memory means when the memory is full, the data recording continues at the beginning of the memory. In contrast, the finite data logger ends the data recording upon reaching the end of memory. A RESET button can be used to delete the stored data.

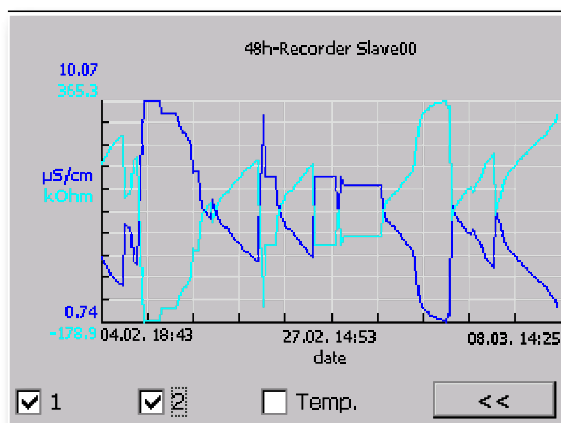


Setting up the data logger

48 hours data recorder

The measured value curve of the main parameter of each channel during the past 48 hours can be graphically displayed on the touchscreen display with the data recorder. The measured values are plotted at an interval of 12 minutes. The axes are always automatically scaled depending on the measured value between minimum and maximum. The corresponding values are plotted on the y-axis. The main parameter is presented in yellow. The measured value 2 is blue and the temperature is plotted in red.

Example image of the data recorder



Control and regulation functions

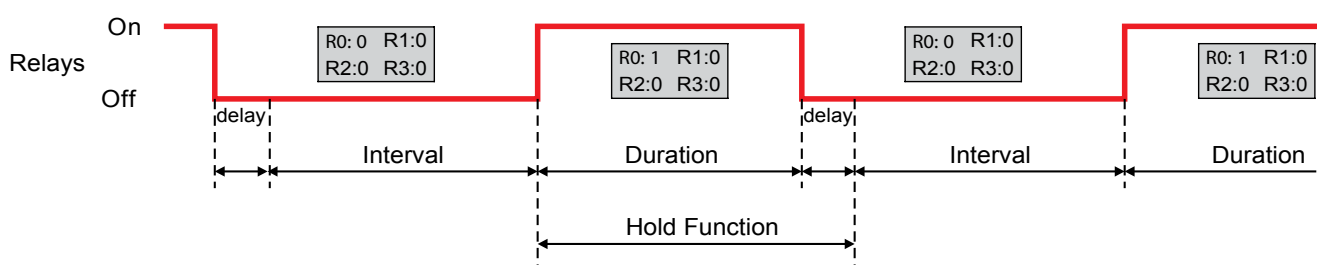
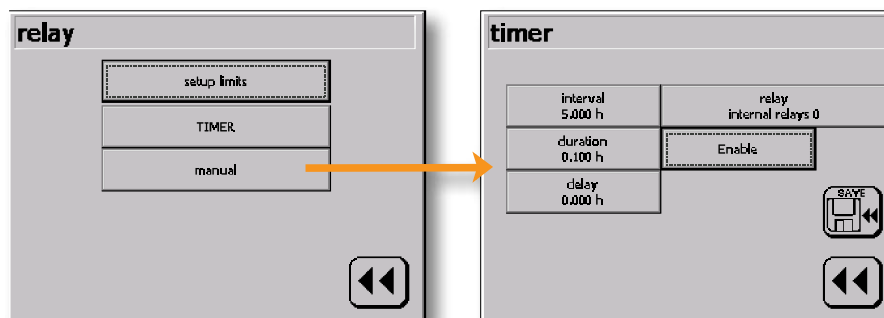
Configuring a relay output

The ProLab 5000 is internally equipped with 4 relays for use as threshold, alarm, timer or regulator output. In order to automatically perform washing and rinsing processes for electrodes in conjunction with corresponding pumps and valves, a timing control can be performed using the integrated timer function. To do this, specify two times for controlling the timer function in the menu: The switch-on time is set as the interval time. The duty cycle indicates how long the relay remains in the "On" state. All measured values for the current outputs and relay functions are frozen (Hold function) for the period in which the relay is turned on.

In addition, a delay time can be adjusted. The delay time has no influence on the switching behavior of the timer relay, but only affects the Hold function for the "freezing" of measured values for current and relay outputs. Setting operations of the sensors/electrodes can thus be considered after the end of the wash or rinse cycle, which should not affect the behavior of the current and relay outputs.

Schematic diagram of the configuration of the timer relay

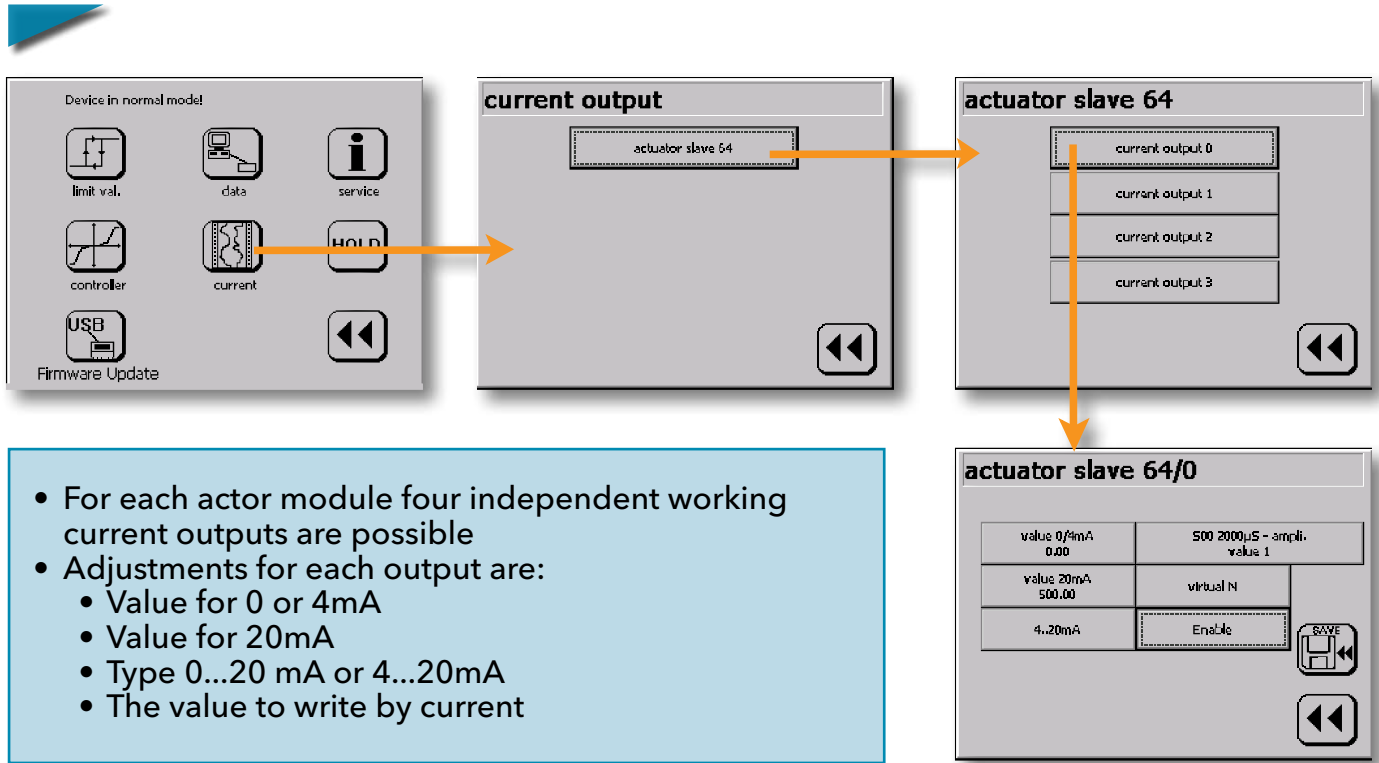
- Can be connected to every realy (internal or external)
- Two adjustable times (interval and duration)
- An additional delay timer to expand the hold function



Configuring a current output

Generally, it is possible to output each measured value to any existing current output. 4 internal current outputs 0(4) ... 20 mA are available on the rear panel of the ProLab 5000.

Overview screen of the settings of a current output



Connections ProLab 5000

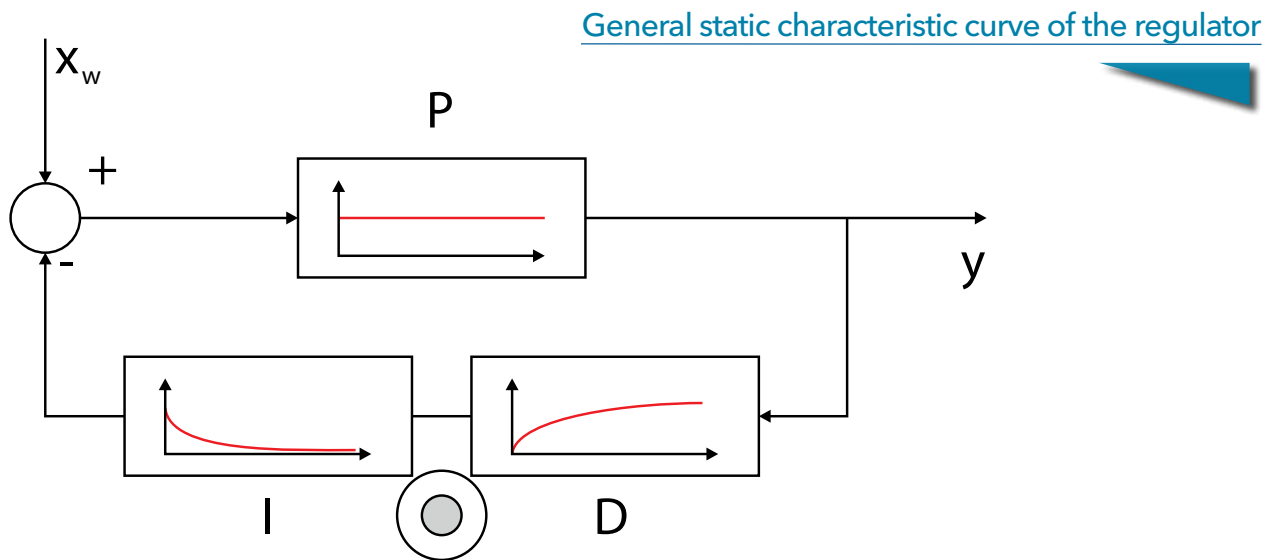


Control and regulation functions

Regulator

For complex regulation tasks, the regulator module is activated with two PID controllers that operate independently from each other. The controllers can be assigned to any parameters and function as analog, pulse width (PWM regulator) or pulse frequency controller using the analog current outputs and the relay outputs of the measuring instrument.

Regul1 is assigned to relays 0 and 1 and Regul2 to relays 2 and 3. Both regulators are used as quasi-continual regulators. For simple regulations, the integrated regulator can be set as a simple P regulator. It is also possible to set a regulator with a differential and/or integral component. If the value 0 is specified as the reset time, the regulator is used without integral component. The same applies to the derivative.

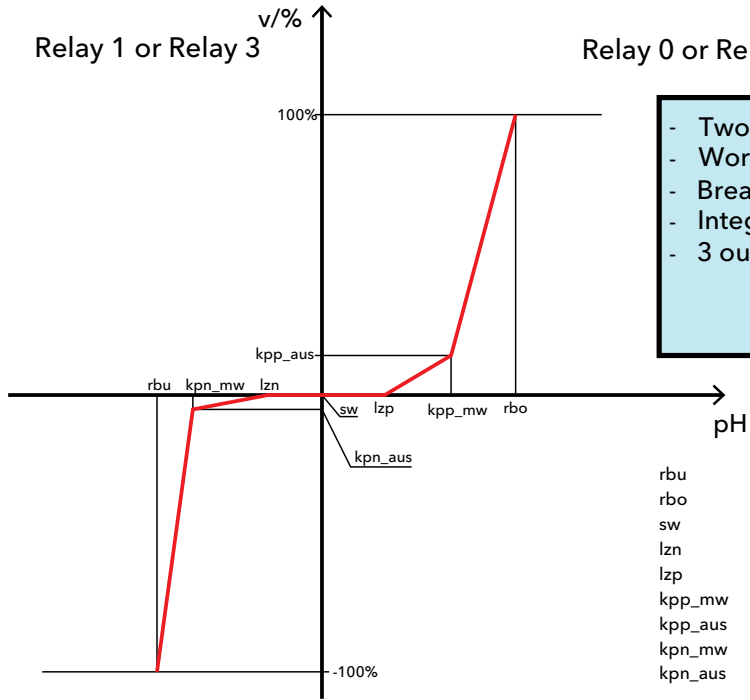


$$y(r) = P + \left[x_i + \frac{T}{T_i} + \sum x_n + \frac{T_d}{T} + (x(r) - x_0(r-i)) \right]$$

$x(r) = \text{xx point} = \text{value (i)}$

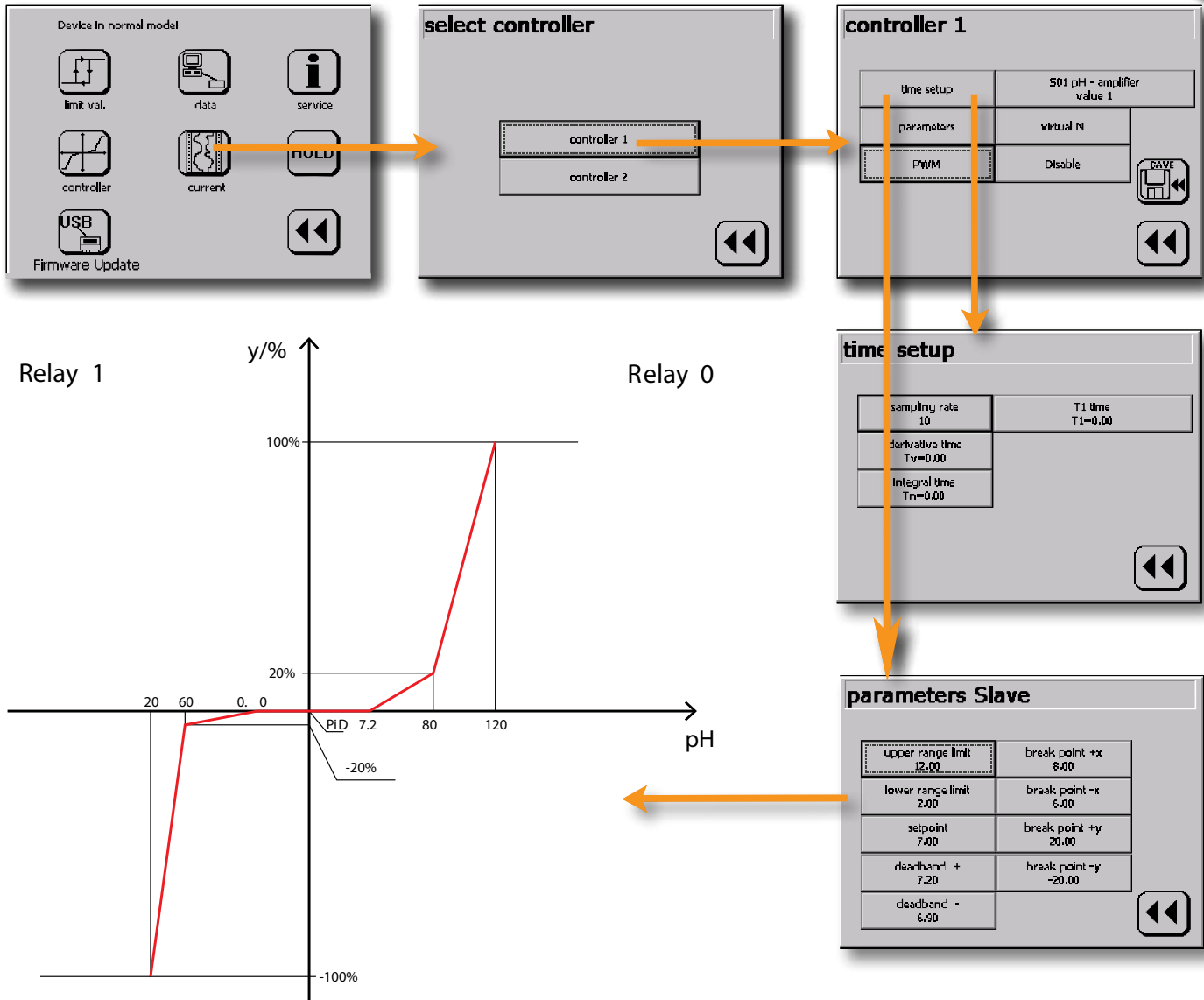
- P** = proportional constant
- T** = cyclus time
- T_d** = derived action time
- T_i** = integral action time

Processes for regulating the pH value are not linear. Often, the transfer constant of the stretch in the range of the target value is orders of magnitude greater than the thresholds of the control range. The use of a regulator with fixed set values results in either instability of the control loop in the vicinity of the target value, or extremely large settling times (for batch processes) and large control deviations (for continuous processes with greater fluctuations of disturbance variables). The regulator integrated into the ProLab 5000 can be adapted to these particulars of the process. The general static characteristic curve of the regulator subsequently is shown. Thus, it is possible to realize different transmission behaviors for parts of the control range.



- Two independent work controller
- Work in both directions
- Break points for easier adjustments (pH)
- Integral and derivative time for difficult processes
- 3 output possibilities:
 - Switching output for frequency or PWM
 - analog output with current drivers

Setting up the ProLab 5000 controller



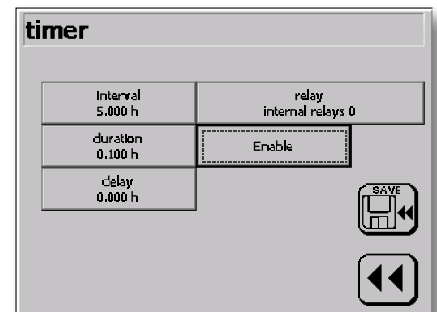
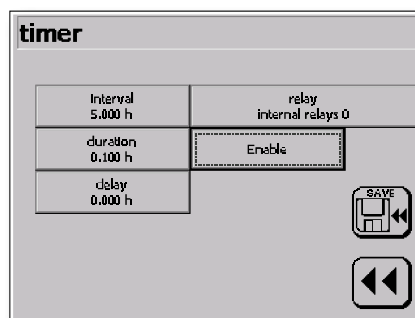
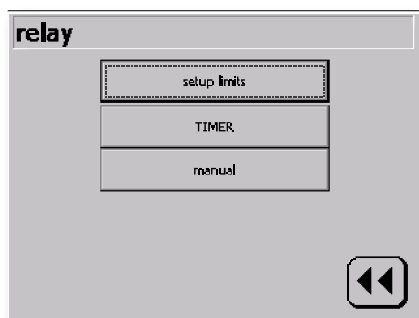
Advanced control functions - Calculation of virtual measured values

The measurement system ProLab 5000 enables the identification, display and evaluation of up to 4 virtual measured values. Virtual measured values result from the mathematical combination of two real measured values that are recorded with the ProLab 5000 in the current configuration. Each measurement channel whose measured values are to be linked to a virtual measurement value should be previously configured and calibrated accordingly. The virtual measured values are shown on the display page 5.

Virtual measured values

With virtual measurement it is possible to calculate new values by following operations:

- Subtraction
- Absolute difference
- Addition
- Polynomial



- Also also physical outputs can be linked to a virtual channel.





Addition/subtraction

The calculation of the difference of two conductivity measurement points for monitoring the effectiveness of filters for water treatment or calculating the difference of two pH measuring points to increase reliability are outstanding examples of the calculation of virtual measured values through addition or subtraction.

Correct subtraction and absolute subtraction are next to the sign when using subtraction. When this function is selected, the result (difference) is always positive, even if the first value (minuend) is less than the second value (subtrahend).

As for real measured values, it is possible to use all output units, such as current outputs, limit relays, regulators and data loggers for the virtual measured value. To do so, a second mathematical operation (addition or subtraction) must be selected instead of selecting just one measured value.

Using polynomial

With the polynomial function, a wide range of applications for the ProLab 5000 open up through the possibility of mapping non-linear functions of various parameters. Characteristic curves no longer necessarily need to be linearized via the conventional 2-point calibration. The non-linear measurement behavior of sensors on the ends of the measurement range are thus also available to the user. The decrease in the slope of ion-selective electrodes at low ion concentrations or polarization effects for conductivity measurements in higher concentrations are examples of it: The polynomial has the form $y = a + bx + cx^2 + dx^3$.

Any sensor that provides an evaluable parameter x for the ProLab 5000 can be integrated into the ProLab 5000. The y value is calculated as a separate virtual measured value and displayed. The coefficients $a \dots d$ of the sensor characteristic curve must be known and be determined with the help of special software tools (MSExcel regression, CurveExpert, ... etc.). The degree of the polynomial is determined by the choice of the coefficients. The characteristic curve is, for example, linear if the coefficients c and d are zero. For example, a measured variable can be converted by simple multiplication through the factor b into a user-friendly value or into a different scale.

Advanced control functions

Logbook

All settings related to the measurement system are recorded in the logbook. Up to 200 such entries can be stored. These entries are output with date, time and a code representing the operator inputs or device fault. Entries for calibration procedures are also logged with date and time. In addition, the new calibration values are stored in the logbook. In addition, for example, the following entries are made:

- ▶ When changing the base settings of the measuring range of the modules, the buffer settings, pH test in the menu, the thresholds for the measuring range, temperature compensation, the polynomial settings, the clock, the modbus settings, calibrations, the sampler settings, the Ethernet settings
- ▶ Configuration of the regulator, threshold relay, data loggers, data output, internal and external power outputs
- ▶ Retain new setup data via data transfer or USB stick
- ▶ Software update performed
- ▶ Reset by the software
- ▶ Manually stopped (hold function)
- ▶ Bus error



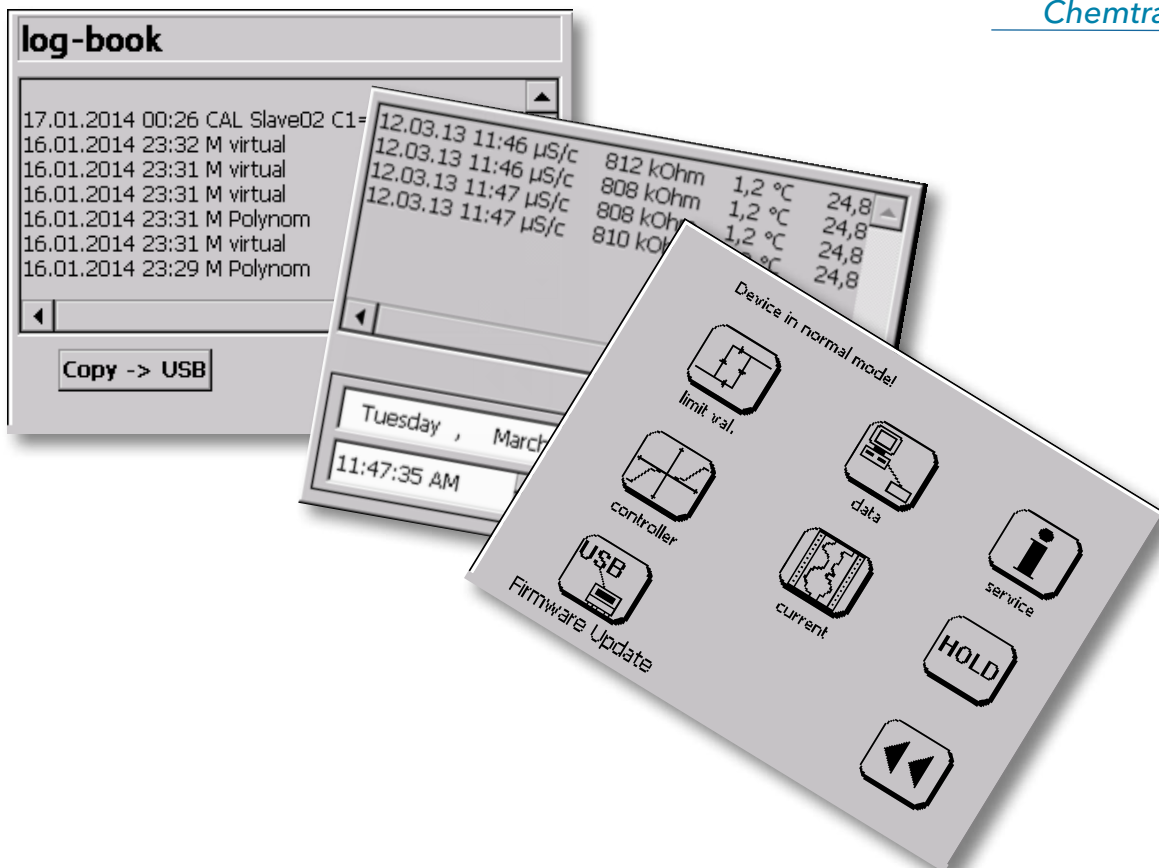
Hold

By activating the Hold function, all output values (thresholds, regulation) are "frozen" and the data transfer for the serial data output is stopped. The outputs remain in their last output state until this function is released again. The current measured values are still shown in the display. Likewise, data logger and logbook are not affected by the Hold function. In the display area of the relay outputs, the Hold state is displayed by the information "Hold" in the display.

The ProLab 5000 achieves automatic transition into the Hold function when activating the calibration menu and the timer relay. After leaving the calibration menu and turning off the timer relay, the device automatically ends the Hold function. In addition, the device can be set manually into the Hold state in order to change or check certain device settings, and to prevent data transfer or uncontrolled activation of relay circuits and regulators during this process.

For the automatic activation of the Hold state during calibration, it can be determined whether only the channel to be calibrated or all channels will be activated during calibration in the Hold state. For spatially separated measuring points, it is advantageous to activate only the channel being calibrated in the Hold function and not to influence the data output for the unaffected channels.

During activation of the timer relay (turn on relay), for example, for controlling automatic cleaning, all channels are automatically placed in the Hold function, since the cleaning function usually refers to several sensors in a measuring point. The display of current measured values in the display of the ProLab 5000 advantageously allows for on-site verification of the cleaning function and the impact on the individual channels. The time for the Hold function can still be adjusted according to the setting behavior of the sensors, i.e., be extended.

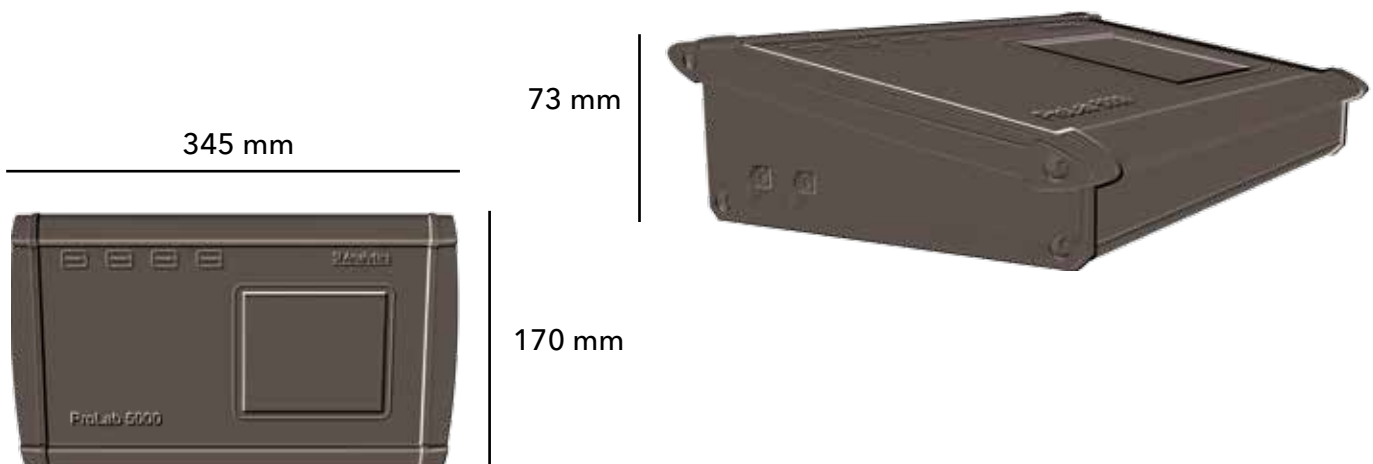


Chemtrac 820M

Technical specifications

Auxiliary energy	24 V DC desktop power supply, voltage disconnect via the unit switch
Ambient temperature	0 ... + 40 °C
Display	Touch screen graphic display 320 x 240 pixel, 256-color, back lit
Menu languages	German, English
Data transmission	Serial interface RS-232 USB port, Ethernet port, USB for PC Connection
Control outputs	4 potential-free relay outputs; resistive load $I \leq 1$ A, $U \leq 24$ V DC for threshold or alarm function; including a relay with timer function (wash contact; adjustable time interval 1 ... 9999 hours)
Data storage	Integrated data logger for about 100,000 values incl. date and time, finite/ring storage, 48 hour data recorder
Logbook	About 200 activities incl. date and time
Housing	Aluminum console housing IP 40/DIN EN 60529; Dimensions see dimensional drawings, wall-mounting kit as an accessory
Connections	BNC, banana, 8-pin Din, BK, USB, Ethernet
Electromagnetic compatibility	89/336/EEC, EN 61326 Class B
Measurement modules	Four internal measurement modules; in any combination; inputs galvanically separated; calibration data storage; sensor monitoring via adjustable threshold bands; manual and automatic temperature compensation; technical data see Table
Regulator module	Optional regulator module PL5000DAC: Standard signal module 4 x 0(4) ... 20 mA
Safety	Protection class III, EC Directive 73/23 EN 61010-1: 2001
GLP	GLP functions (data recording)

Dimensions ProLab 5000:



Multifunctional connections:

Back panel connections



Lateral connections



Measurement modules:

Internal modules	Main parameter measuring range/ Resolution	Secondary parameters/ Resolution	Temperature measurement Measuring range/ Resolution	Electrodes/sensors
PL5000 pH; ORP, ISE	pH value pH 0 ... 14 0.001 pH Accuracy: 0.005 pH	Chain voltage in mV 0.1	-10...130 °C / 0.1 °C	pH single rod measuring cell, separated measuring chain, temperature sensor Pt 1000
	Redox potential -2000... +2000 mV > 0.1 mV	Redox voltage relative to the standard hydrogen electrode 0.1	-10...130 °C / 0.1 °C	Redox single rod measuring cell, separate measuring chain, temperature sensor Pt 1000
	Ion concentration corr. sensor specification (ISE) and calibration	Chain voltage in mV/0.1	-10...130 °C / 0.1 °C	Ion-selective electrode (ISE), separate measuring chain, Pt 1000
PL5000LF	Conductivity 0...200 µS/cm 0,1 µS/cm (4-pol) 0...2 mS/cm 1 µS/cm 0...20 mS/cm 0,01 mS/cm 0...500 mS/cm 0.1 mS/cm automatic switching	Salinity 2 ... 42 g/kg	-10...130 °C / 0.1 °C	4-electrode conductivity measurement cell, temperature sensor NTC30kOhm
PL5000OX	O ₂ saturation 0...120% / 0.1%	O ₂ concentration 0...20 mg/l / 0.1	-10...130 °C / 0.1 °C	Membrane-covered amperometric O ₂ sensor, temperature sensor Pt 1000

Ordering information - ProLab 5000

Type No.	Order No.	Product hierarchy No.	Description
PL5000 0D 1pH 0LF 0OX	285206010	07	Multiparameter measuring instrument ProLab 5000 with one pH/mV/ISE-module
PL5000 0D 1pH 1LF 0OX	285206020	07	Multiparameter measuring instrument ProLab 5000 with each one pH/mV/ISE- and conductivity-module
PL5000 0D 1pH 1LF 1OX	285206030	07	Multiparameter measuring instrument ProLab 5000 with each one pH/mV/ISE-, conductivity- and dissolved oxygen-module
PL5000 0D 1pH 2LF 1OX	285206040	07	Multiparameter measuring instrument ProLab 5000 with each one pH/mV/ISE- and dissolved oxygen- as well as two conductivity-modules
PL5000 0D 2pH 0LF 0OX	285206050	07	Multiparameter measuring instrument ProLab 5000 with two pH/mV/ISE-modules
PL5000 0D 2pH 1LF 0OX	285206060	07	Multiparameter measuring instrument ProLab 5000 with two pH/mV/ISE- and one conductivity-modules
PL5000 0D 2pH 2LF 0OX	285206070	07	Multiparameter measuring instrument ProLab 5000 with each two pH/mV/ISE- and conductivity-modules
PL5000 0D 2pH 1LF 1OX	285206080	07	Multiparameter measuring instrument ProLab 5000 with each one conductivity-, dissolved oxygen- and two pH/mV/ISE-modules
PL5000 0D 3pH 0LF 0OX	285206090	07	Multiparameter measuring instrument ProLab 5000 with three pH/mV/ISE-modules
PL5000 0D 3pH 1LF 0OX	285206100	07	Multiparameter measuring instrument ProLab 5000 with three pH/mV/ISE- and one conductivity-modules
PL5000 0D 3pH 0LF 1OX	285206110	07	Multiparameter measuring instrument ProLab 5000 with three pH/mV/ISE- and one dissolved oxygen-modules
PL5000 0D 4pH 0LF 0OX	285206120	07	Multiparameter measuring instrument ProLab 5000 with four pH/mV/ISE-modules
PL5000 1D 1pH 0LF 0OX	285206130	07	Multiparameter measuring instrument ProLab 5000 with digital-analog-converter and one pH/mV/ISE-module
PL5000 1D 1pH 1LF 0OX	285206140	07	Multiparameter measuring instrument ProLab 5000 with digital-analog-converter as well as each one pH/mV/ISE- and conductivity-module
PL5000 1D 1pH 1LF 1OX	285206150	07	Multiparameter measuring instrument ProLab 5000 with digital-analog-converter as well as each one pH/mV/ISE-, conductivity- and dissolved oxygen-module
PL5000 1D 1pH 2LF 1OX	285206160	07	Multiparameter measuring instrument ProLab 5000 with digital-analog-converter as well as each one pH/mV/ISE-, dissolved oxygen- and two conductivity-modules
PL5000 1D 2pH 0LF 0OX	285206170	07	Multiparameter measuring instrument ProLab 5000 with digital-analog-converter and two pH/mV/ISE-modules
PL5000 1D 2pH 1LF 0OX	285206180	07	Multiparameter measuring instrument ProLab 5000 with digital-analog-converter, two pH/mV/ISE- and one conductivity-modules
PL5000 1D 2pH 2LF 0OX	285206190	07	Multiparameter measuring instrument ProLab 5000 with digital-analog-converter, each two pH/mV/ISE- and conductivity-modules
PL5000 1D 2pH 1LF 1OX	285206200	07	Multiparameter measuring instrument ProLab 5000 with digital-analog-converter, each one conductivity- and dissolved oxygen- as well as two pH/mV/ISE-modules
PL5000 1D 3pH 0LF 0OX	285206210	07	Multiparameter measuring instrument ProLab 5000 with digital-analog-converter and three pH/mV/ISE-modules
PL5000 1D 3pH 1LF 0OX	285206220	07	Multiparameter measuring instrument ProLab 5000 with digital-analog-converter, three pH/mV/ISE- and one conductivity-modules
PL5000 1D 3pH 0LF 1OX	285206230	07	Multiparameter measuring instrument ProLab 5000 with digital-analog-converter, three pH/mV/ISE- and one dissolved oxygen-modules
PL5000 1D 4pH 0LF 0OX	285206240	07	Multiparameter measuring instrument ProLab 5000 with digital-analog-converter and four pH/mV/ISE-modules
Z570	285206250	04	USB cable for ProLab 5000
Z573	285206260	04	Cable for connecting the ProLab 5000 to sample changer
Z575	285206270	04	Wall fix for installing ProLab 5000

pH/mV/ISE	Number of modules		
	Cond	D.O.	Digital-Analog Converter

1	0	0	0
1	1	0	0
1	1	1	0
1	0	0	0
2	2	1	0
2	1	0	0
2	2	0	0
2	1	1	0
3	0	0	0
3	1	0	0
3	0	1	0
4	0	0	0
1	0	0	1
1	1	0	1
1	1	1	1
2	0	0	1
2	1	0	1
2	2	0	1
2	1	1	1
3	0	0	1
3	1	0	1
3	0	1	1
4	0	0	1

Channel 4

SI Analytics



ScienceLine pH combination electrodes

pH combination electrodes with plug head and fixed cable

Reference system: Silamid®
 Shaft material: glass
 Zero point: pH = 7.0 ± 0.3
 Electrolyte: KCl 3 mol/l
 (except
 N 6250: KCl 4.2 mol/l,
 A 7780 and L 7780: gel electrolyte,
 L 8280: Referid® electrolyte)
 Membrane shape: sphere
 pH range: 0 to 14
 Connection cable for plug head: e.g. L 1 A
 (See also page with connection cables)
 fixed cable: 1 m long, with plug A acc. to DIN 19262 or with BNC plug



H 61
 H 62
 H 63
 N 61
 N 62
 H 6180
 H 6280
 H 6380
 N 6180
 N 6250
 N 6280
 N 42 BNC
 N 52 BNC
 H 61-500
 H 61-600

H 64
 N 64

N 65
 H 65
 H 6580
 N 6580

L 32

A 7780
 L 7780

N 6980

L 8280

Note:

The electrodes shown above are only a small part of our product range. To get a better idea of our program, please consult our laboratory catalog and the process electrodes catalog.

Order No.	Type No.	Length L [mm]	Ø [mm]	Junction	pH-glass	Temp. range [°C]	Connection	Remarks
285101260	A 7780	120	12	3 x ceramic	A	-5 to +80	plug head	gel electrolyte
285100207	H 61	170	12	platinum	H	+10 to +100	plug head	
285092583	H 61-500	500	12	platinum	H	0 to +100	plug head	
285092591	H 61-600	600	12	platinum	H	0 to +100	plug head	
285102524	H 6180	170	12	ceramic	H	+10 to +100	plug head	
285100215	H 62	120	12	platinum	H	+10 to +100	plug head	
285102532	H 6280	120	12	ceramic	H	+10 to +100	plug head	
285100223	H 63	320	12	platinum	H	+10 to +100	plug head	
285102549	H 6380	320	12	ceramic	H	+10 to +100	plug head	
285100231	H 64	170	12	ground joint	H	+10 to +100	plug head	
285100248	H 65	103 ¹⁾	10	platinum	H	+10 to +100	plug head	standard taper NS 14.5
285102565	H 6580	103 ¹⁾	10	ceramic	H	+10 to +100	plug head	standard taper NS 14.5
1061093	L 32	120	12	fibre	A	-5 to +50	plug head	plastic shaft
285101252	L 7780	120	12	ceramic	A	-5 to +80	plug head	gel electrolyte
285101277	L 8280	120	12	KPG®	A	-5 to +80	plug head	Referid® electrolyte
285101544	N 42 BNC	120	12	ceramic	A	-5 to +100	BNC plug ²⁾	
285105451	N 52 BNC	120	12	platinum	A	-5 to +100	BNC plug ²⁾	
285100001	N 61	170	12	platinum	A	-5 to +100	plug head	
285100018	N 6180	170	12	ceramic	A	-5 to +100	plug head	
285100034	N 62	120	12	platinum	A	-5 to +100	plug head	
285100112	N 6250	120	12	ceramic	A	+15 to +40	plug head	calomel ref., for TRIS buffers
285100042	N 6280	120	12	ceramic	A	-5 to +100	plug head	
285100059	N 64	170	12	ground joint	A	-5 to +100	plug head	
285100067	N 65	103 ¹⁾	10	platinum	A	-5 to +100	plug head	standard taper NS 14.5
285102516	N 6580	103 ¹⁾	10	ceramic	A	-5 to +100	plug head	standard taper NS 14.5
285101709	N 6980	103 ¹⁾	10	ground joint	A	-5 to +100	plug head	standard taper NS 14.5

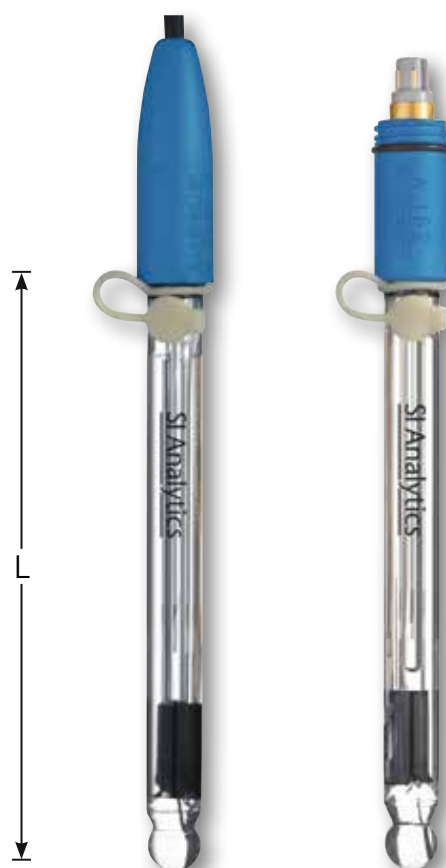
¹⁾ Length from upper end of standard taper

²⁾ with 1 m fixed cable

ScienceLine pH combination electrodes with temperature sensor

pH combination electrodes with temperature sensor

Reference system: Silamid®
Shaft material: glass
Diameter: 12 mm
Zero point: pH = 7.0 ± 0.3
Electrolyte: KCl 3 mol/l
Temperature sensor: Pt 1000
Membrane shape: sphere
pH range: 0 to 14
Connection cable:
for SMEK-plug head: e.g. LS 1 ANN
 (See also page with connection cables)
fixed cable: 1 m long,
 with plug A acc. to DIN 19262
 or with BNC plug, as well as plug for temperature sensor



N 1041 BNC
 N 1042 BNC
 N 1051 BNC
 N 1052 BNC

A 162

Order No.	Type No.	Length L [mm]	Junction	pH-glass	Temp.-range [°C]	Connection	Remarks
285129525	A 162	120	platinum	A	-5 to +100	SMEK plug head	
285100531	N 1041 BNC	170	ceramic	A	-5 to +100	BNC- ¹⁾ + 4-mm plug	
285105476	N 1042 BNC	120	ceramic	A	-5 to +100	BNC- ¹⁾ + 4-mm plug	
285100500	N 1051 BNC	170	platinum	A	-5 to +100	BNC- ¹⁾ + 4-mm plug	
285100380	N 1052 BNC	120	platinum	A	-5 to +100	BNC- ¹⁾ + 4-mm plug	

Note:

The electrodes shown above are only a small part of our product range. To get a better idea of our program, please consult our laboratory catalog and the process electrodes catalog.

ScienceLine conductivity measuring cells with fixed cable

Conductivity measuring cells with fixed cable and 8-pole plug

Temperature sensor: NTC 30 kW



Order No.	Type No.	Length L [mm]	Ø [mm]	Sensor	Cell const. ~ [cm ⁻¹]	Temp. range [°C]	Meas. range ¹⁾ [µS/cm]...[mS/cm]	Remarks
285106150	LF 213 T	120	12	Stainless steel	0.01	0 to +100	0 to 0.03	Trace conductivity cell with integrated flow-through vessel, stainless steel, 1.5 m cable
285414360	LF 313 T	120	12	Stainless steel	0.1	0 to +100	0 to 0.2	Ultrapure water conductivity cell with flow-through vessel, stainless steel shaft, fixed cable 1.5 m
285414351	LF 313 T NFTC	120	12	Stainless steel	0.1	0 to +100	0 to 0.2	Ultrapure water conductivity cell without flow-through vessel, stainless steel shaft, fixed cable 1.5 m
285106172	LF 413 T	120	15.3	4 x Graphite	0.475	-5 to +80	1 to 2,000	Plastic shaft, 1.5 m cable
285106148	LF 413 T-3	120	15.3	4 x Graphite	0.475	-5 to +80	1 to 2,000	Plastic shaft, fixed cable 3 m
285106131	LF 613 T	120	12	4 Pt rings	1.0	-5 to +80	1 to 2,000	Plastic shaft, 1 m cable
285106189	LF 713 T	120	12	4 Pt rings	1.0	-30 to +135	1 to 2,000	Glass shaft, 1 m cable
285106190	LF 713 T-250	250	12	4 Pt-Ringe	1,0	-30 ... +135	1 ... 2.000	Glasschaft, 1 m Kabel

¹⁾ Outside the recommended ranges measuring errors > 10% can occur with these conductivity measuring cells.

Armatures and Accessories

System solutions for all applications

The development and production of these high-quality armatures and its control systems is based on our experience originating from more than 75 years within the area of liquid analysis. Thanks to the constant active contact to our customers we are aware that basically every application has its own requirements. The reliable measuring of pH, redox, conductivity and D.O. values up to temperature within the process requires individual solutions. This affects all industrial branches, whether within the water treatment, food industry, biotechnology or chemical and pharmaceutical productions.

Therefore this product range offers an extensive variety and an especially diverse ability for combining different elements. These system solutions allow the ideal positioning of sensors in the measuring solution among different application conditions. They therefore increase reliability of measurements and the life span of sensors significantly.



CHEMfit - die neuen Universalarmaturen

CHEMfit 340 are adapters for flexible and easy use with electrodes with Pg 13.5 connection with a diameter of 12 mm and a length of 120 mm in NPT process connections.

Your advantages at a glance:

- ▶ Broad application range, e.g. from sewage water treatment and measurements in boiler feed water to freshwater treatment.
- ▶ In stainless steel 1.4404, PP or PVDF on stock. More materials on demand.
- ▶ Standardized available process sealings are EPDM, Viton® and Kalrez®. More options on demand.
- ▶ For all established connections, such as NPT ¾" and NPT 1"
- ▶ Also designed for rough applications with basket guard to avoid damage of the used electrode.
- ▶ Reducing of expenses through the use of low maintenance standard sensors (such as our SteamLine and ProcessLine electrodes, available with coax and VP connectors as well as Memosens® system)



CHEMtrac - Manual retractable fittings

- ▶ Manually retractable fitting for the installation of sensors with 12 mm diameter and Pg 13.5 installation thread in tanks or pipes.
- ▶ Choice between immersion depths of up to 107 or 207 mm.
- ▶ For all types of sensors with a diameter of 12 mm and a length of 225 or 325 mm as low-maintenance design or as a liquid electrolyte versions in 280 or 380 length.
- ▶ Choice of different materials such as stainless steel AISI 316L/1.4404, Hastelloy, PP, PVDF or PEEK.
- ▶ Choice of different sealing materials (e.g., EPDM and FPM (Viton) or FFKM (Kalrez)).
- ▶ Choice of various process connections (DN32, DN40, DN50, ANSI, NPT, Triclamp, Ingold DN25, Varivent, Neumo)
- ▶ Manual operation also against 12 bar.
- ▶ Secure locking of the respective position.
- ▶ Pneumatic drive can be retrofitted.
- ▶ Robust design including an integrated wiper.



CHEMtrac	810M	811M	820M	821M	830M
Design stainless steel	■	■			■
Design plastic			■	■	
For hygienic installation					■
DN and ANSI connection	■	■	■	■	
NPT connection	■		■		
Ingold DN25, Varivent, Triclamp, Neumo connection					■
107 immersion length	■		■		■
207 immersion length		■		■	
For 225 low-maintenance and 280 liquid electrolyte electrodes	■		■		■
For 325 low-maintenance and 380 liquid electrolyte electrodes		■		■	

SI Analytics

a xylem brand

Our company name - SI Analytics - already expresses our core competency - the manufacturing of analysis equipment. Furthermore, SI stands for the main products of our company: Sensors and Instruments.

We have risen from the history of SCHOTT® AG and SI Analytics can offer 75 years of experience in glass technology and the development of analysis equipment. We will continue to develop and manufacture our products with the highest requirements of innovation and quality.

Only the name will change - the quality will remain!

We have been an independent enterprise for over 40 years, and as a former subsidiary of SCHOTT® AG, we continue to value tradition and manufacture in the footsteps of traditional Mainz glass manufacturers.

Our electrodes, meters, titrators and capillary viscosimeters will continue to have their home in areas, where the know-how in analytic measurement technology is in demand.

SI Analytics has been part of the listed company Xylem Inc. since 2011, which is headquartered in Rye Brook / N.Y., USA. Xylem is a leading worldwide provider of problem solutions regarding water.

1973



SCHOTT
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SCHOTT
Instruments

SI Analytics

2015

We are Xylem Analytics

Xylem consists of three business sectors - Water Solutions, Applied Water Systems and Analytics. The following companies make up Xylem Analytics and act like SI Analytics in the chemical, pharmaceutical, biotechnological, food and plastics industries.

Bellingham & Stanley

For almost a century, Bellingham + Stanley has been the leader in the field of:

- Refractometers
- Polarimeters
- Certified Reference Materials

www.bellinghamandstanley.com



a xylem brand

ebro

ebro has been servicing the scientific world with innovative temperature measurement solutions for over forty years and today, customer feedback still plays an important role within the business model. To ebro, customer care not only means supporting existing product and software; it also means being able to provide custom solutions within their field of excellence too!

- Precision thermometers
- Food Safety test kits
- Frying oil monitors
- Humidity, vacuum & temperature dataloggers
- Portable digital refractometers

www.ebro.com



OI Analytical

Since 1963 OI Analytical has been providing innovative products used for chemical analysis and is a key supplier of sample preparation and turn-key analytical solutions for testing food products and water for chemical contaminants.

Beverage & water analyses include the determination of:

- Total Organic Carbon (TOC) & cyanide
- Organophosphorus & organochlorine pesticides
- Volatile Organic Compounds (VOCs)

Sample preparation for food and fruit analyses include:

- Antibiotics & mycotoxins
- Organophosphorus pesticides
- Organochlorine pesticides

www.oico.com



Furthermore, Xylem Analytics comprises:



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What can Xylem do for you?

We're 12,700 people unified in a common purpose: creating innovative solutions to meet our world's water needs. Developing new technologies that will improve the way water is used, conserved, and re-used in the future is central to our work. We move, treat, analyze, and return water to the environment, and we help people use water efficiently, in their homes, buildings, factories and farms. In more than 150 countries, we have strong, long-standing relationships with customers who know us for our powerful combination of leading product brands and applications expertise, backed by a legacy of innovation.

For more information on how Xylem can help you, go to www.xylem.com

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