SENTRON pH Meter

Type TITAN

Operations manual

SENTRON Europe B.V.
Aan de Vaart 3
P.O. Box 125
9300 AC Roden
The Netherlands
Tel: +31(0)50 501 38 00
Fax: +31(0)50 501 68 34
E-mail: info@sentron.nl

Warning! There are no serviceable or replaceable parts in this product. Do not remove any covers as this can damage the instrument and compromise warranty.

All information contained in this manual is current at the time of publication. Our commitment to product improvement requires that we reserve the right to change equipment, procedures and specifications at any time.

Manual TITAN, SENTRON Ref. number E7500176, rev. 06, July 2007

In case your pH meter has this label and you are located in Europe, it means that in case the meter cannot be used any more, you have to send it back to Sentron to be destroyed in an environmental safe way.
Never put the meter into a trash can for 'normal' waste.

1. Introduction

1.1. Welcome

Congratulations! You have purchased a SENTRON TITAN pH-meter capable of highly accurate pH measurement by using the reliable and innovative SENTRON ISFET probes.

We advise to read the Quickstart-card carefully and act according to the instructions to ensure that the SENTRON TITAN system will work enjoyably for a long time. This manual can be of help when further details on features are required.

The SENTRON pH-meters and probes are designed for pH-measuring only. Do not use in any other application as this might result in instrument failure or damage.

Warning! There are no serviceable or replaceable parts in this product. Do not remove any covers as this can damage the instrument and compromise warranty.

1.2. Declaration of Conformity

SENTRON Europe B.V. of Roden, The Netherlands declares that this TITAN system is in compliance with the EMC-norms EN 50081-1 and EN 50082-1.

Due to conformity to these and other norms, the instrument is entitled to wear the CE-mark.

1.3. Definition of this manual

In this manual, words placed between “quotation marks” indicate that this text is shown in the meter’s display. Words between ‘brackets’ indicate that you are prompted to perform an action.

Additional information can be given in a **note** at the end of a section. **Warning!** indicates that potentially harmful actions are to be avoided. **DANGER!** indicates potential hazards when the equipment is improperly used.

At the beginning of this manual a ‘Table of Contents’ gives an overview of its lay-out and indicates where specific information can be found. The last chapter of this manual provides an alphabetic keywords list, referring to the pagenumber(s) where the information can be found.

In most cases however, the meter’s on-board help function can also be sufficient.

1.4. Layout of the meter

1.4.1. Keypad

The ‘controls’ of the SENTRON pH meter are condensed to only six keys located on the keypad.

The names ‘Power’, ‘Enter’ and ‘Arrow’ keys (‘Left’, ‘Right’, ‘Up’ and ‘Down’) will be used consistently throughout this manual.

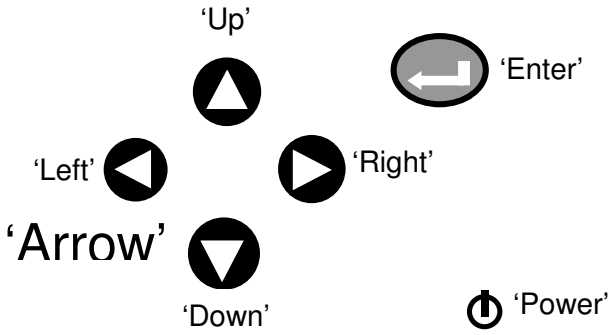


Figure 1: Keypad TITAN

After starting the meter by pressing ‘Power’, the display will briefly show the text ‘SENTRON integrated sensor technology’, the meter type (TITAN), the software revision number and date, and the meter’s serial number. Then the Main menu as described hereafter will be shown.

In the bottom left corner of the display an indication can read “ATT001” or another number. This is quite normal and no cause for concern.

Warning ! As the system is not yet calibrated, the pH value shown in the display is not reliable.

1.4.2. Display

The TITAN's display is a graphics Liquid Crystal Display (LCD). The pH value can be shown in 1 or 2 decimal resolution and temperature can be shown or be omitted. In chapter 3 these settings are explained in detail.

Paragraph 7.1 describes how the display contrast can be set over a wide range, allowing easy reading under virtually any ambient light conditions.

Figure 2 shows all possible contents of the display.

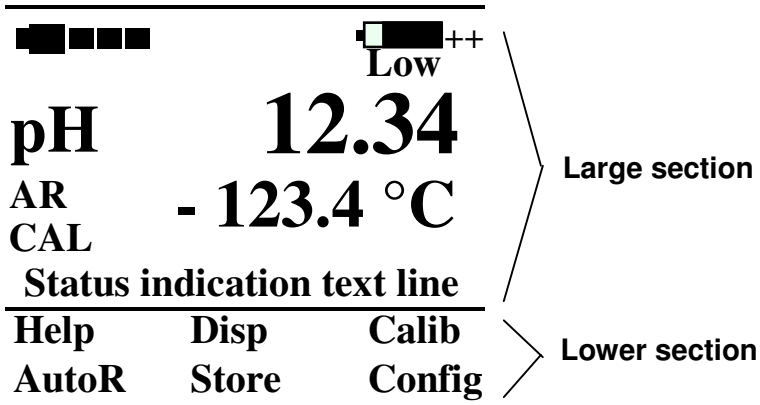


Figure 2: Possible display contents

The large section of the display shows following information:

Probe status indicator

Three blocks means that the probe gives maximum performance.

Two blocks means that the probe functions fine. Some maintenance (see cleaning procedure, page 32) can bring it up to maximum performance.
In case two blocks are achieved by new probes, it is advised to place the probe-tip in hand-warm water for 20 minutes, and then in buffer pH 4 for 1-2 hours. Recalibrate.

One block is typical for a probe that has been in use for some time.
The probe still gives accurate results, but may require cleaning by using water, toothbrush and some mild detergent. Recalibrate using fresh buffers.

If none of the recommended remedial actions lead to probe status improvement, the probe is near to the end of its functional life. Replacement will be necessary in the near future.

pH 12.34 **pH value indication**

These large digits represent the pH value

- 123.4 °C **Temperature indication**

These smaller digits represent the actual temperature in °C/ºF, see paragraph 7.3.1.

Battery status indication

When the remaining operational time is less than approximately 5 hours, a “low” indication will appear. When charging the battery, two alternating “+” symbols are shown on the right hand side of the battery symbol.
The filling of the battery symbol indicates the actual battery status.

AR **Autoread activated**

When the Autoread function (automatic stability check) is activated, the text “AR” will be shown in the display. Both the pH value and the “AR” symbol will blink when the signal is not stable. When the pH measurement signal is within the stability limits, the pH value and the “AR” symbol will be shown continuously, thus providing a clear visual stability indication. Also refer to chapter 5.

CAL **Calibration indication**

In the bottom left corner the text “CAL” will be blinking when calibration is in progress.

Status indication text line

The status text line at the bottom of the middle section is used for a wide variety of indications. Examples can be found throughout this manual.

Help Disp Calib
AutoR Store Config

Lower section menu items

In the lower section, the operating menu allows a variety of choices. Use the ‘Arrow’ keys to go to the desired selection, then use the ‘Enter’-key to activate the highlighted function. The menu options shown here are from the Main menu. Every sub-menu will show its own menu items.

1.4.3. Connections

Physically different connections guarantee that it is impossible to fit connectors to the wrong receptacle.

Connectors are placed on the backside of the TITAN meter as shown in figure 3.

Figure 3: Connectors available on TITAN

From left to right, following connectors are available:

Probe connector. 

This receptacle accepts the probe's 8-pole male connector. A physical insert allows only one possible connection. After insertion, the connector needs to be screwed on handtight by turning the sleeve clockwise.

AC Power supply. 

SENTRON provides adapters that transform wall-outlet AC power to the level required by the TITAN meter. The meter itself takes care of charging the internal battery.
See paragraph 1.4.4 for more information on battery management.

1.4.4. Battery

The built-in battery is a rechargeable Nickel-Metal-Hydride (NiMH) battery. Before shipment from SENTRON the battery is fully charged, but we suggest to connect to AC power for at least 12 hours before relying only on battery power. Battery charging is indicated in the display by a "++" sign on the right hand side of the battery symbol.

A fully charged battery will typically give 24 hours of use. The battery status is constantly indicated in the display, and automatic 'low' battery warning is given when the remaining battery life is approximately 5 hours.

Should the battery be completely exhausted during normal operation, it is still possible to recharge the battery to its normal condition but it is advised that the battery status indication is monitored by the user and that the battery is timely recharged by connecting the meter to AC power.

Note Overcharging the battery is not possible and the applied NiMH-batteries do not suffer from the so called "memory-effect".

A prolonged exhausted battery may result in an automatic meter reset. After recharging a completely exhausted battery, a user-reset may be required to restart the meter. Please refer to paragraph 8.2.

First connect the meter to the mains, and only then switch it off. This allows a visual check if the battery is charging correctly, indicated by the "++" signs next to the battery symbol.

2. HELP-Function

The TITAN meter is equipped with an elaborate on-board help function, designed to provide to-the-point assistance.

The HELP function presents a situation dependant overview of the meter's functionality which will in most cases be sufficient for the user to continue operation.

If a situation occurs that requires the user to take actions (indicated by the text "ATTxxx" on the display) the helptext will accurately describe the situation and what remedy can be taken.

3. Display pH and Temperature

The TITAN meter is a highly sophisticated and accurate instrument, equipped with a high quality graphic Liquid Crystal Display (LCD).

The pH value can be shown with either one- or two-decimal resolution, depending on the calibration method, the user's preference and the application demands.

The sample's temperature is measured by a thermistor which is built into the tip of the probe and provides fully Automatic Temperature Compensation (ATC). The temperature can be indicated in the display.

Thus, the system offers four possible display settings:
- pH 0.1 without temperature indication
- pH 0.1 with temperature indication
- pH 0.01 without temperature indication
- pH 0.01 with temperature indication

To change between these settings, go to the Main menu. Use the 'Arrow' keys to go to "Disp" and press 'Enter' repeatedly until the desired setting appears.

Note Because of the nature of a 1-point calibration, the accuracy is not sufficient for a 0.01 pH indication. When selecting the 0.01 pH resolution indication after a 1-point calibration, the second decimal will blink to indicate that it is not to be regarded as accurate. It is therefore advised to perform a calibration that provides the accuracy required by the application, i.e. a 1-point calibration for 0.1 pH accuracy or a 2- or 3-point calibration for 0.01 pH accuracy.

4. Calibration

To obtain reliable readings from the TITAN system it must first be calibrated, using correct buffers, for maximum accuracy at the same temperature as the sample will be.

The TITAN has four built-in tables of 5 buffers versus temperature. When performing a calibration, the bufferset chosen is shown on the display. The built-in buffersets are standardized DIN, JIS and NIST buffers and a SENTRON provided NIST traceable bufferset.

Factory default, the SENTRON bufferset is selected. Please refer to paragraph 7.3.4 on selection of another bufferset.

The system automatically stores calibration results for later review.
Paragraph 7.3.6 provides all details on this function.

Warning ! Make sure that the buffers used during calibration are identical to the selected bufferset, otherwise significant variations in measurement values may occur.

Over time, the value from a buffer may change. Especially buffers with values over pH 7.00 are susceptible for CO_2 contamination.
Make sure that the buffers used for calibration are fresh, and not contaminated by other materials.
SENTRON provides buffers in twin-neck bottles specially designed to facilitate this use.

4.1. Performing a calibration

If the probe is newly connected to the meter (indicated by ATT021 on the status text line), or if the meter has been switched off for several hours, it is necessary to place the probe in a buffer solution, with the meter switched on, for a period of 10 minutes. This initiating time allows the probe to set itself for use after a period of inactivity and is required to ensure stable readings. Rinse the probe before calibration.

The TITAN allows for various calibration methods. In general, the achievable measurement accuracy over a certain pH range will increase when a more-point calibration is performed.

During calibration, the “CAL” indication will blink in the display

After completing the calibration, the slope percentage is briefly displayed, except with the 1-point calibration as no slope can be calculated there.
Instead, the last calculated slope is used.

Slope values can be interpreted as follows:

Slope %	**Interpretation**
98.0 – 105.0 %	Probe gives maximum performance
94.0 – 97.9 %	Probe functions fine. Some maintenance, cleaning with water, toothbrush, and a mild detergent as described in the Probe Insert can bring it up to maximum performance. In case such low slopes are achieved by new probes, it is advised to place the probe-tip in hand-warm water for 20 minutes, and then in buffer pH 4.00 for 1-2 hours. This will effectively remove any KCl crystalization that may have occurred in the reference diafragma due to long storage.
90.0 – 93.9 %	Typical for a probe that has been in use for some time. Probe still gives accurate results, but may require cleaning. Use water, toothbrush and a mild detergent as described in the Probe Insert to ensure optimum performance, then recalibrate. If the slope remains low, use fresh buffers and recalibrate. If the slope is close to 90% and no longer improves by mentioned remedies, the probe may be aging and a replacement should be purchased.

Following sections describe the various procedures to perform a calibration.

Note For maximum accuracy, choose buffers that are close to, or bracket, the expected sample pH and perform the calibration around the same temperature as the expected sample temperature.

If a calibration has not been successful, a message to that effect will be shown on the display. Also, the user may opt to cancel the calibration procedure before it is finished. In both cases, the meter will use the data from the last successful calibration to work with.

4.1.1. 1-point calibration

The measurement accuracy achieved is $\pm$ 0.1 pH and when the display is set to two-decimal resolution the second decimal will blink continuously to indicate that it is not to be regarded as accurate.

In the Main menu, go to “Calib” and press ‘Enter’.
On the status text line the selected bufferset is shown.
Put the probe in the buffer solution.

Go to “1 Pnt” and press ‘Enter’.

The text on the status text line changes to “First buffer”, and after that to “Recognized XX.XX”. The menu item “Cal 1” is highlighted.

Check if the value of the buffer recognized by the meter is the same as the buffer in use. If not, go to “Set” and press ‘Enter’ repeatedly until the correct buffer value is shown on the status text line, then return to “Cal 1”.
With “Cal 1” highlighted, press ‘Enter’ to confirm the selection.

The text on the status text line will change to “Stabilizing” and the pH value is blinking until a stable signal is reached.

The 1-point calibration is now complete, and the meter automatically returns to the Main menu.

4.1.2. 2- or 3- point calibration

In the Main menu, go to “Calib” and press ‘Enter’. On the status indication line the selected bufferset is shown. Put the probe in the first buffer solution.

Go to the selected calibration method (i.e. “2 Pnt” or “3 Pnt”) and press ‘Enter’.

The text on the status text line changes to “First buffer” and after that to “Recognized XX.XX”. The menu item “Cal 1” is highlighted.

Check if the value of the buffer recognized by the meter is the same as the buffer in use. If not, go to “Set” and press ‘Enter’ repeatedly until the correct buffer value is shown on the status text line, then return to “Cal 1”.
With “Cal 1” highlighted, press ‘Enter’ to confirm the selection.

The text on the status text line changes to “Stabilizing” and the pH value is blinking until a stable signal is reached. Then the status text line changes to “Next buffer” and after some time to “Recognized XX.XX”. The text in the menu item reads “Cal 2”. Rinse the probe and place it in the next buffer solution.

Check if the value of the buffer recognized by the meter is the same as the buffer in use. If not, use the ‘Arrow’ keys to go to “Set” and press ‘Enter’ repeatedly until the correct buffer value is shown on the status text line, then return to “Cal 2”
With “Cal 2” highlighted, press ‘Enter’ to confirm the selection.

The text on the status text line will change to “Stabilizing” and the pH value is blinking until a stable signal is reached.

Repeat this sequence for subsequent calibration points.

After the last calibration point, the slope(s) will briefly be displayed and the meter automatically returns to the Main menu.

A 2-point calibration will give one calculated slope, a 3-point calibration will give 2 calculated slopes. The slope data is automatically recorded for later use as described in paragraph 7.3.6.

5. Autoread: Stability Function

The Autoread function provides a fully automatic stability check which shows the user when a measurement value is stable.

In the Main menu, go to “AutoR” and press ‘Enter’.
The text “Autoread is ON” will briefly be shown in the status text line.
The “AR” symbol is permanently shown in the display (see section 1.4.2).

Pressing ‘Enter’ once more disables the Autoread function. The text “Autoread is OFF” will briefly show in the status text line, and the “AR” symbol is no longer shown in the display.

When the Autoread function is active, both the “AR” indication and the pH value will blink until the stability criterion is met, providing an easy visual indication of when the measurement has become stable.

The stability criterium is default set at 0.02 pH per 30 seconds.

Note Even though the stability criterium is set at a 30-second interval, the system is able to determine stability within 8 seconds by using an advanced extrapolation algorithm.

Even when a measurement value is immediately stable, the system still needs 8 seconds to confirm stability; Hence, the measurement value will blink at least 8 seconds.

SENTRON systems continuously monitor the sample’s pH value, i.e. the stable value is not fixed on the display, and when the sample’s pH changes, the value shown on the display will change accordingly.

6. Measurement data handling

The TITAN can store 300 Measurement Data Sets, including date and time.

These Measurement Data Sets can be recalled on the display for future reference.

6.1. Sample identification

In order to simplify data recognition, a 9-character identification is allocated to the sample. The first six characters are alphanumeric, the last three characters are numeric only.

In the Main menu, go to “Store” and press ‘Enter’.
The status text line in the display shows the text “xxx free XXXXXX-xxx”

“xxx free” indicates the number of free data memory slots (see paragraph 6.4).

The “XXXXXX-xxx” (default: SAMPLE-000) text is the sample identification and can be changed.

Go to “Name&#” and press ‘Enter’
The first letter of the sample identification is highlighted, and can be changed to any alphanumeric character (including ‘space’) by pressing the ‘Up’ or ‘Down’ key. Press the ‘Right’ key to go to the next character. Use above procedure to set the complete name. The name will be constant with each stored Measurement Data Set.

Moving further to the right, set the three-digit sequential number to the desired start value by pressing the ‘Up’ or ‘Down’ key. When storing a Measurement Data Set, this number will automatically increase by 1.

Press ‘Enter’ to return to the Store menu. The system can now be used to store data.

6.2. Data storage

The actual data stored depends on the chosen display setting, i.e. if the temperature is not shown on the display, it will not be stored either. If the pH value is shown in one-decimal accuracy or if the last calibration was a 1-point calibration, the pH value stored will have a one-decimal accuracy.

Data can be stored manually; In the Main menu, go to “Store” and press ‘Enter’.
The status text line in the display shows the text “xxx free XXXXXX-xxx”.

Go to “Meas” and press the ‘Enter’ key to save the data in the meter’s memory.
The “xxx free” indication in the status text line will decrease by one, and the 3-digit sample identification number will increase by one.

The sample identification can be changed at any time by following the procedure described in paragraph 6.1.

Note When the meter’s memory is full (300 Measurement Data Sets stored) a warning will be displayed. The meter will not overwrite previously stored data.

6.3. Data recall

Measurement Data Sets stored in the meter’s memory can be recalled onto the display. The same format will be used as when the data were saved.

In the Main menu, go to “Store” and press ‘Enter’.
Go to “Recal” and press ‘Enter’.

The last measurement stored is shown on the display as follows:

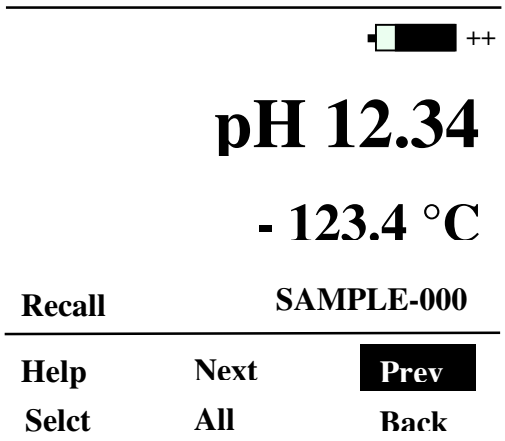


Figure 4: Recall menu

The probe status symbol is not shown in this menu. The text “Recall” is blinking on the status text line. All other data reflect the Measurement Data Set stored in the meter’s memory, i.e. the sample identification, pH value and temperature.

The highlighted menu item is “Prev”. By pressing ‘Enter’, the previous Measurement Data Set is shown on the display. By going to “Next” and pressing ‘Enter’ the next Measurement Data Set in the meter’s memory is shown on the display.

The other two menu items “Selct” and “All” can be used to delete data from the meter’s memory.

Go to “Back” and press ‘Enter’ to return to the Main menu.

6.4. Data deletion

To prevent accidental data deletion, the possibility to delete data can be disabled. Paragraph 7.3.7 gives details on this feature.

Regardless of this setting, it is always possible to delete the last recorded data set.

6.4.1. Delete last recorded data set

To facilitate deletion of an accidentally stored dataset, the menu item “Dellst” will appear when a dataset is stored.

To delete the last stored data set, go to “Dellst” and press ‘Enter’.

The amount of free memory, indicated by “xxx free” will increase by 1 and the sample identification will be adjusted as well.

6.4.2. Delete data

The TITAN has a memory that allows storage of 300 Measurement Data Sets.
In the Store menu, the amount of free memory slots is continuously indicated in the status text line as “xxx free”.

To delete data, the data to be deleted must be selected first.
In the Main menu, go to “Store” and press ‘Enter’.
Go to “Recal” and press ‘Enter’.

To select all data in the meter’s memory, go to “All” and press ‘Enter’.

To select individual Measurement Data Sets, use the ‘Arrow’ keys to go to “Selct” and press ‘Enter’ to select the Measurement Data Set shown on the display.

Use the ‘Arrow’ keys to go to “Prev” or “Next” and press ‘Enter’ to show other Measurement Data Sets on the display. Again, use the ‘Arrow’ keys to go to “Selct” and press ‘Enter’ to select the Measurement Data Set shown on the display.

Selected Measurement Data Sets are marked by an asterix (*) in front of the sample identification.

When the Measurement Data Set selection is complete, go to “More” and press ‘Enter’. Go to “Clear” and press ‘Enter’.
The text “Cleared sel. Samples” is briefly shown on the status text line, and all selected data are deleted from the memory permanently.

Note Both “Selct” and “All” are toggle functions. Thus, it is possible to first select some Measurement Data Sets using “Selct” and then go to “All”.
By pressing ‘Enter’, the previously selected Measurement Data Sets are unselected, and all others are selected. This function can be used to delete a large number of Measurement Data Sets with the exception of a few.

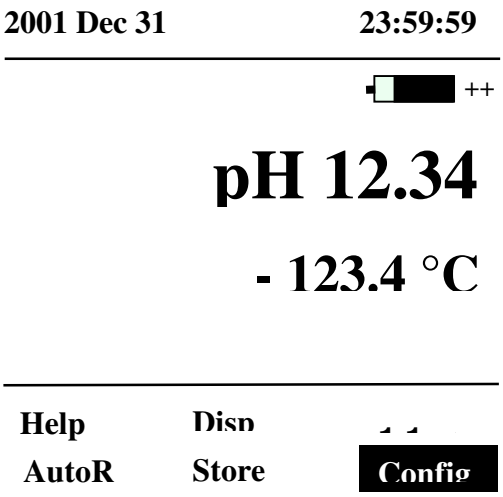
Warning ! Deletion of data is a non-reversible action.

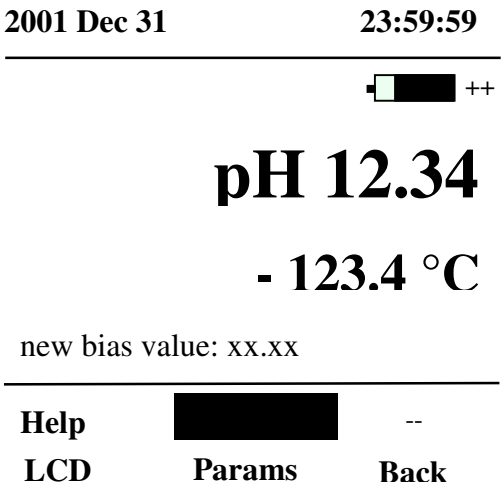
7. Additional system configuration

In this chapter a variety of options for additional system configuration are discussed.

7.1. Bias option

In some cases it is possible that there is a difference in measurement results between a Sentron pH measuring system and a classic glass electrode system. This difference can be eliminated by entering a “bias”.
Use the arrow keys to go to the menu option “bias”. This is a submenu of option “config”. The default settings for the bias option is zero. Use the arrow keys to alter the bias value. The pH measurement result will be corrected with the entered bias value. During calibration, the bias is not used.





7.2. Display contrast

Specific ambient light situations may require a different display contrast.

To adjust the display contrast setting, in the Main menu, go to “Config” and press ‘Enter’. Go to “LCD” and press ‘Enter’.
The status text line will show “Contrast: x”.
Use the ‘Up’ or ‘Down’ key to change the display contrast setting.
When the contrast is optimal, press ‘Enter’ to confirm the selection and return to the Configuration menu.
Go to “Back” and press ‘Enter’ to return to the Main menu.

Warning ! It is possible to change the display contrast to a setting where it is very difficult to read the display at all. Reverse the display setting immediately to a readable contrast.

7.3. Parameter settings

7.3.1. Select ºC/ºF

In the Main menu, go to “Config” and press ‘Enter’.
Go to “Params”, press ‘Enter’ again.
Go to “Select degree C/F” and press ‘Enter’.
Press the ‘Up’- or ‘Down’ arrow to change between ºC and ºF, then press ‘Enter’ to confirm the selection.

7.3.2. Power saving options

Especially with battery powered meter operation, energy conservation is important to optimize the operational time of the meter.

The TITAN can automatically switch itself off after a pre-defined period of inactivity.

In the Main menu, go to “Config” and press ‘Enter’.
Go to “Params”, press ‘Enter’ again.
Go to “Power saving options” and press ‘Enter’.

The Power saving menu is displayed as follows:

Figure 5: Power saving menu

Go to “Meter” and press ‘Enter’.
The text: “Stay ON time of meter (min): xx” is displayed. By using the ‘Up’ or ‘Down’ key, the ON time can be set from 1 minute to 55 minutes or Continuous.
Press ‘Enter’ to return to the Power saving menu.

Use the ‘Down’ key to go to “Display” and repeat the above procedure.

Go to “Back” and press ‘Enter’ to return to the Main menu.

7.3.3. Select language

The meter can be set to one of four languages:

- English
- German
- French
- Spanish

To change the language, in the Main menu go to “Config” and press ‘Enter’.
Go to “Params”, press ‘Enter’ again.
Go to “Select language” and press ‘Enter’.
Use the ‘Down’ or ‘Up’ key to go to the desired language and press ‘Enter’.

Go to “Back” and press ‘Enter’ to return to the Main menu.

7.3.4. Calibration buffers

Following sections list the buffersets built into the meter as Buffervalue versus Temperature. The SENTRON Bufferset is the factory set default.

To change to another bufferset, in the Main menu go to “Config” and press ‘Enter’.
Go to “Params”, press ‘Enter’ again.
Go to “Calibration buffers” and press ‘Enter’.

Go to the desired bufferset and press ‘Enter’.
A message “Selected: BUFFERSETNAME” will appear to confirm the selection.
Also, when entering the Calibration menu, the bufferset used will be shown on the status text line.

Go to “Back” and press ‘Enter’ to return to the configuration menu.
Once more, the selected bufferset and its nominal values at 25 ºC are shown on the display.
Go to “Back” and press ‘Enter’ to return to the Main menu.

7.3.4.1. SENTRON bufferset

The SENTRON bufferset is the factory default setting.
It is a set of 5 NIST-traceable, SENTRON provided buffers with pH values 2.00, 4.00, 7.00, 10.00 and 12.00 at 25 ºC. The full table of Buffervalue versus Temperature is given below.

ºC	#1	#2	#3	#4	#5
5	2.01	4.00	7.10	10.22	12.70
15	2.01	4.00	7.04	10.14	12.38
25	**2.00**	**4.00**	**7.00**	**10.00**	**12.00**
35	2.00	4.02	6.98	9.91	11.63
45	2.00	4.04	6.96	9.81	11.38
55	2.00	4.07	6.96	9.76	11.12
65	2.00	4.10	6.95	9.71	10.86
75	2.00	4.12	6.94	9.66	10.60
85	2.00	4.15	6.93	9.61	10.34
95	2.00	4.17	6.92	9.56	10.08

Table 1: SENTRON Bufferset

Note These values are commonly used and are readily available from other suppliers as well.

7.3.4.2. DIN bufferset

Below table shows the Buffervalue versus Temperature of the DIN buffers stored in the TITAN memory:

ºC	#1	#2	#3	#4	#5
5	3.12	4.67	6.87	9.43	13.57
15	3.08	4.65	6.82	9.32	13.17
25	**3.06**	**4.65**	**6.79**	**9.23**	**12.75**
35	3.04	4.65	6.77	9.14	12.45
45	3.04	4.67	6.76	9.05	12.14
55	3.04	4.69	6.76	8.96	11.83
65	3.03	4.71	6.75	8.87	11.52
75	3.02	4.73	6.75	8.78	11.21
85	3.01	4.75	6.74	8.69	10.90
95	3.00	4.77	6.74	8.60	10.59

Table 2: DIN Bufferset

7.3.4.3. NIST bufferset

Below table shows the Buffervalue versus Temperature of the NIST buffers stored in the TITAN memory:

ºC	#1	#2	#3	#4	#5
5	1.67	4.00	6.95	9.40	13.21
15	1.67	4.00	6.90	9.28	12.81
25	**1.68**	**4.01**	**6.87**	**9.18**	**12.45**
35	1.69	4.02	6.84	9.10	12.13
45	1.70	4.05	6.83	9.04	11.84
55	1.72	4.08	6.83	8.99	11.57
65	1.73	4.11	6.84	8.94	11.33
75	1.75	4.15	6.85	8.90	11.11
85	1.78	4.18	6.87	8.88	10.91
95	1.81	4.23	6.89	8.83	10.73

Table 3: NIST Bufferset

7.3.4.4. JIS bufferset

Below table shows the Buffervalue versus Temperature of the JIS buffers stored in the TITAN memory:

ºC	#1	#2	#3	#4	#5
5	1.67	4.01	6.95	9.39	13.21
15	1.67	4.00	6.90	9.27	12.81
25	**1.68**	**4.01**	**6.86**	**9.18**	**12.45**
35	1.69	4.02	6.84	9.10	12.14
45	1.70	4.04	6.83	9.04	11.84
55	1.72	4.08	6.84	8.99	11.58
65	1.73	4.11	6.84	8.94	11.33
75	1.75	4.14	6.85	8.91	11.11
85	1.78	4.18	6.87	8.87	10.91
95	1.81	4.23	6.89	8.83	10.73

Table 4: JIS Bufferset

7.3.5. mV reading

The ISFET mV output can be viewed as well.

In case the meter is not yet calibrated for the connected probe, the actual ISFET mV output will be shown. If the meter has already been calibrated for the connected probe, the mV output related to the value at pH 7.00 is shown.

In the Main menu, go to “Config” and press ‘Enter’.
Go to “Params”, press ‘Enter’ again.
Go to “mV reading” and press ‘Enter’.

The text “ISFET mVolt: xxx.x” is shown on the display. The mV value reading remains active and only pressing ‘Enter’ brings back the Configuration menu.

To return to the Main menu, go to “Back” and press ‘Enter’.

Note When performing a manual slope calculation, note that for an ISFET a theoretical sensitivity of 52,5 mV/pH should be used.

7.3.6. Calibration data

The TITAN allows for storage, retrieval and export of the last calibration data sets. Following sections describe the various options available.

7.3.6.1. Calibration data storage

When performing a calibration, all calibration data are automatically stored in the meter’s memory and can be recalled.

Information stored includes the bufferset used, buffervalue(s), temperature, slope(s) and the probe status.

Data can be recalled on the screen (see section 7.3.6.2)

7.3.6.2. Calibration data recall

In the Main menu, go to “Config” and press ‘Enter’.
Go to “Params”, press ‘Enter’ again.
Go to “Calibration data”.
The display will show the data from the last calibration in the following way:

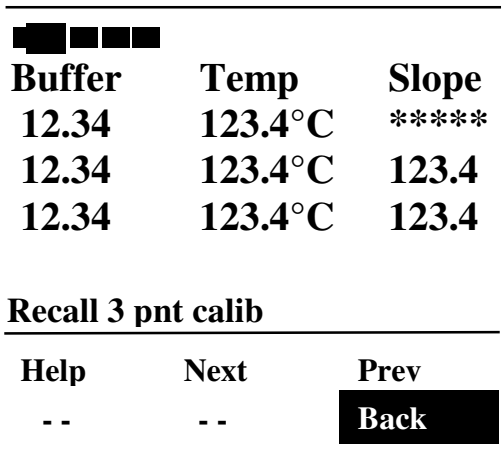


Figure 6: Calibration data recall

Go to “Prev” and press ‘Enter’ to bring the previous calibration data set on the display. Similarly, “Next” brings the next data set on the display.

The calibration data is shown, consisting of the probe status and the chosen bufferset. The buffervalue and temperature are shown, as well as the calculated slope.

With a 1-point calibration no slope can be calculated and the last calculated slope is used.

7.3.7. Allow measurement data deletion

In the Main menu, go to “Config” and press ‘Enter’.
Go to “Params”, press ‘Enter’ again.
Go to “Clear allowed on/off” and press ‘Enter’.
The text “Clear data allowed” is briefly shown on the display, and the user can now delete data from the memory as described in section 6.4.2.

To prevent data deletion, press ‘Enter’ again. The text “Clear data disabled” is briefly shown on the display and the user will no longer be able to delete data.

8. Troubleshooting

8.1. ATT Codes

The TITAN incorporates a comprehensive set of diagnostic functions, allowing it to automatically detect a variety of unwanted situations. In such a case, the text “ATTxxx” will be shown on the status text line.

The built-in helptexts will state the situation at hand and recommend a remedial action. In case of multiple messages, the TITAN itself handles priorities to make sure that only one ATT code is shown.

ATT000:	No probe signal	Ensure that the probe is properly connected to the meter. Ensure that there is a good contact between the sample and the probe. Clean the probe according to the instructions in the Probe Insert.
ATT001:	The pH is out of the 0-14 range.	Verify the buffer and the buffer recognition during calibration. The probe may not have been calibrated to the meter; Recalibrate. The probe may be contaminated, clean the probe; Recalibrate.
ATT002:	The sample reading is more than 3 pH units out of the calibrated range.	For the best results, calibration should always be bracketing the expected pH-value. Re-calibrate with a wider calibration range or use more calibration points.
ATT003:	The pH is out of the 0-14 range during calibration.	Check if the probe is properly immersed in the buffer. Clean the probe according to the instructions in the Probe Insert and recalibrate.
ATT004:	Less then 0.5 pH units difference between two or more calibration points.	When the calibration points are too close together, accurate slope calculation is difficult. Check the buffers and use other buffers if necessary. Check the buffer recognition during calibration.
ATT005:	The used calibration points are more than 7 pH-units apart.	When the calibration points are too wide apart, the results are less reliable. Check the buffer recognition during calibration. Recalibrate using fresh buffers. Use more buffers and more calibration points.

ATT006:	The ISFET output is too close to the ISFET output in the previous buffer.	Check if the probe is in the right buffer. Recalibrate using fresh buffers. If this does not help, replace the probe.
ATT007:	The probe signal is not stable.	Allow 10 minutes stabilization before calibration. Make sure there is good contact between probe and buffer. Stir buffer well before reading. Clean the probe according to the instructions in the Probe Insert and recalibrate.
ATT010:	There is no thermistor signal.	Without this signal, temperature compensation (ATC) is not possible. Check the proper connection of the probe to the meter. If this does not help, replace the probe.
ATT011:	The temperature is out of the probe's specified working range.	The probe may get damaged. Check the sample temperature. Check if the proper type of probe is used. Refer to the temperature specification of the probe in use.
ATT020:	There is no signal from the ß-resistor.	Internal probe malfunctioning. Check the proper connection of the probe to the meter. Replace the probe.
ATT021:	The meter detects a new probe.	Perform a new calibration with this probe.
ATT050:	The slope is too low (slope less than 90).	The sensitivity of the sensor is too low. Recalibrate using fresh buffers. Check for correct buffer recognition during calibration. Check if the used set of buffers matches the programmed set of buffers. Clean the probe according to the instructions in the Probe Insert and recalibrate.
ATT051:	The slope is too high (slope over 110).	The sensitivity of the sensor is too high. Check for correct buffer recognition during calibration. Check if the used set of buffers matches the programmed set of buffers. Clean the probe according to the instructions in the Probe Insert and recalibrate.

ATT060:	Probe status is too low.	Recalibrate using fresh buffers. Check for correct buffer recognition during calibration. Check if the used set of buffers matches the programmed set of buffers. Clean the probe according to the instructions in the Probe Insert.
General	Meter unresponsive	Check times used for Power Saving. Refer to paragraph 7.3.2 Reset the meter. Refer to paragraph 8.2
	No display	Battery may be completely discharged. Connect meter to AC power and wait 10 minutes before turning on the meter. Refer to section 1.4.4 Contrast setting may be set to extreme value. Reverse contrast setting to readable value. Refer to paragraph 7.1. If unable to find contrast setting menu, reset the meter. Refer to paragraph 8.2.
	Occurrence of strange pixels	Reset the meter. Refer to paragraph 8.2.
	No data or illegible characters sent to external device	Check RS-232 cable for proper connection. Check that baudrate is the same for TITAN and external device. In case of printer, check that a serial printer is used. Set both devices to 1200 baud.
Probe	Probe status	See description in paragraph 1.4.2 Monitoring the Probe status as shown on the Calibration data report over a period of time can result in a more accurate lifetime prediction.
	Clean probe.	The probe can be thoroughly cleaned by washing the tip in luke-warm water (approx. 40 ºC). After remaining contamination has been washed off, use the brush and some mild detergent to brush the sensor surface and reference. Put the probe in a saturated KCl solution and let it cool to room temperature. When the probe is cooled down, calibrate again.
Password	Password lost/forgotten	A MASTER Password may be requested from SENTRON by filling out the MASTER Password Request Form in the back of this manual and sending this by fax to SENTRON. SENTRON regards such information as confidential and proprietary and will only release the MASTER password upon receipt of a completely filled out Password Request Form.

8.2. Reset

In case the user has tuned the display contrast to an unreadable setting, it may be required to reset the meter.
Also, unforeseen circumstances that hamper the meter's functioning may require a meter reset.

Reset the meter by depressing and holding the 'Power' key for 40 seconds.
The meter may be seen to switch on and off a number of times.

After releasing the 'Power' key the meter will restart automatically within 5 seconds.
It may be necessary to re-install the display contrast (see paragraph 7.1).

All other data and parameters are automatically saved and restored by the system.

The system will use the data from the last calibration, even though no data are shown in the "calibration data" menu, and the probe status indicator shows no blocks.

Recalibrating the system is recommended.

Note: A prolonged exhausted battery may result in an automatic meter reset.
It is advised that the battery indication is monitored by the user and that the battery is timely recharged by connecting the meter to AC power.

9. Available SENTRON pH probes

This instrument can only perform up to its specifications in combination with one of the SENTRON ISFET pH probes.

The SENTRON “Red-line” series of probes is designed for general purpose use and offers various kinds of probe tips to suit your application. Probe-tips available in the Red-Line series are Standard, ConeFET

The SENTRON “Hot-line” series of probes is developed for applications where sample temperature levels up to 105°C can be reached. Probe-tips available in the Hot-Line series are Standard, ConeFET, SurFET, LanceFET and LanceFET with handle.

The SENTRON “Stream-line” series of probes is specially developed for measurement in low-conductivity or highly contaminating applications. The reference liquid reservoir can be refilled with a SENTRON provided refill liquid. “Stream-line” probes can also be used up to 105°C. Probe-tips available in the Stream-Line series are ConeFET and SurFET.

Typical applications for the Standard ISFET are general applications involving pH measurements in liquids, as well as very small sample volume measurements in case of rare or expensive samples, e.g. in medical or cosmetic environments.
By placing a drop of liquid in the curved probe tip, pH measurements on small sample volumes can be performed.

The LanceFET can be used for extremely viscous samples, or samples that are difficult to penetrate. The LanceFET with handle ensures good grip when force must be applied to perform a measurement, or when the measurement must be done in cold environments where gloves are worn. Typical applications where these probes are used are pH measurements in cheese, meat and fish.

The SurFET is especially designed for direct pH measurements on flat surfaces, e.g. on wood, textile or paper.

In case of viscous or sticky samples, the ConeFET is advised as this tip is shaped to ensure that remaining sample can easily be cleaned off. Typical applications involve pH measurements in pasta, dough, jelly, etc.

DANGER ! The LanceFET and LanceFET with handle probes are especially designed for easy penetration. The stainless steel tip is very sharp and can cause bodily harm when not properly shielded.

The line of Micro Electrodes are thin electrodes with a diameter of only 3 or 4 mm. In this line we have the standard model of PEEK (3 mm diameter) and the stainless steel model (4 mm diameter). These electrodes can be used for applications in meat, cheese, but also in very small volumes or micro titer plates.

10. System specifications

Measuring range:	pH	0.00 … 14.00.
	Temperature:	0℃ … 60℃ or –5℃ …105℃ probe dependent.
Resolution:	pH	0.1 or 0.01 pH-unit, user selectable.
	Temperature:	0.1℃.
Accuracy:	pH	± 0.01 + Least Significant Digit (LSD) using 2 or more point calibration. ± 0.1 using 1 point calibration.
	Temperature:	± 0.5 ℃
Display:		Graphics LCD
Calibration:		1-, 2- or 3-point calibration with automatic buffer recognition.
Buffer tables:		Sets of DIN, NIST and JIS buffers, a set of 5 SENTRON supplied, NIST traceable buffers.
Data logging:		300 measurement data can be stored and retrieved on screen.
Environment:	Temperature:	Measurement 0℃ to 40℃ storage –5℃ to 70℃.
	Rel. Humidity:	Measurement 85%, storage 95%.
Power supply:		AC Mains with NiMH-rechargeable battery back-up
Battery charging time:		24 hours when empty, with non-operating meter
Dimensions (incl. cradle):	Length:	205 mm
	Height:	80 mm
	Width:	155 mm
	Weight:	600 gram
Note	When operating in high humidity-levels, in case of a sudden drop of temperature, problems may arise due to condensation.	
EMC Immunity	When using the AC adapter some interference may be observed at EN50082-1 limits. If unstable readings are observed which cannot be related to the sample, the condition of the probe or meter; try to obtain stable reading on a different location, by RF shielding the sample or by disconnecting the AC adapter.	

11. Default settings

Following table shows the minimum and maximum values and the factory set default value for various parameters.

Parameter		Minimum	Maximum	Default
Power saving Options:	Meter	1 minute	55 minutes/ Continuous	Continuous
	Display	1 minute	55 minutes/ Continuous	Continuous
Autoread	On/Off			Off
	Stability			0.02 pH/30 sec
Clear allowed	Allowed/disabled			Disabled
Cal. Buffers	SENTRON	See section 7.3.4.1		Default
	DIN	See section 7.3.4.2		
	NIST	See section 7.3.4.3		
	JIS	See section 7.3.4.4		
Display	Contrast	-22	+22	0
	pH Resolution	0.1	0.01	0.1
	Temperature	ºC	ºF	ºC
	Temperature	Not shown	Shown	Shown
Sample ID	6 Alphanumeric and 3 numeric	AAAAAA-000	ZZZZZZ-999	SAMPLE-000
Language	English, German, French, Spanish			English

12. Cleaning procedure

In many cases of returned probes, the probe does not work due to a polluted diaphragm. This is caused by the fluid in which the end-user is measuring.
If the customer does not clean de probe regularly, the diaphragm
will block the internal electrode. In such case there is no electrical contact between the electrode and the Isfetchip and the probe will not work.
To prevent this, the end-user must clean the probe regularly, the frequency is depending of the sample the end-user is measuring in. As reference: it is mostly also visible, the diaphragm is no longer white!

Cleaning:
Put the probe in soapy water with a constant temperature of 60℃ for minimal 5 minutes. After this the probe must be placed directly in a KCL solution or buffer 7 with a temperature of ±20℃ for ½ hour. After these actions you can start cleaning with the soft toothbrush.

After measurements in proteins we advise to put the probe alternate in buffer 10 and buffer 3, rinse with water or soak in NaOH or KCl, before you start the cleaning procedure.

Scratches:
To avoid scratches on the chip/epoxy, it is advised to flush the probe with water and to use a wetted brush only after the cleaning procedure as described above (in soapy-water).
Most scratches occur when there are hard pieces on the ISFET and together with the brush they can occur scratches on the surface of the chip and damage the epoxy around the chip, which give bad readings.

FLUSH BEFORE BRUSH!!

13. Warranty

This SENTRON meter is produced, packed and shipped with the utmost care. If, the former notwithstanding, defects do arise, be advised that this SENTRON meter is warranted to be free from defects in material and craftsmanship for the period of 12 months.

SENTRON will repair or replace, at SENTRON's option, any defective part free of charge if this product fails within 12 months from the date of purchase, provided that the failure is due to defective material or lack of craftsmanship and has occurred under normal conditions of usage, to be judged by SENTRON.

All SENTRON probes have a 6 month limited warranty, please refer to the probe manual for specifics.

SENTRON disclaims any liability to customers, to users of its products, or to any other person or persons for any special or consequential damage that might arise out of or that might in any way be connected with the use of this instrument or its accessories.

The warranty described in this paragraph shall be in lieu of any other warranty, expressed or implied, including but not limited to any implied warranty or merchantability or fitness for a particular purpose. The buyer's sole and exclusive remedy is for repair or replacement of defective parts as provided therein.

Representations and warranties made by any person, including dealers, representatives and employees of SENTRON, which are inconsistent or in conflict with the terms of this warranty, shall not be binding upon SENTRON unless in writing and signed by one of its officers.

SENTRON reserves the right to ask for proof of purchase, such as the original invoice or packing slip.

Warning! There are no serviceable or replaceable parts in this product. Do not remove any covers as this can damage the instrument and compromise warranty.

14. Keywords

P

R

S

T

U

W