

SilSter 168®

Water Sterilizer



User Manual

Version L
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1 Table of validity

The following table describes which versions of the software and hardware this user manual was based on.

The *hardware version* is printed on the PCB inside the control unit in the lower left corner.

The *software version* is shown on the display at start-up.

User manual version	Software version	Hardware version
D	V1.2	SILSTER_B
E	V1.2	SILSTER_C
F	V1.2	SILSTER_D
G	V1.5	SILSTER_D
H, J, K, L	V1.81	SILSTER_E

2 Overview

2.1 Disinfection of water

Before consuming drinking water it has to be disinfected. Furthermore the growth of bacteria in storage tanks and pipes has to be prevented. Chlorination is a well known way of disinfection which has a long lasting preservation time. On modern ships chlorination is often replaced by other ways of disinfection in order to avoid handling of hazardous chlorine and to reduce piping corrosion associated with chlorinated water.

UV-sterilisation is another method for disinfection, but the disadvantage with this method is that it only is effective when the UV light is applied upon the water. Downstream from the UV-sterilizer the water may again be infected by bacteria.

Another way of disinfection is by treating the water with ozone, which also has no long term lasting effects, same as water treatment by UV-light.

2.2 Disinfection with silver ions

The use of silver ions is a well proven and accepted method of cleaning and inhibiting the growth of bacteria in drinking water. The method has been in use for decades and several government authorities have adapted the process as being one of the most efficient ways of drinking water treatment.

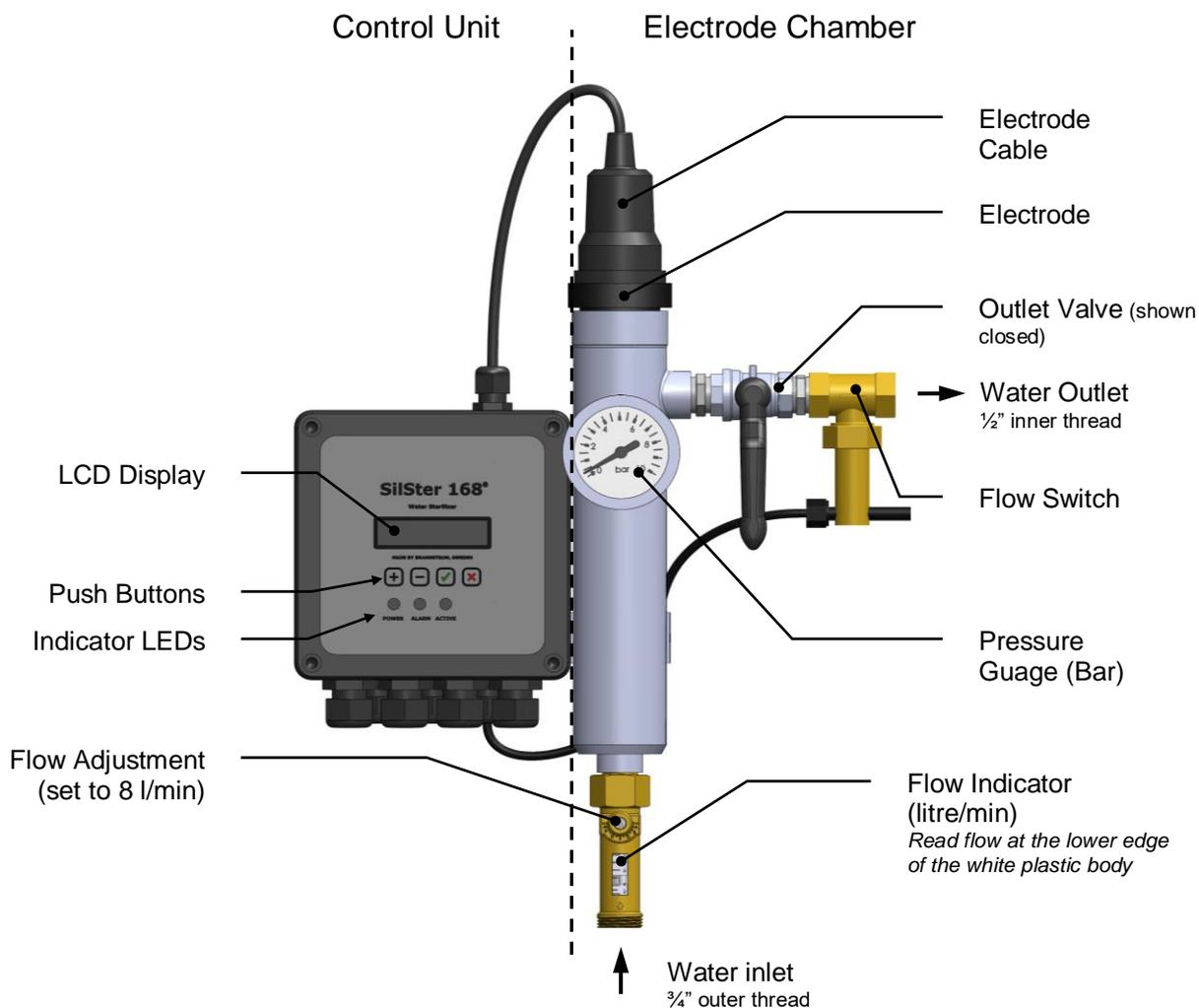
Silver ions do not add taste, smell or change the water in any other means. As long as the concentration of silver ions is present in the water, there will be no bacteria in the water distribution system or in the storage tank.

More silver needs to be added if the water has been in the storage tank for an extended period. This can easily be done by using the menu function *Start re-sterilize*, see chapter 5.2 *Menu system*, page 26. This function is only available with *Pipe setup: A.LOOP*, see chapter 4.1.1 *Configuration & Custom config*. page 12.

2.3 Concentration of silver ions

For fresh water disinfection it is recommended to add 0.1ppm of silver ions into the fresh water holding tank. The minimum time required for sterilization to take effect is 4 hours after the silver has been added to the water in the tank. This should ensure a maximum of 0.08ppm silver in the distribution system.¹

¹ MSN1845 (M), "Maritime Labour Convention, 2006: Food and Catering: Provision of Food and Fresh Water", Maritime and Coastguard Agency (MCA), United Kingdom.



2.4 SilSter 168® water sterilizer

SilSter 168® is a silver sterilizer which provides an active dosing of silver ions into a stream of produced or bunkered fresh water directed into the fresh water holding tank, or directly into a fresh water holding tank. This is done by the use of two silver plates in the electrode. A water stream is passed between the silver plates and the ions are inserted into the stream of water. The current between the silver plates is constantly changing direction in order to consume silver metal from both plates, as well as to clean the plates and reduce the maintenance to a minimum.

The dosing is controlled by an advanced micro processor system which makes sure that the right amount of silver is discharged depending on the water volume to be disinfected. SilSter 168® is operated through a user-friendly menu system.

2.4.1 Features of SilSter 168®

- ✓ Compact design, the control unit can be mounted together or separated from electrode chamber.
- ✓ User-friendly interface.
- ✓ Fully automatic silver ion discharge, proportional to produced water flow.
- ✓ Fail-safe, an alarm output may be used to shut down the water production in case the SilSter 168® is not functioning normally or if the electrode is used up.
- ✓ Two control inputs which can be individually configured for either a flow meter or a run/stop signal.
- ✓ Bunkered water can be sterilized in two ways:
 - *Manually*: Enter the batch volume (m³) and the appropriate amount of silver ions will be injected.
 - *Automatically*: If a flow meter is installed on the bunker line and connected to control input 2, the appropriate amount of silver ions will be injected.
- ✓ Easy to change electrode.
- ✓ An alarm output will be activated if the SilSter 168® is not functioning normally or if the electrode is running low.

3 Technical specifications

Sterilization Capacity

Continuously up to 240 m³/day @ 0.1ppm silver ion concentration (max 0.5A / max 48V / max 20W).

Maximum capacity is reduced by low water temperatures and/or low water conductivity, see section 9 *Performance diagram* for details.

Maximum capacity is also reduced if the control unit is exposed to excessive heat.

3.1 Control unit

Housing

Glass fibre reinforced polyester, IP65.

Control unit can be mounted on electrode chamber or separately.

See section 10 for external dimensions.

User Interface

16 x 2 alphanumeric dot matrix LCD display with background illumination.

4 push buttons.

3 LEDs (Power/Alarm/Active).

Inputs

Flow switch input. Connected to a factory installed flow switch.

Input 1. Configurable either as a flow meter input (0 – 1000Hz) or for run/stop signal (fixed flow, contacts closed = run). Flow has to be lower than or equal to maximum capacity.

Input 2. Configurable either as a flow meter input (0 – 1000Hz) or for run/stop signal (fixed flow, contacts closed = run). Flow can temporary be higher than maximum capacity. A flow meter on the bunker line should be connected to input 2.

Outputs

Valve control output. Outputs mains voltage (max 250mA) when active. Connect to a solenoid valve controlling the water flow to the silver ion chamber.

Alarm output. Potential free relay (max 250mA). Active if there is an alarm or if SilSter 168 is not powered. Can be connected to disable the fresh water maker.

Power Supply

85-285 VAC, 50-60 Hz. 30W power consumption.

Environment

0 – 50 °C ambient temperature. Avoid direct sun exposure on the control unit.

3.2 Electrode Chamber

Materials

Electrode chamber: Electro-polished stainless steel (AISI 316L).

Electrode: Metallic silver. 83% silver, 17% copper

Electrode pipe: Transparent plastic ABS LG TR556

Electrode pipe ends: Black plastic POM FG

Flow indicator & flow switch: Brass.

Manual valve: Nickel-plated brass.

Electrode lifespan

Up to 2500 m³ water @ 0.1ppm silver ion concentration.

Up to 6100 m³ water @ 0.04ppm silver ion concentration.

Alarm goes active when electrode is exhausted or is running low.

Water conditions

Max 6 Bar pressure (built-in pressure gauge: 0-10 Bar).

Approx. 8 litre/minute water flow through Silster 168® (built-in flow adjustment screw).

See section 9 *Performance diagram* for temperature and conductivity limitations.

4 Installation instructions

The installation process is described in 3 steps:

Step 1: Choose a configuration, do the piping and electrical connections according to the figure and set the configuration specific settings as described.

Step 2: Set the general settings.

Step 3: Start the system and adjust the flow through SilSter 168®.

4.1 Step 1: Configure SilSter 168®

SilSter 168® can be configured in a number of ways. Chose *one* of the configurations; connect pipes and electrical cables according to the figure and set the configuration specific settings as described. Be sure to choose a configuration which fulfils all local rules and regulations.

See also *7 Electrical connections* for details on how to connect the electrical cables.

Settings can only be changed in STANDBY mode.

- Make sure input signals are not active.
- Reset any active alarms, see section *6.1 Alarm reset*.
- Reset unsterilized water if necessary.

Press in the *menu Information* -> *Unsteril. vol.* (Warning! Resetting means that water which is in the tank will not be sterilized. Use very carefully).



Change in
STANDBY mode!

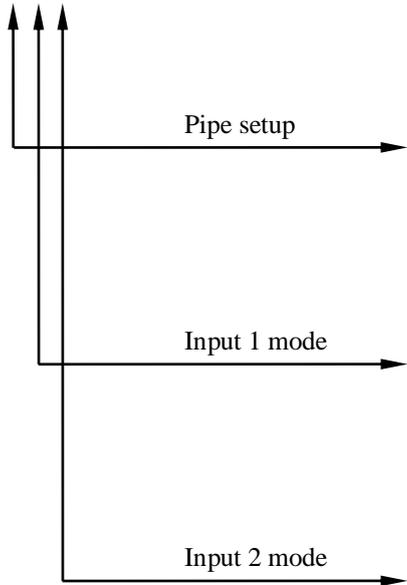
This message is shown if you attempt to change a setting when the unit is not in STANDBY mode.

4.1.1 Configuration & Custom config.

The configuration can be quickly changed via the menu *settings -> Configuration* or through the 3 submenus in *Settings -> Custom config*. Changes in *Configuration* will have effect in *Custom config*. and vice versa, as can be seen in the figure below.

Settings:

```
Configuration:
A02
```



Settings -> Custom config.:

```
Pipe setup:
A.LOOP
```

A = LOOP, B= IN-LINE 3-WAY, C=IN-LINE 2-WAY

```
Input 1 mode:
Disabled
```

0 = Disabled, 1= Fixed Flow, 2=Flow Meter

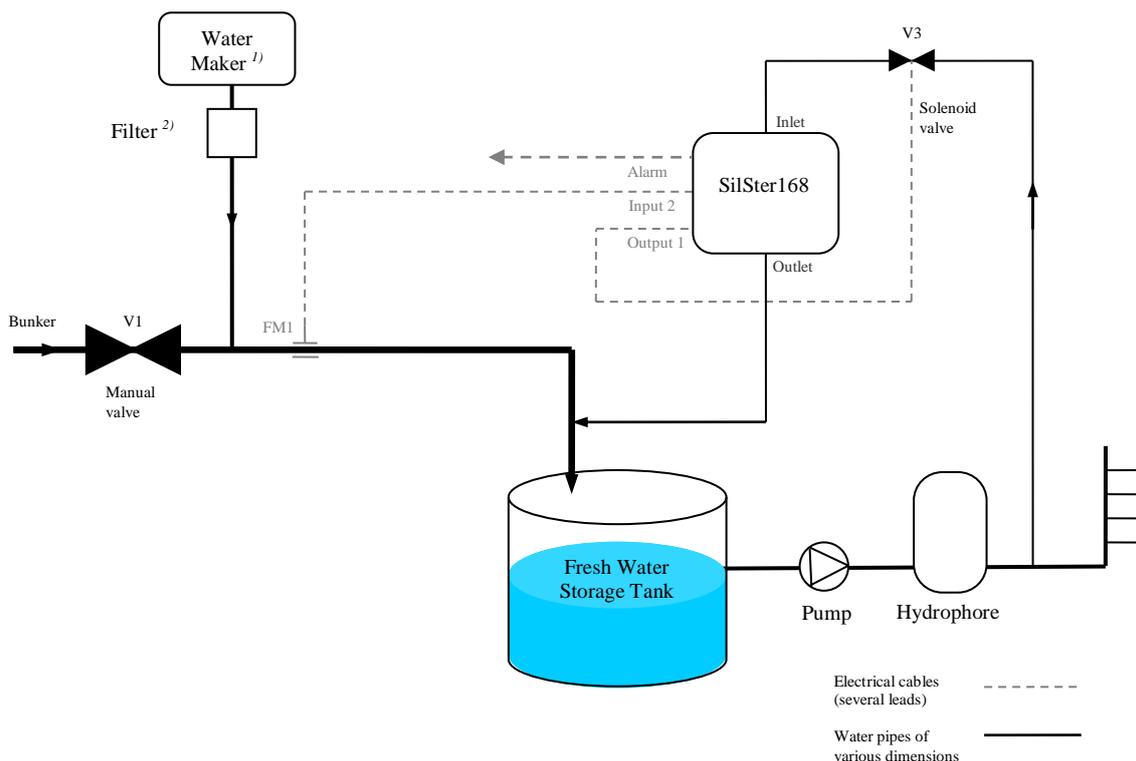
```
Input 2 mode:
Flow Meter
```

0 = Disabled, 1= Fixed Flow, 2=Flow Meter

4.1.2 Configuration A02: Circulation loop with one common flow meter

Features:

- ✓ Once SilSter 168® is configured, silver ions are discharged fully automatically (even when bunkering water).
- ✓ One flow meter measures the flow from both the water maker and the bunker line.
Note: This configuration is only possible if the difference between maximum flow (when bunkering) and minimum flow (from water maker) is small enough so it can be measured with one single flow meter at sufficient precision.
- ✓ The flow meter should be connected to Input 2 on SilSter 168®. That will ensure that the flow can vary over time and temporarily exceed the capacity of SilSter 168®. SilSter 168® will continue to discharge silver ions, even after bunkering has finished, until the correct amount of silver ions has been released.



FM1: If the difference in flow rate between the bunker flow and the water maker flow is too big for the flow meter to accurately measure both flows, a different configuration with two flow meters must be chosen.

V1: Open only when bunkering.

V3: Solenoid valve controlling flow through silver ion chamber.

¹⁾ Reverse Osmosis apparatus or Evaporator

²⁾ pH adjusting & re-hardening filter.

Connect pipes as described in the above figure. Connect electrical cables according to the above figure and section 7 *Electrical connections*. The electric installation has to be done by a trained electrician.

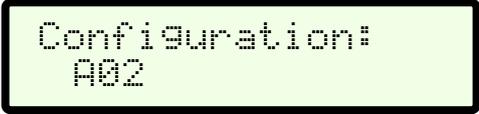
Settings can only be changed in STANDBY mode, see section 4.1 *Step 1: Configure SilSter 168®*.

Configuration specific settings:

1. Go to the *Settings* menu (from the main screen):



Set *configuration* to A02.



```
Configuration:
A02
```

See section 5.2.1 *Changing numerical parameters* & 5.2.2 *Changing multi-choice parameters* for details.

2. Go to *Input 2 setting*:  

Set *Input 2 setting* according to the specification of the flow meter (FM1 in figure above). [millilitres / pulse]



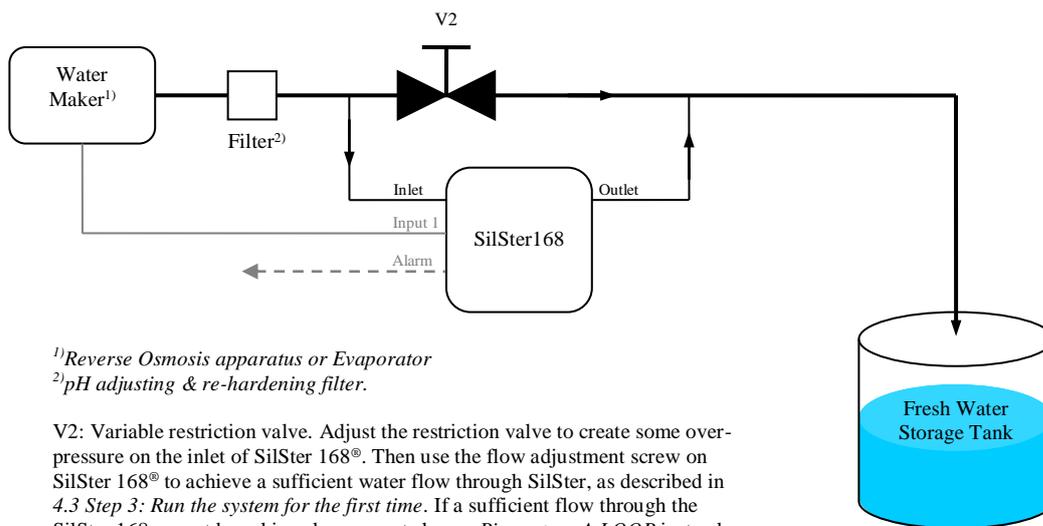
```
Input 2 setting:
000.00 ml/pulse
```

Go to section 4.2 *Step 2: General settings* and continue the installation there.

4.1.3 Configuration B10: In-line

Features:

- ✓ Water produced by the water maker is automatically sterilized. If the water production isn't constant enough to allow for correct adjustment of V2 during all conditions, you must choose *Pipe setup: A.LOOP* instead.
- ✓ Not possible to sterilize bunkered water or to re-sterilize water which is already in the tank.
- ✓ Not applicable to water makers with a capacity below 12 m³/day (flow through SilSter 168® needs to be 8 l/min). Use *Pipe setup: A.LOOP* instead.



¹⁾Reverse Osmosis apparatus or Evaporator
²⁾pH adjusting & re-hardening filter.

V2: Variable restriction valve. Adjust the restriction valve to create some over-pressure on the inlet of SilSter 168®. Then use the flow adjustment screw on SilSter 168® to achieve a sufficient water flow through SilSter, as described in 4.3 Step 3: Run the system for the first time. If a sufficient flow through the SilSter 168 cannot be achieved, you must choose *Pipe setup: A.LOOP* instead.

Connect pipes as described in the above figure. Connect electrical cables according to the above figure and section 7 *Electrical connections*. The electric installation has to be done by a qualified electrician.

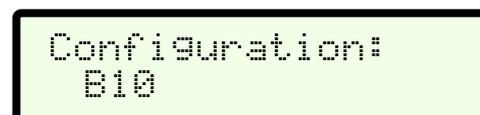
Settings can only be changed in STANDBY mode, see section 4.1 Step 1: *Configure SilSter 168®*.

Configuration specific settings:

1. Go to the *Settings* menu (from the main screen):



Set configuration to B10.



See section 5.2.1 *Changing numerical parameters* & 5.2.2 *Changing multi-choice parameters* for details.

2. Go to *Input 1 setting*:  
Adjust flow according to the specification of the water maker.



Go to the *Flow unit* menu if you wish to change the flow unit before editing the flow: 

See section 5.2.1 *Changing numerical parameters* for details.

Go to section 4.2 *Step 2: General settings* and continue the installation there.

4.1.4 Custom Configuration

If your desired configuration is not described above, use the steps below to setup SilSter 168® for a custom configuration.

For fail-safe operation: Connect the alarm signal from the SilSter 168 to stop the water maker.

Connect pipes depending on the specific configuration. Connect electrical cables according to section 7 *Electrical connections*. The electric installation has to be done by a qualified electrician.

Settings can only be changed in STANDBY mode, see section 4.1 *Step 1: Configure SilSter 168®*.

Make sure that your configuration follows all applicable rules and regulations.

Configuration specific settings:

- Go to the *Settings* -> *Custom config.* menu (from the main screen): 

See section 5.2.1 and 5.2.2 for details on how to change a parameter.

Set *Pipe setup* to one of 3 alternatives:

A. LOOP. SilSter 168® is installed on a circulation loop. SilSter's water inlet should be connected just downstream from the hydrophore (pressure vessel). SilSter's water outlet should be connected to the fresh water holding tank.

See water connections in the diagram in section 4.1.2 *Configuration A02: Circulation loop with one common flow meter*.



Pipe setup:
A.LOOP

B. IN-LINE 3-WAY. SilSter 168® is installed on the pipe from the water maker (a portion of the flow is led through SilSter 168®).

See water connections in the diagram in section 4.1.3 *Configuration B10: In-line*

This configuration is not applicable to water makers with a capacity below 12 m³/day (flow through SilSter 168® needs to be 8 l/min). Use *Pipe setup: A.LOOP* instead.



Pipe setup:
B.IN-LINE 3-WAY

2. Go to *Input 1 mode*: 

Note: Input 1 (as opposed to *Input 2*) does not accept water flow in excess of the maximum sterilization capacity (will trigger an alarm). Do not connect *Input 1* to a bunker line, with a flowrate which temporarily may be higher than 10 m³/h.

Set *Input 1 mode* to one of 2 alternatives:

Disabled. Disable *Input 1* if it will not be used.



```
Input 1 mode:
Disabled
```

Fixed Flow. A potential free contact (switch or relay) is connected to *Input 1*. A fixed water flow (predefined) is assumed when the contact is closed.



```
Input 1 mode:
Fixed Flow
```

Flow Meter. A flow meter with pulse output is connected to *Input 1*.



```
Input 1 mode:
Flow Meter
```

3. Go to *Input 2 mode*: 

Skip point 4 and 5 if *Input 2* will be left unconnected.

Note: Input 2 (as opposed to *Input 1*) accepts temporary flows in excess of the maximum sterilization capacity. A flow meter on the bunker pipe should be connected to *Input 2*. This is only true if *Configuration* (above) is set to *Pipe setup: A.LOOP*.

Set *Input 2 mode* to one of 2 alternatives:

Disabled. Disable *Input 2* if it will not be used.



```
Input 2 mode:
Disabled
```

Fixed Flow. A potential free contact (switch or relay) is connected to *Input 2*. A fixed water flow (predefined) is assumed when the contact is closed.



```
Input 2 mode:
Fixed Flow
```

Flow Meter. A flow meter with pulse output is connected to *Input 2*.

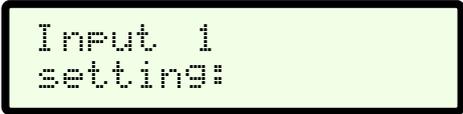


```
Input 2 mode:
Flow Meter
```

4. Go to *Input 1 setting*:  

If *Input 1 mode* was set to *Fixed Flow*:

Set *Input 1 setting* according to the flow that needs to be sterilised when *Input 1* is active (contact closed).



```
Input 1
setting:
```

Go to the *Flow unit* menu if you wish to change the flow unit before editing the flow:  ()

If *Input 1 mode* was set to *Flow Meter*:

Set *Input 1 setting* according to the specification of the flow meter which is connected to *Input 1*. The unit is millilitres per pulse.



```
Input 1  setting:
 000.00  ml/pulse
```

See section 4.4 *Converting to ml/pulse* for help on how to convert from other units.

5. Go to *Input 2 setting*: 

If *Input 2 mode* was set to *Fixed Flow*:

Set *Input 2 setting* according to the flow that needs to be sterilised when *Input 2* is active (contact closed).



```
Input 2  setting:
 000.00  l/min
```

Go to the *Flow unit* menu if you wish to change the flow unit before editing the flow: 

If *Input 2 mode* was set to *Flow Meter*:

Set *Input 2 setting* according to the specification of the flow meter which is connected to *Input 2*. The unit is millilitres per pulse.



```
Input 2  setting:
 000.00  ml/pulse
```

See section 4.4 *Converting to ml/pulse* for help on how to convert from other units.

Go to section 4.2 *Step 2: General settings* and continue the installation there.

4.2 Step 2: General settings

Apart from the settings that are configuration specific, there are 3 more settings that control the operation: *Flow unit*, *Max bunker volume* (only in configuration A) and *Silver concentration*.

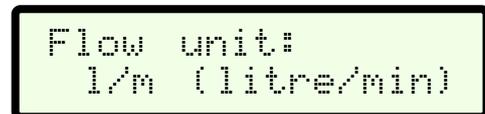
Settings can only be changed in STANDBY mode, see section 4.1 Step 1: Configure SilSter 168®.

1. Go to the *Flow unit* menu: 
If you navigate from the main screen:



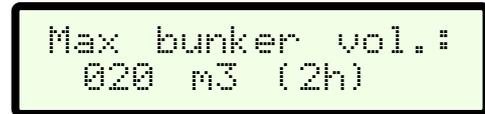
See section 5.2.1 and 5.2.2 for details on how to change a parameter.

2. Chose which unit that should be used when entering or displaying flow.
[l/m (litre/minute), m³/h (cubic meters/hour), IGPM (Imperial gallons per minute) or USGPM (US gallons per minute)]



This setting is only shown in configuration A:

3. Go to *Max bunker vol.:* 
Set the maximum bunker volume. [m³, cubic meter = ton]
This will limit the maximum volume of a batch, see section 5.3 *Bunker water (Batch)*.



 The *Maximum sterilization time* is shown in brackets

The approximate time, in hours, it will take to sterilize this volume (at maximum capacity) is shown in brackets. This time is also the *maximum sterilization time*.

An alarm goes active if the *estimated time to finish* is longer than the *maximum sterilization time*.

The *estimated time to finish* is the time it will take before the correct amount of silver ions has been discharged. The *estimated time to finish* is shown on the main screen, see section 5.1 *Main screen and indicator LEDs*.

4. Go to *Silver conc.*: 

Set the desired silver ion concentration in PPM (parts per million). [0.04-0.2 PPM]



0.10 PPM is the recommended silver ion concentration for fresh water. See section 2.3 *Concentration of silver ions*.

The actual silver ion content in the water system can vary depending on the water, pipes and tanks. The user should take grab samples from the water system and analyze the actual silver ion content. The *Silver conc.* should then be adjusted to compensate if the concentration is too low/high.

4.3 Step 3: Run the system for the first time

Run the system the way that is intended, depending on your configuration.

Once water is flowing through SilSter 168® you must adjust the flow to approx. 8 litres/min. See section 2.4 *SilSter 168® water sterilizer* to find the flow adjustment screw and the flow indicator.

If you get an alarm, see section 6 *Alarms* in order to solve the problem.

If a flow meter is used: Check that the input settings for the flow meter are correct by pumping a known flow through the flow meter. Compare with the flow that is shown in the menu system under *Information -> Input 1* and/or *Information -> Input 2*.

4.4 Converting to ml/pulse

The factor that specifies the quantity of water per pulse from the flow meter (sometimes called k-factor) has to be entered into SilSter 168® in the unit *ml/pulse*. Use the table below to convert the k-factor from other units into *ml/pulse*. Round of the result to 3 decimals.

Convert from:	Into ml/pulse:
Pulses/US Gallon	$\frac{3785}{X}$
PPL (Pulses per litre)	$\frac{1000}{X}$

Calculation example:

The specification for a certain flow meter says that the k-factor is 559.1 pulses per US Gallon.

$$\frac{3785}{559.1} = 6.769809 \approx 6.770$$

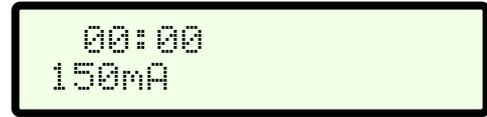
Conclusion: 559.1 pulses/US Gallon is equal to 6.770 ml/pulse.

Tip: Check your calculation by pumping a known flow through the flow meter. Compare with the flow that is shown in the menu system under *Information -> Input 1* or *Information -> Input 2*.

5 Operation instructions

5.1 Main screen and indicator LEDs

The main screen on the LCD display (shown when the user has not entered the menu system) shows the *estimated time to finish* (hh:mm) and the *electrode current* (mA) on the first line. *Estimated time to finish* is only shown in configuration A (see section 4.1 Step 1: *Configure SilSter 168®*).



The *estimated time to finish* is the time it will take before the correct amount of silver ions has been discharged. The time estimation is correct if; (1) The *Input 1* flow stays constant (water maker production) and (2) The *Input 2* flow is zero (no flow registered by the flow meter on the bunker pipe).

00:00 means that there is no lag and the correct amount of silver is being discharged for the present water flow.

99:59 (maximum time) means that the required silver discharge for the present water flow is higher than the delivered discharge.

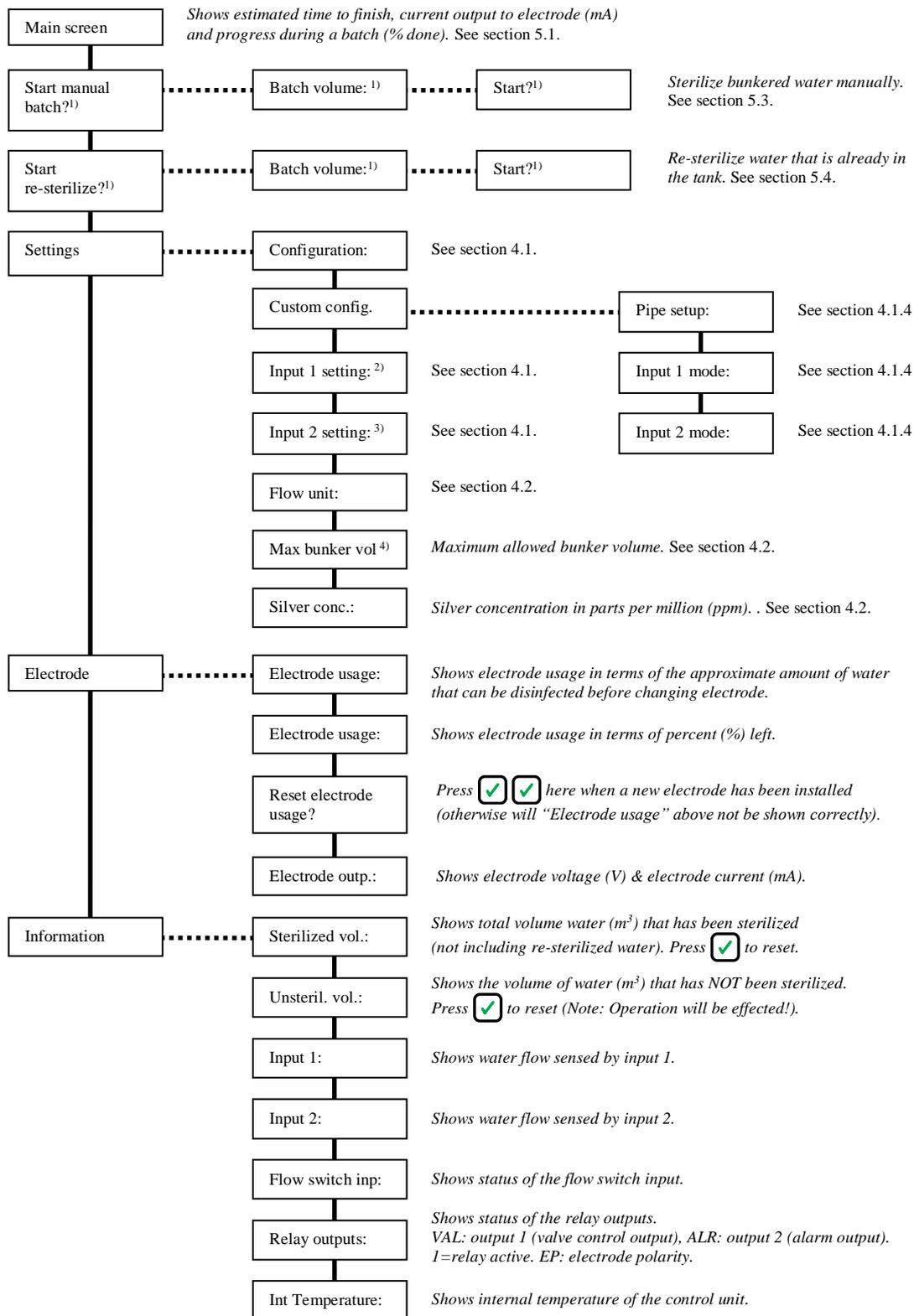
The progress is shown on the second line if a *Batch* or *Re-sterilize* is active.



The LED lamps on the front panel indicate the status of the equipment. The straight/dashed lines indicate if the lamps are lit continuously/flashing.

 POWER		SilSter 168® is powered.
 ALARM		One or several alarms are active. The type of alarm is shown on the display. Output 2 (alarm output) is in the alarm state.
 ACTIVE		Output 1 (valve control output) is active and silver ions are being discharged.

5.2 Menu system

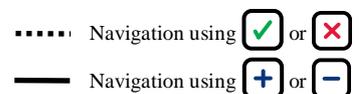


¹⁾ These menus are only shown in configuration A and if Max bunker volume is larger than 0 m³.

²⁾ This menu is not shown if Input 1 mode is set to disabled.

³⁾ This menu is not shown if Input 2 mode is set to disabled.

⁴⁾ This menu is only shown in configuration A.



5.2.1 Changing numerical parameters

To change a numerical parameter, press .

```
Parameter:
 010.000
```

A “>” indicates that the field is being edited.
A cursor “_” shows which digit that is edited.

```
Parameter:
>010.000
```

Press  to select next digit.

Press  or  to change the digit.

```
Parameter:
>020.000
```

Press and hold  for two seconds to store new value.

Press  to cancel and restore previous value.

5.2.2 Changing multi-choice parameters

To change a multi-choice parameter, press .

```
Parameter:
ALTERNATIVE 1
```

A “>” indicates that the parameter is being edited.

```
Parameter:
>ALTERNATIVE 1
```

Press  or  to change alternative.

```
Parameter:
>ALTERNATIVE 2
```

Press and hold  for two seconds to store new value.

Press  to cancel and restore previous value.

5.3 Bunker water (Batch)

Silver ions can be added to bunkered water by starting a manual batch through the menu system.

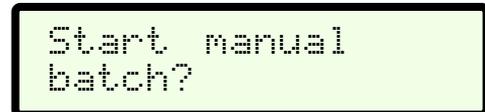
Note: You should *not* manually start a batch to sterilize bunkered water if your system is equipped with a flow meter on the bunker line. Sterilization of the bunkered water will take place automatically in that case.

Note: Bunkered water can only be sterilised if SilSter 168® is installed on a circulation loop (*Pipe setup: A.LOOP*), see for example the configuration in section 4.1.2 on page 13.

5.3.1 Start a manual batch

Start the batch while or after bunkering water.

1. Go to *Start manual batch?* (from the main screen):



2. Enter the water volume that is bunkered in cubic meters, m³. (1 m³ ≈ 1 ton = 1000kg)

See section 5.2.1 for details on how to change a numerical parameter.

3. Press  to confirm entered volume and to start the batch.

Press  to change the volume.



The progress of the batch is shown on the main screen until the batch has finished.

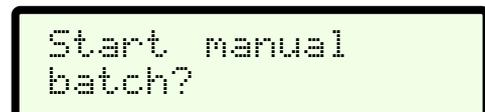


First row shows estimated time to finish (hh:mm) and the current delivered to the electrode.

Second row shows how many percent of the batch that has been done.

5.3.2 Change or cancel an ongoing batch

1. Go to *Start manual batch?* (from the main screen):



This message warns the user that there is an ongoing active batch.



```
Batch is active!
```

2. Press to change the batch volume.
Press to exit (batch will continue as before).



```
Want to change  
batch volume?
```

3. Enter the new batch volume. Set volume to 0.0 m³ if you wish to cancel the batch.



```
Batch volume:  
>0010.000 m3
```

See section 5.2.1 for details on how to change a numerical parameter.

4. Press to let the new volume take effect.
Press to change the volume.



```
OK?  
0020.000 m3
```

Note: The batch will finish immediately if the entered volume is less than the volume that has already been sterilized.

5.4 Adding more silver to the tank (Re-sterilize)

Additional silver ions can be added to the tank through the *Re-sterilize* menu. This can be useful if the water in the tank has been stored for a very long time so that the silver concentration has decreased.

This menu is analogue to the *Batch* menu with one important difference; sterilizing through *Re-sterilize* does not add to the total sterilized volume which is displayed in the menu system under *Information -> Sterilized vol.*

Note: It is only possible to add more silver ions to the tank (re-sterilize) if SilSter 168® is installed on a circulation loop, see for example the configuration in section 4.1.2 on page 13.

5.4.1 Calculating the re-sterilize volume

The amount of silver ions that is to be added is entered in terms of volume water. SilSter 168® will add the amount of silver needed to get the wanted silver ion concentration for the entered water volume (assuming that no silver is present from the beginning).

Calculation example:

Your fresh water tank has 100 m³ of water. The silver concentration has dropped by 20%.

$$100 \text{ m}^3 \times 20\% = 20 \text{ m}^3$$

Conclusion: Re-sterilize with a batch volume of 20 m³ in order to bring the silver ion concentration up to normal.

Note: How fast the silver ion concentration decreases with time is dependent of the individual installation and needs to be determined by taking several grab samples which should be analyzed in a laboratory.

5.4.2 Start to Re-sterilize

1. Go to *Start re-sterilize* (from the main screen):



```
Start
re-sterilize?
```

2. Enter the re-sterilize batch volume in cubic meters, m³. (1 m³ ≈ 1 ton = 1000kg)
See section 5.4.1 *Calculating the re-sterilize volume.*

```
Batch volume:
>0000.000 m3
```

See section 5.2.1 for details on how to change a numerical parameter.

3. Press to confirm entered volume and start to re-sterilize.
Press to change the volume.

```
Start?
0010.000 m3
```

The progress of the re-sterilisation is shown on the main screen until the batch has finished.

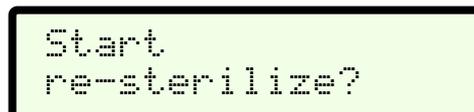


First row shows estimated time to finish (hh:mm) and the current delivered to the electrode.

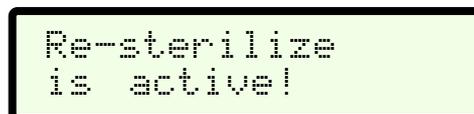
Second row shows how many percent of the batch that has been done.

5.4.3 Change or cancel an ongoing re-sterilization

1. Go to *Start re-sterilize* (from the main screen):



This message warns the user that there is an ongoing re-sterilization.



2. Press to change the re-sterilization volume.
Press to exit (re-sterilize will continue as before).



3. Enter the new re-sterilise batch volume. Set volume to 0.0 m³ if you wish to cancel the batch. See section 5.4.1 *Calculating the re-sterilize volume*.



See section 5.2.1 for details on how to change a numerical parameter.

4. Press to let the new volume take effect.
Press to change the volume.



Note: The batch will finish immediately if the entered volume is less than the volume that has already been sterilized.

5.5 Replacement of silver electrode

The procedure to replace the electrode is as follows. See section 2.4

SilSter 168® water sterilizer for explanation of the different parts of *SilSter 168®*.

1. Close a manual valve on the inlet of *SilSter 168®* and close the manual outlet valve.
2. Remove the electrode cable by pulling the connector on top of the electrode chamber upwards.
3. Unscrew the electrode (spanner size: 32mm).
4. Check that the electrode chamber is clean and free from dirt inside.
5. Put the new silver electrode into the chamber and twist firmly to tighten.
6. Connect the electrode cable.
7. Open the inlet and outlet valves again.
8. Go to the *Reset electrode usage?* menu (from the main screen): 
9. Press .



```
Reset electrode
usage?
```

10. Press again to confirm.

Installed new
electrode?

Electrode usage:
~100% left

11. Go to the main screen:
press again, if necessary to reset alarms.

6 Alarms

SilSter 168® automatically monitors internal and external conditions and shows an alarm if anything abnormal is detected. All active alarms are shown on the main screen.

The table below describes all the alarms. The column *Alarm* shows the message that is displayed on the LCD screen. *Consequence* describes if silver ion discharge is continued or not when the alarm is active. *Solution* describes how to solve the problem that caused the alarm. *Config.* shows in which configuration a certain alarm can appear.

All alarms must be reset by pressing  on the main screen (even if the alarm reason has been solved).

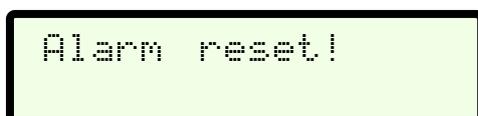
Alarm	Consequence	Solution	Config.
	Stops discharging silver ions.	-Check cable and connection to electrodes. -Inspect electrodes, exchange if exhausted. Press  in main screen to reset alarm.	ALL
 Electrode is not connected, exhausted or is running dry.	Stops discharging silver ions.	-Check cable and connection to electrodes. -Make sure water is flowing through SilSter168®. -Inspect electrodes, exchange if exhausted. Press  in main screen to reset alarm.	ALL
 xx: "Max bunker vol." (maximum bunker volume). The <i>unsterilized volume</i> is larger than "Max bunker vol.", which is not allowed. The <i>unsterilized volume</i> can be viewed and reset in the menu <i>Information -> Unsteril. Vol</i> (Warning! Resetting means that water which is in the tank will not be sterilized. Use very carefully).	Stops discharging silver ions.	-Do not run water maker until sterilization of bunkered water has finished. -Decrease water flow. -Decrease batch size. -Increase water temperature. -Increase water conductivity. -Increase "Max bunker vol." in the settings menu. -Check cable and connection to electrodes. -Inspect electrodes, exchange if exhausted. Press  in main screen to reset alarm.	A

<p>ALARM: Sterili. >xxh to finish</p> <p><i>xx: max sterilization time</i> Cannot deliver enough silver ions at present conditions to be finished within <i>max sterilization time</i>. <i>Max sterilization time</i> can be viewed and changed in the setting for "Max bunker vol." see section 4.2 Step 2: <i>General settings</i>. The <i>unsterilized volume</i> can be viewed and reset in the menu <i>Information -> Unsteril. Vol</i> (Warning! Resetting means that water which is in the tank will not be sterilized. Use very carefully).</p>	<p>Stops discharging silver ions.</p>	<p>-Do not run water maker until sterilization of bunkered water has finished. -Decrease water flow. -Decrease batch size. -Increase water temperature. -Increase water conductivity. -Increase "Max bunker vol." in the settings menu.</p> <p>-Check cable and connection to electrodes. -Inspect electrodes, exchange if exhausted.</p> <p>Press  in main screen to reset alarm.</p>	<p>A</p>
<p>ALARM: INPUT 1 flow is too</p> <p>The flow from input1 is higher than max capacity, which is not allowed.</p>	<p>Stops discharging silver ions.</p>	<p>-Decrease water flow at input 1. -Increase water temperature. -Increase water conductivity. -Inspect electrodes, exchange if exhausted.</p> <p>Press  in main screen to reset alarm.</p>	<p>A</p>
<p>ALARM: INPUT 1+2 flow is too</p> <p>The total flow (input1+input2) is higher than max capacity, which is not allowed.</p>	<p>Stops discharging silver ions.</p>	<p>-Decrease water flow at input 1 or/and 2. -Increase water temperature. -Increase water conductivity. -Inspect electrodes, exchange if exhausted.</p> <p>Press  in main screen to reset alarm.</p>	<p>B or C</p>
<p>ALARM: No flow through SilSter</p> <p>Flow switch does not detect flow although valve output is active and there should be a flow through SilSter 168®.</p>	<p>Stops discharging silver ions.</p>	<p>-Check that the water flow through SilSter 168® is high enough to trigger the flow switch. -Check that the flow switch is working.</p> <p>Press  in main screen to reset alarm.</p>	<p>All</p>
<p>ALARM: Flowswitch error</p> <p>Flow switch detects flow through SilSter 168® although <i>Valve output</i> is off so there should not be a flow.</p>	<p>Stops discharging silver ions.</p>	<p>-Check that the flow switch is working correctly.</p> <p>Press  in main screen to reset alarm.</p>	<p>All</p>
<p>ALARM: INPUTx freq. too high</p> <p>x: "1" or "2". The input frequency on the specified input is too high.</p>	<p>Stops discharging silver ions.</p>	<p>-Choose a flow meter with lower output frequency. <i>OR</i> -Decrease the water flow so that the output frequency from the flow meter decreases.</p> <p>Press  in main screen to reset alarm.</p>	<p>All</p>
<p>ALARM: High temperature</p> <p>Internal temperature is too high (above 80°C!). Silver discharge has been shut down.</p>	<p>Stops discharging silver ions.</p>	<p>-Decrease ambient temperature and make sure that the control unit of SilSter 168® is not exposed to direct sunlight.</p> <p>Press  in main screen to reset alarm.</p>	<p>ALL</p>

<p>ALARM: >xxh High temperature</p> <p><i>xx: max sterilization time</i> Electrode output is limited because internal temperature is too high: Cannot deliver enough silver ions at present conditions to be finished within <i>max sterilization time</i>. <i>Max sterilization time</i> can be viewed and changed in the setting for "Max bunker vol." see section 4.2 Step 2: <i>General settings</i>.</p>	<p>Stops discharging silver ions.</p>	<p>-Decrease ambient temperature and/or make sure SilSter 168® is not exposed to direct sunlight. -Decrease water flow. -Increase water conductivity. -Do not run the water maker until the sterilization of bunkered water is finished.</p> <p>Press  in main screen to reset alarm.</p>	<p>A</p>
<p>ALARM: INPUT1 High flow/temp.</p> <p>Electrode output is limited because internal temperature is too high: The flow from input1 is higher than max capacity at present conditions, which is not allowed.</p>	<p>Stops discharging silver ions.</p>	<p>-Decrease ambient temperature and/or make sure SilSter 168® is not exposed to direct sunlight. -Decrease water flow. -Increase water conductivity.</p> <p>Press  in main screen to reset alarm.</p>	<p>A</p>
<p>ALARM: INPUT1+2 High flow/temp.</p> <p>Electrode output is limited because internal temperature is too high: The flow from input1+input2 is higher than max capacity at present conditions, which is not allowed.</p>	<p>Stops discharging silver ions.</p>	<p>-Decrease ambient temperature and/or make sure SilSter 168® is not exposed to direct sunlight. -Decrease water flow. -Increase water conductivity.</p> <p>Press  in main screen to reset alarm.</p>	<p>B or C</p>
<p>ALARM: ~20% left of electrode</p> <p>ALARM: <10% left of electrode</p>	<p>Continues discharging silver ions.</p>	<p>-Order new electrode. -Replace electrode when exhausted (IMPORTANT: <i>Reset electrode usage</i> in the <i>Electrode</i> menu when the electrode has been replaced).</p> <p>Press  in main screen to reset alarm.</p>	<p>All</p>

6.1 Alarm reset

Press  in the main screen to reset all active alarms. The following message is shown:



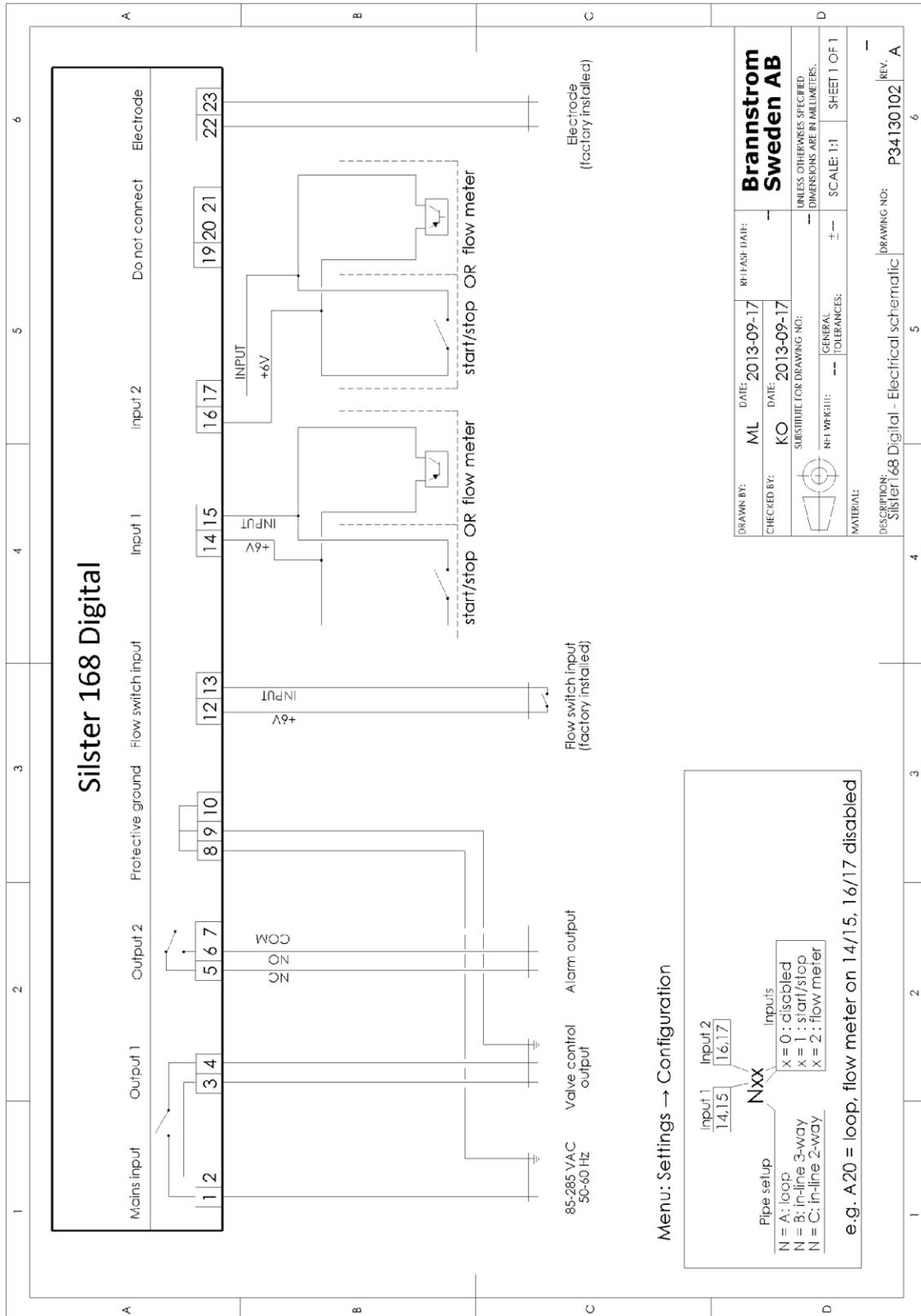
The alarm will come back again after 30 seconds if the problem that caused the alarm has not been resolved.

7 Electrical connections

1		Mains input. 85-285 VAC, 50-60Hz.
2		
3		Output 1. Valve control output. Outputs mains voltage when active. Fused with PTC-resistor (max 250mA).
4		
5	NC	Output 2. Alarm output. Potential free relay. Fused with PTC-resistor (max 250mA). The NC (Normally Closed) terminal is closed when there is no alarm.
6	NO	
7	Common	
8		Protective ground. Terminals 8-10 are used for connecting external protective ground only. These terminals are not connected anywhere internally.
9		
10		
12	+6V	Flow switch input. Connected to the flow switch which detects flow through SilSter 168® (Factory installed). ¹⁾
13	Input	
14	+6V	Input 1. Connect to a flow meter with pulse output (open collector, PNP, 0-1000Hz) or to a potential free contact (switch or relay). ¹⁾
15	Input	
16	+6V	Input 2. Connect to a flow meter with pulse output (open collector, PNP, 0-1000Hz) or to a potential free contact (switch or relay). ¹⁾
17	Input	
18	Gnd_input	Input ground. Ground for <i>Flow switch input</i> , <i>Input 1</i> and <i>Input 2</i> . ¹⁾
19		Do not connect.
20		
21		
22		Electrode.
23		

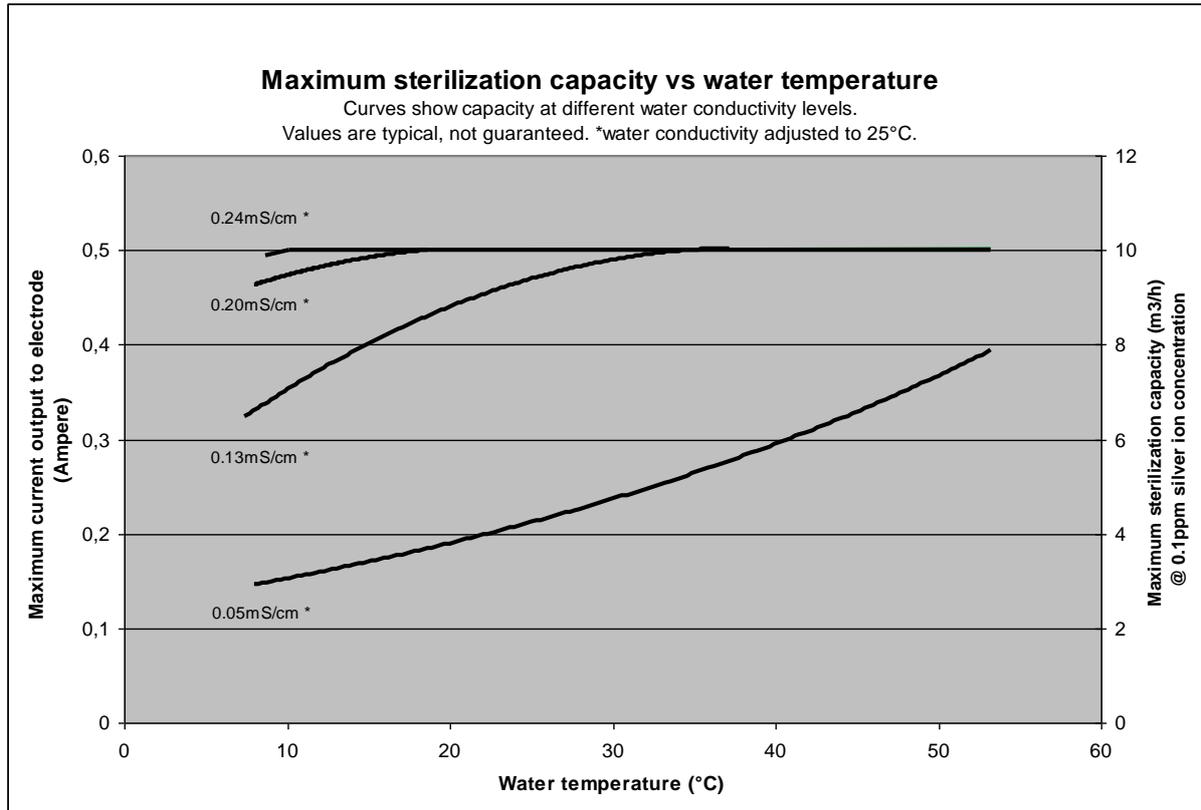
¹⁾The 3 inputs share a common ground but they are galvanically isolated from the rest of the circuit. +6V and *Gnd_input* can be used as power supply for some flow meters, but the total current must not exceed 50mA. +6V is not regulated and is typically 6-8 VDC depending on load.

8 Electrical schematic

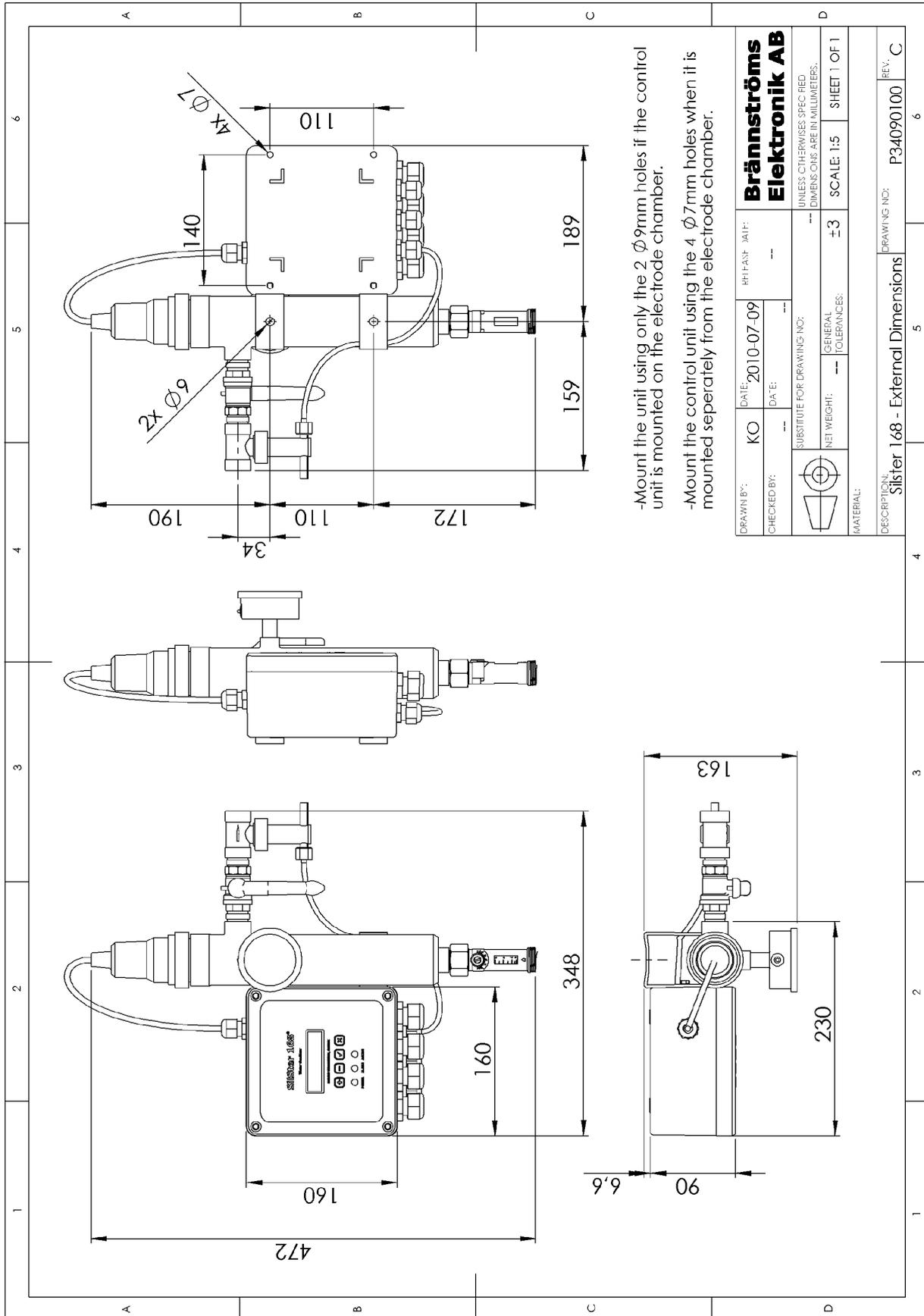


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9 Performance diagram



10 External dimensions



-Mount the unit using only the 2 ϕ 9mm holes if the control unit is mounted on the electrode chamber.
 -Mount the control unit using the 4 ϕ 7mm holes when it is mounted separately from the electrode chamber.

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11 Maintenance and spares

11.1 Maintenance

- Check all components with respect to mounting, clamping of cables, and any signs of damage.
- Check all connections to be tightened and not leaking.
- Check the cables to the control unit, flow switch and electrode chamber along their entire length with respect to any signs of chafe, wear or other damage.
- If in doubt, please contact an authorized service company.

11.2 Most common spares

- Silver electrode
- Flow switch
- Fuse MST 1A/250V