

Instruction Manual

Stratos PROFIBUS 2221 X pH

**Knick** >

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Warranty

Defects occurring within 3 years from delivery date shall be remedied free of charge at our plant (carriage and insurance paid by sender).

Accessories: 1 year

Software release: 2.x

Date of issue: 20070810



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# 1 Information on this instruction manual

## 1.1 Markings



The warning symbol means that the instructions given must always be followed for your own safety.

Failure to follow these instructions may result in injuries



Notes provide important information that should be strictly followed when using the device.



When a key is shown, its function is explained.



When a display is shown, the corresponding information or operating instructions are provided.

### Operating instructions

- Each operating instruction is preceded by a dot.

### Enumerations

- Each enumeration is preceded by a dash.

### Model designation

For practical purposes, the Stratos PROFIBUS 2221 X pH is simply referred to as Stratos in this instruction manual.

### Trademarks

The following names are registered trademarks. For practical reasons they are shown without trademark symbol in this manual.

- Registered trademarks
  - Sensocheck®
  - Sensoface®
  - Calimatic®
  - GainCheck®

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## 2 Safety information

### 2.1 Be sure to read and observe the following instructions!

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The Stratos has been designed in accordance with the state of the art and complying with the applicable safety regulations.

When operating the device, certain conditions may nevertheless be dangerous for the operator or cause damage to the device.



Whenever it is likely that protection has been impaired, the device shall be made inoperative and secured against unintended operation.

The protection is likely to be impaired if, for example:

- the device shows visible damage
- the device fails to perform the intended measurements
- after prolonged storage at temperatures above 70 °C
- after severe transport stress

Before recommissioning the device, a professional routine test in accordance with EN 61010-1 must be performed. This test should be carried out by the manufacturer.



Stratos PROFIBUS 2221 X pH is approved for installation in ATEX, FM Zone 1 with measurement in Zone 0, and FM Class I Div 1.

Before commissioning it must be proved that the intrinsic safety is maintained when connecting the device to other equipment, such as segment coupler and cable.



For hazardous-area applications, the Stratos PROFIBUS 2221 X pH may only be connected to explosion-proof segment couplers, power supplies ....

The Stratos PROFIBUS 2221 X pH may be operated in accordance with the FISCO model.



The stipulations of EN 60079-10:1996 and the following must be observed for the installation.



To protect against electrostatic discharge, the Stratos may only be cleaned with a damp cloth in hazardous locations.

## 3 PROFIBUS technology

### 3.1 General

PROFIBUS is a digital communication system that connects different field devices over a common cable and integrates them into a control system. In the long term, PROFIBUS will replace the 4-20 mA technology, which only supplies pure measured values.

Advantages of the PROFIBUS technology are:

- easy and cost-saving cabling
- convenient operation over a central control station
- transmission, evaluation and control of high amounts of data from field device to control station.

- devices installed in hazardous locations are configured and maintained from the control station

PROFIBUS is the leading open fieldbus system in Europe. Its application range covers manufacturing, process and building automation. As open fieldbus standard to EN 50170, PROFIBUS ensures communication of different devices over one bus.

The PROFIBUS User Organization (PNO) provides for further development and maintenance of the PROFIBUS technology. It combines the interests of users and manufacturers.

English

### 3.2 Variants and basic characteristics

PROFIBUS determines the technical and functional characteristics of a serial bus system.

There are several PROFIBUS variants:

- PROFIBUS-DP (decentralized peripherals)
  - is tailored for communication of automation systems and distributed peripherals. It operates according to the RS 485 standard with transmission rates up to 12 Mbits/sec.
- PROFIBUS-PA (process automation)
  - is dedicated to the process industry. It permits connection of sensors and actuators to a common bus even in hazardous locations. PROFIBUS-PA has a transmission rate of 31.25 kbits/sec.
- Masters
  - control the data traffic on the bus. They send messages without external request.
- Slaves
  - are peripheral devices such as valves, drives, transmitters and analyzers. They can react acyclically to servicing, configuration and diagnostic tasks of the master. The central controller cyclically reads the measurement data with status.

PROFIBUS distinguishes between two types of devices:

### 3.3 Definitions for PROFIBUS-PA

The bus protocol defines type and speed of the data exchange between master and slave devices and determines the transmission protocol of the respective PROFIBUS system.

PROFIBUS-PA permits cyclic and acyclic services.

- Cyclic services are used for transmission of measurement data and actuating commands with status information.

- Acyclic services are used for device configuration, maintenance and diagnostics during operation.

The device profile defines the device class and typical functionalities with parameters, ranges and limit values.

The FISCO model developed by the German PTB for hazardous locations permits connection of several devices to one common bus and defines permissible limits for device and cable parameters.

### 3.4 PROFIBUS-PA with Stratos

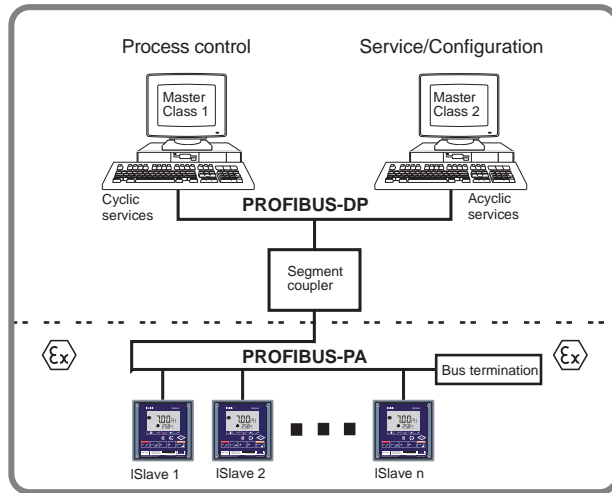


Fig. 3.1 Typical configuration of a PROFIBUS system with Stratos

## 4 Description

### 4.1 Proper use

Stratos is a PROFIBUS-PA analyzer. The Stratos is used for pH/mV, ORP and temperature measurement in industry, environment, food processing and sewage treatment.

The rugged molded enclosure can be wall mounted or fixed into a control panel. It can also be mounted at a post or pipe.

The protective hood provides additional protection against direct

weather exposure and mechanical damage.

The Stratos can be easily replaced since the terminals are of a plug-in design.

The Stratos accepts commercially available electrodes with a nominal zero point at pH 7.

English

### 4.2 Technical features

Communication between measuring point and control room is via PROFIBUS-PA. The data exchange (cyclic and acyclic) is performed

in accordance with the PROFIBUS-DP/V1 protocol.

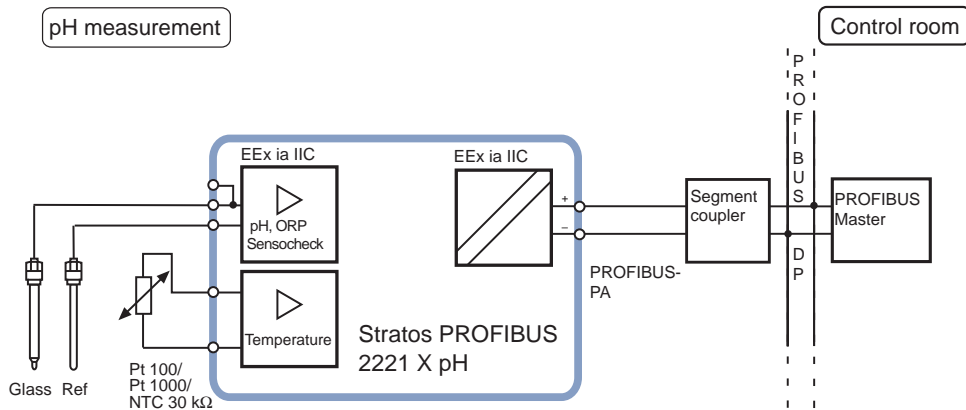


Fig. 4.1 System functions (hardware)

### 4.3 Communication model

The device performance is described by function blocks according to the PNO profile for Process Control Devices. The respective blocks contain different parameters and functions.

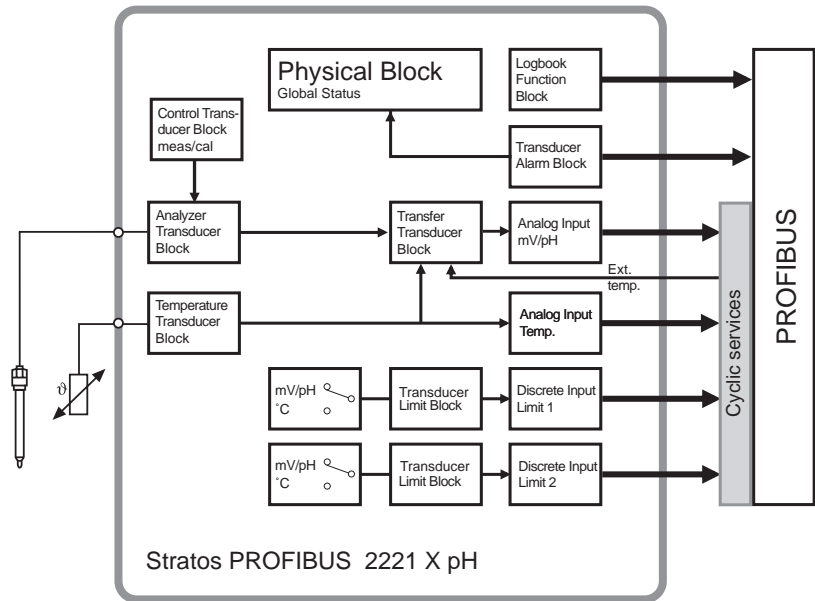


Fig. 4.2 Communication model Stratos PROFIBUS 2221 X pH according to the "Profile for Process Control Devices" (PNO).

## 4.4 Profile for process control devices (extract)

Type of block	Block contents (general)	Block contents (detailed)
Physical Block (PB)	Description of device	Measurement procedure, device configuration Serial number, manufacturer name Operating state (run, maintenance, ...) Global status, diagnostics information
Transducer Block (TB)	Measurement procedure with interpretation	Process variable (plain text and unit) Number of measurement ranges (MR), start and end value of MR, active MR Autorange function On/Off Sampling rate of measured values Uncorrected measured value with time stamp and status
Control Transducer Block	Control of device functions	Status of function execution of respective Transducer Blocks Number of buffer sets available Slope of sensor characteristic
Transfer Transducer Block	Pre-processing of a measured value	Measured value pre-processing Temperature compensation Selection of pre-processing function
Transducer Limit Block	Limit monitoring	Block (TB) for limit setting Threshold, effective direction, hysteresis On-delay, off-delay Reset behavior, reset confirmation Limit status (active, not active)

English

Type of block	Block contents (general)	Block contents (detailed)
Analog Input (AI) Function Block	Measured value	Currently measured value with status and range Rise time, hysteresis of AI limits Upper/lower alarm limit Upper/lower warning limit Switchover manual/automatic operation, measured value simulation Fail-safe behavior
Discrete Input (DI) Function Block	Digital input	Switchover manual/automatic operation Limit value message/status Signal inversion Fail-safe behavior
Transducer Alarm Block	Signaling of states and events	Required maintenance, function check, errors, limits incl. cumulative message
Logbook Function Block	Registration of states and events	Power on, power off, reset State of execution Navigation through entries

Tab. 4.1: Profile for Process Control Devices (function contents)

## 5 Assembly

### 5.1 Package contents and unpacking

Unpack the Stratos carefully. Check the shipment for transport damage and completeness.

The package should contain:

- Front unit of Stratos
- Lower case

- This instruction manual
- Short instruction sheet
- Floppy disk with GSD file KNIC7533.GSD
- Bag containing small parts:

English

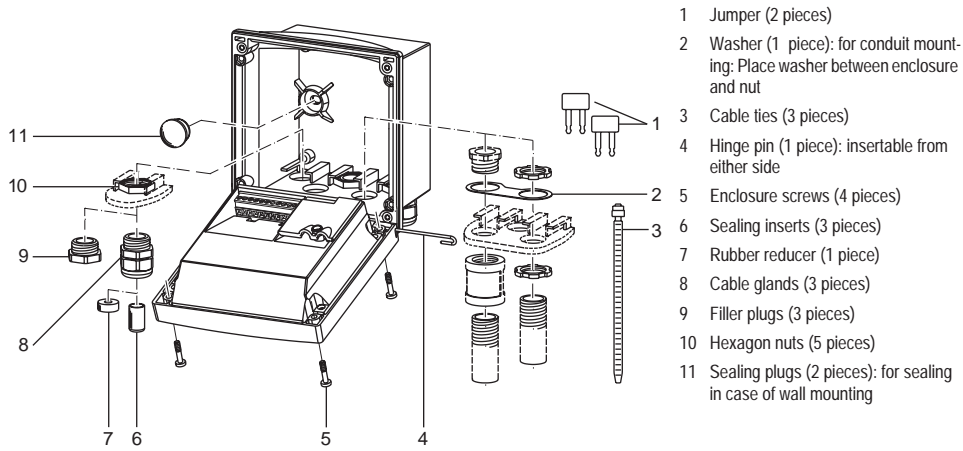


Fig. 5.1 Assembling the enclosure

## 5.2 Mounting plan

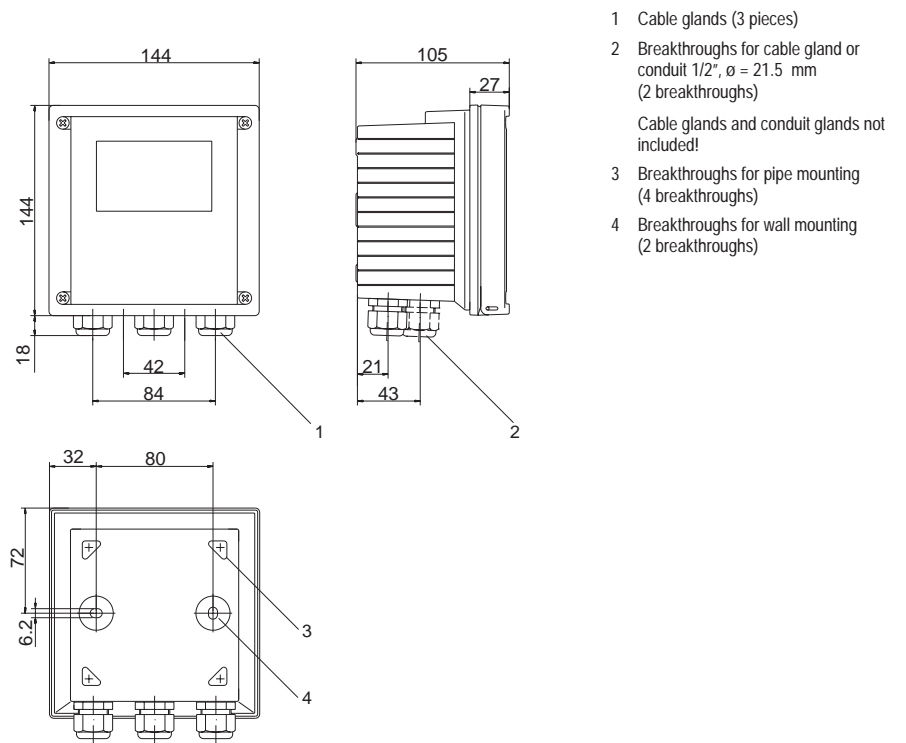
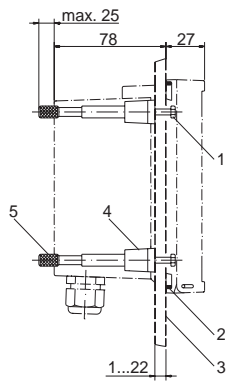
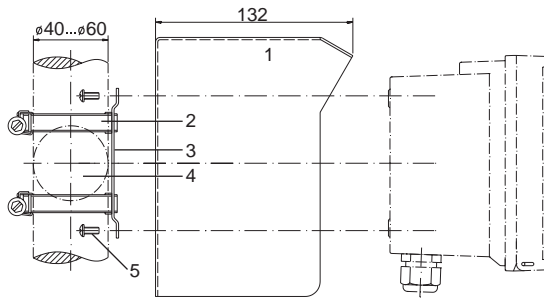


Fig. 5.2 Mounting plan



- 1 Screws (4 pieces)
- 2 Gasket (1 piece)
- 3 Panel
- 4 Span pieces (4 pieces)
- 5 Threaded sleeves (4 pieces)

Fig. 5.3 ZU 0275 panel-mount kit, panel cutout 138 x 138 mm (DIN 43700)



- 1 ZU 0276 protective hood (if required)
- 2 Hose clamps with worm gear drive to DIN 3017 (2 pieces)
- 3 Pipe-mount plate (1 piece)
- 4 For vertical or horizontal posts or pipes
- 5 Self-tapping screws (4 pieces)

Fig. 5.4 ZU 0274 pipe-mount kit

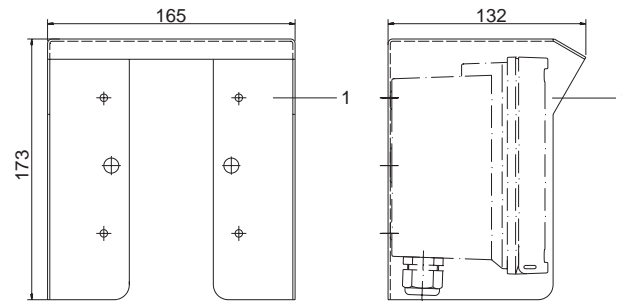


Fig. 5.5 ZU 0276 protective hood for wall and pipe mounting

## 6 Installation and connection

### 6.1 Information on installation



Installation may only be carried out by trained experts in accordance with this instruction manual and as per applicable local and national codes.



Be sure to observe the technical specifications and input ratings.



According to the PTB FISCO model, the limits of the permissible parameter range must be observed for connection in a hazardous location.

See PROFIBUS Technical Guidelines PNO Order No.: 2.091



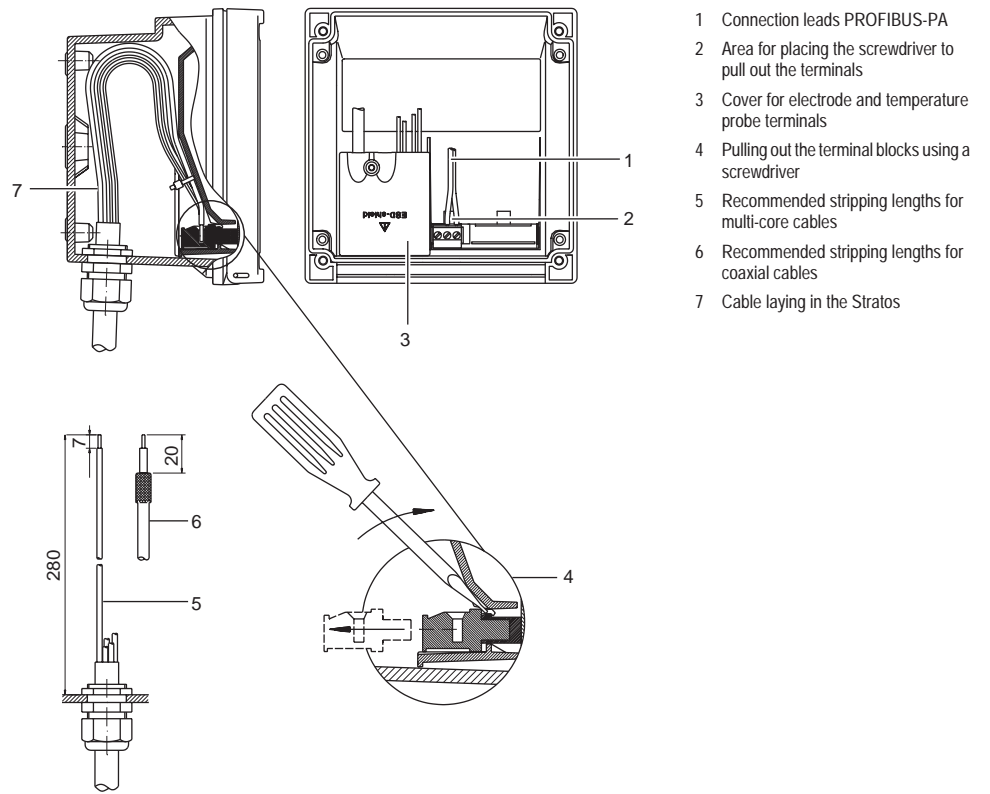
Be sure not to notch the conductor when stripping the insulation.

For easier installation, the terminal strips are of a plug-in design. The terminals are suitable for single wires and flexible leads up to 2.5 mm<sup>2</sup> (AWG 14).

A special twisted and shielded two-wire cable (e.g. Siemens) is used as bus cable.

#### Division 2 wiring

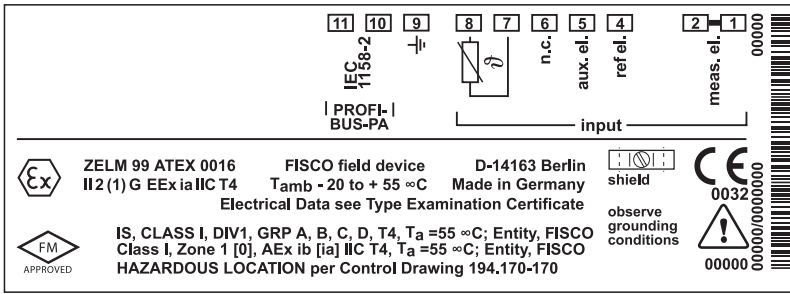
The connections to the Transmitter must be installed in accordance with the National Electric Code (ANSI-NFPA 70) Division 2 hazardous (classified) location non-incendive wiring techniques.



- 1 Connection leads PROFIBUS-PA
- 2 Area for placing the screwdriver to pull out the terminals
- 3 Cover for electrode and temperature probe terminals
- 4 Pulling out the terminal blocks using a screwdriver
- 5 Recommended stripping lengths for multi-core cables
- 6 Recommended stripping lengths for coaxial cables
- 7 Cable laying in the Stratos

Fig. 6.1 Information on installation

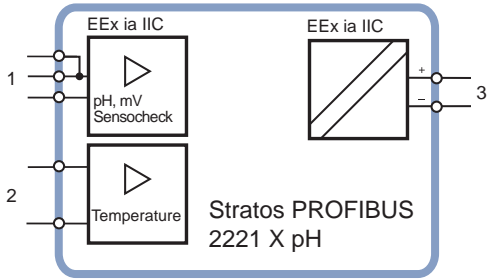
6.2 Terminal assignments



English

Fig. 6.2 Terminal assignments of Stratos

6.3 Overview of the Stratos



- 1 Inputs for glass and reference electrode
- 2 Input for temperature probe
- 3 PROFIBUS-PA

Fig. 6.3 Inputs and outputs

## 6.4 pH measurement

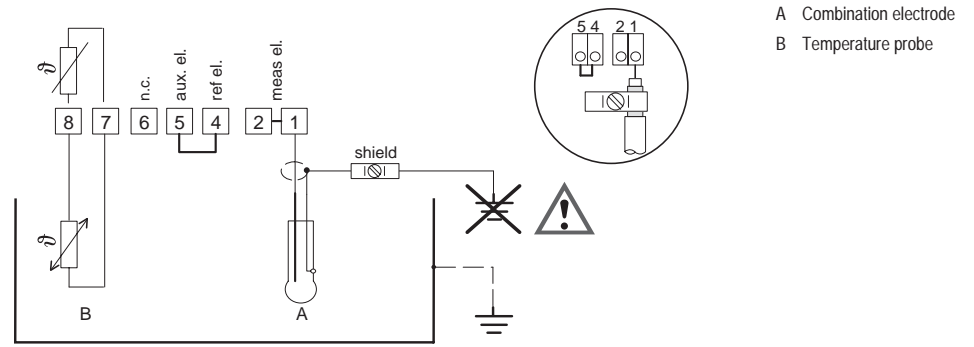


Fig. 6.4 pH measurement with combination electrode, Sensocheck for glass electrode

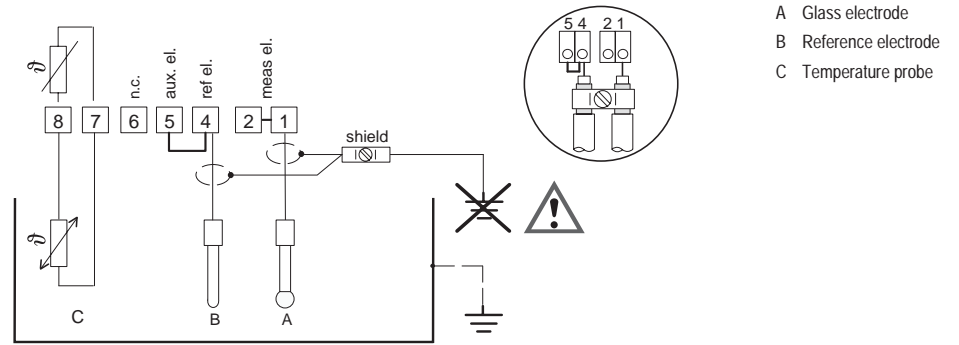
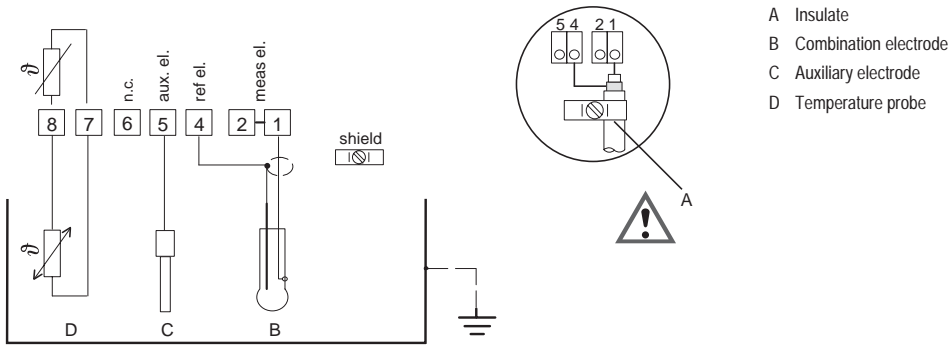


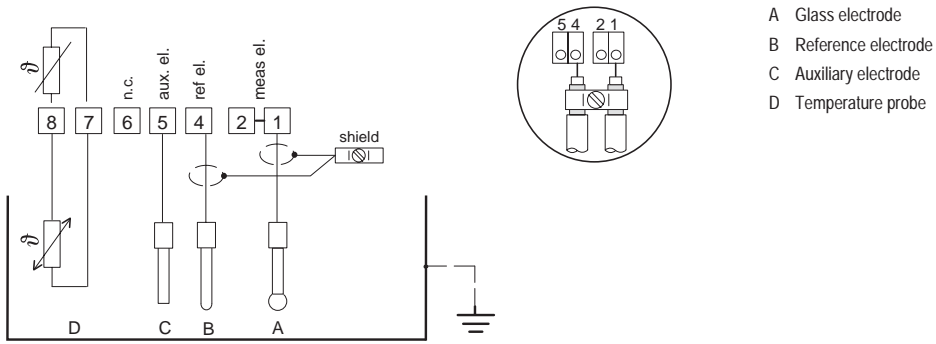
Fig. 6.5 pH measurement with separate glass and reference electrode, Sensocheck for glass electrode



- A Insulate
- B Combination electrode
- C Auxiliary electrode
- D Temperature probe

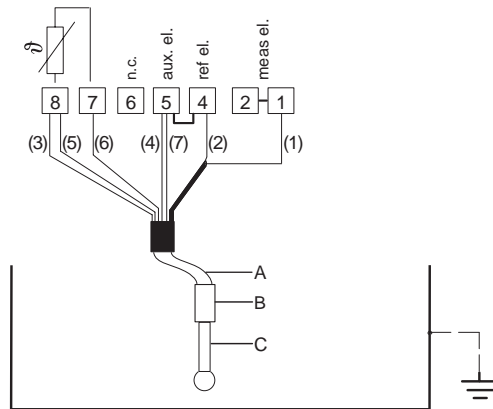
English

Fig. 6.6 pH measurement with combination and aux. electrode, Sensoscheck for glass and reference electrode



- A Glass electrode
- B Reference electrode
- C Auxiliary electrode
- D Temperature probe

Fig. 6.7 pH measurement with separate glass, reference and aux. electrode, Sensoscheck for glass and reference electrode



Wiring	Function
(1) Transparent	pH glass electrode
(2) Copper	Reference electrode
(3) Gray	Not connected
(4) Blue	Not connected
(5) White	Temperature probe
(6) Green	Temperature probe
(7) Green/yellow	Outer shield

- A ZU 0313 VP cable
- B VP screw cap
- C Combination electrode with integrated temperature probe

Fig. 6.8 pH measurement with combination electrode with temperature probe, Sensoscheck for glass electrode, connection with VP cable

6.5 ORP measurement

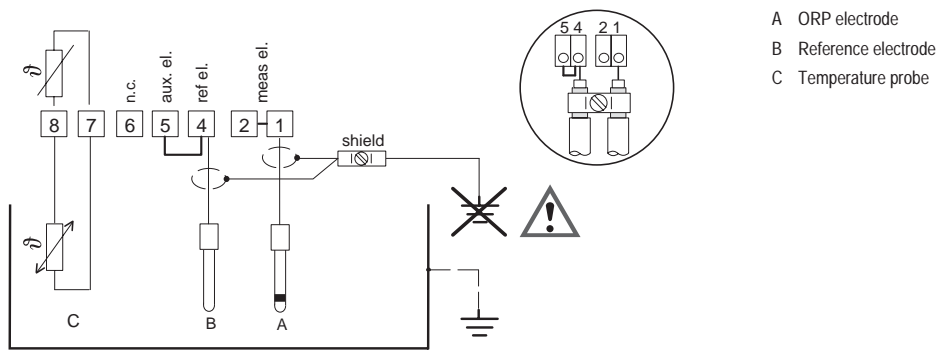


Fig. 6.9 ORP measurement with separate ORP and reference electrode

English

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## 7 Commissioning

### 7.1 Checklist

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Commissioning may only be carried out by trained experts.



Before commissioning the Stratos PROFIBUS 2221 X pH, the following requirements must be met:

- The device must not show any damage.
- When recommissioning the device after a repair, a professional routine test in accordance with EN 61010-1 must be performed.
- It must be proved that the intrinsic safety is maintained when connecting the device to other equipment.
- It must be ensured that the device is configured in accordance with the connected peripherals.
- All connected voltage and current sources must correspond to the technical data of the device.
- The device must only be connected to explosion-proof segment couplers, power supplies, ...

## 8 Operation

## 8.1 Operation possibilities

English

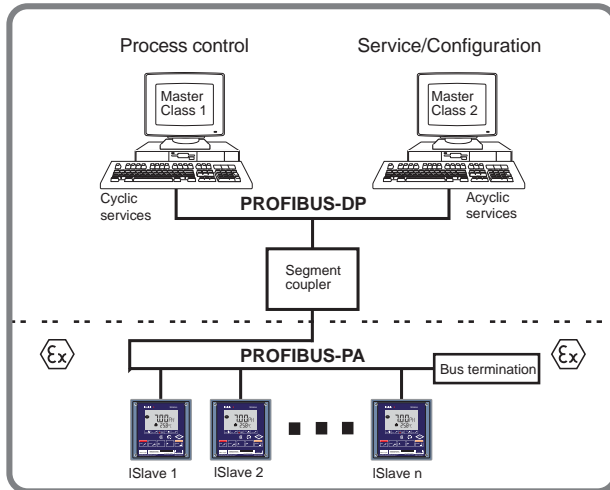


Fig. 8.1 System configuration

The Stratos can be operated as follows:

- using the keypad on the Stratos
- using an operating tool in the service station

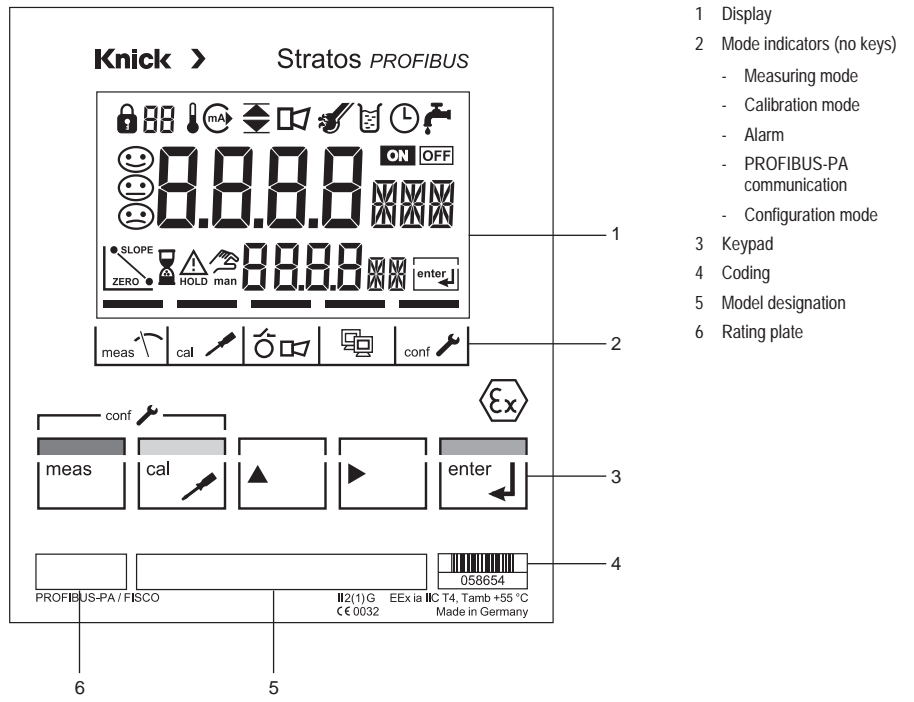
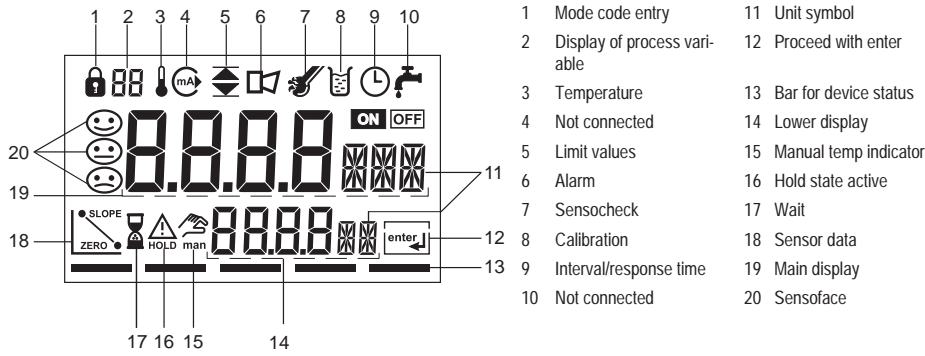


Fig. 8.2 Front view of Stratos

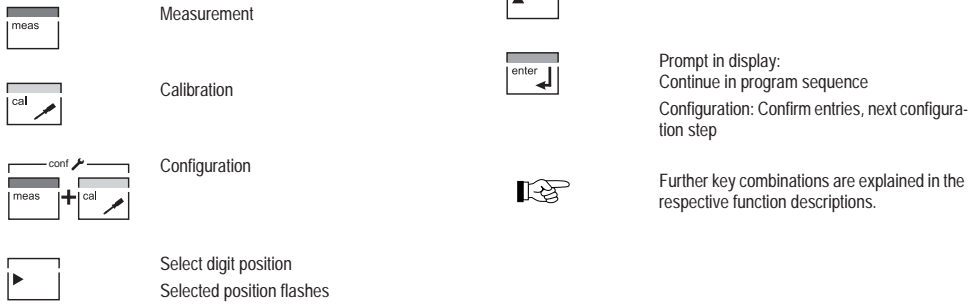
Display



English

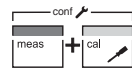
Fig. 8.3 Stratos display

Keypad functions



### 8.3 Mode code

After pressing meas and/or cal you can enter one of the following mode codes to access the designated mode:



conf, 0000 Error Info  
conf, 1200 Configuration mode



cal, 0000 Cal Info  
cal, 1015 Adjusting temp probe  
cal, 1100 Calibration mode  
cal, 2222 Display of electrode potential

### 8.4 Safety functions

#### Sensocheck, Sensoface electrode monitoring

Sensocheck continuously monitors the glass and reference electrodes.



Sensoface provides information on the electrode condition.

The asymmetry potential (zero), slope and response time during calibration are evaluated.

The three Sensoface indicators provide the user with information about wear and required maintenance of the electrode.

#### GainCheck manual device self-test

A display test is carried out, the software version is displayed and the memory and measured value transfer are checked.



Start GainCheck manual device self-test

#### Automatic device self-test

The automatic device self-test checks the memory and measured-value transfer. It runs automatically in the background at fixed intervals.

#### Hold state

The Hold state is a safety state that is activated in the case of interventions such as configuration and calibration. The Stratos freezes the last valid measured value and sends a status message to the control system.



This symbol indicates that the Stratos is in the "Hold" state.

The Hold state is activated by the following mode codes:

- Calibration
  - Mode code 1015 = Temp probe adjustment
  - Mode code 1100 = Calibration mode
  - Mode code 2222 = Display of electrode potential
- Configuration
  - Mode code 1200 = Configuration mode

The measured value and Hold are displayed alternately.



- Check whether the measured value is plausible
- End the Hold state

After 20 sec (for measured value stabilization) the Stratos returns to measuring mode.

## 8.5 Mode indicators

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### Measuring mode



The Stratos is in measuring mode.

### Calibration mode



Calibration mode is active.

### Alarm



During an error message the red alarm LED beneath the display flashes.

The alarm response time is permanently set to 10 sec.

### PROFIBUS-PA communication



The Stratos communicates via PROFIBUS-PA and can be configured from the service station. Measured values, messages and device identification can be downloaded at any time. This allows integration in fully automatic process cycles.

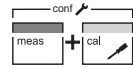
### Configuration mode



The Stratos is in configuration mode.

## 8.6 Configuration

In the configuration mode the device parameters are set.  
The following steps must be executed:



- Activate configuration



- Enter mode code "1200"



- Confirm



Welcome text 3 sec



During configuration the Stratos remains in the Hold state for reasons of safety.



- Select or edit parameter



- Confirm entries

All configurable parameters are shown in the table "Configuration parameters" Pg. 29.



The configuration parameters are checked during the input.

Err

In the case of an incorrect input "Err" is displayed for approx. 3 sec. The incorrect parameters cannot be stored. Input must be repeated.

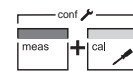


- End configuration

The measured value and Hold are displayed alternately.



- End the Hold state / accept configuration or






- repeat configuration

Configuration parameters

Picto-graph	Display	Parameter	Selection/input	Comment	Factory setting
	PH	Process variable	0.00...14.00 pH -1500...+1500 mV	The selected process variable is shown in the display. When it is changed, a complete configuration is required.	pH
	Auto °C	Temperature display/	Auto °C Auto °F	Automatic detection during measurement and calibration (temp probe must be connected)	Auto °C
	 man	Temperature detection	man °C man °F	Manual input during measurement and calibration	
	 man Auto °C		°C Auto man °F Auto man	Automatic detection during measurement, manual input during calibration	
		Temperature probe	Pt 100 Pt 1000 NTC 30	Selection of temperature probe	Pt 1000
			BUS EXT	External temp during measurement [°C] Manual input during calibration [°C]	
	025.0 °C	Temperature probe	xxx.x °C xxx.x °F	Input of manual temperature	025.0 °C
 ON OFF	CHECK	Sensocheck	ON OFF	Sensor monitoring on/off	OFF

English

Picto-graph	Display	Parameter	Selection/input	Comment	Factory setting
	-01-BUF	Calibration mode: Buffer set selection	Knick / Mettler Toledo	Calibration mode: Automatic with Calimatic	BUF -01-
	-02-BUF		Merck Titrisols, Riedel Fixanals		
	-03-BUF		Ciba (94)		
	-04-BUF		NIST technical buffers		
	-05-BUF		NIST standard buffers		
	-06-BUF		HACH buffers		
	-07-BUF		WTW technical buffers		
	MAN			Calibration with manual buffer entry	
	DAT			Direct entry of zero and slope of premeasured electrodes	

Picto-graph	Display	Parameter	Selection/input	Comment	Factory setting
	0000h	Calibration timer	0000 to 9999 h	Entry of time interval within which the Stratos is to be calibrated. With a time interval of 0000 hrs the calibration timer is not active.	0000 h
		PROFIBUS device address	0001 to 0126	Entry of PROFIBUS address of device. Be sure that the device is not communicating via PROFIBUS.	0126

English

Tab. 8.1: Configuration parameters

## 8.7 Calibration

### Calibration procedures (configurable)

- Automatic calibration with Calimatic / temperature detection automatic or manual (See Page 32)
- Manual calibration / temperature detection automatic or manual (See Page 34)
- Data entry of premeasured electrodes (See Page 36)
- Adjustment of temperature probe (See Page 38)



Incorrectly set parameters may go unnoticed, but change the measuring properties.



The calibration is directly conducted on the Stratos.  
Calibration via PROFIBUS-PA is not provided.



The response times of the electrode and temperature probe are considerably reduced if the electrode is first moved about in the buffer solution and then held still.

### Information on calibration

You can conduct either a one or a two-point calibration.

The calibration can be carried out with the Calimatic automatic buffer recognition, with manual buffer input or by entering premeasured electrode data.



All calibration procedures must be performed by trained personnel.



The Stratos can only operate properly when the buffer solutions used correspond to the configured set.  
Other buffer solutions, even those with the same nominal values, may demonstrate a different temperature behavior. This leads to measurement errors.



During calibration the Stratos remains in the Hold state for reasons of safety.



In the case of an incorrect input "Err" is displayed for approx. 3 sec. The incorrect parameters cannot be stored. Input must be repeated.



For keypad functions refer to Pg. 25.

Automatic calibration with Calimatic (BUF -XX-) / temperature detection automatic or manual



The automatic calibration mode and the type of temperature detection must be preset in the configuration mode. See table 8.6 "Configuration" Pg. 28

The following steps must be executed:



- Activate calibration



- Enter mode code "1100"



- Confirm



Welcome text 3 sec



During calibration the Stratos remains in the Hold state for reasons of safety.



- Remove the electrode and temperature probe, clean them and immerse them in the first buffer solution

It does not matter which buffer solution is taken first.



- Enter calibration temperature



This step is omitted when automatic cal temp detection has been selected.



- Start calibration



While the hour glass flashes, the electrode and temperature probe remain in the first buffer solution.



Buffer recognition



The nominal buffer value is displayed.



Stability check:  
The measured mV value is displayed.



- Abort stability check if desired



When the stability check is aborted, calibration accuracy will be compromised.



Calibration with the first buffer solution is completed.



For a one-point calibration, the procedure is ended at this point.



- End procedure for one-point calibration



For one-point calibration: The Stratos now shows the old slope in the main display and the newly determined asymmetry potential of the electrode related to 25 °C in the lower display.



For a two-point calibration, you must proceed with the following steps.

- Remove the electrode and temp probe from the first buffer solution and rinse them thoroughly



- Immerse electrode and temperature probe in the second buffer solution



- Start calibration  
The calibration process runs again as for the first buffer.



Calibration with the second buffer solution is completed.

The Stratos shows the newly determined slope and the asymmetry potential of the electrode related to 25 °C.



After calibration (one- or two-point) is ended, the following steps must be executed:

- Remove the electrode and temperature probe from the buffer solution, rinse them thoroughly and reinstall them
- Check whether the measured value is plausible
- Repeat calibration if required
- End the Hold state



After 20 sec (for measured value stabilization) the Stratos returns to measuring mode.

Manual calibration / temperature detection automatic or manual

For calibration with manual buffer specification, you must enter the pH value of the buffer solution used in the Stratos for the proper temperature.

This presetting enables calibration with any desired buffer solution.



The MAN calibration mode and the type of temperature detection must be preset in the configuration mode. See table 8.6 "Configuration" Pg. 28

The following steps must be executed:



- Activate calibration



- Enter mode code "1100"



- Confirm




Welcome text 3 sec



During calibration the Stratos remains in the Hold state for reasons of safety.



- Enter calibration temperature and confirm

 This step is omitted when automatic cal temp detection has been selected.



- End procedure for one-point calibration



- Enter the pH value of your buffer solution for the proper temperature and confirm



For one-point calibration: The Stratos now shows the old slope in the main display and the newly determined asymmetry potential of the electrode related to 25 °C in the lower display.



- Start calibration



For a two-point calibration, you must proceed with the following steps.



While the hour glass flashes, the electrode and temperature probe remain in the first buffer solution.

- Remove the electrode and temp probe from the first buffer solution and rinse them thoroughly.



Stability check:  
The measured mV value is displayed.



- Immerse electrode and temperature probe in the second buffer solution



- Abort stability check if desired



- Start calibration  
The calibration process runs again as for the first buffer.



When the stability check is aborted, calibration accuracy will be compromised.



Calibration with the second buffer solution is completed.



Calibration with the first buffer solution is completed.



The Stratos shows the newly determined slope and the asymmetry potential of the electrode related to 25 °C.



For a one-point calibration, the procedure is ended at this point.



After calibration (one- or two-point) is ended, the following steps must be executed:

- Remove the electrode and temperature probe from the buffer solution, rinse them thoroughly and reinstall them
- Check whether the measured value is plausible



- Repeat calibration if required



- End the Hold state

After 20 sec (for measured value stabilization) the Stratos returns to measuring mode.

#### Data entry of premeasured electrodes

You can directly enter the values for slope and asymmetry potential (zero point) of an electrode.

The values must be known, e.g. determined beforehand in the laboratory.



The DAT calibration mode must be preset in the configuration mode. See table 8.6 "Configuration" Pg. 28

The following steps must be executed:



- Activate calibration



- Enter mode code "1100"



- Confirm



Welcome text 3 sec



- Enter asymmetry potential and confirm



- Enter slope and confirm



The Stratos shows the new slope and the asymmetry potential of the electrode related to 25 °C.

- Check whether the measured value is plausible and repeat adjustment if required



- Repeat calibration if required



- End the Hold state

After 20 sec (for measured value stabilization) the Stratos returns to measuring mode.

English

Convert slope [%] to slope [mV/pH] at 25 °C:

%	78	80	82	84	86	88	90	92	94	96	98	100	102
mV/pH	46.2	47.4	48.5	49.7	50.9	52.1	53.3	54.5	55.6	56.8	58.0	59.2	60.4

Tab. 8.2: Slope conversion table at 25 °C

Convert asymmetry potential to electrode zero point:



PROFIBUS-PA transmits the slope in mV/pH and the electrode zero point as pH value.

$$\text{ZERO} = 7 - \frac{V_{AS} [\text{mV}]}{S [\text{mV} / \text{pH}]}$$

ZERO	Electrode zero point
V <sub>AS</sub>	Asymmetry potential
S	Slope

Fig. 8.4 Conversion formula for electrode zero point

Adjustment of temperature probe



Especially for Pt 100 temperature probes, it is advisable to perform an adjustment.



- Measure the temperature of the process medium using an external thermometer
- Enter the determined temperature value in the main display

The following steps must be executed:



- Activate calibration



If you take over the temperature value shown in the lower display, the correction is without effect.



- Enter mode code "1015"



- Confirm the temperature value
- Check whether the measured value is plausible



- Confirm



- Repeat temperature adjustment if required



Welcome text 3 sec



- End the Hold state

After 20 sec (for measured value stabilization) the Stratos returns to measuring mode.

## 8.8 Operating tool

For parameter setting, commissioning and diagnostics of Stratos via PROFIBUS, we recommend operating tools such as SIMATIC-PDM Version 5 or higher.

The current device description is included.

## 8.9 Measurement

### Measuring mode

In the measuring mode the main display shows the configured process variable and the lower display the temperature.



The Stratos returns to measuring mode, also from configuration or calibration mode (after a relax time for measured-value stabilization, if required).

### Cal Info

"Cal Info" shows the asymmetry potential and the slope.



- Select function



- Mode code



- Confirm

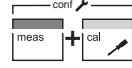
The current calibration data are displayed for approx. 20 sec.



- End "Cal Info"

### Error Info

"Error Info" shows the most recent error message.



- Select function



- Mode code



- Confirm

The error message is displayed for approx. 20 sec. Afterwards, the message will be deleted.



- End "Error Info"

---

Manual temperature specification



This symbol indicates that the temperature is manually specified.

The measuring temperature is set in the configuration, the calibration temperature in the calibration.

## 9 Diagnostics

### 9.1 Sensocheck, Sensoface

Sensocheck continuously monitors the glass and reference electrodes.

Sensocheck can be switched off.



The basis for accurate Sensoface indication is proper calibration.



Sensoface provides information on the electrode condition.



The worsening of a Sensoface criterion leads to the devaluation of the Sensoface indicator (average/poor).



The asymmetry potential (zero), slope and response time during calibration are evaluated.



The three Sensoface indicators provide the user with information about wear and required maintenance of the electrode.



An improvement of the Sensoface indicator can only take place after calibration or removal of an electrode defect.











A friendly Smiley can only be displayed when Sensocheck has been activated.



The Sensoface status does not influence the measured value display.

Sensoface displays

Display	Problem	Status
	Electrode response time	<p>The electrode adjusts slowly to the measured value.</p> <ul style="list-style-type: none"> <li>• Clean the electrode</li> <li>• Soak it in buffer for several hours</li> <li>• Replace electrode if there is no improvement</li> </ul>
		<p>The electrode adjusts very slowly to the measured value. Correct measurement is no longer ensured.</p> <ul style="list-style-type: none"> <li>• Replace the electrode</li> </ul>

Display	Problem	Status
	Asymmetry potential (zero) and slope	 Asymmetry potential (zero) and slope of the electrode are still okay, however cleaning is recommended.
		 Asymmetry potential (zero) and/or slope of the electrode have reached values which no longer ensure proper calibration. <ul style="list-style-type: none"> <li>• Replace the electrode</li> </ul>
	Calibration timer	 Over 80 % of the calibration interval have already past.
		 The calibration interval has been exceeded.
	Electrode defect	 <ul style="list-style-type: none"> <li>• Check the electrode and its connections</li> </ul>

Tab. 9.1: Sensoface display

## 9.2 PROFIBUS-PA limit monitoring

Stratos is equipped with two limit blocks that can be separately configured for temperature and/or the process variable.

Configuration is only performed via the bus.

The limit conditions are transmitted cyclically.

Hysteresis, effective direction, on and off delay can be configured.



When this symbol is displayed, limit block 2 is active.



Limit value setting and output of limit messages is via the PROFIBUS-PA.



When this symbol is displayed, limit block 1 is active.

## 9.3 Error messages

When one of the following error messages is displayed, the Stratos can no longer determine the measured value correctly.

The alarm response time is permanently set to 10 sec.








During an error message the red alarm LED beneath the display flashes.



The error messages are sorted according to their priority. A higher-priority message overlays a lower-priority message.

English

Error No.	Display (flashing)	Problem	Possible causes
Err 01		pH electrode	<ul style="list-style-type: none"> <li>- Electrode defective</li> <li>- Too little electrolyte in electrode</li> <li>- Electrode not connected</li> <li>- Break in electrode cable</li> <li>- Incorrect electrode connected</li> <li>- Measured pH value &lt; 0</li> <li>- Measured pH value &gt; +14</li> </ul>
Err 02		Redox electrode	<ul style="list-style-type: none"> <li>- Electrode defective</li> <li>- Electrode not connected</li> <li>- Break in electrode cable</li> <li>- Incorrect electrode connected</li> <li>- Measured electrode voltage &lt; -1500 V</li> <li>- Measured electrode voltage &gt; +1500 V</li> </ul>
Err 03		Temperature probe	<ul style="list-style-type: none"> <li>- Wrong temperature probe connected</li> <li>- Wrong temperature probe configured</li> <li>- Open circuit in temperature probe</li> <li>- Short circuit in temperature probe</li> <li>- Measured temperature &lt; -20 °C</li> <li>- Measured temperature &gt; +150 °C (NTC 30 kΩ : +130 °C)</li> </ul>
Err 33		Glass electrode	<ul style="list-style-type: none"> <li>- Glass electrode defective</li> <li>- Connection cable or electrode cap defective</li> <li>- Connection terminals or electrode cap dirty</li> </ul>

Error No.	Display (flashing)	Problem	Possible causes
Err 34		Reference electrode	<ul style="list-style-type: none"> <li>- Reference electrode defective</li> <li>- Connection cable or electrode cap defective</li> <li>- Connection terminals or electrode cap dirty</li> <li>- Jumper between terminal 4 and 5 missing</li> </ul>
Err 98	CONF	System error	<ul style="list-style-type: none"> <li>- Memory error in device program (PROM defective)</li> <li>- Measured value transmission defective</li> <li>- Configuration or calibration data defective</li> <li>• Completely reconfigure and calibrate the Stratos</li> </ul>
Err 99	FAIL	Factory settings	<ul style="list-style-type: none"> <li>- EEPROM or RAM defective</li> <li>- Error in factory settings</li> </ul> <p>This error message normally should not occur as the data are protected from loss by multiple safety functions.</p> <ul style="list-style-type: none"> <li>• Should it nevertheless occur, send in the Stratos for repair</li> </ul>

Tab. 9.2: Error messages


Calibration error messages



Calibration error messages only occur during calibration.

English

Display (flashing)	Problem	Possible causes
	Asymmetry potential (zero) out of range ( $\pm 60$ mV)	<ul style="list-style-type: none"> <li>- Electrode "worn out"</li> <li>- Buffer solution contaminated</li> <li>- Buffer does not belong to configured buffer set</li> <li>- Temperature probe not immersed in buffer solution (for automatic temperature compensation)</li> <li>- Wrong buffer temperature set (for manual temperature specification)</li> <li>- Electrode with nominal zero point <math>\neq</math> pH 7</li> </ul>
	Electrode slope out of range (80-103 %)	<ul style="list-style-type: none"> <li>- Electrode "worn out"</li> <li>- Buffer solution contaminated</li> <li>- Buffer does not belong to configured buffer set</li> <li>- Temperature probe not immersed in buffer solution (for automatic temperature compensation)</li> <li>- Wrong buffer temperature set (for manual temperature specification)</li> <li>- Electrode used has different nominal slope</li> </ul>
	Problems during recognition of the buffer solution	<ul style="list-style-type: none"> <li>- Same or similar buffer solution was used for both calibration steps</li> <li>- Buffer solution used does not belong to buffer set currently configured in the Stratos</li> <li>- During manual calibration the buffer solutions were not used in the specified order</li> <li>- Buffer solutions contaminated</li> <li>- Wrong buffer temperature set (for manual temperature specification)</li> <li>- Electrode defective</li> <li>- Electrode not connected</li> <li>- Electrode cable defective</li> </ul>











Display (flashing)	Problem	Possible causes
 <p>The display shows the text 'CAL ERR' in a large, bold, black font. Above the 'A' in 'CAL' is a small circular icon containing a downward-pointing arrow.</p>	<p>Calibration was canceled after approx. 2 minutes, because the electrode drift was too large.</p>	<ul style="list-style-type: none"> <li>- Electrode defective</li> <li>- Electrode dirty</li> <li>- No electrolyte in the electrode</li> <li>- Electrode cable insufficiently shielded or defective</li> <li>- Strong electric fields influence the measurement</li> <li>- Major temperature fluctuation of the buffer solution</li> <li>- No buffer solution or extremely diluted</li> </ul>

Tab. 9.3: Calibration error messages

9.4 Display messages and PROFIBUS communication

User interface / display of device				Cause	Communication via PROFIBUS				
Display pictograph	Display message	Sensoface	LED	For comments see Pg. 43 through Pg. 46	No. of binary message (logbook)	Analog Input status	Physical Block (PB) Global status	Text of binary message (factory setting)	Logbook entry (factory setting)
	Err 99		X	Error in factory settings	1	0000 11xx	Failure	ERR SYSTEM	X
	Err 98		X	Error in configuration data, Gaincheck	2	0000 11xx	Failure	ERR PARAMETERS	X
	Err 98		X	Memory error (RAM, ROM, EPROM)	3	0000 11xx	Failure	ERR MEMORY	X
	Err 01		X	pH range violation (pH electrode)	4	0100 0111 0100 1111	Failure	ERR PH VALUE	X
	Err 02		X	mV range violation (redox electrode)	5	0100 0111 0100 1111	Failure	ERR MV VALUE	X
	Err 03		X	Temp range violation	6	0100 0111 0100 1111	Failure	ERR TEMP VALUE	X
	Err 33		X	Sensocheck Glass electrode	7	0100 0111 0100 1111	Failure	CHK GLASS EL.	X

English

User interface / display of device				Cause	Communication via PROFIBUS				
Display pictograph	Display message	Sensoface	LED	For comments see Pg. 43 through Pg. 46	No. of binary message (logbook)	Analog Input status	Physical Block (PB) Global status	Text of binary message (factory setting)	Logbook entry (factory setting)
	Err 34		X	Sensocheck Reference electrode	8	0100 0111 0100 1111	Failure	CHK REF. EL.	X
				Zero point/ slope	9	0101 00xx	Maintenance required	CHK ZERO/SLOPE	X
				Response time of electrode	10	0101 00xx	Maintenance required	CHK EL. RESPONSE	X
				Calibration timer Cal prompt	11	0101 00xx	Maintenance required	CAL REQUIRED	X
				Calibration	12	0100 0111 0100 1111	Function check	CAL RUNNING	X
				Configuration	13	0100 0111 0100 1111	Function check	CONF RUNNING	X
				HOLD (Device state = Maintenance)	14	0100 0111 0100 1111	Function check	HOLD	X
				HI_HI_LIM FB analysis mV/mV	15	1000 1110	Limit 1 Bit 1	HI_HI_LIMIT PH HI_HI_LIMIT MV	

User interface / display of device				Cause	Communication via PROFIBUS				
Display pictograph	Display message	Sensoface	LED	For comments see Pg. 43 through Pg. 46	No. of binary message (logbook)	Analog Input status	Physical Block (PB) Global status	Text of binary message (factory setting)	Logbook entry (factory setting)
				HI_LIM FB analysis mV/mV	16	1000 1010	Limit 1 Bit 2	HI_LIMIT PH HI_LIMIT MV	
				LO_LIM FB analysis mV/mV	17	1000 1001	Limit 1 Bit 3	LO_LIMIT PH LO_LIMIT MV	
				LO_LO_LIM FB analysis mV/mV	18	1000 1101	Limit 1 Bit 4	LO_LO_LIMIT PH LO_LO_LIMIT MV	
				HI_HI_LIM FB temperature	19	1000 1110	Limit 2 Bit 1	HI_HI_LIMIT TEMP	
				HI_LIM FB temperature	20	1000 1010	Limit 2 Bit 2	HI_LIMIT TEMP	
				LO_LIM FB temperature	21	1000 1001	Limit 2 Bit 3	LO_LIMIT TEMP	
				LO_LO_LIM FB temperature	22	1000 1101	Limit 2 Bit 4	LO_LO_LIMIT TEMP	
				Logbook empty	23		Function Check	EMPTY LOGBOOK	

English

Tab. 9.4: Display messages and PROFIBUS communication

## 9.5 Diagnostics functions

### Cal Info

"Cal Info" shows the asymmetry potential and the slope.



- Select function



- Mode code



- Confirm

The current calibration data are displayed for approx. 20 sec.



- End "Cal Info"



- End "Error Info"

### Display of electrode potential

During electrode maintenance it is useful to directly indicate the electrode potential. This allows, for example, to check electrode response after cleaning.



- Select function



- Enter mode code "2222"



- Confirm

The electrode potential is displayed.



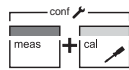
- End display mode



During electrode potential display the Stratos is in the Hold state.

### Error Info

"Error Info" shows the most recent error message.



- Select function



- Mode code



- Confirm

The error message is displayed for approx. 20 sec.  
Afterwards, the message will be deleted.

GainCheck manual device self-test

A display test is carried out, the software version is displayed and the memory and measured value transfer are checked.



Start GainCheck  
manual device self-test

English

Automatic device self-test

The automatic device self-test checks the memory and measured-value transfer. It runs automatically in the background at fixed intervals.

---

## 10 Maintenance and cleaning

### 10.1 Maintenance

---

The Stratos contains no user repairable components.

### 10.2 Cleaning

---

To remove dust, dirt and spots, the external surfaces of the Stratos may be wiped with a soft cloth moistened with water.

A mild household cleaner may also be used if necessary.

# 11 Appendix

## 11.1 Product line

### Devices

Model designation	Ref. No.
Stratos PROFIBUS 2221 X pH for applications in hazardous and safe areas	2221 X pH

### Mounting accessories

Accessories	Ref. No.
Pipe-mount kit	ZU 0274
Panel-mount kit	ZU 0275
Protective hood	ZU 0276

English

## 11.2 Specifications

### General specifications

Manufacturer / ID	Knick Elektronische Meßgeräte GmbH / KNIC
Model designation / ID	Stratos PROFIBUS 2221 X pH / 7533

### Applications

pH/mV, ORP and temperature measurement
--

## input

Process variable	pH or mV (ORP)	Ranges	pH value	0.00 to +14.00
			mV value	-1500 mV to +1500 mV
		Glass electrode input	Input resistance	$>0.5 \times 10^{12} \Omega$
			Input current (20°C) <sup>b</sup>	$<2 \times 10^{-12} \text{ A}$
		Reference electrode input	Input resistance	$>1 \times 10^{10} \Omega$
			Input current (20°C) <sup>b</sup>	$<1 \times 10^{-10} \text{ A}$
	Max. cable length	Glass electrode	20 m	
	Temperature	Temperature sensor <sup>a</sup>	Pt100 / Pt1000 / NTC 30 kΩ	
		Ranges	Pt100 / Pt1000	-20.0 to +150.0 °C / -4 to +302 °F
			NTC 30 kΩ	-20.0 to +130.0 °C / -4 to +266 °F
Resolution		0.1 °C / 1 °F		
Temperature compensation <sup>a</sup>		Automatic	Pt100 / Pt1000 / NTC 30 kΩ	
	Manual input			

a) Configurable

b) Doubles every 10 K

Accuracy ( $\pm$  1 count)

pH value	< 0.02	TC: <0.002 pH/K
mV value	< 1 mV	TC: <0.1 mV/K
Temperature	0.5 K (with Pt100 < 1 K, with NTC > 100 °C < 1 K)	

## Monitoring function

Electrode	Sensocheck (can be disabled)	Monitoring of glass and reference electrode
mV value		Determination of alarm limits during calibration

Electrode standardization

Operating modes <sup>a</sup>	Calimatic automatic calibration with buffer sets	-01- Knick/Mettler Toledo	2.00 / 4.01 / 7.00 / 9.21
		-02- Merck-Titrisols, Riedel Fixanals	2.00 / 4.00 / 7.00 / 9.00 / 12.00
		-03- Ciba (94)	2.06 / 4.00 / 7.00 / 10.00
		-04- NIST technical buffers	1.68 / 4.00 / 7.00 / 10.01 / 12.46
		-05- NIST standard buffers	4.006 / 6.865 / 9.180
		-06- HACH buffers	4.00 / 7.00 / 10.18
		-07- WTW technical buffers	2.00 / 4.01 / 7.00 / 10.00
		MAN calibration with manual buffer entry	
	DAT data entry of premeasured electrodes		
Calibration timer <sup>a</sup>	Adjustment range	0 to 9999 h	
Calibration ranges	Asymmetry potential	±60 mV	
	Slope	80 to 103 %	
	Out-of-range conditions	Sensoface display message	

a) Configurable

English

Conditions for use

Temperature	Operation	-20 to +55 °C	
Electromagnetic compatibility	RFI suppression	EN 50 081-2	
	Immunity to interference	EN 50 082-1, EN 50 082-2	
Ingress protection	Enclosure	IP65	
Explosion protection Stratos PROFIBUS 2221 X pH	ATEX	II 2(1) G EEx ia IIC T4, FISCO	
	FM	IS, Class I Div1, Group A, B, C, D T4 FISCO I / 1[0] / AEx ib [Ia] / IIC / T4 FISCO NI, Class I Div2, Group A, B, C, D T4 NIFW	
Data retention	Parameters and calibration data	> 10 years	EEPROM

---

Construction

Dimensions	Height	144 mm	
	Width	144 mm	
	Depth	105 mm	
Weight	Approx. 1 kg		
Material	PBT (polybutylene terephthalate)		
Color	Bluish gray	RAL 7031	
Assembly	Wall mounting		
	Post/pipe mounting	on pipe with 40 to 60 mm diameter, on square post with 30 to 45 mm edge length	
	Panel mounting	Cutout to DIN 43 700 Sealed against panel	
Electrical connection	Cable glands	3 breakthroughs	for included cable glands
		2 breakthroughs	for NPT 1/2" or Rigid Metallic Conduit or cable glands

Display and user interface

Display	LC display, 7-segment	Measured value display	pH / mV value, temperature
		3 Sensoface states	Good / average / poor
		5 mode indicators	meas / cal / alarm / online / conf
	Alarm LED	Error message	
Operation	5 keys	meas / cal / up / right / enter	
Operating tool	Device description (DD) implemented in SIMATIC PDM		

## Remote interface

PROFIBUS-PA communication	Digital communication by current modulation of supply current Reading of device identification, measured values, status and message Reading and writing of parameter and configuration data	
	Protocol	PROFIBUS-PA (DPV1)
	Connection	via segment coupler or link to SPC, PC, PCS
	Profile	PNO directive: PROFIBUS-PA, Profile for Process Control Devices, Version 3.0
	Physical interface	to IEC 1158-2 (DIN EN 61158-2)
	Address range	1 to 126, factory setting: 126
	Supply voltage	FISCO bus supply: 9 to 17.5 V Linear barrier: (9 to 24 V)
	Current consumption	< 12.7 mA
	Max. current in case of fault (FDE)	< 21.4 mA

English





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(13)

**SCHEDULE**

(14) **EC-TYPE-EXAMINATION CERTIFICATE ZELM 99 ATEX 0016**

(15) Description of equipment

The Transmitter Stratos PROFIBUS 2221X pH<sup>m</sup> with Profibus – PA – communication interface is preferably used for the recognition and processing of electrochemical quantities and is equipped with an input for pH-measurements and a temperature measuring input.

The maximum permissible ambient temperature is 55 °C.

Electrical data

**BUS- / Supply loop**  
(terminals 11/14 and 10/15)

type of protection Intrinsic Safety resp. EEx ia IIC/IIB  
EEx ib IIC/IIB

only for the connection to a certified intrinsically safe circuit (for example FISCO – supply unit) with the following maximum values:

	FISCO-supply unit	linear barrier
U <sub>max</sub>	17,5 V	24 V
I <sub>max</sub>	280 mA	200 mA
P <sub>max</sub>	4,9 W	1,2 W

effective internal capacitance: Ci ≤ 1 nF  
effective internal inductance: Li ≤ 10 µH

**ph-measuring loop**  
(terminals 1/2, 4 and 5)

type of protection Intrinsic Safety resp. EEx ia IIC/IIB  
EEx ib IIC/IIB

maximum values: U<sub>0</sub> = 11,8 V  
I<sub>0</sub> = 12 mA  
P<sub>0</sub> = 18 mW  
(linear characteristic)

	IIC	bzw.	IIB
max. permissible external inductance	240 mH		850 mH
max. permissible external capacitance	1,47 µF		9,9 µF

(only valid if external inductance and external capacitance do not exist in concentrated form at the same time)

Sheet 2/4

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English



SCHEDULE TO EC-TYPE-EXAMINATION CERTIFICATE ZELM 99 ATEX 0016

	IIC	bzw.	IIB
max. permissible external inductance	3 mH		10 mH
max. permissible external capacitance	452 nF		1,47 µF

(also valid if external inductance and external capacitance exist in concentrated form at the same time)

effective internal capacitance:  $C_i \leq 30$  nF  
The effective internal inductance is negligibly small.

Temperature measuring loop (terminals 7 and 8)	type of protection	Intrinsic Safety	EEx ia IIC/IIB
	resp.		EEx ib IIC/IIB
	maximum values:		$U_0 = 5,9$ V $I_0 = 3,1$ mA $P_0 = 4,6$ mW (linear characteristic)

	IIC	bzw.	IIB
max. permissible external inductance	1000 mH		1000 mH
max. permissible external capacitance	43 µF		1000 µF

(only valid if external inductance and external capacitance do not exist in concentrated form at the same time)

	IIC	bzw.	IIB
max. permissible external inductance	5 mH		10 mH
max. permissible external capacitance	550 nF		1,75 µF

(also valid if external inductance and external capacitance exist in concentrated form at the same time)


effective internal capacitance:  $C_i \leq 250$  nF  
The effective internal inductance is negligibly small.

DF-output (terminals 17, 18 and 19)	type of protection	Intrinsic Safety	EEx ia IIC/IIB
	resp.		EEx ib IIC/IIB
	maximum values:		$U_0 = 11,8$ V $I_0 = 32,8$ mA $P_0 = 48,4$ mW (linear characteristic)


Sheet 3/4

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**SCHEDULE TO EC-TYPE-EXAMINATION CERTIFICATE ZELM 99 ATEX 0016**

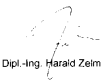
	IIC	bzw.	IIB
max. permissible external inductance	34	mH	130
max. permissible external capacitance	1,47	µF	9,9
(only valid if external inductance and external capacitance do not exist in concentrated form at the same time)			
	IIC	bzw.	IIB
max. permissible external inductance	2,8	mH	9
max. permissible external capacitance	424	nF	1,47
(also valid if external inductance and external capacitance exist in concentrated form at the same time)			
effective internal capacitance: $C_i \leq 30$ nF			
The effective internal inductance is negligibly small.			

EP (terminal 9 or terminal 16) for the connection to the equipotential bonding system


References:  
Connecting the equipotential bonding is absolutely required to guarantee electrostatic leakage.  
The BUS- / Supply loop is safely electrically isolated from the other loops up to a voltage of 60 V.  
The operation manual has to be considered.

(16) Report No. ZELM Ex 0069914024  
(17) Special conditions for safe use  
not applicable  
(18) Essential Health and Safety Requirements  
met by standards

Zertifizierungsstelle ZELM Ex



Dipl.-Ing. Harald Zelm



Braunschweig, February 21, 2000

Sheet 4/4

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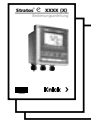
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## 11.4 Provided documentation:

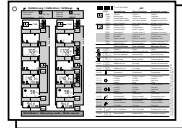
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- Instruction manual




- Safety instructions /  
EC Declarations of Conformity



- Short instructions

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 Devices only:



- EC-Type Examination Certificate

**pH Transmitter**  
**Stratos PROFIBUS PA 2221 X pH**  
**Stratos FF 2231 X pH**  
 IS/II/ABC/D/TA, Ta=55°C, Entity, FISCO  
 I/II/AEx ib I/a/II/CT/TA, Ta=55°C, Entity, FISCO

**Entity Parameters:**

Terminals 1/2, 4, 5 and 6  
 $V_n = 118\text{ V}$      $C_p = 147\text{ }\mu\text{F}$   
 $I_n = 12\text{ mA}$      $L_p = 240\text{ mH}$   
 $P_{max} = 18\text{ mW}$

Terminals 7 and 8  
 $V_{oc} = 5.9\text{ V}$      $C_p = 4.9\text{ }\mu\text{F}$   
 $I_{sc} = 31\text{ mA}$      $L_p = 1\text{ H}$   
 $P_{max} = 4.6\text{ mW}$

Terminals 17, 18 and 19  
 $V_n = 118\text{ V}$      $C_p = 147\text{ }\mu\text{F}$   
 $I_n = 32.8\text{ mA}$      $L_p = 34\text{ mH}$   
 $P_{max} = 48.4\text{ mW}$

The intrinsically safe equipment connecting to 1, 2, 4, 5, 6 and 7, 8 must be FM Approved or be simple apparatus, a device which will neither generate nor store more than 15 V, 0.1 A, 25 mW.  
 The intrinsically safe equipment connecting to 17, 18 and 19 must be FM Approved.

pH sensor series InPro 2xxx  
 pH sensor series InPro 3xxx  
 pH sensor series InPro 4xxx

17/18/19 + Parameters - see Table 1  
 19/18/17 not connected

**Table 1**

Concept	Groups	V <sub>max</sub> (V)	I <sub>max</sub> (mA)	P <sub>max</sub> (W)	C <sub>p</sub> (nF)	L <sub>p</sub> (µH)
Entity	IC/ABC/D	24	200	12	12	7
FISCO	IC/ABC/D	17.5	280	4.9		

**FISCO rules**  
 The FISCO concept allows the interconnection of intrinsically safe apparatus to associated apparatus not specifically assessed in such combination. The criterion for such interconnection is that the voltage (V<sub>oc</sub>) the current (I<sub>sc</sub>) and the power (P) which intrinsically safe apparatus can receive and deliver, considering both, must be equal or greater than the voltage (V<sub>n</sub>), the current (I<sub>n</sub>), and the power (P) which can be provided by the associated apparatus (supply unit). In addition, the maximum inductor constant (L<sub>p</sub>) and capacitance (C<sub>p</sub>) of each apparatus (other than the terminator) connected to the Fieldbus must be less than or equal to 5 nF and 50 µH respectively.

In each I.L. Fieldbus segment only one active source, normally the associated apparatus, is allowed to provide the necessary power for the Fieldbus system. The allowed voltage (V<sub>oc</sub>), V<sub>n</sub> or I<sub>sc</sub> of the associated apparatus used to supply the bus must be limited to the range of 14 V d.c. to 24 V d.c. All other equipment connected to the bus cable has to be passive, meaning that the apparatus is not intended to provide energy to the system, except for limited control of peak-to-peak commutation device. Separately powered equipment needs galvanic isolation to ensure that the intrinsically safe Fieldbus circuit remains passive.

The cable used to interconnect the device needs to comply with the following parameters:  
 Loop inductance L<sub>p</sub> ≤ 100 nH/m  
 Inductance per unit length L<sub>p</sub>: 0.4 ... 1 mH/m  
 Capacitance per unit length C<sub>p</sub>: 80 ... 200 nF/m  
 C<sub>p</sub> = C<sub>p</sub> (shield) + 0.5 C<sub>p</sub> (screen), if both lines are floating  
 C<sub>p</sub> = C<sub>p</sub> (shield) + C<sub>p</sub> (screen), if the screen is connected to one line  
 Length of open cable: max. 30 m  
 Length of trunk cable: max. 1 km  
 Length of spurs: max. 1 m  
 Terminations  
 At each end of the trunk cable an approved line terminator with the following parameters is suitable:  
 R = 90 ... 100 Ω  
 C<sub>p</sub> ≤ 2.2 nF

**System evaluation**  
 The number of passive devices like transmitters, actuators, connected to a single bus segment is not limited due to I.L. reasons. Furthermore, if the above rules are respected, the inductance and capacitance of the cable need not to be considered and will not impair the intrinsic safety of the installation.

**Installation Notes For FISCO and Entity Concepts**

- The Intrinsic Safety Entity concept allows the interconnection of FM Approved intrinsically safe devices with entity parameters not specifically assessed in combination as a system when:
  - It is V<sub>n</sub> or V<sub>oc</sub> ≤ 24 V d.c. or I<sub>sc</sub> ≤ 300 mA, or P<sub>max</sub> ≤ 25 mW, or C<sub>p</sub> ≤ 100 nF, or L<sub>p</sub> ≤ 100 µH.
  - For intrinsically safe devices see Table 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100.
- The Intrinsic Safety FISCO concept allows the interconnection of FM approved intrinsically safe devices with FISCO concepts not specifically assessed in combination as a system when:
  - It is V<sub>n</sub> or V<sub>oc</sub> ≤ 24 V d.c. or I<sub>sc</sub> ≤ 300 mA, or P<sub>max</sub> ≤ 25 mW, or C<sub>p</sub> ≤ 100 nF, or L<sub>p</sub> ≤ 100 µH.
  - For intrinsically safe devices see Table 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100.
- Control equipment connected to the Associated Apparatus must not use a parameter more than 250 V<sub>n</sub> or V<sub>oc</sub>.
- Installation of intrinsically safe systems for hazardous (classified) locations must be in accordance with ATEX/IECEx Part 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100.
- The configuration of associated apparatus must be FM Approved under the associated concept.
- Associated Apparatus manufacturer's installation drawing must be followed when installing this associated apparatus.
- The Stratos PA, Stratos FF Series are approved for Class I, Zone 0 applications. Exemptions AEx (B) associated Apparatus or AEx (B) L, Apparatus to the Stratos PA, Stratos FF Series I.L. circuit is only suitable for Class I, Zone 1, or Class I, Zone 2, and is not suitable for Class I, Zone 0 for Class I, Division 1, Hazardous (Classified) Locations.
- No restriction to drawing without prior FM Approvals authorization.
- Simple Apparatus is defined as a device that does not generate more than 1.5 V, 0.1 A or 25 mW.

Unclassified Locations

Hazardous (Classified) Locations  
 Class I, Zone 1, Group IC  
 Class I, Division 1, Groups A, B, C and D

Stratos PROFIBUS PA 2221 X pH  
 Stratos FF 2231 X pH

Any FM Approved  
 Intrinsic Safe Apparatus

Any FM Approved  
 Terminator (May not be necessary for Entity installations)

Any FM Approved  
 Terminator (May not be necessary for Entity installations)

Vertikale Nr. (ID)	Zu Abrechnung für Neue Teilerzeugung SO ZNE - #	Datum	Name	Merkmal	Heißung	page 1/2
1	Texte geändert	20.11.04	gr			
2	Texte hinzugefügt	20.11.04	gr			
3	Texte geändert	26.09.04	gr			
4	Texte geändert	26.09.04	gr			
5	Texte geändert	26.09.04	gr			
6	Texte geändert	26.09.04	gr			
7	Texte geändert	26.09.04	gr			
8	Texte geändert	26.09.04	gr			
9	Texte geändert	26.09.04	gr			
10	Texte geändert	26.09.04	gr			

English



11.6 Buffer tables

English

°C	pH			
	2.03	4.01	7.12	9.52
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
25	2.00	4.01	7.00	9.21
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

Tab. 11.1: BUF -01- Knick / Mettler Toledo

°C	pH				
	2.01	4.05	7.13	9.24	12.58
0	2.01	4.05	7.13	9.24	12.58
5	2.01	4.04	7.07	9.16	12.41
10	2.01	4.02	7.05	9.11	12.26
15	2.00	4.01	7.02	9.05	12.10
20	2.00	4.00	7.00	9.00	12.00
25	2.00	4.01	6.98	8.95	11.88
30	2.00	4.01	6.98	8.91	11.72
35	2.00	4.01	6.96	8.88	11.67
40	2.00	4.01	6.95	8.85	11.54
45	2.00	4.01	6.95	8.82	11.44
50	2.00	4.00	6.95	8.79	11.33
55	2.00	4.00	6.95	8.76	11.19
60	2.00	4.00	6.96	8.73	11.04
65	2.00	4.00	6.96	8.72	10.97
70	2.01	4.00	6.96	8.70	10.90
75	2.01	4.00	6.96	8.68	10.80
80	2.01	4.00	6.97	8.66	10.70
85	2.01	4.00	6.98	8.65	10.59
90	2.01	4.00	7.00	8.64	10.48
95	2.01	4.00	7.02	8.64	10.37

Tab. 11.2: BUF -02- Merck Titrisols, Riedel Fixanals

°C	pH			
	2.04	4.00	7.10	10.30
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>a</sup>	4.10 <sup>a</sup>	6.92 <sup>a</sup>	9.61 <sup>a</sup>
70	2.07	4.11	6.92	9.57
75	2.04 <sup>a</sup>	4.13 <sup>a</sup>	6.92 <sup>a</sup>	9.54 <sup>a</sup>
80	2.02	4.15	6.93	9.52
85	2.03 <sup>a</sup>	4.17 <sup>a</sup>	6.95 <sup>a</sup>	9.47 <sup>a</sup>
90	2.04	4.20	6.97	9.43
95	2.05 <sup>a</sup>	4.22 <sup>a</sup>	6.99 <sup>a</sup>	9.38 <sup>a</sup>

a) Interpolated

Tab. 11.3: BUF -03- Ciba (94) (Nominal values: 2.06; 4.00; 7.00; 10.00)

°C	pH				
	1.67	4.00	7.12	10.32	13.42
0	1.67	4.00	7.12	10.32	13.42
5	1.67	4.00	7.09	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	1.68	4.00	7.02	10.06	12.64
25	1.68	4.00	7.00	10.01	12.46
30	1.68	4.02	6.99	9.97	12.30
35	1.69	4.03	6.98	9.93	12.13
40	1.69	4.03	6.98	9.89	11.99
45	1.70	4.05	6.98	9.86	11.84
50	1.71	4.06	6.97	9.83	11.71
55	1.72	4.08	6.97	9.83	11.57
60	1.72	4.09	6.97	9.83	11.45
65	1.73	4.10	6.98	9.83	11.45
70	1.74	4.13	6.99	9.83	11.45
75	1.75	4.14	7.01	9.83	11.45
80	1.77	4.16	7.03	9.83	11.45
85	1.78	4.18	7.05	9.83	11.45
90	1.79	4.21	7.08	9.83	11.45
95	1.81	4.23	7.11	9.83	11.45

Tab. 11.4: BUF -04- NIST technical buffers

°C	pH		
0	4.010	6.984	9.464
5	4.004	6.951	9.395
10	4.000	6.923	9.332
15	3.999	6.900	9.276
20	4.001	6.881	9.225
25	4.006	6.865	9.180
30	4.012	6.853	9.139
35	4.021	6.844	9.102
40	4.031	6.838	9.068
45	4.043	6.834	9.038
50	4.057	6.833	9.011
55	4.071	6.834	8.985
60	4.087	6.836	8.962
65	4.109	6.841	8.942
70	4.126	6.845	8.921
75	4.145	6.852	8.903
80	4.164	6.859	8.885
85	4.185	6.868	8.868
90	4.205	6.877	8.850
95	4.227	6.886	8.833

Tab. 11.5: BUF -05- NIST standard buffers

°C	pH		
0	4.00	7.14	10.30
5	4.00	7.10	10.23
10	4.00	7.04	10.11
15	4.00	7.04	10.11
20	4.00	7.02	10.05
25	4.01	7.00	10.00
30	4.01	6.99	9.96
35	4.02	6.98	9.92
40	4.03	6.98	9.88
45	4.05	6.98	9.85
50	4.06	6.98	9.82
55	4.07	6.98	9.79
60	4.09	6.99	9.76
65	4.09 <sup>a</sup>	6.99 <sup>a</sup>	9.76 <sup>a</sup>
70	4.09 <sup>a</sup>	6.99 <sup>a</sup>	9.76 <sup>a</sup>
75	4.09 <sup>a</sup>	6.99 <sup>a</sup>	9.76 <sup>a</sup>
80	4.09 <sup>a</sup>	6.99 <sup>a</sup>	9.76 <sup>a</sup>
85	4.09 <sup>a</sup>	6.99 <sup>a</sup>	9.76 <sup>a</sup>
90	4.09 <sup>a</sup>	6.99 <sup>a</sup>	9.76 <sup>a</sup>
95	4.09 <sup>a</sup>	6.99 <sup>a</sup>	9.76 <sup>a</sup>

a) Values complemented (buffer values up to 60 °C as specified by Bergmann & Beving Process AB)

Tab. 11.6: BUF -06- HACH buffers (Nominal values: 4.00; 7.00; 10.18)

°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
25	2.00	4.01	7.00	10.00
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	

Tab. 11.7: BUF -07- WTW technical buffers

## 11.7 Glossary

## Asymmetry potential

The voltage which a pH electrode provides at a pH of 7. The asymmetry potential is different for each electrode and changes with age and wear.

## Buffer set

Contains selected buffer solutions which can be used for automatic calibration with the Calimatic. The buffer set must be selected prior to the first calibration.

## Buffer solution

Solution with an exactly defined pH value for calibrating a pH meter.

## Calibration

Adjustment of the pH meter to the current electrode characteristics. The asymmetry potential and slope are adjusted. Either a one- or two-point calibration can be carried out. With one-point calibration only the asymmetry potential (zero point) is adjusted.

## Calibration buffer set

See buffer set

## Calimatic

Automatic buffer recognition. Before the first calibration, the buffer set used must be activated once. The patented Calimatic then automatically recognizes the buffer solutions used during calibration.

## Combination electrode

Combination of glass and reference electrode in one body.

## Electrode

A pH electrode system consists of a glass and a reference electrode. If they are combined in one body, they are referred to as combination electrode.

## Electrode slope

See slope

## Electrode zero point

pH value at which the pH electrode outputs the voltage 0 mV. The zero point is different for each electrode and changes with age and wear.

## FISCO Model (Fieldbus Intrinsically Safe Concept)

Permits connection of several devices to a common bus line and defines limit values for device and cable parameters.

This model developed by the German PTB assumes that only one "active" device, i.e. the bus supply is connected to the field bus. All other devices are "passive" with regard to the power supply into the bus.

Within the defined limits, the line characteristics have no influence on the intrinsic safety.

## GainCheck

Device self-test which runs automatically in the background at fixed intervals. The memory and measured-value transmission are checked. You can also start the GainCheck manually. Then a display test is also conducted and the software version displayed.

## GSD file (device database file)

Contains the communication parameters of slave devices. During commissioning it is loaded and installed in the process control system.

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<p><b>Limit values</b></p> <p>The Stratos provides two limit blocks which can be assigned to the process variables pH/mV or °C. The limit conditions are cyclically transmitted via PROFIBUS. Hysteresis, effective direction, on and off delay can be configured via the PROFIBUS.</p> <p><b>Link</b></p> <p>A link collects the transmission data from the segment couplers and sends them in blocks to the control system.</p> <p><b>Mode code</b></p> <p>Preset four-digit number to select certain modes.</p> <p><b>One-point calibration</b></p> <p>Calibration with which only the asymmetry potential (zero point) is taken into account. The previous slope value is retained. Only one buffer solution is required for a one-point calibration.</p> <p><b>PROFIBUS-DP (decentralized peripherals)</b></p> <p>Standardized specification (EN 50 170) of an open fieldbus system for binary and analog signals of sensors and actuators. It has been designed for high-speed data exchange at the device level.</p> <p><b>PROFIBUS-PA (process automation)</b></p> <p>Open fieldbus standard for process automation. It makes use of the transmission technology to IEC 1158-2 (DIN EN 61158-2) approved for operation in hazardous locations, which at the same time allows the field devices to be powered over the bus.</p> <p><b>Response time</b></p> <p>Time from the start of calibration to the stabilization of the electrode potential.</p> <p><b>Sensocheck</b></p> <p>Sensocheck continuously monitors the glass and reference electrodes.</p>	<p><b>Sensoface</b></p> <p>Provides information on the electrode condition.</p> <p><b>SIMATIC-PDM</b></p> <p>Tool developed by Siemens for projecting, configuring, commissioning and diagnostic of smart process analyzers. The Stratos device description is implemented in the SIMATIC-PDM.</p> <p><b>Slope</b></p> <p>Is indicated in % of the theoretical slope (59.2 mV/pH at 25 °C). The electrode slope is different for each electrode and changes with age and wear.</p> <p><b>Two-point calibration</b></p> <p>Calibration with which the electrode asymmetry potential (zero point) and slope are determined. Two buffer solutions are required for two-point calibration.</p> <p><b>Zero point</b></p> <p>See electrode zero point</p>
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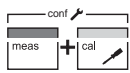
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Mode Codes



conf, 0000 Error Info  
conf, 1200 Configuration mode



cal, 0000 Cal Info  
cal, 1015 Temp probe adjustment  
cal, 1100 Calibration mode  
cal, 2222 Electrode potential

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