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RTC105 N/DN-Module

Real-Time Control System for Nitrogen Removal

User manual

02/2013, Edition 3

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Section 1 Technical data

These are subject to change without notice.

| Embedded PC (compact industrial 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) |
| Interfaces | 1x RJ 45 (Ethernet), 10/100 Mbit/s |
| Diagnostic LED | 1x power, 1x LAN speed, 1x LAN activity, TC status, 1x flash access |
| Expansion slot | 1x CompactFlash type II slot with ejector 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) |
| 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.) |
| Weight | Approximately 0.9 kg (1.98 lb) |
| Analog input | 0/4 to 20 mA for flow rate measurement |
| Internal resistance | 80 ohm + diode voltage 0.7 V |
| Signal current | 0 to 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 V DC |
| Electrical isolation | 500 V _{eff} (K-bus/signal voltage) |
| Digital outputs | Aeration and alarm activation |
| Number of outputs | 2 (KL2032), 4 (KL2134), 8 (KL2408), 16 (KL2809) |
| Nominal load voltage | 24 V DC (-15% / +20%) |
| Load type | ohmic, inductive lamp load |
| Max. output current | 0.5 A (short-circuit proof) per channel |
| Reverse polarity protection | Yes |
| Electrical isolation | 500 V _{eff} (K-bus/field voltage) |

Technical data

| | |
|---------------------------------|--|
| Digital inputs | Release of aeration control for plants in accumulation operation (SBR, sequencing batch reactor) |
| Number of inputs | 2 |
| Nominal voltage | 24 V DC (–15% / +20%) |
| Signal voltage "0" | –3 to +5 V |
| Signal voltage "1" | 15 to 30 V |
| Input filter | 30 ms |
| Input current | 5 mA (typ.) |
| Electrical isolation | 500 V _{eff} (K-bus/field voltage) |
| 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 | 3 |
| Protection class | III |
| Installation category | I |
| Maximum altitude | 2000 m (6.562 ft.) |
| Degree of protection | 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.
5. 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 Precautionary labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed.

| | |
|---|---|
|  | 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 European 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. |

| |
|---|
| ⚠ CAUTION |
| The manufacturer is not responsible for any damages due to misapplication or misuse of this product including, without limitation, direct, incidental and consequential damages, and disclaims such damages to the full extent permitted under applicable law. The user is solely responsible to identify critical application risks and install appropriate mechanisms to protect processes during a possible equipment malfunction. |

2.2 Areas of application

The RTC105 N/DN-Module is a universally applicable open-loop and closed-loop controller for setting nitrification and denitrification times at waste water treatment plants, dependent on load. There are several variants available for plants that operate intermittently (*non*-continuous operation, charging) or in accumulation (SBR, Sequencing-Batch-Reactor).

In addition, the RTC105 N/DN-Module can optionally be equipped with a closed-loop controller for setting the dissolved oxygen concentration (O₂) in the activated sludge tank.

The single-channel version of the RTC module controls one activated sludge tank. The two-channel version controls two activated sludge tanks (or two SBR reactors) simultaneously.

NOTICE

The use of an RTC module (real time controller) does not release the operator from the duty of care to 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 sensors and laboratory comparative measurements) is essential! (Refer to the user manual for the relevant instrument.)

2.3 Scope of delivery

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 guideline can be proved through technical measurements.

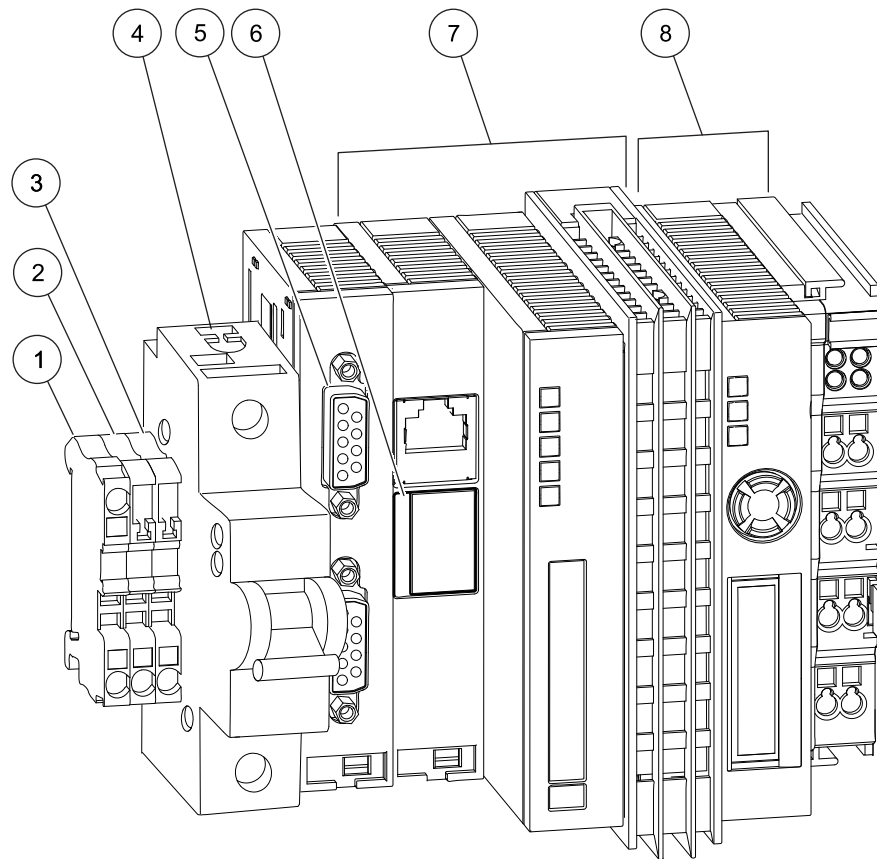
Each RTC105 N/DN-Module is supplied with:

- A SUB-D connector (9 pin)
- Ferrite core, foldable
- User manual

Check that the order is complete. All listed components must be present. If anything is missing or damaged, contact the manufacturer or distributor immediately.

2.4 Instrument overview

Figure 1 Base module RTC 24 V version

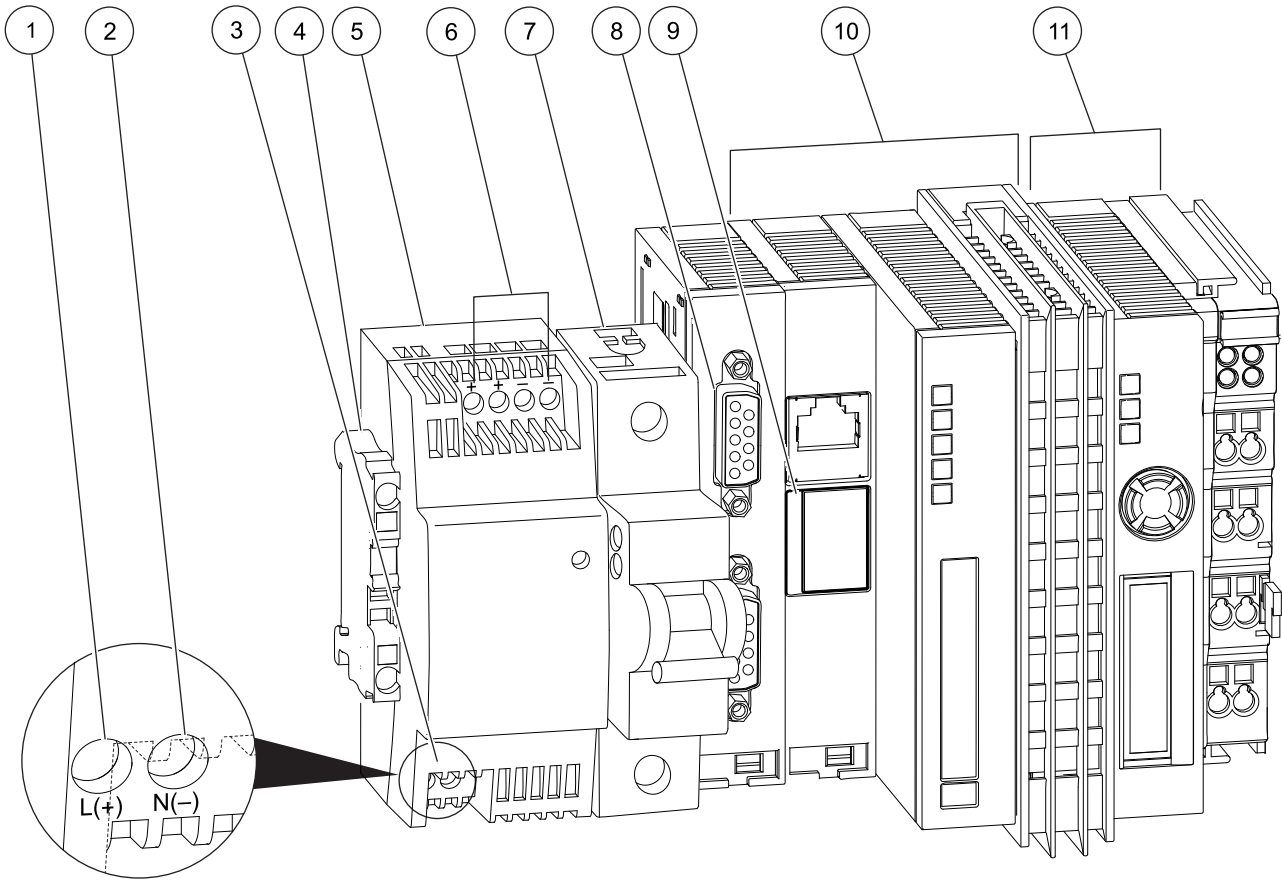


| | | | |
|---|---|---|--|
| 1 | PE (protective earth) | 5 | sc 1000 connection: RS485 (CX1010-N031) |
| 2 | 24 V | 6 | Battery compartment |
| 3 | 0 V | 7 | CPU base module, consisting of Ethernet port with battery compartment (CX1010-N000), CPU module with CF card (CX1010-0021) and passive aeration 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.

General Information

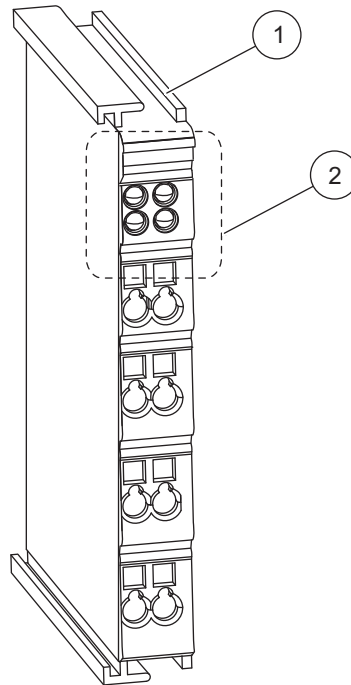
Figure 2 Base module RTC 100-240 V version



| | | | |
|---|--|----|--|
| 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 AVC 100–240 V / Input DC 95–250 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 (Specifications refer 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.

Figure 3 Design of the analog and digital input and output modules



| | |
|--|---|
| <p>1 Analog or digital input or output module or bus termination module</p> | <p>2 LED area with installed LEDs or free LED installation spaces.</p> |
|--|---|

Note: The number of LEDs indicates the number of channels.

2.5 Theory of operation

2.5.1 Theory of operation of the RTC105 N/DN-Module

On the RTC105 N/DN-Module, the times for nitrification and denitrification are determined according to the current $\text{NH}_4\text{-N}$ (ammonium nitrogen) and $\text{NO}_3\text{-N}$ (nitrate nitrogen) concentrations. The controller assesses absolute measured values as well as slew or decay rate of the measurements.

Dependent on the validity of the measured values for $\text{NH}_4\text{-N}$ and $\text{NO}_3\text{-N}$ in the activated sludge container, the controller works as a:

- combination controller for $\text{NH}_4\text{-N}$ and $\text{NO}_3\text{-N}$,
- $\text{NH}_4\text{-N}$ controller or
- $\text{NO}_3\text{-N}$ controller.

Operation is guaranteed even if all measurements fail. A time frame with adjustable minimum and maximum nitrification and denitrification times is defined. This time frame has fixed limits for the RTC module; these fixed limits are not fallen below or exceeded. In addition, the time frame has priority above all other settings.

The controllers are designed as proportional-differential controllers (PD controllers). They enable assessment of absolute deviation of the measured values from their selectable target values and the assessment of their change over time.

During analysis, the RTC105 N/DN-Module differentiates between aerated/non-aerated phases according to the following criteria:

The **nitrification phase** is complete, if

- the deviation of the $\text{NH}_4\text{-N}$ concentration and the $\text{NO}_3\text{-N}$ concentration from their target values (if applicable, in conjunction with the decay rate of the $\text{NH}_4\text{-N}$ concentration and the slew rate of the $\text{NO}_3\text{-N}$ concentration) exceed a specific amount to the detriment of the $\text{NO}_3\text{-N}$ concentration.

The aforementioned time frame is always in effect, thus the nitrification is

- complete, if the maximum nitrification time (**NITRI MAX**) has expired
- not complete until the minimum nitrification time (**NITRI MIN**) has occurred.

The **denitrification phase** is complete, if

- the deviations of the $\text{NH}_4\text{-N}$ concentration and the $\text{NO}_3\text{-N}$ concentration exceed their target values (if applicable in conjunction with the slew rate of the $\text{NH}_4\text{-N}$ concentration and the decay rate of the $\text{NO}_3\text{-N}$ concentration) by a specific amount to the detriment of the $\text{NH}_4\text{-N}$ concentration.

The time frame is always in effect, thus the denitrification is

- complete, if the maximum denitrification time (**DENITRI MAX**) has expired
- not complete until the minimum denitrification time (**DENITRI MIN**) has occurred.

2.5.1.1 Controller behavior with low nitrogen content

If both the $\text{NO}_3\text{-N}$ and the $\text{NH}_4\text{-N}$ concentrations are very low, there is no selection criteria for whether there should be more or less aeration. To save energy, the aeration is switched off in this case. However, the time frame remains in effect. That is, the switch off cannot occur until the minimum nitrification time has been completed.

2.5.1.2 Time delay control (2-channel version)

In the RTC module variant for two activations, the time frame (which ensures useful cyclical operation under all conditions) is responsible for aerating activation 1 and activation 2 with a time delay. Thus, in one tank there is nitrification and in the other denitrification, for the longest time frames possible. This reduces load peaks in power consumption.

Note: Time delay control only works with time frames that are set to be the same!

2.5.2 Function principle of the O_2 control

The optional oxygen control allows the aeration power to be adapted to the respective need in the aeration phases. The oxygen control has up to 6 different aeration stages per channel. These aeration stages are activated by min-max limit controllers. These min-max limit controllers also receive a time assessment that takes the change rate into consideration.

2.5.3 Control for reactors in accumulation operation (SBR plants)

For control of SBR plants, the controller is notified of sedimentation and drain process by a binary input signal. This stops the control and, in a final measure, the controller switches off the aeration request.

A change of the binary input signals to the RTC Module the drain process has ended. Depending on the configured pre-selection, the RTC module starts a nitrification or denitrification phase with selectable duration.

⚠ 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 switching on the power supply, you must refer to the instructions in the relevant operating manuals.

3.1 Installation of the RTC Module

Only install the RTC Module on a DIN rail. The module must be attached horizontally, with at least 30 mm (1.2 in.) space at the top and bottom to make sure that the passive aeration element can function correctly.

When used indoors, the RTC Module must be installed in a control cabinet. When used outdoors, the RTC Module requires a suitable enclosure that follows the technical specifications.

The RTC Module is only operated via the sc1000 controller (see the user manual for the sc1000 controller).

Note: The software version of the sc1000 controller must be V3.20 or above.

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 | 230 V, 50–60 Hz, approximately 25 VA |

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

3.2 Connection of process measuring instruments (for NH₄-N, NO₃-N and O₂)

The measurement signals of the sc sensors for measuring NH₄-N and NO₃-N (e.g. AMTAX sc, NH4D sc, NITRATAX plus sc, NO3D sc, AN-ISE sc, ...) are supplied to the RTC module via the RTC communication card (YAB117) in the sc1000.

This also applies to the O₂ measurement, if a corresponding O₂ control is available.

3.2.1 Power supply of the sc sensors and the sc1000 controller

See operating instructions of the respective sc sensors and the sc1000 controller.

3.3 Connecting the sc 1000 controller

The supplied SUB-D connector is attached to a two-wire, shielded data cable (signal or bus cable). For additional information regarding the data cable connection, refer to the enclosed assembly instructions.

3.4 Connection to the automation unit on the plant side

Depending on the variant and option, the RTC105 N/DN-Module is equipped with various components that can be connected to the automation unit of the plant:

- The volumetric flow rate is provided to the RTC module as a 0/4 to 20 mA signal for all variants and options
- The RTC module provides the digital nitrification/denitrification output signal of 0 or 24 V
- The RTC module provides a digital signal with 0 or 24 V for up to 6 different aeration stages (per channel)
- The RTC module provides a general fault signal of 0 or 24 V
- For the SBR variant, a digital (0 or 24 V) release signal must be provided to differentiate between sedimentation/decantation phases, or feed (0 V) and nitrification or denitrification phases (24 V).

Table 2 Signal assignment of the individual assemblies of the RTC module

| Assembly | Designation | Terminal | Signal | Assembly | RTC module options | | | |
|-----------------------|-------------|----------|--------------|--|---------------------|---|---------------------|---|
| | | | | | 1 channel | | 2 channel | |
| | | | | | with O ₂ | | with O ₂ | |
| 1-fold analog input | KL3011 | 1–2 | 0/4 to 20 mA | Feed volume flow | X | X | X | X |
| 2-fold digital output | KL2032 | 1 | +24 V/0 V | Nitrification/denitrification | X | | | |
| | | 5 | +24 V/0 V | No fault/fault | X | | | |
| 4-fold digital output | KL2134 | 1 | +24 V/0 V | Container 1: nitrification | | | X | |
| | | 5 | +24 V/0 V | No fault/fault Channel 1 | | | X | |
| | | 4 | +24 V/0 V | Container 2: nitrification | | | X | |
| | | 8 | +24 V/0 V | No fault/fault Channel 2 | | | X | |
| 8-fold digital output | KL2408 | 1 | +24 V/0 V | Container 1: nitrification/denitrification | | X | | |
| | | 5 | +24 V/0 V | Container 1: aeration stage 1 ON/OFF | | X | | |
| | | 2 | +24 V/0 V | Container 1: aeration stage 2 ON/OFF | | X | | |
| | | 6 | +24 V/0 V | Container 1: aeration stage 3 ON/OFF | | X | | |
| | | 3 | +24 V/0 V | Container 1: aeration stage 4 ON/OFF | | X | | |
| | | 7 | +24 V/0 V | Container 1: aeration stage 5 ON/OFF | | X | | |
| | | 4 | +24 V/0 V | Container 1: aeration stage 6 ON/OFF | | X | | |
| | | 8 | +24 V/0 V | No fault/fault | | X | | |

Table 2 Signal assignment of the individual assemblies of the RTC module

| Assembly | Designation | Terminal | Signal | Assembly | RTC module options | | | |
|------------------------|-------------|----------|-----------|--|--------------------|---------------------|-----------|---------------------|
| | | | | | 1 channel | | 2 channel | |
| | | | | | | with O ₂ | | with O ₂ |
| 16-fold digital output | KL2809 | 1 | +24 V/0 V | Container 1: nitrification/denitrification | | | | X |
| | | 2 | +24 V/0 V | Container 1: aeration stage 1 ON/OFF | | | | X |
| | | 3 | +24 V/0 V | Container 1: aeration stage 2 ON/OFF | | | | X |
| | | 4 | +24 V/0 V | Container 1: aeration stage 3 ON/OFF | | | | X |
| | | 5 | +24 V/0 V | Container 1: aeration stage 4 ON/OFF | | | | X |
| | | 6 | +24 V/0 V | Container 1: aeration stage 5 ON/OFF | | | | X |
| | | 7 | +24 V/0 V | Container 1: aeration stage 6 ON/OFF | | | | X |
| | | 8 | +24 V/0 V | No fault/ fault on channel 1 | | | | X |
| | | 9 | +24 V/0 V | Container 2: nitrification/denitrification | | | | X |
| | | 10 | +24 V/0 V | Container 2: aeration stage 1 ON/OFF | | | | X |
| | | 11 | +24 V/0 V | Container 2: aeration stage 2 ON/OFF | | | | X |
| | | 12 | +24 V/0 V | Container 2: aeration stage 3 ON/OFF | | | | X |
| | | 13 | +24 V/0 V | Container 2: aeration stage 4 ON/OFF | | | | X |
| | | 14 | +24 V/0 V | Container 2: aeration stage 5 ON/OFF | | | | X |
| | | 15 | +24 V/0 V | Container 2: aeration stage 6 ON/OFF | | | | X |
| | | 16 | +24 V/0 V | No fault/ fault on channel 2 | | | | X |

| Assembly | Designation | Terminal | Signal | Assembly | additional for SBR variant | | | |
|----------------------|-------------|----------|------------------------|--|----------------------------|---------------------|-----------|---------------------|
| | | | | | 1 channel | | 2 channel | |
| | | | | | | with O ₂ | | with O ₂ |
| 2-fold digital input | KL1002 | 1 5 | +24 V/0 V +24 V/0 V | Release controller channel 1 Release controller channel 2 | X - | X - | X X | X X |

Section 4 Parameterization and operation

4.1 Operating the sc controller

The RTC module can only be operated using the sc1000 controller, in conjunction with the RTC communication card. Before the RTC module is used, the user must be familiar with the functionality of the sc1000 controller. Learn how to navigate through the menu and perform the relevant functions.

4.2 System setup

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

4.3 Menu structure

4.3.1 SENSOR STATUS

| SENSOR STATUS | | |
|---------------|--|--|
| RTC | | |
| ERROR | Possible error messages: RTC MISSING, RTC CRC, CHECK KONFIG, RTC FAILURE | |
| WARNINGS | Possible warning messages: MODBUS ADDRESS, PROBE SERVICE | |

Note: Refer to [Section 6 Troubleshooting, page 37](#) for a list of all possible error and warning messages together with a description of all necessary countermeasures to be taken.

4.3.2 SYSTEM SETUP

The system setup is dependent on the number of channels.

For 1 channel:
refer to [4.4 1-channel RTC105 N/DN-Module parameterization on sc1000 controller, page 19](#).

For 2 channel:
refer to [4.5 2-channel RTC105 N/DN-Module parameterization on the sc1000 controller, page 22](#)

4.4 1-channel RTC105 N/DN-Module parameterization on sc1000 controller

The following menu entries can be found in the MAIN MENU.

4.4.1 1-channel closed-loop control

| RTC MODULES / PROGNOSYS | | |
|-------------------------|---|----------|
| RTC MODULES | | |
| RTC | | |
| CONFIGURE | | |
| SELECT SENSOR | Selection list of available, relevant sensors for the RTC module in the sc network (refer to 4.6 Select sensors on page 28). | |
| PRESELECT PROG. | | |
| NH4-N & NO3-N | Control based on ammonium and nitrate measurements | |
| NH4-N | Control based on ammonium measurements | |
| NO3-N | Control based on nitrate measurements | |
| TIME CONTROL | Control based on the preselected nitrification and denitrification times | |
| N/DN-CONTROL | | |
| TARGET VALUES | (Refer to 4.9.1 Target values, page 30) | |
| NH4-N | Selected ammonium output value | [mg/L] |
| NO3-N | Selected nitrate output value | [mg/L] |
| NH4/NO3 WEIGHT | (Refer to 4.9.2 Valuation ratio, page 30) | [none] |
| TIME FRAME | (Refer to 4.9.3 Time frame, page 30) | |
| NITRI MIN | Preselection of a minimum aeration time | [min] |
| NITRI MAX | Preselection of a maximum aeration time | [min] |
| DENITRI MIN | Preselection of a minimum non-aerated time | [min] |
| DENITRI MAX | Preselection of a maximum non-aerated time | [min] |
| ADD TIME BIO-P | Additional non-aerated time to enable biological phosphorous elimination | [min] |
| CTRL PARAMETER | | |
| P GAIN NH4+NO3 | Gain factor: strength of reaction to the ammonium and nitrate contents, if both measurements are available. Determines the length of the entire cycle time (nitrification and denitrification). (Refer to 4.9.5 Gain factors, page 31) | [1/mg/L] |
| DERIV TIME NH4 | Derivative time for ammonium: Closed-loop controller monitors the ammonium value that is expected to be reached after the configured derivative time. (Refer to 4.9.6 Derivative times, page 32) | [min] |
| DERIV TIME NO3 | Derivative time for nitrate: Closed-loop controller monitors the nitrate value that is expected to be reached after the configured derivative time. (Refer to 4.9.6 Derivative times, page 32) | [min] |
| P GAIN NH4 | Gain factor: strength of the reaction to the ammonium content. Determines the length of the aerated phase (applies if only ammonium measurement is available). (Refer to 4.9.5 Gain factors, page 31) | [1/mg/L] |
| P GAIN NO3 | Gain factor: strength of the reaction to the nitrate content. Determines the length of the non-aerated phase (applies if only nitrate measurement is available). (Refer to 4.9.5 Gain factors, page 31) | [1/mg/L] |

4.4.1 1-channel closed-loop control (Continued)

| | | |
|--------------------------------|--|-------|
| RTC MODULES / PROGNOSYS | | |
| RTC MODULES | | |
| RTC | | |
| CONFIGURE (Continuation) | | |
| MODBUS | | |
| ADDRESS | Start address of an RTC within the MODBUS network. | |
| DATA ORDER | Specifies the register order within a double word. Presetting: NORMAL | |
| DATALOG INTRVL | Indicates the interval in which the data is saved in the log file. | [min] |
| SET DEFAULTS | Restores the factory settings. | |
| MAINTENANCE | | |
| RTC DATA | | |
| RTC MEASUREMEN | Specifies the value measured by the RTC, e. g. the influent measurement. | |
| RTC ACTUAT VAR | Specifies the variable calculated by the RTC, e. g. whether the aeration should be switched on or off. | |
| DIAG/TEST | | |
| EEPROM | Hardware test | |
| RTC COMM TO | Communication time-out | |
| RTC CRC | Communication check sum | |
| MODBUS ADDRESS | Here, the address is displayed where the communication actually takes place. Presetting: 41 | |
| LOCATION | Here, a location name can be assigned for better identification of the RTC module, e.g. activation 2. | |
| SOFT-VERSION | Shows the software version of the RTC communication card (YAB117) in the sc1000. | |
| RTC MODE | Shows the installed RTC module variant, e.g. 1-channel closed-loop control. | |
| RTC VERSION | Shows the software version of the RTC module. | |

4.4.2 1-channel closed-loop control, SBR option

| | | |
|--------------------------------|---|-----|
| RTC MODULES / PROGNOSYS | | |
| RTC MODULES | | |
| RTC | | |
| CONFIGURE | | |
| N/DN-CONTROL | | |
| TIME FRAME | (Refer to 4.9.3 Time frame, page 30) | |
| START N/DN? | Preselection of phase with which the treatment process is to be started. | |
| N-PHASE | Nitrification phase | |
| DN-PHASE | Denitrification phase | |
| TIME INITPHASE | Preselection of duration for the first treatment phase (in % of the corresponding MAX time) | [%] |

4.4.3 1-channel closed-loop control, O₂ closed-loop control option

| | | |
|-------------------------|---|--------|
| RTC MODULES / PROGNOSYS | | |
| RTC MODULES | | |
| RTC | | |
| CONFIGURE | | |
| O2 control | | |
| MAX O2 | Maximum O ₂ concentration in the nitrification phase. (Refer to 4.10.2.1 Maximum value MAX O2, minimum value MIN O2, page 33) | [mg/L] |
| MIN O2 | Minimum O ₂ concentration in the nitrification phase. (Refer to 4.10.2.1 Maximum value MAX O2, minimum value MIN O2, page 33) | [mg/L] |
| DERIVATIV.TIME | Differentiation time of controller | [min] |
| ABSORPTION | Absorption time to influence the switch frequency between the aeration stages | [min] |
| NO. OF STAGES | Number of controlled aeration levels (maximum 6) | [none] |
| SUBST AERATION | If the oxygen sensor (e.g. LDO) signals a fault, the set aeration stage is selected (stages 1 to 6) | [none] |

4.5 2-channel RTC105 N/DN-Module parameterization on the sc1000 controller

In addition to the 1-channel version, there is also a 2-channel version that can regulate two activated sludge tanks or two SBR reactors at the same time. The relevant parameters therefore appear twice and are identified as channel 1 and channel 2.

4.5.1 2-channel closed-loop control

| | | |
|-------------------------|---|--|
| RTC MODULES / PROGNOSYS | | |
| RTC MODULES | | |
| RTC | | |
| CONFIGURE | | |
| SELECT SENSOR | Selection list of available, relevant sensors for the RTC module in the sc network (refer to 4.6 Select sensors on page 28). | |
| PRESELECT PROG. | | |
| CHANNEL 1 | | |
| NH4-N & NO3-N | Control based on ammonium and nitrate measurements | |
| NH4-N | Control based on ammonium measurements | |
| NO3-N | Control based on nitrate measurements | |
| TIME CONTROL | Control based on the preset nitrification and denitrification times | |
| CHANNEL 2 | | |
| NH4-N & NO3-N | Control based on ammonium and nitrate measurements | |
| NH4-N | Control based on ammonium measurements | |
| NO3-N | Control based on nitrate measurements | |
| TIME CONTROL | Control based on the preset nitrification and denitrification times | |

4.5.1 2-channel closed-loop control (Continued)

| | | |
|-------------------------|---|----------|
| RTC MODULES / PROGNOSYS | | |
| RTC MODULES | | |
| RTC | | |
| CONFIGURE (continue) | | |
| N/DN-CONTROL | | |
| CHANNEL 1 | | |
| TARGET VALUES | (Refer to 4.9.1 Target values, page 30) | |
| NH4-N | Selected ammonium output value | [mg/L] |
| NO3-N | Selected nitrate output value | [mg/L] |
| NH4/NO3 WEIGHT | (Refer to 4.9.2 Valuation ratio, page 30) | [none] |
| TIME FRAME | (Refer to 4.9.3 Time frame, page 30) | |
| NITRI MIN | Preselection of a minimum aeration time | [min] |
| NITRI MAX | Preselection of a maximum aeration time | [min] |
| DENITRI MIN | Preselection of a minimum non-aerated time | [min] |
| DENITRI MAX | Preselection of a maximum non-aerated time | [min] |
| ADD TIME BIO-P | Additional non-aerated time to allow a biological phosphorous elimination. | [min] |
| CTRL PARAMETER | | |
| P GAIN NH4+NO3 | Gain factor: strength of reaction to the ammonium and nitrate contents, if both measurements are available. Determines the length of the entire cycle time (nitrification and denitrification). (Refer to 4.9.5 Gain factors, page 31) | [1/mg/L] |
| DERIV TIME NH4 | Derivative time for ammonium: Closed-loop controller monitors the ammonium value that is expected to be reached after the configured derivative time. (Refer to 4.9.6 Derivative times, page 32) | [min] |
| DERIV TIME NO3 | Derivative time for nitrate: Closed-loop controller monitors the nitrate value that is expected after the configured derivative time. (Refer to 4.9.6 Derivative times, page 32) | [min] |
| P GAIN NH4 | Gain factor: strength of the reaction to the ammonium content. Determines the length of the aerated phase (applies if only ammonium measurement is available). (Refer to 4.9.5 Gain factors, page 31) | [1/mg/L] |
| P GAIN NO3 | Gain factor: strength of the reaction to the nitrate content. Determines the length of the non-aerated phase (applies if only nitrate measurement is available). (Refer to 4.9.5 Gain factors, page 31) | [1/mg/L] |

Parameterization and operation

4.5.1 2-channel closed-loop control (Continued)

| RTC MODULES / PROGNOSYS | | |
|-----------------------------|---|----------|
| RTC MODULES | | |
| RTC | | |
| CONFIGURE (Continuation) | | |
| N/DN-CONTROL (Continuation) | | |
| CHANNEL 2 | | |
| TARGET VALUES | (Refer to 4.9.1 Target values, page 30) | |
| NH4-N | Selected ammonium output value | [mg/L] |
| NO3-N | Selected nitrate output value | [mg/L] |
| NH4/NO3 WEIGHT | (Refer to 4.9.2 Valuation ratio, page 30) | [none] |
| TIME FRAME | (Refer to 4.9.3 Time frame, page 30) | |
| NITRI MIN | Preselection of a minimum aeration time | [min] |
| NITRI MAX | Preselection of a maximum aeration time | [min] |
| DENITRI MIN | Preselection of a minimum non-aerated time | [min] |
| DENITRI MAX | Preselection of a maximum non-aerated time | [min] |
| ADD TIME BIO-P | Additional non-aerated time to allow a biological phosphorous elimination. | [min] |
| CTRL PARAMETER | | |
| P GAIN NH4+NO3 | Gain factor: strength of reaction to the ammonium and nitrate contents, if both measurements are available. Determines the length of the entire cycle time (nitrification and denitrification). (Refer to 4.9.5 Gain factors, page 31) | [1/mg/L] |
| DERIV TIME NH4 | Derivative time for ammonium: Closed-loop controller monitors the ammonium value that is expected to be reached after the configured derivative time. (Refer to 4.9.6 Derivative times, page 32) | [min] |
| DERIV TIME NO3 | Derivative time for nitrate: Closed-loop controller monitors the nitrate value that is expected to be reached after the configured derivative time. (Refer to 4.9.6 Derivative times, page 32) | [min] |
| P GAIN NH4 | Gain factor: strength of the reaction to the ammonium content. Determines the length of the aerated phase (applies if only ammonium measurement is available). (Refer to 4.9.5 Gain factors, page 31) | [1/mg/L] |
| P GAIN NO3 | Gain factor: strength of the reaction to the nitrate content. Determines the length of the non-aerated phase (applies if only nitrate measurement is available). (Refer to 4.9.5 Gain factors, page 31) | [1/mg/L] |
| MODBUS | | |
| ADDRESS | Start address of an RTC within the modbus network. | |
| DATA ORDER | Specifies the register order within a double word. Presetting: NORMAL | |
| DATALOG INTRVL | Indicates the interval in which the data is saved in the log file. | [min] |
| SET DEFAULTS | Restores the factory default settings | |

4.5.1 2-channel closed-loop control (Continued)

| | | |
|--------------------------------|--|--|
| RTC MODULES / PROGNOSYS | | |
| RTC MODULES | | |
| RTC | | |
| MAINTENANCE | | |
| RTC DATA | | |
| RTC MEASUREMEN | Specifies the value measured by the RTC, e. g. the influent measurement. | |
| RTC ACTUAT VAR | Specifies the variable calculated by the RTC, e. g. whether the aeration should be switched on or off. | |
| DIAG/TEST | | |
| EEPROM | Hardware test | |
| RTC COMM TO | Communication time-out | |
| RTC CRC | Communication check sum | |
| MODBUS ADDRESS | Here, the address is displayed where the communication actually takes place. Presetting: 41 | |
| LOCATION | Here, a location name can be assigned for better identification of the RTC module, e.g. activation 2. | |
| SOFT-VERSION | Shows the software version of the RTC communication card (YAB117) in the sc1000. | |
| RTC MODE | Shows the installed RTC module variant, e.g. 2-channel closed-loop control. | |
| RTC VERSION | Shows the software version of the RTC module. | |

4.5.2 2-channel closed-loop control, SBR option

| | | |
|-------------------------|---|-----|
| RTC MODULES / PROGNOSYS | | |
| RTC MODULES | | |
| RTC | | |
| CONFIGURE | | |
| N/DN-CONTROL | | |
| CHANNEL 1 | | |
| TIME FRAME | (Refer to 4.9.3 Time frame, page 30) | |
| START N/DN? | Preselection of phase with which the treatment process is to be started. | |
| N-PHASE | Nitrification phase | |
| DN-PHASE | Denitrification phase | |
| TIME INITPHASE | Preselection of duration for the first treatment phase (in % of the corresponding MAX time) | [%] |
| CHANNEL 2 | | |
| TIME FRAME | (Refer to 4.9.3 Time frame, page 30) | |
| START N/DN? | Preselection of phase with which the treatment process is to be started. | |
| N-PHASE | Nitrification phase | |
| DN-PHASE | Denitrification phase | |
| TIME INITPHASE | Preselection of duration for the first treatment phase (in % of the corresponding MAX time) | [%] |

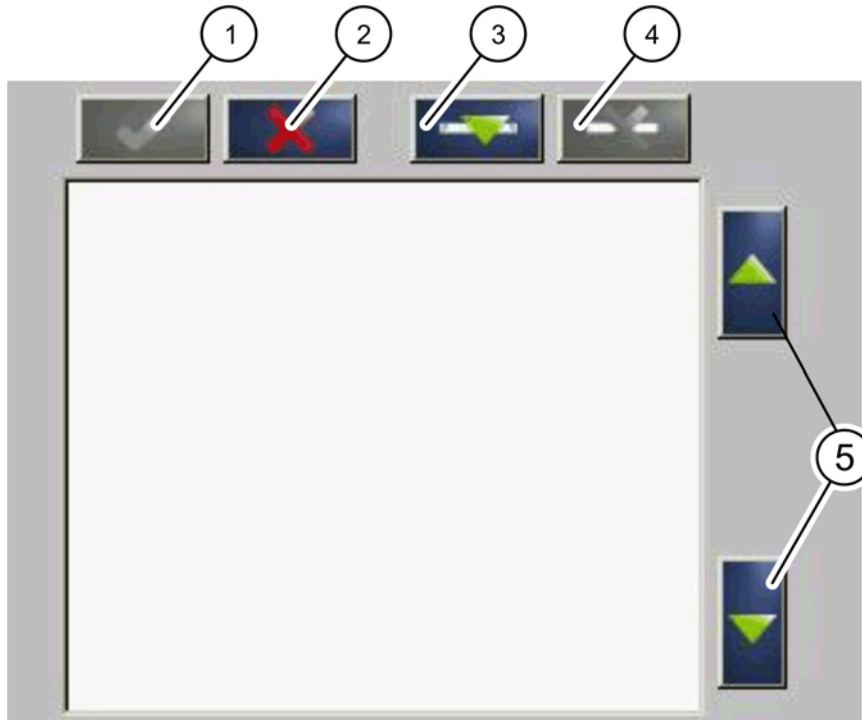
4.5.3 2-channel closed-loop control, O₂ closed-loop control option

| | | |
|-------------------------|--|--------|
| RTC MODULES / PROGNOSYS | | |
| RTC MODULES | | |
| RTC | | |
| CONFIGURE | | |
| O2 CONTROL | | |
| CHANNEL 1 | | |
| MAX O2 | Maximum O ₂ concentration in the nitrification phase. (Refer to 4.10.2.1 Maximum value MAX O2, minimum value MIN O2, page 33) | [mg/L] |
| MIN O2 | Minimum O ₂ concentration in the nitrification phase. (Refer to 4.10.2.1 Maximum value MAX O2, minimum value MIN O2, page 33) | [mg/L] |
| DERIVATIV.TIME | Differentiation time of controller | [min] |
| ABSORPTION | Absorption time to influence the switch frequency between the aeration stages | [min] |
| NO. OF STAGES | Number of controlled aeration levels (maximum 6) | [none] |
| SUBST AERATION | If the oxygen sensor (e. g. LDO) signals a fault, the set aeration stage is selected (stages 1 to 6). | [none] |
| CHANNEL 2 | | |
| MAX O2 | Maximum O ₂ concentration in the nitrification phase. (Refer to 4.10.2.1 Maximum value MAX O2, minimum value MIN O2, page 33) | [mg/L] |
| MIN O2 | Minimum O ₂ concentration in the nitrification phase. (Refer to 4.10.2.1 Maximum value MAX O2, minimum value MIN O2, page 33) | [mg/L] |
| DERIVATIV.TIME | Differentiation time of controller | [min] |
| ABSORPTION | Absorption time to influence the switch frequency between the aeration stages | [min] |
| NO. OF STAGES | Number of controlled aeration levels (maximum 6) | [none] |
| SUBST AERATION | If the oxygen sensor (e. g. LDO) signals a fault, the set aeration stage is selected (stages 1 to 6). | [none] |

4.6 Select sensors

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

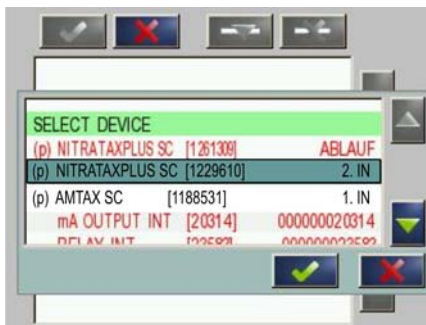
Figure 4 Select sensor



| | |
|---|--|
| 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).

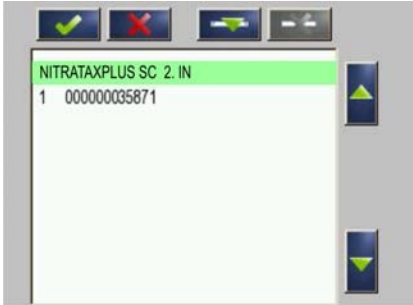
A selection list of all subscribers to the sc1000 network opens.



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



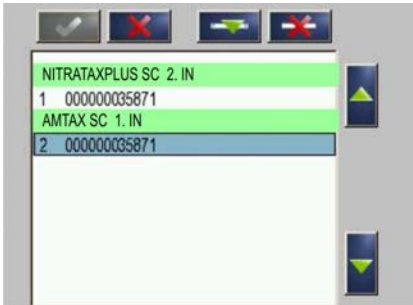
- 4. The selected sensor is shown in the sensor list. Press **ADD** (Figure 4, item 3) to open the selection list again.



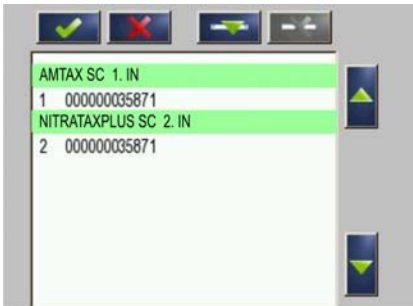
- 5. Select the second sensor for the RTC module and confirm by pressing **ENTER** below the selection list.

Note: Previously selected sensors are shown in gray.

The selected sensors are shown in the sensor list.



- 6. 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.



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

4.7 Control programs

To adapt to local circumstances and the instruments available, there are 4 different programs available for calculating the time intervals for the nitrification and denitrification

Table 3 Control programs to calculate the time intervals for nitrification and denitrification

| TIME CONTROL | FIXED TIME FRAME |
|-----------------|--|
| NH4-N | Control based on the NH ₄ -N concentration |
| NO3-N | Control based on the NO ₃ -N concentration |
| NH4-N and NO3-N | Control based on the NH ₄ -N and NO ₃ -N concentration |

4.8 Automatic program change

If a measurement signal fails, e. g. during an operational fault, an automatic program change occurs from NH₄-N and NO₃-N to the respective measurement still available (NH₄-N or NO₃-N). If neither the NH₄-N nor the NO₃-N measurement is available, the program automatically switches back to the fixed time frame. If the measurements are available again after a failure, it is automatically switched back to the preselected program. The change between programs occurs with a delay of 5 minutes.

4.9 Explanations of nitrification/denitrification controller parameters

4.9.1 Target values

The RTC105 N/DN-Module assesses both the NH₄-N and the NO₃-N concentration in the activated sludge tank. Selected target values for both parameters are entered via the **NH4-N** or **NO3-N** parameters. The target values shall correspond to the average selected or achievable output values.

Table 4 Target values, default setting

| | |
|-------|----------|
| NH4-N | 2.5 mg/L |
| NO3-N | 2.5 mg/L |

4.9.2 Valuation ratio

The valuation ratio **NH4/NO3 WEIGHT** can specify, how the NH₄-N concentration in combination with the NO₃-N concentration affects the controller result. Ratios >1 result in a stronger influence on the NH₄-N concentration. Ratios < 1 affect a greater influence on the NO₃-N concentration. The preset ratio is 1.0. The valuation ratio should only be changed if you absolutely wish to avoid the increase of one of the two parameters by a specific value. A change in the valuation ratio can cause an undesired decrease of the (non)aerated phases, within the set time frame.

Table 5 Valuation ratio, default setting

| | |
|----------------|-----|
| NH4/NO3 WEIGHT | 1.0 |
|----------------|-----|

4.9.3 Time frame

The sum of the maximum times for nitrification and denitrification should be approximately 1.25 times the desired cycle time

(1 cycle = 1 unaerated phase + 1 aerated phase). The desired cycle time shall lie between 90 and 360 minutes.

High NH₄-N (NO₃-N) concentrations with low NO₃-N (NH₄-N) concentrations require a check of the maximum times **NITRI MAX** or **DENITRI MAX**. If the nitrification or the denitrification is limited by the corresponding maximum time, this maximum time shall be increased or the other be decreased.

The values for **NITRI MIN** and **DENITRI MIN** shall ensure a useful cyclical process under all operating conditions. They should be set as low as possible, and if possible, should have no influence on the control.

Table 6 Time frame, default setting

| | |
|--------------------|--------|
| NITRI MAX | 60 min |
| NITRI MIN | 30 min |
| DENITRI MAX | 60 min |
| DENITRI MIN | 30 min |

4.9.4 Increased biological phosphorous elimination (BIO-P)

If an increased biological phosphorous elimination is desired, by selecting the parameter ADD TIME BIO-P after the denitrification phase, a forced non-aerated phase for phosphorous dissolution (for NO₃-N approx. 0 mg/L) is introduced.

Table 7 BIO-P, default setting

| | |
|-----------------------|-------|
| ADD TIME BIO-P | 0 min |
|-----------------------|-------|

4.9.5 Gain factors

In all versions of the RTC105 N/DN-Module, the gains

- P GAIN NH₄+NO₃
- P GAIN NH₄ and
- P GAIN NO₃

(below), determine the resulting cycle time:
This applies to the controllers

- NH₄-N and NO₃-N,
- NH₄-N and
- NO₃-N.

The gains shall first be set equally and selected so that the desired cycle length (nitrification + denitrification) is set in the middle. With average load, the switch should occur between the respective minimum or maximum time and not be limited by either the maximum or the minimum times. If the control reaches the maximum times too frequently, the **P GAIN** are too small. In contrast, if the cycles are too short or if the controller frequently only runs the minimum times, the **P GAIN** are too big.

Changes should be made in increments of ±01. If no satisfactory behavior can be achieved with a set time frame, the time frame shall be adapted.

In general, all gains P GAIN are set to the same values.

- **P GAIN NH4+NO3** only applies if both measurements (NH₄-N and NO₃-N) are present.
- **P GAIN NH4** only applies if only the NH₄-N measurement supplies valid values.
- **P GAIN NO3** only applies if only the NO₃-N measurement supplies valid values.

The target value multiplied by the associated gain factor **P GAIN** must always be greater than 1.0.
(For **P GAIN NH4+NO3**, the average value of the target values of **NH4-N** and **NO3-N** applies)

Table 8 Gain factors, default setting

| | |
|-----------------------|-------------|
| P GAIN NH4+NO3 | 1.0 /(mg/L) |
| P GAIN NH4 | 1.0 /(mg/L) |
| P GAIN NO3 | 1.0 /(mg/L) |

4.9.6 Derivative times

The derivative times **DERIVATIV.TIME NH4** and **DERIV TIME NO3** assess the change rates of the applicable parameters.

DERIV TIME NO3 shall only be used if larger quantities of NO₃-N are present in the inlet.

DERIV TIME NH4 can be changed to counteract NH₄-N peaks in the inlet on time by increasing the nitrification times. The derivative time is increased in increments of 1.0 minute. An observation time frame must follow every change, in which it is checked, how strongly the cycle time increases and the NO₃-N concentration increases in the medium.

Table 9 Derivative times, default setting

| | |
|-----------------------|--------|
| DERIV TIME NO3 | 0 min. |
| DERIV TIME NH4 | 0 min. |

4.10 Explanations of oxygen controller (O₂ control option)

4.10.1 General aeration parameters

NO. OF STAGES defines the number of the aeration stages. The RTC105 N/DN-Module with the option for oxygen closed-loop control can actuate between 1 and 6 discrete aeration stages.

Table 10 General aeration parameters, default setting

| | |
|----------------------|---|
| NO. OF STAGES | 3 |
|----------------------|---|

SUBST AERATION defines which aeration stage is to be activated in case of an invalid O₂ measurement.

Table 11 Substitute aeration, default setting

| | |
|-----------------------|---|
| SUBST AERATION | 3 |
|-----------------------|---|

4.10.2 Aeration control with stage actuation

Oxygen controllers with stage actuation are min-max limit controllers that receive an additional time assessment. This time assessment considers the change rate.

4.10.2.1 Maximum value MAX O₂, minimum value MIN O₂

The parameters, **MAX O₂** and **MIN O₂**, define an upper and lower oxygen limit value. **MAX O₂** is the O₂ concentration that when exceeded, the controller begins to switch back the aeration stage. Below the O₂ concentration **MIN O₂**, the aeration stages are switched higher.

The oxygen concentration in the activated sludge tank will fluctuate between the average value of MIN O₂ and MAX O₂ during operation. The closer the two values are to each other, the more frequently the blower switches on during the nitrification phase.

Table 12 Maximum value MAX O₂, minimum value MIN O₂, default setting

| | |
|--------------------------|----------|
| MAX O₂ | 2.0 mg/L |
| MIN O₂ | 0.7 mg/L |

4.10.2.2 DERIVATIVE TIME

The **DERIVATIV.TIME** allows the controller to also react to the change rate of O₂ concentration. This enables the controller to react more quickly to the deviations from the target value.

Table 13 Derivative time, default setting

| | |
|-----------------------|-------|
| DERIVATIV.TIME | 0 min |
|-----------------------|-------|

4.10.2.3 ABSORPTION

The closed-loop controller contains an absorption to prevent too frequent switching. A switch procedure is triggered dependent on how much time has past since the last switch and to what extent a limit value has been exceeded or not met. An increase in the **ABSORPTION** parameter causes a decrease in the switch frequency between the fan stages. On the other hand, the limit values **MAX O2** and **MIN O2** are more heavily exceeded.

Section 5 Maintenance

5.1 Maintenance schedule

⚠ DANGER

Multiple hazards

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

| | Interval | Maintenance task |
|--|----------------------|---|
| Visual inspection | Application-specific | Check for contamination and corrosion |
| CF card | 2 years | Replacement by manufacturer's service department (Section 8, page 41) |
| Battery, type CR2032 Panasonic or Sanyo | 5 years | Replacement |

Section 6 Troubleshooting

6.1 Error messages

Possible RTC errors are displayed by the sc controller.

| Displayed errors | Definition | 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. Change, if necessary. |
| CHECK KONFIG | The sensor selection of the RTC was deleted by removal or selection of 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). |

6.2 Warnings

Possible RTC sensor warnings are displayed by the sc controller.

| Displayed warnings | Definition | Resolution |
|-----------------------|--|--|
| MODBUS ADDRESS | The RTC menu SET DEFAULTS was opened. This deleted the Modbus address of the RTC in the sc1000. | MAIN MENU > RTC MODULES / PROGNOSYS > RTC MODULES > RTC > CONFIGURE > MODBUS > ADDRESS : Access this menu 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

| Component | Number | Service life |
|---|---------|--------------|
| CF card, type for RTC module | 1 piece | 2 years |
| Battery, type CR2032 Panasonic or Sanyo | 1 piece | 5 years |

Section 7 Replacement parts and accessories

7.1 Replacement Parts

| Description | Cat. No |
|---|-----------|
| DIN rail NS 35/15, punched according to DIN EN 60715 TH35, made of galvanized steel. Length: 35 cm (13.78 in.) | LZH165 |
| Transformer 90–240 V AC/24 V DC 0.75 A, module for top hat 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 ventilation element. (CX1010-0021) and RS422/485 connection module (CX1010-N031) | LZH171 |
| Power supply module, consisting 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 |
| Digital input module 24 V DC (2 inputs) (KL1002) | LZH204 |
| Digital output module 24 V DC (8 outputs) (KL2408) | LZH205 |
| Digital output module 24 V DC (16 outputs) (KL2809) | LZH206 |
| Bus termination module (KL9010) | LZH178 |
| RTC communication card | YAB117 |
| CF card, type for RTC module | LZY748-00 |

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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 must be set for Modbus communication both on the sc1000 controller display and on the RTC105 N/DN-Module. Since 20 slave numbers are reserved for internal purposes, the following numbers are available for assignment:

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

The start address 41 is preset at the factory.

NOTICE

If this address is to be or must be changed because, for example, it has already been allocated for another RTC module the changes must be made both on the sc1000 controller and on the CF card of the RTC module.

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

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