Wallace & Tiernan®

an EVOQUA brand

SFC ANALYZER/CONTROLLER

BOOK NO. WT.050.590.000.UA.IM.0814

W3T110727

SFC
ANALYZER / CONTROLLER

BOOK NO. WT.050.590.000.UA.IM.0814

W3T110727

EQUIPMENT SERIAL NO. _____

DATE OF START-UP _____

START-UP BY _____

Prompt service available from nationwide authorized service contractors.

ORDERING INFORMATION

In order for us to fill your order immediately and correctly, please order material by description and part number, as shown in this book. Also, please specify the serial number of the equipment on which the parts will be installed.

WARRANTY

Seller warrants for a period of one year after shipment that the equipment or material of its manufacture is free from defects in workmanship and materials. Corrosion or other decomposition by chemical action is specifically excluded as a defect covered hereunder, except this exclusion shall not apply to chlorination equipment. Seller does not warrant (a) damage caused by use of the items for purposes other than those for which they were designed, (b) damage caused by unauthorized attachments or modifications, (c) products subject to any abuse, misuse, negligence or accident, (d) products where parts not made, supplied, or approved by Seller are used and in the sole judgment of the Seller such use affects the products' performance, stability or reliability, and (e) products that have been altered or repaired in a manner in which, in the sole judgment of Seller, affects the products' performance, stability or reliability. **SELLER MAKES NO OTHER WARRANTY OF ANY KIND, AND THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR OF FITNESS OF THE MATERIAL OR EQUIPMENT FOR ANY PARTICULAR PURPOSE EVEN IF THAT PURPOSE IS KNOWN TO SELLER.** If Buyer discovers a defect in material or workmanship, it must promptly notify Seller in writing; Seller reserves the right to require the return of such defective parts to Seller, transportation charges prepaid, to verify such defect before this warranty is applicable. In no event shall such notification be received by Seller later than 13 months after the date of shipment. No action for breach of warranty shall be brought more than 15 months after the date of shipment of the equipment or material.

LIMITATION OF BUYER'S REMEDIES. The **EXCLUSIVE REMEDY** for any breach of warranty is the replacement f.o.b. shipping point of the defective part or parts of the material or equipment. Any equipment or material repaired or replaced under warranty shall carry the balance of the original warranty period, or a minimum of three months. Seller shall not be liable for any liquidated, special, incidental or consequential damages, including without limitation, loss of profits, loss of savings or revenue, loss of use of the material or equipment or any associated material or equipment, the cost of substitute material or equipment, claims of third parties, damage to property, or goodwill, whether based upon breach of warranty, breach of contract, negligence, strict tort, or any other legal theory; provided, however, that such limitation shall not apply to claims for personal injury.

Statements and instructions set forth herein are based upon the best information and practices known to Evoqua Water Technologies, but it should not be assumed that every acceptable safety procedure is contained herein. Of necessity this company cannot guarantee that actions in accordance with such statements and instructions will result in the complete elimination of hazards and it assumes no liability for accidents that may occur.

725 Wooten Road
Colorado Springs, Co 80915

INTRODUCTION

This instruction manual provides the information for installation, operation and maintenance personnel.

This instruciton manual is intended for the operating personnel. It contains important information for safe, reliable, trouble-free and economical operation of the unit. Observance of this information helps to prevent hazards, lower repair costs, reduces down-times, and increases the reliability and service life of the unit.

The chapters on installation and maintenance are solely provided for trained service personnel. These sections contain important information on the installation, configuration and commissioning of the unit as well as information on its repair.

All persons working with the unit ,ust have read and understood the operating instructions, in particular, the safety instructions it contains.

Intended Use

The SFC (Single Function Controller) is exclusively designed for measurement and control tasks required for the treatment of waste water, potable water and industrial water.

The operational safety of the unit is only guaranteed if it is used in accordance with its intended application. The unit may only be used for the purpose defined in the order and under the operating conditions indicated in the technical specifications.

Compliance with the intended use also includes reading this operating manual and observing all the instructions it contains. All inspection and maintenance work must be performed at the prescribed intervals by qualified personnel.

The operator bears full responsibility if this unit is put to any use which does not comply strictly and exclusively with the intended use.

Table Of Contents

GENERAL SAFETY INSTRUCTIONS

Evoqua Water Technologies attaches great imporatnce to ensuring work on its system is safe. This is taken into account in the design of the system, by the integration of safety features.

Safety Instructions

The safety instructions in this documentation must always be observed. These do not impact any additional national or company safety instructions.

Safety Instructions on the System

All safety instructions attached to the system itself must be observed.

Technical Standard

The system or unit has been constructed in accordance with state of-the-art technology and the accepted safety regulations. In the event of the system or unit being used by persons who have not been adequately instructed, risks hazard to of such persons or third parties and damage to the system or unit itself or to other property are possible. Work described in this operating manual may only be performed by authorized personnel.

Personnel

The operator of the system must ensure that only authorized and qualified specialized personnel are permitted to work with and on the unit within their defined scope of authority. "Authorized specialists“ are trained technicians employed by the operator, by Evoqua Water Technologies, or, if applicable, the service partner. Only qualified electricians may perform work on electrical components.

Spare Parts/Components

Trouble-free operation of the system is only guaranteed if original spare parts and components are used as described in this operating manual. Failure to observe this instruction may incur the risk of malfunction or damage to the system.

Modifications and Extensions

Never attempt to perform any modifications or conversions to the unit without the written approval of the manufacturer.

Electrical Power

During normal operation, the control unit must remain closed. Before starting any assembly, inspection, maintenance, or repair work, the system must be switched OFF, and the switch must be secured against reactivation. Connect all cables in accordance with the wiring diagram.

Waste Disposal

Ensure safe and environmentally-friendly disposal of reagents and replaced parts.

WARRANTY CONDITIONS

The following must be observed for compliance with warranty conditions:

- Installation, commissioning by trained and authorized personnel.
- Intended use.
- Observation of the operational parameters and settings.
- The unit may only be operated by trained personnel.
- An operating log book must be kept.
- Only approved calibration chemicals may be used.
- The unit must not be exposed to ambient conditions outside those specified.
- Maintenance work must be executed at recommended intervals.
- Use of original Evoqua Water Technologies spare parts.

If any of the above conditions are not met, the warranty could be void.

SPECIFIC OPERATING PHASES

Normal Operation

Never employ procedures which could affect safety.

Only operate the unit when the housing is closed.

Inspect the unit at least once daily for externally visible damage and faults. Inform the responsible person/authority immediately of any detected changes (including any changes in the operating
performance).

In the event of malfunctions, switch the unit off immediately. Have malfunctions remedied immediately.

Installation and Maintenance Work

Always perform installation or maintenance work in accordance with this operating manual.

Secure the unit against activation during installation and maintenance work.

Always retighten released screw connections.

Never use corrosive cleaning agents. Use only a damp cloth to clean the unit.

Ensure safe disposal of reagents and replaced parts in accordance with environmental regulations.

VERY IMPORTANT SAFETY PRECAUTIONS

This page provides very important safety information related to safety in installation, operation, and maintenance of this equipment.

WARNING

TO AVOID POSSIBLE SEVERE PERSONAL INJURY OR EQUIPMENT DAMAGE, OBSERVE THE FOLLOWING:

ALL USERS OF THIS EQUIPMENT SHOULD BE MADE AWARE OF THE PROBLEMS ASSOCIATED WITH HANDLING HAZARDOUS MATERIALS IN EITHER LIQUID OR GASEOUS FORM AND OF THE EFFECTS OF EXPOSURE TO THEIR FUMES. REFERENCE SHOULD BE MADE TO THE LITERATURE AVAILABLE FROM THE SUPPLIERS OF THESE CHEMICALS, PARTICULAR ATTENTION BEING PAID TO THE INFORMATION AND ADVICE ON PROTECTIVE CLOTHING.

THIS EQUIPMENT IS CONNECTED TO LINE VOLTAGE. IT IS ESSENTIAL THAT THE UTMOST CARE IS TAKEN WHEN WORK IS CARRIED OUT ON EQUIPMENT WHERE LINE VOLTAGES ARE PRESENT. IT IS RECOMMENDED THAT ALL POWER SUPPLIES ARE SWITCHED OFF WHENEVER POSSIBLE.

WHEN DEALING WITH HAZARDOUS MATERIAL, IT IS THE RESPONSIBILITY OF THE EQUIPMENT USER TO OBTAIN AND FOLLOW ALL SAFETY PRECAUTIONS RECOMMENDED BY THE MATERIAL MANUFACTURER.

DO NOT DISCARD THIS INSTRUCTION BOOK UPON COMPLETION OF INSTALLATION. INFORMATION PROVIDED IS ESSENTIAL TO PROPER AND SAFE OPERATION AND MAINTENANCE.

ADDITIONAL OR REPLACEMENT COPIES OF THIS INSTRUCTION BOOK ARE AVAILABLE FROM:

Evoqua Water Technologies
725 Wooten Road
Colorado Springs, CO 80915
Phone: (800) 524-6324

NOTE

Minor part number changes may be incorporated into Evoqua Water Technologies products from time to time that are not immediately reflected in the instruction book. If such a change apparently has been made in your equipment and does not appear to be reflected in your instruction book, contact your local Evoqua Water Technologies sales office for information.

Please include the equipment serial number in all correspondence. It is essential for effective communication and proper equipment identification.

REGIONAL OFFICES

INSTALLATION, OPERATION, MAINTENANCE, AND SERVICE INFORMATION

Direct any questions concerning this equipment that are not answered in the instruction book to the Reseller from whom the equipment was purchased. If the equipment was purchased directly from Evoqua Water Technologies, Colorado Springs, CO contact the office indicated below.

UNITED STATES

725 Wooten Road
Colorado Springs, CO 80915
TEL: (800) 524-6324

CANADA

If the equipment was purchased directly from Evoqua Water Technologies, Canada, contact the nearest office indicated below.

ONTARIO

Evoqua Water Technologies Ltd.
2045 Drew Road
Mississauga, Ontario
L5S 1S4
(905) 944-2800

QUEBEC

Evoqua Technologies des Eaux Itee
505 Levy Street
St. Laurent, Quebec
H4R 2N9
(450) 582-4266

SECTION 1

SECTION 1 - TECHNICAL DATA

List of Contents

1.1 Versions

There are two versions of the SFC.

They differ in the type and number of inputs and outputs that are available and in terms of functionality.

Version 1 (SFC with sensor measuring module)

This analyzer or analyzer/controller supports all applications 1-3 (see section 4.4, "Applications") and is available with or without control capabilities.

- slot for 1 sensor module
- 4 relays
- 2x mA input
- 1x feedback input
- 2x digital input
- 1x temperature input PT 1000
- 1x mA output
- 1x SD card receptacle
- 1x CAN interface
- 1x RS485 interface
- 1x RS232 interface for Gateway
- 1x interface for firmware updates

Version 2 (SFC without sensor measuring module)

This controller supports only applications 3 (see section 4.4, "Applications") without recording measured values via the sensor measuring module. The SFC-SC is a direct proportional controller. The SFC-PC is a compound loop PID controller.

- 2 relays
- 1x mA input
- 1x feedback input
- 2x digital input
- 1x mA output
- 1x interface for firmware updates

1.2 Specifications

1.2.1 SFC Electronic Module and Input Modules

Dimensions (W x H x D)	7.3” x 10.4” x 5.7” (185mm x 265mm x 145mm)
Weight	approx. 5.5 Lbs (2.5 kg)
Protection category	Nema 4X (IP 66), UL, CE
Power supply	100 - 240 VAC ± 10%, 50 - 60 Hz, 15 W Fuse 1A (T) Type: TR5 or 24 VDC ± 20%, 15 W Fuse 1A (T) Type: TR5
Operating conditions	Ambient temperature: 0 to 50 °C (32 to 122 °F) Environment: No direct sunlight Atmospheric pressure: 11 to 15 PSI (75 to 106 kPa) Storage temperature: 4 to 158 °C (-20 to 158 °F) Noise emission: <45 dB
Digital inputs	2 x for floating contact (< 100 Ohm) Power supply through SFC (12 V) D1: Sample water flow switch / freely selectable in menu D2: Freely selectable in menu

Measurement inputs

1 x temperature input
- PT1000 32 to 122 °F (0 to 50 °C) with sensor error display (with analyzer only)

1 x feedback input
- Positioner position feedback
- Potentiometer 1 kOhm or 5 kOhm, 0 - 1 V, 0 - 20 mA (selectable using DIP switch)

1 x measured value input (electronically isolated up to 50 V to ground) for plug-in cards of the sensor measuring module (with analyzer only):
- 3-electrode cell for chlorine, chlorine dioxide or potassium permanganate
- Membrane sensors for total chlorine TC1, free chlorine FC1, chlorine dioxide CD7, ozone OZ7
- pH value
- Redox voltage
- Fluoride
- Conductivity
- mA/V input

1 x mA input for flow rate 0 - 20 mA / 4 - 20 mA
1 x mA input for external setpoint or dosing factor 0 - 20 mA / 4 - 20 mA (not available with analyzer only version)

Interfaces

1 x RS232 for firmware upload (not electronically isolated)
1 x RS232 (optional) (not available in SFC-SC and SFC-PC) for connection to:
- ChemWeb-Server
- OPC Server Data Access V2.0
- CMS Software 3.0
- SECO-S7

*The RS485 interface is electronically isolated up to 50 V to ground
1 x CAN interface for controlling CAN actuators and evaluating external CAN measurements (not available in SFC-SC and SFC-PC)
1 x RS232 interface for Gateway module (not available in SFC-SC and SFC-PC)

Display and operating unit

1 x Operating panel with 9 keys
1 x Graphics display - Resolution 128 x 64 pixels and White background illumination

Relay plug-in card (outputs)	4 relay outputs analyzer and analyzer controller) or 2 relay outputs (SFC-SC and SFC-PC) (each with two-way switch) Switching values 5 A, 250 V AC, 1250 VA max. 5 A, 220 V DC, 150 W max. UL/CSA-rating - 5 A, 1/6 HP 125, 250 V AC 5 A, 30 V DC, 30 W max. 1 A, 30 V DC - 0.25 A, 125 V DC
mA output	1 x ma output (freely configurable): Outputs 0/4 - 0-20mA Accuracy < 0.5 % FS Load max. 500 Ohm Temperature drift max. 0.2 % / 10 °C Load monitoring Electrically isolated up to 50 V to ground
Memory card	1 x SD memory card slot for installing an SD memory card (not available in SFC-SC and SFC-PC)

1.3 Scope of Supply

1.3.1 Standard

Depending on the individual order, the scope of supply includes the following:

Elctronic module SFC
including accessories set and mounting set, comprising of:

- 4x screws Ø 5mm
- 4x dowels Ø 8mm
- 4x washers
- 3 multiple seal inserts 2x6mm
- 3 multiple seal inserts 4x5mm
- 3 reducing sealing rings Ø 8mm
- 4 bolts for multiple seal inserts 5mm
- 2 bolts for multiple seal inserts 6mm
- DIN rail

1.3.2 Options

Flow block assembly

- Depolox® 5 analyzer
- VariaSens™ sensor
- Y flow-through adapters
- Mirco/200® and Deox/2000® analyzers
- Strantrol® flow assembly

Sensor measuring module kit including accessories

- pH
- Redox
- Strantrol® pH
- Strantrol® HRR ORP
- Conductivity
- Fluoride
- Free chlorine (FC1)
- Chlorine dioxide selective (CD7)
- Ozone selective (OZ7)
- Total chlorine (TC1)
- Depolox® 5 3-electrode cell
- Depolox® 3 plus 3-electrode cell with PT 100
- mA/V input card
- Micro/2000® analyzer
- Deox/2000® analyzer

NOTE: All sensor measuring modules are avilable with or without Process Control option.

1.4 Description

1.4.1 Versions

SFC (Single Function Controller)

The SFC is available in two different versions (see section 3.1, "Versions), each in two voltage variations:

- 100 to 240 VAC
- 24 VDC

Depending on the application, the SFC can be operated either without a flow block assembly (no sensor measuring module) or in connection with a flow block assembly and sensor measuring module.

Flow Block Assembly

The flow block assembly is available in different versions:

- Depolox 5
- VariaSens
- Various Y flow-through adapters
- Micro/2000
- Deox/2000
- Strantrol® flow assembly

1.5 Design

1.5.1 Overall Design

The SFC unit is a modular design and can be equipped with various types of measuring modules. Several SFC modules can be installed next to each other on a DIN rail or using surface moutning brackets.

A	Depolox® 5 flow block assembly
B	Sensors
C	Electronic module SFC

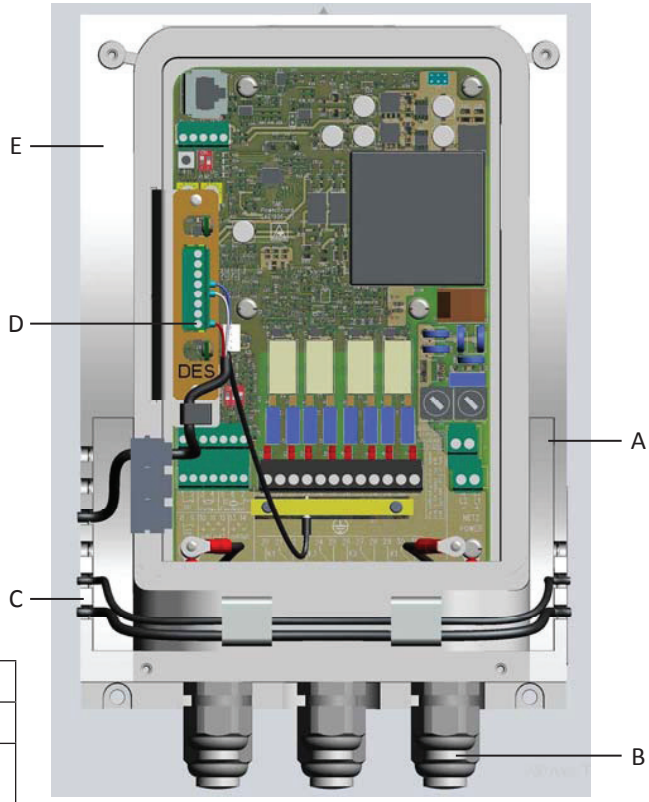
Figure 1.1 - SFC Cl_2 with Depolox® 5 flow block assembly

1.5.2 SFC Electronic Module

The SFC electronic module consists of a plastic housing with a removable cover.

The housing contains:

- IC board
- Housing ducts for the cables of the sensor measuring modules
- the cable glands
- the sensor measuring module (optional)



A	IC board
B	Cable glands
C	Housing ducts for the cables of the sensor measuring modules
D	Slot for sensor measuring module
E	Housing

Figure 1.2 - SFC basic with card and cable

The following are integrated into the cover:

- Front panel board with graphic display and interface connections
- Insertable strips
- SD memory card

A	Housing cover
B	Front panel board
C	Insertable strips
D	Memory card (optional)

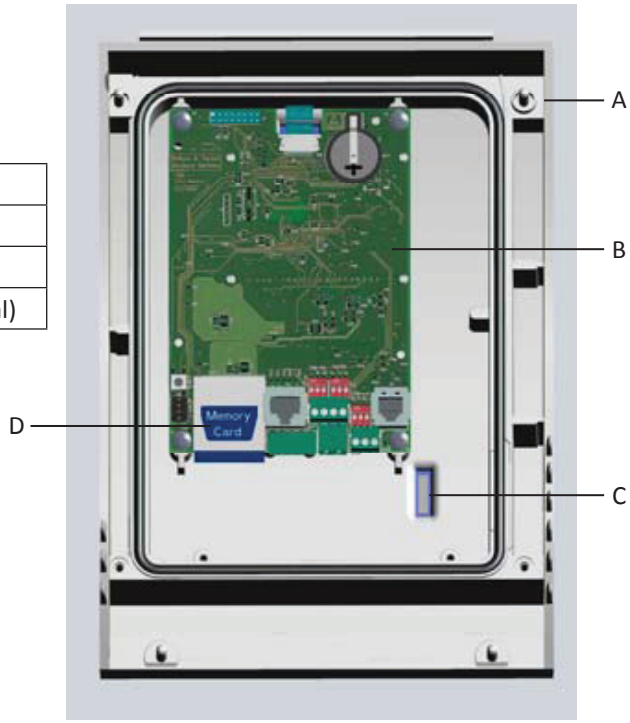


Figure 1.3 - SFC operating front (rear)

1.5.3 Sensor Measuring Module

The sensor measuring module consists of:

- Sensor (Not with 3-electrode cell Depolox® 5 electrode cells, Micro/2000®, Deox/2000® or mA/V input.)
- Sensor cable with watertight housing cable gland (Not with 3-electrode cell Depolox® 5 electrode cells, Micro/2000®, Deox/2000® or mA/V input.)
- Factory-calibrated plug-in card

Due to the modular design, sensor measuring modules can be installed and configured at any time. All sensor measuring modules for Cl_2, pH, mV, F^-, etc. can be plugged into the module slot. This configuration determines the functionality of the SFC, see section 4.2, "Measurement Inputs".

A	Sensor cable
B	Housing cable gland
C	Sensor
D	Plug-in card

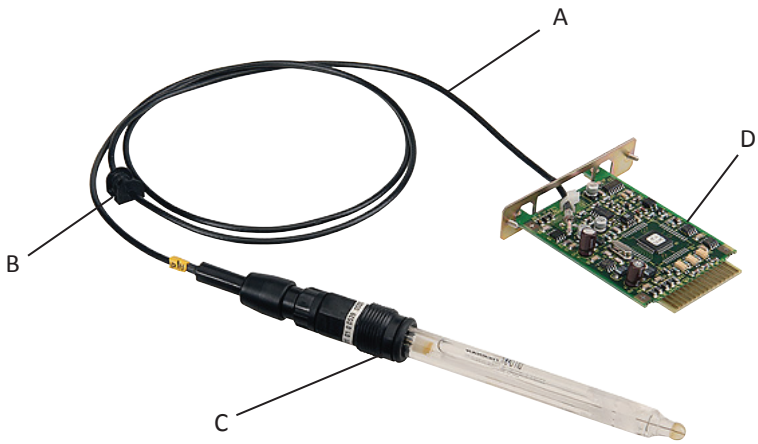


Figure 1.4 - Example sensor measuring module pH

SECTION 2

SECTION 2 - INSTALLATION

List of Contents

List of Contents (Cont'd)

2.1 Transport and Storage

2.1.1 Transport

The unit is supplied in standard packaging. During transport the packaged unit must be handled carefully ans should not be exposed to wet weather or moisture.

Check that the transport packaging is undamaged. In the event of damage please inform the transport company immediately.

If the device is damaged, please contact the respective Evoqua Water Technologies agency immediately. Keep the packing until the unit has been correctly installed and put into operation.

2.1.2 Storage

Store the unit and the sensors in a dry condition without any residual water in a dry place. Storage temperature, see section 1.2, "Specifications".

2.2 Installation

The device must be protected against rain, frost and direct sunlight and should not be installed outdoors. It must be mounted horizontally on a flat wall with an ambient temperature of 32 to 122 °F (0 to 122 °C). The air in the room should be non-condensing.

2.2.1 Opening the Housing

1. Remove the housing cover of the flow block assembly, by lightly pressing the two buttons on the top of the housing (optional).

2. Loosen the four screws on the cover of the SFC electronic module.

CAUTION: The indication and operator controls on the cover of the SFC electronic module are connected to the housing with strain relief cables.

NOTE: The device switches off automatically when the cover is removed.

3. Carefully remove the cover of the SFC electronic module and leave to hang on the strain relief cables.

2.2.2 Installation with Mounting Rail (see drawing 50.590.100.030)

1. Fasten the mounting rail to the wall with two screws.

2. Hook the electronic module onto the mounting rail so that it is flush to the right and fasten to the wall with two screws.

3. Hook the flow block assembly onto the mounting rail to the left of the SFC electronic module and fasten to the wall with two screws.

NOTE: The flow block assembly does not need to be mounted directly next to the SFC electronics, it can be mounted on separate mounting rail. The exact location limited by available probe cable lengths.

2.2.3 Installation without Mounting Rails (see drawing 50.590.100.040):

If the electronic module and the flow block assembly are to be mounted in different places, the modules can be hooked onto suitable tallow-drop screws by the top holding fixtures instead of onto the mounting rail. Proceed with the installation as described above.

NOTE: If the electronic module and the flow block assembly are mounted at separate locations, the Evoqua Water Technologies sensor cable extensions with a maximum length of 50m must be used. An impedance converter for the Redox, fluoride and pH sensors is also required. (Not available with Depolox® 5, Micro/2000® and Deox/2000® units)

2.3 Commissioning

2.3.1 Installation Guide

Commissioning procedure:

When the unit has been mounted, the sensor measuring module can be equipped (not applicable to unit version 2). The electrical connections can then be setup in accordance with the required application. To set applications, refer to section 2.3.11, "Setting the Applications".

The following table contains the individual commissioning steps in their correct sequence. More detailed information is contained in the chapters listed in the "Chapter Referece" column.

NOTE: If this installation sequence cannot be complied with, please contact you Evoqua Water Technologies service department.

Commissioning using the example of application 2:

Sequence	Task	Section	Completed
1	Setup electrical connection in accordance with the application.	1.5.2 & 2.3.7	☐
2	Install sensor measuring module	2.3.3	☐
3	Insert the sensors and connect	1.5.3 & 2.3.3	☐
4	Insert the labeling field in the housing cover	2.3.4	☐
5	Close the housing cover	2.3.5	☐
6	Switch the unit on	2.3.6	☐
7	Set the language	2.3.6	☐
8	Set the application	2.3.7	☐
9	If another operating mode is activated, switch to "Manual"	4.3.1	☐
10	Set the time	4.3.1	☐
11	Set the date	4.3.1	☐
12	Enter system name	4.3.1	☐
13	Set the trend graphs assignment	4.3.1	☐
14	Set module descriptions	4.3.1	☐
15	Select control mode	4.3.1	☐
16	Set dosing output, and adjust positioner running time, Tp, and max. pulses if necessary	4.3.1	☐
17	On positioner with feedback calibrate Ym	4.4.2 & 4.4.3	☐
	With feedback signals, such as mA signal, 0-1V, 5kOhm, the DIP switch S4 must be adjusted on the IC board. Factory setting: 1kOhm potemtiometer	3.3.2	
18	Check setpoint and dosing factor, adjust if necessary	4.3.1	☐
19	Check setpoint and dosing source, adjust if necessary	4.3.1	☐

Sequence	Task	Section	Completed
20	Check flow rate source, adjust if necessary	4.3.1	☐
21	Check flow rate direction, adjust if necessary	4.3.1	☐
22	Check control variable 2, adjust if necessary (ratio control only)	4.3.1	☐
23	Check X direction, adjust if necessary (ratio control only)	4.3.1	☐
24	Check X factor, adjust if necessary (ratio control only)	4.3.1	☐
25	Adjust values for Xp and Tn on control loop (single feedback closed-loop control only)	4.3.1	☐

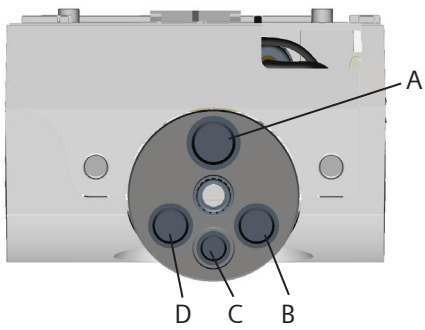
NOTE: These values may be optimized later by adaption or manually.

Sequence	Task	Section	Completed
26	Adjust values for Tconst and Tvar on control (combi-control only)	3.6 & 4.3.1	☐
27	Check max. Lin. corr., adjust if necessary (combi-control only)	3.6 & 4.3.1	☐
28	Check control factor, adjust if necessary (Combi-control only)	3.6 & 4.3.1	☐
29	Check Yout factor, adjust if necessary	3.6 & 4.3.1	☐
30	Check measuring range, adjust if necessary	4.3.1	☐
31	Check limit values, adjust if necessary	4.3.1	☐
	Input and output settings:		
32	Check flow rate signal settings such as signal, unit, factor, format, measuring range start and end value, adjust if necessary	4.3.1	☐
33	Check flow rate limit values, adjust if necessary	4.3.1	☐
34	Check external set point/dosing factor setting such as signal and factor, adjust if necessary (only if using an external set-point/dosing factor)	4.3.1	☐

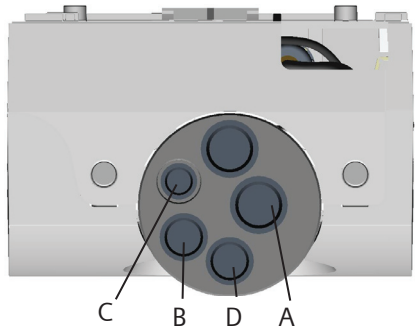
Sequence	Task	Section	Completed
35	Check limit values for external set point/ dosing factor, adjust if necessary (only if using an external setpoint/dosing factor)	4.3.1	☐
36	Check mA signal, adjust if necessary (only if mA output is used)	4.3.1	☐
37	Check mA allocation, adjust if necessary (only if mA output is used)	4.3.1	☐
38	Check settings for digital inputs 1-2, adjust if necessary	4.3.1	☐
39	Configure RS485 interface as required	3.9.2	☐
40	Configure CAN interface as required	3.10	☐
41	Check function of alarms 1-4, adjust if necessary	3.7	☐
42	Configure alarm 1-4 assignment as required	3.7	☐
43	Via Mode-Man.Dos, check that all connected actuators and dosing pumps are working properly	4.4.2 & 4.4.3	☐
44	Calibrate the fitted sensors after approx. 1 hour running-in time	See Sensor Manual	☐
45	Switch to operating mode "Auto"	4.3.1	☐
46	Repeat calibration after 24 hours running time	See Sensor Manual	☐

2.3.2 Insert the Sensors and Connect

Arrangement of the sensors:



Depolox® 5 Sensors



VariaSens™ Sensors

A	Membrane sensor: FC1, CD7, OZ7, TC1
B	Redox
C	Fluoride / pH
D	Conductivity

Figure 2.1

1. Remove the protection caps from the sensors.

2. Install sensors (see figure above) in the cell body cover.

The sensors are marked as follows:

Membrane sensor for free chlorine FC1, chlorine dioxide CD7, ozone and OZ7 and total chlorine TC1 (A) marked "DES"

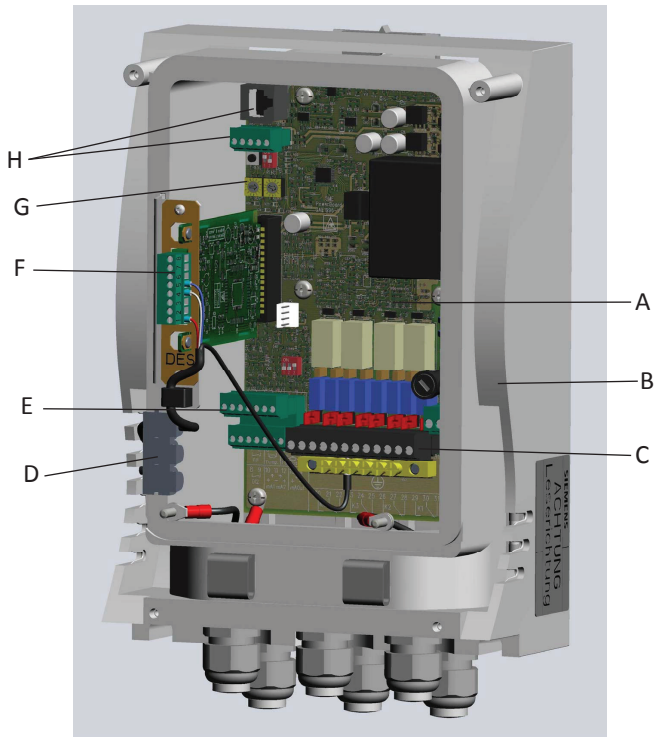
mV: Sensor for Redox, marked “mV” (B)
pH: Sensor for fluoride or pH value, marked “pH” (D)
µS: Sensor for conductivity, marked “LF325” (C)
Des: Sensor for free chlorine, marked "DES" (E)
F1: Sensor fluoride, marked "F1" (C)

NOTE: Keep the dust protection caps and watering caps of the sensors for subsequent use.

Cable extension:
The sensor cable for (FC1) free chlorine probe, conductivity and (TC1) total chlorine probe may be extended to a max. of 50 m.

If the pH, Redox or fluoride sensor cables must be extended (max. 50 m), an impedance converter must be attached to the sensor. The impedance converter converts the very high-resistance sensor signal into a low-resistance signal. The impedance converter is supplied by an installed battery. The life of the battery is approx. 5 years. Depolox® 5, Micro/2000® and Deox/2000® cables can not be extended.

Arrangement of the plug-in cards and cables:



A	IC board
B	Housing
C	Relay terminal
D	Sensor cable duct
E	Terminal signal inputs/outputs
F	Sensor measuring module
G	Coding switch IC board
H	Connecting plug or terminal at the front panel board

Figure 2.2 - Electronic Module Cutaway

Connecting the sensor cables:

1. Place the sensor cables with the attached glands into the cable ducts of the housing.

2. Depending on the sensor design, either plug or screw the cable in place.

3. Insert the supplied bushes into ducts that are not in use in order to seal housing.

4. It is recommended the cable glands in the bottom of the housing be used for routing the Micro/2000® and Deox/2000® sensor cable.

NOTE: The coding switch of the IC board may not be changed. If changed, proper function of the SFC can no longer be guaranteed. The settings must remain as shown on the following figure.

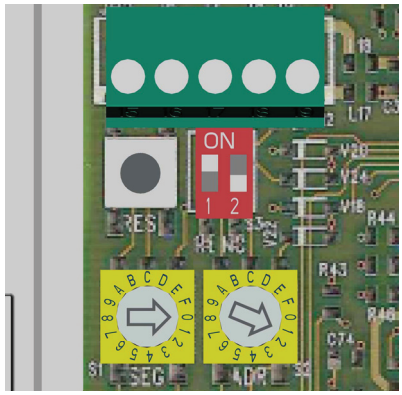


Figure 2.3 - Settings View

2.3.3 Connect the Device to the Power Supply

WARNING: ONLY AUTHORIZED AND QUALIFIED ELECTRICIANS ARE PERMITTED TO INSTALL THE DEVICE AND OPEN THE HOUSING. THE DEVICE MAY ONLY BE TAKEN INTO OPERATION WHEN THE HOUSING IS CLOSED, AND MUST BE CONNECTED TO PROTECTION EARTH. MODIFICATIONS TO THE DEVICE WHICH GO BEYOND THOSE DESCRIBED IN THIS MANUAL ARE NOT PERMISSIBLE.

WARNING: THE DEVICE IS NOT EQUIPPED WITH A MAINS SWITCH AND IS IN OPERATION AS SOON AS THE SUPPLY VOLTAGE IS APPLIED. AN EXTERNAL SWITCH OR CIRCUIT BREAKER IS NECESSARY, (6 A) MIN. THE CONDUCTOR CROSS SECTION OF THE MAINS CABLE MUST BE AT LEAST 0.75 MM (AWG 18). WHEN CONNECTING SYSTEM COMPONENTS (E.G. DEVICES, MOTORS, PUMPS) AS WELL AS WHEN ENTERING OPERATING DATA, THE SYSTEM COMPONENTS MUST BE SWITCHED OFF.

CAUTION: To ensure safe and correct commissioning, knowledge of the operation, connected electrical load, measurement signals, cable assignment and fuse protection of the connected devices and machines and the relevant safety regulations is required. The device may only be commissioned by qualified and authorized electricians. Incorrectly connected devices can be damaged, possibly irreparably, or cause faults in other equipment when they are switched on or in operation. Ensure that the measuring and control cables are not confused or make contact with one another. Never connect or disconnect any cables to which voltage is applied!

NOTE: A line-side fuse (max. 16 A) in the main supply line is necessary when connecting to 230 V or 115 V.

RECOMMENDATION: Provide an on/off facility for the unit at the installation site. 6 A is recommended for the line fuse. Observe local installation regulations.

Connect system components in accrodance with the application relevent wiring diagrams at the end of this section)

2.3.4 Attaching the Labeling Field

1. Select the required labeling field depending on what module is loaded.
2. Insert labeling field in the housing cover.

2.3.5 Mounting the Housing Covers

1. Ensure that the cable bushes are fitted correctly.
2. Carefully fit the housing cover of the electronic module and secure with the four housing screws.
3. Carefully place the housing cover onto the flow block assembly and snap into place.

2.3.6 Switching the Device On

<u>WARNING</u>: THE DEVICE IS NOT EQUIPPED WITH A MAINS SWITCCH AND IS IN OPERATION AS SOON AS THE SUPPLY VOLTAGE IS APPLIED. WHEN ENTERING OPERATING DATA IT MUST BE TAKEN INTO ACCOUNT THAT THESE COULD DIRECTLY INFLUENCE THE CONNECTED SYSTEM COMPONENTS.

Activate the power supply to the device.

The following appear in succession on the graphic display.

During the first commissioning, the language setup menu always appears first. Open the menu with the "Enter" key and set the required language using the up and down arrow keys. Then press "Enter" to confirm the selection. When the country language is set, this screen is no longer shown.

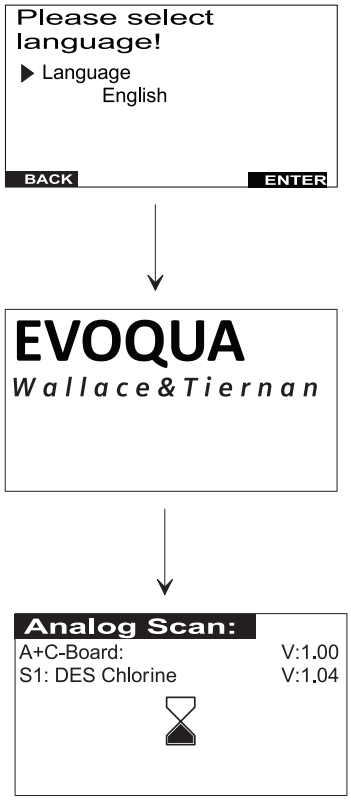


Figure 2.4 - Basic display in main menu

2.3.7 Setting the Applications

1. Starting from the basic display, restart the system by selecting “Reset” under the “System” menu, and then selecting “System Restart” ... “Yes”.
   “Evoqua Wallace & Tiernan” appears.

   When this appears, press the "left" and "right" arrow keys simulaneously for at least two seconds, in order to obtain the display of the softkey "APPLIC".

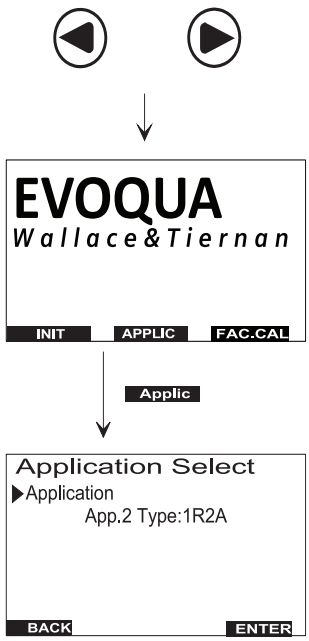


Figure 2.5 - Application selection

2. Select the “APPLIC” softkey.
   The “Application Select” menu appears.

3. Select the set application with the “ENTER” softkey.

4. Another application can now be set with the “Up” or “Down” arrow keys (see section 3.4, Applications).

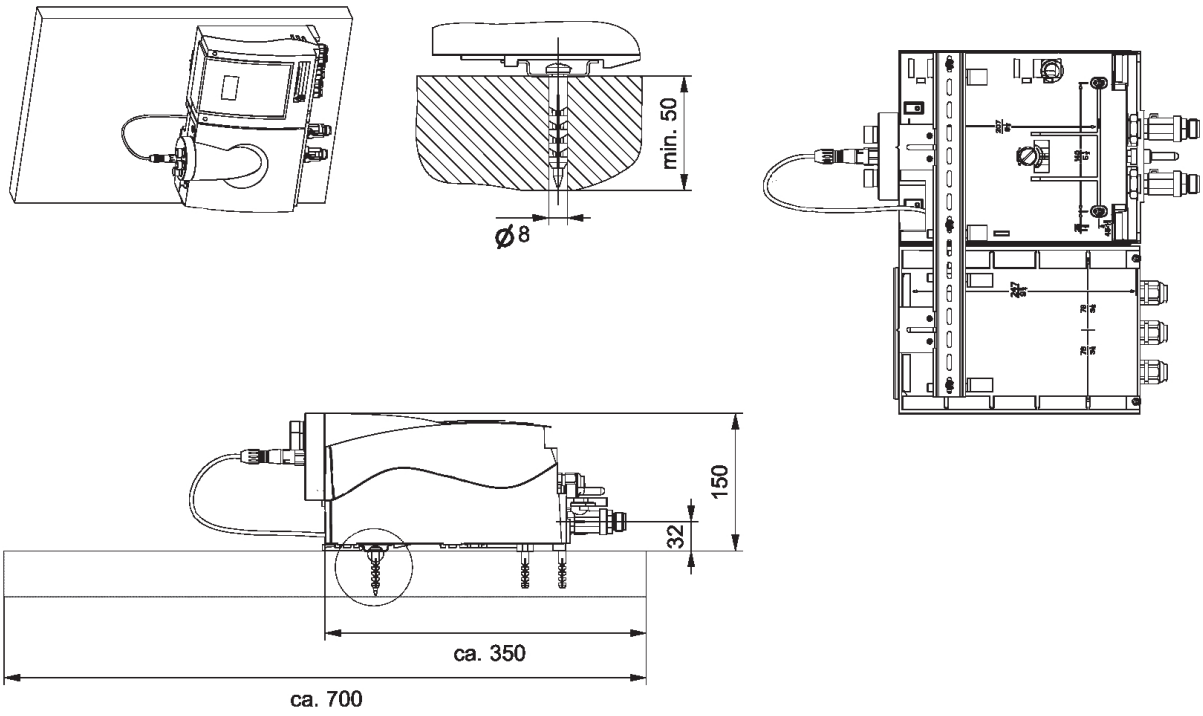
5. Select “ENTER” to program the set application. Select “BACK” to return to the basic display.

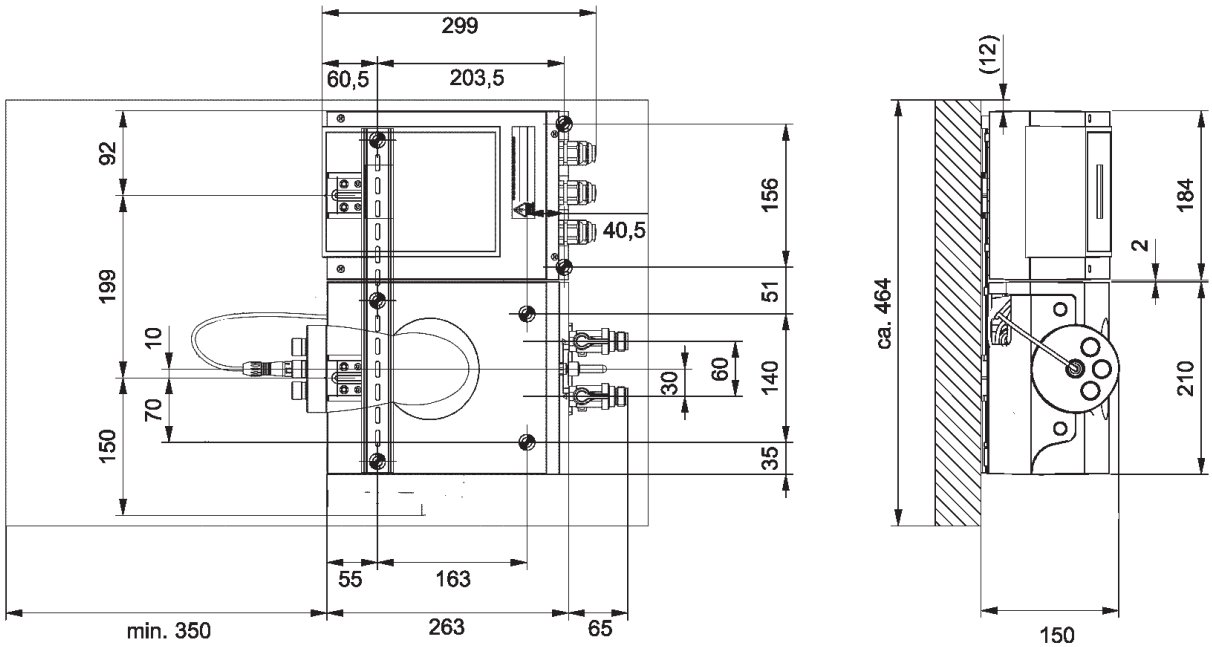
2.4 System Shut Down

<u>CAUTION</u>: Danger of uncontrolled dosing of chlorine or pH correction medium: Shut down dosing system, close positioner!

<u>NOTE</u>: If the installation site of the flow block assembly is not frost-free, the system must be shut down prior to any possible frost formation.

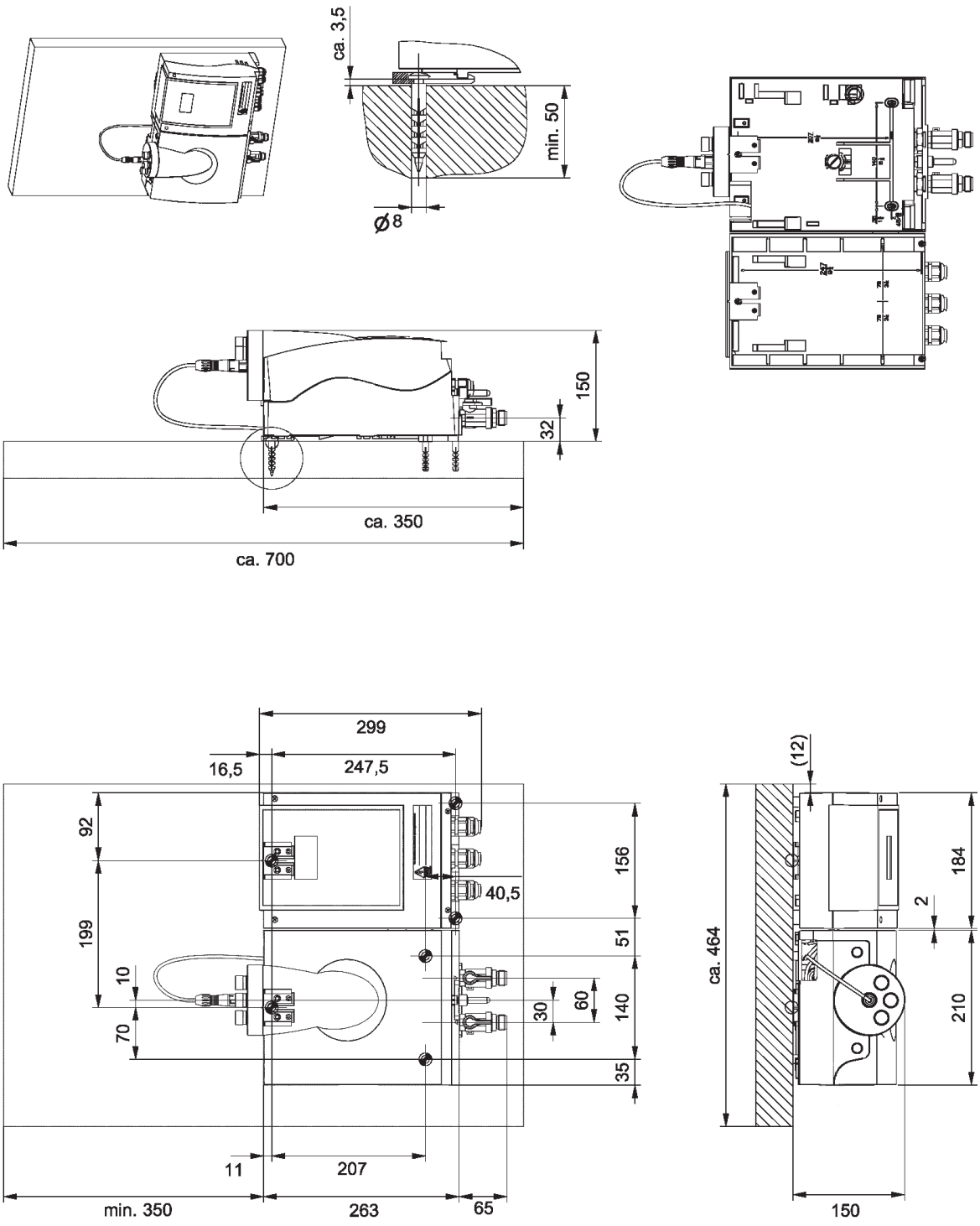
1. Switch off the power supply.
2. Drain the sample water supply line and drainage line (hold container underneath).
3. Empty cell bodies and remove grit.
4. Dismantle the filter housing and/or check valve housing.
5. When the remaining water has drained from the flow control valve, refit the filter housing and the check valve housing.
6. Remove the sensors from the cell body cover and disconnect from the cable.





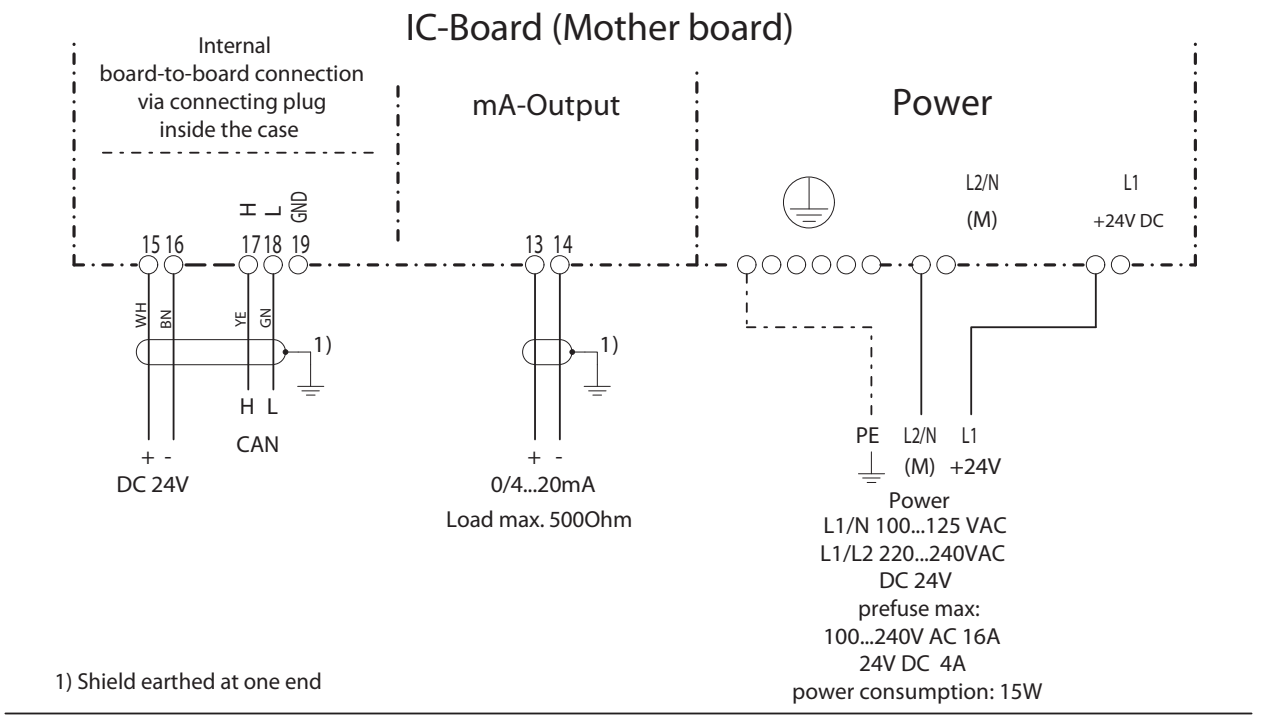
TOP HAT RAIL ASSEMBLY - DIMENSIONS
Single SFC Analyzer/Controller with Single Wet Side

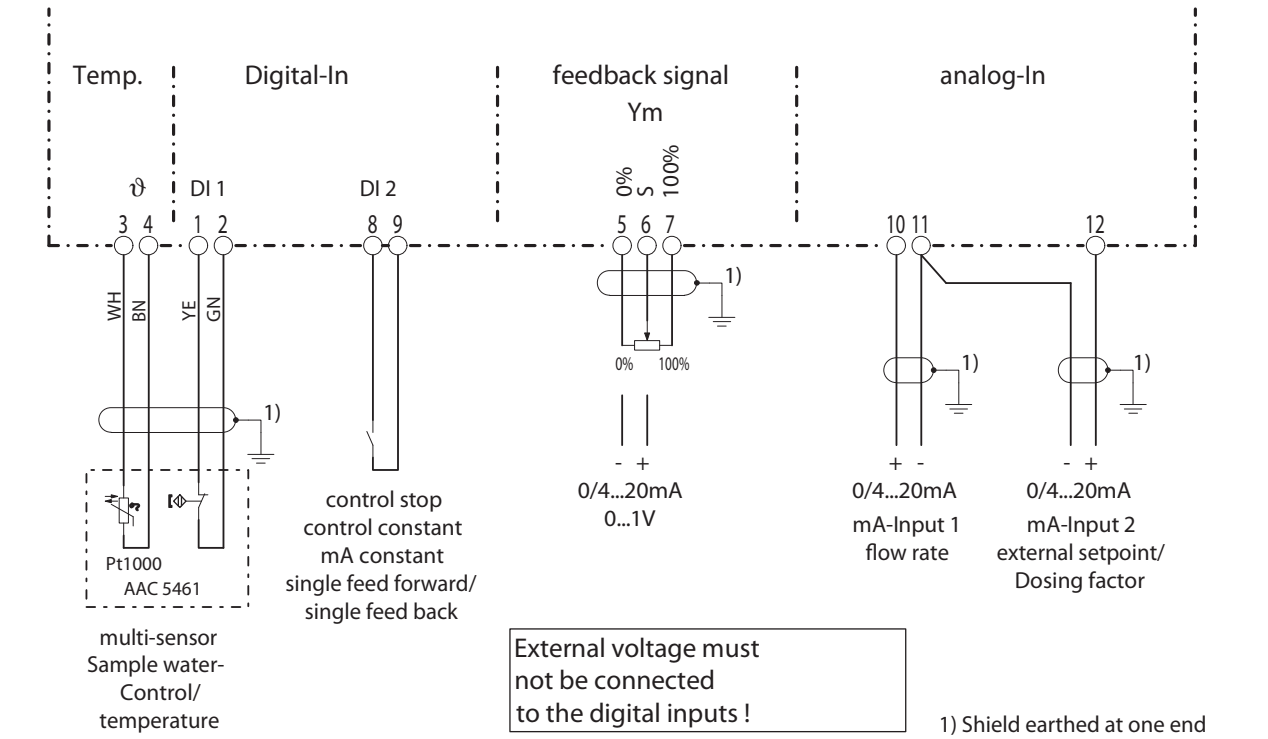
50.590.100.030
ISSUE 1 12-08



WALL MOUNT ASSEMBLY - DIMENSIONS
Single SFC Analyzer/Controller with Single Wet Side

50.590.100.040
ISSUE 1 12-08



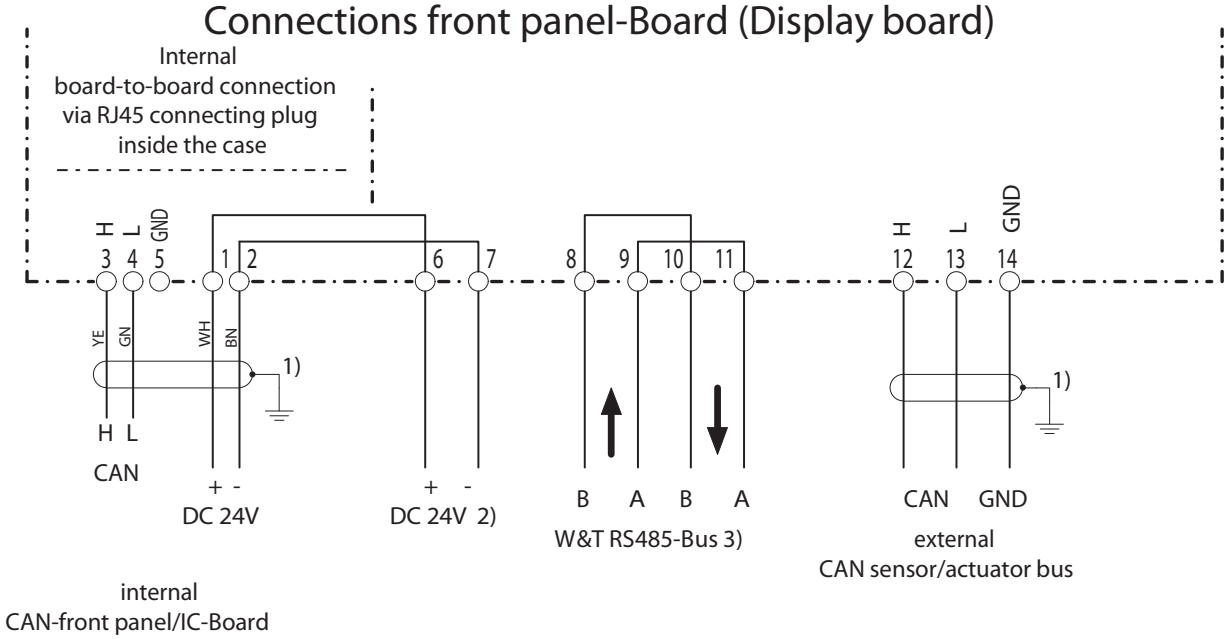


SFC - SCHEMATIC WIRING

50.590.155.010A

ISSUE 1 1-11

Connections front panel-Board (Display board)



1) Shield earthed at one end

2) Only use if not using terminals 1 + 2 or preassembled plug cable

3) For shielding concept or RS485 bus design, please refer to the RS485 instructions provided with the SFC unit.

SFC- SCHEMATIC WIRING

50.590.155.010B

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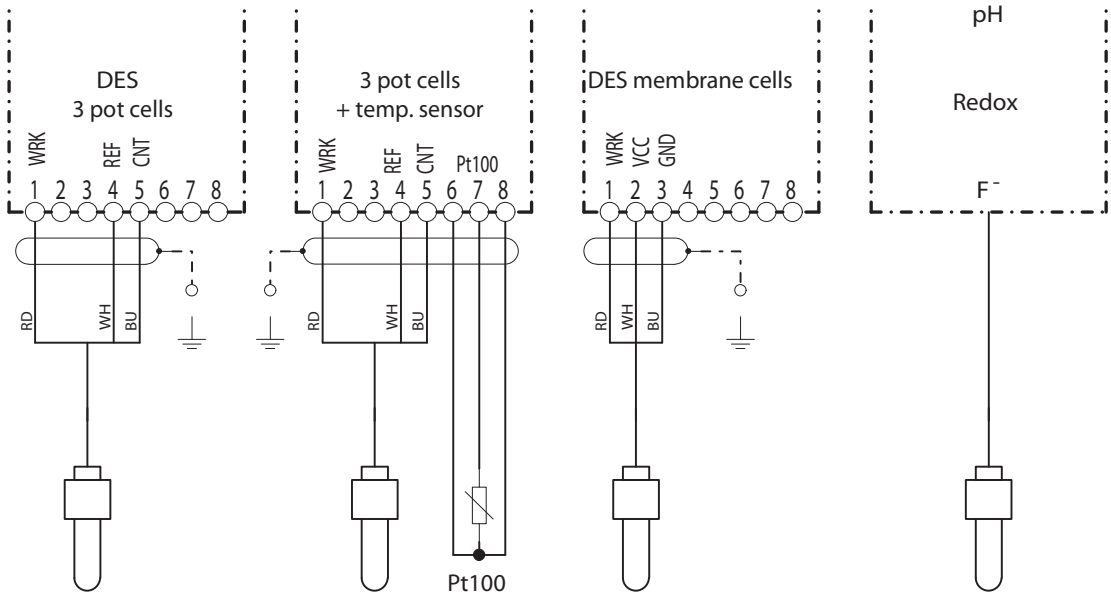
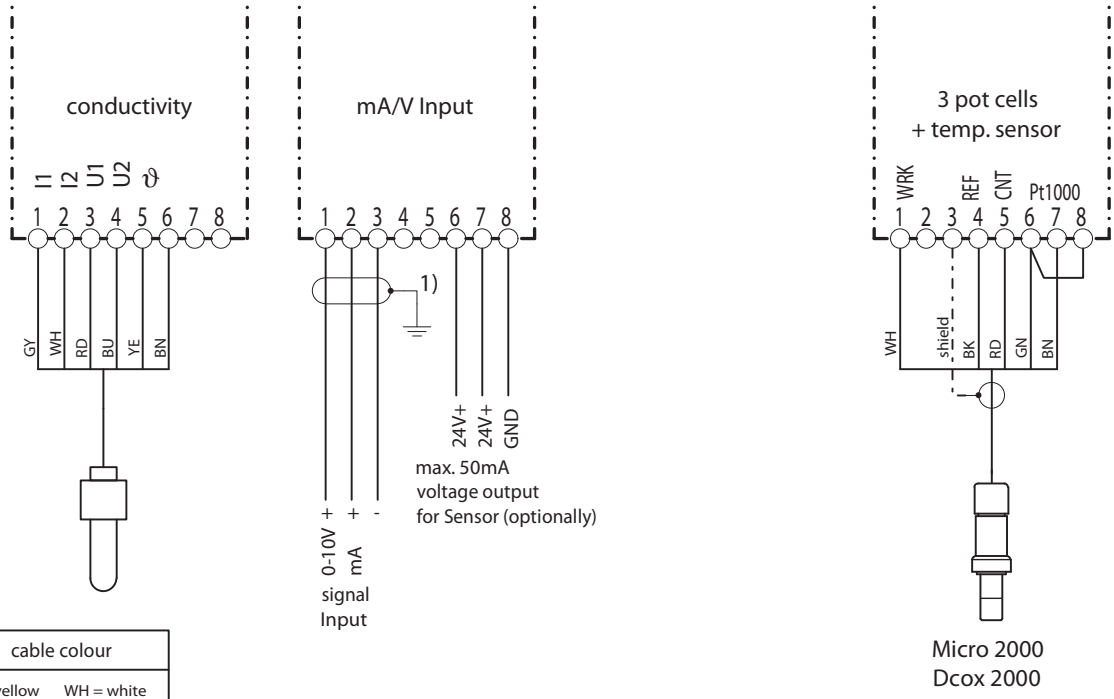
Connection (sensor) - measurement module



Depolox 5,

Depolox 3 Plus

membrane sensor



cable colour	
YE = yellow	WH = white
BN = brown	RD = red
GN = green	GY = grey
BU = blue	

Micro 2000
Dcox 2000

1) Shield earthed at one end

SFC - SCHEMATIC WIRING

50.590.155.010C

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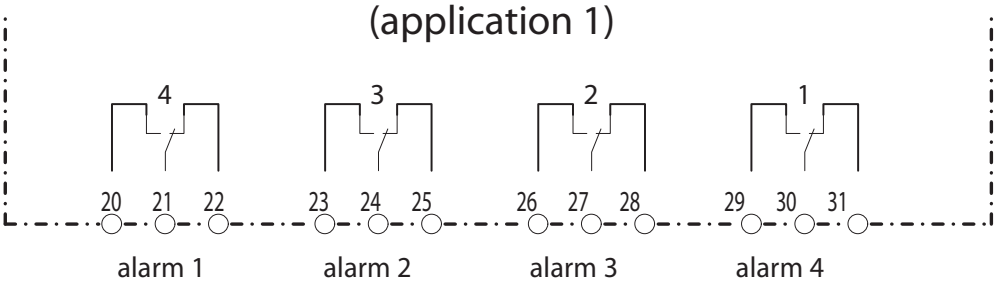
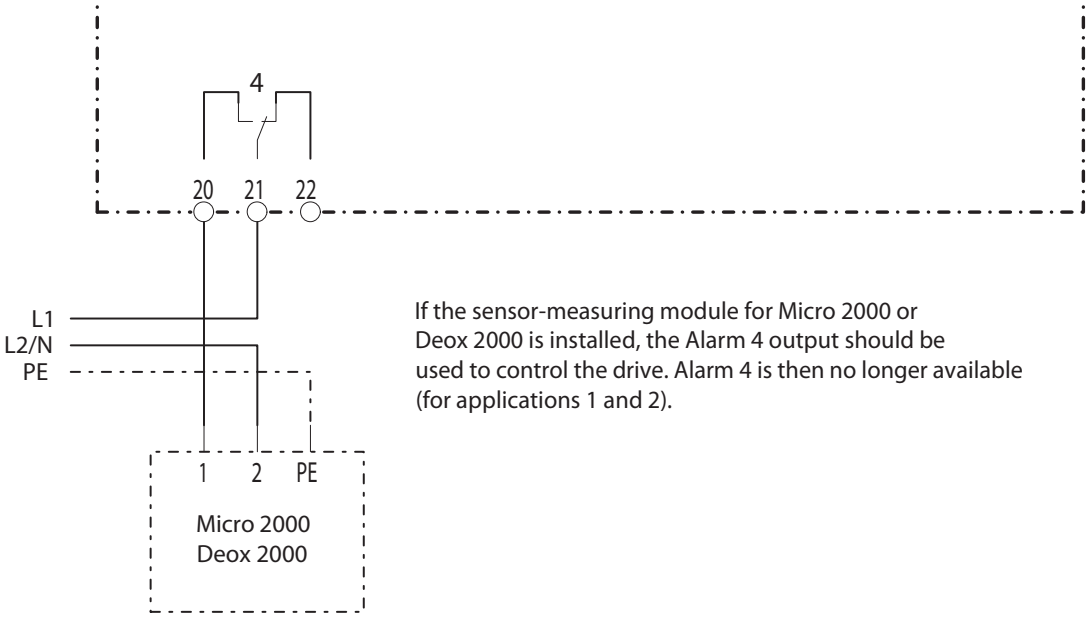
Relay-outputs IC-Board (Mother board) (application 1)



Connection from Micro 2000 / Deox 2000 Drive



If the sensor-measuring module for Micro 2000 or Deox 2000 is installed, the Alarm 4 output should be used to control the drive. Alarm 4 is then no longer available (for applications 1 and 2).

Mains voltage
Drive for Micro 2000 / Deox 2000
3-electrode cells

External voltage may still be connected even when the main switch is set to OFF !

SFC- SCHEMATIC WIRING

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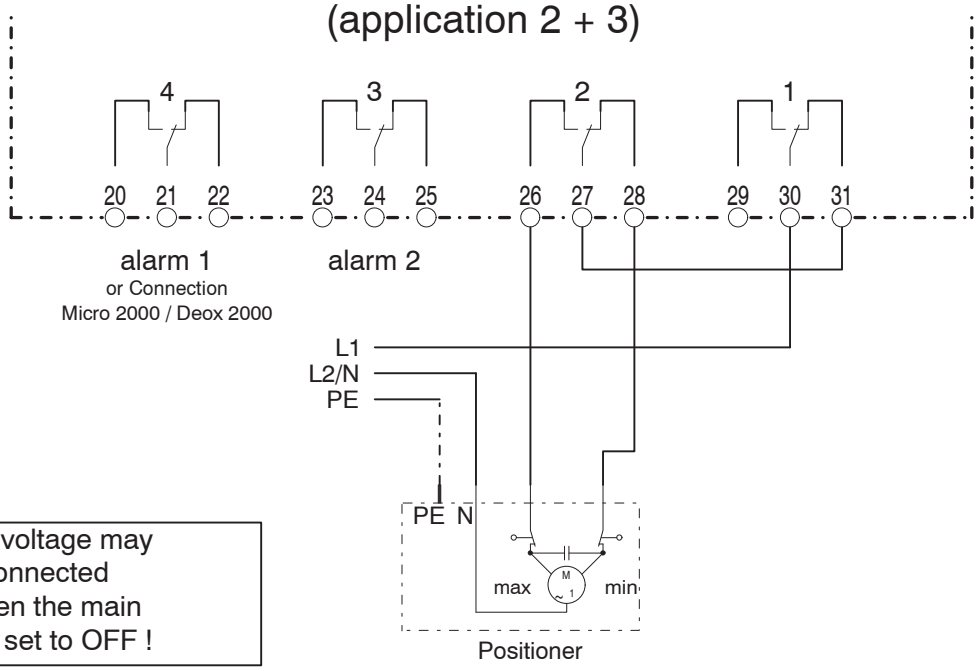
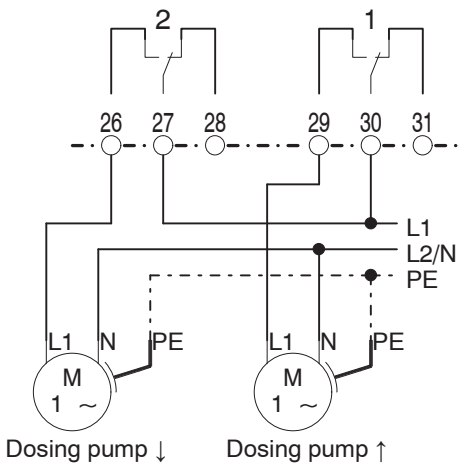
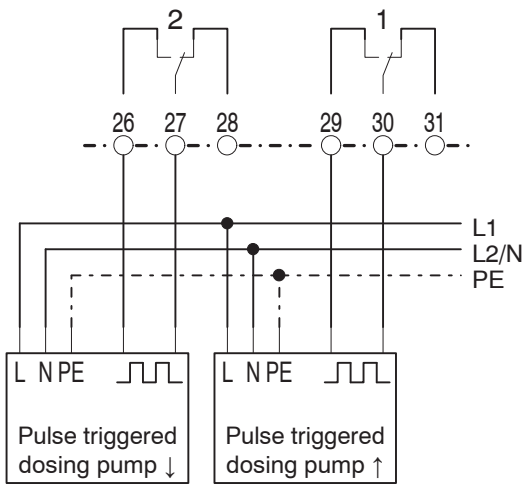
Relay-outputs(Mother board)
(application 2 + 3)

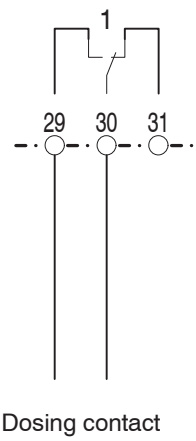


External voltage may still be connected even when the main switch is set to OFF !



To prevent starting delay we recommend to use pumps with external release signal input. In this case connect the release signal input directly to the relay contact.





SFC - SCHEMATIC WIRING

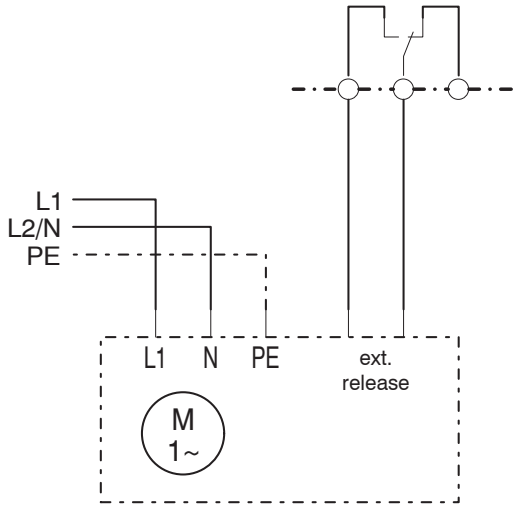
50.590.155.010E

ISSUE 0 10-08

Connection of a dosing pump with external release signal input contact

Note:

To prevent starting delay we recommend to use pumps with external release signal input. In this case connect the release signal input directly to the relay contact.

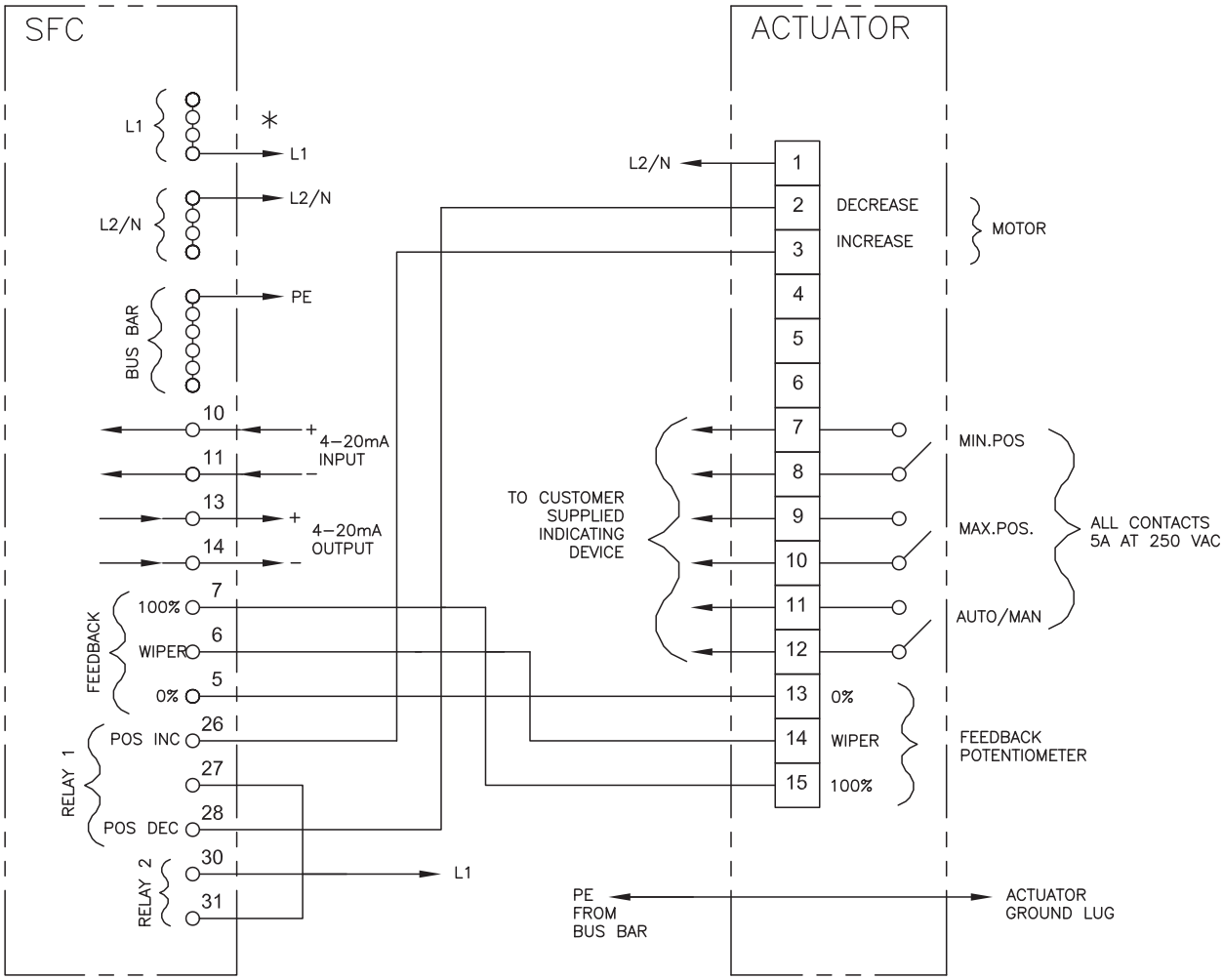


Dosing pump

SFC- SCHEMATIC WIRING

50.590.155.010F

ISSUE 0 10-08



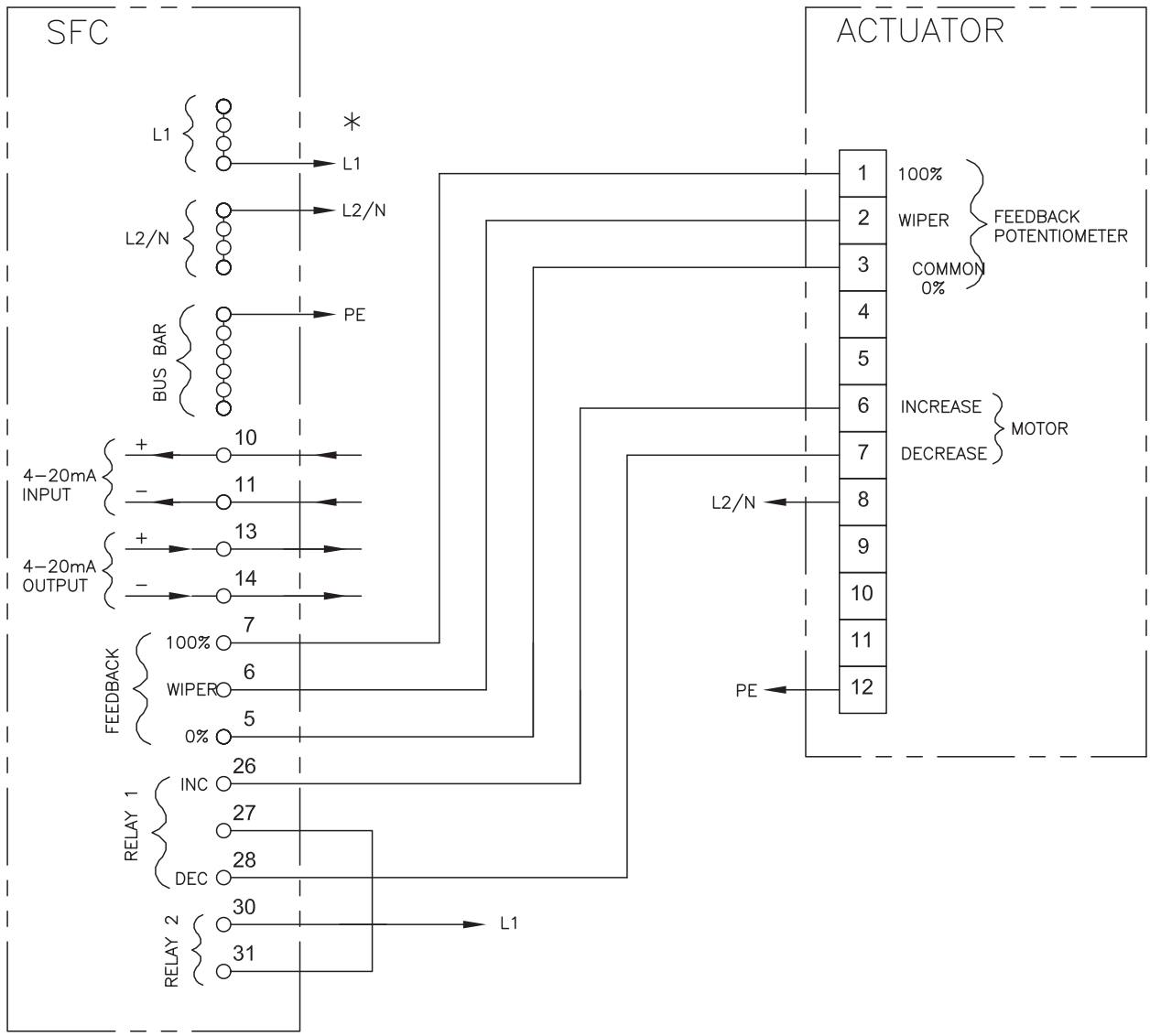
NOTE: —— FIELD WIRING (NOT BY EVOQUA WATER TECHNOLOGIES) MUST CONFORM TO LOCAL ELECTRICAL CODES.

* POWER, L1/N AC, 100...125 VAC.
L1/L2 AC, 220...240 VAC.

CONNECTING SFC TO MOTOR CONTROLLED ACTUATORS - INSTALLATION WIRING

Used with V10K and S10K Gas Feeders; Encore® 700 Series Metering Pumps;
and LVN-2000 Liquid Chemical Feed System
V-Notch - W2T11479 (115VAC); UXA96285 (230VAC)
Pump - W3T108074 (115VAC); W3T108075 (230VAC)

50.590.130.010
ISSUE 3 6-14



NOTES:

1. —— FIELD WIRING (NOT BY EVOQUA WATER TECHNOLOGIES) MUST CONFORM TO LOCAL ELECTRICAL CODES.
2. RELEVANT INTERNAL FACTORY WIRING FOR W3T110034 ACTUATOR TERMINALS IS AS FOLLOWS:

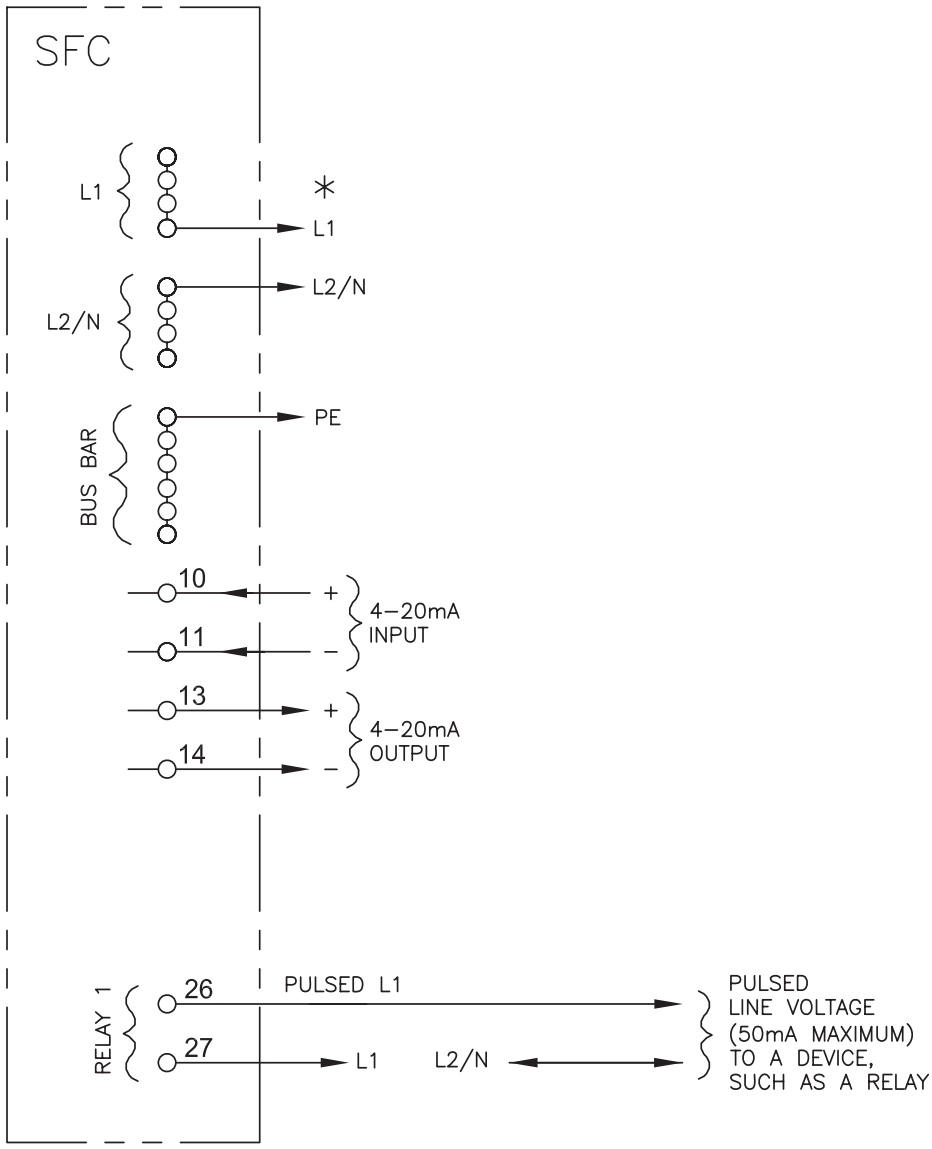
WIRE #	TERMINAL
16	4
17	4
18	5

3. ACTUATOR KIT W3T124548 REQUIRED FOR PROPER SFC-SC RELAY OPERATION.
4. ✱ POWER, L1/N, 100...125 VAC.
   L1/L2, 220...240 VAC.

CONNECTING SFC TO MOTOR CONTROLLED ACTUATORS - INSTALLATION WIRING

Used with V-2000 Gas Feeders
V-Notch - W3T110034

50.590.130.020
ISSUE 3 6-14

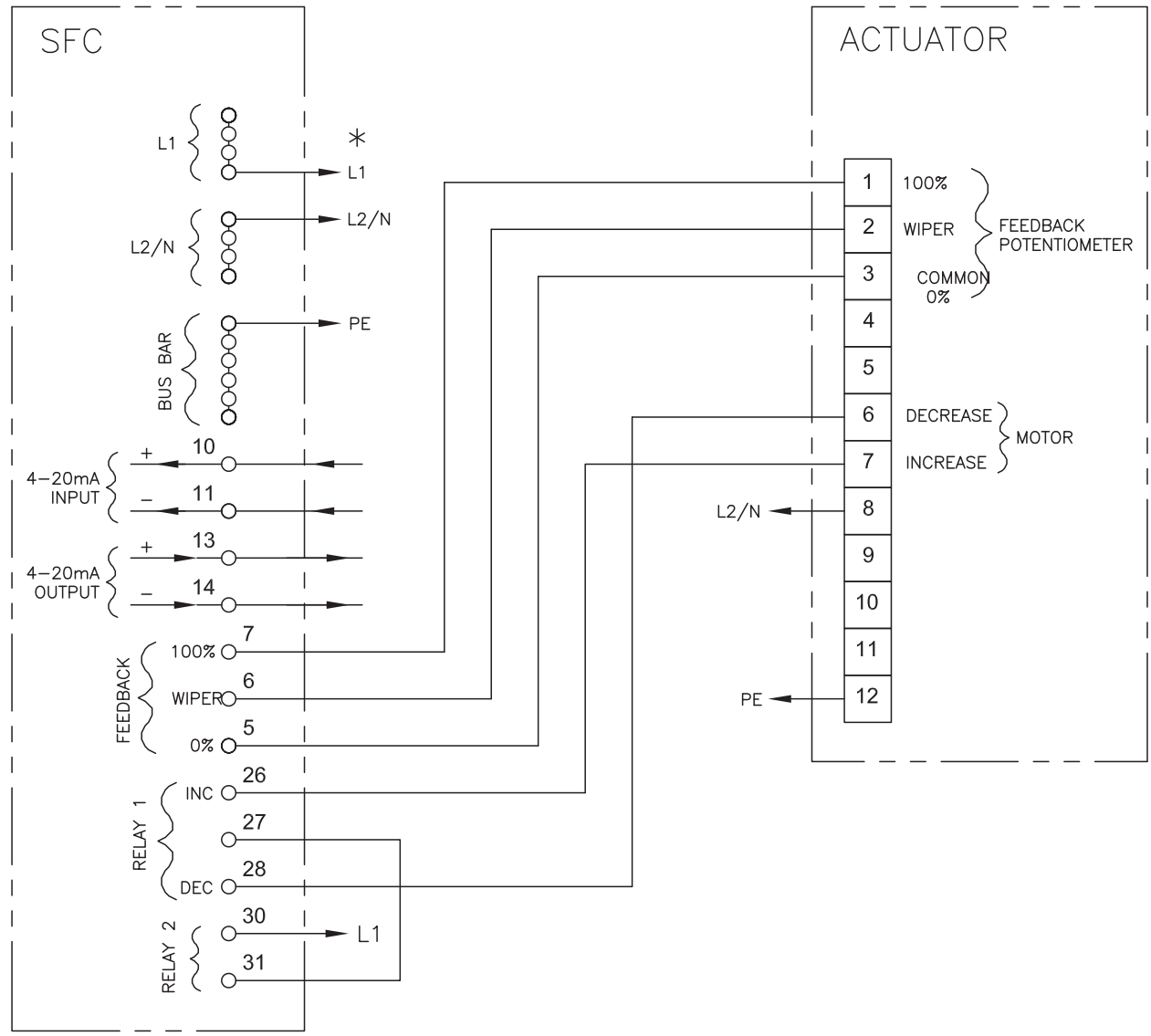


NOTE: —— FIELD WIRING (NOT BY EVOQUA WATER TECHNOLOGIES) MUST CONFORM TO LOCAL ELECTRICAL CODES.

* POWER, L1/N, 100...125 VAC.
L1/L2, 220...240 VAC.

CONNECTING SFC TO PULSE CONTROLLED DEVICE - INSTALLATION WIRING

50.590.130.030
ISSUE 2 6-14



NOTES:

1. —— FIELD WIRING (NOT BY EVOQUA WATER TECHNOLOGIES) MUST CONFORM TO LOCAL ELECTRICAL CODES.
2. RELEVANT INTERNAL FACTORY WIRING FOR U29202 ACTUATOR TERMINALS IS AS FOLLOWS:

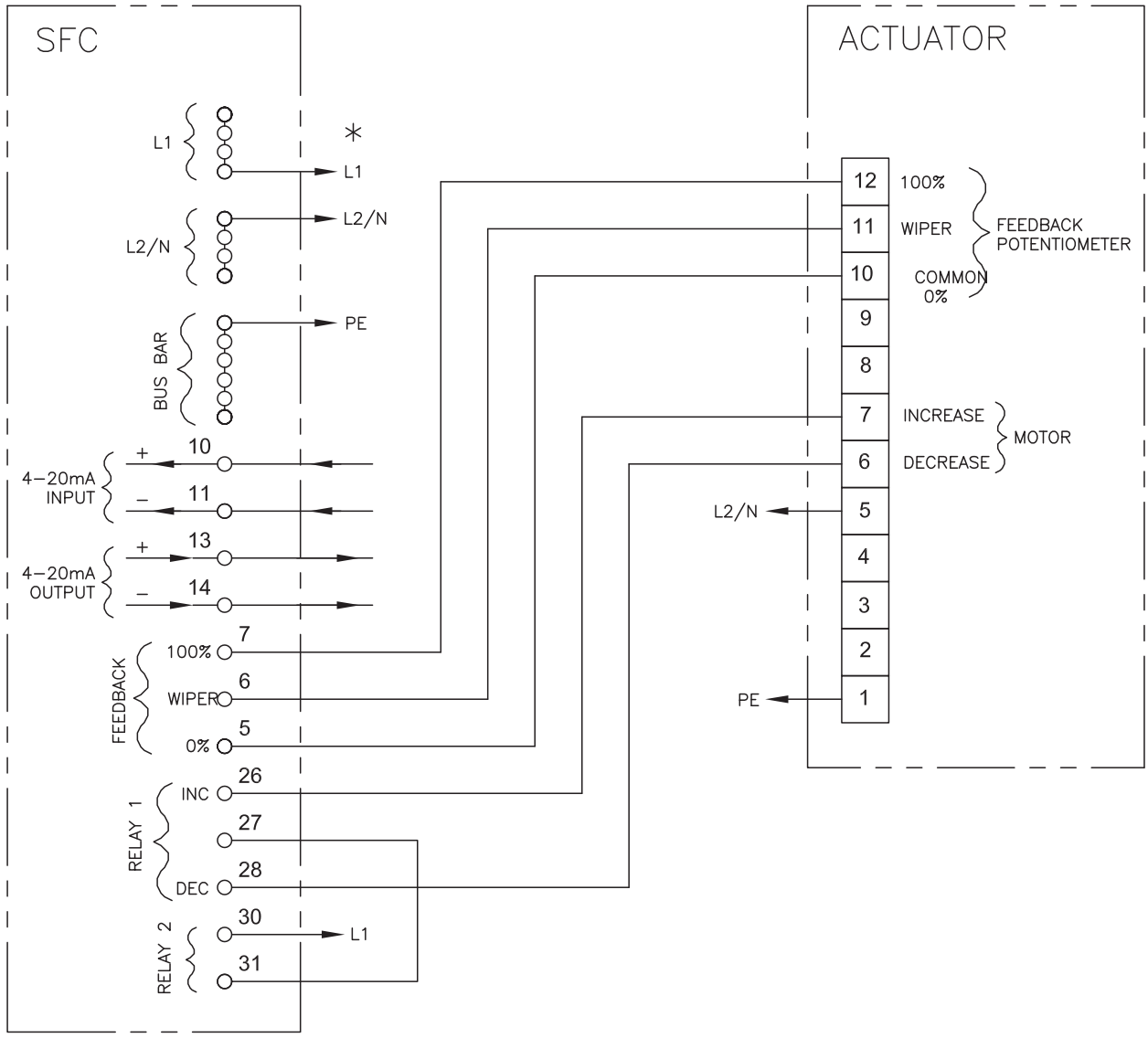
WIRE #	TERMINAL
16	4
18	4
17	5

3. ACTUATOR KIT W3T124548 REQUIRED FOR PROPER SFC-SC RELAY OPERATION.
4. * POWER, L1/N, 100...125 VAC.
   L1/L2, 220...240 VAC.

CONNECTING SFC TO MOTOR CONTROLLED ACTUATORS - INSTALLATION WIRING

Used with V-75, V-100 and V-500 Gas Feeders
V-Notch - U29202

50.590.130.040
ISSUE 3 6-14



NOTES:

1. —— FIELD WIRING (NOT BY EVOQUA WATER TECHNOLOGIES) MUST CONFORM TO LOCAL ELECTRICAL CODES.
2. RELEVANT INTERNAL FACTORY WIRING FOR U27960 ACTUATOR TERMINALS IS AS FOLLOWS:

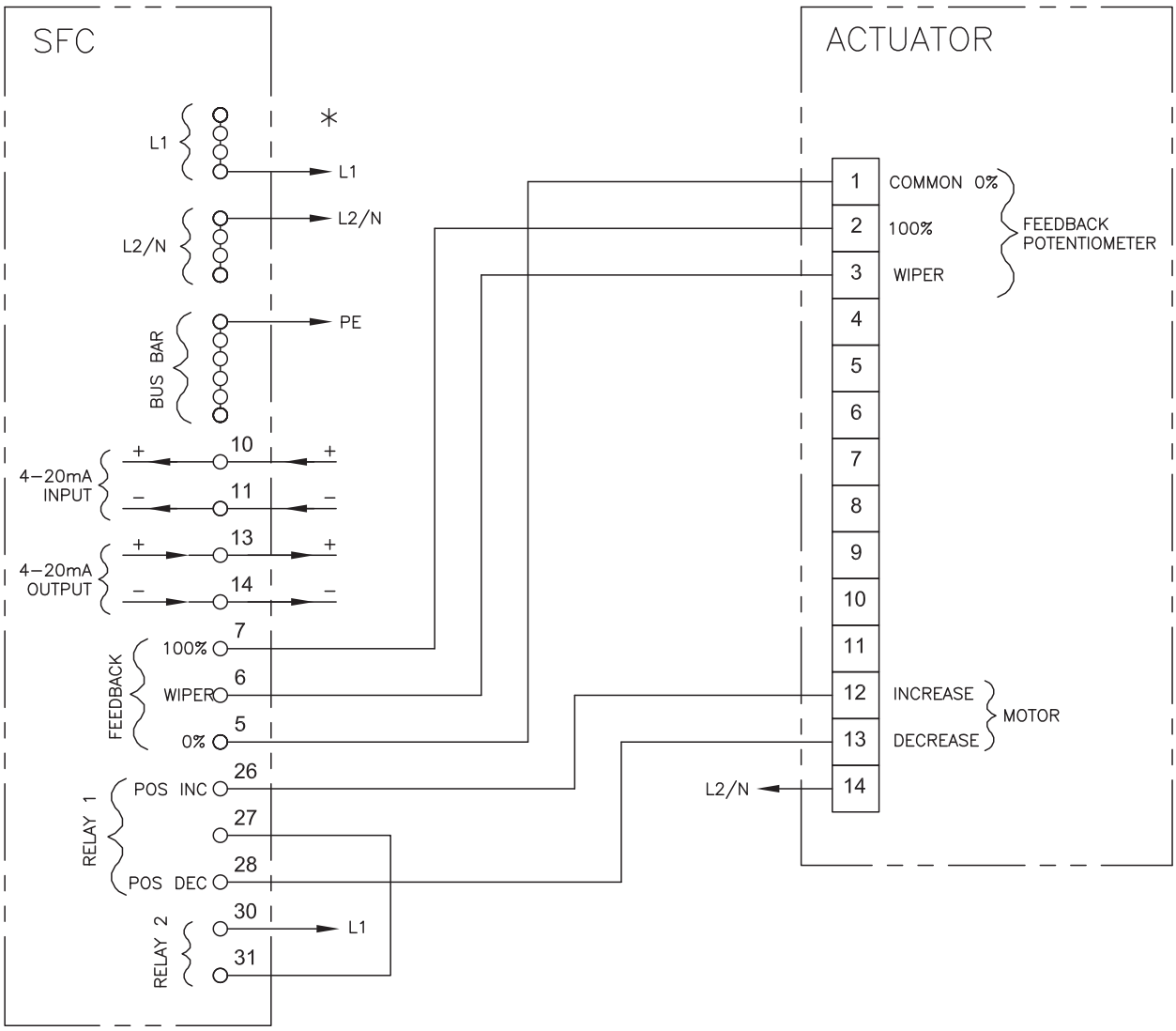
WIRE #	TERMINAL
16	9
17	9
18	8

3. ACTUATOR KIT W3T124548 REQUIRED FOR PROPER SFC-SC RELAY OPERATION.
4. * POWER, L1/N, 100...125 VAC.
   L1/L2, 220...240 VAC.

CONNECTING SFC TO MOTOR CONTROLLED ACTUATORS - INSTALLATION WIRING

Used with 44 Series Metering Pumps
Pump - U27960

50.590.130.050
ISSUE 3 6-14



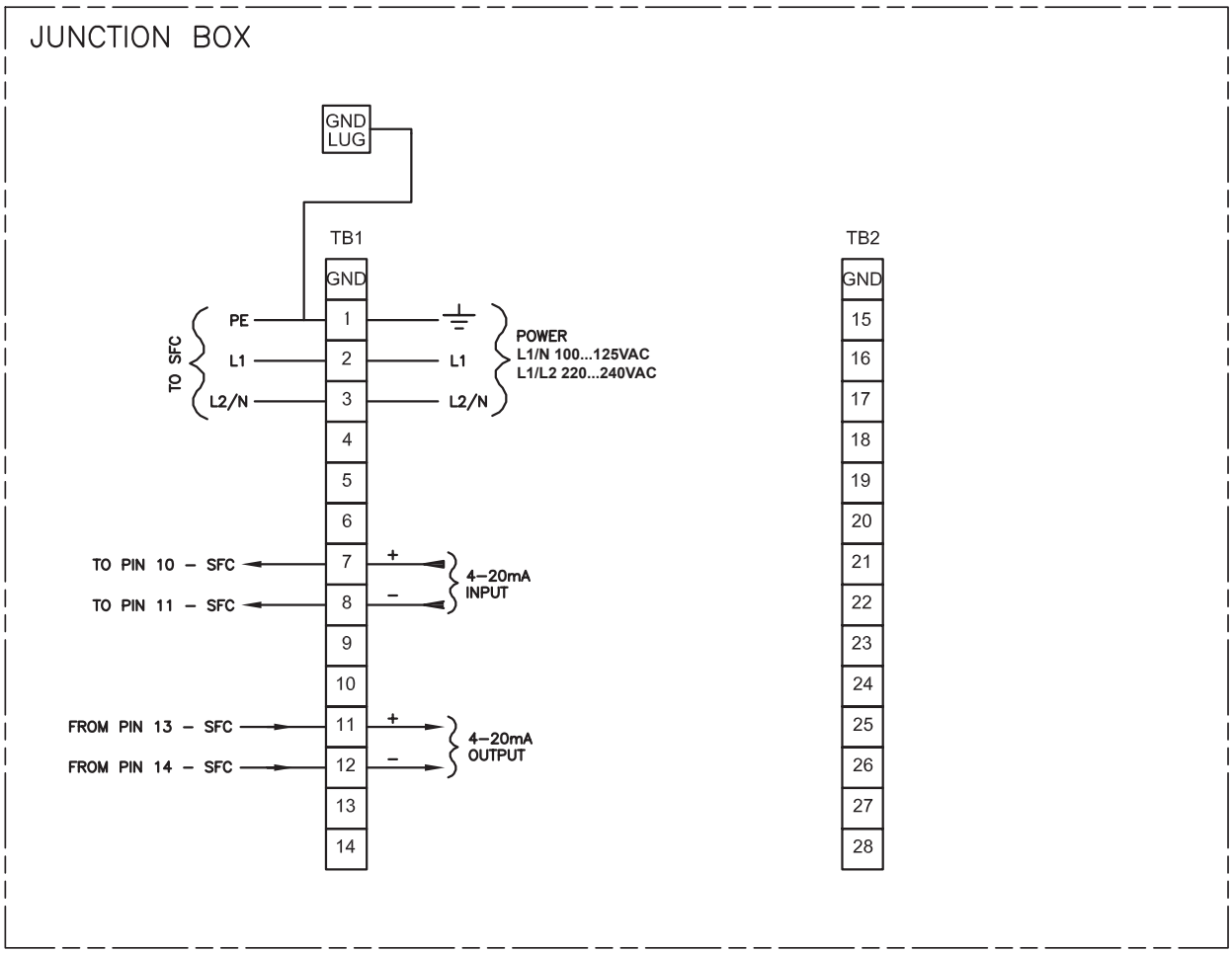
NOTE: ——FIELD WIRING (NOT BY EVOQUA WATER TECHNOLOGIES) MUST CONFORM TO LOCAL ELECTRICAL CODES.

* POWER, L1/N, 100...125 VAC
L1/L2, 220...240 VAC

CONNECTING SFC TO MOTOR CONTROLLED ACTUATORS - INSTALLATION WIRING

Used with Series 43-300 HATD Pumps
Pump - U28342

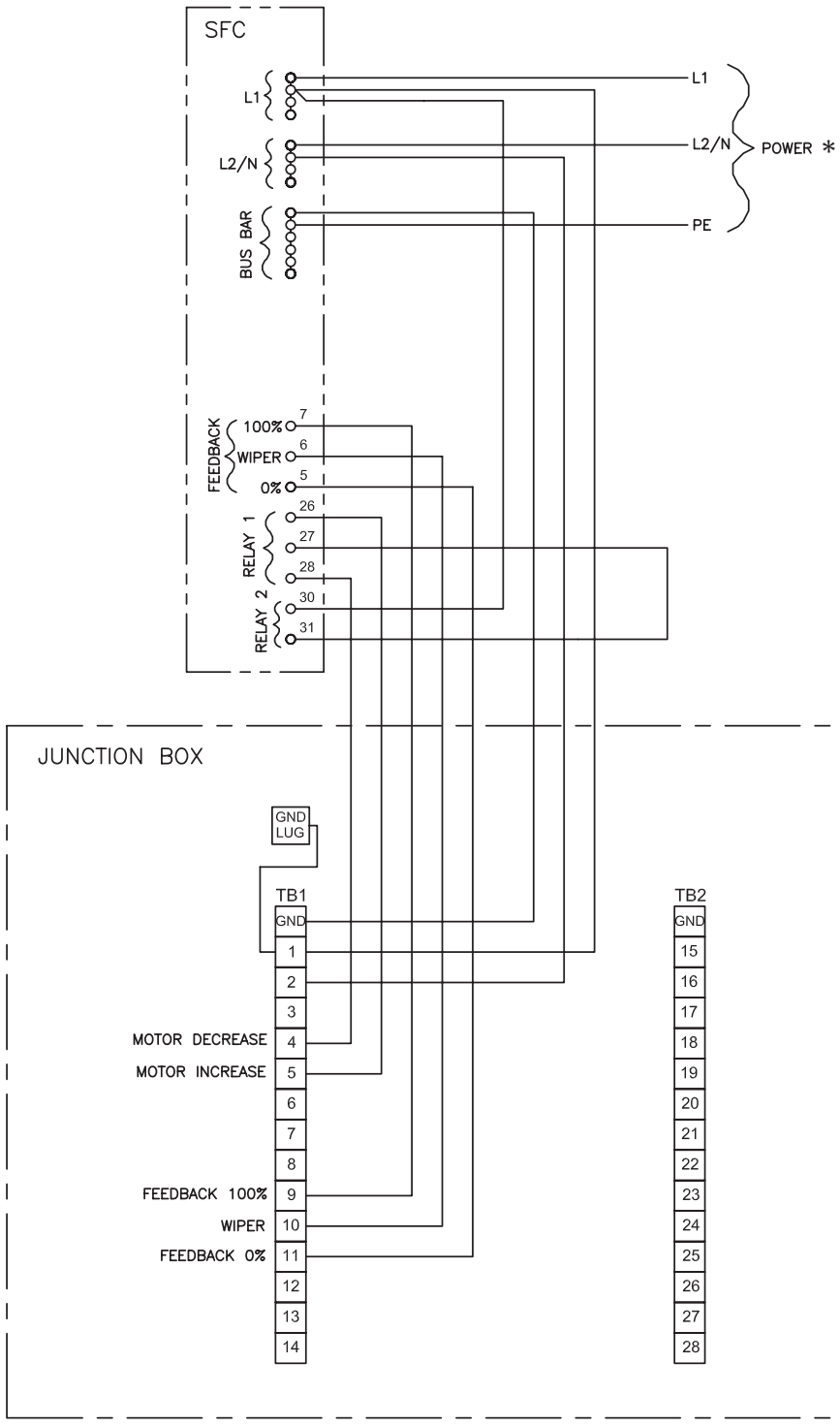
50.590.130.060
ISSUE 3 6-14



NOTE: ——FIELD WIRING (NOT BY EVOQUA WATER TECHNOLOGIES) MUST CONFORM TO LOCAL ELECTRICAL CODES.

MODULE MOUNTED SFC CONTROLLER
V-2000 MODULE MOUNTED GAS FEEDER - INSTALLATION WIRING

50.590.130.070
ISSUE 2 6-14

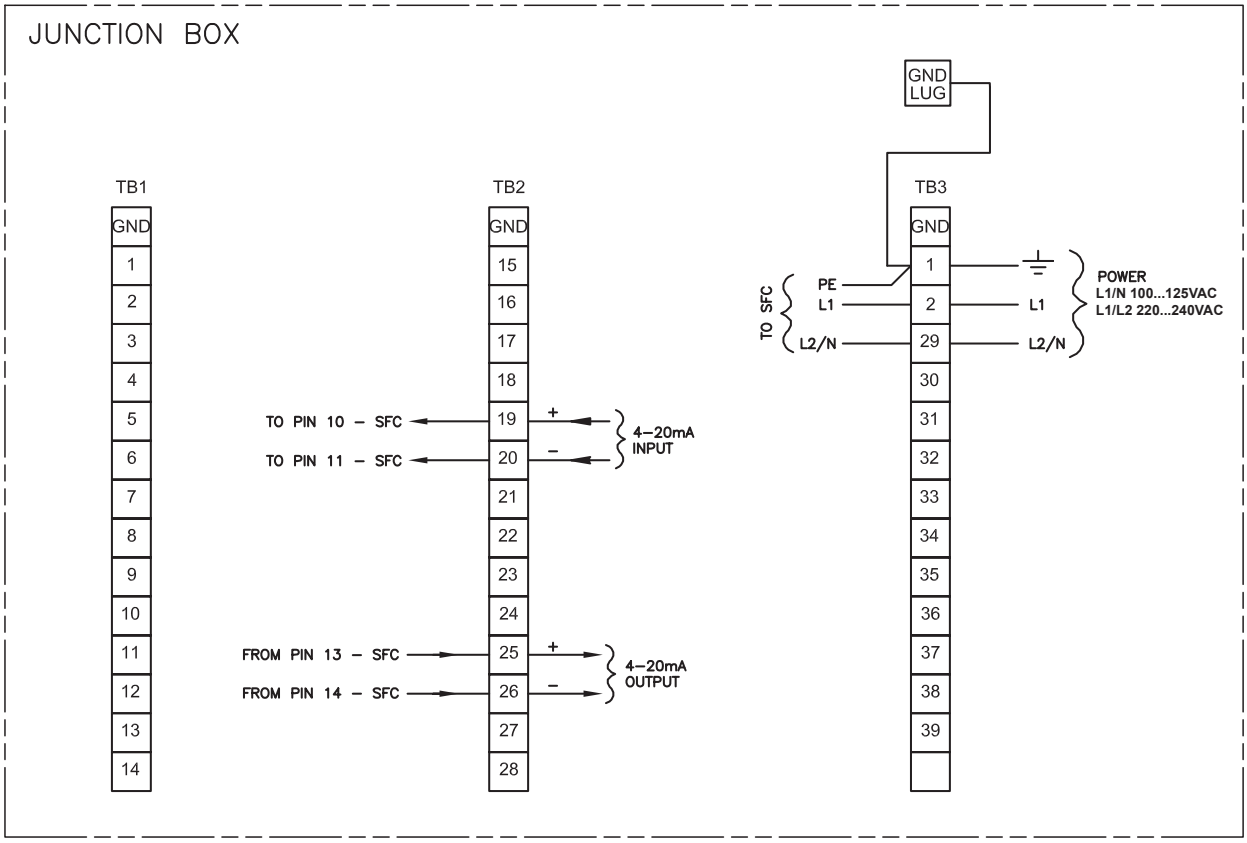


NOTE: ——FIELD WIRING (NOT BY EVOQUA WATER TECHNOLOGIES) MUST CONFORM TO LOCAL ELECTRICAL CODES.

* POWER, L1/N, 100...125 VAC.
L1/L2, 220...240 VAC.

REMOTE MOUNTED SFC CONTROLLER
V-2000 MODULE MOUNTED GAS FEEDER - INSTALLATION WIRING

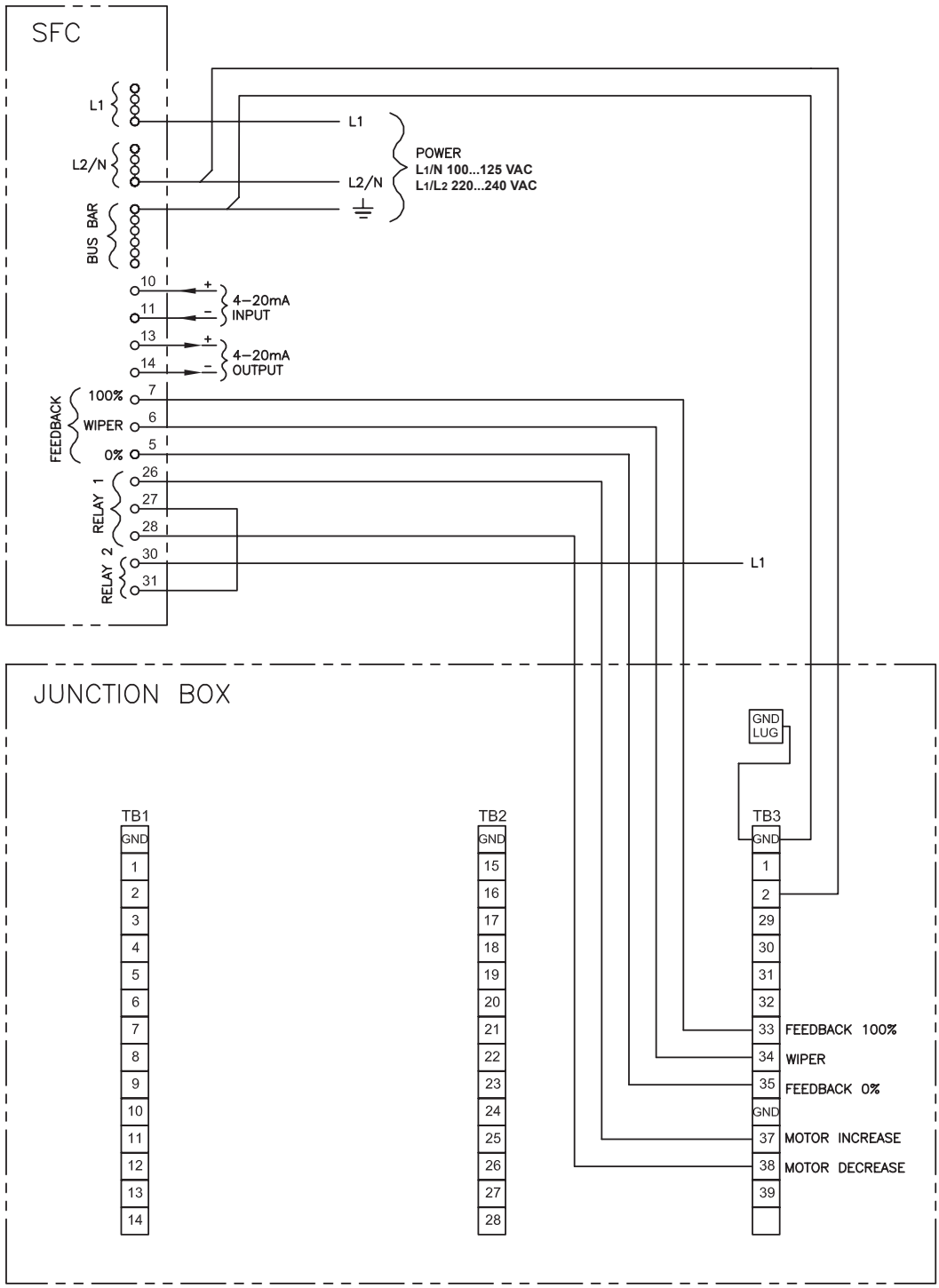
50.590.130.080
ISSUE 2 6-14



NOTE: ——FIELD WIRING (NOT BY EVOQUA WATER TECHNOLOGIES) MUST CONFORM TO LOCAL ELECTRICAL CODES.

SFC CONTROLLER IN WALL MOUNTED V-2000 GAS FEEDER - INSTALLATION WIRING

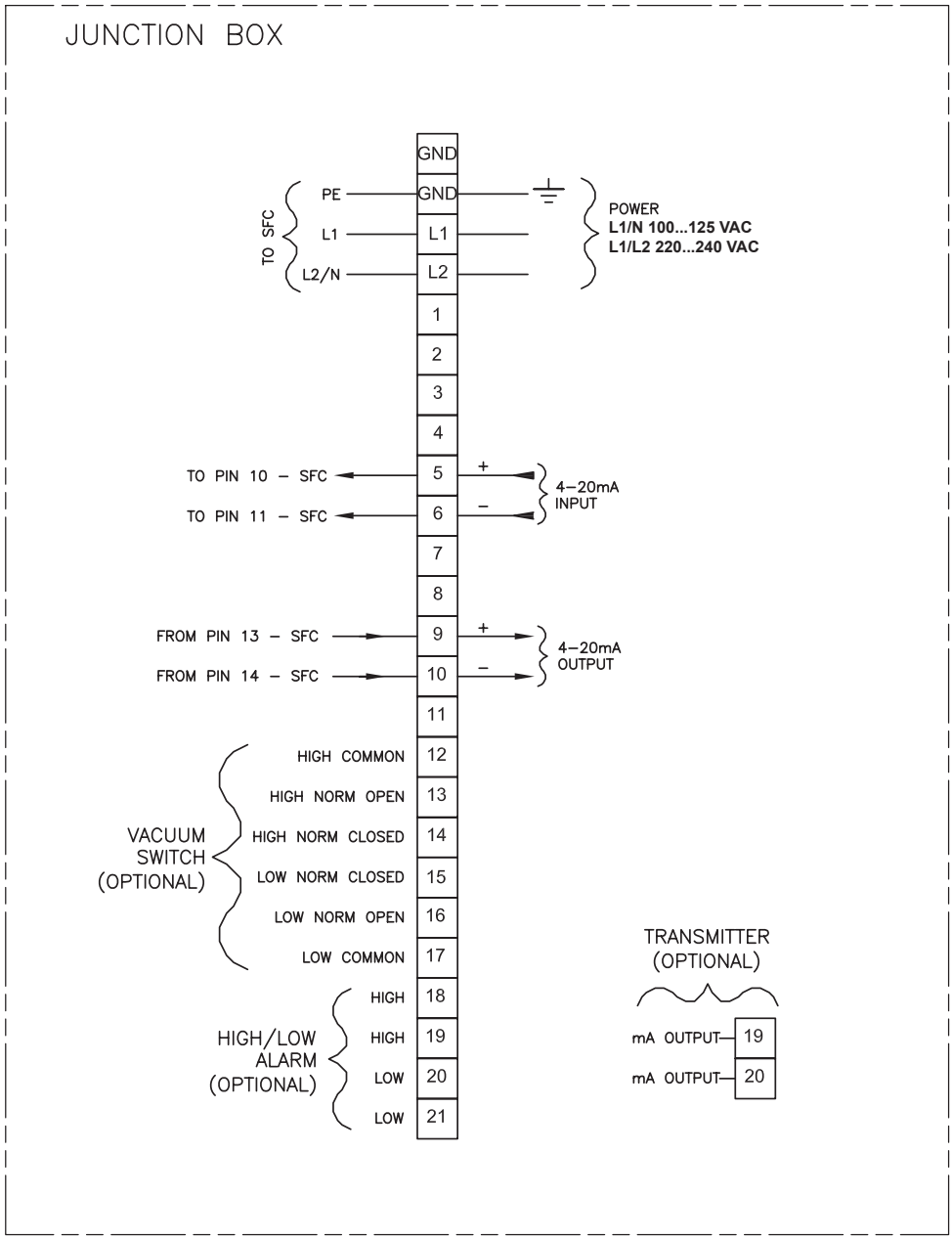
50.590.130.090
ISSUE 2 6-14



NOTE: ——FIELD WIRING (NOT BY EVOQUA WATER TECHNOLOGIES) MUST CONFORM TO LOCAL ELECTRICAL CODES.

REMOTE MOUNTED SFC CONTROLLER
V-2000 WALL MOUNTED GAS FEEDER - INSTALLATION WIRING

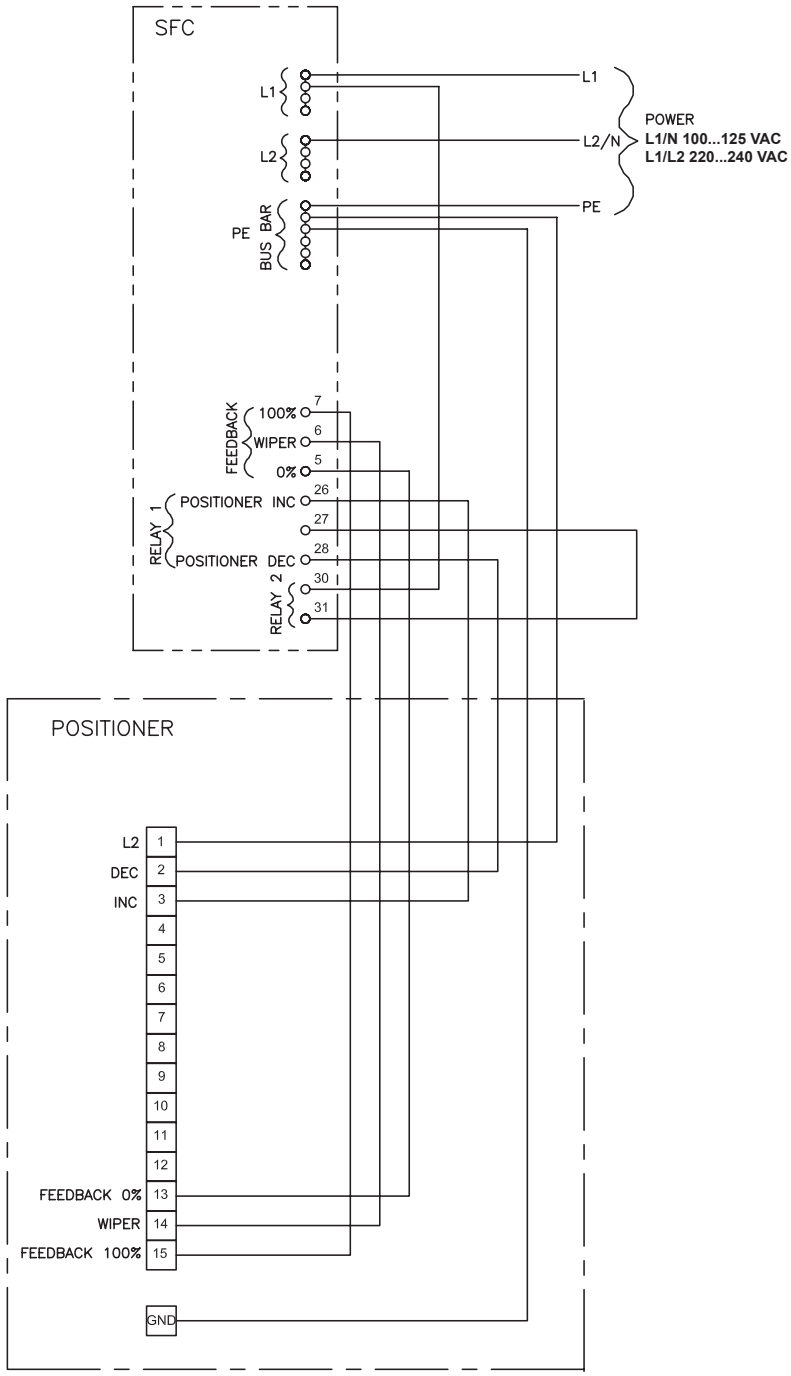
50.590.130.100
ISSUE 2 6-14



NOTE: ——FIELD WIRING (NOT BY EVOQUA WATER TECHNOLOGIES) MUST CONFORM TO LOCAL ELECTRICAL CODES.

PANEL MOUNTED SFC CONTROLLER
LVN-2000 LIQUID CHEMICAL FEED SYSTEM - INSTALLATION WIRING

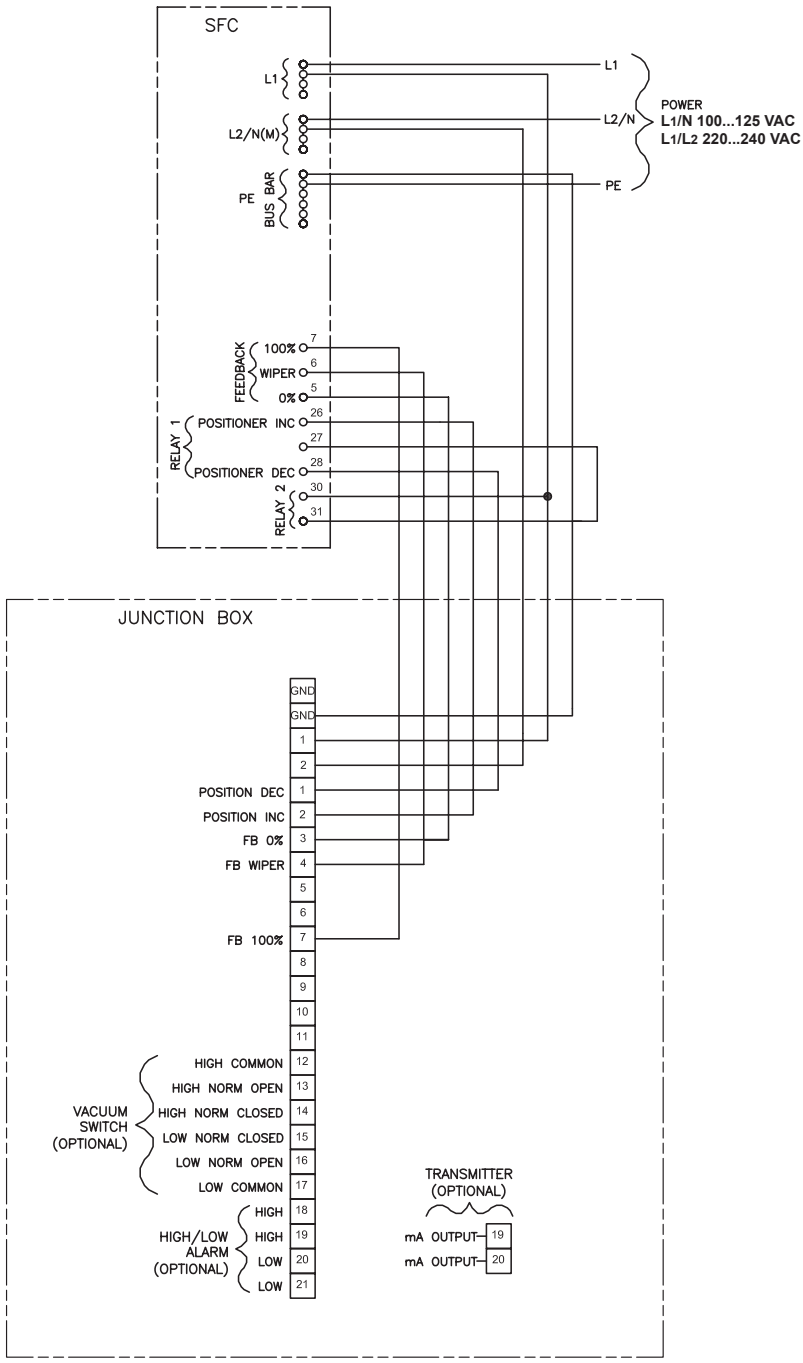
50.590.130.110
ISSUE 2 6-14



NOTE: ——FIELD WIRING (NOT BY EVOQUA WATER TECHNOLOGIES) MUST CONFORM TO LOCAL ELECTRICAL CODES.

REMOTE MOUNTED SFC CONTROLLER WITHOUT JUNCTION BOX
LVN-2000 LIQUID CHEMICAL FEED SYSTEM - INSTALLATION WIRING

50.590.130.120
ISSUE 2 6-14



NOTE: ——FIELD WIRING (NOT BY EVOQUA WATER TECHNOLOGIES) MUST CONFORM TO LOCAL ELECTRICAL CODES.

REMOTE MOUNTED SFC CONTROLLER WITH JUNCTION BOX
LVN-2000 LIQUID CHEMICAL FEED SYSTEM - INSTALLATION WIRING

50.590.130.130
ISSUE 2 6-14

SECTION 3

SECTION 3 - SETUP AND CONTROL FUNCTIONS

List of Contents

3.1 General Information

The SFC is a special measuring and control device for use on potable water, industrial process water and waste water.

Two different versions of the unit are available (see section 1.1) which differ in terms of their inputs and outputs. Version 1 analyzer or analyzer/controller supports all of the applications described in secton 1.1. Due to the restricted number of inputs and outputs, version 2 works as a controller only (SFC-SC and SFC-PC).

Typical applications:

- Measurement and monitoring of water parameters
- Flow-controlled potable water chlorination (combi-control)
- Flow-controlled fluroide dosing (combi-control)
- pH single feedback closed-loop control
- Chlorine single feedback closed-loop control
- Quantity-proportional dosing of disinfectants (ratio control)
- Quantity-proportional dosing of disinfectants with linearization of the actuator (with positioner)

Possible process measurements (only with applications 1 and 2) are:

- free chlorine
- combined chlorine
- total chlorine
- chlorine dioxide
- potassium permanganate
- ozone
- pH (Strantrol and Wallace & Tiernan)
- redox (Strantrol® HRR and Wallace & Tiernan)
- fluoride
- conductivity
- sulfur dioxide
- soduim bisulfite

As an option, two additional control signal inputs can be installed to log flow rate and external setpoint using combi-control or ratio control.

NOTE: For the simultaneous recornding of process measurements (Cl_2, pH, ...) an flow-controlled dosing of chemicals (ratio control, combi-control), it is necessaary to use sensor measuring modules with the process control option (see section 3.4, "Aplications").

The intergrated graphic display shows the following:

- Measured values
- Mode
- Bar graph with limit values
- Setpoint and measuring range
- Description of customized measuring points
- etc.

The menus are easy to use, displayed in plain text and are slected using softkeys.

A 30-day trend enables you to view past measured values of up to two selectable process variables (with SD card). Without SD card, the trend from 0-24 hours is displayed.

With the SD card installed, a measured value file is saved for every month, with the available measured values and the associated time. The file is a text file and can be opened with every editor.

A mA output and a RS485 bus interface, including Wallace & Tiernan protocol, are available to connect systems. Three different process applications, which reflect the variety of on-site conditions, are integrated into the SFC to simplify commissioning.

3.1.1 Overall Function

Possible measured values:

- Free chlorine*/Cl_2^{++}*, potassium permanganate*, chlorine dioxide*, ozone* (3-electrode cells)
- Free chlorine*, total chlorine*, potassium permanganate*, chlorine dioxide*, ozone* (Micro/2000® 3-electrode cell)
- Total chlorine*/Combined chlorine* (membrane sensor)
- Total chlorine*, sulfur dioxide* (Deox/2000® 3-electrode cells)
- pH value
- Redox voltage
- Conductivity*
- Ozone* (membrane sensor)
- Chlorine dioxide* (membrane sensor)
- Free chlorine* (membrane sensor)
- Fluoride
- External mA/V inputs
- Temperature measurement
- Actuator feedback

The value of the combined chlorine is calculated from the difference between the total chlorine and the free chlorine (optional). This requires a free chlorine and total chlorine measurement in the same sample water.

* These measurements are automatically temperature-compensated.

The Cl_2^{++} value is a pH-compensated chlorine measurement (optional). This requires a pH-measurement in the same sample water as the 3-electrode cell (Not applicable to Micro/2000® and Deox/2000®).

The graphic display shows the measured data, limit values and setpoints as numeric values, diagrams or a trend line.

3.1.2 Applications

Thecontrol functions available to the SFC are determined by the type of sensor measuring modules, the version of the SFC and the application selected.

Application 1	Only measurement (analyzer)
Application 2	Process measurement with various controller functions (analyzer/controller). • Single feedback closed loop control. • Combi-control (only with sensor measuring modules with the Process Control option). • Ratio control (only with sensor measuring modules with the Process Control option).
Application 3	Ratio control with linearization of the actuator (positioner), no process mesaurement or measured value display (SFC-SC and SFC-PC)

3.1.3 Controller Outputs

Controller outputs for positioners, dosing pumps, pulse pumps, continuous mA output as well as a sample line dosing contact. CAN actuators are also supported.

3.1.4 Adaption Program

The adaption program automatically determines the control parameters when commissioning the single feedback closed loop control (chlorine, chlorine dioxide, ozone and potassium permanganate modules only).

3.1.5 Safety Functions

The following safety functions are integrated into the control if configured accordingly:

- Safety cut-off if dosing tank signals empty and also if the sample water supply fails
- Dosing time delay (D1)
- Alarms
- External stop for all controllers with digital input
- “Positioner closed” function in the event of a power failure (only if positioner has external power supply)
- Password protection on two levels

3.1.6 Configuration Switch-Over

The SFC gives the option of either saving internally or loading all necessaary operating parameters as a configuration. A maximum of two configurations are possible. These can also be copied to or loaded from the optionally installed SD card.

3.1.7 Interfaces

The SFC supports the following links:

RS485 Interface

- CMS 3.0:
  Visualization software for archiving and display of measured values on PCs with Windows operating systems
- SECO-S7:
  PLC driver for data links to Evoqua PLC, Type S7-300
- OPC-Server Data Access V2.0:
  Server software for Windows operating systems for data links to visualization system with OPC client capability
- ChemWeb-Server:
  Measured value archiving and display, remote diagnosis, remote access with standard browser with Internet and e-mail capability
- Process control systems of different manufacturers
  (refer to the manual “RS485 Bus Interface for MFC” WT.050.580.002.UA.IM for description, specification and protocol)

CAN Interface

- The SFC has an integrated CAN interface. This is used for data exchange between CAN-capacble actuators and measuring and control devices. (See section 3.10, CAN Interface, for description and bus system.)

3.2 Measurement Inputs

In principle, the following sensor measuring module types or retrofit kits can be installed at the module slot. The sensor measuring modules are only supported in applications 1 and 2:

DES	-	for 3-electrode cell (Depolox® 5)
DES	-	for 3-electrode cell with PT100 temperature option (Depolox® 3 plus)
DES	-	for free chloring (FC1), chlorine dioxide (CD7), ozone (OZ7), and total chlorine (TC1) membrane sensors
DES	-	for Micro/2000® analyzer with PT1000
DES	-	for Deox/2000® analyzer with PT1000
pH	-	pH value (Strantrol and Wallace & Tiernan)
mV	-	Redox value (Strantrol® HRR and Wallace & Tiernan)
F^-	-	Fluoride value
mS	-	Conductivity
mA/V	-	Input module

NOTE: As a 3-electrode cell, Depolox® 5 or Depolox® 3 plus can be connected. Both of these sensor measuring modules are available with the "Process Control" option (PC).

When the device is switched on, the menus are initialized according to the installed sensor module. If the sensor modules are changed at a later date, the user menus are automatically initialized when the device is switched on. If no sensor measuring module is installed when the unit Version 1, the message "No measurement available" appears. When delivered from the factory, version 1 (SFC/analyzer) is set to application 1, version 1 (SFC/analyzer/controller) is set to application 2. Unit version 2 (SFC-SC and SFC-PC) can only operate in application 3.

The sensor measuring module should be considered as the main measurement, and control functions such as ratio control, single feedback closed loop, and combi-control are supported depending on the Process Control option. No controller output is available for application 1.

3.2.1 mA/V Input Module

The mA/V input module is used for connecting sensors or external measurements with mA or voltage output signal. 0/4 – 20 mA signal or 0 – 10 V input voltage are possible.

Various controller functions are available depending on the application selected. If the mA/V module is used with the "Process Control“ option (PC), combi-control and ratio control are also available.

As measured value display, the unit and display format can be freely selected in the menu.

3.2.2 Temperature Measurement

The IC board of SFC has a temperature measurement for connecting a PT 1000 sensor (multi-sensor). This temperature measurement is used for temperature compensation of the "DES" module and pH measurement. The temperature is shown on the main display and can be calibrated if necessary. The measuring range is 0 – 50 °C. The unit may be adjusted to °F.

3.2.3 mA Inputs of the IC Boards

The IC board integrates two mA inputs (mA 1 and mA 2) for recording process parameters.

mA input 1	Used for recording the flow rate signal as 0 – 20 mA or 4 – 20 mA signal.
mA input 2	Used for recording an external setpoint value or dosing factor as 0 – 20 mA signal. Both input signals can be freely scaled in the menu (see Inputs/ Outputs menu).
Special Function	When measuring the combined chlorine, it is also possible to record the measured value "free chlorine", which is required for combined chlorine measurement, via mA input instead of CAN bus. However, ratio control and combi-control, with recording of the flow rate, will then no longer be supported by SFC.

3.3 Outputs

3.3.1 mA Output

The mA output of the SFC is electronically isolated and can be parameterized to 0–5 mA, 0–10 mA, 0–20 mA or 4–20 mA in the menu. Any measured value, actuator output (Y_{out}) or temperature can be assigned to the mA outputs.

3.3.2 Relay Outputs

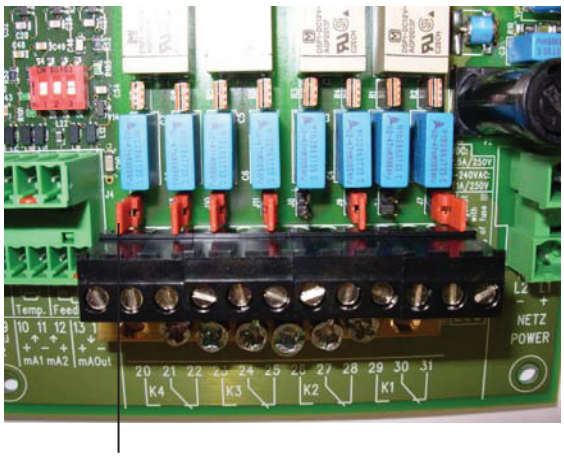
The SFC has a maximum of four relays, each with a two-way switch. These switches are assigned various switching tasks depending on the selected application (see section 3.4 - Applications). The corresponding diagrams for the three applications are in section 5 - SFC Wiring Diagrams. In order to switch larger inductive load, we recommend installing an additional contact such as a contactor or load relay, in order to guarantee the contacts have a longer service life.

Protection of the relay contacts of alarm and control outputs is provided at the factory using RC circuits. These provide radio interference suppression for inductive loads such as pumps, motors, etc.

Connection of small loads

When connecting small loads to the mains voltage, e.g. contactors or positioners with low power consumption (e.g. V10K), the closed-circuit current via the RC circuits can suffice to activate the loads (humming of the positioner, contactor is not deactivated, etc.). In this case, the plug-in jumpers of the relevant contacts should be removed to deactivate the RC circuits.

K1	J6/J7	K3	J10/J11
K2	J8/J9	K4	J12/J13



Plug-in jumpers

Figure 3.1 - Connection diagram

3.4 Applications

The configuration of the system is determined by:

- The Version of the SFC
- The required measurement and control parameters
- The installed components
- The selection of the suitable application
- The type of sensor module installed

The SFC provides the option to customize the system to the various on-site systems using five integrated applications.

- Factory setting of version 1 - analyzer = application 1
- Factory setting of version 1 - analyzer/controller = application 2
- Factory setting of version 2 = application 3

The connections are determined by selecting the applications 1, 2, or 3. Factory settings are always set for the respective application. However, these can be customized to the respective system.

NOTE: The defined application 1, 2, or 3 must be entered the first time the device is switched on (see section 2.3.10, “Switching the device on”). It is then not possible to change this for the defined configuration, otherwise the incorrect controller outputs are activated.

The three applications 1, 2, and 3 are shown below.

3.4.1 Application 1 - Process Measurement

With application 1, the SFC operates exclusively as a measuring device. A maximum of four freely configurable alarm relays are available. The type of measurement is determined by the type of the sensor measuring module. Controller outputs are not supported in this application.

Figure 3.16 gives an overview of the available inputs and outputs of the SFC.

Application 1

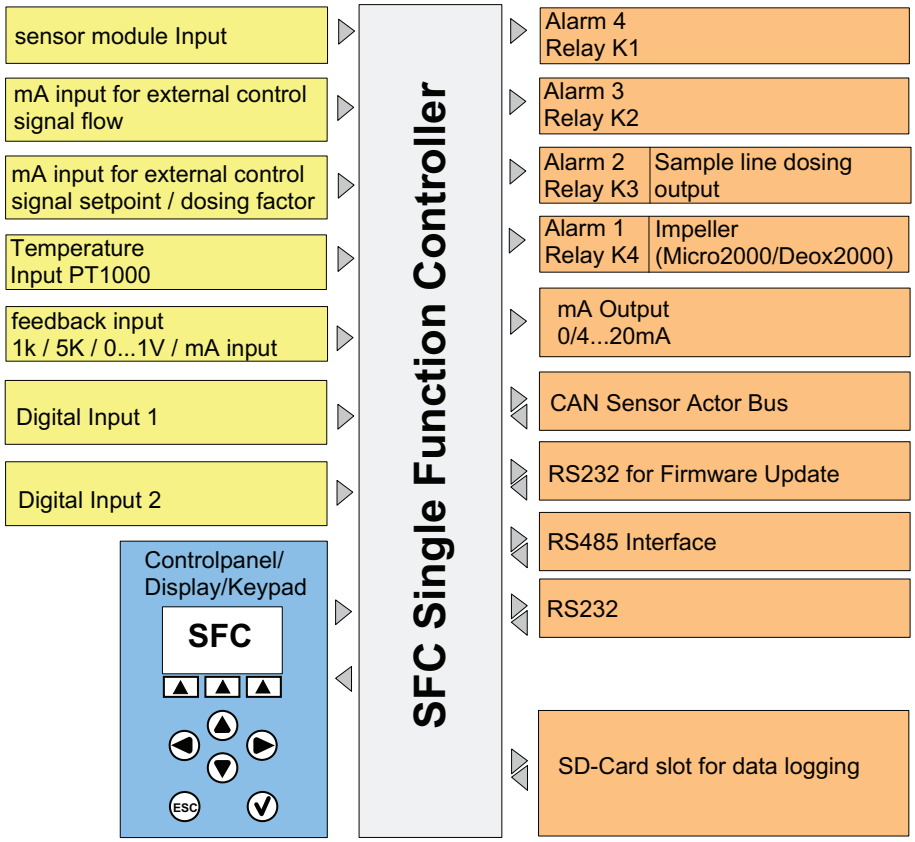


Figure 3.2 - Application 1

Figure 3.3 shows a sample implementation of application 1 as individual process measurement. The measured value can be forwarded via mA signal or CAN bus to a higher-level controller.

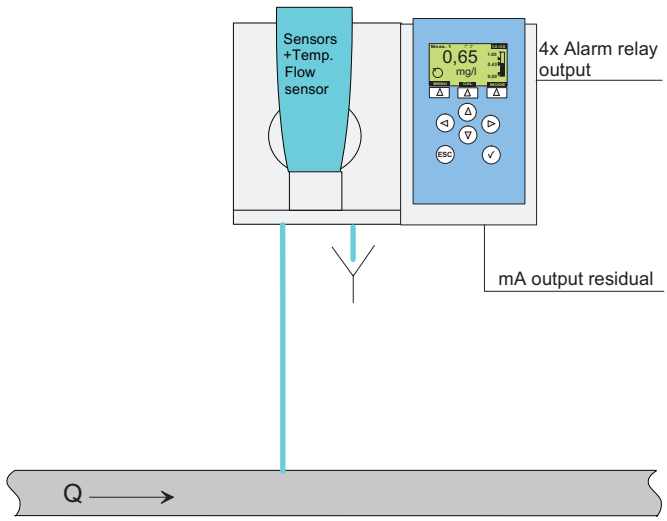


Figure 3.3 - Process measurement

3.4.2 Application 2

In application 2, the SFC works as a measuring device and as a control device. Various controller modes can be selected depending on the installed sensor measuring module:

- Sensor measuring module without "Process Control" option (PC)
  - Single feedback closed loop control
- Sensor measuring module with "Process Control" option (PC)
  - Single feedback closed loop control
  - Combi-control
  - Ratio control

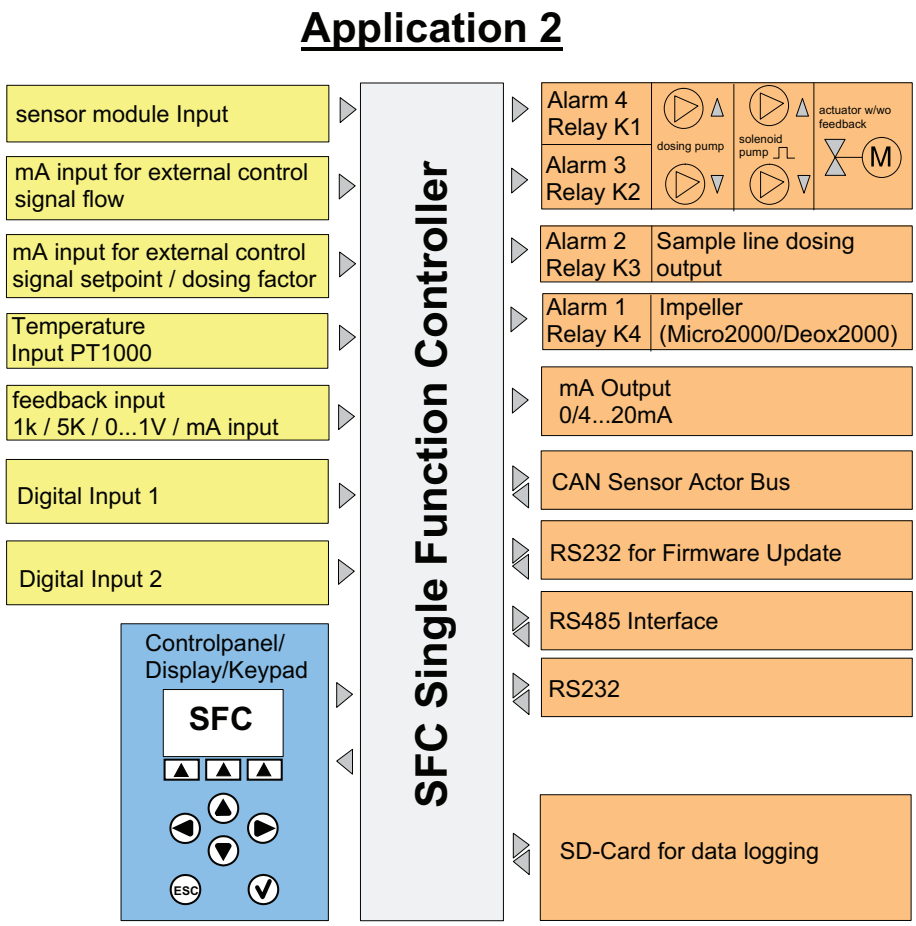


Figure 3.4 - Application 2

Controller functions in Application 2

The following integrated control modes are available for selection:

- Ratio control (with Process Control option)
- Single feedback closed loop control
- Combi-control (with Process Control option)
- Ratio control with linearization of the positioner output, with actuators with feedback output, (max. 11 calibration points) (with Process Control option).

Online measurements can be transmitted direct from the SFC by means of a sensor measuring module and from external measuring systems via mA input signal. External control signals, such as flow rate and external setpoint, are recorded by two integrated mA inputs. The SFC system can record a main measurement and two external control signals. In addition, measuring inputs for temperature, actuator feedback and two digital inputs are available.

3.4.2.1 Ratio Control and Flow Proportional

This operating mode controls the quantity-proportional dosing of disinfectants. The ratio control with process measurement is only supported with sensor measuring modules with the Process Control option.

A typical application is simple flow-controlled potable water chlorination, as shown in the following figure.

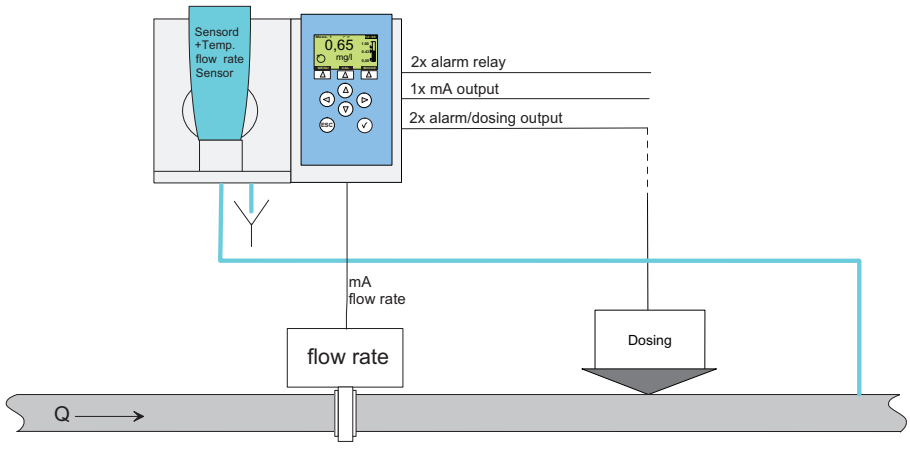


Figure 3.5 - Process measurement with ration control

Required module configuration:

- MOD1 -To record the measured value

Input signals:

- Module 1 measured value recording
- Flow rate measurement (0/4 – 20mA) scalable
- Second control variable is possible via sensor measuring module
- Internal or external dosing factor (0/4 – 20 mA)

The following controller outputs are possible:

- Dosing pump
- Pulse pump
- Positioner with feedback 1kOhm/5kOhm/0 –1 V/mA signal
- mA analog output

Ratio Control Theory of Operation

The flow rate is recorded and the dosing rate adjusted proportionally to the flow rate using the flow rate sensor with linear mA/V output signal.

For the flow signal settings, see menu “Input/Output” – “Flow Wq“.

NOTE: If the measuring range end value of the flow meter is not identical with the actual maximum flow rate, a factor for adjusting the flow rate signal should be input in the menu "Inputs/Outputs“ - "Flow Wq“.

For example: Measuring range flow meter = 5000 l/h / max. flow rate = 2500 l/h => factor = 5000: 2500 = 2.0

The ratio between control variables and dosing output is determined by the internal dosing factor (control "Dos.Fact.Source” = internal), or it can also be set by an external mA/V input signal (Dos.Fact.Source = external).

You can switch between internal and external dosing factor (DF) via the digital input (“Dos.Fact.Source” = “external with DI3” or “internal with DI3”).

It is possible that a second control variable “Measured Value X” (measured value from module 1) will proportionally or reverse proportionally influence the ratio control (“X-direction” = direct / inverse variable).

The second control variable X is activate if the parameter “Control Variable X” “Measured Value X” (second control variable deactivated by “Off” setting (factory setting).

The amplification factor for this parameter is defined by the X-factor input parameter.

The controller output is calculated in this operating mode as follows:

Yout = Wq x DF x (X-measured value x X-factor) x Yout-factor

Wq	*Control variable 1 flow in %*
DF	*Set dosing factor in %*
X-measured value	*Control variable 2 measured value sensor measuring module 1 in %*
Yout	*Amplification factor for X measured value*
Yout	*Determined controller output value %*
Yout factor	*This factor gives the option of increasing the dosing output by a dosing factor DF of 100% when the setpoint value is not reached.* *Increase the dosing output.* *Setting range: 1.0– 4.0* *Factory setting: 1*

NOTE: If this factor is increased, there is a danger that the setpoint value will also not be reached with a higher flow rate value, because the Yout value takes the value 100 % prematurely.

Single Feedback Closed-Loop Control with Process Measurement

This operating mode controls the desired measured variable according to the provided setpoint. Single feedback closed loop control is supported with all sensor measuring modules (with and without the Process Control option).

The following figure shows a typical application of a chlorine single feedback closed loop control for tanks which are circulated in cycles.

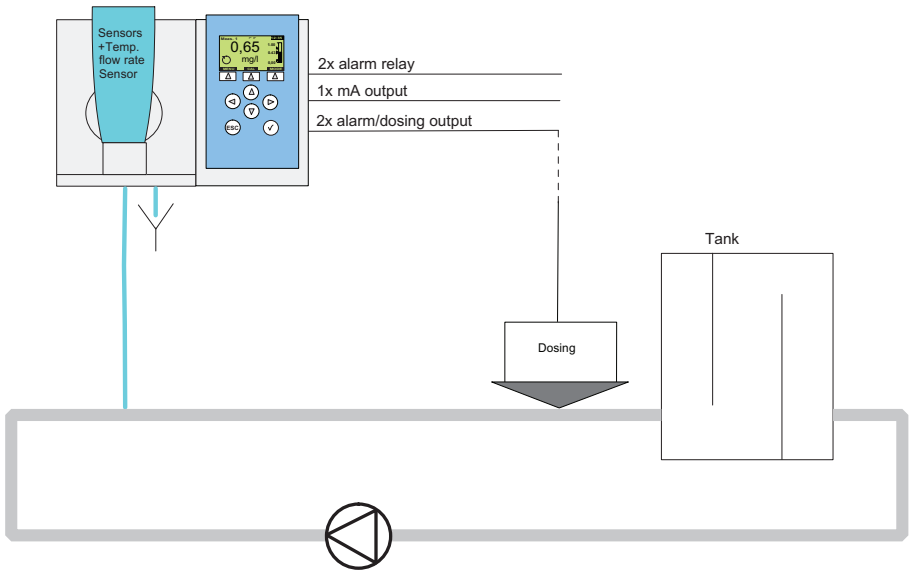


Figure 3.6 - Process measurement with single feedback closed loop control

<u>NOTE</u>: This control operating mode is only available when application 2 is selected.

Required module configuration:

- Sensor measuring module for measured value recording

Input signals:

- Measured value recording module
- Internal or external setpoint module

The following controller outputs are possible:

- Dosing pumps
- Solenoid pump
- Positioner with/without feedback (1kOhm/5kOhm/0-1 V/mA)
- Continuous
- CAN actuator

Single Feedback Closed-Loop Control Theory of Operation

A PI controller is used to control the measured variables of the sensor measuring module continuously and without control deviation from the desired setpoint. It continuously determines the required dosing output.

The setpoint can be set within the measuring range (at “Setpoint Source” = internal).

Xp and Tn are control parameters to be set. They can also be automatically determined via the integrated adaption during a chlorine control.

An external setpoint from 0–100 % can be provided via the mA/V input signal ("Setpoint Source" = external) You can switch between internal and external setpoint via the digital input ("Setpoint Source" = "external with DI3" or "internal with DI3").

The control direction can be selected with the parameter "Control Direction" = direct or inverse (e.g. direct = chlorination, inverse = dechlorination).

The controller output is calculated in this operating mode as follows:

Yout = Ypi = ek x Kp x (1 + t/tn)

t	*Controller cycle time*
tn	*Integral action time*
Kp	*Control amplification 100 / Xp*
ek	*Setpoint-actual value control deviation*
Ypi	*PI controller output variable*
Yout	*Determined controller output value %*

Compound Loop with Process Control

The compound loop control is a combination of the ratio control with additional single feedback closed-loop control to correct control deviations. The combi-control is only supported with sensor measuring modules with the Process Control option.

The following figure shows a typical chlorine combi-control as implemented in the treatment of potable water.

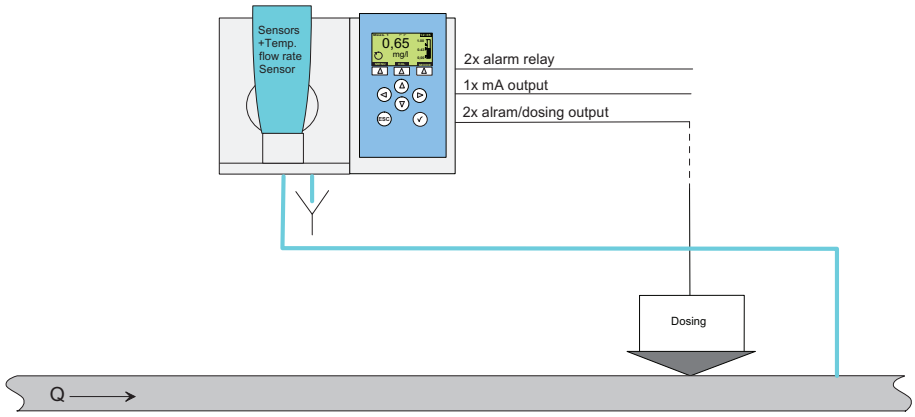


Figure 3.7 - Process measurement with combi-control

Required module configuration:

- Sensor measuring module for measured value recordning

Input signals:

- Flow rate measurement (0/4–20mA) scalable
- Measured value recording module
- Internal or external setpoint module

Output parameter:

- Dosing pumps
- Solenoid pump
- Positioner with/without feedback (1kOhm/5kOhm)
- Continuous
- CAN actuator

Compound Loop Control Theory of Operation

The combi-controller outputs a dosing rate proportional to the flow rate, which does not have a fixed dosing factor proportional to the flow rate as in the ratio control, but varies depending on demand.

To detect control deviations, the sensor measuring module records the control variable and a setpoint is specified, which are compared with the integrated single feedback closed-loop control.

The internal setpoint can be set within the measuring range. “Setpoint Source” must be set to “internal”. An external setpoint from 0–100 % can be provided via the mA/V input signal. “Setpoint Source” must be set to “external”. You can switch between internal and external setpoint via the digital input. The “Setpoint Source” must be set to “external with DI3” or “internal with DI3”.

The Xp and Tn control parameters of this higher-level single feedback closed-loop control are automatically determined by the integrated fuzzy logic Tconst and Tvar process times to be entered at 100 % flow rate. Because the Tvar process time changes, Tvar, Xp and Tn are continuously updated by the integrated fuzzy logic.

The SFC operates internally with a dosing factor table for 0 – 105% flow. In 5% intervals, the device determines the required dosing factors automatically during operation based on the corresponding flow rate. The single feedback closed-loop control corrections are transferred into the dosing factor table during this process. Non-linearities in the control loop are learned this way. This quickly activates the setpoint if flow rate changes occur.

The dosing factor table can be checked in the "Diagnosis" menu. It is possible to delete the dosing factor table and to initialize it with a particular dosing factor (factory setting: 50%), for example, in order to prevent too high dosing factors during commissioning. To do this, the required dosing factor must be entered in the menu "System" - "Reset" - "Dosing Factors".

The control operating mode can be switched between ratio control and single feedback closed-loop control via digital input.

The control direction can be selected with the parameter “Control Direction” = direct or inverse (e.g. direct = chlorination, inverse = dechlorination)

Behavior in Operation

Operation after a flow rate change:

The single feedback closed-loop control remains switched off (Ypi stop function) during the disturbance variables (flow rate change, positioner running time, dead time from line lengths). This maintains a stable control, which means the control operates with the dosing factor from the dosing factor table applicable for the new flow rate. The time the single feedback closed-loop control is switched off is determined by the fuzzy module and is therefore variable (“PI” display in seconds).

A larger change in the setpoint deletes all learning meters, in order to reinitialise the dosing rate curve when the setpoint is reached. However, the learned dosing factors remain initially unchanged. Inactivated flow rate values are automatically preassigned a dosing factor. The single feedback closed-loop control is always active.

Control deviations that occur are quickly offset by the PI single feedback closed-loop control during continuous flow.

A positive jump in the flow rate causes a brief drop below the setpoint due to the running time of the positioner and the dosing delay. Therefore, the PI controller freezes for a brief period (“PI” display in seconds).

A negative jump in the flow rate causes the setpoint to be briefly exceeded due to the running time of the positioner and the dosing delay. Therefore, the PI controller freezes for a brief period (“PI” display in seconds).

The PI controller is not deactivated if the flow rate is continuously rising or falling if the dosing rate can quickly adjust to these changes. This is true of fast positioner running times and loops without dosing delay.

Special Functions

- The control direction can be switched.
- Automatic determination of the control parameter using the integrated fuzzy module. The fuzzy module determines the control parameter from the embedded Tconst and Tvar process times.
- The setpoint can be switched between internal and external
- Ypi stop function during a change in control variable
- Control variable Wq available optionally as proportional or indirect proportional as well as factor adjustment
- Smooth switch from compound loop control to ratio control or residual only control via digital input 1, 2 or 3 available

$$Yout = Wq \times (DF_{Wq} + ek \times Kp \times (1 + t/tn)) \times Yout\ factor$$

Ratio — Feedback control

t	*Internal controller cycle time*
tn	*Integral action time*
Kp	*Control amplification 100 / Xp*
ek	*Setpoint-actual value*
DF_{Wq}	*Learned dosing factor for the current flow rate*
Wq	*Flow rate signal in %*
Yout	*Determined controller output value %*
Yout factor	*This factor gives the option of increasing the dosing output by a dosing factor DF of 100% when the setpoint value is not reached.* *Increase the dosing output.* *Setting range: 1.0– 4.0* *Factory setting: 1*

NOTE: If Yout factor is increased > 1, there is a danger that the setpoint value will also not be reached with a higher flow rate value, because the Yout value takes the value 100 % prematurely.

Determining Compound Loop Control Process Times

To adjust the control for compound loop control, the Tconst and Tvar process times must be entered in the parameter menu path. These times refer to control loop dead times,which on the one hand are independent of the control variables, and on the other hand depend proportionally on the control variables.

The constant dead time < Tconst > (independent of control variable) consists of the control variable measurement dead time (measuring dead time) and possible dosing delays.

The variable dead time < Tvar > depends on the current control variable and is entered in the menu at a control variable of 100%.

The following calculation examples apply for the use of the SFC for flow-controlled chlorine dosing with chlorine overfeed correction (potable water control loop).

Determining the Control Variable Independent Dead Time Tconst

The control variable independent dead time Tconst consists of the measuring dead time and the dosing dead time.

Calculating the Measuring Dead Time

Calculation 1:

The sample water is extracted right after the mixture loop and fed to the measuring cell.

The sample water dead time depends on the nominal diameter and length of the sample water line and the flow rate to the measuring cell. A flow rate of 36 l/h is assumed for the Depolox® 5 measuring cell.

The following equation applies to the Depolox® 5:

t_{mw}(Depolox® 5_5) = (d_{mw} x d_{mw} x l_{mw}) : 7.65 (result in min)

In general, this equation applies:

t_{mw} = (4.71 x d_{mw} x d_{mw} x l_{mw}) : Q_{mw} (result in min)

d_{mw} = Internal diameter of the sample water line in cm
l_{mw} = Length of the sample water line in meter
Q_{mw} = Flow rate to the measuring cell in l/h

Example

The sample water line is 10 m long and connected to a Depolox® 5 chlorine measuring cell.

t_{mW} = (0.6 x 0.6 x 10) : 7.65 min = 0.47 min, (i.e. approx. 28 sec.)

Calculation 2:

The sample comes from the sample water pump (bypass line).

Sample water dead time depends on the flow rate of the sample water pump, nominal diameter of the bypass line and its length up to the sample water branch pipe to the measuring cell.

$$\mathbf{T_{by} = (4.71 \times d_{by} \times d_{by} \times l_{by}) : Q_{by}}$$

d_{by} = Internal diameter of the bypass line in cm
l_{by} = Length of the bypass line from the sample water extraction point to the sample water branch pipe to the cell in m
Q_{by} = Flow rate to the bypass pump in l/h (result in min)

Check whether the length of the sample water line to the measuring cell can be neglected. If so, establish the sum from calculation 1 and 2.

Calculation 3:

The sample water distraction is carried out as in calculation 1 and/or 2. To increase the exposure time, the sample water is also sent through a delay tank.

The exposure time in the delay tank must be added to the calculated time.

Determining the Dosing Dead Time (Dosing Delay)

Dosing dead times arise from long dosing lines and positioner running times.

Calculation 1:

Determining the dead time based on dosing line length

The dosing dead time can be determined as follows:

$$\mathbf{t_{dos} = (4.71 \times d_{dos} \times d_{dos} \times l_{dos}) : Q_{dos}\ (result\ in\ min)}$$

d_{dos} = Internal diameter of the dosing line in cm
l_{dos} = Length of the dosing line in m
Q_{dos} = Dosing line flow rate in l/h

Calculation 2:

If rapid control variable changes are expected in the system, which the dosing equipment cannot adjust to (e.g. positioner running times, dosing pump cycle times), the dosing delay time should be assumed under all circumstances to be half of the positioner running time ty or the cycle time tp.

At a positioner running time of 80 seconds, a value of approx. 40 s should be assumed as the constant dosing delay.

The sum of the measured dead time and the dosing delay is displayed in the < Tconst > menu in minutes.

Determining the Control Variable Dependent Tvar Dead Time

The control variable dependent Tvar dead time depends on the nominal flow rate, the internal diameter of the line and the distance between where the chlorine is added and the sample water extracted.

$$\mathbf{t_{var} = (d_{pipe} \times d_{pipe} \times l_{pipe}) : 212.3 \times Q_{nom}}$$ **(result in min)**

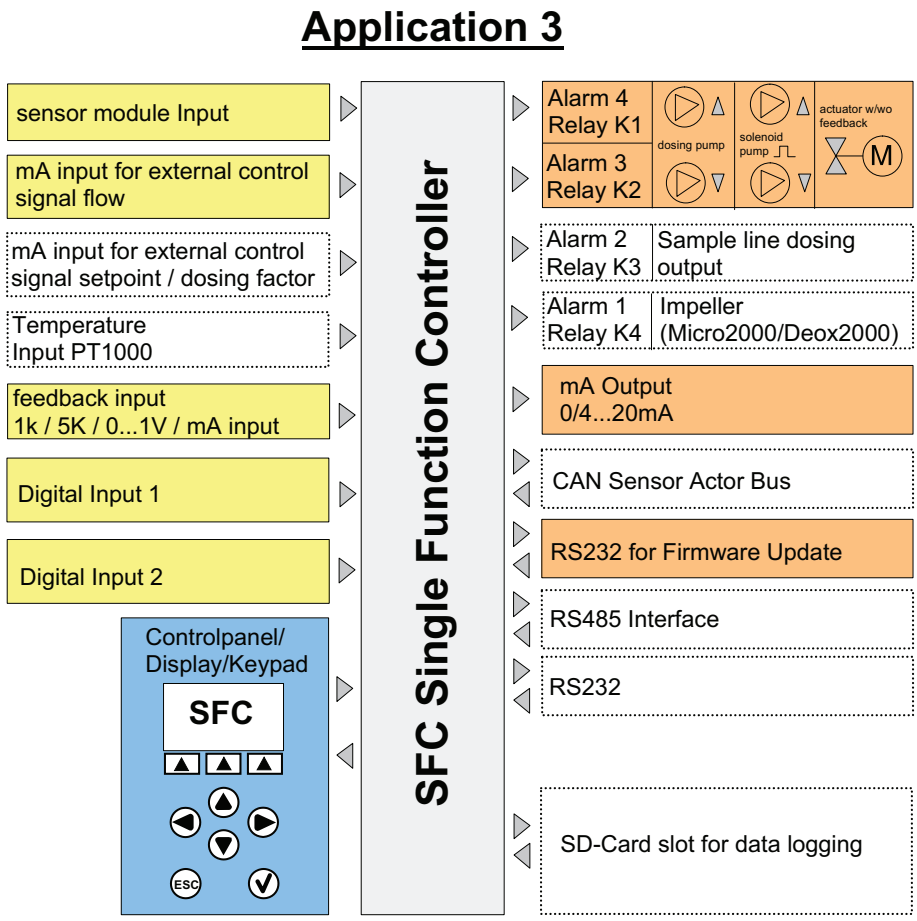
d_{pipe}	=	Internal diameter of the pipeline in cm
l_{pipe}	=	Distance between where chlorine is added and sample water extracted in m
Q_{nom}	=	Nominal flow rate in m^3/h (reflects the flow rate, which is preset for the controller as 100% flow signal)

If there are special reaction tanks in the system, they must be treated separately.

3.4.3 Application 3 - Ratio Control without Process measurement

In application 3, the SFC operates exclusively as a ratio control. The installation of a sensor measuring module is not supported in this application.

The dosing capacity of the connected device is controlled automatically, depending on a measuring signal (external flow rate control signal) and a settable dosing factor. When actuators with feedback are involved, it is possible to adjust the non-linearity using a maximum of 11 calibration points.



..... The features with dotted lines are included as an option

Figure 3.8 - Application 3

Ratio Control without Process Measurement

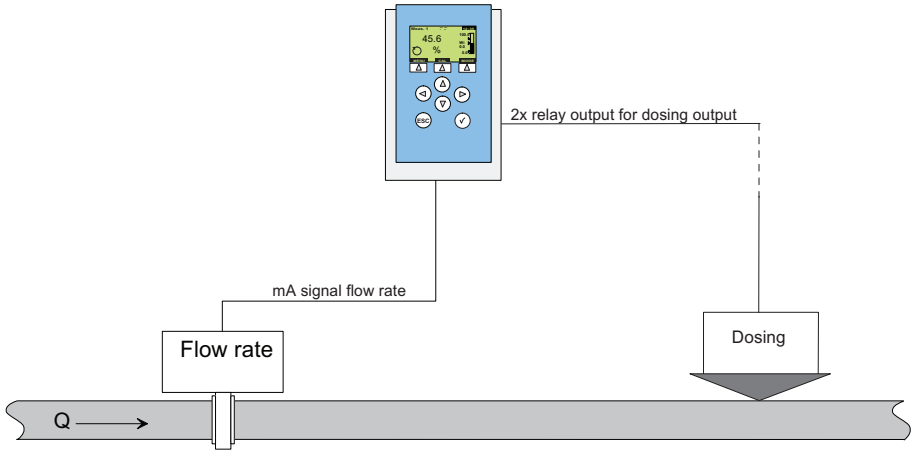


Figure 3.9 - Sample application of SFC as ratio control

Required module configuration:

Sensor measuring modules for measured value recording, e.g., of Cl_2, pH, etc., are not supported or evaluated in this application.

Input signals:

- Flow rate measurement (0/4 – 20mA) scalable

The following dosing outputs are possible:

- Dosing pump
- Pulse pump
- Positioner with feedback 1kOhm/5kOhm/0 –1 V/mA signal
- mA analog output

Ratio Control without Process Measurement Theory of Operation

The flow rate is recorded and the dosing capacity adjusted proportionally to the flow rate using the flow rate sensor with linear mA output signal. On the settings for the flow rate signal see menu "Inputs/Outputs" - "Flow Wq".

<u>NOTE</u>: If the measuring range end value of the flow meter is not identical with the actual maximum flow rate, a factor for adjusting the flow rate signal should be input in the menu "Inputs/Outputs“ - "Flow Wq“.

For example: Measuring range flow meter = 5000 l/h / max. flow rate = 2500 l/h => factor = 5000: 2500 = 2.0

The relationship between control variable and dosing output is determined by the internal dosing factor.

If a positioner with feedback is used as the dosing output, it can be linearized using several support points. At least two points are required (0/100 %). It possible to define 2, 3, 6 or 11 support points with definite steps. In the menu "Dosing" - "Ym Calib. Points" the number can be defined. The support points then have to be set in menu "Dosing" - "Ym Calib. Manual" (see section 4.4.3 - Positioner Calibration with SFC (application 3) or ratio control (application 2)).

The controller output is calculated in this operating mode as follows:

Yout = Wq x DF

Wq - *Control variable 1 flow rate in %*
DF - *Set dosing factor in %*

The figure below shows the output dosing capacity depending on the flow rate Wq and the set dosing factor.

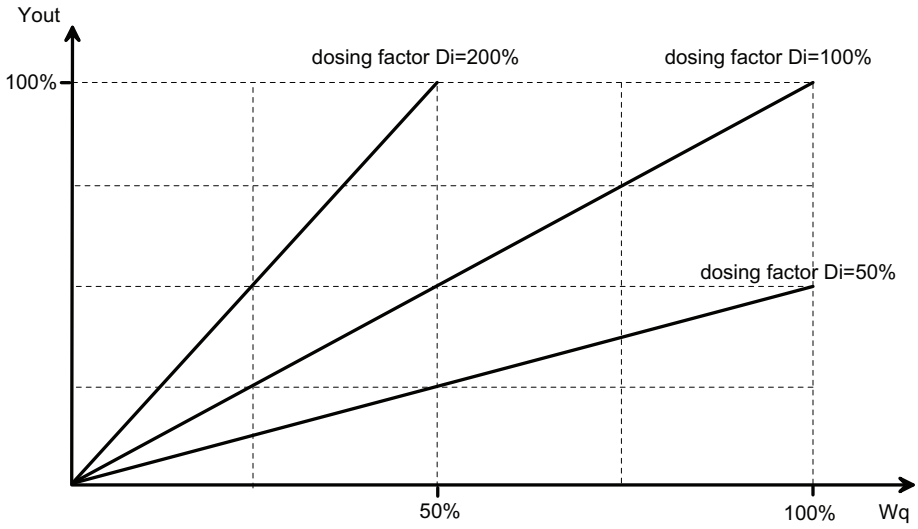


Figure 3.10 - Dosing factor

3.5 Controller Outputs

3.5.1 Controller Types

Controller For	Type	Parameter Description	Action
Positioner with feed-back	3-point	Positioner with Ym	Dosing ↑ or ↓
Positioner without feedback	3-point	Positioner without Ym	Dosing ↑ or ↓
Motor dosing pump (pulse duration controller)	2-point	Dosing pump 2p	Dosing ↑ or ↓
2 Motor dosing pumps (pulse duration control-ler)	3-point	Dosing pump 3p	Dosing ↑ or ↓
Pulse pump (pulse fre-quency controller)	2-point	Pulse pump 2p	Dosing ↑ or ↓
2 Pulse pumps (pulse frequency controller)	3-point	Pulse pump 3p	Dosing ↑ or ↓
Dosing pump with mA-input	2-point	Analog output 2p	Dosing ↑ or ↓
2 Dosing pumps with mA-input	3-point	Analog output 3p	Dosing ↑ or ↓
Dosing contact	2-point	Enable contact	Dosing ↑

3.5.2 Positioner (With and Without Feedback)

With the selection of the integrated controller for “positioner”, for example, it is possible to use chlorine overfeed control in connection with a positioner as dosing equipment in a chlorinator.

If positioner feedback is available, it must be calibrated during commissioning. Potentiometer 1 kOhm/5 kOhm or 0 – 1 V or 0/ 4 – 20 mA signals can be connected as positioner feedback (see section 3.12 - Actuator feedback).

3.5.3 2-Point Pulse Duration Controller for Dosing Pumps

The dosing pump is switched on for the calculated time within an adjustable cycle period TP (relay contact). The cycle period is mainly determined by the reaction time of the connected system and entered as the cycle period TP.

Example:

Cycle period TP	=	100 s
Output value Yout	=	30%
Duty cycle	=	30 s
Off duty cycle	=	70 s

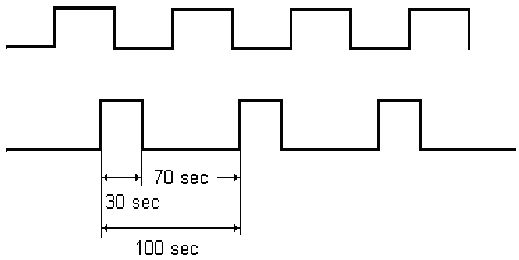


Figure 3.11 - Cycle period

3.5.4 2-Point Pulse Frequency Controller For Pulse Pumps

Pulse pumps are controlled with 0 to 100 or 0 to 120 pulses per minute, depending on the specification of the connected pump.

The duty cycle during each dosing is 0.3 s. The break time is calculated between 0.2 and 60 s depending on the dosing rate.

Example for a solenoid pump with 120 pulses/min.:

Yout in %	100...	84...	72...	56	50...	33...	25...	10...	5...	10
Pulses/ min	120...	96...	85...	75	60...	40...	30...	12...	6...	10

3.5.5 3-Point Pulse Duration Controller for Dosing Pumps and 3-Point Pulse Frequency Controller for Solenoid Pump

Pump 1 decreases the control value.
Pump 2 increases the control value.

The control range is between -100% (pump 1) and +100% (pump 2); this range can also be set in manual mode.

If the setpoint = actual value, no pump is activated (neutral zone Xsh).

Output signals as for 2-point pulse-duration controller and 2-point pulse-frequency controller.

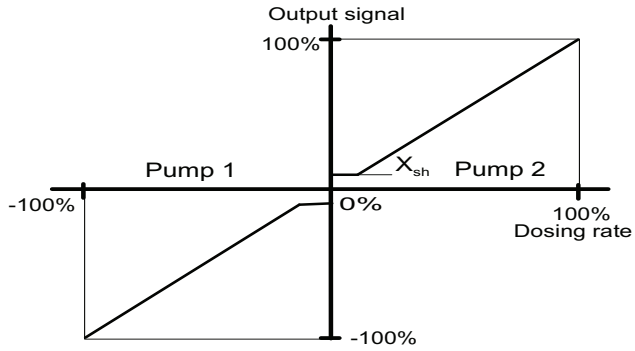


Figure 3.12

3.5.6 Dosing Factor (e.g. For Electrolysis Systems)

A special controller is required for controlling electrolysis units to prevent excessive on/off switching (on account of the response times of the electrolysis unit).

This controller output, therefore, uses a minimum duty cycle as well as a switching hysteresis to minimize the switching cycles.

If the value falls below the specified Cl_2 setpoint minus hysteresis (e.g. setpoint 0.50mg/l - hysteresis 0.05 = 0.45mg/l), the controller output switches on. The controller output remains active for at least the set minimum duty cycle. If the setpoint is exceeded and the minimum duty cycle has expired, the contact switches off.

The minimum duty cycle is ignored in manual mode.

3.5.7 Controller With mA Output

The SFC has an analog mA output. This can be assigned as a registration or controller output.

If pH dosing “analog output.2p” or “analog output.3p” is selected, the output is permanently assigned.

3.5.8 Analog Output Controller 2-Point

With a controller output of 0%, the output current is 0 or 4mA; with a higher controller output, the output current reaches up to 20mA. Pumps with current input, thyristor controllers with DC or 3-phase pumps or analog control valves can be used as dosing equipment.

3.5.9 Analog Output Controller 3-Point

Pump 1 decreases the control value.
Pump 2 increases the control value.

Output behavior is similar to “analog output controller (2-point)”, but with 50% offset. This means that with a control deviation of 0% (setpoint = actual value) a current of 10 or 12 mA is output (pump is idle).

Setting	Signal	Pump	Signal	Pump
0–20 mA	0–0.10 mA	Pump 1	10–20 mA	Pump 2
4–20 mA	4–0.12 mA	Pump 1	12–20 mA	Pump 2

Therefore, 2 suitable pumps can be controlled with one mA current loop.

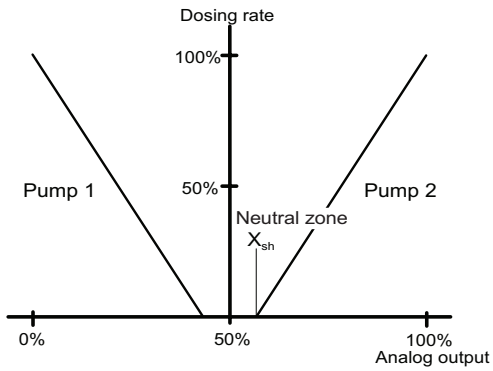


Figure 3.13

3.6 Control Parameters

Control parameters and setting values for determining the control functions of a controller. Different parameters apply for each controller type.

<u>NOTE</u>: The control parameters are listed alphabetically.

Flow Rate Source

This parameter is only available during ratio control in application 2.

This parameter switches off the flow input (off) and activates the flow rate signal for the ratio control (factory setting = flow measurement) as control variable.

The parameter must be set to “Flow Measurement” for quantity-proportional dosing.

Flow Rate Direction

This parameter determines the direction of the flow rate signal directly proportional to the actuator output:

Direct	=	flow rate input signal directly proportional to actuator output (factory setting).
Inverse	=	1 flow rate input signal
Example:		0–100% flow rate = 0–20 mA (direct). 0–100% flow rate = 20–0 mA (inverse).

Max. Pulses/Min

Meaning:	Maximum number of pulses.
Explanation:	The pulses max./min parameter only applies to solenoid pumps.

This parameter is used to set the maximum number of pulses per minute in accordance with the employed pump.

Setting range:	The parameter max. pulses/min can be set at either 100, 120, 140, 160, or 180 pulses.

Max.lin.Corr

This parameter monitors changes to already learned dosing factors. If new dosing factor changes are learned, which are larger than the max. linearity correction, this dosing factor is used for all values in the dosing curve = > initialization of the curve.

Max.lin.Corr. = 0:	No curve function; only one dosing factor for all flow rates.

Example:

Max.lin.Corr. = 50% (based on dosing factor):	
Previous dosing factor:	30%
Newly learned dosing factor:	48%
max. permissible correction range:	30 ± (50% from 30%) = 30% ± 15%
Change in this case:	48% - 30% = +18%

=> The new dosing factor is assumed for the entire curve because the new dosing factor (+ 48%) is greater than the max.lin.Correction (+18%).

Control Factor

Setting the ratio of control range and measuring range, in order to adjust the control amplification Xp to the process.

Control factor =
(End of measuring range - start of measuring range): Control range

Example:
Start of measuring range: pH 4
End of measuring range: pH 9
Max. process control range: ± 1 pH (=> 2 pH increments)
=> Control factor =
(9 - 4) : 2 = 2.5

Control Direction

Meaning:	Direction of the control.
Display:	Direct/inverse (e.g. for pH).
Explanation:	Defines which medium is used to perform the correction.

Example:

pH:	Control direction “inverse”: Lowering pH-value by adding acid.
pH:	Control direction “direct”: Adding alkaline to raise the pH value.

Setpoint

Specified value at which the control variable can be maintained by the controller. The setting range corresponds to the respective measuring range.

Control Variable 2

This parameter activates and deactivates a second control variable during the ratio control (only with application 2).

If “Control Variable 2” = measured value X is selected, this influences the actuator output. The setting “Off“ indicates this control variable is inactive (factory setting) (see section 3.4.2.1, Ratio Control with Process Measurement).

T

Sampling time T is the time after which a change control variable or set-point is responded to. This value must be adjusted in the case of delayed feedback signals.

Tconst

Defines the constant dead time in the combi-controller loop. Consists of the sample water line dead time and the dosing delay time (for the calculation, see section 3.4.2.1, Compound Loop with Process Measurement).

Tn

Meaning:	Integral action time (I-element).
Display:	Minutes (min).
Explanation:	On the basis of the integral action time Tn, the dosing capacity changes constantly until the setpoint is reached. The higher the value of Tn, the longer it takes until the controller increases the dosing rate.
Tn higher: Tn lower:	Control response is slower. Control response is faster.
Setting range:	The parameter Tn can be set from 0–100 min (Tn = 0 means that the “I-element” is de-activated, i.e. a pure P-control response applies). It may not be possible to reach the setpoint value.

Tp

Meaning:	Cycle period.
Display:	Seconds (s).
Explanation:	The parameter Tp only applies to dosing pumps. The cycle period Tp defines a switching period, which must be coordinated with the respective pump type.
Setting range:	The parameter Tp can be set from 10–180 s.
Example:	Fast dosing pumps correspond to a low Tp; slow dosing pumps correspond to a high Tp.

The control parameter Tp must always be adjusted to suit the pump employed:

Dosing pump strokes/min	up to 20	20-40	40-80	80-125	125-200
Tp value	120	100	60	30	15

Ts

Meaning: Loop rise time.

Display: Minutes (min.).

Explanation: Time required to reach the measuring range end value with 100% dosing chemical supply (see section 3.8, Adaption).

Setting range: The parameter Ts can be set from 1 s – 8 h.

NOTE: If the values Tu and Ts are manually modified, the control parameters Xp and Tn are re-calculated.

Tu

Meaning: Loop dead time.

Display: Seconds (s).

Explanation: Time required between dosing start and clear recognition of the rise in the control variable.

Setting range: The parameter Tu can be set from 1 s – 59 min 59s.

NOTE: If the values Tu and Ts are manually modified, the control parameters Xp and Tn are re-calculated.

Tvar

Defines the variable dead time in the combi-controller loop. The time to be entered is based on 100% flow rate (for the calculation, see section 3.4.2.1, Compound Loop with Process Measurement).

Ty

Meaning: Running time of the positioner.

Display: Seconds (s).

Explanation: The parameter Ty only applies to positioners.

Ty is the time which the positioner requires to adjust from 0% to 100%.

Setting range: The parameter Ty can be set from 10–180 s.

X Factor

This parameter is only available during ratio control, control variable 2 = measured value X.

Determines an adjustment factor, how strongly the measured value influences the actuator output (factory setting 1.0).

Xp

Meaning: Proportional factor.

Display: Percentage (%) with factor.

Explanation: The control amplification is determined with the proportional factor.

The lower the proportional factor Xp is selected in %, the greater the deviation from the setpoint is amplified, and the more quickly the controller attempts to control the deviation from the setpoint.

The control amplification factors is calculated using the following formula:

Factor = (1/Xp) x 100 %

Setting range: The parameter XP can be set from 1 % (factor 100) – 1000 % (factor 0.1).

X Direction

Determines the direction of the second control variable during the ratio control.

Direct	=	measured value directly proportional to the actuator output
inverse	=	actuator output indirectly proportional to measured value (factory setting = direct)

Xsh

Meaning:	Neutral zone.
Display:	Percentage (%).
Explanation:	The parameter Xsh only applies to 3-point controllers.

No controller output occurs in the neutral zone.

Setting range:	The parameter Xsh can be set from 1–5% (depending on the measuring range). The neutral zone is the defined range of setpoint + X_{sh} to setpoint X_{sh}.

Ym Calibration

This parameter is only possible for dosing output positioner with feedback.

Adjust the positioner feedback signal to 0% and 100% dosing capacity. When automatic Ym calibration is started, the positioner moves to positions 0% and 100% and calibrates both positions with the SFC.

With manual calibration of the up-to-11 positions, all positions must be shifted to manually and saved in the menu using the Enter key.

Ymax

Meaning: Dosing rate limitation (single feedback control-loop control only).

Display: Percentage (%).

Explanation: The parameter Ymax only applies to:

- Positioner with feedback
- Dosing pumps
- Solenoid pump
- Controller with mA output

Ymax defines the maximum control output to the actuator

The control parameter corresponds to electronic dosing limitation of the actuator.

Setting range: The parameter Ymax can be set from 0–100%.

Ymin

Meaning: Dosing rate basic load (single feedback control-loop control only).

Display: Percentage (%).

Explanation: The parameter Ymin only applies to:

- Positioner with feedback
- Dosing pumps 2p
- Solenoid pumps 2p
- Controllers with mA output 2p

A basic dosing rate is output to the actuators with Ymin.

Setting range: The parameter Ymin can be set from 0–100%.

NOTE: Ymin and Ymax is only available for the single feedback closed-loop control. The control range is limited by the parameters Ymax and Ymin. Do not select a Ymax value lower than Ymin. At Ymin > 0 overdosing can occur.

Yout-factor

Meaning:	Multiplication factor for dosing output.
Setting range:	The parameter Yout factor can be set from 1.0 - 4.0.
Explanation:	If the dosing factor 100% is not sufficient, the parameter Yout factor is used to increase the dosing output. The paramter is available with combi-control and ratio control.

3.7 Alarms

The output of the alarms takes place by means of relay contacts and alarm indicators on the display. The number of the max. four alarms is determined in the application or by the version of SFC.

Each alarm can be assigned the following functions:

Limit value = Min	All measured values are individually selectable Cl_2, pH, mV, Cl-N, conductivity, etc.
Limit value = Max	All measured values are individually selectable Cl_2, pH, mV, Cl-N, conductivity, etc.
Digital inputs	1 to 2 can be selected individually
Error	
Flow rate min/max	
ext. Setpoint/DF min, max	
Yout min/max	
Manual mode	
Ypi min/max	

The type of alarm can be selected in the “Alarms” menu in the displays “Alarm ... Functions” displays. There are three types of alarms.

In all alarm types the response can be influenced by entering a delay (td) (refer to the diagrams in this chapter).

3.7.1 Unlatched Alarm Without Acknowledgement Option (N.O. Unlatched, N.C. Unlatched)

The alarm symbol on the display is on when an alarmis triggered and goes out automatically when the alarm condition is removed. The same applies for the contact.

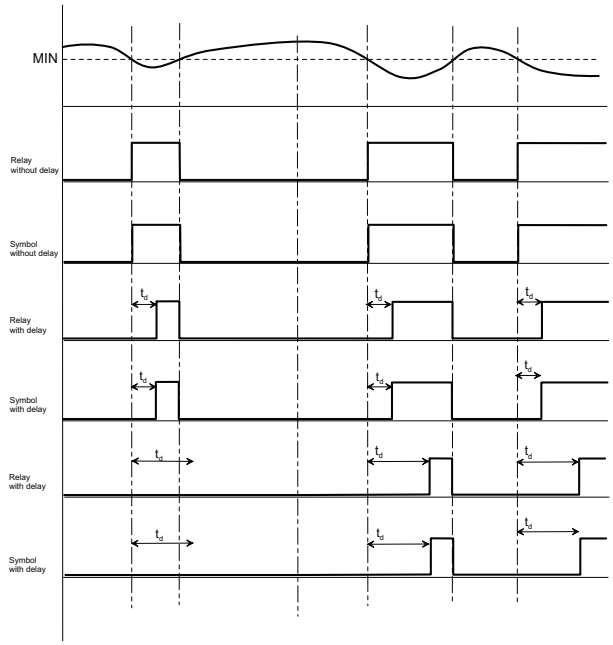


Figure 3.14 - Example MIN alarm

3.7.2 Latched Alarm With Reset Acknowledgement Option (N.O.Latched Reset, N.C.Latched Reset)

In the even of an alarm, the alarm symbol on the display flashes until the alarm is scknoledged. The LED also goes out even if the alarm conditions still apply when the alarmis acknoledged.

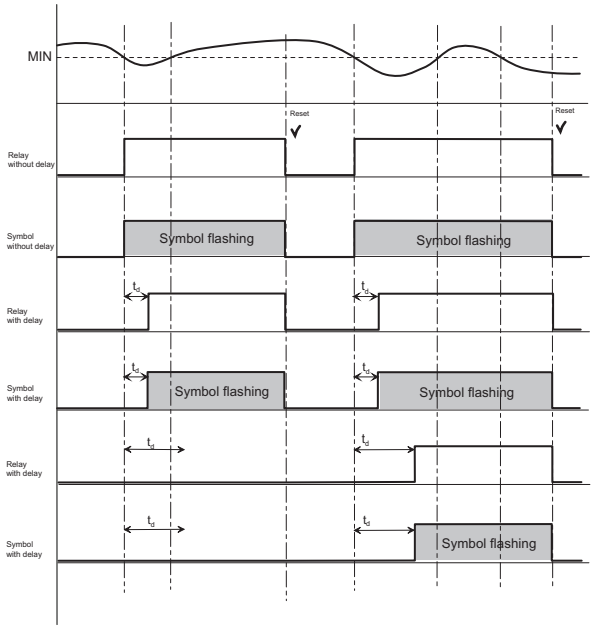


Figure 3.15 - Example MIN alarm

3.7.3 Latched Alarm With Confirmation (Acknowledgement Option) (N.O. Latched Ack., N.C. Latched Ack.)

In the event of an alarm, the alarm symbol on the display flashes until the alarm is acknowledged.

- If the alarm condition is no longer present when the alarm is acknowledged, the symbol disappears.
- If the alarm condition is still present when the alarm is acknowledged, the symbol is reset from flashing to a permanent state. The symbol or the contact is active until the alarm condition has been removed (auto-reset).

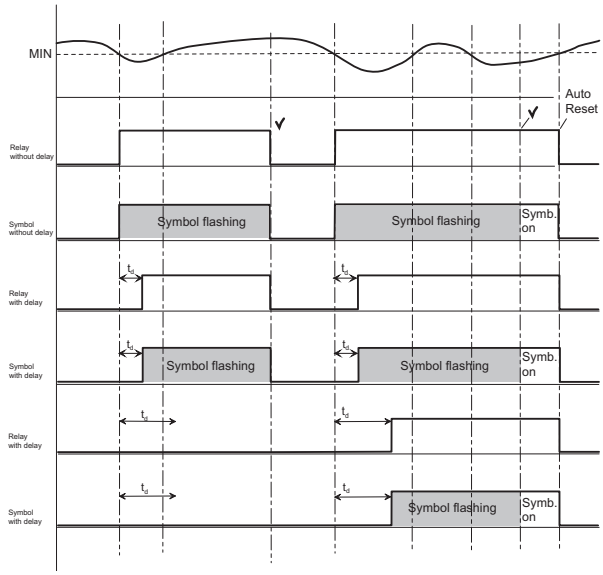


Figure 3.16 - Example MIN alarm

3.8 Adaption

This only applies to Cl_2 single feedback closed-loop control.

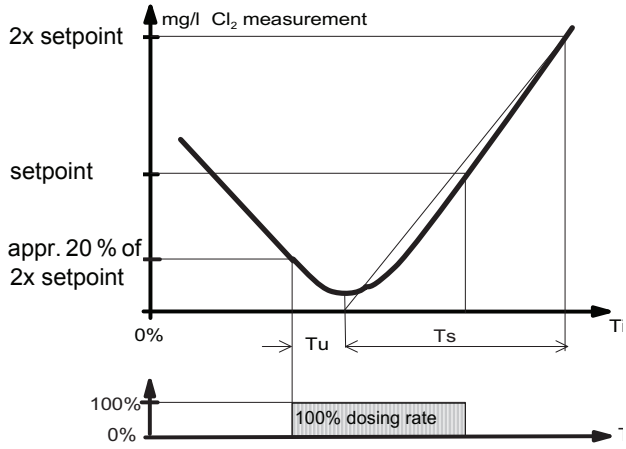


Figure 3.17

3.8.1 Application

Adaption is used for automatic determination of the reaction times of the control loop (loop dead time Tu and loop rise time Ts) or the resulting control parameters Xp and Tn.

<u>NOTE</u>: The control parameters Xp and T ascertained by the adaption must be considered as a recommendation for the first startup. The control parameters Xp and T can be manually optimized to ensure maximum control quality.

3.8.2 Requirements

- Positioner set to automatic (manual wheel engaged) Dosing pump set to automatic
- Calibrated Cl_2 measurement (zero point and span value)
- Loop dead time < 60 min
- Loop rise time < 480 min (8 h) for 0–100% measuring range
- Decomposition time < 480 min (8 h) of the current value to 20% of the measuring range
- Correct menu setting of the end value, control direction (direct or inverse), actuator (e.g. positioner), positioner running time (Ty)

Adaption may not be started:

- If a large volume of fresh water is added
- If the chlorine sensor has not been run in
- During cleaning work
- During filter backwashing
- When the circulation changes
- If there are flow rate fluctuations

3.8.3 Starting Adaption

1. Starting from the basic display, select “Adaption” from the “Cl_2free ( )” menu.

2. In the “Adaption” menu, select the “ADAPT” softkey.

3. This displays the current chlorine value, the actuator output Ym/Y and the control variable in %. The diagram of the previous adaption is shown when the key → is pressed. ☐

4. Press “START” to start the adaption. Adaption starts.

5. Adaption can be cancelled using the "Cancel" softkey.

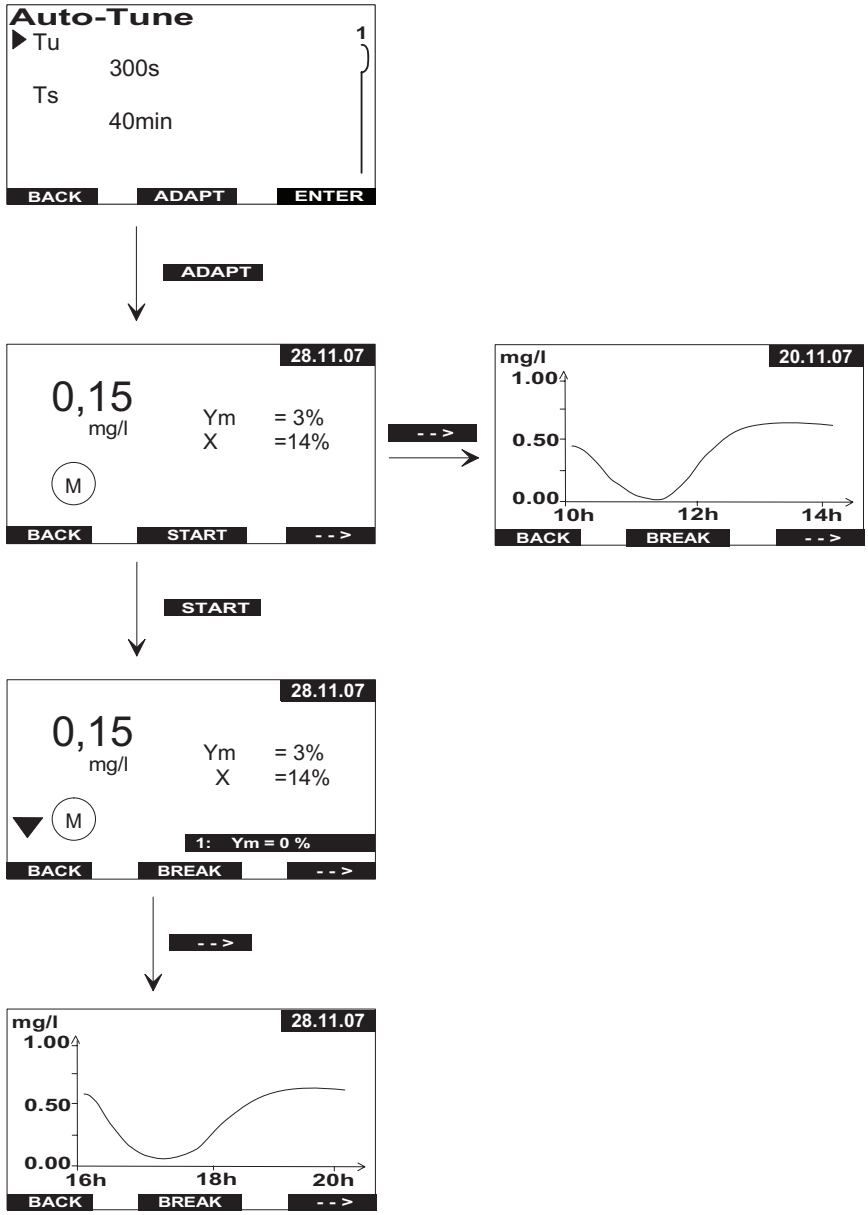


Figure 3.18 - Adaption displays

3.8.4 Displays

The diagram shows the chlorine value curve during the adaption phases. The current phase of adaption (total of 13) is shown in the bottom line.

Successful adaption is confirmed by the “ADAPTION OK” message.

Press the “BACK” softkey to return to the basic display.

If adaption is not successful, the error message “ADAPTION?” is displayed.

3.8.5 Adaption Sequence

Each adaption phase is then displayed with a status message:

Display text	Explanation
“0: Init“	Start
“1: Ym = 0%“	Chlorinator to 0% or dosing pump off
“2: X = 20%“	Delay until actual value < 0.2 x end value
“3: Ym = 100%“	Chlorinator to 100% or dosing pump on
“4: Ym = 100%“	Wait until the chlorinator reaches 100%
“5: Tu! “	Start dead time measurement
“6: Tu! “	Measurement of the loop dead time Tu
“7: Tu Check“	Plausibility enquiry dead time
“8: Init Ts“	Start of rise time measurement
“9: Ts “	Measurement of the loop rise time Ts
“10: TS “	Calculate control parameters
“11: Y = 0%“	Chlorinator to 0% or dosing pump off
“12: Y = 0%“	Wait until the chlorinator reaches 0%
“13: Adaption OK“	End

Various status messages can be output, depending on the selection of the actuator. Different status messages also have different execution times. It is possible that several status messages are only displayed briefly or not at all if the execution time is very short.

CAUTION: Adaption can take up to 13 hours, depending on the control loop. During this time no errors should occur on the control loop (e.g. filter back-washing, changes in the circulation).

NOTE: The adaption procedure can be terminated at any time with “STOP”. The previously set parameters remain unchanged.

3.8.6 Completing Adaption Without Errors

When the loop times (dead time Tu and rise time Ts) have been completed without errors, calculation of the control parameters Xp and Tn commences. This is indicated by the message “Adaption OK”. The calculated parameters are entered into the menus. When adaption has been concluded, the measuring amplifier adjusts with the newly calculated control parameters and continues in the selected operating mode (e.g. automatic).

These are entered into the “Tu” and “Ts” menus to monitor the determined loop times.

If errors occur in the control loop during adaption, incorrect loop times and therefore incorrect control parameters can be determined.

<u>CAUTION</u>: The remaining control parameters Ymin, Ymax and Tp are not influenced when adaption is performed. The control parameters Xp and Tn are determined for Ymin = 0% (no basic load) and Ymax = 100% (no dosing rate limitation). If a basic load Ymin or dosing rate limitation Ymax are required for specific system requirements, it must be taken into account that the control loop is restricted as a result. There is then the risk of excessive chlorination (Ymin too high) or inadequate chlorination (Ymax limits excessively).

3.8.7 Completing Adaption With Error

If errors occur in the control loop during adaption (e.g. filter backwashing, changes in the circulation) or if the reaction times of the control loop are too long, adaption is interrupted.

Possible error conditions:

Initial value not reached (Display: “T = > 8h”)
When adaption has started and the dosing system has closed or the dosing pump has switched off, the measuring amplifier waits until the actual value has dropped below the initial value (0.2 x the measurement range value). This delay is indicated by the message “2: X = 20%” and the maximum permissible time is 8 hours.

Loop dead time too high (Display: “Tu = > 1h”)
The value determined by the time measurement between starting up the dosing, switching on the dosing pumps and the rise of the actual value may only take a maximum of 1 hour. This measured time is displayed by “6: Tu!”

Loop rise time too high (Display: “Ts = > 8h”)
The time is determined by a measurement, which the control loop requires at a 100% dosing rate of the dosing system or the dosing pump, to increase the actual value to 50% of the measuring range. This measurement is indicated by the message “9: Ts!” and may take up to 4 hours.

If any of the error conditions described above occur, adaption is interrupted. The measuring amplifier indicates an error message. The “old” parameters Xp and Tn are not changed.

3.8.8 Determination of the Control Parameters With Known Tu and Ts Times

If the loop times Tu and Ts are already known or if these cannot be determined automatically due to specific system conditions, the loop times can be entered into the “Tu” and “Ts” menus. When Tu or Ts are saved, the control parameters Xp and Tn are also calculated and entered into the menus.

3.9 Serial Interfaces

Various interfaces are available to externally link the SFC.

3.9.1 RS232

The RS232 interface serves to connect:

- A laptop or PC for a Firmware update (Download the latest firmware version with an update program and update instruction from the Wallace & Tiernan homepage (www.wallace-tiernan.de). Matching RS232 connecting cable: Ref. W2T320242).

3.9.2 RS485

The RS485 interface provides connectivity to:

- Web technology via Wallace & Tiernan® ChemWeb server
- Higher level visualisation systems through OPC Server Data Access V2.0
- Visualization systems under Windows® TM via Wallace & Tiernan® CMS software 3.0
- SECO S7 - Serial data link to SIMATIC S7-300
- External gateways

The SFC RS485 interface is electrically isolated. To integrate into a Evoqua Water Technologies bus system, four terminal strips, a terminating resistor Rt and balancing resistor R_u and R_d are integrated into the SFC.

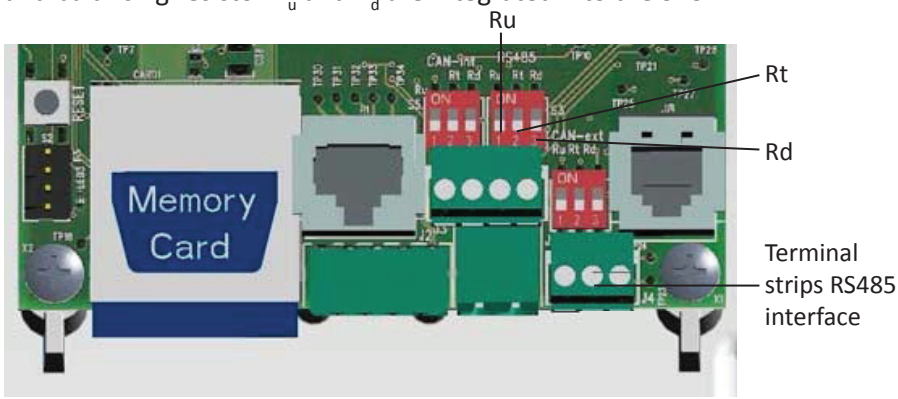


Figure 3.19 - Front panel board

Information on the RS485 interface (WT.050.580.002.UA.IM) can be requested separately from Evoqua Water Technologies.

3.10 CAN Interface

The CAN interface provides connectivity to:

- CAN actuators, such as V10K with CAN interface
- CAN measuring systems, such as SFC measuring systems for Cl_2 tot./Cl_2 free for displaying the combined chlorine
- CAN measuring systems, such as SFC-Cl_2++ with pH value entry via CAN bus

The CAN interface of the SFC is electrically isolated. For connection to a Wallace & Tiernan® CAN bus system, three terminals, a terminating resistor Rt and the balancing resistors Ru and Rd are integrated in the SFC.

The CAN bus is wired from station to station as a two-wire bus. The cable of type 1x 2x0.75 mm^2 (part. no. AAD8569) is used as the installation cable. Stub cables are not permitted.

Do not exceed the maximum line length of 1000 m. The CAN bus is divided into max. 31 segments. In every segment there can only be one CAN master. All unit that communicate with one another must be operated in the same segment.

Setting parameters: Segment address 1...31
CAN address for actuator 0...31

The bus master in the segment is responsible for controlling the actuators. The bus master is, for example, SFC, MFC.

CAN slaves include, e.g., dosing pumps with CAN interface, V10K with CAN interface.

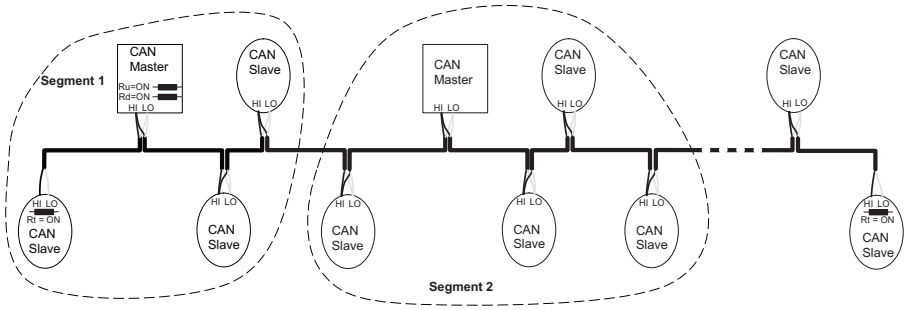


Figure 3.20 - CAN-Bus

<u>NOTE</u>: This CAN interface is not compatible with CAN Open or other CAN systems. Only CAN nodes with a W&T-compatible software protocol may be integrated in this CAN system.

To illustrate the CAN functionality, two examples for CAN applications are listed below:

Example 1
An SFC (master) is operated with a CAN actuator dosing pump in a CAN installation.

Both units must be operated in the same segment. In the following example, segment 1 is used, it could, however, be any segment from 1 -31. The following device settings are required:

SFC-Cl_2:	
Menu - Inputs/Outputs - Interface - "CAN segment":	1
Menu - Cl_2 free - Dosing - "Dosing output":	CAN-Bus actuator
Menu - Cl_2 free - Dosing - "CAN address":	2

CAN dosing pump:	
Menu - Configuration - CAN Bus:	✓
Menu - Configuration - Segment address:	1
Menu - Configuration - Slave address:	2
Menu - Configuration - Bus termination:	- (only with the last and first units of the bus installation ✓)

Example 2

An SFC-Cl_2++ (master or slave) is installed with an SFC pH, in order to compensate the chlorine measurement with the pH value. In this application, both units need not be operated in the same segment. In the following example, segment 1 is used and the following settings must be carried out.

SFC-Cl_2++:	
Menu - Inputs/Outputs - Interface - "CAN segment":	1
Menu - Cl_2++ - Measuring range - "CAN address pH":	2

SFC-pH:	
Menu - Inputs/Outputs - Interface - "CAN seg. (Sens)>":	1
Menu - Cl_2++ - Measuring range - "CAN addr. (Sens)>":	2

A bus end (bus termination Rt) must be installed at the first and last units in the bus. Some units have a dip switch Rt (e.g. SFC see image). Other units require a menu setting that activates the bus termination.

Balancing of the CAN bus must take place once in the CAN bus. For this purpose, there are dip switches for Ru and Rd integrated in the Ru and Rd SFC in the immediate vicinity of the CAN terminal. By means of the dip switches, resistances can be turned on or off (see front panel board in the cover of the SFC).

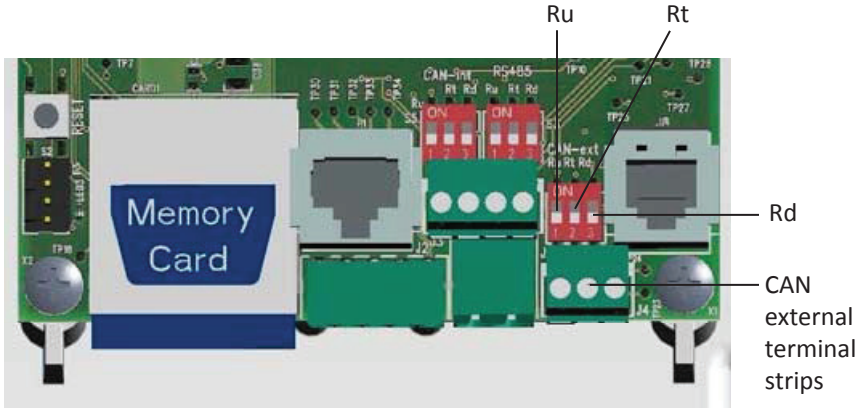


Figure 3.21 - Front panel board

3.11 Serial Firmware Update

Via the serial interface of a laptop/PC, it is possible to update the firmware of the SFC. A special download software and the latest firmware including a description can be downloaded from the Wallace & Tiernan homepage at www.wallace-tiernan.de. A special update cable is available for the firmware update under order no. W2T320242.

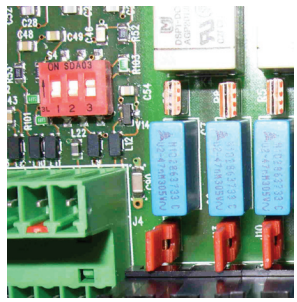
3.12 Actuator feedback

The actuator feedback of the SFC is set at the factory to potentiometer with 1 kOhm. For other feedback signals the device must be reset using the DIP switch S4 (see IC board).

Possible signals are:

- Potentiometer 1 KOhm
- Potentiometer 5 KOhm
- 0/4–20mA signal
- 0–1V signal

Switch settings of DIP switch S4:

	S2-A 1	S4-B 2	S4-C 3	
Potentiometer 1K	Off	Off	On	
Potentiometer 5K	Off	Off	Off	
0/4-20mA	On	On	Off	
0-1 V	On	On	Off	

3.13 Digital Inputs

Two digital inputs are integrated in the IC board of the SFC. These are provided for connecting voltage-free contacts (< 100 Ohm) and are supplied internally with 12 V.

<u>WARNING</u>: NO VOLTAGE MAY BE APPLIED TO THE DIGITAL INPUT TERMINALS!

3.14 SD Memory Card

The SFC can optionally be equipped with an SD memory card for saving or copying unit configurations (see section 3.15, Unit Configuration) and for recording measured data. Every minute, all measured values, such as the main measurement (e.g. Cl_2, pH, etc.), flow rate, external setpoint or dosing factor, actuating variable Yout and temperature, along with the date and time, are saved on this card. The data are stored in files every month and have the following format:

The SD card is installed inside the SFC. In order to remove or replace the SD card, the cover of the SFC must be opened.

Example:

D200711.DAT

↗ ↖

Year 2007 Month 11 (November)

The data can be further processed using any text editor or table processing program, such as EXCEL. The SD memory cards can be read-out and the data copied by any standard card reading device or PC.

Example of a file section:

Date		MW-mg/l	Wq	Wext./DF	Yout	Temperature
2008-01-01	00:01	0.21	20.1	0.0	10.1	19.1
2008-01-01	00:02	0.21	20.1	0.0	10.1	19.1
2008-01-01	00:03	0.22	20.0	0.0	10.1	19.1
...						
...						
...						

Figure 3.22 - Installed SD card

NOTE: Files ending with "*.Bin" can not be evaluated. They are only used as data storage for the SFC and must not be altered.

3.15 Unit Configuration

The SFC gives the option of saving all unit settings as a configuration. Unit settings include all parameters that can be set in the menu, such as the controller mode, setpoint, limit values, etc. A maximum of two configurations can be saved in the internal memory SFC (see Menu-System-Configurations-Save-Config 1, Config 2).

If configurations are saved in the internal memory as Config 1 and Config 2, they can be restored when required as the current unit settings. The previous unit settings are deleted in the process. It is possible to switch between Config 1 and Config 2 via digital input 1 or 2 (see Menu-Inputs/Outputs-Digital input-DI (1), DI (2)).

When "Config 2" is selected, a signal on the digital input causes configuration 2 to be loaded, and the SFC continues to operate with the unit settings of Config 2. If the signal on the digital input is deactivated, then configuration 1 is loaded again and the SFC continues to operate with the unit settings of Config 1.

3.15.1 Unit Configuration of SD Memory Card

For data backup purposes, internally saved configurations can be copied to the SD memory card (see Menu-System-Configurations¬Copy-Config 1 -> SD, Config 2 -> SD).

The config file copied to the SD card (directory "JOB"-JOB1.Bin, JOB2.Bin) can be copied with any laptop/PC with a card reader, and can be transferred to other SFC systems via SD card (see Menu-System-Configurations-Copy-SD -> Config 1, SD -> Config 2, SD Config 1 -> act.* SD Config 2 -> act.*).

* act. refers to the current unit setting

3.16 Special Features

3.16.1 Temperature Measurement

If there is no temperature measurement integrated into the sensor measuring module (DES), the PT 1000 temperature measurement is automatically used from the IC board for temperature compensation. This can also be switched off in the "Temperature“ calibration menu. The PT 1000 temperature compensation is thereby generally turned off.

If a temperature measurement is integrated into a sensor measuring module for chlorine, it is automatically used for compensation.

In the menu, it is possible to chose or switch between the temperature measurements of the sensor measuring module and the IC board.

In the calibration menu for pH, you can select between a manual, permanently set temperature value or the temperature measurement with PT 1000 provided by the IC board for compensation. If the PT 1000 measurement of the mother board is switched off, only a manual value may be set for compensation.

3.16.2 Calculated Measured Value Displays

Cl_2^{++} Measurement

The pH dependency of the chlorine measurement is compensated if the pH value fluctuates within the range of ph 6.5 – pH 9. This function is only guaranteed to a max. 10 mg/l free chlorine.

If free chlorine measurement is equipped with a DEPOLOX® 5 measuring cell, and a pH measurement is connected via CAN interface, it is possible to select this measured value display as Cl_2++ measurement in the menu "Meas. Range - Sensor Type“. The corresponding pH measurement can be selected for pH compensation of this Cl_2 (allocate CAN address).

Combined Chlorine Display

If a total chlorine measurement and a free chlorine measurement are installed via CAN bus or mA signal, it is possible to display the combined chlorine value. To do this, set the display to "Cl-comb“ in the total chlorine measurement "Meas. Range - Sensor Type“. The CAN address of the corresponding free chlorine measurement is then assigned in the "Meas. Range“ menu, in order to be able to determine the difference (Cl-combined) between the total chlorine and the free chlorine.

If the free chlorine measurement is transmitted via mA signal, the mA input signal can be defined in the menu "Meas. Range“. For this purpose, the mA signal of the free chlorine measurement is connected to mA input 1.

NOTE: If mA input 1 is used to record the free chlorine, then the operating modes combi-control or ratio control are not available.

SECTION 4

SECTION 4 - OPERATION

List of Contents

4.1 Display and Operator Controls

Graphic display and operating panel

All information is shown on the graphic display.

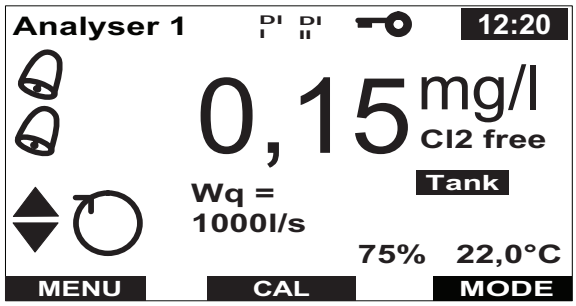


Figure 4.1 - Graphic display

The SFC is operated with nine keys. The software function is controlled with the top three keys (softkeys).

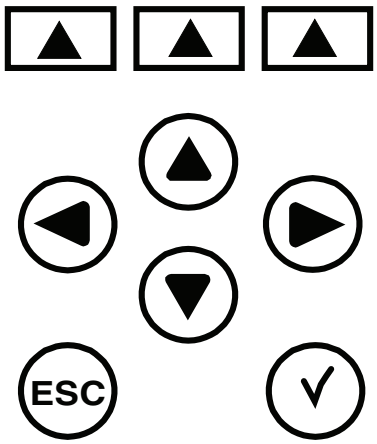


Figure 4.2 - Operating panel

The exact depiction of the individual parameters on the graphic display is described in section 4.3, Menu Structure.

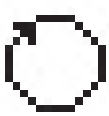
Indicators

CONTROL 1 System name (Entered under “System” - “Common” - “System name”)

Digital inputs 1 and 2 active.
The symbols indicate that a function has been selected for the digital signal and that a signal is pending.

Password active
The defined password must be entered to permit modification of parameters and for calibrating the device.

12:35 Time



“AUTO” operating mode active
The control unit is running in automatic mode.
Dosing is performed automatically.

Positioner is started, dosing pump on
Positioner stopped, dosing pump on

Pulse pump on, 15 pulses/min in the example

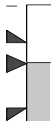
“MANUAL” operating mode active
Dosing can be set manually.

Alarm on
Upper alarm symbol corresponds to Alarm 1, beneath it are alarms 2 - 4

“System stopped” operating mode
Dosing is switched off.

“Adaption” operating mode is active during “Automatic” operation
Automatic determination of the control parameters for single feedback closed loop control is active.

“Adaption” operating mode is active during “Manual” operation.
Automatic determination of the control parameters for single feedback closed loop control is active.



Bar graph
This indicates a measured value, the measuring range (column height), limit values (◣and ◤) as well as the setpoint, Wi (internal setpoint), We (external setpoint), Di (internal dosing factor), De (external dosing factor).

Softkeys Current softkey assignments

BREAK	Stop the adaption procedure.
SELECT	Select one or more options from the list provided.
CHANGE	Change the operating mode.
ENTER	Confirm selection/Save input.
CAL	Select the “Calibration” menu.
LOCK	Activate password protection.
MENU	Select a menu.
MODE	Select the “Mode” menu.
UNLOCK	Start deactivation of password protection.
BACK	Move back one menu level.
--->	Open next diagnosis display.
START	Starts adaption.
13s	The time until dosing resumes after interruption.
ADAPT	Opens the display for adaption
100%	If the display blinks, the positioner is in manual mode and cannot be activated.
28.4°C	Sample water temperature
mA? 1/5	Error indication active (display bottom right) The system has detected an error. The error can be specified with the table in section 4.5 “Errors”. The number combination states the series number of the error message and the total number of error messages (in this case the first error of a total of five).
PI 85 s	YPI stop time display. The time it takes after a spike in the flow rate for the single feedback closed loop control in the combi-control to reactivate.

Scroll bar
This is used to indicate the actual menu position of the menu arrow. If the selection mark is at the top, the menu arrow is on parameter 1 (see example). A maximum of eight parameters per display is possible.

TANK

The SFC provides the option to assign a customer-specific name or designation to each measurement. In the menu “System Module designation”, you can name each measurement as desired up to six characters, such as “Inlet”, “Main”, “Tank”, etc. This name is displayed in the main display under the associated measurement. If blanks (default setting) are entered as a module name, it is deactivated and does not appear in the main displays.

General messages

Adaption is running!
This message appears if an attempt is made during adaption to automatically calibrate the positioner.

This function is possible in the MANUAL mode only!
This message appears, for example, if an attempt is made to calibrate the positioner during automatic operation. Acknowledge by pressing ENTER or the ESC key.

A module was removed!
Do you wish to accept this configuration?
This message appears when the device is switched on after removal of a module. Confirm with the yes/no key.

New hardware component found!
This message appears when the device is switched on after addition of a module.

No data available!
This message appears when there is no configuration saved on the SD card and an attempt is made to load a configuration from the SD card.

No measurement available!
This message appears when the SFC is operated in application 1 or 2 and no senor measuring module has been loaded.

Data are not compatible!
This message appears when a configuration is loaded from an SD card and may be caused by the following:

- Sensor measuring module different from the current measuring module
- The software version of the front panel board is different from the current version

No SD card available!
An attempt was made to save a configuration on an SD card, but no SD card was loaded or the SD card is faulty.

Function is not possible!
It is not possible to calibrate the positioner feedback at the CAN actuator.

NOTE: Information on the plug-in cards which are contained in the device are displayed in "Analog scan" when it is switched on or can be viewed statically in the "Diagnosis" menu under "Software Versions".

Operator Controls

Softkey

- Activate the function shown on the graphic display with the keys.

Up

- Move up one level.
- Display the previous option.
- Increase the value.

Down

- Move down one level.
- Display the next option.
- Decrease the value.

Left/right

- Change the column in the menu.
- Change the position in the displayed value (cursor menu).
- Move forwards or backwards by six hours in the trend graph.

Escape

- Cancel the entry without saving the new value.
- Move up one menu level.

Enter/Acknowledge

- Acknowledge alarm message.
- Set the running delays to zero.
- Delete adaption error.
- Acknowledge max. dosing time to reactivate dosing.

4.2 Notes On Operation

During operation observe the following points:

- Check your entry and modifications before exiting the menu.
- Only press the keys with your fingers, never with hard or pointed objects such as pencils, etc. This could damage the sealed keypad.

4.2.1 Password

The system runs with up to two passwords to ensure protection against unauthorized or inadvertent changing of parameters:

- The system password permits full access to all setting options.
- The calibration password only permits access to the calibration menu and the display of the menus.

Each password is a four-digit number combination.

NOTE: The password is not pre-set at the factory (four zeros). A calibration password can only be set if a system password has been set. If the password protection was not activated with the "LOCK" softkey after entry/calibration, the system is automatically locked one hour later. The password can be changed after correct entry of the existing password.

4.2.2 Operation

You have the following options starting from the basic display (the basic display is opened by pressing the "ESC" key in the menu four times):

Switch between the basic displays and trend graphs	• Press the up or down key
Select menu	• Press the “MENU” softkey to select the menu • Press the “CAL” softkey to calibrate • Press the “MODE” softkey to set the operating mode
Select a menu item in the menu display	• Select the menu item with the arrow keys (arrow in front of menu item) • Confirm the selection with “ENTER”
Change/enter displayed parameters	• Select the parameter with the arrow keys (arrow in front of parameter) • Confirm the selection with “ENTER” • Change/enter the display with the up or down arrow keys • Confirm the entry with “ENTER”
Cancel entry	• Press the “ESC” key to exit the menu item. Entries which have not been confirmed are reset to their original settings.
Reactivate password protection	This function is only active when a password has been programmed. • Change/enter displayed parameters • Block the system entry with the “LOCK” softkey in the menu display
Exit the menu item	• Press the “ESC” key or • Press the “BACK” softkey

4.3 Menu Structure

The SFC has various menus:

- Main menu
- Module type, e.g. Cl_2 free 1
- Inputs/Outputs
- Alarms
- System
- Diagnosis
- Calibration
- Mode

Display of these depend on the number of sensor measuring modules installed.

The “Calibration” and “Mode” menus are opened with the corresponding soft keys directly from the basic display. All other menus can be accessed with the “MENU” softkey.

The following pages show the eight individual menus. The displays contain the default settings.

NOTE: The actual displays on your device can vary from those illustrated. The displays and menus depend on the number of sensor measuring modules installed and the selected settings.

4.3.1 Main Menu

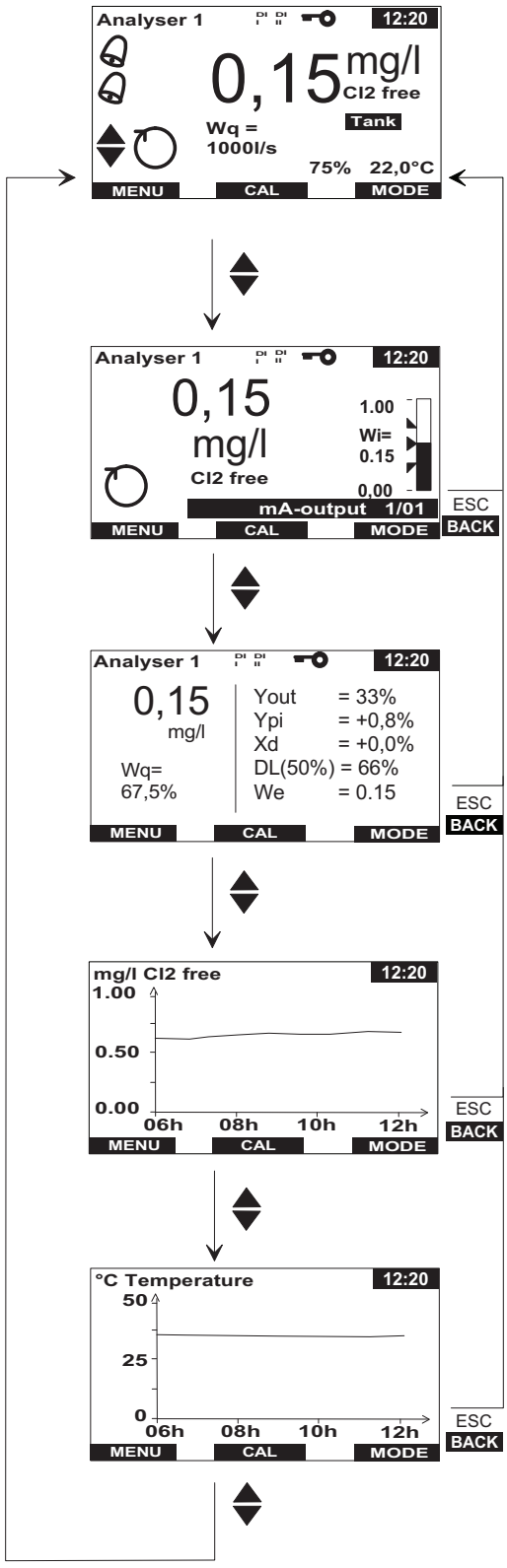
Basic display 1

Basic display 2

Basic display 3

Trend graph 1

Trend graph 2



Basic Display 1

Top status line

- System name
- Digital inputs activated
- Password protection activated
- Time

Center display range

- Mode
- Measured value, e.g. free chlorine (mg/l) as a digital display with module designation (optional)
- Flow rate display Wq
- Alarm relay display
- Control output
- Fedd delay (s), e.g. following sample water stop or change of mode from manual to automatic
- Fault message (instead of positioner feedback, temperature and feed delay) In the case of several fault messages the display alternates.
- Sample water temperature (°C)

Bottom status line

- Softkey display

Basic Display 2

Top status line

- See basic display 1

Center display range

- Mode
- Measured value display with bar graph display

Bottom status line

- See basic display 1

Basic Display 3

Top status line

- See basic display 1

Center display range

- Measured value display
- Flow rate display
- Controller-specific input/output variables, such as Yout, Ypi, Xd, dosing capacity DL depending on Wq, setpoint value Wi/We

Bottom status line

- See basic display 1

Trend Graph (2 max.)

Top status line

- Unit and type of the selected measurement parameter
- Date of the displayed diagram

Center display range

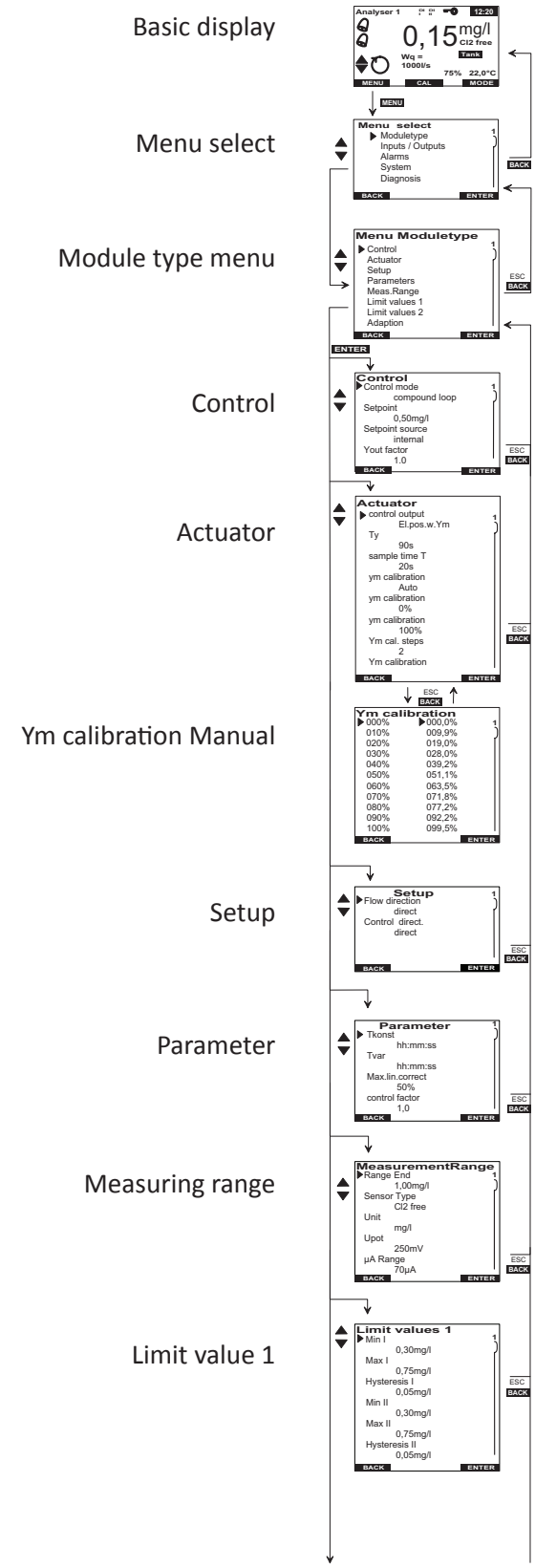
- 6-hour trend graph (can be scrolled back by up to 30 days with option SD card)

Bottom line

- Softkey display

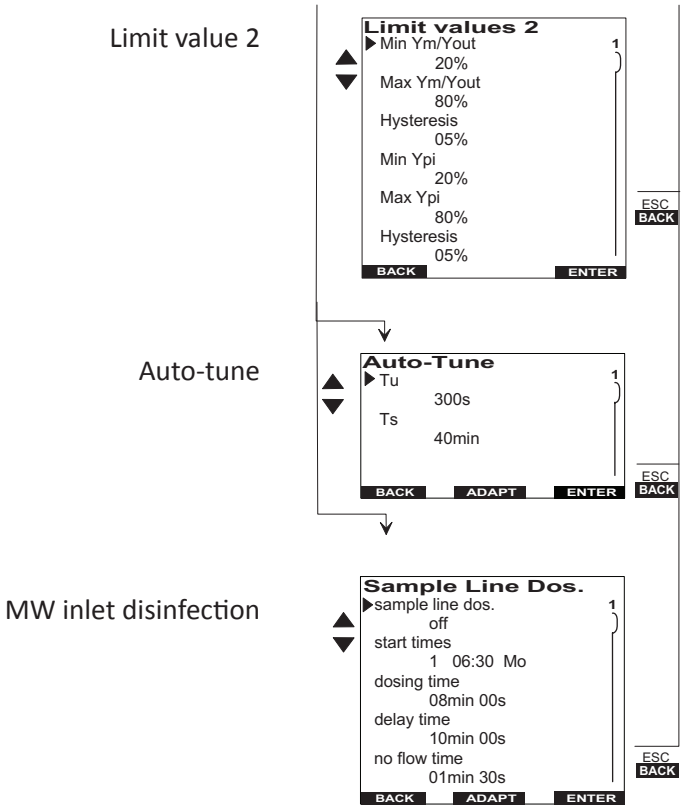
Module Type - Menu

Display using the example of a free chlorine measurement.



Module Type - Menu

Display using the example of a free chlorine measurement.



<u>NOTE</u>: The displayed menus and selection parameters depend on the number of sensor measuring modules installed and the selected application. All the parameters illustrated here are not displayed at the same time.

Basic Display

Refer to main menu

Selection Menu

Display of all available menus

Module Type (1) Menu

Display of all available settings for module type 1

Control

Control mode	Combined/ratio/single feedback (combined and ratio only available with modules with PC option)
Setpoint	Measuring range
Setpoint source	internal / external / internal with DI 2/ external with DI 2
Dosing factor	0–100%
Dos. fact source	internal / external / internal with DI 3/external with DI 3
Yout-factor	1.0 - 4.0

Actuator

Control output	Positioner with Ym
	Positioner without Ym
	CAN-Bus actuator
	Dosing pump 2p.
	Dosing pump 3p.
	Solenoid pump 2p.
	Solenoid pump 3p.
	Analog output 2p.
	Analog output 3p.
	Dosing contact
CAN slave addresses	---(off), 00...31
Tp	10 s - 180 s (60 s)
Ty	10 s - 180 s (90 s)
Sample time T	1 - 20 s
Ym calibration	Auto
Ym calibration	Manual
Ym calib. points	2, 3, 6, 11
max. Pulse/min	100/120/140/160/180
Hysteresis	Depending on measuring range 0.01 - 0.50 / 00.1 - 5.0 / 1 - 50
min. ON	1min00s - 59min59s

Setup

Flow source	Off / flow rate measured value
Flow direction	direct / inverse
Control variable 2	Off / measured value X
X direction	direct / inverse
Control direction	direct / inverse
X factor	0.1 to 4.0
Ymin	0–100%
Ymax	0–100%

Parameter

Xsh	0.0 to 5.0 %
Tconst	30 s – 10 min
Tvar	30 s – 10 min
Max. lin. corr.	0–100%
Control factor	0.1 to 10
Xp	1–1000%
Tn	0.0 to 100.0 min

Measuring Range

Range Start

		pH	mV			mA/V

Adjustment of measuring range initial value:

pH	0.00 to 5.00
mV	-1000 to 700 (min 300 mV to end value)
mA/V	Any combination

Range Start

		pH	mV			mA/V

Adjustment of the measuring range end value:

pH	9.00 to 14.00
mV	-700 to 1000
mA/V	Any combination

Measuring Range

Cl_2	Mem			F^-	LF	

Adjustment of the measuring range:

Cl_2 (Depolox® 5	100 / 200 / 500 µg/l
(Micro/2000®)	1.00 / 2.00 / 5.00 / 10.0 / 20.0 / 50.0 / 100 / 200 mg/l
Mem	100 / 200 / 500 µg/l
	1.00 / 2.00 / 5.00 / 10.0 / 20.0 / 50.0 / 100 / 200 mg/l
F^-	2.00 / 5.00 / 20.00 mg/l
LF	2500 µS/cm / 10.00 mS/cm / 20.0 mS/cm / 50.0 mS/cm
	100.0 mS/cm / 200 mS/cm
Deox/2000®	±0.50, ±1.00, ±2.00, ±2.50, ±5.00, ±10.0

Sensor Type

Cl_2	Mem					

Definition of the sensor at 3 electrode cells:
free Cl_2, Cl_2^{++}, ClO_2, O_3, $KMnO_4$

Definition of the sensor at membrane cells:
Cl^-N total, Cl^-N combined, ClO_2 sel., O_3 sel., Cl_2 free (M)

Unit

Cl_2	Mem					mA/V

Cl_2	mg/l, µg/l, ppb, ppm
Mem	mg/l, µg/l, ppb, ppm
mA/V	5 characters max. (any combination)

Format

						mA/V

Selection of the displayed number format for mA/V

Sensor modules:
000.0 / 00.00 / 0000

Upot

Cl_2						

Adjustment of the potential voltage at 3 electrode cells:
0–1000 mV

µA Measuring Range

Cl_2	Mem					

Selection of the µA signal measurement range for 3 electrode cells and membrane sensors:
70 µA, 100 µA, 200 µA, 1000 µA
For Micro/2000® and Deox/2000®: 10 µA, 100 µA, 1000 µA

Signal

						mA/V

Setting the connected measurement signal:
0–20 mA, 4–20 mA, 0–10 V, CAN external
Complete electrical connection according to this setting (see section 5, SFC Schematic Wiring)

Factor

						mA/V

Factor to adapt an external input signal:
0.1 to 4.0

CAN Address pH

Cl_2						

only for sensor type Cl_2^{++}:
Assignment of which pH module will be used to compensate for the Cl_2 measurement. The pH value is obtained via the CAN bus.

CAN Address Cl_2 Free

	Mem					

For sensor type Cl^-N combined only:
Assignment of which free Cl_2 module will be used to calculate the combined Cl_2. The value of the free Cl_2 obtained vai the CAN bus.

CAN Address

						mA/V

Only with sensor type mA/V:
Allocation of the measurement to be obtained via CAN bus.

Reference Temp.

					LF	

Adjustment of the reference temperature for the conductivity measurement: 20°C / 25°C

Limit Value 1

Min I	within measuring range
Max I	within measuring range
Min II	within measuring range
Max II	within measuring range
Hysteresis	Depends on measuring range 0.01 to 0.25 / 00.1 to 05.0 / 1 to 50

Limit Value 2

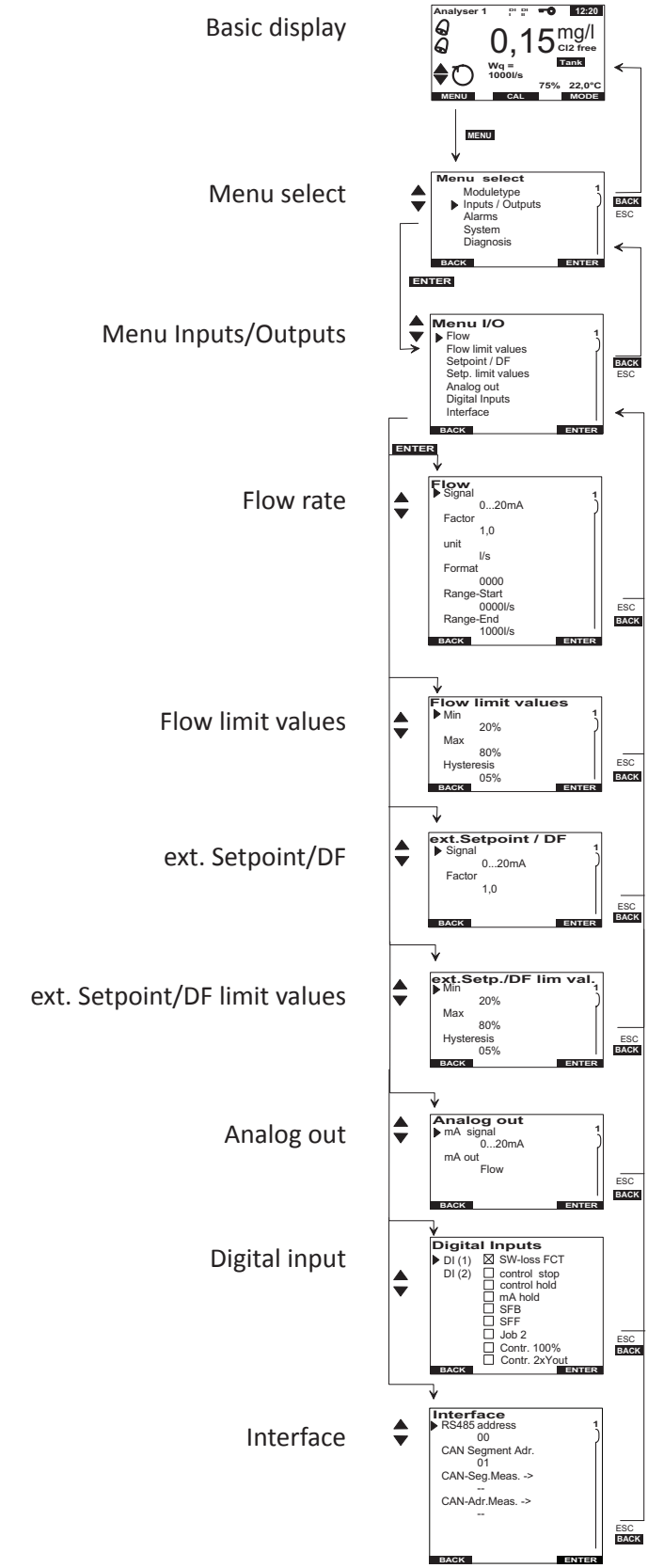
Min Ym/Yout	0–100.0% (not in single feedback closed-loop-control)
Max Ym/Yout	0–100.0% (not in single feedback closed-loop control) Ym is only output if the actuator feedback is present, otherwise the controller output is Yout
Hysteresis	0.1 to 5.0%
Min Ypi	0–100.0% (for combi-controller only)
Max Ypi	0–100.0% (for combi-controller only)
Hysteresis	0.1 to 5.0% (for combi-controller only)

Adaption

Adaption is only available for single feedback closed-loop control with "DES" modules.

Tu	1–3600 s (60 s)
Ts	0.1 to 480.0 min (10 min)

Inputs/Outputs - Menu



Basic Display
Refer to main menu

Menu Select
Display of all available menus

Menu Inputs/Outputs
Display of all available input/output settings

Flow Rate

Signal	0–20 mA, 4–20 mA, 0–10 V
Factor	0.1 to 4.0
Unit	Max. 5 digits (any combination)
Format	Measurement display 000.0 / 00.00 / 0000
Range-start	Unlimited
Range-end	Unlimited

Flow Rate Limit Value

Min	Min. limit value within measuring range
Max	Max. limit value within measuring range
Hysteresis	0.1 to 5.0%

Ext. Setpoint/DF

Signal	0–20 mA, 4–20 mA
Factor	0.1 to 4.0

Setpoint DF Limit Values

Min	Min. limit value of the external signal input 0–100.0%
Max	Max. limit value of the external signal input 0–100.0%
Hysteresis	1–25%

Analog Output

mA signal	0-5mA, 0–20 mA, 4–20 mA, 0–10 mA, off
mA	Measured value sensor module, flow rate Wq, ext. Setpoint/DF, Yout/Ym, Ypi

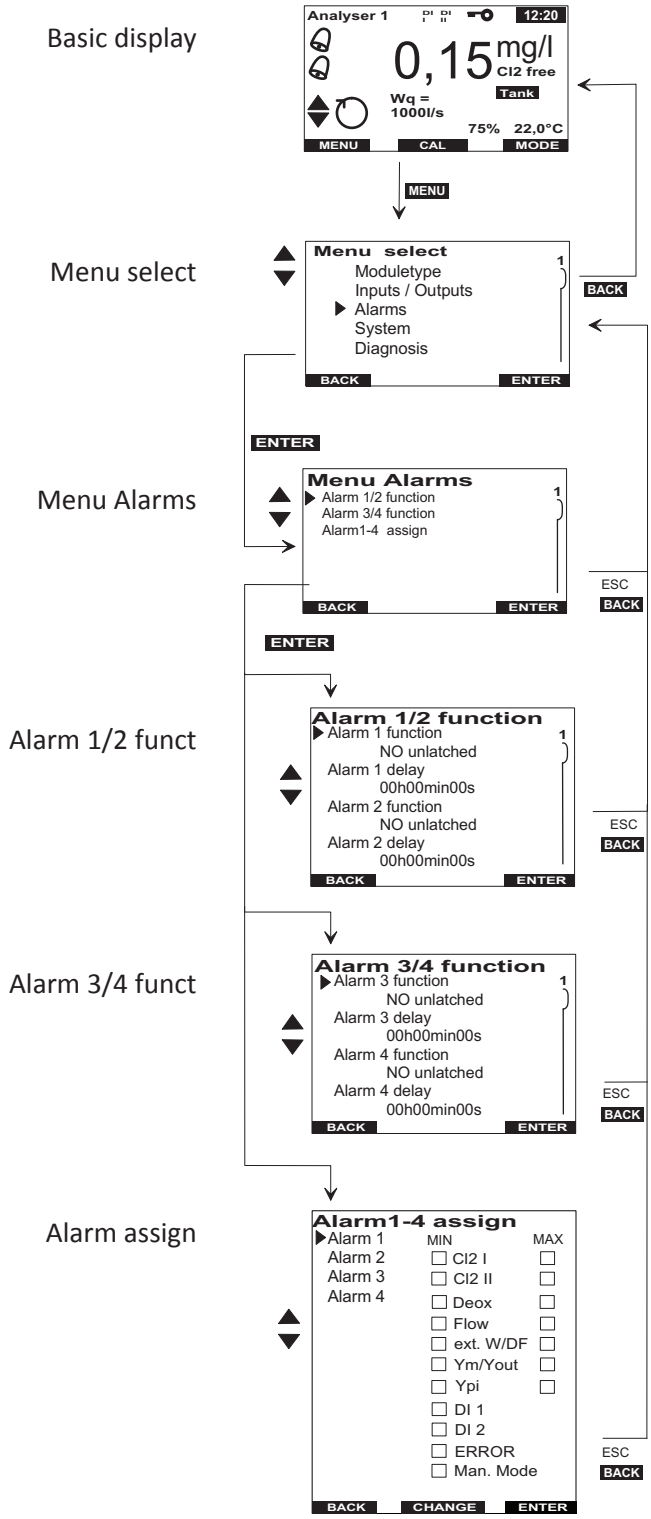
Digital Input

DI (1), DI (2)	Every digital in put can be assigned a function.
MW-STOP funct. (only with DI (1))	Yout=0%, dosing, mA continuous = 0% if DI is activated, the feed stops after the preset sample water delay. If DI is deactivated, the feed starts after the preset feed delay. See Menu - System - Safety
Control stop	Yout = 0%, dosing, mA continuous = 0%
Controller const	Yout remains constant (i.e., the control signals are kept constant).
mA const	All mA outputs remain unchanged, while DI is active.
Ratio	If the DI is active, the control mode switches to ratio control.
Single feed back	If the DI is active, the control mode switches to single feedback closed loop control.
Job 2	If the DI is active, the device switches to the settings of configuration 2.
Contr 100%	If the DI is active, the controller output switches to Yout = 100%.
Contr 2x Yout	If the DI is active, the controller output Yout is doubled.

Interface

RS485 address	Bus addresses 00 to 31 (0)
CAN segment	Setting the segment address in the CAN bus -- (CAN bus turned off) 01...31
CAN seg. (Sens)>	Setting the CAN segment in which the measured value is to be transmitted -- (off) 01...31
CAN addr. (Sens)>	Setting the CAN address with which the measured value is transmitted -- (off) 00...31

Alarm - Menu


Basic display
Analyser 1
12:20
0,15 mg/l
Cl2 free
Tank
Wq = 1000l/s
75% 22,0°C
MENU
CAL
MODE
MENU
Menu select
Moduletype
Inputs / Outputs
Alarms
System
Diagnosis
BACK
ENTER
ENTER
Menu Alarms
Alarm 1/2 function
Alarm 3/4 function
Alarm1-4 assign
BACK
ENTER
ESC
BACK
ENTER
Alarm 1/2 funct
Alarm 1/2 function
Alarm 1 function
NO unlatched
Alarm 1 delay
00h00min00s
Alarm 2 function
NO unlatched
Alarm 2 delay
00h00min00s
BACK
ENTER
ESC
BACK
Alarm 3/4 funct
Alarm 3/4 function
Alarm 3 function
NO unlatched
Alarm 3 delay
00h00min00s
Alarm 4 function
NO unlatched
Alarm 4 delay
00h00min00s
BACK
ENTER
ESC
BACK
Alarm assign
Alarm1-4 assign
Alarm 1
Alarm 2
Alarm 3
Alarm 4
MIN
MAX
Cl2 I
Cl2 II
Deox
Flow
ext. W/DF
Ym/Yout
Ypi
DI 1
DI 2
ERROR
Man. Mode
BACK
CHANGE
ENTER
ESC
BACK

Basic Display

Refer to main menu

Menu Select

Display of all available menus

Menu Alarms

Display of all available settings

Alarm 1/2 Function

Alarm 1 func	Defines the alarm relay contact conditions, if the alarm is inactive. N.O. unlatched N.C. unlatched N.O. latched with reset N.C. latched with reset N.O. latched with confirmation N.C. latched with confirmation
Alarm 1 delay	00:00 – 10:00 h ON delay
Alarm 2 func	See description of alarm 1
Alarm 2 delay	See description of alarm 1

Alarm 3/4 Function

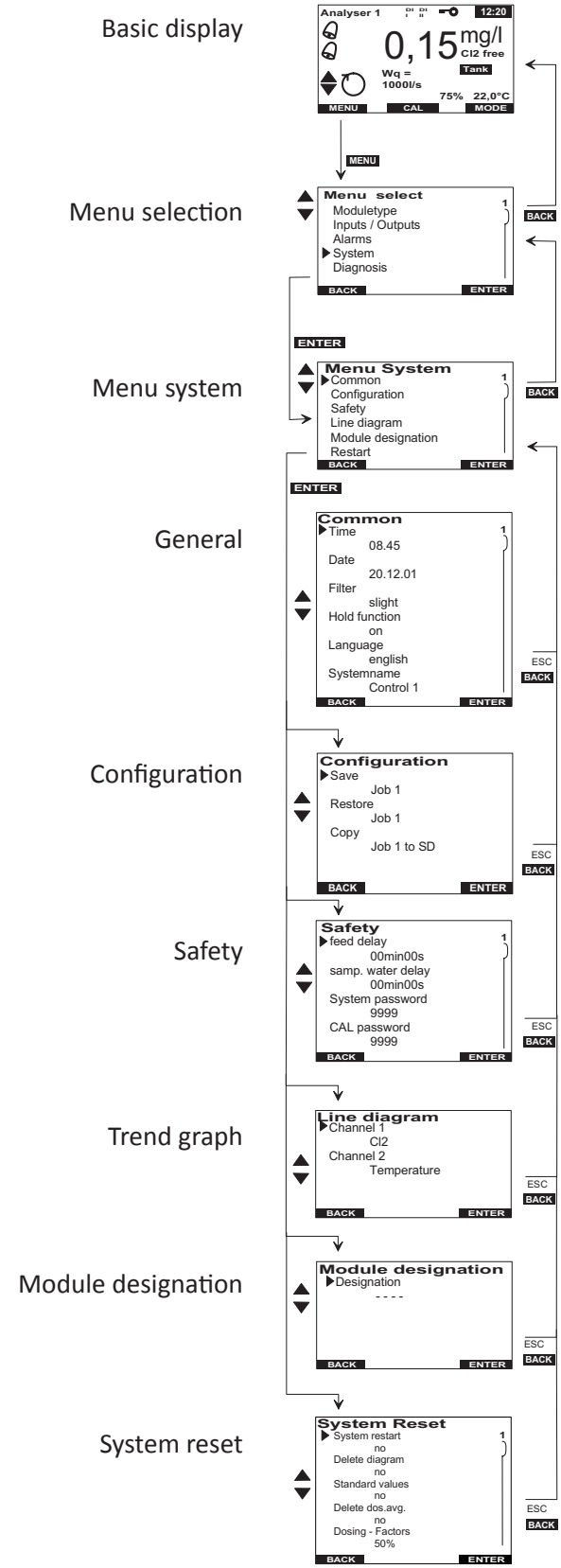
Alarm 3 func	See description of alarm 1
Alarm 3 delay	See description of alarm 1
Alarm 4 func	See description of alarm 1
Alarm 4 delay	See description of alarm 1

Alarm Assignment 1/2/3/4

This parameter gives the option of defining the switching conditins for the alarms:

Min I and Max I of the measurement of the sensor module
Min II and Max II of themeasurement of the sensor module
Min and Max of the SO_2 measurement with Deox application
Min and max of the flow rate Wq
Min and max of the external setpoint/doing factor
Min and max of the controller output Yout or Ym
Min and max of the controller output Ypi
Digital input DI (1)
Digital input DI (2)
Fault
Manual operating mode

System - Menu


Basic display
Analyser 1
12:20
0,15
mg/l
Cl2 free
Tank
Wq =
1000l/s
75%
22,0°C
MENU
CAL
MODE
MENU
Menu selection
Menu select
Moduletype
Inputs / Outputs
Alarms
System
Diagnosis
BACK
ENTER
ENTER
Menu system
Menu System
Common
Configuration
Safety
Line diagram
Module designation
Restart
ENTER
General
Common
Time
08.45
Date
20.12.01
Filter
slight
Hold function
on
Language
english
Systemname
Control 1
ESC
Configuration
Configuration
Save
Job 1
Restore
Job 1
Copy
Job 1 to SD
Safety
Safety
feed delay
00min00s
samp. water delay
00min00s
System password
9999
CAL password
9999
Trend graph
Line diagram
Channel 1
Cl2
Channel 2
Temperature
Module designation
Module designation
Designation
- - - -
System reset
System Reset
System restart
no
Delete diagram
no
Standard values
no
Delete dos.avg.
no
Dosing - Factors
50%

Basic Display

Refer to main menu

Menu Select

Display of all available menus

Menu System

Display of all available system settings

General

Time (hh:mm)	Current time
Date (dd.mm.yy)	Current date
Measuer filter[1)]	off / low / high
Hold function	Off / On (Keeps the measured value constant during calibration)
Language	German, English, French, Dutch
System name	12 characters, each with character set A-Z and digits 1-9 including special characters

Safety

Save	Gives the option of saving all device settings, including the application, as Job 1 or Job 2
Restore	Gives the option of restoring saved or stored configurations. The current menu settings are overwritten inthe process. Job 1 or Job 2
Copy	If an SD card is installed, the configurations Job 1 and Job 2 can be copied to and from the SD card. The current operating configuration (cur.) can also be copied. Job 1 -> SD, Job 2 -> SD, SD -> Job 1, SD -> Job 2, SD Job 1 -> cur., SD Job 2 -> cur., cur. -> SD Job 1, cur. -> SD Job 2

Safety

Feed delay[2)]	00:00 – 10:00 (03min : 00s)
Samp. water delay[3)]	00:00 – 10:00 (01min : 00s) (sample water delay)
System password	four-digit numeric code (activate with Softkey “LOCK” in the “Menu Select” window)
Calib password*	four-digit numeric code (activate with Softkey “LOCK” in the “Menu Select” window)

* only if system password is set

Trend Graph

Channel 1 to 2	Assignment of a measured value to the trend graph. The selected measured value is plotted in the trend graph (can be traced back up to 30 days if the SD card is installed, without the SD card from 0 to 24 hours). Options include the measured value from the sensor measuring module, external setpoint/dosing factor, temperature, output signal Yout. If the setting is "sel"ected, the relevant channel is not logged.

NOTE: If Ym is available, the Yout value is displayed in Ym.

Module Designation

Module	Max. 7 characters, customized entry. If blanks are entered, the module description is switched off. The designation is shown on the main display beneath the unit.

System Reset

System restart[4)]	yes / no
Delete graph[5)]	yes / no
Standard value[6)]	yes / no
Delete dos. avg[7)]	yes / no
Delete DL diagram[8)]	0–100%

NOTE: The system settings marked with [1)] to [8)] are explained below.

Explanation of System Settings

[1)]Measure. filter

The measurement filter serves to compensate measurement value fluctuations in the event of irregular measurement value signals.

[2)]Feed delay

The feed delay delays dosing start when the device is switched on and when the operating mode has been changed. Running of the selected time can be cancelled with the “Acknowledge” key.

[3)]Samp.water delay

The sample water delay (DI 1) determines the time after which dosing is deactivated, e.g. in the event of sample water stop. DI 1 flashes while the delay time is running.

[4)]System restart

When the applications are changed, the device must be restarted with System Restart.

[5)]Delete graph

The stored measured values of the trend graph are deleted.

[6)]Standard values

Deletes customer settings (except for the selected application), resets system to factory settings. The sensors must be recalibrated.

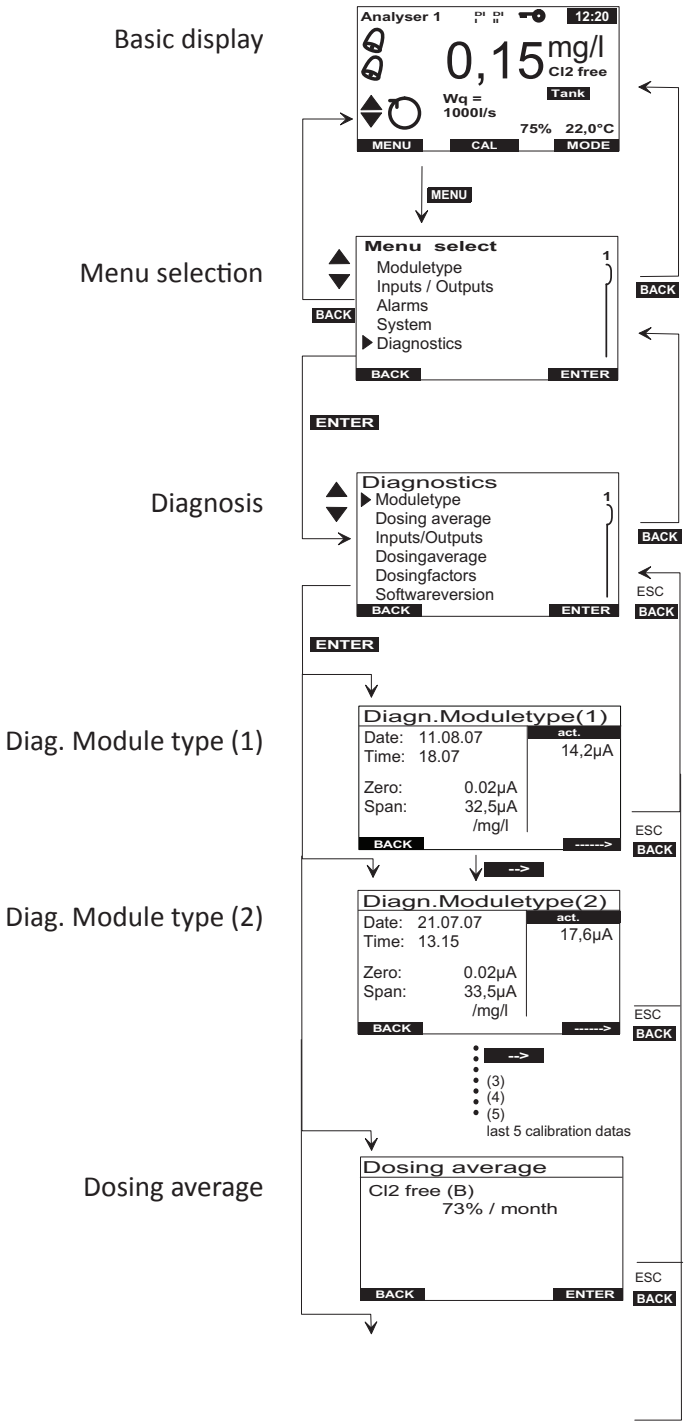
[7)]Delete dos.avg

The dosing average is set to zero.

[8)]Delete DL diagram

Resets the dosing factor table to the set value and all training meters to zero.

Diagnosis - Menu



Basic Display

Refer to main menu

Menu Select

Display of all available menus

Diagnosis

Display of all available diagnosis displays

Diagnosis (1-4) Using the Example of Cl_2

(Scroll with softkey "-->")

Calibration Data of 3-electrode Sensor for Cl_2, $KMNO_4$, O_3, ClO_2, Cl_2^{++}

Calibration data with the date and time of the last 5 calibrations (1-5)

Zero	Zero point signal of the measuring cell
DPD mg/l	µA-signal based on 1 mg/l
act. (I)	Current µA sensor signal

pH Calibration Data

Date and time of the last 5 calibrations

pH7	Signal offset at pH 7 in mV
Span/pH	mV signal of the pH sensor based on 1 pH step
Offs	manual offset in pH (Menu 2.1.2 - Offset pH)
act. (U)	Current mV sensor signal

Redox Calibration Data

Date and time of the last 5 calibrations

Offset	Signal offset of the mV sensor in mV
act. (U)	Current mV sensor signal

Membrane Sensor Calibration Data Cl-tot, O_3 sel, ClO_2 sel, Cl-comb., Cl_2 free

Date and time of the last 5 calibrations

Zero	Membrane sensor zero point signal (only for 2-point calibration mode, not for Cl_2-tot)
DPD mg/l	µA-signal based on 1 mg/l
act. (I)	Current µA sensor signal

F^- Calibration Data

Date and time of the last 5 calibrations

Zero	Established sensor zero point signal
Decade	mV signal of the sensor based on 1 decade (log)
act. (U)	Current mV sensor signal

Conductivity Calibration Data

Date and time of the last 5 calibrations

Span	Conductivity measuring cell calibration factor
Cur	Displays current sensor current in mA Displays current sensor voltage in mV Displays temperature of the conductivity sensor

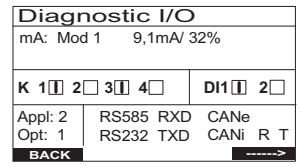
Diagnosis Dosing Average

Displays the dosing average of the previous hour, day, week, month.

Diagnosis - Menu

"Diagnosis Menu" continued

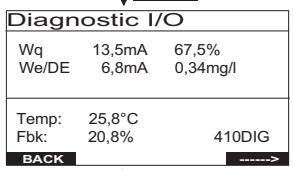
Inputs/Output diagnosis



ESC BACK

-->

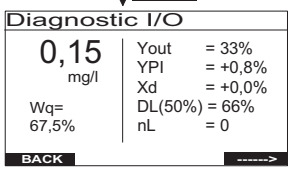
Inputs/Output diagnosis



ESC BACK

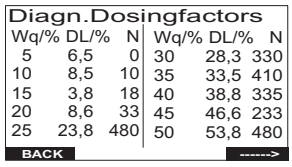
-->

Inputs/Output diagnosis



ESC BACK

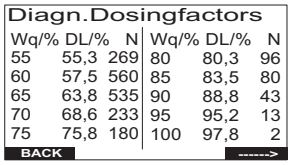
Diagnost.Dosingfactor



ESC BACK

-->

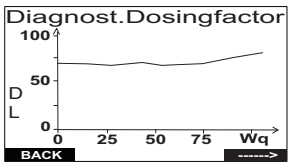
Diagnost.Dosingfactor



ESC BACK

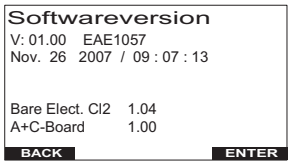
-->

Diagnost.Dosingfactor



ESC BACK

Software versions



ESC BACK

Inputs/Output Diagnosis

Information on

- The assignment of the mA outputs
- The current mA output in mA and %
- The current switching conditions of the relays:
  ☐ Relay off ☐ Relay on
- The selected application
- Display the option (Opt = 1 -> withprocess control, Opt = 0 -> without process control)
- The send/receive condition of both interfaces RS485, RS232, CAN external and CAN internal
- The current switching conditions of the digital inputs 1 and 2

Second Display - Input/Output

Information on

- The current input signal of the flow rate measurement (Wq)
- The current input signal of the external setpoint (We) or external dosing factor (ext. DF) DF
- Temperature display
- Feedback signal display

Third Display - Input/Output

Information on

- Measured value module
- Combi-control Yout in %
- Ypi-share of Yout in %
- Control deviation Xd in %
- Dosing rate (DL) in % acc. to the current flow rate from the dosing factor table
- nL delay until new DL value is accepted in the dosing factor table (entry at 120)

Dosing Factor Diagnosis

Displays the learned DL dosing factors for the combi-control output depending on Wq (display in 5% increments).

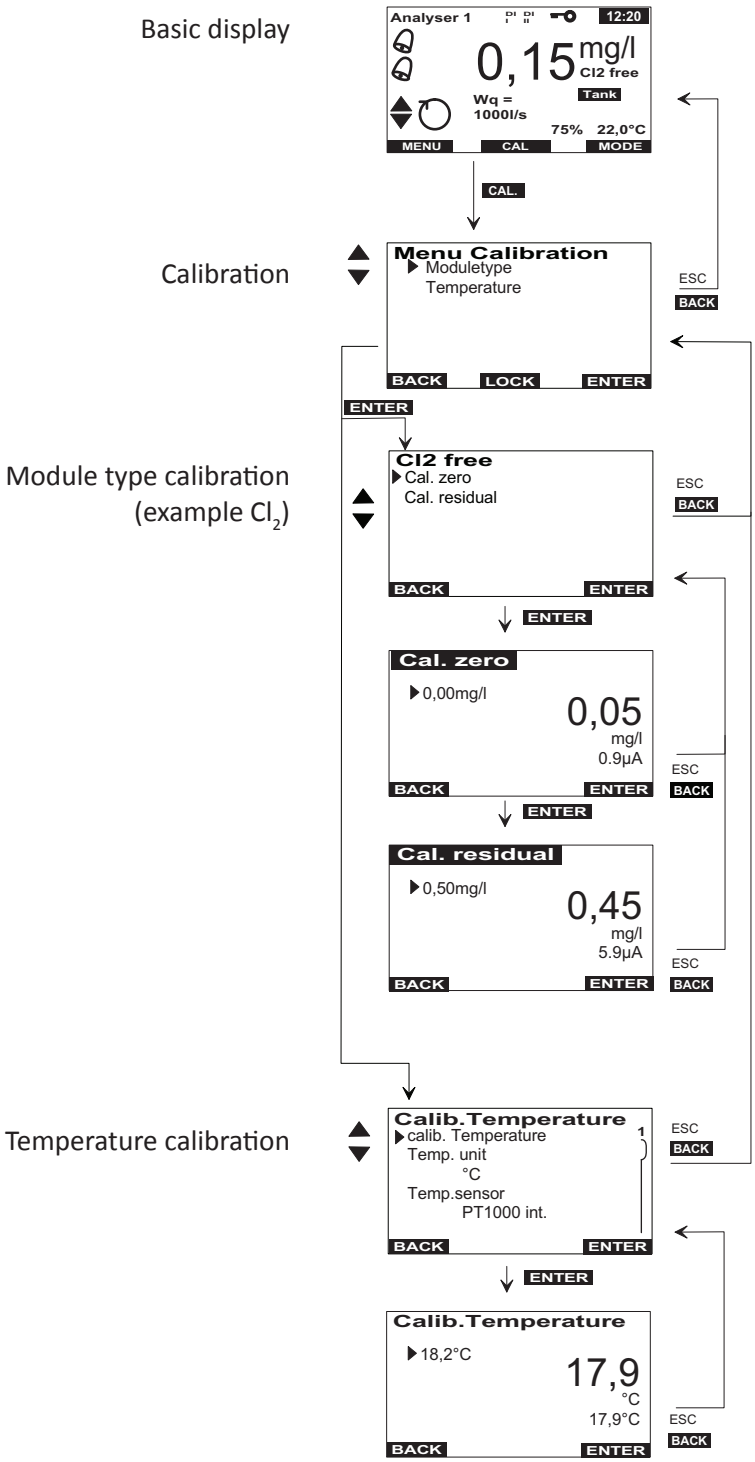
N describes the training meter, how often a dosing factor was learned for this Wq value. This table can be displayed as a diagram (toggle with the ---> key).

Software Version Diagnosis

Displays the software version of the front panel boards of the sensor measuring module and the IC boards.

Calibration - Menu 2.1

Refer to section 4.4, “Calibration”.



Basic Display

Refer to main menu

Calibration

Display of all available calibration options

Module Type Calibration Cl_2 free, Cl_2^{++}, ClO_2, O_3, $KMNO_4$

Cal. zero	The "ENTER" softkey sets the display to "0.00 mg/l"
Cal. residual	within measuring range

Module Type pH Calibration

Calibrate pH 7	6.85 to 7.15 pH
pH calibration	within measuring range
Corr. pH	-1.00 to 1.00 pH (0 pH)
Cal. at temp.	32 to 122 °F (0 to 50 °C)
Man. temp. compens.	32 to 122 °F (0 to 50 °C)

Module Type mV Calibration

Cal. ORP	within measuring range

F^- Calibration

Cal. lower value	within measuring range
Cal. upper value	within measuring range

Module Type Calibration Conductivity

Calib.	0-200 mS/cm
Calib. temperature	32 to 122 °F (0 to 50 °C)

Module Type Calibration Membrane Sensors ClO_2, O_3 sel, Cl_2 free

Zero Span	within measuring range
Cal. Span	within measuring range
Calibration mode	1-point/2-point

Membrane Sensor Calibration Cl-tot

Cal. total	within measuring range

Membrane Sensor Calibration Cl-comb.

Cal. total	within measuring range
Cal. combined	within measuring range

mA/V Input Calibration

Cal. zero	within measuring range
Cal. span	within measuring range

Temperature Calibration

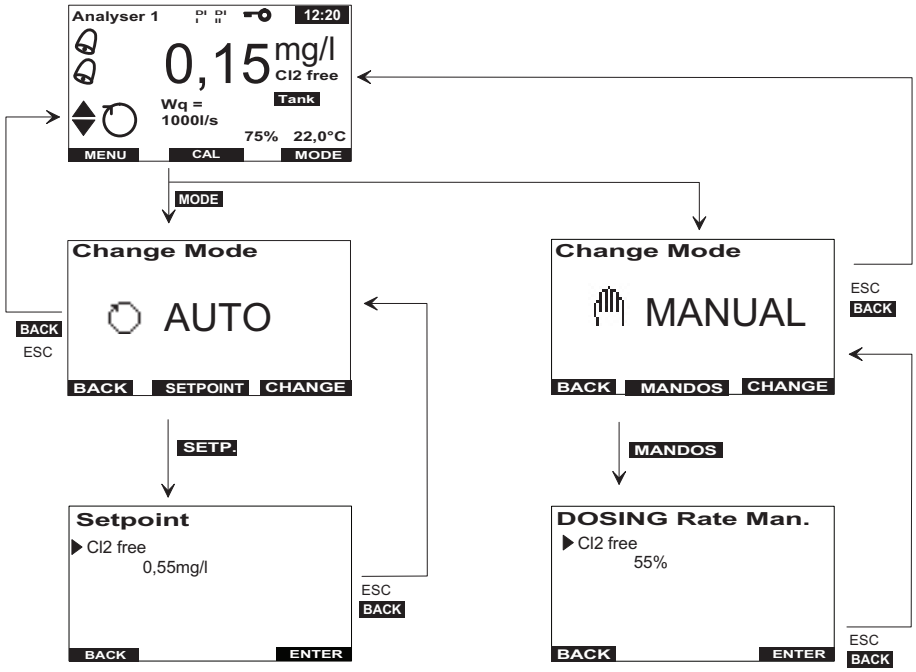
Calib. temperature	32 to 122 °F (0 to 50 °C)
Unit	°C / °F
Temp. sensor	Switching automatic temperature compensation on or off, selection of the internal temperature sensor (temperature input IC board), or sensor measuring module (temperature input sensor measuring module option). With the PT 1000 switched off, a manual temperature value can be entered in the calibration menu when a pH measurement is taken.

Micro/2000® and Deox/2000® Sensor Calibration

Zero span	within measuring range
Calib. span	within measuring range
Calibration mode	1-point/2-point

Mode - Menu 3

Display using an example of a chlorine measurement



Basic Display

Refer to main menu

Manual / Automatic

AUTO / MANUAL toggle using the “CHANGE” softkey

Setpoints

Setting the setpoint or dosing factor (depending on the sensor measuring module and application)

Dosing rate MANUAL

Setting the dosing capacity for manual operation

Description of the Operating Modes

MANUAL

In MANUAL mode dosing is not automatically controlled. The values must be continuously monitored.

MANUAL mode is used:

- In the event of any possible system faults
- During maintenance/cleaning work or while checking the system

<u>NOTE</u>: When MANUAL mode is set: The pumps are off, the positioner remains in its current position, if necessary unlock the positioner and close either by hand or with the Man.dos. menu.

AUTOMATIC

Automatically controls the measured variables acc. to the selected application

STOP

STOP mode is automatically activated:

- When the sample water flow is faulty
- When a stop signal is received via the digital inputs

After activation:

- Pumps off, positioner closed, mA analog output 0%. If the stop conditions are no longer active, the system automatically switches to automatic mode.

ADAPTION

ADAPTION mode is activated, if the adaption for the Cl_2 single feedback closed-loop control.

For adaption refer to 3.8, Adaption.

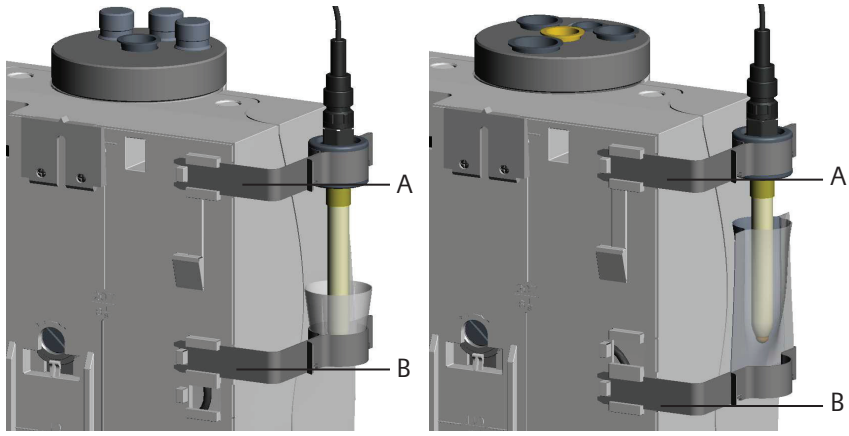
4.4 Calibration

CAUTION: The electrode fingers or membranes on the sensors are extremely sensitive. Do not touch, soil or damage them.

NOTE: To prevent loss of control during calibration, the "Hold function" in the system/common menu should be set to "On" (mA-outputs and controller outputs then remain constant during calibration). To determine how often you must calibrate, refer to section 5.1, Maintenance Schedules.

Calibration Aids Depolox® 5 and VariaSens™

Two clips are installed in the housing cover. These clips can be inserted into the rear panel of the housing. The clip (A) for the sensor will be inserted into the upper catch. When the electrodes are calibrated in the beaker with the calibration solution, the second clip (B) will be inserted into the catch (left figure). The lower clip position is provided for calibrating with the calibration solution bag (right figure).



A	Upper clip
B	Lower clip

Figure 4.3 - Fastening clips

4.4.1 Temperature Calibration

1. Starting from the basic display in the main menu select the "Calibration" menu.

2. Select the "Temperature" menu item

The "Calib. temperature" window appears on the graphic display.

3. Select "Cal. temperature".

4. Perform comparative temperature measurement

5. Open the menu with the “Enter” key and enter the ascertained value with the arrow keys.

6. Save the value by pressing the "Enter" key.

NOTE: °C or °F can be selected in the “Temp. unit” menu. The required temperature input can be selected or switched off in the "Temp. sensor" menu.

4.4.2 Positioner Calibration with Combined Control and Single Feedback Closed Loop Control

Only possible with selection of "El.Pos.w.Ym".

Automatic calibration:

1. Ensure that the feedback signal is correctly set on the IC board (factory setting 1kOhm potentiometer) see section 3.12, "Actuator Feedback".

2. Starting withthe basic display in the main menu, open the "Dosing" window from the "Module Type" menu.

3. Select the parameter "Act. Calibr. Auto" and confirm the selection.

4. Select the "Auto" function and confirm the selection. Feedback signal alignment starts automatically.

The motor moves to the end positions Ym = 100% and Ym = 0%. The end of the alignment isindicated by the message, "YM calibration was complete". If an error occurs during automatic setting, an error is indicated and the setting is terminated.

5. Determine the running time of the positioner from 0% to 100%.

6. Enter the determined running time inthe "Dosing" window under Ty.

NOTE: If automatic alignment is not successful, perform alignment manually.

Manual calibration:

1. Starting with the basic display, open the „Dosing“ window from the "Module Type“ menu.

2. Select and confirm the parameter "Act.Calibration.Manual“.

3. Open the "000%“ menu with the Enter key and close the positioner using the arrow-down key until the limit switch turns off.

4. Save with the Enter key.

5. Open the "100%“ menu with the Enter key and open the positioner using the arrow-up key until the limit switch turns off.

6. Save with the Enter key.

NOTE: There must be a distance of at least 60 % of the total path between the set 0% position and the 100% position.

7. Check the position in a second operation:

   Select the "MANUAL" operating mode. Move to various positions via the "MAN.DOS“ key and check dosing capacity. Repeat calibration at 0% and 100%, if necessary.

8. Determine the running time of the positioner from 0% to 100%.

9. Enter the determined running time in the "Dosing" menu under Ty.

4.4.3 Positioner Calibration with SFC (Application 3) or Ratio Control (Application 2)

In these applications the linearization of the control output is possible, such as for example with a gas feeder which has positioner feedback. Here, for example, 30% control (opening) does not equal 30% dosing capacity. Calibration of the positioner feedback allows up to eleven dosing capacity points to be aligned, in order to obtain dosing that is as linear as possible.

For this purpose, the number of support points to be calibrated can be selected in the "Dosing“ menu - "Ym Calib.Points“. It is possible to calibrate 2, 3, 6 or 11 support points. The more support points are selected, the more accurate is the dosing.

- Starting from the basic display, select the „Dosing“ menu.

- In the "Ym Calib.Points“ menu, select the number of calibration support points.

- Select the "Act.Calibration.Man“ menu and confirm with the Enter key.

- The dosing outputs to be calibrated are shown on the display (max. 11).

  000% 0.0 (calibration point 0% dosing)
  020% 20.0 (calibration point 20% dosing)
  040% 40.0 (calibration point 40% dosing)
  060% 60.0 (calibration point 60% dosing)
  080% 80.0 (calibration point 80% dosing)
  100% 100.0 (calibration point 100% dosing)

The calibration points can be selected using the up/down arrow keys. Press Enter to calibrate the support points, and use the up/down arrow keys to open/close the positioner until the actual dosing shown on the dosing capacity indicator (e.g. gas feed inspection glass) agrees with the calibration point (e.g. 20%). Save the value by pressing the Enter key.

- Select the next calibration point and align the actuator position as described.

NOTE: All calibration points must be aligned or checked in order to obtain linear dosing output.

4.5 Errors and Remedies

Error Messages

The following table shows and explains all possible error messages which can be displayed. If several errors occur at the same time, the corresponding messages appear alternately in succession. When the error has been remedied, the error message is automatically deleted.

If you are unable to remedy the error yourself, please contact your local Evoqua Water Technologies service department.

Table 4.1 - Error Message

Error message	Cause	Remedy
Measured value display flashes	Measured value is outside the measuring range	Check measuring range and change, if necessary. Check dosing or controller settings
Positioner feedback flashes	Positioner in manual mode	Press the adjusting nob on the positioner
DI I flashes	Sample water flow recently insufficient (delay running), signal at the signal input DI I	Check sample water flow rate (approx. 33 l/h)
DI I Permanent display	Sample water flow insufficient for some time (delay elapsed)	Clean or replace the preliminary filter Multi-sensor incorrectly connected or defective
DI II	Signal on signal input DI II	Check connection and setting
Zero ?	In 3 electrode cells Sensor has zero current > +5 µA or < -5 µA	Electrodes in the 3 electrode cell are soiled; clean and service, if necessary Sample water is turned off or sample line leaks Upot potential voltage set incorrectly; change, if necessary
	In membrane sensors Sensor has zero current > +5 µA or < -5 µA	Disinfectant in water; calibrate with disinfectant-free water, if necessary Check sensors and replace or service, if necessary

Table 4.1 - Error Message (Cont'd)

Error message	Cause	Remedy
Calibration ?	In 3 electrode cells and membrane sensors Slope error - the sensor current based on 1 mg/l has fallen below the required minimum In measuring range: 10 µA: in. 0.04 µA/mg/l 70 µA: in. 0.2 µA/mg/l 100 µA:min. 0.4 µA/mg/l 200 µA: min. 2 µA/mg/l 1000 µA: min. 4 µA/mg/l	Check whether there are air bubbles on the membrane sensor and remove, if necessary Service membrane sensors - replace electrolyte/membrane cap Clean 3 electrode cells, replace cell sand
	In pH In pH 7 calibration, the sensor signal is outside -100 to +100 mV or the sensor sends a signal outside 46–70 mV pre pH increment The calibration point distance is smaller than 1 pH increment	Check electrodes, Check buffer solutions, Replace, if necessary
	In mV The mV electrode correction offset is outside -50 to +50 mV	Check electrodes, Check calibration solution, Replace, if necessary
	Conductivity Conductivity measurement spread is smaller than 0.8 or larger than 1.2	Clean sensor, Inspect, Replace sensor, if necessary
	Fluoride The rate of change of the sensor curve is too small or the calibration limits have been exceeded 0.2 mg/l: 40 to 160 mV 2.0 mg/l: -10 to 100 mV 20 mg/l: -60 to 40mV The lower cal. value sensor voltage must be 20 mV higher than the upper cal. value	Check electrode, cable and standard solution, use fresh standard solution, replace electrodes

Table 4.1 - Error Message (Cont'd)

Error message	Cause	Remedy
Cl_2^{++}?	pH <6 or pH>8.75 pH measurement via CAN bus is not available	Check pH measurement Check CAN addresses/segment, check setup of CAN bus
mA output?	Load error: The mA output cannot drive its mA output current through the connected current loop (500 Ohm at 20 mA max.).	Check whether the mA signal is required at all (e.g. for plotter). If not, switch off the output signal in the "INPUTS/OUTPUTS" menu (analog output). Check mA signal cable for interruption
Temperature?	Interruption in the temperature sensor or cable	Check multi-sensor and cable
Setpoint?	Due to modification of the measuring range, the controller setpoint is outside the measuring range.	Reset the controller setpoint or adjust the measuring range
Temp. mod?	Temperature measurement of the sensor measurement module is faulty Interruption in the temperature sensor or cable	Check the temperature sensor and cable
Cl_2 comb?	Free Cl_2 measurement via CAN bus is not available	Check CAN addresses/check segment, check setup of CAN bus

Table 4.1 - Error Message (Cont'd)

Error message	Cause	Remedy
Cell ?	In 3 electrode cells: Chlorine sensor not connected properly No sand cleaning Sensor, sensor cable or sensor module defective Sensor measuring module µA measuring range exceeded In pH, F^- and mV modules: Sensor, sensor cable or sensor module defective In membrane sensors: Sensor, sensor cable or sensor module defective Sensor measuring module µA measuring range exceeded In conductivity modules: Sensor, sensor cable or sensor module defective	Connect sensor correctly. Check sand cleaning; add if necessary Check the sensor, sensor cable or sensor module, replace if necessary Select higher µA measuring range Check the sensor, sensor cable and sensor module, replace if necessary Check the sensor, sensor cap, sensor cable and sensor module, replace if necessary Check the sensor, sensor cable or sensor module, replace if necessary; clean sensor
Positioner Ym?	Ym range too narrow: Position 0% or 100% incorrectly calibrated	Check the distance between the calibration points
	Positioner selected, but not connected	Check setting: Positioner with Ym
	Feedback signal incorrect	Check DIP switch for feedback
	Positioner feedback incorrectly connected or defective	Check (refer to section 5)
Module?	Sensor module was removed Sensor module defective	Refit or replace the sensor module
Adaption?	Adaption terminated with error	Refer to section 3.8, Adaption

Table 4.1 - Error Message (Cont'd)

Error message	Cause	Remedy
Range?	Min/max limit value is outside the measuring range	Check the min/max limit values and change, if necessary
mA-Input 1 ? mA-Input 2 ?	mA-Input signal has been exceeded or fallen short of	Check mA connection or signal
Ym calibration?	Positioner calibration incorrect	Check calibration of the positioner
CAN measurement?	No CAN bus station present	Check CAN bus, configure CAN station
CAN-actuator?	No CAn bus actuator present	Check CAN bus, configure CAN station
Ym display blinking	Positioner disconnected	Switch positioner to automatic
Sample Line Dos	Automatic sample water inlet disinfection	Time-controlled function is ended automatically, as soon as the process is complete

Error

The following table shows and explains possible errors which can occur. If you are unable to remedy the error yourself, please contact the Evoqua Water Technologies service department.

Table 4.2 - Errors

Error	Cause	Remedy
No indication on device	No power supply	External switch or fuse off
	Device fuse defective	Check the power supply and replace fuse
	Housing cover is fitted incorrectly	Check, fit the housing cover correctly (cable possibly trapped)
Displayed/output value incorrect	Change on sensor or in the sample water	Calibrate
Low controller quality (controller swings, setpoint not reached)	Incorrect control parameters	Check, adjust controller parameters; perform automatic adaption on single feedback closed-loop control
	Dosing chemical tank empty	Fill, replace
	Incorrect actuator selected	Check, correct actuator
	Positioner or pump defective	Check, replace positioner/pump
Measured value display not available, although the appropriate measuring module is installed	Measuring module defective or fitted incorrectly	Check, refit module correctly, replace measuring module
Positioner/pump does not work	Positioner in manual mode	Engage manual knob
	Dosing device selected incorrectly	Select correct dosing device
	Positioner/pump incorrectly connected	Connect the positioner/pump correctly
	Relay card defective or fitted incorrectly	Check, replace relay card
	Incorrect application	Check (refer to sections 3.4, Applications & 5, Schematic Wiring)

Table 4.2 - Errors (Cont'd)

Error	Cause	Remedy
Positioner runs in wrong direction	Positioner incorrectly connected	Correct connections
Positioner closes	Positioner feedback interrupted	Correct connections
Digital outputs without function	Digital inputs not activated	Activate digital inputs

SECTION 5

SECTION 5 - MAINTENANCE

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PARA. NO.

5.1 Changing the Fuse on th IC Board

WARNING: ONLY AUTHORIZED AND QUALIFIED ELECTRICIANS ARE PERMITTED TO OPEN THE HOUSING. THE DEVICE IS NOT EQUIPPED WITH A MAINS SWITCH.

1. Disconnect the device from the power supply.
2. Remove the cover of the electronic module.
3. Remove screw-in fuse holder
4. Change the defective fuse.
5. Screw the screw-in fuse holder back in.
6. Reassemble the device.

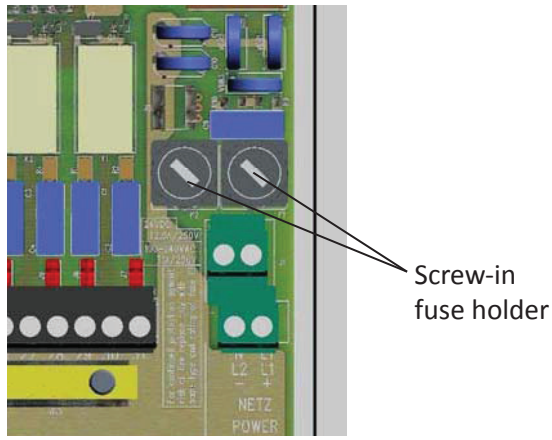

Figure 5.1 - Cutaway model of fuses

5.2 Replacing the Battery

<u>WARNING</u>: ONLY AUTHORIZED AND QUALIFIED ELECTRICIANS ARE PERMITTED TO OPEN THE HOUSING. THE DEVICE IS NOT EQUIPPED WITH A MAINS SWITCH.

The buffer battery is required for the real time clock in case of a power failure. If the time is not correct or if time controlled functions show faulty behavior, the battery must be changed. After five years it must be replaced.

1. Disconnect the device from the power supply.
2. Remove the cover of the electronic module.
3. Take out the old buffer battery and dispose of in accordance with the regulations.
4. Insert the new battery type CR2032.
5. Replace the housing cover.
6. Switch on the main power.
7. Set the date and time.

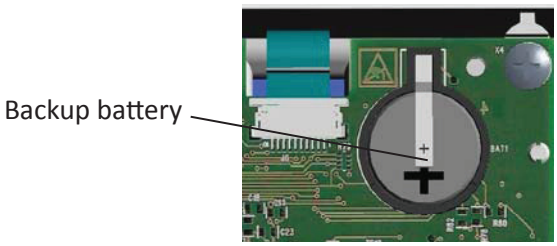

Figure 5.2 - Housing cover with battery

SECTION 6

SECTION 6 - COMPLETE DEVICES, RETROFIT KITS & SPARE PARTS

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6.1 Complete Devices

CAUTION: For reasons of safety, only use original spare parts.

Please contact our customer service department if you need any spare parts.

Complete Unit		Part No.
SFC Electronic module for wall installation	100 – 240 V, 4x relays, 1x mA output, 1x feedback input, 2x mA input, 2x DI, temperature input, SD card slot, RS485, CAN, 1x module slot for sensor measuring module	W2T290005
	24 V DC, 4x relays, 1x mA output, 1xfeedback input, 2x mA input, 2x DI, temperature input, SD card slot, RS485, CAN, 1x module slot for sensor measuring module	W3T158816
SFC PC electronic module for wall installation with mA/V measuring module	100 – 240 V, 4x relays, 1x mA output, 1x feedback input, 2x mA input, 2x DI, temperature input, SD card slot, RS485, CAN, 1x sensor measuring module for mA/V signal installed for process control	W3T158817
	24 V DC, 4x relays, 1x mA output, 1x feedback input, 2x mA input, 2x DI, temperature input, SD card slot, RS485, CAN, 1x sensor measuring module for mA/V signal installed for process control	W2T290008
SFC SC electronic module for wall installation	100 – 240 V, 2x relay, 1x mA input, 1x feedback input, 2x DI, 1x mA output	W3T158819
	24 V DC, 2x relay, 1x mA input, 1xfeedback input, 2x DI, 1x mA output	W2T290009
Operating Manual SFC		WT.050.590.000.UA.IM
Operating instructions for retrofit set		
Operating instructions RS485 bus interface of the SFC		

6.2 SFC Spare Parts

Description	Part No.
Spare part circuit board IC board SFC 100 – 240 V AC	W2T348256
Spare part circuit board IC board SFC 24 V DC	W2T350410
Spare part circuit board IC board SFC-SC 100 – 240 V AC	W2T350411
Spare part circuit board IC board SFC-SC 24 V DC AAD9493	W2T350413
Operating front SFC for wall mounting	W2T350415
Operating front SFC-SC for wall mounting	W2T350416
Basic electronics SFC 100 – 240 V wall mounting	W2T350418
Basic electronics SFC 24 V DC wall mounting	W2T350506
Basic electronics SFC-SC 100 – 240 V wall mounting	W2T350507
Basic electronics SFC-SC 24 V DC wall mounting	W2T350508
SD memory card 128 MB or larger	AAD8572
Connection cable IC board front panel board approx. 0.5 m	W2T350529
IC board fuse for 24 V DC and 100 – 240 V AC (1A time-lag)	W2T350536
Varta battery CR2032	W2T439137
Update cable for SFC with 9 pin RS232-DSUB connector	W2T320242
Accessory set, comprising: screws, dowels, multiple seal inserts, bolts, reducing sealing ring	AAD8146
Mounting rails V2A for assembling the SFC on top-hat rail 3 Meter Length	