DOC023.52.90448

RTC103 N-Module

Real-Time Control System for Ammonium Removal

User manual

07/2013, Edition 1A

Table of Contents

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	1× RJ 45 (Ethernet), 10/100 Mbit/s
Diagnostic LED	1× power, 1× LAN speed, 1× LAN activity, TC status, 1× flash access
Expansion slot	1× 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 × W × H)	350 mm × 120 mm × 96 mm (13.78 in. × 4.72 in. × 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)	< ± 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)

Analog output	Outputs for DO setpoint or VFD control
Number of outputs	One-channel: 1 (KL4011); 1 (KL4012) VFD control Two-channel: 1 (KL4012); 2 (KL4012) VFD control
Supply voltage	24 V DC via the power contacts (Alternatively, 15 V DC with bus termination KL9515)
Signal current	0/4 to 20 mA
Working resistance	< 500 Ohm
Measurement error	± 0.5 LSB linearity error ± 0.5 LSB offset error ± 0.5 % (relative to the measuring range end value)
Resolution	12 bit
Conversion time	Approximately 1.5 ms
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 **Protection class** **Installation category** **Maximum altitude**	3 III I 2000 m (6.562 ft.)
Degree of protection	IP20
Installation	DIN rail EN 50022 35 × 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.

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 RTC103 N-Module is an universally applicable control unit which optimizes nitrification processes in wastewater treatment plants. In addition, the RTC103 N-Module can optionally be equipped with a closed-loop controller for setting the dissolved oxygen concentration (O_2) 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 simultaneously.

NOTICE

The use of an RTC module (Real-Time Controller) does not release the operator from the responsibility of maintaining 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.

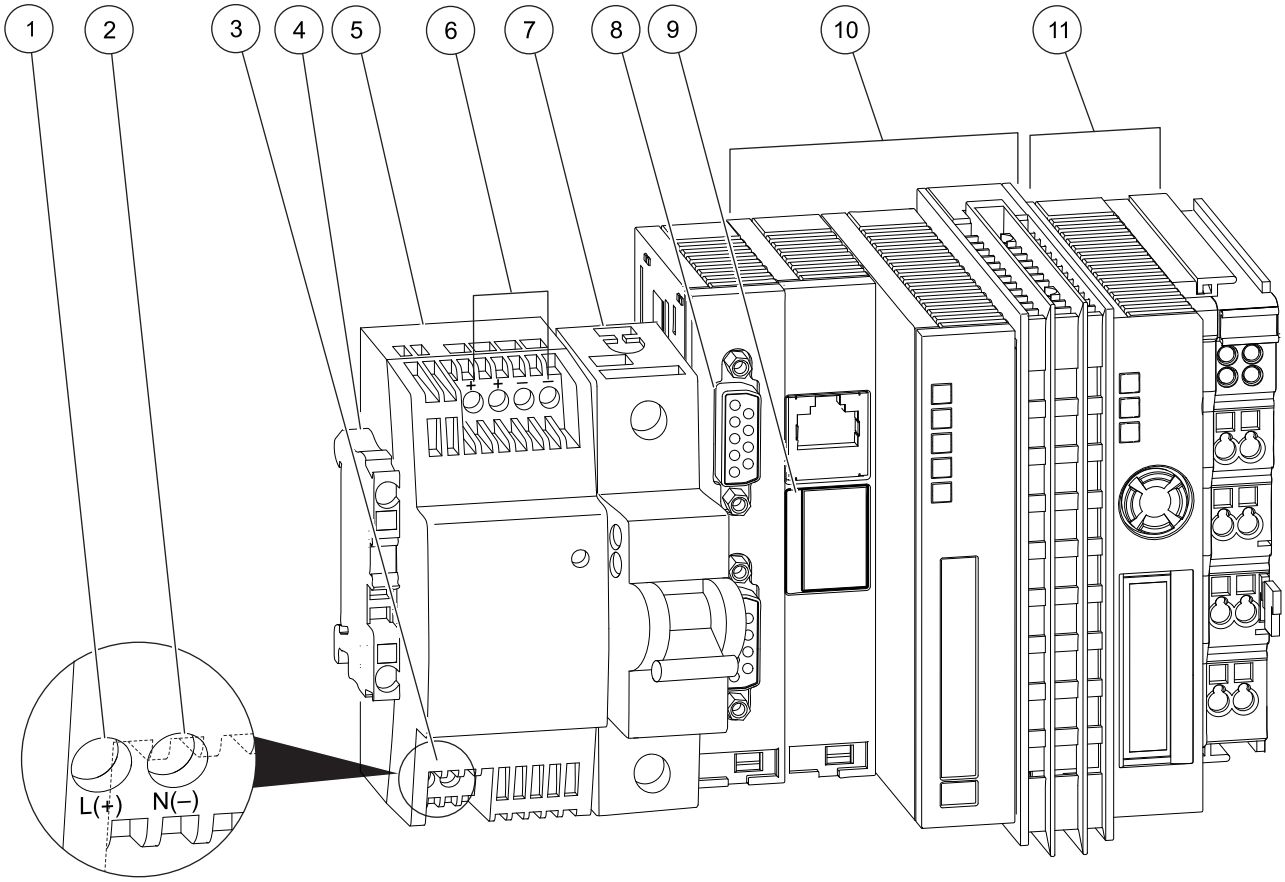
Each RTC103 N-Module is supplied with:

- 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

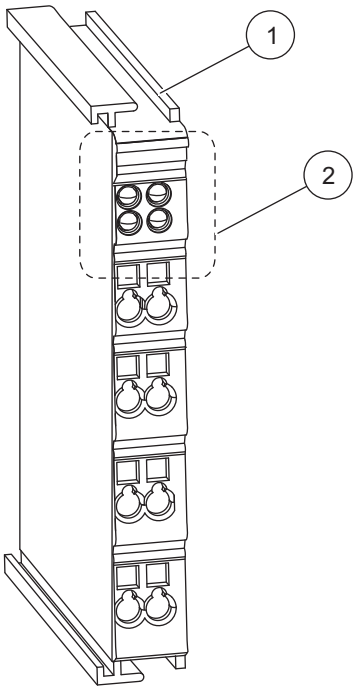
Figure 1 Base module RTC 100-240 V version



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 2 Design of the analog and digital input and output modules



1	Analog or digital input or output module or bus termination module	**2**	LED area with installed LEDs or free LED installation spaces.

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

2.5 Theory of operation

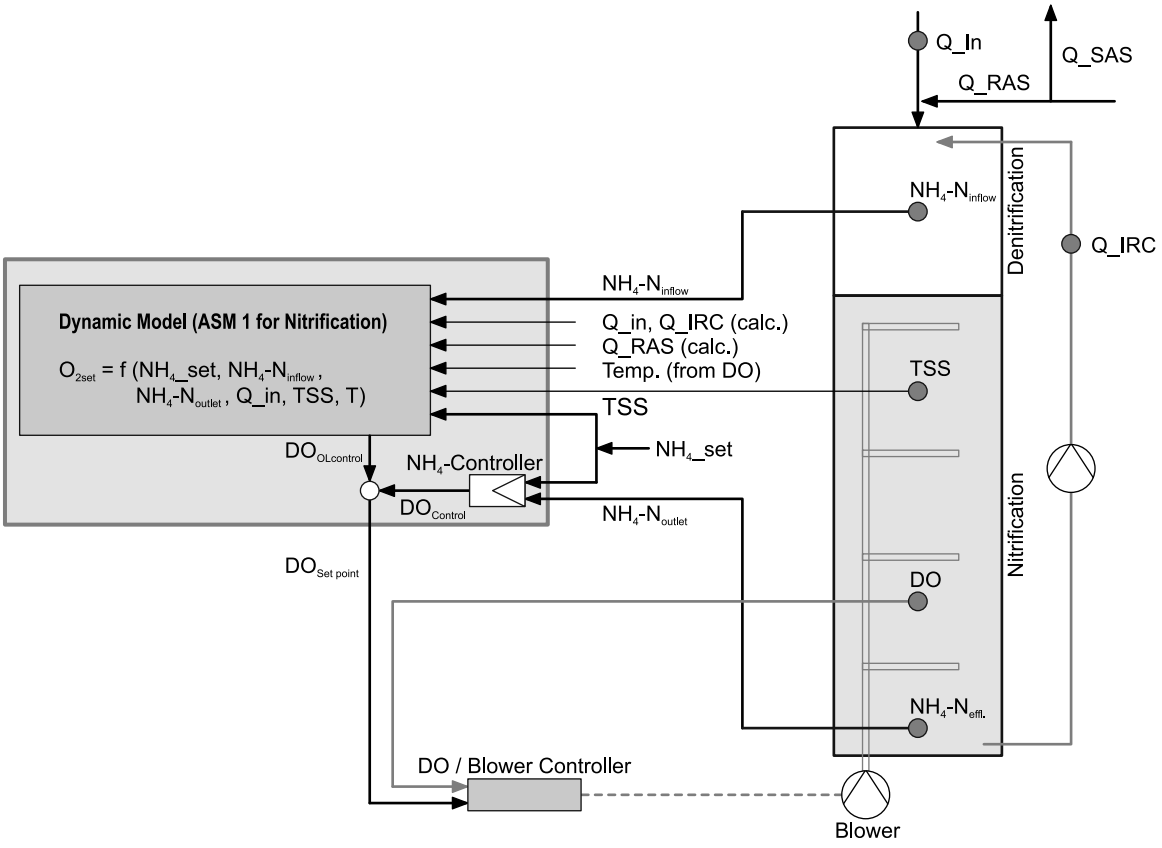
2.5.1 Theory of operation of the RTC103 N-Module

The RTC103 N-Module (Real-Time Controller for Nitrification) optimises nitrification processes in waste water treatment plants which are continuously aerated (e.g. plug flow nitrification tanks or pre-denitrification).

The RTC103 N-Module consists of an open-loop controller, based on NH_4-N influent concentration, flow rate, and the temperature in the aeration tank. Optionally, the Total Suspended Solids concentration in the aeration tank (MLSS) can be taken into account.

Based on that information, a DO set-point is calculated which is required to reach the desired NH_4-N set-point at the effluent of the aeration tank. In addition to open-loop control, there is also a closed-loop PID based on the NH_4-N concentration at the end of the nitrification zone that can be applied to improve control performance. The PID-output values are combined with the open-loop output to calculate the required DO set point (Figure 3).

Figure 3 Principle operation mode of RTC103 N-Module



Basic RTC103 N-Module

For each lane the calculated DO set point is delivered either by analog output or via the sc1000 ProfiBus communication card to the PLC. The DO control algorithm has to be implemented on the PLC.

Option 2: RTC103 N-Module with DO aeration stages controller

The RTC103 N-Module is equipped with an additional DO controller adjusting the aeration intensity to reach the calculated DO concentration. The DO control can have up to 6 different aeration stages per channel (e.g. in order to activate blower or activate discrete aeration intensities). These aeration stages are activated by a min limit DO concentration and the calculated DO set-point.

Option 3: RTC103 N-Module with analog DO controller

The RTC103 N-Module is equipped with an additional DO controller which, using 6 different aeration stages, adjusts the aeration intensity to reach the calculated DO concentration. This option has two analog outputs per lane, to control up to two variable speed drive blowers per lane.

All the above options for the RTC103 N-Module are available as single-channel (for control of one lane) or dual-channel (for control of two lanes).

⚠ 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 supplies the following technical specifications (see Section 1 Technical data, page 7).

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 NH_4-N, TSS and O_2)

The measurement signals of the sc sensors for measuring NH_4-N, TSS, Dissolved Oxygen and Temperature (e.g. AMTAX sc, AN-ISE sc, AISE sc, SOLITAX sc, LDO2 sc,...) are supplied to the RTC module via the RTC communication card (YAB117) in the sc1000.

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 (1-channel or 2-channel RTC103 N-Module, with or without DO control) the RTC103 N-Module is equipped with various components that have to be connected to the automation unit of the plant:

Output signals from RTC103 N-Module:

Basic	For each lane, a single DO set-point 0/4 to 20 mA or ProfiBus / ModBus via sc1000 communication card
Option 2	For each lane, Aeration intensity (1 to 6 stages) for the aeration system (0/24 V per stage or ProfiBus / MODBUS) via sc1000 communication card
Option 3	For each lane, 2 additional analog outputs (0/4 to 20 mA or ProfiBus / MODBUS) via sc1000 communication card

Input signals to RTC103 N-module:

- Flow rate, overall wastewater (Q_in, 0/4 to 20 mA)
- IRC flow rate input (Q_IRC, 0/4 to 20 mA)
  or
  IRC flow = C1 * Q_in with minimum and maximum values
- RAS flow rate (Q_RAS 0/4 to 20 mA)
  or
  RAS flow = C2 * Q_in with minimum and maximum values

Note: *0/4 to 20 mA input can be used either for Q_IRC or for Q_RAS. The other value has to be calculated (C*Q_xxx with minimum and maximum values).*

Input signals from sc1000 via RTC communication card to RTC103 N-module

- Common or individual NH4-N – concentration inlet aeration
  (Measuring points: 1. Inflow 2. Settled Sewage and RAS Mixing / Distribution Chamber 3. aeration tank after IRC input)
- Common or individual NH4-N – concentrations at the end of each lane
- DO concentration for each lane
- TSS concentration aeration tank (option)
- Temperature (coming from a connected sensor DO or NH_4, or via analog input card)

Main Input parameters:

- Parameters for open-loop control
- Parameters for PID control (closed-loop)
- Min/max DO concentration, max. rate of change
- Control parameters for DO control

1-Channel RTC103 N-Module					
Module	**Name**	**Terminal**	**Signal**	**Channel**	**Function**
2 fold digital output[1]	KL2032	1	+24 V/0 V		Input Signals ok (24V), Input signal faulty (0V)
		5	+24 V/0 V		RTC operating (24V), RTC failure (0V)
1 fold analog output	KL4011	1 - 3	0/4 to 20 mA		Output DO set point
1 fold analog intput	KL3011	1 - 2	0/4 to 20 mA		Flow rate aeration lane
1 fold analog input	KL3011	1 - 2	0/4 to 20 mA		Flow rate internal recirculation or return sludge
Bus termination	KL9010				Bus termination

[1] Ground Connector 3 and 7, 24 V Connector 6.

2-Channel RTC103 N-Module					
Module	**Name**	**Terminal**	**Signal**	**Channel**	**Function**
4 fold digital output[1]	KL2134	1	+24 V/0 V	1	Input Signals ok (24V), Input signal faulty (0V)
		5	+24 V/0 V	1	RTC operating (24V), RTC failure (0V)
		4	+24 V/0 V	2	Input Signals ok (24V), Input signal faulty (0V)
		8	+24 V/0 V	2	RTC operating (24V), RTC failure (0V)
2 fold analog output	KL4012	1 - 3	0/4 to 20 mA	1	Output DO set point lane 1
		5 - 7	0/4 to 20 mA	2	Output DO set point lane 2
1 fold analog intput	KL3011	1 - 2	0/4 to 20 mA	1	Flow rate aeration lane 1
1 fold analog input	KL3011	1 - 2	0/4 to 20 mA	2	Flow rate internal recirculation or return sludge lane 1
1 fold analog intput	KL3011	1 - 2	0/4 to 20 mA	1	Flow rate aeration lane 2
1 fold analog input	KL3011	1 - 2	0/4 to 20 mA	2	Flow rate internal recirculation or return sludge lane 2
Bus termination	KL9010				Bus termination

[1] Ground Connector 3 and 7, 24 V Connector 6.

1-Channel RTC103 N-Module DO aeration stages control					
Module	**Name**	**Terminal**	**Signal**	**Channel**	**Function**
8 fold digital output[1]	KL2408	1	+24 V/0 V		Input Signals ok (24V), Input signal faulty (0V)
		2	+24 V/0 V		Aeration step 1 ON / OFF
		3	+24 V/0 V		Aeration step 2 ON / OFF
		4	+24 V/0 V		Aeration step 3 ON / OFF
		5	+24 V/0 V		Aeration step 4 ON / OFF
		6	+24 V/0 V		Aeration step 5 ON / OFF
		7	+24 V/0 V		Aeration step 6 ON / OFF
		8	+24 V/0 V		RTC operating (24V), RTC failure (0V)
1 fold analog output	KL4011	1 - 3	0/4 to 20 mA		Output DO set point
1 fold analog intput	KL3011	1 - 2	0/4 to 20 mA		Flow rate aeration lane
1 fold analog input	KL3011	1 - 2	0/4 to 20 mA		Flow rate internal recirculation or return sludge
Bus termination	KL9010				Bus termination

[1] Ground Connector 3 and 7, 24 V Connector 6.

2-Channel RTC103 N-Module DO aeration stages control					
Module	**Name**	**Terminal**	**Signal**	**Channel**	**Function**
16 fold digital output[1]	KL2809	1	+24 V/0 V	1	Input Signals ok (24V), Input signal faulty (0V)
		2	+24 V/0 V	1	Aeration step 1 ON / OFF
		3	+24 V/0 V	1	Aeration step 2 ON / OFF
		4	+24 V/0 V	1	Aeration step 3 ON / OFF
		5	+24 V/0 V	1	Aeration step 4 ON / OFF
		6	+24 V/0 V	1	Aeration step 5 ON / OFF
		7	+24 V/0 V		Aeration step 6 ON / OFF
		8	+24 V/0 V		RTC Channel 1 operating (24V), RTC failure (0V)
		9	+24 V/0 V	2	Input Signals ok (24V), Input signal faulty (0V)
		10	+24 V/0 V	2	Aeration step 1 ON / OFF
		11	+24 V/0 V	2	Aeration step 2 ON / OFF
		12	+24 V/0 V	2	Aeration step 3 ON / OFF
		13	+24 V/0 V	2	Aeration step 4 ON / OFF
		14	+24 V/0 V	2	Aeration step 5 ON / OFF
		15	+24 V/0 V		Aeration step 6 ON / OFF
		16	+24 V/0 V		RTC Channel 2 operating (24V), RTC failure (0V)
2 fold analog output	KL4012	1 - 3	0/4 to 20 mA	1	Output DO set point lane 1
		5 - 7	0/4 to 20 mA	2	Output DO set point lane 2
1 fold analog intput	KL3011	1 - 2	0/4 to 20 mA	1	Flow rate aeration lane 1
1 fold analog input	KL3011	1 - 2	0/4 to 20 mA	2	Flow rate internal recirculation or return sludge lane 1
1 fold analog intput	KL3011	1 - 2	0/4 to 20 mA	1	Flow rate aeration lane 2
1 fold analog input	KL3011	1 - 2	0/4 to 20 mA	2	Flow rate internal recirculation or return sludge lane 2
Bus termination	KL9010				Bus termination

[1] Ground Connector 3 and 7, 24 V Connector 6.

1-Channel RTC103 N-Module connectors DO aeration stages / analog control					
Module	**Name**	**Terminal**	**Signal**	**Channel**	**Function**
8 fold digital output[1]	KL2408	1	+24 V/0 V		Input Signals ok (24V), Input signal faulty (0V)
		2	+24 V/0 V		Aeration step 1 ON / OFF (VFD)
		3	+24 V/0 V		Aeration step 2 ON / OFF (VFD)
		4	+24 V/0 V		Aeration step 3 ON / OFF
		5	+24 V/0 V		Aeration step 4 ON / OFF
		6	+24 V/0 V		Aeration step 5 ON / OFF
		7	+24 V/0 V		Aeration step 6 ON / OFF
		8	+24 V/0 V		RTC operating (24V), RTC failure (0V)
2 fold analog output	KL4012	1 - 3	0/4 to 20 mA		Output 1 VFD for DO control
		5 - 7	0/4 to 20 mA		Output 2 VFD for DO control
1 fold analog intput	KL3011	1 - 2	0/4 to 20 mA		Flow rate aeration lane
1 fold analog input	KL3011	1 - 2	0/4 to 20 mA		Flow rate internal recirculation
Bus termination	KL9010				Bus termination

[1] Ground Connector 3 and 7, 24 V Connector 6.

2-Channel RTC103 N-Module connectors DO aeration stages / analog control					
Module	**Name**	**Terminal**	**Signal**	**Channel**	**Function**
16 fold digital output[1]	KL2809	1	+24 V/0 V	1	Input Signals ok (24V), Input signal faulty (0V)
		2	+24 V/0 V	1	Aeration step 1 ON / OFF (VFD)
		3	+24 V/0 V	1	Aeration step 2 ON / OFF (VFD)
		4	+24 V/0 V	1	Aeration step 3 ON / OFF
		5	+24 V/0 V	1	Aeration step 4 ON / OFF
		6	+24 V/0 V	1	Aeration step 5 ON / OFF
		7	+24 V/0 V	1	Aeration step 6 ON / OFF
		8	+24 V/0 V	1	RTC Channel 1 operating (24V), RTC failure (0V)
		9	+24 V/0 V	2	Input Signals ok (24V), Input signal faulty (0V)
		10	+24 V/0 V	2	Aeration step 1 ON / OFF (VFD)
		11	+24 V/0 V	2	Aeration step 2 ON / OFF (VFD)
		12	+24 V/0 V	2	Aeration step 3 ON / OFF
		13	+24 V/0 V	2	Aeration step 4 ON / OFF
		14	+24 V/0 V	2	Aeration step 5 ON / OFF
		15	+24 V/0 V	2	Aeration step 6 ON / OFF
		16	+24 V/0 V	2	RTC Channel 2 operating (24V), RTC failure (0V)
2 fold analog output	KL4012		0/4 to 20 mA	1	Output 1 VFD for DO control
			0/4 to 20 mA	1	Output 2 VFD for DO control
2 fold analog output	KL4012		0/4 to 20 mA	2	Output 1 VFD for DO control
			0/4 to 20 mA	2	Output 2 VFD for DO control
1 fold analog intput	KL3011	1 - 2	0/4 to 20 mA	1	Flow rate aeration lane
1 fold analog input	KL3011	1 - 2	0/4 to 20 mA	1	Flow rate internal recirculation
1 fold analog intput	KL3011	1 - 2	0/4 to 20 mA	2	Flow rate aeration lane
1 fold analog input	KL3011	1 - 2	0/4 to 20 mA	2	Flow rate internal recirculation
Bus termination	KL9010				Bus termination

[1] Ground Connector 3 and 7, 24 V Connector 6.

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 55 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 RTC103 N-Module parameterization on sc1000 controller, page 21.

For 2-channel:
refer to 4.5 2-channel RTC103 N-Module parameterization on the sc1000 controller, page 32

4.4 1-Channel RTC103 N-Module parameterization on sc1000 controller

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

4.4.1 1-Channel RTC103 N-Module

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 45).	
N CONTROL		
SRT MODE	Three different types of operation regarding the aerobic Sludge Retention Time (SRT) can be selected: • **Manually**: The SRT is provided as a manual input to the controller • **SRT-RTC**: The SRT is provided by a separate SRT-RTC and forwarded to the RTC103 N-Module • **TSS mL**: The SRT is calculated based on the TSS concentration and the amount of TSS daily removed.	
SRT (MANUALLY)	Manual input for the SRT (also used as fallback value)	[days]
DAILY SURPLUS MASS	The amount of sludge daily removed from the process. Based on that amount, the MLSS concentration in the aeration tank and the aerated volume the SRT is calculated.	[kg/d]
COD-TKN RATIO	This is the assumed COD / TKN ratio. The N-RTC considers a certain COD-related amount of NH4-N to be incorporated in the bio mass, reducing the amount of NH4-N to be nitrified.	
MIN NITRIFERS CONC.	Based on the amount of NH4-N nitrified during the last SRT, the N-RTC calculates the concentration of nitrifiers in the activated sludge. This concentration is required to determine the DO set point. If the calculated concentration is lower than the MIN NITRIFERS CONC., the MIN NITRIFERS CONC. will be used to determine the DO set point.	[%]
MAX NITRIFERS CONC.	Based on the amount of NH4-N nitrified during the last SRT, the N-RTC calculates the concentration of nitrifiers in the activated sludge. This concentration is required to determine the DO set point. If the calculated concentration is higher than the MAX NITRIFERS CONC., the MAX NITRIFERS CONC.. will be used to determine the DO set point.	]%]
MODEL CORRECTION FACT.	This factor can be used to fine tune the DO concentration calculated by the model (feed forward part of the N-RTC).	
SUBSTIT. DO FOR MODEL	If there is a failure in any of the input signals (NH4-N, TSS, Flow) the N-RTC will apply this DO feed forward set point for all further calculations.	[mg/L]
NH4-N SETPOINT	Desired set point of the NH4-N concentration effluent aeration.	[mg/L]

4.4.1 1-Channel RTC103 N-Module (Continued)

RTC MODULES / PROGNOSYS			
RTC MODULES			
RTC			
	P FACT NH4	***Note:*** *These settings are only necessary if NH_4-N measurement in effluent for feed back control is available!* Proportional factor for the PID closed loop controller for the NH4-N concentration effluent aeration.	[1/mg/L]
	INTEGRAL TIME NH4	***Note:*** *These settings are only necessary if NH_4-N measurement in effluent for feed back control is available!* Integral time for the PID closed loop controller for the NH4-N concentration in the thickened sludge. ***Note:*** *INTEGRAL TIME NH4 is set to "0" to deactivate the integral part of the PID controller.*	[min]
	DERIVATIVE TIME NH4	***Note:*** *These settings are only necessary if NH_4-N measurement in effluent for feed back control is available!* Derivation time for the PID closed loop controller for the NH4-N concentration effluent aeration ***Note:*** *DERIVATIVE TIME NH4 is set to "0" to deactivate the derivative part of the PID controller.*	[min]
	LIMITS		
	MIN DO	If a calculated DO set point is lower than the MIN DO value, the DO set point is set to that value	[mg/L]
	MAX DO	If a calculated DO set point is higher than the MIN DO value, the DO set point is set to that value	[mg/L]
	SMOOTHING	Smoothing on the calculated DO set point	[min]
	INPUTS		
	MIN INFLOW	Minimum flow rate of influent according to measurement signal corresponding to 0/4mA	[L/s]
	MAX INFLOW	Maximum flow rate of influent according to measurement signal corresponding to 20mA	[L/s]
	0/4 to 20 mA	Transfer range of 0/4 to 20 mA current loop as set in connected flow measuring instrument.	

4.4.1 1-Channel RTC103 N-Module (Continued)

RTC MODULES / PROGNOSYS			
RTC MODULES			
RTC			
	MIN RECIRCULATION	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Minimum recirculation flow rate according to measurement signal corresponding to 0/4mA	[L/s]
	MAX RECIRCULATION	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Maximum recirculation flow rate of influent according to measurement signal corresponding to 20mA	[L/s]
	0/4 to 20 mA	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Transfer range of 0/4 to 20 mA current loop as set in connected flow measuring instrument. ***Note:*** *The input is not connected to the 0/4 to 20 mA has to be calculated in ratio to Qinflow.*	
	Q RECI RATIO	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* If the value Q RECI RATIO is “0” the RECI flow is calculated bases on the mA input signal. If the value is different from “0” the RECI flow is calculated from the inflow: Q RECI= Q RECI RATIO * INFLOW within the limits of MIN RECIRCULATION and MAX RECIRCULATION.	[%]
	MIN RETURN SLUDGE	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Minimum return sludge flow rate according to measurement signal corresponding to 0/4mA	[L/s]
	MAX RETURN SLUDGE	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Maximum return sludge flow rate of influent according to measurement signal corresponding to 20mA	[L/s]
	0/4 to 20 mA	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Transfer range of 0/4 to 20 mA current loop as set in connected flow measuring instrument.	
	Q RETURN RATIO	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* If the value Q RETURN RATIO is “0” the RAS flow is calculated bases on the mA input signal. If the value is different from “0” the RAS flow is calculated from the inflow: Q RETURN = Q RETURN RATIO * INFLOW within the limits of MIN RETURN SLUDGE and MAX RETURN SLUDGE.	[%]

4.4.1 1-Channel RTC103 N-Module (Continued)

RTC MODULES / PROGNOSYS		
RTC MODULES		
RTC		
OUTPUTS		
MIN DO SETTING	Minimum DO set point corresponding to 0/4mA	[mg/L]
MAX DO SETTING	Maximum DO set point corresponding to 20mA	[mg/L]
0/4 to 20 mA	Transfer range of 0/4 to 20 mA current loop as set in connected flow measuring instrument.	
VOLUME		
VOLUME	Aerated volume	[m^3]
MODBUS		
ADDRESS	Start address of an RTC within the MODBUS network.	
DATA ORDER	Specifies the register order within a double word. Presetting: NORMAL	
DATALOG INTRVAL	Indicates the interval in which the data is saved in the log file.	[min]
PROGNOSYS	Activate or deactivate PROGNOSYS for RTC control. "Activate" means if Measurement Indicator from relevant sensor decrease to 50% or lower RTC control do not use this measurement and switch to adequate fall back strategy.	
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 RTC103 N-Module Stages

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 45).	
N CONTROL		
SRT MODE	Three different types of operation regarding the aerobic Sludge Retention Time (SRT) can be selected: • **Manually**: The SRT is provided as a manual input to the controller • **SRT-RTC**: The SRT is provided by a separate SRT-RTC and forwarded to the RTC103 N-Module • **TSS mL**: The SRT is calculated based on the TSS concentration and the amount of TSS daily removed.	
SRT (MANUALLY)	Manual input for the SRT (also used as fallback value)	[days]
DAILY SURPLUS MASS	The amount of sludge daily removed from the process. Based on that amount, the MLSS concentration in the aeration tank and the aerated volume the SRT is calculated.	[kg/d]
COD-TKN RATIO	This is the assumed COD / TKN ratio. The N-RTC considers a certain COD-related amount of NH4-N to be incorporated in the bio mass, reducing the amount of NH4-N to be nitrified.	
MIN NITRIFERS CONC.	Based on the amount of NH4-N nitrified during the last SRT, the N-RTC calculates the concentration of nitrifiers in the activated sludge. This concentration is required to determine the DO set point. If the calculated concentration is lower than the MIN NITRIFERS CONC., the MIN NITRIFERS CONC. will be used to determine the DO set point.	[%]
MAX NITRIFERS CONC.	Based on the amount of NH4-N nitrified during the last SRT, the N-RTC calculates the concentration of nitrifiers in the activated sludge. This concentration is required to determine the DO set point. If the calculated concentration is higher than the MAX NITRIFERS CONC., the MAX NITRIFERS CONC.. will be used to determine the DO set point.	]%]

4.4.2 1-Channel RTC103 N-Module Stages (Continued)

RTC MODULES / PROGNOSYS			
RTC MODULES			
RTC			
	MODEL CORRECTION FACT.	This factor can be used on order to fine tune the DO concentration calculated by the model (feed forward part of the N-RTC).	
	SUBSTIT. DO FOR MODEL	If there is a failure in any of the input signals (NH4-N, TSS, Flow) the N-RTC will apply the this DO feed forward set point for all further calculation	[mg/L]
	NH4-N SETPOINT	Desired set point of the NH4-N concentration effluent aeration ***Note:*** *These settings are only necessary if NH4-N measurement in effluent for feed back control is available!*	[mg/L]
	P FACT NH4	Proportional factor for the PID closed loop controller for the NH4-N concentration effluent aeration.	[1/mg/L]
	INTEGRAL TIME NH4	Integral time for the PID closed loop controller for the NH4-N concentration in the thickened sludge. ***Note:*** *INTEGRAL TIME NH4 is set to "0" to deactivate the integral part of the PID controller.*	[min]
	DERIVATIVE TIME NH4	Derivation time for the PID closed loop controller for the NH4-N concentration effluent aeration ***Note:*** *DERIVATIVE TIME NH4 is set to "0" to deactivate the derivative part of the PID controller.*	[min]
	LIMITS		
	MIN DO	If a calculated DO set point is lower than the MIN DO value, the DO set point is set to that value	[mg/L]
	MAX DO	If a calculated DO set point is higher than the MIN DO value, the DO set point is set to that value	[mg/L]
	SMOOTHING	Smoothing on the calculated DO set point	[min]
	DO CONTROL		
	DERIVATIVE TIME	Derivative Time of DO controller	[min]
	DAMPING	Damping of DO control	[min]
	SUBST AERATION	If the DO sensor (e.g. LDO) signals a fault, the set aeration stage is selected	[Stage]
	NO. OF STAGES	Number of controlled aeration stages (maximun 6)	[Stage]
	VFD P MIN	fixed to 100%	[%]
	INPUTS		
	MIN INFLOW	Minimum flow rate of influent according to measurement signal corresponding to 0/4mA	[L/s]
	MAX INFLOW	Maximum flow rate of influent according to measurement signal corresponding to 20mA	[L/s]
	0/4 to 20 mA	Transfer range of 0/4 to 20 mA current loop as set in connected flow measuring instrument. ***Note:*** *0/4 to 20 mA input can be used either for Qreci or for Qras!*	

4.4.2 1-Channel RTC103 N-Module Stages (Continued)

RTC MODULES / PROGNOSYS			
RTC MODULES			
RTC			
	MIN RECIRCULATION	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Minimum recirculation flow rate according to measurement signal corresponding to 0/4mA	[L/s]
	MAX RECIRCULATION	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Maximum recirculation flow rate of influent according to measurement signal corresponding to 20mA	[L/s]
	0/4 to 20 mA	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Transfer range of 0/4 to 20 mA current loop as set in connected flow measuring instrument. ***Note:*** *The input is not connected to the 0/4 to 20 mA has to be calculated in ratio to Qinflow.*	
	Q RECI RATIO	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* If the value Q RECI RATIO is “0” the RECI flow is calculated bases on the mA input signal. If the value is different from “0” the RECI flow is calculated from the inflow: Q RECI= Q RECI RATIO * INFLOW within the limits of MIN RECIRCULATION and MAX RECIRCULATION.	[%]
	MIN RETURN SLUDGE	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Minimum return sludge flow rate according to measurement signal corresponding to 0/4mA	[L/s]
	MAX RETURN SLUDGE	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Maximum return sludge flow rate of influent according to measurement signal corresponding to 20mA	[L/s]
	0/4 to 20 mA	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Transfer range of 0/4 to 20 mA current loop as set in connected flow measuring instrument.	
	Q RETURN RATIO	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* If the value Q RETURN RATIO is “0” the RAS flow is calculated bases on the mA input signal. If the value is different from “0” the RAS flow is calculated from the inflow: Q RETURN = Q RETURN RATIO * INFLOW within the limits of MIN RETURN SLUDGE and MAX RETURN SLUDGE.	[%]
VOLUME			
	VOLUME	Aerated volume	[m^3]

4.4.3 1-Channel RTC103 N-Module VFD

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 45).	
N CONTROL		
SRT MODE	Three different types of operation regarding the aerobic Sludge Retention Time (SRT) can be selected: • **Manually**: The SRT is provided as a manual input to the controller • **SRT-RTC**: The SRT is provided by a separate SRT-RTC and forwarded to the RTC103 N-Module • **TSS mL**: The SRT is calculated based on the TSS concentration and the amount of TSS daily removed.	
SRT (MANUALLY)	Manual input for the SRT (also used as fallback value)	[days]
DAILY SURPLUS MASS	The amount of sludge daily removed from the process. Based on that amount, the MLSS concentration in the aeration tank and the aerated volume the SRT is calculated.	[kg/d]
COD-TKN RATIO	This is the assumed COD / TKN ratio. The N-RTC considers a certain COD-related amount of NH4-N to be incorporated in the bio mass, reducing the amount of NH4-N to be nitrified.	
MIN NITRIFERS CONC.	Based on the amount of NH4-N nitrified during the last SRT, the N-RTC calculates the concentration of nitrifiers in the activated sludge. This concentration is required to determine the DO set point. If the calculated concentration is lower than the MIN NITRIFERS CONC., the MIN NITRIFERS CONC. will be used to determine the DO set point.	[%]
MAX NITRIFERS CONC.	Based on the amount of NH4-N nitrified during the last SRT, the N-RTC calculates the concentration of nitrifiers in the activated sludge. This concentration is required to determine the DO set point. If the calculated concentration is higher than the MAX NITRIFERS CONC., the MAX NITRIFERS CONC.. will be used to determine the DO set point.	]%]
MODEL CORRECTION FACT.	This factor can be used on order to fine tune the DO concentration calculated by the model (feed forward part of the N-RTC).	
SUBSTIT. DO FOR MODEL	If there is a failure in any of the input signals (NH4-N, TSS, Flow) the N-RTC will apply the this DO feed forward set point for all further calculation	[mg/L]
NH4-N SETPOINT	Desired set point of the NH4-N concentration effluent aeration	[mg/L]

4.4.3 1-Channel RTC103 N-Module VFD (Continued)

RTC MODULES / PROGNOSYS			
RTC MODULES			
RTC			
	P FACT NH4	***Note:*** *These settings are only necessary if NH_4-N measurement in effluent for feed back control is available!* Proportional factor for the PID closed loop controller for the NH4-N concentration effluent aeration.	[1/mg/L]
	INTEGRAL TIME NH4	***Note:*** *These settings are only necessary if NH_4-N measurement in effluent for feed back control is available!* Integral time for the PID closed loop controller for the NH4-N concentration in the thickened sludge. ***Note:*** *INTEGRAL TIME NH4 is set to "0" to deactivate the integral part of the PID controller.*	[min]
	DERIVATIVE TIME NH4	***Note:*** *These settings are only necessary if NH_4-N measurement in effluent for feed back control is available!* Derivation time for the PID closed loop controller for the NH_4-N concentration effluent aeration ***Note:*** *DERIVATIVE TIME NH4 is set to "0" to deactivate the derivative part of the PID controller.*	[min]
LIMITS			
	MIN DO	If a calculated DO set point is lower than the MIN DO value, the DO set point is set to that value	[mg/L]
	MAX DO	If a calculated DO set point is higher than the MIN DO value, the DO set point is set to that value	[mg/L]
	SMOOTHING	Smoothing on the calculated DO set point	[min]
DO CONTROLL			
	P GAIN DO	Proportional factor for the PD closed loop controller for the DO concentrtion in the aeration.	[1/mg/L]
	DERIVATIVE TIME	Derivative Time of DO controller	[min]
	INT PART	Integral part for DO control	
	DAMPING	Damping of DO control	[min]
	SUBST AERATION	If the DO sensor (e.g. LDO) signals a fault, the set aeration stage is selected	[Stage]
	NO. OF STAGES	Number of controlled aeration stages (maximun 6)	[Stage]
	VFD P MIN	Set minimum speed for VFD controlled blowers (stage 1 and 2)	[%]
INPUTS			
	MIN INFLOW	Minimum flow rate of influent according to measurement signal corresponding to 0/4mA	[L/s]
	MAX INFLOW	Maximum flow rate of influent according to measurement signal corresponding to 20mA	[L/s]
	0/4 to 20 mA	Transfer range of 0/4 to 20 mA current loop as set in connected flow measuring instrument.	

4.4.3 1-Channel RTC103 N-Module VFD (Continued)

RTC MODULES / PROGNOSYS			
RTC MODULES			
RTC			
	MIN RECIRCULATION	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Minimum recirculation flow rate according to measurement signal corresponding to 0/4mA	[L/s]
	MAX RECIRCULATION	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Maximum recirculation flow rate of influent according to measurement signal corresponding to 20mA	[L/s]
	0/4 to 20 mA	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Transfer range of 0/4 to 20 mA current loop as set in connected flow measuring instrument. ***Note:*** *The input is not connected to the 0/4 to 20 mA has to be calculated in ratio to Qinflow.*	
	Q RECI RATIO	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* If the value Q RECI RATIO is “0” the RECI flow is calculated bases on the mA input signal. If the value is different from “0” the RECI flow is calculated from the inflow: Q RECI= Q RECI RATIO * INFLOW within the limits of MIN RECIRCULATION and MAX RECIRCULATION.	[%]
	MIN RETURN SLUDGE	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Minimum return sludge flow rate according to measurement signal corresponding to 0/4mA	[L/s]
	MAX RETURN SLUDGE	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Maximum return sludge flow rate of influent according to measurement signal corresponding to 20mA	[L/s]
	0/4 to 20 mA	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Transfer range of 0/4 to 20 mA current loop as set in connected flow measuring instrument.	
	Q RETURN RATIO	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* If the value Q RETURN RATIO is “0” the RAS flow is calculated bases on the mA input signal. If the value is different from “0” the RAS flow is calculated from the inflow: Q RETURN = Q RETURN RATIO * INFLOW within the limits of MIN RETURN SLUDGE and MAX RETURN SLUDGE.	[%]
OUTPUTS			
	0/4 to 20 mA	Analog outputs to control VFD blowers. Transfer range of 0/4 to 20 mA current loop	
VOLUME			
	VOLUME	Aerated volume	[m^3]

4.4.3 1-Channel RTC103 N-Module VFD (Continued)

RTC MODULES / PROGNOSYS		
RTC MODULES		
RTC		
MODBUS		
ADDRESS	Start address of an RTC within the MODBUS network.	
DATA ORDER	Specifies the register order within a double word. Presetting: NORMAL	
DATALOG INTRVAL	Indicates the interval in which the data is saved in the log file.	[min]
PROGNOSYS	Activate or deactivate PROGNOSYS for RTC control. "Activate" means if Measurement Indicator from relevant sensor decrease to 50% or lower RTC control do not use this measurement and switch to adequate fall back strategy.	
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.	

4.5 2-channel RTC103 N-Module parameterization on the sc1000 controller

In addition to the 1-channel version, there is also a 2-channel version that can control two activated sludge tanks. The relevant parameters therefore appear twice and are identified as channel 1 and channel 2.

4.5.1 2-Channel RTC103 N-Module

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 45).	
N CONTROL		
SRT MODE	Three different types of operation regarding the aerobic Sludge Retention Time (SRT) can be selected: • **Manually**: The SRT is provided as a manual input to the controller • **SRT-RTC**: The SRT is provided by a separate SRT-RTC and forwarded to the RTC103 N-Module • **TSS mL**: The SRT is calculated based on the TSS concentration and the amount of TSS daily removed.	
SRT (MANUALLY)	Manual input for the SRT (also used as fallback value)	[days]
DAILY SURPLUS MASS	The amount of sludge daily removed from the process. Based on that amount, the MLSS concentration in the aeration tank and the aerated volume the SRT is calculated.	[kg/d]
COD-TKN RATIO	This is the assumed COD / TKN ratio. The N-RTC considers a certain COD-related amount of NH4-N to be incorporated in the bio mass, reducing the amount of NH4-N to be nitrified.	
MIN NITRIFERS CONC.	Based on the amount of NH4-N nitrified during the last SRT, the N-RTC calculates the concentration of nitrifiers in the activated sludge. This concentration is required to determine the DO set point. If the calculated concentration is lower than the MIN NITRIFERS CONC., the MIN NITRIFERS CONC. will be used to determine the DO set point.	[%]
MAX NITRIFERS CONC.	Based on the amount of NH4-N nitrified during the last SRT, the N-RTC calculates the concentration of nitrifiers in the activated sludge. This concentration is required to determine the DO set point. If the calculated concentration is higher than the MAX NITRIFERS CONC., the MAX NITRIFERS CONC.. will be used to determine the DO set point.	]%]

4.5.1 2-Channel RTC103 N-Module (Continued)

RTC MODULES / PROGNOSYS			
RTC MODULES			
RTC			
	MODEL CORRECTION FACT.	This factor can be used to fine tune the DO concentration calculated by the model (feed forward part of the N-RTC).	
	SUBSTIT. DO FOR MODEL	If there is a failure in any of the input signals (NH4-N, TSS, Flow) the N-RTC will apply this DO feed forward set point for all further calculations.	[mg/L]
	NH4-N SETPOINT	Desired set point of the NH4-N concentration effluent aeration	[mg/L]
	P FACT NH4	***Note:*** *These settings are only necessary if NH_4-N measurement in effluent for feed back control is available!* Proportional factor for the PID closed loop controller for the NH4-N concentration effluent aeration.	[1/mg/L]
	INTEGRAL TIME NH4	***Note:*** *These settings are only necessary if NH_4-N measurement in effluent for feed back control is available!* Integral time for the PID closed loop controller for the NH4-N concentration in the thickened sludge. ***Note:*** *INTEGRAL TIME NH4 is set to "0" to deactivate the integral part of the PID controller.*	[min]
	DERIVATIVE TIME NH4	***Note:*** *These settings are only necessary if NH_4-N measurement in effluent for feed back control is available!* Derivation time for the PID closed loop controller for the NH_4-N concentration effluent aeration ***Note:*** *DERIVATIVE TIME NH4 is set to "0" to deactivate the derivative part of the PID controller.*	[min]
	LIMITS		
	MIN DO	If a calculated DO set point is lower than the MIN DO value, the DO set point is set to that value	[mg/L]
	MAX DO	If a calculated DO set point is higher than the MIN DO value, the DO set point is set to that value	[mg/L]
	SMOOTHING	Smoothing on the calculated DO set point	[min]
INPUTS			
	CHANNEL 1		
	MIN INFLOW	Minimum flow rate of influent according to measurement signal corresponding to 0/4mA	[L/s]
	MAX INFLOW	Maximum flow rate of influent according to measurement signal corresponding to 20mA	[L/s]
	0/4 to 20 mA	Transfer range of 0/4 to 20 mA current loop as set in connected flow measuring instrument.	

4.5.1 2-Channel RTC103 N-Module (Continued)

RTC MODULES / PROGNOSYS			
RTC MODULES			
RTC			
	MIN RECIRCULATION	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Minimum recirculation flow rate according to measurement signal corresponding to 0/4mA	[L/s]
	MAX RECIRCULATION	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Maximum recirculation flow rate of influent according to measurement signal corresponding to 20mA	[L/s]
	0/4 to 20 mA	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Transfer range of 0/4 to 20 mA current loop as set in connected flow measuring instrument. ***Note:*** *The input is not connected to the 0/4 to 20 mA has to be calculated in ratio to Qinflow.*	
	Q RECI RATIO	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* If the value Q RECI RATIO is “0” the RECI flow is calculated bases on the mA input signal. If the value is different from “0” the RECI flow is calculated from the inflow: Q RECI= Q RECI RATIO * INFLOW within the limits of MIN RECIRCULATION and MAX RECIRCULATION.	[%]
	MIN RETURN SLUDGE	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Minimum return sludge flow rate according to measurement signal corresponding to 0/4mA	[L/s]
	MAX RETURN SLUDGE	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Maximum return sludge flow rate of influent according to measurement signal corresponding to 20mA	[L/s]
	0/4 to 20 mA	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Transfer range of 0/4 to 20 mA current loop as set in connected flow measuring instrument.	
	Q RETURN RATIO	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* If the value Q RETURN RATIO is “0” the RAS flow is calculated bases on the mA input signal. If the value is different from “0” the RAS flow is calculated from the inflow: Q RETURN = Q RETURN RATIO * INFLOW within the limits of MIN RETURN SLUDGE and MAX RETURN SLUDGE.	[%]
CHANNEL 2		same as CHANNEL 1	

4.5.1 2-Channel RTC103 N-Module (Continued)

RTC MODULES / PROGNOSYS		
RTC MODULES		
RTC		
OUTPUTS		
CHANNEL 1		
MIN DO SETTING	Minimum DO set point corresponding to 0/4mA	[mg/L]
MAX DO SETTING	Maximum DO set point corresponding to 20mA	[mg/L]
0/4 to 20 mA	Transfer range of 0/4 to 20 mA current loop as set in connected flow measuring instrument.	
CHANNEL 2	same as CHANNEL 1	
VOLUME		
CHANNEL 1		
VOLUME	Aerated volume	[m^3]
CHANNEL 2	same as CHANNEL 1	
MODBUS		
ADDRESS	Start address of an RTC within the MODBUS network.	
DATA ORDER	Specifies the register order within a double word. Presetting: NORMAL	
DATALOG INTRVAL	Indicates the interval in which the data is saved in the log file.	[min]
PROGNOSYS	Activate or deactivate PROGNOSYS for RTC control. "Activate" means if Measurement Indicator from relevant sensor decrease to 50% or lower RTC control do not use this measurement and switch to adequate fall back strategy.	
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.	

4.5.2 2-Channel RTC103 N-Module Stages

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 45).	
N CONTROL		
SRT MODE	Three different types of operation regarding the aerobic Sludge Retention Time (SRT) can be selected: • **Manually**: The SRT is provided as a manual input to the controller • **SRT-RTC**: The SRT is provided by a separate SRT-RTC and forwarded to the RTC103 N-Module • **TSS mL**: The SRT is calculated based on the TSS concentration and the amount of TSS daily removed.	
SRT (MANUALLY)	Manual input for the SRT (also used as fallback value)	[days]
DAILY SURPLUS MASS	The amount of sludge daily removed from the process. Based on that amount, the MLSS concentration in the aeration tank and the aerated volume the SRT is calculated.	[kg/d]
COD-TKN RATIO	This is the assumed COD / TKN ratio. The N-RTC considers a certain COD-related amount of NH4-N to be incorporated in the bio mass, reducing the amount of NH4-N to be nitrified.	
MIN NITRIFERS CONC.	Based on the amount of NH4-N nitrified during the last SRT, the N-RTC calculates the concentration of nitrifiers in the activated sludge. This concentration is required to determine the DO set point. If the calculated concentration is lower than the MIN NITRIFERS CONC., the MIN NITRIFERS CONC. will be used to determine the DO set point.	[%]
MAX NITRIFERS CONC.	Based on the amount of NH4-N nitrified during the last SRT, the N-RTC calculates the concentration of nitrifiers in the activated sludge. This concentration is required to determine the DO set point. If the calculated concentration is higher than the MAX NITRIFERS CONC., the MAX NITRIFERS CONC.. will be used to determine the DO set point.	]%]

4.5.2 2-Channel RTC103 N-Module Stages (Continued)

RTC MODULES / PROGNOSYS			
RTC MODULES			
RTC			
	MODEL CORRECTION FACT.	This factor can be used on order to fine tune the DO concentration calculated by the model (feed forward part of the N-RTC).	
	SUBSTIT. DO FOR MODEL	If there is a failure in any of the input signals (NH4-N, TSS, Flow) the N-RTC will apply the this DO feed forward set point for all further calculation	[mg/L]
	NH4-N SETPOINT	Desired set point of the NH4-N concentration effluent aeration	[mg/L]
	P FACT NH4	***Note:*** *These settings are only necessary if NH_4-N measurement in effluent for feed back control is available!* Proportional factor for the PID closed loop controller for the NH4-N concentration effluent aeration.	[1/mg/L]
	INTEGRAL TIME NH4	***Note:*** *These settings are only necessary if NH_4-N measurement in effluent for feed back control is available!* Integral time for the PID closed loop controller for the NH4-N concentration in the thickened sludge. ***Note:*** *INTEGRAL TIME NH4 is set to "0" to deactivate the integral part of the PID controller.*	[min]
	DERIVATIVE TIME NH4	***Note:*** *These settings are only necessary if NH_4-N measurement in effluent for feed back control is available!* Derivation time for the PID closed loop controller for the NH_4-N concentration effluent aeration ***Note:*** *DERIVATIVE TIME NH4 is set to "0" to deactivate the derivative part of the PID controller.*	[min]
	LIMITS		
	MIN DO	If a calculated DO set point is lower than the MIN DO value, the DO set point is set to that value	[mg/L]
	MAX DO	If a calculated DO set point is higher than the MIN DO value, the DO set point is set to that value	[mg/L]
	SMOOTHING	Smoothing on the calculated DO set point	[min]
DO CONTROL			
	CHANNEL 1		
	DERIVATIVE TIME	Derivative Time of DO controller	[min]
	DAMPING	Damping of DO control	[min]
	SUBST AERATION	If the DO sensor (e.g. LDO) signals a fault, the set aeration stage is selected	[Stage]
	NO. OF STAGES	Number of controlled aeration stages (maximun 6)	[Stage]
	VFD P MIN	fixed to 100%	[%]
	CHANNEL 2	same as CHANNEL 1	

4.5.2 2-Channel RTC103 N-Module Stages (Continued)

RTC MODULES / PROGNOSYS		
RTC MODULES		
RTC		
INPUTS		
CHANNEL 1		
MIN INFLOW	Minimum flow rate of influent according to measurement signal corresponding to 0/4mA	[L/s]
MAX INFLOW	Maximum flow rate of influent according to measurement signal corresponding to 20mA	[L/s]
0/4 to 20 mA	Transfer range of 0/4 to 20 mA current loop as set in connected flow measuring instrument.	
MIN RECIRCULATION	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Minimum recirculation flow rate according to measurement signal corresponding to 0/4mA	[L/s]
MAX RECIRCULATION	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Maximum recirculation flow rate of influent according to measurement signal corresponding to 20mA	[L/s]
0/4 to 20 mA	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Transfer range of 0/4 to 20 mA current loop as set in connected flow measuring instrument. ***Note:*** *The input is not connected to the 0/4 to 20 mA has to be calculated in ratio to Qinflow.*	
Q RECI RATIO	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* If the value Q RECI RATIO is “0” the RECI flow is calculated bases on the mA input signal. If the value is different from “0” the RECI flow is calculated from the inflow: Q RECI= Q RECI RATIO * INFLOW within the limits of MIN RECIRCULATION and MAX RECIRCULATION.	[%]
MIN RETURN SLUDGE	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Minimum return sludge flow rate according to measurement signal corresponding to 0/4mA	[L/s]
MAX RETURN SLUDGE	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Maximum return sludge flow rate of influent according to measurement signal corresponding to 20mA	[L/s]
0/4 to 20 mA	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Transfer range of 0/4 to 20 mA current loop as set in connected flow measuring instrument.	

4.5.2 2-Channel RTC103 N-Module Stages (Continued)

RTC MODULES / PROGNOSYS			
RTC MODULES			
RTC			
	Q RETURN RATIO	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* If the value Q RETURN RATIO is “0” the RAS flow is calculated bases on the mA input signal. If the value is different from “0” the RAS flow is calculated from the inflow: Q RETURN = Q RETURN RATIO * INFLOW within the limits of MIN RETURN SLUDGE and MAX RETURN SLUDGE.	[%]
	CHANNEL 2	same as CHANNEL 1	
VOLUME			
	CHANNEL 1		
	VOLUME	Aerated volume	[m^3]
	CHANNEL 2	same as CHANNEL 1	

4.5.3 2-Channel RTC103 N-Module VFD

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 45).	
	N CONTROL		

4.5.3 2-Channel RTC103 N-Module VFD (Continued)

RTC MODULES / PROGNOSYS

RTC MODULES

RTC

SRT MODE	Three different types of operation regarding the aerobic Sludge Retention Time (SRT) can be selected: • **Manually**: The SRT is provided as a manual input to the controller • **SRT-RTC**: The SRT is provided by a separate SRT-RTC and forwarded to the RTC103 N-Module • **TSS mL**: The SRT is calculated based on the TSS concentration and the amount of TSS daily removed.	
SRT (MANUALLY)	Manual input for the SRT (also used as fallback value)	[days]
DAILY SURPLUS MASS	The amount of sludge daily removed from the process. Based on that amount, the MLSS concentration in the aeration tank and the aerated volume the SRT is calculated.	[kg/d]
COD-TKN RATIO	This is the assumed COD / TKN ratio. The N-RTC considers a certain COD-related amount of NH4-N to be incorporated in the bio mass, reducing the amount of NH4-N to be nitrified.	
MIN NITRIFERS CONC.	Based on the amount of NH4-N nitrified during the last SRT, the N-RTC calculates the concentration of nitrifiers in the activated sludge. This concentration is required to determine the DO set point. If the calculated concentration is lower than the MIN NITRIFERS CONC., the MIN NITRIFERS CONC. will be used to determine the DO set point.	[%]
MAX NITRIFERS CONC.	Based on the amount of NH4-N nitrified during the last SRT, the N-RTC calculates the concentration of nitrifiers in the activated sludge. This concentration is required to determine the DO set point. If the calculated concentration is higher than the MAX NITRIFERS CONC., the MAX NITRIFERS CONC.. will be used to determine the DO set point.	]%]

4.5.3 2-Channel RTC103 N-Module VFD (Continued)

RTC MODULES / PROGNOSYS			
RTC MODULES			
RTC			
	MODEL CORRECTION FACT.	This factor can be used on order to fine tune the DO concentration calculated by the model (feed forward part of the N-RTC).	
	SUBSTIT. DO FOR MODEL	If there is a failure in any of the input signals (NH4-N, TSS, Flow) the N-RTC will apply the this DO feed forward set point for all further calculation	[mg/L]
	NH4-N SETPOINT	Desired set point of the NH4-N concentration effluent aeration	[mg/L]
	P FACT NH4	***Note:*** *These settings are only necessary if NH_4-N measurement in effluent for feed back control is available!* Proportional factor for the PID closed loop controller for the NH4-N concentration effluent aeration.	[1/mg/L]
	INTEGRAL TIME NH4	***Note:*** *These settings are only necessary if NH_4-N measurement in effluent for feed back control is available!* Integral time for the PID closed loop controller for the NH4-N concentration in the thickened sludge. ***Note:*** *INTEGRAL TIME NH4 is set to "0" to deactivate the integral part of the PID controller.*	[min]
	DERIVATIVE TIME NH4	***Note:*** *These settings are only necessary if NH_4-N measurement in effluent for feed back control is available!* Derivation time for the PID closed loop controller for the NH_4-N concentration effluent aeration ***Note:*** *DERIVATIVE TIME NH4 is set to "0" to deactivate the derivative part of the PID controller.*	[min]
	LIMITS		
	MIN DO	If a calculated DO set point is lower than the MIN DO value, the DO set point is set to that value	[mg/L]
	MAX DO	If a calculated DO set point is higher than the MIN DO value, the DO set point is set to that value	[mg/L]
	SMOOTHING	Smoothing on the calculated DO set point	[min]
DO CONTROLL			
	CHANNEL 1		
	P GAIN DO	Proportional factor for the PD closed loop controller for the DO concentrtion in the aeration.	[1/mg/L]
	DERIVATIVE TIME	Derivative Time of DO controller	[min]
	INT PART	Integral part for DO control	
	DAMPING	Damping of DO control	[min]
	SUBST AERATION	If the DO sensor (e.g. LDO) signals a fault, the set aeration stage is selected	[Stage]
	NO. OF STAGES	Number of controlled aeration stages (maximun 6)	[Stage]
	VFD P MIN	Set minimum speed for VFD controlled blowers (stage 1 and 2)	[%]
	CHANNEL 2	same as CHANNEL 1	

4.5.3 2-Channel RTC103 N-Module VFD (Continued)

RTC MODULES / PROGNOSYS		
RTC MODULES		
RTC		
INPUTS		
CHANNEL 1		
MIN INFLOW	Minimum flow rate of influent according to measurement signal corresponding to 0/4mA	[L/s]
MAX INFLOW	Maximum flow rate of influent according to measurement signal corresponding to 20mA	[L/s]
0/4 to 20 mA	Transfer range of 0/4 to 20 mA current loop as set in connected flow measuring instrument.	
MIN RECIRCULATION	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Minimum recirculation flow rate according to measurement signal corresponding to 0/4mA	[L/s]
MAX RECIRCULATION	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Maximum recirculation flow rate of influent according to measurement signal corresponding to 20mA	[L/s]
0/4 to 20 mA	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Transfer range of 0/4 to 20 mA current loop as set in connected flow measuring instrument. ***Note:*** *The input is not connected to the 0/4 to 20 mA has to be calculated in ratio to Qinflow.*	
Q RECI RATIO	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* If the value Q RECI RATIO is “0” the RECI flow is calculated bases on the mA input signal. If the value is different from “0” the RECI flow is calculated from the inflow: Q RECI= Q RECI RATIO * INFLOW within the limits of MIN RECIRCULATION and MAX RECIRCULATION.	[%]
MIN RETURN SLUDGE	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Minimum return sludge flow rate according to measurement signal corresponding to 0/4mA	[L/s]
MAX RETURN SLUDGE	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Maximum return sludge flow rate of influent according to measurement signal corresponding to 20mA	[L/s]
0/4 to 20 mA	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* Transfer range of 0/4 to 20 mA current loop as set in connected flow measuring instrument.	

4.5.3 2-Channel RTC103 N-Module VFD (Continued)

RTC MODULES / PROGNOSYS		
RTC MODULES		
RTC		
Q RETURN RATIO	***Note:*** *0/4 to20 mA input can be used either for Qreci or for Qras.* If the value Q RETURN RATIO is “0” the RAS flow is calculated bases on the mA input signal. If the value is different from “0” the RAS flow is calculated from the inflow: Q RETURN = Q RETURN RATIO * INFLOW within the limits of MIN RETURN SLUDGE and MAX RETURN SLUDGE.	[%]
CHANNEL 2	same as CHANNEL 1	
OUTPUTS		
CHANNEL 1		
0/4 to 20 mA	Analog outputs to control VFD blowers. Transfer range of 0/4 to 20 mA current loop	
CHANNEL 2	same as CHANNEL 1	
VOLUME		
CHANNEL 1		
VOLUME	Aerated volume	[m^3]
CHANNEL 2		
MODBUS		
ADDRESS	Start address of an RTC within the MODBUS network.	
DATA ORDER	Specifies the register order within a double word. Presetting: NORMAL	
DATALOG INTRVAL	Indicates the interval in which the data is saved in the log file.	[min]
PROGNOSYS	Activate or deactivate PROGNOSYS for RTC control. "Activate" means if Measurement Indicator from relevant sensor decrease to 50% or lower RTC control do not use this measurement and switch to adequate fall back strategy.	
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.	

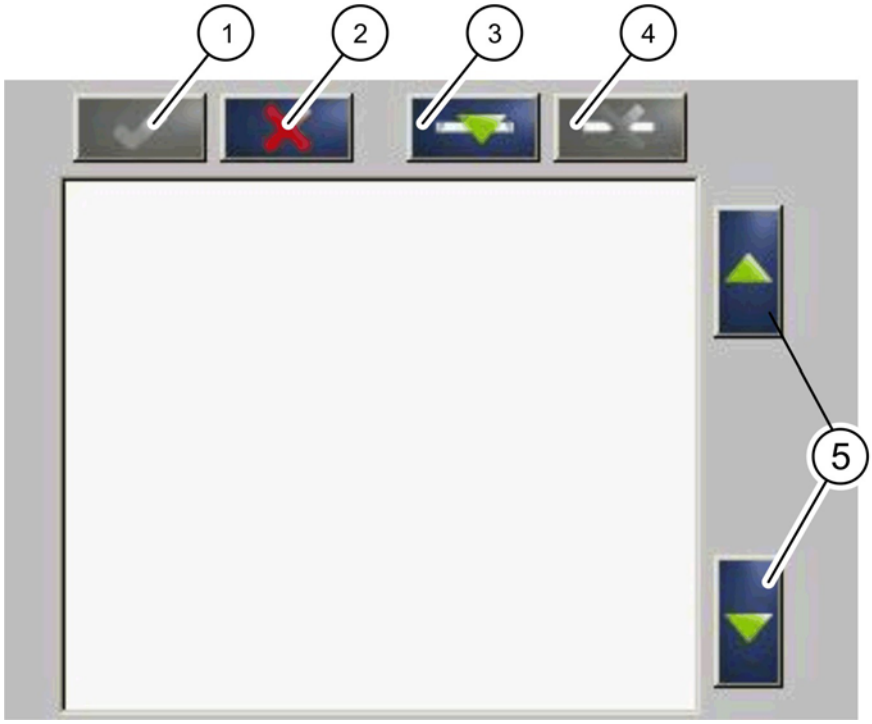
4.5.3 2-Channel RTC103 N-Module VFD (Continued)

RTC MODULES / PROGNOSYS		
RTC MODULES		
RTC		
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.	

4.6 Select sensors

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

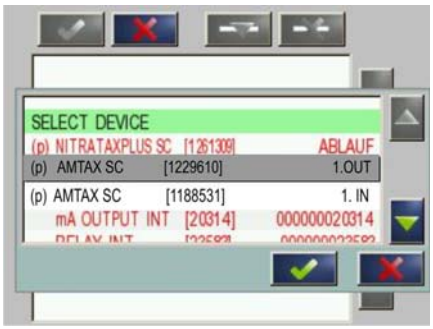
Figure 4 Select sensor



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).

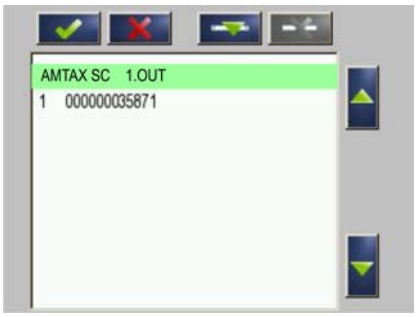
   A selection list of all subscribers to the sc1000 network opens.



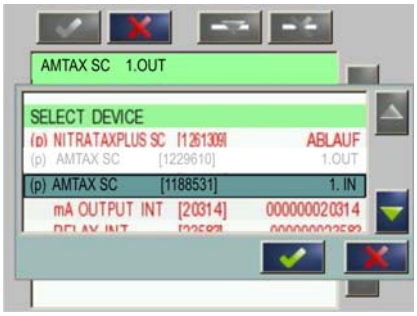
3. Press the required sensor for the RTC module and confirm by pressing **ENTER** below the selection list.

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).*



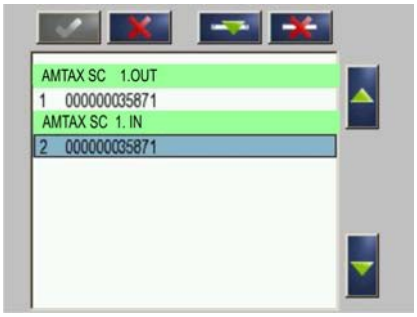
4. The selected sensor is shown in the sensor list.
Press **ADD** (Figure 4, item 3) to open the selection list again.



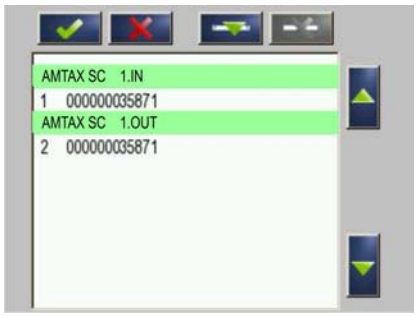
5. Select the second sensor for the RTC module and confirm by pressing **ENTER** below the selection list.

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.

Note: *The order of selected sensors has to be defined and pre-configured by Service of Supplier on CF-card of RTC103 N-Module.*

4.7 Control programs

To adapt to local circumstances and the instruments available, there are 4 different programs available for calculating desired DO concentration for nitrification

The choice of program depends on the available measurement signals.

Suitable program has to be selected and pre-configurated on CF card from RTC103 N-Module by the Service of supplier!

Table 2 Control programs to calculate the desired DO concentration for nitrification

NH4-N influent nitrification	Calculate desired DO concentration based on NH_4-N load to nitrification, only.
NH4-N influent and TSS	Calculate desired DO concentration based on NH_4-N load considering the current Sludge retention time
NH4-N influent and NH4-N effluent	Caluclate desired DO concentration based on NH_4-N load to nitrification and NH_4-N effluent concentration.
NH4-N influent, NH4-N effluent and TSS	Caluclate desired DO concentration based on NH_4-N load to nitrification and NH_4-N effluent concentration considering the current Sludge retention time.

4.8 Automatic program change

If a measurement signal fails, e. g. during an operational fault, an automatic program change occurs using only the available measuring signals and replaces the failing measurement by this fallback strategy. 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 controller parameters

4.9.1 SRT MODE

Three different types of operation regarding the Sludge Retention Time (SRT) can be selected

- **MANUALLY:** The SRT is provided as a manual input to the controller, if no TSS measurement is available in aeration tank.
- **SRT-RTC:** The SRT is provided by a separate SRT-RTC and forwarded to the RTC103 N-Module.
- **TSSml:** The SRT is calculated based on MLSS concentration and the amount of daily removed TSS mass.

4.9.2 SRT (MANUALLY)

Manual input for the Sludge Retention Time (SRT [d]).

In case of a failing TSS signal, this is also used as fallback value.

4.9.3 DAILY SURPLUS MASS

The amount of sludge daily removed from the process. Based on that amount, the MLSS concentration in the aeration tank and the aerated volume the SRT is calculated.

4.9.4 COD-TKN RATIO

This is the assumed COD / TKN ratio. The RTC103 N-Module considers a certain COD-related amount of NH_4-N to be incorporated in the bio mass, reducing the amount of NH_4-N to be nitrified.

4.9.5 MIN NITRIFERS CONC.

Based on the amount of NH_4-N nitrified during the last SRT, the RTC103 N-Module calculates the concentration of nitrifiers in the activated sludge. This concentration is required to determine the DO set point. If the calculated concentration is lower than the MIN NITRIFERS CONC., the MIN NITRIFERS CONC. will be used to determine the DO set point.

4.9.6 MAX NITRIFERS CONC.

Based on the amount of NH_4-N nitrified during the last SRT, the RTC103 N-Module calculates the concentration of nitrifiers in the activated sludge. This concentration is required to determine the DO set point. If the calculated concentration is higher than the MAX NITRIFERS CONC., the MAX NITRIFERS CONC.. will be used to determine the DO set point.

4.9.7 MODEL CORRECTION FACT.

This factor can be used on order to fine tune the DO concentration calculated by the model (feed forward part of the RTC103 N-Module).

4.9.8 SUBSTIT. DO FOR MODEL

If there is a failure in the input signals (NH_4-N, TSS, Flow) and the RTC103 N-Module is not able to calculate the required DO concentration, the RTC103 N-Module will apply this DO feed forward set point for all further calculation.

4.9.9 NH4-N SETPOINT

Desired set point of the NH_4-N concentration effluent aeration.

4.9.10 P FAKT NH4 (only if NH_4-N measurement in effluent is available for feed back control)

Proportional factor for the PD closed loop controller for the NH_4-N concentration effluent aeration.

4.9.11 INTEGRAL TIME NH4 (only if NH_4-N measurement in effluent is available for feed back control)

Integral time for the PID closed loop controller for the NH_4-N concentration in the thickened sludge.

Note: *INTEGRAL TIME NH4 is set to "0" to deactivate the integral part of the PID controller.*

4.9.12 DERIVATIVE TIME NH4 (only if NH_4-N measurement in effluent is available for feed back control)

Derivation time for the PID closed loop controller for the NH_4-N concentration effluent aeration.

Note: *DERIVATIVE TIME NH4 is set to "0" to deactivate the derivative part of the PID controller.*

4.9.13 Min DO

If a calculated DO set point is lower than the MIN DO value, the DO set point is set to that value.

4.9.14 Max DO

If a calculated DO set point is higher than the MIN DO value, the DO set point is set to that value.

4.9.15 SMOOTHING

Smooth this calculated DO set-point, for more economical blower control.

4.10 Explanations of DO CONTROL (For DO control option only)

Note: *The configuration for DO control, different kind of blowers, aeration stages has to be carefully pre-configured from service of supplier on CF-card of RTC103 N-Module.*

4.10.1 P FAKT O2 (For VFD option only)

Proportional factor for the PD closed loop controller for the DO concentration in the aeration.

4.10.2 DERIVATIVE TIME

Derivative time of the controller

4.10.3 INT PART

Integral part for the closed loop controller for the DO concentration in the aeration.

Note: *INT PART is set to "0" to deactivate the integral part of the controller.*

4.10.4 DAMPING

Damping of DO control - for avoiding quick changes in blowers control.

4.10.5 SUBST AERATION

If the oxygen sensor (e.g. LDO) signals a fault, the set aeration stage is selected (stages 1 to 6).

4.10.6 NUMBER OF STAGES

Number of controlled aeration stages (maximum 6).

4.10.7 VFD P MIN (For DO control without VFD option this is fixed to 100%)

Set minimum speed [%] for VFD controlled blowers.

4.11 INPUTS

There are available two mA input connector for each channel. The first is the flowrate signal (inlet or effluent of plant or lane).

The second is for the recirculation flow rate or the return sludge flow rate, depending on which is available and not travelled in ratio to the inlet/outlet flow rate.

4.11.1 MIN INFLOW

Minimum flow rate of influent according to measurement signal corresponding to 0/4mA

4.11.2 MAX INFLOW

Maximum flow rate of influent according to measurement signal corresponding to 20mA

4.11.3 0/4 to 20mA

Transfer range of 0/4 to 20mA current loop as set in connected flow measuring instrument.

4.11.4 MIN RECIRCULATION

Minimum recirculation flow rate according to measurement signal corresponding to 0/4mA.

4.11.5 MAX RECIRCULATION

Maximum recirculation flow rate of influent according to measurement signal corresponding to 20mA.

4.11.6 0/4 to 20mA

Transfer range of 0/4 to 20mA current loop as set in connected flow measuring instrument.

4.11.7 Q RECI RATIO

If the value Q RECI RATIO is “0” the RECI flow is calculated bases on the mA input signal. If the value is different from “0” the RECI flow is calculated from the inflow:
Q RECI= Q RECI RATIO * INFLOW
within the limits of MIN RECIRCULATION and MAX RECIRCULATION.

4.11.8 MIN RETURN SLUDGE

Minimum return sludge flow rate according to measurement signal corresponding to 0/4mA.

4.11.9 MAX RETURN SLUDGE

Maximum return sludge flow rate of influent according to measurement signal corresponding to 20mA.

4.11.10 0/4 to 20mA

Transfer range of 0/4 to 20mA current loop as set in connected flow measuring instrument.

4.11.11 Q RETURN RATIO

If the value Q RETURN RATIO is “0” the RAS flow is calculated bases on the mA input signal. If the value is different from “0” the RAS flow is calculated from the inflow:
Q RETURN = Q RETURN RATIO * INFLOW
within the limits of MIN RETURN SLUDGE and MAX RETURN SLUDGE.

4.12 OUTPUTS

4.12.1 MIN DO SETTING (only for option without DO control)

Minimum DO set point corresponding to 0/4mA.

4.12.2 MAX DO SETTING (only for option without DO control)

Maximum DO set point corresponding to 20mA.

4.12.3 0/4 to 20mA

Transfer range of 0/4 to 20mA current loop

- without DO control: for DO setpoint signal.
- with VFD DO control: for VFD blowers signal.

4.13 Volume

4.13.1 Aerated volume

Size of aerated basin (or zone) in m^3.

4.14 MODBUS

4.14.1 ADDRESS

Start address of an RTC within the modbus network.

4.14.2 DATAORDER

Specifies the register order within a double word.

Presetting: NORMAL

4.15 Displayed measurement values and variables

The following measurement values and variables are shown on the SC1000 display and transferred via fieldbus.

	Parameter	Unit	Description	Note
RTC103 N-Module, 1-channel				
MEASUREMEN 1	Qin 1	L/s	Flow rate aeration lane	
MEASUREMEN 2	Qrec 1	L/s	Flow rate internal recirculation or return sludge	
ACTUAT VAR 3	NffO 1	mg/L	DO demand calculated for influent NH_4-N load	
ACTUAT VAR 4	NfbO 1	mg/L	Additional DO demand calculated from NH_4-N effluent concentration	always 0 if no effluent NH_4-N measurement available
ACTUAT VAR 5	Osetp 1	mg/L	DO Setpoint calculated from sum NffO + NfbO	
ACTUAT VAR 6	Oreg 1		Internal calculation value for DO control	always 0 if RTC103 N without DO control
ACTUAT VAR 7	B_S 1	Stage	Aeration stage (B_S1)	always 0 if RTC103 N without DO control
ACTUAT VAR 8	A_S 1	%	Aeration VFD (A_S 1)	always 0 if RTC103 N without DO control
RTC103 N-Module, 2-channel				
MEASUREMEN 1	Qin 1	L/s	Flow rate aeration lane 1	
MEASUREMEN 2	Qrec 1	L/s	Flow rate internal recirculation or return sludge lane 1	
MEASUREMEN 3	Qin 2	L/s	Flow rate aeration lane 2	
MEASUREMEN 4	Qrec 2	L/s	Flow rate internal recirculation or return sludge lane 2	
ACTUAT VAR 5	NffO 1	mg/L	DO demand calc.from influent load(NffO 1)	
ACTUAT VAR 6	NfbO 1	mg/L	Additional DO demand calculated from NH_4-N effluent concentration	always 0 if no effluent NH_4-N measurement available
ACTUAT VAR 7	Osetp 1	mg/L	DO Setpoint (Osetp1)	
ACTUAT VAR 8	Oreg 1		Internal calculation value Oreg1	always 0 if RTC103 N without DO control
ACTUAT VAR 9	B_S 1		Aeration stage (B_S1)	always 0 if RTC103 N without DO control
ACTUAT VAR 10	A_S 1		Aeration VFD (A_S 1)	always 0 if RTC103 N without DO control
ACTUAT VAR 11	NffO 2	mg/L	DO demand calc.from influent load (NffO 2)	
ACTUAT VAR 12	NfbO 2	mg/L	Additional DO demand calculated from NH_4-N effluent concentration	always 0 if no effluent NH_4-N measurement available
ACTUAT VAR 13	Osetp 2	mg/L	DO Setpoint (Osetp2)	
ACTUAT VAR 14	Oreg 2		Internal calculation value Oreg2	always 0 if RTC103 N without DO control
ACTUAT VAR 15	B_S 2	Stage	Aeration stage (B_S2)	always 0 if RTC103 N without DO control
ACTUAT VAR 16	A_S 2	%	Aeration VFD (A_S 2)	always 0 if RTC103 N without DO control

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 59)
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	Quantity	Service life
CF card, type for RTC module	1	2 years
Battery, type CR2032 Panasonic or Sanyo	1	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

Section 8 Contact information

HACH Company
World Headquarters
P.O. Box 389
Loveland, Colorado
80539-0389 U.S.A.
Tel (800) 227-HACH
(800) -227-4224
(U.S.A. only)
Fax (970) 669-2932
orders@hach.com
www.hach.com

Repair Service in the United States:
HACH Company
Ames Service
100 Dayton Avenue
Ames, Iowa 50010
Tel (800) 227-4224
(U.S.A. only)
Fax (515) 232-3835

Repair Service in Canada:
Hach Sales & Service
Canada Ltd.
1313 Border Street, Unit 34
Winnipeg, Manitoba
R3H 0X4
Tel (800) 665-7635
(Canada only)
Tel (204) 632-5598
Fax (204) 694-5134
canada@hach.com

Repair Service in Latin America, the Caribbean, the Far East, Indian Subcontinent, Africa, Europe, or the Middle East:
Hach Company World Headquarters,
P.O. Box 389
Loveland, Colorado,
80539-0389 U.S.A.
Tel +001 (970) 669-3050
Fax +001 (970) 669-2932
intl@hach.com

HACH LANGE GMBH
Willstätterstraße 11
D-40549 Düsseldorf
Tel. +49 (0)2 11 52 88-320
Fax +49 (0)2 11 52 88-210
info@hach-lange.de
www.hach-lange.de

HACH LANGE LTD
Pacific Way
Salford
GB-Manchester, M50 1DL
Tel. +44 (0)161 872 14 87
Fax +44 (0)161 848 73 24
info@hach-lange.co.uk
www.hach-lange.co.uk

HACH LANGE LTD
Unit 1, Chestnut Road
Western Industrial Estate
IRL-Dublin 12
Tel. +353(0)1 460 2522
Fax +353(0)1 450 9337
info@hach-lange.ie
www.hach-lange.ie

HACH LANGE GMBH
Hütteldorfer Str. 299/Top 6
A-1140 Wien
Tel. +43 (0)1 912 16 92
Fax +43 (0)1 912 16 92-99
info@hach-lange.at
www.hach-lange.at

HACH LANGE GMBH
Rorschacherstrasse 30a
CH-9424 Rheineck
Tel. +41 (0)848 55 66 99
Fax +41 (0)71 886 91 66
info@hach-lange.ch
www.hach-lange.ch

HACH LANGE FRANCE S.A.S.
8, mail Barthélémy Thimonnier
Lognes
F-77437 Marne-La-Vallée
cedex 2
Tél. +33 (0) 820 20 14 14
Fax +33 (0)1 69 67 34 99
info@hach-lange.fr
www.hach-lange.fr

HACH LANGE NV/SA
Motstraat 54
B-2800 Mechelen
Tel. +32 (0)15 42 35 00
Fax +32 (0)15 41 61 20
info@hach-lange.be
www.hach-lange.be

DR. LANGE NEDERLAND B.V.
Laan van Westroijen 2a
NL-4003 AZ Tiel
Tel. +31(0)344 63 11 30
Fax +31(0)344 63 11 50
info@hach-lange.nl
www.hach-lange.nl

HACH LANGE APS
Åkandevej 21
DK-2700 Brønshøj
Tel. +45 36 77 29 11
Fax +45 36 77 49 11
info@hach-lange.dk
www.hach-lange.dk

HACH LANGE AB
Vinthundsvägen 159A
SE-128 62 Sköndal
Tel. +46 (0)8 7 98 05 00
Fax +46 (0)8 7 98 05 30
info@hach-lange.se
www.hach-lange.se

HACH LANGE S.R.L.
Via Rossini, 1/A
I-20020 Lainate (MI)
Tel. +39 02 93 575 400
Fax +39 02 93 575 401
info@hach-lange.it
www.hach-lange.it

HACH LANGE SPAIN S.L.U.
Edificio Seminario
C/Larrauri, 1C- 2ª Pl.
E-48160 Derio/Bizkaia
Tel. +34 94 657 33 88
Fax +34 94 657 33 97
info@hach-lange.es
www.hach-lange.es

HACH LANGE LDA
Av. do Forte nº8
Fracção M
P-2790-072 Carnaxide
Tel. +351 214 253 420
Fax +351 214 253 429
info@hach-lange.pt
www.hach-lange.pt

HACH LANGE SP. ZO.O.
ul. Krakowska 119
PL-50-428 Wrocław
Tel. +48 801 022 442
Zamówienia: +48 717 177 707
Doradztwo: +48 717 177 777
Fax +48 717 177 778
info@hach-lange.pl
www.hach-lange.pl

HACH LANGE S.R.O.
Zastrčená 1278/8
CZ-141 00 Praha 4 - Chodov
Tel. +420 272 12 45 45
Fax +420 272 12 45 46
info@hach-lange.cz
www.hach-lange.cz

HACH LANGE S.R.O.
Roľnícka 21
SK-831 07 Bratislava – Vajnory
Tel. +421 (0)2 4820 9091
Fax +421 (0)2 4820 9093
info@hach-lange.sk
www.hach-lange.sk

HACH LANGE KFT.
Vöröskereszt utca. 8-10.
H-1222 Budapest XXII. ker.
Tel. +36 1 225 7783
Fax +36 1 225 7784
info@hach-lange.hu
www.hach-lange.hu

HACH LANGE S.R.L.
Str. Căminului nr. 3,
et. 1, ap. 1, Sector 2
RO-021741 Bucureşti
Tel. +40 (0) 21 205 30 03
Fax +40 (0) 21 205 30 17
info@hach-lange.ro
www.hach-lange.ro

HACH LANGE
8, Kr. Sarafov str.
BG-1164 Sofia
Tel. +359 (0)2 963 44 54
Fax +359 (0)2 866 15 26
info@hach-lange.bg
www.hach-lange.bg

HACH LANGE SU ANALİZ SİSTEMLERİ LTD.ŞTİ.
Ilkbahar mah. Galip Erdem
Cad. 616 Sok. No:9
TR-Oran-Çankaya/ANKARA
Tel. +90312 490 83 00
Fax +90312 491 99 03
bilgi@hach-lange.com.tr
www.hach-lange.com.tr

Contact information

HACH LANGE D.O.O.
Fajfarjeva 15
SI-1230 Domžale
Tel. +386 (0)59 051 000
Fax +386 (0)59 051 010
info@hach-lange.si
www.hach-lange.si

HACH LANGE E.Π.E.
Ηρακλείτου 3
GR-15235 Χαλάνδρι
Τηλ. +30 210 7777038
Fax +30 210 7777976
info@hach-lange.gr
www.hach-lange.gr

HACH LANGE D.O.O.
Ivana Severa bb
HR-42 000 Varaždin
Tel. +385 (0) 42 305 086
Fax +385 (0) 42 305 087
info@hach-lange.hr
www.hach-lange.hr

HACH LANGE MAROC SARLAU
Villa 14 – Rue 2 Casa Plaisance
Quartier Racine Extension
MA-Casablanca 20000
Tél. +212 (0)522 97 95 75
Fax +212 (0)522 36 89 34
info-maroc@hach-lange.com
www.hach-lange.ma

HACH LANGE OOO
Finlyandsky prospekt, 4A
Business Zentrum “Petrovsky fort”, R.803
RU-194044, Sankt-Petersburg
Tel. +7 (812) 458 56 00
Fax. +7 (812) 458 56 00
info.russia@hach-lange.com
www.hach-lange.com

Section 9 Warranty and liability

The manufacturer warrants that the supplied product is free of material and manufacturing defects, and undertakes to repair or to replace any defective parts without charge.

The warranty period is 24 months. If a maintenance contract is taken out within 6 months of purchase, the warranty period is extended to 60 months.

With the exclusion of further claims, the supplier is liable for defects, including the lack of assured properties, as follows: all parts that, within the warranty period calculated from the day of the transfer of risk, can be demonstrated to have become unusable or that can only be used with significant limitations owing to circumstances prior to transfer of risk, in particular due to incorrect design, substandard materials or inadequate finish, shall be repaired or replaced at the supplier's discretion. The identification of such defects must be reported to the supplier in writing as soon as possible, but no later than 7 days after the discovery of the fault. If the customer fails to notify the supplier, the product is considered approved despite the defect. Further liability for indirect or direct damages is not accepted.

If device-specific maintenance- or inspection work prescribed by the supplier is to be performed within the guarantee period by the customer (maintenance) or by the supplier (inspection) and these requirements are not met, claims for damages that result from non-observance of these requirements are void.

Further claims, in particular for consequential damages, cannot be made.

Wear and damage caused by improper handling, incorrect installation or non-designated use are excluded from this clause.

The process instruments of the manufacturer have proven their reliability in many applications and are therefore often used in automatic control loops to enable the most economical and efficient operation of the relevant process.

To avoid or limit consequential damage, it is therefore recommended that the control loop be designed such that an instrument malfunction results in an automatic changeover to the backup control system. This guarantees the safest operating condition both for the environment and the process.

Appendix A MODBUS address setting

The same slave address must be set for Modbus communication both on the sc1000 controller display and on the RTC103 N-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)!

Index