Possible cause	Possible solution
Bubbles within a pole mounted installation	Nucleated bubbles on the sensor surface can be removed if the Auto Clean system if fitted. The Auto Clean can be used to fire a jet of water across the sensor surface, removing bubbles. The Auto Clean can be used to fire a jet of water across the sensor surface, removing bubbles. The Auto Clean operation can be scheduled to be carried out at a frequency to prevent the build up of bubbles.

3.21 StreamerSense

3.21.1 General Information

3.21.1.1 Health and Safety

When using this instrument, basic safety precautions must always be followed to reduce the risk of fire, electrical shocks and injury to persons, including the following.

Disconnect electrical supply before working on this equipment.

- Before attempting to unpack, set up, or operate this instrument, please read this entire manual.
- Make certain the unit is disconnected from the power source before attempting to service or remove any component.
- Follow all warnings marked on the instrument.
- Failure to follow these precautions could result in personal injury or damage to the equipment.
- Do not attempt to disassemble the unit.
- Water must not be allowed to enter the housing of the unit.
- Close and fasten the covers of the unit prior to any external cleaning to prevent water ingress.
- Do not drop or jar the unit.
- Do not modify any internal electrical wiring or electronics.
- Use a mild non-abrasive cleanser when cleaning the outer cover of the unit.

In order to provide maximum user safety this instrument is designed with all electrical circuitry within a protective non-conductive housing.

3.21.1.2 Environmental Considerations

The sensor contains electronics, plastics and stainless steel. Please use this product in a manner sensitive to the environment and at the end of its life dispose, or recycle, in a manner that is in compliance with local regulations.

3.21.1.3 Theory of Operation

The StreamerSense sensor is a remote streaming current sensor that is used to measure the charge of “treated water”, with the sample point being downstream of the coagulant addition point. Charge is reported as Streaming Current Value (SCV) with a range of -1000 to +1000 (0 being neutral). The StreamerSense sensor provides the user with an online measurement of charge neutralisation, allowing the user to optimise and in many cases automate their coagulant dosing. Other applications include charge measurement in wastewater and on the wet end of a paper machine, which generally entails measuring low consistency samples (such as tray water or white water). This main focus of this manual is on the water treatment application.

The treated water sample flows into the sample cell where it is drawn into the bore during the upstroke of the piston cycle and is expelled from the bore on the piston down stroke. Ionic species and colloidal sized particles contained in the sample are temporarily immobilised on the piston and cylinder surfaces. As the water is moved back and forth by the piston, ionic charges that have collected onto the piston surfaces (+ and -) are moved downstream to the electrodes. This movement of ions causes an alternating current to be generated, defined as “streaming current”.

It is in this manner that the StreamerSense sensor measures the net ionic and colloidal surface charge (positive and negative) in a treated sample.

3.21.1.3.1 Determining the Optimum SCV

Online Streaming Current offers a very simple and easy to maintain online method of charge measurement. Due to the rapid response to changes in water quality (NTU & TOC), online Streaming Current provides a reliable way to optimise coagulant dosage and allows one to make gradual reductions in dosage over time. This allows the user to cut back on the practice of slightly overfeeding coagulant, which can sometimes reduce coagulant usage by surprising amounts. Issues with chemical feed pumps can also be detected within minutes of there being a problem.

The first step in using Streaming Current comes with finding an optimum streaming current value (SCV), or what can be called the SCV setpoint. The process of finding this optimum value is simple. The operator performs jar testing or laboratory charge analysis to determine an optimum (or near optimum) dosage, and then takes note of the SCV once that dosage is applied to the process. Once that is done, automatic or manual adjustments are made to maintain that setpoint value. If process results continue to look acceptable, small reductions in coagulant dosage can be made and a new optimum SCV setpoint is established to see how those results compare to the previous value. If results with the new value continue to look acceptable (or better) over an extended period of time, then the process of reducing the dosage and establishing a new “setpoint” SCV is continued until results indicate that lowering dosage further is no longer improving treatment results.

The optimum SCV setpoint can sometimes change seasonally (e.g. due to seasonal pH or water temp changes) or when certain process changes are made. For example, some plants might blend water from multiple sources, or feed oxidizing agents on and off depending on circumstances. These types of changes can change the optimum SCV setpoint.

Once an optimum value is identified, the goal is to keep the SCV at that point by making manual or automatic coagulant dosage adjustments. Below are the most common examples of the type of responses that a user might observe.

3.21.1.3.2 Streaming Current Responses

Positive Responses

- Increase in cationic additive
- Increase in cationic additive.
- Decrease in anionic additive.
- Decrease in NTU / TOC.
- Increase in process flow rate (mostly a factor when using inorganic coagulant like Alum).
- Decrease in pH.
- Decrease in temperature.
- Addition of chlorine (generally goes positive, but not always, depends on certain factors).
- Increase in conductivity when SCV is negative.
- Decrease in conductivity when SCV is positive.

Negative Responses

- Decrease in cationic additive.
- Increase in anionic additive.
- Increase in NTU/TOC.
- Decrease in process flow rate (mostly a factor when using inorganic coagulant like Alum).
- Increase in pH.
- Increase in temperature.
- Loss of chlorine (generally goes negative, but not always, depends on certain factors)
- Decrease in conductivity when SCV is negative.
- Increase in conductivity when SCV is positive.

> **If the StreamerSense Sensor is being used to control a cationic or anionic additive, be aware that these process and chemistry changes can possibly result in the user**

needing to redefine their optimum SCV setpoint. It is impossible to predict how much of a change is acceptable with any of these parameters because so much depends on the type of coagulant being used and chemistry interactions.

A common view of the streaming current measurement is that it is primarily responding to the coagulant dosage and changes in NTU, with higher coagulant dosage causing the SCV to go more positive and higher NTU causing the SCV to go more negative.

While these are typical observations the measurement of ionic charge is a bit more complex in the real world and especially when it comes to surface waters with higher levels of dissolved solids and alkalinity. One aspect of charge measurement that is not generally well known is that a given concentration of naturally organic matter (NOM) will have a much larger influence on measurements of charge than an equal concentration of insoluble inorganic material that composes the NTU measurement.

pH and conductivity are also very important to consider. pH has a significant impact on ionic charge because it influences the rate of hydrolysis of inorganic coagulants. The more hydroxide (OH^-) interacts with an inorganic coagulant, the less positive the coagulant becomes, and thus the less responsive it appears to measurements of streaming current. Changes in pH at the StreamerSense sensor will have direct impact on charge readings, and so it is highly recommended to monitor this parameter at the streaming current sample point. The impact from conductivity can also be important to monitor if changes in conductivity can swing by more than 25%, and especially more than 50%, in a relatively short period of time (e.g. during rain events).

Other potential factors which can impact the reading and call for a change to the SCV setpoint are changes in temperature, process flow rate, and dosage of other additives like oxidising agents.

3.21.1.3.3 Where Will Streaming Current Work Best?

The best overall application for Streaming Current technology is in lower alkalinity surface waters that have a moderate to high amount of NTU and organics. Due to their lower alkalinity, these waters will generally run at a pH below 7 which, regardless of coagulant selection, is more likely to produce larger SCV responses to a given dosage of coagulant. Processes that feed low basicity inorganic coagulants, like Alum, at pH above 7 (post coagulant addition) will likely see less of a streaming current response to process changes. This is because at higher pH's the monomeric forms of inorganic coagulants (like $Al(OH)^{2+}$) can quickly hydrolyse into an insoluble species with a neutral ionic charge, or further hydrolyse into an anionic charged species. Since neither species carries a positive ionic charge, they will not produce a streaming current response. Generally, the more variable the chemistry is in terms of pH, alkalinity, conductivity, and temperature, the more likely it becomes that the SCV reading will become less reliable as a control tool. That being the case, the StreamerSense sensor is still often a valuable monitoring tool in these situations as it provides an indication of when certain parameters (like TOC) might be changing. We are now seeing more WTP's using high basicity inorganic coagulants (like PACl or ACH) and low molecular weight, high cationic charge polymers. These coagulants will produce a much more favourable SC response than traditional coagulants, especially in applications with >7 pH. WTP's previously using Alum, and not able to use a streaming current device to control their dosage are now able to do so after switching to a product like ACH.

3.21.1.4 Technical Data

Power 110 VAC, 60 Hz (standard) or 220 VAC, 50 Hz (optional)
Sample Flow Rate 1..19 litres per minute
Sample Cell Type External receiver, high flow
Probe Type Quick replacement cartridge
Water Sample Connections Inlet 3/4" Barb
Materials Contacting Sample Delrin, neoprene, viton, stainless steel
Interconnect Wiring 4 Conductor, Shielded, 18 AWG
Enclosure Type NEMA 250 type 4X, reinforced fiberglass
Enclosure Size 234mm (w) x 183mm (h) x 135mm (d)
Weight 4.5kg
Operating Temp. 0..50℃

Range ±1000
Signal Gain User-adjustable, 1..600x
Zero Offset User-adjustable
Gain and Zero Offset User-adjustable, Manual or Automatic
Repeatability (Conductivity Range) Better than 2% from 10 to 250μS/cm, better than 3% from 250 to 500μS/cm and better than 5% from 500 to 1000μS/cm.
Self Diagnostics Motor RPM

3.21.2 Installation

The reliability of the streaming current measurement is largely a function of how and where the sample is taken. Therefore, it is very important to read this section carefully and to understand what constitutes an optimum sample point for the StreamerSense sensor.

When possible, avoid sampling from places where sludge, grit, etc., will be drawn into the sensor sample cell (sensor parts are made of plastic and will wear down quickly if exposed to abrasive material). To avoid blockages, keep sample lines at least $\frac{1}{2}$" to 1" (12.7mm to 25.4mm) ID and with enough flow to prevent solids accumulation. Keep sample lines as short as possible to minimise delay in response time.

The sample must be taken at a point where uniform distribution and mixing of coagulant is obtained for all flow rate conditions, and at a point that allows for a quick response to chemical feed changes as measured by the monitor. In many cases, the sample is best pulled right out of the flash mixer or very soon after a static mixer.

> **Always try to pull the sample before the slow mixer or flocculation basin.**

The lag time, or the amount of time it takes the water to travel from the point of chemical addition to the sensor, should be no greater than 1 minute (<30 seconds is ideal). In certain conditions, longer lag times are acceptable, however please consult with a Pi application expert about your application if you feel a sample point has to be located further than 1 minute downstream.

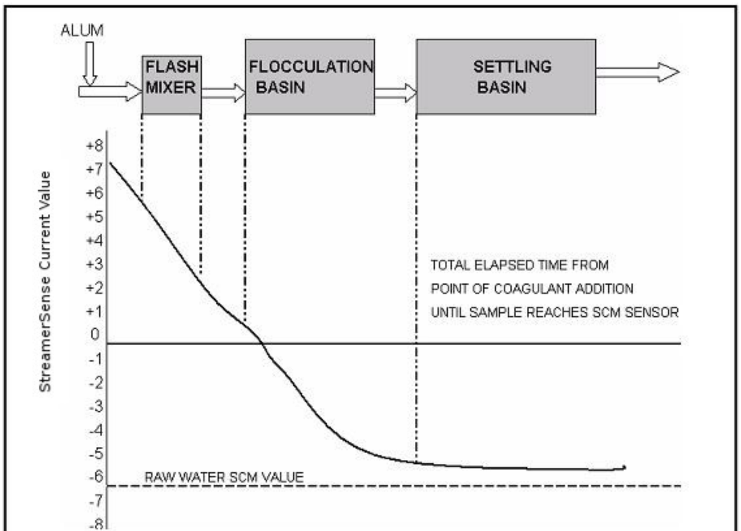
If uniform distribution and mixing is not being obtained at a selected sample point, the streaming current reading will oscillate or be unstable. If the coagulant is not being properly mixed, try to first take any possible steps to improve mixing (contact Pi for suggestions). If nothing can be done to improve mixing, either the coagulant needs to be moved further upstream or the sample point needs to be moved further downstream to allow the chemical more time to mix. Be mindful that moving the sample point further downstream in order to obtain a more stable reading can result in a loss of sensitivity to changes in raw water quality and coagulant dosage changes, and make the measurement more susceptible to drift in the optimum SCV setpoint due to changes in process flow.

As discussed above, it is best to have the sample delivered to the sensor in under 1 minute from the time it was dosed with coagulant. To understand why this is important, consider the following figure. This shows an example of how the streaming current profile might look if measurements were taken at different points in the process. As seen here, under certain conditions and mainly due to hydrolysis reactions, the streaming current value can drop off quickly as you move the sensor further away from coagulant addition. This means the response to changes in raw water quality will also drop off as you go further downstream, making the Streaming Current measurement less reliable. In some situations, the streaming current value will drop off almost completely in just a few minutes after the coagulant is introduced. This is especially true for low basicity inorganic coagulants when fed into water with higher pH and alkalinity.

Another problem with having the sensor located too far downstream is that flow changes through the WTP will become more problematic for the Streaming Current measurement. This is because those flow changes will have a larger impact on the “lag time” (how long it takes the treated sample to reach the sensor). Even though the sensor is stationary, a large increase in lag time has the same impact as moving the sensor further downstream. Keeping the sensor closer to the injection point, and ideally pulling the sample from the flash mixer, minimises the impacts of flow changes.
To review, the proper sample point for a specific plant depends upon the following conditions:

1. Point or points of coagulant feed.
2. Mixing efficiency of raw water and coagulant.

3. Magnitude of raw water flow swings.
4. Type and coagulants used.
5. Water chemistry (mainly pH and alkalinity)



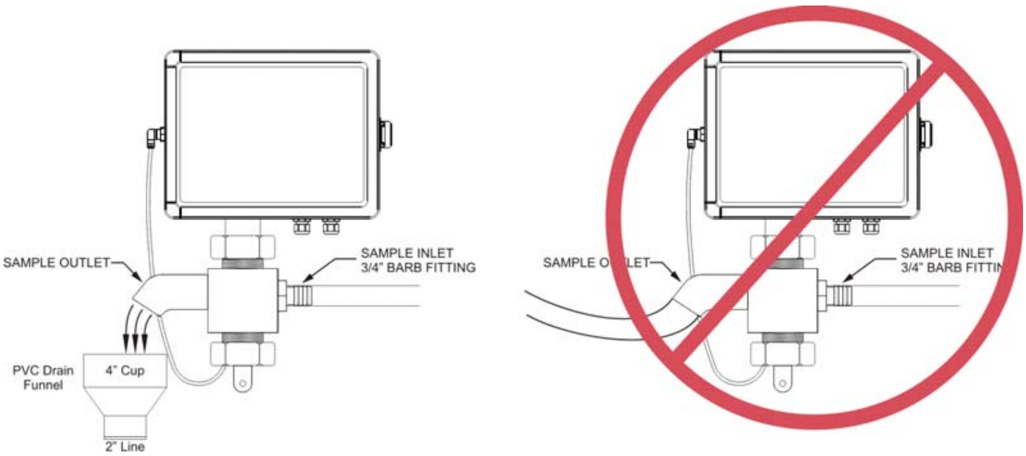
Streaming Current Profile

Finding the optimum sample point can be complex for some applications. To avoid wasting time and money on an improper installation, it is very highly recommended you call to discuss your application before installing your sensor. A lot of time and expense can be saved by doing so. Ask to speak with a Sales Representative (all are highly knowledgeable on installation guidelines), and that person will help guide you on the best installation practices for your application based on a few simple questions.

3.21.2.1 Mounting and Plumbing

The sensor can be located several hundred feet from the BT6108®. The sensor must be mounted in a vertical position with the sample flowing into the inlet and exiting from the other side and going straight to an atmospheric drain.

> **Draining to atmosphere (unobstructed) is required. The drain should never be pressurised!**



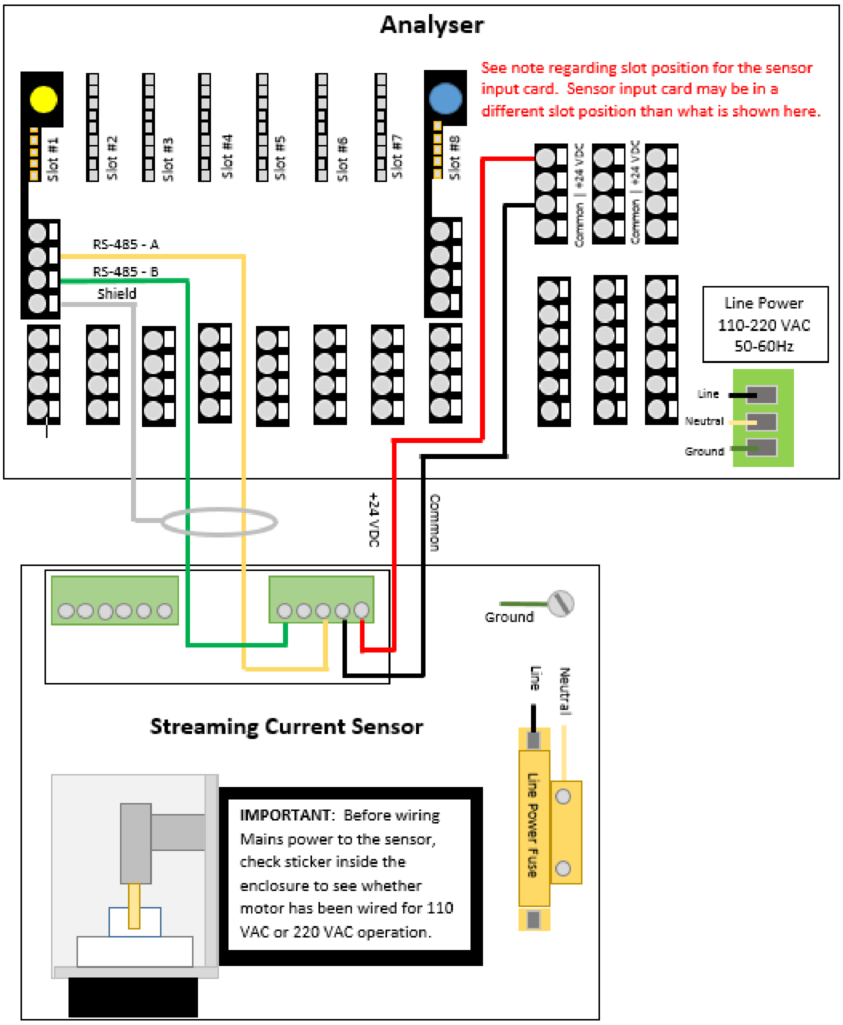
Typically, the sensor is mounted as closely as possible to the sampling point. Minimising sample line lengths provides quicker response to process changes. Sample may be obtained by using a sample pump, tapping off a pressurised line, or using gravity feed system to get sample to the sensor. The sample flow rate should not exceed 19 litres per minute (5 GPM).

3.21.2.2 Wiring

Connections for AC power and between the BT6108® and StreamerSense sensor are indicated in the following image.

Note regarding sensor card slot position:

If the analyser is only equipped to work with a single sensor (as evident by there only being one plugin card installed in slots 1 and slots 2 to 4 being empty) then the RS-485 sensor input card for the Streaming Current (SCM) sensor will be in the “Slot #1” position as shown in this diagram. Otherwise, if additional plugin cards are installed in slots 2 to 4 it will be necessary to power up the BT6108® and check the sensor name and/or connections diagram under the sensor menu to determine the correct slot position for the streaming current sensor input card. There will be numbers appearing at the end of the sensor name like SCM 1.1 or SCM 1.2. A designation of 1.2 indicates the sensor input card is located in slot #2, whereas a designation of 1.3 indicates slot #3. If the numbers which appear begin with 5 (e.g. SCM 5.1), then it means the sensor input card is located in slot #1 of the expansion module. The slot position in which the sensor input card is located can also be verified by going to the connections diagram under the sensor menu as described in the Connections section of this manual.



For safety and correct operation, the sensor must be properly earthed.

3.21.3 Commissioning

To achieve the most reliable performance, the following guidelines should be followed:

1. Ensure the coagulant will be sufficiently mixed into the raw water before it reaches the sample point location.

2. The time it takes for the sensor to see a change in coagulant feed (i.e. Lag Time) should be less than 1 minute. (Ideally less than 30 seconds.)

> **Depending on the coagulant being used and water chemistry conditions, Streaming Current response to the coagulant could be significantly diminished if the lag time is too long.**

3. pH of the treated water sample should ideally be kept as stable as possible (preferably +/- 0.2 pH). Be aware that larger pH fluctuations can affect the streaming current measurement and, if large enough, result in having to change the control setpoint value to maintain optimum dosage. Note: Depending on the coagulant being used, Streaming Current response to the coagulant could significantly diminish if pH increases too much.
4. Sample flow rates to the sensor should be kept relatively stable. If flow to the sensor changes by a significant amount, the SCV reading may drift. It is not recommended to install flow meters with any sort of restriction that may become blocked. While the StreamerSense sensor is capable of working with a flow rate anywhere between 1 and 19 litres per minute, a flow rate of at least 4 litres per minute is recommended to help keep solids from accumulating in the sample line and sensor.
5. Coagulant pumps should be kept in good mechanical condition to respond quickly and accurately to process changes.
6. Allow the sensor to run on treated water for at least 1 hour and preferably 3 hours after first installing the sensor (or after cleaning the sensor). This allows time for the sensor to fully condition and stabilise.
7. Raw water quality should be in a stable condition (turbidity, pH, colour, etc. should not change rapidly or widely) when initially establishing an optimum “setpoint”.

3.21.3.1 Calibration

3.21.3.1.1 Initial Gain Setup

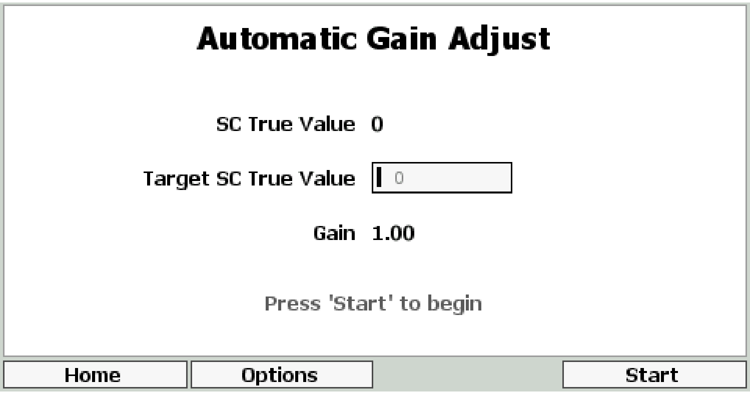
The StreamerSense sensor has a broad range signal gain adjustment of 1X to 600X which allows the user to select the best signal amplification for the application. The main determining factors of what the gain setting needs to be are conductivity and probe wear. As either increases, the gain will also need to be increased. There are two methods for setting the gain that will be discussed here.

3.21.3.1.2 Automatic Gain Adjustment

This method requires a sample of Raw Water (with no coagulant) be collected and poured into the sensor. Then, the gain is automatically adjusted to bring the reading to a value of -300. This is an adequately strong signal for most applications and should produce acceptable sensitivity to changes in water quality and coagulant dosage. If the sensitivity seems too high after doing this procedure, repeat the steps but use -200 in step.

1. Stop treated water sample flow.
2. Make sure Zero Offset is Off.
3. Slowly pour in 1 to 2 litres of raw water.
4. On the BT6108®:

   Options → Maintenance → Automatic Gain



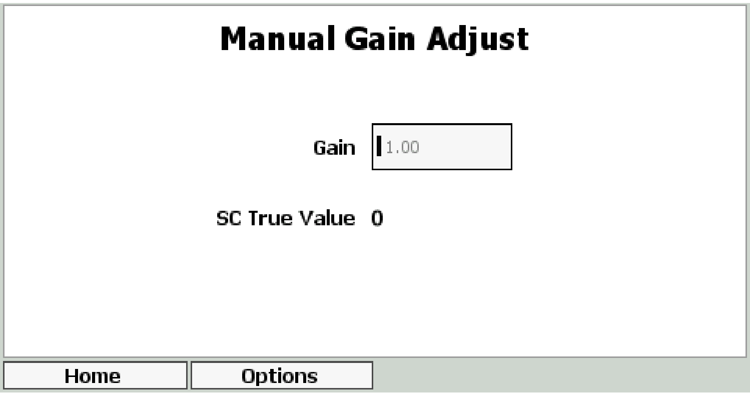
5. Change the SCV value to show -300 and then click on OK.
6. Screen will show “Please Wait - Adjustment In Progress”.
7. Press the Finish button when adjustment is completed and exit out of menu.

3.21.3.1.3 Manual Gain Adjustment Based On SCV Response

This method of gain adjustment requires the user to make small adjustments to coagulant dosage to test SC response.

1. On ® navigate to:

   Options → Maintenance → Manual Gain



2. Change Gain value to 5.0 for water treatment and 50.0 for wastewater.
3. Increase or decrease coagulant dosage by 10% (e.g. Go from 30 to 33 ppm)
4. Desired change in SCV is 10 to 20 units. If change is smaller, increase the gain. If change is too large, decrease the gain.

3.21.3.1.4 Zero Offset

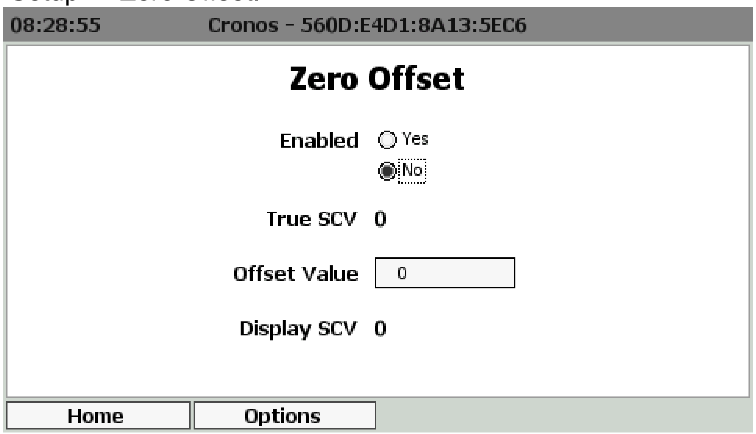
The Zero Offset feature is used to give the operator (or control system) an easy target to adjust coagulant dosage. That target being a value of 0. If the reading goes to a positive (+) reading, then coagulant dosage needs to be reduced. If the reading goes to a negative (-) reading, then coagulant dosage needs to be increased. Enabling the Zero Offset causes the analyser to take a snap shot reading at the moment the zero offset is enabled, and apply an offset that is equal to the reading, but of opposite polarity. For example, if the Zero Offset is enabled when the SCV reading is -80, then the analyser will continuously apply a +80 offset value to the SCV reading, which causes the Offset reading to be zero whenever the true (or raw) SCV is -80. If raw SCV goes to -83, then the offset reading would be -3 (the value is determined by taking -83 and adding +80 for a result of -3). Toggling the Zero Offset Off and back On causes the analyser to grab a new offset value.

> **In addition to the following, you can also zero the reading from the Streaming Current home screen or sensor overview screen by pressing and holding the button labeled "Zero" for 3 seconds.**

Procedure for enabling Zero Offset:

1. Optimise coagulant dosage and allow SCV to stabilise.
2. On the BT6108® navigate to:

   Options → Setup → Zero Offset.



3. Scroll down to highlight “Offset” and change the setting to “On” and then press “OK”
4. This zero’s the SCV reading. The Offset Value will then appear and this value can be adjusted if desired.

3.21.3.1.5 Online Response Test

This is a simple test that should be performed routinely to check the sensor response to changes in coagulant dosage. This test consists of increasing the coagulant dosage by at least 10% and documenting how much of a response is seen in the SC reading. For example, assume the SC reading is -50 and coagulant dosage is 30 ppm. Increase the coagulant dosage to at least 33 ppm and record how much the reading moves in the positive direction. If the reading goes from -50 to -40, then that is an adequate response. If the reading doesn’t change at all, or only changes by less than 3 units, then this is not an adequate response. At a minimum, a 5 unit change should occur (ideally 10 to 20 units) with the SC reading after coagulant dosage is adjusted by 10%. If the response is too small or nonexistent, or if the response is greater than 30 units, see the gain adjustment procedure.

3.21.3.1.6 Jar Response Test

This test does not reliably replace the online response test, but it can be useful as a troubleshooting tool or whenever changes to chemical dosage can not be made.

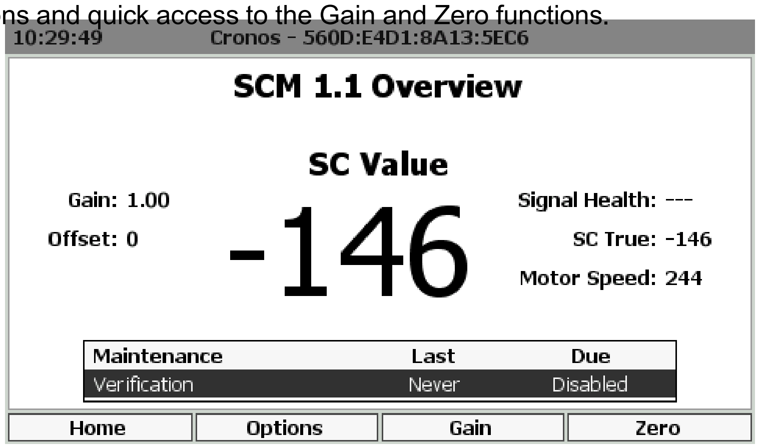
1. Collect two 1 litre jars of raw, untreated water. If possible, collect sample that includes all the upstream additives besides coagulant. Otherwise, manually dose the samples with those other additives at the appropriate dosages.
2. Slowly pour in 1 litre of raw water into sensor and record reading. If reading is below -100, it is recommended to increase the gain setting as detailed in section 3.21.3.1.3
3. Dose the second 1 litre with an optimum dosage of coagulant and mix rapidly for 5 to 10 seconds and then begin pouring sample into sensor.
4. After that jar is drained, record the SCV reading and compare to Raw Water reading. Ideally, the charge will have been reduced by over 50% (for example, if raw water jar was -200, then treated jar would ideally be -100).
5. If the difference is smaller than 50%, especially smaller than 25%, pour through a second and possibly third treated jar to see if reading climbs any further positive (sometimes several jars are needed to condition the probe and piston).

3.21.3.1.7 What to Do if SCV Response is Poor

If SCV response appears small to chemical feed changes, try cleaning probe and piston, check gain adjustment in accordance with Section 3.21.3.1.2, and repeat above testing. If cleaning does not improve response, try replacing the piston. If this does not improve response, see Section 3.21.6 of this manual or contact Pi for additional troubleshooting steps.

3.21.4 Operation

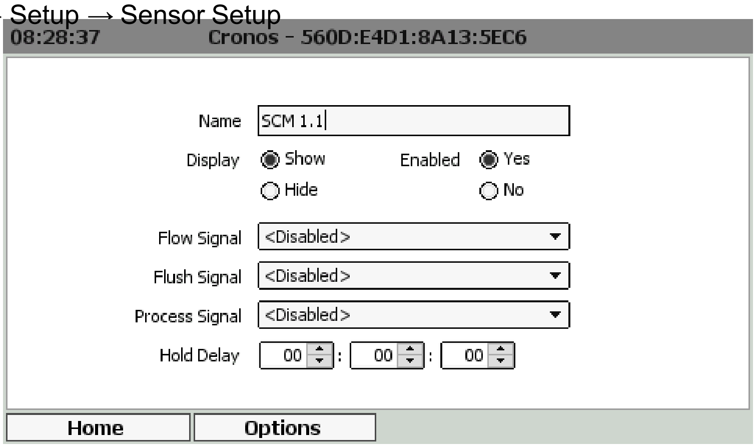
When selecting the StreamerSense tile from main menu, the sensor overview screen will be displayed. This shows the current SC Value, Gain, Offset, SC True and Motor Speed values. The table shows the date of the last verification and due date of the next. The buttons allow access to the sensor options and quick access to the Gain and Zero functions.



3.21.4.1 Sensor Setup

Sensor settings are accessed by selecting:

Options → Setup → Sensor Setup



Name Edit the sensor name used to identify the sensor. Up to 25 characters.

Display Options are “Show” or “Hide”. This relates to whether the tile for this sensor will show on the Menu screen.

Enabled Options are “Yes” or “No”. If “No” is selected the sensor will not update and will not generate alarms.

Flow Signal Allows a flow switch to be associated with a sensor. Options are “Disabled” or selectable from a list of available digital inputs.

Flush Signal Allows an external flush signal to be associated with a specific sensor. The flush signal will notify the sensor that an automatic cleaning operation is underway. Options are “Disabled” or selectable from a list of available digital inputs.

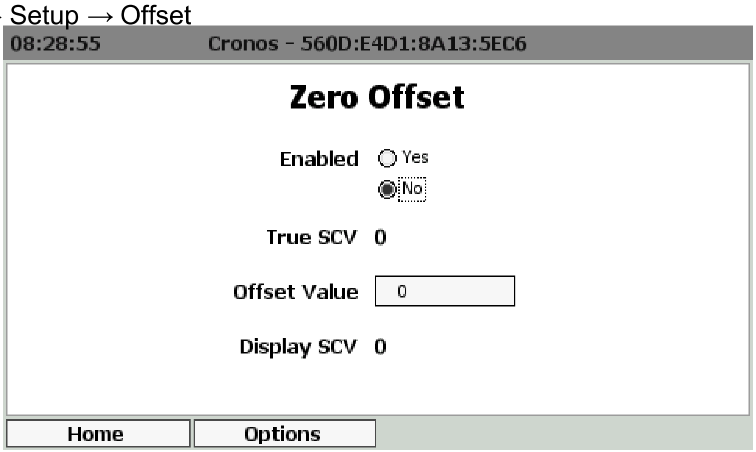
Process Signal Allows an external process signal to be associated with a specific sensor and allows the external signal to enable or disable a sensor. Options are “Disabled” or selectable from a list of available digital inputs.

Hold Delay The Sensor hold delay is used following a flush event to allow the sensor reading to recover. Time entered in HH:MM:SS format.

3.21.4.2 Offset

To modify the SCV zero offset, select:

Options → Setup → Offset

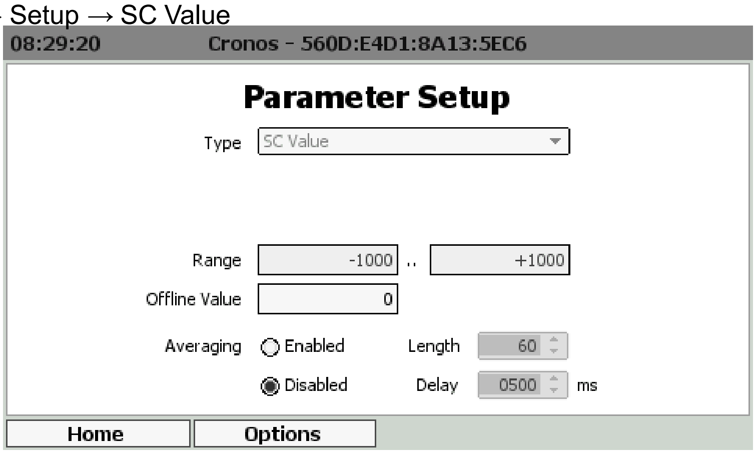


Enabled The streaming current zero offset can be enabled or disabled using this setting. Select "Yes" or "No".
Offset Value Displays, and allows the editing of, the current streaming current offset. This is often set as part of the Zero Offset procedure.
True SCV Indicates the raw streaming current value with no offsets or compensations applied.
Display SCV Indicates the streaming current value with any enabled offset or compensation applied.

3.21.4.3 SC Value

Parameter settings are accessed by selecting:

Options → Setup → SC Value



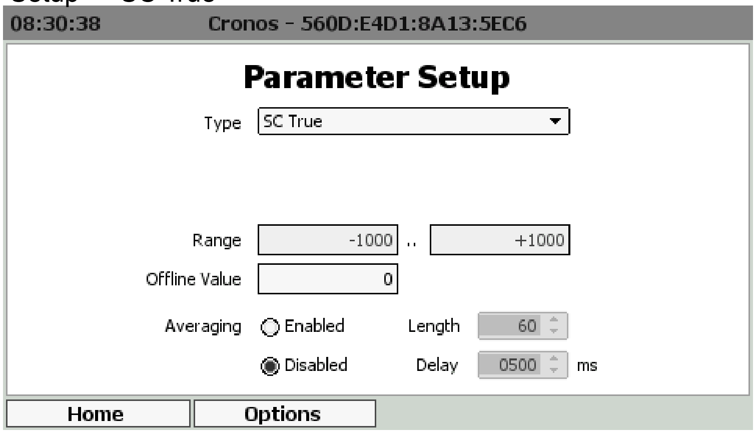
Type A selectable list of parameter types. The selection made here will affect what options are available below.
Name Available if "User defined" is selected as the type. The name can be up to 25 characters.
Offline Value This is the value reported by the parameter when in 'Offline' mode, for example, if the sensor is in alarm. Options are within the range of the parameter.
Averaging Enables or disables a rolling average for the parameter to smooth the reading. Options are "Enabled" or "Disabled". Selecting "Enabled" will allow editing of the following two form fields.
Length Enter the number of data points in the rolling average buffer. Options are 2..60.

Delay Enter the delay between collecting data points for the rolling average[105]. Options are 200..5000ms.

3.21.4.4 SC True

Parameter settings are accessed by selecting:

Options → Setup → SC True



Type A selectable list of parameter types. The selection made here will affect what options are available below.

Name Available if “User defined” is selected as the type. The name can be up to 25 characters.

Offline Value This is the value reported by the parameter when in ‘Offline’ mode, for example, if the sensor is in alarm. Options are within the range of the parameter.

Averaging Enables or disables a rolling average for the parameter to smooth the reading. Options are “Enabled” or “Disabled”. Selecting “Enabled” will allow editing of the following two form fields.

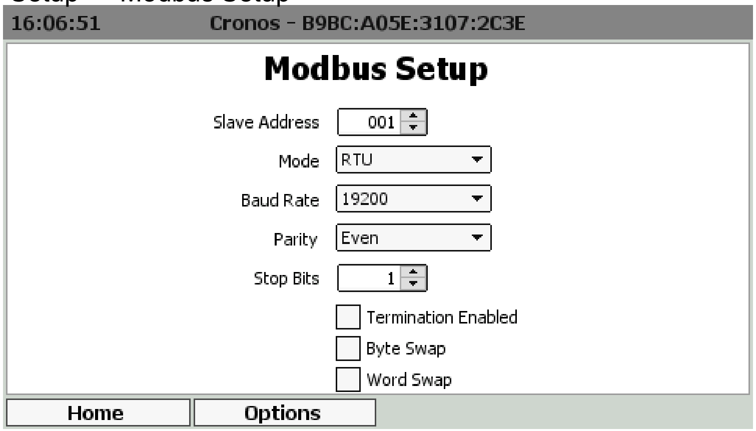
Length Enter the number of data points in the rolling average buffer. Options are 2..60.

Delay Enter the delay between collecting data points for the rolling average[106]. Options are 200..5000ms.

3.21.4.5 Modbus Setup

Modbus settings can be accessed by selecting:

Options → Setup → Modbus Setup



[105] An averaging delay of 2000ms with a length of 30 will result in a rolling average of 1 minute (30 × 2s) with a reading taken every 2 seconds. If averaging is enabled it will apply to all aspects of the parameter value, e.g., it will apply to the value displayed, logged and outputted.

[106] An averaging delay of 2000ms with a length of 30 will result in a rolling average of 1 minute (30 × 2s) with a reading taken every 2 seconds. If averaging is enabled it will apply to all aspects of the parameter value, e.g., it will apply to the value displayed, logged and outputted.

Slave Address Enter the Modbus slave address of the sensor. This is unlikely to change from 1.

Mode Select the Modbus serial mode. Options are “ASCII” or “RTU”.

Baud Rate Select the RS485 baud rate. Options are standard baud rates between 1200 and 115200.

Parity Select the RS485 parity bit option. Options are “Odd”, “Even”, or “None”

Stop Bits Select the number of stop bits. Options are 1 or 2.

Termination Enabled Use the checkbox to enable the use of a termination resistor.

Byte Swap To support different microprocessors that store data in different formats, the BT6108® can alter the data it sends and receives to match the format expected by the sensor. The byte swap option allows the order of bytes in the 16-bit registers to be reversed.

Word Swap When two 16-bit registers are combined for larger data types, e.g., floating-point number representations, this option reverses the order of the two 16-bit words to match the format expected by the sensor.

3.21.4.6 Maintenance Setup

The StreamerSense sensor comes equipped with proactive maintenance alerts. These take the form of a verification warning. In effect the user determines how long after the verification event occurs they would like to be reminded that the next verification is due again. When an alert occurs, the colour of the parameter display will change and a parameter flag is set.

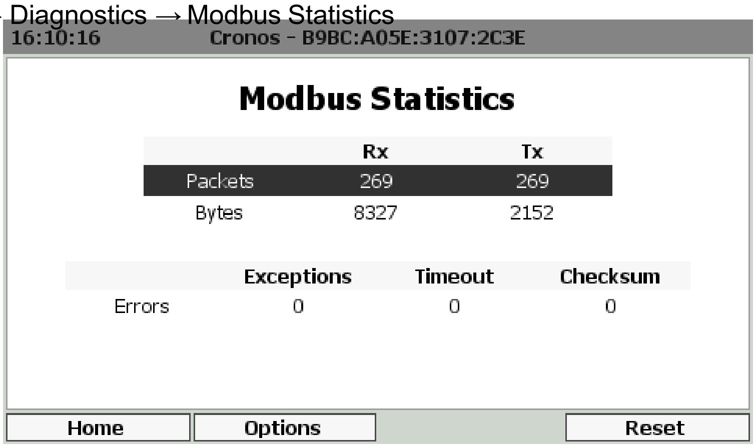
The maintenance requirements can be enabled or disabled and frequencies entered into simple forms. To configure the maintenance warnings, select:

Options → Maintenance → Setup

3.21.4.7 Modbus Statistics

To access the Modbus statistics diagnostic information, select:

Options → Diagnostics → Modbus Statistics



Received and transmitted byte and packet counts are displayed along with error counters. Error counters for packets received with checksum errors, timeouts and exception packets generated are recorded. Counters are unsigned 32-bit and will overflow back to 0 if they reach 4,294,967,295. Alternatively, all counters can be manually reset by pressing the “Reset” button.

3.21.4.8 Alarms and Thresholds

Alarms are the means by which values obtained from sensors cause visible, audible or physical actions to occur. Alarms are not to be confused with relays. An alarm in a BT6108® unit will create a visible bar across the top of the screen and sound a buzzer. One flow alarm per sensor and two data alarms per parameter are available.

Thresholds are similar to alarms except that they are events that are supposed to occur and therefore will not cause the instrument to go into “Alarm”. Thresholds are most frequently used to trigger relays to cause something to happen when a parameter reaches a value.

To access the alarm and threshold configuration select:

Options → Alarms & Thresholds → *Parameter Name*

The display has a tab for each alarm and threshold. Navigate to the tab using the right and left buttons indicated on the bottom of the display or navigate through the settings using the up and down arrows. Options are:

Enabled Selecting this option turns the alarm/threshold on or off.

Set The *Value* is used to trigger the alarm or threshold[107]. The *Delay* is the amount of time the value has to exceed the set value before the alarm/threshold is triggered.

Reset The *Value* is used to clear the alarm or threshold. The *Delay* is the amount of time the value has to exceed the reset value before the alarm/threshold is cleared.

3.21.4.9 Status Flags

The status flags show the state of a device. These flags can either be active or not. To see the state of these status flags, select:

Options → Device Flags → Status Flags

Flags that are active are shown in black text on a white background, those that are not active are greyed out. Available flags are:

Display on main menu When active the device tile is displayed on the main menu. If inactive, the tile is hidden in the default view.

Sensor enabled This flag is enabled if the sensor is enabled.

Sensor on-line This flag is enabled if the sensor is on-line.

Sensor reading in warm up If the sensor reports that the current reading is not ready, then this flag is set.

Sensor reading in hold This flag is enabled when the sensor output value is held, usually during, or just after, self-cleaning or periods of maintenance.

Sensor process stopped If the sensor is off-line due to a process stop signal, this flag is set.

Sensor flush active This flag is set when the sensor is self-cleaning.

Sensor calibration warning reached If the calibration is due and the maintenance warning is enabled, then this flag is set

Sensor maintenance period x warning reached If the maintenance warning is enabled and the due date has passed, then this flag is set. The exact type of maintenance is sensor-specific. See section 3.21.3.1 for details.

3.21.4.10 Error Flags

The error flags show any problems causing an error for a device. These flags can either be active or not. To see the state of these error flags, select:

Options → Device Flags → Error Flags

Flags that are active are shown in black text on a white background, those that are not active are greyed out. Available flags are:

[107] A set value above a reset value will result in a rising alarm. A set value below a reset value will result in a falling alarm.

I/O card fault detected If set, this flag indicates that a low-level hardware fault has occurred. Report to your supplier.

Incorrect I/O card found If set, this flag indicates that the I/O card fitted is of the wrong type. **I/O card in use** This flag is set when two devices are attempting to use the same I/O card. **Sensor connection error** This flag is set when the sensor hardware detects a physical connection fault.

Sensor failed to read input signal If set, the sensor has failed to read the state of the flow, flush or process signal.

Sensor flow alarm active This flag is set if a low/no flow condition is reported by the flow signal.

Sensor data alarm active When the sensor readings trigger a data alarm, this flag is set.

I/O card configuration failed This flag is set if the I/O plugin card fails to respond correctly. Contact your supplier for advice.

Modbus communications error This flag is set when a Modbus exception, timeout or checksum failure occurs. If clear, communication with the sensor is normal.

Device identifier mismatch If set, this flag indicates that the sensor connected to the Modbus input is not responding as expected. Check that the correct sensor is connected.

3.21.4.11 Parameter Flags

The parameter flags show the state of an individual parameter of a particular sensor. These flags can either be active or not. To see the state of these parameter flags, select:

Options → Device Flags → *Parameter Name*

Flags that are active are shown in black text on a white background, those that are not active are greyed out. Available flags are:

Alarm 1 active The first parameter data alarm is active and triggered. **Alarm 2 active** The second parameter data alarm is active and triggered.

Averaging enabled The value displayed for this parameter is averaged.

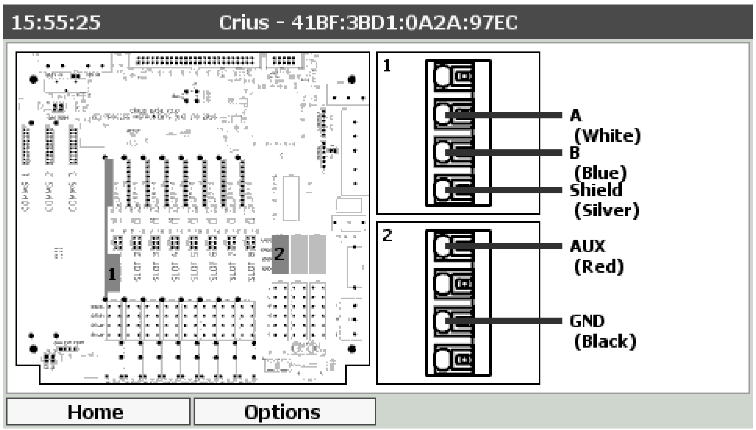
Threshold 1 active The first parameter threshold is active and triggered.

Threshold 2 active The second parameter threshold is active and triggered.

3.21.4.12 Connections

As the BT6108® is a modular system the exact wiring details will be specific to each order. Electrical connections required can be viewed by selecting:

Options → Connections



In the image above, the left side shows the position of the connector. The right side shows the connections required on the marked connectors.

Disconnect the power before making or breaking electrical connections.

3.21.5 Maintenance

3.21.5.1 Sensor Cleaning Considerations

To maintain correct operation, the Streaming Current sensor will require routine cleaning of the probe, piston, and occasionally the inside of the probe block. Cleaning frequency is application dependent. Waters heavily loaded with solids or substances which tend to deposit easily on sensor's plastic and/or metal surfaces will require more frequent cleaning intervals. In addition to routine cleaning, cleaning should also be performed if you answer "Yes" to any of the following questions:

- Has the reading become noticeably less stable?
- Is the SC signal appearing less responsive to process changes than seen previously?

In many cases, simply running a brush through the sensor and across the piston surfaces to break up deposits and then rinsing with water is all that is required. In other cases, a harder to remove scale, deposit, or stain may have built up on the probe and piston surfaces. In these cases, it is recommended to first try cleaning with a mild soap or detergent.

Other products which are designed to remove calcium, lime, iron, and magnesium can also be used if those types of deposits are present and can't be readily removed with the before mentioned cleaners. Avoid using any cleaner or chemical that is aggressive towards Delrin plastic or stainless steel. It is also recommended to not "soak" the probe and piston in a cleaning solution unless it is known to be completely compatible with Delrin and stainless steel.

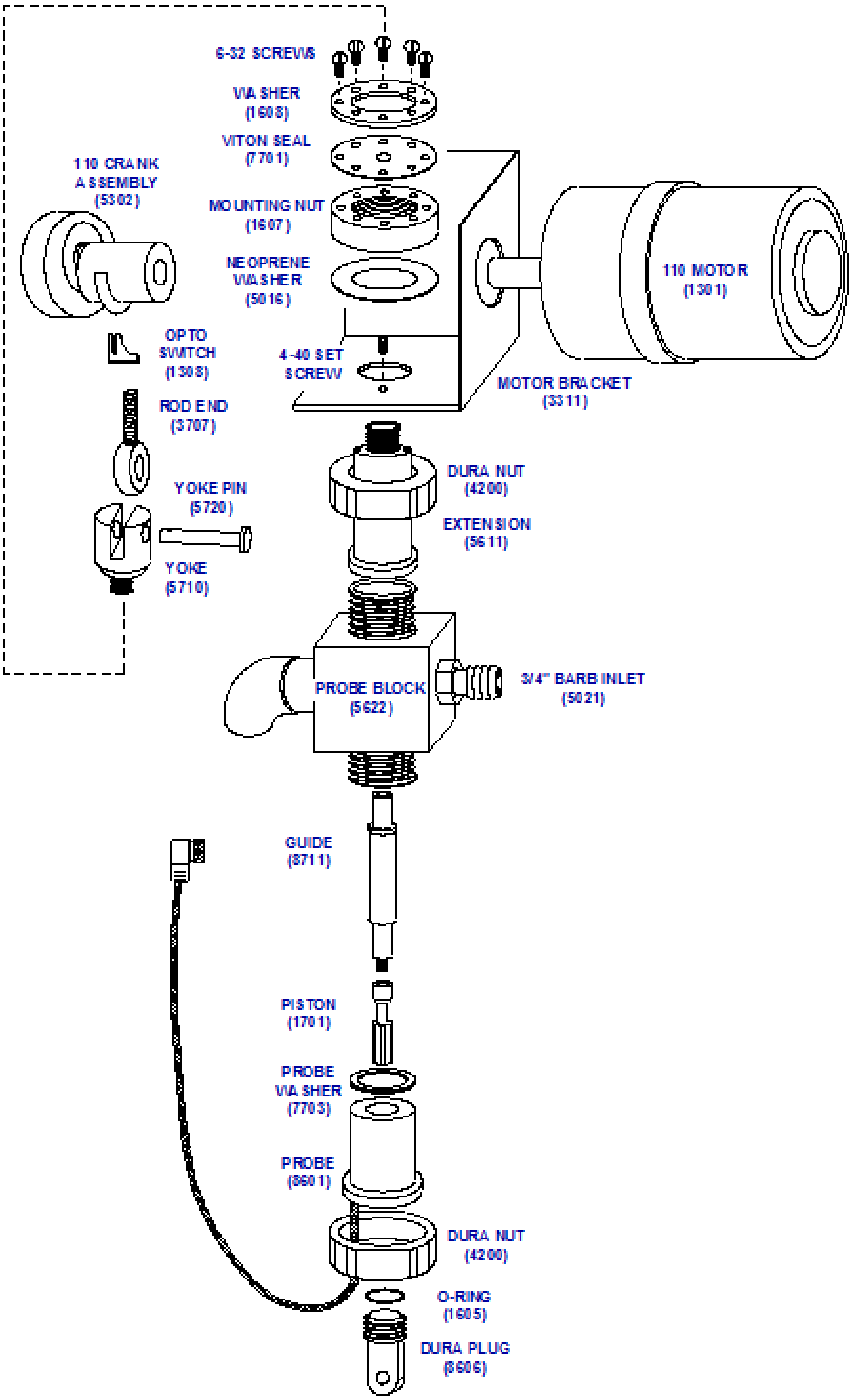
After cleaning the Streaming Current reading will require a certain period of time to reach stabilisation. During this stabilisation time, the SC reading may be seen to slowly climb in the positive direction. In many cases, the probe and piston will condition very quickly to the sample which allows the SC reading to re-stabilise very soon after a cleaning is performed. However, for some applications the stabilisation time can be as long as 1 to 2 hours. It is recommended to clean the sensor when everything is expected to be stable and there will be adequate time for the SC reading stabilise.

3.21.5.1.1 Cleaning Procedure

1. Stop sample flow to the sensor, and power down the sensor by disconnecting AC Mains power.
2. Loosen large slip nut at bottom of probe block and pull probe out. Then disconnect probe cable from enclosure by unscrewing the fitting.
3. Reach fingers inside probe block and unscrew piston.
4. Inspect up inside probe block and use spray water and brush to remove any significant solids build up.
5. Take probe and piston to a sink and clean parts using a mild soap or detergent. Avoid getting the TNC connector at the cable end wet. Rinse parts thoroughly and reinstall.
6. Turn sample and AC Mains power back on.
7. Allow the sensor sufficient time to stabilise before using reading for auto or manual chemical feed adjustment.

3.21.5.1.2 Part Identification

Refer to the following diagram when ordering parts as certain part numbers might change.



3.21.5.1.3 Parts Replacement Interval

The following are commonly replaced parts and it is recommended to keep spares of these on hand.

8601 (Probe) Every 1 to 3 years on average.

7701 (Viton Seal) Every 1 to 3 years on average. Replace annually if sensor is not draining directly to an atmospheric drain. Backpressure on the sensor will result in water leaking past the viton seal if it ruptures.

1705 (Piston) Every 6 to 18 months on average.

5710 (Yoke) Every 3 years on average. Replacement is only necessary when loose motion is detected between Yoke, Yoke Pin and Rod End.

5720 (Yoke Pin) Every 3 years on average. Replacement is only necessary when loose motion is detected between Yoke, Yoke Pin and Rod End.

3703 (Rod End) Every 3 years on average. Replacement is only necessary when loose motion is detected between Yoke, Yoke Pin and Rod End.

The following are less commonly replaced parts:

1301 (Motor) Specify Voltage. The motor is expected to last 3 to 5 years. If a very noticeable grinding/rubbing sound is heard from motor, replacement is recommended.

8711 (Guide) The guide is expected to last beyond 5 years. Replacement is generally only necessary due to damage from over tightening the piston or yoke.

5302 (Crank) The crank is expected to last beyond 5 years. If the Crank feels loose, replacement may be necessary.

3.21.6 Troubleshooting

3.21.6.1 SC reading very erratic

Possible cause	**Possible solution**
Probe/Piston dirty.	Clean probe/piston.
Cell bottom plug loose or O-ring missing.	Tighten plug. Replace O-ring.
Flush assembly (if installed) is malfunctioning.	Make sure water is not leaking past the flush control valve. Clean out and check proper operation of check value.
Drive linkage loose.	Inspect drive linkage to make sure all parts fit tightly togther and move as one piece.
Electrical interference, galvanic currents.	Ensure any metal piping and/or sample pumps are properly grounded.

3.21.6.2 Opto/Motor Fault Alarm is active

Possible cause	**Possible solution**
Motor has stopped turning.	Inspect and replace motor if necessary.
Opto switch damaged/failed, or wiring is loose.	Inspect and replace Opto switch if necessary.
Sensor card malfunction.	Sensor card may need to be replaced.

3.21.6.3 Display does not change in coagulant/polymer dosage

Possible cause	**Possible solution**
The GAIN setting is too low.	Increase the GAIN setting.
Wrong sample point or insufficient mixing.	Select correct sample point, improve mixing.
Sample cell dirty.	Clean cell (see Cleaning Procedures).
Excessive lag time between chemical injection point and sensor sample cell.	Move sampling point closer to coagulant feed point and/or decrease sample transport time.

Chemical feeders in need of maintenance.	Perform draw down to check feeders are adjusting feed rate correctly.

3.21.6.4 SC reading very close to 0.

Possible cause	Possible solution
No water sample to sensor.	Establish proper sample flow.
Loose probe connection, loose internal connection on sensor card.	Check probe connector is fully screwed on. Open sensor enclosure and inspect to make sure sensor wiring is secure.
Electrodes in probe covered with scale.	Clean electrodes to remove scale and expose bare metal.
Probe malfunction.	Unscrew probe assembly and inspect wiring. Make sure that there is no water intrusion or corrosion.

3.22 StreamerSense Rugged

3.22.1 General Information

3.22.1.1 Health and Safety

When using this instrument, basic safety precautions must always be followed to reduce the risk of fire, electrical shocks and injury to persons, including the following.

Disconnect electrical supply before working on this equipment.

- Before attempting to unpack, set up, or operate this instrument, please read this entire manual.
- Make certain the unit is disconnected from the power source before attempting to service or remove any component.
- Follow all warnings marked on the instrument.
- Failure to follow these precautions could result in personal injury or damage to the equipment.
- Do not attempt to disassemble the unit.
- Water must not be allowed to enter the housing of the unit.
- Close and fasten the covers of the unit prior to any external cleaning to prevent water ingress.
- Do not drop or jar the unit.
- Do not modify any internal electrical wiring or electronics.
- Use a mild non-abrasive cleanser when cleaning the outer cover of the unit.

In order to provide maximum user safety this instrument is designed with all electrical circuitry within a protective non-conductive housing.

3.22.1.2 Environmental Considerations

The sensor contains electronics, plastics and stainless steel. Please use this product in a manner sensitive to the environment and at the end of its life dispose, or recycle, in a manner that is in compliance with local regulations.

3.22.1.3 Theory of Operation

The StreamerSense Rugged sensor is a remote streaming current sensor that is used to measure the charge of “treated water”, with the sample point being downstream of the coagulant addition point. Charge is reported as Streaming Current Value (SCV) with a range of -1000 to +1000 (0 being neutral). The StreamerSense Rugged sensor provides the user with an online measurement of charge neutralisation, allowing the user to optimise and in many cases automate their coagulant dosing. Other applications include charge measurement in wastewater and on the wet end of a paper machine, which generally entails measuring low consistency samples (such as tray water or white water). This main focus of this manual is on the water treatment application.