User Manual

HA600 Analyser

IPM42
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Firmware Version 1.46.01
Serial No: 00-00-00-00-00-00

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www.chemtrac.com

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Part I General Information

1

Safety Precautions

DANGER

- 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.

Disconnect electrical supply before working on this equipment.

1.1 General

This manual has been generated to accompany the serial number of the instrument as recorded on the front of the manual. It is specific to that serial number. Information regarding options or features 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 the Manual be read by the contractor before installing and commissioning the HA600, 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 this main heading Safety Precautions, the special safety precautions outlined in other sections must also be observed.

1.1.1 Warnings used in this Manual

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

DANGER

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

Danger

WARNING

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

Warning

CAUTION

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

Caution

IMPORTANT OR NOTICE

Appears in conjunction with safety instructions which may endanger the analyser and its operation if disregarded.

Notice

IMPORTANT

Draws attention to supplementary information to make the work easier and ensure trouble-free operation.

Markings which are affixed directly to the equipment must be observed without fail, and must remain fully legible at all times.

Important

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:

NOTICE

Read and follow all instructions. Save these instructions.

Danger

WARNING

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

Warning

WARNING

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 electrical supply cable.

Electric shock hazard

WARNING

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

Electric shock hazard

WARNING

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.

Electric shock hazard

1.1.4 Hazards due to Non-compliance

Danger

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.

1.1.5 Safe Operation

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

1.1.6 Safety Instructions for the Owner/Operator

Electric shock hazard

- Danger due to electric current must be excluded. Refer to local electrical safety standards and regulations.

1.1.7 Installation, Maintenance and Inspection

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

Warning

- The HA600 must always by isolated before starting any work.
- Please be aware that the HA600 may be controlling chemical dosing and as such shutting down the HA600 without due regard to the systems it is controlling can lead to chemical release.

1.1.8 Unauthorised Modification

Caution

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

1.1.9 Impermissible Modes of Operation

Warning

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

1.1.10 Chemicals

Caution

Should the sensors attached to the HA600 be in contact with hazardous chemicals, great care must be taken when handling the sensors.

CAUTION

Danger

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

PPE: examples of protective clothing, gloves and goggles.

DANGER

Danger

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

IMPORTANT

Important

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 local distributor.

2

Overview

Thank you for purchasing a HA600 analyser. The HA600 is a compact electronic communication and control system. It is designed for use with many different measuring sensors. Any other use 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.

Danger

Every analyser is carefully checked before leaving the factory. If for any reason you are unhappy with your purchase, please contact the organisation that you purchased the analyser from or Chemtrac, Inc directly.

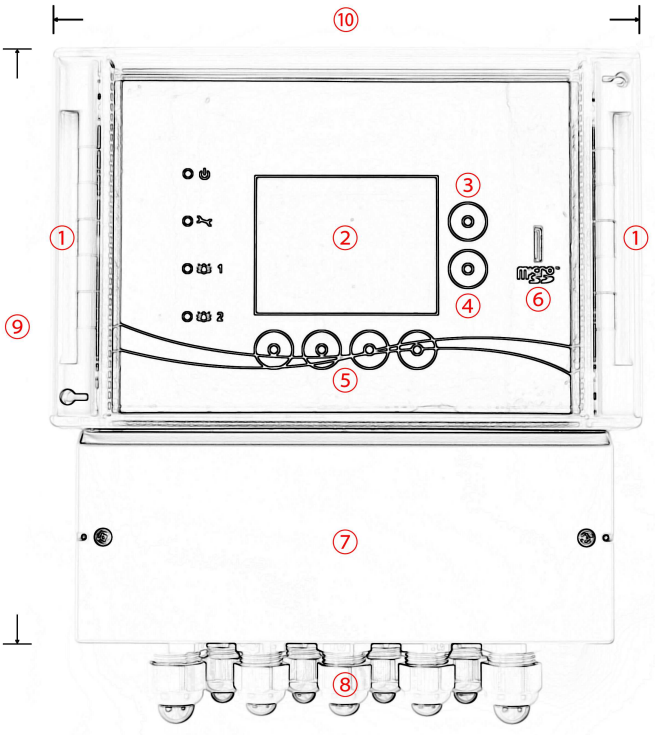


Figure 2.1: HA600 Overview.

1. Door Catch
2. Display
3. Up Key
4. Down Key
5. Soft Keys
6. MicroSD Card Slot
7. Wiring Compartment
8. Cable Glands
9. 9.3”
10. 9.1”

2.1 Specification

Power	100-240VAC or 12VDC at up to 8W, depending on number of sensors.
Fuse	2A (100-240VAC).
Display	3.5" QVGA 65.5K colour TFT
Inputs	Up to 6 sensors or 4..20mA inputs. Up to 4 digital inputs (e.g., low flow switch).
Outputs	Up to 8 configurable contact relays (250VAC, 8A/30VDC, 5A) **or** up to 6 configurable solid state relays (100-240VAC, 3A). Up to 6 4..20mA, 15V outputs.
Communications	Up to 2 RS485 Modbus interfaces for advanced sensors. 4 expansion slots for communication options from Modbus TCP, Modbus RS485 (ASCII or RTU), Profibus DP, Remote Access via GPRS, and Remote Access via LAN.
System Log	Up to 8000 events
Data Log	Up to 8000 data points per channel. Can be extended by using MicroSD card.
Weight	1kg
IP Rating	IP65
Box Material	ABS
Lid Material	Polycarbonate
Seals	EPDM
μSD slots	1

Part II Setup

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.

Danger

Electric shock hazard

3.1 Site Selection

Important

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.

3.2 Unpacking

Important

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 sales outlet immediately. If the instrument needs to be returned for any reason please follow the return instructions given in this manual (refer to section 13).

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

3.3 HA600 Mounting and Connections

The HA600 electronics enclosure should be mounted away from sources of heat or direct sunlight. For mounting the HA600, please refer to the images below.

The HA600 should be mounted such that the instrument is vertical and that there is sufficient clearance to either the left or right-hand side to allow the enclosure compartments to be fully opened and removed.

The HA600 should be mounted away from sources of vibration and should not be hosed down.

Danger

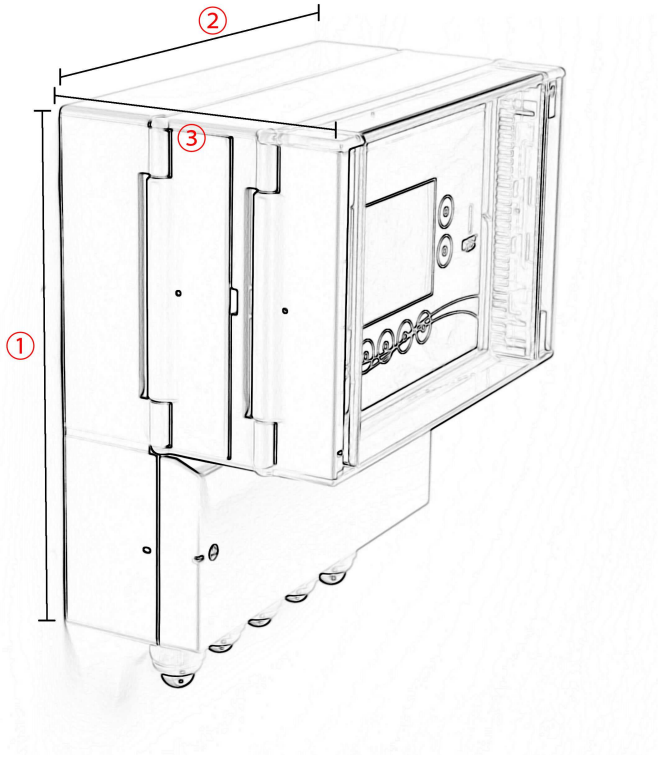


Figure 3.1: HA600 side view.

1. 9.3”
2. 9”
3. 5.3”

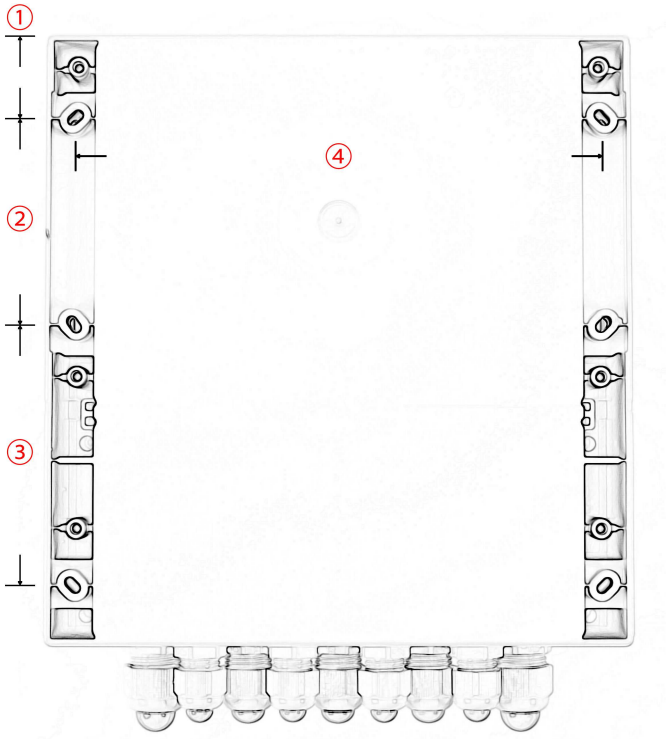


Figure 3.2: HA600 rear view. Two slots and 2 half holes, 5.5mm width.

1. 1.3”
2. 3.1”
3. 3.9”
4. 8.0”

3.4 Sensor Installation

4

Electrical and Sensor Connections

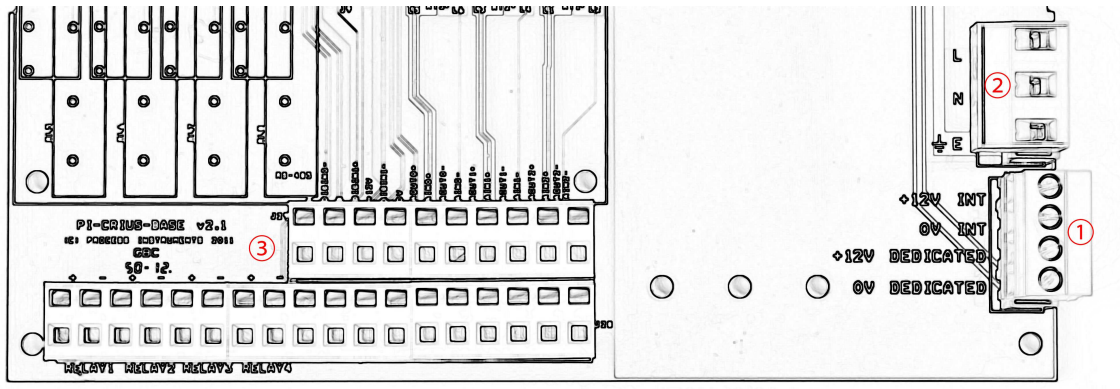


Figure 4.1: HA600 electrical connections.

1. DC power connector
2. AC power connector
3. Industrial I/O connectors

Electrical connections include power connections, sensor connections, communications connections and output connections.

The connections are made with either a connection tool [1] or a small screwdriver.

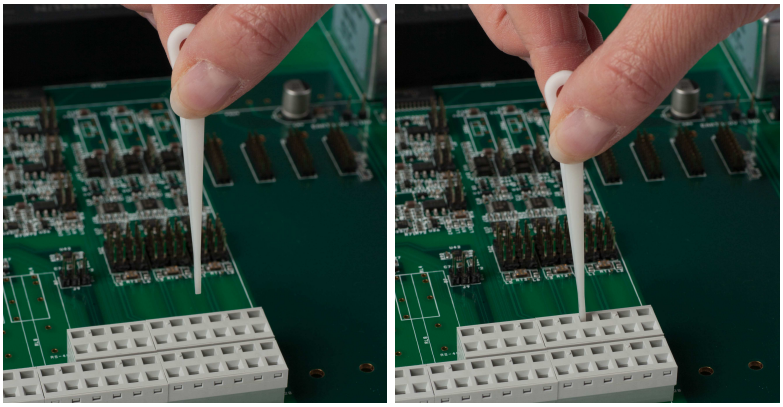


Figure 4.2: Connection tool and connectors, closed and open.

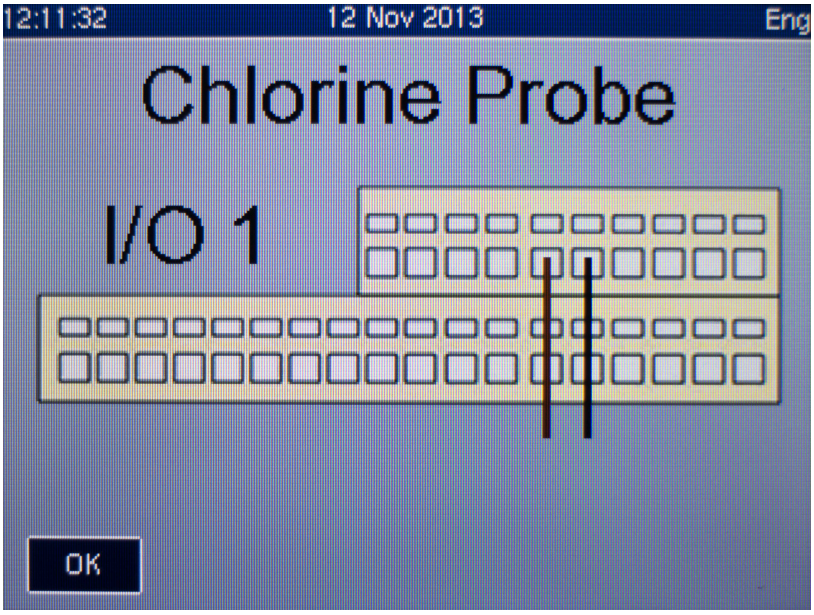
Electric shock hazard

Each instrument has a large number of possible wiring combinations depending on which sensors, inputs, outputs or communications are selected at time of purchase. For this reason the connections to sensors, inputs, outputs and communication are shown on each analyser rather than in this manual.

[1] **Note:** The connection tool allows the user to safely open the spring-loaded connectors.

To access these connections on the analyser:

Menu → Maintenance → Connections



Terminal connections indicated by colour of wire.

Figure 4.3: HA600 device connections screen (Example only)

4.1 Connection Types

4.1.1 Power

Electric shock hazard

The HA600 can operate on 100-260 VAC 50-60Hz or 12 VDC. The current draw depends on how much functionality is enabled and how many sensors/control loops are attached.

Cable type and rating - 6.15mm/0.24 inches, overall diameter, 3×0.75mm^2/18 awg conductors (24 strands), current rating 6A, 300V rated.

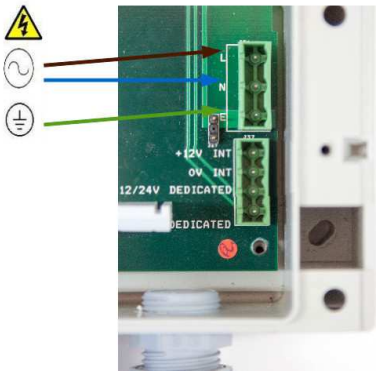


Figure 4.4: HA600 power connection.

Please note that the use of expansion boards within the HA600 mean that some connectors can be difficult to access. This is a compromise to ensure that all possible functionality is available at a reasonable price inside a compact electronics unit.

4.1.2 RS 485

Cable type and rating - two pairs, 0.25mm^2/23awg conductors, 120Ω impedance, 300V rated. Reserved for digital sensor connections (e.g., SoliSense, OxySense, UV254Sense, StreamerSense, ConductiSense etc.).

4.1.3 Relays

The unit has either up to 8 normally open (NO) mechanical relays[2], or up to 6 solid state relays. Cable type and rating - 6.15mm/0.24 inch overall diameter, 3×0.75mm^2/18awg conductors (24 strands), current rating 5A, 250 VAC rated.

[2] Mechanical relays are suitable for switching AC or DC, but solid state relays are only suitable for switching AC.

4.1.4 Sensors

Most sensors connect via the analogue input connections, at the base of the HA600 board. Cable type and rating - 4mm/0.16 inch overall diameter, 2×0.25mm^2/23awg conductors for electrochemical sensors (e.g., HaloSense sensors), or multicore co-axial cable for high impedance probes (e.g, pH and ORP).

4.1.5 4-20mA Inputs and Outputs

Cable type and rating - 2×0.25mm^2/23awg conductors (7 strands), 300V rated, PVC outer sheath.

Inputs

The analogue input types are user selectable via jumper links[3]. Consult the supplier before attempting to change an input configuration. The powered input supplies +15VDC at 50mA max.

[3] **NOTE:** Incorrect use of the input can cause failure of the board.

Outputs

The analogue output maximum loop loading is 700Ω, at 14VDC.

4.1.6 Digital Inputs

0..30VDC digital inputs can be used for low flow fail indication or pulse counting devices (e.g. flow meters) or other switch (e.g. interlock).

Digital inputs can be 'powered' or 'unpowered'.

5

Sensor Commissioning

6

Analyser Configuration

6.1 User Interface

6.1.1 Buttons

The display is a colour TFT screen. The buttons are inductive and do not need to be pressed to activate. A light touch or even hovering a finger over the button will activate it. Touching the button for an extended period will inject multiple key presses of increasing speed until the button is released.

The up and down buttons on the right hand side of the display are always up and down. The remaining four buttons along the bottom are defined for each screen by the legend above the button.

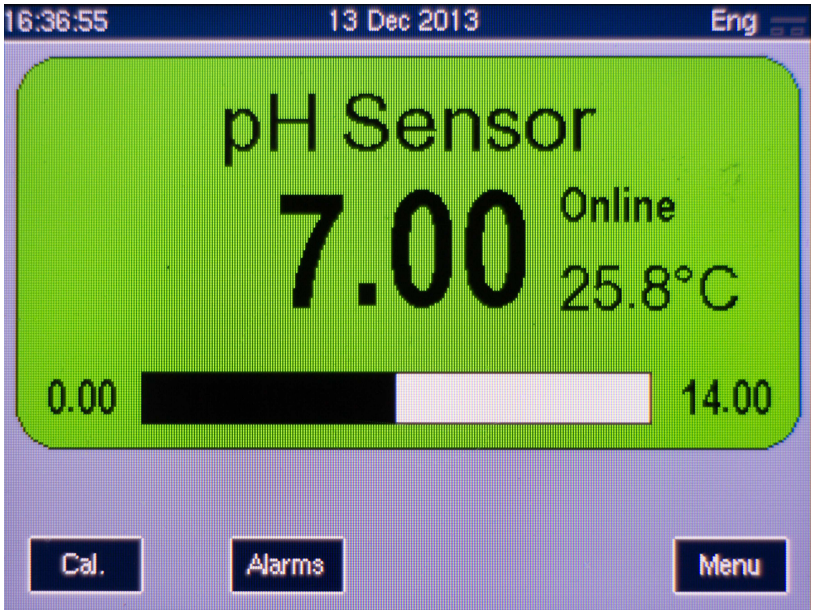


Figure 6.1: HA600 main screen.

6.1.2 Log On

By pressing the "Menu" button you will be taken to the log in screen, where a *User*, *Technician* or *Engineer* security code is entered[1]. Use the up, down, left and right buttons to alter, and "OK" to proceed. If the correct code is entered you will be presented with the main menu where configuration of the instrument is performed.

[1] Note that the buzzer is silent during code entry

To indicate which user, if any is currently logged in to the instrument, the `User`, `Tech` or `Eng` will appear in the top right of the display. The default passwords are:

User	1
Technician	2
Engineer	3

These can be changed in the set up menu. You need to log off to swap between levels or leave the instrument in a secure state. The log off option can be found on the main menu screen. The instrument will automatically log off after a timeout period (see section 6.2.0.8 on page 30).

Once a valid security code is entered the main menu will be displayed. The following table describes the four options and outlines the menu structure.

Information	The menu provides information to the operator relating to the hardware or firmware installed on the instrument.
Maintenance	This menu provides access to those actions that may be repeated such as calibration etc.
Setup	This menu provides access to the settings and setup of the analyser/controller.
Logs	This menu provides access to the system and data logs and the download functions.

The other buttons available from the main screen are user-configurable. The default assignments are detailed below.

By pressing the "Calib." button you will be taken to the sensor calibration section. Password entry may be required.

By pressing the "Alarms" button you will be taken to a page that shows the current status of the alarms (password entry may be required). When an alarm is active (the top bar of the screen goes red as well as the affected sensor), the alarm screen will also have a button marked "Ack." Pressing this button will acknowledge the alarm and silence the buzzer.

If more than one sensor is fitted, then pressing the up or down arrow buttons will scroll around the sensors.

6.1.3 Changing Numbers

Numbers can be changed in two ways. The first is to simply highlight the number and using the up and down buttons increase or decrease the number by an increment.

For larger number changes it is possible (by using the right and left buttons) to select a single digit and increase or decrease that number using the up and down arrows.

6.2 Analyser

Analyser settings are those that relate to the analyser (controller) setup and usage only. These typically don't affect the sensors, communications or control functions.

6.2.0.1 All

Throughout the menu structure of the HA600 selecting 'All' will run through every possible setting in that section of the menu. This enables the inexperienced user to ensure that they have completed every possible setup required. The All option under 'Analyser' can be accessed by:

Menu → Setup → Analyser → All

6.2.0.2 Language

The user interface of the HA600 can be set to any language for which there exists a translation. The languages menu can be accessed by:

Menu → Setup → Analyser → Language

The process by which the language of the analyser is changed is:

1. Change the language using the left and right buttons until the required language is on the display.
2. Press the "OK" button.

The analyser will display a warning letting you know that it is resetting. When the analyser powers back up it will return to the main display in the newly selected language.

6.2.0.3 Date and Time

The date and time are used in the Data Logs and System Logs of your controller and it is, therefore important that they are set correctly. They can be accessed by going to:

Menu → Setup → Analyser → Date and Time

6.2.0.4 Display

Various aspects of your HA600 display can be set. Decreasing your display brightness for example will increase its life, as will setting a backlight time out.

If your HA600 is fitted with a touchscreen and it becomes difficult to use then you can recalibrate it from this menu.

Aspects of the Display that can be altered are:

Menu → Setup → Analyser → Display

Brightness Represented by a bar, selectable using up/down and left/right buttons.

Backlight Set the time out before backlight automatically dims. Options are 0-1000 seconds (0 = always on).

6.2.0.5 User Interface

The user has options as to how the HA600 presents information. These are accessed via:

Menu → Setup → Analyser → User Interface

The options are:

Buzzer Options are "On" or "Off".[2]

Display Options are "Application"[3], "Dual Parameter"[4], "Signal Parameter"[5], "All Parameters" [6], "Sensor" [7].

Ticker Options are "On" or "Off". [8]

6.2.0.6 Buttons

The HA600 utilises "soft"[9] buttons. This allows the user to set shortcuts from the main display to parts of the menu used the most e.g. Datalogs. There are up to three soft buttons available and the shortcut options can be accessed via:

Menu → Setup → Analyser → Buttons

6.2.0.7 Tag Details

The Tag details setup allows the user to use the instrument in various ways. These tags are used to identify the instrument should that option be required, e.g., when an instrument sends a text alarm, the Tag details are used to inform the recipient as to which instrument is in alarm. The Tag Name would typically be the site name and the Tag ID would typically refer to a specific analyser. For example:

Tag Name Burnley Pool

Tag ID Main Pool

Tag Details can be accessed via:

Menu → Setup → Analyser → Tag Details

Tag Name Up to 16 alphanumeric characters

Tag ID Up to 16 alphanumeric characters

[2] The HA600 comes equipped with an internal buzzer which will sound an alarm or when a button is pressed.

[3] Specific applications such as 'AquaSense' Pool Controller have specific display layouts optioned for that application.

[4] Displays two parameters simultaneously. Other parameters can be viewed by pressing up or down arrow.

[5] Displays a single parameter. Other parameters can be viewed by pressing up or down arrow.

[6] Displays up to 6 parameters on the main screen.

[7] Displays the parameters from a single sensor. Other sensors can be viewed by pressing the up or down arrow.

[8] A scrolling display of information across the bottom of the HA600 display.

[9] Soft buttons are buttons that can change their functionality.

6.2.0.8 Security

Each HA600 has 4 levels of security. These are; None, User, Technician and Engineer.

None The screen can be viewed but no changes to the setup or calibration of the instrument are allowed.

User Calibration is allowed but no setpoint or other setup changes are allowed.

Technician All user capability plus setpoint and alarm changes.

Engineer Access to all user changeable settings including 'Factory reset'.

Each security level requires a password and if remote access is enabled in addition a User, Technician and Engineer name is required, these can be set via:

Menu → Setup → Analyser → Security

User Pass Up to 16 alphanumeric characters

The authentication data for users up to and including the current logged in user are shown. The factory defaults are:

User 1

Technician 2

Engineer 3

Setting the passwords to blank (i.e. nothing) will remove the security. 'Factory reset' allows the user to reset all settings to as they were when the instrument left the factory.

Timeout The timeout function is how long access is allowed under the currently entered password before the password needs to be re-entered. Values are between 1:00 to 10:00 minutes following the last key press.

6.2.0.9 Upgrade

The HA600 has a version of firmware and it is possible to upgrade this to a later version if required for bug fixes or additional new functionality.

This option should only be used under specific advice from the manufacturer or your local sales outlet and additional instructions will be provided at this time.

6.2.0.10 Add Device

The HA600 manages what functionality is available to the user via hardware (e.g. what outputs are physically installed) and via firmware. The firmware is enabled using Device Codes. If, for example, a HA600 is purchased with no PID control options but later the user needs PID control options this functionality can be added by the use of Device Codes (hardware allowing).

If you would like to upgrade your instrument functionality with a Device Code please contact your sales outlet.

6.2.0.11 Load Devices

An alternative to keying in the 16 digit device codes above is to enter them using the MicroSD card. Place each code to be entered on a new line of a plain text file called `devices.txt`. Place the card in the HA600 slot and select this option. A message will appear once the codes have been entered displaying the result. The analyser will then restart.

6.3 Sensors

Sensors[10] connect to the HA600 in a variety of ways. Each sensor may report one or more parameters.[11]

[10] The term 'sensor' in this context refers to a physical device, e.g., a physical probe.

[11] The term 'parameter' in this context refers to a measurand reported by the sensor. For example a single chlorine sensor only reports the chlorine contents of the water. So a chlorine sensor is a single sensor with a single parameter. A pH sensor, for example, will typically report both pH and temperature. A pH sensor then is typically a single sensor with two parameters.

6.3.1 Typical Sensors

For each sensor there are settings that refer to the sensor and also settings that refer to each parameter. The sensor and parameter settings follow the same format for all sensors with specific differences relating to specific sensors. Only settings that differ from those below are specifically described in later sections. If a setting shown below is not displayed on your HA600 it is because it is not available with your specific configuration.

6.3.1.1 Sensor Settings

Typical settings are described below and can be accessed via:

Menu → Setup → Sensors → <Device Name>[12] → Settings

[12] Select the sensor of interest from those available on the display.

Name User definable. Alphanumeric up to 20 characters.

Enabled Select if the sensor is enabled. Disabled sensors will be taken off-line and alarms will be suppressed. The sensor will appear greyed out on the main display. Options are "Yes" or "No".

Display This setting allows the user to utilise a sensor whilst not displaying it. Options are "Yes" or "No".[13]

[13] The HA600 provides menus and options when they are appropriate. The displayed option is only available if the user interface is set to sensor view. To change the view mode see section 6.2.0.5 on page 29.

Auto-Flush If this sensor is part of an auto-flush system, select the auto-flush controller from a list.

6.3.1.2 Parameter Settings

If a setting shown below is not displayed on your HA600 it is because it is not available with your specific configuration. Parameter settings can be accessed via:

Menu → Setup → Sensors → <Device Name> → <Parameter Name>[14]

[14] Select the parameter of interest from those available on the display.

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". Alphanumeric up to 16 characters.

Units If "User defined" is selected above, set the units string up to 6 characters. Otherwise select from an appropriate list of units for the parameter type.

Abbrev User definable. Allowable characters are A-Z, a-z, 0-9, - and _, up to 8 characters.[15]

Displayed This setting allows the user to utilise a parameter whilst not displaying it. Options are "Yes" or "No".[16]

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

Offline This is the value reported by the parameter when in 'Offline' mode - for example if cleaning a sensor. Options are -1,000,000 to 1,000,000.

Minimum Set the minimum range value for the parameter. Options are -1,000,000 to 1,000,000.[17]

Maximum Set the maximum range value for the parameter. Options are -1,000,000 to 1,000,000.

Datalog Enables or disables the data logging for the parameter. Options are "On" or "Off".

Log delay If data logging is enabled, set the delay between data log records. Options are 1 minute to 1 hour in MM:SS.

Averaging Enables or disables a rolling average for the parameter to smooth the reading. Options are "On" or "Off".[18]

Delay If averaging is enabled, set the delay between adding readings to the rolling average. Options are between 0.5 and 600 seconds.

Size Set the size of the rolling average buffer. Options are between 1 and 60.

[15] The abbreviation is used on some displays and also as part of the file name for the datalogs if available. Note that the user must ensure the abbreviation is unique for the system.

[16] The HA600 provides menus and options when they are appropriate. The displayed option is only available if the user interface is set to single or dual parameter view. To change the view mode see section 6.2.0.5 on page 29.

[17] The minimum and maximum values set the range for the parameter. Please note that they must be within the range of the sensor, e.g., the minimum and maximum of a 0..5 mg/l free chlorine sensor should be set within 0 and 5 mg/l

[18] An averaging delay of 2 seconds with a size of 30 will result in a rolling average of 1 minute (30s × 2) 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 output.

6.4 Signals

Signals are the means by which external devices or internal events indicate a change to the HA600. The signal source can be a switch (a high/low voltage or volt free relay contact) or timer within the analyser. In order to utilise this feature, it will be necessary to map the signal to the various alarm, process interlock or status options of the HA600. Depending on your order, further signals (analogue, digital, or RTC[19]) can be added.

[19] Real Time Clock - an internal clock and calendar within the HA600.

6.4.1 Digital Signals

Digital inputs are switched by an external contact (mechanical or electrical). These can be internally or externally powered. Contact yor supplier for information on changing this. The digital inputs can be configured via the user interface of the HA600. To access the configuration:

Menu → Setup → Signals → <Device Name>[20]

[20] e.g., Signal 1.1.

For the signals, the following parameters can be configured:

Name Device name to identify signal in menus. Text can be up to 20 characters long.

Enabled Enables or disables the signal. Options are “Yes” or “No”.

Delay Following a change of the external switch, the time before action is taken. Values in MM:SS up to 60 minutes.

Type Set the default (inactive) state. Either normally open (NO) or normally closed (NC).

Alarm Enables or disables the visible alarm and buzzer. Options are “On” or “Off”.

6.4.2 Analogue Signals

Analogue signals convert an analogue input of the HA600, to a digital state input. This input can only be externally powered.[21] The analogue signals can be configured via the user interface of the HA600. To access the configuration:

[21] The 12 VDC available from the HA600 can be used for switched signals.

Menu → Setup → Signals → <Device Name>[22]

[22] e.g., Signal 1.1.

For the signals, the following parameters can be configured:

Name Device name to identify signal in menus. Text can be up to 20 characters long.

Enabled Enables or disables Signal. Options are “Yes” or “No”.

Type Set the default (inactive) state. Either normally open (NO) or normally closed (NC).

Alarm Enables or disables the visible alarm. Options are "On" or "Off".

6.4.3 RTC Signals

RTC[23] signals are timers, which can be used to trigger an action. The RTC signal can be configured via the HA600 user interface via:

Menu → Setup → Signals → <Device Name>[24]

The process by which to map a RTC signal is to:

1. Select a RTC signal.
2. Enable the RTC signal.
3. Select what type of signal time it should be.
4. Set the associated configuration.

6.4.3.1 General Setup

Name Device name to identify the signal in menus. Text can be up to 20 characters long.

Enabled Enables or disables Signal. Options are "Yes" or "No".

Type Set the type of timer event. Options are "Disabled", "Delay", "Time", "Day" or "Date".

6.4.3.2 RTC Signal Types

DISABLED: RTC signal timer turned off.

DELAY: Requires the setting of the Delay time and the Duration time, both in HH:MM:SS. For example,

Delay 00:15:00

Duration 00:45:00

If a relay is mapped to this RTC signal, then the relay state will change after 15 minutes and change back after a further 45 minutes, and would then start again.

TIME: Requires the setting of the Start and End, both in HH:MM:SS. For example,

[23] Real Time Clock. Uses an internal clock and calendar to generate signals.

[24] e.g., RTC Signal 1.1.

Start 09:00:00

End 17:00:00

If a relay is mapped to this RTC signal, then the relay state will change at 9am, then change back at 5pm, every day.

DAY: Requires the setting of the days when the action is required. For example,

Monday On

Tuesday Off

Wednesday Off

Thursday On

Friday Off

Saturday Off

Sunday Off

If a relay is mapped to the RTC signal, then the relay state will change on Monday, change back on Tuesday, change again on Thursday and change back on Friday, of every week.

DATE: Requires the settings of the Start Date and End Date. For example,

Start Date:

Date 3

Month June

End Date:

Date 28

Month August

If a relay is mapped to this RTC signal, then the relay state will change on 3rd June and change back on 28th August, every year.

6.4.4 Status Signals

Status signals allows the status of a sensor, parameter or control to change the value of signal internally within the HA600. This allows, for example, the status of a data alarm on a parameter reading to start or stop a controller with the appropriate process run control. To access the configuration from the HA600 User Interface;

Menu → Setup → Signals → <Device Name>[25]

[25] e.g., Status Signal 1.1.

Name Device name to identify the signal in menus. Text can be up to 20 characters long.

Enabled Enables or disables the status signal. Options are "Yes" or "No".

Type Select the type of status the signal monitors to set it's state. Options are "Data Alarm", "Data Status" or "Control Status".

If the type selected above was "Data Status" or "Data Alarms", then the next screen will prompt the user to select the sensor parameter which the signal will monitor.

Sensor Select the sensor to monitor.[26]

[26] e.g. Chlorine probe or pH probe

Parameter Only visible if the sensor selected is a multi-parameter probe. Select the parameter to monitor.[27]

[27] e.g. Temperature on a pH probe.

Alarm Sources

If "Data Alarm" was selected as the type above, then the following screen will allow the choice of the type of alarm to monitor.

Fault If selected, the status of the sensor error alarm is monitored. Options are "On" or "Off".

Flow If selected, the status of the flow alarm for the sensor is monitored. Options are "On" or "Off".

Alarm 1 If selected, the status of the first parameter alarm [28] is monitored. Options are "On" or "Off".

[28] See section 6.5.1.

Alarm 2 If selected, the status of the second parameter alarm [29] is monitored. Options are "On" or "Off".

[29] See section 6.5.1.

Status Sources

If "Data Status" was selected as the type above, then the following screen will allow the choice of which parameter status options to monitor.

Warm-up If selected, the signal will be active when the parameter being monitored is in warm-up. Options are "On" or "Off".

On-line If selected, the signal will be active when the parameter being monitored is on-line. Options are "On" or "Off".

Offline If selected, the signal will be active when the parameter being monitored is offline. Options are "On" or "Off".

T'hold 1 If selected, then the signal will monitor the state of the first parameter threshold.[30] Options are "On" or "Off".

[30] See section 6.5.2.

T'hold 2 If selected, then the signal will monitor the state of the second parameter threshold.[31] Options are "On" or "Off".

[31] See section 6.5.2.

Control Status Sources

If "Control Status" was selected as the type above, then the following screen will appear.

Source Select the control to monitor from a list of available control devices e.g., PID Controller or VSD Controller.

Type Select the type of status event to monitor. Options are "Threshold"[32], "Alarms"[33], or "Error"[34]

[32] See section 6.5.3 for details

[33] See section 6.5.4 for details

[34] This is set when the controller enters an error status requiring user intervention. See the system log for details of the error.

At the end of the output configuration wizard, the message "Press 'Finish' to save settings" is displayed. **If 'Finish' is not pressed then any changes made will be lost.**

6.5 Alarms and Thresholds

6.5.1 Sensor Alarms

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[35], as Chemtrac utilises very flexible firmware and electronics. An alarm in a HA600 unit will create a visible red bar across the top of the screen and sound a buzzer. One flow alarm per sensor and two data alarms per parameter are available.

[35] 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 time of order.

Alarms can be configured via the user interface of the HA600 . To access the configuration:

Menu → Setup → Alarms & Thresholds → Sensors → Alarms → <Device Name>[36]

[36] Name of sensor, e.g., Chlorine Probe or SoliSense.

Flow Alarm

This allows the use of a signal (see section 6.4) from a flow switch[37]. This generates a System Alarm (if activated) and an appropriate message is added to the System Log.

[37] Supplied with your system, if ordered

Flow Alarm Enables or disables flow alarm. Options are "On" or "Off".

Signal Flow signal selection list. Signal should be active when flow is too low.[38]

[38] See section 6.4 on page 34 for details of signal configuration.

Data Alarm

Select the parameter name to configure and the following options are available for each of the two data alarms.

Alarm Enables or disables data alarm. If enabled, the following options are available. Options are "On" or "Off".

Set Parameter value at which alarm activates. Values are between the minimum and maximum parameter readings.

Reset Parameter value at which alarm deactivates. Values are between the minimum and maximum parameter readings.[39]

[39] For a rising alarm, the reset point must be below the set point. For a falling alarm, the set point must be below the reset point.

Delay Time that set value must be exceeded before alarm occurs. Values between 0 seconds and 10 hours in MM:SS format.

6.5.2 Sensor Thresholds

Thresholds are similar to alarms, except they cause no visible or audible action. Thresholds are often used as a basic form of control. For example,

to maintain a level of biocide in a recirculating system. Thresholds can be used to switch on dosing pumps only when the reading falls below a certain level. Two thresholds per parameter are supplied.

Thresholds can be configured via the user interface of the HA600 . To access the configuration:

Menu → Setup → Alarms & Thresholds → Sensors → Thresholds → <Device Name>[40]

[40] Name of sensor, e.g., Chlorine Probe or SoliSense.

Configuration

Select the parameter name to configure. The following options are available for each of the two thresholds.

Threshold Enables or disables threshold. If enabled, the following options are available. Options are "On" or "Off".

Set Parameter value at which threshold activates. Values are between the minimum and maximum parameter readings.

Reset Parameter value at which threshold deactivates. Values are between the minimum and maximum parameter readings.[41]

[41] For a rising threshold, the reset point must be below the set point. For a falling threshold, the set point must be below the reset point.

Delay Time that set value must be exceded before threshold occurs. Values between 0 seconds and 10 hours in MM:SS format.

6.5.3 Control Alarms

Alarms can also be configured to monitor control outputs[42]. One alarm per control device is available for configuration. [43] Control Alarms can be configured via the user interface of the HA600 . To access the configuration:

Menu → Setup → Alarms & Thresholds → Controls → <Device Name>[44]

[42] Only control devices that produce a percent output have the ability to configure alarms. For example, PID.

[43] Control alarms are assessed when the control is running in automatic or manual modes. If the control is off, then the alarm is inactive.

[44] Name of the control device, e.g., PID Controller 1.1.

Alarm Enables or disables alarm. If enabled, the following options are available. Options are "On" or "Off".

Set Control output value at which alarm activates. Values are 0.0..100.0%.

Reset Control output value at which alarm deactivates. Values are 0.0..100.0%.[45]

[45] For a rising alarm, the reset point must be below the set point. For a falling alarm, the set point must be below the reset point.

Delay Time that set value must be exceded before alarm occurs. Values between 0 seconds and 10 hours in MM:SS format.

6.5.4 Control Thresholds

See section 6.5.2 for a description of thresholds. Control thresholds are identical to sensor thresholds but monitor the output of a control device, instead of a sensor reading.[46]

[46] Control thresholds are assessed when the control is running in automatic or manual modes. If the control is off, then the threshold is inactive.

Thresholds can be configured via the user interface of the HA600 . To access the configuration:

Menu → Setup → Alarms & Thresholds → Controls → Thresholds → <Device Name>[47]

[47] Name of control, e.g., PID Controller 1.1.

Threshold Enables or disables threshold. If enabled, the following options are available. Options are "On" or "Off".

Set Control output value at which threshold activates. Values are 0.0..100.0%.

Reset Control output value at which threshold deactivates. Values are 0.0..100.0%.[48]

[48] For a rising threshold, the reset point must be below the set point. For a falling threshold, the set point must be below the reset point.

Delay Time that set value must be exceded before threshold occurs. Values between 0 seconds and 10 hours in MM:SS format.

6.6 Outputs

Outputs are the means by which values from measuring sensors are transmitted to another device. For example to a SCADA[49] or to a pump for dosing control.

The two types of output used by HA600 are the analogue output[50] or relay.[51]

Historically the term 'Alarm' could be considered synonymous with 'Relay' as the value at which a relay was triggered was fixed and unique to a sensor. Chemtrac utilises the latest in firmware and electronic innovations and as such Analogue and Relay outputs are extremely flexible, and are not tied to individual sensors. The term 'Analogue Output' was also always the same as the range of the sensor. More recently the capability of the analogue output to be more flexible has come about with advances in electronics.

In order to utilize the full capability of the instrument it is necessary to 'map'[52] the various alarm, threshold and control options to the relays or analogue outputs.

[49] Supervisory Control and Data Acquisition - a central data logging and control system.

[50] A current or voltage output proportional to a signal generated in the instrument. The number and variety of analogue outputs is specified at the time of order.

[51] 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 time of order.

[52] A verb describing a link between a signal/value generated by the instrument and an output device (relay or analogue). For specific mapping options please see the following sections.

6.6.1 Analogue Outputs

Analogue outputs, typically a current output (although other options are available) varying between 4mA and 20mA, are proportional to a varying signal of interest generated by the instrument. Analogue outputs are installed at time of manufacture. Installed analogue outputs can be viewed by following the links below. Some default configurations, e.g. AquaSense include predefined relays and analogue outputs.

Menu → Information → Installed Hardware

6.6.1.1 Mapping

The values that can be mapped to an analogue output are shown below.

6.6.1.2 Configuration

The analogue outputs can be configured via the user interface of the HA600. To access the configuration:

Menu → Setup → Outputs → Map Analogue → <Device Name>[53]

[53] e.g., Output 1.1

The process by which to map an analogue output is to:

1. Select an output.
2. Select the mode, either "Unused", "Data"[54], or "Control".[55]
   (a) For "Data", select sensor parameter and decide the range of the analogue output, if it is a data output.

[54] The signal from a sensor parameter

[55] The output from a control algorithm, e.g. PID (see section 6.7.1).

(b) For “Control”, select control value to output, e.g. PID or VSD[56].

[56] Variable Speed Drive.

General Setup

Name Device name to identify output in menus. Text can be 20 alphanumeric characters long.

Abbrev. User definable. Allowable characters are A-Z, a-z, 0-9, - and _, up to 8 characters.[57]

[57] The abbreviation is used on some displays and also as part of the file name for the datalogs if available. Note that the user must ensure the abbreviation is unique for the system.

Enabled Options are “Yes” or “No”. This option must be enabled for further options to be available.

Mode Options are “Data”, “Control” or “Unused”.

Datalog Used to enable data logging of output value. Options are “Yes” or “No”. If “Yes” is selected then the following options are available.

Log Delay Output data log interval. Values in MM:SS from 01:00 to 60:00.

Log Percent Options are “Yes” or “No”. If “Yes” is selected then the log value will be 0..100%, otherwise the analogue output value will be recorded.

Control Source

This option is only available if the mode above is “Control”.

Source Select the control value to output from a list of available control devices, e.g. PID Controller or VSD Controller.

Data Source

The next two configuration screens are only available if the mode above is “Data”.

Sensor Select the sensor value to output from a list of available sensor devices, e.g. Chlorine Probe or pH Probe.

Parameter Only visible if the sensor selected is a multi-parameter probe. Select the parameter value to output, e.g. temperature on a pH.

Data Range

Minimum The parameter value that translates to an output of 4mA/0V.

Maximum The parameter value that translates to an output of 20mA/10V.

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 2.4ppm to 5.3ppm. At the end of the output configuration wizard, the message "Press 'Finish' to save settings" is displayed. **If 'Finish' is not pressed then any changes made will be lost.**

Important

6.6.2 Relay Outputs

Relay outputs, typically mechanical reed relays (although other options are available) are installed at time of manufacture. Installed relay outputs can be viewed by following the links below. Some default configurations, e.g. AquaSense include predefined relays and analogue outputs.

Menu → Information → Installed Hardware

6.6.2.1 Mapping

The values that can be mapped to relay output are shown below.

6.6.2.2 Configuration

The relay outputs can be configured via the user interface of the HA600 .

To access the configuration:

Menu → Setup → Outputs → Map Relays → <Device Name>[58]

[58] e.g., Relay 1.1

The process by which to map a relay output is to:

1. Select the relay.
2. Select the mode. Select from "Unused", "Contact", "Pulse Width"[59], or "Pulse Frequency".[60]
   (a) If "Contact", select what event triggers the relay.
   (b) If a "Pulse Output", select control value to output, e.g. PID.

[59] An on/off control method using relays where by the amount of time 'on' in a given time is determined by a control output, e.g. 75% output equals to 45 seconds on and 15 seconds off in a total loop time of 60 seconds.

[60] A on/off control method using relays where by the number of pulses in a given time is determined by a control output value, e.g. 45 pulse in 1 minute, with a max. freqency of 1Hz, is equivalent to a 75% PID output.

General Setup

Name	Device name to identify output in menus. Text can be 20 alphanumeric characters long.
Abbrev.	User definable. Allowable characters are A-Z, a-z, 0-9, - and _, up to 8 characters.[61]
Enabled	Options are "Yes" or "No". This option must be enabled for further options to be available.
Mode	Options are "Unused", "Contact", "Pulse Width" or "Pulse Frequency".

[61] The abbreviation is used on some displays and also as part of the file name for the datalogs if available. Note that the user must ensure the abbreviation is unique for the system.

Datalog Used to enable data logging of output value. Options are "Yes" or "No". If "Yes" is selected then the following options are available.

Log Delay Output data log interval. Values in MM:SS from 01:00 to 60:00.

Contact Source

This option is only available if the mode above is "Contact".

Source Select the source of the trigger for the relay. Options are "None", "Data Alarm", "Data Status", "System Alarms", "System Status", "Signal", "Control", "Control Status".

Relay Source

This option is only available if the source above is "Data Alarm" or "Data Status".

Sensor Select the sensor for status or alarm information from a list of available sensor devices, e.g. Chlorine Probe or pH Probe.

Parameter Only visible if the sensor selected is a multi-parameter probe.

Data Alarm Mask[62]

This option is only available if the source above is "Data Alarm".

Fault Relay will activate if a sensor fault condition is detected on the selected parameter. Select "On" or "Off".

Flow Relay will activate if a low flow condition is detected on the selected parameter. Select "On" or "Off".

Alarm 1 Relay will activate if the first data alarm is active on the selected parameter. Select "On" or "Off".

Alarm 2 Relay will activate if the second data alarm is active on the selected parameter. Select "On" or "Off".

[62] A mask is applied to a list of options to determine which conditions activate the alarms. For example, setting "Fault" and "Flow" to off and "Alarm 1" and "Alarm 2" to on would create a relay that would activate when either Alarm 1 or 2 was active, but not if a sensor fault condition or low flow is detected.

Data Status Mask

This option is only available if the source above is 'Data Status".

Warm-up Relay will activate if the selected parameter is in warm-up. Select "On" or "Off".[63]

On-line Relay will activate if the selected parameter is on line. Select "On" or "Off".[64]

[63] Electrochemical sensors often require time to reach equilibrium. Warm up describes a state where the sensor output is not yet ready. Calibration is inhibited during warm up.

[64] When the signal from the sensor is within acceptable limits the sensor is considered to be online.

Off-line Relay will activate if the selected parameter is off line. Select "On" or "Off".[65]

T'hold 1 Relay will activate if the first threshold is active on the selected parameter. Select "On" or "Off".

T'hold 2 Relay will activate if the second threshold is active on the selected parameter. Select "On" or "Off".

DSSI The relay will activate if the selected parameter "device specific status indicator" is set. [66] Select "On" or "Off".

Hold The relay will activate if the selected parameter is in hold. Select "On" or "Off".

[65] A sensor can be deliberately taken offline in which mode it will display a manually entered value. In offline mode the alarms and thresholds are inhibited.

[66] The use of the DSSI is sensor dependent. Most sensors do not use this feature. Notable exceptions are the dual feed sensors use the override sample line selection (e.g. when used with UV254Sense with autoclean option) and StreamerSense use to indicate the zero offset is enabled.

System Alarm Mask

This option is only available if the source above is "System Alarm".

All alarms Relay will activate if any alarm condition is active. This can be used as a general alarm signal. Select "On" or "Off".

Data alarms Relay will activate if any sensor has an active data alarm. Select "On" or "Off".

Sensor fault Relay will activate if any sensor detects a fault condition. Select "On" or "Off".

Signal alarm Relay will activate if any signal is active and is configured to generate an alarm. Select "On" or "Off".

System fault Relay will activate if any other alarm condition is detected, e.g. PID overfeed alarm. Select "On" or "Off".

System Status Mask

This option is only available if the source above is "System Status".

Normal Relay will activate if the analyser is operating normally. Select "On" or "Off".

Alarm active Relay will activate if any alarm condition is active, and not acknowledged. This can be used as a general alarm signal that can be acknowledged and deactivated. Select "On" or "Off".

Alarm ack. Relay will activate if any alarm condition is active, but acknowledged. This can be used as a general alarm signal. Select "On" or "Off".

Signal Source

This option is only available if the source above is "Signal".

Source Select the signal state to output from a list of available signal devices, e.g. RTC Signal.

Control Source

This option is only available if the source above is "Control".

Source Select the control state to output from a list of available control devices, e.g. Auto-Flush.

Option Select the option value, if applicable.[67]

[67] See the control option documentation for details of this setting.

Control Status Source

This option is only available if the source above is "Control Status".

Source Select the control status from a list of available control devices, e.g., PID Control.

Type Select the type of control status to output. Options are "Threshold", "Alarm", or "Error".

Relay Action

Action Select the default relay state. Options are "Normally Open" or "Normally Closed".

Control Relay

This option is only available if the mode above is "Pulse Width" or "Pulse Frequency".

For "Pulse Width":

Source Select the control value to output from a list of available control devices, e.g. PID Controller.

Pulse Width This is the total pulse width time which will be split between the relay open or closed based on the control output. Values are between 1.0 and 600.0 seconds.

Dead Band Pulses of length below this setting are ignored to avoid relay chatter. Values are between 0.0 and 10.0 seconds.

For "Pulse Frequency":

Source Select the control value to output from a list of available control devices, e.g. PID Controller.

Pulse Width Enter the time each pulse is to last. Values are between 0.1 and 5.0 seconds.[68]

Max. Freq. Enter the maximum frequency of pulse outputs. Values are between 0.01 and 5.00 Hertz.

[68] It is up to the user to ensure that the maximum frequency and pulse width allow a sufficient period of pulse low time and that pulses do not merge at high frequeny output.

At the end of the output configuration wizard, the message “Press ‘Finish’ to save settings” is displayed. **If ‘Finish’ is not pressed then any changes made will be lost.**

Important

6.7 Controls

6.7.1 PID Control

The PID[69] implementation of the HA600 analyser is very flexible and can be configured as any permutation of P, I, and D. This allows P, I, PI or PD 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.

[69] P - Proportional, I - Integral, D - Derivative

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.[70]

[70] Control offsets in a purely proportional system are referred to as proportional droop. Offsets occur in systems were 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 setpoint.

PI CONTROLLER. Integral action enables PI controllers to eliminate offset, 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.

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 cannot 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.

6.7.1.1 The PID Algorithm

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 (the derivative term). The PID controller output is the sum of the three constituent terms as shown in figure 6.2. The result is in the form of a decimal fraction[71] that is converted to a percentage for control output.

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

PROPORTIONAL TERM

The proportional term produces an output value that is proportional to the current error value. The proportional response can be adjusted by

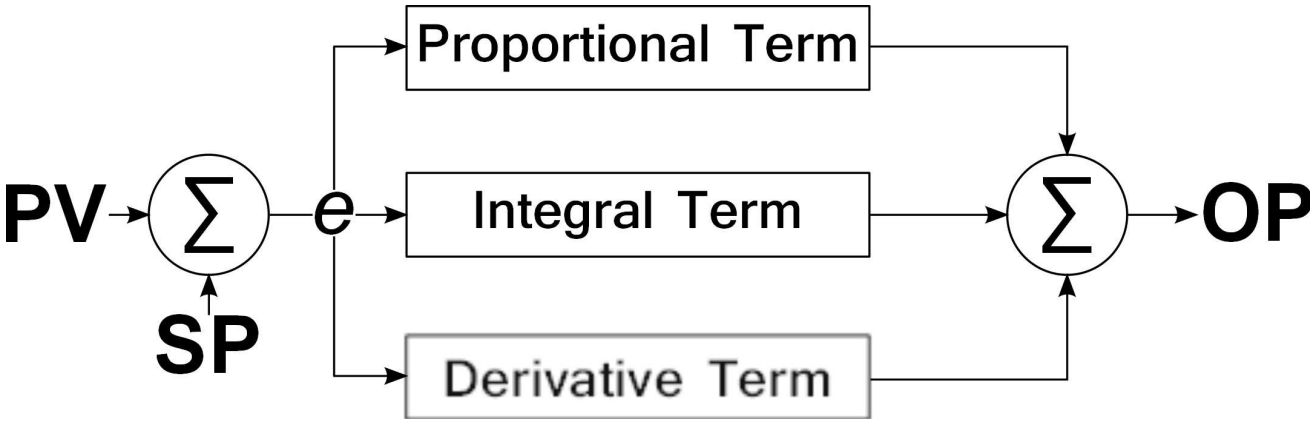


Figure 6.2: Block diagram of PID algorithm. PV - process variable, SP - setpoint, e - error, OP - output.

multiplying the error by the proportional gain, adjustable in the PID configuration.[72]

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 setpoint.

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

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.[73]

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.

[73] $$I_{out(t)} = I_{out(t-1)} + K_i.e$$ where I_{out} is the integral term output, K_i is the integral gain and e is the error.

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.[74]

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.

[74] $$D_{out} = K_d \frac{e-p}{dt}$$ where D_{out} is the derivative term output, K_d is the derivative gain, dt is the loop time, e is the error and p is the previous error.

6.7.1.2 Configuration

The PID controller can be configured via the user interface of the HA600 . To access the configuration:

Menu → Setup → Controls → <Device Name>[75]

[75] e.g., PID Controller 1.1 or Cl Controller

Configuration of the PID controller is accessed via a GUI wizard with the following data entry pages.[76]

[76] Settings are only saved at the end of the GUI wizard when pressing 'Finish'.

General Setup

Name Device name to identify control in menus. Text can be up to 20 characters long.

Start Delay If value is greater than 0, controller will start in the mode set below before switching to run mode when this timer expires. Values in MM:SS up to 60 minutes.

Start Mode Select start mode. This option is only available if the Start Delay is greater than 0. Options are "Off" or "Manual".

Run Mode Select normal operating mode. Options are "Off", "Manual" or "Automatic".

Fail Mode Select operating mode if the controller detects an error condition. Options are "Off" or "Manual".

Signal Process interlock signal selection list. If a signal is selected, controller will disable dosing when signal is active.[77]

[77] See section 6.4 on page 34 for details of signal configuration.

Manual Output

Value Set manual output value. Values from 0.0% to 100.0%.

Bumpless Transfer[78]

[78] Options only available if *Engineer* login is used.

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.

Bumpless transfer is only applied when the controller is running. It will not operate during the start delay.

Enable Enables bumpless transfer when switching to or from automatic run mode. Options are "Yes" or "No".

Power On Set the power on manual output value. Values from 0.0% to 100.0%.

Control Setup

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).

Setpoint Select "Static" if setpoint value is to be specified via user interface or "Variable" if setpoint is set remotely via 4-20mA input (e.g., from SCADA or PLC).

Min. Output Set the minimum output of the PID controller. Values from 0.0% to 100.0%.

Max. Output Set the maximum output of the PID controller. Values from 0.0% to 100.0%.

Loop Time The update delay between controller output updates. Values from 0.5 to 300 seconds.[79]

[79] If controller output is via relay set in PWM mode, the loop time should equal the relay maximum pulse width. See section 6.6.2 on page 44 for details of relay configuration.

Process Variable

Sensor Select the sensor measuring the parameter requiring control.

Parameter Only visible for multi-parameter sensors. Select the desired parameter for control.[80]

[80] For example, advanced pH Sensors have two parameters; pH and temperature.

Over Feed Protection

Over feed protection is designed to identify problems associated with dosing equipment.[81] 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 initiated a control alarm. Manual intervention is required to rectify the fault and reset the PID controller by setting the desired run mode using this configuration wizard or the diagnostics function (see section 6.7.1.3).

[81] Blocked injectors, empty day tanks and dosing pump failures are likely causes to trigger this feature. The alarm may identify the problem before the detrimental effects of control loss are encountered.

Enabled Enables over feed protection. If enabled the parameters below are available for configuration. Options are "Yes" or "No".

Timeout Time period in which the process variable must respond to dosing before over feed protection activates. Values in MM:SS up to 300 min.

Interval Amount the process variable must move towards setpoint to reset the timeout timer set above.

Deadband Over feed protection is disabled when process variable is within this value of setpoint.

Static Setpoint[82]

[82] Visible if setpoint type is static in Control Setup above

Value Control setpoint value.

Variable Setpoint[83]

[83] Visible if setpoint type is variable in Control Setup above

Sensor Select the sensor input providing the desired setpoint value.

Parameter Only visible for multi-parameter sensors.

Setpoint Ramping

Large step changes in process variable error can produce 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.

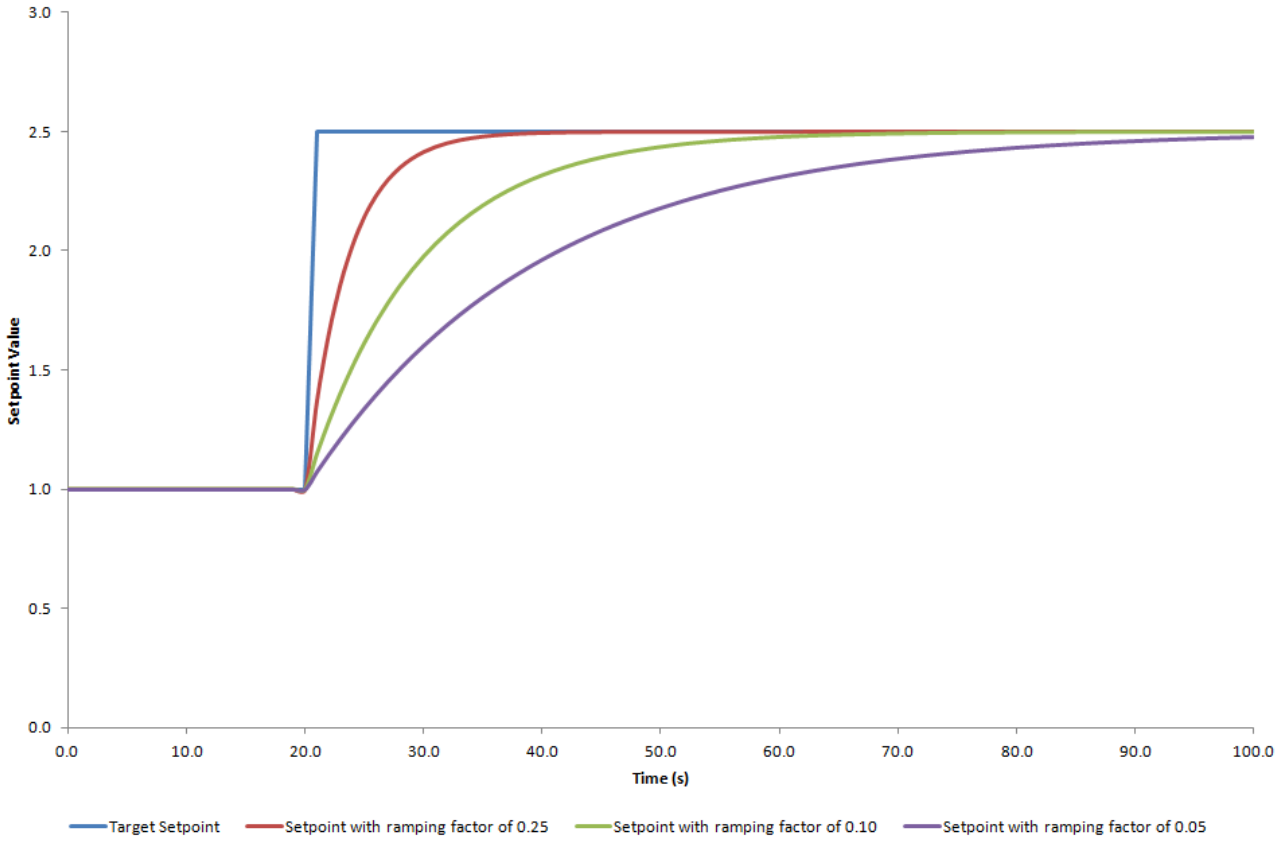


Figure 6.3: Effect of setpoint ramping factor on setpoint value during step change. PID loop time in example set to 1 second.

Enabled Enables the setpoint ramping feature. Options are "Yes" or "No".

Factor If enabled, set the ramping factor. Values from 0.00 to 1.00.[84]

[84] 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.

PID Tuning

See section 6.7.1.1 for a full description of the settings below.

Scale Factor Scaling factor applied to calculated error. For example, a scaling factor of 1000.0 will convert an ORP reading (±2000mV) into a -2.0..+2.0 error range to which the proportional, integral and derivative functions are applied. Values from 0.000 to 10000.000.

Proportional Proportional gain setting. Values from 0.000 to 10.000.

Integral Integral gain setting. Values from 0.000 to 10.000.

Derivative Derivative gain setting. Values from 0.000 to 10.000.

Integral Windup Protection

Integral windup refers to the situation when process variable spends a significant amount of time below 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 limits the maximum windup, both positive and negative.[85]

[85] Integral windup protection is only available if the integral gain is greater than 0.

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. Values from −500.00% to 500.00%.

Maximum The largest accumulated error the integral term is allowed to wind up, usually positive. Values from −500.00% to 500.00%.

6.7.1.3 Diagnostics

The PID controller diagnostic information can be accessed using:

Menu → Maintenance → Controls → <Device Name>[86]

[86] e.g., PID Controller 1.1 or Cl Controller

Information displayed depends on the PID controller mode. 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.

Mode Displays controller mode; Off, Manual or Automatic.

If the controller is in automatic mode and not in error, the following information is displayed.

SP The controller setpoint value. If setpoint ramping is enabled and active, then the information displayed is `current (target)` setpoint values.

Error The current process variable error.

PID Displays the `Proportional/Integral/Derivative` term outputs.

If the controller is in manual or automatic modes, the following information is displayed.

Output Displays the current output of the controller.

If the controller is in error, the following information is displayed.

Error Provides description of error cause.

Reset Select "Yes" to reset controller.

6.7.2 Flow Proportional Control

The flow proportional control of the HA600 analyser is for use in applications where variations in flow are the primary control mechanism. This control allows modification of a secondary control loop, normally PID, to implement a flow pacing, residual trim functionality.

$$F_{out} = P_{out} \times C_{trim}$$

Figure 6.4: where F_{out} is the controller output, P_{out} is the flow proportional output (figure 6.5) and C_{trim} is the secondary controller trim component (figure 6.6).

$$P_{out} = \frac{F_{value}}{F_{nominal}} \times F_{gain}$$

Figure 6.5: where F_{value} is the flow rate, $F_{nominal}$ is the typical flow rate for the process and F_{gain} is the proportional gain.

$$C_{trim} = 1 + \left(\frac{C_{out} - 50}{100} \times T_{factor} \right)$$

Figure 6.6: where C_{out} is the secondary controller output and T_{factor} is the trim factor applied to the controller output. The trim factor controls how much influence the PID output has on the flow proportional output.

The flow proportional control output requires that a flow meter input and a secondary control loop are mapped in the configuration (see section 6.7.2.1). Once the nominal flow rate is specified, the main tuning parameters are flow gain and trim factor. Figure 6.7 shows the effect of these parameters on controller behaviour.

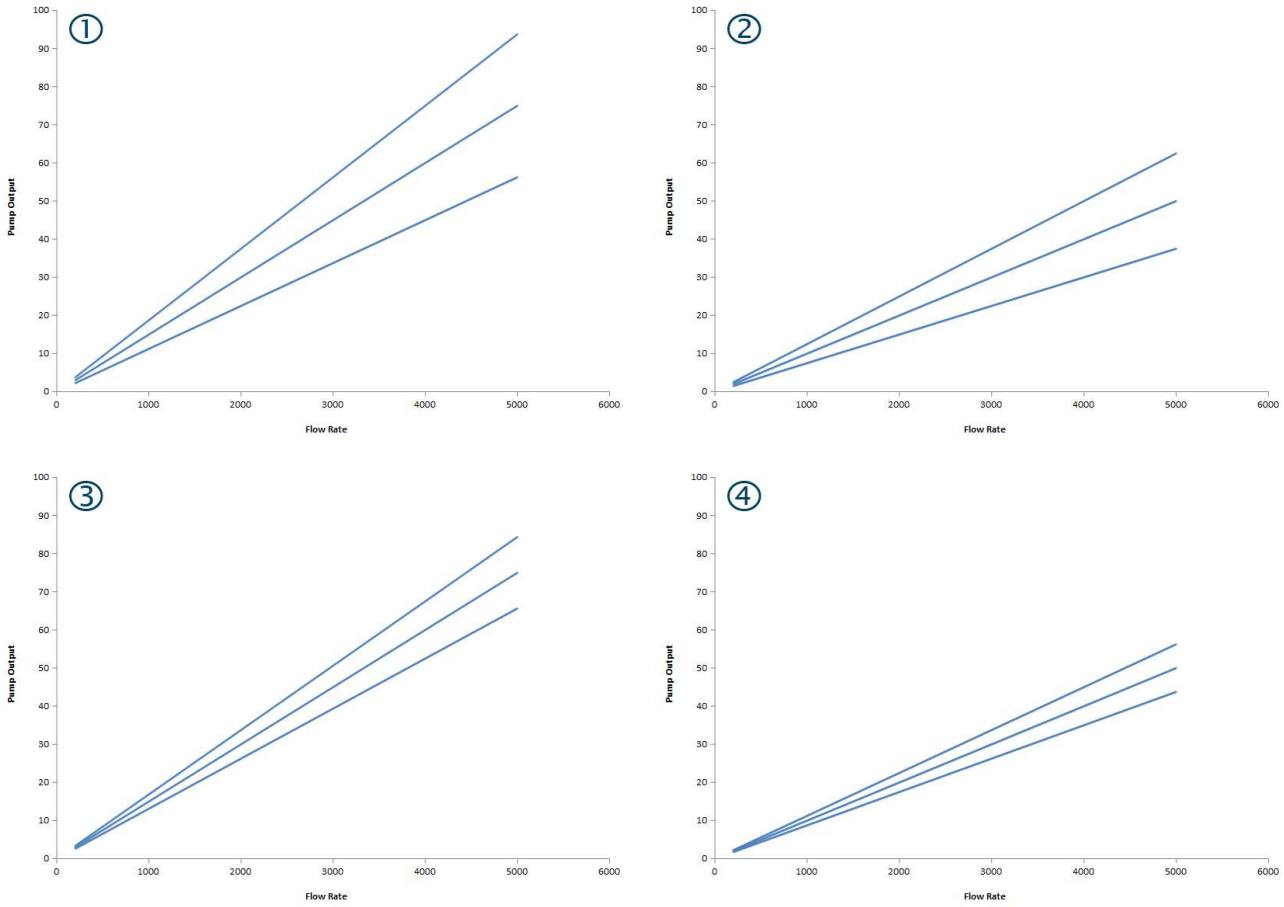


Figure 6.7: The effect of changing the two main tuning factors, flow gain and control trim factor. Graphs show the effect of changing flow with a secondary control output of 100% (upper line), 50% (middle line), and 0% (lower line), where nominal flow is 2000 m^3/hr. Flow gain is 30% in graphs 1 and 3, and 20% in graph 2 and 4. The trim factor is 0.5 in graphs 1 and 2, and 0.25 in graph 3 and 4.

6.7.2.1 Configuration

The flow proportional controller can be configured via the user interface of the HA600 . To access the configuration:

Menu → Setup → Controls → <Device Name>[87]

[87] e.g., Flow Controller 1.1

Configuration of the PID controller is accessed via a GUI wizard with the following data entry pages.[88]

[88] Settings are only saved at the end of the GUI wizard when pressing 'Finish'.

General Setup

Name Device name to identify control in menus. Text can be up to 20 characters long.

Run Mode Select normal operating mode. Options are "Off", "Manual" or "Automatic".

Fail Mode Select operating mode if the controller detects an error condition. Options are "Off" or "Manual".

Signal Process interlock signal selection list. If a signal is selected, controller will disable dosing when signal is active.[89]

[89] See section 6.4 on page 34 for details of signal configuration.

Manual Output

Value Set manual output value. Values from 0.00% to 100.00%.

Flow Input

Sensor Select the flow meter from the list of sensors.

Parameter Only visible if flow input is part of a multi-parameter sensor.

Control Setup

Control Select the control output to apply as a trim to the flow proportional controller output.

Trim Factor Set the trim factor gain to apply to the secondary controller output[90]. Values from 0.000 to 2.000.

[90] See figure 6.6 for details

Control Tuning

Nominal Flow Set the nominal flow. This value is used to calculate the relative ratio. This should be set to the flow rate usually experienced at the plant. Available values are determined by the flow meter range selected above.

Flow Gain Set the gain to apply to the relative flow as the primary output of the controller. The value should be the expected output at the nominal flow rate. Values from 0.0% to 100.0%.[91]

[91] See figure 6.5 for details

Min. Output Set the minimum output of the Flow controller. Values from 0.00% to 100.00%.

Max. Output Set the maximum output of the Flow controller. Values from 0.00% to 100.00%.

Loop Time The update delay between controller output updates. Values from 0.5 to 300 seconds.[92]

[92] If controller output is via relay set in PWM mode, the loop time should equal the relay maximum pulse width. See section 6.6.2 on page 44 for details of relay configuration.

6.7.2.2 Diagnostics

The proportional flow controller diagnostic information can be accessed using:

Menu → Maintenance → Controls → <Device Name>[93]

[93] e.g., Flow Controller 1.1

Information displayed depends on the proportional flow controller mode. 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.

Mode Displays controller mode; Off, Manual or Automatic.

Output Controller output value.

If the controller is in automatic mode and not in error, the following information is displayed.

Flow Input

Value Flow meter input reading.

Output Value of P_{out} as described in figure 6.5.

Control Input

Value Secondary control output.

Trim Factor Value of C_{trim} as described in figure 6.6.

6.8 Options

6.8.1 Auto-Flush

The Auto-Flush control option is available in two options; standard and process.[94] The standard Auto-Flush uses a single relay output and is used in the following applications:

[94] The type of Auto-Flush must be specified at time of order.

- To control the Pi Auto-Flush hardware to allow use of sensors in applications where fouling is a problem.
- To provide the Auto-Clean option of the and sensors.

The process Auto-Flush option is used to control the Pi Auto-Flush hardware in applications where the process is intermittent. The majority of sensors need to stay wet through their operational life and fouling can increase in static samples. Via a signal supplied to the HA600 Auto-Flush unit, the sample is drained and sensors washed in clean water while the process is stopped. When the process is restarted, the sample is restored to the flow cell and measurement continued.

6.8.1.1 Configuration

The Auto-Flush control can be configured via the user interface of the HA600 . To access the configuration, log in with *Technician* or greater privileges and go to:

Menu → Setup → Options → <Device Name>[95]

[95] e.g., Auto-Flush 1.1

For the standard Auto-Flush, the following parameters can be configured:

Name Device name to identify control in menus. Text can be up to 20 characters long.

Control Enables or disables Auto-Flush routine. Options are "On" or "Off".

Delay Time between flushes (d in figure 6.8). Values in HH:MM:SS up to 168 hours.

Length Length of flush (ℓ in figure 6.8). Values in MM:SS up to 60 minutes.

Hold Period of time following flush completion when sensors will remain in hold (h in figure 6.8). Values in MM:SS up to 100 minutes.

For Auto-Flush controls with the process option enabled, the following parameters are available in addition to those detailed above:

Process Process interlock signal selection list. Signal should be active when process is shutdown.[96]

[96] See section 6.4 on page 34 for details of signal configuration.

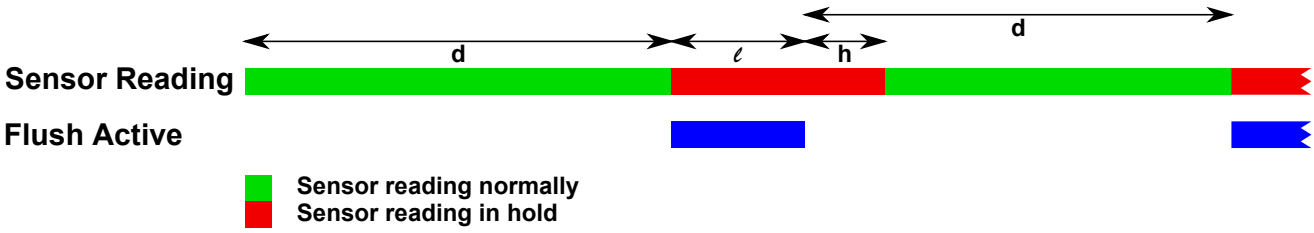


Figure 6.8: Timing diagram for Auto-Flush sequence. d - delay, ℓ - length, h - hold

Sample Controls whether the sample valve is held open or closed through the process shutdown period. Options are "Closed" or "Open".

Fill Extra time beyond the flush length required to fill the flow cell with cleaning water during process shutdown. Values in MM:SS up to 60 min.

Restart Sensor hold time following process restart. This allows longer hold period to allow sample lines to refresh and sensors to recover from long process shutdowns. Values in HH:MM:SS up to 24 hours.

6.8.1.2 Output Options

When mapping a relay to the Auto-Flush controller[97] the Option setting when selecting the control source should be set as follows:

[97] See section 6.6.2 on page 44 for details of relay configuration.

Standard Single relay with Option set to 0.

Process Three relays are required. Relays with the following Option values have the function listed below:

1. Sample valve
2. Drain valve
3. Wash valve

6.8.1.3 Manual Flush

Operators logged in with *User* or greater privileges can start a cleaning cycle by using the HA600 user interface. Select Menu → Maintenance → Flush Now → <Device Name>.[98]

[98] If only one Auto-Flush option is available the sub-menu to select the device will not be present.

Part III Operation and Maintenance

7

Logs

The HA600 logs both data and system events. These logs are useful for detecting system faults or for viewing and recording previous data events.

7.1 System Logs

This is a list of notable events that are recorded. The data recorded includes date, time, and details of the event. The latest event is at the top of the screen. Scroll down for older events and right to read long error messages.

Menu → Logs → System Logs

This data is available to view on the display and via GPRS/LAN.

The system log records notable events such as (but not limited to):

- Analyser turned off.
- Alarms.
- System faults.
- Time and date of setup changes.
- Sensor calibrations.

If you need to contact the manufacturer or their representative for assistance with a problem, please have any relevant data from the system log to hand.

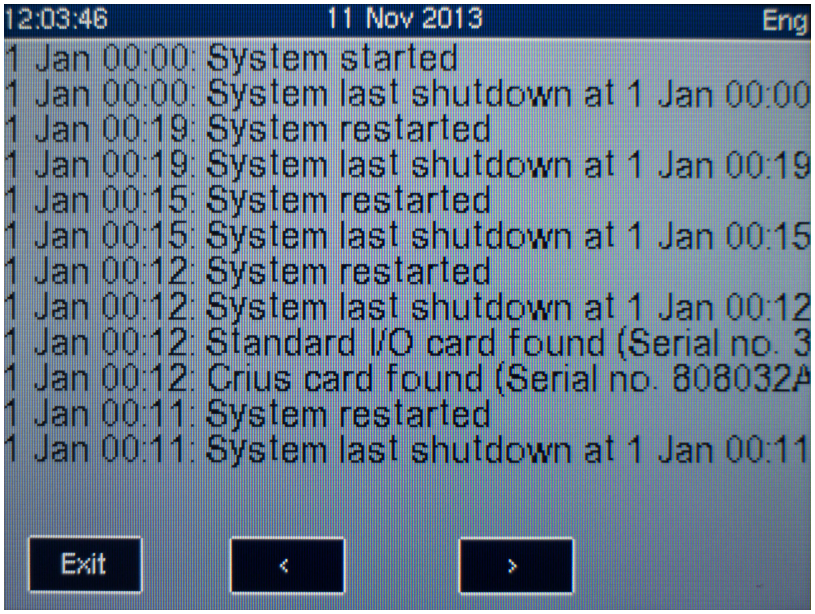


Figure 7.1: HA600 system logs.

It is not possible to download the system log.

7.2 Data Logs

This is a log of sensor and output values that can be exported in CSV format.[1] Note that for the log data to appear here it must be enabled in

Menu → Setup → Sensors → <Sensor Name> → <Parameter Name>[2]

[1] Comma separated values readable by any spreadsheet application.

[2] See section 6.3 for naming details.

7.2.1 Sensor Logs

Select the sensor to view:

Menu → Logs → Sensor Logs → <Sensor Name>[3] → <Parameter Name>[4]

[3] e.g. pH Sensor.

[4] e.g. Temperature.

This will bring up an automatically generated graph of the last 400 data points. If too few data points have been recorded up to that point, a message 'Too few data points' will be displayed. To view the data press 'Data'.

Options are:

Save	Saves the data to a MicroSD card.[5]
Data	Displays a list of the log.
Graph	Displays the graph of up to the last 400 data points of the log.

[5] The log will be saved to the MicroSD card using the abbreviation set in section 6.3.1.2 in the form <abbrev>.CSV.

7.2.2 Output Logs

Select the output to view, the options are as above. The filename when saving logs is derived from the abbreviation set in sections 6.6.1 and 6.6.2

Menu → Logs → Output Logs → <Device Name>[6]

[6] e.g. Relay 1.1.

7.2.3 Graphs

The HA600 has the capability to plot more than one measurand on a single graph. Up to six combination[7] graphs can be configured. These can be useful in generating an understanding of cause and causality in process control and process monitoring applications. To set up a combination graph go to:

[7] Called "Combo" on instrument.

Menu → Logs → Data Logs → Graphs → Set Up → <Combo 1-6>

Label	Combination graph name alpha numeric x characters.
Parameters	1-4 parameters (measurands).

Pressing 'Next' will take you to the next step in the setup wizard where you can select the sensor and the parameters to graph. Repeat this process until all the parameters have been selected. Press 'Finish'.

To view the combination graph you have created, select the name entered in “Label” above from:

Menu → Logs → Data Logs → Graphs

7.2.4 Save All

In order to save all of the available Datalogs with one command:

Menu → Logs → Data Logs → Save All

You will be prompted “Insert blank MicroSD and press ‘Next’ to start”.

Pressing ‘Next’ will save all the data logs to the MicroSD card in the slot on the front of the analyser.

The file is in a .csv format and can be opened by any spreadsheet program. The filename is the same as described in section 7.2.1 and 7.2.2 and 7.2.2

The data will be in date order (i.e. newest at the top).

Each measurement will have its own file. This is to allow for the increased flexibility (i.e. different measurands etc. logging at different frequencies.)

7.2.5 Backing up of Data Logs

Datalogs are stored in the internal flash memory of the analyser. There is limited storage space available, so old log files are over-written when the space is filled. This data can be backed up to MicroSD card prior to deletion if required. No configuration is required. Simply leave a MicroSD card in the slot and when data is deleted, it is first copied to the MicroSD card in CSV format. To avoid overwriting data already on the card, data backed up in this way is stored in a file named _<abbrev>.csv. If the file already exists the data is appended to the end of the file. Please note, a manual download will be required to save the most recent data to the MicroSD card and the two csv files will need to be manually combined.

8

Sensor Maintenance

Part IV Troubleshooting

9

Troubleshooting Guide

9.1 HA600 Operation

Symptom	Possible cause	Possible solution
No display or LEDs.	No power. Ribbon cable disconnected.	Check power connections. Open unit and check the fuse. Turn off the power then check ribbon cable connection.
LEDs light up, but no display.	Display faulty.	Return unit for repair. Use returns sheet.
HA600 LEDs count from right to left.	Resetting.	Wait 4 cycles, switch power OFF/ON. Allow this action again. After second power OFF, if resetting continues, power OFF. Put power ON and at first countdown of LEDs, enter SAFE MODE (when countdown starts press the lower right hand key and right of bottom keys, when countdown finishes, release the keys). In MENU → MAINTENANCE → FACTORY RESET the unit (Tech or higher level password entry).
Sensor on display is GREY and displays OFFLINE	Channel not enabled	In MENU → SETUP → SENSORS → SETTINGS. ENABLED is set to OFF, change it to ON.
Sensor on display is RED and displays ERROR.	Sensor not connected (correctly). Jumpers for this Sensor are set wrong. Channel PSU fault.	Check Sensor connections in MENU → INFORMATION → CONNECTIONS → SENSORS Contact Chemtrac Support for jumper settings. Directly above the wiring connection is a PSU, number.
4..20mA output not working.	Not configured. Jumpers in wrong position	Check assignment of output (section 6.6.1, page 42). Contact Chemtrac Support.

Continued on next page

Table 9.1 – *Continued from previous page*

Symptom	**Possible cause**	**Possible solution**
Relays not working.	Not configured.	Check assignment of output (section 6.6.2, page 44).
When unit powers on, Chemtrac logo displayed.	Device codes not installed.	Contact Chemtrac for device codes.
No RED light PSU indicated. Unit won't respond.	PSU faulty. Check fuse, replace. If needed, return to Chemtrac.	Check supply to unit.
HA600 loss of functionality i.e. PID not responding.	Battery dead.	Check voltage, if under 3.0V replace. Contact Chemtrac first. See manual for identification.
Time and date wrong after power has been OFF	Battery	Contact Chemtrac.

9.2 Further help

For more help and guidance, please visit `http://chemtrac.com` or contact your sales or service outlet.

Part V Documentation

10

Certificates and Approvals

10.1 CE Approval

Figure 10.1: CE logo

10.1.1 Declaration of Conformity

The product meets the legal requirements of the harmonised European standards. Chemtrac, Inc (Chemtrac) confirms compliance with the standards by affixing the CE symbol. Specifically the product complies with the following directives:

73/23/EEC The Low Voltage Directive and its amending directives.

89/336/EEC The Electromagnetic Compatibility Directive and its amending directives.

10.2 Waste electrical and electronic equipment (WEEE)

10.2.1 Commitment to RoHS and WEEE

Chemtrac is committed to meeting all requirements of the European Union's (EU) WEEE (Waste Electrical and Electronic Equipment) and RoHS (short for Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment) Directives. These directives require strategies for waste management and product design for the environment for electrical and electronic equipment sold into EU countries.

10.2.2 Compliance statement WEEE

Chemtrac is committed to meeting all requirements of the Waste Electrical and Electronic Equipment Directive (2002/96/EC).

1. Background

   The European Union's Waste Electrical and Electronic Equipment Directive 2012/19/EU, has been published in issue L197 of the Official Journal on 24 July 2012. There are several obligations imposed on Pi as a producer of electrical and electronic equipment. Chemtrac's compliance approach for each of these obligations is provided below.

2. Product Design

   Chemtrac's products are designed to ensure that all of our equipment can be dismantled and the components and materials are recoverable.

3. WEEE Marking

   All Chemtrac's products that are subject to the WEEE directive shipped from 13th August 2005 are compliant with the WEEE marking requirement. Such products are marked with the"crossed-out wheelie bin" WEEE symbol (shown, right) in accordance with European Standard EN50419.

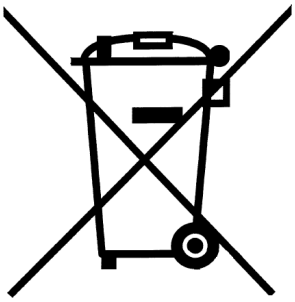


Figure 10.2: WEEE logo

4. Information for Customers

   According to the requirement of the WEEE legislation the following user information is provided to customers for all branded Chemtrac products subject to the WEEE directive. "The symbol on the product or its packaging indicates that this product must not be disposed of with your other household waste. Instead, it is your responsibility to dispose of your waste equipment by handing it over to a designated collection point for the recycling of waste electrical and electronic equipment. The separate collection and recycling of your waste equipment at the time of disposal will help conserve natural resources and ensure that it is recycled in a manner that protects human health and the environment. For more information about where you can drop off your waste for recycling, please contact your local authority, or where you purchased your product."

5. Registrations and Reporting

   Chemtrac will fulfill all legal requirements and have registered with the relevant authorities.

   Our contractor's unique registation number is: CB/WE5237GH.

   Chemtrac will ensure that all information required by our compliance scheme will be provided in a timely manner.

6. WEEE from Private Households

   If any of Chemtrac's branded products are held by private households then any WEEE can be recycled via your local collection facilities. Details of these should be obtained from your local authority.

7. WEEE from users other than Private Households

   Chemtrac will ensure the proper recycling of waste arising from any of its equipment purchased before 13th August 2005 arising at Pi's customers (other than private households) from the purchase of Chemtrac branded product on a like-for-like basis. For Chemtrac products sold after 13th August 2005, Chemtrac will ensure the proper recycling of waste resulting from those products arising at the customer's location within the United Kingdom.

   The costs of recycling described above are included in the product price as standard. The costs of collecting such waste from customers' premises are not included in Chemtrac's standard offer. However, Chemtrac can provide a chargeable collection service or addresses where customers can return their products. All returns must be issued with a Return Number before customers arrange for delivery of WEEE product.

8. Treatment

   In accordance with UK legislation, Chemtrac confirm that treatments and recycling of WEEE done on behalf of Chemtrac, either by a collective scheme or individually, will be carried out in accordance with the requirement of the WEEE Directive, including requirements in respect of special treatment for specific parts and overall recovery rates.

9. Information

   Chemtrac will provide information on reuse and treatment of each new type of WEEE placed on the market within one year.

10. Legal

    The information contained herein is subject to change without notice. Nothing herein should be construed as constituting an additional warranty. Chemtrac shall not be liable for technical or editorial errors or omissions contained herein.

For further information on the WEEE Directive, please visit:

`http://ec.europa.eu/environment/waste/weee/index_en.htm`

10.2.3 Compliance statement RoHS

Chemtrac also is committed to meeting or exceeding the requirements of the RoHS directive (2002/95/EC). The RoHS directive requires that manufacturers eliminate or minimise the use of lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls and polybrominated diphenyl ethers in electrical and electronic equipment sold in the EU after July 1, 2006.

For further information on the RoHS Directive, please visit:

`http://ec.europa.eu/environment/waste/rohs_eee/`

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Material Safety Data Sheets (MSDS)

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Warranty

Chemtrac, Inc (Chemtrac) warrants its product to be free of defects in material and workmanship for a period of one (1) year from date of shipment to the original customer unless specifically agreed elsewhere. Upon receipt of written notice from the customer, Chemtrac 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.

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Returns

If the analyser has to be repaired, please return it cleaned to your local sale organisation or Chemtrac, Inc Service Centre. Please follow the steps below:

- Please use the original packaging, if possible.
- Complete Contaminant Sheet (refer to section 13.1).
- Enclose the completed Contaminant Sheet, with the packaging and shipping documents.

No repair will be undertaken without a completed Contaminant sheet!

13.1 Contamination Sheet

For legal requirements and the safety of our employees, we require that this "Contamination Sheet" is filled in (with your signature) before your instrument can be handled. Please put the completely filled in declaration with the instrument and the shipping documents. Add any safety data sheets (MSDS) and/or specific handling instructions if necessary.

Please provide the following information:

Description:

Serial Number:

Possible contaminants and how cleaned:

Please mark the appropriate warnings:

Radioactive	☐	Harmful	☐
Explosive	☐	Biological Hazard	☐
Caustic	☐	Flammable	☐
Poisonous	☐		

If any of the above are ticked, please give details:

Please provide contact details:

Health and Safety Declaration

I hereby certify that the returned equipment has been cleaned and decontaminated according to good practices and is in compliance with all regulations. This equipment poses no health or safety risks due to contamination.

Signature

Date