

User Manual

# Portavo® 904(X) PH

Portable Meter



Read before installation.  
Keep for future use.





## Repair

The meter cannot be repaired by users. For inquiries regarding repairs, please contact Knick Elektronische Messgeräte GmbH & Co. KG at [www.knick.de](http://www.knick.de).

## Returns

Clean and securely package the product before returning it to Knick Elektronische Messgeräte GmbH & Co. KG.

If there has been contact with hazardous substances, the product must be decontaminated or disinfected prior to shipment. The consignment must always be accompanied by a corresponding return form to prevent service employees being exposed to potential hazards.

Further information can be found at [www.knick.de](http://www.knick.de).



## Disposal

The local codes and regulations must be observed when disposing of the product.

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Check the shipment for transport damage and completeness.

The package of the Portavo 904(X) PH includes:

- Meter, incl. premounted quiver
- 4 batteries (AA)
- Carrying strap
- USB cable, 1.5 m
- Quickstart overview for attaching to the inside of the protective cover (German, English, French)
- Safety guide
- Quickstart guide in various languages
- Test report 2.2 according to EN 10204

For Portavo 904X PH Ex version:

- EU Declaration of Conformity
- Control drawing no. 209.009-110 (ATEX, IECEx, cFMus)

User manuals, certificates, the Paraly SW 112 PC software, and other product information can be downloaded from [www.knick.de](http://www.knick.de).



## Intended Use

The Portavo 904(X) PH is a portable pH meter. With a plain text line on a high-contrast LCD, operation is largely intuitive. The device variant 904X PH is available for applications in hazardous locations up to Zone 0.

The meter stands out by the following features:

- Use of digital Memosens sensors
  - Memosens sensors and DIN pH sensors can be used on one device.
  - A detachable quiver protects the sensor and prevents it from drying out. Furthermore, it can be used for calibration.
  - The rugged housing is made of a high-performance polymer. It provides high impact resistance and dimensional stability even when exposed to extreme moisture.
- 
- Scratch-proof clear glass display, perfectly readable even after years
  - Very long operating times with one set of batteries (4x AA) or use of a Li-ion battery for reliable operation even at high or very low operating temperatures (Li-ion battery not suited for Portavo 904 X PH for application in hazardous locations)
  - Data logger with 5000 values
  - Micro USB port for communication with Paraly SW 112 PC software for data evaluation of digital sensors (Memosens)
  - Sensoface icons provide single-glance information on the sensor condition (page 40)
  - Calibration with "Calimatic" automatic buffer recognition (page 17)
  - Manual calibration by free specification of buffer values
  - Real-time clock and display of battery charging level
  - At measuring temperatures from -20 to +100 °C the temperature detector can be automatically identified.

## Value-Added Features

### Memosens

The Portavo 904 can communicate with Memosens sensors. When these digital sensors are connected to the meter, they are automatically identified and indicated by the logo shown on the right. Furthermore, Memosens allows the storage of calibration data, which will be available and can still be used when the sensor is connected to another Memosens-capable device.



### Sensoface

Sensoface provides quick information on the sensor condition. The three "smiley" faces as shown on the right represent the sensor condition during measurement and after a calibration. When the condition deteriorates, an "INFO ..." message provides additional information on the cause.



### Automatic Calibration with Calimatic

Calimatic is a very convenient method for pH calibration with automatic buffer recognition. You only have to select the buffer set with the buffers used. The buffers can then be used in any order. As delivered, this calibration method is preset. It can be adjusted or disabled in the configuration menu.



## Protective Cover

The front of the meter is protected by a cover, which can be completely flipped over and secured to the back for operation. A label on the inner side of the cover explains the control functions and device messages.



## Hook

A fold-out hook on the back allows the meter to be suspended. This leaves your hands free for the actual measurement. The **nameplate** is located beneath the hook.

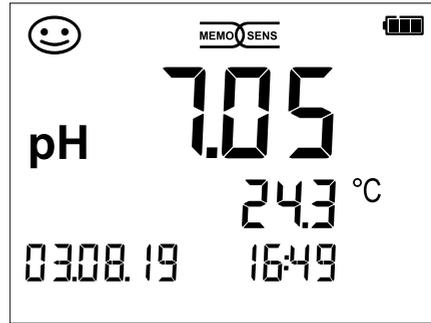


## Protective Cover and Hook Combined

The two parts can be combined to form a benchtop stand, enabling convenient and fatigue-free work with the device at a laboratory table or desk.

## Display

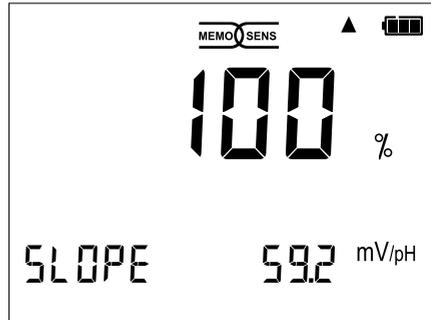
The meter has a three-line display for showing alphanumeric information such as measurement and calibration data, temperatures, and date/time. Additional information is provided by means of icons (Sensoface, battery icon, etc.). Some typical displays are shown here.



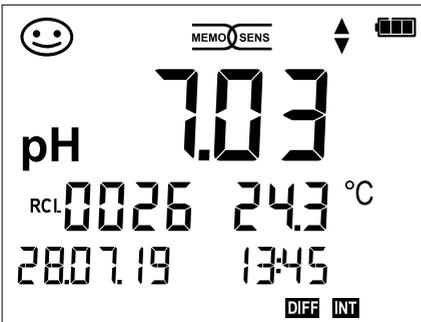
Measuring  
(display of measured value, temperature, date and time)



Calibration – step 1



End of calibration  
(display of slope)



Logger data  
(display of measured value, memory location, temperature, date and time)



Clock  
(display of hours and minutes, seconds and date).



## Keypad

The keys of the membrane keypad have a noticeable pressure point.

They have the following functions:

- on/off** Switches the meter on and displays the device and calibration data (see Start-up)
- meas** Switches the meter on / Activates measuring mode / Data logger, stopping
- cal** Start calibration
- set** Activates configuration / Confirms entries
- clock** Displays time and date, allows setting the clock using **set**
- RCL** View stored values
- STO** Holds and saves a measured value, allows setting and starting of the logger by pressing **set** (page 26)
- ▲**  
**▼** When this icon is displayed, you can use the arrow keys for navigation.

Check the shipment for transport damage and completeness (see Package Contents).

### **⚠ CAUTION!**

Do not operate the device when one of the following conditions applies:

- the device shows visible damage
- failure to perform the intended function
- prolonged storage at temperatures above 70 °C / 158 °F
- after severe transport stresses

In this case, a professional routine test must be performed.

This test should be carried out at our factory.

### **Note on Use in Hazardous Locations**

#### **⚠ WARNING! Impairment of explosion protection.**

Only open the battery compartment of the Portavo 904X outside the hazardous location.

- The device cannot be repaired by users. For inquiries regarding repairs, please contact Knick Elektronische Messgeräte GmbH & Co. KG at [www.knick.de](http://www.knick.de).
- Never use the USB port within the hazardous location.

## **Inserting the Batteries**



With four AA batteries, the Portavo has an operating time of over 1000 h.

Open the battery compartment on the rear of the device. Be sure to observe the correct polarity when inserting the batteries (see markings in the battery chamber). Close the battery compartment cover and fasten it finger tight.

A special lithium-ion battery (ZU 0925) suited to the battery compartment is available for the Portavo 904. Only this battery type can be charged directly from the USB port.

**Note:** Not available for the Portavo 904X (device variant for applications in hazardous locations).

**A battery icon in the display indicates the battery power level:**

	Icon fully filled	Batteries at full capacity
	Icon partially filled	Battery capacity is sufficient
	Icon empty	Battery capacity not sufficient; calibration is possible, no logging
	Icon blinks	Max. 10 operating hours remaining, measurement is still possible <b>NOTICE!</b> It is absolutely necessary to replace the batteries.

**⚠ WARNING! Impairment of explosion protection.**

When using the Portavo 904X (device variant for applications in hazardous locations) in a hazardous location, only the battery types listed below may be used. The batteries must be from the same manufacturer and of identical type and capacity. Never use new and used batteries together (see also Control Drawing 209.009-110).

**Batteries for Application in Hazardous Locations**

Batteries (4x each)	Temperature class	Ambient temperature range
Duracell MN1500 <sup>1)</sup>	T4	-10 °C ≤ Ta ≤ +40 °C
Energizer E91	T3	-10 °C ≤ Ta ≤ +50 °C
Power One 4106	T3	-10 °C ≤ Ta ≤ +50 °C
Panasonic Pro Power LR6	T3	-10 °C ≤ Ta ≤ +50 °C

1) The Duracell Plus Power 4ct (EAN: 5000394017641) is an MN1500 battery.

## Connecting a Sensor

The Portavo 904(X) PH provides several connections so that many types of sensors can be used for measurement. Note that only **one** sensor may be connected to the meter at a time.

The meter automatically recognizes a connected Memosens sensor and switches accordingly. Memosens is signaled in the display.

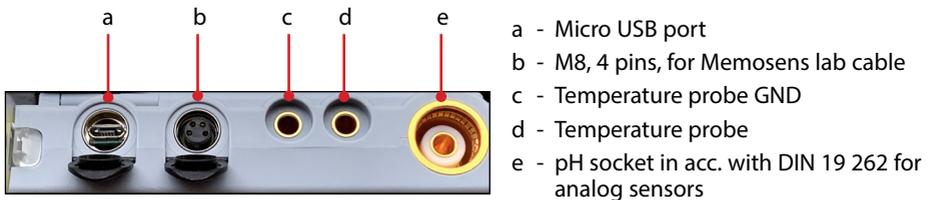
### Separate Temperature Probe

**Note:** Temperature measurement using a separate temperature probe is only possible when no Memosens sensor is connected.

After power-on, a separate temperature probe is automatically recognized. If you want to replace the temperature probe, you must switch off the meter and then switch it on again.

**NOTICE!** Always make sure that a sensor is connected to the meter before starting measurement.

Explanation: The analog pH input of the Portavo is an electrometer amplifier with an extremely high-impedance. When the sensor is not in contact with the medium or not connected to the meter, electric charges on the input can generate arbitrary, stable pH or mV values, which will be shown in the display.



Memosens sensors have a **cable coupling** that allows for the convenient replacement of sensors while the cable remains connected to the meter. The connecting cable is connected to socket **b** (M8, 4 pins for Memosens sensors).

### **⚠ WARNING! Impairment of explosion protection.**

Never use digital Memosens sensors or Memosens cables without Ex approval in a hazardous location. For these applications, you must use Memosens sensors with Ex approval. These sensors and the Memosens Ex cable are marked by an orange-red ring.

## Switching On the Meter



When you have connected the sensor, you can switch on the meter by pressing the **meas** or **on/off** key.

If you press **meas**, the meter immediately switches to measuring mode.



### Analog sensors:

After pressing the **on/off** key, the meter displays selected adjustment data before it switches to measuring mode.

### Memosens sensors:

After pressing the **on/off** key, the meter displays selected sensor information, incl. adjustment data, before it switches to measuring mode.

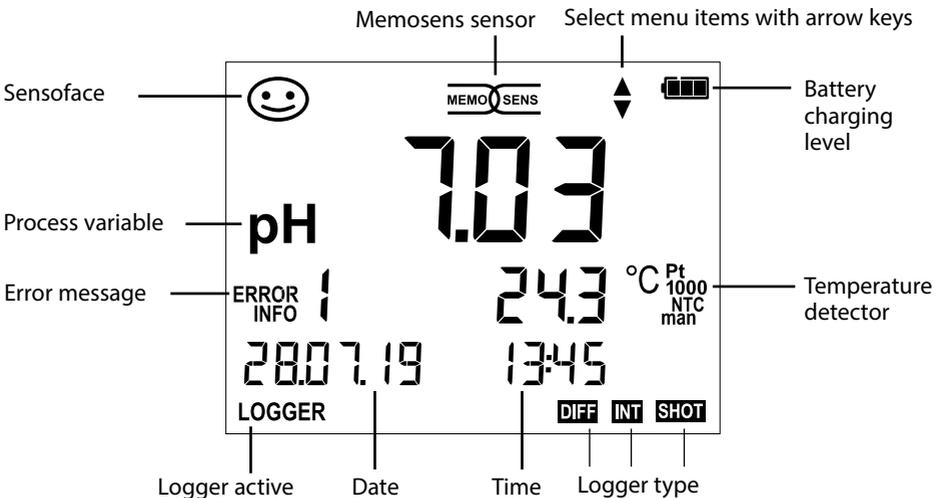
## Alternating Use of Analog and Memosens Sensors

The meter initially starts in analog measuring mode. If a Memosens sensor is connected and detected during operation, the meter switches to Memosens.

If the Memosens sensor is now removed, the meter remains in Memosens mode. If you want to resume measurements with an analog sensor, the meter needs to be restarted by pressing the **on/off** key. The Memosens cable may remain connected.

## Icons

Important information about the state of the device:





Press the **set** key to access configuration mode.

Configuration is required to match the connected sensor and the desired measurement performance. Furthermore, you can select the suitable calibration method. The following table gives you an overview. Factory settings are shown in **bold print**.

Measurement

↓ **set**

“SETUP” view

	DISPLAY 1	<b>pH x.xx</b>   pH x.xxx   mV	
	DISPLAY 2	<b>OFF</b>   Date + Time   Date   Time	
	CAL TIMER	<b>OFF</b>   1 ... 99 days	
	CAL	<b>CALIMATIC</b>   MANUAL   DATA INPUT   ISFET-ZERO   CAL SOP (Option 001)   ORP OFFSET (for ORP or pH/ORP combo sensors)   TEMP. OFFSET (Option 001)   FREE CAL	
	CAL POINTS	1   <b>2</b>   3   1-2-3 (for CALIMATIC, Manual, FREE CAL)	
		BUFFER SET (CALIMATIC, FREE CAL)	-01- Mettler-Toledo 2.00 4.01 7.00 9.21 -02- Knick CaliMat 2.00 4.00 7.00 9.00 12.00 -03- Ciba (94) 2.06 4.00 7.00 10.00 -04- NIST Technical 1.68 4.00 7.00 10.01 12.46 -05- NIST Standard 1.679 4.006 6.865 9.180 -06- HACH 4.01 7.00 10.01 12.00 -07- WTW techn. buffers 2.00 4.01 7.00 10.00 -08- Hamilton 2.00 4.01 7.00 10.01 12.00 -09- Reagecon 2.00 4.00 7.00 9.00 12.00 -10- DIN 19267 1.09 4.65 6.79 9.23 12.75 -U 01- loadable via Paraly SW 112 (User)
		AUTO OFF	<b>OFF</b>   12h   6h   1h   0.1h
		TEMP UNIT	°C   °F
		TIME FORMAT	<b>24h</b>   12h
		DATE FORMAT	<b>DD.MM.YY</b>   MM.DD.YY
		TAN TEMP CAL	Enter TAN to enable option (see page 36)
		TAN SOP	
		SETUP CODE	<b>OFF (0000)</b>   0001 ... 9999 (with option 001 SOP only, see page 37)
		CAL CODE	
		LOGGER CODE	
	DEFAULT	<b>NO</b>   YES (reset to factory settings) <b>Note:</b> All data logger entries will be deleted.	

Select using arrow keys, confirm by pressing **set**.



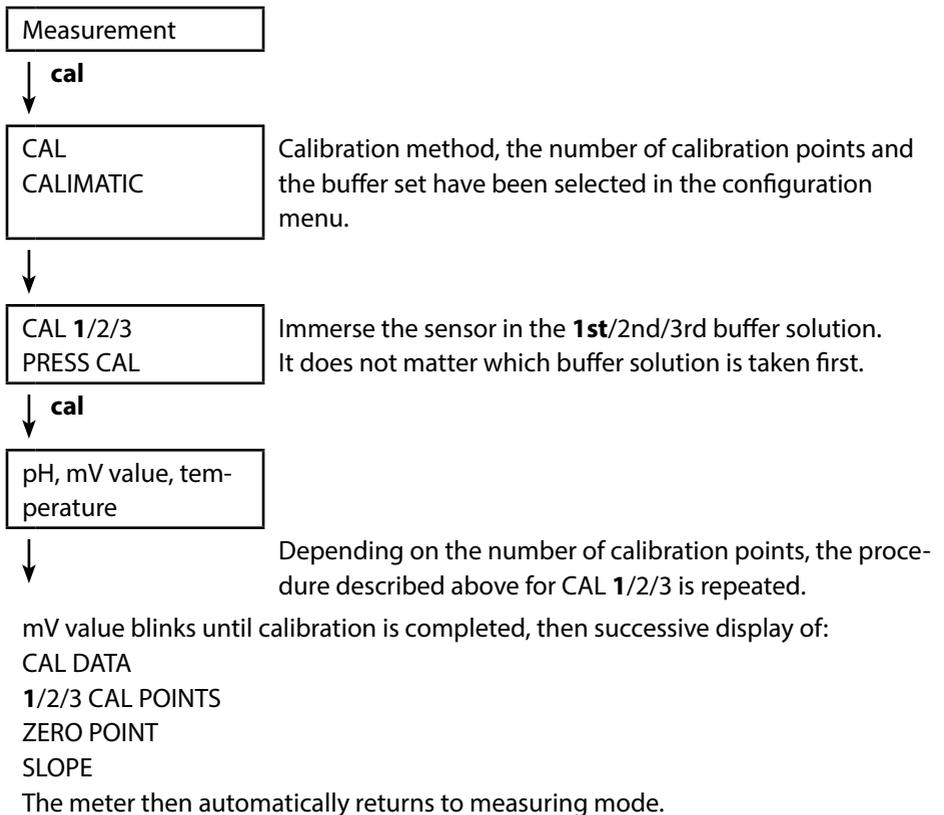
This icon prompts you to select a menu item using the arrow keys – the selection is confirmed by pressing **set**.



## CALIMATIC Calibration

### (Calibration with automatic buffer recognition)

The calibration method is selected in the configuration menu. Calibration is required to adjust the sensor to the meter. It is indispensable for achieving comparable and reproducible measurement results.



**Note:** To abort calibration, you can press **meas** at any time. This will be confirmed by the "CAL ABORTED" display message. Exception: When you have selected "CAL POINTS 1-2-3" and the first calibration step has been completed, the calibration process cannot be stopped any more.



## MANUAL Calibration

### (Manual calibration)

The calibration method is selected in the configuration menu.

Measurement

↓ **cal**

CAL  
MANUAL

The number of calibration points has been selected in the configuration menu.

↓

CAL 1/2/3  
PRESS CAL

↓ **cal**

pH display blinks  
PRESS CAL

Take the temperature-corrected pH value from the buffer description and enter it using ▲▼.

↓ **cal**

mV display blinks

Depending on the number of calibration points, the procedure described above for CAL 1/2/3 is repeated.

mV value blinks until calibration is completed, then successive display of:

CAL DATA

1/2/3 CAL POINTS

ZERO POINT

SLOPE

The meter then automatically returns to measuring mode.

**Note:** To abort calibration, you can press **meas** at any time. This will be confirmed by the "CAL ABORTED" display message. Exception: When you have selected "CAL POINTS 1-2-3" and the first calibration step has been completed, the calibration process cannot be stopped any more.



## DATA INPUT Calibration

(Calibration by entering known sensor values)

The calibration method is selected in the configuration menu.

Measurement

↓ **cal**

CAL  
DATA INPUT

↓

ZERO POINT

Use ▲▼ to select the zero point value.

↓ **cal**

SLOPE

Use ▲▼ to select the slope value.

↓ **cal**

The calibration data will be displayed successively:

Date and time

ZERO POINT

SLOPE

The meter then automatically returns to measuring mode.

**Note:** To abort calibration, you can press **meas** at any time.

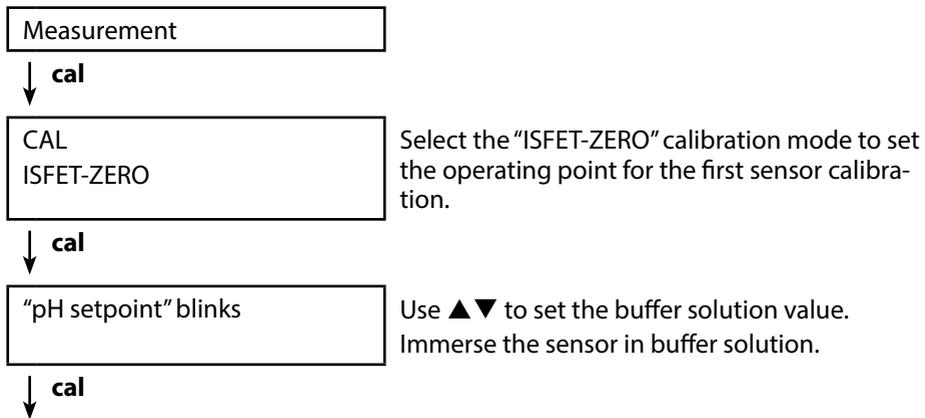


## ISFET Calibration

– available if an ISFET sensor is connected

The calibration method is selected in the configuration menu.

When using ISFET sensors for pH measurement, the individual operating point of the sensor first needs to be determined, and should be in the pH 6.5...pH 7.5 range. The sensor is immersed in a buffer solution with a pH value of 7.00 for this purpose.



Calibration is performed. The ISFET operating point is displayed. The meter then automatically returns to measuring mode.

Keep the sensor connected to the Portavo while performing the next calibration step. The operating point will be taken into account for the following calibration.

**Note:** The operating point only needs to be determined once for each ISFET sensor. To abort calibration, you can press **meas** at any time.



## CAL SOP Calibration

(Option 001 SOP, must have been configured in Paraly SW 112 PC software)

In the Paraly SW 112 PC software, you specify which buffers are to be used in which sequence. You can combine buffer solutions from different buffer sets. Please note that the minimum distance allowed between two buffer solutions is  $\Delta 2$  pH.

SOP calibration allows you to:

- use up to 3 buffers for adjustment
- use a 4th point for verification (“verification buffer”) specify a maximum deviation from the verification buffer
- use buffers from different buffer sets, including a “user buffer”.

Measurement

↓ **cal**

CAL  
CAL SOP

Use ▲▼ to set the required calibration method (CAL SOP).

↓ **cal**

Perform the selected calibration

(see Paraly SW 112 PC software for description).

The meter then automatically returns to measuring mode.

**Note:** To abort calibration, you can press **meas** at any time.



## ORP OFFSET Calibration

(available if an ORP or  
pH/ORP combo sensor is connected)

Selected in the configuration menu.

Measurement

↓ **cal**

CAL  
ORP OFFSET

You can specify an offset for the ORP value measured by the sensor.

After calibration has been activated, the following values are listed in the display:

- ORP setpoint (in mV)
- temperature measured by sensor
- measured ORP value (in mV)

↓ **cal**

"ORP setpoint" blinks

Use ▲▼ to set the ORP value.

↓ **cal**

Calibration is performed, the offset value is indicated.  
The meter then automatically returns to measuring mode.

**Note:** To abort calibration, you can press **meas** at any time.



## TEMP. OFFSET OFFSET (option)

Temperature calibration (offset)

Selected in the configuration menu.

Measurement

↓ **cal**

CAL  
TEMP. OFFSET

You can specify an offset for the temperature measured by the sensor.

After calibration has been activated, the following values are listed in the display:

- temperature setpoint
- temperature measured by sensor
- offset (display in K)

↓ **cal**

Temperature setpoint value  
blinks.

Use ▲▼ to set the temperature setpoint value.

↓ **cal**

Calibration is performed, the offset value is indicated.

The meter then automatically returns to measuring mode.

**Note:** To abort calibration, you can press **meas** at any time.



## FREE CAL Calibration

(Free selection of calibration method)

FREE CAL calibration is selected in the configuration menu.

Measurement

↓ **cal**

CAL  
CALIMATIC blinks

↓ **cal**

Perform the selected calibration as described on the previous pages. The meter then automatically returns to measuring mode.

Use ▲▼ to select the required calibration method (CALIMATIC, MANUAL, DATA INPUT, ISFET-ZERO, CAL SOP (Option 001), ORP OFFSET (for ORP or pH/ORP combo sensors), or TEMP. OFFSET (Option 001)).

**Note:** To abort calibration, you can press **meas** at any time.

Once you have completed all preparations, you can start with the actual measurement.

## Keys for measurement

- 1) Connect the desired sensor to the meter. Some sensors require a special preparation. Information on this can be found in the sensor's user manual.
- 2) Switch the meter on using the **on/off** or **meas** key.
- 3) Depending on the measurement method and the sensor used, immerse the sensing part of the sensor in the medium to be measured.
- 4) Watch the display and wait for the reading to stabilize.
- 5) By pressing the **STO** key, you can hold and save a measured value (see data logger, page "Data Logger" on page 26).



Measurement can also be controlled using the Paraly SW 112 PC software.



## Toggling the Measurement Display

During measurement, you can toggle between pH and mV display by pressing the **meas** key. With a pH/ORP combo sensor connected, the display toggles between the pH and ORP values in mV.

## Manually Adjusting the Temperature

When you connect an analog sensor without temperature detector, you can manually adjust the temperature for measurement or calibration:

- 1) Press **meas** to access measuring mode. The adjusted temperature will be displayed.
- 2) Set the desired temperature value using the ▼ or ▲ arrow. Holding the key depressed changes the temperature value at high speed.

## The Data Logger

The meter provides a data logger. **Prior to use**, it must be configured and then activated. You can choose from the following logger types:

- DIFF (signal-controlled logging of measured variable and temperature)
- INT (time-controlled logging at a fixed interval)
- DIFF+INT (combined time- and signal-controlled logging)
- SHOT (manual logging by pressing the **STO** key)

The data logger records up to 5000 entries and saves them in a circular buffer.

Already existing entries will be overwritten.

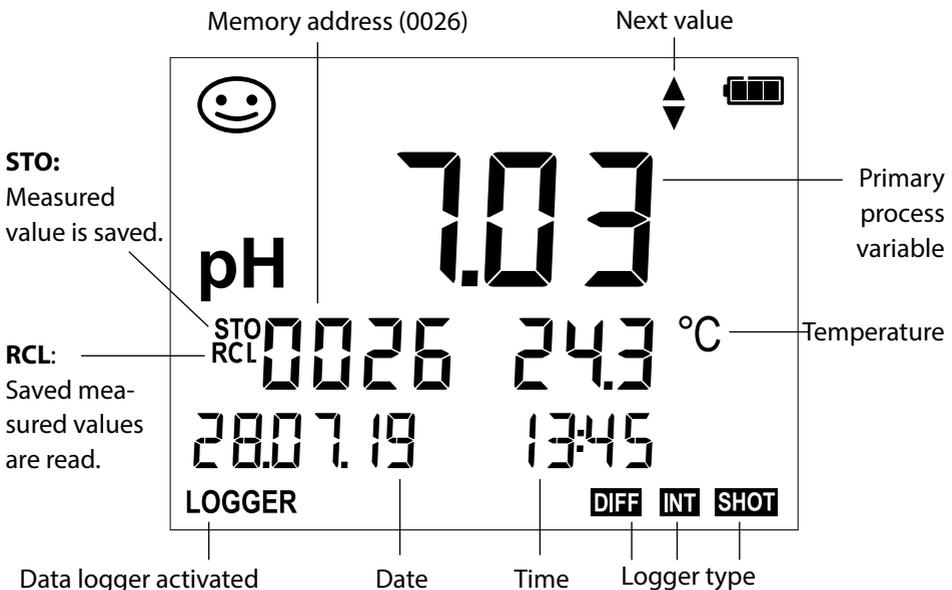
The following data are recorded: primary value, temperature, time stamp and device status.

Option 001 SOP can be used to set up an access lock for the data logger, which in the absence of an access code allows only logger data to be displayed (see page 35).

The Paraly SW 112 PC software allows convenient management of the data logger.

It is always the currently selected process variable which is recorded. The "STO" icon and the memory address is displayed briefly to indicate that an entry is being saved.

### Display: Icons Related to the Data Logger



## Operating Modes of the Data Logger (Logger Type)

### Manual Logging when Logger is Activated (SHOT)

In this mode, a measured value is recorded each time the **STO** key is pressed.

Measurement  
Logger **activated**

↓ **STO**

The measured value is saved to the address of the last recorded value + 1

### Manual Logging when Logger is Deactivated

Measurement  
Logger **deactivated**

↓ **STO**

Measured value is maintained  
Proposed address blinks  
(address of the last recorded  
value + 1)

If desired: Select a start address using ▲▼.

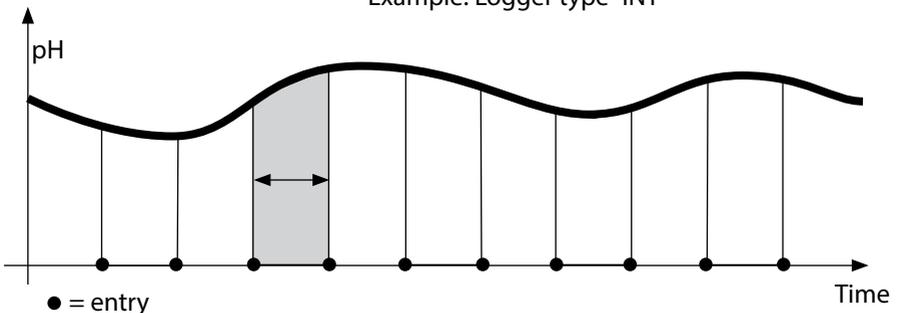
↓ **STO**

Measured value is saved to the desired address (e.g., for overwriting an incorrect measurement).

### Interval (INT)

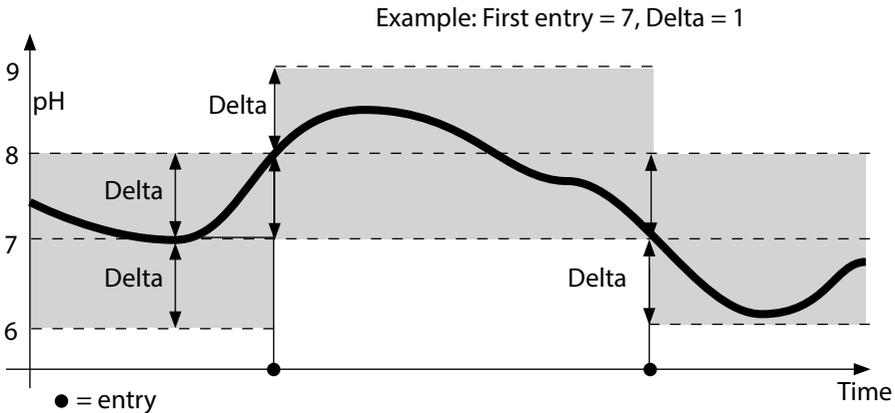
In this mode, the measured values are cyclically recorded.

Example: Logger type "INT"



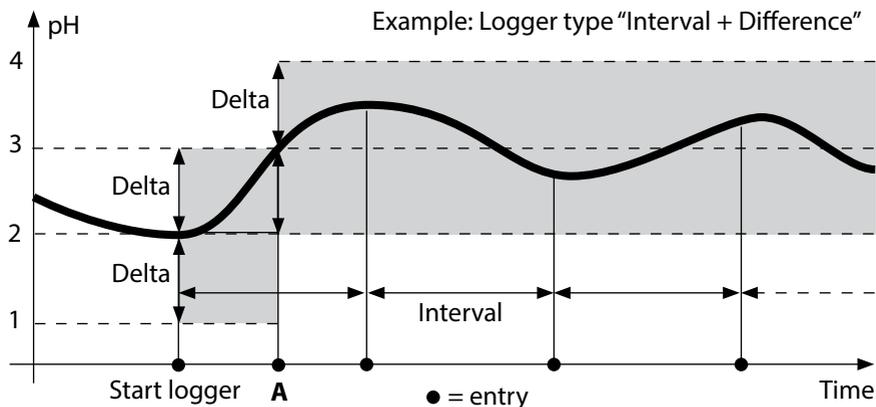
### Difference (DIFF)

When the delta range (process variable and/or temperature) related to the last entry is exceeded, a new entry is created and the delta range is displaced upwards or downwards by the delta value. The first entry is automatically created when the data logger is started.



### Difference + Interval Combined (DIFF+INT)

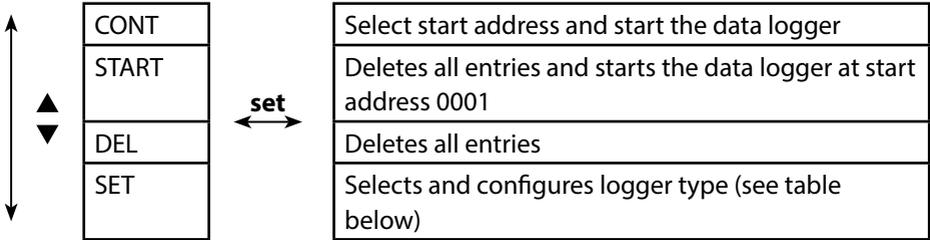
When the delta range related to the last DIFF entry is exceeded, a new entry is created (example: entry **A**) and the delta range is displaced upwards or downwards by the delta value. As long as the measured value remains within the delta range, logging is performed at the preset interval. The first DIFF entry is automatically created when the data logger is started.



## Data Logger Menu

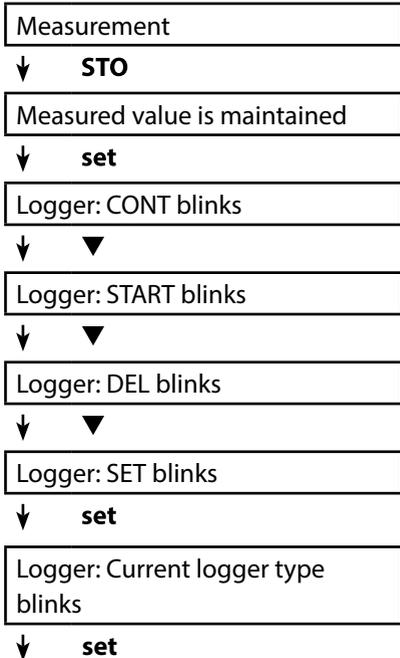
Logger view

Select using arrow keys, confirm by pressing **set**.



## Configuring the Data Logger

Prerequisite: The data logger is stopped (press **meas**).



Select desired logger type using ▲▼: DIFF, INT, DIFF+INT or SHOT.

Select the appropriate parameters using ▲▼ and confirm each selection by pressing **set**. When configuration is finished, CONT blinks. You can start the data logger by selecting START or CONT (see page 31).

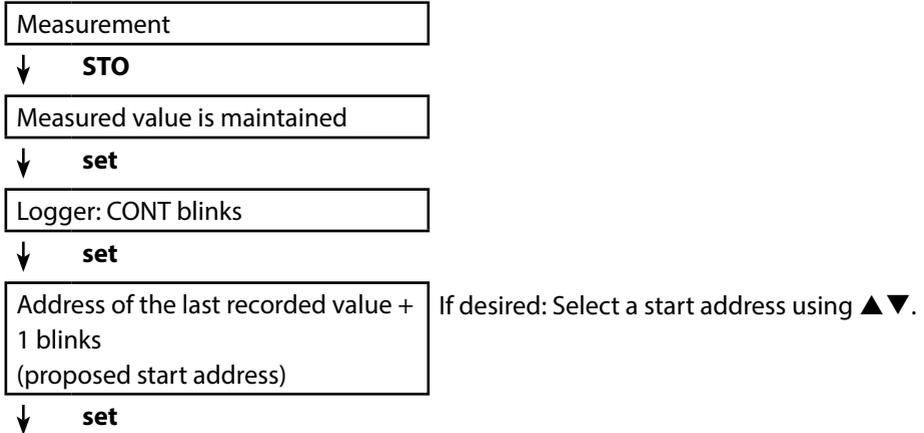
## Configuring the Logger Type

Logger type	Select (default in bold print)	
DIFF <sup>1)</sup>	Delta pH / mV	OFF / pH 0.01 ... 14.00 / <b>pH 1.00</b> OFF / 1... 1000 mV / <b>1 mV</b>
	Delta °C / °F	OFF / 0.1 ... 50.0 °C / <b>1.0 °C</b> OFF / 0.1 ... 100.0 °F / <b>1.0 °F</b>
INT	Interval	h:mm:ss 0:00:01 ... 9:59:59 / <b>0:01:00</b>
DIFF+INT	DIFF	See logger type DIFF
	INT	See logger type INT
SHOT	Currently selected process variable is saved.	

1) Process variables dependent on configuration, see page 16

## Starting the Data Logger using CONT

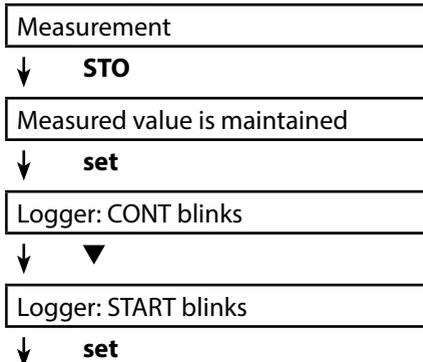
Prerequisite: Data logger is configured. Every time the meter has been switched off, the data logger must be restarted (exception: SHOT).



The measured value is saved to the selected start address (exception: SHOT). “... FREE MEMORY” is displayed. “LOGGER” and “active logger type” icons are displayed.

## Starting the Data Logger using START

Prerequisite: Data logger is configured. All existing entries are deleted. The start address for saving the values is 0001. Every time the meter has been switched off, the data logger must be restarted (exception: SHOT).



All entries will be deleted. “5000 FREE MEMORY” is displayed. “LOGGER” and “active logger type” icons are displayed.

## Displaying the Logger Data

Pressing the **RCL** key displays all stored values. The Paraly SW 112 PC software allows convenient management of the data logger.

Measurement

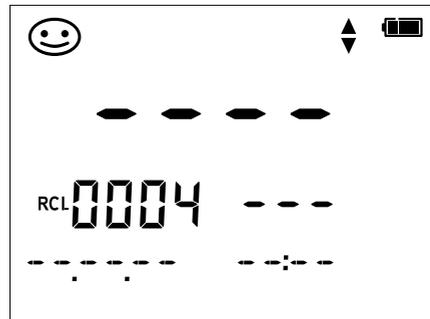
**RCL**

The "RCL" icon and the last recorded value is displayed.

Use ▲▼ to select the desired address.  
Empty memory locations will also be displayed.

**RCL or meas**

Return to measurement



## Stopping the Data Logger

You can stop the data logger at any time by pressing the **meas** key.

Measurement, logger **activated**



**meas**

Data logger is stopped. "LOGGER" and "active logger type" icons are no longer displayed. It is still possible to hold a measured value by pressing **STO** and send it to any desired address.

## Clearing the Data Logger

Selecting "DEL" deletes all data records.

Measurement



**STO**

Measured value is maintained



**set**

Logger: CONT blinks



▼

Logger: START blinks



▼

Logger: DEL blinks  
PRESS SET



**set**

All stored data are deleted.  
"0000 DELETED" is displayed.



Press the **clock** key to access the clock mode. Date and time will be displayed in the format as set in the configuration menu.

To set the clock, proceed as follows:

Display of  
time+date

↓ **set**

Hour display blinks  
SET HOUR



Set value.

↓ **set**

Minute display blinks  
SET MINUTE



Set value.

↓ **set**

Second display blinks and  
shows 00

**set**

Clock is started, the seconds count up.

↓ **set**

Year display blinks  
SET YEAR



Set value.

↓ **set**

Month display blinks  
SET MONTH



Set value.

↓ **set**

Day display blinks  
SET DAY



Set value.

↓ **set**

Display of  
corrected time+date

## Option 001 SOP (Standard Operating Procedure)

### Scope:

#### Cal SOP Calibration Method

The calibration method must be configured using the Paraly SW 112 PC software. Here, you specify which buffers are to be used in which sequence. You can combine buffer solutions from different buffer sets. Please note that the minimum distance allowed between two buffer solutions is  $\Delta 2$  pH units.

SOP calibration allows you to:

- select up to three calibration points and three buffer sets.
- add a verification buffer.
- specify a maximum deviation (0 ... 0.5 pH units) for the verification buffer as delta pH.

#### Sensor Verification

The Paraly SW 112 PC software allows a sensor to be assigned to the device. See the Paraly SW 112 PC software user manual.

#### Setup / Cal / Logger Code

Access codes can be set on the meter or using the Paraly SW 112 PC software; see page 37.

Configuration: SETUP CODE

Calibration: CAL CODE

Data logger: LOGGER CODE

Without entry of an access code, the data logger will only display logger data (RCL).

#### Temperature Calibration

(also separately available as Option 002 TEMP.CAL)

## Option 002 TEMP.CAL (Temperature Calibration)

For Memosens sensors, you can perform a 1-point calibration of the internal temperature detector. See the Calibration chapter for a description.

## Enabling Options / TAN Input



When you have bought an option, you receive a document with a code (TAN) for enabling this option on your device.

Press the **set** key to access the configuration mode.

Use the arrow keys to select the "TAN TEMP CAL" function, for example, where you can enter the TAN for enabling the option.

↓ **set**

TAN TEMP CAL

**set** Press the **set** key.

↓ **set**



Enter the TAN code:

First digit blinks.



Set value.

↓ **set**

Next digit blinks.



Set value.

↓ **set**

...



Set value, press **set** to save the TAN.

After correct input of the TAN, the device signals "PASS" – the option is now available

## Access Codes for CONF, CAL, and Data Logger

(with Option 001 SOP only)



Press the **set** key to access the configuration mode.

Use the arrow keys to select the "SETUP CODE" function and set an access code for configuration, "CAL CODE" to set an access code for calibration, and/or "LOGGER CODE" to set an access code for the data logger.

### Important Note:

If you lose the SETUP access code, system access is locked.  
See the next page for more information.

↓ **set**

SETUP CODE

**set** Press the **set** key.

↓ **set**

First digit blinks.



Set value.

↓ **set**

Next digit blinks.



Set value.

↓ **set**

...



Set value, press **set** to save the configuration access code.

When accessing the configuration menu, you will be prompted to enter an access code.

If you want to set a code for access to calibration or the data logger, select "CAL CODE" or "LOGGER CODE" and proceed as described above.

**Note:** Functions are accessible to anyone with access code "0000".

## Inputting the Rescue TAN

If you lose the SETUP access code, system access is locked.

The manufacturer can generate a rescue TAN (TAN RESCUE).

For this purpose, please have the serial number of the corresponding device to hand.

If you have any questions, please contact Knick Elektronische Messgeräte

GmbH & Co. KG using the contact details provided on the last page of this

document.

The menu for input of the rescue TAN appears if the SETUP access code is incorrectly entered three times:



The Paraly SW 112 PC software supplements the Portavo series. It allows convenient management of the data that have been acquired by the meters as well as simple and clear configuration of the meters. Paraly SW 112 starts automatically when the Portavo USB port is connected to the computer.

The Paraly SW 112 PC software stands out by the following features:

- Intuitive Windows user interface
- Easy configuration and management of several meters
- Display of device and sensor information
- Configuration of individual buffer sets
- Convenient management and evaluation of the data logger
- Export function for Microsoft Excel
- Print function
- Upgrade/downgrade of device firmware

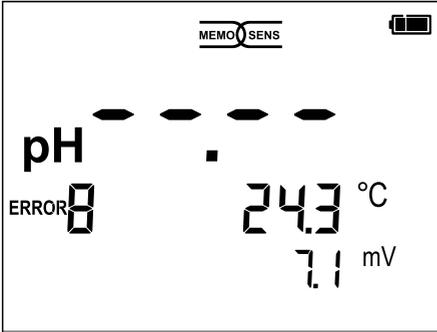
**Note:** Prior to upgrading/downgrading the device firmware, Portavo is reset to its factory settings.

Make the following backups prior to upgrading or downgrading:

- Read out Portavo data logger.
- Save the Portavo device configuration in Paraly.

The Paraly SW 112 PC software, incl. a detailed user manual, can be downloaded from [www.knick.de](http://www.knick.de).

Error messages are indicated as “ERROR ...” on the display. Information on the sensor condition is indicated by the “Sensoface” icon (friendly, neutral, sad) possibly accompanied by an info message (“INFO ...”).



Example of an error message:  
ERROR 8 (identical calibration media)



Example of a “Sensoface” message:  
INFO 1 (cal timer expired)

Sensoface (the “smiley” icon) provides information on the sensor condition (maintenance request). Measurement can still be performed. After a calibration, the corresponding Sensoface icon (friendly, neutral, sad) is shown together with the calibration data. Otherwise, Sensoface is only visible in measuring mode.

The most important error messages and “Sensoface” info messages are shown on the inside of the protective cover. A complete list of messages and their meanings is provided in the following tables.



## “Sensoface” Messages

The “Sensoface” icon provides information on the sensor condition:

### Sensoface Meaning



Sensor is okay



Calibrate the sensor soon



Calibrate or replace the sensor

The “neutral” and “sad” Sensoface icons are accompanied by an “INFO ...” message to give a hint to the cause of deterioration.

Sensoface	Message	Cause
	INFO 1	Calibration timer
	INFO 3	Sensocheck
	INFO 5	Zero / Slope
	INFO 6	Response time
	INFO 7	ISFET: Operating point (asymmetry potential)
	INFO 8	ISFET: Leakage current
	INFO 9	ORP offset

## Error Messages

The following error messages can be shown in the display.

Message	Cause	Remedy
 blinks	Battery empty	Replace batteries
ERROR 1	pH value out of range	Check whether the measurement conditions correspond to the adjusted measuring range.
ERROR 2	ORP value out of range	
ERROR 3	Temperature value out of range	
ERROR 4	Sensor zero point too high/low	Thoroughly rinse the sensor and recalibrate. If this does not help, replace the sensor.
ERROR 5	Sensor slope too high/low	
ERROR 8	Calibration error: Identical buffers	Use a buffer solution with a different nominal value before starting the next calibration step.
ERROR 9	Calibration error: Buffer unknown	Make sure that you use the same buffer set as configured.
ERROR 10	Cal media interchanged	Repeat calibration.
ERROR 11	Measured value unstable Drift too high	Leave the sensor in the liquid until the temperature is stable. If this does not help, replace the sensor.
ERROR 14	Time and date invalid	Set time and date
ERROR 18	Configuration invalid	Restart, reset to factory settings (Setup: DEFAULT YES), configure and calibrate. If this does not help, send in the device for repair.
ERROR 19	Factory settings error	Device defective, send it in.
ERROR 21	Sensor error (Memosens) or Sensor verification message	Connect an operational Memosens sensor. With sensor verification activated in Paraly SW 112, this error message indicates that an unassigned sensor was connected.
ERROR 25	Buffer distance (user-defined buffer table)	Re-enter the buffer table.

## Accessories/Options

Item	Order No.
Robust field case (for meter, sensor, various small parts and user manual)	ZU0934
Li-ion battery (for Portavo 904 PH only)	ZU0925
Replacement quiver (5 units)	ZU0929
Adapter for process sensors with Ø 12 mm and PG 13.5 thread for use with quiver	ZU0939
Sensor protection for process sensors with Ø 12 mm and PG 13.5 thread	ZU1054
Sensor protection for process sensors with Ø 12 mm and PG 13.5 thread made of PVDF	ZU1121
Base stand for mounting up to 3 sensors, with base plate made of stainless steel	ZU6953
Measuring cable with M8 connector for sensors with Memosens connector	
Length 1.5 m / 4.92 ft	CA/MS-001XFA-L
Length 2.9 m / 9.51 ft	CA/MS-003XFA-L
<b>Temperature Detectors</b>	<b>Order No.</b>
Pt1000 temperature detector	ZU6959
Pt1000 temperature detector with angled connector	ZU0156

**Note:** When a Memosens sensor is connected, the temperature detector of the Memosens sensor is used. When a Memosens sensor is not connected, the Portavo can be used as a temperature meter.

**TAN Options****Order No.**

SOP (Standard Operating Procedure): Cal SOP calibration method, user management, sensor verification, temperature detector adjustment in the Memosens sensor (offset correction)	SW-P001
Temperature detector adjustment in the Memosens sensor (offset correction)	SW-P002

Paraly SW112 PC software for configuration and firmware updates:  
Free download from [www.knick.de](http://www.knick.de)

**pH Sensors**

Please visit our website for more information on our product range: [www.knick.de](http://www.knick.de).

## Knick CaliMat Buffer Solutions

Ready-to-Use Quality pH Buffer Solutions

<b>pH Value (20 °C/68 °F)</b>	<b>Quantity</b>	<b>Order No.</b>
2.00	250 ml	CS-P0200/250
4.00	250 ml	CS-P0400/250
	1000 ml	CS-P0400/1000
	3000 ml	CS-P0400/3000
	250 ml	CS-P0700/250
7.00	1000 ml	CS-P0700/1000
	3000 ml	CS-P0700/3000
	250 ml	CS-P0900/250
9.00	1000 ml	CS-P0900/1000
	3000 ml	CS-P0900/3000
	250 ml	CS-P1200/250
12.00		
<b>Buffer Solution Sets (20 °C/68 °F)</b>		
Set 4.00	3 x 250 ml	CS-PSET4
Set 7.00	3 x 250 ml	CS-PSET7
Set 9.00	3 x 250 ml	CS-PSET9
Set 4.00, 7.00, 9.00	250 ml each	CS-PSET479
KCl solution, 3 molar	250 ml	ZU0062

<b>pH/mV input</b>	pH socket DIN 19 262 (13/4 mm)	
pH measuring range	-2 ... 16	
Decimal places <sup>*)</sup>	2 or 3	
	Input resistance	1 x 10 <sup>12</sup> Ω (0 ... 35 °C/32 ... 95 °F)
	Input current	1 x 10 <sup>-12</sup> A (at RT, doubles every 10 K)
Measuring cycle	Approx. 1 s	
Measurement error <sup>1,2,3)</sup>	< 0.01 pH, TC < 0.001 pH/K	
mV measuring range	-1300 ... 1300 mV	
Measuring cycle	Approx. 1 s	
Measurement error <sup>1,2,3)</sup>	< 0.1 % of measured value + 0.3 mV, TC < 0.03 mV/K	
<b>Temperature input</b>	2 x Ø 4 mm for integrated or separate temperature probe	
Measuring ranges	NTC30 temp. detector	-20 ... 120 °C/-4 ... 248 °F
	Pt1000 temp. detector	-40 ... 250 °C/-40 ... 482 °F
Measuring cycle	Approx. 1 s	
Measurement error <sup>1,2,3)</sup>	< 0.2 K (T <sub>amb</sub> = 23 °C/73.4 °F); TC < 25 ppm/K	
<b>Memosens pH input (also ISFET)</b>	M8 socket, 4-pin, for Memosens laboratory cable	
Display ranges <sup>4)</sup>	pH	-2.00 ... 16.00
	mV	-2000 ... 2000 mV
	Temperature	-50 ... 250 °C/-58 ... 482 °F
<b>Memosens input ORP</b>	M8 socket, 4-pin, for Memosens laboratory cable	
Display ranges <sup>4)</sup>	mV	-2000 ... 2000 mV
	Temperature	-50 ... 250 °C/-58 ... 482 °F

\*) User-defined

1) At rated operating conditions

2) ± 1 digit

3) Plus sensor error

4) Ranges dependent on Memosens sensor

## Sensor adjustment

Operating modes *	CALIMATIC	Calibration with automatic buffer recognition
	Manual	Manual calibration with entry of individual buffer values
	DATA INPUT	Data entry of zero and slope
	ISFET calibration	Setting the ISFET operating point
	Cal-SOP (TAN option)	Software option SW-P001: Defining the pH buffers and the sequence of the calibration steps; defining the delta deviation for the verification buffer
	ORP calibration	Zero offset for ORP or ph/ORP combo sensors
	Temperature Calibration (TAN option)	Software option SW-P002 for temperature probe adjustment in the Memosens sensor (offset correction)
	FREE CAL	Free selection of calibration method
Calimatic buffer sets *	-01- Mettler-Toledo	2.00/4.01/7.00/9.21
	-02- Knick CaliMat	2.00/4.00/7.00/9.00/12.00
	-03- Ciba (94)	2.06/4.00/7.00/10.00
	-04- NIST technical	1.68/4.00/7.00/10.01/12.46
	-05- NIST standard	1.679/4.006/6.865/9.180
	-06- HACH	4.01/7.00/10.01/12.00
	-07- WTW techn. buffers	2.00/4.01/7.00/10.00
	-08- Hamilton	2.00/4.01/7.00/10.01/12.00
	-09- Reagecon	2.00/4.00/7.00/9.00/12.00
	-10- DIN 19267	1.09/4.65/6.79/9.23/12.75
	-U1- (User)	loadable via Paraly SW 112
Permissible calibration ranges	Zero point	6 ... 8 pH
	For ORP sensor: ΔmV (offset)	-700 ... 700 mV
	With ISFET sensor: Operating point (asymmetry)	-750 ... 750 mV
	Slope	approx. 74 ... 104 %
		(possibly restricting notes from Sensoface)

**Calibration timer<sup>1)</sup>** Interval 1 ... 99 days, can be switched off

**Sensoface** Provides information on the condition of the sensor

Evaluation of Zero point/slope, response time, calibration interval, see p. 41

\*) User-defined

<b>Connections</b>	1x pH socket DIN 19262 2x 4-mm socket for separate temperature detector 1x M8 socket, 4 pins, for Memosens lab cable 1x micro USB-B for data transmission to PC <b>Portavo 904X:</b> Be sure to observe the safety instructions when using the USB port.
<b>Display</b>	LCD STN 7-segment display with 3 lines and icons
Sensoface	Status display (friendly, neutral, sad)
Status indicators	Battery condition, logger
Notices	Hourglass
Keypad	[on/off], [cal], [meas], [set], [▲], [▼], [STO], [RCL], [clock]
<b>Data logger</b>	With up to 5000 memory locations
Recording	Manual, interval- or event-controlled
<b>Communication</b>	USB 2.0
Profile	HID, driverless installation
Usage	Data exchange and configuration via Paraly SW 112 PC software
<b>Diagnostic functions</b>	
Sensor data (Memosens only)	Manufacturer, sensor type, serial number, operating time
Calibration data	Calibration date, zero point, slope
Device self-test	Automatic memory test (FLASH, EEPROM, RAM)
Device data	Device type, software version, hardware version
<b>Data retention</b>	Parameter, calibration data > 10 years
<b>EMC</b>	EN 61326-1 (General requirements)
Emitted interference	Class B (residential)
Immunity to interference	Industrial applications EN 61326-2-3 (Particular Requirements for Transmitters)
<b>Explosion protection</b>	See control drawing for entity parameters.
Portavo 904X	

<b>RoHS conformity</b>	According to Directive 2011/65/EU
<b>Power supply</b>	
Portavo 904	Batteries: 4x AA alkaline or 4x NiMH (rechargeable) or 1x Li-ion battery, USB chargeable
Portavo 904X	4x AA batteries For battery types, see Control Drawing No. 209,009-110
Operating time	Approx. 1000 h (alkaline)
<b>Rated operating conditions</b>	
Ambient temperature	-10 °C ... 55 °C/ 14 ... 122 °F
Ambient temperature 904X	-10 °C ≤ Ta ≤ +40 °C T4 Duracell MN1500 -10 °C ≤ Ta ≤ +50 °C T3 Energizer E91 -10 °C ≤ Ta ≤ +50 °C T3 Power One 4106 -10 °C ≤ Ta ≤ +50 °C T3 Panasonic Pro Power LR6
Transport/ Storage temperature	-25 ... 70 °C/-13 ... 158 °F
Relative humidity	0 ... 95 %, brief condensation permissible
<b>Housing</b>	
Material	PA12 GF30 (silver gray RAL 7001) + TPE (black)
Protection	IP66/67 with pressure compensation
Dimensions	Approx. 132 x 156 x 30 mm
Weight	Approx. 500 g

pH

**-01- Mettler-Toledo**

Nominal values in bold.

°C	pH			
0	2.03	4.01	7.12	9.52
5	2.02	4.01	7.09	9.45
10	2.01	4.00	7.06	9.38
15	2.00	4.00	7.04	9.32
20	2.00	4.00	7.02	9.26
<b>25</b>	<b>2.00</b>	<b>4.01</b>	<b>7.00</b>	<b>9.21</b>
30	1.99	4.01	6.99	9.16
35	1.99	4.02	6.98	9.11
40	1.98	4.03	6.97	9.06
45	1.98	4.04	6.97	9.03
50	1.98	4.06	6.97	8.99
55	1.98	4.08	6.98	8.96
60	1.98	4.10	6.98	8.93
65	1.99	4.13	6.99	8.90
70	1.99	4.16	7.00	8.88
75	2.00	4.19	7.02	8.85
80	2.00	4.22	7.04	8.83
85	2.00	4.26	7.06	8.81
90	2.00	4.30	7.09	8.79
95	2.00	4.35	7.12	8.77

## -02- Knick CaliMat

Nominal values in bold.

°C	pH				
0	2.01	4.05	7.09	9.24	12.58
5	2.01	4.04	7.07	9.16	12.39
10	2.01	4.02	7.04	9.11	12.26
15	2.00	4.01	7.02	9.05	12.13
<b>20</b>	<b>2.00</b>	<b>4.00</b>	<b>7.00</b>	<b>9.00</b>	<b>12.00</b>
25	2.00	4.01	6.99	8.95	11.87
30	2.00	4.01	6.98	8.91	11.75
35	2.00	4.01	6.96	8.88	11.64
40	2.00	4.01	6.96	8.85	11.53
50	2.00	4.01	6.96	8.79	11.31
60	2.00	4.00	6.96	8.73	11.09
70	2.00	4.00	6.96	8.70	10.88
80	2.00	4.00	6.98	8.66	10.68
90	2.00	4.00	7.00	8.64	10.48

pH

**-03- Ciba (94)**

Nominal values: 2.06 4.00 7.00 10.00

°C	pH			
0	2.04	4.00	7.10	10.30
5	2.09	4.02	7.08	10.21
10	2.07	4.00	7.05	10.14
15	2.08	4.00	7.02	10.06
20	2.09	4.01	6.98	9.99
25	2.08	4.02	6.98	9.95
30	2.06	4.00	6.96	9.89
35	2.06	4.01	6.95	9.85
40	2.07	4.02	6.94	9.81
45	2.06	4.03	6.93	9.77
50	2.06	4.04	6.93	9.73
55	2.05	4.05	6.91	9.68
60	2.08	4.10	6.93	9.66
65	2.07 <sup>1)</sup>	4.10 <sup>1)</sup>	6.92 <sup>1)</sup>	9.61 <sup>1)</sup>
70	2.07	4.11	6.92	9.57
75	2.04 <sup>1)</sup>	4.13 <sup>1)</sup>	6.92 <sup>1)</sup>	9.54 <sup>1)</sup>
80	2.02	4.15	6.93	9.52
85	2.03 <sup>1)</sup>	4.17 <sup>1)</sup>	6.95 <sup>1)</sup>	9.47 <sup>1)</sup>
90	2.04	4.20	6.97	9.43
95	2.05 <sup>1)</sup>	4.22 <sup>1)</sup>	6.99 <sup>1)</sup>	9.38 <sup>1)</sup>

1) extrapolated

**-04- Technical Buffers to NIST**

Nominal values in bold.

°C	pH				
0	1.67	4.00	7.115	10.32	13.42
5	1.67	4.00	7.085	10.25	13.21
10	1.67	4.00	7.06	10.18	13.01
15	1.67	4.00	7.04	10.12	12.80
20	1.675	4.00	7.015	10.06	12.64
<b>25</b>	<b>1.68</b>	<b>4.005</b>	<b>7.00</b>	<b>10.01</b>	<b>12.46</b>
30	1.68	4.015	6.985	9.97	12.30
35	1.69	4.025	6.98	9.93	12.13
40	1.69	4.03	6.975	9.89	11.99
45	1.70	4.045	6.975	9.86	11.84
50	1.705	4.06	6.97	9.83	11.71
55	1.715	4.075	6.97	9.83 <sup>1)</sup>	11.57
60	1.72	4.085	6.97	9.83 <sup>1)</sup>	11.45
65	1.73	4.10	6.98	9.83 <sup>1)</sup>	11.45 <sup>1)</sup>
70	1.74	4.13	6.99	9.83 <sup>1)</sup>	11.45 <sup>1)</sup>
75	1.75	4.14	7.01	9.83 <sup>1)</sup>	11.45 <sup>1)</sup>
80	1.765	4.16	7.03	9.83 <sup>1)</sup>	11.45 <sup>1)</sup>
85	1.78	4.18	7.05	9.83 <sup>1)</sup>	11.45 <sup>1)</sup>
90	1.79	4.21	7.08	9.83 <sup>1)</sup>	11.45 <sup>1)</sup>
95	1.805	4.23	7.11	9.83 <sup>1)</sup>	11.45 <sup>1)</sup>

1) values added

pH

**-05- NIST Standard (DIN 19266: 2015-05)**

Nominal values in bold.

°C	pH				
0	1.666	4.000	6.984	9.464	
5	1.668	3.998	6.951	9.395	13.207
10	1.670	3.997	6.923	9.332	13.003
15	1.672	3.998	6.900	9.276	12.810
20	1.675	4.000	6.881	9.225	12.627
<b>25</b>	<b>1.679</b>	<b>4.005</b>	<b>6.865</b>	<b>9.180</b>	<b>12.454</b>
30	1.683	4.011	6.853	9.139	12.289
35	1.688	4.018	6.844	9.102	12.133
37		4.022	6.841	9.088	
38	1.691				12.043
40	1.694	4.027	6.838	9.068	11.984
45					11.841
50	1.707	4.050	6.833	9.011	11.705
55	1.715	4.075	6.834	8.985	11.574
60	1.723	4.091	6.836	8.962	11.449
70	1.743	4.126	6.845	8.921	
80	1.766	4.164	6.859	8.885	
90	1.792	4.205	6.877	8.850	
95	1.806	4.227	6.886	8.833	

**Note:** The actual pH(S) values of the individual batches of the reference materials are documented in a certificate of an accredited laboratory. This certificate is supplied with the respective buffers. Only these pH(S) values shall be used as standard values for the secondary reference buffer materials. Correspondingly, this standard does not include a table with standard pH values for practical use. The table above only provides examples of pH(S) values for orientation.

## -06- HACH

Nominal values: 4.01 7.00 10.01 ( $\pm 0.02$  at 25 °C)

°C	pH		
0	4.00	7.118	10.30
5	4.00	7.087	10.23
10	4.00	7.059	10.17
15	4.00	7.036	10.11
20	4.00	7.016	10.05
25	4.01	7.00	10.00
30	4.01	6.987	9.96
35	4.02	6.977	9.92
40	4.03	6.97	9.88
45	4.05	6.965	9.85
50	4.06	6.964	9.82
55	4.07	6.965	9.79
60	4.09	6.968	9.76
65	4.10	6.98	9.71
70	4.12	7.00	9.66
75	4.14	7.02	9.63
80	4.16	7.04	9.59
85	4.18	7.06	9.56
90	4.21	7.09	9.52
95	4.24	7.12	9.48

pH

**-07- WTW Technical Buffers**

Nominal values in bold.

°C	pH			
0	2.03	4.01	7.12	10.65
5	2.02	4.01	7.09	10.52
10	2.01	4.00	7.06	10.39
15	2.00	4.00	7.04	10.26
20	2.00	4.00	7.02	10.13
<b>25</b>	<b>2.00</b>	<b>4.01</b>	<b>7.00</b>	<b>10.00</b>
30	1.99	4.01	6.99	9.87
35	1.99	4.02	6.98	9.74
40	1.98	4.03	6.97	9.61
45	1.98	4.04	6.97	9.48
50	1.98	4.06	6.97	9.35
55	1.98	4.08	6.98	
60	1.98	4.10	6.98	
65	1.99	4.13	6.99	
70	2.00	4.16	7.00	
75	2.00	4.19	7.02	
80	2.00	4.22	7.04	
85	2.00	4.26	7.06	
90	2.00	4.30	7.09	
95	2.00	4.35	7.12	

## -08- Hamilton

Nominal values in bold.

°C	pH				
0	1.99	4.01	7.12	10.19	12.46
5	1.99	4.01	7.09	10.19	12.46
10	2.00	4.00	7.06	10.15	12.34
15	2.00	4.00	7.04	10.11	12.23
20	2.00	4.00	7.02	10.06	12.11
<b>25</b>	<b>2.00</b>	<b>4.01</b>	<b>7.00</b>	<b>10.01</b>	<b>12.00</b>
30	1.99	4.01	6.99	9.97	11.90
35	1.98	4.02	6.98	9.92	11.80
40	1.98	4.03	6.97	9.86	11.70
45	1.97	4.04	6.97	9.83	11.60
50	1.97	4.06	6.97	9.79	11.51
55	1.97	4.08	6.98	9.77	11.51
60	1.97	4.10	6.98	9.75	11.51
65	1.97	4.13	6.99	9.74	11.51
70	1.97	4.16	7.00	9.73	11.51
75	1.97	4.19	7.02	9.73	11.51
80	1.97	4.22	7.04	9.73	11.51
85	1.97	4.26	7.06	9.74	11.51
90	1.97	4.30	7.09	9.75	11.51
95	1.97	4.35	7.09	9.75	11.51

pH

**-09- Reagecon**

Nominal values in bold.

°C	pH				
0	2.01 <sup>1)</sup>	4.01 <sup>1)</sup>	7.07 <sup>1)</sup>	9.18 <sup>1)</sup>	12.54 <sup>1)</sup>
5	2.01 <sup>1)</sup>	4.01 <sup>1)</sup>	7.07 <sup>1)</sup>	9.18 <sup>1)</sup>	12.54 <sup>1)</sup>
10	2.01	4.00	7.07	9.18	12.54
15	2.01	4.00	7.04	9.12	12.36
20	2.01	4.00	7.02	9.06	12.17
<b>25</b>	<b>2.00</b>	<b>4.00</b>	<b>7.00</b>	<b>9.00</b>	<b>12.00</b>
30	1.99	4.01	6.99	8.95	11.81
35	2.00	4.02	6.98	8.90	11.63
40	2.01	4.03	6.97	8.86	11.47
45	2.01	4.04	6.97	8.83	11.39
50	2.00	4.05	6.96	8.79	11.30
55	2.00	4.07	6.96	8.77	11.13
60	2.00	4.08	6.96	8.74	10.95
65	2.00 <sup>1)</sup>	4.10 <sup>1)</sup>	6.99 <sup>1)</sup>	8.70 <sup>1)</sup>	10.95 <sup>1)</sup>
70	2.00 <sup>1)</sup>	4.12 <sup>1)</sup>	7.00 <sup>1)</sup>	8.67 <sup>1)</sup>	10.95 <sup>1)</sup>
75	2.00 <sup>1)</sup>	4.14 <sup>1)</sup>	7.02 <sup>1)</sup>	8.64 <sup>1)</sup>	10.95 <sup>1)</sup>
80	2.00 <sup>1)</sup>	4.16 <sup>1)</sup>	7.04 <sup>1)</sup>	8.62 <sup>1)</sup>	10.95 <sup>1)</sup>
85	2.00 <sup>1)</sup>	4.18 <sup>1)</sup>	7.06 <sup>1)</sup>	8.60 <sup>1)</sup>	10.95 <sup>1)</sup>
90	2.00 <sup>1)</sup>	4.21 <sup>1)</sup>	7.09 <sup>1)</sup>	8.58 <sup>1)</sup>	10.95 <sup>1)</sup>
95	2.00 <sup>1)</sup>	4.24 <sup>1)</sup>	7.12 <sup>1)</sup>	8.56 <sup>1)</sup>	10.95 <sup>1)</sup>

1) values added

**-10- DIN 19267**

Nominal values in bold.

°C	pH				
0	1.08	4.67	6.89	9.48	13.95 <sup>1)</sup>
5	1.08	4.67	6.87	9.43	13.63 <sup>1)</sup>
10	1.09	4.66	6.84	9.37	13.37
15	1.09	4.66	6.82	9.32	13.16
20	1.09	4.65	6.80	9.27	12.96
<b>25</b>	<b>1.09</b>	<b>4.65</b>	<b>6.79</b>	<b>9.23</b>	<b>12.75</b>
30	1.10	4.65	6.78	9.18	12.61
35	1.10	4.65	6.77	9.13	12.45
40	1.10	4.66	6.76	9.09	12.29
45	1.10	4.67	6.76	9.04	12.09
50	1.11	4.68	6.76	9.00	11.89
55	1.11	4.69	6.76	8.96	11.79
60	1.11	4.70	6.76	8.92	11.69
65	1.11	4.71	6.76	8.90	11.56
70	1.11	4.72	6.76	8.88	11.43
75	1.11	4.73	6.77	8.86	11.31
80	1.12	4.75	6.78	8.85	11.19
85	1.12	4.77	6.79	8.83	11.09
90	1.13	4.79	6.80	8.82	10.99
95	1.13 <sup>1)</sup>	4.82 <sup>1)</sup>	6.81 <sup>1)</sup>	8.81 <sup>1)</sup>	10.89 <sup>1)</sup>

1) extrapolated

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