Operating Manual

AEGIS Ammonia Analyzer

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CONTENTS

AMMONIA User Manual

A. THEORY OF OPERATION

What is ammonia?

Ammonia (NH_3) is a poisonous and pungent-smelling colorless gas that makes the eyes water. Ammonia is readily soluble in water. The aqueous solution has an alkaline reaction and is known as ammonia water or tincture of ammonia. In conjunction with acid, ammonia forms salts that disassociate in water, to form ammonium ions (NH_4^+) and the corresponding anions. In nature, ammonia is produced by the decomposition of animal or vegetable material that contains nitrogen.

Typical areas of application for ammonia sensors

The ProMinent ammonia analyzer sensor can be used to measure ammonia (NH_3) in aqueous solutions. Ammonia in an aqueous solution is in a pH-dependent equilibrium with ammonium ions. If ammonium ions are converted into ammonia by the addition of an alkali, then the sensor will detect the resulting ammonia gas. The ammonium ions themselves will not be detected.

Fig. 1: ProMinent Ammonia Analyzer

Some typical applications using ammonia sensors are:

- municipal water plant chloramination monitoring
- wastewater of gas scrubbers
- wastewater monitoring
- ammonia leaks in cooling towers
- the food sector, e. g. for wine and beer
- laboratories.

The measurement can be made directly in the liquid medium. This means that it is not necessary to carry out time-consuming and complicated sample preparation. Colored or cloudy samples can also be measured. The pH value must be greater than 7.3 or the chemical equilibrium of the ammonium ions shifts towards the ammonia state.

If the sample contains substances that could damage the sensor membrane, such as oils, fats or tensides, then the ammonia can still be measured, using the technique known as “head space”. In this case, damage to the sensor is ruled out, because there is no direct contact between the sensor and the sample. Measurement is performed in a gas-tight space above the substance being measured. This gas-tight space above the substance being measured is in equilibrium with the liquid as far as ammonia is concerned.

The simple sample preparation makes determination of the ammonia concentration a fast and economical operation that can be applied with high precision over a wide range of concentration.

Principles of analyzer operation

The ammonia sensor consists of a glass pH electrode and a reference electrode which are surrounded by a common electrolyte that is separated from the liquid being measured by a hydrophobic, gas-permeable membrane.

A thin layer of electrolyte is between the hydrophobic membrane and the glass pH electrode. Its pH value increases when NH_3 gas makes its way through the membrane. The chemical processes in the electrolyte layer are described by the following reaction equation.

$$NH3 + H2O \rightarrow NH4^{+} + OH^{-} \quad (1)$$

This means that NH_3 functions as a base and thus increases the pH in the thin electrolyte layer in front of the glass pH electrode. Since there is only a very small volume of liquid between the hydrophobic PTFE membrane and the glass electrode, the electrode reacts very sensitively to the smallest amount of ammonia.
A strongly simplified derivation leads to the following relationship between the sensor signal and the concentration of ammonia in the substance being measured: The reaction (Equation 1) is described by the law of mass action:

$$K = [NH4^{+}] [OH^{-}] / [NH3] \quad (2)$$

K = equilibrium constant
[x] = concentration component x

The electrolyte has a relatively high concentration of ammonium chloride, so the concentration of ammonium ions in the thin electrolyte layer may be regarded as constant if a small amount of NH_3 permeates the membrane and NH_4^+ is formed in accordance with the equation given above. As a result, the concentration of ammonium ions can be included in the equilibrium constant K´.

$$K' = [OH^-] / [NH3] \quad \text{or} \quad [OH^-] \sim [NH3] \qquad (3)$$

Applying the Nernst equation thus results in the following dependency:

$$E = E_0 - S \log [NH3] \qquad (4)$$

E = electrode potential
E_0 = standard electrode potential
S = slope, f (T)

pH dependence

In accordance with the above-mentioned reaction equation (Equation 1), ammonia (NH_3) in an aqueous solution is in a pH-dependent equilibrium with ammonium ions (NH_{4+}). This dependence is shown in Figure 3.

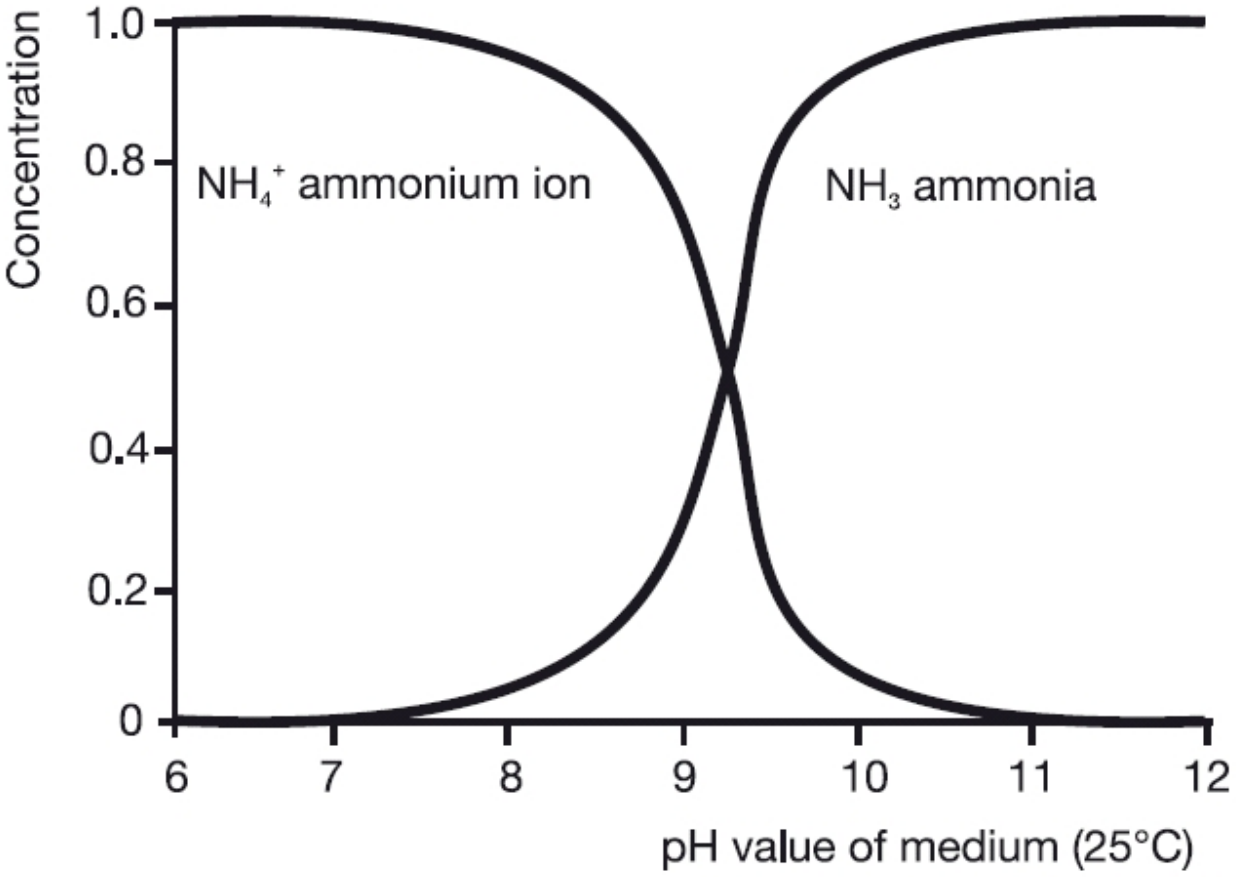


Fig. 3: pH dependence of the equilibrium between ammonia and ammonium ions

- Only NH_4^+ ions (ammonium) are present at pH <7
- The ratio of NH_4^+ ions (ammonium) to NH_3 (ammonia) is 1:1 at pH 9.3
- Only NH_3 (ammonia) is present at pH >11

If ammonium ions are predominant in the solution, as is the case in the acidic range, then they must be converted into ammonia (NH_3) by the addition of a strong alkali (e. g. NaOH, adding 10 N NaOH solution to the liquid being measured for a pH > 11), since the membrane is only permeable for ammonia (water in a liquid aggregate or ionic constituents such as ammonium ions cannot pass through the membrane).

Ammonia sensor membrane caps

The advantage of the ProMinent sensor for ammonia is that prefabricated membrane caps are available, thus avoiding the manual fitting under tension of the sensitive membrane.

Concentration range

The potentiometric measurement of ammonia shows a linear characteristic over a wide range of concentration on a semi-logarithmic plot, as is indicated in the following conversion table for various units of concentration.

mol/l	ppm as N	ppm as NH_3
5×10^{-7}	7×10^{-3}	8.5×10^{-3}
10^{-6}	1.4×10^{-2}	1.7×10^{-2}
…	…	…
10^{-1}	1400	1700
1	14000	17000

Table 1: Conversion table for various units of concentration

At especially low levels of concentration, the response time can be considerably longer, as shown in the table above. It may be possible to improve the response time by diluting the electrolyte by a factor of 10, using distilled water.

And, particularly at high concentration, there is a risk that readings are too low because of ammonia losses. Samples should therefore be measured as soon as possible. Loss of ammonia can be reduced by a cover or by using the apparatus in an enclosed vessel.

ProMinent Ammonia Analyzer measurements

The relationship between the electrode voltage and the concentration of ammonia in water is stored in the form of a typical characteristic (Figure 5). The ProMinent analyzer is thus able to calculate the ammonia concentration from the electrode voltage measurement and display the result directly in the concentration unit “parts per million” (ppm) on the analyzer display.

The characteristic curve that is stored in the transmitter is, of course, valid for certain specified conditions, such as the composition of the liquid and the pH value, and individual sensor characteristics also play a part. If conditions differ from those specified, or different electrodes are used, then this will affect the

displayed value for the concentration. The individual characteristics of the particular sensor are allowed for in the zero point calibration. First of all, the sensor voltage is measured in the presence of ammonia, and the curve shown in Figure 5. is shifted accordingly. The slope is calculated according to the Nernst equation. This requires an automatic temperature measurement with a Pt 100 sensor.

Special aspects

Coloration or opacity of the liquid being measured does not affect the measurement. Most ionic substances in the sample will also have no effect, since they cannot pass through the hydrophobic membrane. But volatile amines, for instance, may affect measurement. These include various substances, e. g. methylamine, ethylamine and hydrazine. Such substances also exhibit an alkaline reaction in the sensor electrolyte. The presence of such substances in addition to ammonia leads to an erroneously high concentration reading.

If the liquid being measured contains solvents or tensides from cleaning agents or detergents that can affect the hydrophobic properties of the membrane, then measurements should be made in a gas space above the liquid. This “head space” method requires that the ammonia sensor is built into a completely gas-tight fitting. A head space measurement is also advisable if oil or grease is present, since these would also block the membrane and thus adversely affect the response time of the electrode.

The sensor membrane is very delicate and must not be touched in any circumstances. Cleaning by mechanical means is not possible. Measurements cannot be performed under pressure, because the compression of the inevitable air bubbles in the sensor electrolyte can cause distortion and damage to the inelastic membrane.

B. INSTALLATION & NAVIGATION

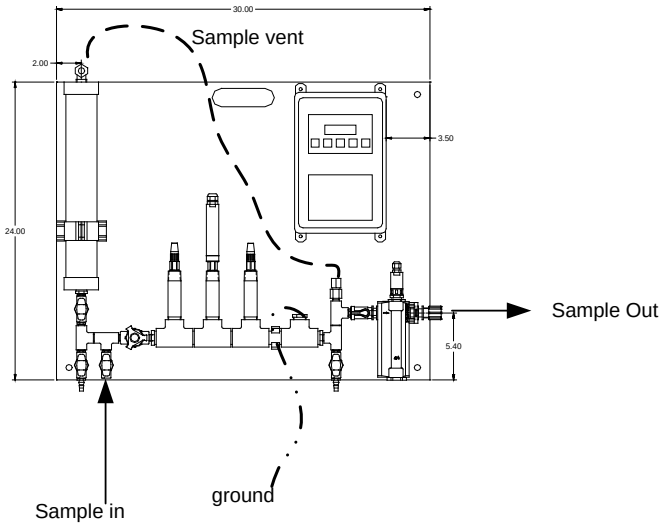
Panel is intended for wall mounting at a height where the analyzer can be easily viewed.

B.1 Plumbing

Inlet fitting is 3/8” hose barb and outlet connection and sample vents are 1/2” compression tubing. The inlet source should be a representative sample from the process with the following criteria:

Sample flow rate: Adjust needle valve to permit enough flow to allow flow switch to actuate.
Pressure range at the analyzer inlet: 45 psi
Pressure at the analyzer outlet: if not to drain then it should be lower than inlet pressure.
Water quality: Clear, not turbid
Maximum temperature: 40 deg C (104 deg F)

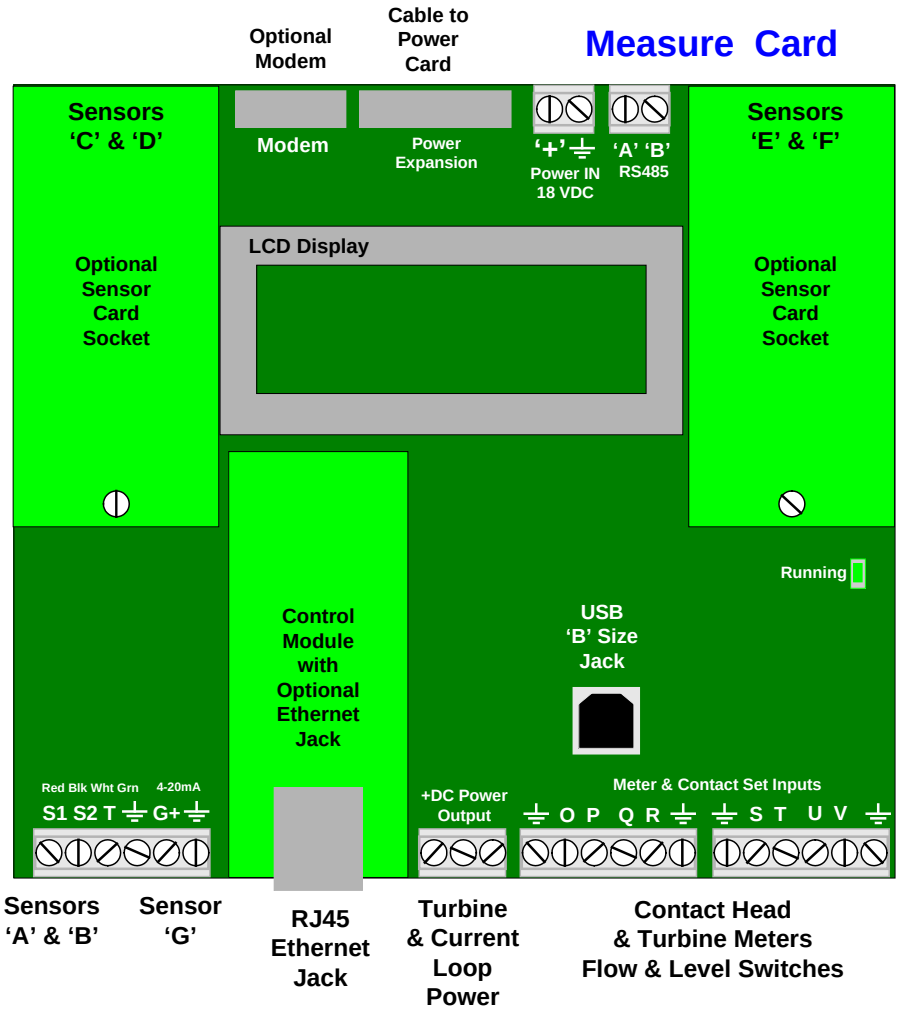
Note: Do not expose sensors to high pressures! Always open the downstream sample shutoff and needle valves first before opening the upstream sample valve when commissioning the unit. When turning off the sample stream close valves in reverse order by first closing the upstream valve.



B.2 Cabling – Wiring

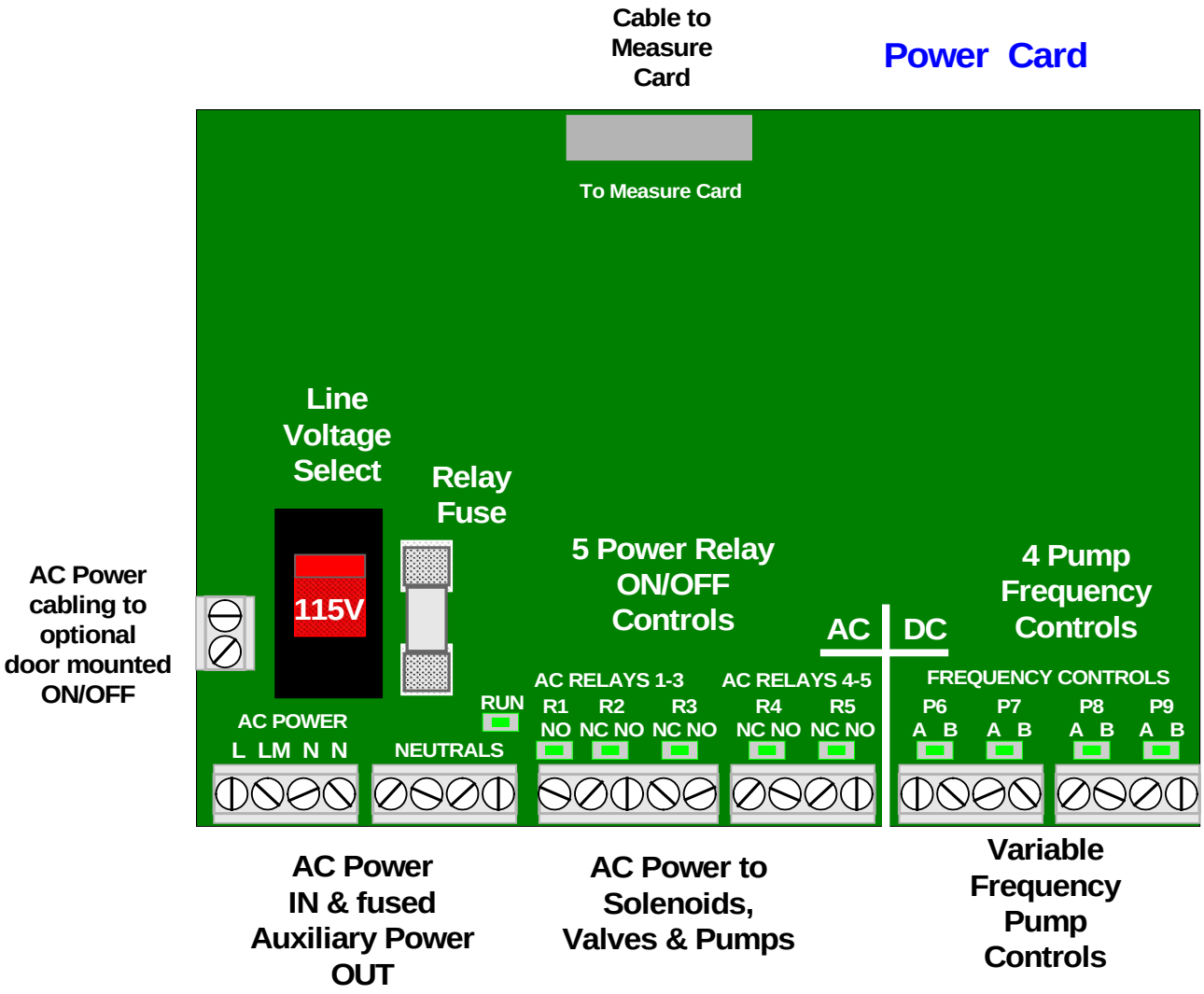
B.2.1 Analyzer Wiring Terminals

Controllers consist of two circuit boards, a front **Measure** circuit board and a back **Power** board.
The front, **Measure** circuit board supports 7 sensor inputs & 8 digital Inputs.
It includes a 2 line x 16 character LCD display, USB Type 'B' jack and a microcontroller module.



B.2.1 Analyzer Wiring Terminals cont.

The back, **Power** circuit board has 5 ON/OFF Power Relays, 4 Variable Frequency Feed outputs and the controller power supply.
The **Ai**, industrial version of the Aegis, includes an enclosure door mounted AC Power ON/OFF switch.



A blue tinted electrical shield, secured by two thumbscrews, covers the terminals of the **Power** board. Controllers may be supplied prewired with either 120VAC NEMA sockets or with an optional plug box. Variable frequency pump control cables may be pre-wired.

B.2.2 Wiring Rules

Analog Sensor Wiring

Analog sensors, contact sets, water meters and flowswitches may be cabled in a common conduit without causing operational problems.

Do not mix AC Line, 120VAC & 240VAC wiring with any sensor or communications cable in a common conduit. Grounded, metallic conduit is preferred in areas where variable frequency drives operate.

Sensor cables, with the exception of pH sensors, may be extended in paired AWG22, 0.25mm^2 cable. Ensure that cabling splices are accessible in conduit fittings or junction boxes.

Verify that the shields on contact head water meters are also spliced when meter cables are extended. Ground cable shields at one end only to the internal frame lower bottom grounding screw.

Ethernet LAN Cabling

CAT5 LAN cabling is limited to a maximum of 300ft / 100m from controller to access hub.
Do not exceed this limit.

AC Controller Power

Power the controller using a dedicated, separate breaker in the local lighting-distribution panel.
Do not route the controller AC power in common conduit with variable frequency pump drives.

AC Power to Valves & Solenoids

Controller ON/OFF relays switch and power the AC line to valves & solenoids. Ensure that each valve & solenoid has a dedicated neutral cable between the controller and the valve or solenoid. Do not share a common neutral to multiple valves or solenoids.

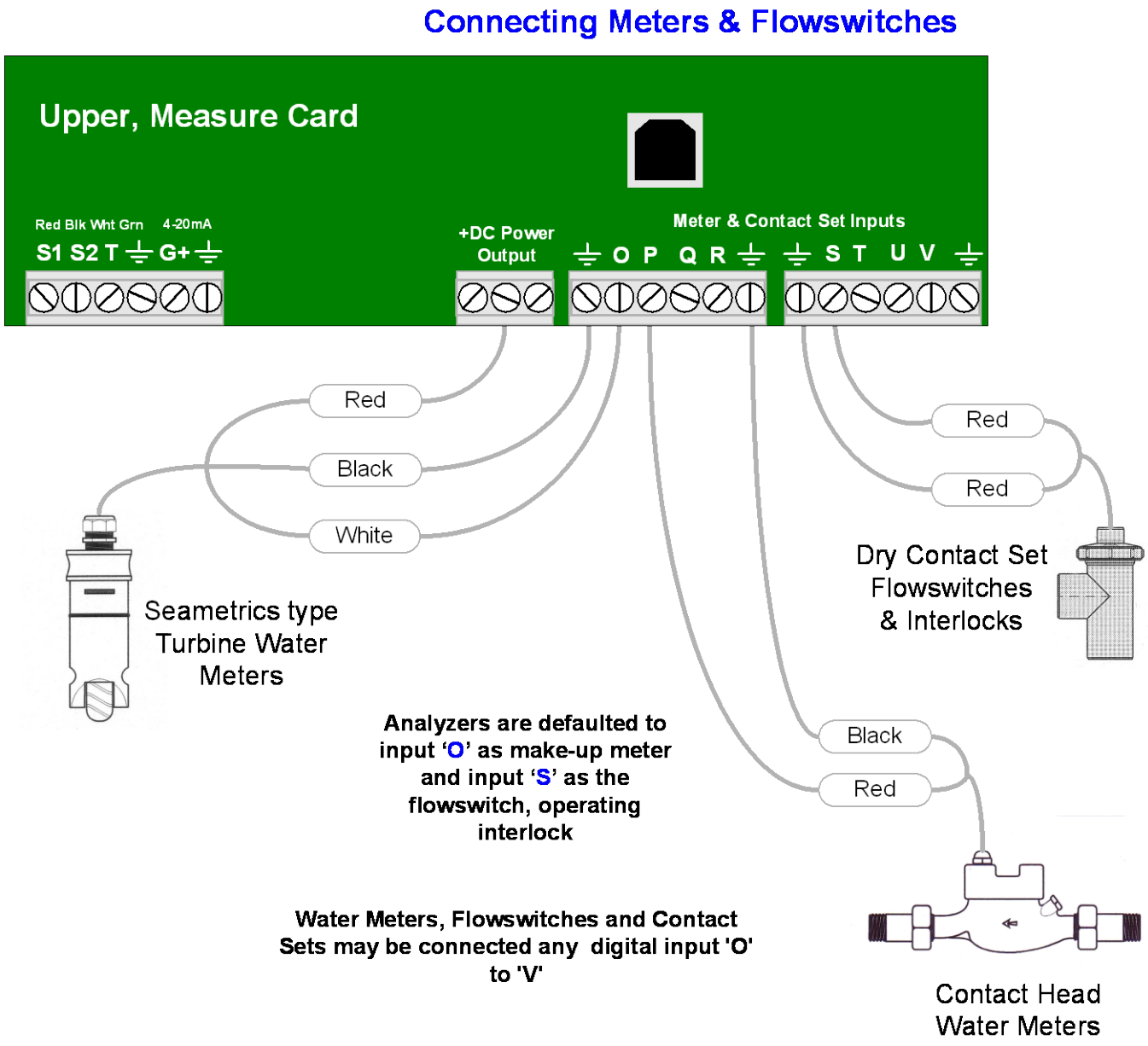
Fractional Horsepower Chemical Feed Pumps

The controller ON/OFF relays are fused at 5 amps total which will power multiple solenoid driven chemical feed pumps and solenoid coils. Fractional horsepower chemical feed pumps cannot be directly powered by the controller. Use the controller 120VAC control output to switch a motor start relay with a 120VAC coil.
Fractional horsepower feed pumps are commonly used in high pressure boiler chemical feed applications and waste water polymer feeds.
Typically the motor inrush current requires a dedicated breaker and separate AC feed from the controller AC power breaker.

B.3 Water Meters – Flowswitches – Contact Sets

Water meters, flowswitches and 'dry' contact sets are connected to input terminals 'O' through 'V' and a ground terminal. 5VDC limited by 10K puts 1/2mA through a closed contact set.

Hall effect Turbines and Paddlewheel water meters are powered by the 15-22VDC analyzer supply, thermally fused at 100mA.



Connect cabling shields at the controller ends of the cable only, to any ground terminal either on the Measure card or on the aluminum backplate, bottom, center

B.4 Safety & Navigation

Safety Electrical Shock Hazard

Opening the Analyzer enclosure with the Analyzer plugged in, exposes the user to AC line voltages on the lower of the two Analyzer circuit boards.

Ground the Analyzer AC power to the ground screw labeled  and located on the bottom, right of the aluminum backplate.

External, 120VAC socket or optional plug boxes are provided with Analyzers installed in North America. Both are grounded to the ground screw labeled  located on the bottom, center of the aluminum backplate.

USER WARNING : CAUTION

Water Treatment Analyzers operate steam and water valves and may pump hazardous, corrosive and toxic chemicals. Opening the Analyzer enclosure exposes user to the risk of electrical shock at power line voltages.

Understand fully the implications of the control setpoints, interlocks and alarms that you select. Harm to personnel and damage to equipment may result from mis-application.

Unplug or turn OFF the AC power to the Analyzer if you have any concerns regarding safety or incorrect Analyzer operation and notify supervisory staff.

YOUR ANALYZER

Ammonia Analyzers are supplied in many different configurations, part numbers and sensor sets. Applications extend beyond water treatment.

The **HELP** section depicts the installation plumbing header showing the sensor set supplied with your Analyzer. It also includes the information for terminating the sensors supplied with your specific Analyzer part number.

The **START-UP** section is specific to your application and details modifying the default Analyzer settings for your site.

NAVIGATION

KEYPAD

If you get lost in a sub-menu, press **EXIT** & you'll stop what you're doing & move back to the main menu

An **ENTER** symbol on the display signals that there are sub-menus available,

UP & **DOWN** to view options or to EDIT numbers

Move **RIGHT** to select next field when EDITing

ENTER to select an option & to execute EDITing

EXIT to escape option, info display or EDITing

MAIN MENU

The sensors and controls in the main menu vary with your Analyzer part number and sensors and pumps that you enable or disable.

The main menu groups sensors with the relays that they control.

Where are Sensors and Relays Connected?

You may modify the names of sensors and outputs but the Analyzer tags each input with a letter **A** to **Z** and each output with a number **1** to **9** representing where each is wired.

Inputs **A**, **B** and **G** and **O** to **V** have fixed wiring terminals on the upper Analyzer board.
G is a temperature sensor
Inputs **O** to **V** may be individually selected to be digital inputs.

Terminals for outputs **1** to **5** are located on the lower board.
They are ON/OFF power relays that switch 120 or 230VAC.

Terminals for outputs **6** to **9** are also located on the lower circuit board.
They are electronic switches used for frequency control.

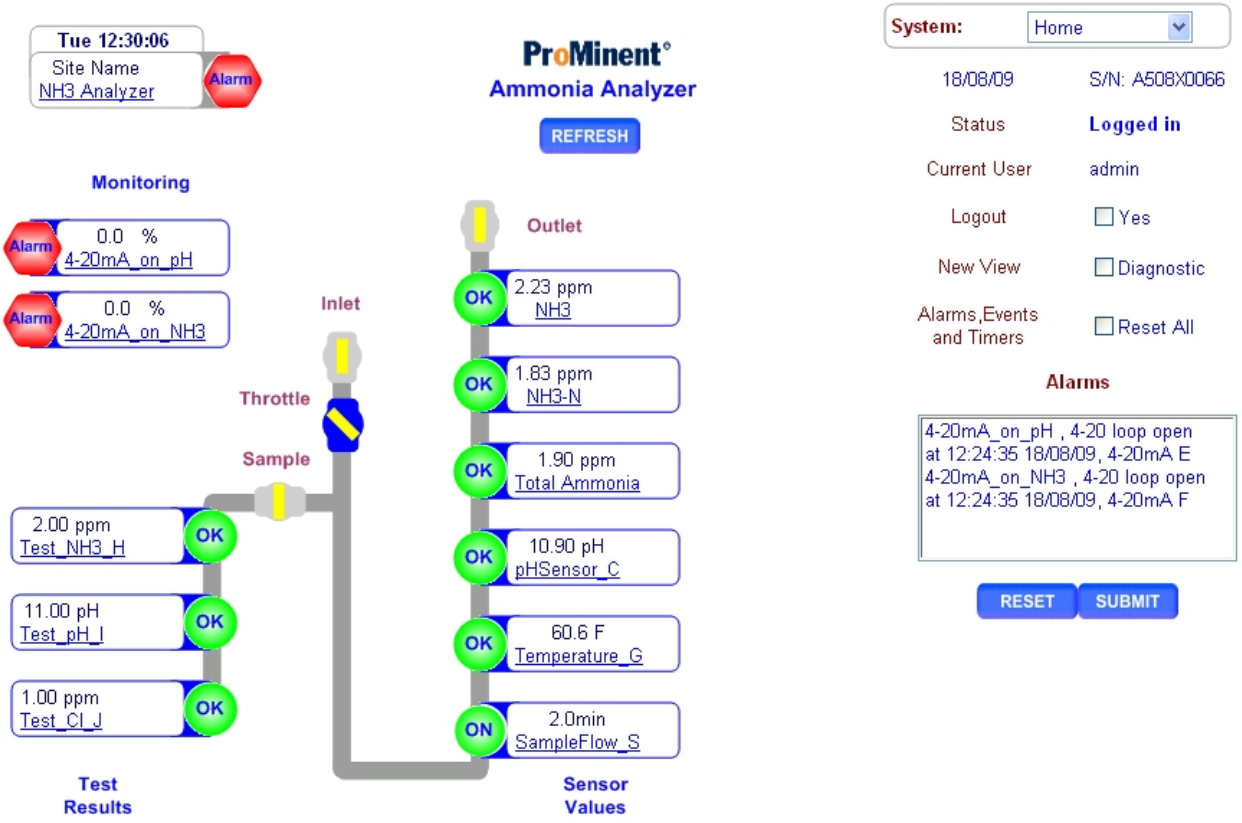
Inputs **C-D** and **E-F** are used for plug-in sensor cards which add optional 4-20mA inputs & outputs to the Analyzer. The pH sensor and NH3 sensor are wired into the OP card as inputs C-D, respectively.

Sensor inputs **H to N** and meter/contact set inputs **W to Z** don't physically exist in the Analyzer and are used to calculate other advanced Analyzer functions.

B.5 Browser

Analyzers with the '**LB**' LAN-Browser option include a built-in command & control web server with real time views of your Analyzer operation.
You can browse with Mozilla's Firefox or Internet Explorer 7 over a 10BaseT Ethernet connection or the internal modem, if installed.

If the '**LB**' option is included in your Analyzer, the Browser appendix '**LB**' has been added to this manual



Sidebars: Are used to explain typical uses for feed and control functions.
Sidebars are at the bottom of the page detailing the function.
New users & users new to water treatment will find these explanations helpful.

B.6 Communications

USB Services

All Ammonia Analyzers include a USB port which is used for three purposes:

1. Upload of logged data in XML format to a notebook PC or a PDA operating as a USB host.
2. Download of View-Configuration Sets into the analyzer.
3. Upload of the current controller configuration from the analyzer to support generation of View-Configuration Sets and for controller cloning.

Configuration-View sets:

Controllers with the '**LB**' Ethernet option are loaded with the ammonia view. It is selected when the controller is manufactured to be the 'as shipped' view-configuration.

LAN TCP-IP:

The **LB** analyzer option adds a 10 Base T, RJ45 Ethernet port with a user assigned static IP. The controller operates as an HTML micro-server for command & control using IE7 and Mozilla's Firefox browsers. Logged data is served as an XML file in response to an HTML request.

Modem:

The **RM** controller option adds a 57,600 baud micro modem that provides a PPP connection so that remote users can browse the controller. AJAX supports the same graphical View interface used by on-site users.

B.7 Data Logging

Each enabled input and output is logged by the analyzer as a user set interval from 5 to 1440 minutes. Each I/O can be independently logged at its own rate. The default rate for all I/O is 60 minutes with a 600 sample log size. Sensors log minimum, maximum and average. Water meters log volume. Contact sets log time ON. Power relays and valves, log ON time in seconds.

Alarms are time & date stamped. The last 25 controller activities are time and date stamped with the user ID.

Note: Data logging of relay ON time stops when AC fuse fails since without a fuse a relay can't power ON a valve or solenoid**.**

C. MINIMAL START GUIDE

Safety:

Sensors are installed into pressurized piping.
Loose or improperly assembled fittings may leak water or chemicals.

Do not leave the analyzer turned ON unless you have configured it for the site's water treatment program & verified that auxiliary equipment is operating.

FYI: **inserts 'For Your Information' explanations.**

Here's what we're going to do:

Startup walks you through analyzer set-up step by step.
We'll start by verifying each sensor.

First time users:

Have the analyzer user manual available to step you through thecalibrate, configure and setpoint sequences.

If you have the '**LB**' LAN-browser option installed, you can use a notebook PC & Ethernet crossover cable to startup. Refer to Appendix 'H' of the user manual if you haven't set-up your notebook to browse the analyzer

FYI: Your analyzer may have been pre-configured for this site.

Minimum Startup Sequence

Valve ON flow: 1

Open the downstream isolation valve on the sensor mount manifold header and then the upstream isolation valve.

FYI: Always OPEN in this order & CLOSE upstream first.

Check for leaks: 2

Inspect the sensor entries for leaks & correct.
Check that installation fittings are not leaking.

Verify Flowswitch: 3

Plug-in or power up the analyzer. Scroll **UP** or **DOWN** to the '**S**' Flowswitch_S display and ensure that within 30 seconds of power ON the flowswitch shows ON.
Don't proceed until the flowswitch shows ON.

Check Temperature: 4

Scroll **UP** or **DOWN** to the sensor '**G**' Temperature_G display & check that it's displaying the approximate temperature, +/-10F.

FYI: Temperature needs to be accurate. We're using it to compensate ammonia, so it has to track, changing when the sample water changes temperature.

Calibrate pH: 5

Scroll **UP** or **DOWN** to the sensor '**C**' pH_C display
Measure the water pH at the sensor sample valve and calibrate the pH sensor per Appendix E.

Calibrate NH3: 6

Scroll **UP** or **DOWN** to the sensor '**D**' NH3 Sensor_D display
Measure the water NH3 at the sensor sample valve and calibrate the NH3 sensor per Appendix E.

Correct for Time Zone: 7

Key **EXIT** to the Day – Time display.
If necessary, key **ENTER** scroll to **Time&Date** & adjust the time for your time zone.

FYI: Sets the time & date stamp correctly for timed data logging

Minimum Startup Set Alarms

Set pH Alarms: 8

Scroll **UP** or **DOWN** to the sensor '**C**' pH Sensor_C display
Key **ENTER** to **Alarms** and adjust both **High Alarm** and **Low Alarm**.

Set ammonia alarms: 9

Scroll **UP** or **DOWN** to the sensor '**D**' NH3 Sensor_D display
Key **ENTER** to **Alarms** and adjust both **High Alarm** and **Low Alarm**.

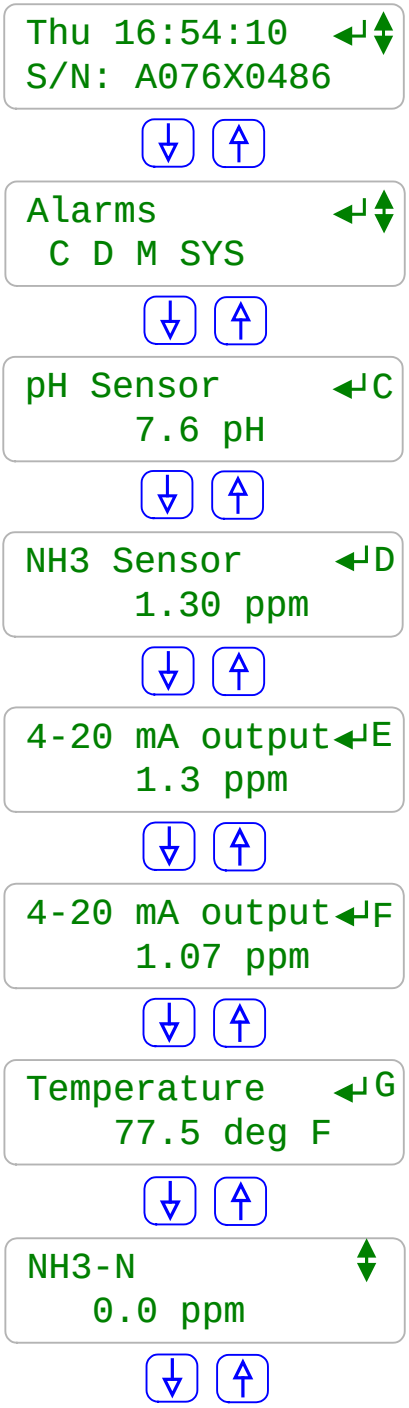
24/7 Sites, Set Flowswitch Alarm: 10

Scroll **UP** or **DOWN** to the '**S**' Flowswitch_S display.
Key **ENTER** to **Alarms** and adjust **No Flow Alarm.**
FYI:A No Flow alarm indicates no flow past the measuring sensors.

1.0 Day-to-Day Operation

1.1 Main Menu

This is the power-on day of week & time display. The Serial Number tracks special features & the sensor set installed in your Analyzer. Press **ENTER** to view-set system settings



Active alarms are displayed by the letter, **A..Z**, of the input or the number **1..9**, of the output
Press **ENTER** to reset alarms, to view alarm detail, or to scroll the key-press log,

Present value of the pH connected to sensor input '**C**'. Updates every second.
Press **ENTER** to Calibrate, view-set Alarms, Compensation

A NH3 sensor is connected to Analyzer input '**D**'.
Press **ENTER** to Calibrate, view Diagnostics, Configure…

A temperature sensor is connected to Analyzer input '**G**'
Press **ENTER** to Calibrate, view Diagnostics, Configure…

continued

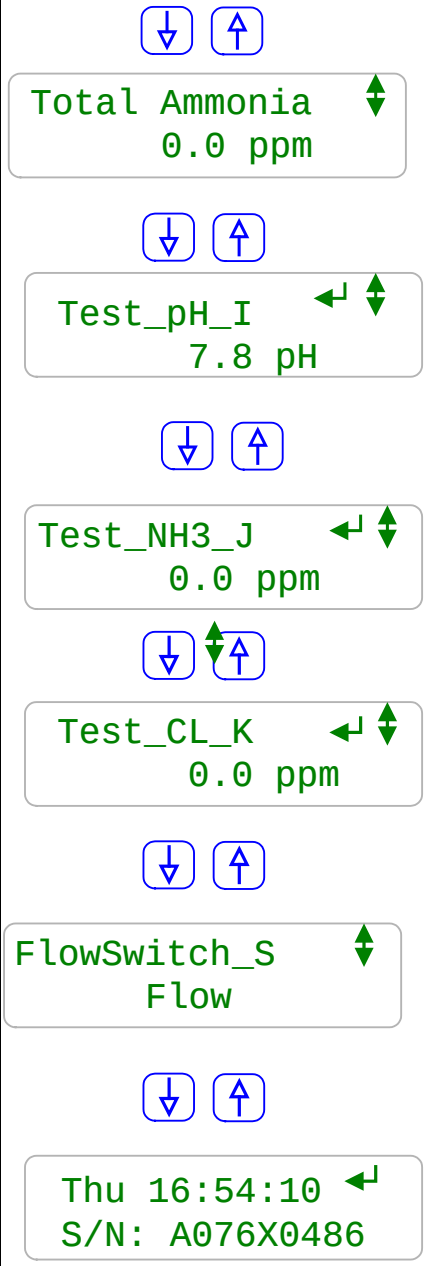
Users may use the Analyzer to key in results of chemical tests. These results may be used to alarm, The result of a drop test is entered, logged and displayed on control input '**J**'

Input '**S**' is the default flowswitch input for the sample header sensor flow.

You can edit the name of any input or output.

You can disable unused sensors, pumps or relays to un-clutter the display and turn them back ON as site needs change. Plug-in a new sensor card and the Analyzer auto reconfigures

Key **EXIT** anytime on the **Main Menu** & you'll get back to this power ON display



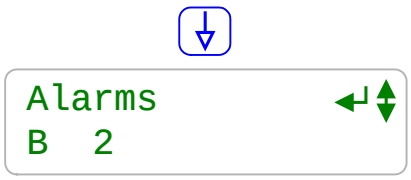
Sidebar: Sensor alarms will re-trip after the user set 'Delay' unless the fault is corrected. Relays controlled by sensors power devices ON and OFF. (Relays are outputs 1 to 5).

1.2 Checking & Clearing Alarms

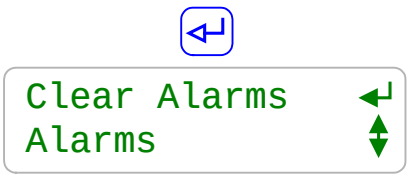
Key **DOWN** from the power ON display to view alarms.

In this example, the sensor connected to input '**B**' and the device controlled by Relay '**2**' have alarmed

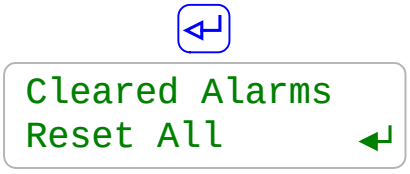
Press **ENTER** to view or clear **Alarms**



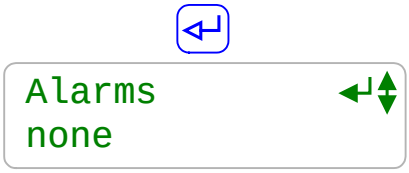
Press **ENTER** to clear **Alarms**, and reset all alarmed feeds, and reset the delay on alarm for all sensors



Exit the acknowledge display by pressing **ENTER** or any key



Returns to the main menu **Alarms** display.
See **Sidebar** @ bottom of page.

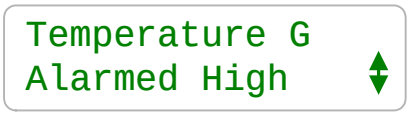


View Alarms

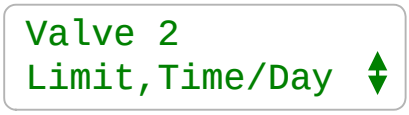
Press **ENTER** then **DOWN** to view active alarms. Alarms display until cleared so you'll know there was a problem although it may have occurred when you were not @ the Analyzer.

Press **ENTER** at **Alarms** and **UP** or **DOWN** to view active alarms.

'**G**' is a Temperature sensor which has exceeded or is exceeding it's high alarm.



'**2**' is a valve which has exceed it's minutes ON today alarm.



2.0 Sensors: Ammonia, pH, Temperature, 4-20mA…

2.1 Sensors

4-20mA Inputs: Specialized sensors for other process and water treatment parameters are connected to the Analyzer 4-20mA inputs where they are used for monitoring and data logging.

Sensor Measures	Operating Issues / Notes
Ammonia	Sensor measures free ammonia within a pH range of 7.3 to 12.0. Calibration is performed with a pH adjusted standard solution. The terms ammonia, NH3, and free ammonia are used interchangeably in reference to this sensor.
pH	Install vertically, tip down. Requires a solution ground. Reliability increases if calibrated in-line.
Temperature	Sensors connect directly to the Analyzer and sensor driver cards. Some sensor types are converted to 4-20mA inputs prior to measuring.
4-20mA Inputs	Most operational problems occur during commissioning; ensuring the loop is powered and converting the measured current to the sensor units.

General advice on performing ammonia sensor calibration

Possible calibration procedures for the potentiometric measurement of ammonia are: direct calibration with a series of calibration solutions, or the addition method. For the latter method, a known quantity of a standard solution is added to a sample of the liquid with the unknown concentration, and from the change in signal one can work back to calculate the initial concentration.

During calibration and measurement, care must be taken that the sample and the calibration solution have the same temperature, otherwise the transport of water vapor through the membrane can cause drifting of the electrode. Furthermore, the temperature also affects the slope of the sensor characteristic (which is temperature-dependent in accordance with the Nernst equation). Basically, the ammonia sensor can be used over the temperature range 0 to 50°C. Ammonium chloride is recommended for making up calibration solutions. A strong alkali is used to adjust the pH of the calibration solutions to pH $>$ 11. The sample solutions are prepared in the same way.

For standard on-line operation the preparation of ppm standards for a two point calibration differing by at least a factor of 10 is described in appendix E.

Sensor calibration

The sensor is, of course, also suitable for measurement in situations where the user needs to determine the ammonia concentration as accurately as possible. In this case, more complex means are required for the calibration, in order to account for the various influences on the measurement.
There are two ways of making a quantitative measurement of ammonia:

- direct measurement, with a multi-point calibration
- the standard addition method.

The first method requires the setting up of a calibration curve, using reference solutions with known ammonia concentration levels. The concentration levels of the reference solutions should cover the expected concentration range of the samples. The calibration solutions and sample solutions must be treated in the same way: in order to achieve maximum measurement accuracy, the chemical equilibrium between the ammonium ions and the ammonia must be shifted towards ammonia.

This is done by adding an alkali, which is used to achieve a pH value $>$ 11. The adjustment of the pH is carried out not only for the sample solution (with the unknown concentration) but also for the calibration solutions. Furthermore, the measurement of the samples and reference solutions must be performed at the same temperature, because the results will otherwise be influenced by the temperature.

Calibration starts off with the reference solution that has the lowest concentration, and proceeds through increasingly higher concentrations. Before changing over to the next sample vessel, the sensor must be flushed with ammonia-free distilled water and dried off by dabbing with a soft paper tissue (without touching the membrane!).

The result of the calibration measurements is a calibration curve that can be evaluated with normal analytical methods. In some laboratory instruments (ion meters), the instrument itself performs the evaluation, so that the concentration can be displayed directly after calibration. For lengthy series of measurements, the calibration should be repeated at intervals.

With the standard addition method, a known amount of ammonia (in the form of ammonium chloride) is added to the sample with the unknown concentration. From the increase in the signal after this augmentation, one can work back to derive the unknown initial concentration, whereby the increased volume of the total augmented solution must be taken into account in the calculation. With the standard addition method, the user can exclude matrix-specific influences that are not accounted for when setting up a calibration curve (the first method). The remarks made previously about the shift of the chemical equilibrium in the ammonia direction also apply to the standard addition method.

Procedure for laboratory measurements

In order to ensure that the chemical equilibrium between ammonium ions and ammonia is shifted towards ammonia as completely as possible, alkali must be added to the samples with the unknown concentration and the standard solutions just before starting measurement. One can, for instance, proceed as follows: 100ml of standard solution resp. 100ml of the sample have 1ml 10- mol caustic soda added until the pH value has reached at least 11 (samples with a low pH may require the addition of a substantial amount of caustic soda to reach a pH of at least 11. If in doubt, the pH must be measured).

Samples and standard solution should be stirred with a magnetic mixer and mixer paddle, so that the measurement stabilizes quickly. But care must be taken that the samples and standard solutions are not warmed up by action of the magnetic mixer. If necessary, a thermally insulating plate must be placed between the vessel and the mixer plate. The ammonia sensor should be mounted on a stand in such a way that it is immersed in the liquid in the sample vessel placed on the mixer, but does not touch the magnetic mixer paddle or the bottom of the vessel. Any air bubbles on the membrane must be removed.

To calibrate a sensor, key **UP** or **DOWN** to the target sensor and press **ENTER**.

Key **ENTER** @ **Calibrate**.

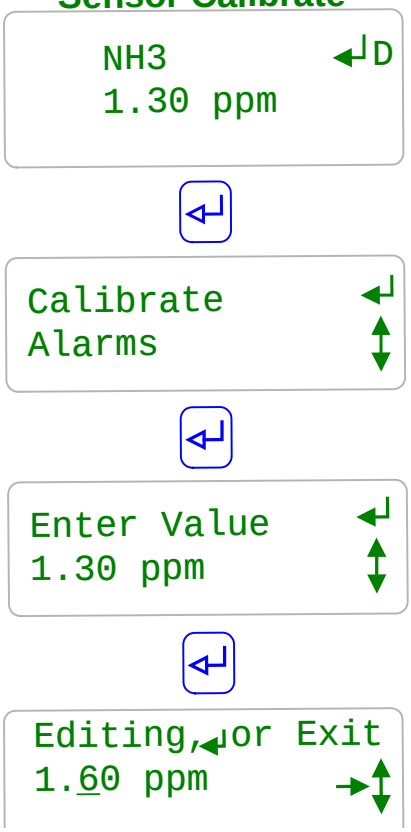
Displays current value. Key **ENTER** to modify.

Key **UP** or **DOWN** to change the underlined digit.
Key **RIGHT** to move the digit underline.

Press **ENTER** to calibrate.
or **EXIT** to leave unchanged.

In this example we increased the value measured by a NH3 sensor from **1.30 ppm** to **1.60 ppm**.

Sensor Calibrate



Sidebar:

Single Point and Two Point Sensor Calibration: The pH, temperature, and Ammonia sensors should be initially calibrated using two points. For example, the pH should be calibrated using standard pH buffer solutions of 7 and 10 for the low and high points, respectively. The Analyzer supports direct sets of sensor OFFSET & GAIN values. After the initial two point calibration, we recommend that you perform a single point calibration. This can be done by measuring a sample from the sensor sample header and calibrating the sensor based on the grab sample test value. In most cases, it's the simplest and most repeatable method.

Appendix E describes in more detail the single and two point calibration methods. The NH3 sensor should be calibrated based upon a Standard Methods procedure. The 1000 ml calibration column is used to calibrate the NH3 sensor in its housing. The pH and and temperature sensors should be temporarily removed from the sample header to perform their calibrations.

Calibration Faults: Refer to the next page for options on fault.

2.2 Sensor Calibration

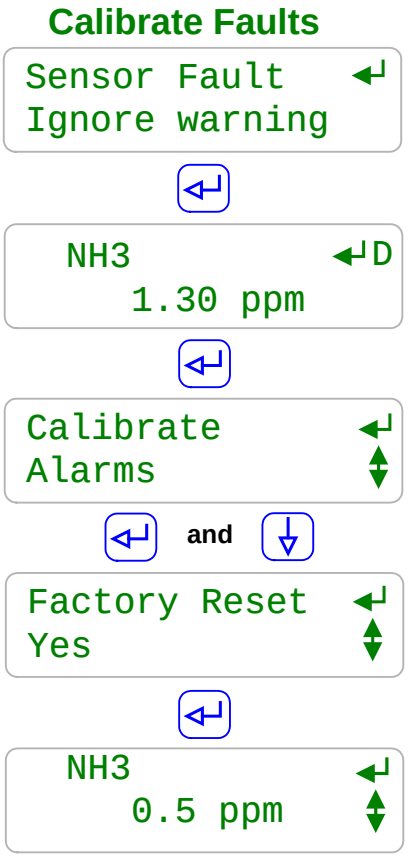
If the Analyzer cannot calibrate you'll view this warning after you modify the sensor value & key **ENTER**.

Key **ENTER** to ignore the warning or **EXIT** to return the sensor to its pre-calibration value.

To reset the sensor to its factory default setting key **ENTER** and **DOWN** to **Factory Reset**.

Press **ENTER**.
Factory Reset doesn't correct the problem which caused the warning

In this example, we started at **1.30 ppm**, got a warning when we performed a single point calibration at **1.60 pp** and returned to **0.05 ppm** after **Factory Reset**. Looks like this sensor could be fouled.



Sidebar:
Sensor Fault: The Analyzer verifies that sensor OFFSET or GAIN required to make the sensor read its new value are within the range of typical sensor operation.
If out of range, **Sensor Fault** displays.

Fault Cause varies with sensor type**.**
Ammonia: Fouling lowers the measured value. Remove and inspect. Whitish deposits indicate overcycling & may require HCl cleaning to remove. If no visible fouling, clean with alcohol or solvent then **Factory Reset**.

pH: Verify solution ground connected & excess sensor cable coiled at sensor, not in enclosure. Verify sensor cable not shortened & firmly connected. Then replace if no recovery after **Factory Reset**. pH sensor life decreases with handling and temperature extremes.

Temperature: Verify color coding correct and sensor wires firmly connected. Inspect sensor for damage or leaking.

2.3 Sensor Alarms

To view or adjust sensor alarm, key **UP** or **DOWN** to the target sensor and press **ENTER**.

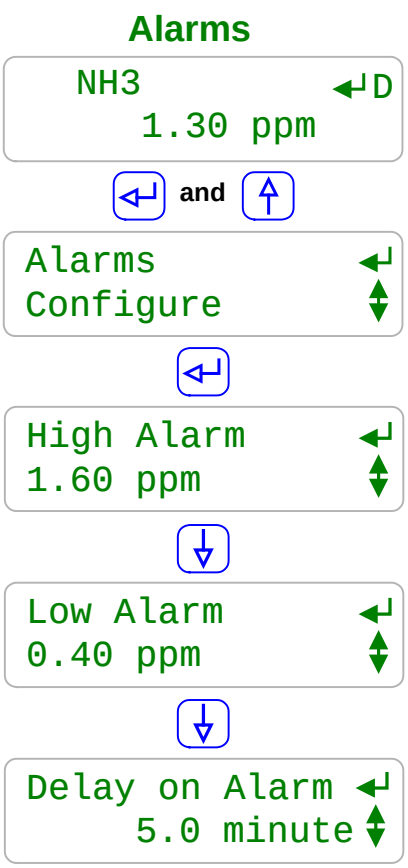
Key **UP** and **ENTER** @ **Alarms**.

In this example, the Analyzer will alarm if the NH3 exceeds **1.60 ppm**
Key **ENTER** to modify.

In this example, the Analyzer will alarm if the NH3 falls below **0.50 ppm**
Key **ENTER** to modify.

Delay on Alarm prevents nuisance alarms by requiring, in this example, **5** minutes of fault occur before alarming.

Set the Delay to zero minutes if you require an immediate alarm.
Key **ENTER** to modify.



Sidebar:

Sensor Alarms: Nuisance alarms tend to be ignored.
Select alarm limits that represent control fault or sensor failure.

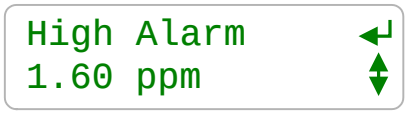
2.3 Sensor Alarms

Adjust Alarms

To adjust a sensor alarm, key **UP** or **DOWN** to the target sensor and press **ENTER**.

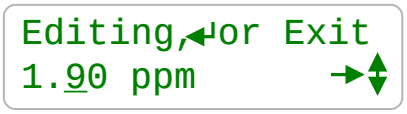
Key **UP** and **ENTER** @ **Alarms**.

Key **UP** or **DOWN** to select **High Alarm**, **Low Alarm** or **Delay on Alarm** & press **ENTER**.

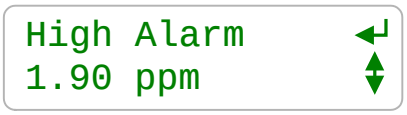


Key **UP** or **DOWN** to change the underlined digit.
Key **RIGHT** to move the digit underline.

Press **ENTER** to modify.
or **EXIT** to leave unchanged.



In this example we've increased the **High Alarm** from **1.60 ppm** to **1.90 ppm**.



Sidebar:
Reset Alarms: Section 1.2 **Clear Alarms** resets the **Delay on Alarm** time
If the **Delay on Alarm** is set to zero minutes and the sensor is above the **High Alarm** or below the **Low Alarm**, the sensor alarm will immediately re-trip.

2.4 Sensor Configure

To view or modify sensor configuration, key **UP** or **DOWN** to the target sensor and press **ENTER**.

Key **DOWN** and **ENTER** @ **Configure**.
Key **UP** or **DOWN** to view current configuration.

Sensor **Description** may be up to 14 characters & numbers
Press **ENTER** to modify.

Sensor **units** may be up to 3 characters & numbers.
In most cases, you'll use default units.
4-20mA Inputs may use '**%**','**ppm**','**GPM**', **deg F** as **units**
Press **ENTER** to modify.

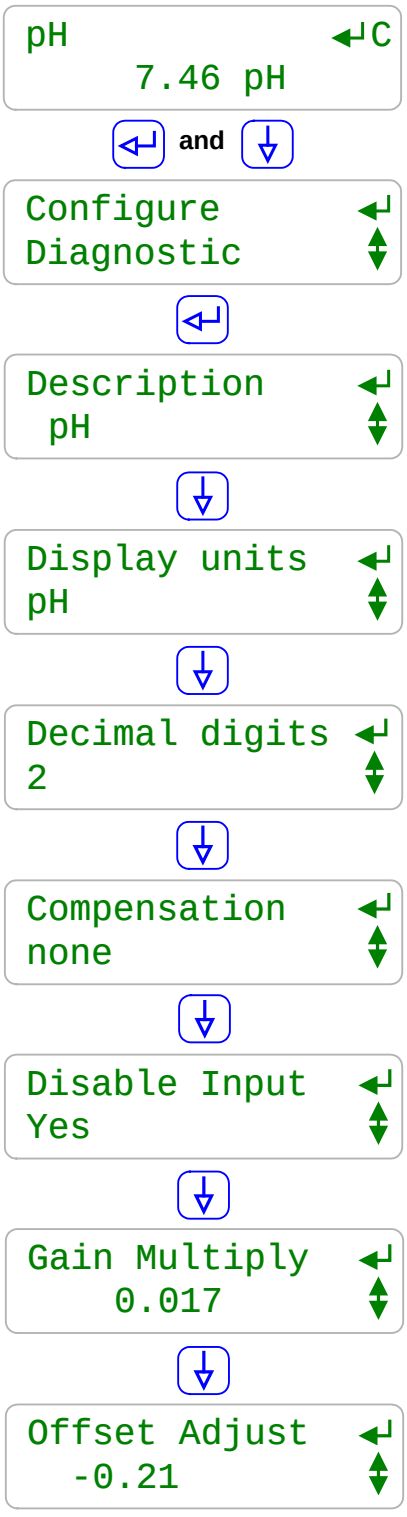
Sensor values may be displayed with from zero to three digits of resolution after the decimal.
Temperature is usually 1
pH & NH3 typically 2
Press **ENTER** to modify.

Available **Compensation** varies with sensor type.
pH may have **Temperature** compensation.
Press **ENTER** to select & modify.

A sensor used for control or to compensate another sensor, cannot be disabled.
Disable unused sensors to unclutter and speed display scrolling.

Although you can override single point calibration by directly modifying the sensor **Gain** & **Offset**, this is seldom done.

These values are more useful in flagging failing and fouling sensors



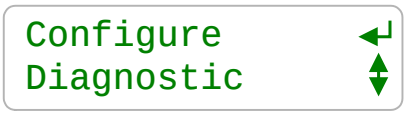
Sidebar:
The Analyzer Sensors are factory pre-configured for operation.

2.4 Sensor Configure

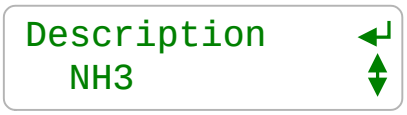
Edit Description

To modify sensor **Description**, key **UP** or **DOWN** to the target sensor and press **ENTER**.

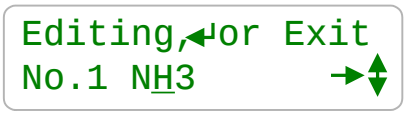
Key **DOWN** and **ENTER** @ **Configure**.



Key **ENTER** to view **Description**.
Sensor **Description** may be up to 14 characters & numbers
Press **ENTER** to modify.

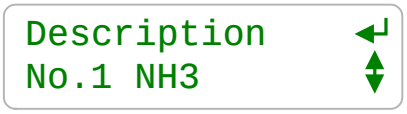


Key **UP** or **DOWN** to change the underlined letter or digit.
Key **RIGHT** to move the underline.



Press **ENTER** to save the new **Description**.
or **EXIT** to leave unchanged.

In this example we've changed the name of the **NH3** sensor connect to control input '**D**';
from **NH3** to **No. 1 NH3.**



Sidebar:
Description editing using the keypad is limited to capital letters and numbers to keep scrolling time reasonable.
Browser users are not limited but all user text editing is rejected if it contains HTML delimiters like < >.

Avoid assigning duplicate or similar names for sensors, requiring the user to identify using only the identifying letter '**A**' to '**N**'.

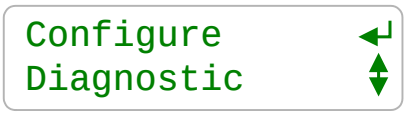
Each sensor has only one name. It's the same for both Keypad-LCD and Browser users and is included in the Analyzer data logs.

2.4 Sensor Configure

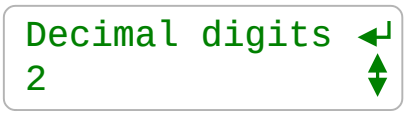
Adjust Resolution

To modify sensor **Resolution**, the number of digital after the decimal, key **UP** or **DOWN** to the target sensor and press **ENTER**.

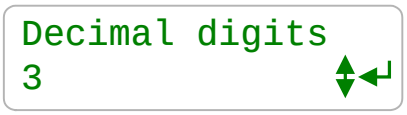
Key **DOWN** and **ENTER** @ **Configure**.



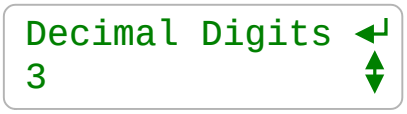
Key **DOWN** to view **Decimal digits**. Press **ENTER** to modify.



Key **UP** or **DOWN** to change the resolution.



Press **ENTER** to set a new **Decimal digits**. or **EXIT** to leave unchanged.



In this example we've changed the number of digits after the decimal point from **2** to **3**, changing the display of **NH3** from **1.30 ppm** to **1.306 ppm**.

Sidebar:

When you select the number of digits displayed after the decimal:

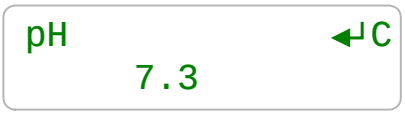
Keep the number to a minimum to unclutter the display, making sensor values easier to read & remember.

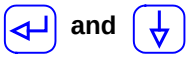
The displayed resolution of a sensor does not alter the data log resolution or the accuracy of sensor calculations.

2.4 Sensor Configure

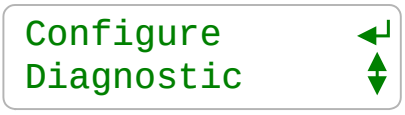
Disabling Sensors

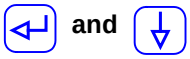
To **Disable** a sensor, key **UP** or **DOWN** to the target sensor and press **ENTER**.



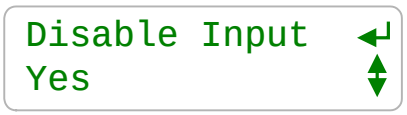


Key **DOWN** and **ENTER** @ **Configure**.

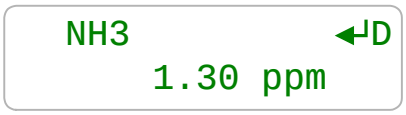




Key **DOWN** to view **Disable Input**.
Press **ENTER** to **Disable**.



The Analyzer removes the sensor from the display **UP** - **DOWN** sequence and reorders the display.



OR

or

If the sensor is in use for control, used to compensate another sensor or used for inventory or manual entry, it will NOT be disabled & you'll see this display.
Key **EXIT**.

Sidebar:
Disabling a sensor removes it from the display and all selection menus used. Data logging stops for disabled sensors.
Refer to **Enabling Inputs & Outputs** if you need to re-enable a disabled sensor.

Use Disable Input to unclutter the display, reducing scrolling key presses.

2.5 Sensor Compensation

Some sensor compensation, like thermal compensation is user selectable.
Other types of compensation are set by the sensor driver card, like corrosion rate.
Each sensor type has its own set of compensations.

Sensor Type	Compensation	User Sets or Selects
Ammonia	**Temperature** or **None**	Temperature sensor '**G**' Compensation rate in %/degree
4-20mA Input	**Temperature** or **None**	Temperature sensor '**B**' to '**G**' Compensation rate in %/degree
pH	**Temperature** or **None**	Temperature sensor '**B**' to '**G**' Analyzer supplies compensation rate per degree.
Manual	**Manual Input** or **None**	Enable an input '**H**' to '**N**' for use as manual test or drop count tracker.
Temperature	**None**	

2.5 Sensor Compensation

Thermal Compensation

To view of modify sensor **Compensation**, key **UP** or **DOWN** to the target sensor and press **ENTER**.

Key **DOWN** and **ENTER** @ **Configure**.

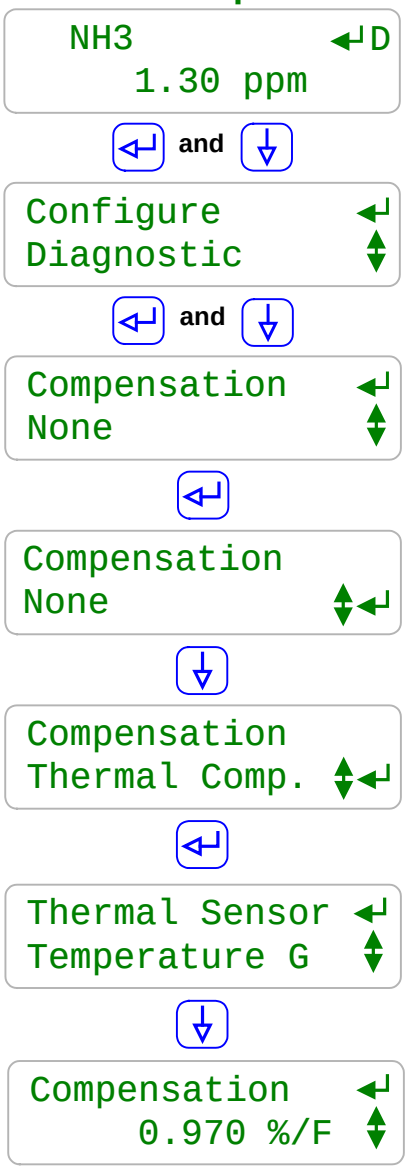
Key **DOWN** to view **Compensation**. Displays current **Compensation** type; **None** in this example. Press **ENTER** to modify.

Press **UP** or **DOWN** & **ENTER** to select. Key **EXIT** to not modify.

In this example we selected **Thermal Compensation**. The Analyzer then displayed **None** as the temperature sensor & we scrolled to and keyed **ENTER** @ **Temperature B**.

Key **DOWN** to view or modify the %/degree value.

This value is typical for cooling water & is not modified unless you are immersed in brine or another non-cooling water stream.

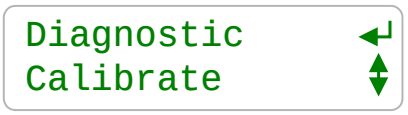


2.6 Sensor Diagnostics

Diagnostic

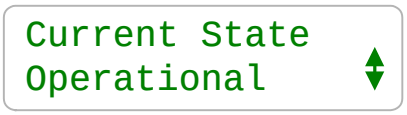
To view sensor **Diagnostics**, key **UP** or **DOWN** to the target sensor and press **ENTER**.

Key **UP** and **ENTER** @ **Diagnostic**.

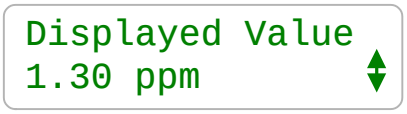


Sensor Type; **NH3** in this example. Also displays pH, Temperature, unused, or 4-20mA Input

Current State may also display **Alarmed**, **Fail Calibrate**, **4-20mA Open** (4-20mA Inputs only), or **Overrange** (Hardware fault)

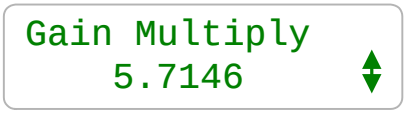


Current value of the sensor. With user set digits after the decimal and user set units.



Thermal Compensation is used with pH and NH3

Gain Multiply is the value required to make the displayed NH3 value match your last calibration.



Default Gain is the **Gain** after a **Factory Reset**. An increasing **Gain Multiply** usually Indicates a fouling sensor.

continued

Sidebar:
Diagnostic displays how the sensor is configured, compensated and calibrated.
This is where you go if you have a non-obvious sensor problem.

2.6 Sensor Diagnostics

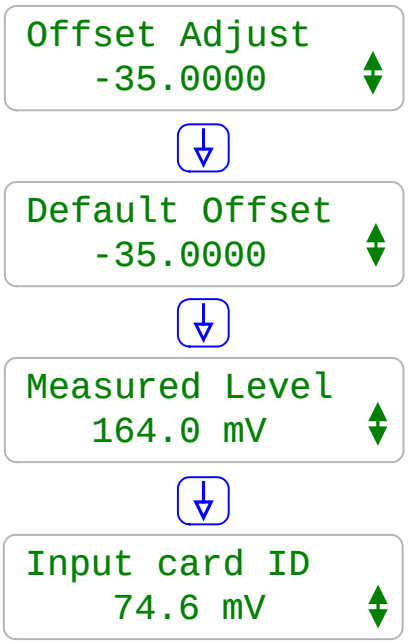
Diagnostic cont.

Offset Adjust is the value required to make the displayed pH, NH3, or temperature match your last calibration.

Default Offset is the **Offset** after a **Factory Reset**. pH & NH3 sensors with offsets twice the default offset will not usually track & have failed, contaminated or fouled. Refer to Section **4.2 Calibrate Faults.**

Measured Level is the sensor voltage measured by the Analyzer. Useful when converting 4-20mA currents & diagnosing non-tracking sensors.

The Analyzer uses the **card ID** to auto-configure on new driver cards. Some cards also use this level to determine range.



Sidebar:

Gain & Default Gain

When you calibrate an ammonia sensor, the Analyzer adjusts the GAIN to make your measured value match the displayed value.

Offset & Default Offset

When you calibrate a pH, ammonia, or temperature sensor, the Analyzer adjusts the OFFSET to make your measured value match the displayed value.

When you two point calibrate a 4-20mA input, the Analyzer adjusts both OFFSET and GAIN.

Manual Sensors:

These sensor types use only the OFFSET to set the displayed value.
The Analyzer ignores GAIN for these sensor types.
For example when you **Calibrate** a sensor to display 48.5 degrees, **Offset Adjust** will display 48.5.

Measured Level:

pH sensors have a well defined mV to pH relationship.
Example pH7 = 0mV, pH10=176 mV and pH4 = -176 mV.
Displayed sensor value = (**GAIN** x **Measured Level**) + **OFFSET**.
Using this simple equation, you can directly modify the OFFSET & GAIN to get a desired display.
This is seldom done, but it's convenient for some unusual sensor types.

3.1 Contact Sets

Flowswitch: Provides a set of contacts that close when there is flow past or through the sensor. Flowswitch contact sets are used to permit the sensor measurement.

Contact Set	State	Operating Issues / Notes
Flowswitch	**Flow:** OK to turn ON relay actuated device or validate sensor measurements. **No Flow:** Immediately turns OFF a relay actuated device or suspends sensor measurement.	Contact set closes when flow measured. Default: Connect to Analyzer input '**S**' A manual RUN/STOP switch may be used in place of or in series with a Flowswitch.

Dry Contact Sets:
Contact sets connected to the Analyzer must be 'dry', without AC or DC voltage on either of the contact set wires. Contact sets cannot be shared between the Analyzer and any other Analyzer type or automation system.

Sidebar:

Volume & Contact Set Inputs:
Analyzer inputs '**O**' through '**V**' may be set individually to be a water meter or a contact set.
The Analyzer is defaulted to meters at inputs '**O**' to '**R**' and contact sets at inputs '**S**' to '**V**'.

Phantom Inputs:
Analyzer inputs '**W**' through '**Z**' do not have physical terminals
but may be enabled individually as either water-volume meters or contact sets.
Phantom meters are used as '**Rate-to-volume'** or '**Copy Volume to'** targets.
Phantom contact sets are used to '**Mirror'** Analyzer outputs and then to
sequence or block other Analyzer outputs

3.2 Contact Set Alarms

To view or modify contact set **Alarms** key **UP** or **DOWN** to the target contact set input and press **ENTER**.

Key **UP** and **ENTER** @ **Alarms**.

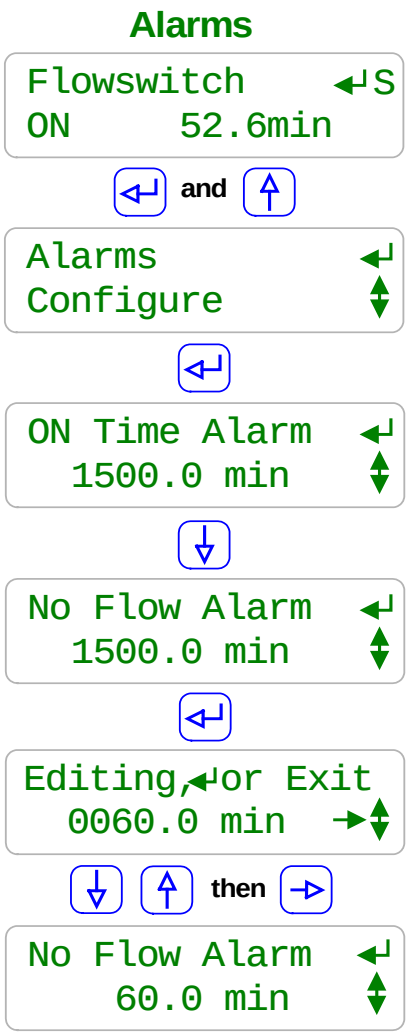
Alarms if the contact set is **ON** today for longer than the **ON Time Alarm**. Timing resets every time contact set turns **OFF** and at midnight.

Alarms if the contact set is **OFF** today for longer than the **No Flow Alarm**. Timing resets every time contact set turns **ON** and at midnight.

Keying **ENTER** to modify.
Key **UP** or **DOWN** to change the underlined digit.
Key **RIGHT** to move the underline.

Press **ENTER** to save the new **No Flow Alarm**.
or **EXIT** to leave unchanged.

In this example we've reduced the **No Flow Alarm** from its factory default of **1500** minutes to **60** minutes.



Sidebar:
Default alarm times are set so that contact sets won't alarm unless user configured.
It's unlikely that you would set both alarms on any one contact set but the ability to alarm both ON & OFF states gives you a lot of application flexibility.

ON Time Alarm:
If the pressure switch on your RO or sidestream filter shows high pressure for more than 30 minutes, you'd like to log an alarm.
If the flowswitch is ON between 6:00AM & 6:00PM
Is ON for more than 13 hours, either the flowswitch has faulted or operation has changed.

No Flow Alarm:
If you had a treatment system that runs 24/7 you'd want to alarm on a flowswitch
That has no flow since it indicates that the sensor or injection line is blocked or inadvertently valved OFF.

3.3 Inverting Contact Sets

A contact set **ON** can be switched to **OFF** using **Invert Sense.**

To view or modify a contact set **Invert Sense** key **UP** or **DOWN** to the target contact set and press **ENTER** then **DOWN**.

Note that in this example **RUN/STOP U** is currently **OFF**.

Key **ENTER** @ **Configure**. and then **UP** to **Invert Sense**

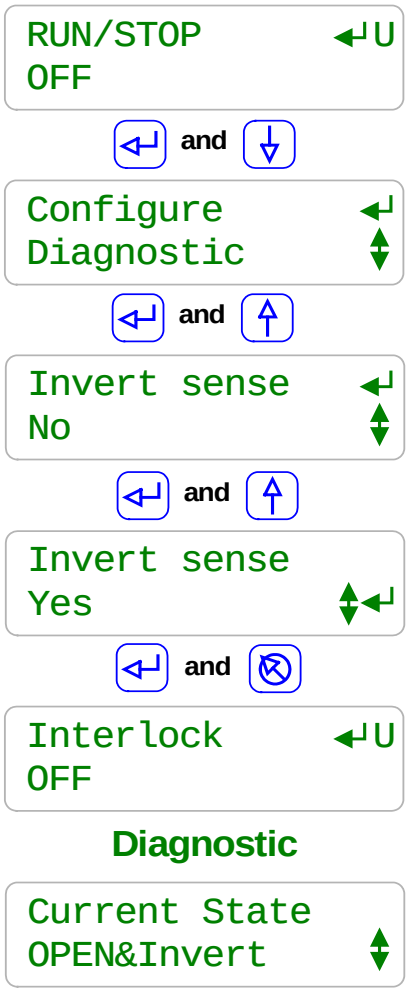
Key **ENTER** and **UP** to display **Yes**.

Key **ENTER** to select **YES** and **EXIT** to display that in this example **RUN/STOP U** now displays **ON**.

Key **ENTER** and **UP** to **RUN/STOP U Diagnostic**.

Current State displays that the '**U**' contact set is **OPEN** and that '**U**' is inverted, **&Invert**.

Invert sense



Diagnostic

Sidebar:
Inverting Sense:
Contact sets interlock and control when they are **ON**.
For non-inverted contact sets, **ON** is when the contact set is closed.

If you wish to Interlock or control when the contact set is open, set Invert sense to YES.
If your contact sets are open when they are measuring the state you wish to alarm, control using or log, set Invert sense to YES.

RUN/STOP an 'Invert sense' Example:
Contact set '**U**' is used for a RUN/STOP switch.
The switch contacts are OPEN when the switch is set to RUN.
Invert sense is set for '**U**' so that RUN displays on the Analyzer as **ON** and so that '**U**' can be used as a flowswitch for pumps and solenoids.

3.4 Contact Set Controls

In this example the **Solenoid 1** is powered by relay **4**.
Relay **4** is controlled by **Pressure** switch '**V**'

To view or modify the **Solenoid 1** setpoints key **UP** or **DOWN** to **Solenoid 1** and press **ENTER**.

Key **ENTER** @ **Setpoints** and then **UP** or **DOWN** to the **Setpoint** you wish to modify.

In this example we've already modified **TurnON** to 30 seconds

Key **ENTER** @ **OFF Setpoint** to modify
Frequency controlled pumps will display **then Feed** and a setpoint in **mL**.

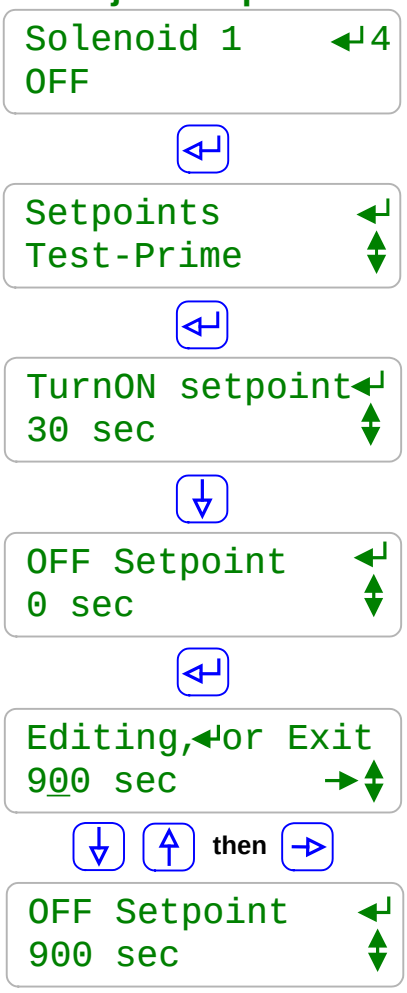
Key **UP** or **DOWN** to change the underlined digit.
Key **RIGHT** to move the underline.

Press **ENTER** to save the new **OFF Setpoint**.
or **EXIT** to leave unchanged.

Each time you modify you'll get an extra digit.
So in this example you'll have to edit twice to get to 3 digits from the default 1 digit

See the following **Contact Set Control Example**.

Adjust Setpoints



Sidebar:
Contact Set Control Example:
A pressure switch connected to Analyzer input '**V**' turns **ON** when the pressure drop across a sidestream filter indicates a need to open Solenoid 1.
The **TurnON Setpoint** is set to 30 seconds to prevent transient states from triggering a backwash.
The **OFF Setpoint** is set to 900 seconds, 15 minutes, the time required to backwash the filter.

Set the **ON Time alarm** on **Pressure** '**V**' to 20 minutes, because if '**V**' hasn't turned **OFF** in 20 minutes, then backwashing failed and filter pressure is still high.

4.0 4-20mA Outputs

4.1 4-20mA Output Setpoints

4-20mA Outputs display both the loop current and its corresponding the 0-100%. This example display occurs on installing a new 4-20mA output card.

To view or modify a current output **Manual** setpoint key **UP** or **DOWN** to the target output and press **ENTER**.

Key **ENTER** @ **Setpoints**.

Manual = User sets current. **Auto** = Sensor controls current. Displays the present **0%** to **100%** output setpoint. Key **ENTER** to modify.

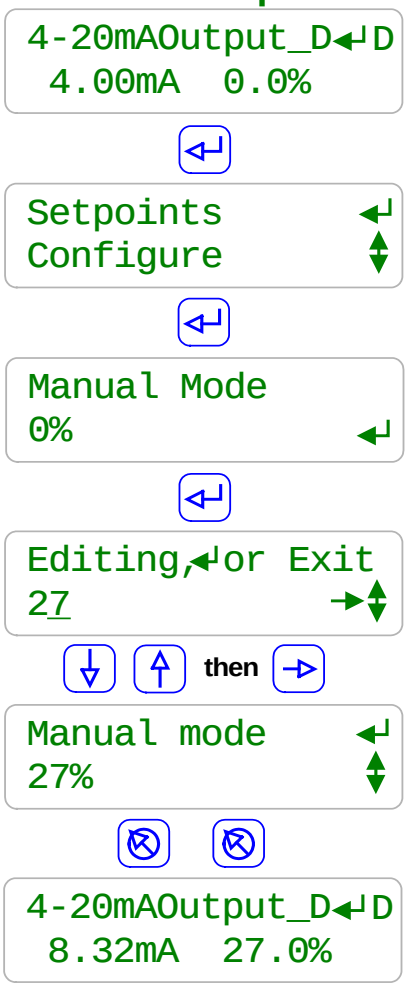
Key **UP** or **DOWN** to change the underlined digit. Key **RIGHT** to move the underline.

Press **ENTER** to save the new **Manual Mode** setpoint or **EXIT** to leave unchanged.

Key **EXIT** twice to view the effect of the new setpoint.

In the example we've increased the loop current from **4.00mA** to **8.32mA**.

Manual Setpoint



Sidebar:

Manual Mode:

Use **Manual mode** to verify the 100% ON=20mA, OFF=4mA or modulate operation of the proportional pump or valve that the 4-20mA output is controlling.
Use **Manual mode** to verify the monitoring input that is using the current loop value to represent an Analyzer NH3, pH, or temperature sensor or ppm calculation.

Load Powered 4-20mA Loop:

4-20mA current outputs are powered by the loop load or by the Analyzer 15VDC power supply. Building automation system typically supply 24VDC to power current loops. Current loop controlled pumps and valves usually use the Analyzer 15VDC supply to power the loop.

Open Loop Alarm:

The DC isolated 4-20mA output alarms on an open loop or a loss of loop power.

4.1 4-20mA Output Setpoints

In this example an ammonia sensor is controlling the 4-20mA out current. The **100.0%** indicates that the ammonia is greater than the 20mA setpoint

To view or modify the **20mA Setpoint** press **ENTER**.

Key **ENTER** @ **Setpoints**.

Key **DOWN** to **20mA Setpoint**.
When the NH3 sensor measures than **1000uS** the loop current is **20mA**
Key **ENTER** to modify.

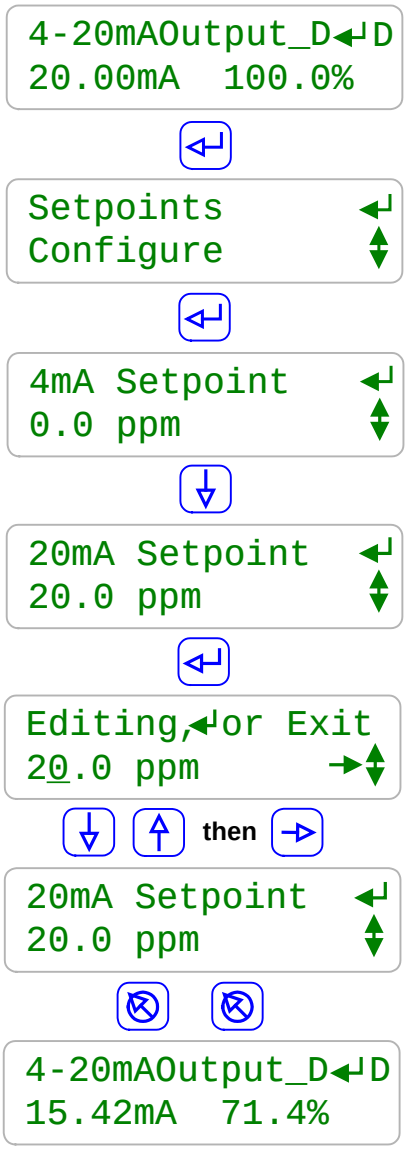
Key **UP** or **DOWN** to change the underlined digit.
Key **RIGHT** to move the underline.

Press **ENTER** to save the new **20mA Setpoint** .
or **EXIT** to leave unchanged.

Key **EXIT** twice to view the effect of the new setpoint.

In the example the loop current is now **15.36mA**.
71.4% of the **0 ppm** to **20 ppm** span is **14.28 ppm**

Sensor Setpoint



Sidebar:
Setpoints: Setpoints may be positive or negative numbers.
The 4mA Setpoint may be greater or less than the 20mA setpoint so that the loop current may either increase or decrease as the sensor increases.

Calculating Loop Current:
4-20mA Output current (mA) = 4 + 16 x (Sensor Value / (**20mA Setpoint** – **4mA Setpoint**))
Use the absolute value of the setpoint difference for **20mA Setpoint** < **4mA Setpoint**.
For this page's example **15.46mA** = 4 + (16 (14.28 / (**20** - **0**)))

4.2 4-20mA Configuration

To view or modify the sensor controlling the 4-20mA output current, key **UP** or **DOWN** to the target 4-20mA output and press **ENTER**.

Key **UP** and **ENTER** @ **Configure**.

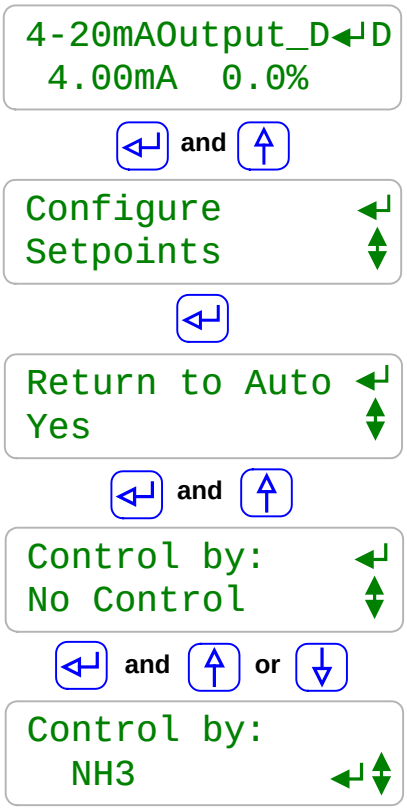
We're presently in **Manual** mode. Key **ENTER** to **Return to Auto** and then **UP** to **Control by:**

Key **ENTER** to modify **Control by:**

Key **UP** or **DOWN** to scroll through all enabled sensors.
Key **ENTER** to select or **EXIT** to leave unchanged.

In this example we selected NH3 to control the 4-20mA loop current.

Select Sensor



Sidebar:
Control by: Any enabled sensor of any type 'A' to 'N' may be used to control the 4-20mA loop current.
Once you've selected a controlling sensor, adjust the **4mA Setpoint** and **20mA Setpoint** to reflect the range for a remote DCS monitoring input.

Example: You are controlling the 4-20mA output current using a pH sensor.

If the 4-20mA current is monitored by a building automation system or distributed control system, you could set 4mA= 6.0pH and 20mA = 10.0pH. since this span represents the likely range of measured pH.

4.2 4-20mA Configuration

To calibrate, view or modify
a 4-20mA output
key **UP** or **DOWN** to the target output
and press **ENTER** then **UP**.

Key **ENTER** @ **Configure**.

The 4-20mA current output is in **Manual** mode
The current mA level is fixed at the user set level.

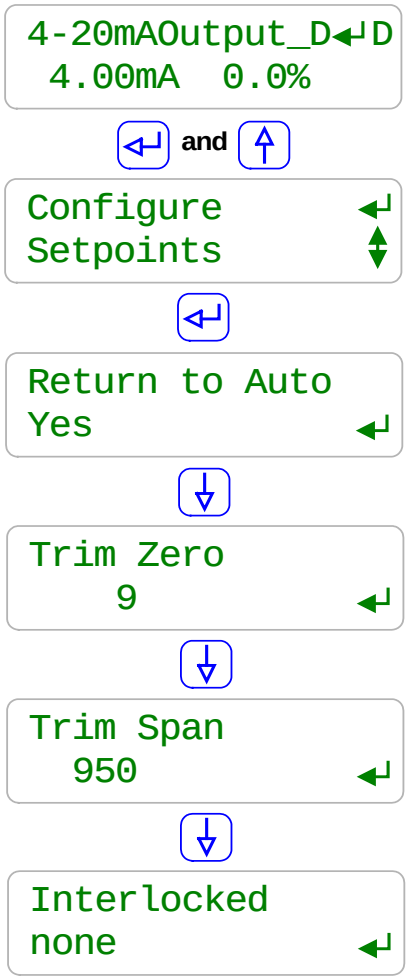
Selecting **Auto** controls the current based on the value
of a sensor and the 4mA and 20mA setpoints.

Trim Zero adjusts the 4mA level.
Put a mA meter is series with the loop current and
key **ENTER** and **UP** or **DOWN** to adjust.

Trim Span adjusts the 20mA level.
Put a mA meter is series with the loop current and
key **ENTER** and **UP** or **DOWN** to adjust.

4-20mA outputs may be **Interlocked**
When the interlock is **ON** the current is **4.00mA**, **0%**
key **ENTER** and **UP** or **DOWN** to select an interlock.

Calibrate - Interlock



Sidebar:
Calibrate:
Trim Zero and **Trim span** places the current loop into **Manual** mode and
then adjusts the zero, 4mA or span, 20mA level.
Set your digital voltmeter to measure mA and install it in *series* with the current loop wiring.
(*Series:* Disconnect one 4-20mA wire from the Analyzer terminal.
Connect the wire to the DVM '-' or Common and connect the DVM '+' to the wiring terminal)

If **UP** or **DOWN** stops changing the measured current it's because
you've hit the limits of loop adjustment.

Resolution: The nominal resolution of the current loop is 0.1%.
Example: If 4mA = 0uS and 20mA = 1000uS the current loop has 1uS resolution.
If 4mA = 0uS and 20mA = 10000uS, the current loop has 10uS resolution.

5.0 System Settings

5.1 Passwords

Analyzers are defaulted to **Keypad Password** OFF.

To turn ON the **Keypad Password** press **ENTER** and **DOWN** to **Configure** at the power up or day-time display.

Key **ENTER** @ **Configure**.

Key **DOWN** to **Keypad Password**.

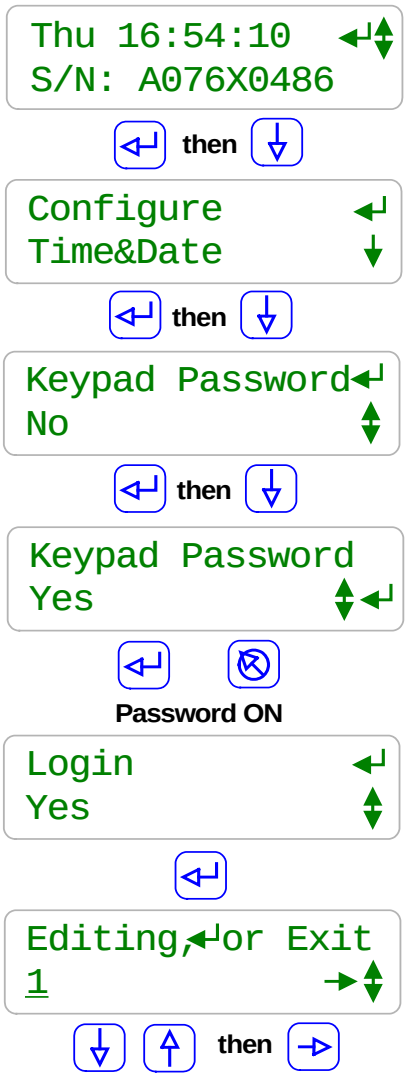
Key **ENTER DOWN ENTER** to turn ON **Keypad Password**.

You'll view the **Login** display when you select a password protected part of the Analyzer. See **Login Displays**:.
Key **ENTER**

Key **UP** or **DOWN** to change the underlined letter or digit.
Key **RIGHT** to move the underline.

Press **ENTER** to **Login**.
If you have not keyed any of the current, valid passwords, you'll view an error message.

Turn ON Passwords



Sidebar:
Default Passwords:
The first time you turn ON **Keypad Password** the 8 default passwords are**:**
Operator1 = **1** Operator2 = **2** Operator3 = **3** Operator4 = **4**.
Configure5 = **5** Configure6 = **6** Configure7 = **7** Administrator = **AAAA**
There are 3 password levels, Operator, Configure and Administrator.
The 8 default User IDs are used in the Analyzer's keypress log.

Modify Password: Once you Login you can modify you password.
Refer to the following page.

Login Displays: Prompts you for the required password level. **Login** @ **Admin**, **Config** or **Operate** depending on what key press activity required a password.

5.1 Passwords

After you've turned ON passwords and logged in as one of the eight users:

To modify your **Keypad Password** press **ENTER** and **UP** to **Passwords** at the power up or day-time display.

Key **ENTER** @ **Passwords**.

To **Logout** as the current user, key **ENTER** at **Logout**.
The Analyzer automatically logs you out 30 minutes after your last key press.
Note that this display shows **Operator1,** your user ID.

Key **ENTER** at **Reset Pswrds**.
to key in the reset code which returns all passwords to default.

Key **ENTER** at **Edit Passwords** to view or modify your password.

Key **UP** or **DOWN** to change the underlined letter or digit.
Key **RIGHT** to move the underline.

Press **ENTER** to change your password or EXIT to leave unchanged.
In this example we changed **Operator1**'s default password from '**1**' to **OP1**.

Modify Password

Sidebar:
Modify Passwords:
Because all 8 default passwords are listed on the previous page.
You'll should modify all 8 passwords when you initially turn ON passwords.
Passwords are limited to 8 capital letters and numbers.
Any space in a password ends the password on both editing and **Login** password entry

Two users cannot share the same password because the password is used to identify the user.
The Analyzer displays **Password Fail** on a duplicate password.

Reset Passwords: If you forget your password, a **Reset Password** is available from Aquatrac & specific to your Analyzer's serial number that sets all passwords to default.

Passwords: This menu item only displays on Analyzers that have turned ON **Keypad Password**.

5.2 Time & Date

To view or adjust the **Time&Date**
press **ENTER** and **DOWN** to **Time&Date**
at the power up or day-time display.

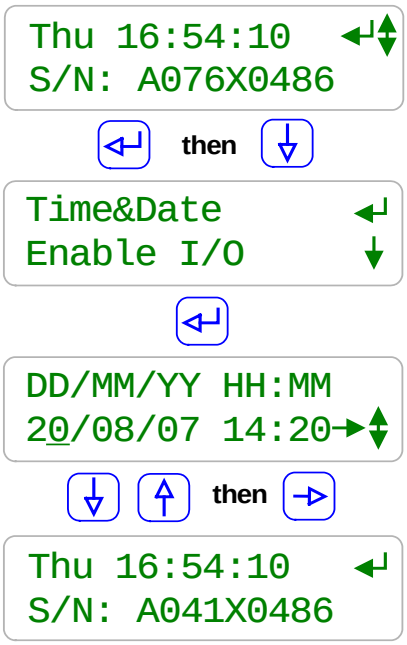
Key **ENTER** @ **Time&Date**.

See **Analyzer Response to a new Time&Date:**
on this page **Sidebar** prior to adjusting.

Display current date and time.
Key **UP** or **DOWN** to change the underlined digits.
Key **RIGHT** to move the underline.

Press **ENTER** to save the new **Time&Date**.
or **EXIT** to leave unchanged.

Time & Date



Sidebar:
Time & Date:
The Analyzer uses a 24 hour clock where 14:30 is 2:30 PM.
When you set the Date, the Analyzer automatically sets the correct day of the week.

Analyzer Response to a new Time&Date:
When you change the time & date, the Analyzer:
1. Turns all outputs OFF, resets all control timing and restarts the logging period on each I/O.
2. Does a midnight reset which will may set volume-meter Low Alarms and will reset any output alarms set to reset @ midnight.
3. Sets the biocide Day 1 to the most recent Sunday.
   Example: If you are at Day 19, Thursday of week 3, on a 28 day biocide cycle.
   After a **Time&Date** change you are now at, Day 5,Thursday of week 1

5.3 Keypress-Alarm Log

View Activity Log

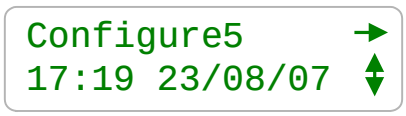
To view the **Activity Log** press **ENTER** and **DOWN** to **Activity Log** at the **Alarms** display.

Key **ENTER** @ **Activity Log**.

Each entry in the log initially displays it's activity as you key **DOWN** .

In this example the limit **Alarms** for the **NH3 sensor** were **Adjusted**.

Key **RIGHT** to view the User ID and the Time & Date stamp for the Activity.



Key **RIGHT** again to get back to the **Activity** or key **DOWN** to scroll the User ID and Time-Date stamps.

Scroll UP or **DOWN** through the Activity Log.
Keying **RIGHT** to view the User Ids & Time-Date stamps

Sidebar:
Keypress-Alarm Log:
The log contains the last 25 activities that effect the operation of the Analyzer.
Most recent activities first. Both keypad and browser user activities are logged.

User IDs:
Keypad Password ON: Logs the User IDs listed in **Section 5 Sidebar::Default Passwords**.
Keypad Password OFF: Logs all User IDs as **Keypad**.
Browser user IDs are always logged because login is required to browse.
Actions taken by the Analyzer, like configuring a new driver card, use the **System** used ID.

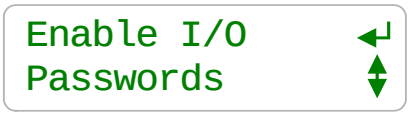
5.4 Enabling Inputs & Outputs

To **Enable I/O** press **ENTER** and **DOWN** to **Enable I/O** at the power up or day-time display..

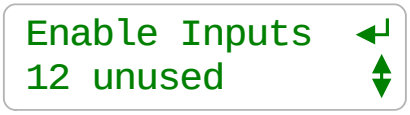
Enable I/O

then

Key **ENTER** @ **Enable I/O**.



Displays the number of sensor inputs and meter-contact input available for enabling. Key **ENTER** to select one.



or

Displays the number of relays and frequency controlled outputs available for enabling. Key **ENTER** to select one.

Sidebar:

Disabling I/O:

Individual Inputs and Outputs are disabled by keying **ENTER** at the target I/O display and selecting a **Configure** sub-menu option.

I/O in use by the Analyzer for control or sensor compensation cannot be disabled.

Disabled I/O does not display, is not logged and does not appear in the selections used to compensate and configure other enabled I/O

Enabling Inputs:

Sensor inputs **A**, **B**, and **G**: **Temperature**

A,**B** & **G** may be enabled or disabled but their function is fixed.

The function of Sensor inputs **C-D** is set by the installed sensor-driver card to be **pH** and **AMMONIA**

Phantom Sensor inputs '**H**' to '**N**' are enabled as needed to for tank inventory and ppm calculations and to log manually entered drop counts.

Contact Set Inputs '**O**' to '**V**' are enabled and configured for either water-volume meters OR flowswitches,

Phantom Meter-Volume or Contact Set inputs '**W**' to '**Z**' are enabled as needed

Enabling Outputs:

Outputs **1** to **5** are AC power switching relays that are enabled to power field devices.

Outputs **6** to **9** are frequency controlled outputs.

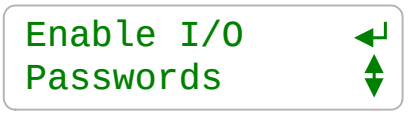
5.4 Enabling Inputs & Outputs

Enable an Input

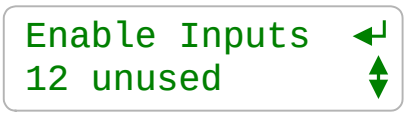
To enable a sensor, or contact set input press **ENTER** and **DOWN** to **Enable I/O** at the power up or day-time display..

then

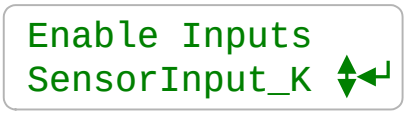
Key **ENTER** @ **Enable I/O**.



In this Analyzer 12 of the 26 sensor, meter-volume and contact set inputs are unused..
Key **ENTER** to select one.

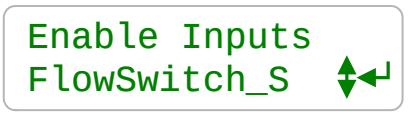


Key **UP** or **DOWN** to scroll through the unused, disabled inputs
Key **ENTER** select one
or **EXIT** to not select any inputs.



or

In this example we'll **FlowSwitch_S**.
After enabling, scroll to **FlowSwitch_S** input, re-name it and configure it for use.



Sidebar:
Enabling Inputs:
In each Analyzer there are 26 inputs; 14 Sensors '**A**' to '**N**'
and 12 Meter-Volume or Contact Sets '**O**' to '**Z**'.
Of the 14 sensors, 7, **A-G**, have terminal blocks where you can connect actual sensors and 7, **H-N**, are 'Phantom' and are used for manual and calculated values.
Of the 12 Meter-Volume or Contact Sets, 8, **O-V** have terminal blocks where you can connect actual meters or contact sets and 4, **W-Z** are 'Phantom' and are used for copy targets and mirroring.

Enabling Outputs:
Outputs are enabled in the same way as inputs. Each Analyzer has 5 outputs.
Outputs **1-5** are relays which switch Analyzer AC power to turn ON and OFF

5.5 Metric & U.S. Units

To view or adjust the Metric - U.S. Units setting press **ENTER** and **DOWN** to **Configure** at the power up or day-time display.

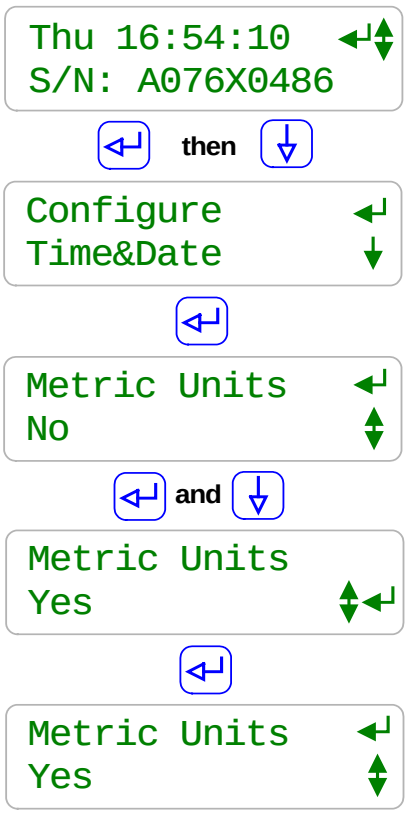
Key **ENTER** @ **Configure**

This Analyzer in currently set to U.S. units. Temperatures are in F and volumes greater than 100mL are in Gallons.

Key **ENTER** to **DOWN** to switch to **Metric Units**.

Key **ENTER** to set **Metric Units** or **EXIT** to leave as U.S. Units.

Switch to Metric



Sidebar:
Commissioning:
Select U.S. or Metric Units when you commission or install the Analyzer.
Data logging uses the Units setting for the units on logged volumes and temperatures.
Changing units does not change data already logged.

Metric Inputs:
Non 4-20mA temperature inputs are converted to Centigrade using the default offset and gain for each of the thermal input type.
If you switch back to U.S. units, temperatures are converted to Fahrenheit using the default offset & gain, removing the effect of any user calibration.
ppm calculations now assume metered volumes in Liters and not gallons.

Metric Outputs:
Volumes are reported in mL & Liters.
Event volumes are in Liters and not Gallons.
The Analyzer uses the units of the ammonia sensor for setpoints.

5.6 Configurations

To view or adjust the configuration of the whole Analyzer press **ENTER** and **DOWN** to **Configure** at the power up or day-time display.

Key **ENTER** @ **Configure**

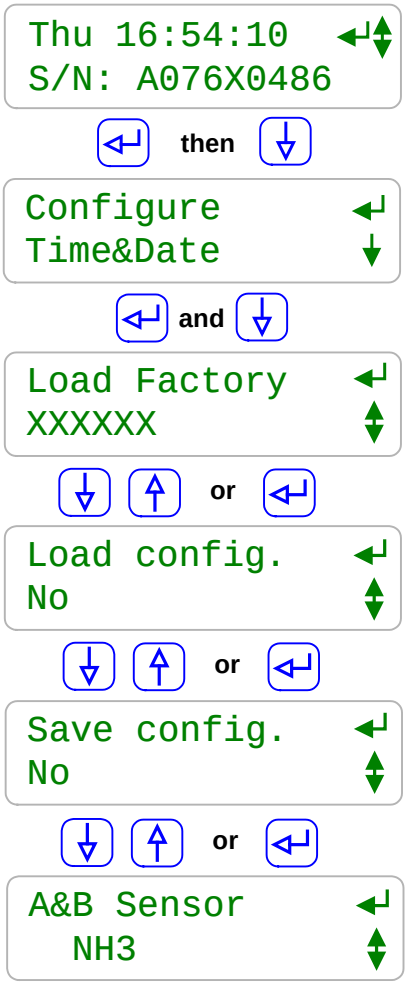
Requires 'LB' Option

Load Factory configures the Analyzer to one of the 1 to 15 configurations shipped with the Analyzer. This Analyzer is currently running the AMMONIA configuration.
. View and select an alternative Analyzer configuration by keying **ENTER**.

Load Config. returns to the last saved configuration. Key **ENTER**,select **Yes** & **ENTER**.

After you've modified the Analyzer for your site and its water treatment program, **Save config.** by keying **ENTER** & selecting **Yes**
Once saved, you can always recover by using **Load config**.

The **A&B** Analyzer inputs may be configured for several sensor types. Usually this is done once/site.
Key **ENTER** to view or modify the current **A&B Sensor** type.



Sidebar:
Warning: Load Factory & **Load config** Analyzer re-configuration may change sensors, Reconfiguration and run occurs as soon as either option selected.

Load Factory: 'LB' Option
Up to 15 configurations may be included with the Analyzer.
The configurations shipped with the Analyzer may make it easy to add a 2nd boiler blowdown,
They may also include complete preset feed programs complete with setpoints.

Recommended:
Turn on Keypad password (Manual Section 5.1).
Log on as the 'admin' and modify the password if this Analyzer is Is likely to be accessed by uniformed users. Do this to prevent accidental or malicious Analyzer reconfiguration.

5.7 Communications

This display sequence is only applicable to Analyzers with the '**LB**', LAN-Browser option. *See appendix LB*
To view or adjust the Analyzer Ethernet setting press **ENTER** and **DOWN** to **Communicate** at the power up or day-time display.

Key **ENTER** @ **Communicate**

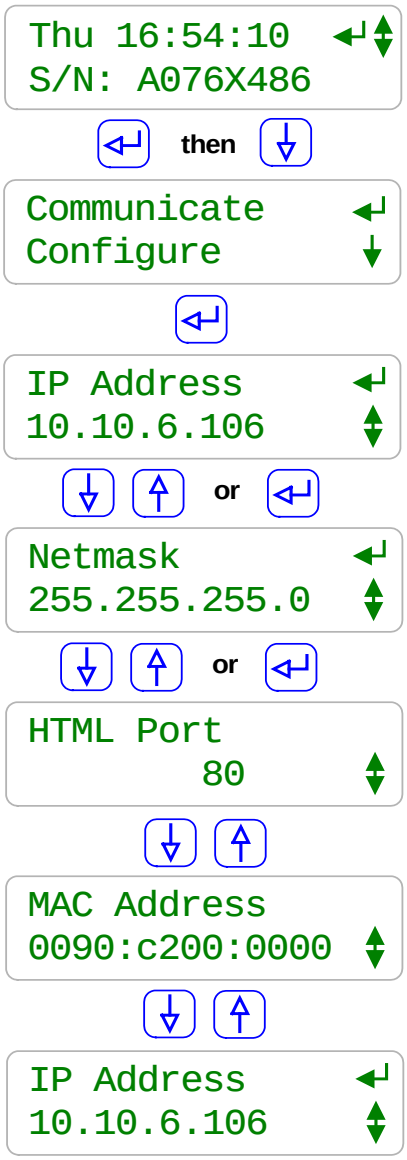
Displays the current LAN **IP address**.
In this example, it's the factory default.
If you are connecting into the site LAN, **IP address** is assigned by the site IT staff.
Key **ENTER** to modify.

Netmask is usually this value for most sites.
Key **ENTER** to modify.

This is the default **HTML Port** for browsing.
It can be modified only via the browser.

The site IT staff may require the Analyzer **MAC Address** to register-allow the Analyzer on the site network.
The **MAC address** is six 2 digit hexadecimal numbers, separated by colons into 3 groups of 4 to fit the LCD screen.
In this example, the **MAC address** is **00 90 C2 00 00 00**

Communicate



Sidebar:
Warning: Do not connect the Analyzer Ethernet connection into a site LAN until the site IT staff have assigned a valid IP Address.

Not Connected to the Site LAN:
Leave the IP Address at 10.10.6.106. Connect a crossover cable from your notebook PC to the Analyzer and browse 10.10.6.106.
Browser passwords are the same as the default keypad passwords listed in manual Section **5.1 Passwords**.
You'll need to configure your notebook to connect.
Refer to Appendix '**C**' **'LB' LAN Browser Option** at the back of this manual.

5.7 Communications

This display sequence is only applicable to Analyzers with the '**LB**', LAN-Browser option.

To view or adjust the Ethernet **IP Address** press **ENTER** and **DOWN** to **Communicate** at the power up or day-time display.

Key **ENTER** @ **Communicate**

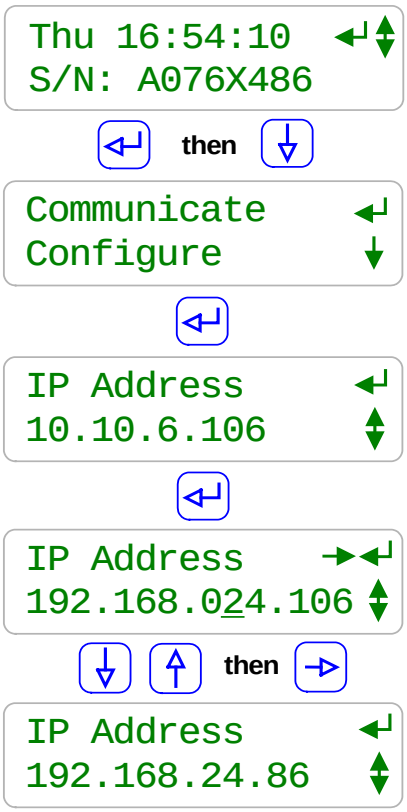
Key **ENTER** to modify.

Key **UP** or **DOWN** to change the underlined number
Key **RIGHT** to move to the next 3 digit number.

Key **ENTER** to change or **EXIT** to leave the **IP Address** unchanged.

In this example we've changed the **IP Address** from **10.10.6.106** to **192.168.24.86**.

Modify IP Address

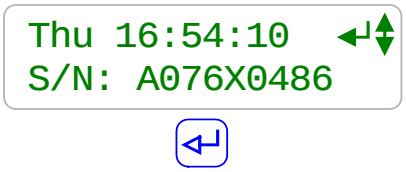


Sidebar:
Warning: Do not connect the Analyzer Ethernet connection into a site LAN until the site IT staff have assigned a valid IP Address.

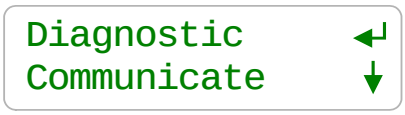
Using An Ethernet CrossOver Cable:
You'll need to set your notebook PC's IP Address to the same network to browse the Analyzer using a crossover cable. In this pages example, the Analyzer **IP Address** is **192.168.24.86**. To be on the same network, your notebook needs an **IP Address 192.168.24.**xxx where xxx is any number from 1 to 255, excluding **86**.

5.8 System Diagnostic

To view the Analyzer's **Diagnostic** press **ENTER** at the power up or day-time display.

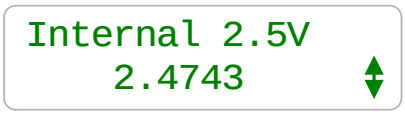


Key **ENTER** @ **Diagnostic**.



Displays the state of the Relay 1 to Relay 5 AC power fuse. Displays '**OPEN**' if AC fuse has failed.

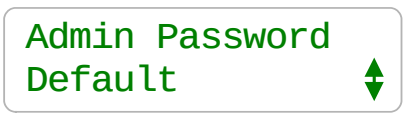
The **Internal 2.5V** level corrects analog voltages measured by the Analyzer. Displays from 2.4500 to 2.5500.



The **15VDC Power** level is the unregulated voltage @ the Analyzers **+DC Power Output** terminals. Displays from 15 to 23 Volts depending on AC line voltage and load on the **+DC Power Output** supply.

Displays the time and date of the last Analyzer reset or the time and date of the most recent **Load Factory** was executed.

An **Admin Password** @ **Default** has not been modified from '**AAAA**'. If modified displays '**Changed**'.



An **Watchdog Resets** should always display **0**. An increasing number of **Resets** indicates corrupted firmware or Analyzer electrical fault or interference.

The Analyzer **Firmware Version** indicates the date of issue of the software operating the Analyzer.

Sidebar:
Reset to Factory: Sets all volume-water meter totals for this year and the previous year to zero.

6.0 Product Support

6.1 Application & Technical Support

www.aquatrac.com
Aquatrac Instruments, Inc.
1957 Cedar Street
Ontario, CA 91761
800.909.9283

ProMinent Fluid Controls, Inc.
136 Industry Drive
Pittsburgh, PA 15275
412.787.2484

Ammonia Analyzers are supplied in a many configurations; some with specialized controls. The Analyzer Serial Number and Part number available on the top, center of the Analyzer circuit board, helps us to help you.

Replacement Sensors and Parts:
Analyzer User and Technical Manuals:
Click on the NH3 Analyzer icon @ **www.aquatrac.com**

Upgrade Kits:
Controls and sensors can be added to installed Analyzers.
Upgrade kits include sensor, entry fitting, driver card and installation instructions
Click on the NH3 Analyzer icon @ **www.aquatrac.com**

AC Power Fuse:
This fuse provides AC power to the pumps, solenoids and valves connected to Relays '**1**' to '**5**'.

Protects	Rating / Type	Manufacturer – Vendor
Power Relays 1 to 5 AC Fuse	5 Amps @ 120VAC 2.5 Amps @ 250VAC 5mm x 20mm, Fast Acting	Littlelfuse, Type 217P, 250VAC Digikey Part# F2395-ND Digikey Part# F2400-ND www.digikey.com 1-800-344-4539 OR Aquatrac Part# **AG-FUSE**, 10 fuse kit

6.2 Specifications

Analog – Digital I/O	Rating - Detail	Notes
Analog Inputs **A...G**	**3 Analog Sensors** of which 3 are fixed, **C**: pH **D**: NH3; & **G**: Temperature Socketed for two single or dual sensor drivers or 4-20mA output cards @ Inputs **C-D** and **E-F**	Analyzer auto-configures on Driver card installation and removal.
H...N	**7 Phantom** analog inputs may be used for manual data logging…	pH, NH3, Temperature, 4-20mA Input & Output cards available
4-20 mA Outputs **Uses C-D and/ or E-F sockets**	**0 to 4**, DC isolated, loop powered. Nominal 0.1% resolution. Auto polarity correction field wiring.	Single & Dual Drivers Alarms on open current loop.
Digital Inputs **O...V**	**8 Meter & Contact Set** Dry Contacts, 250mS response Water Meters, 400 Hz max 0.5mA @ 5VDC measurement current.	User configurable as water meters or contact sets. **S**: FlowSwitch sample flow
U...Z	**4 Phantom** inputs may be used for volume tracking, mirroring…	
Relay Outputs **1..5**	**5** 1 SPST, 4 SPDT Fused @ 6.3A 120VAC or 3.15A 230VAC.	Relays rated 10A, 120VAC Detection and Alarm on relay AC fusing.
Frequency Outputs **6..9**	**4** Isolated, Dry Contact SPST Outputs 400 SPM maximum.	500 ohms in series with non-polarized, bounce free, silicon contact sets.

Mechanical	Rating	Notes
Enclosure **Rating, Dimensions, Weight**	Non-metallic, NEMA4X, IP66 7.5”W x 11.3”H x 5.5”D 190mmW x 287mmH x 140mmD 15 lb. 7 Kg nominal Mounting hardware included.	Nominal dimensions, excluding entry fittings and external power and sensor cabling. Enclosure door hinged left.
120VAC 4 Plug Box (optional)	Rated for outdoor use. Includes 36” of flexible non-metallic conduit	Plug boxes not available for Analyzers shipped outside of North America
ON/OFF Switch (optional)	IP67 rated 10A @ 125/250VAC	Mounted bottom, left of enclosure door.

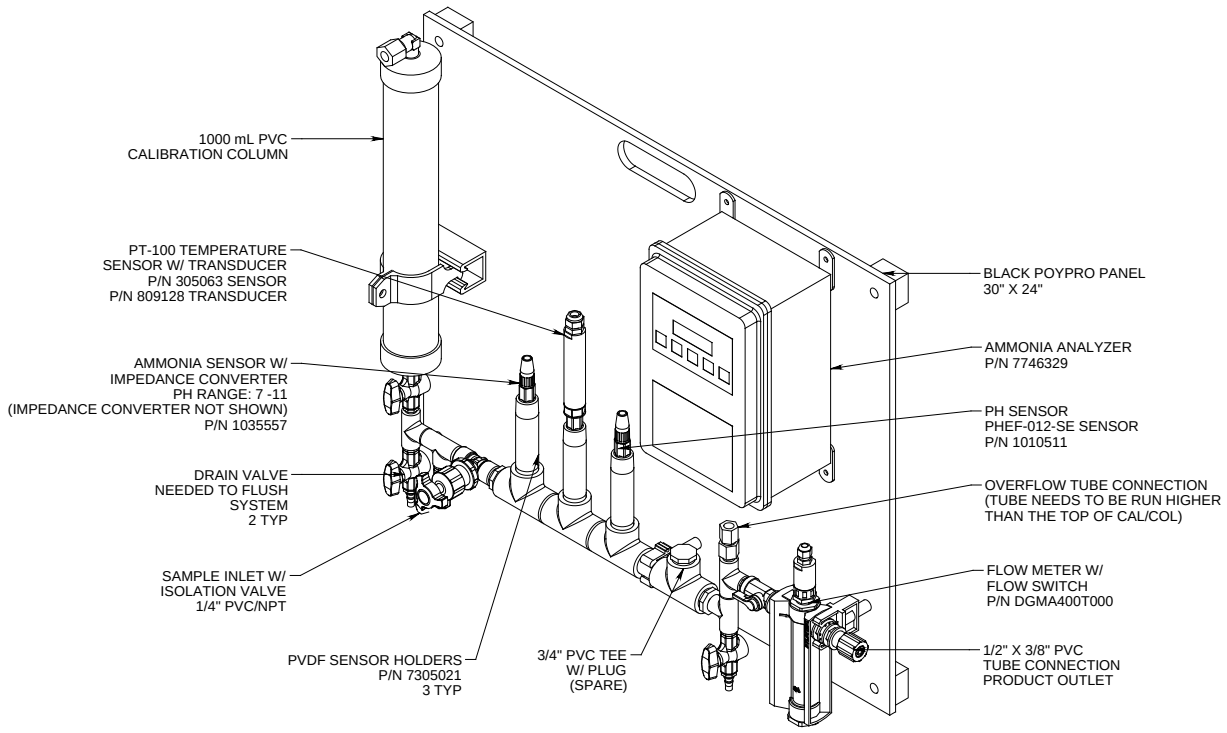
6.2 Specifications

Communications User Interface	Rating - Detail	Notes
Keypad - LCD	5 Key Tactile feedback: UP / DOWN / ENTER / EXIT / RIGHT 2 Line x 16 Character, Backlit	Scan rate 100mS nominal User adjustable contrast
USB	Data log download. View-configuration upload.	Includes display support for USB connection state
10 BaseT, TCP-IP Ethernet LAN (Optional)	HTML – AJAX micro Web Server for Mozillla's Firefox and IE7 Full command, control, reconfigure via browser. Network parameters and HTML port user set. Static IP	Password, UserID protected. Auto-configures views linking sensors and controls.
Modem (Optional)	56K, V.90 PPP access provides remote browsing via Mozillla's Firefox and IE7	Alarms accessed via Trackster3 polling.

Electrical	Rating - Detail	Notes
AC Input	120 or 230 VAC, 50/60Hz,	Switch selectable
5 Relay Fusing	6.3 Amps @ 120VAC 3.15 Amps @ 230VAC	5x20mm, AC fusing: Relays alarm & OFF on fusing.
120VAC Power Cord	0 to 1, AWG18, NEMA grounded plug, SJTW jacket, black, 60"	Quantity varies with Analyzer part number.
120VAC Pump-Solenoid Plug Sockets	0 to 5, AWG18, 3 wire, 12" long NEMA receptacle sockets, black.	Quantity varies with Analyzer part number.
Surge-Spike Suppression Control Fusing	Relays 2-5 NO contacts snubbed 0.1uF, 150R Varistor on control AC input	Analyzer, transformer isolated from AC line. Control fusing not user accessible.
AC Terminals	AWG 14, 150mm^2 UL rated 300V @ 10A Rising clamp type.	Electrical grounds at bottom of aluminum backplate. Conductor insulation rated 600VAC minimum.
Sensor, Digital Input Terminals	AWG 22, 0.25 – 0.50mm^2	MAX AWG14, 150 150mm^2
DC Loop – Turbine Meter Power	15 – 22 VDC, unregulated Thermally fused @ 100mA hold, trip @ 200mA	Available at 3 field wiring terminals: **+DC Power Output**

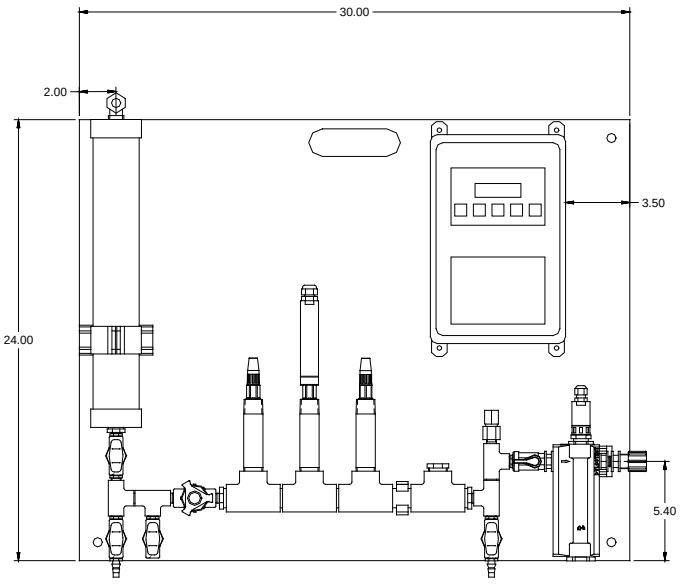
APPENDIX A

Ammonia Analyzer Assembly



APPENDIX B

Ammonia Analyzer Dimensions



APPENDIX C

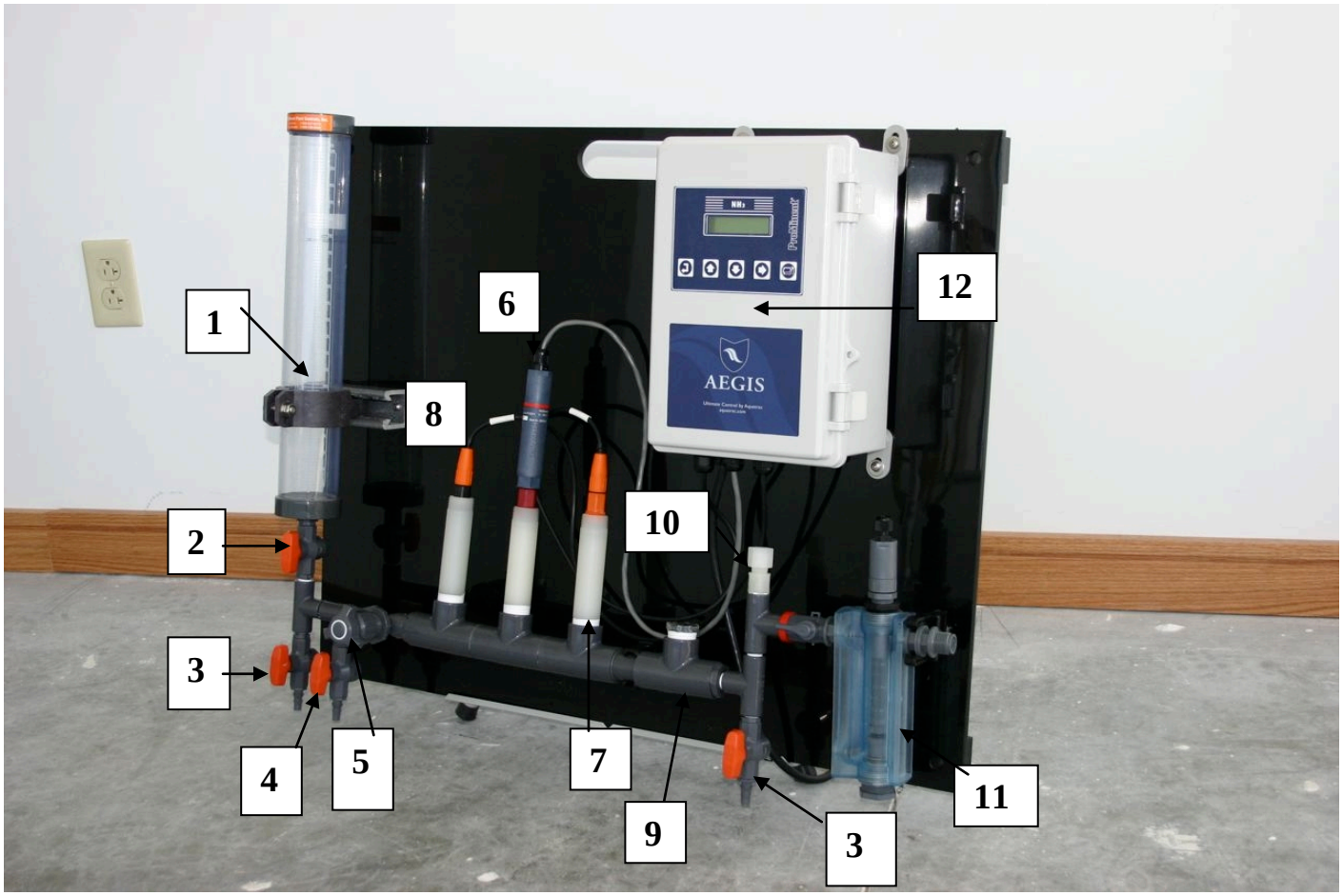
Ammonia Analyzer Parts

Item	Qty	Part No	Description
1	1	305350	Impedence Converter for Jumo sensor
2	1	1028807	Back panel
3	5	7500135	PVC shut off valve
4	1	7744652	1/4" PVC needle valve
5	4	7741483	3/4" PVC tee
6	2	7741908	1/4" to 3/4" reducting bushing
7	1	7714637	3/4" plug
8	1	7000325	1/2" plug
9	4	7745126	1/4" PVC tee
10	1	7741839	1/2" to 1/4" reducing bushing
11	1		DGMa 400T000 flow meter
12	3	7305021	PVDF holder
13	2	7741561	tubing connector
14	1	305063	PT-100 sensor
15	1	809128	PT-100 -V1 transducer
16	2	305030	6 ft. SN-6 to open end cables
17	1	1010511	PHEF sensor*
18		725122 2	wire cable 10 ft
19	1		Jumo sensor p/n
20	1		Aegis controller with ammonia option
21	1	7744247	2" FRP pipe clamp
22	6	7744109	1/4"x close PVC nipple sch 80 NPT
23	4	7742138	3/4" PVC tee SxSxFNPT sch 80
24	4	7741483	3/4"PVC tee SxSxS sch 80
25	3	703885	connector pg9 black (7735074.2)
26	3	7500067	pg9 nut
27	1		Jumo sensor membrane cap*
28	1		Jumo electrolyte*
29	1		1 Bottle ammonia standard 1,000 ppm*
30	1		1 pipette with bulb
31	1	1028807	1000 ml calibration column
32	1	7760254	Dual 4-20 mA output board
33	1	7760256	Dual pH/ORP Driver board

* Recommended Spare Part

APPENDIX D

Component Description



Component description:

1 – Calibration column is used for:
- Adding or making calibration standards-when calibrating to standard methods.
- Capturing sample when calibrating to a photometer.
- Normal operation acts as a delay chamber and a dampener.

2- Valve for isolating calibration coulomb.
3- Drain valves needed to flush system for standard method calibration. Also it is could be used for taking a calibration sample, for photometer calibration.
4 – Sample inlet with isolation valve.
5- Metering valve to set flow rate between 200ml -500ml/min.
6- Ammonia sensor with impedance converter. (Impedance converter not shown)
7- Pt-100 temperature sensor with transducer.
8-pH sensor
9-solution grounding screw
10-overflow tube connection-tube needs to be run higher than the top of the calibration coulomb.
11- Flow meter with flow switch.
12- Ammonia analyzer.

APPENDIX E

Standards Preparation for Sensor Calibration

Recommended Standard solutions:

For pH

Use pH buffer solutions 7 and 10 for two point calibration. Remove pH sensor from its mount and place in container holding buffer solution. Rinse sensor and container with distilled water thoroughly before filling with second buffer solution.

For Temperature

A two point calibration can be achieved using an ice bath (32 deg. F) for the low point and a room thermometer for the high point. The sensor should be removed from its mounting and allowed to stabilize for several minutes before calibration at each value.

For Ammonia

Recommended Standard: Ricca Chemical Co. Cat. No. 615-32 Ammonia Standard
CAS No. 12125-02-9
1.00 ml = 1.00 mg NH_3 (1000 ppm NH_3)
[1.00 ml = 822.4 ug N (822.4 ppm N)]
NH_4Cl in water

Use the ammonium chloride standard solution above and make up standard solutions for two point calibration. To ensure proper operation and for the initial ammonia sensor calibration, prepare two test solutions that differ in their ammonia concentration by at least a factor of 10. The standards should be made up to cover the expected operation range. 2 ml of 10 mol caustic soda should be added to each standard prior to calibration to elevate the pH >11 in order to convert any ammonium to ammonia.

Preparation of the two required solutions for ammonia calibration

1. For stock 100.0 ppm ammonia solution

Pour 10 ml of the recommended NH_4Cl (ammonium chloride) standard (1 mg = 1 ml = 1000 ppm NH_3) solution into a 100 ml graduated measuring flask partially filled with ammonia free distilled water, mix slightly, and then fill up to the 100 ml mark with ammonia free distilled water. This is a 100.0 ppm NH_3 solution standard which can be used to prepare the actual calibration standards.

2. For 10-mol caustic soda solution

40g of NaOH (sodium hydroxide) are dissolved in about 80ml of ammonia-free distilled water, in a 100ml measuring flask. The solution will become a little warm. When it has cooled down to 20°C, top up to 100ml with distilled water.

To prepare the ammonia standards and calibrate the sensor

1. Close the system sample inlet valve (item 4, Appendix D)
2. Rinse the 1000 ml ammonia analyzer calibration column (item 1, Appendix D) with distilled water
3. Allow to drain by opening the two valves at the bottom of the column
4. Close both bottom valves and fill column approximately 250 ml with ammonia free distilled water.
5. Add appropriate amount of the stock 100 ppm ammonia solution through the top of the calibration column based upon the concentration of the standard desired:
   - For 0.1 ppm ammonia add 1 ml
   - For 1.0 ppm ammonia add 10 ml
   - For 10.0 ppm ammonia add 100 ml
6. Pipette 2 ml of the 10 mol caustic soda solution through the top of the calibration column.
7. Fill the calibration column to the 1000 ml mark with ammonia free distilled water without creating air bubbles.
8. Open the valve immediately below the column (valve 2, Appendix D) and allow standard to gravity flow past the ammonia sensor. Calibrate the sensor per section 2.2 sensor calibration.
9. Place valves back in correct position to measure incoming system sample after calibration(s).

NOTE: Refer to Section 2.2 Sensor Calibration for keypad sequences to perform calibrations.

UP & **DOWN** to view options or to EDIT numbers

Move **RIGHT** to select next field when EDITing

ENTER to select an option & to execute EDITing

EXIT to escape option, info display or EDITing

APPENDIX F

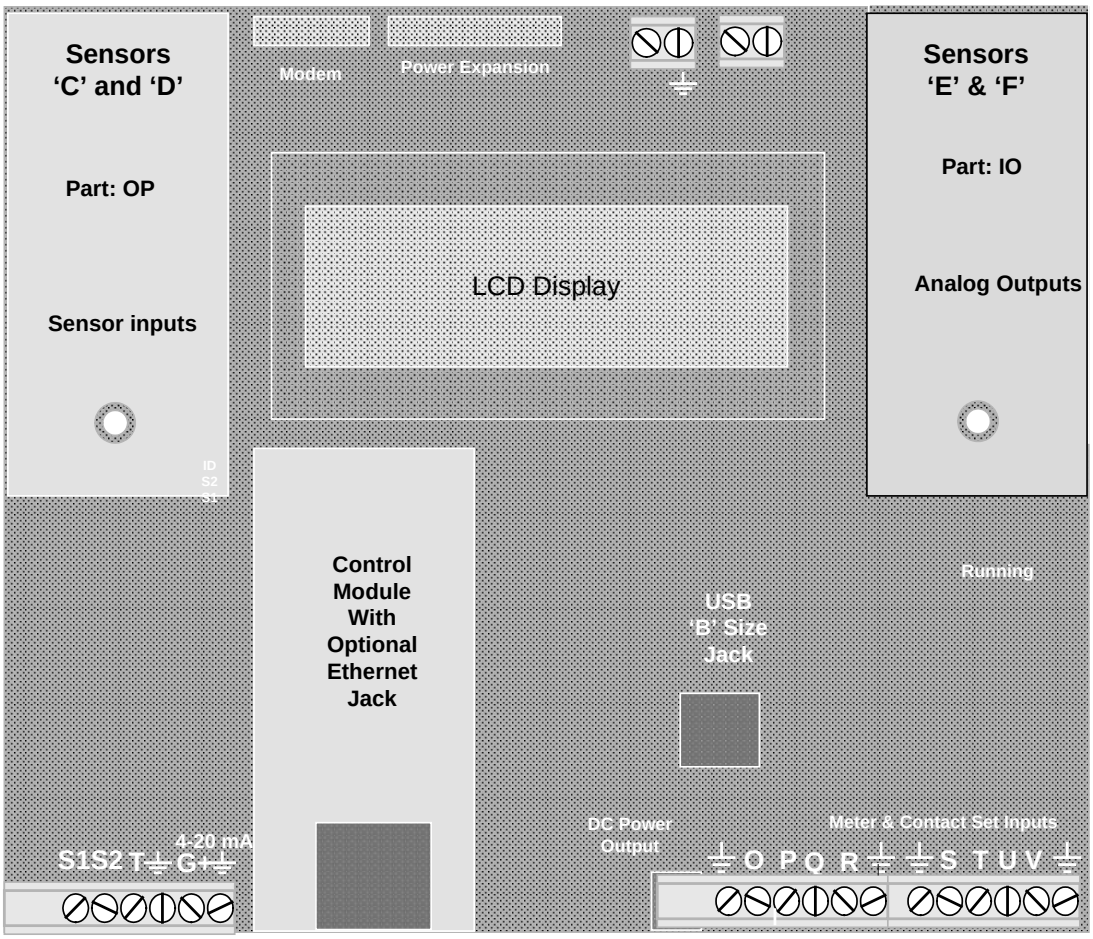
SENSOR AND OUTPUT DRIVER CARDS

OP Driver

The OP driver measures ammonia and pH sensors.

Driver Card Installation

1. Enable both of the analog inputs at the driver socket location.
2. Turn OFF the controller AC power
3. OP driver must be installed in the slot indicated below.
4. Connect the ammonia and pH sensors to the driver field wiring terminals.
5. Turn ON the analyzer after installing the OP Driver and the controller will auto-configure, displaying the installed sensor or sensors on the LCD display and browser.



Sensor Types

ProMinent pH type, Ammonia type, and temperature type.

Warning 1: Do not install the pH sensor without installing and connecting a solution ground. Unstable, drifting pH will occur if the solution ground is disconnected.

Warning 2:
Turn OFF the controller before connecting or disconnecting pH and ammonia sensors.

Sensor Inputs

The controller uses the letters '**A**' thru '**Z**' to identify sensor, water meter, flowswitch and contact set inputs and the numbers **1** to **9** to identify AC power switching relays and frequency outputs.

'**A**' to '**G**' and '**O**' to '**V**' exist as terminal blocks where inputs are connected. Sensor inputs '**H**' to '**N**' and meter/contact set inputs '**W**' to '**Z**' are used to implement more complex control and monitoring functions.

Any input may be used to control any output or outputs.

I/O Point	Function	Notes
Sensor **A**	Fixed conductivity sensor drive	Support for both cooling tower and boiler-condensate sensors. Most controllers have at least one conductivity sensor.
Sensor **B**	Fixed thermal sensor drive	Support for the 10mV/K and CTF type temperature sensors, Thermal compensation for the 'A' conductivity or stand-alone feedwater thermal sensor
Sensors **C-D** and **E-F**	Two sensor card slots. Each slot can take a single or dual sensor driver card	Plug & Play sensor cards auto-reconfigure the controller when the card is installed. Card set: C = pH, D = NH3
Sensor **G**	Fixed 4-20mA input	Support for loop powered and isolated 4-20mA levels on Temperatujre
Sensors **H** to **N**	Phantom sensor inputs used for control and logging.	Inputs used to for calculated and manually entered values: Calculated ppm & inventory-tank levels. Manually entered drop count-chemical test results…
Meter-Contacts **O** to **V**	Eight digital inputs, individually configurable as meter-volume or contact set inputs	Meter-volume inputs totalize, display volume today and this year, calculate turbine 'K' factors and debounce contact head meters. Contact sets are flow and level switches. They are used to interlock and to initiate feeds.
Meter-Contacts **W** to **Z**	Phantom digital inputs used for control and logging.	A 4-20 GPM input may be converted to a volume @ 'X' A relay state may be 'mirrored' by phantom input 'Y' which is used to start a rinse sequence by controlling relay No.4
Relays **1** to **5**	AC Line powered ON/OFF controls	Controller powered outputs switch 120 or 230VAC pumps, valves & solenoids ON/OFF. Log time ON.

		Alarm on runtime per actuation & per day. Relays 2-5 are SPDT for motorized valves requiring power OPEN & power CLOSE.
Frequency Outputs **6** to **9**	DC isolated, non-mechanical 0 to 400Hz	Variable speed feeds, with presets for popular pump ml/stroke and maximum rate. Calculates & logs volume fed. Use volume fed to calculate ppm & inventory.

Field Replacements

Sensor driver cards can be added after installation by powering OFF the controller, plugging in the upgrade card and powering ON. The controller recognizes the new hardware and auto-configures, modifying the LCD display to add the new sensor inputs and sub-menus. The diagnostic browser view auto-enables the new sensors and displays their current values.

No additional hardware is required to connect another water meter, flow or level switch. Enable the input and the new device appears automatically in all of the selection and configuration menus.

OP: pH – Ammonia

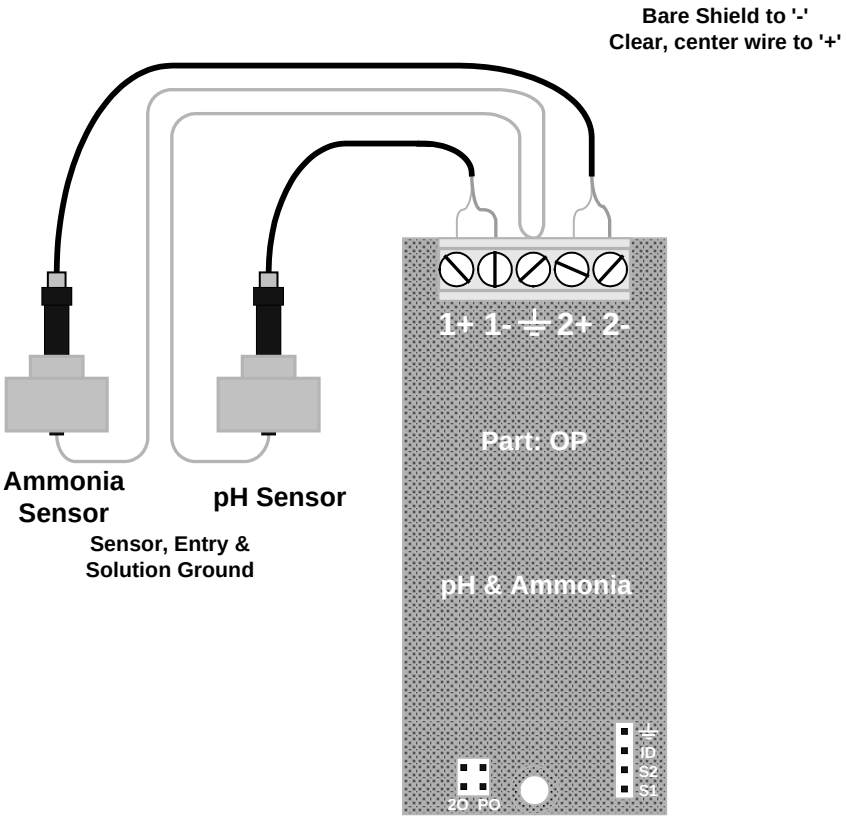
Safety
+/-1VDC maximum on field wiring terminals.
24 VDC maximum on internal card surfaces.

OP Driver Installation

Services
The OP driver measures ammonia and pH sensors.

Driver Card Installation
1. Turn OFF the controller AC power
2. OP driver cards can only be installed in the Sensor ‘C’ & ‘D’ slot.
3. Connect the pH and ammonia sensors to the driver field wiring terminals.
4. Turn ON the analyzer after installing the OP Driver and the controller will auto-configure, displaying the installed sensor or sensors on the LCD display and browser.

Sensor Wiring



Do not install sensor cabling in the same conduit as AC power cabling.

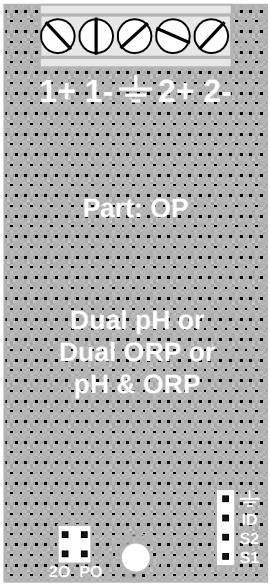
Solution grounds are single conductor AWG18-22 / 0.25-0.75 mm^2.

Warning 1: Do not install pH sensors without installing and connecting a solution ground. Unstable, drifting pHs will occur if the solution ground is disconnected.

Warning 2:
Turn OFF the controller before connecting or disconnecting pH and ammonia sensors.

Sensor Set Selection

Turn controller OFF before changing sensor selection jumpers.
Controllers check selection jumpers on power up, loading default Offset and Gain on range change.

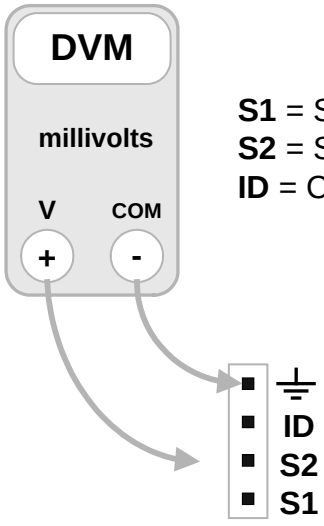


Dual pH
No Jumper

Dual ORP
Jumper **2O**

pH & ORP
Jumper **PO**

Driver Test Header



S1 = Sensor 1 mV x -1
S2 = Sensor 2 mV x -1
ID = Card ID Level

ID = Card ID Level

pH & NH3 1450

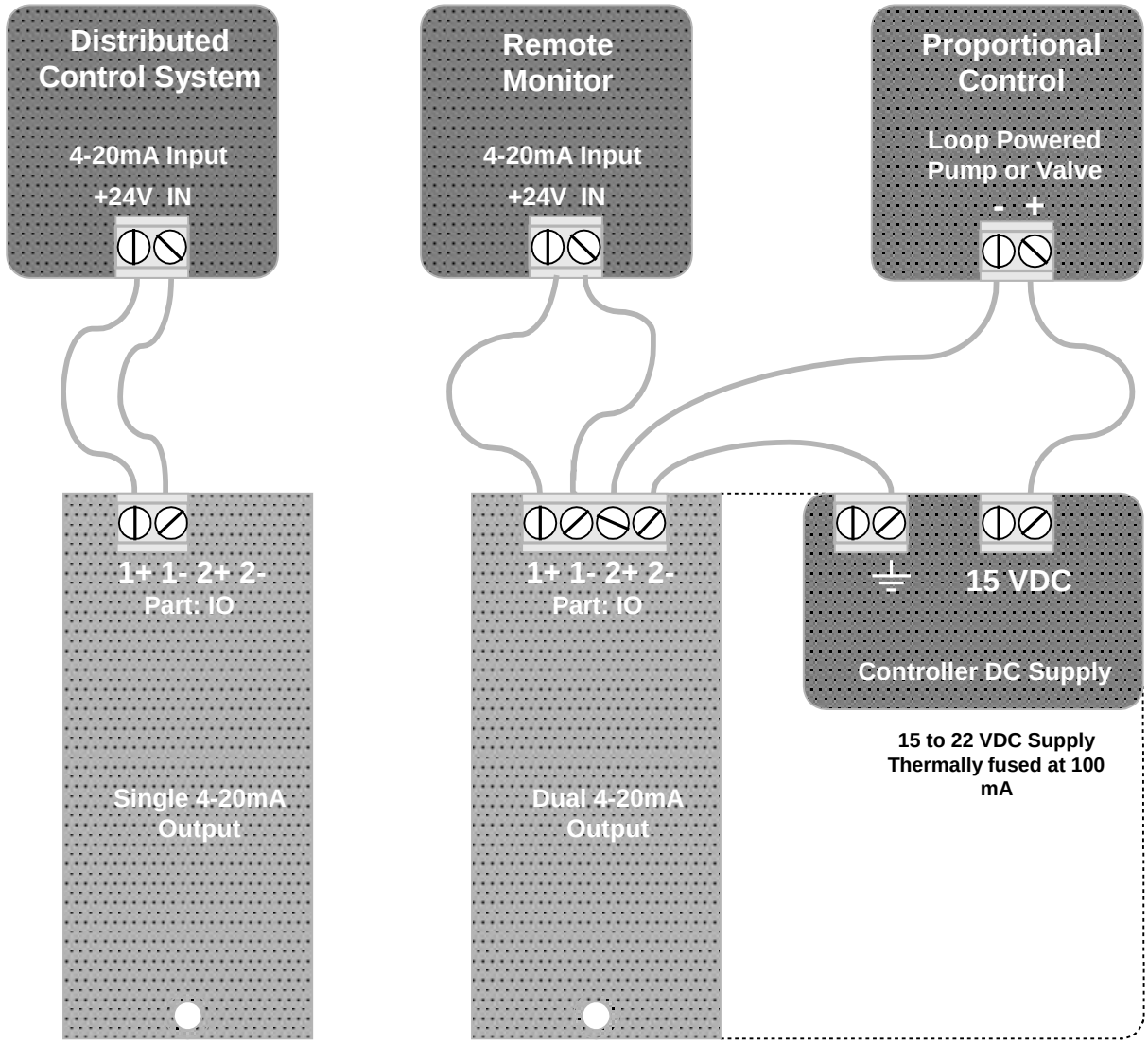
IO: 4-20mA Output

Safety
30 VDC maximum on field wiring terminals.
24 VDC maximum on internal card surfaces.

Services
The IO driver provides one or two, DC isolated, loop powered 4-20mA outputs.
The current output level 0% to 100% is logged by the analyzer.

Card Installation
1. Turn OFF the controller AC power
2. IO driver cards may be installed in the Sensors 'E' & 'F' slot.
3. Turn ON the controller after installing the IO Driver and the controller will auto-configure, displaying the current output, on the LCD display and browser.

Current Loop Wiring

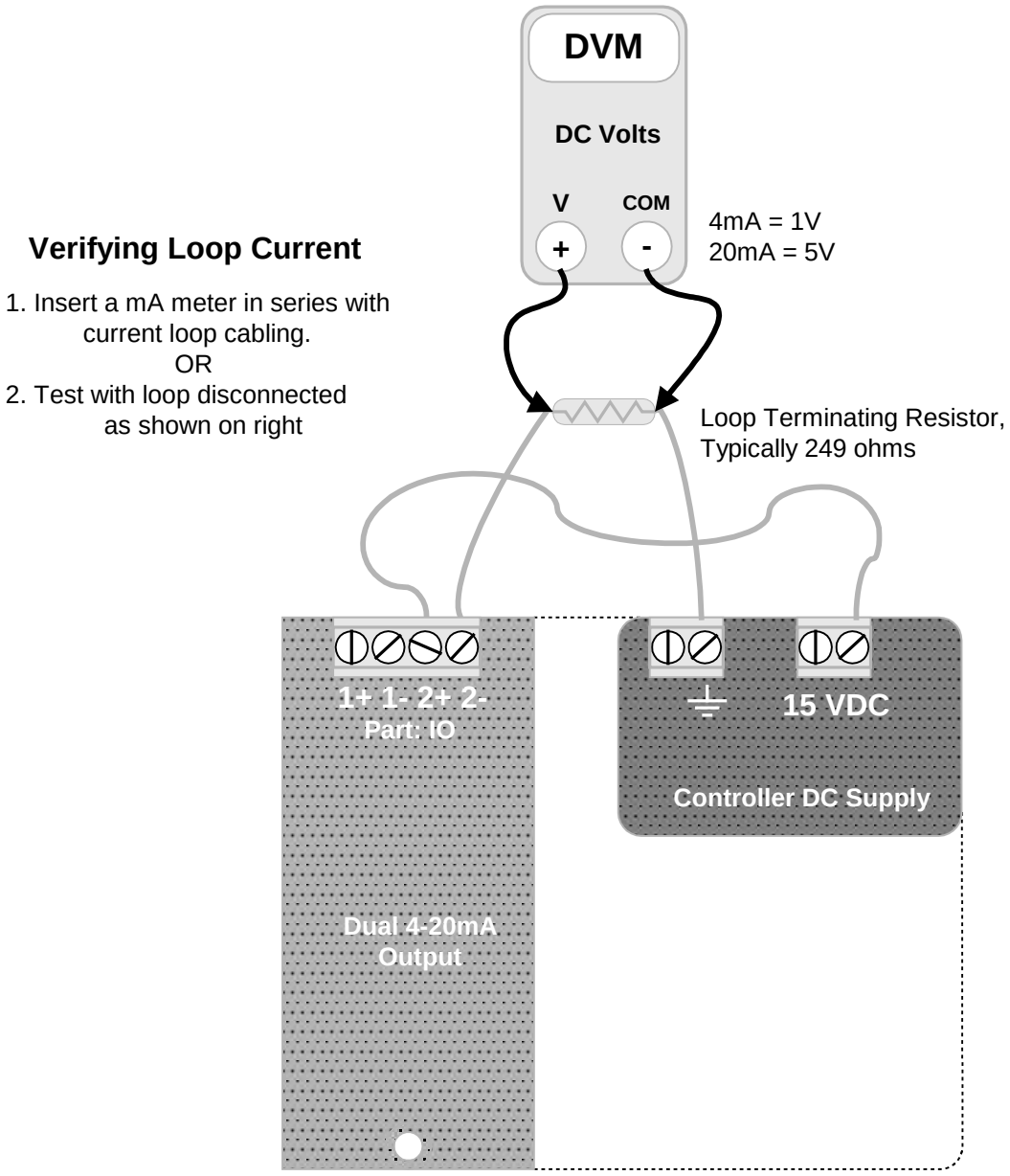


Configuration - Operation

Manual - Auto

A 4-20mA output may be switched from Auto control to Manual.
Manual mode allows the user to set an output from 0% to 100% to base feed, set up feed rates and verify monitoring inputs.
On return to Auto the 4-20mA span and controlling sensor or relay are restored, unchanged.

Hardware Calibration



Hardware Calibration is used to compensate for component level errors.
It's only available via the keypad and forces the current loop to 20mA to adjust SPAN and to 4mA to adjust ZERO. Trim Zero default = 9 Trim Span default = 950