Arcus-EDS

Application Description

SK08-WAQ

KNX Sensor Water Quality pH ORP

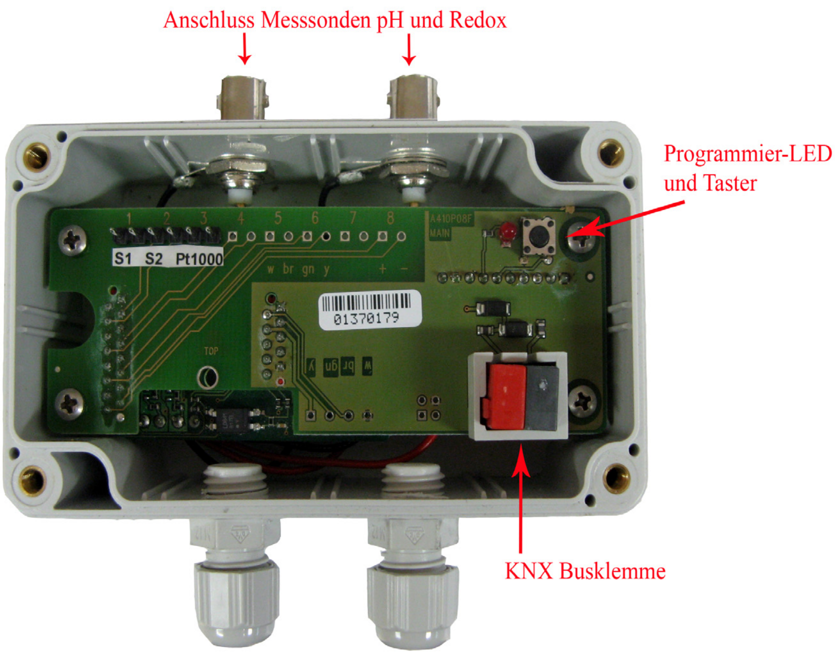
Operating Principals and Areas of Application:

The production series S8 uses sensors and controllers for a number of physical and chemical measurements for both indoor and outdoor areas.

The measuring system SK08-WAQ records the electrochemical measurements of pH level (concentration of hydrogen) and ORP (Oxidation/Reduction Potential, or Redox Potential). These measurements are important for determining the water quality of swimming pools, aquariums, ponds, service water systems, etc. The measuring electrodes provide voltages with levels of a few mV, which depends on the electrochemical value. This voltage is amplified in a high-impedance amplifier (> 500GOhm), digitally converted and sent to the KNX bus. Between the electrodes and the KNX bus is a galvanic separator which prevents ground loops. All standard pH and ORP electrodes can be used as long as they are single-rod measuring cell whose shielding can be connected. The measurements can be compensated for temperature if a temperature sensor is applied; otherwise a calibration at operating temperatures should be carried out.

The controller is able to feed chemicals or fresh water automatically into the system. Thresholds allow notification of maintenance personnel.

The devices in the series MS08 come in a housing for surface mounting with a cable gland for EIB/KNX insertion and one for the temperature sensor. The external measuring electrodes are connected to BNC connectors which are attached to the side. It is absolutely necessary that the contact plugs are clean, dry, fat free and dust free to ensure the necessary input resistance. After installation, the protective caps should be tightly imposed on the connectors.



The electrodes must be checked and calibrated at regular intervals. Should deviations occur more frequently and the time it takes the display to show a data change becomes longer, the sensors should be changed.

For further information on pH values see: **http://de.wikipedia.org/wiki/PH-Wert**
For further information on ORP see: **http://de.wikipedia.org/wiki/Redoxpotential**

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Application and Functions:

KNX sensors are set up using the ETS (KNX Tool Software) with the associated application program SK08-WAQ. The device is delivered unprogrammed. All functions are parameterized and programmed by ETS. The controller can be switched on or off by activation or locking via the KNX bus.

Functions:

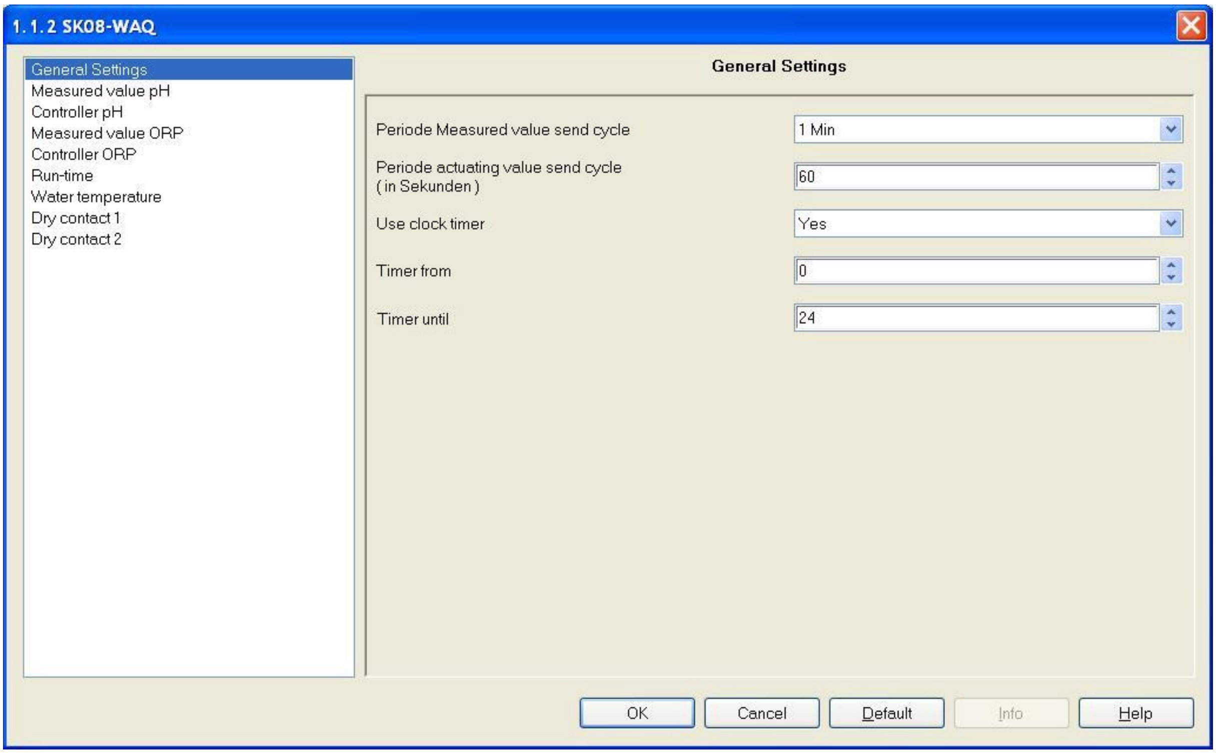
- Measured data pH-Wert und ORP (redox potential)
- Two-position controller with switching and pulsed 1 Bit output for pH and ORP
- Pulsed controller output for chemical and fresh water input
- PI controller with static 8 Bit or pulse-width modulated 1 Bit output for pH and ORP
- Adjustable periodic sending of control variable: no periodic sending/10-250 seconds
- All controllers with release and lock function (parameter driven)
- Threshold alarm for upper and lower thresholds
- Auxiliary quantity for changing the set point or threshold via the bus
- Calibration of the sensors (1 point and 2 point calibration) via the KNX bus, reset to factory settings available
- Operating time counter with threshold and reset
- Additional inputs for one Temperature sensor and two dry contacts

General Settings:

Periodic Measured Data Cycle: Measured data to be periodically displayed can be configured from a length of 1 to 120 minutes.

Periodic Actuating Variable Cycle: The actuating variable cycle can be set between 10 and 250 seconds.

To display the measured data periodically use the measured data settings; to periodically display the control variable use the controller settings.



When using the **internal timer**, there are two additional objects for the system-time and –date available. Each controller can be locked independent from each other depending on the time. In this page you can set whether the timer is used at all and the span of time the controllers are active. Whether the timer is used for a controller is determined at his parameter page.

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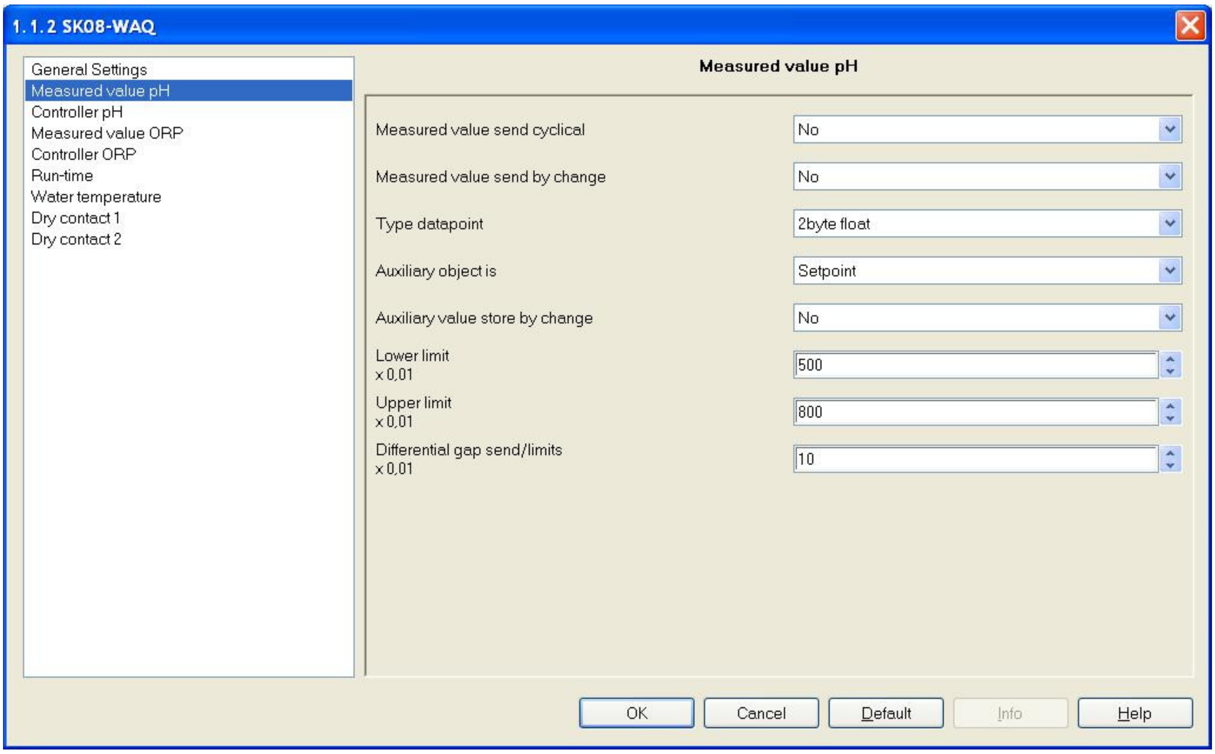
Measured Data pH:

Periodic Sending: Yes/No the period is set in General Settings

Measured value send by change: Yes/No The threshold is defined in "Display Differential Gap/Threshold".

Value Type: 1-byte Integer /2-byte Integer /2-byte float/4-byte float Measured Data Output and Auxiliary Quantity is defined concurrently.



Auxiliary object is: Set point/Upper Threshold/Lower Threshold Every controller has an auxiliary quantity which can control either the set point of the controller or the limit values.

Auxiliary value store by change: Yes/No When the auxiliary quantity is changed the new value is carried over to EEPROM and saved in case of a bus voltage breakdown. This should be used only when the set point is not frequently changed as EEPROM has only a limited memory cycle.

Lower Threshold: 0 … 14,00

Upper Threshold: 0 … 14,00

Differential gap send/limits: 0 … 14,00 To reduce the bus load when a value is changed and to avoid multiple switching between measured data and thresholds, a hysteresis between 0,02 und 0,1 should be used.

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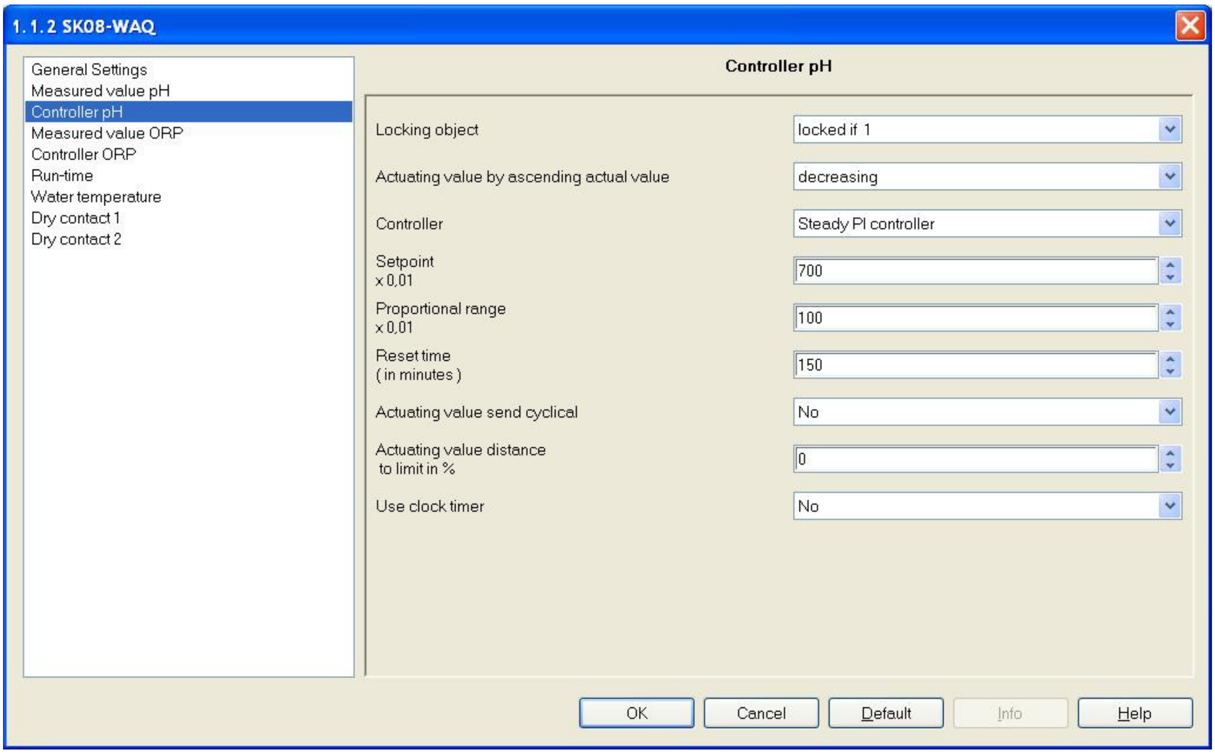
Controller pH:

Lock: lock with 0/lock with 1 when using the lock function the controller output is deactivated. The lock function can be set up as "release" or "lock".



Actuating value by ascending actual value: decrease/increase The Actuating direction of the controller can be adapted to the characteristics of the controlled system.

Set Point: 0,00 … 14,00

Controller: Two-position Controller / Pulsed Two-position Controller /Continuous PI Controller/ Switching PI Controller These controller models and their applicable parameters are covered in the section "Controller Algorithms".

Display controller value periodically: Yes/No The display period is set in "General Settings"

Actuating Variable border spacing in %: 0…50 When the lower threshold is surpassed 0% is set, when the upper threshold is surpassed 100% will be set. This is important for actuators which do not operate reliably at threshold levels.

Use clock timer: Yes/No The use of the clock timer can be enabled/disabled for each channel separately.

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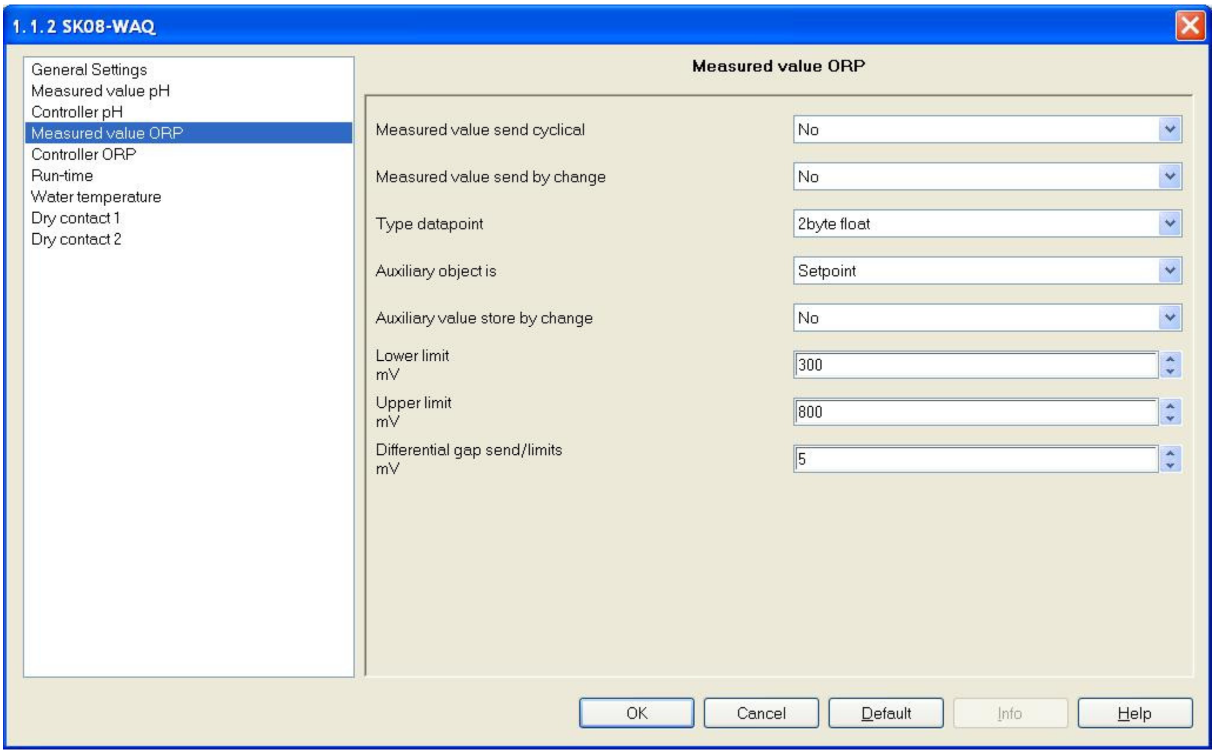
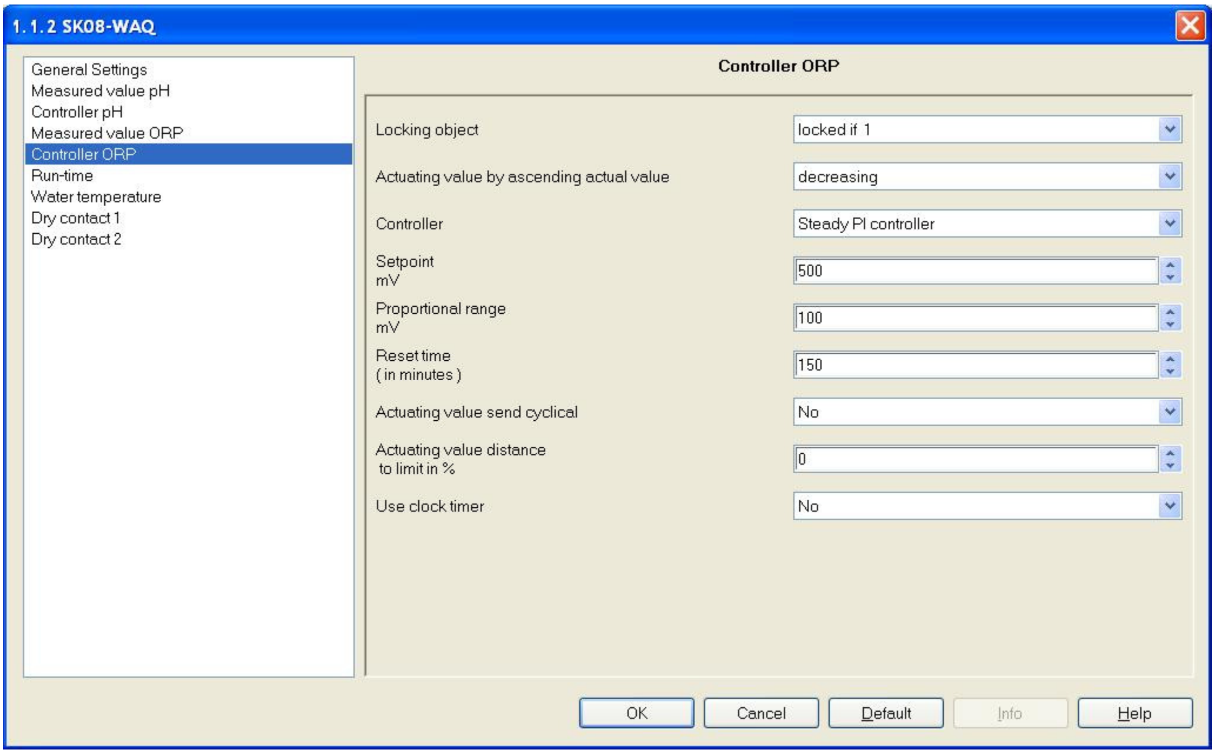
Measured Value ORP:



All settings for the rider "Measured Value ORP" should be made analogous to "Measured Value pH" The threshold and differential gap should be set in the range of -1200 to +1200.

Controller ORP:



All settings for "Controller ORP" should be made analogous to "Controller pH".
The set point, differential gap and proportional area should be set in the range of -1200 to +1200.

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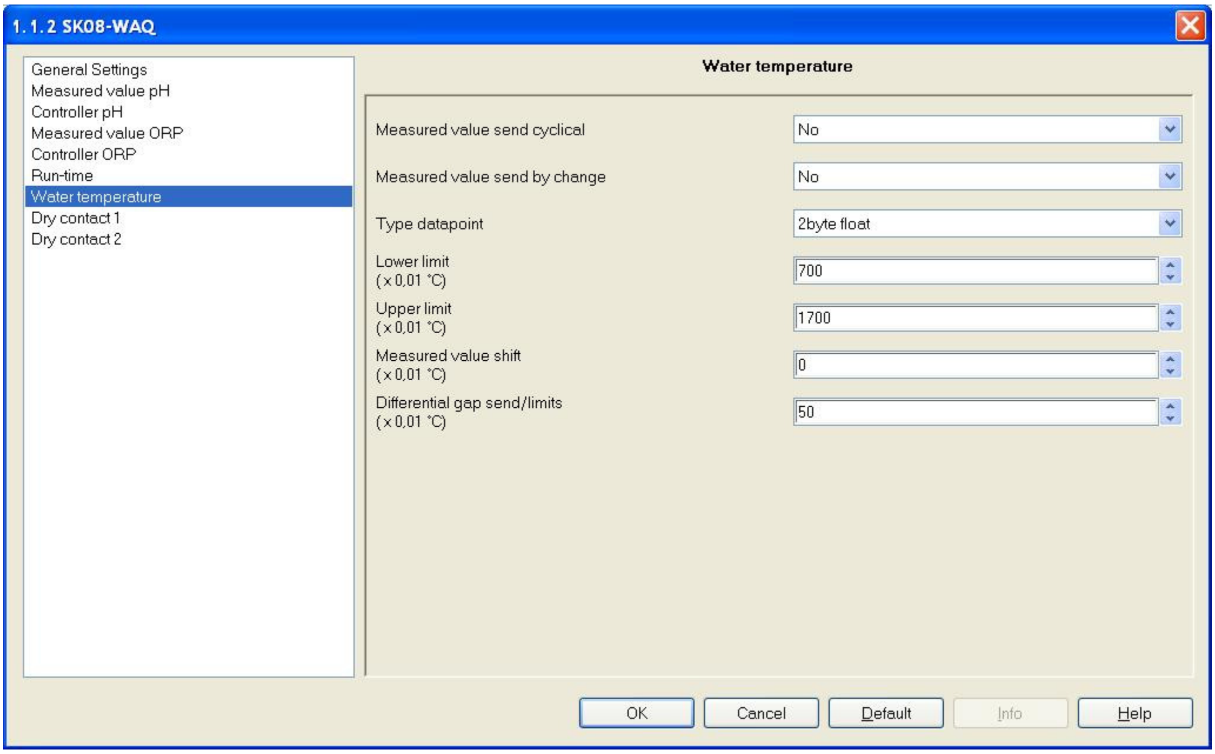
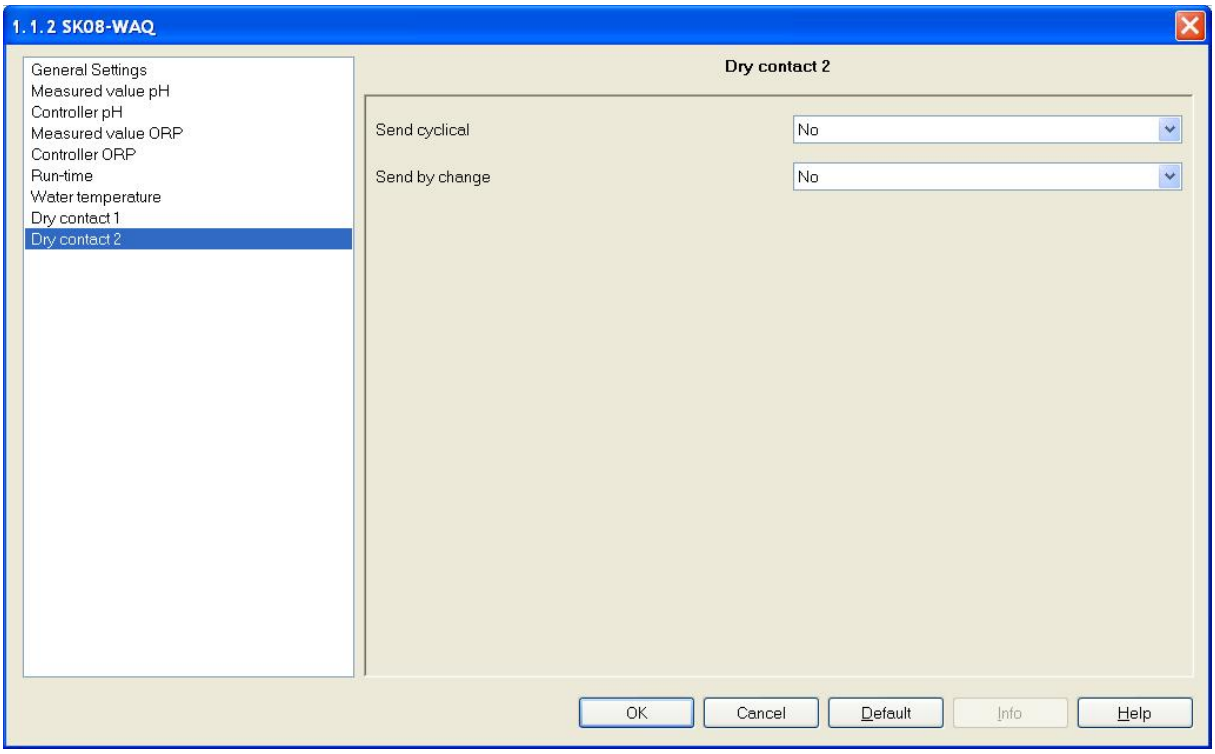
Water Temperature:



All settings for the rider "Water temperature" should be made analogous to "Measured Value pH" The threshold and differential gap can be set in the range of 0° to 100°C in steps of 0.01°.

Switching Inputs S1 and S2:



The Parameters “Send on change” and “Send periodically” can be set independent for the 2 dry contact inputs.

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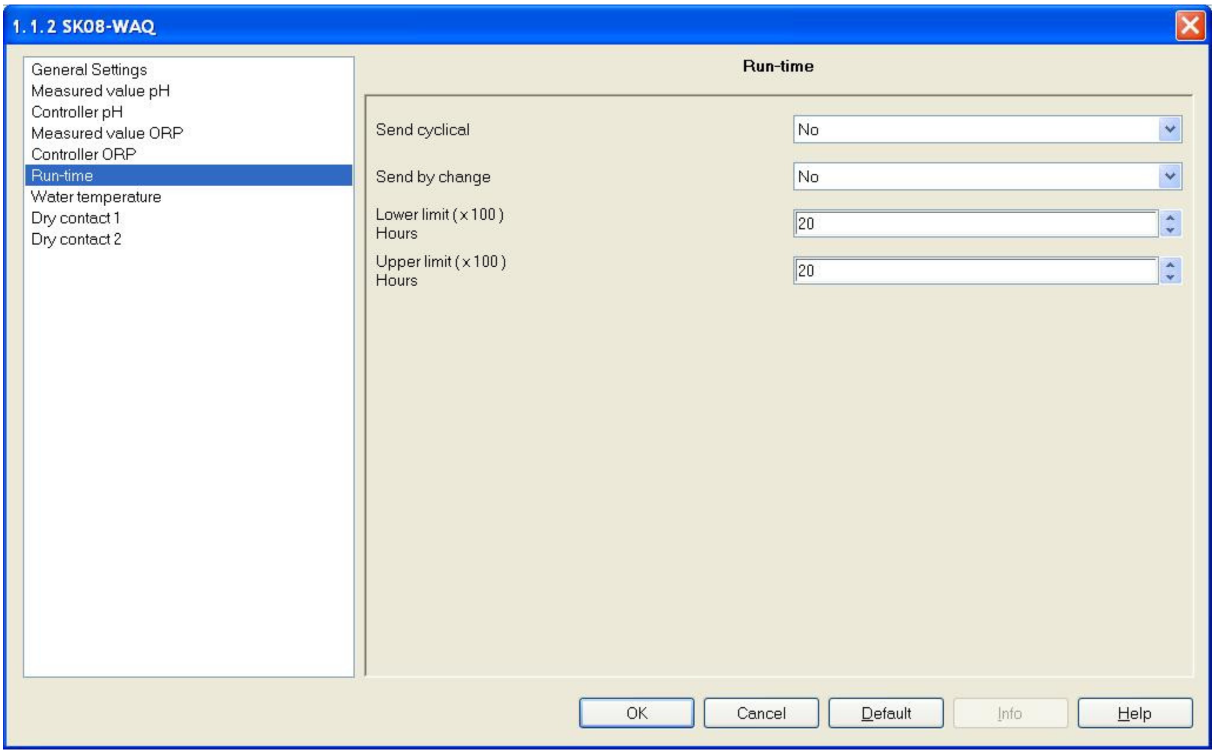
Operating Time:



The operating time of the sensor pH/ORP is important for controlling the calibration of the electrodes. The current operating time can be set for either periodic or hourly output. Thresholds can be configured as alerts for recalibration. Calibration times vary according to the type of electrode and the manufacturer. The usual time period is between 3 and 6 months (2000 – 4000 hours).

Calibration:

The electrodes must be calibrated at the time of installation, when the electrodes are changed and at regular intervals depending on the electrode and the application. Two objects control the calibration: the calibration key and the calibration value. Different calibration functions have different keys and the calibration values are added up by reception. A calibration value of 0 resets the calibration and enables an evaluation of the condition of the sensor. The measured data of the electrodes are temperature-dependent, thus the calibration should occur at the expected standard temperature if no temperature sensor is used.

Calibration Point		Key	Calibration Value *)
pH Zero Offset	pH 7,00	0xA0 (160)	* 100
pH Transconductance	pH X	0xA1 (161)	* [(XSet - XIs)/(7-XSet)*300]
ORP Zero Offset	0 mV	0xA2 (162)	* 1 mV **)
ORP Transconductance	X mV	0xA3 (163)	* [((XSet - XIs) /XSet) *3000] mV

*) A calibration value of 0 resets the calibration, from 0 several values are accumulated.
**) As a rule, zero point ORP can be disregarded.

Example:
1) Use the buffer solution pH 7, determine the measured value and wait for a stable result. If the value is 0,12 write 0xA0 on the calibration key and -12 on the calibration value. Check if the value is actually 0,00 (+/- 0,01). You can use 12 times -1 instead of 1 time -12 to do this.
2) Use the buffer solution pH4, determine the measured value and wait for a stable result. If the value is 4,09, write 0xA1 on the calibration key and -9 (or 9 times -1) for the calibration function. Check the value.
3) For standard applications skip the calibration of ORP zero offset because it rarely changes.
4) Use a testing solution 470mV redox (or any other different from 0 mV) and go to 2
5) Write 0xAF (175) on the calibration key to reset the operating time counter.

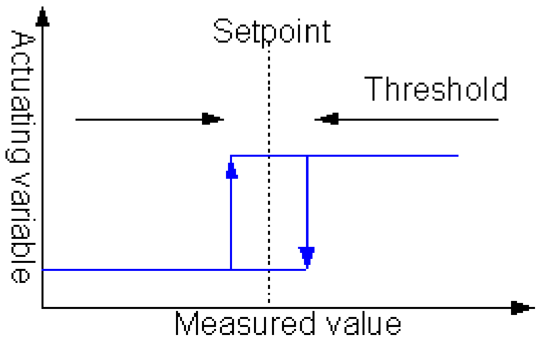
Controller Algorithms:

Controller models available are the PI controller or a two-position controller. Both controllers are equipped with pulsed output. The pulsed two-position controller works with constant duty cycle, which like the cycle duration is parameterized. The duty cycle of the pulsed PI controller is variable and depends on the control variable (pulse-width modulation).

Two-Position Control:

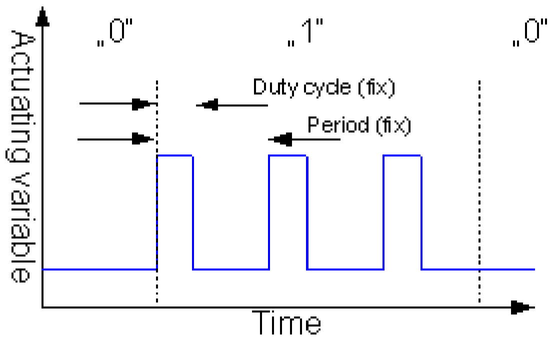
Two-position control is a very simple way of controlling. Once the actual value (+/- half the differential gap) exceeds or falls below the set point a switch-on or switch-off command is sent to the bus. Set the differential gap large enough to keep bus load to a minimum. Configure the differential gap small enough to avoid extreme actual value fluctuations.

The two-position controller is parameterized using the set point and the differential gap.



Two-Position Control with Pulsed Output:

The controller works analogous to the two-position controller, but the actuating variable emits pulses with fixed duty cycle.



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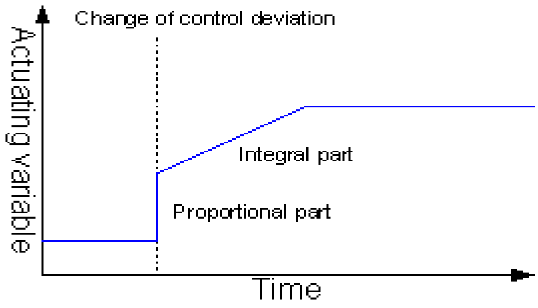
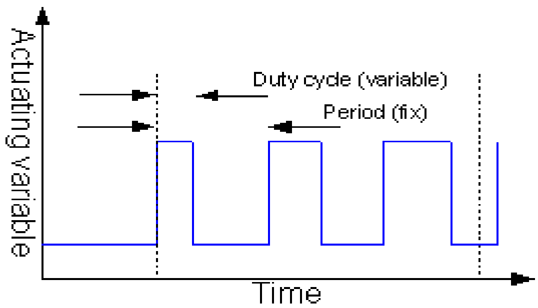
Continuous PI Control:

To understand a PI controller one should think of an algorithm consisting of a proportional and integral part. By combining these two parts it is possible to get a quick yet exact adjustment of the actuating variable. The controller calculates the control variable every second. It can constantly be updated and is displayed periodically (value parameterized) by the PI controller. Through the integral part an offset is adjusted to 0 over a certain period of time.



Continuous PI Control with Pulsed Output (PWM):

The controller works analogous to the PI controller, but the actuating variable emits pulses with a variable duty cycle. PWM control sets the cycle duration of the transmission interval. This allows a permanent on and off within the cycle time with object 15, which reaches an average valve position. When the control variable reaches 40% in a cycle time of 10 minutes it will repeatedly turn on for 4 minutes and turn off for 6 minutes.



General Rules for Adjusting the PI Parameter:

The reset time must be significantly larger than the delay time of the control system. The proportional area corresponds to the reinforcement of the control circuit. The smaller the proportional area, the larger the reinforcement is.

Parameters	Effect
Low Proportional Area	Large overshooting of set point balance (potential for constant oscillation), quick set point reset
High Proportional Area	Little or no overshooting, but slow reset
Short Integration Time	Quick adjustment of control deviations (based on conditions) danger of constant oscillation
Long Integration Time	Slow adjustment of control deviations

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Object Table for the application SK08-WAQ:

The length of data point 2/3 and 9/10 varies according to the selected data point format.

Number	Name	Object Function	Length
0	Input, calibration object	Calibration object	1 Byte
1	Input, calibration value	Calibration value	1 Byte
2	Output, measured value pH	Measured value	2 Byte
3	Input, auxiliary object pH	Auxiliary object	2 Byte
4	Output, upper limit pH	Exeeding limit	1 bit
5	Output, lower limit pH	Undercut limit	1 bit
6	Output, controller pH	Actuating value	1 Byte
7	Input, enable/lock pH	Enable/lock	1 bit
8	Output, status object pH	Status	1 Byte
9	Output, measured value ORP	Measured value	2 Byte
10	Input, auxiliary object ORP	Auxiliary object	2 Byte
11	Output, upper limit ORP	Exeeding limit	1 bit
12	Output, lower limit ORP	Undercut limit	1 bit
13	Output, controller ORP	Actuating value	1 Byte
14	Input, enable/lock ORP	Enable/lock	1 bit
15	Output, status object ORP	Status	1 Byte
16	Output, run-time	Measured value	2 Byte
17	Input, auxiliary object run-time	Auxiliary object	2 Byte
18	Output, run-time upper limit	Exeeding limit	1 bit
19	Output, run-time lower limit	Undercut limit	1 bit
23	Output, measured value Temperatur	Measured value	2 Byte
25	Output, upper limit temperatur	Limit	1 bit
26	Output, lower limit temperatur	Limit	1 bit
30	Output, S1	Contact S1	1 bit
37	Output, S2	Contact S2	1 bit

Tips on how to use the calibration functions 0 and 1 are found in the section "Calibration".

Status functions 8 and 15 are coded as follows:

Description	**Bit Number**	**Hexadecimal value**
Upper Threshold Exceeded	0	0x01
Lower Threshold Surpassed	1	0x02
Actuating Variable does not equal 0	2	0x04
Lock Active	4	0x08
Save Auxiliary Quantity	5	0x10

The values of the individual bits are added and transmitted to the bus. The status functions monitor the controller status for purposes of reporting and troubleshooting.

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Imprint:

Publisher: Arcus-EDS GmbH, Rigaer Str. 88, 10247 Berlin

Responsible for Content: Hjalmar Hevers, Reinhard Pegelow

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