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RTC101 P-Module

Real-Time Control System for Phosphorus Removal

User manual

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Section 1 Specifications

Subject to change without notice.

Industrial Personal Computer (IPC), (Embedded PC)	
Processor	Pentium®1, MMX compatible, 500 MHz clock rate
Flash memory	2 GB compact flash card
Internal working memory	256 MB DDR-RAM (not expandable)
Interface	RJ 45 (Ethernet), 10/100 MBit/s
Diagnostic LEDs	Power, LAN speed, LAN activity, TC status, flash access
Expansion slot	Compact flash type II slot with ejection mechanism
Clock	Internal, battery-buffered clock for time and date (battery can be replaced)
Operating system	Microsoft Windows®2 CE or Microsoft Windows Embedded Standard
Control software	TwinCAT PLC Runtime or TwinCAT NC PTP Runtime
System bus	16 Bit ISA (PC/104 standard)
Power supply	Via system bus (through power supply module CX1100-0002)
Max. power loss	6 W (including the system interfaces CX1010-N0xx)
Analog input	4–20 mA for flow rate measurement
Internal resistance	80 Ohm x diode voltage 0.7 V
Signal current	0–20 mA
Common mode voltage (U_{CM})	35 V max.
Measurement error (for entire measurement range)	$< \pm 0.3\%$ (from measurement range end value)
Electrical surge resistance	35 VDC
Electrical isolation	500 V_{eff} (K-bus/signal voltage)
Analog output	4–20 mA for dosing pump
Number of outputs	1
Power supply	24 V DC via power contacts (alternatively 15 V DC with bus terminal KL9515)
Signal current	0–20 mA
Working resistance	$< 500 \Omega$
Measurement error	± 0.5 LSB linearity error ± 0.5 LSB offset error $\pm 0.1\%$ (relative to the measuring range end value)
Resolution	12 bit
Conversion time	~ 1.5 ms
Electrical isolation	500 V_{eff} (K-bus/signal voltage)

Specifications

Digital outputs	1-channel: 1 x for dosing pump and 1 x alarm 2-channel: 2 x for dosing pump and 1 x alarm
Nominal load voltage	24 VDC (-15% / +20%)
Load type	Ohmic, inductive, lamp load
Max. output current	0.5 A (short-circuit proof) per channel
Short-circuit current	0.7 to 1.7 A
Reverse polarity protection	Yes
Electrical isolation	500 V _{eff} (K-bus/field voltage)
Power contact current consumption	20 mA typ. (for typ. 30 mA 2-channel device)
Equipment properties	
Dimensions (L x W x H)	350 mm x 120 mm x 96 mm (13.78 in. x 4.72 in. x 3.78 in.)
Mass	approx. 0.9 kg
Environmental conditions	
Working temperature	0 to 50 °C (32 to 122 °F)
Storage temperature	-25 to +85 °C (-13 to 185 °F)
Relative humidity	95%, non-condensing
Miscellaneous	
Pollution Degree	2
Protection Class	1
Installation Category	II
Maximum Altitude	2000 m (6.562 ft.)
Protection class	IP20
Installation	DIN rail EN 50022 35 x 15

¹ Pentium is a registered trademark of the Intel Corporation.

² Microsoft Windows is a brand name for operating systems of the Microsoft Corporation.

Canadian Radio Interference-Causing Equipment Regulation, IECS-003, Class A:

Supporting test records reside with the manufacturer.

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing

Equipment Regulations.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

FCC Part 15, Class "A" Limits

Supporting test records reside with the manufacturer. The device complies with Part 15 of the FCC

Rules. Operation is subject to the following conditions:

1. The equipment may not cause harmful interference.
2. The equipment must accept any interference received, including interference that may cause

undesired operation.

Changes or modifications to this equipment not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules.

These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at their expense. The following techniques can be used to reduce interference problems:

1. Disconnect the equipment from its power source to verify that it is or is not the source of the interference.
2. If the equipment is connected to the same outlet as the device experiencing interference, connect the equipment to a different outlet.
3. Move the equipment away from the device receiving the interference.
4. Reposition the receiving antenna for the device receiving the interference.

Try combinations of the above.

Section 2 General Information

2.1 Safety information

Please read this entire manual before unpacking, setting up, or operating this equipment. Pay attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

To prevent damage to or impairment of the device's protection equipment, the device may only be used or installed as described in this manual.




2.1.1 Use of hazard information

⚠ DANGER
Indicates a potentially or imminently hazardous situation that, if not avoided, can result in death or serious injury.
⚠ WARNING
Indicates a potentially or imminently dangerous situation that, if it is not avoided, can lead to death or to serious injuries.
⚠ CAUTION
Indicates a possible dangerous situation that can have minor or moderate injuries as the result.
NOTICE
Indicates a situation that, if it is not avoided, can lead to damage to the device. Information that requires special emphasis.

Note: Information that supplements points in the main text.

2.1.2 Warning signs

Read all labels and tags attached to the instrument. Non-observance may result in personal injury or damage to the equipment..

	This symbol is a warning triangle. Follow all safety notes that follow this symbol to prevent possible injuries. If this symbol is located on the device, it refers to information in the operating and/or safety notes of the user manual.
	This symbol can be attached to a housing or a barrier in the product and shows that electric shock risk and/or the risk of a death through electric shock exists.
	Electrical equipment marked with this symbol may not be disposed of in European domestic or public disposal systems after 12 August 2005. In conformity with local and national regulations, European electrical equipment users must now return old or end-of life equipment to the manufacturer for disposal at no charge to the user. Note: You obtain instructions on the correct disposal of all (marked and not marked) electrical products that were supplied or manufactured by Hach-Lange at your relevant Hach-Lange sales office.

2.2 Areas of application

The RTC101 P-Module is a universal open-loop control and closed-loop control unit in waste water treatment plants for automatic precipitant metering for phosphate precipitation.

Depending on the operating situation, the precipitant dosage can be based on measured values in the influent or effluent or based on profiles. The system automatically selects the best possible strategy. The user is able to make restrictions manually.

NOTICE

The use of an RTC Module does not release the operator from the duty of care to the system. No guarantees as to the functionality or operational safety of the system.

In particular, the operator must make sure that instruments connected to the RTC open/closed-loop controller are always fully functional.

To make sure these instruments supply correct, reliable measurement values, regular maintenance work (for example, cleaning of the sensor and laboratory comparative measurements) is essential! (Refer to the user manual for the relevant instrument.)

2.3 Functional principle

In the following, a distinction is made between the **open-loop control** and the **closed-loop control** of the precipitant concentration.

For the **open-loop control** of the precipitant dosing, the measuring point for the phosphate concentration is **upstream of** the precipitant dosing point.

For the **closed-loop control** of the precipitant dosing, the measuring point for the phosphate concentration is **downstream of** the precipitant dosing point.

The measuring point for the **flow rate** is usually located in the **influent** of the waste water treatment plant. At the measuring point, the actual flow rate (influent quantity and recirculation - e.g. RAS, MLR, etc) is determined via further entries in the RTC module.

If the measured values for the flow rate quantity and/or phosphate concentration are temporarily not available (e.g. due to a malfunction), the system automatically refers back to saved profiles.

Connect the following input signals on the control unit in order to make optimum use of all system functions:

- Flow rate, measurement signal 4–20 mA
- Fault indicator signal of the flow rate measurement (230 V AC or 24 V DC)
In the event that measured value failures are not signaled according to NAMUR 43, as the values are below the 4 mA threshold.

Note: If these signals are not available, the equipment operates with limited functionality.

- sc1000 controller with PO₄P PHOSPHAX sc analyzer.
The measured value is adopted directly.
- Dosing pump for the precipitant
The dosing pump is continuously actuated via a 0–20 mA or 4–20 mA current loop signal as well as via a changeover contact. If the dosing rate is below the minimum precipitant flow rate of the pump, the system automatically switches to pulse/pause mode.

2.4 Scope of delivery

Each RTC101 P-Module is supplied with:

- SUB-D connector (9 pin)
- Ferrite core, folding
- Manual

Check that the order is complete. If anything is missing or damaged, please contact the manufacturer or distributor.

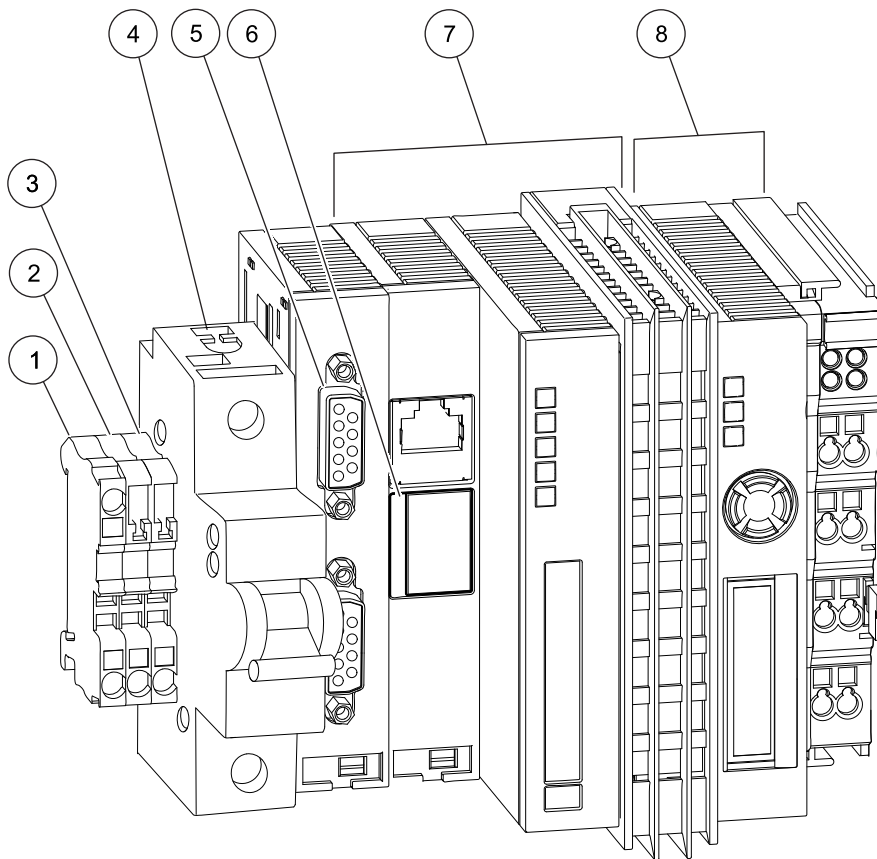
NOTICE

The combination of pre-assembled components supplied by the manufacturer does not represent a standalone functional unit. In accordance with EU guidelines, this combination of pre-assembled components is not supplied with a CE mark, and there is no EU declaration of conformity for the combination.

However, the conformity of the combination of components with the guidelines can be proved through technical measurements.

2.5 Instrument overview

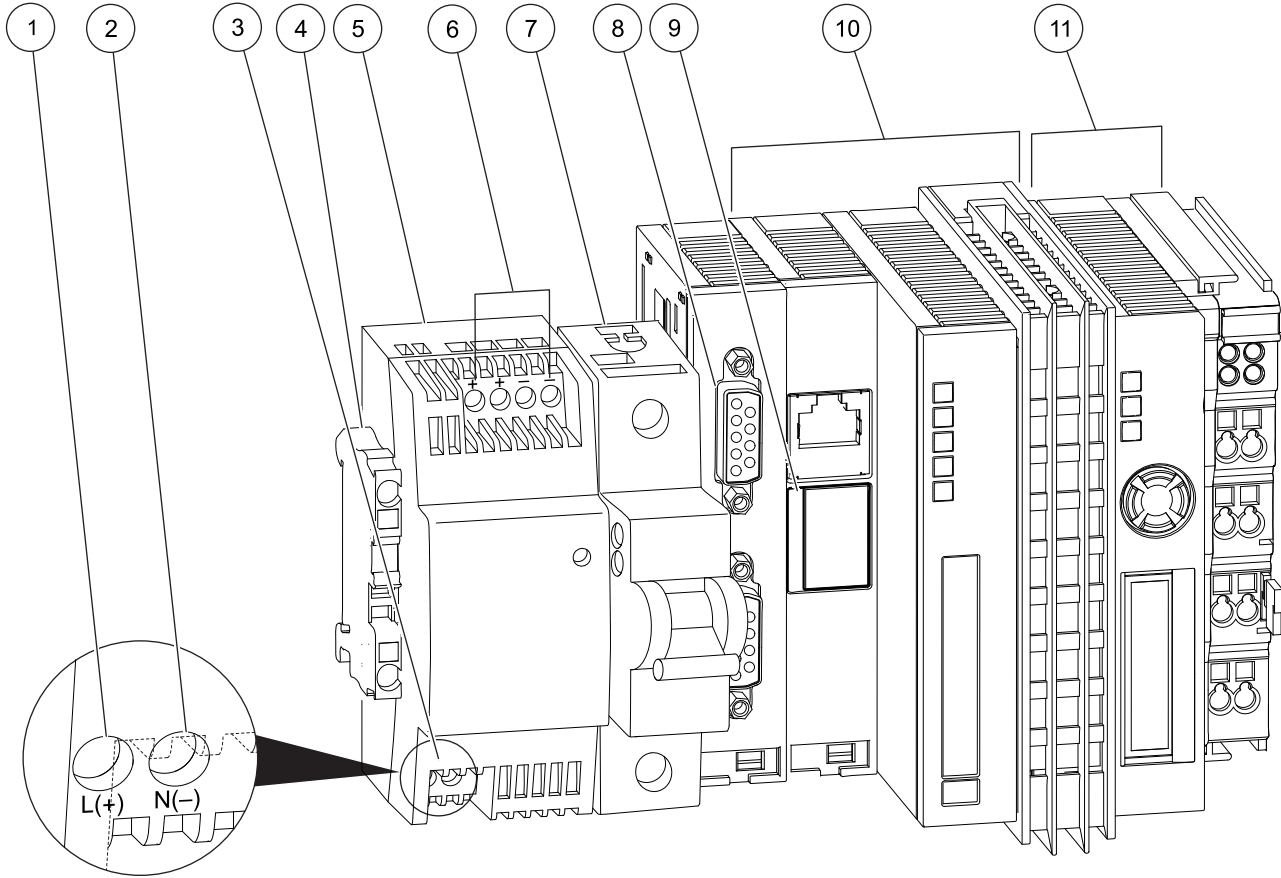
Figure 1 Base module RTC 24 V version .



1	PE (protective earth)	5	sc 1000 connection: RS485 (CX1010-N031)
2	24 V	6	Battery compartment
3	0 V	7	CPU base module, consisting of Ethernet port with battery compartment (CX1010-N000), CPU module with CF card (CX1010-0021) and passive aeration element.
4	Automatic circuit breaker (ON/OFF switch for item 7 and 8 without fuse function).	8	Power supply module, consisting of bus coupler (CX1100-0002) and terminal module 24V.

Note: All components are pre-wired.

Abbildung 2 Base module RTC 100-240 V version



1	L(+)	7	Automatic circuit breaker (ON/OFF switch for item 10 and 11 without fuse function).
2	N(-)	8	sc 1000 connection: RS485 (CX1010-N041)
3	Input AC 100–240 V / Input DC 95 V–250 V	9	Battery compartment
4	PE (protective earth)	10	CPU base module, consisting of Ethernet port with battery compartment (CX1010-N000), CPU module with CF card (CX1010-0021) and passive aeration element.
5	24 V transformer (Specification Section 3.1.1, page 15)	11	Power supply module, consisting of bus coupler (CX1100-0002) and terminal module 24V.
6	Output DC 24 V, 0,75 A		

Note: All components are pre-wired.

⚠ DANGER

Only qualified experts may perform the tasks described in this section of the manual, while adhering to all locally valid safety regulations.

⚠ CAUTION

Always lay cables and hoses so that they are straight and do not pose a tripping hazard.

⚠ CAUTION

Before the power supply is switched on, refer to the instructions in the relevant manuals!

3.1 RTC101 P-Module connection

The RTC module must be installed on a DIN rail/standard rail.

Install the module horizontally, with at least 30 mm clearance at the top and bottom, in order to guarantee the functionality of the passive ventilation element. The RTC module is operated solely via the sc1000 controller (see sc1000 controller operating instructions).

When used indoors, the RTC module can be installed in a control cabinet.

When used outdoors, the RTC module requires its own housing that follows the technical specifications.

3.1.1 Power supply to the RTC module

⚠ WARNING

Alternating current may destroy the direct current system and therefore jeopardize user safety. Never connect an alternating current voltage to the 24 V direct current model.

Table 1 Supply voltage of the RTC Module

Voltage	24 V DC (-15% / +20%), max. 25 W
Recommended fuse	C2
With 110–230 V option	110–230 VAC, 50-60 Hz, approximately 25 VA

Note: An external deactivation switch is recommended for all installations.

3.2 Dosing pump connection

There are two connections for the dosing pump:

- Current loop signal 0/4 to 20 mA for analog actuation of pumps with frequency converters.
- 24 V output for the actuation of pumps without frequency converters or below the analog adjustment range in pulse/pause mode.

Note: It must also be possible to switch the pump off via the digital output in the case of analog actuation!

3.3 PHOSPHAX sc analyzer connection

The measuring signal of the PHOSPHAX sc analyzer is transmitted to the RTC101 P-Module from the sc-system via the RTC communication card.

Previous designs of the analyzer (e.g. PHOSPHAX inter) can be connected to an analog input card (YAB018).

Installation

3.3.1 PHOSPHAX sc analyzer power supply

Refer to the PHOSPHAX sc manual.

3.4 sc1000 controller connection

Connect the SUB-D plug supplied to a dual-core, sheathed data cable (signal or bus cable). For further information regarding the data cable connection, refer to the enclosed assembly instructions.

3.5 Flow rate signal connection

If a flow rate measurement signal of 4 to 20 mA is available, connect it to the analog input of the RTC module.

3.6 Connection to the automation unit on the plant side

Depending on the variant and option, the RTC101 P-Module is equipped with various components that must be connected to the plant's automation unit.

- The volumetric flow rate is provided to the RTC module as a 0/4 to 20 mA signal for all variants and options.
- The precipitant volume to be metered is delivered by the RTC module as a 0/4 to 20 mA signal for all variants and options.
Alternatively, the precipitant volume can also be output by the fieldbus variants provided by the sc1000 (see sc1000 operating instructions).
- The RTC module supplies the digital output signal for activating the precipitant pump at 0 V or 24 V.
- The RTC module supplies a collective fault message at 0 V (fault) or 24 V (device functional).

Table 2 Signal allocation of individual components of the RTC module

Component	Name	Connection	Signal	Function	RTC module options	
					1-channel	2-channel
2-fold digital output ¹	KL2032	1	+24 V/0 V	Precipitant pump on/off	X	
		5	+24 V/0 V	No fault/fault	X	
4-fold digital output ¹	KL2134	1	+24 V/0 V	Precipitant pump 1 on/off		X
		5	+24 V/0 V	No fault/fault in channel 1		X
		4	+24 V/0 V	Precipitant pump 2 on/off		X
		8	+24 V/0 V	No fault/fault in channel 2		X
Single analog output	KL4011	1(+) 3(-)	+24 V/0 V	Precipitant pump dosing rate	X	
2-fold analog output	KL4012	1(+) 3(-)	+24 V/0 V	Precipitant pump 1 dosing rate		X
		5(+) 7(-)	+24 V/0 V	Precipitant pump 2 dosing rate		X
1-fold analog input	KL3011	1(+) – 2(-)	0/4 to 20 mA	Feed volume flow Channel 1	X	X
2-fold analog input	KL3011	1(+) – 2(-)	0/4 to 20 mA	Feed volume flow Channel 2		X

¹ Ground to connections 3 and 7 or equal to voltage supply

Section 4 Parameterization and operation

4.1 Open-loop control and closed-loop control programs

Four different programs are provided to enable optimal adaptation to local conditions and to the available measurement signals.

Programs 3 and 4 have various functions depending on whether open-loop control or closed-loop control is selected.

4.1.1 Open-loop control

For the **open-loop control** of precipitant dosing, the measuring point for phosphate concentration is **upstream of** the precipitant dosing point.

4.1.1.1 Open-loop control according to phosphate concentration profiles

Program 1

Load-proportional open-loop control:

- Specified profile of the phosphate concentration in the reactor inlet
- Specified profile for the flow rate

Program 2

Load-proportional open-loop control:

- Specified profile of the phosphate concentration in the reactor inlet
- Flow rate measured value

Note: The prerequisite for this program is that the flow rate measurement signal is valid. "Valid" means that the signal is present at the relevant input.

4.1.1.2 Open-loop control according to measured phosphate values

Program 3

Load-proportional open-loop control:

- Measured value of the phosphate concentration in the reactor inlet
- Specified profile for the flow rate

Note: The prerequisite for this program is that the PO_4 -P measurement signal is valid. "Valid" means that the signal is present at the relevant input.

Program 4

Load-proportional open-loop control:

- Measured value of the phosphate concentration in the reactor inlet
- Flow rate measurement

Note: The prerequisite for this program is that both measurement signals are valid. "Valid" means that the signal is present at the relevant input.

4.1.2 Closed-loop control according to measured phosphate values

For the **closed-loop control** of the precipitant dosing, the measuring point for the phosphate concentration is **downstream** of the precipitant dosing point.

Program 3

Closed-loop control:

- Measured value of the phosphate concentration in the reactor outlet
- Specified profile for the flow rate (can be deactivated)

Note: The prerequisite for this program is that the PO_4 -P measurement signal is valid. "Valid" means that the signal is present at the relevant input.

Program 4

Load-proportional closed-loop control:

- Measured value of the phosphate concentration in the reactor inlet
- Flow rate measurement

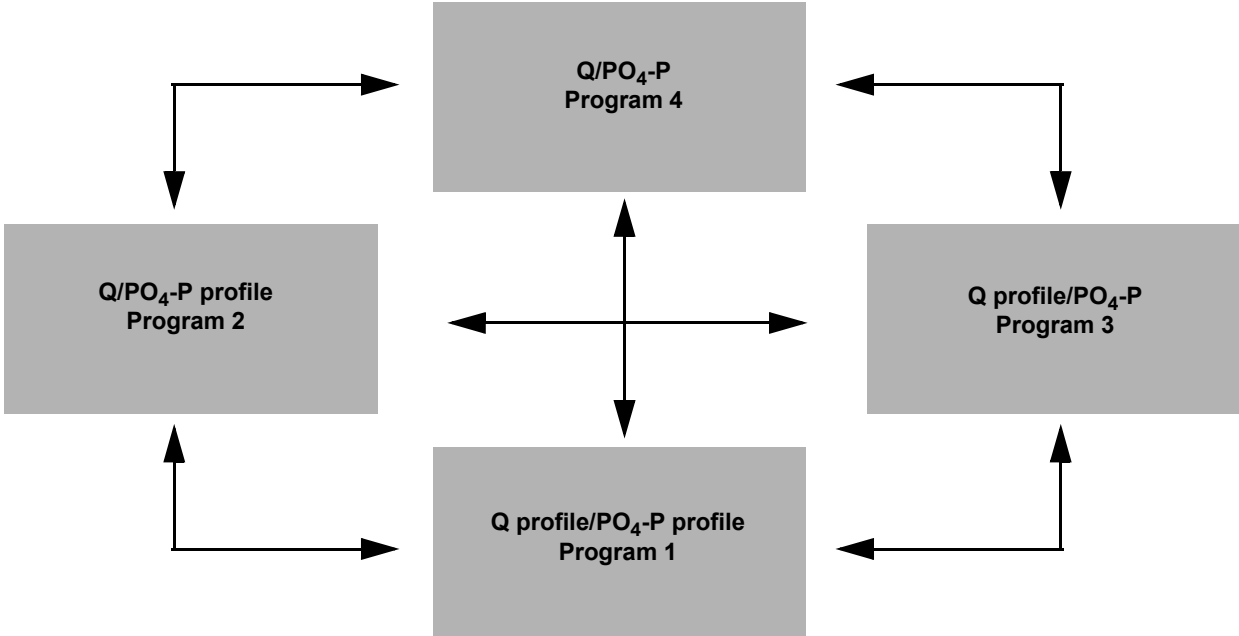
Note: The prerequisite for this program is that both measurement signals are valid. "Valid" means that the signal is present at the relevant input.

4.2 Program change

4.2.1 Automatic program change

If a measurement signal drops out, an automatic program change occurs and the system refers to the specified profile. The program selection can be limited manually. The change between programs occurs with a 5 minute delay, whereby the last manipulated value set for the dosing is retained at the output.

Figure 3 Program change



If both measurement signals become invalid at the same time, the system switches between programs 4 and 1 without intermediate stages.

4.2.2 Manual pre-selection

Manual pre-selection limits the selection of programs.

Pre-selection 1:	Always	Program 1		
Pre-selection 2:	Open-loop control:	Program 2	On signal drop out	Program 1
Pre-selection 3:	Closed-loop control:	Program 3	On signal drop out	Program 2 if possible
		Program 3		Otherwise program 1

4.2.3 CF card configuration

NOTICE
Never remove the CF card from the RTC module during operation! This can damage the instrument!

The function of the RTC101 P-Module, i.e. control/regulation, is indicated on the CF card. If this setting is to be changed, please contact the manufacturer's service department (Section 8).

4.3 Parameterization on the sc1000

4.3.1 User interfaces and navigation

Before the system is used, the user must be familiar with the sc controller functions. Learn how to navigate through the menu and perform the relevant functions.

4.3.2 System setup

1. Open the **MAIN MENU**.
2. Select **RTC MODULE / PROGNOSYS** and confirm.
3. Select the **RTC MODULE** menu and confirm.
4. Select the RTC module and confirm.

4.3.3 1-channel open-loop control

1-channel open-loop control

CONFIGURE	
SELECT SENSOR	Select the sensor installed for the open-loop control (see Section 4.4, page 31).
OPEN-LOOP	
PRECIP. TYPE	Precipitation, simultaneous precipitation, post-precipitation
SETPOINT PO₄-P	Desired orthophosphate value in effluent (refer to 4.5.1, page 33) [mg/L]
CORR FACTOR	Percentage correction of precipitant dosing (see 4.5.2, page 33) [%]
BIO-P	Phosphate biologically eliminated after influent (refer to 4.5.3, page 33) [%]
MIN DOS RATE	Minimum flow rate of dosing pump [L/h]
PRESELECT PROG	Programs 1 to 4 (refer to 4.1, page 17)
PROFILE	<i>Active</i> when a measurement signal <i>fails</i>
Q-PROFILE	Daily profiles (2 h average) of waste water influent according to feed measurement signal [m ³ /h]
P-PROFILE	Daily profiles for PO ₄ -P concentrations, 2 h average (see 4.5.4, page 34) [mg/L]
WEEK PROFILE	Percentage daily averages of the phosphate load (refer to 4.5.4, page 34) (volume x concentration) [%]
IN- OUTPUTS	
DOSING PUMP	
MIN PUMP RANGE	Lower threshold of flow rate range [L/h]
MAX PUMP RANGE	Upper threshold of flow rate range [L/h]
0/4...20MA	Selection of transfer range according to pump input
CONTROL CYCLE	Control cycle comprising on- and off-time (see 4.5.6, page 35) [s]
MIN RUNTIME	Minimum on-time of pump (refer to 4.5.6, page 35) [s]
FLOW RATE	
MIN Q-INFLUENT	Minimum flow rate in inlet according to measurement signal [m ³ /h]
MAX Q-INFLUENT	Maximum flow rate in inlet according to measurement signal [m ³ /h]
0/4...20MA	Transfer range of 0/4–20 mA current loop, as set in the connected flow measuring instrument
MIN RET SLUDGE	Minimum flow rate of return activated sludge pump(s) (refer to 4.5.7, page 36) [m ³ /h]
MAX RET SLUDGE	Maximum flow rate of return activated sludge pump(s) (refer to 4.5.7, page 36) [m ³ /h]
Q RET RATIO	Ratio between measured flow rate and return activated sludge volume, for a return activated sludge volume proportional to the measured flow rate (refer to 4.5.7, page 36) [%]
Q INFL SMOOTH	Smoothing of influent signal (refer to 4.5.7, page 36)

Parameterization and operation

1-channel open-loop control

CONFIGURE (CONTINUE)	
PRECIPITANT	
METAL CONTENT	Metal concentration in precipitant (refer to 4.5.8, page 37) [g/L]
ATOMIC WEIGHT	Relative atomic weight of active precipitant substance (refer to 4.5.8, page 37) [g/mol]
MODBUS	
ADDRESS	Start address of an RTC module within the MODBUS network. Default is 41. This setting must only be changed by the manufacturer's service department (Section 8). (Refer to Appendix A, page 49)
DATA ORDER	Specifies the register order within a double word. Default is NORMAL . This setting must only be changed by the manufacturer's service department (Refer to Section 8)
DATALOG INTRVL	Indicates the interval in which the data is saved in the log file [min]
MAINTENANCE	
RTC DATA	
RTC MEASUREMEN	Displays up to 5 measured values; additional values can be selected by scrolling
RTC ACTUAT VAR	Displays up to 5 actuating variables; additional variables can be selected by scrolling
DIAG/TEST	
EEPROM	Hardware test
RTC COMM TO	Communication time-out
RTC CRC	Communication checksum
LOCATION	A location name can be issued here for better identification of the RTC module e.g. activation 2
SOFTWARE VERSION	Version number for service
RTC MODE	Indicates the mode set in the RTC module.

4.3.4 2-channel open-loop control

In addition to the 1-channel version, a 2-channel version is also available. The 2-channel version is able to control 2 phosphate precipitants separately.

All of the key parameters appear twice and are identified as channel 1 and channel 2.

In contrast to the 1-channel version, a percentage factor for distribution of the profile (**DIST PROFILE**) has been added. If measurement signals drop out, the percentage factor **DIST PROFILE** distributes the influent waste water to the precipitant.

2-channel open-loop control

CONFIGURE	
SELECT SENSOR	Select the sensors installed for the open-loop control (see Section 4.4, page 31).
OPEN-LOOP	
PRECIP. TYPE	Precipitation, simultaneous precipitation, post-precipitation
CHANNEL 1	
SETPOINT PO4-P	Desired orthophosphate value in effluent (refer to 4.5.1, page 33) [mg/L]
CORR FACTOR	Percentage correction of precipitant dosing (see 4.5.2, page 33) [%]
BIO-P	Phosphate biologically eliminated after influent (refer to 4.5.3, page 33) [%]
MIN DOS RATE	Minimum flow rate of dosing pump [L/h]
PRESELECT PROG	Programs 1 to 4 (refer to 4.1, page 17)
CHANNEL 2	
SETPOINT PO4-P	Desired orthophosphate value in effluent (refer to 4.5.1, page 33) [mg/L]
CORR FACTOR	Percentage correction of precipitant dosing (see 4.5.2, page 33) [%]
BIO-P	Phosphate biologically eliminated after influent (refer to 4.5.3, page 33) [%]
MIN DOS RATE	Minimum flow rate of dosing pump [L/h]
PRESELECT PROG	Programs 1 to 4 (refer to 4.1, page 17)
PROFILE	
	<i>Active when a measurement signal fails</i>
Q-PROFILE	Daily profiles (2 h average) of waste water influent according to feed measurement signal [m ³ /h]
DIST PROFILE	Percentage distribution of flow rate; input refers to channel 1. [%]
P-PROFILE	Daily profiles of PO ₄ -P concentrations, 2 h average (see 4.5.4, page 34) [mg/L]
WEEK PROFILE	Percentage daily averages of the phosphate load (refer to 4.5.4, page 34) [%]
IN- OUTPUTS	
DOSING PUMP	
CHANNEL 1	
MIN PUMP RANGE	Lower threshold of flow rate range [L/h]
MAX PUMP RANGE	Upper threshold of flow rate range [L/h]
0/4...20MA	Selection of transfer range according to pump input
CONTROL CYCLE	Control cycle comprising on- and off-time (see 4.5.6, page 35) [s]
MIN RUNTIME	Minimum on-time of pump (refer to 4.5.6, page 35) [s]

Parameterization and operation

2-channel open-loop control

CONFIGURE (CONTINUE)		
CHANNEL 2		
MIN PUMP RANGE	Lower threshold of flow rate range	[L/h]
MAX PUMP RANGE	Upper threshold of flow rate range	[L/h]
0/4...20MA	Selection of transfer range according to pump input	
CONTROL CYCLE	Control cycle comprising on- and off-time (see 4.5.6, page 35)	[s]
MIN RUNTIME	Minimum on-time of pump (refer to 4.5.6, page 35)	[s]
FLOW RATE		
CHANNEL 1		
MIN Q-INFLUENT	Minimum flow rate in inlet according to measurement signal	[m ³ /h]
MAX Q-INFLUENT	Maximum flow rate in inlet according to measurement signal	[m ³ /h]
0/4...20MA	Transfer range of 0/4–20 mA current loop, as set in the connected flow measuring instrument.	
MIN RET SLUDGE	Minimum flow rate of return activated sludge pump(s) (refer to 4.5.7, page 36)	[m ³ /h]
MAX RET SLUDGE	Maximum flow rate of return activated sludge pump(s) (refer to 4.5.7, page 36)	[m ³ /h]
Q RET RATIO	Ratio between measured flow rate and return activated sludge volume, for a return activated sludge volume proportional to the measured flow rate (Refer to 4.5.7, page 36)	[%]
Q INFL SMOOTH	Smoothing of influent signal (refer to 4.5.7, page 36)	
CHANNEL 2		
MIN Q-INFLUENT	Minimum flow rate in inlet according to measurement signal	[m ³ /h]
MAX Q-INFLUENT	Maximum flow rate in inlet according to measurement signal	[m ³ /h]
0/4...20MA	Transfer range of 0/4–20 mA current loop, as set in the connected flow measuring instrument.	
MIN RET SLUDGE	Minimum flow rate of return activated sludge pump(s) (refer to 4.5.7, page 36)	[m ³ /h]
MAX RET SLUDGE	Maximum flow rate of return activated sludge pump(s) (refer to 4.5.7, page 36)	[m ³ /h]
Q RET RATIO	Ratio between measured flow rate and return activated sludge volume, for a return activated sludge volume proportional to the measured flow rate (Refer to 4.5.7, page 36)	[%]
Q INFL SMOOTH	Smoothing of influent signal (refer to 4.5.7, page 36)	

2-channel open-loop control

CONFIGURE (CONTINUE)	
PRECIPITANT	
CHANNEL 1	
METAL CONTENT	Metal concentration in precipitant (refer to 4.5.8, page 37) [g/L]
ATOMIC WEIGHT	Relative atomic weight of active precipitant substance (refer to 4.5.8, page 37) [g/mol]
CHANNEL 2	
METAL CONTENT	Metal concentration in precipitant (refer to 4.5.8, page 37) [g/L]
ATOMIC WEIGHT	Relative atomic weight of active precipitant substance (refer to 4.5.8, page 37) [g/mol]
MODBUS	
ADDRESS	Start address of an RTC module within the MODBUS network. Default is 41. This setting must only be changed by the manufacturer's service department (Section 8). (Refer to Appendix A, page 49)
DATA ORDER	Specifies the register order within a double word. Default is NORMAL . This setting must only be changed by the manufacturer's service department (Refer to Section 8)
DATALOG INTRVL	Indicates the interval in which the data is saved in the log file. [min]
MAINTENANCE	
RTC DATA	
RTC MEASUREMEN	Displays up to 5 measured values; additional values can be selected by scrolling.
RTC ACTUAT VAR	Displays up to 5 actuating variables; additional variables can be selected by scrolling.
DIAG/TEST	
EEPROM	Hardware test
RTC COMM TO	Communication time-out
RTC CRC	Communication checksum
LOCATION	A location name can be assigned here for better identification of the RTC module, e.g. activation 2.
SOFTWARE VERSION	Version number for service
RTC MODE	Indicates the mode set in the RTC module.

Parameterization and operation

4.3.5 1-channel closed-loop control

1-channel closed-loop control

CONFIGURE	
SELECT SENSOR	Select the sensor installed for the closed-loop control (refer to Section 4.4, page 31).
CLOSED-LOOP	
SETPOINT PO4-P	Desired orthophosphate value in effluent (refer to 4.5.1, page 33) [mg/L]
GAIN P CONTR.	Proportional gain of the closed-loop control (refer to 4.5.5, page 34)
INTEGRAL TIME	Integral time of closed-loop control (refer to 4.5.5, page 34) [min]
DERIVATIVE TIME	Derivative time of closed-loop control (refer to 4.5.5, page 34) [min]
MIN DOS RATE	Minimum flow rate of dosing pump [L/h]
PRESELECT PROG	Programs 1 to 4 (refer to 4.1, page 17)
PROFILE	<i>Active when a measurement signal fails</i>
Q-PROFILE	Daily profiles (2 h average) of waste water influent according to feed measurement signal [m ³ /h]
P-PROFILE	Daily profiles of PO ₄ -P concentrations, 2 h average (see 4.5.4, page 34) [mg/L]
WEEK PROFILE	Percentage daily averages of the phosphate load (refer to 4.5.4, page 34) [%]
IN- OUTPUTS	
DOSING PUMP	
MIN PUMP RANGE	Lower threshold of flow rate range [L/h]
MAX PUMP RANGE	Upper threshold of flow rate range [L/h]
0/4...20MA	Selection of transfer range according to pump input
CONTROL CYCLE	Control cycle comprising on- and off-time (see 4.5.6, page 35) [s]
MIN RUNTIME	Minimum on-time of pump (refer to 4.5.6, page 35) [s]
FLOW RATE	
MIN Q-INFLUENT	Minimum flow rate in inlet according to measurement signal [m ³ /h]
MAX Q-INFLUENT	Maximum flow rate in inlet according to measurement signal [m ³ /h]
0/4...20MA	Transfer range of 0/4–20 mA current loop, as set in the connected flow measuring instrument.
MIN RET SLUDGE	Minimum flow rate of return activated sludge pump(s) (refer to 4.5.7, page 36) [m ³ /h]
MAX RET SLUDGE	Maximum flow rate of return activated sludge pump(s) (refer to 4.5.7, page 36) [m ³ /h]
Q RET RATIO	Ratio between measured flow rate and return activated sludge volume, for a return activated sludge volume proportional to the measured flow rate (Refer to 4.5.7, page 36) [%]
Q INFL SMOOTH	Smoothing of influent signal (refer to 4.5.7, page 36)

1-channel closed-loop control

CONFIGURE (CONTINUE)	
PRECIPITANT	
METAL CONTENT	Metal concentration in precipitant (refer to 4.5.8, page 37) [g/L]
ATOMIC WEIGHT	Relative atomic weight of active precipitant substance (refer to 4.5.8, page 37) [g/mol]
MODBUS	
ADDRESS	Start address of an RTC module within the MODBUS network. Default is 41. This setting must only be changed by the manufacturer's service department (Section 8). (Refer to Appendix A, page 49)
DATA ORDER	Specifies the register order within a double word. Default is NORMAL . This setting must only be changed by the manufacturer's service department (Refer to Section 8)
DATALOG INTRVL	Indicates the interval in which the data is saved in the log file. [min]
MAINTENANCE	
RTC DATA	
RTC MEASUREMEN	Displays up to 5 measured values; additional values can be selected by scrolling.
RTC ACTUAT VAR	Displays up to 5 actuating variables; additional variables can be selected by scrolling.
DIAG/TEST	
EEPROM	Hardware test
RTC COMM TO	Communication time-out
RTC CRC	Communication checksum
LOCATION	A location name can be issued here for better identification of the RTC module, e.g. activation 2.
SOFTWARE VERSION	Version number for service
RTC MODE	Indicates the mode set in the RTC module.

4.3.6 2-channel closed-loop control

In addition to the 1-channel version, a 2-channel version is also available, which enables separate closed-loop control of two phosphate precipitants.

All of the key parameters appear twice and are identified as channel 1 and channel 2.

In contrast to the 1-channel version, a percentage factor for distribution of the profile (**DIST PROFILE**) has been added. If measurement signals drop out, the percentage factor **DIST PROFILE** distributes the influent waste water to the precipitant.

Parameterization and operation

2-channel closed-loop control

CONFIGURE	
SELECT SENSOR	Select the sensors installed for the closed-loop control (see Section 4.4, page 31).
CLOSED-LOOP	
CHANNEL 1	
SETPOINT PO4-P	Desired orthophosphate value in effluent (refer to 4.5.1, page 33) [mg/L]
GAIN P CONTR.	Proportional gain of the closed-loop control (refer to 4.5.5, page 34)
INTEGRALTIME	Integral time of closed-loop control (refer to 4.5.5, page 34) [min]
DERIVATIVE TIME	Derivative time of closed-loop control (refer to 4.5.5, page 34) [min]
MIN DOS RATE	Minimum flow rate of dosing pump [L/h]
PRESELECT PROG	Programs 1 to 4 (refer to 4.1, page 17)
CHANNEL 2	
SETPOINT PO4-P	Desired orthophosphate value in effluent (refer to 4.5.1, page 33) [mg/L]
GAIN P CONTR.	Proportional gain of the closed-loop control (refer to 4.5.5, page 34) [%]
INTEGRALTIME	Integral time of closed-loop control (refer to 4.5.5, page 34) [%]
DERIVATIVE TIME	Derivative time of closed-loop control (refer to 4.5.5, page 34)
MIN DOS RATE	Minimum flow rate of dosing pump [L/h]
PRESELECT PROG	Programs 1 to 4 (refer to 4.1, page 17)
PROFILE	<i>Active when a measurement signal fails</i>
Q-PROFILE	Daily profiles (2 h average) of waste water influent according to feed measurement signal [m ³ /h]
DIST PROFILE	Percentage distribution of flow rate; input refers to channel 1. [%]
P-PROFILE	Daily profiles of PO ₄ -P concentrations, 2 h average (see 4.5.4, page 34) [mg/L]
WEEK PROFILE	Percentage daily averages of the phosphate load (refer to 4.5.4, page 34) [%]

2-channel closed-loop control

CONFIGURE (CONTINUE)		
IN- OUTPUTS		
DOSING PUMP		
CHANNEL 1		
MIN PUMP RANGE	Lower threshold of flow rate range	[L/h]
MAX PUMP RANGE	Upper threshold of flow rate range	[L/h]
0/4...20MA	Selection of transfer range according to pump input	
CONTROL CYCLE	Control cycle comprising on- and off-time (see 4.5.6, page 35)	[s]
MIN RUNTIME	Minimum on-time of pump (refer to 4.5.6, page 35)	[s]
CHANNEL 2		
MIN PUMP RANGE	Lower threshold of flow rate range	[L/h]
MAX PUMP RANGE	Upper threshold of flow rate range	[L/h]
0/4...20MA	Selection of transfer range according to pump input	
CONTROL CYCLE	Control cycle comprising on- and off-time (see 4.5.6, page 35)	[s]
MIN RUNTIME	Minimum on-time of pump (refer to 4.5.6, page 35)	[s]
FLOW RATE		
CHANNEL 1		
MIN Q-INFLUENT	Minimum flow rate in inlet according to measurement signal	[m ³ /h]
MAX Q-INFLUENT	Maximum flow rate in inlet according to measurement signal	[m ³ /h]
0/4...20MA	Transfer range of 0/4–20 mA current loop, as set in the connected flow measuring instrument	
MIN RET SLUDGE	Minimum flow rate of return activated sludge pump(s) (refer to 4.5.7, page 36)	[m ³ /h]
MAX RET SLUDGE	Maximum flow rate of return activated sludge pump(s) (refer to 4.5.7, page 36)	[m ³ /h]
Q RET RATIO	Ratio between measured flow rate and return activated sludge volume, for a return activated sludge volume proportional to the measured flow rate (Refer to 4.5.7, page 36)	[%]
Q INFL SMOOTH	Smoothing of influent signal (refer to 4.5.7, page 36)	
CHANNEL 2		
MIN Q-INFLUENT	Minimum flow rate in inlet according to measurement signal	[m ³ /h]
MAX Q-INFLUENT	Maximum flow rate in inlet according to measurement signal	[m ³ /h]
0/4...20MA	Transfer range of 0/4–20 mA current loop, as set in the connected flow measuring instrument.	
MIN RET SLUDGE	Minimum flow rate of return activated sludge pump(s) (refer to 4.5.7, page 36)	[m ³ /h]
MAX RET SLUDGE	Maximum flow rate of return activated sludge pump(s) (refer to 4.5.7, page 36)	[m ³ /h]
Q RET RATIO	Ratio between measured flow rate and return activated sludge volume, for a return activated sludge volume proportional to the measured flow rate (Refer to 4.5.7, page 36)	[%]
Q INFL SMOOTH	Smoothing of influent signal (refer to 4.5.7, page 36)	

Parameterization and operation

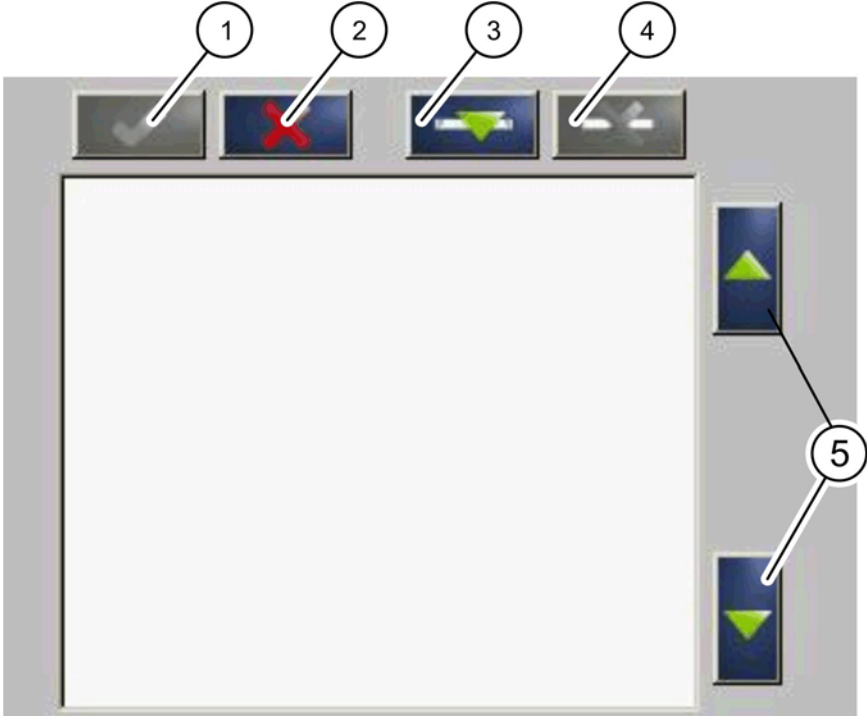
2-channel closed-loop control

CONFIGURE (CONTINUE)	
PRECIPITANT	
CHANNEL 1	
METAL CONTENT	Metal concentration in precipitant (refer to 4.5.8, page 37) [g/L]
ATOMIC WEIGHT	Relative atomic weight of active precipitant substance (refer to 4.5.8, page 37) [g/mol]
CHANNEL 2	
METAL CONTENT	Metal concentration in precipitant (refer to 4.5.8, page 37) [g/L]
ATOMIC WEIGHT	Relative atomic weight of active precipitant substance (refer to 4.5.8, page 37) [g/mol]
MODBUS	
ADDRESS	Start address of an RTC module within the MODBUS network. Default is 41. This setting must only be changed by the manufacturer's service department (Section 8). (Refer to Appendix A, page 49)
DATA ORDER	Specifies the register order within a double word. Default is NORMAL . This setting must only be changed by the manufacturer's service department (Refer to Section 8)
DATALOG INTRVL	Indicates the interval in which the data is saved in the log file. [min]
MAINTENANCE	
RTC DATA	
RTC MEASUREMEN	Displays up to 5 measured values; additional values can be selected by scrolling.
RTC ACTUAT VAR	Displays up to 5 actuating variables; additional variables can be selected by scrolling.
DIAG/TEST	
EEPROM	Hardware test
RTC COMM TO	Communication time-out
RTC CRC	Communication checksum
LOCATION	A location name can be assigned here for better identification of RTC module, e.g. activation 2.
SOFTWARE VERSION	Version number for service
RTC MODE	Indicates the mode set in the RTC module.

4.4 Select sensors

1. To select the sensors and their sequence for the RTC module, press RTC > CONFIGURE > SELECT SENSOR.

Figure 4 Select sensor



1 ENTER — Saves the setting and returns to the CONFIGURE menu.	4 DELETE — Removes a sensor from the selection.
2 CANCEL — Returns to the CONFIGURE menu without saving.	5 UP/DOWN — Moves the sensors up or down.
3 ADD — Adds a new sensor to the selection.	

2. Press **ADD** (Figure 4, item 3).

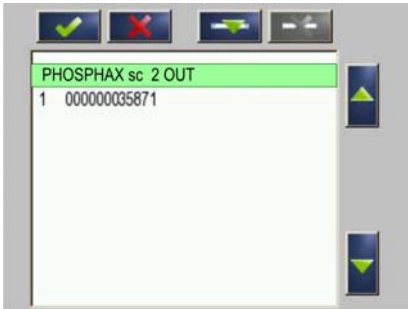
A selection list of all subscribers to the sc1000 network opens.



3. Press the required sensor for the RTC module and confirm by pressing **ENTER** below the selection list.

Sensors in black type are available for the RTC module. Sensors in red type are not available for the RTC module.

Note: *PROGNOSYS* is available for sensors marked (p) if these sensors have been selected in conjunction with an RTC module (refer to the *PROGNOSYS* user manual).



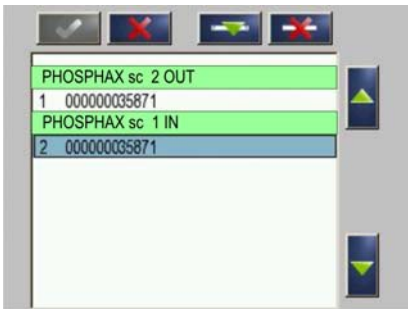
- The selected sensor is shown in the sensor list.
Press **ADD** (Figure 4, item 3) to open the selection list again.



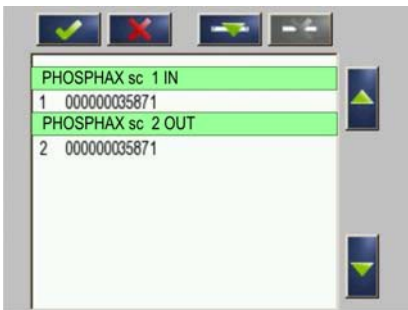
- Select the second sensor for the RTC module and confirm by pressing **ENTER** below the selection list.

Note: Previously selected sensors are shown in gray.

The selected sensors are shown in the sensor list.



- To sort the sensors in the order specified for the RTC module, press the sensor and use the arrow keys to move it (Figure 4, item 5).
Press **DELETE** (Figure 4, item 4) to remove an incorrect sensor from the sensor list again.



- Press **ENTER** (Figure 4, item 1) to confirm the list once it is finished.

4.5 Explanations

4.5.1 Ortho-phosphate and total phosphate

The goal of phosphate control is to reduce the total phosphate in the effluent stream at a waste water treatment plant. However, the precipitation only affects the ortho-phosphate content. The $\text{PO}_4\text{-P}$ target value specifies the ortho-phosphate value to be maintained in the precipitation reactor. Therefore, this value must be lower than the value to be maintained in the effluent.

*Note: If **CLOSED-LOOP** is set in the controller, the setpoint is effective immediately. If **OPEN-LOOP** is set in the controller, the desired $\text{PO}_4\text{-P}$ effluent concentration of the reactor is required.*

4.5.2 Recycling the chemical sludge

Precipitant savings can be achieved, particularly in activated sludge plants, if existing chemical sludge is reused for phosphorus elimination. In the case of precipitant overdosage, the stoichiometrically excessive metal content (for metal phosphate formation) is reused in the formation of metal phosphate upon renewed contact with dissolved phosphate. Renewed adsorption of phosphate, by precipitates already formed, is possible. The existing precipitant-sludge portion thus represents a reserve for the precipitation of P-influent peaks or for a short-term failure of the dosing devices; however, other authors consider this reserve to be minimal.

The precipitant savings automatically take effect for **closed-loop controls**. To be able to use the reserve for **open-loop controls** as well, the correction (**CORR FACTOR**) can be used. A negative input reduces the precipitant dosing:

Example:

A correction value of -50% is set.

This reduces the precipitant dosing by half.

In the event of negative influences on the phosphate precipitation, a positive correction value can be entered:

Example:

A correction value of $+100\%$ is set.

This doubles the precipitant dosing.

4.5.3 Biological phosphate elimination

The BIO-P parameter is used to take biological phosphate elimination into account. If no phosphate elimination is effective at the phosphate measuring point, the **BIO-P** factor can be used to specify the percentage of influent phosphates that is biologically incorporated into the sludge on an empirical basis. In this case, it is important to differentiate between the measurement of ortho-phosphate and total phosphate. For total phosphate, the "unavoidable" biological phosphate elimination must always be taken into account. This can be set at 1% of the BOD_5 . An increased biological phosphate elimination can be added in all cases and must be estimated on the basis of empirical values.

4.5.4 Phosphate profile

The same conditions as specified under [4.5.3, page 33](#) must apply for the phosphate flow rate profile. If biological phosphate elimination is still not effective at the measuring point, the flow profile rate remains unaffected by the biological phosphate elimination. If biological phosphate elimination is already effective at the measuring point, this must also be reflected in the profile.

Note: *In this case, the value zero (0) must be entered as Bio P proportion!*

For **open-loop controls**, the results of the online measurement can be directly employed in the profile determination. This also ensures that the measurement conditions are identical.

Due to missing data, the configuration for **closed-loop controls** is more complex. A reliable data pool for a waste water treatment plant can only be obtained on the basis of 2 h composite samples. Any samples that were taken during unusual influent events (heavy rains, unauthorized discharge) are excluded.

A sample unaffected by precipitation can only be taken from the influent to the activated sludge plant. At this point, the organic phosphorous has not yet hydrolyzed. If total phosphate is determined here, the "unavoidable" biological phosphate elimination must be considered.

Since the entry of a Bio-P amount is not possible for closed-loop controls (option hidden), lower values can be entered directly. If the online measurement fails, it is safer to forego a reduction.

Over the course of a week, there can be strong fluctuations in the load on the waste water treatment plant. To ensure an accurate representation of actual conditions, the daily profiles can be superimposed with a weekly profile.

4.5.5 PID closed-loop (proportional, integral, differential closed-loop)

The proportional precipitant dosing quantity calculated by the RTC module is increased or reduced by the proportional intensification factor (**GAIN P CONTR.**) of the closed loop control.

As the precipitant has already become effective at the measuring point, the measurement indicates the following:

- The dosage is too low
- The dosage is sufficient
- The dosage is too high and must be corrected accordingly

The proportional gain factor specifies the precipitant dosage required based on the exceedance of the target value. Large gains result in large changes to the dosing and therefore a high closed-loop control speed; however, the closed-loop control oscillations also increase in line with the gain.

The **DERIVATIVE TIME** allows the RTC module to react not only to the absolute target value deviations but also to the speed with which the phosphate content rises or falls. Necessary corrections can thus be made at an earlier stage.

Example:

A derivative time of 1 minute means that closed-loop control takes place according to the phosphate concentration that is actually achieved in only 1 minute (if the current measured value change remains the same).

The integration time takes effect by means of the temporal integration of the control deviation ($\text{PO}_4\text{-P}$ setpoint to $\text{PO}_4\text{-P}$ actual value), to the actuating variable with the weighting by the **INTEGRALTIME**. The integral time states when the integral proportion has the same effect as the P proportion. A short timeframe can lead to an overshoot or strong oscillations of the $\text{PO}_4\text{-P}$ concentration. An increase in the integral time reduces the oscillation. In this case, the I proportion of the closed-loop control can be specified through the entry of **INTEGRAL TIME = 0**.

Setting tips: As a **DERIVATIVE TIME** >0 min has a highly significant impact on the metered precipitant quantity, this should be used only in exceptional cases, e.g. plants demonstrating rapid escalations in $\text{PO}_4\text{-P}$ concentrations.

To ensure the metered precipitant quantity increases/decreases more quickly, the **GAIN P CONTR.** must be increased or the **INTEGRALTIME** reduced. To ensure the metered quantity changes more slowly, the **GAIN P CONTR.** must be reduced or the **INTEGRAL TIME** increased.

4.5.6 Pump runtime

The on/off duration in pulse/pause mode can be influenced via the control cycle time (**CONTROL CYCLE**). For example, with a cycle time of 100 seconds and a dosing control value of 60%, the dosing pump is periodically switched on for 60 seconds and off for 40 seconds. Short cycle times increase the switch frequency, but enable more precise adaptation to individual requirements.

A minimum on-time is also configured to protect the dosing pump. The pump is not activated for less than this time span. The time must be a fraction of the control cycle time.

4.5.7 Inclusion of return sludge quantity

To be able to record the entire flow at the measuring point, the return sludge quantity must also be taken into account, depending on the specific application. For this purpose, the minimum and maximum flow rate of the return activated sludge pump(s) can be specified, as well as the ratio of return activated sludge transport relative to the measured flow rate.

The flow rate, e.g. for simultaneous precipitation with a measuring point in the activated sludge tank, is calculated as follows:

$$Q_{\text{total}} = Q_{\text{to}} + Q_{\text{RSL}}$$

$$\text{Where: } Q_{\text{RSL}} = Q_{\text{RS}_{\text{ratio}}} \times Q_{\text{to}}$$

Within the limits of $Q_{\text{RS}_{\text{minimum}}}$ and $Q_{\text{RS}_{\text{maximum}}}$

$Q_{\text{RS}_{\text{minimum}}}$ and $Q_{\text{RS}_{\text{maximum}}}$ thus represent the limits within which the calculated return activated sludge volume is varied according to $Q_{\text{RS}_{\text{ratio}}}$.

If the measuring location is at a measuring point that is not influenced by the return activated sludge volume, all variables described below must be set to "0".

Under **MIN RET SLUDGE**, the minimum flow rate of the return sludge pump(s) must be specified in m³/h. In the case of a constant return sludge flow rate, the relevant value must also be specified here.

Under **MAX RET SLUDGE**, the maximum flow rate of the return sludge pump(s) must be specified in m³/h. If a constant return activated sludge volume is pumped, $Q_{\text{RS}_{\text{maximum}}}$ can be set to "0".

In the event of a return activated sludge volume that is proportional to the flow rate (Q), the percentage ratio must be specified under **Q RET RATIO**. If the same return activated sludge volume is pumped continuously, this volume must be specified under $Q_{\text{RS}_{\text{minimum}}}$. The $Q_{\text{RS}_{\text{ratio}}}$ must then be selected as "0".

A heavily fluctuating flow rate signal (e.g. caused by pumping stations) that is integrated in the RTC module via the 4-20 mA current loop can be smoothed using **Q INFL SMOOTH**. As a result, only a marginally fluctuating target value is issued.

Q INFL SMOOTH can lie between 1 and 99.

- **Q INFL SMOOTH** = 1. The influent signal is not smoothed.
- **Q INFL SMOOTH** = 2. The influent signal is smoothed over 3 minutes.
- **Q INFLUENT SMOOTH** = 3. The influent signal is smoothed over 2 minutes.
- **Q INFLUENT SMOOTH** = 5. The influent signal is smoothed over 12 minutes.
- **Q INFLUENT SMOOTH** = 10. The influent signal is smoothed over 25 minutes.

Example:

With the setting **Q INFLUENT SMOOTH = 2**, it takes three minutes for the smoothed value to reach 95 % of the final value (following a sudden change of the influent rate).

4.5.8 Precipitants

For calculations, the effective metal content of the precipitant must be specified in g/l as well as the relative atomic weight of the metal in g/mol.

4.5.8.1 Metal content

The metal content (active component) of the precipitant is specified by the manufacturer in:

- g/kg
multiply the value by the density δ of the product to obtain the metal content in g/L
- %
multiply the value by 10 to obtain the concentration in g/kg. Multiply this value by the density δ of the product to obtain the metal content in g/L
- mol/L
This value can be entered instead of the concentration in g/L. Enter a 1 for the atomic weight of the metal.

4.5.8.2 Atomic weight of metal

The type of the precipitant is determined by the atomic weight.

Atomic weight of iron: 55.8 g/mol

Atomic weight of aluminum: 26.9 g/mol

Composite products

For products that contain both aluminum and iron, the molar metal concentration is calculated from the sum of the molar concentrations of iron and aluminum.

Example: Compound of iron (12%) and aluminum (8%):

Molar aluminum concentration:

$$\frac{80 \frac{\text{g}}{\text{kg}}}{26.9 \frac{\text{g}}{\text{mol}}} = 2.97 \frac{\text{mol}}{\text{kg}}$$

Molar iron concentration:

$$\frac{120 \frac{\text{g}}{\text{kg}}}{55.8 \frac{\text{g}}{\text{mol}}} = 2.15 \frac{\text{mol}}{\text{kg}}$$

Parameterization and operation

Molar metal concentration for a compound of iron (12%) and aluminum (8%):

$$2.79 \frac{\text{mol}}{\text{kg}} + 2.15 \frac{\text{mol}}{\text{kg}} = 5.12 \frac{\text{mol}}{\text{kg}}$$

A conversion is performed with the product density for entry in the RTC module:

$$1.43 \frac{\text{kg}}{\text{L}} \times 5.12 \frac{\text{mol}}{\text{kg}} = 7.32 \frac{\text{mol}}{\text{L}}$$

The product of the molar concentration [mol/kg] and the density of the product [kg/L] yields the molar metal concentration in mol/L. As stated above, this numerical value must be entered for the metal content. Enter a 1 for the atomic weight of the metal.

Section 5 Maintenance

⚠ DANGER

Multiple hazards

Only qualified personnel must conduct the tasks described in this section of the manual.

5.1 Maintenance schedule

	Interval	Maintenance task
Visual inspection	Application-specific	Check for contamination and corrosion
CF card	2 years	Replacement by manufacturer's service department (Section 8)
Battery, type CR2032 Panasonic or Sanyo	5 years	Replacement

Section 6 Troubleshooting

6.1 Error messages

The sc controller displays the possible sensor errors.

Displayed errors	Cause	Resolution
RTC MISSING	No communication between RTC and RTC communication card	Supply RTC with voltage Test connection cable Reset the sc1000 and the RTC (switch so it is completely voltage free and switch back on)
RTC CRC	Interrupted communication between RTC and RTC communication card	Make sure +/- connections of the connector cable between RTC and RTC communication card in the sc1000 are installed correctly.
CHECK CONFIG	The sensor selection of the RTC was deleted by deleting or selecting a new sc1000 participant.	From MAIN MENU > RTC MODULES / PROGNOSYS > RTC MODULES > RTC > CONFIGURE > SELECT SENSOR , select the correct sensor for the RTC again and confirm.
RTC FAILURE	Brief general read/write error on the CF card, mostly caused by a brief interruption to the power supply.	Acknowledge error. If this message is shown frequently, eliminate the cause of the power disruptions. If necessary, inform the service team of the manufacturer (Section 8, page 45).
FAULTY PUMP 1	Faulty measurement signal	Test sensor, check cable connections
FAULTY PUMP 2	Faulty measurement signal	Test sensor, check cable connections
INFLUENT1 NOT G.	Faulty measurement signal	Test sensor, check cable connections
INFLUENT2 NOT G.	Faulty measurement signal	Test sensor, check cable connections

6.2 Warnings

The sc controller displays the possible warning messages from the sensor.

Displayed warnings	Cause	Resolution
MODBUS ADDRESS	The RTC menu PLANT CONFIG was opened. This deletes the MODBUS address of the RTC module.	OPEN THE MODBUS menu of the RTC module and set the correct MODBUS address.
PROBE SERVICE	A configured sensor is in service status.	The sensor must exit service status.

6.3 Wear parts

Designation	Number	Service life
CF card, type RTC module	1 piece	2 years
Battery, type CR2032 Panasonic or Sanyo	1 piece	5 years

Section 7 Replacement parts and accessories

7.1 Spare parts

Description	Cat. no.
NS 35/15 DIN rail, punched according to DIN EN 60715 TH35, made from galvanized steel. Length: 35 cm (13.7 in)	LZH165
90–240 V AC/24 V DC 0.75 A transformer, module for DIN rail assembly	LZH166
Terminal for 24 V connection without power supply	LZH167
Grounding terminal	LZH168
SUB-D connector	LZH169
C2 circuit breaker	LZH170
CPU base module with Ethernet port, passive venting element (CX1010-0021) and RS422/485 interface module	LZH171
Power supply module, consists of a bus coupler and a 24 V terminal module (CX1100-0002)	LZH172
Digital output module 24 V DC (2 outputs) (KL2032)	LZH173
Digital output module 24 V DC (4 outputs) (KL2134)	LZH174
Analog output module (1 output) (KL4011)	LZH175
Analog output module (2 outputs) (KL4012)	LZH176
Analog input module (1 input) (KL3011)	LZH177
Bus termination module (KL9010)	LZH178
RTC communication card	YAB117
CF card type RTC module	LZY748-00

Section 8 Contact information

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Section 9 Limited warranty

Hach Company warrants its products to the original purchaser against any defects that are due to faulty material or workmanship for a period of one year from date of shipment unless otherwise noted in the product manual.

In the event that a defect is discovered during the warranty period, Hach Company agrees that, at its option, it will repair or replace the defective product or refund the purchase price excluding original shipping and handling charges. Any product repaired or replaced under this warranty will be warranted only for the remainder of the original product warranty period.

This warranty does not apply to consumable products such as chemical reagents; or consumable components of a product, such as, but not limited to, lamps and tubing.

Contact Hach Company or your distributor to initiate warranty support. Products may not be returned without authorization from the Hach Company.

Limitations

This warranty does not cover:

- Damage caused by acts of God, natural disasters, labor unrest, acts of war (declared or undeclared), terrorism, civil strife or acts of any governmental jurisdiction
- Damage caused by misuse, neglect, accident or improper application or installation
- Damage caused by any repair or attempted repair not authorized by the Hach Company
- Any product not used in accordance with the instructions furnished by the Hach Company
- Freight charges to return merchandise to the Hach Company
- Freight charges on expedited or express shipment of warranted parts or products
- Travel fees associated with on-site warranty repair

This warranty contains the sole express warranty made by the Hach Company in connection with its products. All implied warranties, including without limitation, the warranties of merchantability and fitness for a particular purpose, are expressly disclaimed.

Some states within the United States do not allow the disclaimer of implied warranties and if this is true in your state the above limitation may not apply to you. This warranty gives you specific rights, and you may also have other rights that vary from state to state.

This warranty constitutes the final, complete, and exclusive statement of warranty terms and no person is authorized to make any other warranties or representations on behalf of Hach Company.

Limitation of Remedies

The remedies of repair, replacement or refund of purchase price as stated above are the exclusive remedies for the breach of this warranty. On the basis of strict liability or under any other legal theory, in no event shall the Hach Company be liable for any incidental or consequential damages of any kind for breach of warranty or negligence.

Appendix A MODBUS address setting

The same slave address for MODBUS communication must be set on both the sc1000 display and on the RTC101 P-Module. As 20 slave addresses are reserved for internal purposes, the following slave addresses are available for assignment:

1, 21, 41, 61, 81, 101 etc.

Slave address 41 is preset at the factory.

NOTICE

If this slave address is must be changed because, for example, it is already assigned to another RTC module , it must be edited on both the sc1000 and on the CF card of the RTC module.

This can only be done by the manufacturer service department ([Section 8](#))!

