# HydroAct 4 User Manual

### Chemtrac, Inc

**Firmware Version: 1.19**

**November 15, 2017**

# Contents

## I                           Analyzer

## II        Options

## III        Documentation

# 1. Introduction

This manual has been generated to accompany the serial number of the instrument as recorded on the front of this manual. It is specific to that serial number. Information regarding options or accessories that do not apply to this instrument do not appear in this manual. If you upgrade your firmware or your hardware please ask for a new manual to be generated for you.

This manual contains basic information to be noted during installation, operation and maintenance. It is therefore essential that this manual be read by the contractor before installing and commissioning the HydroAct 4, as well as by the relevant operating personnel/owner of the unit. It must remain available for reference at all times.

In addition to the general safety instructions under the main heading Safety Precautions, the special safety precautions outlined in other sections must also be observed.

This manual has been supplied electronically. A hard copy is available on request from hardware-support@chemtrac.com.

## 1.1 Safety Precautions

- 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.
- Make certain the unit is disconnected from other sources of force or pressure (for example, pneumatic or hydraulic), before attempting to service or remove any component.
- Failure to follow these precautions could result in personal injury and damage to the equipment.

### 1.1.1 Warnings used in this manual

This manual contains vital information relating to the safety of people and the environment, the analyzer and any equipment attached. These statements are identified by the following markings:

Refers to an imminent danger or a potential hazardous situation. Non-compliance can lead to death or extremely serious injury.

Refers to a potential hazardous situation. Non-compliance can lead to injury or property damage.

Draws attention to supplementary information to make the work easier and ensure trouble-free operation. May also appear in conjunction with safety instructions which may endanger the analyzer and its operation if disregarded.

### 1.1.2 Qualification and Training of Personnel

The personnel employed for installation, operation, inspection, and maintenance, must be suitably qualified for this work. The areas of responsibility, competence and supervision of the personnel must be precisely defined by the owner. Personnel who do not have the required know-how must be trained and instructed. If required, this can also be undertaken by the manufacturer/supplier on behalf of the owner.

In addition, the owner of the system must ensure that the relevant personnel are fully familiar with and have understood the contents of this manual.

### 1.1.3 Important Safety Instructions

When installing and using this electrical equipment, basic safety precautions should always be observed, including the following:

Read and follow all instructions. Save these instructions.

To reduce the risk of injury, do not permit children to use this product.

Risk of electric shock. Connect only to a suitable isolated, hard wired electrical outlet. It is recommended that the outlet is protected by an RCD (Residual Current Detector) or is in any event in compliance with all local electrical regulations. Do not bury the electrical supply cable.

To reduce the risk of electric shock, replace damaged electrical cable immediately.

To reduce the risk of electric shock, do not use an extension cable to connect the unit to an electric supply; provide a properly located outlet.

#### 1.1.3.1 Hazards due to non-compliance

Failure to comply with the safety instructions may endanger not only people, but also the environment and the unit. The following hazards in particular may arise:

- Failure of major unit functions.
- Failure of specified methods for maintenance and repair.
- Danger to people due to electrical, mechanical and chemical effects.

### 1.1.4 Safe Operation

The safety instructions contained in this manual must be observed. The owner is responsible for ensuring compliance with local safety regulations.

# Analyzer

# 2. Overview

The HydroAct 4 is a compact electronic communication and control system. It is designed for use with many different measuring sensors. Any use other than the one described here compromises the safety of persons and the entire measuring system and is, therefore, not permitted. The manufacturer is not liable for damage caused by improper or non-designated use.

Every analyzer is carefully checked before leaving the factory. If for any reason, you are unhappy with your purchase, please contact the organization that you purchased the analyzer from or Chemtrac, Inc directly.
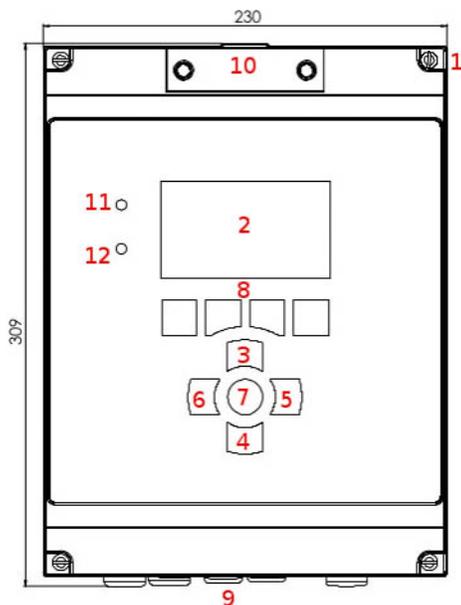
**HydroAct 4 Overview**
1. Front panel screws ($\times 4$)
2. Display
3. Up button
4. Down button
5. Right button
6. Left button
7. Enter/Select button
8. Soft keys
9. Cable glands
10. Micro SD access
11. Power lamp
12. Indication lamp

## 2.1 Safety Precautions

### 2.1.1 Installation, Maintenance and Inspection

The owner must ensure that all maintenance, inspection and installation work is undertaken by authorized and duly qualified personnel who have also studied this manual.

- The HydroAct 4 must always be isolated before starting any work.
- Please be aware that the HydroAct 4 may be controlling chemical dosing and as such shutting down the HydroAct 4 without due regard to the systems it is controlling can lead to chemical release.

### 2.1.2 Unauthorized Modification

The device may only be modified or converted in consultation with the manufacturer. Genuine spare parts and accessories authorized by the manufacturer ensure greater safety.

### 2.1.3 Impermissible Modes of Operation

Usage other than as described in this manual will lead to the immediate cancellation of the warranty and any other manufacturer's liability.

### 2.1.4 Chemicals

Should the sensors attached to the HydroAct 4 be in contact with hazardous chemicals, great care must be taken when handling the sensors.

> **Fire hazard. No parts are suitable for use in a hazardous rated area.**

> **When working with this equipment, the accident prevention regulations applicable on site must be observed and the specified personal protective equipment worn.**

> **Please unpack the equipment and ordered accessories carefully in order not to miss small parts. Immediately compare the scope of delivery to the delivery note. If there are any discrepancies, contact your supplier.**

## 2.2 Technical Data

**Power** 100-240VAC/0.25 A or 12VDC/0.8 A

**Fuse** 2A (100-240VAC)

**Display** 4.3" 480x272 24-bit color

**Inputs** Up to 4 configurable sensor inputs; 4-20mA, 4-20mA loop-powered, 0-2 VDC, +/- 2000 mV for pH, ORP, or ISEs, PT100, potentiometric, pulse and Modbus. Expandable to 16 inputs. Up to 8 digital inputs, expandable to 32

**Outputs** Up to 16 dedicated configurable analog outputs: 0-20mA, 4-20mA, 0-1 VDC, 0-10 VDC, 1-10 VDC. Unused inputs can be used as outputs allowing up to 32 output channels. Up to 32 SPST electromechanical relays rated 10A at 125 VAC, 3A at 250 VAC, 5A at 30 VDC

**Communication (Optional)** Modbus ASCII/RTU (RS485), Profibus DP, Modbus TCP (Ethernet), 2G/3G Modem
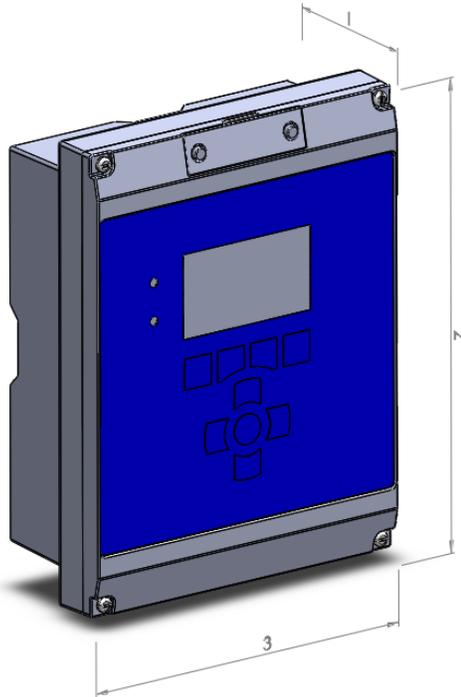
**Status Log** Over 1 million records

**Data Log** Internal - Single parameter data log or status message log over 1 million records

**Weight** 2kg

**IP Rating** IP65, Nema 4X

**Enclosure Material**  ABS flame retardant
**Seals**  EPDM



**HydroAct 4 Dimensions**
1. 103mm
2. 309mm
3. 230mm

## 2.3  Installation

> As with all instrumentation the installation and commissioning of this instrument is crucial to its safe and effective operation.  This instrument must only be used for its purpose as outlined in this manual.  It must be installed and commissioned in accordance with this manual and by trained, qualified personnel.

### 2.3.1  Site Selection

Please choose a suitable location for the installation of the electronics. The choice of installation point on any site is a compromise and is best undertaken by an experienced installation engineer. The following is a list of the factors that need to be taken into consideration. This list is not intended as a check-list, neither is it implied that the list is complete.

- Ensure that the mounting allows access to all serviceable parts.
- Try to mount the electronics in a position where they are not habitually hosed down in a cleaning process.
- The electronics enclosure should be mounted away from sources of heat or direct sunlight.
- Consider the length of wiring runs when mounting the instrument.
- Try to keep the electronics away from substations, motors or other large EMI emitters.
- Consider whether the sample will be representative and well mixed.
- Consider sample line run times.
- Consider sample return points.
- In a plastic run, with a low conductivity liquid sample, consider earthing the sample.
- If the instrument is controlling a dosing pump, size the pump appropriately.

## 2.3.2  Unpacking

Please have a copy of your order with you when you unpack your instrument. All orders are checked when they leave the factory. Please check that you have all the parts that were ordered as soon as you open the box. If anything is missing, or damaged, please contact your supplier immediately. If the instrument needs to be returned for any reason please follow the return instructions given in this manual (refer to section 7).

**Please dispose of the packing in an environmentally responsible manner and in compliance with local regulations.**

## 2.3.3  Mounting

The HydroAct 4 enclosure is very versatile and can be wall mounted, panel mounted or mounted on a handrail or pole[1]. The HydroAct 4 electronics should be mounted so that:

- it is away from sources of heat or direct sunlight,
- it is vertical,
- there is sufficient clearance above to allow the enclosure compartment to be opened and removed,
- it is away from sources of vibration, and
- it will not be hosed down.

### 2.3.3.1  Wall Mounting

The analyzer enclosure can be screwed directly onto the wall. Mark and drill the holes as per the drawing below. Insert wall plugs and secure with appropriate screws (not supplied).
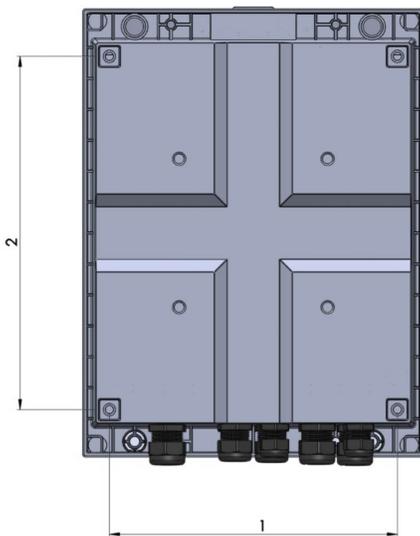


**HydroAct 4 Wall Mounting**
1. 194mm
2. 238mm

### 2.3.3.2  Panel Mounting

The analyzer enclosure can be panel mounted using the optional panel mount kit. The support bracket can be used as a template for cutting and drilling the panel.

---

[1]For panel or handrail mounting the enclosure requires optional mounting kits that can be ordered from Chemtrac.

**HydroAct 4 Panel Mounting**
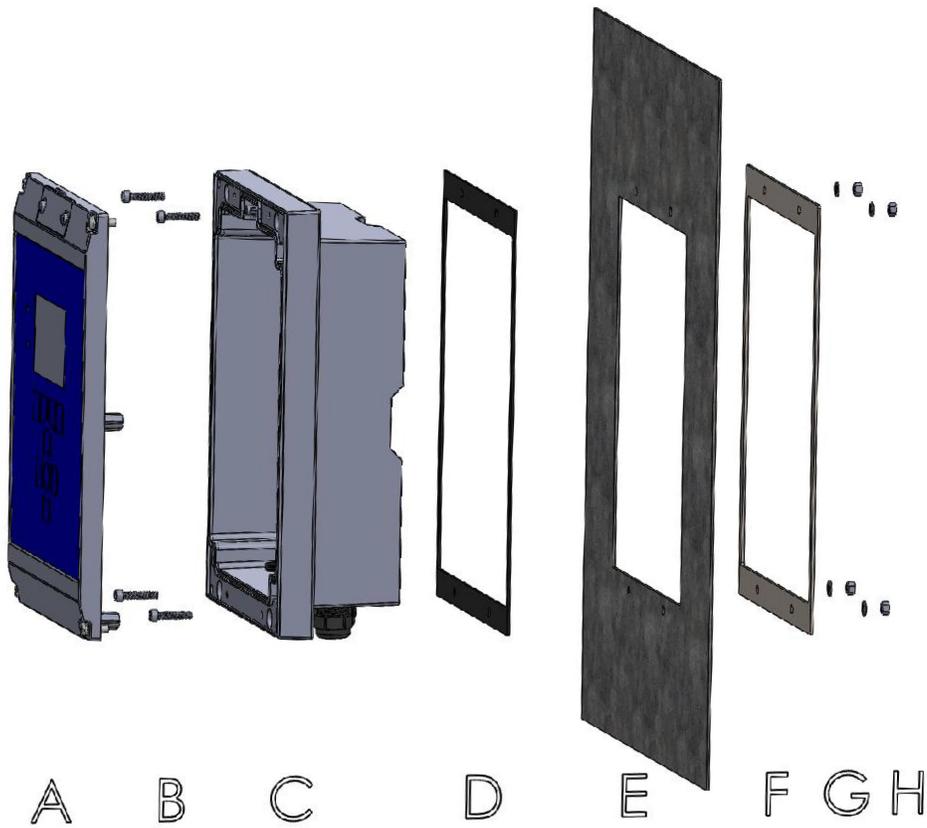


A - HydroAct 4 front section, B - Four M5 bolts, C - HydroAct 4 rear section, D - Rubber gasket, E - Panel, F - Support bracket, G - Four M5 washers, H - Four M5 nuts.

### 2.3.3.3 Handrail Mounting
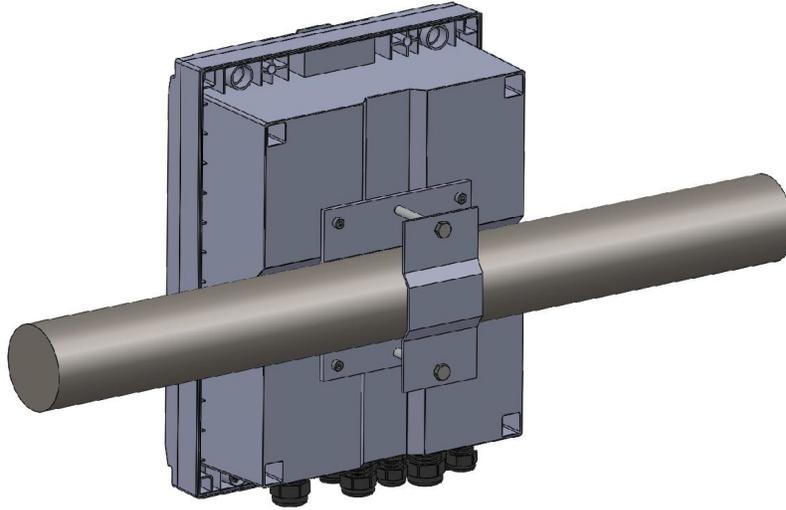


The analyzer enclosure can be handrail mounted using the optional handrail mount kit. By turning the brackets through 90° the analyzer can also be pole mounted.
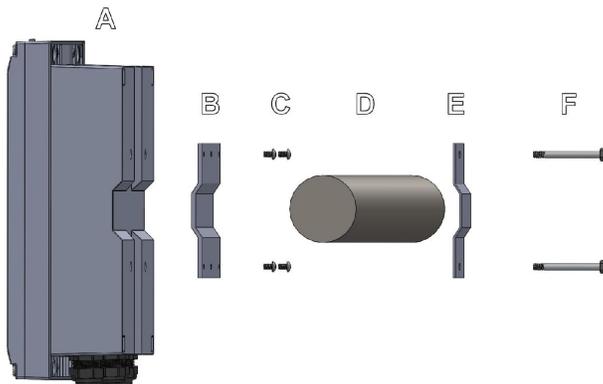


**HydroAct 4 Handrail Mounting**
- A  HydroAct 4
- B  Large bracket
- C  Four M5×8mm bolts
- D  Handrail
- E  Small bracket
- F  Two M6 bolts
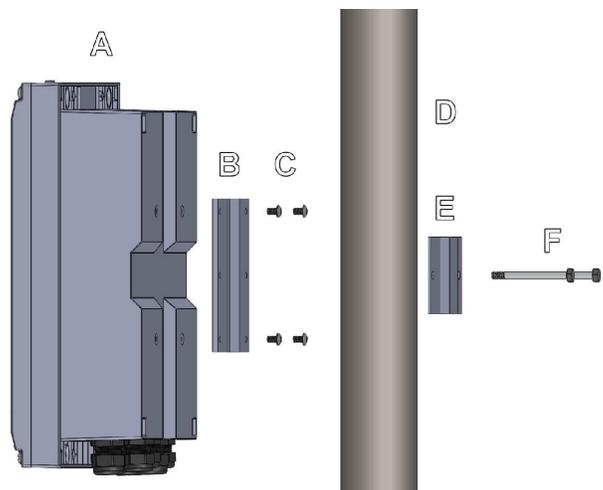


**HydroAct 4 Pole Mounting**
- A  HydroAct 4
- B  Large bracket
- C  Four M5×8mm bolts
- D  Pole
- E  Small bracket
- F  Two M6 bolts

### 2.3.4  Electrical Connections
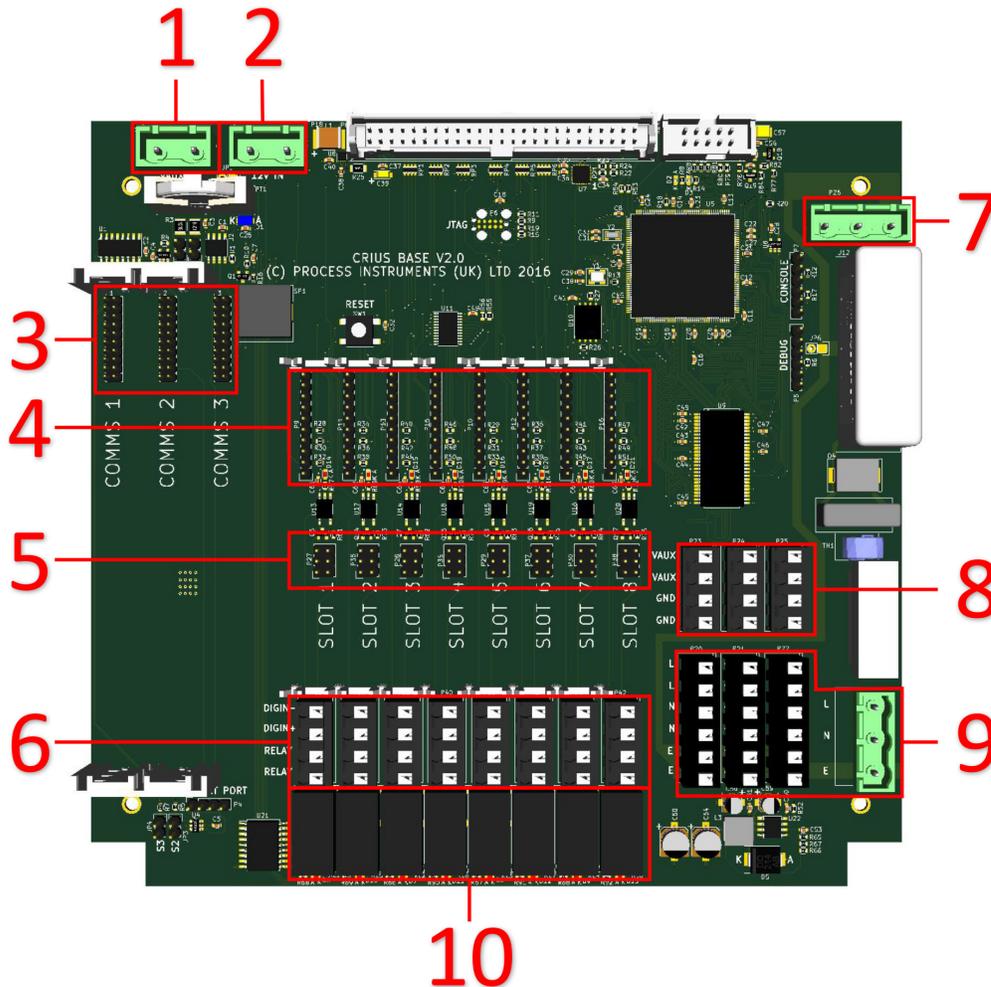


1. Auxiliary power from secondary PSU
2. 12V input from main PSU
3. Communication card slots
4. Sensor and output card slots
5. Digital input configuration jumpers
6. Relay and digital input connectors
7. AC Power to main PSU
8. Auxiliary power out[2]
9. AC power connectors
10. Electromechanical relays

   The connections are made via press to open connectors or screw terminals. An insulated screwdriver can be used to operate the connector. Each instrument has a large number of possible wiring combinations depending on which sensors, inputs, outputs or communications are selected at the time of purchase. This is achieved by the use of expansion electronics cards specific to each role. These expansion cards are fitted to "Slots".

   The connections for sensors, inputs, outputs and communication cards are detailed in Part II of this

---

[2]If secondary PSU is not fitted, these connectors are linked to the main 12V PSU.

manual.

## 2.4   Operation

### 2.4.1   User Interface

The HydroAct 4 display is a 4.3", 480 × 272, 24-bit color display and is best viewed from directly in front. The user interface is accessed via nine buttons embedded in the membrane overlay. There are also two status LEDs, showing power and alarm status, and an audible buzzer.

The buttons all have a tactile feedback response. Holding the buttons in will inject multiple key presses of increasing speed until the button is released. In some cases holding a button will provide access to a different function. These are highlighted in the manual. The four buttons along the bottom of the screen, are defined for each screen by the legend above the button. The navigation and Select buttons below the display are alway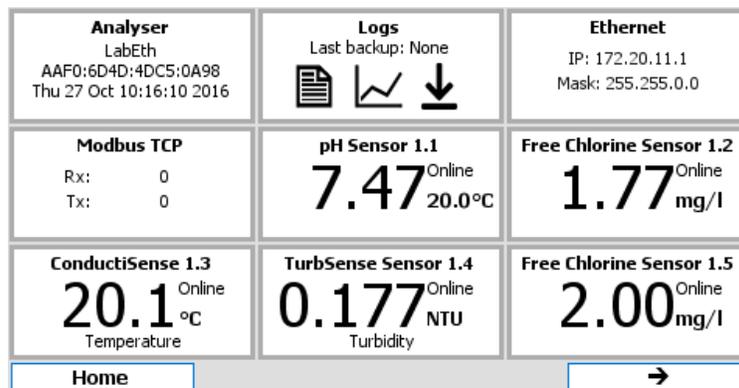s for navigation of the display. The Up and Down, Left and Right buttons are used for moving the "Select" target around the display.

The screen displayed once the system is started is either the default "Home" screen (see section 2.4.3), if configured, or the Main Menu.

### 2.4.2   Main Menu

| Analyser<br>LabEth<br>AAF0:6D4D:4DC5:0A98<br>Thu 27 Oct 10:16:10 2016 | Logs<br>Last backup: None<br>📄 〽 ⬇ | Ethernet<br>IP: 172.20.11.1<br>Mask: 255.255.0.0 |
|---|---|---|
| Modbus TCP<br>Rx:        0<br>Tx:        0 | pH Sensor 1.1<br>7.47 Online 20.0°C | Free Chlorine Sensor 1.2<br>1.77 Online mg/l |
| ConductiSense 1.3<br>20.1 Online °C<br>Temperature | TurbSense Sensor 1.4<br>0.177 Online NTU<br>Turbidity | Free Chlorine Sensor 1.5<br>2.00 Online mg/l |
| Home | | ➔ |

**Example Main Menu**

The Menu screen is a standard display in your HydroAct 4 and is a tile based display of all the different parts or "devices" that make up your analyzer. By using the Up, Down, Left, Right and Select button it is possible to navigate to any part of the analyzer by highlighting the icon and selecting it. Devices are firmware modules that control a physical device, such as a sensor, or a purely software construct, such as a PID control calculation. Some hardware devices have multiple device tiles associated with them. For example, an Ethernet communications card will add an "Ethernet" tile which allows physical interface to be configured and a "Modbus TCP" tile allowing access to the main communications protocol used on the interface.

There are two standard device tiles available on all analyzers, regardless of configuration. The "Analyzer" tile gives access to information and configuration options for the unit, e.g., selecting the language and setting the time and date. The "Logs" tile allows access to the status and data logs stored on the unit.

Selecting a device tile from the menu will open an overview or set up screen. The overview display gives the user key information for that device and may allow the entering of commonly changed variables. For example, an overview for a chlorine sensor will display the chlorine reading and sensor maintenance information, and offer the user a shortcut to calibrate the sensor.
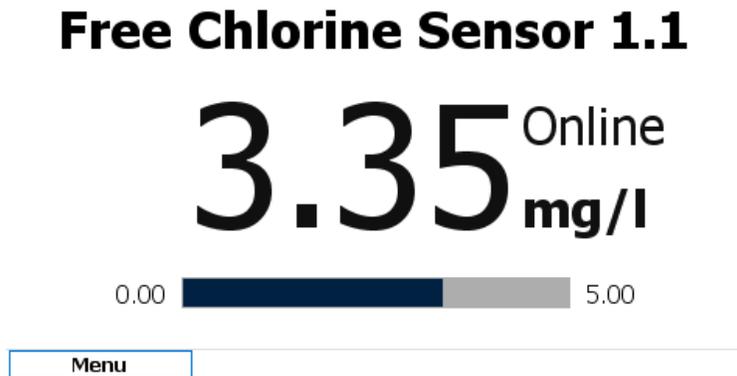
Many screens will have an "Options" button. Pressing this button will produce a pop-up menu on the display. Some of the items on this menu will have a ▶ next to them indicating that there are further

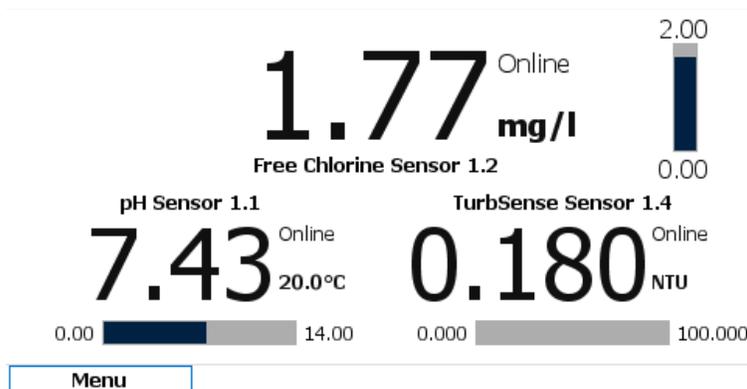menus accessible by highlighting the menu item and either pressing the Select button or the Right button.

### 2.4.3  Home Screens

Home screens are used to display information from more than one source on a single display. They are accessed by pressing "Home" from any screen displaying the soft-key and then by pressing the Left or Right button to scroll through the available Home Screens. On any Home Screen pressing Up and Down will highlight different aspects of the display which can then be accessed by pressing the "Select" button.

Home screens can simply show information about a single sensor:

**Free Chlorine Sensor 1.1**

$3.35$ Online mg/l

0.00  ████████████      5.00

Menu

or several sensors readings and control outputs:

2.00

$1.77$ Online mg/l

Free Chlorine Sensor 1.2

0.00

pH Sensor 1.1                                 TurbSense Sensor 1.4

$7.43$ Online 20.0°C             $0.180$ Online NTU

0.00  ████████      14.00        0.000  ████████      100.000

Menu

For details of how home screens are defined and configured see section 2.4.5.3.

### 2.4.4  User Authentication

When attempting to access a function that requires authentication you will be taken to the log in screen, where a user is selected and security code entered. Use the "Select" key to open the user drop down list, Up/Down to highlight the desired user and "Select" to move to the next step, the first box for the six digit security code entry will now be highlighted.

When entering a security code, all buttons except the fourth soft-key (top right) can be used for code entry. If the correct code is entered you will be presented with the tile requested. To indicate which user, if any, is currently logged in to the instrument, the user name will appear in the top right of the display. See section 2.4.5.4 for configuration of security options.
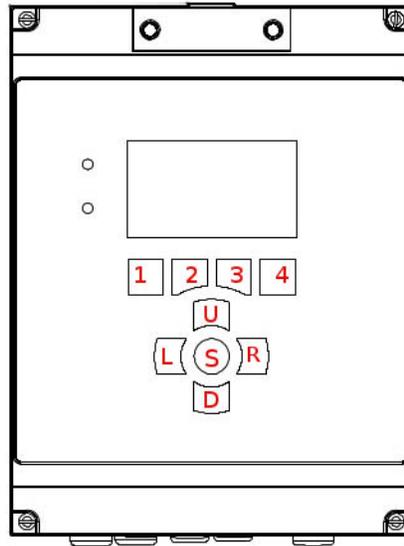
**HydroAct 4 Button Layout**

The analyzer is preconfigured with a default user called "user1" who has full access to the analyzer, with the default password of:

1, 1, 1, 1, 1, 1

From the button layout above.

To force a user to log out, press and hold the "Home" or "Menu" button for a few seconds until "Logout" is displayed. If default security access is enabled (see section 2.4.5.4) and different security access is required, press and hold the select button on the desired device tile in the main menu for a few seconds. The login screen will appear. Select the desired user and enter the password.

## 2.4.5   Analyzer Options

Selecting the Analyzer tile on the main menu will take you to the Analyzer Overview (below). From here you can access settings that relate to the analyzer setup. These typically do not affect the sensors, communications or control functions.
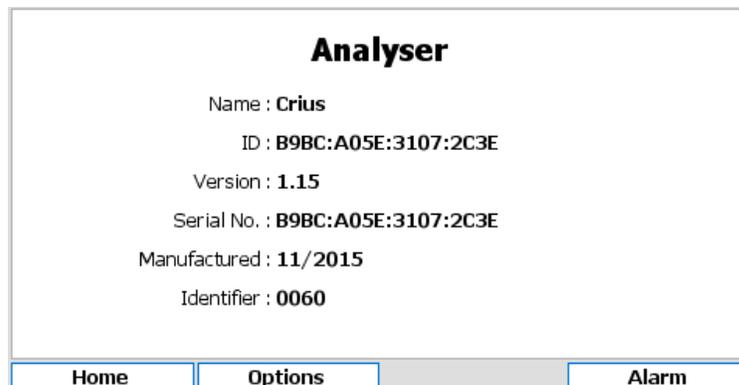


**Analyzer Overview**

**2.4.5.1 Analyzer Setup**

The date and time are used in the data logs and status logs of your controller and it is therefore important that they are set correctly. To modify the analyzer labels, time and date settings or language go to:

Options → Setup → Analyzer



**Name & ID** The Name and ID details allows the user to name the instrument in various ways. These tags are used to identify the instrument, e.g., when an instrument sends a text alarm, the Name and ID details are used to inform the recipient as to which instrument is in alarm. The Name would typically be the site name and the ID would typically refer to a specific analyzer.

**Language** The user interface of the HydroAct 4 can be set to any supported language. Use the drop down list to select the language of choice.

**Time Zone** Select the required time zone. The internal clock stores the time in UTC format. Therefore changing the time zone will change the current time. Daylight savings, if applicable for the selected time zone, will automatically be followed.

**Time** Set the required time by modifying the values using the up/down buttons

**Date** Select the date using the calendar widget that will appear when the date entry box is selected.

**2.4.5.2 User Interface**

Configuration options that affect the user interface are presented in tabbed windows. Use the keys marked "←" and "→" to move between tabs. The configuration is accessible by selecting:

Options → Setup → User Interface



**Buzzer** The buzzer will sound when a key is pressed or to indicate that the analyzer is in alarm. Use the checkbox to enable or disable the buzzer sounding.

**Backlight Timeout** In order to extend the life of the display a timeout can be set. At the end of the timeout the display will go dark. Any button press will turn the screen back on. Use the checkbox to enable or disable the backlight timeout and set the desired timeout using the up/down buttons. The timeout is in HH:MM:SS format.

**Home Button** On most displays the left button under the display can be set to take the user to the "Home" screen or the "Menu" screen.

**Blink highlighted** If this option is enabled, the element the user needs to look at blinks between two colors to attract attention.

### 2.4.5.2.1 Menu
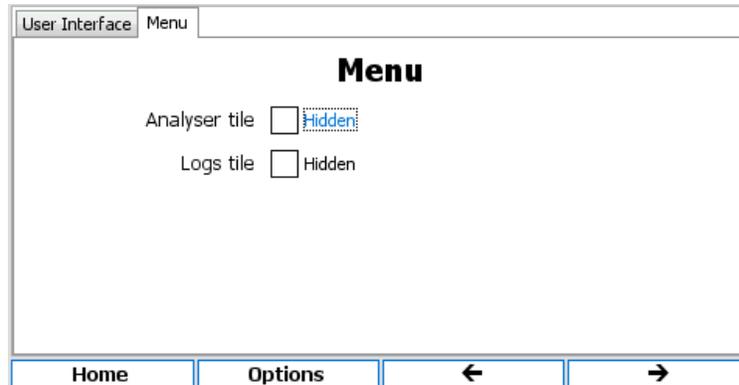


**Analyzer tile** If the checkbox is ticked then the Analyzer tile will be hidden as default on the main menu.

**Logs tile** If the checkbox is ticked then the Logs tile will be hidden as default on the main menu.

### 2.4.5.3 Home Screens

The HydroAct 4 has the capability to have multiple home screens which give the user options as to how the display provides information (see section 2.4.3). To set up a new home screen, edit or delete an existing home screen, select:

Options → Setup → Home Screen
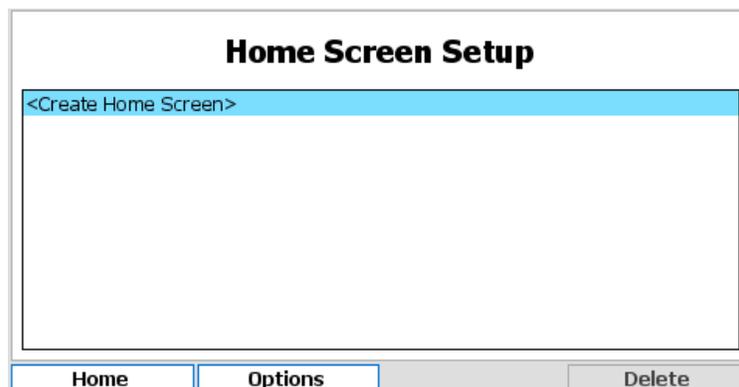


To delete a home screen highlight the home screen name with the up/down buttons and press "Delete". Pressing and holding the "Delete" key will make the "Delete All" function available. A confirmation message box will appear before all home screens are deleted. To edit the home screen, again select the name, and press the select button. To create a new home screen, select "Create Home Screen" and press select.

**Create Home Screen**

Select home screen type and press Create

Type    Generic          ▼

| Home | Options | | Create |

Select the home screen type from the drop down list. Generic home screens allow up to 4 devices to be displayed in a variety of formats. Other home screen types are application-dependent and are described below, if applicable. For this example, select "Generic" and press "Create".

**Home Screen Setup**

Name    Generic

Layout    Layout 1          ▼

1

| Home | Options | | Done |

Editing an existing Generic home screen or creating a new Generic home screen will display the above form. Select the desired layout as shown in the diagram below the layout selection box. The layout is made up of a series of windows that display selected information. The possible window arrangements for the layouts are as follows:

1

**Layout 1**

1

2

**Layout 2**
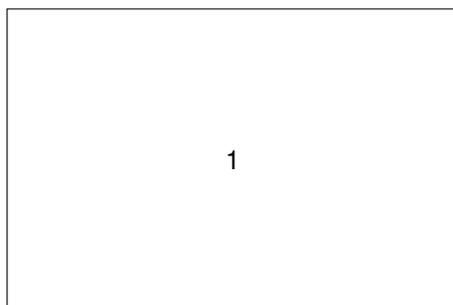
**Layout 3**
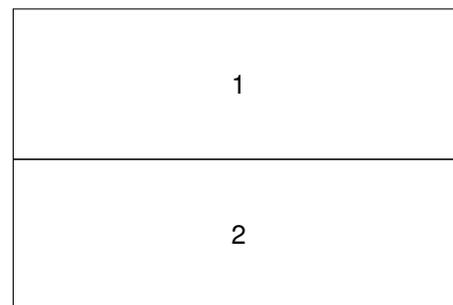
**Layout 4**
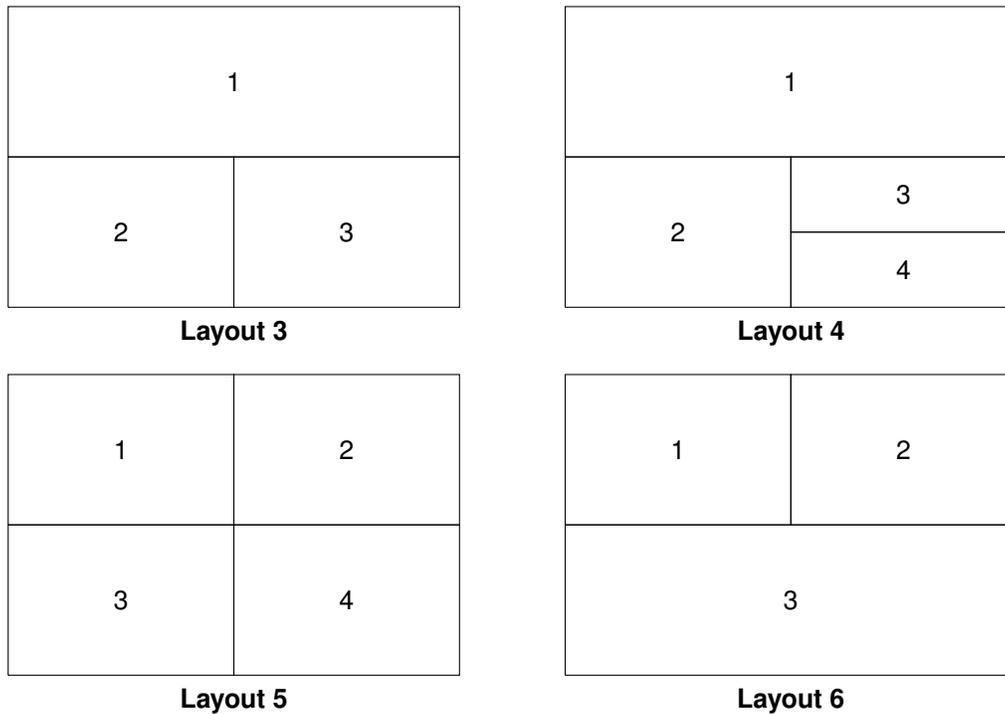
**Layout 5**

**Layout 6**

Each window can display information about a device or a data log graph. To select what is displayed in each window of a particular layout, move the selection to highlight the window and press the select button.

**Edit Window**

Select a module and window type to occupy home screen section

Type   Device ▼

Device   <None> ▼

Home        Options                    Done

**Type**  Select the type of information to display in the selected window. Options are "Device" or "Data Log".

**Data Log**  If "Data Log" is selected in the type field, this option will be available. Select the data log to display.

**Device**  If "Device" is selected in the Type field above, this option will be available. Select the device to display in the selected window.

**Window**  If the device selected above has multiple types of display possible for this type of window, then this option will be available. Select the type of information to display.

### 2.4.5.4  Security

To access the security setup options, select:

Options → Setup → Security

**Login Timeout** If no user activity is detected within this given time period while the main menu or home screen is displayed, then the current user will be logged out. The time is in HH:MM:SS format.

**Default Access** If enabled, then no user authentication will be attempted when accessing a device tile or using a quick access function from the home screen. Instead the user will be allowed access at the security level set out in the boxes below it.

#### 2.4.5.4.1 Security access levels

Access to many of the analyzer functions is secured using password protection. To allow flexible security profiles the HydroAct 4 is split into six access areas:

**System** Controls access to analyzer-specific settings and communication options.
**Sensor** Controls access to sensor devices.
**Signal** Controls access to signal devices, such as digital inputs.
**Output** Controls access to output devices, such as relays and analog outputs.
**Control** Controls access to control devices, such as PID.
**Event** Controls access to event devices, such as timers and schedulers.

With each of these areas, operations have been assigned to four security levels:

**None** No access to the assigned area is enabled.
**Basic** Users with this access level can see information and perform basic maintenance tasks. Users generally can not change any settings with this access level.
**Intermediate** Users with this access level can perform routine maintenance tasks and change common settings.
**Advanced** Users with this access level can perform all available actions.

Using this security model it is possible to assign specific tasks to individual users. For example, It is possible to allow a user to calibrate sensors (intermediate access for sensors), but not change PID settings (no access for controls). Access to restricted functions will require the entry of the operator's security password.

#### 2.4.5.5 Users

To add, remove users or modify access rights, select:

Options → Setup → Users

**User Setup**

| |
|---|
| user1 (1) |
| <+ Add User> |

| Home | Options | | Delete |
|---|---|---|---|
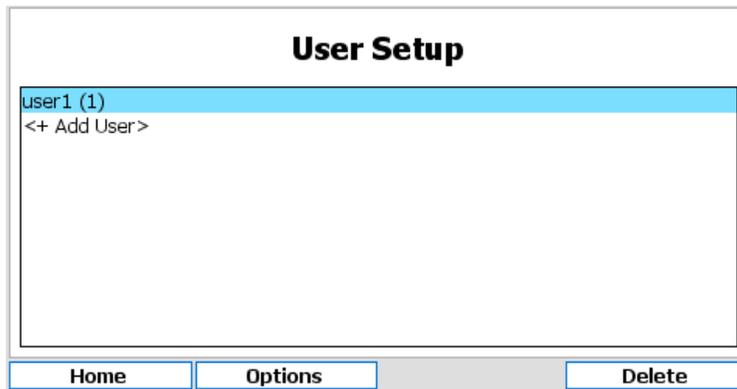
To add a user, highlight "<+ Add User>" and press the select button. Enter the desired user name and access rights. To set the password, press "Password" and follow the on screen prompts. To delete a user, highlight the user name and press "Delete"[3]. To modify a user account, highlight the user name and press the select button. The user name and security access rights will then be editable.

A user can change their own password by selecting the following and following the on screen prompts.

Options → Change Password

### 2.4.5.6 Analyzer Information

Information regarding the analyzer hardware and software setup is useful for diagnosing problems and correctly configuring the analyzer. To access the hardware map, i.e., information about the hardware installed in the analyzer, select:

Options → Information → Hardware Map

**Hardware Map**

Select a node for further information

| Node | Type | Version | Serial No. |
|---|---|---|---|
| 1 | Base | 1.15.00 | B9BC:A05E:3107:2C3E |
| 3 | Undefined | 0.00.00 | 0000:0000:0000:0000 |
| | | | |
| | | | |
| | | | |
| | | | |

| Home | Options | |
|---|---|---|

Information given for each Node[4] includes board number, board type, firmware version number and unique serial number. Each enclosure in a system contains a base board. These boards are numbered 1, 5, 9 and 13. Board 1 is the master board with the screen and keypad attached. Each base board has three slots for communication boards, whose node number increments from the base board they are installed on. For example, the master board, or node 1, has communication slots with nodes numbered 2, 3 and 4.

Highlighting a base board and pressing the "Select" key will open a further information screen showing the I/O plugin cards installed, their location and hardware and software version numbers.

---

[3]A user can not delete their own user account. This prevents the possibility of having no privileged user accounts and effectively leaving an instrument in an unusable state.

[4]The mainboards and communication boards in an analyzer communicate over a CANBUS network. Each board has a unique Node number for identification on this network.

**Node 1 - Base**

| Slot | Type | Hardware Version | Software Version |
|------|------|------------------|------------------|
| 1 | pH Card | 1.01.00 | 1.02.00 |
| 2 | Analogue Input Card | 1.01.00 | 1.03.00 |
| 8 | Analogue Output Card | 1.00.00 | 1.03.00 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

| Home | Options | | Back |
|------|---------|--|------|

The HydroAct 4 makes use of several internal read-only file systems as well as the micro SD card. Information regarding the file system usage can be viewed by selecting:

Options → Information → File Systems

**File Systems**

| Name | Used | / | Total |
|------|------|---|-------|
| /bin | 0.79MB | / | 0.79MB |
| /opt | 0.50MB | / | 0.50MB |
| /usr | 2.43MB | / | 2.43MB |
| /var | 0.00MB | / | 1.73MB |
| config | 0.00MB | / | 0.12MB |
| /mnt | 20.44MB | / | 1914.62MB |
| | | | |
| | | | |
| | | | |

| Home | Options |
|------|---------|

All entries other than "/mnt" are internal read-only file systems and the information may be useful for technical support inquiries. The "/mnt" file system refers to the micro SD card and a total size of 0.00MB indicates that the card is missing or not detected.

The device list shows which software modules are installed and active on the anlayser. To access this information, select:

Options → Information → Device List

Each installed device is listed. Use the Up and Down keys to scroll through the list.

#### 2.4.5.7  Alarm Settings

When the analyzer detects an error condition, it will enter an alarm state. This will be indicated on the screen and sounded using the buzzer. To access the alarm configuration, select:

Options → Alarm → Setup

**Alarm Setup**

Re-alarm Enable ☐ Enabled

Re-alarm Timeout 01 ⇕ : 00 ⇕ : 00 ⇕

| Home | Options |
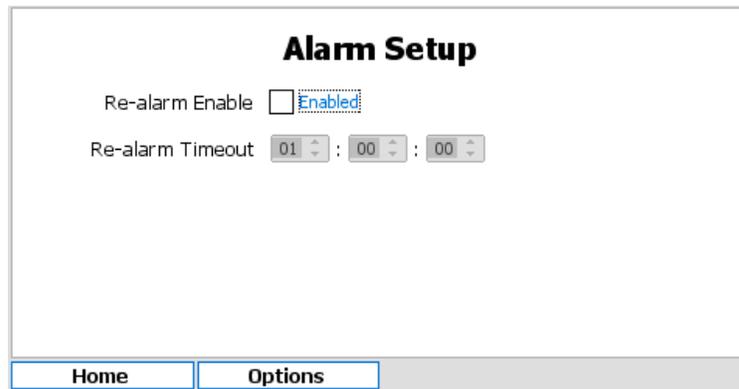
The "re-alarm" feature can be enabled and the timeout set. If the analyzer is in alarm and that alarm is acknowledged (see below), then the analyzer will return to the alarm state after the timeout has expired if the error condition has not been rectified. The exact reason for the active alarm is shown by selecting:

Options → Alarm → Message

When the analyzer is in alarm, the message shows the time and date of when the message was updated and an "Ack" button silences the alarm and prevents any further alarm SMS messages[5] being generated. The alarm message will change to indicate the alarm has been acknowledged.

### 2.4.5.8 Service Options

Service options are used to gather information for technical support personnel. Other options allow firmware upgrades and factory reset of configuration information. Operations in this menu should only be accessed when requested by a service engineer.

### 2.4.5.9 Device Codes

Device codes enable firmware modules. Adding new hardware or software features usually requires adding device codes. Devices codes can be entered directly using the user interface or imported from a MicroSD card. Technical support will provide instructions should this need to be done outside of the factory.

### 2.4.5.10 Backup, Clone and Restore Configuration
#### 2.4.5.10.1 Backup

To create an analyzer backup navigate to:

Analyzer → Options → Backup → Backup

Select an existing file to overwrite or select "+New File" and select "Next". If creating a new file, enter the desired filename (by default the date is included in the filename). Then select "Next". When notified that the backup file has been created select "OK".

#### 2.4.5.10.2 Restore/Clone

To begin a restore/clone operation navigate to:

Analyzer → Options → Backup → Restore

Select the file to restore/clone from and select "Next" and then "OK". If this is the analyzer on which the backup file was created a restore operation will occur. If this is a different analyzer a clone operation will occur.

---

[5]Available if a 2G/3G Modem option is installed

| Configuration Files | Restore | Clone |
|---|---|---|
| Analyzer Settings (Name, Alarm, Users, etc) | Yes | Yes |
| Communications Card Settings[6] | Yes | Yes |
| Data Logs Setup[7] | Yes | No |
| Home Screens | Yes | No |
| Device Codes | Yes | No[8] |
| Device Settings | Yes | Yes |
| Modbus Maps | Yes | Yes |

## 2.4.6  Logs

Selecting the log tile from the main menu will display a secondary logs menu. These available options are; Backup Logs, Status Log and Create Data Log.
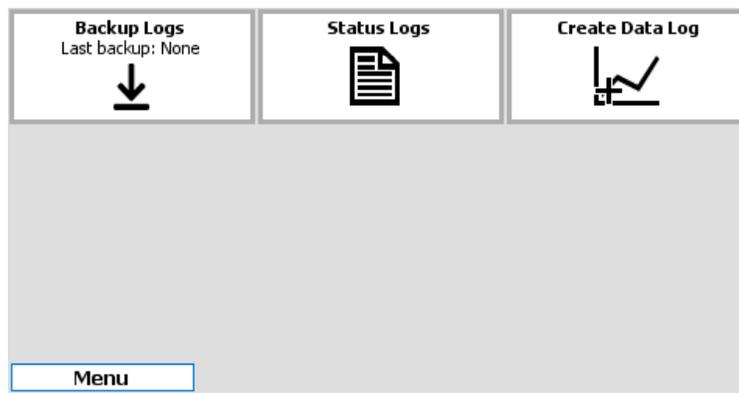


If any data logs are defined, each will be displayed as its own file.

### 2.4.6.1  Backup Logs

Logs can be backed up by selecting this tile. The screen will display the last time logs were successfully backed up. With a SD card inserted in to the analyzer, press the "Backup" button to begin. Log entries since the last successful backup will be written to the SD card. A progress bar will display the backup task progress and a message displayed to indicate the result.

### 2.4.6.2  Status Log

Selecting the Status Log tile will display the Status Log messages.  These will include important information such as recording when calibrations are performed, users log in and any error messages:

---

[6]Communication cards must be present in the same order for restore/clone to function.
[7]All data log data will be cleared
[8]Same device codes must already be present on the analyzer for device configurations to be cloned successfully.

**Status Logs**

| ID | Time | Message |
|------|---------------------------|------------------------------------------------------------|
| 2351 | 24/02/2017 12:55:51 GMT | pH Sensor 1.2 error: Sensor failed to read input signal |
| 2350 | 24/02/2017 12:55:51 GMT | Free Chlorine Sensor 1.1 error: Sensor failed to read input s |
| 2349 | 24/02/2017 12:52:07 GMT | Login by user user1 |
| 2348 | 24/02/2017 11:10:28 GMT | User logged out |
| 2347 | 24/02/2017 06:21:22 GMT | Login by user user1 |
| 2346 | 24/02/2017 06:19:12 GMT | pH Sensor 1.2 error: Sensor failed to read input signal |
| 2345 | 24/02/2017 06:19:12 GMT | Free Chlorine Sensor 1.1 error: Sensor failed to read input s |
| 2344 | 24/02/2017 06:16:02 GMT | Login by user user1 |
| 2343 | 24/02/2017 05:40:59 GMT | User logged out |
| 2342 | 24/02/2017 05:38:54 GMT | Login by user user1 |
| 2341 | 20/02/2017 07:24:58 GMT | User logged out |

| Home | Back | Clear | Download |
|------|------|-------|----------|

Use the arrow keys to scroll up, down, left and right. Press "Clear" to delete the current status log messages and truncate the status log. Press "Download" to save the status log to SD card.

#### 2.4.6.3  Data Logs
##### 2.4.6.3.1  Creating a Data Log
To create a new data log, select "Create Data Log".

**New Data Log**

Name    New Data Log

Interval    30 Minutes    ▼

| Back | Next |
|------|------|

Enter the name to identify the data log and the log interval. Available options are 1, 2, 5, 10, 15, 20, 30 minutes or 1 hour. Press "Next" to continue.

**Items Logged**

Free Chlorine Sensor 1.1 (Free Chlorine)
pH Sensor 1.2 (pH)
PID Controller 1.1 (Primary Output)

| Back | None | All | Done |
|------|------|-----|------|

Select from a list of available parameters, signal inputs and control outputs to populate the data log. Highlight the desired measurements or press "All" to highlight all available measurements. Up to the first 4 measurements selected will be displayed on the data log graph. Press "Done" when finished. The data log will be created and data collected.

**2.4.6.3.2**  **Viewing a Data Log**
Each data log configured will be displayed as a tile in the Logs menu. Select the data log of interest to view the data.



The overview allows the renaming of the log and changing of the log interval. The "Delete" button will remove the log completely and prevent any further data logs being collected. The "Clear" button will truncate the data log and remove any historic data. The "Download" button allows the data log to be saved to SD card as comma-separated values.



To view the data log values collected, press the "Data" button. A table of recorded values will be displayed. Use the arrow keys to scroll up, down, left and right.
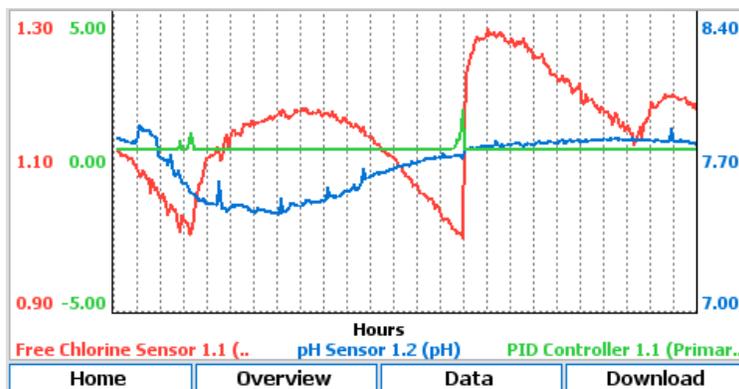


To view the data log graph, press the "Graph" button. The legend shows the line style for each measurement and axis.
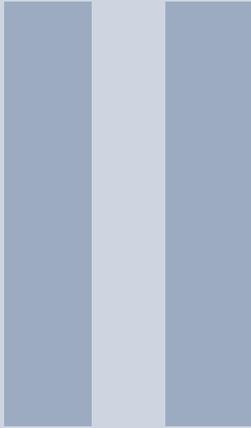
# Options

# 3. Sensors

## 3.1 DuraTrac 4 Streaming Current

### 3.1.1 General Information

#### 3.1.1.1 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.

#### 3.1.1.2 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.

### 3.1.1.3 Theory of Operation

The DuraTrac 4 Streaming Current 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 DuraTrac 4 Streaming Current sensor provides the user with an online measurement of charge neutralization, allowing the user to optimize 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 immobilized 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 DuraTrac 4 Streaming Current sensor measures the net ionic and colloidal surface charge (positive and negative) in a treated sample.

#### 3.1.1.3.1 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 optimize 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.

#### 3.1.1.3.2 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 DuraTrac 4 Streaming Current 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 DuraTrac 4 Streaming Current 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 oxidizing agents.

### 3.1.1.3.3 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 hydrolyze into an insoluble species with a neutral ionic charge, or further hydrolyze 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 DuraTrac 4 Streaming Current 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 favorable 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.

### 3.1.1.4  Technical Data

**Power**  115 VAC, 60 Hz (standard) or 230 VAC, 50 Hz (optional)
**Sample Flow Rate**  1..40 liters per minute
**Sample Cell Type**  External receiver, high flow
**Probe Type**  Quick replacement cartridge, user replaceable sleeve
**Water Sample Connections**  Inlet 1" FNPT
**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**  285mm (w) x 234mm (h) x 161mm (d)
**Mounting Holes**  247mm (w) x 266mm (h)
**Overall Height with Sensor**  477mm
**Weight**  6.8kg
**Operating Temp.**  0..50°C
**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 250$\mu$S/cm, better than 3% from 250 to 500$\mu$S/cm andr better than 5% from 500 to 1000$\mu$S/cm.
**Self Diagnostics**  Motor RPM, Signal Health

## 3.1.2  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 DuraTrac 4 Streaming Current 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 minimize 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 Chemtrac 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 Chemtrac 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, 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, minimizes 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
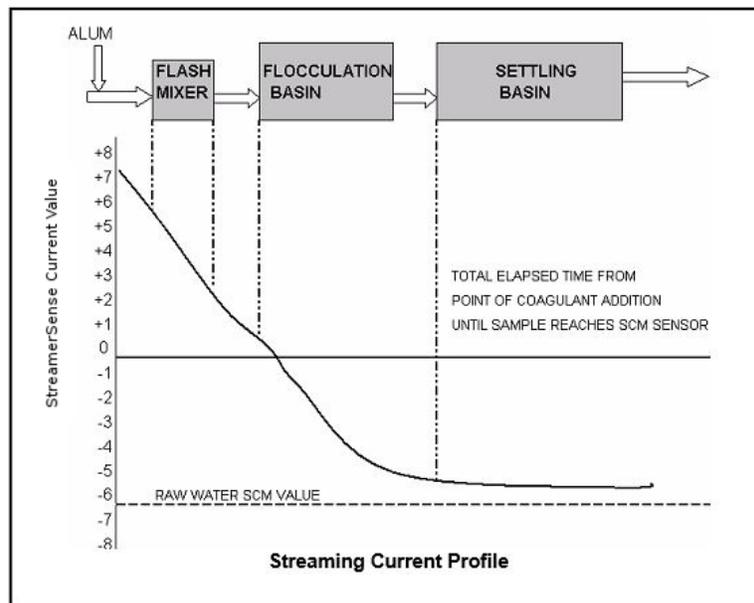
Finding the optimum sample point can be complex for some applications. To avoid wasting time and money on an improper installation, it is very highly recommended you call to discuss your application before installing your sensor. A lot of time and expense can be saved by doing so. Ask to speak with a 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.

**3.1.2.1  Mounting and Plumbing**

The sensor can be located several hundred feet from the HydroAct 4. The sensor must be mounted in a vertical position with the sample flowing into the inlet (either side of probe block can be used as the inlet) and exiting from the other side and going back to a drain or return point in the process. An atmospheric drain with as little backpressure as possible is recommended. Sample pressure must not exceed 20 PSI (1.4 bar) and less than 5 PSI (0.35 bar) is recommended.
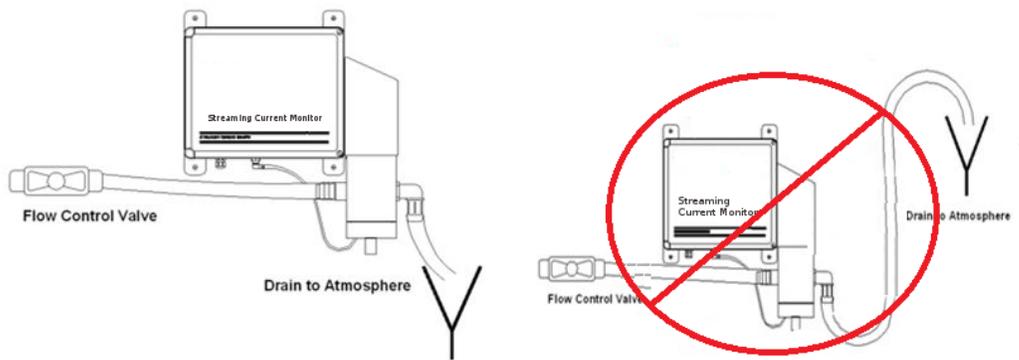


Typically, the sensor is mounted as closely as possible to the sampling point. Minimizing sample line lengths provides quicker response to process changes. Sample may be obtained by using a sample pump, tapping off a pressurized line, or using gravity feed system to get sample to the sensor. The sample flow rate should not exceed 40 liters per minute (10 GPM).

**3.1.2.2  Wiring**

Connections for AC power and between the HydroAct 4 and DuraTrac 4 Streaming Current sensor are indicated in the following image.

**Note regarding sensor card slot position:**

If the analyzer 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 HydroAct 4 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.
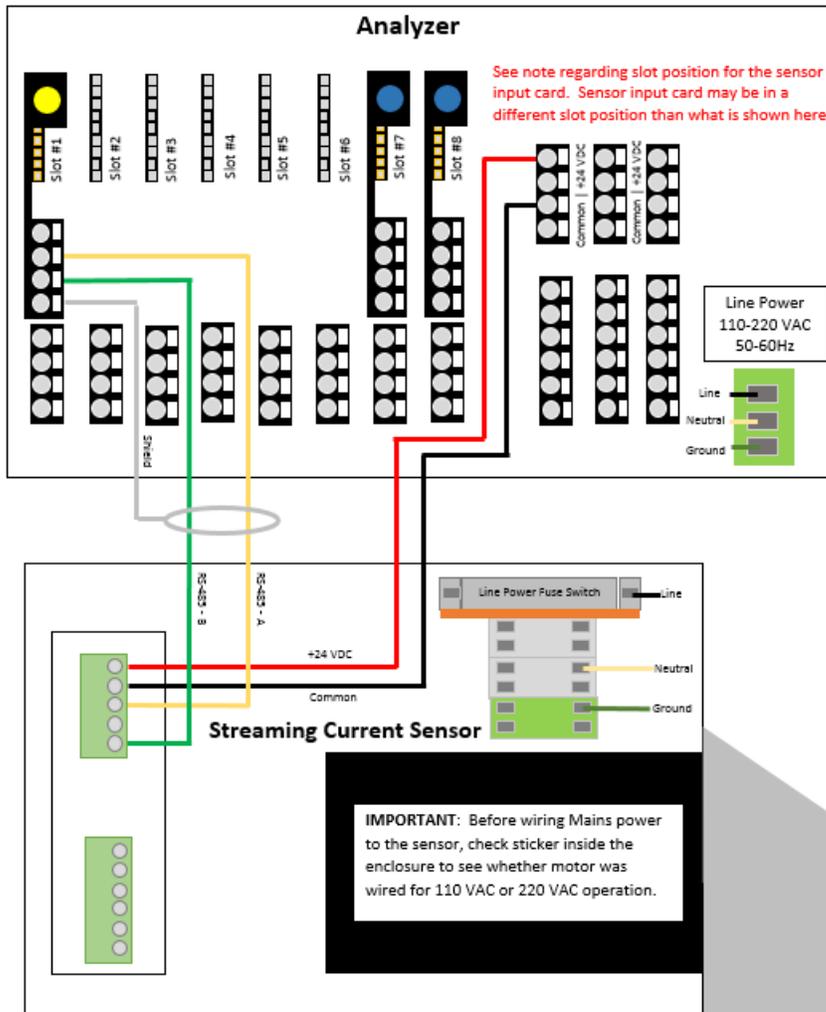
For safety and correct operation, the sensor must be properly earthed.

### 3.1.3 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 DuraTrac 4 Streaming Current sensor is capable of working with a flow rate anywhere between 1 and 40 liters per minute, a flow rate of at least 4 liters 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 stabilize.
7. Raw water quality should be in a stable condition (turbidity, pH, color, etc. should not change rapidly or widely) when initially establishing an optimum "setpoint".

### 3.1.3.1  Calibration

#### 3.1.3.1.1  Initial Gain Setup

The DuraTrac 4 Streaming Current 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.

#### 3.1.3.1.2  Automatic Gain Adjustment

This method requires a sample of Raw Water (with no coagulant) be collected and poured into the sensor (an injection port is provided on the front of the sensor to assist with this). 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 liters of raw water.
4. On the HydroAct 4:

   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.

**3.1.3.1.3 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 the HydroAct 4 navigate to:

   Options → Maintenance → Manual Gain
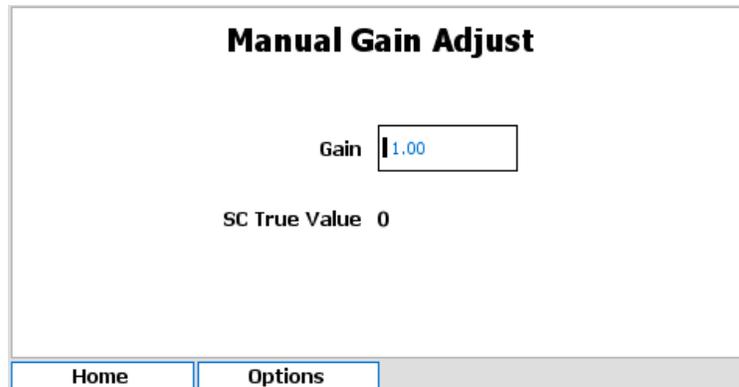


2. Change Gain value to 5.0 for water treatment and 50.0 for wastewater.
3. Increase or decrease coagulant dosage by 10% (e.g. Go from 30 to 33 ppm)
4. Desired change in SCV is 10 to 20 units. If change is smaller, increase the gain. If change is too large, decrease the gain.

**3.1.3.1.4 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 analyzer 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 analyzer 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 analyzer to grab a new offset value.

> **In addition to the following procedure, 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. Optimize coagulant dosage and allow SCV to stabilize.
2. On the HydroAct 4 navigate to:

   Options → Setup → Zero Offset.

**Zero Offset**

Enabled   ○ Yes
          ◉ No

True SCV   0

Offset Value   [ 0 ]

Display SCV   0

| Home | Options |

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.

#### 3.1.3.1.5   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.

#### 3.1.3.1.6   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 liter 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 liter 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 3.1.3.1.3
3. Dose the second 1 liter with an optimum dosage of coagulant and mix rapidly for 5 to 10 seconds and then begin pouring sample into sensor (a sample injection port is provided on the front of the probe block).
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).

#### 3.1.3.1.7   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 3.1.3.1.2, and repeat above testing. If cleaning does not improve response, try replacing piston and probe sleeve. If neither of these improve response, see Section 3.1.6 of this manual or contact Chemtrac for additional troubleshooting steps.

### 3.1.4   Operation

When selecting the DuraTrac 4 Streaming Current 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.



#### 3.1.4.1   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.

**3.1.4.2  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.

**3.1.4.3  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.

**Units**  If "User defined" is selected above, set the units using the custom units' entry screen that will be displayed when pressing the select button. Otherwise select from an appropriate list of units for the parameter type.

**Precision**  Select the number of digits following the decimal point to display. This should be appropriate for the measurement. Options are 0 to 5.

**Range**  Set the range values for the parameter. Options are restricted to those appropriate to the parameter.

**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[1]. Options are 200..5000ms.

### 3.1.4.4  SC True

Parameter settings are accessed by selecting:

Options $\rightarrow$ Setup $\rightarrow$ 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.

**Units**  If "User defined" is selected above, set the units using the custom units' entry screen that will be displayed when pressing the select button. Otherwise select from an appropriate list of units for the parameter type.

**Precision**  Select the number of digits following the decimal point to display. This should be appropriate for the measurement. Options are 0 to 5.

**Range**  Set the range values for the parameter.  Options are restricted to those appropriate to the parameter.

**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[2]. Options are 200..5000ms.

### 3.1.4.5  Signal Health

Parameter settings are accessed by selecting:

Options $\rightarrow$ Setup $\rightarrow$ Signal Health

---

[1]An averaging delay of 2000ms with a length of 30 will result in a rolling average of 1 minute (30 $\times$ 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.

[2]An averaging delay of 2000ms with a length of 30 will result in a rolling average of 1 minute (30 $\times$ 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.

**Parameter Setup**

Type [Signal Health ▼]

Range [          0] .. [        101]
Offline Value [          0]

Averaging ○ Enabled        Length [  60 ⇕]
              ◉ Disabled       Delay [0500 ⇕] ms

[ Home ]  [ Options ]

**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.

**Units** If "User defined" is selected above, set the units using the custom units' entry screen that will be displayed when pressing the select button. Otherwise select from an appropriate list of units for the parameter type.

**Precision** Select the number of digits following the decimal point to display. This should be appropriate for the measurement. Options are 0 to 5.

**Range** Set the range values for the parameter. Options are restricted to those appropriate to the parameter.

**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[3]. Options are 200..5000ms.

### 3.1.4.6 Modbus Setup

Modbus settings can be accessed by selecting:

Options → Setup → Modbus Setup

**Modbus Setup**

Slave Address [ 001 ⇕]
Mode [RTU ▼]
Baud Rate [19200 ▼]
Parity [Even ▼]
Stop Bits [ 1 ⇕]
                  ☐ Termination Enabled
                  ☐ Byte Swap
                  ☐ Word Swap

[ Home ]  [ Options ]

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

---

[3]An averaging delay of 2000ms with a length of 30 will result in a rolling average of 1 minute ($30 \times 2s$) 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.

**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 HydroAct 4 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.

### 3.1.4.7  Maintenance Setup

The DuraTrac 4 Streaming Current 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 color 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



### 3.1.4.8  Waveform Diagnostics

The waveform download allows the user to see exactly how the signal from the probe and optoswitch appear. This information can be accessed through the Diagnostics menu via:

Options → Diagnostics → Display Waveform
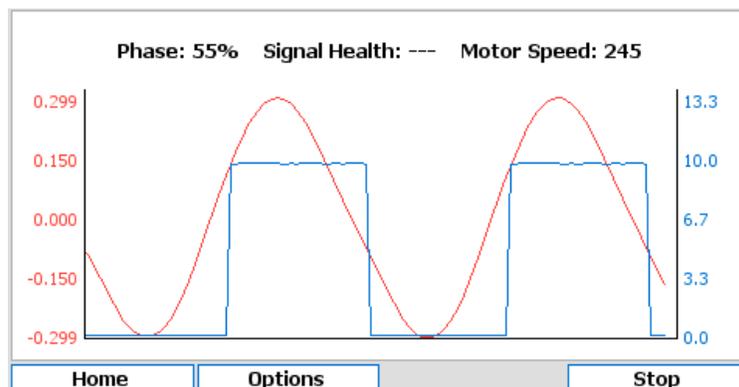
The waveform image will update approximately every 5 seconds. Press the button labeled "Stop" to pause the update to allow for inspection of the signal. The image below is how the waveform should appear when a sample of raw (untreated)water is poured into the sensor.

Notice the peak of the sine wave lines up well with the center of the square wave.
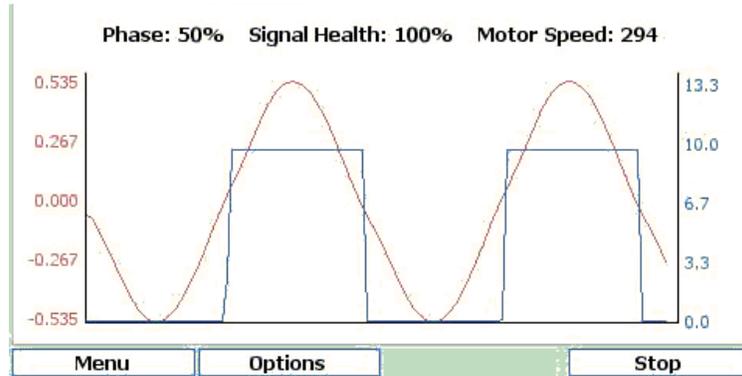


The next image shows a marginal waveform which may appear on treated water if the sensor was fouled or if the drive mechanics were to become worn.

Notice the hitch in the upslope of the sine wave as well as the fact that the phase has shifted off of center (50%). This is clear where the peak of the sine wave has shifted to the right of center of the square wave.
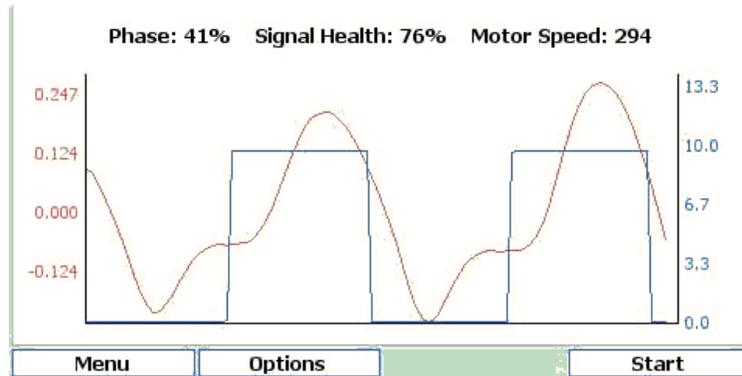


The final image is a fairly poor waveform. The signal appears to be rather noisy and the distinctive sine wave is not apparent.

If you are having problems with your sensor, a factory technician may ask you to view the waveform and possibly send a picture of the screen to the factory for analysis. This can help shorten troubleshooting efforts.

### 3.1.4.9  Modbus Statistics

To access the Modbus statistics diagnostic information, select:

Options → Diagnostics → Modbus Statistics

**Modbus Statistics**

|         | Rx      | Tx    |
|---------|---------|-------|
| Packets | 3501    | 3501  |
| Bytes   | 108519  | 28008 |

|        | Exceptions | Timeout | Checksum |
|--------|------------|---------|----------|
| Errors | 0          | 0       | 0        |

| Home | Options | | Reset |

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.

### 3.1.4.10  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 HydroAct 4 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[4]. 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.

### 3.1.4.11  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:

---

[4]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.

Options → Device Flags → Status Flags

Flags that are active are shown in black text on a white background, those that are not active are grayed 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 3.1.3.1 for details.

### 3.1.4.12   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 grayed out. Available flags are:

**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.

### 3.1.4.13   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 grayed 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.
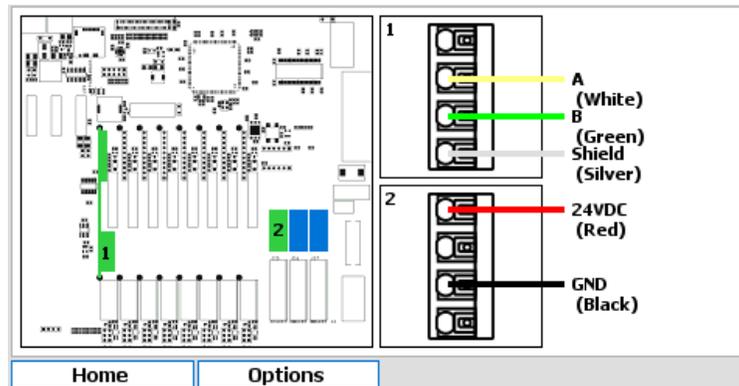**Threshold 1 active**  The first parameter threshold is active and triggered.
**Threshold 2 active**  The second parameter threshold is active and triggered.

#### 3.1.4.14  Connections

As the HydroAct 4 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.**

### 3.1.5  Maintenance

#### 3.1.5.1  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?
- Has the Signal Health dropped to below 85% and remained there for 1 minute or longer?
- Is the Signal Health value jumping around sporadically?
- 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 stabilization. During this stabilization 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-stabilize very soon after a cleaning is performed. However, for some applications the stabilization 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 stabilize.

#### 3.1.5.1.1 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 stabilize before using reading for auto or manual chemical feed adjustment.

#### 3.1.5.1.2 Part Identification

On the inside door of the DuraTrac 4 Streaming Current sensor is a diagram similar to the following. Refer to that diagram when ordering parts as certain part numbers might change.
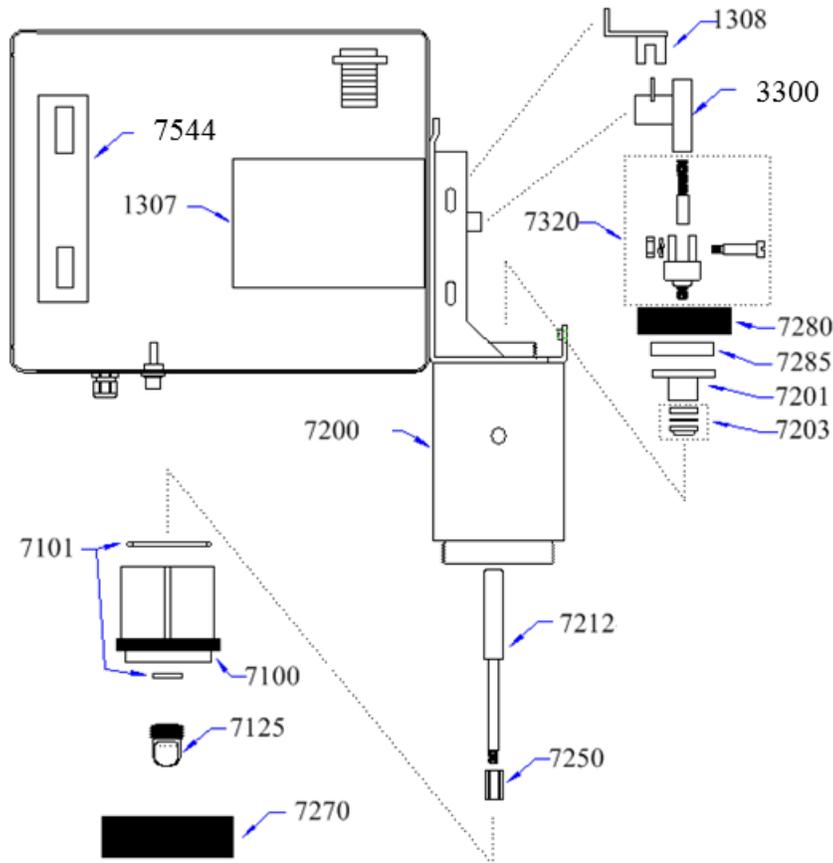


#### 3.1.5.1.3 Parts Replacement Interval

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

**7100 (Probe)** This is a user serviceable part, or it may be returned to factory for refurbishment. Recommended to keep a spare on hand.

**7101 (Probe O-Rings)** Replace as needed. (e.g. When lost or deteriorated.)

**7110 (Probe Sleeve)** Internal to P/N: 7100 (Probe). The probe sleeve will typically need replacement every 1 to 2 years.

**7203 (Seal Kit)** Replacement interval depends on applied sensor pressure and level of solids in sensor. If leaking occurs out of the bleed hole, first try tightening compression nut (P/N 7280) by hand, **don't use a wrench**. If the nut is fully hand tight, replace the seal kit.

**7250-A (Piston)** Every 6 to 18 months on average. (For applications with fiber in sample, order 7250-B.)

**7320 (Yoke and Rod)** Every 3 years on average. Replacement is only necessary when loose motion is detected between those parts, and especially if, following cleaning and/or probe/piston replacement, Signal Health remains below 90%.

The following are less commonly replaced parts:

**1307 (Motor)** Specify Voltage. If oil leaks out of motor or a very noticeable grinding/rubbing sound is heard from motor, replacement is recommended.

**7212 (Guide)** Replacement is generally only necessary if running sensor under pressure and wear on guide is observed when replacing seal kit (P/N 7203).

**3300 (Crank)** If Crank feels loose, replacement may be necessary.

## 3.1.6  Troubleshooting

### 3.1.6.1  Signal Health Reading Below 90%

| 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. |

### 3.1.6.2  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. |

### 3.1.6.3  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. |

### 3.1.6.4 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. |

# 4. Controls

## 4.1 PID Control

### 4.1.1 General Information

#### 4.1.1.1 Theory of Operation

The PID control calculates an error value as the difference between a desired setpoint and a measured sensor input, called the process variable. The control then calculates an output using this error value based on proportional, integral and derivative terms. The output of these terms is combined to give a final output.
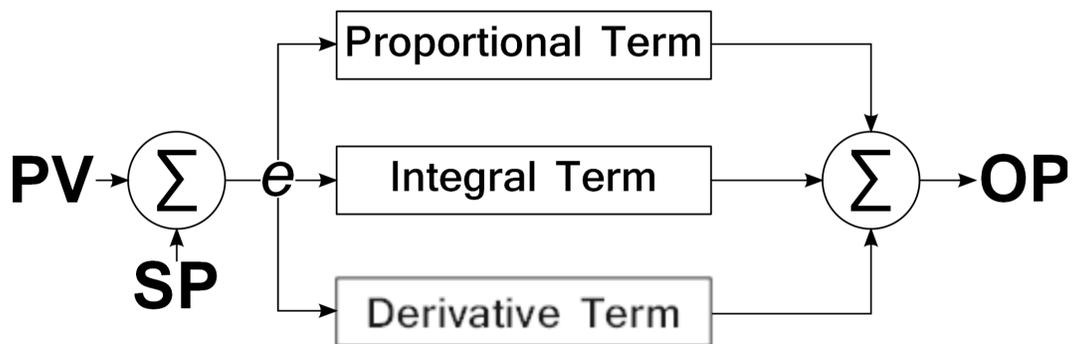


Figure 4.1: PID Calculation

The PID implementation of the HydroAct 4 is very flexible and can be configured as any permutation of P, I and D. This allows P, I, PI, PD or PID controllers to be implemented using the same interface. The optimal control response for any application requires the correct selection of control components. Some examples are given below.

**P Controller** A simple linear control algorithm ideally suited to recirculating systems with small deviations such as those found in pools and spas. Major deviations may result in an overshoot

and control offsets are to be expected. Control offsets in a purely proportional system are referred to as proportional droop. Offsets occur in systems where there is an opposing process affecting the process variable. For example, chlorine will evaporate from a pool surface. When the rate of loss is equal to the rate of chlorine addition then a steady state will be achieved. This equilibrium point will be at a chlorine concentration below the set point. A dosing pump being controlled by a P controller will be slightly off when the setpoint is reached.

**PI Controller** Integral action enables PI controllers to eliminate offset, which is a major weakness of a P controller. PI controllers provide a balance of complexity and capability that makes them by far the most widely used algorithm in process control applications. A dosing pump controlled by a PI controller will still be pumping when the setpoint is reached.

**PD Controller** PD control is useful for fast response controllers that can tolerate, or are not affected by, a control offset. Derivative action acts on the rate of change of the process variable error. This provides a fast response but is susceptible to measurement noise. PD controllers can be useful in applications where overshoot can not be tolerated, such as batch pH neutralization.

**PID Controller** Used in applications where control provided by other permutations of P, I and D actions are inadequate. The PID controller calculates an error value between a measured process variable and a desired setpoint. The calculated error is used in three separate calculations that calculate an output proportional to the error (the proportional term), an output proportional to the magnitude and duration of the error (the integral term) and an output proportional to the rate of change of the error (derivative term). The PID controller output is the sum of the three constituent terms as shown in figure 4.1. The result is in the form a decimal fraction[1] that is converted to a percentage for control output.

#### 4.1.1.1.1 Proportional Term

The proportional term produces an output value that is proportional to the current error value. The proportional response can be adjusted by multiplying the error by the proportional gain, adjustable in the PID configuration.

$$P_{out} = K_p.e$$

where $P_{out}$ is the proportional term output, $K_p$ is the proportional gain and $e$ is the error.

A large proportional gain value gives a large change in the output for a given change in the error. If the proportional gain is too high, the system can become unstable and overshoot will occur. Too small a gain value results in a small output response to a large input error, and a less responsive controller. If the proportional gain is too low, the control action may be too small when responding to system disturbances and may not achieve a setpoint.

#### 4.1.1.1.2 Integral term

The Integral term is proportional to both the magnitude of the error and the duration of the error. The integral in a PID controller is the sum of all the measured error over time and gives the accumulated offset that should have been corrected previously. The accumulated error is then multiplied by the integral gain, adjustable in the PID configuration.

$$I_{out(t)} = I_{out(t-1)} + K_i.e$$

where $I_{out}$ is the integral term output, $K_i$ is the integral gain and $e$ is the error.

The integral term accelerates the movement of the process towards setpoint and eliminates the residual steady state error that occurs with a pure proportional controller. However, since the integral term responds to accumulated errors from the past, it can cause the present value to overshoot the setpoint value.

---

[1] Value is in the range 0..1, where 1 is equivalent to 100%

**4.1.1.1.3 Derivative Term**

The derivative term is calculated by determining the slope of the error over time and multiplying this rate of change by the derivative gain, adjustable in the PID configuration.

$$D_{out} = K_d[\frac{e-p}{\delta t}]$$

where $D_{out}$ is the derivative term output, $K_d$ is the derivative gain, $\delta t$ is the loop time, $e$ is the error and $p$ is the previous error.

The derivative term slows the rate of change of the process variable. Derivative control is used to reduce the magnitude of the overshoot produced by the integral component and improve the process stability. However, the derivative term is susceptible to noise in the process variable signal and can result in an unstable system if the noise is too high.

## 4.1.2 Operation

When selecting the PID control tile from the main menu of the HydroAct 4, the control overview tile will be displayed.

**PID Controller 1.1 Overview**

PV: Free Chlorine Sensor 1.1 – Free Chlorine
Target: 2.00mg/l

**0.0**%  Running

Run Mode      Automatic ▼
Manual Value      0.0 %
Setpoint      2.00 mg/l

| Home | Options | Boost |

The overview display of the PID controller is designed to allow the user to see the output and key information, and also be able to see key actions without having to enter the setup of the PID. Information shown includes the process variable, the target setpoint, the controller output and its operational mode. Options available for user input are:
**Run Mode** Options include: "Off", "Manual", "Automatic".
**Manual Value** Sets the output when in manual mode. Options are between 0.00%..100.00%.
**Setpoint** Edit the setpoint within the range of the process variable.

Also on the display is a "Boost" button, if it is enabled. This engages the "Boost" function. See section 4.1.2.6 for details. If the control is in fail mode due to an error, the "Reset" button will be available to restart the control.

The following sections describe the functionality found in the pop-up menu that appears when pressing "Options".

**4.1.2.1 Control Setup**

This control is configured via the user interface of the HydroAct 4. To access the configuration, log in with advanced privileges and select:

Options → Setup → Control Setup

**Name**  Enter the device name used to identify the control on the menu tiles, alarm messages etc. The
name can be up to 25 characters.

**Display**  Setting used to determine if device tile is shown on default main menu screen. Options are
"Show"or "Hide"

**Enabled**  Select whether to enable or disable the control device.

**Process Signal**  Select whether to use a signal input to control the device process run/stop state.
Controls in process stop are inhibited or paused. Options are "Disabled" or choice from a list of
signal inputs.

**Start Delay**  If a control is enabled and not in a process stop state, it can be in one of three states;
started, running or fail. If a start delay is set, when a control is enabled or comes out of a process
stop, it enters the mode specified by the start mode below. After the start delay has elapsed the
control will automatically move into the run mode. The time specified is in HH:MM:SS.

**Start Mode**  Select the start mode if a start delay is specified. Options are "Off", "Manual" or "Auto-
matic".

**Run Mode**  Select the run mode. Options are "Off", "Manual" or "Automatic".

**Fail Mode**  If an error occurs the control will enter an alarm state and switch to the mode selected here.
Options are "Off" or "Manual".

#### 4.1.2.2  Process Variable

This variable is configured via the user interface of the HydroAct 4. To access the configuration go to:

Options → Setup → Process Variable



Options to select the control process variable are:

**Sensor**  Select from a list of sensors.

**Parameter**  Select from a list of parameters.

**Update delay**  Update delay is the frequency that the feedback loop updates its output. The value is in HH:MM:SS format. The maximum update delay is 24 hours.

### 4.1.2.3  Output Setup

The output is configured via the user interface of the HydroAct 4. To access the configuration go to:

Options → Setup → Output Setup



**Manual Value**  Set the manual output value. The control output is set to this value if "Manual" is selected above. If the control has multiple output values, further tabs are available to define the output for each value. Values from 0.00% to 100.00% for any of "Start", "Run" or "Fail" Mode.

**Output Limits**[2]
**Minimum**  Set minimum output. Values from 0..100%
**Maximum**  Set maximum output. Values from 0..100%

### 4.1.2.4  PID Setup

The analyzer breaks down the setup of the PID control loop into different screens accessed from the tabs at the top of the display. Navigate around the screen using the "←" and "→" buttons.

#### 4.1.2.4.1  Setpoint Tab



**Type**  Select "Static" if setpoint value is to be specified via user interface or "Dynamic" if setpoint is set remotely via 4..20mA input (i.e., from a SCADA or PLC). If "Static" is selected enter the target setpoint value. If "Dynamic" is selected choose the input parameter from the drop down lists.

---

[2]Output limits allow the user to put minimum and maximum limits on the control algorithm.

**Ramping**  Enable or disable setpoint ramping. Large step changes in process variable errors can pro-
duce excessive PID output movements that could result in large over or undershoot, particularly
for controllers using the I or D terms. These step changes are likely when the controller is first
switched on or if the setpoint is changed. Setpoint ramping gradually moves the setpoint from its
current value, or current process variable reading when the controller is first turned on, to the
target value. This avoids the discontinuity present in a simple step change.

**Ramping Factor**  If ramping is enabled, set the ramping factor. Values from 0.00 to 1.00. A value of
0.00 will prevent the setpoint from ramping at all, while a value of 1.00 will effectively turn this
feature off.

#### 4.1.2.4.2  PID Tuning Tab



**Action**  Select "Direct" if dosing increases process variable value (e.g., sodium hypochlorite addition
increases free chlorine reading), or "Reverse" if dosing decreases value (e.g., acid dosing
decreases pH).

**Bumpless Transfer**  Bumpless transfer is only applied when the controller is running. It will not
operate during the start delay. Bumpless transfer is designed to allow smooth transitions between
automatic and manual control modes. It avoids large changes in pump output when changing
the control mode. Bumpless transfer from automatic to manual control sets the manual output
value to the last calculated control output. For bumpless transfer from manual to automatic mode,
some integral control must be used. The initial integral error is set so that the pump output is
equal to the current manual value. The PID algorithm will then make appropriate changes to this
value to achieve the setpoint.

**Scale Factor**  Scaling factor applied to calculated error. For example, a scaling factor $\times 1000.0$ will
convert an ORP reading ($\pm$ 2000mV) into a -2.0..+2.0 error range to which the proportional,
integral and derivative functions are applied. Values from $\times 0.1$ to $\times 1000.0$.

**Proportional**  Sets the proportional gain. Values from 0.000 to 10,000.000. A value of 0.000 disables
proportional control.

**Integral**  Sets the integral gain. Values from 0.000 to 10,000.000. A value of 0.000 disables integral
control.

**Derivative**  Sets the derivative gain. Values from 0.000 to 10,000.000. A value of 0.000 disables
derivative control.

#### 4.1.2.4.3  IWP Tab

Integral windup refers to the situation when the process variable spends a significant amount of time
away from the setpoint. During this time the integral term accumulates a significant error (referred to
as windup) and an overshoot occurs whilst the accumulated error is negated by errors in the opposite
direction (the error is unwound). To prevent this excessive overshoot integral windup protection (IWP)
limits the maximum windup, both positive and negative. Integral windup protection is only available if
the integral gain is greater than 0 (i.e., there is an integral part to the control).

Setpoint | PID Tuning | IWP | Overfeed Protection | Boost | Options

**Integral Wind-Up Protection**

Enabled  ○ Yes
         ◉ No

Minimum    -100.0  %
Maximum   +100.0  %

Home | Options | ← | →

**Enabled**  Enables the integral windup protection feature. Options are "Yes" or "No".
**Minimum**  The smallest accumulated error the integral term is allowed to wind up, usually negative or commonly zero. Values from -1000.00/% to +1000.00/%
**Maximum**  The largest accumulated error that the integral term is allowed to windup, usually positive. Values from -1000.00/% to +1000.00/%

#### 4.1.2.4.4  Overfeed Protection Tab

Overfeed protection is designed to identify problems associated with dosing equipment. Blocked injectors, empty day tanks and dosing pump failures are likely causes to trigger this feature. This alarm may identify the problem before the detrimental effects of control loss are encountered. If the PID output is judged to be having no effect then the controller will enter the specified fail mode, log the event in the system log and sets off a control alarm. Manual intervention is required to rectify the fault and reset the PID controller by setting the desired run mode using the PID Setup or Overview screens.

Setpoint | PID Tuning | IWP | Overfeed Protection | Boost | Options

**Overfeed Protection**

☐ Enabled

Timeout   01 ⬍ : 00 ⬍ : 00 ⬍
Interval         0.10  mg/l
Deadband         0.20  mg/l

Home | Options | ← | →

**Enabled**  This enables overfeed protection. If enabled the parameters below are available for configuration.
**Timeout**  Time period in which the process variable must respond to dosing before overfeed protection activates. Values in HH:MM:SS
**Interval**  Amount the process variable must move towards setpoint to reset the timeout timer set above.
**Deadband**  Overfeed protection is disabled when process variable is within this value of setpoint.

#### 4.1.2.4.5  Boost Tab

Boost allows for a temporary secondary setpoint or a fixed control output. This can be used for shock dosing of a swimming pool or periodic increased dosing for additional disinfection of a bottle plant washer. When activated the boost function will either change the PID setpoint to the secondary value (usually higher) or set the control output to the selected level and will maintain it for a pre-determined time. It will then disable the function for a configurable period to prevent overuse.

**Enabled** Enables the boost feature and allows users to initiate the boost from the "Boost Status" option.

**Action** Options are "Output" or "Setpoint". Selecting "Output" allows the user to set a pre-determined control output. Selecting "Setpoint" allows the user to set a new target for the PID control.

**Value** Set the new output value or target setpoint, based on the selection above.

**Duration** Set the duration of the boost. Value is in HH:MM:SS format, up to 24 hours.

**Delay** Set the inhibition delay, the time after a boost before a user can initiate a subsequent boost. Value is in HH:MM:SS format, up to 24 hours.

#### 4.1.2.4.6 Options Tab



**Fail-safe on PV Alarm.** If the process variable goes into data alarm the controller will go into fail-safe mode.

### 4.1.2.5 Alarms and Thresholds

Alarms are the means by which values obtained from sensors cause visible, audible or physical action to occur. Alarms are not to be confused with relays[3], as very flexible firmware and electronics are utilized. An alarm in a HydroAct 4 unit will be visible on the screen and sound a buzzer. Two output alarms per control output 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 used to trigger relays to cause something to happen when a control output reaches a value.

To access the configuration:

Options → Alarms & Thresholds

---

[3]A mechanical or electronic device mounted on the electronics within the instrument that can switch (much like a light switch). The number and type of relays is specified at the time of order.

The display has a tab for each alarm and threshold. Navigate to the tab using the Right and Left buttons or 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[4]. The *Delay* is the amount of time the value has to exceed the set value before the alarm/threshold is triggered.
**Delay** The amount of time the value has to exceed the set point before the alarm/threshold is triggered. HH:MM:SS up to 24 hours.

### 4.1.2.6 Boost Status

Selecting this will show the user the status of the boost function including the delay controls. Access this information at:

Menu $\rightarrow$ Options $\rightarrow$ Boost Status
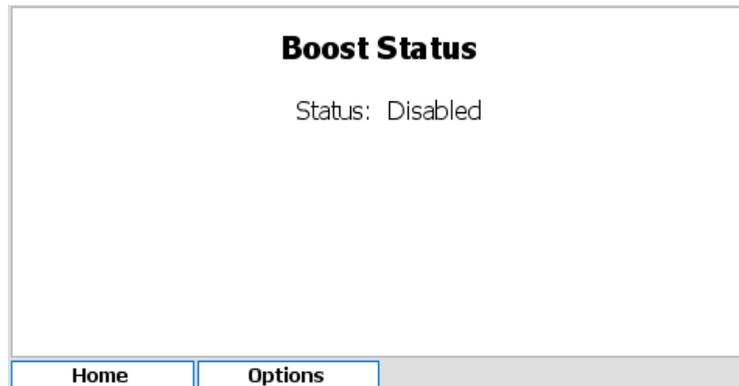


### 4.1.2.7 Status Flags

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 $\rightarrow$ Device Flags $\rightarrow$ Status Flags

Flags that are active are shown in black text on a white background, those that are not active are grayed 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.
**Control enabled** This flag is set if the control is enabled.
**Control process stopped** If this flag is set, the control is stopped due to the process run/stop signal state.
**Control started** This flag is set when the control is started, i.e., the control is either in start-up or run mode.
**Control running** This flag is set when the control is in run mode.
**Primary Output pump output limit reached** This flag is set when the primary output loop is limited by the pump miniumum or maximum output settings.
**Secondary Output pump output limit reached** This flag is set when the secondary output loop (if used) is limited by the pump miniumum or maximum output settings.
**Tertiary Output pump output limit reached** This flag is set when the tertiary output loop (if used) is limited by the pump miniumum or maximum output settings.

---

[4]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.

***Loop* Output threshold *N* active**  If set, this flag indicates that the threshold *N* (where *N* is either 1 or 2) is active for the given output.

**Proportional control enabled**  If set, this flag indicates that the proportional control is active in the current PID configuration.

**Integral control enabled**  If set, this flag indicates that the integral control is active in the current PID configuration.

**Derivative control enabled**  If set, this flag indicates that the derivative control is active in the current PID configuration.

**Bumpless transfer enabled**  This flag is set when bumpless transfer is enabled.

**Integral wind-up protection enabled**  This flag is set when integral wind-up protection is enabled.

**Integral wind-up protection active**  If set, this flag indicates that integral wind-up protection is currently active.

**Boost enabled**  This flag is set when the boost feature is enabled.

**Boost active**  If set, this flag indicates the control is currently modified by the boost feature.

**Boost Inhibited**  This flag is set when the boost feature is inhibited from further activation.

### 4.1.2.8  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 grayed out. Available flags are:

**Process run/stop signal error**  If set, this flag indicates that the control can not read the state of the run/stop signal.

**Process variable read error**  This flag is set if the control can not read the process variable.

***Loop* Output alarm *N* active**  If set, this flag indicates that the alarm *N* (where *N* is either 1 or 2) is active for the given output. *Loop* is either primary, secondary or tertiary (most controls only have a primary output).

**Error reading PID setpoint**  If set, this flag indicates the control is unable to read the setpoint value when using dynamic setpoints.
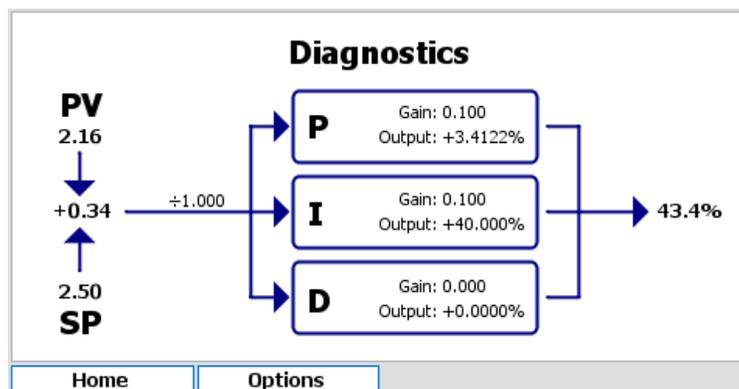
**Fail-safe mode active**  This flag is set if the control enters failsafe mode.

**Overfeed protection active**  This flag is set if over feed protection has been activated.

### 4.1.2.9  Diagnostics

The PID controller diagnostic information can be accessed using:

Options → Diagnostics

**Information displayed is only relevant if the control is in automatic mode.**

This display shows the diagram of the PID control and the current totalized PID output.  For diagnostic information in automatic mode, the display is updated when the control loop is executed and there may be a delay equal to the loop time before all information is available. Process variable input (PV), and setpoint (SP) are shown pointing to the current error. The error feeds into each of the three P, I and D terms via the scale factor shown above the line. Each term shows the gain factor applied and the output calculated. These are summed together and trimmed within the set output limits to determine the control output.

# 5. Outputs

Outputs are the means by which values from measuring sensors, control outputs or system status are transmitted to another device. For example to a SCADA[1] for data acquisition or to a pump for dosing control. The two types of output used by HydroAct 4 are the analog output[2] and relay[3].

In order to utilize the full capability of the instrument it is necessary to link the signal/value and an output device, such as an alarm, threshold or control options for the relays or analog outputs.

Chemtrac utilizes the latest in firmware and electronic innovations and as such analog outputs and relays are extremely flexible, and are not tied to individual sensors. In the past outputs were typically fixed to a specific sensor or control and the range was also the same as the range of the sensor. More recently the capability of the analog output to be more flexible has come about with advances in electronics.

## 5.1 Analog Outputs

### 5.1.1 General Information

Analog outputs are typically a current output varying between 4mA and 20mA (although other options are available), and are proportional to a varying signal of interest generated by the instrument. Analog outputs are installed by plugging in a small output board into one of the available slots. Other output options in addition to 4..20 mA are shown below.

### 5.1.2 Technical Data

**Supported modes** 0..20mA, 4..20mA, 0..1V, 0..10V, 1..10V
**Maximum voltage output** 15V DC (0/4..20mA only)

---

[1]Supervisory Control and Data Acquisition, a central data logging and control system
[2]A current or voltage output, proportional to a signal generated in the instrument
[3]A mechanical or electronic device mounted on the electronics within the instrument that can switch. The number and type of relays is specified at the time of order

### 5.1.3  Commissioning

When cables attach to analog outputs the instrument is forced to drive into different resistances. This can result in the analog range being slightly affected. For example a 4-20mA output at the analyzer could end up being 3.95mA to 19.9mA at the end of the cable. The HydroAct 4 has the capability to drive more or less current to account for this resistance so that the analog output is exactly that required at the end of the cable. This is achieved by calibrating the zero (offset) and span (top of the scale) of the analog output.

#### 5.1.3.1  Calibrate Offset

This configuration screen is accessed by navigating via the Options Menu:

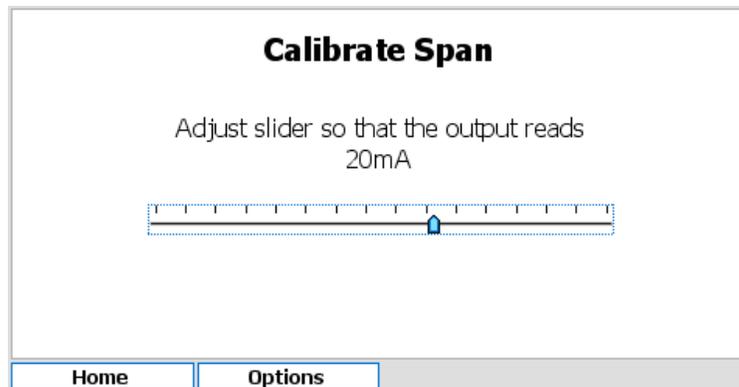Options → Maintenance → Calibrate Offset
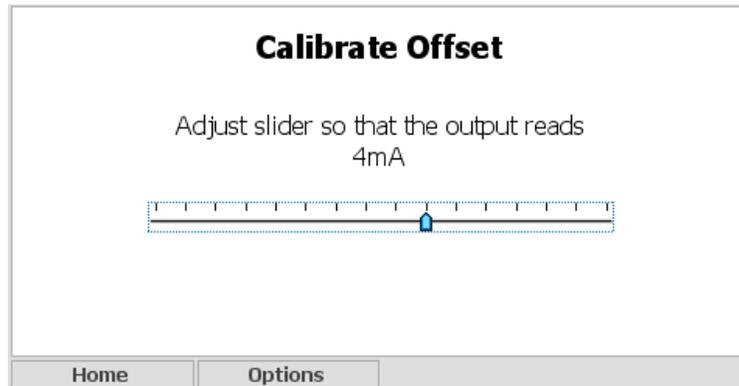


Select the slider and then use the Left and Right buttons to adjust the zero.

#### 5.1.3.2  Calibrate Span

This configuration screen is accessed by navigating via the Options Menu:

Options → Maintenance → Calibrate Span



Select the slider and then use the Left and Right buttons to adjust the span.

### 5.1.4  Operation

To access the analog output setup and maintenance options, select the relevant device tile in the main menu and press "Select". The output setup screen will be displayed initially, though other functions are available by pressing the "Options" button.

**5.1.4.1  Setup**

The setup of the analog output is split into three sections. Later sections can be accessed separately from the menu or by selecting "Next" from any of the previous pages. To access the analog output setup:

Options → Setup → Output Setup

**Output Setup**

| | |
|---|---|
| Name | Analogue Output 1.8 |
| Display | ● Show          Enabled  ● Yes |
| | ○ Hide                           ○ No |
| Mode | Control Output ▼ |

| Home | Options | | Next |
|---|---|---|---|

**Name**  Device name to identify the control in menus. Text can be up to 25 characters long.
**Display**  Options are to "Show" or "Hide" the device tile on the menu screen.
**Enabled**  Options are "Yes" or "No".
**Mode Options**  Options are "Manual" which allows the user to manually set an output value; "Data Output" which maps the output to an analog data source such as a parameter; and "Control Output" which maps the output to an analyzer generated control signal.
The "Next" button is a shortcut to the following configuration screen.

**5.1.4.2  Options for Manual Mode**

**5.1.4.2.1  Map Output**

This configuration screen is accessed by pressing "Next" from the Output Setup configuration screen or navigating via the Options Menu.

Options → Setup → Map Output

**Map Output**

There are no configuration options for this device setting.

| Home | Options | | Next |
|---|---|---|---|

**5.1.4.2.2  Configuration**

This configuration screen is accessed by pressing "Next" from the Map Output above screen or navigating via the Options Menu.

Options → Setup → Configuration

**Type** Choose the type of analog output from the drop down box. See technical data for a list of
supported output types. See section 5.1.2.

**Manual Value** Enter the manual value of the output as a percentage. For example if 4..20mA output
type is selected a manual value of 50% will force the current output to 12mA.

### 5.1.4.3   Options for Data Output Mode

#### 5.1.4.3.1   Map Output

This configuration screen is accessed by pressing "Next" from the Output Setup screen or navigating
via the Options Menu.

       Options → Setup → Map Output



**Sensor** Select the appropriate sensor from the drop down list.

**Parameter** Choose the appropriate parameter from the drop down list. If the selected sensor has only
one parameter this option may not be available.

    The "Next" button is a shortcut to the following configuration screen.

#### 5.1.4.3.2   Configuration Setup

This configuration screen is accessed by pressing "Next" from the Map Output screen or navigating via
the Options Menu.

       Options → Setup → Configuration

**Type**  Choose the type of analog output from the drop down box. See the technical data in section 5.1.2 for a list of supported outputs.

**Minimum**  Enter the parameter value that translates to a minimum output of e.g. 4mA if "type" is set to 4..20mA.

**Maximum**  Enter the parameter value that translates to a maximum output of e.g. 20mA if "type" is set to 4..20mA.

The minimum and maximum values can be anywhere within the range of a parameter. For example the data output for a chlorine sensor with a range of 0..10ppm, the output could be ranged 0..10ppm (common) but could be ranged, for example 2.4..5.3ppm.

#### 5.1.4.4  Options for Control Output Mode

##### 5.1.4.4.1  Map Output

This configuration screen is accessed by pressing "Next" from the Output Setup screen or navigating via the Options Menu.

Options → Setup → Map Output



**Control**  Select from a list of available control devices.

**Output**  If the control selected above has more than one output value, this option will be available. Select the appropriate output value.

The "Next" button is a shortcut to the following configuration screen.

##### 5.1.4.4.2  Configuration

This configuration screen is accessed by pressing "Next" from the Map Output screen or navigating via the Options Menu.

Options → Setup → Configuration

**Configuration**

Type  [4..20mA                    ▼]

Home          Options
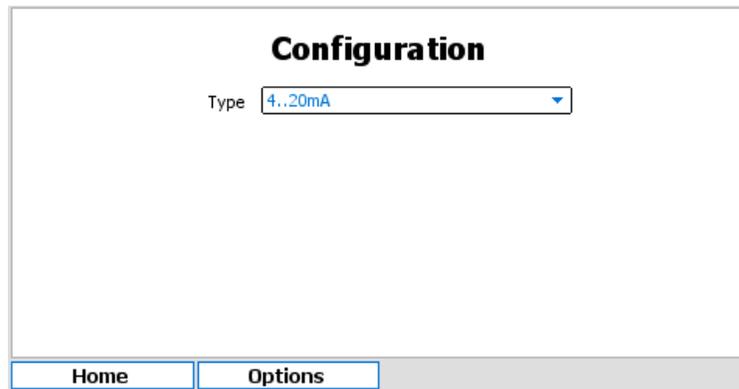
Type  Choose the type of analog output from the drop down box. See the technical data in section 5.1.2 for a list of supported outputs.

### 5.1.4.5  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 grayed 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.

**Output calibrating offset**  This flag is set when calibrating the analog output offset.

**Output calibrating span**  This flag is set when calibrating the analog output span.

### 5.1.4.6  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 grayed out. Available flags are:

**Output mapping error**  This indicates that one of the outputs is mapped incorrectly e.g., mapped to a sensor or control that no longer exists.

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

**Incorrect I/O card found**  If set, this flag indicates that the I/O card fitted is of the wrong type.
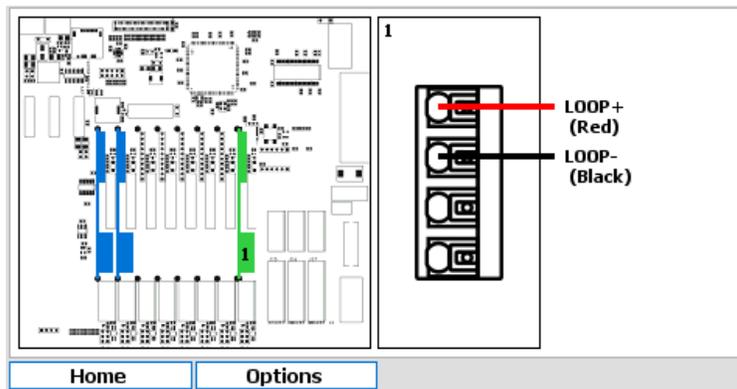
**I/O card in use**  This flag is set when two devices are attempting to use the same I/O card.

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

### 5.1.4.7  Connections

This screen is accessed by navigating via the Options Menu:

Options → Connections

The image above is for an output with the types selected as 0..20mA or 4..20mA. The connections will reflect the configuration of the device and differ between current and voltage outputs.

## 5.2 Relay Output

### 5.2.1 General Information

Relay outputs, typically mechanical reed relays are installed at time of manufacture. A relay is a mechanical or electronic device mounted on the electronics within the instrument that can switch. The number and type of relays must be specified at time of order. In order to take advantage of the full capability of modern electronics, it is necessary to "map"[4] the various alarms, thresholds and other options to the relays.

### 5.2.2 Technical Data

**Maximum Current**  10A at 125 VAC, 3A at 250 VAC, 5A at 30 VDC

### 5.2.3 Operation

To access the relay output setup and maintenance options, select the relevant device tile in the main menu and press "Select". The output setup screen will be displayed initially, though other functions are available by pressing the "Options" button.

#### 5.2.3.1 Setup

The setup of the analog output is split into three sections. Later sections can be accessed separately from the options or by selecting "Next" from any of the previous sections.

To access the relay output setup:

Options $\rightarrow$ Setup $\rightarrow$ Output Setup

---

[4]This describes the link between a signal/value generated by the instrument and an output device (relay or analog).

## Output Setup

Name    Relay 1.1

Display    ○ Show      Enabled    ○ Yes
           ● Hide                    ● No

Mode    Manual               ▼

| Home | Options | | Next |

**Name**   Device name to identify control in menus. Text can be up to 25 characters long.

**Display**   Options are "Show" or "Hide" the device tile on the menu screen.

**Enabled**   Options are "Yes" or "No". This option must be enabled for the option to function.

**Mode Options**   Options are "Manual" which sets a relay to manual output; "Control Output" which maps a relay to a control output and allows the setup of either pulse width modulation or pulse frequency modulation; "Data Output" which outputs a pulse for each set increment of a sensor parameter value; "Device Status Flags" which allows the mapping of a relay to activate if the status of a device changes; "Device Error Flags" which allows the mapping of a relay to activate if a device goes into error; "Parameter Flags" which allows the mapping of a relay to activate on selected parameter flags and "System Flags" which allows the mapping of a relay to activate on a system alarm state.

### 5.2.3.2   Options for Manual Mode

#### 5.2.3.2.1   Map Output

This configuration screen is accessed by pressing "Next" from the Output Setup configuration screen or navigating via the Options Menu.
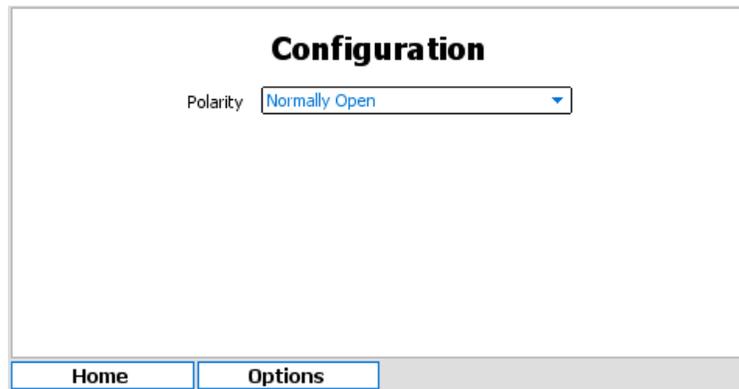
       Options → Setup → Map Output

## Map Output

There are no configuration options for
this device setting.

| Home | Options | | Next |

       The "Next" button is a shortcut to the following configuration screen.

#### 5.2.3.2.2   Configuration

This configuration screen is accessed by pressing "Next" from the Map Output screen or navigating via the Options Menu.

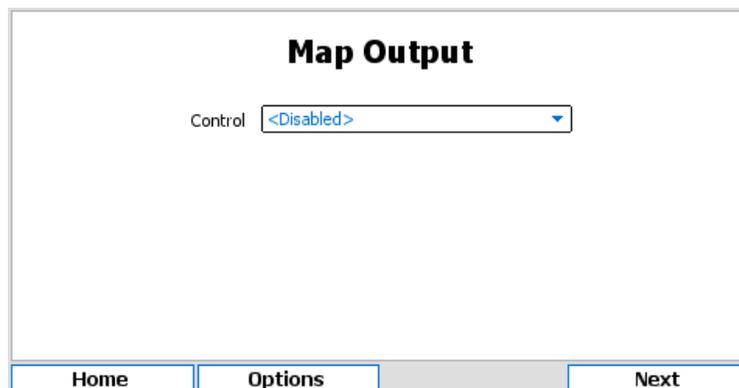       Options → Setup → Configuration

**Polarity**  Options are "Normally Open" and "Normally Closed".

### 5.2.3.3  Options for Control Output Mode

#### 5.2.3.3.1  Map Output

This configuration screen is accessed by pressing "Next" from the Output Setup configuration screen or navigating via the Options Menu.

Options → Setup → Map Output



**Control**  Choose from a list of available controls to output the control value.

The "Next" button is a shortcut to the following configuration screen.

#### 5.2.3.3.2  Configuration

This configuration screen is accessed by pressing "Next" from the Map Output configuration screen or navigating via the Options Menu.

Options → Setup → Configuration

In all cases the polarity and output mode of the relay will need to be configured. Pulse width modulation outputs a repeated pulse with a fixed width. The control signal is output by increasing the proportion of time the relay is active in any pulse as the value increases. Pulse frequency modulation outputs pulses of a fixed activated width, but increases the frequency of the pulses in respect of the control output value.

**Polarity**  Options are "Normally Open" and "Normally Closed".

**Mode**  Options are "Pulse Width Modulation" or "Pulse Frequency Modulation".

**When "Pulse Width Modulation" is selected further options are:**

**Pulse Width**  Define the maximum pulse width in MM:SS. The relay will energize for a proportion of this time based on the control output value.

**Deadband**  Defines the minimum pulse width that would be output. This can be used to avoid relay chatter due to a small control output value.



**When "Pulse Frequency Modulation" is selected further options are:**

**Pulse Width**  Define the length of pulses output. Options are between 0..5000 ms.

**Maximum Frequency**  As the control output value increases, the frequency of pulses outputs increase. This setting defines the maximum frequency of pulse outputs.

### 5.2.3.4  Options for Data Output Mode

#### 5.2.3.4.1  Map Output

This configuration screen is accessed by pressing "Next" from the Output Setup screen or navigating via the Options Menu.

Options → Setup → Map Output

**Map Output**

| | |
|---|---|
| Sensor | Flow Meter 1.3 ▼ |
| Parameter | Volume ▼ |

| Home | Options | | Next |
|---|---|---|---|

**Sensor**  Select the appropriate sensor from the drop down list.
**Parameter**  Choose the appropriate parameter from the drop down list. If the selected sensor has only one parameter this option may not be available.

The "Next" button is a shortcut to the following configuration screen.

#### 5.2.3.4.2  Configuration Setup

This configuration screen is accessed by pressing "Next" from the Map Output screen or navigating via the Options Menu.

Options → Setup → Configuration

**Configuration**

| | |
|---|---|
| Polarity | Normally Open ▼ |
| Frequency | 2 m³ |
| Pulse Width | 0200 ms |
| Pulse Gap | 0200 ms |

| Home | Options |
|---|---|

**Polarity**  Options are "Normally Open" and "Normally Closed".
**Frequency**  Set the pulse frequency as a desired increase in parameter value.
**Pulse Width**  Set the pulse width. The values are in milliseconds and increment in steps of 200ms.
**Pulse Gap**  Set the minimum pulse gap. The values are in milliseconds and increment in steps of 200ms.

### 5.2.3.5  Options for Device Status Flags

#### 5.2.3.5.1  Map Output

This configuration screen is accessed by pressing "Next" from the Output Setup configuration screen or navigating via the Options Menu.

Options → Setup → Map Output

**Map Output**

Device [ pH Sensor 1.1                ▼ ]

| Home | Options | | Next |

**Device**  Choose from a list of available devices.

The "Next" button is a shortcut to the following configuration screen.

#### 5.2.3.5.2  Configuration

This configuration screen is accessed by pressing "Next" from the Map Output configuration screen or navigating via the Options Menu.

Options → Setup → Configuration

**Configuration**

Polarity [ Normally Open              ▼ ]
Mode [ Pulse Width Modulation         ▼ ]
Pulse Width [ 00 ▲▼ ] : [ 00 ▲▼ ]
Deadband [ 00 ▲▼ ] s

| Home | Options |

**Polarity**  Options are "Normally Open" and "Normally Closed". The device status flags available depend on the device mapped above. See the status flag descriptions for that device for details.
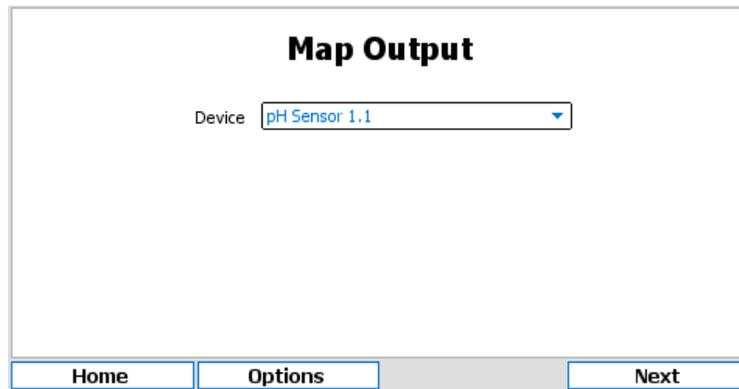
Press the "Next" button to select the device status flags used to activate the relay.

### 5.2.3.6  Options for Device Error Flags

#### 5.2.3.6.1  Map Output

This configuration screen is accessed by pressing "Next" from the Output Setup screen or navigating via the Options Menu.

Options → Setup → Map Output

**Map Output**

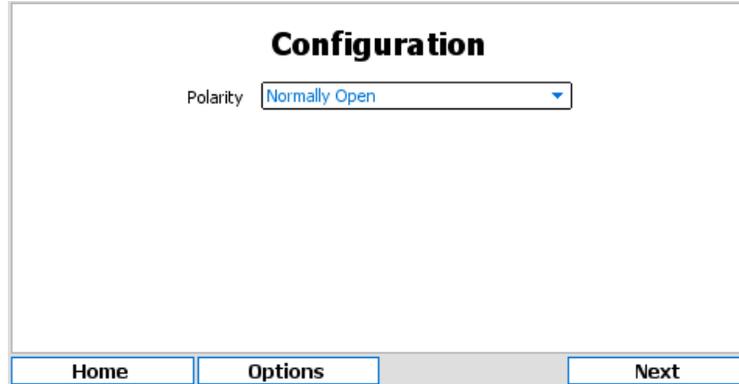Device  pH Sensor 1.1  ▼

| Home | Options | | Next |

**Device**  Choose from a list of available devices.

The "Next" button is a shortcut to the following configuration screen.

**5.2.3.6.2  Configuration**

This configuration screen is accessed by pressing "Next" from the Map Output screen or navigating via the Options Menu.

Options → Setup → Map Configuration

**Configuration**

Polarity  Normally Open  ▼

| Home | Options | | Next |

**Polarity**  Options are "Normally Open" and "Normally Closed". The device error flags available will depend on the device mapped above. See that device description for details.

Press the "Next" button to select the device error flags used to activate the relay.

**5.2.3.7  Options for Parameter Flags**

**5.2.3.7.1  Map Output**

This configuration screen is accessed by pressing "Next" from the Output Setup screen or navigating via the Options Menu.

Options → Setup → Map Output

**Map Output**

Sensor: pH Sensor 1.1 ▼

Parameter: pH ▼

| Home | Options | | Next |

**Sensor**  Choose the appropriate sensor from the drop down list.

**Parameter**  Choose the appropriate parameter from the drop down list.

The "Next" button is a shortcut to the following configuration screen.

**5.2.3.7.2  Configuration**

This configuration screen is accessed by pressing "Next" from the Map Output screen or navigating via the Options Menu.

Options → Setup → Configuration

**Configuration**

Polarity: Normally Open ▼

| Home | Options | | Next |

**Polarity**  Options are "Normally Open" and "Normally Closed".

The "Next" button is a shortcut to the following configuration screen.

**5.2.3.7.3  Relay Selection**

This configuration screen is accessed by pressing "Next" from the Configuration screen.

**Relay 1.1**

Flag Selection

Alarm 1 active
Alarm 2 active
Averaging enabled
Threshold 1 active
Threshold 2 active

| Home | Options | |

Flags that are active are shown in black text on a white background, those that are not active are grayed out. Selecting the flag will cause the relay to activate if that parameter flag becomes active.

### 5.2.3.8  Options for System Status

#### 5.2.3.8.1  Map Output

This configuration screen is accessed by pressing "Next" from the Output Setup configuration screen or navigating via the Options Menu.
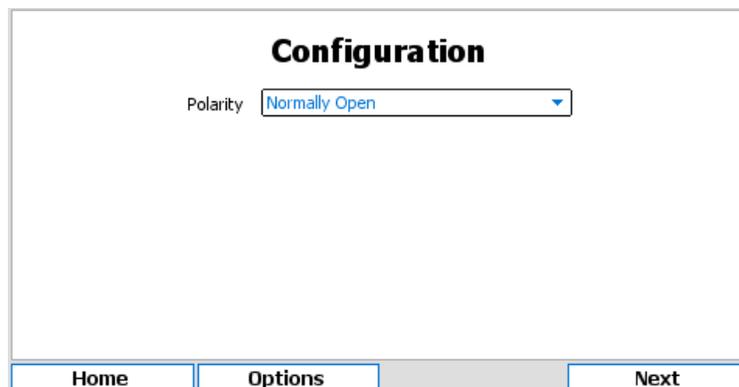
Options → Setup → Map Output
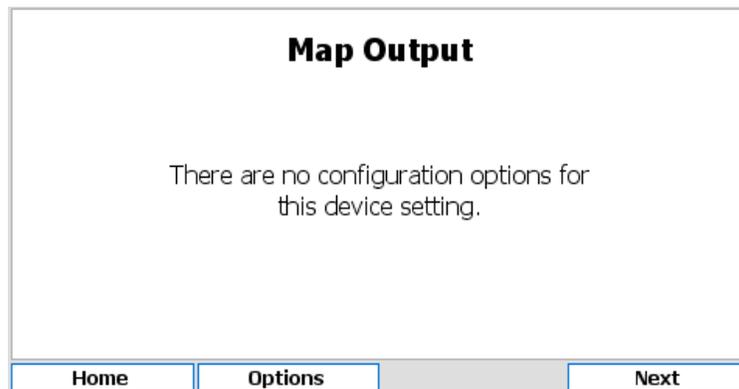


#### 5.2.3.8.2  Configuration

This configuration screen is accessed by pressing "Next" from the Output Setup configuration or navigating via the Options Menu.
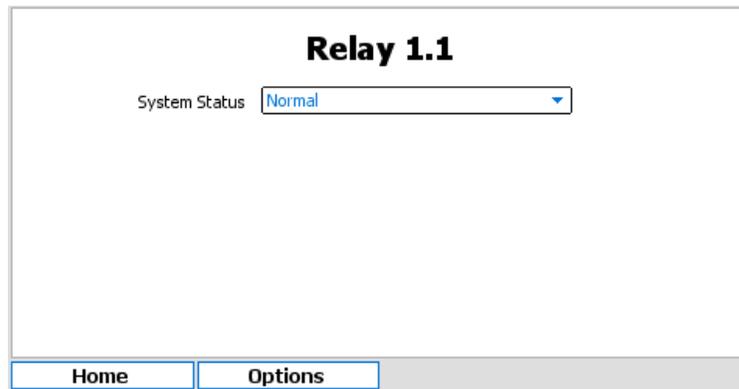
Options → Setup → Configuration



**Polarity**  Options are "Normally Open" and "Normally Closed". The "Next" button is a shortcut to the following configuration screen.

#### 5.2.3.8.3  Relay Selection

This configuration screen is accessed by pressing "Next" from the Configuration screen.
The system status show the state of the device.

**Relay 1.1**

System Status    Normal    ▼

Home          Options

System Status  Options are "Normal", "Alarm Active" or "Alarm Acknowledged"

### 5.2.3.9  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 grayed 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.

**Relay polarity**  This reflects the relay polarity, if set the relay is normally closed.

**Relay output state**  This reflects the relay activation state. Taken together with the relay polarity above, it is possible to determine if the relay is open or closed.

### 5.2.3.10  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 grayed out. Available flags are:

**Output mapping error**  This indicates that one of the outputs is mapped incorrectly e.g., mapped to a sensor or control that no longer exists.

### 5.2.3.11  Test Output

It is possible to test a relay. The relays polarity and active state can be manually changed. Leaving this configuration screen will return the relay to its previous state. To do this navigate to:

Options → Test Output

**Relay 1.1**
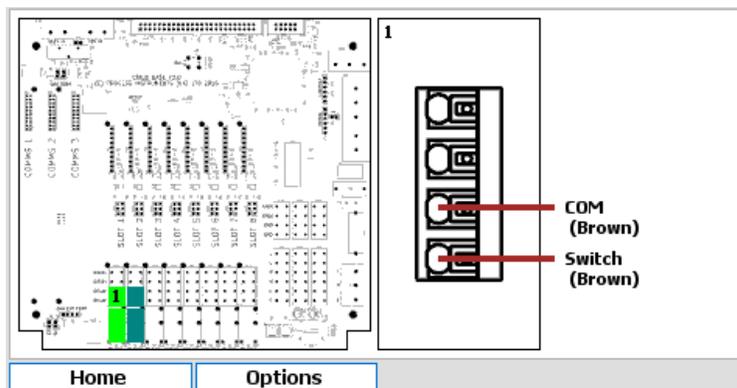
Polarity  ◉ Normally Open
          ○ Normally Closed

Active    ◉ No
          ○ Yes

| Home | Options |

Options are
**Polarity**  Options are "Normally Open" or "Normally Closed"
**Active**  Options are "No" or "Yes"

### 5.2.3.12  Connections

Options → Connections

| Home | Options |

COM (Brown)

Switch (Brown)

This screen identifies the terminals to use for electrical connections for this relay. The left hand pane identifies the terminal block and the right hand pane the connectors on the terminal block.
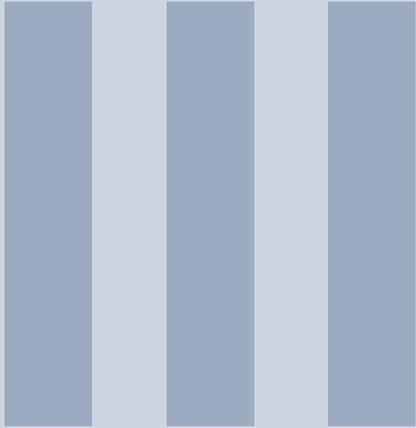
# Documentation

# 6. Warranty

Chemtrac, Inc warrants its product to be free of defects in material and workmanship for a period of one year from date of shipment to the original customer unless specifically agreed elsewhere. Upon receipt of written notice from the customer, Chemtrac shall issue a returns form for the defective product and, upon its receipt, shall repair or replace (at the discretion of Chemtrac) the defective equipment or components. Chemtrac assumes no responsibility for equipment damage or failure caused by:

1. Improper installation, operation, or maintenance of the equipment.
2. Abnormal wear and tear on moving parts caused by some processes.
3. Acts of nature (i.e. lightning, flooding, etc.).

This warranty represents the exclusive remedy of damage or failure of the equipment. Under no circumstances shall Chemtrac be liable for any special, incidental, or consequential damage, such as loss of production, profits or product quality. The warranty cannot be guaranteed if the customer fails to service and maintain the equipment in accordance with Chemtrac written instructions and policies, as stated in the Operations Manual.

Any costs associated with this warranty, such as the cost of returning the products to Chemtrac or the cost of returning a repaired unit to the customer lies with the customer. Any warranty replacements will be covered by the warranty, with the same terms and conditions as the original.

# 7. Returns

If the analyzer has to be repaired, please return it cleaned to your local service organization or Chemtrac, Inc at the address below. To return your equipment for repair:

- Contact Chemtrac support, open a service ticket and request a returns form.
- Complete the returns form, including the contaminant declaration.
- Enclose the completed returns form with the packaging and shipping documents.
- Address the package to "The Service Department" at the address below and mark the box with the service ticket number to ensure the package is dealt with as efficiently as possible.
- Please use the original packaging, if possible.

**No repair can be undertaken without a returns form with a completed contaminant declaration. This is required to comply with our Health and Safety responsibilities.**

## 7.1 Contact Details

**Address**

Chemtrac, Inc
1555 Oakbrook Drive
Suite 100
Norcross, GA 30093

**Email** hardwaresupport@chemtrac.com
**Phone** 800 442 8722