AccuLase-GPA™

Tunable Diode Laser Adsorption Spectroscopy Analyzer

Operation & Maintenance Manual

Revision 6
January 2023

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NOTICES

All information in this manual is subject to change without notice and does not represent a commitment on the part of Galvanic Applied Sciences, Inc.

Note: Changes or modifications not expressly approved by Galvanic Applied Sciences, Inc. could void the user's authority to operate the equipment.

Purpose

This manual describes how to safely operate and maintain the AccuLase-GPA™.

Important

Read Section 1 before proceeding to use the AccuLase-GPA™. Galvanic Applied Sciences is not responsible for any deviation from this manual.

Scope

If products and components from other manufacturers are used, these must be recommended or approved by Galvanic Applied Sciences (The ‘Manufacturer’). Due to design changes and product improvements, information is subject to change without notice. The Manufacturer reserves the right to change hardware and software design at any time, which may subsequently affect the contents of this manual. The Manufacturer assumes no responsibility for any errors that may appear in this manual. The Manufacturer will make every reasonable effort to ensure that the manual is up to date and corresponds with your AccuLase-GPA™.

Users

The AccuLase-GPA™ described in this manual is intended for use by trained personnel. Trained personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with the AccuLase-GPA™. For start-up or technical assistance contact:

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Table of Contents

Safety Symbols used in Manual

DANGER

The Danger symbol indicates a hazardous situation that, if not avoided will result in death or serious injury.

WARNING

The Warning symbol indicates a hazardous situation that, if not avoided could result in death or serious injury.

CAUTION

The Caution symbol with the safety alert symbol indicates a hazardous situation that, if not avoided could result in minor or moderate injury, and/or damage to the analyzer system.

NOTICE

The Notice symbol is used to highlight information that will optimize the use and reliability of the system.

Important Safety Guidelines for the AccuLase-GPA™

Please read the following warnings and cautions carefully before using the AccuLase-GPA™.

⚠WARNING THIS EQUIPMENT MUST BE USED AS SPECIFIED BY THE MANUFACTURER OR OVERALL SAFETY WILL BE IMPAIRED.

⚠WARNING ACCESS TO THIS EQUIPMENT IS LIMITED TO AUTHORIZED, TRAINED PERSONNEL ONLY.

⚠WARNING USE OF UNAUTHORIZED PARTS MAY IMPAIR SUITABILITY FOR EXPLOSIVE OR HAZARDOUS LOCATIONS.

⚠WARNING OBSERVE ALL WARNING LABELS ON THE ANALYZER ENCLOSURES, AS WELL AS ON RELATED CONTAINERS AND CHEMICALS.

⚠WARNING THIS MANUAL SHOULD BE FULLY REVIEWED PRIOR TO OPERATION OF THE ANALYZER.

The analog outputs and alarm relay contacts may be powered by a source separate from the one (s) used to power the analyzer system. Disconnecting the main power source may not remove power from the analog output signals

Any safety recommendations or comments contained herein are suggested guidelines only. Galvanic Applied Sciences Inc. bears no responsibility and assumes no liability for the use and/or implementation of these suggested procedures.

This system, when operating in its normal mode, and/or when it is being serviced, maintained, installed and commissioned contains items which may be hazardous to humans if handled or operated incorrectly or negligently.

The AccuLase-GPA™ can be configured to be safely operated in a CSA hazardous areas Class 1, Div. 2, Groups B, C. D (D2 Model), a Class 1, Div. 1, Groups B, C, D (D1 model) or ATEX/IECEx zones II 2G IIB+H2 or II 3G IIB+H2.

Manufacturer's Warranty Statement

Galvanic Applied Sciences Inc. ("Seller") warrants that its products will be free from defects in materials and workmanship under normal use and service in general process conditions for 12 months from the date of Product start-up or 18 months from the date of shipping from Seller's production facility, whichever comes first (the "Warranty Period"). Products purchased by Seller from a third party for resale to Buyer ("Resale Products") shall carry only the warranty extended by the original manufacturer. Buyer agrees that Seller has no liability for Resale Products beyond making a reasonable commercial effort to arrange for procurement and shipping of the Resale Products. Buyer must give Seller notice of any warranty claim prior to the end of the Warranty Period. Seller shall not be responsible for any defects (including latent defects) which are reported to Seller after the end of the Warranty Period.

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Except in the case of an authorized distributor or seller, authorized in writing by Seller to extend this warranty to the distributor's customers, the warranty herein applies only to the original purchaser from Seller ("Buyer") and may not be assigned, sold, or otherwise transferred to a third party. No warranty is made with respect to used, reconstructed, refurbished, or previously owned Products, which will be so marked on the sales order and will be sold "As Is".

Limitations

These warranties do not cover:

- Consumable items such as lamps.
- Analyzer components which may be damaged by exposure to contamination or fouling from the process fluid due to a process upset, improper sample extraction techniques or improper sample preparation, fluid pressures in excess of the analyzer's maximum rated pressure or fluid temperatures in excess of the analyzer's maximum rated temperature. These include but are not limited to sample filters, pressure regulators, transfer tubing, sample cells, optical components, pumps, measuring electrodes, switching solenoids, pressure sensors or any other sample wetted components.

- Loss, damage, or defects resulting from transportation to Buyer's facility, improper or inadequate maintenance by Buyer, software or interfaces supplied by Buyer, operation outside the environmental specifications for the instrument, use by unauthorized or untrained personnel or improper site maintenance or preparation.
- Products that have been altered or repaired by individuals other than Seller personnel or its duly authorized representatives, unless the alteration or repair has been performed by an authorized factory trained service technician in accordance with written procedures supplied by Seller.
- Products that have been subject to misuse, neglect, accident, or improper installation.
- The sole and exclusive warranty applicable to software and firmware products provided by Seller for use with a processor internal or external to the Product will be as follows: Seller warrants that such software and firmware will conform to Seller's program manuals or other publicly available documentation made available by Seller current at the time of shipment to Buyer when properly installed on that processor, provided however that Seller does not warrant the operation of the processor or software or firmware will be uninterrupted or error-free.

The warranty herein applies only to Products within the agreed country of original end destination. Products transferred outside the country of original end destination, either by the Seller at the direction of the Buyer or by Buyer's actions subsequent to delivery, may be subject to additional charges prior to warranty repair or replacement of such Products based on the actual location of such Products and Seller's warranty and/or service surcharges for such location(s).

Repaired Products

Repaired products are warranted for 90 days with the above exceptions.

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IN NO EVENT SHALL SELLER BE LIABLE TO BUYER FOR ANY INDIRECT, CONSEQUENTIAL, INCIDENTAL, SPECIAL OR PUNITIVE DAMAGES, OR FOR ANY LOSS OF USE OR PRODUCTION, OR ANY LOSS OF DATA, PROFITS OR REVENUES, OR ANY CLAIMS RAISED BY CUSTOMERS OF BUYER OR ANY ENVIRONMENTAL DAMAGE OR ANY FINES IMPOSED ON BUYER BY ANY GOVERNMENTAL OR REGULATORY AUTHORITIES, WHETHER SUCH DAMAGES ARE DIRECT OR INDIRECT, AND REGARDLESS OF THE FORM OF ACTION (WHETHER FOR BREACH OF CONTRACT OR WARRANTY OR IN TORT OR STRICT LIABILITY) AND WHETHER ADVISED OF THE POSSIBILITY OF SUCH DAMAGES OR NOT.

Section 1 AccuLase-GPA™

1.1 Overview

The Galvanic Applied Sciences AccuLase-GPA™ uses Tunable Diode Laser Absorption Spectroscopy (TDLAS) to determine the concentration of a target gas species in a variety of gaseous process streams. The AccuLase-GPA™ can be configured for detection and monitoring of any single or any combination of the following gaseous analytes: carbon dioxide (CO_2), hydrogen sulfide (H_2S) and water vapour (H_2O).

1.2 Principle of Operation

The AccuLase-GPA™ is based on TDLAS in the near-infrared part of the electromagnetic spectrum, combined with the use of a Herriott Cell to provide an optical path length of over 50 metres in a compact package. Near-infrared TDLAS sensors provide fast, high-sensitivity measurement of a selected gas or gases in complex sample gas mixtures. As with any optical absorption-based instrument, the concentration of the target gas species can be determined by measuring the absorbance at a specific wavelength characteristic of the target gas species. Molecules of the target gas absorb laser light at frequencies corresponding to rotation, stretch, and bend vibrational modes for those molecules. The relationship between the absorbance and is given by the Beer-Lambert Law, shown below:

$$A = \varepsilon C l$$

Where:

A = Absorbance
ε = molar absorptivity of the target gas
C = concentration of the target gas
l = optical path length

The specific wavelength at which the absorbance is measured is chosen to reduce interference from other gaseous species in the gas mixture being analyzed to the greatest extent possible. The specific wavelength of light emitted by the laser can be controlled by adjusting the current and / or the temperature of the laser emitter. In order to improve the sensitivity of the analyzer, a detector signal processing method known as Wavelength Modulation Spectroscopy is used. This method rejects noise and thus increases the signal-to-noise ratio, allowing a much lower detectable limit for the target gas species than would otherwise be possible.

1.3 Features of the Analyzer

The AccuLase-GPA™ provides the following capabilities:

- Concentration measurement of hydrogen sulfide gas over a 0-500ppmv range with exceptional linearity and repeatability
- Concentration measurement of carbon dioxide gas over a 0-5% range and sensitivity of 50ppmv
- Concentration measurement of water vapour over a 0-500ppmv range and sensitivity of 5ppmv
- The ability to measure as many as 4 sample streams on a single analyzer
- Sensitivity down to 0.15ppm for Hydrogen Sulfide

- Rapid response within 1 second
- No consumables other than calibration standard gas
- Very low maintenance and low cost of operation
- Ethernet communication for local and remote operation via a web-based GUI
- Built-in Data Logging
- Modbus communication via either RS232 or RS485

1.4 System Operating Control

The AccuLase-GPA™ is controlled by a dedicated data acquisition system which provides supervisory control, performs all calculations, and provides the local user interface. This control system also stores the web based graphical user interface (GUI) which allows the user to view analyzer results, configure the analyzer configuration, and carry out manual analyses as necessary. The preferred method of connecting to the AccuLase-GPA™ is by ethernet, either to a local computer or to a local area network (LAN). See Section 4.2 of this document for more information.

The control system includes an onboard computer system that provides a full screen color display of the target gas concentration, key system control parameters, and their status. A hand held keypad is provided for user interface with the control system, and can be used to view and edit the analyzer configuration, as well as navigate through the variety of display screens included in the local user interface. Operation of the system using the handheld keypad is described in Section 3. As an alternative, a web browser-based graphical user interface (GUI) can be used to view and / or enter data on a local or remote basis. Operation of the analyzer via the web-based GUI is described in Section 4.

1.5 Installation and Safety

It is not required to connect to any other port or terminal block within the analyzer for proper operation of the AccuLase-GPA™ unit. However, connection to the analyzer may be by serial port (RS485) or analog signals (4-20mA), connected directly from the analyzer to an analog receiver. Relay signals can also be connected for status monitoring.

⚠WARNING TO ENSURE THAT THE ANALYZER OPERATES CORRECTLY, THE CHASSIS GROUND CONNECTION ON THE OUTSIDE OF THE ENCLOSURE MUST BE CONNECTED TO THE FACILITY'S HIGH INTEGRITY GROUND.

⚠CAUTION IF IT IS DESIRED TO HAVE REGULAR CONNECTION TO A LOCAL COMPUTER, A REMOTE ETHERNET TERMINAL IS RECOMMENDED SO THAT THE ELECTRONICS ENCLOSURE DOES NOT NEED TO BE OPENED FOR ACCESS.

NOTICE CONNECTIONS TO THE INPUT//OUTPUT BOARD ARE MADE BY CONNECTING WIRE TO THE PLUGGABLE TERMINAL SCREW BLOCKS. THE TERMINAL BLOCKS MAY BE UN-PLUGGED FROM THE BOARD FOR CONVENIENCE DURING MAINTENANCE.

For more information regarding the safety considerations, installation requirements, and hazardous area classifications of the AccuLase-GPA™, please refer to the document *AccuLase-GPA™ Analyzer Installation and Safety Manual.*

Section 2 AccuLase-GPA™ Components

2.1 Overview

The AccuLase-GPA™ is an integrated system designed to monitor the concentration of a target gas, hydrogen sulfide, in a gaseous stream or multiple streams using the Tunable Diode Laser Absorption Spectroscopy (TDLAS) method described in Section 1.2. The AccuLase-GPA™ can be divided into three separate areas, as follows:

- Electronics Enclosure (Section 2.2)
- Optics / Sample Cell Enclosure (Section 2.3)
- Sample Conditioning System (Section 2.4)

2.2 Electronics Enclosure

The electronics enclosure is located on the top of the AccuLase-GPA™. It houses all the analyzer electronics, including the analyzer's local display, controller (mother) board, input/output (I/O) board, AC/DC power supply, and intrinsically safe barrier board (AccuLase-GPA™ D1 only).

⚠CAUTION DO NOT POWER-UP ELECTRONICS WITHOUT A USB CONNECTION BETWEEN THE CONTROLLER BOARD AND INPUT/OUTPUT BOARD AND SERIAL CARDS (IF PRESENT). DO NOT DISCONNECTION USB CONNECTIONS BETWEEN THE CONTROLLER BOARD AND INPUT/OUTPUT BOARD AND SERIAL CARDS (IF PRESENT) WHILE POWERED UP.

2.2.1 Controller Board

The controller board, which is mounted behind the analyzer display board on the electronics enclosure door, is the control computer for the AccuLase-GPA™. It includes the system central processor unit, memory, solid state storage, clock battery, and USB / Ethernet connection ports. The controller board is shown in Figure 1.

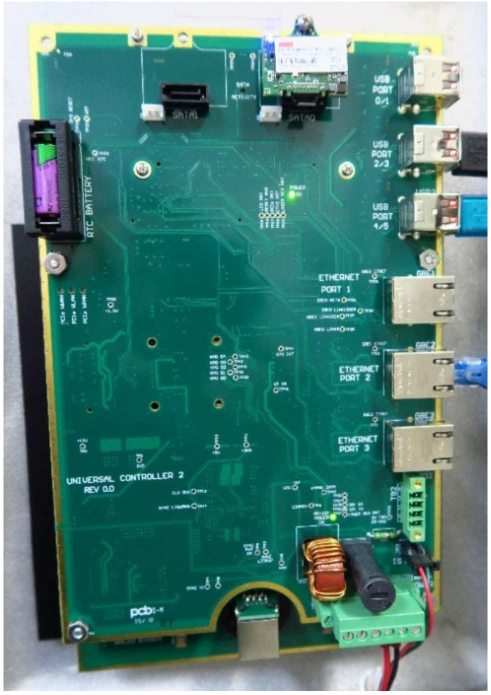


Figure 1: AccuLase-GPA™ Controller Board. Actual controller board colour may vary.

The Ethernet ports can be used for local or remote connection via the web-based GUI program. One USB port is used for communication with the Input / Output (IO) board. The other USB ports can be used to download the archive data from the on-board storage.

2.2.2 Display Board

The AccuLase-GPA™ display board is the electronics board that includes the analyzer's 5.7-inch full color liquid crystal display (LCD), shown in Figure 2.

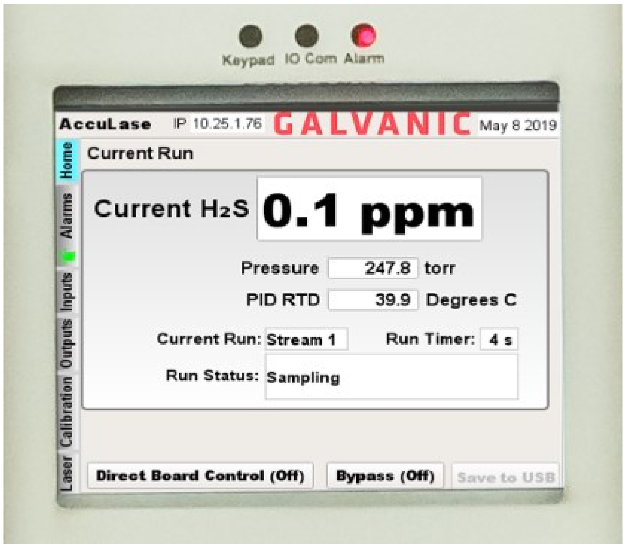


Figure 2: AccuLase-GPA™ Display

The LCD is used to display the analyzer's local user interface, which displays analysis results and a variety of other analyzer parameters. It can also be used to make some changes to the analyzer configuration. The local display can be manipulated using the analyzer's hand-held keypad. The operation of the local user interface is described in Section 3 of this manual.

Above the display are three status LEDs which are used to indicate various aspects of the analyzer status. The function of these LEDs is described in Section 3.2.

2.2.3 Input / Output Board

The Input / Output (IO) board is mounted inside the electronics enclosure. The IO board handles all of the analyzer's inputs and outputs. Inputs to the IO board include the data from the laser control module from the analyzer's optics/sample cell enclosure, the sample cell temperature and pressure transducer inputs, and inputs from the analyzer's hand held keypad. Outputs from the IO board include 4-20mA analog outputs (up to 4) for analysis data, mechanical relays (4) for status outputs, and serial (RS-485) communication for MODBUS. The IO board communicates with the analyzer's controller board via a USB connection.

NOTICE CONNECTIONS TO THE INPUT//OUTPUT BOARD ARE MADE BY CONNECTING WIRE TO THE PLUGGABLE TERMINAL SCREW BLOCKS. THE TERMINAL BLOCKS MAY BE UN-PLUGGED FROM THE BOARD FOR CONVENIENCE DURING MAINTENANCE.

2.2.4 Intrinsically Safe (IS) Barrier (D1 Model Only)

The intrinsically safe (IS) barrier is mounted in the top left corner of the control enclosure of AccuLase-GPA™ D1 control enclosure. The intrinsically safe barrier connections are shown in Figure 3.

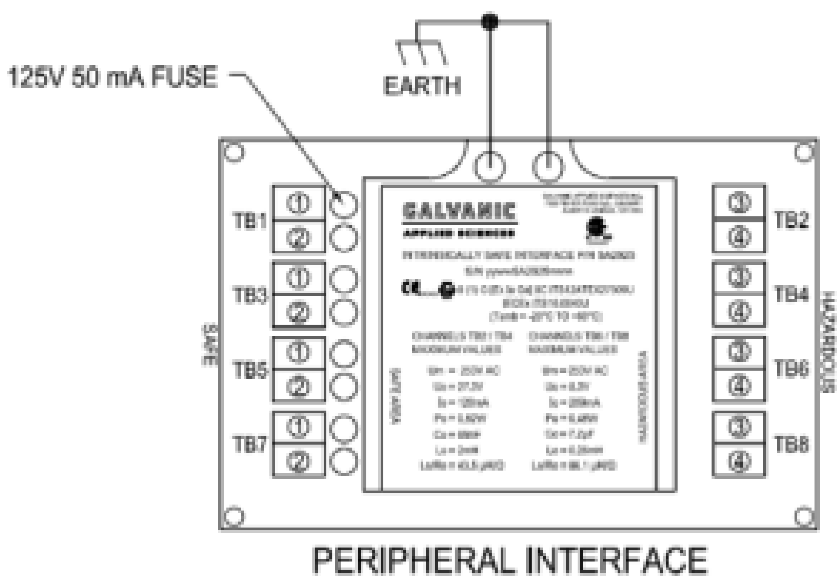


Figure 3: Intrinsically Safe (IS) Barrier

The wiring connections for the analyzer's hand-held keypad pass through the IS barrier.

⚠WARNING TO ENSURE THAT THE ANALYZER OPERATES CORRECTLY, THE GROUND SCREWS ON THE IS BARRIER MUST BE CONNECTED TO THE FACILITY'S HIGH INTEGRITY GROUND.

2.3 Optics / Sample Cell Enclosure

The Optics / Sample Cell Enclosure contains all components related to the analyzer's optical system, as well as the actual measurement cell. In Division 1 / CE models, the Optics / Sample Cell enclosure is a large cylindrical enclosure below the electronics enclosure, as shown in Figure 4.

Figure 4: Location of Optics / Sample Cell Enclosure (Division 1 / CE)

In the Division 1 / CE models, the optics / sample cell enclosure is covered by a insulated blanket for better temperature control, as also seen in Figure 4. In the Division 2 model, the optics / sample cell enclosure is located directly below the electronics enclosure, as shown in Figure 5.

Figure 5: Location of Optics / Sample Cell Enclosure (Division 2)

2.3.1 Internal Layout

The internal layout of the components in the optics / sample cell enclosure of the Division 2 model is shown in Figure 6.

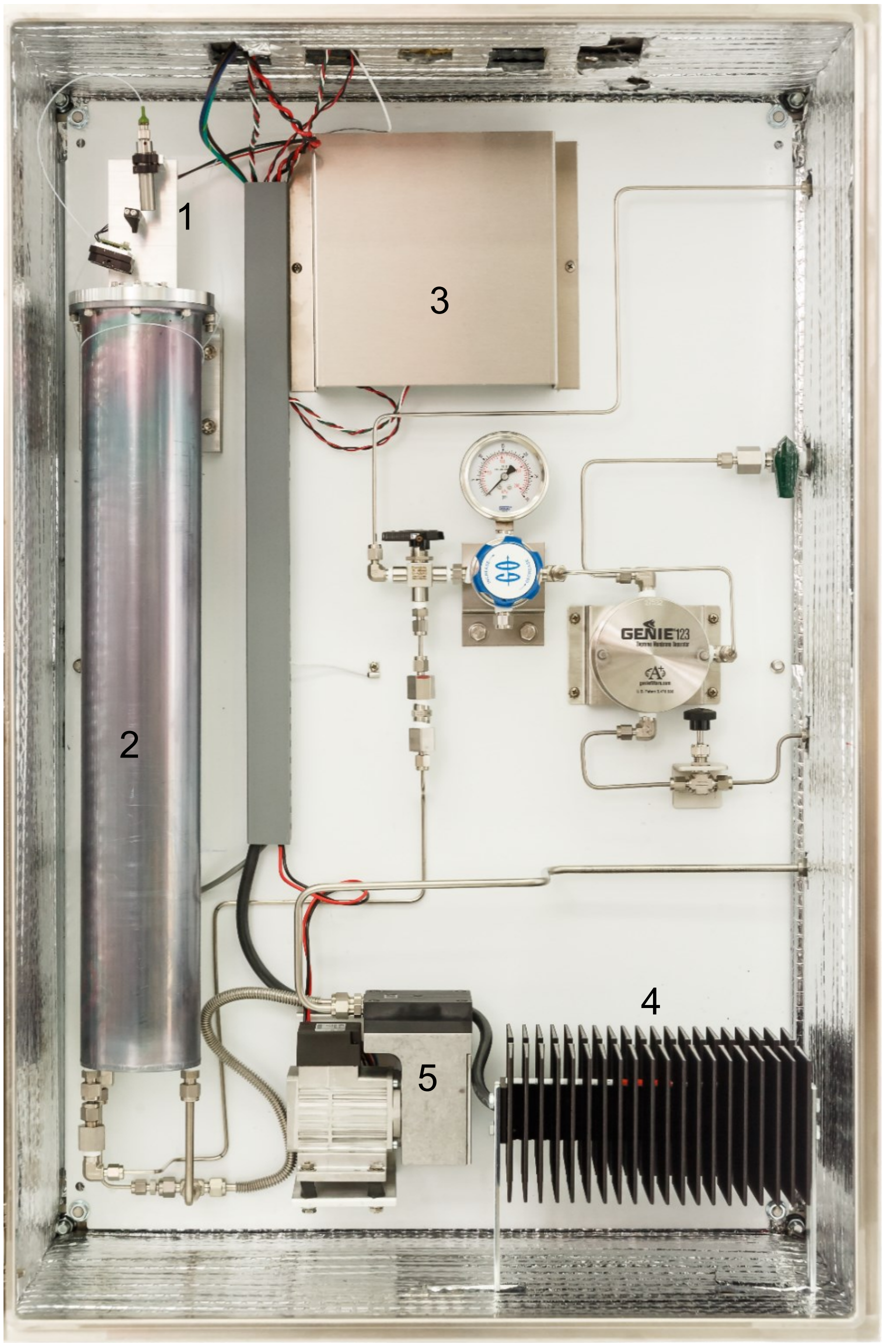


Figure 6: Optics / Sample Cell Enclosure Layout (D2)

The main components found in the optics / sample cell enclosure (all models)include the laser launcher and detector (1), the Herriott sample cell (2), the TDLAS control module(s) and laser source(s) (3), the cell heater (4), and the vacuum pump (5).The Division 2 model also includes the sample handling system inside this enclosure, while on the Division 1 / CE models, the sample handling system is mounted directly to the analyzer system back panel.

2.3.2 TDLAS Control Module and Laser Source

The TDLAS Control Module is an electronics board mounted inside the Optics / Sample Cell enclosure. The laser source is mounted on this electronics board and connected to the sample cell laser launcher optics via a telecommunications grade optical fibre. The TDLAS Control Module with Laser source is shown in Figure 7.

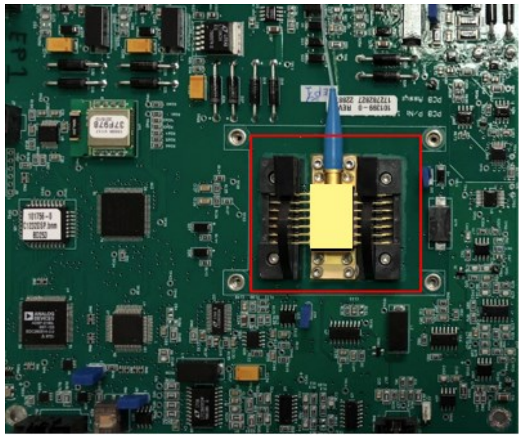


Figure 7: TDLAS Control Module and Laser Source

The laser source is mounted just to the right of the centre of the board in the photo, along with its associated heating and cooling equipment used for the tuning of the output wavelength.

2.3.3 Sample Cell

The sample cell is a Herriott- style multi-pass cell with an internal path length of >50 metres. It is coated with a sulfinert coating to prevent absorption of hydrogen sulfide by the cell wall. The laser launcher and detector are located at the same end of the cell, as the laser light enters and exits the cell through the same opening. During operation, the cell is entirely filled with sample gas.

2.3.4 Cell Heater

The sample cell and associated optical components are heated to 40°C to ensure measurement stability. The temperature is controlled precisely by a PID heater controller on the analyzer's IO Board. The cell temperature is monitored using an RTD that sends signals back to the IO board.

2.3.5 Vacuum Pump

To improve the separation between the chosen absorbance wavelengths for the target gases and absorbance wavelengths of other interfering species, the interior of the sample cell is maintained at a partial vacuum by use of a vacuum pump. The vacuum pump is an oil-free design with very low maintenance requirements. The cell pressure is monitored using a pressure transducer that sends signals to the analyzer's IO board, and this pressure is available for display on both the analyzer's local display screen and in the web-based GUI software. There is no direct control between the analyzer and the vacuum pump.

2.3.6 Optics Sleeve

The optics sleeve covers the laser launcher and detector. It provides physical protection to sensitive analyzer components as well as shields from ambient light. To remove and install the optics sleeve, the Herriott-style sample cell must be partially or completely removed. It is held in place by four bolts to the optics stage.

2.4 Sample Conditioning System

The sample conditioning system is used to ensure that the conditions of the sample entering the sample cell are within the required specifications. A typical sample conditioning system for an AccuLase-GPA™ is shown in Figure 8.

Figure 8: Sample Conditioning System

A typical sample conditioning system for the AccuLase-GPA™ will include a pressure regulator, a liquid membrane separator, and a sample sweep valve. If the analyzer is configured to measure multiple sample streams, it will also include solenoid valves for stream switching.

For the AccuLase-GPA™ Division 2 model, the sample conditioning system is located inside the Optics / Sample Cell enclosure. For the Division 1 and CE models, it is mounted on the analyzer system back panel.

Section 3 AccuLase-GPA™ Local Display User Interface

3.1 Introduction

The front panel of the AccuLase-GPA™ control enclosure includes three LEDs and a color LCD display which provides information about the status of the analyzer. In addition, a handheld keypad can be used to view and/or edit a range of analyzer settings and analytical results.

3.2 Local UI Layout

The screen layout of the AccuLase-GPA™ local UI is shown in Figure 9.

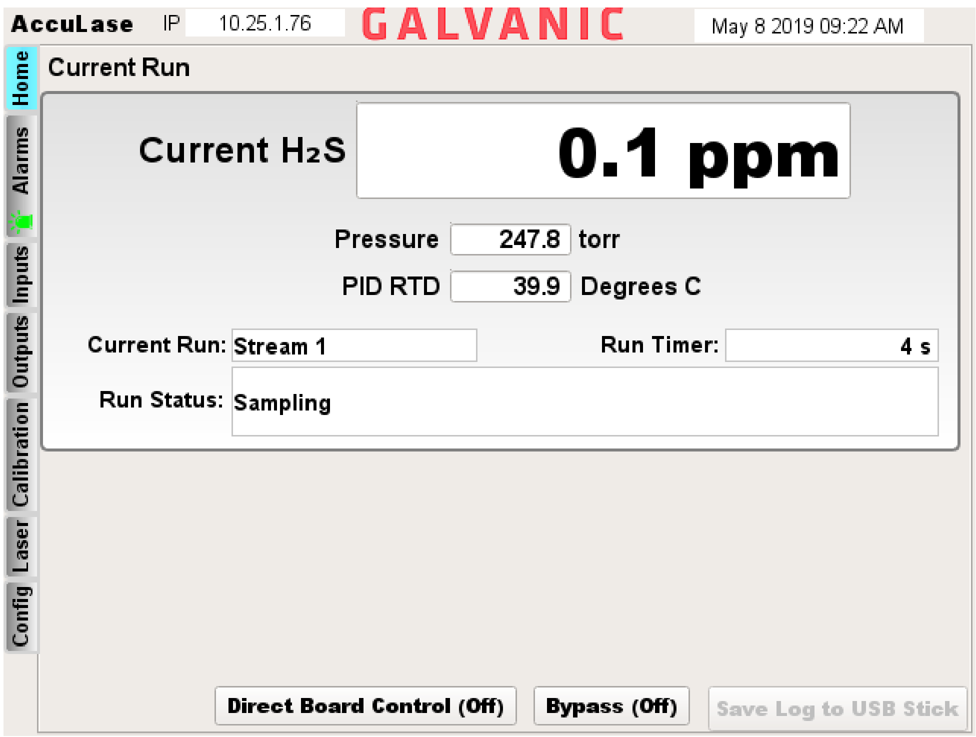


Figure 9: Local UI Layout

On the top row of the screen are two fields. The field on the left displays the analyzer's IP address. This is the address that must be entered into the web browser of a computer connected either directly to the analyzer via the Ethernet port on the front panel of the analyzer or remotely via the plant local area network in order to access the analyzer's web-based graphical user interface. The Web GUI is described in detail in Section 4. The field on the right displays the current date and time of the analyzer's real time clock. This date and time is used to timestamp all data in the analyzer's data logs.

On the left of the screen are a series of tabs oriented vertically. These tabs represent the various panels of the analyzer's local user interface. The tab of the panel that is currently being displayed on the screen is highlighted in blue. The PANEL NEXT and PANEL PREV buttons on the keypad can be used to navigate through these panels. Pressing PANEL NEXT will move downwards to the subsequent tab, while pressing PANEL PREV will move up to the previous tab. Pressing PANEL NEXT from the bottom-most tab will return to the top-most tab. The data displayed on each panel will be discussed in detail in this section.

3.3 Front Panel LEDs

There are three colored LEDs above the LCD on the front panel of the AccuLase-GPA™, as shown in Figure 10.

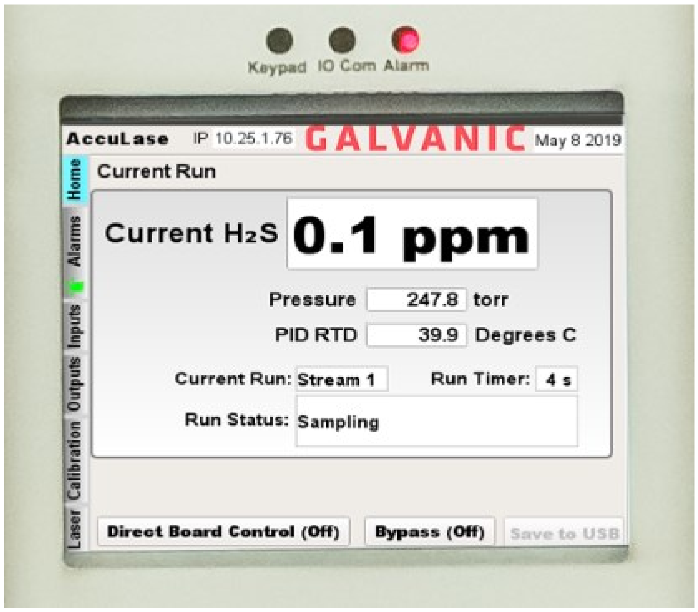


Figure 10: Front panel LCD Showing Status LEDs

These LEDs are used to indicate specific analyzer status-related information. The function of these three LEDs is indicated in Table 1.

Table 1: Front Panel LEDs

LED Label	LED Color	Function
Keypad	**Blue**	This LED illuminates any time a key on the keypad is pressed. It remains illuminated until the input from the keypad has been processed by the analyzer electronics. While this LED is illuminated, no further input from the keypad will be recognized until the LED turns off.
IO Comm	**Green**	This LED flashes green to indicate successful communication between the controller and IO boards.
Alarm	**Red**	This LED illuminates when there is an active alarm.

3.4 Hand-Held Keypad

The hand-held keypad allows the user to navigate through the AccuLase-GPA™ local user interface. The AccuLase-GPA™ handheld keypad is shown in Figure 11.

Figure 11: AccuLase-GPA™ Handheld Keypad

The keypad has 20 keys. Eleven keys are used for data entry (numerals 0-9 and a decimal point). The remaining 9 keys have functions that are described in Table 2.

Table 2: Keypad Key Functions

Key	Function
PANEL PREV	Used to navigate to the previous display panel (up) in the local UI.
PANEL NEXT	Used to navigate to the next display panel (down) in the local UI.
FIELD PREV	Used to navigate to the previous data entry field /manipulatable control on a given display panel (up).
FIELD NEXT	Used to navigate to the next data entry field / manipulatable control on a given display panel (down).
HOME	Used to navigate directly to the Home panel which displays the current calculated concentration.
BYPASS	Used to toggle bypass mode on and off.
DEL	Used to delete data while editing a numerical value.
EXIT	Used to exit from editing a numerical parameter without saving changes.
ENTER	Used to save changes when editing a numerical parameter or to toggle a manipulatable control.

3.5 Home Panel

The Home panel, which can be accessed from any other panel in the analyzer's local user interface by pressing the HOME key on the keypad, displays several analysis-related parameters. The Home panel is shown in Figure 12.

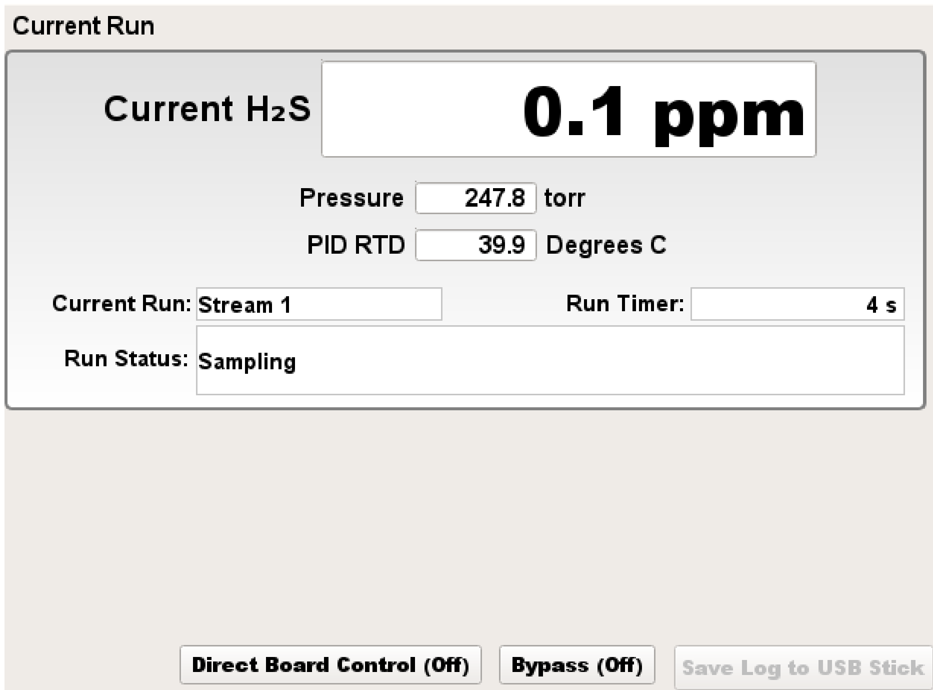


Figure 12: Home Panel. Number of analytes shown will depend on the configuration of your AccuLase analyzer

The Home panel displays several analysis-related parameters on the top half of the screen. The parameters displayed on the Home panel are explained in Table 3.

Table 3: Home Panel Displayed Parameters

Field	Explanation
Live readings	Displays the H_2S, CO_2 and/or H_2O concentration in the sample gas stream currently being analyzed. A separate field will appear for each analyte being measured. An asterisk will be displayed beside the value currently being updated.
Pressure	Indicates the current pressure inside the sample cell as measured in torr (760 torr = 1 atm = 101.325kPa)
PID RTD	Indicates the current temperature inside the sample cell as measured by the cell RTD.
Current Run	Indicates the current stream being analyzed. Depending on the analyzer configuration, this could be anything from Stream 1 to Stream 4, or span calibration, zero calibration, or reference.
Run Timer	Shows the amount of time remaining in the current analysis. The displayed concentration is a rolling average of results obtained over a sample interval duration that is user configurable via the web GUI.
Run Status	Shows the analyzer's current status. If the analyzer is currently analyzing gas, the run status will show 'Sampling'; if the analyzer is purging after a stream switch, the status will show 'Purging'.

Additionally, at the bottom of the Home panel there are three status indicators / toggles whose functions are described in Table 4.

Table 4: Home Panel Status Indicators / Toggles

Indicator	Function
Direct Board Control	Will indicate either (On) or (Off). If set to (Off), the analyzer's inputs and outputs are under control of the analyzer control board. If set to (On), the analyzer's inputs and outputs can be controlled manually to test functionality during commissioning / maintenance. If set to (On), the analyzer cannot function normally as it is unable to automatically control inputs / outputs in this state. To toggle on or off, use the FIELD NEXT / FIELD PREV buttons to select, then press ENTER to toggle.
Bypass	Will indicate either (On) or (Off). If set to (On), the analyzer's analog output(s) will output the fail-safe value (default 3mA) and the analyzer's alarm / fault relays will not be triggered in the case of an alarm / fault condition. This mode is typically only set to (On) during analyzer maintenance. Bypass mode can be set to automatically time out after a specified time interval of no input into the analyzer keypad. The time interval can be set via the AccuLase-GPA™ web GUI. To toggle on or off, use the FIELD NEXT / FIELD PREV buttons to select, then press ENTER to toggle.
Save Log to USB Stick	This function is only available if there is a USB thumb drive connected to one of the USB ports on the AccuLase-GPA™ control board – if there is no thumb drive connected, this function will be greyed out as shown in Figure 12. If a thumb drive is connected, navigating to this function with the FIELD NEXT or FIELD PREV buttons and pressing ENTER when the function is highlighted will cause the analyzer's archive log data to be copied to the attached USB thumb drive.

3.6 Alarms Panel

The Alarms panel indicates all currently system alarms, which can be hardware faults or stream related (i.e. concentration) alarms. It is shown in Figure 13. When there are no alarms active, this screen will be blank. Additionally, the bell icon to the left of the word 'Alarms' in the tab on the left side of the screen will be green. However, if there are any alarms active, either hardware faults or stream-related alarms, the bell icon be replaced with a yellow exclamation point icon ( ); this icon will also appear in the top right corner of the analyzer display and will be visible on all panels. The alarm LED above the display will also be illuminated. The description of all currently active alarms will be shown on this panel. Additionally, alarms can be configured to be 'latchable'. If an alarm is set to be latchable, it will continue to be displayed on this page, and the hardware actions associated with that alarms (such as a relay or a solenoid) will remain active until the alarm is manually acknowledged from this page. To manually acknowledge alarms, use the FIELD NEXT / FIELD PREV button to select the Acknowledge Alarms button at the bottom of the page, then press ENTER. All currently latched alarms will then be unlatched and cleared. If an alarm is not configured to be latchable, it will automatically clear from this page, and the associated hardware actions disabled, when the condition that caused the alarm to be triggered is cleared.

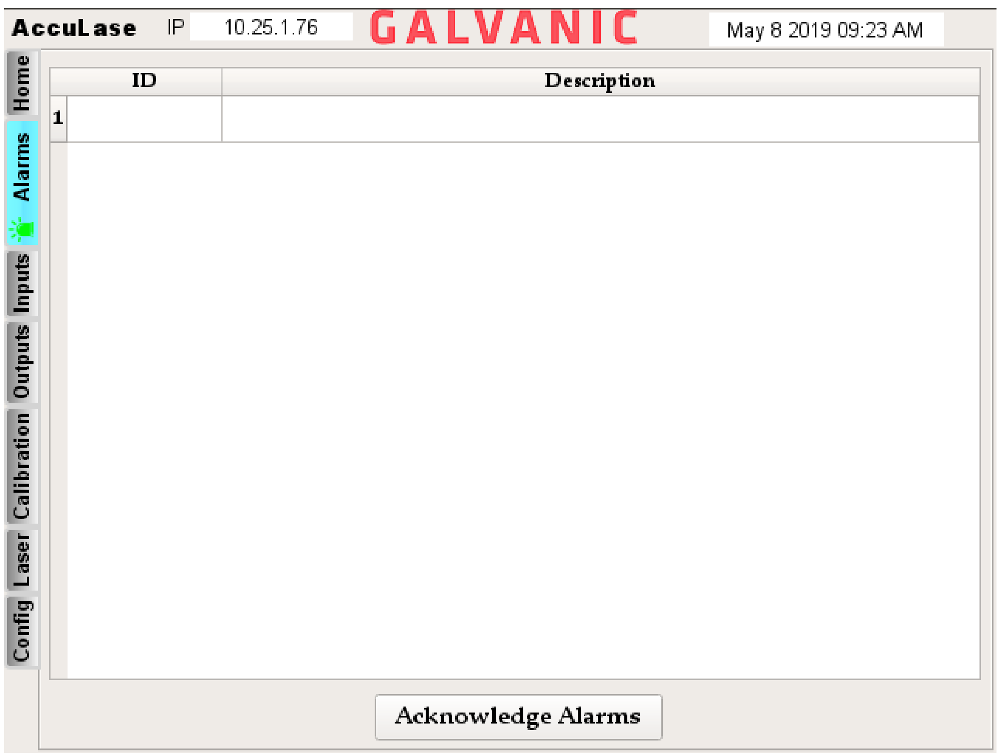


Figure 13: Alarms Panel

3.7 Inputs Panel

The Inputs panel shows the current status of the AccuLase-GPA™ IO board's five analog inputs and four digital inputs. See Figure 14.

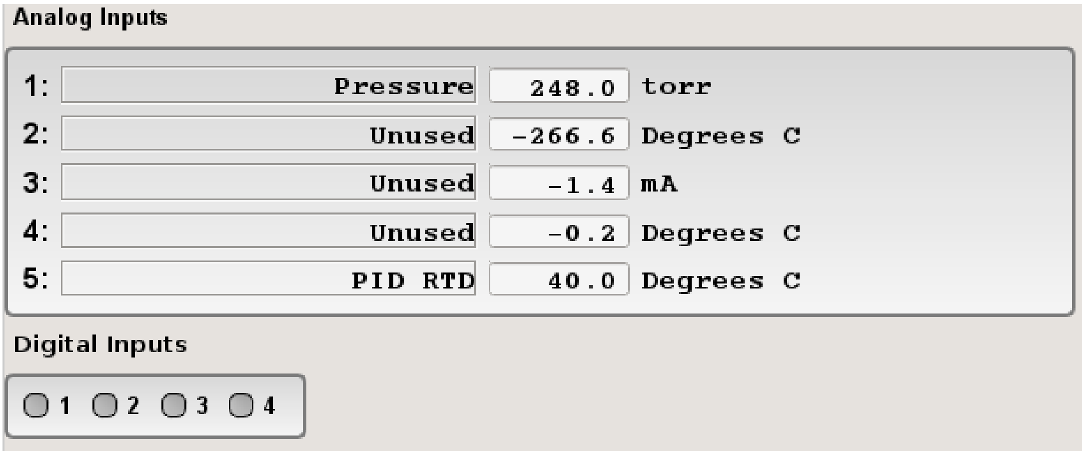


Figure 14: Inputs Panel

By default, only two of the analog inputs are configured from the factory. Analog Input 1 is used for the sample cell pressure transducer and is calibrated in units of torr. The typical pressure indicated here should be approximately 250 torr. Analog input 5 is used for the sample cell temperature RTD input and is calibrated in units of °C. The typical temperature indicated here should be 40°C. The other three analog inputs can be configured as per the user's requirements for inputs for any device (e.g. pressure transducer, temperature sensor, etc.) that outputs data in a 4-20mA analog signal. Configuration of the analog inputs is done from the AccuLase-GPA™ web GUI.

The status of the four digital inputs is indicated using four circles, one for each digital input. If the circle for a given digital input is grey, that indicates that the digital input is not receiving a signal from the attached device (i.e. it is off). If the circle is green, that indicates that the digital input is receiving a signal from the attached device (i.e. it is on). Digital inputs can be used to remotely initiate a specific stream analysis. They must be configured via the AccuLase-GPA™ web GUI before they can be used.

Wiring diagrams for a variety of digital and analog input connection devices are given in Section 7 of this manual.

This panel has no user-configurable parameters – it is used for display purposes only.

3.8 Outputs Panel

The Outputs panel shows the current status of the AccuLase-GPA™ IO board's analog outputs (up to 4, one per configured stream), solenoid outputs (8), and solid-state relays (4). It is shown in Figure 15.

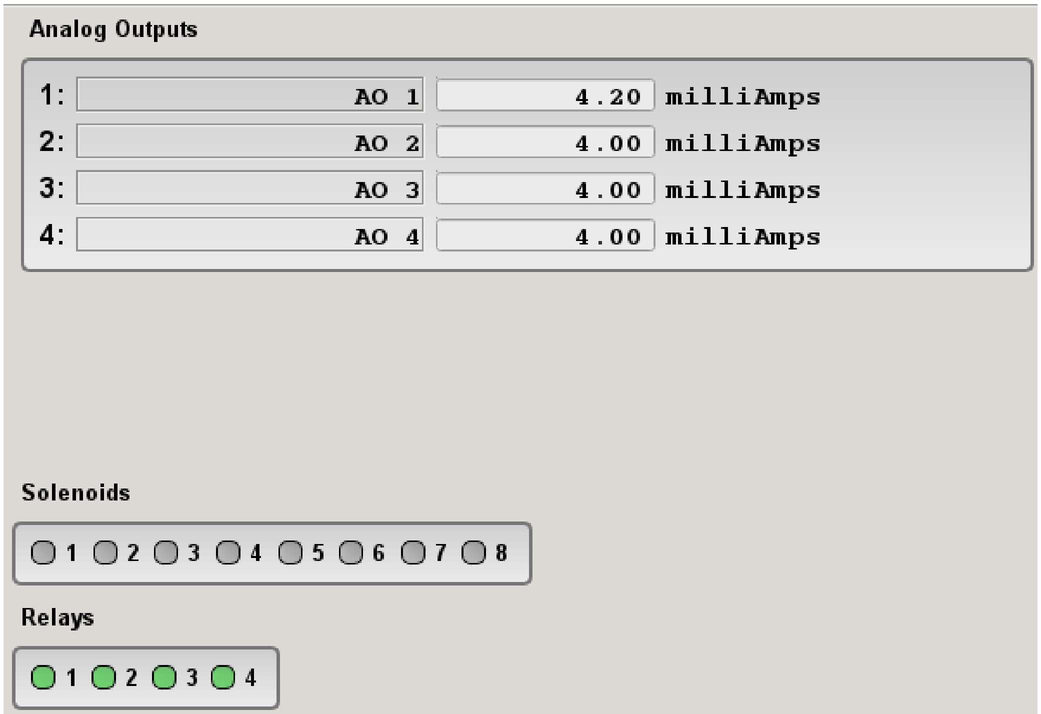


Figure 15: Outputs Panel

For each analog output, the current signal being output from that output is displayed. Using a multimeter, the current reading can be measured to compare against this value. If the current value measured by the multimeter is not the same as the current value displayed on this panel, this indicates that the analog output channel requires calibration. Calibration of the analog output channels can be done using the AccuLase-GPA™ web GUI.

The status of the eight solenoid drivers and four relays are indicated using a circle for each solenoid and relay. If the circle is grey, this indicates that the solenoid or relay is currently off. If the circle is green, that indicates that the solenoid or relay is currently on.

Wiring diagrams for analog outputs, solenoid outputs, and relay outputs, are all given in Section 7 of this manual.

3.9 Calibration Panel

The Calibration panel is used for calibrating the AccuLase-GPA™ for both zero and span. It is shown in Figure 16.

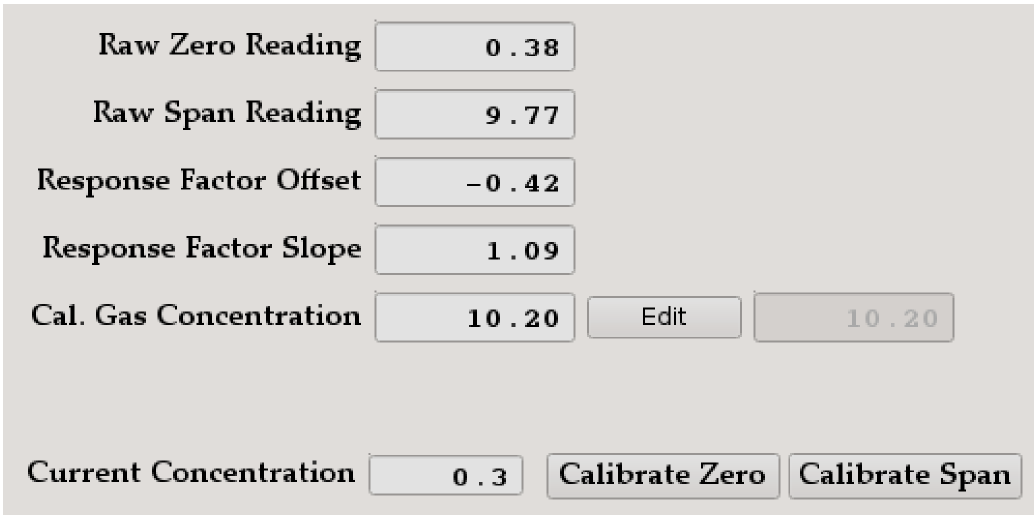


Figure 16: Calibration Panel

The first four fields on the Calibration panel indicate the analyzer's calibration parameters. These parameters are described in Table 5.

Table 5: Calibration Parameters

Parameter	Explanation
Raw Zero Reading	The analyzer's concentration reading prior to calibration, in ppm, when analyzing zero gas. For hydrogen sulfide analysis, the zero gas should be pure methane.
Raw Span Reading	The analyzer's concentration reading prior to calibration, in ppm, when analyzing calibration span gas. For hydrogen sulfide analysis, the span calibration gas should be hydrogen sulfide of a concentration 50-100% of the analyzer's full-scale concentration in a balance of methane.
Response Factor Offset	The y-intercept on a graph that places the raw concentrations at zero and span on the x-axis and the true concentrations on the y-axis.
Response Factor Slope	The slope of the calibration plot that plots raw concentrations at zero and span on the x-axis and the true concentrations on the y-axis.

When calibration is performed, the analyzer takes the raw readings and stores them in memory. Once a raw reading is obtained for both zero and span, the analyzer will then calculate the slope and offset for the calibration curve by plotting the raw readings on the x-axis and the true readings on the y-axis. An example of a calibration curve for the AccuLase-GPA™ is shown in Figure 17.

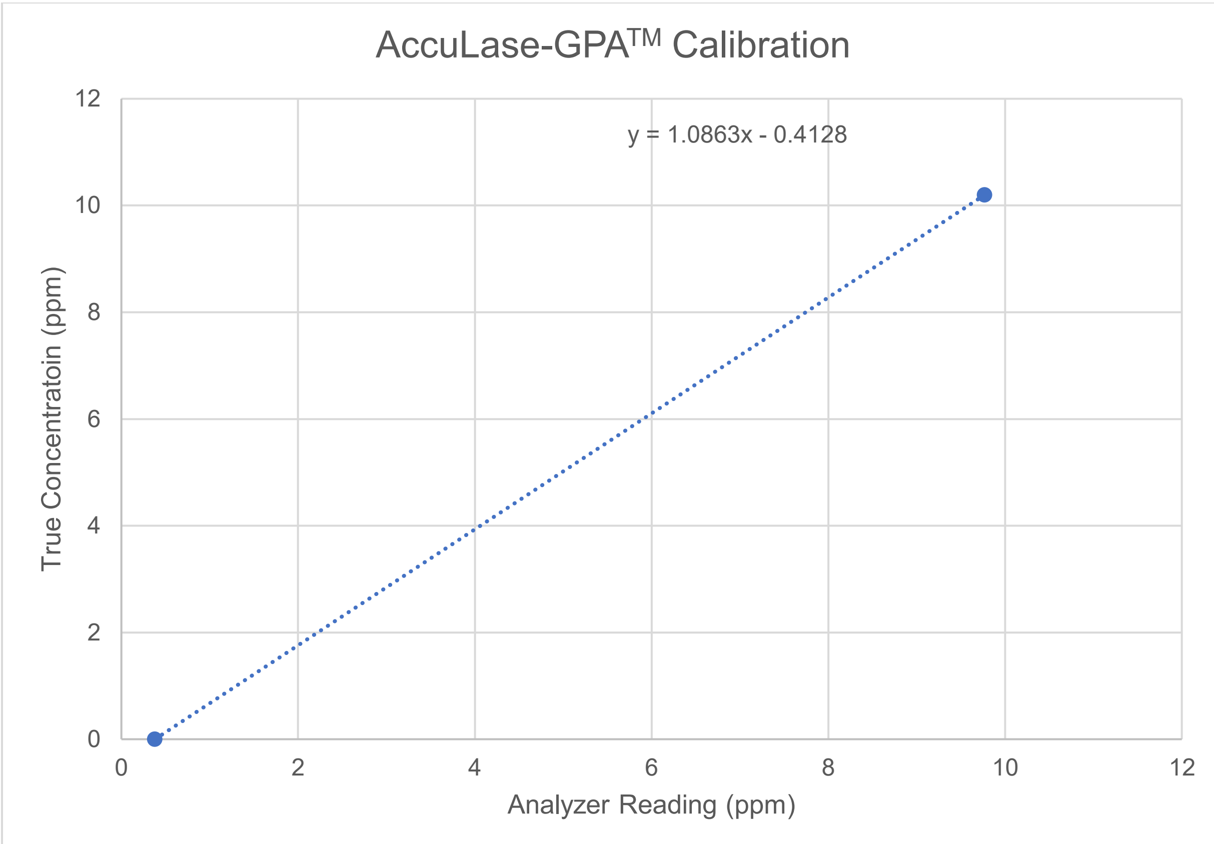


Figure 17: AccuLase-GPA™ Calibration Curve

The calibration curve in Figure 17 is based on the calibration parameters shown in Figure 16. As can be seen from the equation displayed on the calibration curve, the slope and intercept are the same as those shown in the analyzer calibration parameters. From this curve, the analyzer can calculate the true concentration of the target gas for any raw concentration reading.

The **Cal. Gas Concentration** field displays the certificate value for the span calibration gas being used. To edit this value, use the FIELD NEXT / FIELD PREV buttons on the keypad to select the Edit button on the Calibration panel, then press Enter. Using the numerical keys, enter in the certificate value from the span calibration gas being used, then press ENTER to save to the analyzer. The value displayed in the left field should then change to match the entered value.

The **Current Concentration** field displays the currently calculated concentration of the target gas in the gas present in the sample chamber. The **Calibrate Zero** and **Calibrate Span** buttons to the right of this field are used to carry out zero and span calibrations.

3.10 Laser Panel

The Laser panel shows parameters related to the analyzer's laser and laser detector. See Figure 18.

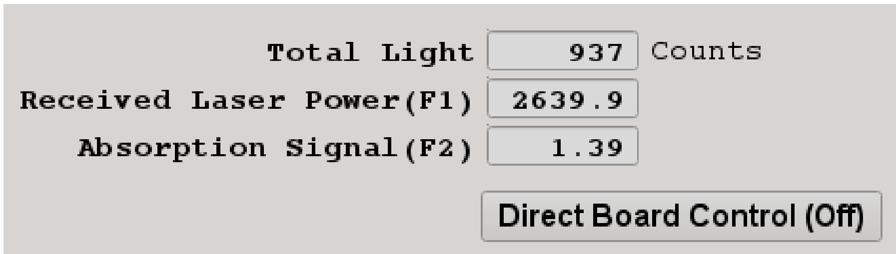


Figure 18: Laser Panel

The parameters show the amount of laser light being received by the laser detector. If the concentration of the target gas in the sample cell is low, the light absorption by the target gas will also be low, and thus the indicated **Absorption Signal** will also be low. The higher the concentration of the target gas in the sample cell is, the larger the Absorption Signal will be. If the **Total Light** and **Received Laser Power** values are low even with zero gas in the cell, this could be indicative of a problem in the optics / sample cell enclosure. Refer to Section 6 for more details on troubleshooting problems with the optics/sample cell enclosure.

3.11 Config Panel

The Configuration (Config) panel is used to configure the stream related alarms for the AccuLase-GPA™. See Figure 19.

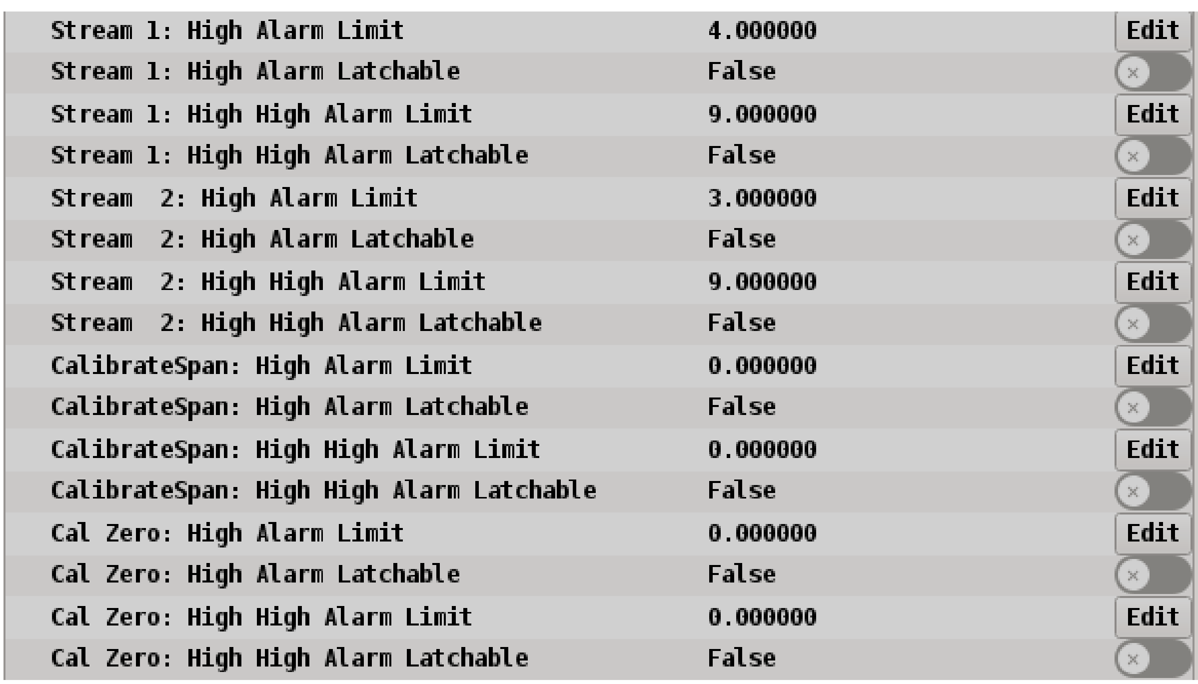


Figure 19: Config Panel

For each stream configured on the analyzer (sample Stream 1 to up to 4, CalibrateSpan, and Cal Zero) there are four configurable parameters as described in Table 6.

Table 6: Configurable Alarm Parameters

Parameter	Explanation
High Alarm Limit	If the calculated concentration exceeds this set point, the High Alarm will be triggered along with any associated hardware outputs configured in the AccuLase-GPA™ web GUI. To edit the alarm setpoint, use the FIELD NEXT / FIELD PREV button to select the Edit button for the stream of interest, then press ENTER. Use the numerical keys to enter the desired setpoint, then press ENTER again to save. If the alarm setpoint is set to 0, the alarm will be disabled.
High Alarm Latchable	If this toggle is set to True (ON), the high alarm for the given stream will be latched, and can only be cleared on the Alarms panel (Refer to Section Alarms Panel for more details on latchable alarms. To toggle the Latchable function, use the FIELD NEXT / FIELD PREV button to select the toggle for the stream of interest, then press ENTER to change the toggle position.
High High Alarm Limit	If the calculated concentration exceeds this set point, the High High Alarm will be triggered along with any associated hardware outputs configured in the AccuLase-GPA™ web GUI. In addition, when the concentration of the stream exceeds the High High alarm setpoint, the display and the analog output associated with the stream will begin to update in real time, rather than waiting for the sample interval to complete. The alarm setpoint can be set in the same way as the High Alarm limit. The value for the High High alarm setpoint should be greater than that of the High Alarm setpoint for a given stream. If the alarm setpoint is set to 0, the alarm will be disabled.
High High Alarm Latchable	The toggle for the High High alarm is set in the same fashion as the toggle for the High Alarm.

Typically, the High and High High alarms are only set for sample streams, and not for Span or Zero Calibration streams. However, should the user wish to set these alarms for the calibration streams, they can do so.

3.12 Net Panel

The Network (Net) panel is used for configuring local and remote IP settings for connection to the AccuLase-GPA™ via Ethernet. The network panel is shown in Figure 20.

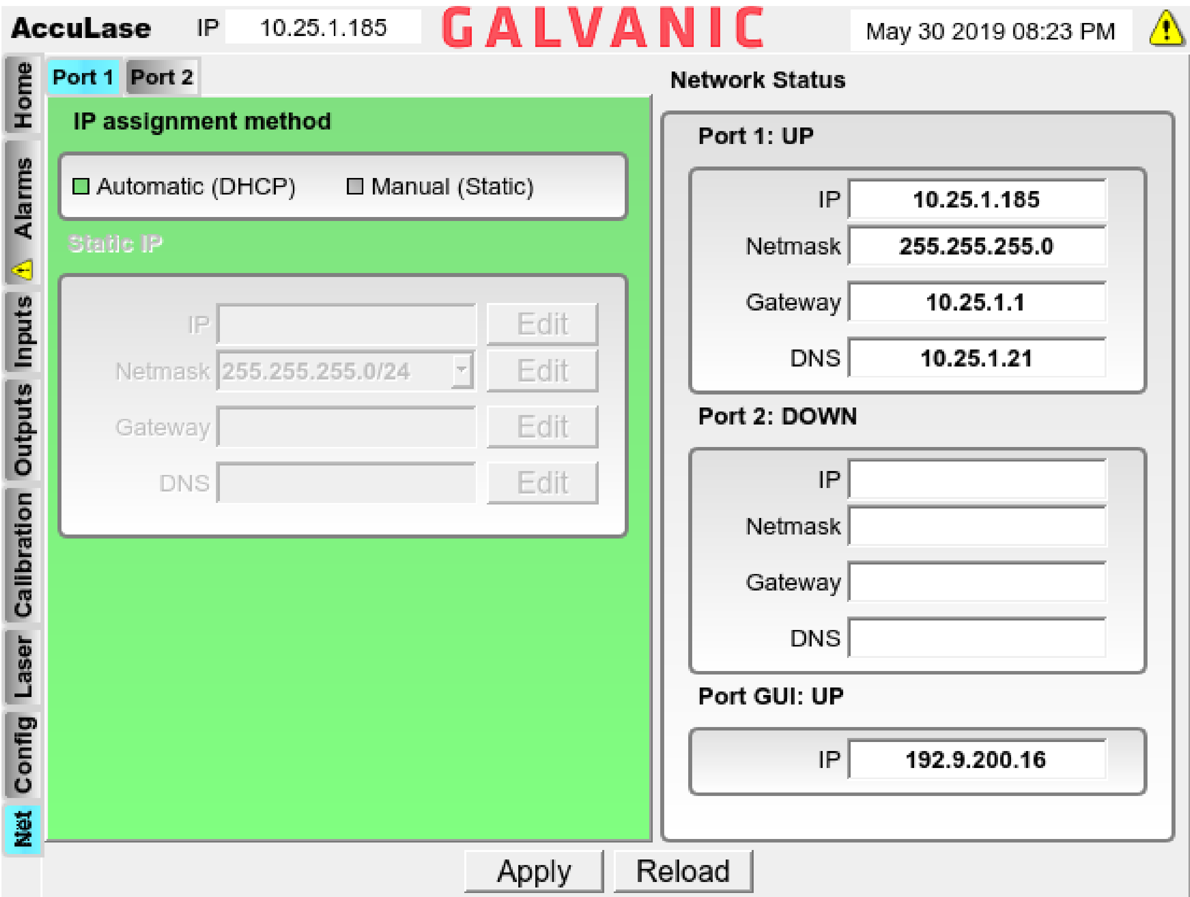


Figure 20: Network Panel

The Network panel is divided into two sections – the **Port Configuration** on the left, and the **Network Status** on the right.

3.12.1 Port Configuration

The configuration of the two Ethernet ports on the AccuLase-GPA™ controller board is set in this portion of the Network panel. The two ports are accessible via tabs at the top left corner, one marked **Port 1** and the other marked **Port 2**. To switch between the two tabs, use the FIELD NEXT / FIELD PREV buttons to select the tab of interest, then press ENTER to switch to that tab.

Each port can be configured to obtain an IP address either automatically from the network via DHCP or via manual entry of the IP settings. **Automatic (DHCP)** is the default setting for each port. If the plant LAN to be connected to supports DHCP, then no changes need to be made on the Network panel. However, if the plant LAN to be connected does not support DHCP, or the LAN configuration requires every device on the LAN to have a static IP address, then the **Manual (Static)** option must be chosen. To select this option, use the FIELD NEXT / FIELD PREV buttons to select Manual (Static), then press Enter. The Static IP configuration options will no longer be greyed out, as shown in Figure 21.

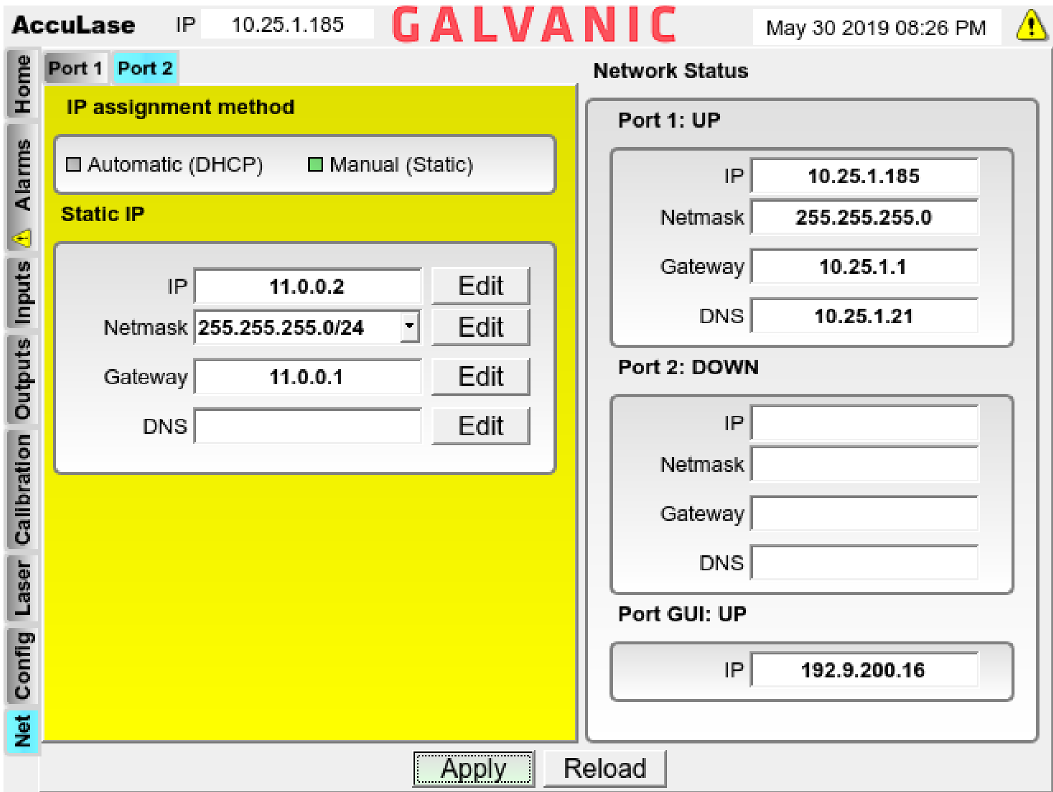


Figure 21: Network Panel (Static IP Address Configuration)

Each field in the Static IP configuration panel must be filled in correctly to ensure that the AccuLase-GPA™ is able to be accessed remotely via the plant LAN. Obtain the correct settings to be used in each of the four fields from the plant IT department. To enter in a value into each field, use the FIELD NEXT / FIELD PREV buttons to navigate to the Edit button beside the field to be edited, then press ENTER. Use the numerical keys and the decimal key to enter in the correct value into the field, then press ENTER again.

Once all data has been successfully entered into the fields, use the FIELD NEXT / FIELD PREV buttons to select the **Apply** button at the bottom of the screen. Press ENTER to save the Static IP address configuration to the analyzer. Alternatively, if the user wishes to discard all changes, selecting the **Reload** button and pressing ENTER will cause the screen to reload the previously saved configuration.

3.12.2 Network Status

The Network Status section of the Network panel shows the status of the three Ethernet ports in the AccuLase-GPA™. Port 1 and Port 2 are both located on the controller board, while Port GUI is located on the analyzer's front panel underneath the display. If the port name has the word UP beside it, this indicates that the port is connected to an external device. If the port name has the word DOWN beside it, all the configuration fields for that port will be blank. This will indicate that the port is not connected to an external device. The IP address of the GUI port is not user configurable – it will always have the IP address indicated in the **Port GUI** IP field.

Section 4 AccuLase-GPA™ Web-Based GUI

4.1 Introduction

The AccuLase-GPA™ web-based graphical user interface (GUI) allows the user to view analyzer results, configure the analyzer configuration, and carry out manual analyses as necessary. The GUI is accessible through any modern internet browser software, though Galvanic Applied Sciences recommends the use of either Google Chrome or Mozilla Firefox. As the GUI is web-based, it is operating system agnostic, and thus can be accessed by computers running Microsoft Windows, MacOS, or many varieties of Linux. Further, no installation program is required on the connected PC as the entire GUI is stored in the analyzer controller board.

4.2 Connecting to the AccuLase-GPA™ via Ethernet

The AccuLase-GPA™ can be connected to either a local computer directly using an Ethernet cable, or to a remote computer elsewhere in the plant if the analyzer is linked into the plant's local area network (LAN) via a permanent Ethernet link.

4.2.1 Local Ethernet Connection

To connect a local computer to the AccuLase-GPA™, a computer with an Ethernet port and an Ethernet cable are required.

NOTICE THE ETHERNET CABLE USED TO CONNECT FROM THE LOCAL COMPUTER TO THE ACCULASE-GPA™ MUST BE A STRAIGHT THROUGH (PATCH) CABLE AND NOT A CROSSOVER CABLE.

Connect one end of the cable to the Ethernet port on the computer and the other end of the cable to the Ethernet port on the front panel of the analyzer, beneath the LCD screen, as indicated in Figure 22, or to Ethernet Port 3 inside the electronics enclosure if a front panel connection is not available.

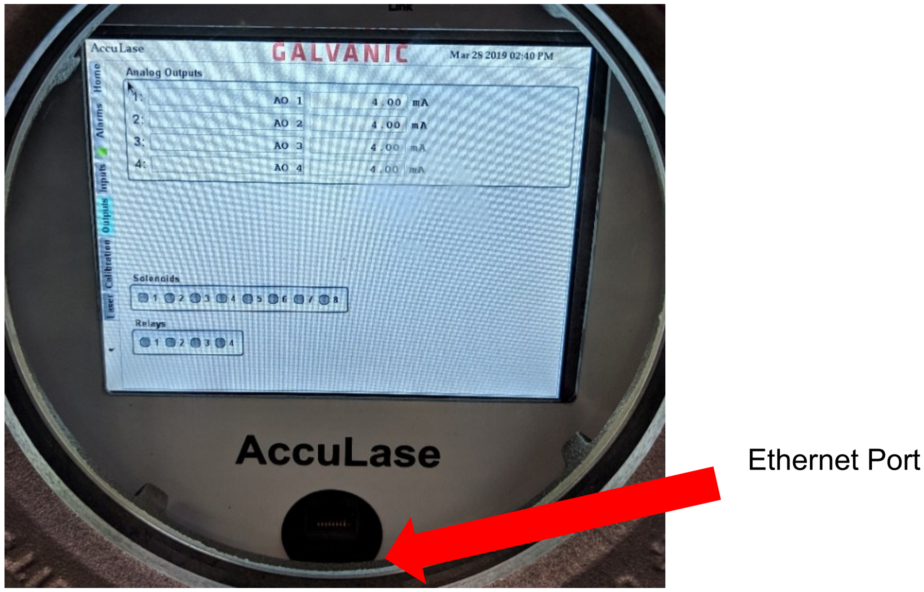


Figure 22: Possible location of Front Panel Ethernet Port

⚠WARNING DO NOT OPEN THE FRONT GLASS COVER OF AN ACCULASE-GPA™ D1/Z1 OR CONNECT / DISCONNECT ANY CABLES TO THE ETHERNET PORT OF AN ACCULASE-GPA™ D2 UNLESS THE AREA IS KNOWN TO BE NON-HAZARDOUS!

4.2.2 Remote Ethernet Connection via LAN

The AccuLase-GPA™ can also be connected to the facility's local area network (LAN), which allows access to the web-based GUI from a remote location connected to the same LAN. To connect to the plant LAN, one end of a straight through (patch) cable should be connected to one of the top two Ethernet ports on the analyzer's controller board. The location of the Ethernet ports on the controller board is indicated in Figure 23. Note that Ethernet Port 3 is dedicated for a local PC connection only. Do not connect this port to a LAN.

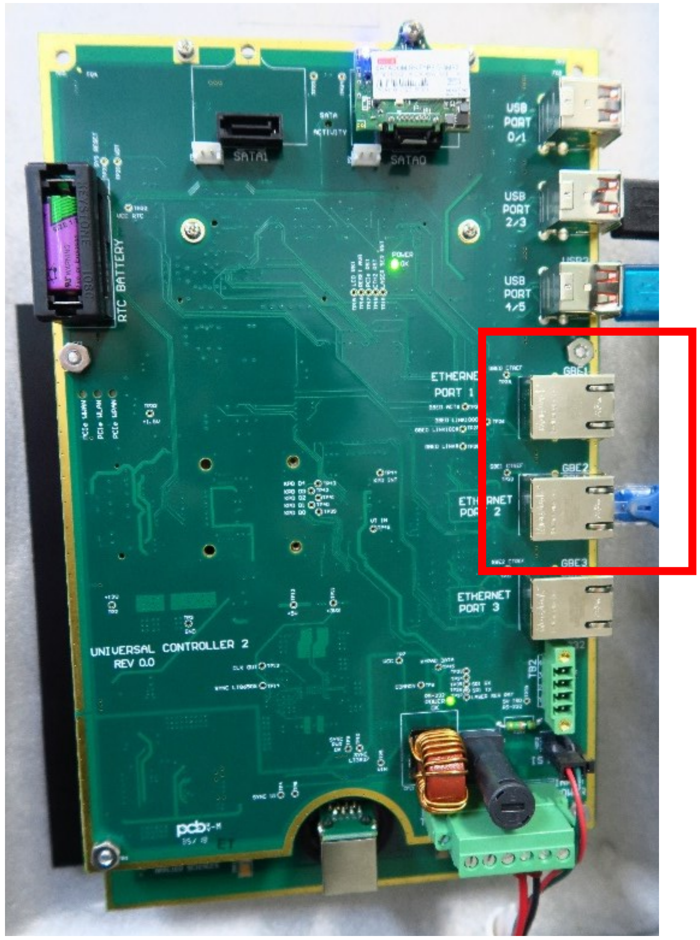


Figure 23: Ethernet Ports on Controller Board. Top two ports are for LAN connection.

4.3 AccuLase-GPA™ Web GUI Overview

Once the AccuLase-GPA™ is connected to the computer, either locally or via the plant LAN, it will be possible to access the Web GUI via an internet browser on the connected computer. Simply type in the IP Address indicated on the analyzer display into the address bar on the internet browser on the connected computer and press enter. The AccuLase-GPA™ Web GUI Home screen, shown in Figure 24, will then appear.

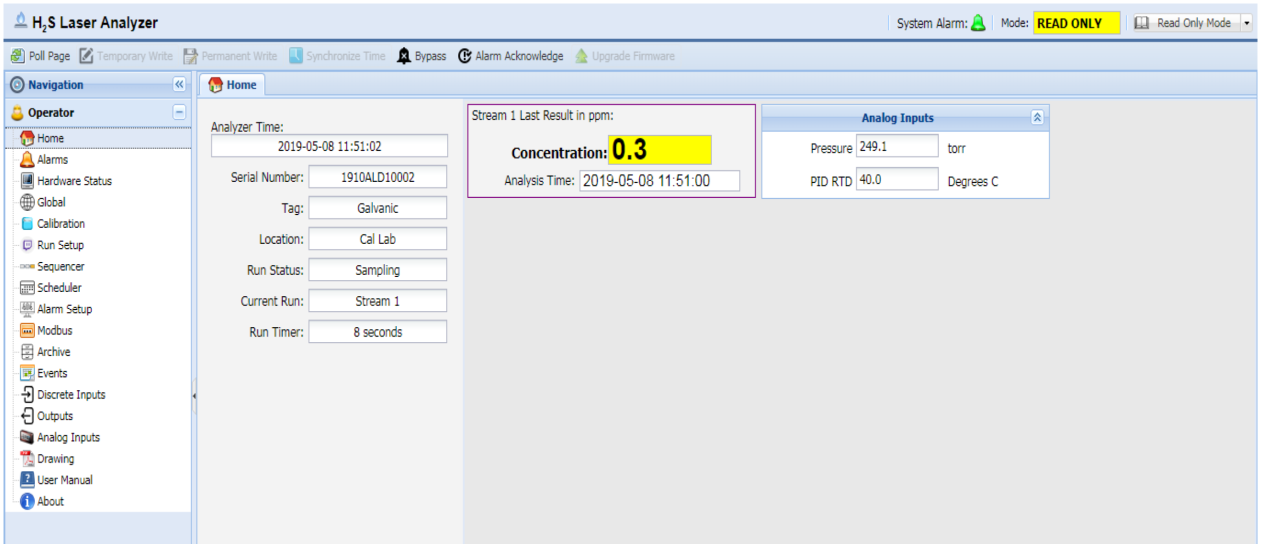


Figure 24: AccuLase-GPA™ Web GUI Home Screen

The AccuLase-GPA™ web GUI is divided into three sections – the toolbar on the top of the panel, the **Navigation** pane on the left of the screen, and the information panel on the right of the screen.

4.3.1 Status Indicators and Toolbar

The two rows at the top of the screen include a toolbar with a series of buttons used to operate and configure the AccuLase-GPA™, as well as some status indicators. The status indicators, shown in Figure 25, give information about the alarm status of the analyzer as well as the access level the user has in the AccuLase-GPA™ web GUI.

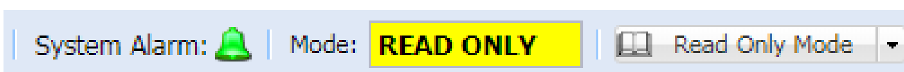


Figure 25: Toolbar Status Indicators

The purpose of these three indicators is described in Table 7.

Table 7: AccuLase-GPA™ Web GUI Toolbar Status Indicators

Indicator	Explanation
System Alarm	Indicates the overall alarm status of the system. If the bell icon to the right of the text is green, this indicates there are no active alarms and the system status is normal. If it is red, there is at least one system alarm active. Clicking on this indicator will bring the user directly to the Alarms page.
Mode	Indicates the current user access level for the AccuLase-GPA™ web GUI. In READ ONLY mode, the user is only able to observe the analysis results and analyzer configuration. In UPDATE MODE, the user is able to observe the analyzer results and configuration, and also is able to make changes to the analyzer configuration.
Mode Select Menu	To the right of the Mode field is a drop-down menu that allows the user to choose the current access level for the AccuLase-GPA™ web GUI. Selecting Update Mode will require the user to enter the Update mode password; the default password for this mode is 'fact'.

Below the status indicators is a toolbar with several buttons that can be used to operate the analyzer and make changes to the analyzer configuration. The toolbar is shown in Figure 26.

Figure 26: AccuLase-GPA™ Web GUI Toolbar

These function of each button on the toolbar is described in Table 8.

Table 8: Toolbar Buttons

Button Label	Explanation
Poll Page	Pressing this button will reload all information for the currently displayed information panel. If any changes have been made to the configuration on the currently displayed information panel that have not yet been saved to the analyzer
Temporary Write	Pressing this button will save all changes made to the analyzer configuration to the analyzer's volatile memory. Changes written only temporarily to the analyzer will be lost if the analyzer's power is cycled. This button is greyed out in Read Only mode as no changes can be made to the configuration in this mode.
Permanent Write	Pressing this button will save all changes made to the analyzer configuration to the analyzer's flash memory. Changes written permanently will persist through an analyzer restart. This button is greyed out in Read Only mode.
Synchronize Time	Pressing this button will set the analyzer time / date to the time / date configured on the connected computer. This time / date is used on all archival data and event logs, so the time should be synchronized upon analyzer start up for accurate data and event logging. This button is greyed out in Read Only mode.
Bypass	Pressing this button will place the analyzer into Bypass mode. In Bypass mode, all alarm hardware outputs (relays, etc) are disabled, and analog outputs are set to output a fail-safe signal (3mA by default). This mode is primarily used for maintenance.
Alarm Acknowledge	Pressing this button will acknowledge and clear all latched alarms and reset their hardware outputs to the normal state.
Upgrade Firmware	Pressing this button will allow the user to upgrade the AccuLase-GPA™ controller firmware and web GUI. This should only be done under the guidance of Galvanic Applied Sciences Inc. This button is greyed out in Read Only mode.

4.3.2 Navigation Pane

The **Navigation** pane, shown in Figure 27, is located on the left side of the screen.

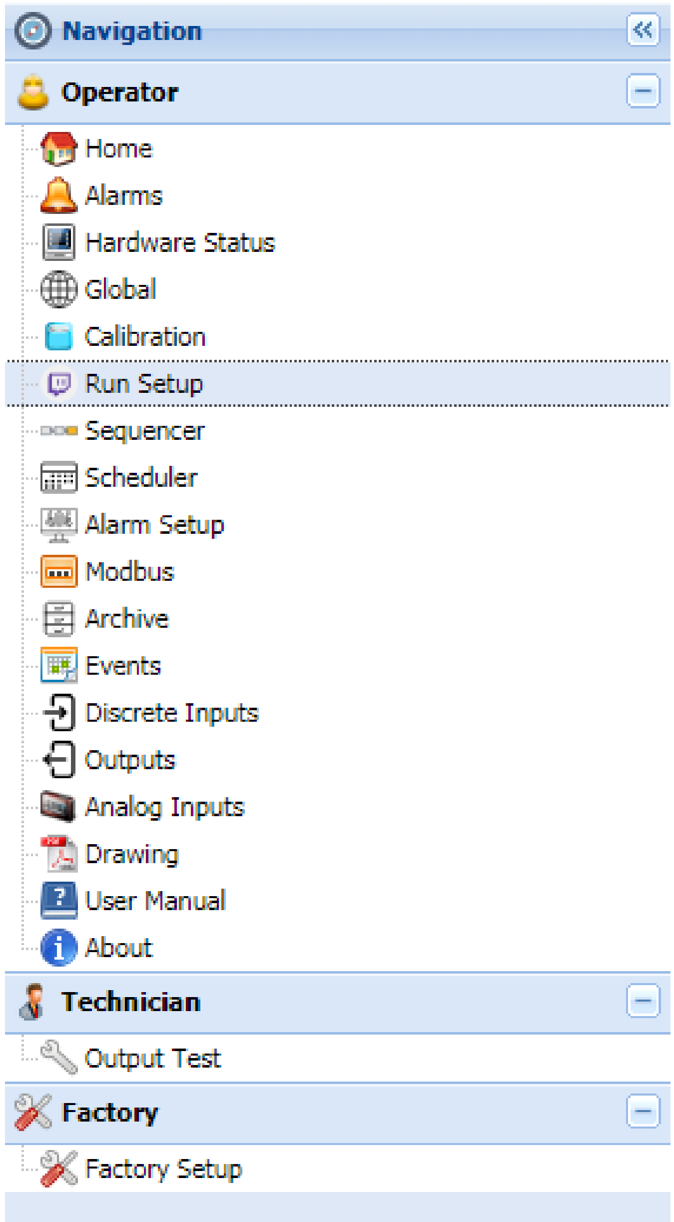


Figure 27: Navigation Pane

It is divided into three access levels – **Operator**, **Technician**, and **Factory**. The Operator menu is discussed in Section 4.4, the Technician menu in Section 4.5, and the Factory menu in section 4.6. If the current access mode is Read Only, only the Operator access level will be displayed, and no changes can be made to the configuration. Each access level displays a list of pages that can be accessed in that access level. Each page is used to either view analyzer analysis or status information, or view or edit a certain aspect of the analyzer's configuration. The Navigation pane can be hidden by clicking on the (**<<**) button to the right of the word 'Navigation' at the top of the pane. The pages contained in a given access level list can be collapsed by clicking on the (**-**)

button to the right of the access level title. When collapsed, clicking on the (**+**) button to the right of the access level title will re-display all the available pages in that access level.

4.4 Operator Menu

The Operator menu consists of a series of pages that can be used to view current and historical analysis data as well as analyzer operational parameters and configure a wide range of parameters that affect the operation of the AccuLase-GPA™.

NOTICE WHEN CHANGING FROM ONE PAGE TO ANOTHER, THE WEB GUI WILL AUTOMATICALLY POLL DATA FROM THE ANALYZER, SO ANY CHANGES MADE ON ONE PAGE WILL BE LOST IF THE USER NAVIGATES TO ANOTHER PAGE WITHOUT FIRST CLICKING ON THE TEMPORARY WRITE AND/OR PERMANENT WRITE BUTTONS IN THE TOOLBAR.

4.4.1 Home Page

The **Home** page provides an overview of a variety of analyzer status and configuration-related parameters, as well as an overview of analysis results from all configured sample streams. The Home page is shown in Figure 28.

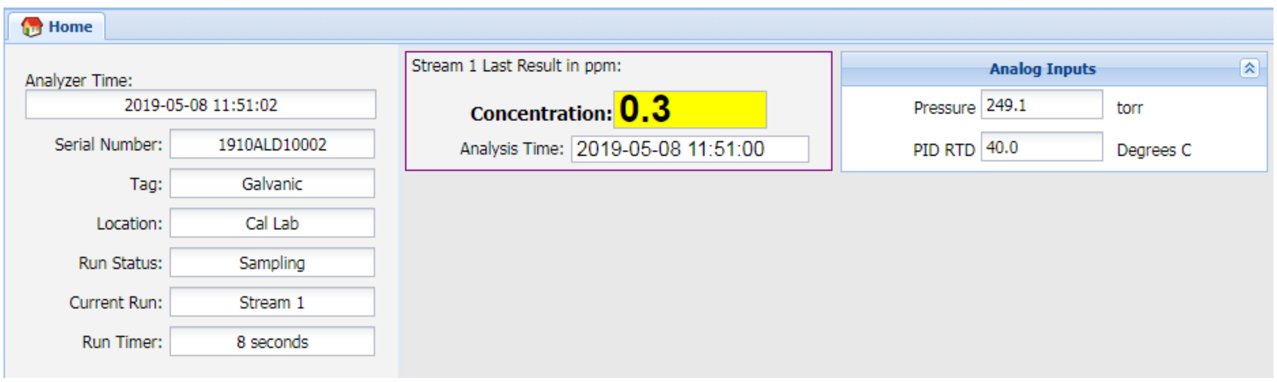


Figure 28: Home Page

On the left-hand side of the page are a series of Analyzer related parameters. These parameters are described in Table 9.

Table 9: Home Screen Analyzer Parameters

Parameter	Explanation
Analyzer Time	Indicates the current analyzer time / date. This is parameter is used to provide timestamps for all stored data and event logs, so it should be set correctly. If it is not correct, it can be set correctly according to the connected computer time by pressing the Synchronize Time button on the toolbar.
Serial Number	The analyzer's unique factory serial number. This serial number should be provided to Galvanic Applied Sciences as part of any service-related correspondence.
Tag	The analyzer's unique customer-provided tag number
Location	The location where the analyzer is installed
Run Status	Indicates whether the analyzer is currently carrying out an analysis (sampling) or purging after a sample steam switch.
Current Run	Indicates what sample stream is currently being analyzed.
Run Time	Time remaining, in seconds, in the current Sampling or Purging interval.

In the middle of the Home page are the last stream results for all configured sample streams. If there is only one configured sample stream, only one Stream result will be displayed, as in Figure 28. For each stream, the last concentration result, in ppm, as well as the Analysis Time (when the result was calculated) will be displayed. The stream result fields are color coded. If the field background is yellow, that indicates the stream is currently active. If the field background is blue, that indicates that stream will be the next to be analyzed after the current analysis is complete.

On the right side of the Home page, the Cell Temperature (**RTD PID**), in degrees Celsius, and the Cell **Pressure**, in torr, are displayed. This provides the user with an at-a-glance indication of whether the cell conditions are normal.

There are no user-editable parameters on the Home page – the home page is used for observation of the analyzer's current situation only.

4.4.2 Alarms Page

The **Alarms** page displays all currently active analyzer alarms. It is shown in Figure 29.

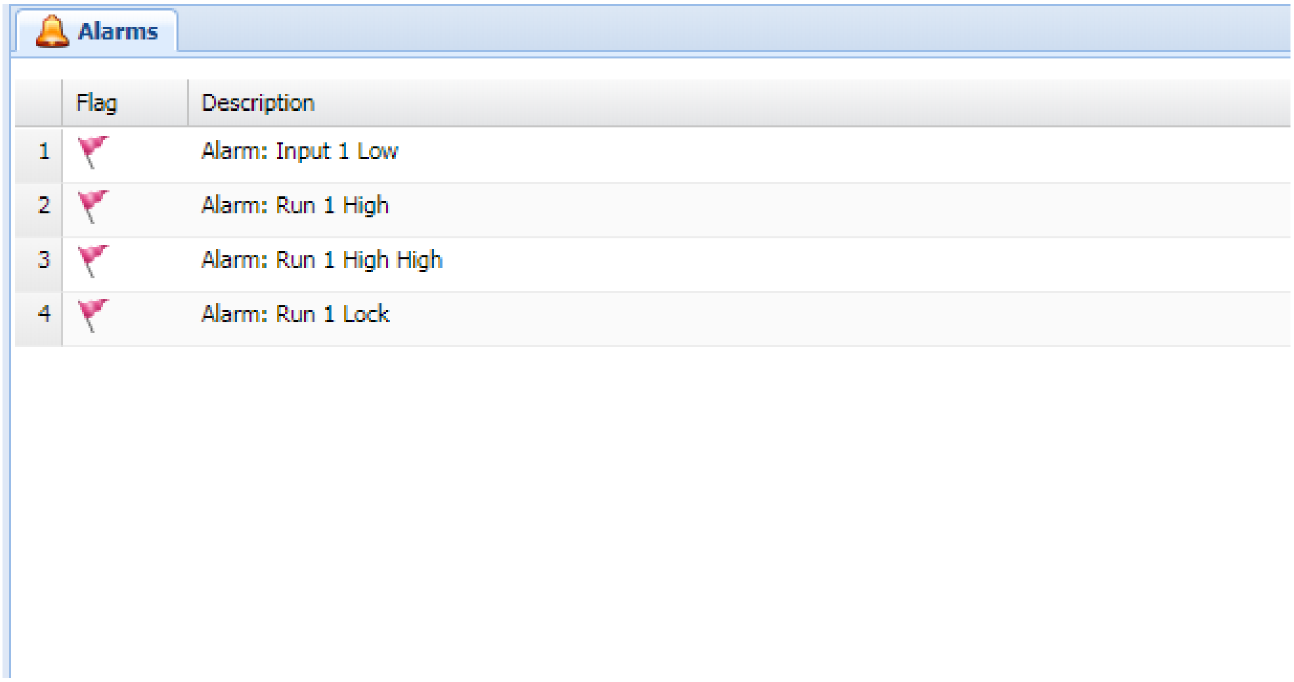


Figure 29: Alarms Page

If there are no alarms currently active, the Alarms page will be blank. If there are active alarms, the Alarms page will display explanations for all currently active alarms. If alarms are set to be latched, it will be necessary to click the Alarm Acknowledge button in the toolbar to clear them from the Alarms page, even if the condition that triggered the alarm has already been cleared.

4.4.3 Hardware Status Page

The **Hardware Status** page shows the current status of all the analyzer's on-board hardware inputs and outputs. It is shown in Figure 35.

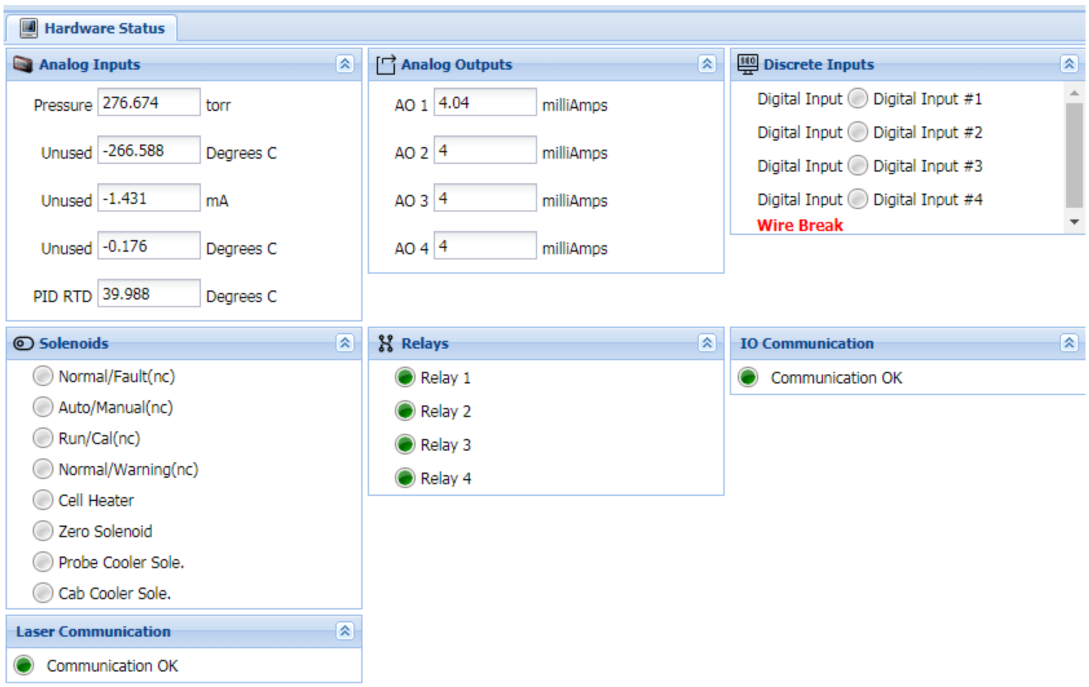


Figure 30: Hardware Status Page

The Hardware Status Page is divided into several sections.

4.4.3.1 Analog Inputs

The **Analog Inputs** section shows the current calibrated inputs to the analyzer's five analog inputs. By default, only the first (Cell **Pressure**) and fifth (**PID RTD**) are calibrated from the factory; the other three analog input readings can be ignored. If the user connects additional measurement devices to the other three available analog inputs, the readings from those additional measurement devices will be indicated here once the analog inputs are correctly calibrated. Wiring diagrams for the connection of external devices of a variety of types are given in Section 7 of this manual.

4.4.3.2 Analog Outputs

The **Analog Outputs** section shows the current output, in mA, from the AccuLase-GPA™ analog output(s). The current output indicated here for each analog output will either be 3mA (fail-safe, indicates Bypass mode is active) or between 4 and 20mA. The AccuLase-GPA™ is configured by default with only one analog output per stream, so if the analyzer is configured to only analyze a single sample stream, it will only have one analog output. A wiring diagram for the connection of signal wiring to the analyzer's analog output(s) is given in Section 7 of this manual.

4.4.3.3 Digital Inputs

The **Digital Inputs** section shows the current status of the analyzer's four Digital Inputs. If the circle for each digital input is grey, this indicates that no signal is being received on that digital input. If the circle is green, that indicates that a signal is being received on that digital input. If one or more digital inputs have incomplete circuits between the digital input and an external device, the words 'Wire Break' will be indicated underneath the status indicators for the digital inputs. A wiring diagram for the connection of signal wiring to the analyzer's digital input(s) is given in Section 7 of this manual.

4.4.3.4 Solenoids

The **Solenoids** section shows the current status of the analyzer's solenoids. The AccuLase-GPA™ can control up to eight solenoids, but in most hardware configurations the number of attached solenoids will be fewer than eight. Solenoids that are connected to the analyzer will have descriptive titles, while solenoid drivers with no solenoids connected will be marked with the term '**Spare**'. The indicator for each solenoid will be grey if the solenoid is off, and green if the solenoid is energized.

4.4.3.5 Relays

The Relays section shows the current status of the analyzer's four solid state relays. Solid state relays can be used for status enunciation if connected to a remote device such as a DCS. If the indicator for a given relay is grey, that indicates that the relay is in the inactive state. If the indicator is green, that indicates that the relay is active. Relays can be configured to either be active ON or active OFF, depending on the user requirements. Configuration of relay behaviour is set in the Outputs page. A wiring diagram for the connection of signal wiring to the analyzer's relay output(s) is given in Section 7 of this manual.

4.4.3.6 Communication Indicators

The last two sections are indicators that show the status of the communication between the analyzer's TDLAS control module and the IO board, as well as between the IO board and the controller board. If these indicators are green, the communication is normal. If one or both indicators are red, there is a communication fault and the analyzer will not be able to function normally.

4.4.4 Global Page

The **Global** page allows the user to view and edit a variety of parameters that impact the overall configuration and operation of the analyzer. The Global page is shown in Figure 36.

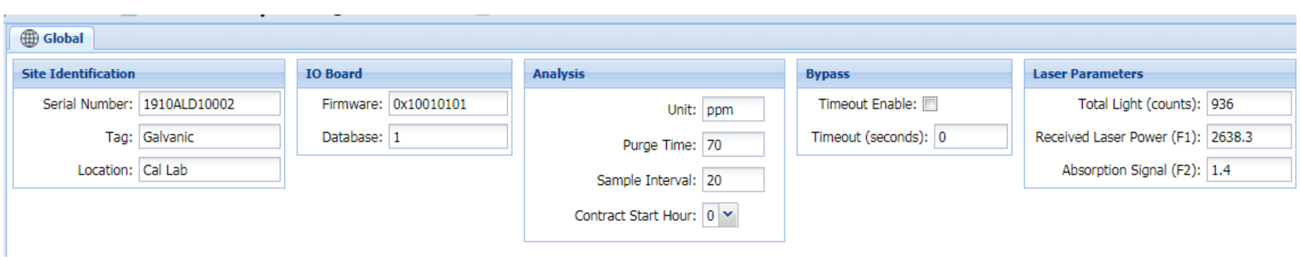


Figure 31: Global Page

Items on the Global page can be edited only if the user is logged in to Update mode. There are several sections on the Global page.

4.4.4.1 Site Identification

The three fields in the Site Identification field are used to provide unique identifiers for the AccuLase-GPA™. The **Serial Number** field is set at the factory and should not be changed under any circumstances, as this serial number allows the factory to review the analyzer's hardware configuration should service be required. The **Tag** and **Location** fields can be set by the user as per their site-specific requirements.

4.4.4.2 IO Board

The **IO board** section shows the firmware revision and database revision for the AccuLase-GPA™ IO board. These parameters are useful for troubleshooting purposes. They are not user editable.

4.4.4.3 Analysis

The **Analysis** section contains several user configurable parameters that affect the analyses carried out by the AccuLase-GPA™. These parameters are described in Table 10.

Table 10: Analysis Parameters

Parameter	Explanation
Unit	Changes the measurement unit displayed for the concentration in the web GUI and on the analyzer display. NOTICE: Display only. No unit conversion is done. Default is ppm.
Purge Time	Changes the amount of time, in seconds, that the analyzer will purge the sample cell after a stream switch before starting a new analysis. Default is 70s.
Sample Interval	Changes the interval at which the stream is switched for multi-stream configurations.
Contract Start Hour	Allows the user to choose what time, from 0 (midnight) to 23 (11pm), analyses scheduled to be run daily will be carried out.

4.4.4.4 Bypass

The **Bypass** section contains parameters that govern the behaviour of the AccuLase-GPA™ while in bypass mode. In bypass mode, hardware outputs associated with alarm conditions are disabled, and the analog output(s) is/are set to output the fail-safe value (3mA). If the **Timeout Enable** checkbox is selected, the analyzer will automatically exit bypass mode after a specified period with no inputs being made to the analyzer either from the keypad or from the web GUI. The bypass timeout length, in seconds, is user configurable in the **Timeout (seconds)** field. The default value for this timeout is 240 seconds (4 minutes).

4.4.4.5 Laser

The **Laser** section contains several laser-related parameters. These parameters are read-only and are primarily used for troubleshooting purposes. The parameters displayed in the Laser section are the same as those displayed on the Laser panel of the AccuLase-GPA™ local display. Refer to section 3.9 for more information.

4.4.5 Calibration Page

The **Calibration** page shows the AccuLase-GPA™ calibration parameters. See Figure 32.

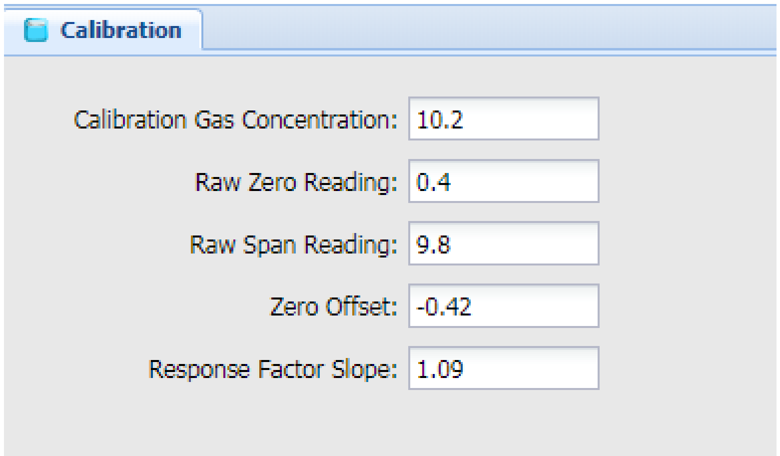


Figure 32: Calibration Page

The parameters displayed on the Calibration page are identical to those displayed on the Calibration panel of the analyzer's local display UI. Refer to section 3.8 for more information on these parameters. Unlike the local display Calibration panel, the calibration parameters displayed on the Calibration page are read-only. Additionally, calibration runs cannot be initiated from the Calibration page – they must be initiated from the Calibration panel on the analyzer's local display.

4.4.6 Run Setup Page

The **Run Setup** page is used to configure the various analysis runs that the AccuLase-GPA™ can carry out. It is shown in Figure 33. There are a total of 8 different runs that can be configured on the Run Setup page. When the page is first opened, the **Run 1** setup is opened, and all seven others are collapsed. To collapse a run, press the (**-**) button at the top right of its setup screen. To expand a run, press the (**+**) on the right end of the Run title bar.

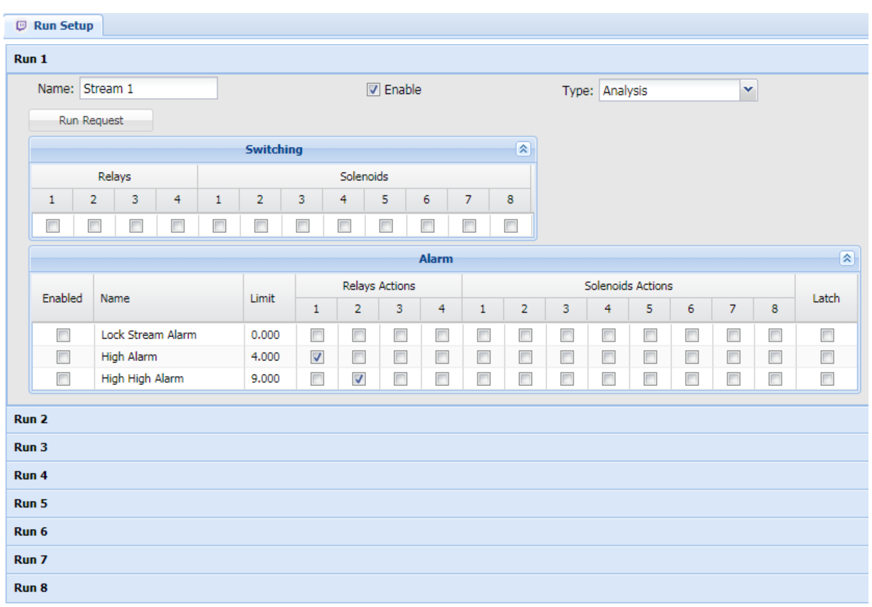


Figure 33: Run Setup Page

4.4.6.1 Run Definition

At the top of each run's setup section are three fields that are used to define the parameters of the run.

- The **Run Name** is used to refer to the run everywhere throughout the AccuLase-GPA™ local display UI and in the web-based GUI. By default, Stream 1-4 are the run names used for sample streams, Cal Span is used for the span calibration stream, and Cal Zero is used for the zero calibration stream.
- The **Enable** checkbox is used to enable the run and allow it to be carried out. If this checkbox is not checked, the run will not run under any circumstances – it cannot be initiated manually, cannot be set up as part of a stream sequence, and cannot be initiated via a digital input or a timed frequency basis.
- The **Type** drop-down menu is used to select the run type. Runs can either be one of four types:
    1. **Analysis** runs, where a concentration is calculated based on the analyzer's calibration parameters
    2. **Zero Calibration** runs, which are used to establish the raw zero reading in the analyzer's calibration parameters
    3. **Span Calibration** runs, which are used to establish the raw span reading in the analyzer's calibration parameters
    4. **Reference** runs, which are used to verify the validity of the analyzer's calibration parameters.

Directly underneath the Run Name field is a button marked **Run Request**. This button is used to manually place a single instance of the run being edited into the AccuLase-GPA™ analysis queue.

4.4.6.2 Switching

The **Switching** fields are used to associate hardware actions with a given run. For each run, specific relays and/or solenoids can be set to energize when the run is carried out. Relays are typically used for remote run enunciation, while solenoids are typically used to physically switch the gas source entering the sample cell. To choose the hardware actions associated with a given run, simply place a checkmark in the checkbox associated with the desired hardware actions for that run.

4.4.6.3 Alarms

There are three alarms available to configure for each run in the Alarms section. Each alarm may be configured for any measurement analyte available with your analyzer. These alarms are explained in Table 11.

Table 11: Stream Alarms

Alarm	Explanation
Lock Stream	If the average measured concentration of the analyte in the sample stream being analyzed over the entire sample interval exceeds the alarm set point, the stream will be ‘locked’, and no further stream switches will occur until the concentration of the target gas in the sample stream drops below the alarm set point.
High Alarm	If the average measured concentration of the analyte in the sample stream being analyzed over the entire sample interval exceeds the alarm set point, the High Alarm will be triggered at the end of the Sample Interval.
High High Alarm	If the instantaneous concentration of the analyte in the sample stream being analyzed at any point during the sample interval exceeds the alarm set point, the High High alarm will immediately be triggered, and the analyzer display and outputs (analog outputs, Modbus, etc) will immediately ‘go live’, showing the maximum instantaneous concentration of the target gas recorded up to that point.

To enable any of the run-related alarms, a checkmark must be placed in the **Enable** checkbox to the left of the alarm name. The set point for each alarm can then be entered into the field in the **Limit** column. Hardware output actions, both relays and solenoids, can be associated with each type of alarm by placing a checkmark in the checkbox(es) for the hardware output(s) that should be associated with the alarm. Additionally, each alarm can be configured to latch by placing a checkmark in the checkbox in the **Latch** column. If an alarm is configured to be latched, it will not clear from the Alarms list in the web GUI and on the analyzer display, nor will the associated hardware outputs return to their deactivated state, until the alarm is manually acknowledged either via the local display and keypad or via the web GUI, even if the condition that caused the alarm to be triggered has cleared. If the alarm is not configured to be latched, it will automatically be cleared once the condition that caused the alarm to be triggered has cleared.

4.4.7 Sequencer Page

The **Sequencer** page is used to set up the AccuLase-GPA™ automatic sequence of analyses. It is shown in Figure 34. The automatic sequence is a list of runs that the analyzer will perform sequentially. When the defined automatic sequence is complete, the analyzer will return to the beginning of the sequence and carry it out again. An automatic sequence will not be interrupted by a scheduled analysis, an analysis initiated remotely via Modbus or a digital input, or an analysis initiated manually via the Run Setup page – these runs will only be carried out once the currently in progress sequence is complete. Further, once any run triggered by schedule, remotely, or manually is completed, the analyzer will automatically return to the automatic sequence.

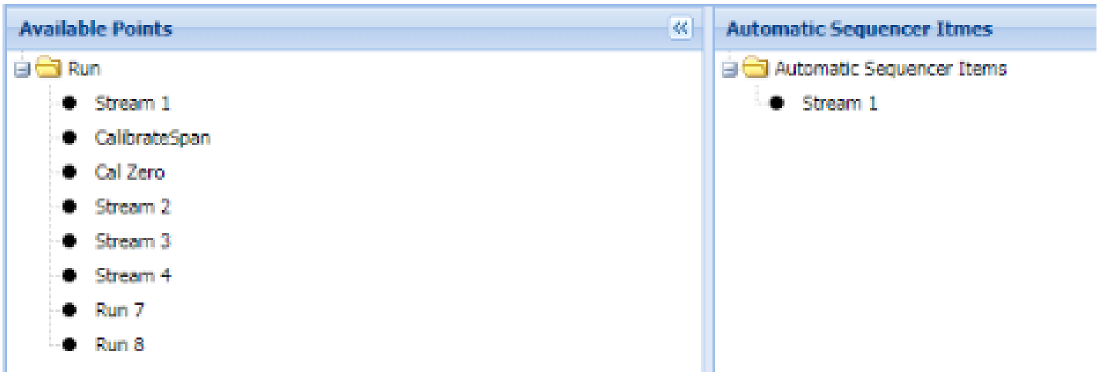


Figure 34: Sequencer Page

To add a run to the automatic sequencer, simply drag the desired run from the **Available Points** list and drop it in the **Automatic Sequencer Items** list. The same run can be placed in the automatic sequencer list more than once if desired. Only runs that have been enabled in the Run Setup page will run as part of the automatic sequence. To remove a run from the automatic sequencer, simply click on it to highlight it, then hit the Delete key on the keyboard to remove it.

4.4.8 Scheduler Page

The **Scheduler** page is used to schedule runs to be initiated at a specific time. See Figure 35.

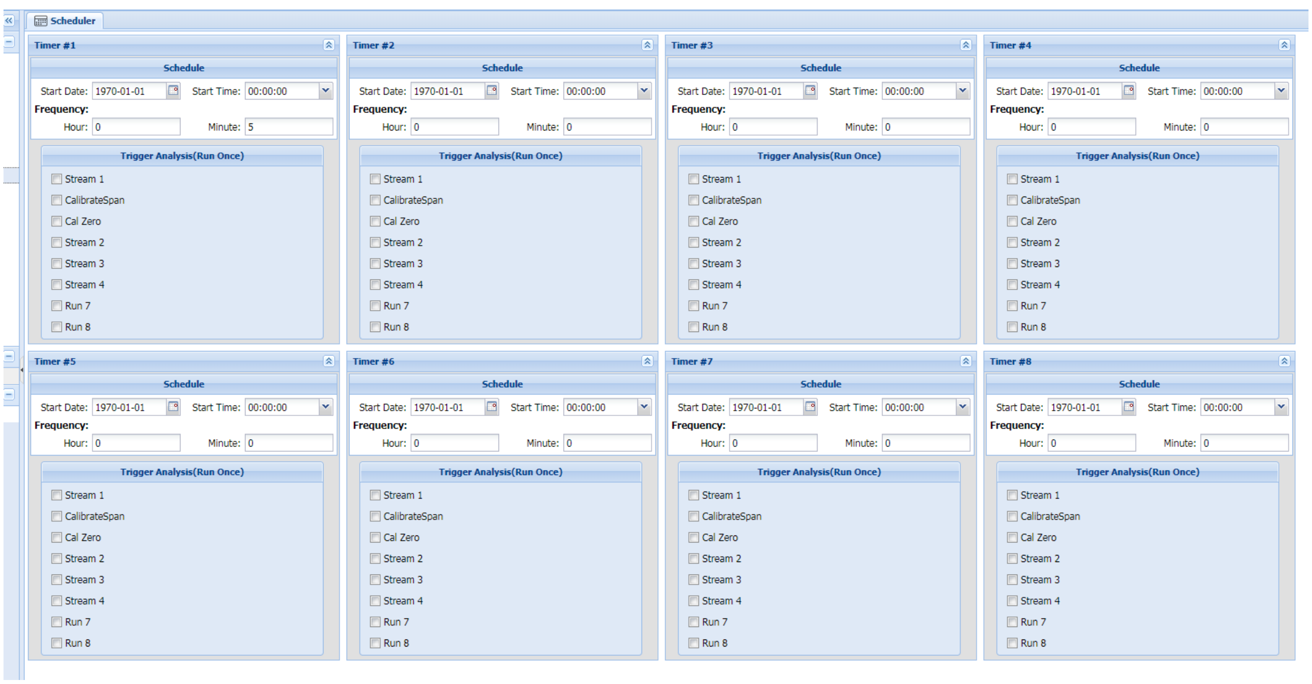


Figure 35: Scheduler Page

Up to 8 different timers can be configured. For each timer, a **Start Date** and a **Start Time** must be configured. The date and time will be referenced against the AccuLase-GPA™ real time clock, so it is very important that the real time clock is correct. If it is not, be sure to set the clock correctly by pressing the **Synchronize Time** button on the toolbar before setting timers. The date is in the format YYYY-MM-DD. The time is in 24-hour format. The frequency at which the scheduled analysis will reoccur, in hours and minutes, can be set in the fields below the start date and time. If the frequency is set to 0 hours and 0 minutes, the scheduled analysis will not run as per the schedule. A frequency MUST be set for the scheduled run to run as desired. The run that is to be triggered by the timer can be chosen by placing a checkmark in the checkbox of the desired run in the **Trigger Analysis** section of the timer configuration.

NOTICE IF THE ACCULASE-GPA™ IS CURRENTLY IN THE MIDDLE OF RUNNING AN AUTOMATIC SEQUENCE AT THE PRECISE TIME THE CHOSEN ANALYSIS IS SCHEDULED TO BE RUN, THE AUTOMATIC SEQUENCE WILL FIRST COMPLETE, AND THEN THE SCHEDULED RUN WILL BE CARRIED OUT. AS A RESULT, SCHEDULED ANALYSES MAY NOT BEGIN AT PRECISELY THE TIME THEY ARE SCHEDULED TO BE INITIATED.

4.4.9 Alarm Setup Page

The **Alarms Setup** page is used to configure hardware and calibration related alarms. It is shown in Figure 36.

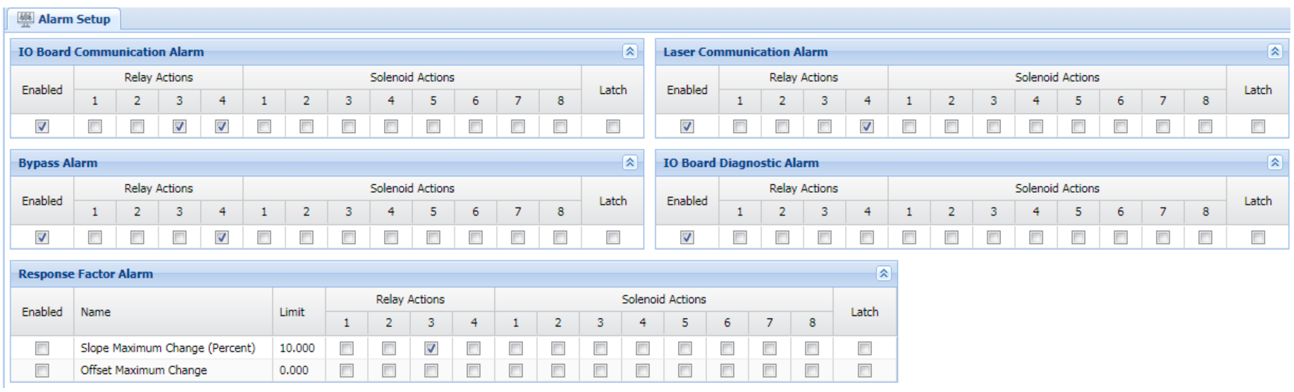


Figure 36: Alarms Setup Page

4.4.9.1 Hardware Alarms

There are four hardware fault related alarms that can be enabled and configured on the Alarms Setup Page. These alarms are described in Table 12.

Table 12: Alarms Setup Page Hardware Alarms

Alarm	Explanation
IO Board Communication	If the controller board is unable to communicate with the IO board, this alarm will be triggered.
Laser Communication	If the IO board is unable to communicate with the TDLAS module in the AccuLase-GPA™ Optics/Sample Cell enclosure, this alarm will be triggered.
Bypass	Treats Bypass Mode as an alarm for remote enunciation that the analyzer is currently in bypass and output results are not currently valid.
IO Board Diagnostic	If the hardware diagnostics determine there is a hardware related fault on the analyzer's IO board, this alarm will be triggered.

For each of these alarms, they can be enabled by placing a checkmark in the **Enable** box. Desired **Relay Actions** and **Solenoid Actions** can be associated with each alarm by placing checkmarks in the checkboxes associated with the desired hardware actions for each alarm. The alarms can also be set to be latched by placing a checkmark in the **Latch** checkbox for each alarm.

4.4.9.2 Calibration Alarms

There are two calibration alarms that can be enabled and configured on the Alarms Setup page. These alarms are described in Table 13.

Table 13: Calibration Alarms

Alarm	Explanation
Slope Maximum Change (Percent)	If the percentage difference between the previous calibration slope and the newly calculated calibration slope is greater than the value placed in the Limit field for this alarm, the alarm will be triggered. The new slope will also be rejected and the analyzer will continue to use the previous calibration slope.
Offset Maximum Change	If the absolute difference between the previous calibration offset and the newly calculated offset is greater than the value placed in the Limit field for this alarm, the alarm will be triggered. The new offset will also be rejected and the analyzer will continue to use the previous offset.

For each of these alarms, they can be enabled by placing a checkmark in the **Enable** box. Desired **Relay Actions** and **Solenoid Actions** can be associated with each alarm by placing checkmarks in the checkboxes associated with the desired hardware actions for each alarm. The alarms can also be set to be latched by placing a checkmark in the **Latch** checkbox for each alarm.

4.4.10 Modbus Page

The **Modbus** page is used to configure the AccuLase-GPA™ data output via Modbus. It is shown in Figure 37.

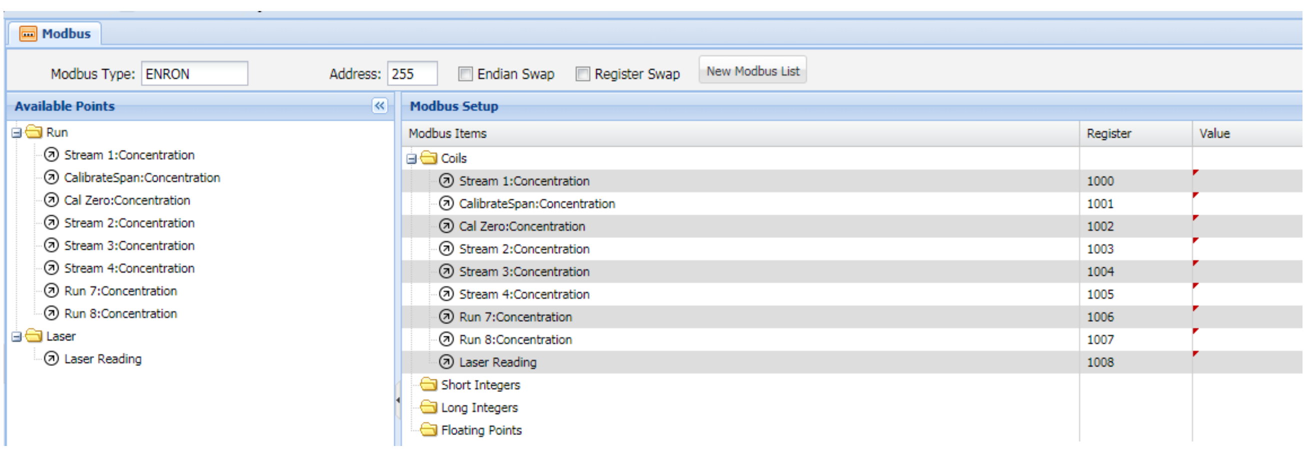


Figure 37: Modbus Page

The outputs can be configured by clicking and dragging the desired data points from the **Available Points** and dropping them onto the applicable Modbus item under **Modbus Setup**. The starting address for Modicon is 1 and the starting address for Enron is 7000 (floats).

4.4.11 Archive Page

The Archive page is used to access archival data stored in the AccuLase-GPA™ on-board memory. The Archive page is shown in Figure 38.

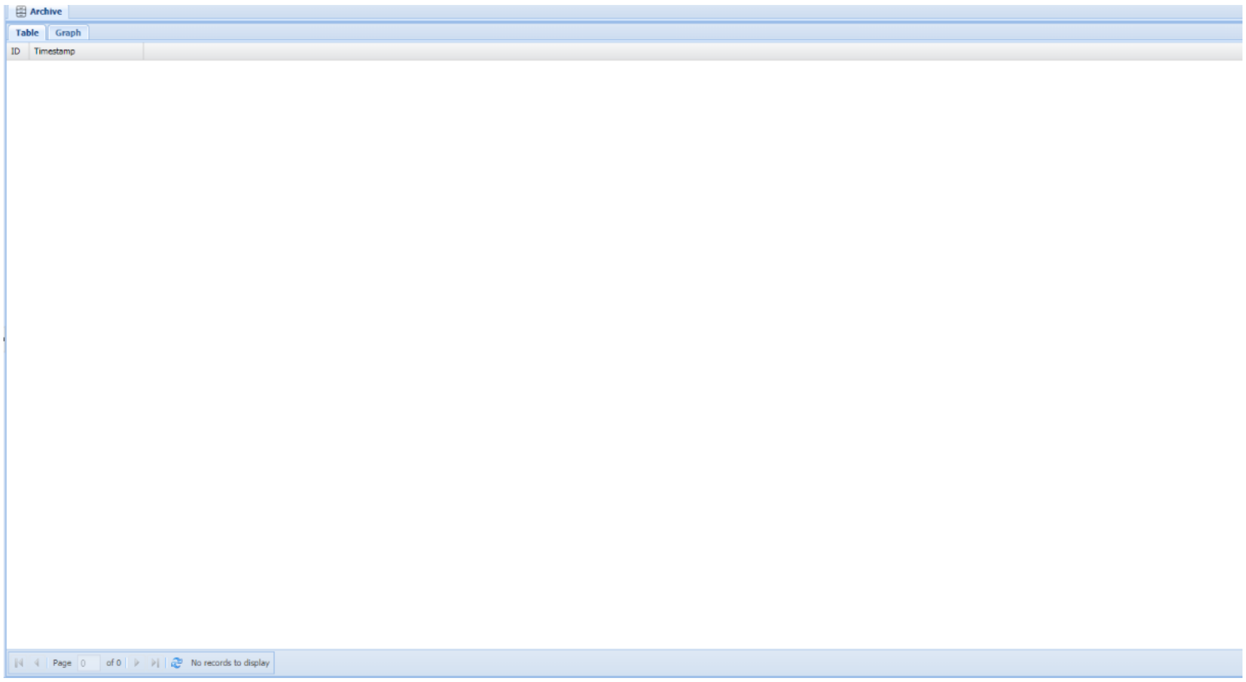


Figure 38: Archive Page

The AccuLase-GPA™ logs the current calculated concentration, the cell temperature, and the cell pressure every 30 seconds. The data stored in the archive can be downloaded by clicking on the refresh button ( ) at the bottom left of the Archive page. If there are no records stored in the analyzer archive, this button will read **No records to display.** If there is data stored in the archive, clicking on this button will immediately display all the stored data records. Only 50 records can be displayed per page. To the left of the download button are a series of buttons that can be used to navigate through multiple pages of data, as well as fields that show the current page number as well as the total pages of archive data available. Pressing the **|<** button will return to the first page, pressing the **<** button will go to the previous page, pressing the **>** button will go to the next page, and pressing the **>|** button will go to the last page. To export the data, simply right-click on the displayed table and select the desired export type. Please note, each page will need to be exported individually.

In the Table tab, each set of archival data (concentration, temperature, and pressure) will have a **Timestamp** set according to the AccuLase-GPA™ real time clock and a sequence **ID** number. Data can be exported to a Microsoft Excel or CSV format by right clicking anywhere on the data table, then selecting Export to File. If a subset of data is selected, right clicking on it can also be used to select the Graph Data function. Once this function has been clicked, the graph created from the selected data can be observed in the Graph tab.

4.4.12 Events Page

The **Events** page is used to access the Event log that is stored in the AccuLase-GPA™ on-board memory. The Events page is shown in Figure 39.

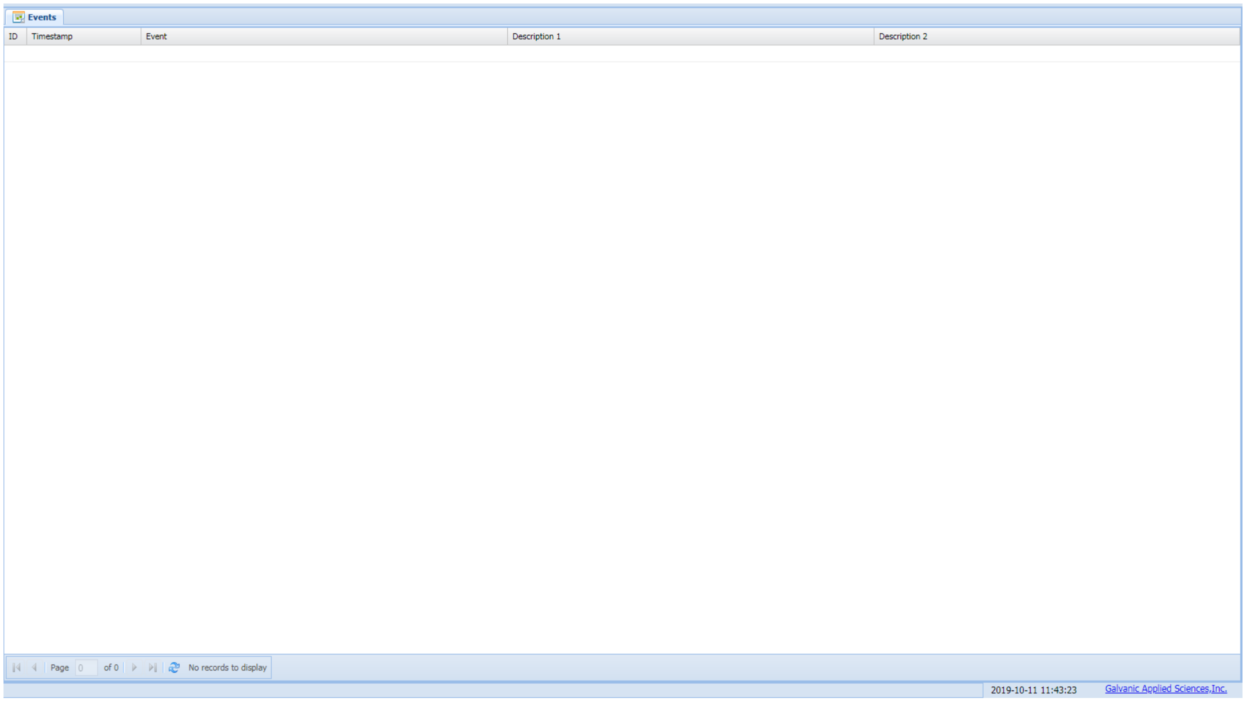


Figure 39: Events Page

To display the analyzer's Event Log, simply press the refresh button ( ) at the bottom left of the Events page. A change of one type or another is what causes a record to be placed into the event log. Changes that can cause a record to be entered into the event log include an alarm condition being triggered or being cleared, a change in the analyzer configuration either from keypad or from the web GUI, or an event triggered remotely via a digital input. Every event record in the event log has a sequence **ID**, a **Timestamp** set according to the analyzer's real time clock, an **Event** title, and at least one **Description** that describes what the event was.

4.4.13 Discrete Inputs Page

The **Discrete Inputs** page is used to configure the AccuLase-GPA™ digital inputs, which can be used to remotely trigger any analysis run and / or hardware output of the user's choice. It is shown in Figure 40.

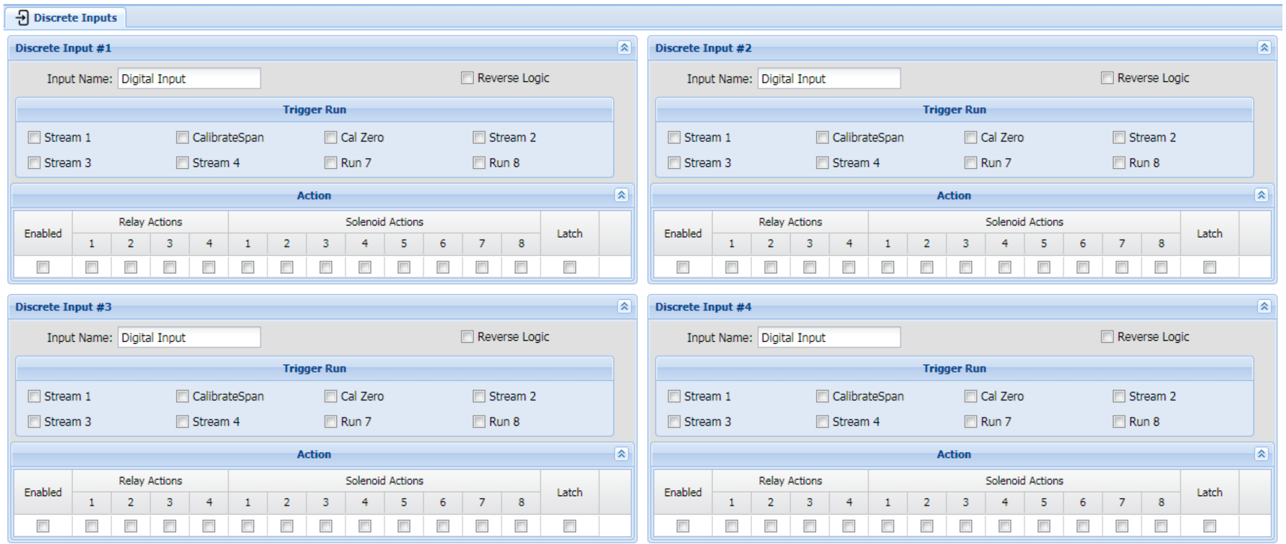


Figure 40: Discrete Inputs Page

There is a total of four discrete inputs available for configuration. The hardware for the discrete inputs is found on the AccuLase-GPA™ IO board. Each discrete input has the same set of options that can be configured.

4.4.13.1 General Options

Each discrete input can be given an **Input Name** that is used to refer to the discrete input elsewhere in the web GUI as well as on the analyzer's local display screen. If multiple discrete inputs are to be configured, it is recommended to use a unique name for each configured discrete input. The **Reverse Logic** checkbox is used to configure the behaviour of the remote input. If this checkbox is not checked, the discrete input will be disabled when the remote input is set to OFF, and enabled when the remote input is set to ON. However, if this checkbox is checked, the behaviour will be reversed – the discrete input will be disabled when the remote input is set to ON, and enabled when the remote input is set to off.

4.4.13.2 Trigger Run

The **Trigger Run** box is used to select the analysis run that will be triggered when a signal is received on the discrete input. Only one analysis run can be associated with any discrete input. Only runs that have been enabled in the Run Setup screen can be initiated remotely via a discrete input.

4.4.13.3 Action

The **Action** box is used to select the hardware output(s) that are to be associated with a signal input on the discrete input. Any of the AccuLase-GPA™ relay and solenoid outputs can be associated with a discrete input signal. For the chosen hardware outputs to be enabled when a signal is received on the discrete input, a checkmark must be placed in the **Enable** checkbox. The desired hardware outputs can then be selected by placing checkmarks in the associated checkboxes. If a checkmark is placed in the **Latch** checkbox, the hardware output will be latched in the enabled position until another signal is received on the digital input.

4.4.14 Outputs Page

The **Outputs** page is used to configure the behaviour of the AccuLase-GPA™ hardware outputs. It is shown in Figure 41.

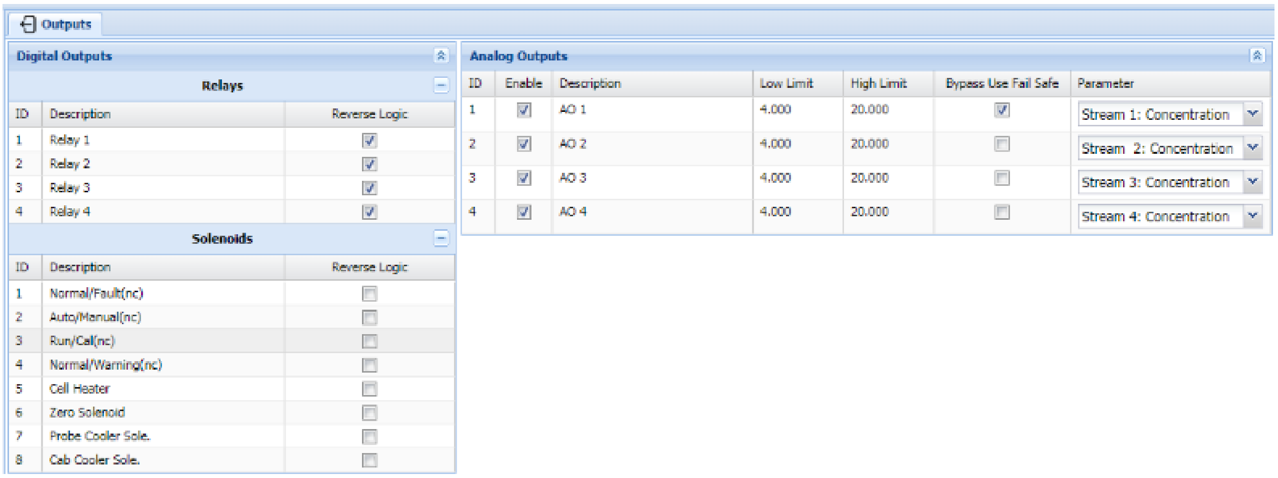


Figure 41: Outputs Page

The Outputs page is divided into three sections, one for each of the three types of hardware outputs available – relays, solenoids, and analog outputs.

4.4.14.1 Relays

Each of the four available relays has three parameters associated with it. The relay parameters are described in Table 14.

Table 14: Relay Configuration

Parameter	Explanation
ID	The hardware ID for the relay on the IO board. The ID number for the relay in the web GUI is the same as the relay number printed on the IO board.
Description	Provides a description of the relay's function (e.g. Normal / Fault). The description can be edited by left clicking on the description, typing in the new description, and pressing Enter.
Reverse Logic	If this option is chosen, the relay will be energized (NO and C) when inactive, and de-energized (NC and C) when active. If the option is not selected, the relay will be de-energized when inactive, and energized when active.

4.4.14.2 Solenoids

Each of the 8 available solenoids has three parameters associated with it. These parameters are described in Table 15.

Table 15: Solenoid Configuration

Parameter	Explanation
ID	The hardware ID for the solenoid on the IO board. The ID number for the solenoid in the web GUI is the same as the solenoid number printed on the IO board.
Description	Provides a description of the solenoid's function, such as, Zero Calibration, Span Calibration, Stream 1, etc. The description can be edited by left clicking on the description, typing in the new description, and pressing Enter.
Reverse Logic	If this option is chosen, the solenoid will be energized (gas connected to the NC port will flow) when inactive, and de-energized (gas connected to the NO port will flow) when active. If the option is not selected, the solenoid will be de-energized when inactive, and energized when active.

4.4.14.3 Analog Outputs

The AccuLase-GPA™ can be configured with as many as four hardware 4-20mA analog outputs, and each analog output has several configurable parameters associated with it. These parameters are described in Table 16.

Table 16: Analog Output Configuration

Parameter	Explanation
ID	The hardware ID for the analog output on the IO board. The ID number for the analog output in the web GUI is the same as the analog output number printed on the IO board.
Enable	If this checkbox is checked, the analog output will be enabled and output an electrical current; if it is not checked, the analog output will be disabled and will not output an electrical current.
Description	Provides a description of the analog output's function. The description can be edited by left clicking on the description, typing in the new description, and pressing Enter.
Low Limit	The value entered into this field will be the value for the chosen output parameter that will be associated with an electrical current reading of 4mA. In most cases, the low limit field will have a value of zero.
High Limit	The value entered into this field will be the value for the chosen output parameter that will be associated with an electrical current reading of 20mA. If the parameter being output is concentration, the value in this field will typically be the analyzer's maximum range concentration.
Bypass Use Failsafe	If this checkbox is checked, when the analyzer is placed into Bypass mode, the analog output will output the failsafe electrical current of 3mA. If this checkbox is not checked, the analog output will continue to output 'live' values even if the analyzer is in Bypass mode. The default is to check this checkbox.
Parameter	The specific parameter to be output on the analog output. The parameter to be output can be chosen from the drop-down menu that shows all possible output parameters. The default configuration would be to have Analog Output 1 output Stream 1: Concentration, Analog Output 2 output Stream 2: Concentration, and so on.

4.4.15 Analog Inputs Page

The **Analog Inputs** page is used to configure and calibrate each of the five available analog inputs, as well as their associated alarms, on the AccuLase-GPA™ IO board. It is shown in Figure 47.

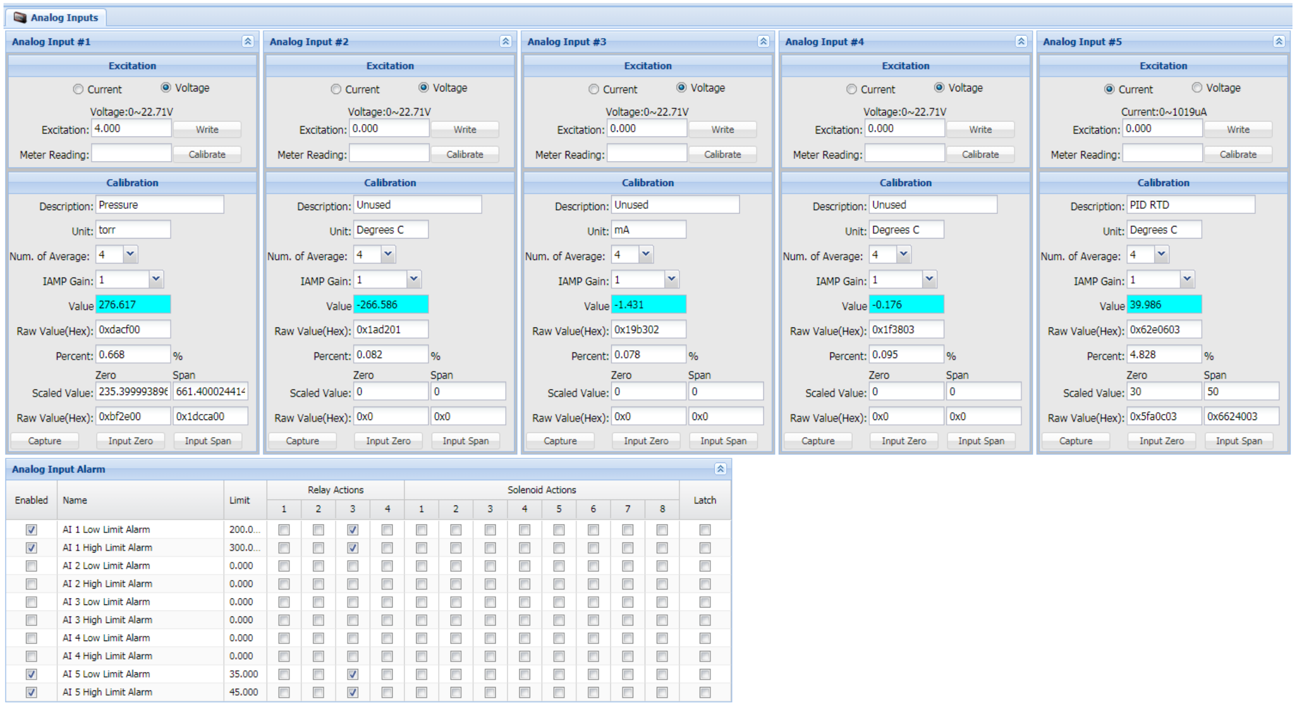


Figure 42: Analog Inputs Page

⚠ CAUTION ANALOG INPUTS 1 AND 5 ARE RESERVED FOR INPUTS FOR THE ANALYZER'S CELL PRESSURE TRANSDUCER AND CELL TEMPERATURE RTD RESPECTIVELY. THESE INPUTS SHOULD NOT BE MODIFIED EXCEPT UNDER THE EXPRESS INSTRUCTION OF GALVANIC APPLIED SCIENCES. UNAUTHORIZED MODIFICATION TO THESE INPUTS MAY RESULT IN THE ACCULASE-GPA™ BEING UNABLE TO FUNCTION NORMALLY.

The **Excitation** and **Calibration** sections for each Analog Input are used to configure and calibrate each analog input so the input from the connected device is displayed correctly.

4.4.15.1 Excitation

The **Excitation** section is used to configure the excitation voltage or current that is used to excite the connected device. The selection of current or voltage will depend on the type of device connected – check with the device manufacturer for more information.

4.4.15.2 Calibration

The **Calibration** section consists of a variety of parameters that must be correctly configured for the data input from the external device to be displayed correctly in the AccuLase-GPA™ web GUI and on the analyzer's local display screen. The parameters that must be configured are described in Table 17.

Table 17: Calibration Configuration

Parameter	Explanation
Description	A word or phrase used to describe what the analog input is displaying. The description entered here will be used elsewhere in the web GUI and on the analyzer's local display when referring to this analog input.
Unit	The displayed measurement unit associated with the analog input. This measurement unit is ONLY used for display – changing the unit entered here does not automatically convert the displayed value to the new unit.
Num. of Averages	The number of readings taken from the analog input and averaged together before updating the displayed value. The number of averages can be chosen from the drop-down menu. The default value is 4.
IAMP Gain	The instrument amplifier gain applied to the signal input to the analog input. The gain can be chosen from the drop-down menu. The default value is 1.
Value	The value in this field displays the current calibrated value being input into the analog input, based on the analog input's calibration. This is a read only value and cannot be edited.
Raw Value (Hex)	The raw signal being read from the Analog Input, in hexadecimal format. This is a read only value and cannot be edited.
Percent	The magnitude of the currently input signal to the analog input, expressed as a percentage of the analog input's full scale. This is a read only value and cannot be edited.
Scaled Value – Zero and Span	The scaled values to be used as a zero and span for the calibration of the analog input. For example, if the analog input is to be calibrated for a temperature reading, temperatures in the desired temperature units should be entered into the zero and span fields, with the temperature in the zero field being lower than the temperature in the span field.
Raw Value (Hex) – Zero and Span	The raw values, in hexadecimal format, associated with the inputs of zero and span given in the scaled value zero and span fields.
Input Span	Pressing this button when the value being input into the analog input is the span calibration value will update the span Raw Value (Hex).
Input Zero	Pressing this button when the value being input into the analog input is the zero calibration value will update the zero Raw Value (Hex)
Capture	Pressing this button will save the Raw Value (Hex) for zero and span to the analyzer – this will then produce a two point calibration for the analog output.

4.4.15.3 Analog Input Alarms

This section of the Analog Inputs page is used to configure alarms associated with values being input into the analog inputs. Analog Input alarms must be enabled by placing a checkmark in the **Enable** checkbox for that alarm. Each analog input has a **Low Limit Alarm** and a **High Limit Alarm** that is associated with it. If enabled, and the value being input into the analog input falls below the value in the Low Limit Alarm **Limit** field, or rises above the value in the High Limit Alarm **Limit** field, an alarm will be triggered. The alarm will be visible on the Alarms page on both the analyzer's local display and in the web GUI. As with other alarms, hardware actions can be associated with both Low Limit Alarms and High Limit Alarms by placing a checkmark in the checkbox of the desired hardware output to be triggered. Low Limit and High Limit Alarms can also be configured to latch by placing a checkmark in the **Latch** checkbox.

NOTICE ONLY LOW LIMIT AND HIGH LIMIT ALARMS ASSOCIATED WITH ANALOG INPUTS THAT ARE CALIBRATED AND IN USE SHOULD BE ENABLED TO AVOID ALARMS BEING TRIGGERED WHEN NO ALARM CONDITION ACTUALLY EXISTS.

4.4.16 Drawing Page

This page allows the user to download a series of AccuLase-GPA™ drawings in PDF format, including installation dimensions and wiring diagrams for the connection of external devices to the analyzer. The drawings available in the web GUI are similar to those given in Section 7 of this manual.

NOTICE THE DRAWINGS AVAILABLE ON THE DRAWING PAGE ARE GENERIC DRAWINGS. DEPENDING ON THE ANALYZER'S SPECIFIC CONFIGURATION, THESE DRAWINGS MAY NOT BE 100% ACCURATE. WHEN IN DOUBT, ALWAYS REFER TO THE SPECIFIC ANALYZER'S AS-BUILT DRAWINGS, INCLUDED ON THE USB THUMB DRIVE THAT IS INCLUDED WITH EVERY ANALYZER.

4.4.17 Manual Page

This page allows the user to download the AccuLase-GPA™ Installation and Safety manual and Operation and Maintenance manual in PDF format.

NOTICE THE MANUALS AVAILABLE ON THE MANUAL PAGE MAY NOT BE THE MOST RECENT VERSIONS OF THESE MANUALS. WHEN IN DOUBT ALWAYS REFER TO THE MANUALS INCLUDED ON THE USB THUMB DRIVE THAT IS INCLUDED WITH EVERY ANALYZER.

4.4.18 About Page

This page presents information about the hardware and firmware of the AccuLase-GPA™, including version numbers. This information is useful for troubleshooting in the event of analyzer problems and should be provided to the Service Department of Galvanic Applied Sciences Inc. when asking for assistance.

4.5 Technician Menu

The **Technician** menu is used to configure the hardware outputs of the AccuLase-GPA™ Input / Output (IO) board. It consists of only one menu item.

4.5.1 Output Test

The **Output Test** page is used to test the variety of hardware outputs on the IO board. It can also be used to set up and calibrate the analog output(s). The Output Test page is shown in Figure 43.

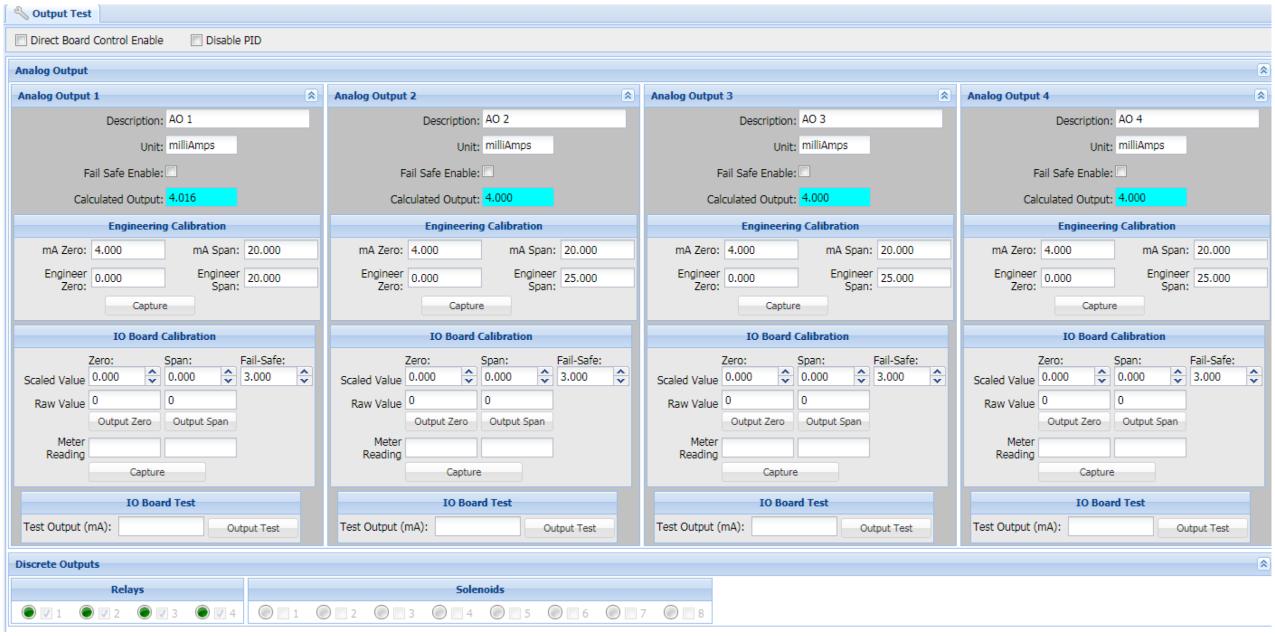


Figure 43: Output Test

Before any testing or calibration can be performed on the Output Test page, the IO board must be placed in **Direct Board Control** mode by selecting the **Direct Board Control Enable** option at the top left of the screen. In Direct Board Control mode, all hardware outputs on the IO board are under manual control and cannot be controlled by the analyzer's controller board.

NOTICE

WHEN IN DIRECT BOARD CONTROL MODE, THE OUTPUTS ON THE IO BOARD ARE UNDER MANUAL CONTROL ONLY. NO NORMAL ANALYSIS CAN BE CARRIED OUT IN THIS MODE. PRIOR TO LEAVING THE OUTPUT TEST PAGE, THE DIRECT BOARD CONTROL ENABLE TOGGLE MUST BE DISABLED TO PLACE THE IO BOARD OUTPUTS BACK UNDER AUTOMATIC CONTROL OF THE ANALYZER CONTROLLER BOARD.

The **Disable PID** toggle is used to disable the temperature control for the sample cell. Unless this option is selected, the PID temperature control will remain under automatic control of the analyzer controller board even when the IO board is in Direct Board Control mode.

4.5.1.1 Analog Output Calibration and Testing

The **Analog Output** section of the Output Test page is used to calibrate and test the analog output(s) on the IO board. The number of analog outputs available for calibration and testing will depend on the analyzer's specific hardware configuration. The Analog Output section for a single analog output is shown in Figure 44.

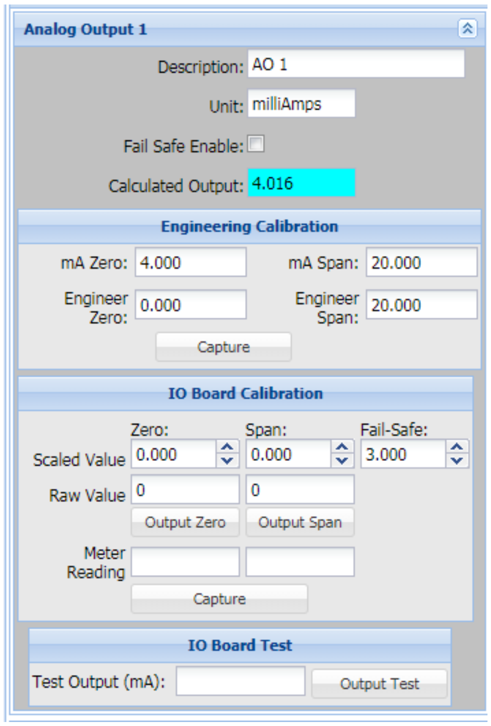


Figure 44: Analog Output Calibration and Test

In the top box are several fields. The **Description** field describes the analog output, and by default this field simply contains the analog output number. The **Units** field describes the unit in which the signal is output from the analog output. By default, the output unit for any analog output is milliamps. If the **Failsafe** option is selected, when the AccuLase-GPA™ is placed into bypass mode the analog output value will switch to the fail-safe output signal, which by default is 3mA. The **Calculated Output** field shows the signal output, in milliamps, from the analog output based on the output configuration configured in the sections below.

The **Engineering Calibration** section is used to associate concentration values with the milliamp signal output. The **mA Zero** field is used to enter the milliamp value that is output when the analog output is outputting a zero signal; the default value for this field is 4mA. The **mA Span** field is used to enter the milliamp value that is output when the analog output is outputting a full-scale signal; the default value for this field is 20mA. The **Engineer Zero** and **Engineer Span** fields are used to enter the concentration values for a zero output (typically 0ppm) and a span output (typically the full scale value). Once the desired values have been entered into these fields, the **Capture** button must be clicked to save these values to the board.

The **IO Board Calibration** section is used to calibrate the analog output so that it outputs a zero signal when a zero signal is required and a span signal when a span signal is required. In the **Scaled Value** fields for **Zero**, **Span**, and **Fail-safe**, the current outputs associated with each of these points should be set (default values are 4mA, 20mA, and 3mA respectively). The **Raw**

Value fields below each of the Scaled Value fields shows the raw hardware output value for zero and span. To calibrate the analog output, follow the procedure below:

1. Connect a multimeter or other current measuring device to the analog output to be calibrated.
2. Click on **Output Zero** and ensure that the meter reads approximately 4mA.
3. Enter the exact reading on the multimeter into the **Meter Reading** field for Zero. Press Enter. The number displayed in the **Raw Value** field for zero should change and the current reading on the multimeter should now be exactly 4.00mA.
4. Click on **Output Span** and ensure that the meter reads approximately 20mA.
5. Enter the exact reading on the multimeter into the **Meter Reading** field for Span. Press Enter. The number displayed in the **Raw Value** field for Span should change and the current reading on the multimeter should now be exactly 20.00mA.
6. Press **Capture** to save the analog output calibration to the IO board.

Once the analog output has been calibrated, the output can be tested by using the **IO Board Test** section. The desired current output can be placed in the **Test Output (mA)** field, and this current can then be output on the analog output by clicking on the **Output Test** button. If the current displayed on the meter does not match the expected test output, the output may require recalibration; repeat the procedure outlined above.

Once the analog output has been calibrated and tested, repeat the calibration and testing procedure for all other analog outputs to be used. Once all analog outputs have been calibrated and tested, be sure to save the calibration(s) to the analyzer by clicking on the **Temporary Write** / **Permanent Write** buttons.

4.5.1.2 Discrete Output Testing

At the bottom of the Output Test page is a row of circles associated with each of the discrete outputs (relays and solenoids) on the analyzer's IO board. The **Discrete Output** test section is shown in Figure 45.

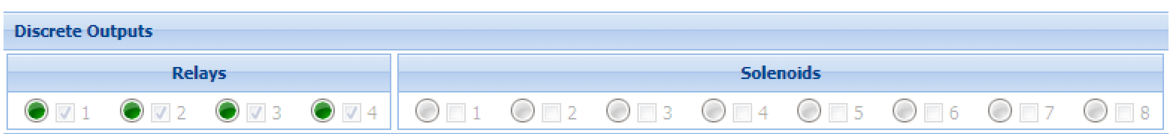


Figure 45: Discrete Output Testing

Each discrete output has a colored circle and a checkbox associated with it. The colored circle shows the current state of the discrete output. Green indicates that the discrete output is active, and grey indicates that the discrete output is not active. The checkbox associated with each discrete output can be used to turn the output on or off. If Direct Board Control mode is enabled, clicking on the checkbox can be used to enable / disable the discrete output. When a discrete output is switched on, confirm that the associated hardware (relay or solenoid) does indeed switch on, either by sound or by visual means (e.g. indicator at DCS for relays, flow meter indication for solenoids).

4.6 Factory Menu

The **Factory** menu is used to set a variety of factory-related parameters. It consists of only one page, the **Factory Setup** page, which is shown in Figure 46.

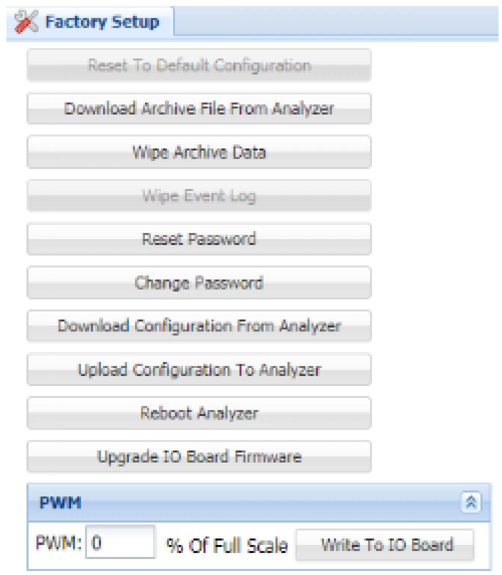


Figure 46: Factory Setup

The Factory Setup page consists of a set of buttons which can be used for a variety of purposes. The function of each button is described in Table 18.

Table 18: Factory Setup Parameters

Button	Explanation
Reset to Default Configuration	Used to reset the AccuLase-GPA™ configuration to the factory default configuration.
Download Archive File From Analyzer	Used to download the analyzer's archive data in a Galvanic-proprietary file format.
Wipe Archive Data	Used to wipe all records from the analyzer's on-board data storage memory.
Reset Password	Used to reset analyzer passwords to the factory default
Change Password	Used to change analyzer passwords to a customer-chosen value.
Download Configuration from Analyzer	Used to download the analyzer's complete configuration and save it to a Galvanic-proprietary file format.
Upload Configuration to Analyzer	Used to upload a previously-saved configuration file to the analyzer
Reboot Analyzer	Used to trigger a reboot of the entire analyzer system.
Upgrade IO Board Firmware	Used to upgrade the firmware of the analyzer's IO board

In addition to these buttons, there is also a field marked **PWM % of Full Scale** which is used to set heater PID parameters. The chosen percentage should be entered into the field, and the **Write to IO Board** button pressed to save this value to the analyzer's IO Board.

CAUTION MAKING CHANGES TO ANY PARAMETERS ON THE FACTORY SETUP PAGE HAS THE POTENTIAL TO RENDER THE ANALYZER INOPERABLE. NO CHANGES SHOULD BE MADE ON THIS PAGE WITHOUT THE EXPRESS GUIDANCE OF THE GALVANIC APPLIED SCIENCES SERVICE DEPARTMENT.

NOTICE THE CONTROLLER FIRMWARE AND WEB GUI (.RPM FILES) MUST BE UPDATED BEFORE UPDATING THE IO BOARD FIRMWARE (.BIN FILES).

Section 5 AccuLase-GPA™ Maintenance and Repair

5.1 Overview

While the AccuLase-GPA™ has been designed to be a low maintenance analyzer, there will still be a need to perform the occasional maintenance procedure throughout its lifetime. This section of the manual is intended to provide detailed instructions on performing some of the more common maintenance procedures which may be required.

5.2 Extracting the Component Rail from the AccuLase-GPA™ D1 / CE Optics / Sample Cell Enclosure

Should maintenance be required on any of the AccuLase-GPA™ components housed within the D1 / CE optics / sample cell explosion proof enclosure (see Figure 47), the following steps describe how to extract and gain access to those components.

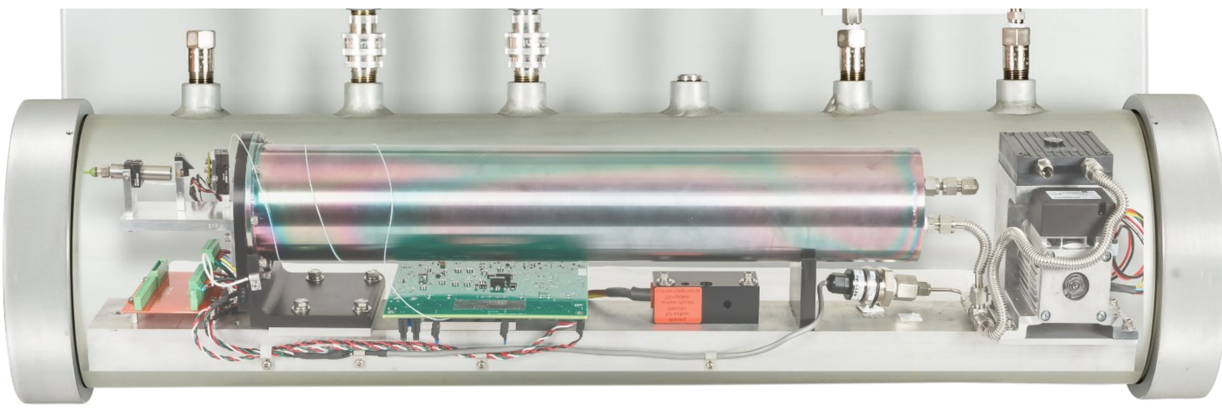


Figure 47: Cutaway Showing Components Contained within AccuLase-GPA™ D1 Enclosure

5.2.1 List of Materials Required

The following list of materials is required to complete the extraction process:

- Set of SAE hex keys
- Metric #2 hex key
- Set of SAE wrenches
- Small flathead screwdriver
- Flashlight (optional)

5.2.2 Preparatory Steps

1. Purge the analyzer sample handling system and sample cell with an inert gas, such as nitrogen, for at least 5 minutes to ensure that all sample gas has been cleared from the sample handling system and sample cell..
2. Disconnect the analyzer from the source of electrical power.
3. As the interior of the optics / sample cell enclosure and its components may be hot, allow time for them to cool before handling.

5.2.3 Extracting the Component Rail

1. Remove the thermal blanket around the Optics / Sample Cell enclosure.
2. Prior to disassembly, make note of the orientation and position of the individual parts as they are removed. This will ensure they can be reassembled correctly after maintenance is complete.
3. Using a Metric #2 hex key, loosen the set screws holding the end caps of the enclosure in place. See Figure 48.

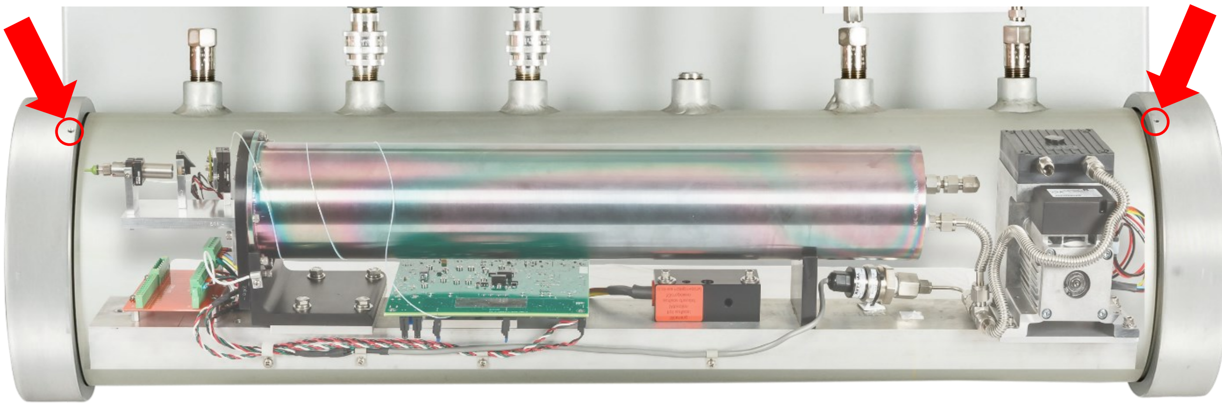


Figure 48: Location of Set Screws in Enclosure End Caps

4. Remove the enclosure end caps by rotating them counter clockwise. To avoid binding between the threads, gently lift the caps upwards while rotating. Make note of which side each end cap came from in order to prevent any issues during reassembly later.
5. With the end caps removed, locate the screws holding the component rail in place. See Figure 49.

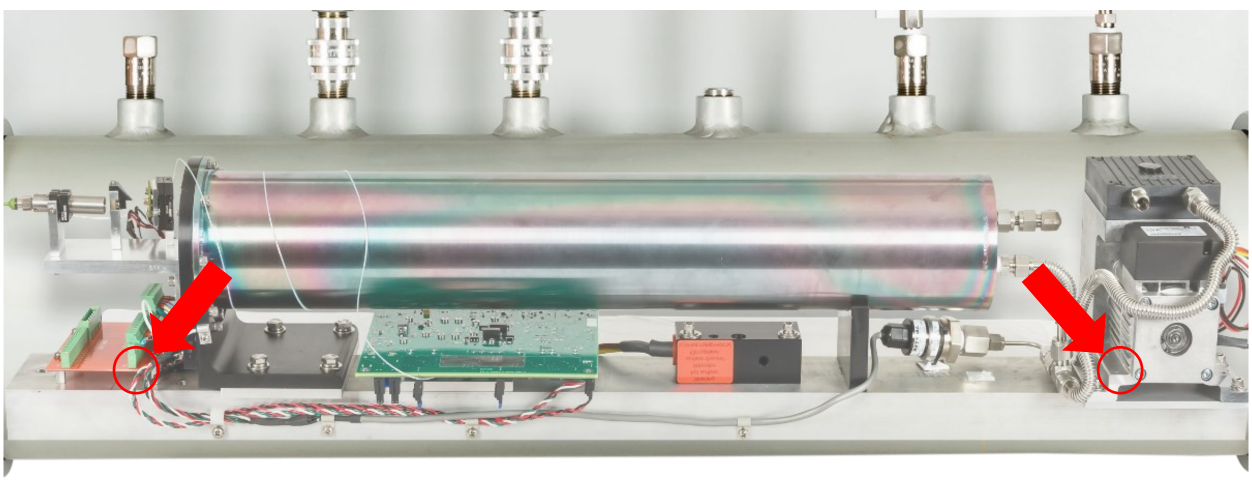


Figure 49: Location of Screws Holding Component Rail

6. Remove the component rail screws by using the appropriate size hex key. The component rail should now be loose.
7. Locate the wiring connections shown in Figure 50. Make a note of these connections in order to ensure correct reassembly later.

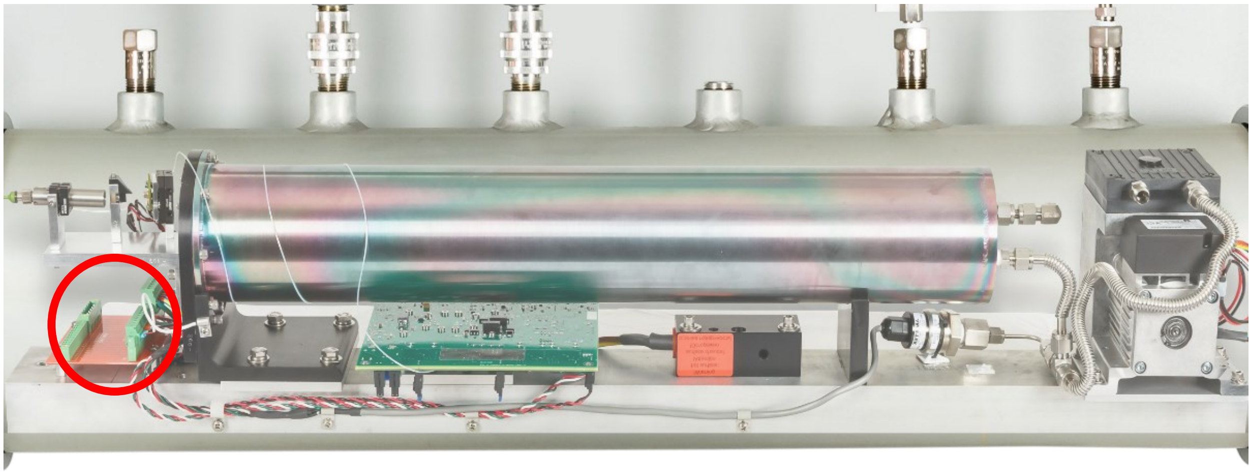


Figure 50: Wiring Connections

8. Using the small flathead screwdriver, loosen the screws holding the wiring connectors in place.
9. Disconnect the wiring connectors from the board by gently pulling on them.
10. Carefully slide the component rail out of the enclosure towards the side with the vacuum pump as indicated in Figure 51. The component rail will only slide as much as the attached tubing and fittings will allow, approximately 6-8 inches (15 – 24cm).

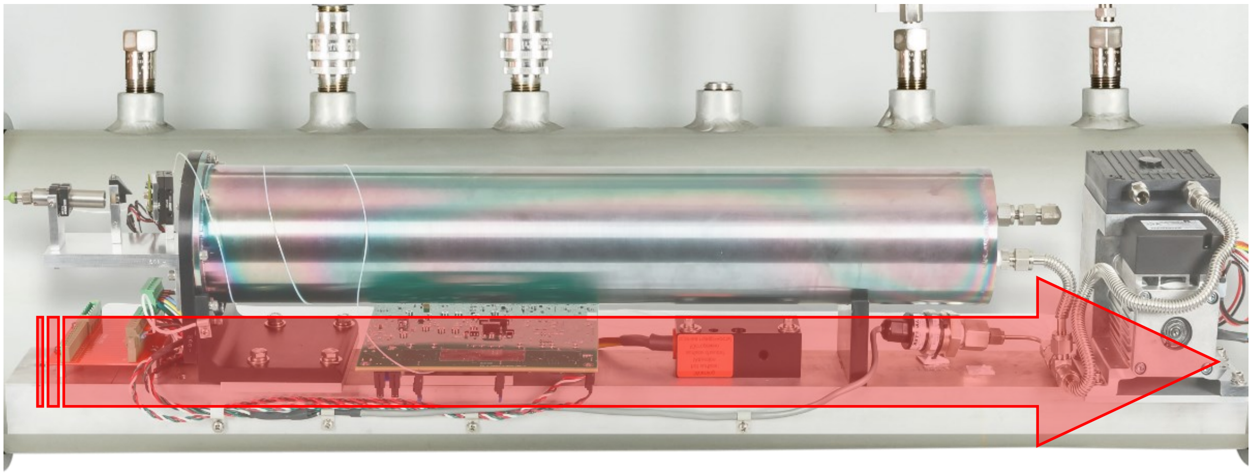


Figure 51: Initial Sliding Direction

11. Identify the fittings connecting the components on the rail to the rest of the enclosure as indicated in Figure 52. Make a note of these connections in order to ensure correct reassembly later. A flashlight may be helpful at this point.

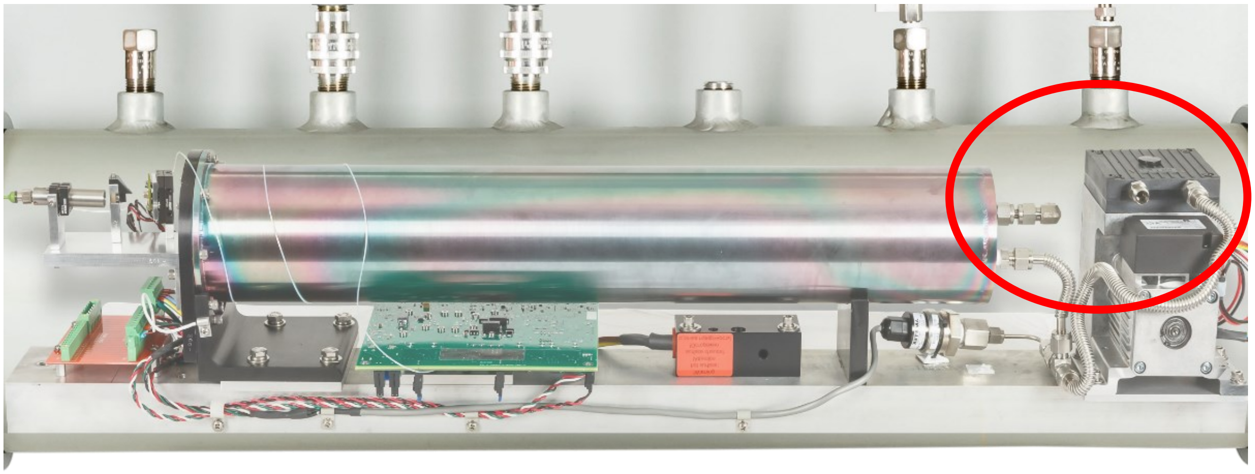


Figure 52: Fittings with Connections to the Enclosure

12. Disconnect the fittings using the appropriate size wrenches.
13. Carefully slide the component rail in the opposite direction until it is completely extracted from the enclosure as indicated in Figure 53. Use caution to avoid any tubing or wiring that may be obstructing the slide path.

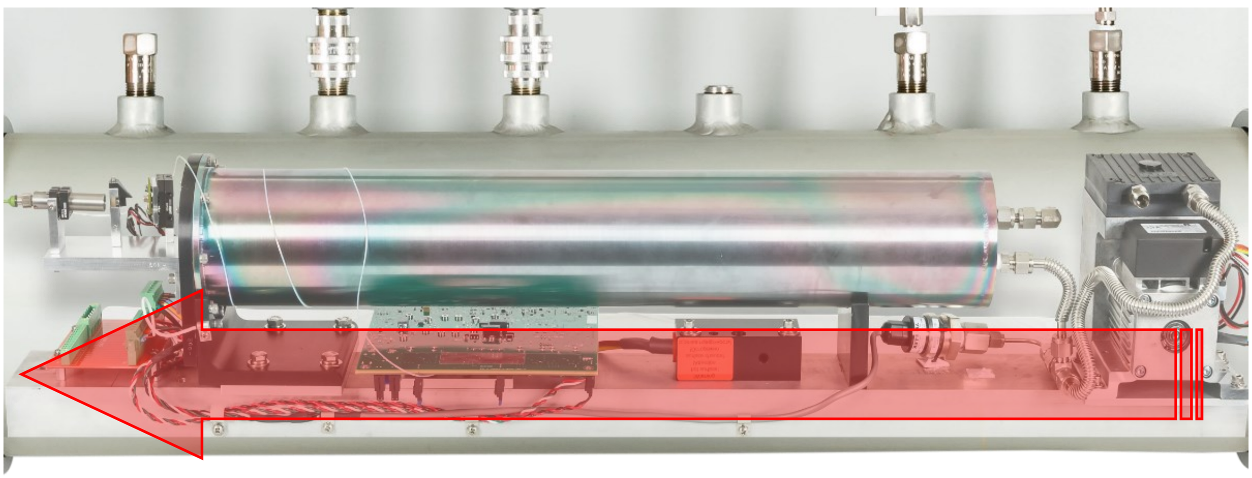


Figure 53: Final Slide Direction

14. Place the extracted component rail on a clean workbench and proceed with any further maintenance procedures.
15. To reassemble the enclosure, simply perform these steps in the reverse order.

5.3 Removing the Herriott Cell from the AccuLase-GPA™

Should access to the Herriott cell be required, the following steps describe how to successfully remove and isolate the cell from the D1, CE, and D2 versions of the AccuLase-GPA™.

5.3.1 List of Materials Required

The following list of materials is required to remove the Herriott cell from the AccuLase-GPA™:

- Set of SAE hex keys
- Set of SAE wrenches

- Phillips No. 1 screwdriver
- Phillips No. 2 Screwdriver (D2 version only)
- Large flathead screwdriver (D2 version only)

5.3.2 Preparatory Steps

1. Purge the analyzer sample handling system and sample cell with an inert gas, such as nitrogen, for at least 5 minutes to ensure that all sample gas has been cleared from the sample handling system and sample cell.
2. Disconnect the analyzer from the source of electrical power.
3. As the interior of the optics / sample cell enclosure and its components may be hot, allow time for them to cool before handling.

5.3.3 Removing the Herriott Cell from the AccuLase-GPA™ D1 / CE

1. Complete all steps described in section 5.2 of this manual to extract the component rail from the AccuLase-GPA™ D1 / CE optics / sample cell enclosure.
2. Once extraction is complete, locate the fitting connecting the Herriott cell to the vacuum pump shown in Figure 54.

Figure 54: Location of the Fitting Connecting the Herriott Cell to the Vacuum Pump

3. Using the appropriate size wrenches, undo the fitting and disconnect the associated tubing from the Herriott cell.
4. Using the appropriate size hex key, remove the four bolts from the optics sleeve covering the laser launcher and detector.
5. Locate the RTD connector shown in Figure 55.

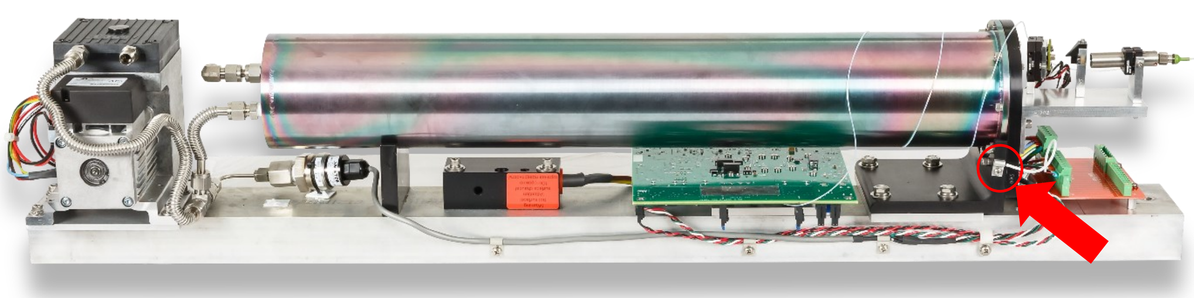


Figure 55: Location of RTD Connector

6. Using a Phillips #1 screwdriver, undo the screw holding the RTD connector in place.
7. Locate the detector shown in Figure 56.

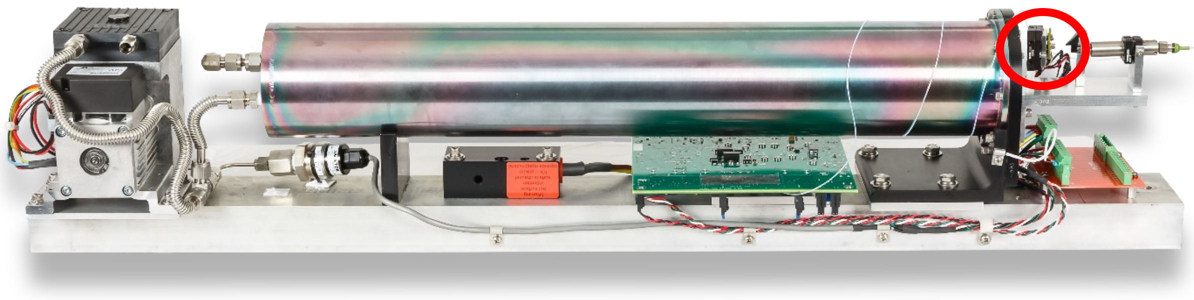


Figure 56: Location of the Detector

8. Trace the wires from the detector to the main laser board shown in Figure 57.

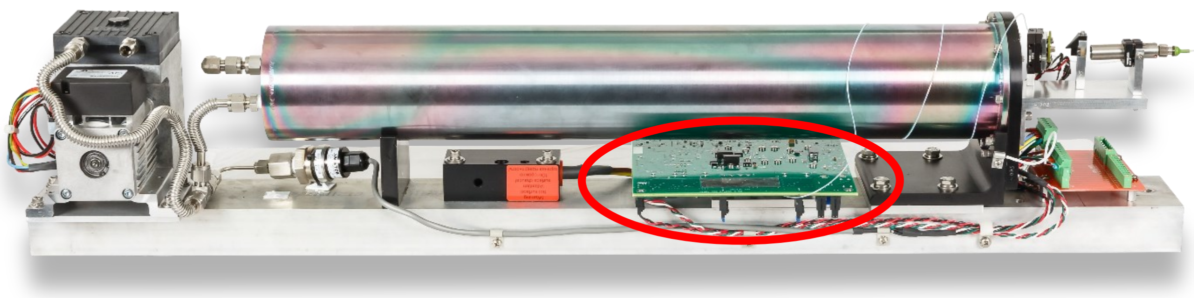


Figure 57: Location of the Main Laser Board

9. Gently disconnect to connector to the detector from the main laser board.
10. Locate the fibre optic connector shown in Figure 58.

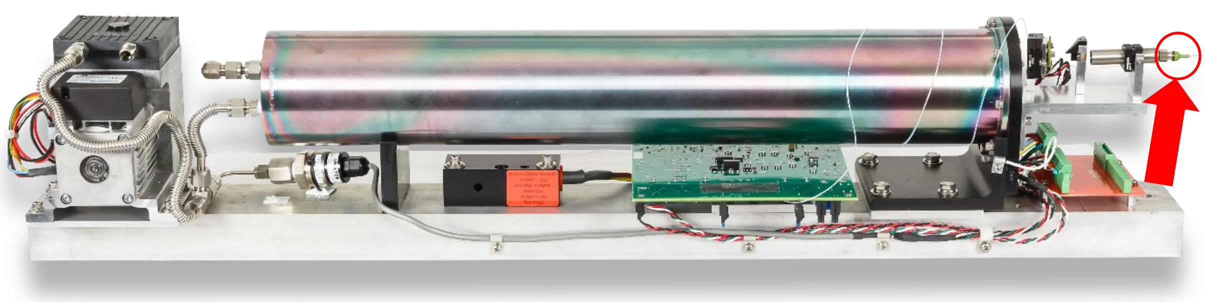


Figure 58: Location of the Fibre Optic Connector

11. Disconnect the fibre optic connector by gently unscrewing it counterclockwise.
12. If the fibre optic cable is wrapped around the Herriott cell, gently unwrap it.
13. Locate the bolts securing the Herriott cell to the component rail as indicated in Figure 59.

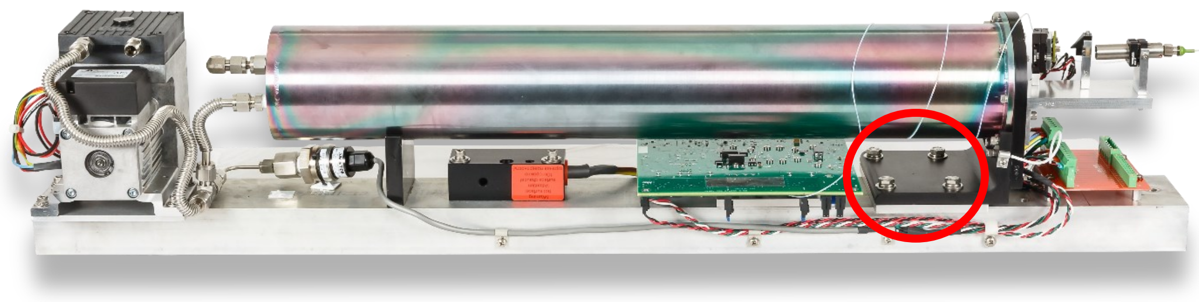


Figure 59: Location of Bolts Securing Herriott Cell

14. Remove the bolts using an appropriate size wrench. The Herriot cell should now be free of any attachments to the component rail.
15. Lift the Herriott cell off of the component rail and transfer it to a clean workspace to complete any further maintenance.
16. To reattach the Herriott cell once maintenance is complete, simply perform all the steps in this section in the reverse order.

5.3.4 Removing the Herriott Cell from the AccuLase-GPA™ D2

1. Gain access to the optics / sample cell enclosure by turning the door locks counterclockwise with a large flathead screwdriver, as indicated in Figure 60

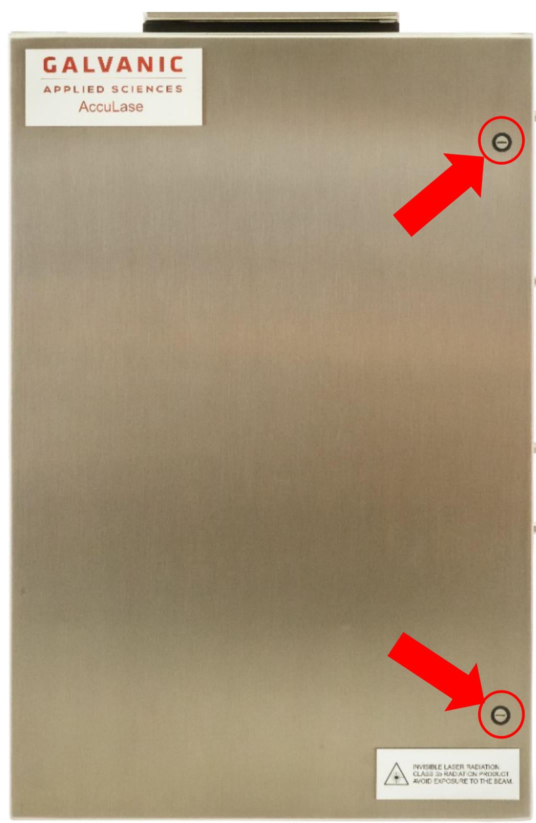


Figure 60: Location of Main Enclosure Door Locks

2. Locate the fittings connecting the Herriott cell to the rest of the analyzer as indicated in Figure 61.

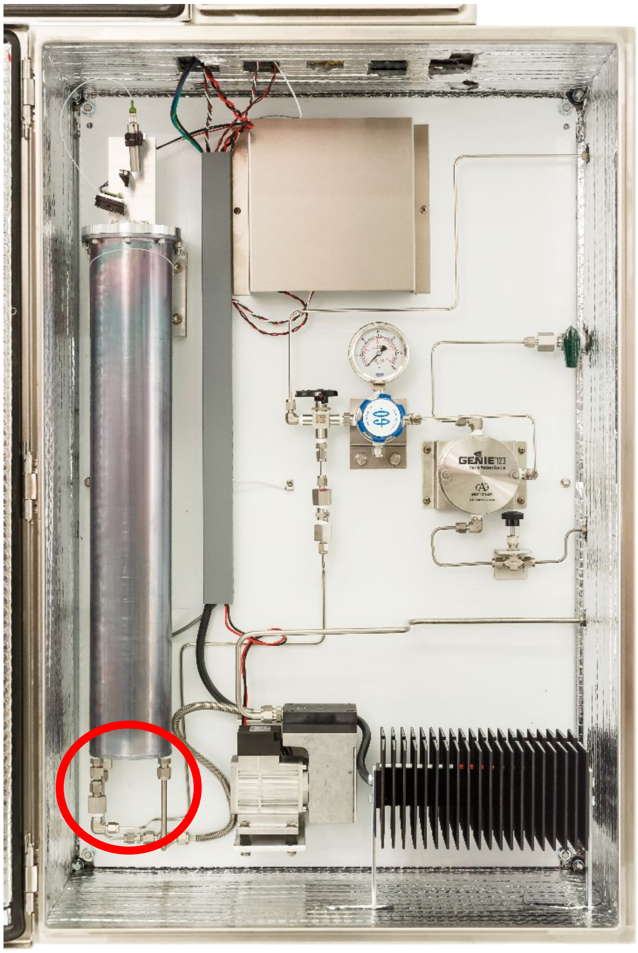


Figure 61: Locating of Fittings Connected to the Herriott Cell

3. Using the appropriate size wrenches, undo the fittings.
4. Locate the screws holding the main laser board cover plate in place as indicated in Figure 62.

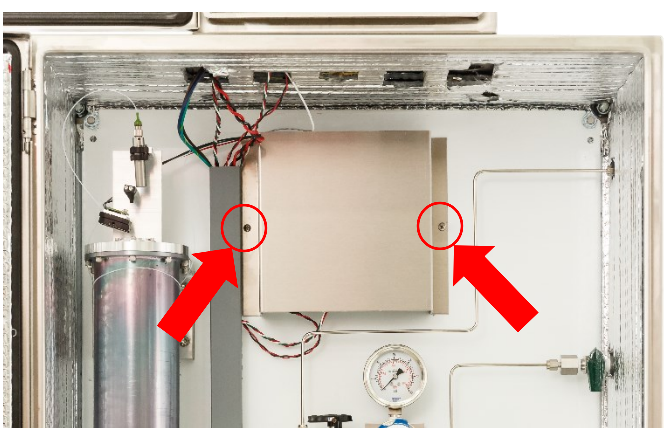


Figure 62: Location of Screws for the Main Board Cover Plate

5. Support the cover plate in order to prevent it from falling out.
6. Remove the screws by using a Phillips No. 2 screwdriver.
7. Remove the main laser board cover plate.
8. Locate the detector shown in Figure 63.

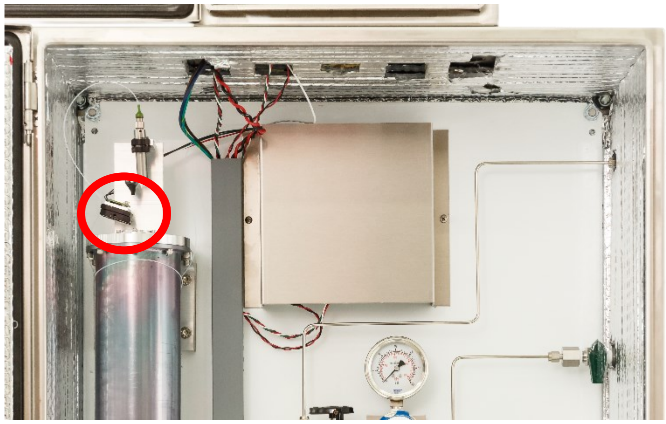


Figure 63: Location of the Detector

9. Trace the wires from the detector to the main laser board.
10. Gently disconnect to connector to the detector from the main laser board.
11. Locate the fibre optic connector shown in Figure 64.

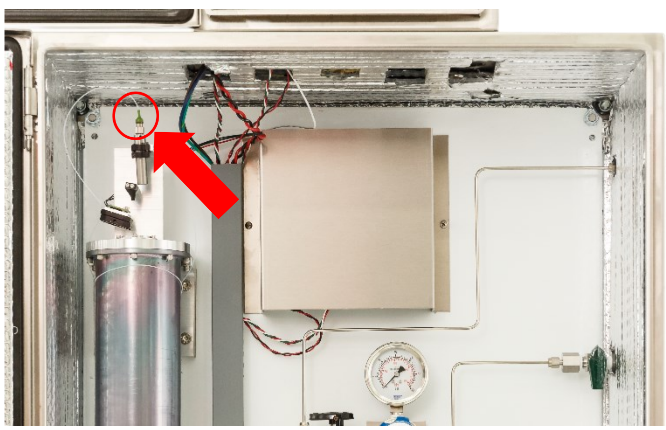


Figure 64: Location of the Fibre Optic Connector

12. Disconnect the fibre optic connector by gently unscrewing it counterclockwise.
13. If the fibre optic cable is wrapped around the Herriott cell, gently unwrap it.
14. Locate the screws securing the Herriott cell to the back of the enclosure. See Figure 65.

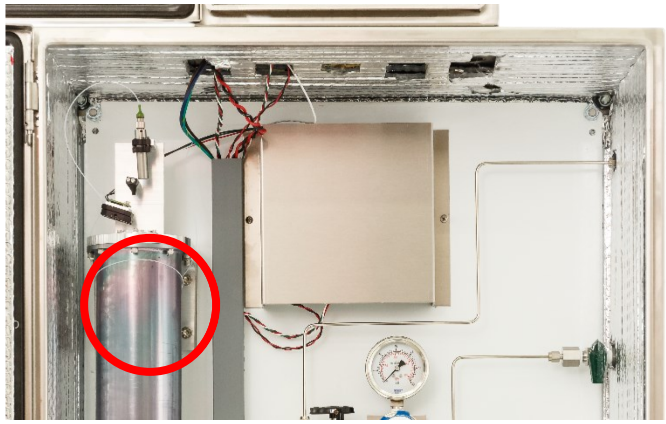


Figure 65: Location of Bolts Securing Herriott Cell

15. Support the Herriott cell in order to prevent it from falling out.
16. Remove the bolts by using the appropriate size hex key. The Herriot cell should now be free of any attachments to the rest of the analyzer.
17. Pull the Herriott cell out of the main enclosure and transfer it to a clean workspace to complete any further maintenance.
18. To reattach the Herriott cell once maintenance is complete, simply perform all the steps in this section in the reverse order.

5.4 Accessing and Cleaning the Herriot Cell Mirrors

Should there be a need to perform maintenance on the Herriott cell mirrors, the following steps describe the actions necessary to access, inspect, and clean them.

5.4.1 List of Materials Required

The following list of materials is required to complete the Herriott cell mirror maintenance:

- Set of SAE hex keys
- Set of SAE wrenches
- L-bracket mount (optional, but recommended)
- Methanol (small amount)
- Lint-free non-scratch wipes (such as Kimwipes)
- Compressed air (if available)
- Clean workspace

5.4.2 Preparatory Steps

1. For the AccuLase-GPA™ D1 / CE versions, complete all the steps in section 5.3.3 of this manual.
2. For the AccuLase-GPA™ D2 version, complete all the steps in section 5.3.4 of this manual.

5.4.3 Accessing and Cleaning the Herriott Cell Mirrors

1. Ensure the L-bracket mount (see Figure 66) is attached and fixed to the edge of a stable surface, such as a workbench. Please note that the use of the L-bracket mount is optional, but recommended. The maintenance on the Herriott cell mirrors can still be performed without it; however, the Herriott cell will most likely need to be secured directly to the workbench instead.

Figure 66: L-bracket Mount

2. Ensure the mounting side of the L-bracket mount is free of any obstructions, such as screws or bolts. See Figure 67.

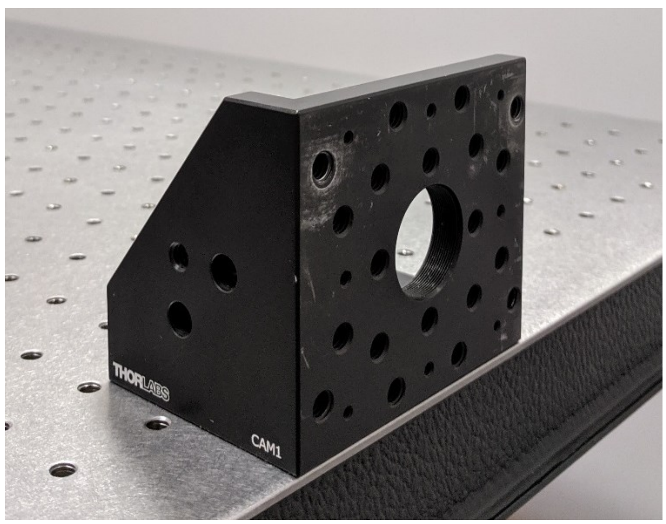


Figure 67: L-bracket Mount Free of Obstruction

3. With the Herriott cell oriented vertically, line up the holes on the Herriott cell bracket with the mounting holes on the L-bracket mount.
4. Secure the Herriott cell to the L-bracket mount by fastening bolts or screws as shown in Figure 68.

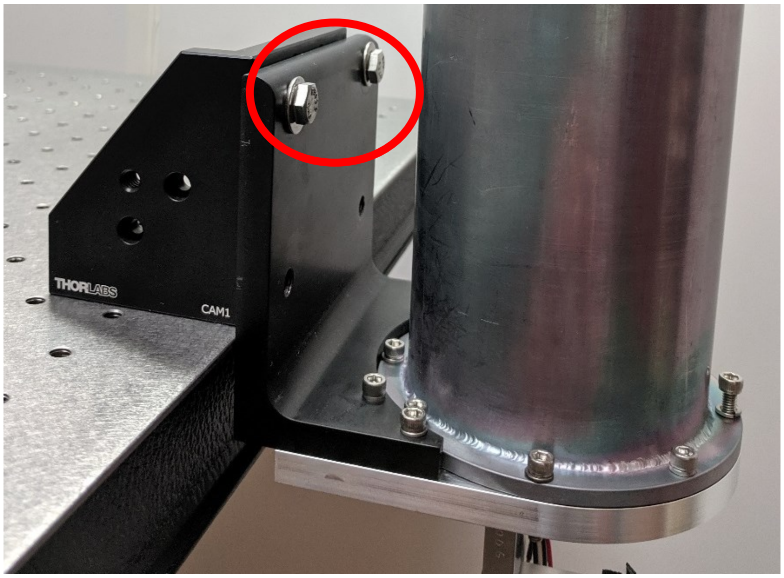


Figure 68: Herriott Cell Secured to L-bracket Mount

5. Make note of the orientation of the Herriott cell cover in relation to the rest of the Herriott cell. This is important to ensure proper reassembly after maintenance is complete.
6. Remove all eight screws holding the Herriott cell cover in place. Figure 69 shows one of the eight screws which has been partially removed.

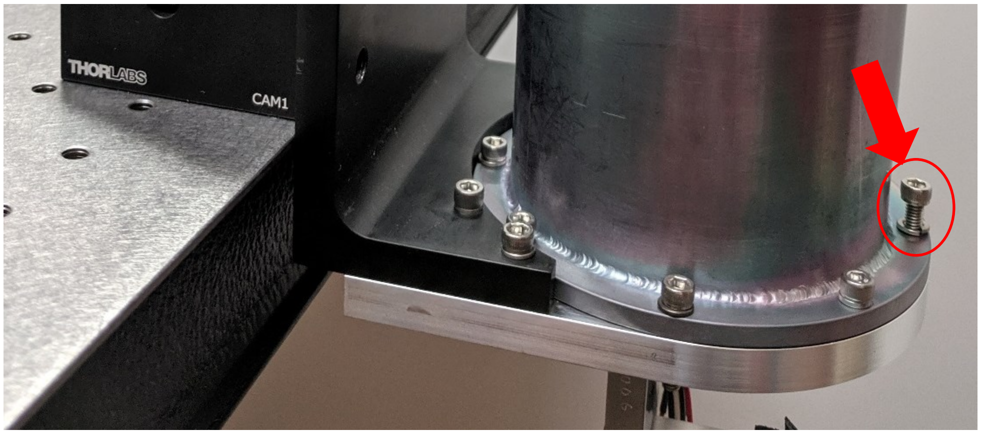


Figure 69: Screws Holding Herriott Cell Cover in Place

7. Gently slide the cover off and set it aside. The Herriott cell mirrors should now be exposed. See Figure 70. Use extra caution from this point forward to avoid inadvertently scratching the mirrors.

Figure 70: Location of Herriott Cell Mirrors

8. Inspect the mirrors for cleanliness.
9. If available, use compressed air to blow away any loose debris or particles which may have accumulated on the surface of the mirrors.
10. Apply a small amount of methanol to a lint-free non-scratch wipe and gently wipe the mirrors. Repeat this step as much as necessary in order to remove any dirt, smudges, or clouding from the surface or the mirrors. They should be clean and reflective when done.
11. Once maintenance is complete, inspect the cell O-ring and ensure it is sitting properly in its groove. See Figure 71.

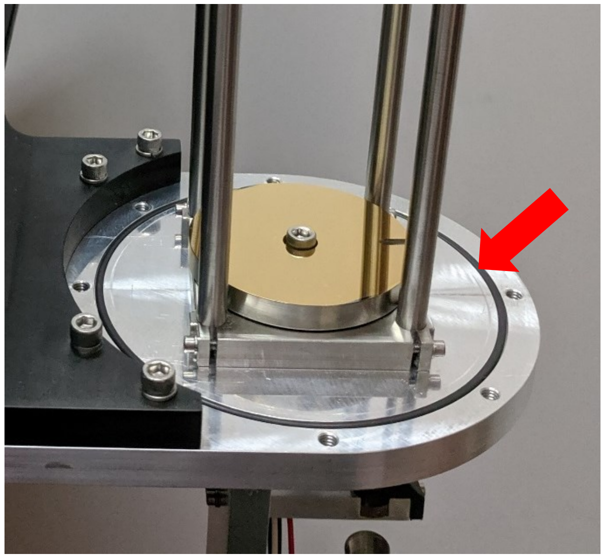


Figure 71: Herriott Cell O-ring Sitting in its Groove

12. Slide the Herriott cell cover back over the Herriott cell in the same orientation in which it was removed.
13. Perform steps 1-6 of this section in the reverse order to return the Herriott cell to its starting state.

5.5 Maintaining the Vacuum Pump Diaphragm, Plates and Seals

Some models of the AccuLase-GPA may have an internal vacuum pump. If you do not know if your AccuLase-GPA™ has an internal vacuum pump, please contact your Galvanic Service representative.

Should maintenance be required, the following steps describe the actions necessary to successfully replace or clean the diaphragm, plates and seals located inside the internal vacuum pump used with the AccuLase-GPA™. For external vacuum pumps, please refer to the separate AccuLase-GPA External Pump Addendum document.

5.5.1 List of Materials Required

The following list of materials is required to complete the pump maintenance:

- Replacement diaphragm, plates and seals set
- Phillips No. 1 screwdriver
- Phillips No. 2 screwdriver
- Clean dry cloth
- Compressed air (if available)
- Clean workspace

5.5.2 Preparatory Steps

1. Disconnect the vacuum pump from the source of electrical power.
2. The vacuum pump may be hot; allow time for it to cool before handling.
3. Make note of any fittings and screws used to attach and connect the vacuum pump to the analyzer in order to reconnect and reattach them correctly when maintenance is complete.

4. Remove the vacuum pump from the analyzer by disconnecting the fittings and screws holding it in place.
5. Once removed, place the vacuum pump on a clean workspace and commence the maintenance steps. Figure 72 shows the vacuum pump prior to disassembly.

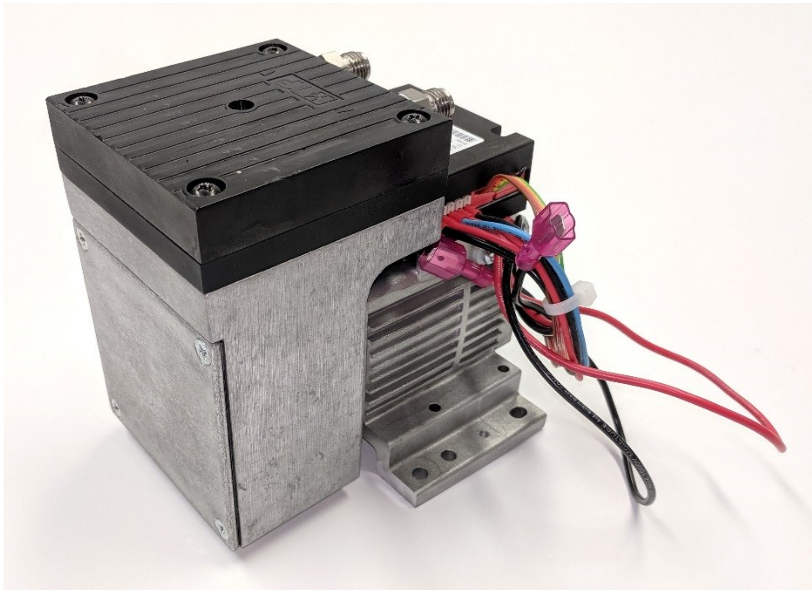


Figure 72: Fully Assembled Vacuum Pump

5.5.3 Vacuum Pump Disassembly and Maintenance

1. Prior to disassembly, make note of the orientation and position of the individual parts as they are removed. This will ensure they are reassembled correctly after maintenance is complete.
2. Remove the four corner screws holding the side cover plate in place and pull the side cover plate off. This will expose the side compartment containing the counterweight and connecting rod. See Figure 73.

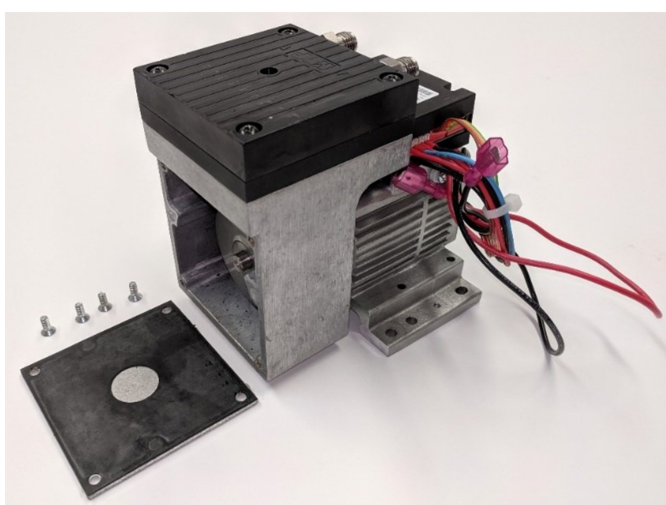


Figure 73: Vacuum Pump with Side Cover Plate Removed

3. Remove the four corner screws holding the pump head unit in place and lift the pump head unit off. This will expose the top of the diaphragm. See Figure 74.

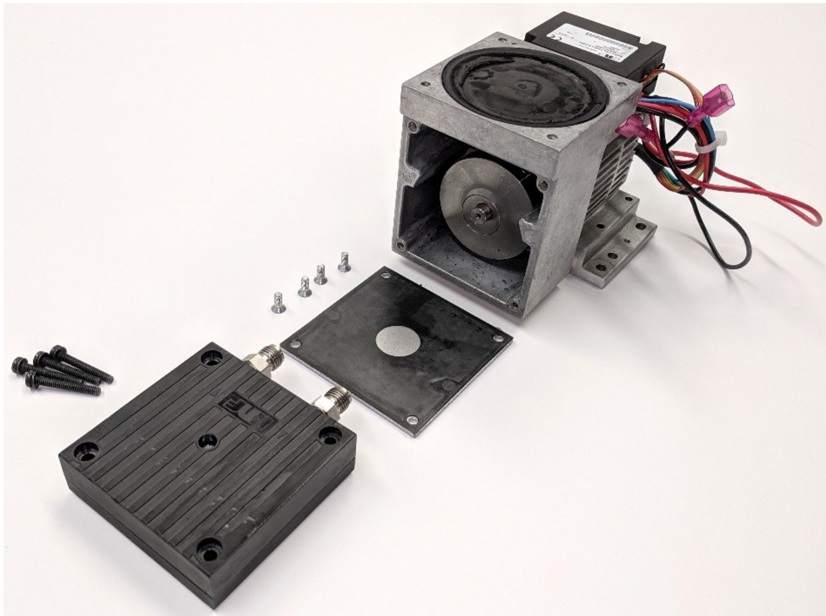


Figure 74: Vacuum Pump with Pump Head Unit Removed

4. Rotate the counterweight located within the side compartment by hand until the connecting rod moves the diaphragm into its highest position. At this point you may be able to see if the existing diaphragm is worn or damaged. See Figure 75.

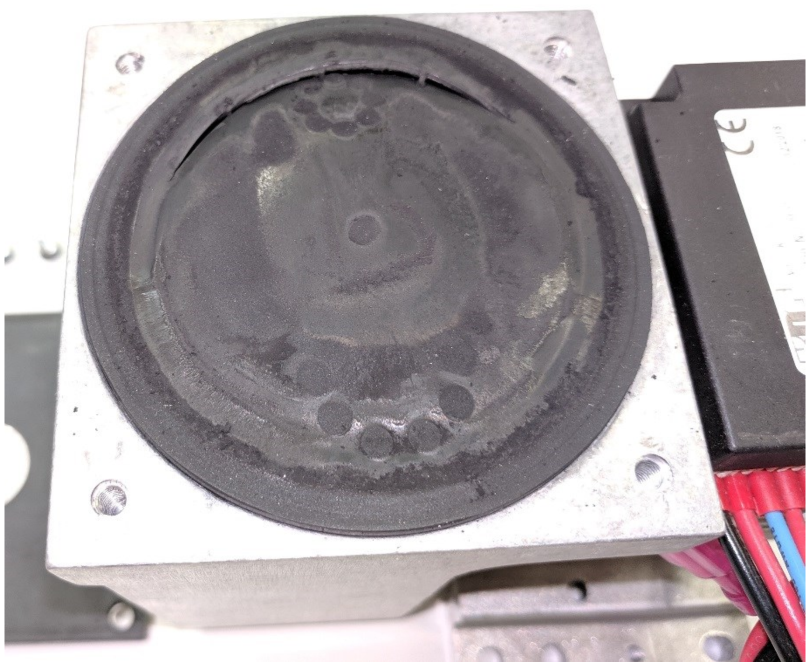


Figure 75: Damaged Diaphragm in Highest Position

5. Lift and grip the edges on opposite sides of the diaphragm with fingers and turn counter clockwise to unscrew it from the connecting rod. Ensure to remove and retain the

diaphragm spacers which will be located on the threaded portion of the diaphragm. See Figure 76.

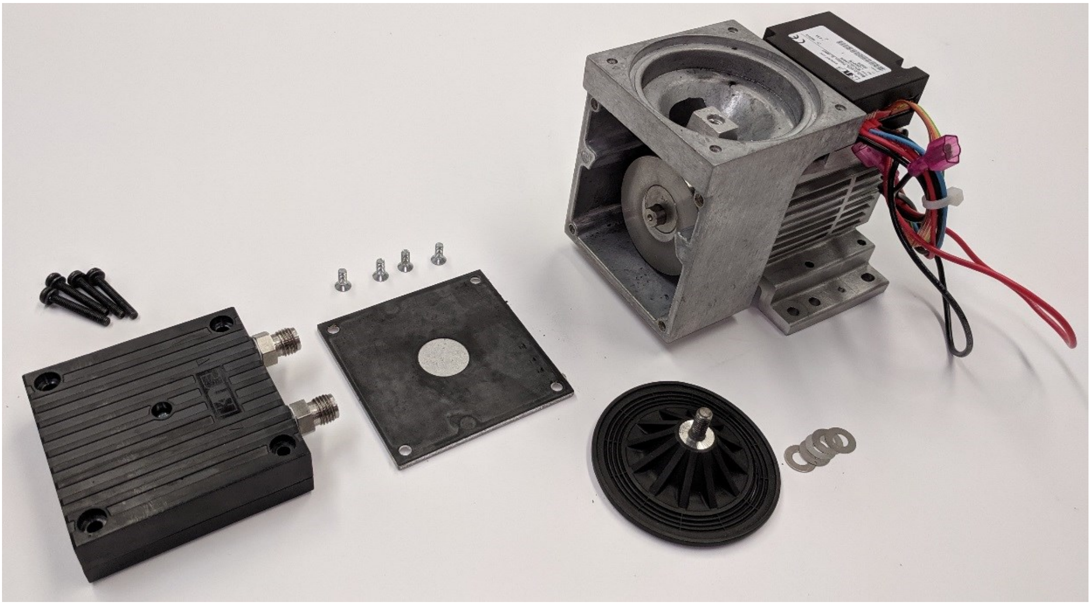


Figure 76: Vacuum Pump with Diaphragm and Spacers Removed

6. Inspect the removed diaphragm to assess the amount of wear and determine whether a replacement is required. The example shown in Figure 77 is a diaphragm that is torn and requires replacement. If a replacement is not required, clean any dirt or debris from the existing diaphragm and spacers using a clean dry cloth and compressed air (if available). Do not use solvents for cleaning as they may cause damage to some parts.

Figure 77: Torn Diaphragm and Diaphragm Spacers

7. Inspect the pump housing for any dirt or debris. Some dirt is visible in the example shown in Figure 78; this pump housing would require mild cleaning. Clean the pump

housing using a clean dry cloth and compressed air (if available). Do not use solvents for cleaning as they may cause damage to some parts.

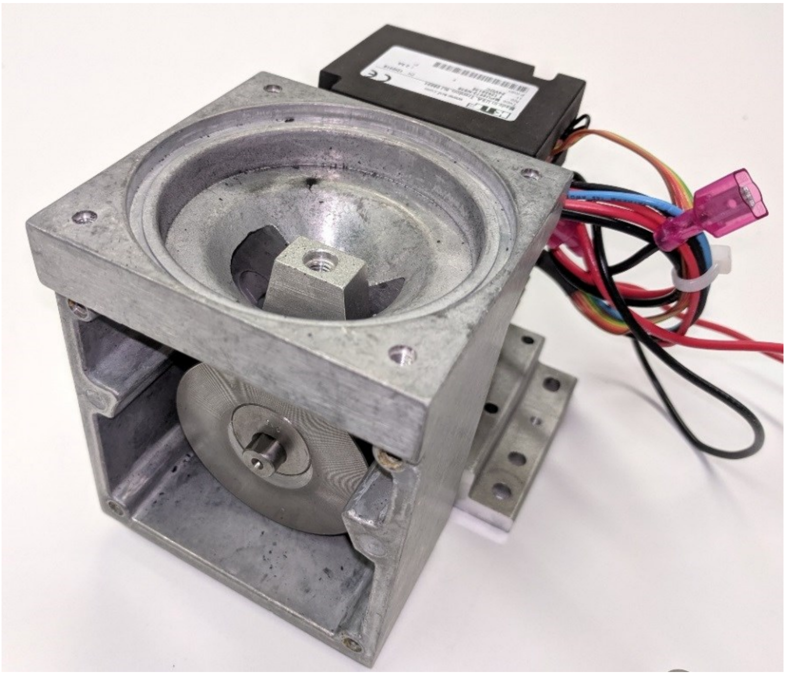


Figure 78: Pump Housing with Mild Amount of Dirt

8. Remove the centre screw from the pump head unit. See Figure 79.

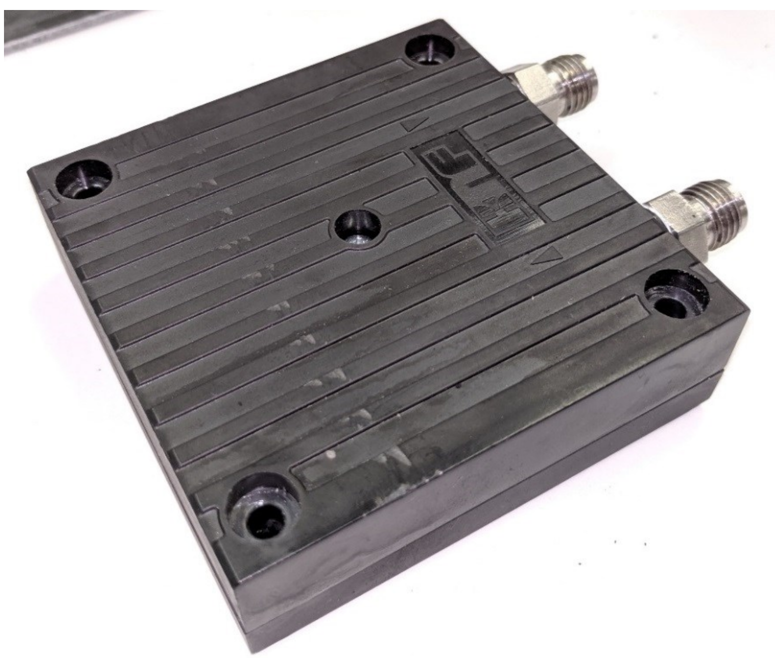


Figure 79: Pump Head Unit

9. Separate the two plates which make up the pump head unit. See Figure 80.

Figure 80: Separated Pump Head Plates

10. Remove the two seals contained between the two pump head plates. See Figure 81.

Figure 81: Separated Pump Head Plates with Seals Removed

11. Inspect the pump head plates and seals to assess the amount of wear and determine whether replacement is required. If a replacement is not required, clean any dirt or debris from the existing pump head plates and seals using a clean dry cloth and compressed air (if available). Do not use solvents for cleaning as they may cause damage to some parts.
12. Once all maintenance and cleaning has been completed, reassemble the vacuum pump by reinstalling each component in the reverse order it was removed. Keep in mind the orientation of the parts needs to be the same as they were prior to disassembly. Refer to Figure 72 to see an image of a fully assembled vacuum pump.
13. Reinstall the reassembled vacuum pump into the analyzer by connecting and attaching it using the same screws and fittings that were in place prior to performing maintenance.
14. Reconnect the source of electrical power to the vacuum pump.

5.6 Replacing the Membrane and O-ring within the Liquid Membrane Separator

Should maintenance be required, the following steps describe the actions necessary to successfully replace the membrane and O-ring located inside the Genie Model 123 liquid membrane separator used in the sample handling and pre-treatment system of the AccuLase-GPA™.

5.6.1 List of Materials Required

The following list of materials is required to complete the maintenance on the liquid membrane separator:

- Replacement membrane and O-ring set
- Large screwdriver or wrench (optional)
- Small flathead screwdriver (optional)
- Clean workspace

5.6.2 Preparatory Steps

1. Stop or block the sample flow into the liquid membrane separator.
2. Depressurize the liquid membrane separator.

5.6.3 Liquid Membrane Separator Disassembly and Maintenance

1. Unscrew the cover of the liquid membrane separator by turning it counter clockwise (See Figure 82). If turning the cover is difficult, use a large screwdriver or wrench braced across the metal pins on the surface to assist. See Figure 83.

Figure 82: Unscrewing Liquid Membrane Separator Cover

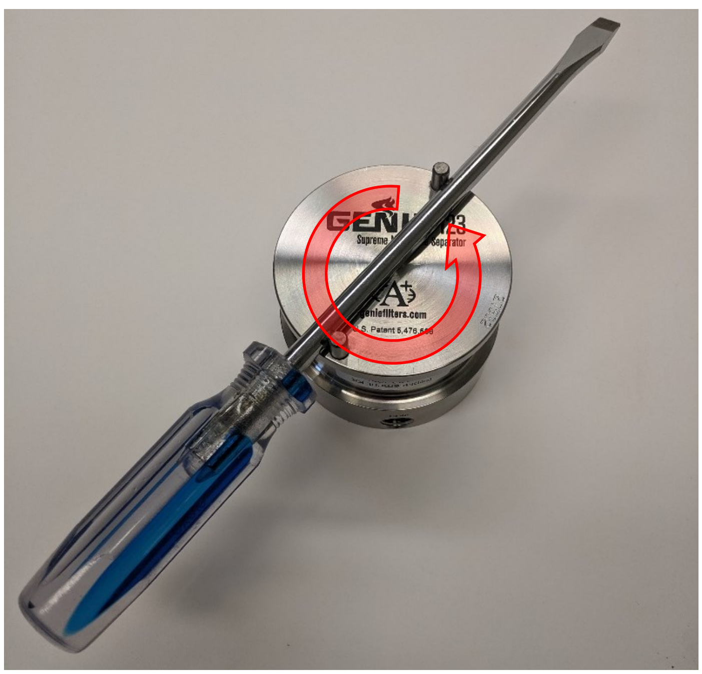


Figure 83: Unscrewing Liquid Membrane Separator Cover with Assistance

2. Once removed, place the cover with the membrane side up on the surface of a clean workspace. See Figure 84.

Figure 84: Removed Liquid Membrane Separator Cover

3. Lift and remove the O-ring. Use a small flathead screwdriver to assist if necessary but be extra cautious to avoid scratching or scoring any of the metal surfaces. See Figure 85.

Figure 85: Liquid Membrane Separator Cover with O-ring Removed

4. Remove and discard the used membrane. This should expose the membrane support shown in Figure 86.

Figure 86: Liquid Membrane Separator Cover with Exposed Membrane Support

5. Place the new membrane over the centre of the membrane support.
6. Place the new O-ring over the new membrane and centre it with the groove. See Figure 87.

Figure 87: Liquid Membrane Separator Cover with Centred Membrane and O-ring

7. Gently press the O-ring into place.
8. Turn the cover over and place it on a clean, flat surface with the membrane side down. See Figure 88.

Figure 88: Liquid Membrane Separator Cover with Membrane Side Down

9. Press down on the cover and apply firm pressure to ensure the O-ring is seated properly in the groove.
10. Screw the cover back into the body of the separator until it reaches a mechanical stop. Do not use a wrench or any other tool at this point as this may overtighten and damage the separator.
11. Maintenance is complete; restore the sample flow and pressure to the system.

Section 6 AccuLase-GPA™ Troubleshooting

6.1 Overview

This section provides information on troubleshooting and resolving some basic issues which may occur during the operation of the AccuLase-GPA™

6.2 Diagnostic Alarms

The AccuLase-GPA™ is equipped with several self-diagnostic alarms which may be generated to indicate a problem with the analyzer.

If an alarm is present, there are two indications on the local display. The first is a flashing yellow caution triangle in the upper right corner of the display. The second is a red LED located above the display that is labelled **Alarm**. To determine what alarm is active use the PANEL NEXT / PANEL PREV keys on the keypad to navigate to the **Alarms** page.

The presence of an alarm is also indicated in the web-based GUI by a red flashing bell icon at the top right of the screen. Table 19 describes these alarms and potential resolutions for each type of alarm.

Table 19: Troubleshooting Alarms

Alarm Name	Cause	Resolution
IO Board Communication	The IO Board is not communicating with the Controller.	• Check the USB cable connection between the controller board and the IO board. • Contact Galvanic Applied Sciences Customer Support.
Laser Communication	The Laser Driver Board is not communicating with the Controller.	• Contact Galvanic Applied Sciences Customer Support.
Laser Total Light Alarm	The intensity of the laser is too low.	• Possible dirty gas cell. Clean the cell mirrors as per Section 5.4. • The laser driver has failed. Contact Galvanic Applied Sciences Customer Support.
Bypass Alarm	Indicates that the analyzer is in bypass mode.	• Use the BYPASS toggle on the keypad to disable the bypass. • OR use the BYPASS toggle icon on the web-based GUI to disable the bypass.
IO Board Diagnostics Alarm	The IO Board is Faulty	• Contact Galvanic Applied Sciences Customer Support.
Response Factor Alarm	The analyzer has failed calibration.	• Ensure calibration gas is present and reattempt calibration. • Contact Galvanic Applied Sciences Customer Support if problem persists.
AI1 Low Limit Alarm	The cell pressure is too low.	• Possible blockage of the gas flow to the inlet of the analyzer.
AI1 High Limit Alarm	The cell pressure is too high.	• The pump has failed. • There is too much backpressure at the analyzer vent line.
AI5 Low Limit Alarm	The cell temperature is too low.	• The cell heater has failed. • The heater fuse has blown.
AI5 High Limit Alarm	The cell temperature is too high.	• The analyzer is located in an area where the ambient temperature is too high.

Section 7 Drawings

This section provides a series of generic AccuLase drawings and wiring diagrams which may be useful when installing the AccuLase-GPA analyzer.

Item No.	Qty	Description
1	1	Electronics Enclosure
2	2	Seal Fitting
3	2 to 7	Gum Union
4	3	Flame Arrestor
5	5 or less	Solenoid Valve
6	1	Laser Detector Enclosure

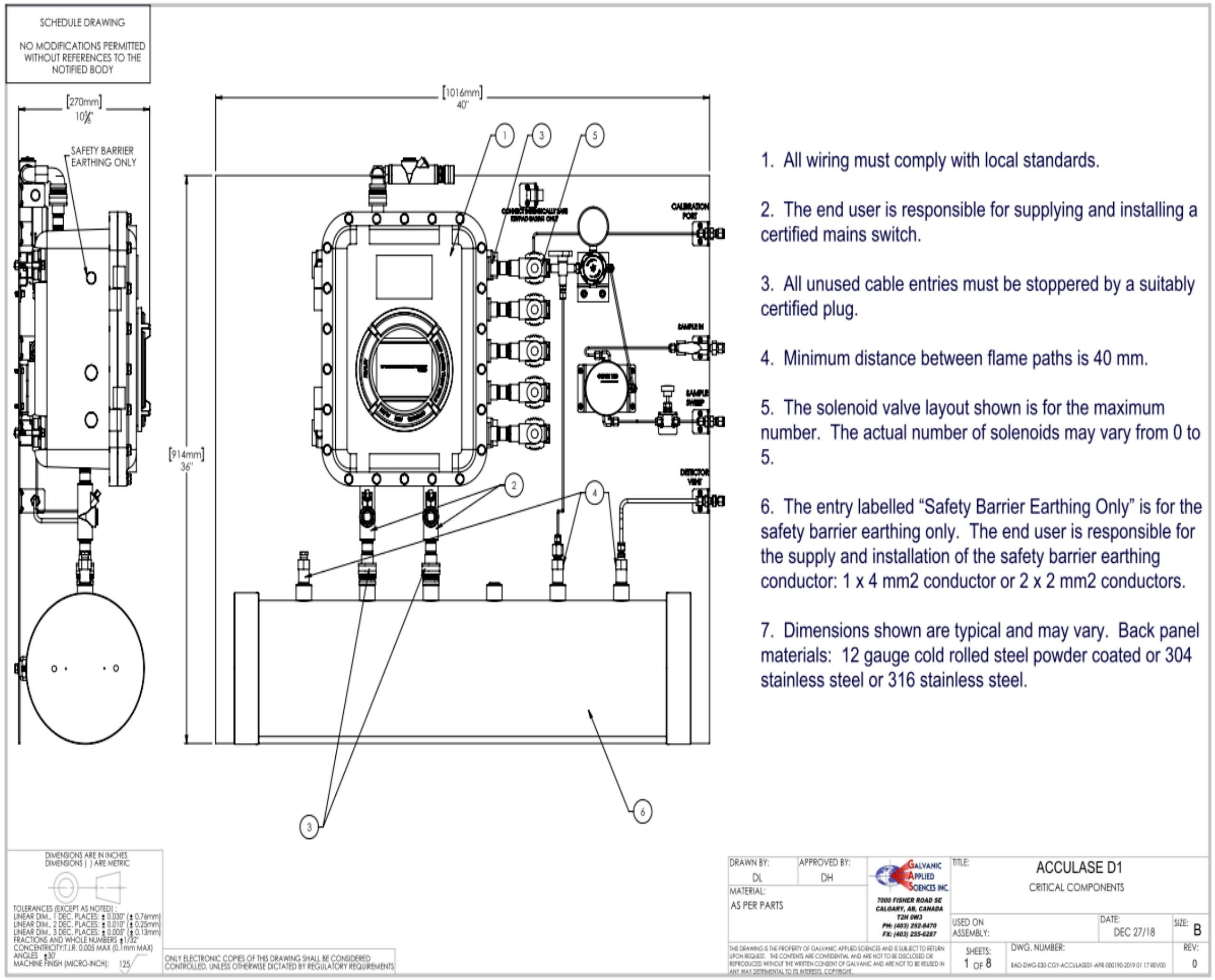
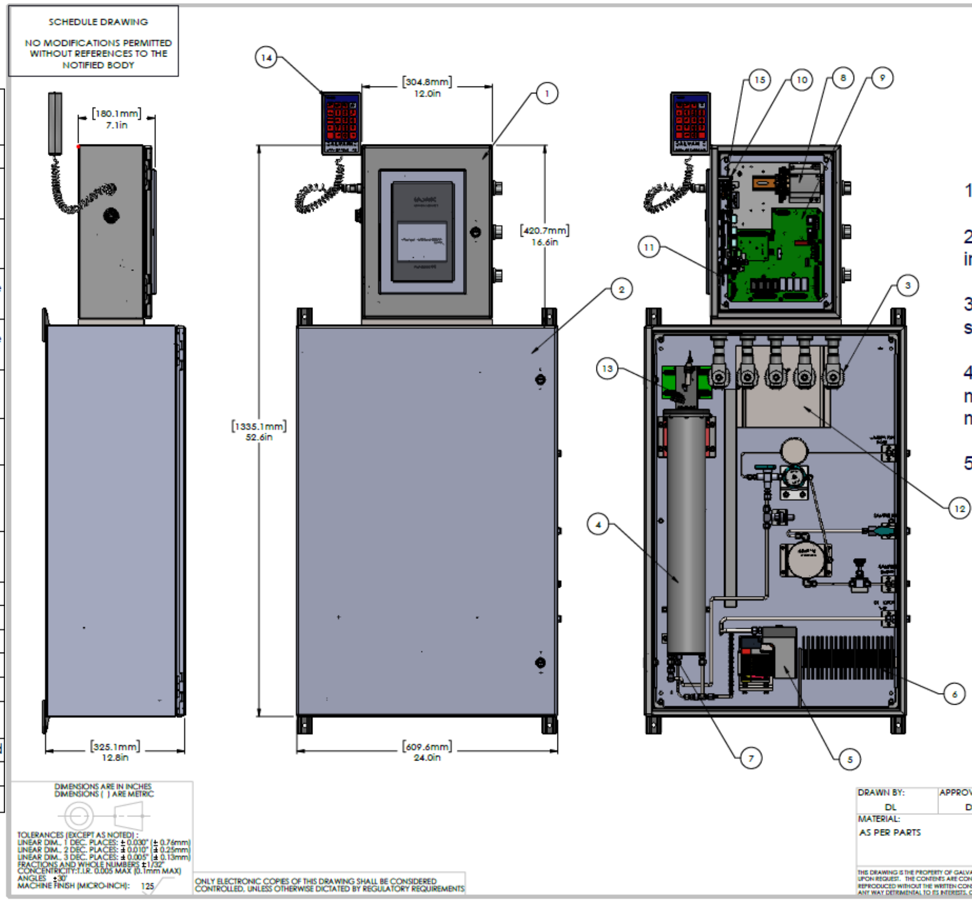


Figure 89: AccuLase D1 - External

Item No.	Qty	Description
1a	1	Electronics Enclosure (Stainless Steel)
1b	1	Electronics Enclosure (Painted Steel)
2a	1	Laser Detector Enclosure (Stainless Steel)
2b	1	Laser Detector Enclosure (Painted Steel)
3	5 or less	Solenoid Valve
4	1	Laser Gas Cell
5	1	Pump
6	1	Heater
7	1	Pressure Transducer
8	1	Power Supply
9	1	I/O Board
10	1	Controller Board
11	1	Display Board
12	1	Laser Controller Board
13	1	Preamps Detector board
14	1	Keypad
15	1	Mini Computer Module



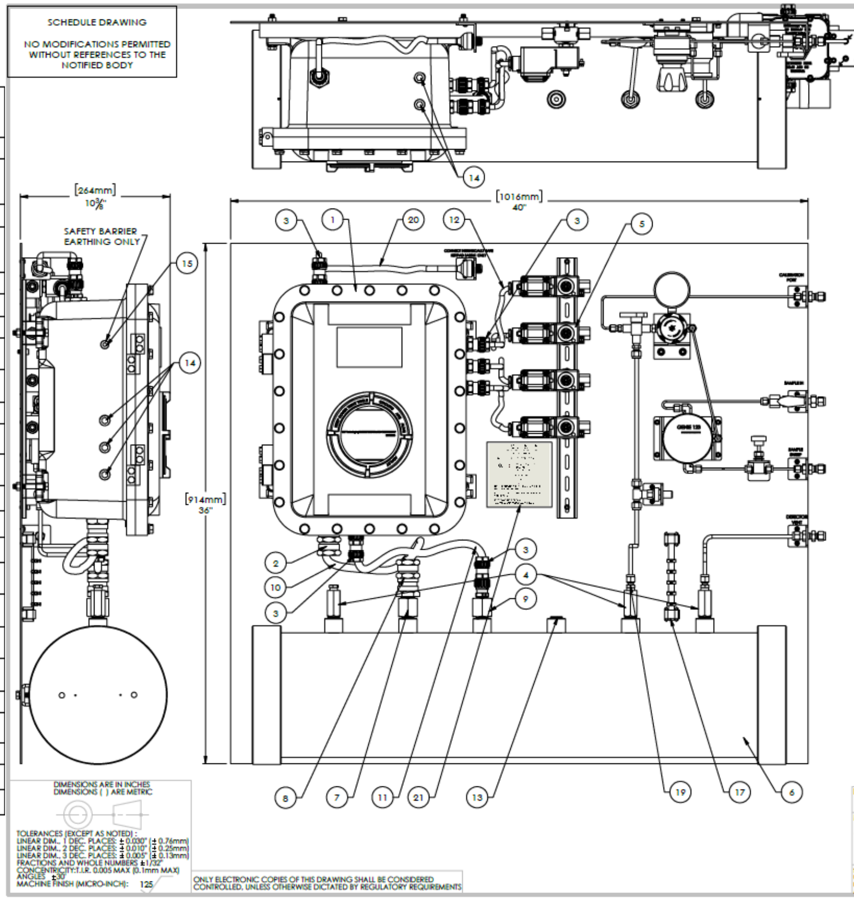
REVISIONS			
REV	DESCRIPTION	DATE	BY
03	REMOVED PAGE 4 AND 6 ADDED PAGE 10	JULY 26/19	DL
04	UPDATED PAGE 1, 2, 4, AND 5	NOV 12/19	DL
05	REMOVED PAGE 8	NOV 15/19	DL
06	REMOVED ITEM 6 ON PAGE 5	DEC 03/21	DL

1. All wiring must comply with local standards.
2. The end user is responsible for supplying and installing a certified mains switch.
3. All unused cable entries must be stoppered by a suitably certified plug.
4. The solenoid valve layout shown is for the maximum number. The actual number of solenoids may vary from 0 to 5.
5. Eclosure may be stainless steel or painted steel

DRAWN BY: DL
APPROVED BY: DH
MATERIAL: AS PER PARTS
GALVANIC APPLIED SCIENCES INC.
TITLE: ACCULASE-GPA-D2
CRITICAL COMPONENTS
USED ON ASSEMBLY:
DATE: MAR 14/19
SIZE: B
SHEETS: 1 OF 9
DWG. NUMBER: RAD-DWG-830-CGY-ACCULASE03-APR-000193-REV06
REV: 06

Figure 90: AccuLase D2 - External

Item No.	Qty	Description
1	1	Electronics Enclosure
2	2	Cable Gland
2	2	Cable Gland (Alternate)
3	2 to 8	Cable Gland
4	3	Flame Arrestor
5	5 or less	Solenoid Valve
6	1	Laser Detector Enclosure
7	1	Adapter
8	1	Cable Gland
8	1	Cable Gland (Alternate)
9	1	Adapter
10	-	Cable
11	-	Cable
12	-	Cable
13	1	Plug-1/4" NPT
14	8	Plug-M20X1.5
15	1	Plug-M16X1.5
16	2	Plug-M25X1.5
17	1	Ground Bar
18	1	Heater
19	1	Flow Orifice .021"
20	-	Cable
21	1	Nameplate



1. THE END USER IS RESPONSIBLE FOR THE SUPPLY AND INSTALLATION OF A CABLE AND CERTIFIED 'Ex db' CABLE ENTRY DEVICE SUITABLE FOR USE IN A ZONE 1 IIB + H2 EXPLOSIVE GAS ATMOSPHERE FOR THE AC MAINS CONNECTION. THE OVERALL LENGTH FROM THE SEALANT (GROMMET OR SEALING COMPOUND) OF THE CABLE ENTRY DEVICE TO THE ENTRANCE OF THE ENCLOSURE SHALL BE EQUAL TO OR LESS THAN 3" (76.2mm)

2. DIAMETER OF THE CABLE MUST MATCH THE ALLOWABLE CABLE DIAMETER OF THE SELECTED CABLE GLAND.

3. THE END USER IS RESPONSIBLE FOR THE SUPPLY, INSTALLATION AND CONNECTION OF A SUITABLY CERTIFIED AC MAINS DISCONNECT SWITCH.

4. ALL UNUSED CABLE ENTRIES MUST BE SEALED WITH A CERTIFIED 'Ex db' STOPPING (BLANKING) PLUG SUITABLE FOR USE IN A ZONE 1 IIB+H2 EXPLOSIVE GAS ATMOSPHERE FITTED DIRECTLY TO THE OPENING, REDUCERS OR ADAPTERS SHALL NOT BE USED.

5. MINIMUM DISTANCE BETWEEN FLANGE FLAME PATHS AND ADJACENT EQUIPMENT IS 40mm.

6. THERE IS NO CONTAINMENT SYSTEM IN THE CONTROL ENCLOSURE (ITEM 1).

7. SOLENOID VALVE LAYOUT SHOWN IS TYPICAL. NUMBER OF SOLENOID VALVES VARIES FROM ZERO (0) TO A MAXIMUM OF FOUR (4). SOLENOID VALVE MAY BE FITTED DIRECTLY TO STOPPER BOX. ALL INSTALLED SOLENOID VALVES ARE THE SAME VOLTAGE. REFER TO ANALYZER OR SOLENOID VALVE NAMEPLATE FOR VOLTAGE.

8. THE UPPER MOST M16 THREADED ENTRY ON THE LEFT HAND SIDE OF THE CONTROL ENCLOSURE IS FOR THE SAFETY BARRIER EARTHING CONDUCTOR(S) ONLY. THE END USER IS RESPONSIBLE FOR THE SUPPLY AND INSTALLATION OF THE SAFETY BARRIER PERMANENT EARTHING CONDUCTOR(S); ONE (1) $4mm^2$ CONDUCTOR OR TWO (2) $2mm^2$ CONDUCTORS AND A CERTIFIED 'Ex db' CABLE ENTRY DEVICE SUITABLE FOR USE IN A ZONE 1 IIB +H2 EXPLOSIVE GAS ATMOSPHERE. THE OVERALL LENGTH FROM THE SEALANT (GROMMET OR SEALING COMPOUND) OF A CABLE ENTRY DEVICE TO THE ENTRANCE OF THE ENCLOSURE SHALL BE EQUAL TO OR LESS THAN 3" (76.2mm). CONNECTION(S) TO THE BARRIER EARTH TERMINAL MUST BE MADE USING A RING CRIMP TERMINAL. THE TEMPORARY CONNECTION MUST BE REMOVED AFTER THE PERMANENT CONNECTION HAS BEEN COMPLETED.

9. DIMENSIONS SHOWN ARE TYPICAL AND MAY VARY. BACKPAN MATERIALS 12 GAUGE COLD ROLLED STEEL POWDER COATED, OR 316SS, OR 304SS.

10. STOPPER BOXES OR BARRIER CABLE GLANDS MUST BE INSTALLED WITHIN 3"(76mm) OF THE WALL OF THE ENCLOSURE.

11. EXTERNAL EARTH CONNECTION - COPPER OR TIN PLATED COPPER CONDUCTOR STRANDED 12 AWG (4.00 mm2/) WITH WIRE END FERRULES (TIN PLATED COPPER) WITHOUT PLASTIC COLLAR AND/OR RING CRIMP TERMINAL (TIN PLATED COPPER) WITHOUT INSULATION. GROUND BAR - TIN PLATED COPPER

12. THE MAIN ENCLOSURE (1) AND LASER ENCLOSURE (6) SHALL NOT CONTAIN MORE THAN 7.5% IN TOTAL OF MAGNESIUM, TITANIUM OR ZIRCONIUM.

13. INLET PRESSURE TO THE FLOW ORIFICE (19) SHALL NOT EXCEED 15 psig (103.4 kPag)

14. CABLES SHOWN ARE FOR ROUTING PURPOSES ONLY. WHERE CABLES ARE SECURED TO EQUIPMENT OR CABLE TRAYS, THE BEND RADIUS ON THE CABLES SHOULD BE IN COMPLIANCE WITH THE CABLE MANUFACTURER'S DATA OR BE AT LEAST 8 TIMES THE CABLE DIAMETER TO PREVENT DAMAGE TO THE CABLE. THE BEND RADIUS SHOULD START AT LEAST 25 mm FROM THE END OF THE CABLE GLAND.

DRAWN BY: DL | APPROVED BY: DH | MATERIAL: AS PER PARTS

Galvanic Applied Sciences Inc., 7000 Fisher Road SE, Calgary, AB, Canada T2H 0W3, PH: (403) 252-8470, FX: (403) 255-6287

TITLE: ACCULASE-GPA-CE, CRITICAL COMPONENTS | DATE: MAY 25/20 | SIZE: B | SHEETS: 1 OF 9 | DWG. NUMBER: RAD-DWG-E30-CGY-ACCULASE02-APR-000191-REV14 | REV: 14

Figure 91: AccuLase CE - External

Item No	Qty	Description
1	1	Power Supply
2	1	Neutral / Ground Terminal Block
3	1	Fused Terminal Block
4	1	Power Filter
5	1	Intrinsically Safe Barrier Isolation Wall (Z Bracket)
6	1	Intrinsically Safe Barrier
7	1	Input/Output Board
8	1	Controller Board

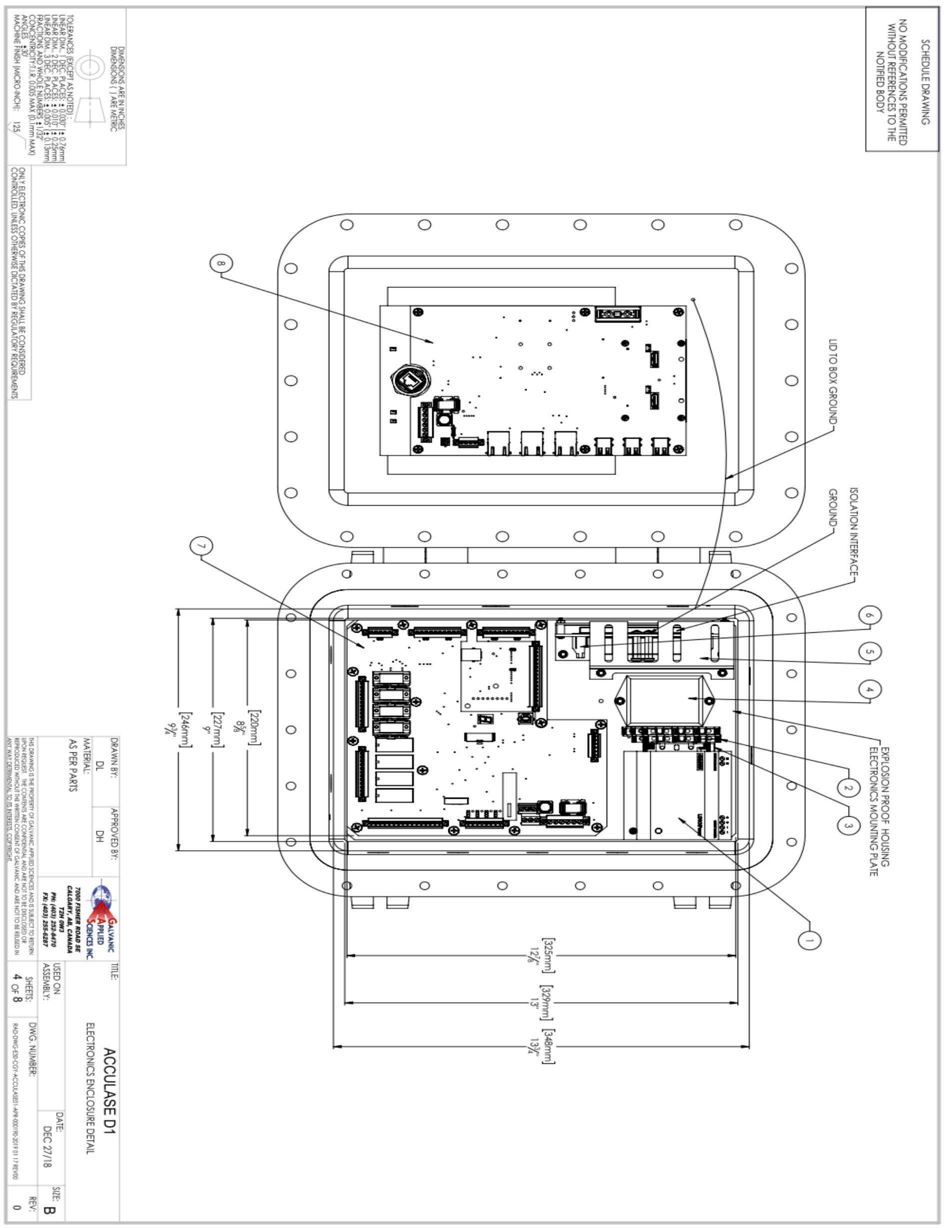


Figure 92: Electronics Cabinet - D1

Item No	Qty	Description
1	1	Power Supply
2	1	Neutral / Ground Terminal Block
3	1	Fused Terminal Block
4	1	Power Filter
5	1	Input/Output Board
6	1	Controller Board

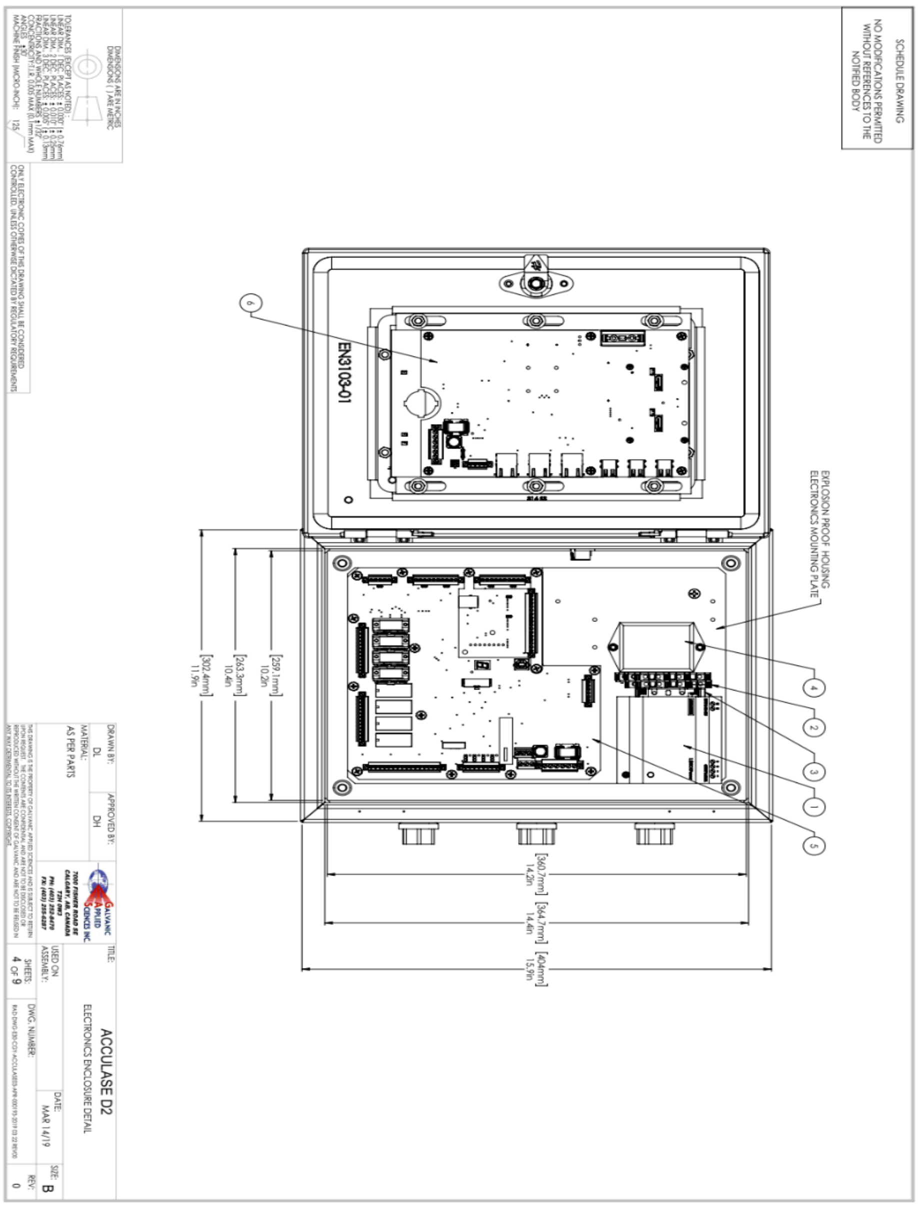


Figure 93: Electronics Cabinet - D2

Item No	Qty	Description
1	1	Power Supply
2	1	Neutral / Ground Terminal Block
3	1	Fused Terminal Block
4	1	Power Filter
5	1	Intrinsically Safe Barrier Isolation Wall (Z Bracket)
6	1	Intrinsically Safe Barrier
7	1	Input/Output Board
8	1	Controller Board

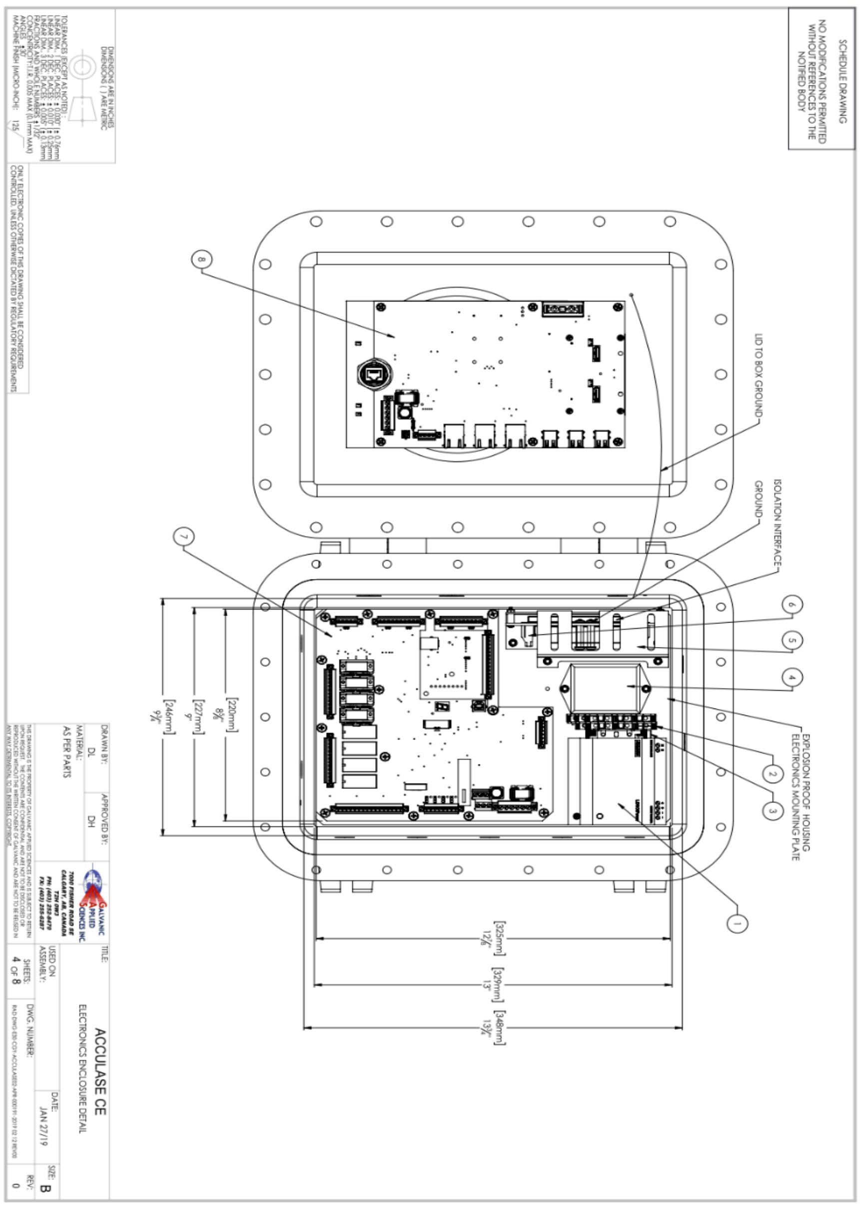


Figure 94: Electronics Cabinet - CE

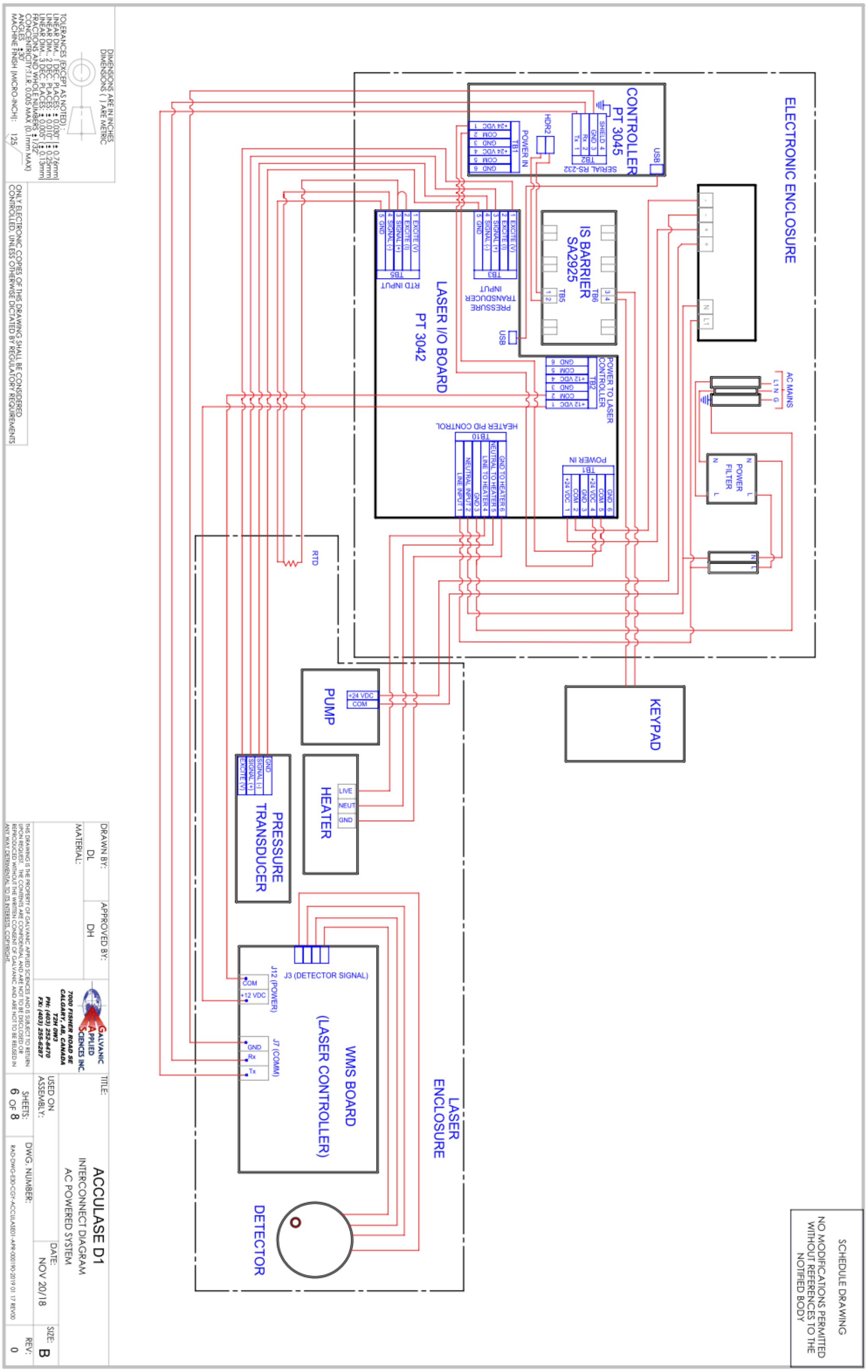


Figure 95: System Wiring - AC (D1 / CE)

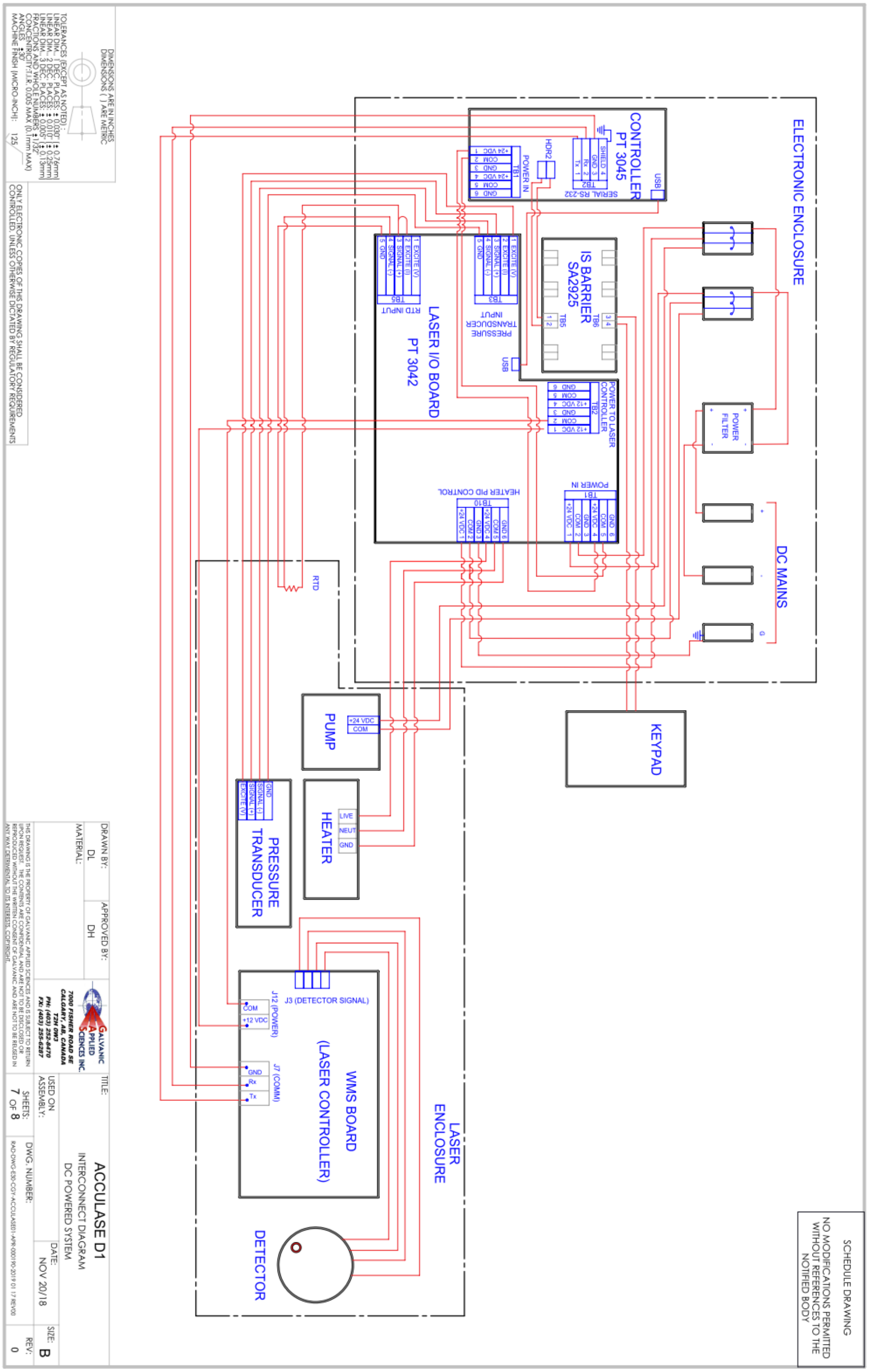


Figure 96: System Wiring - DC (D1 / CE)

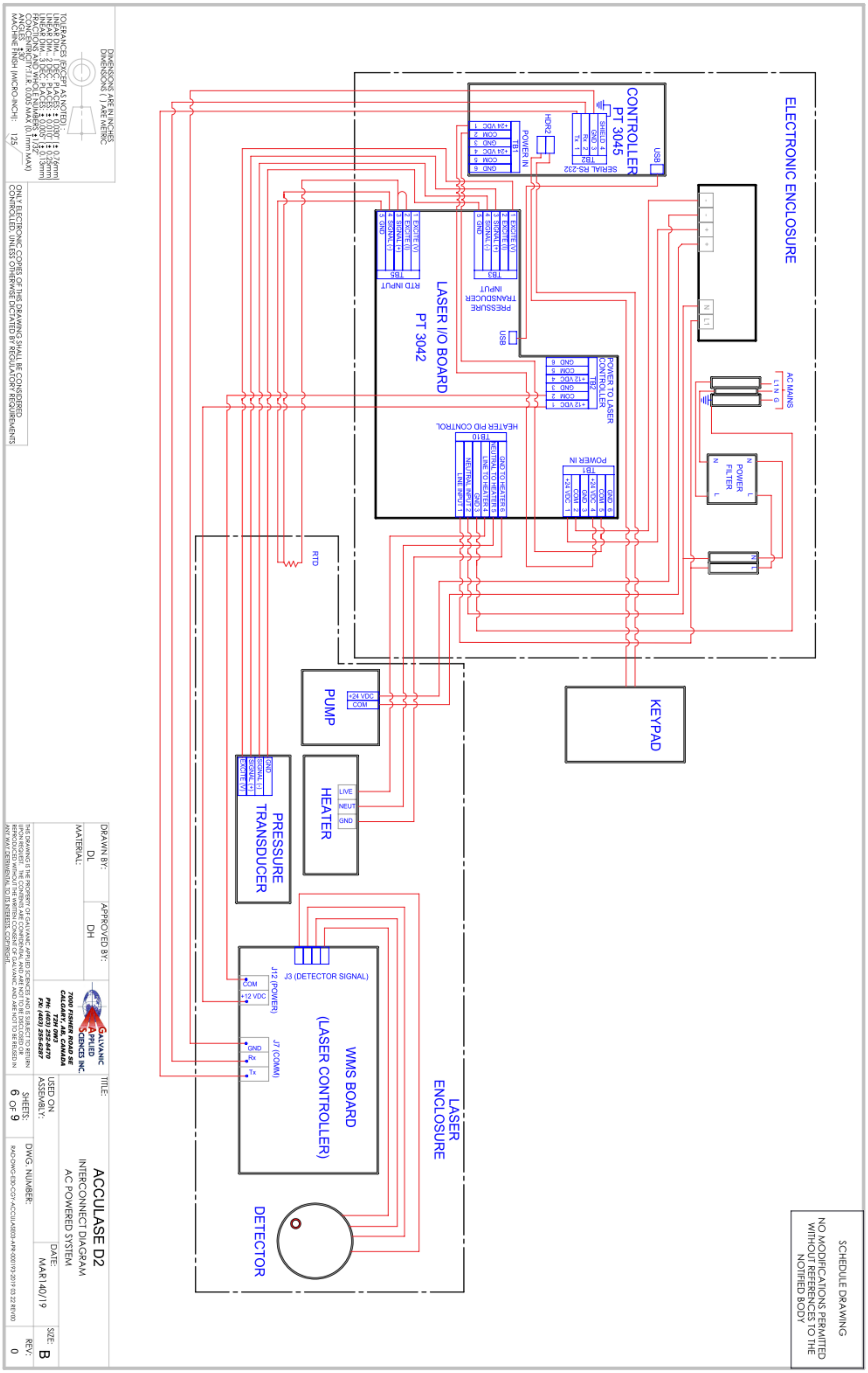


Figure 97: System Wiring - AC (D2)

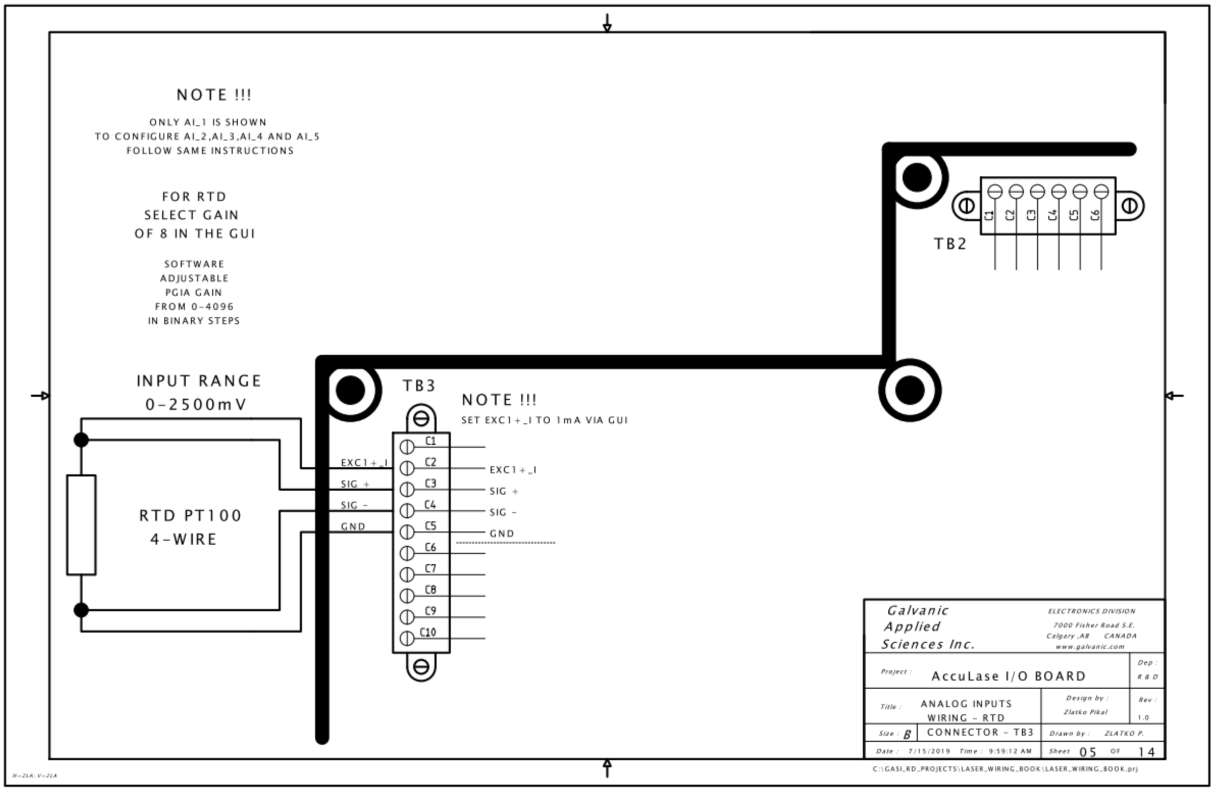


Figure 98: Analog Input Wiring Diagram (4-Wire RTD)

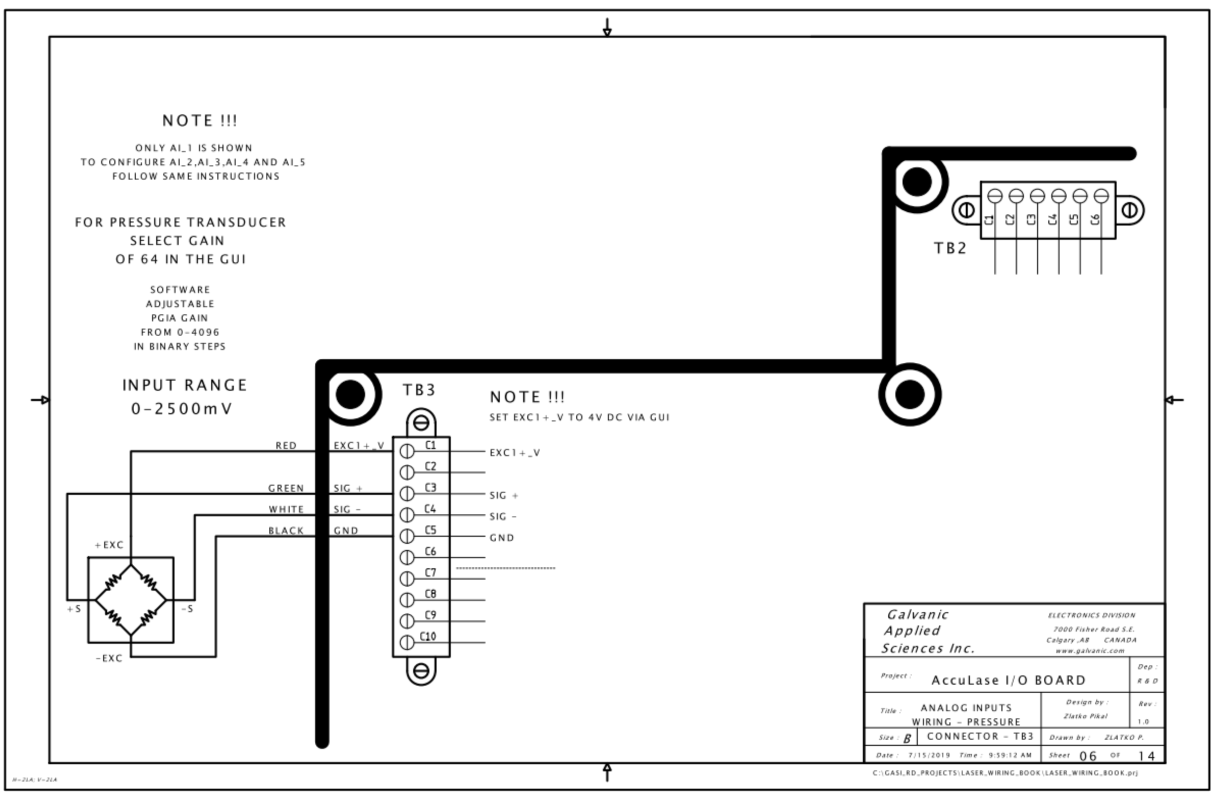


Figure 99: Analog Input Wiring (Pressure Transducer)

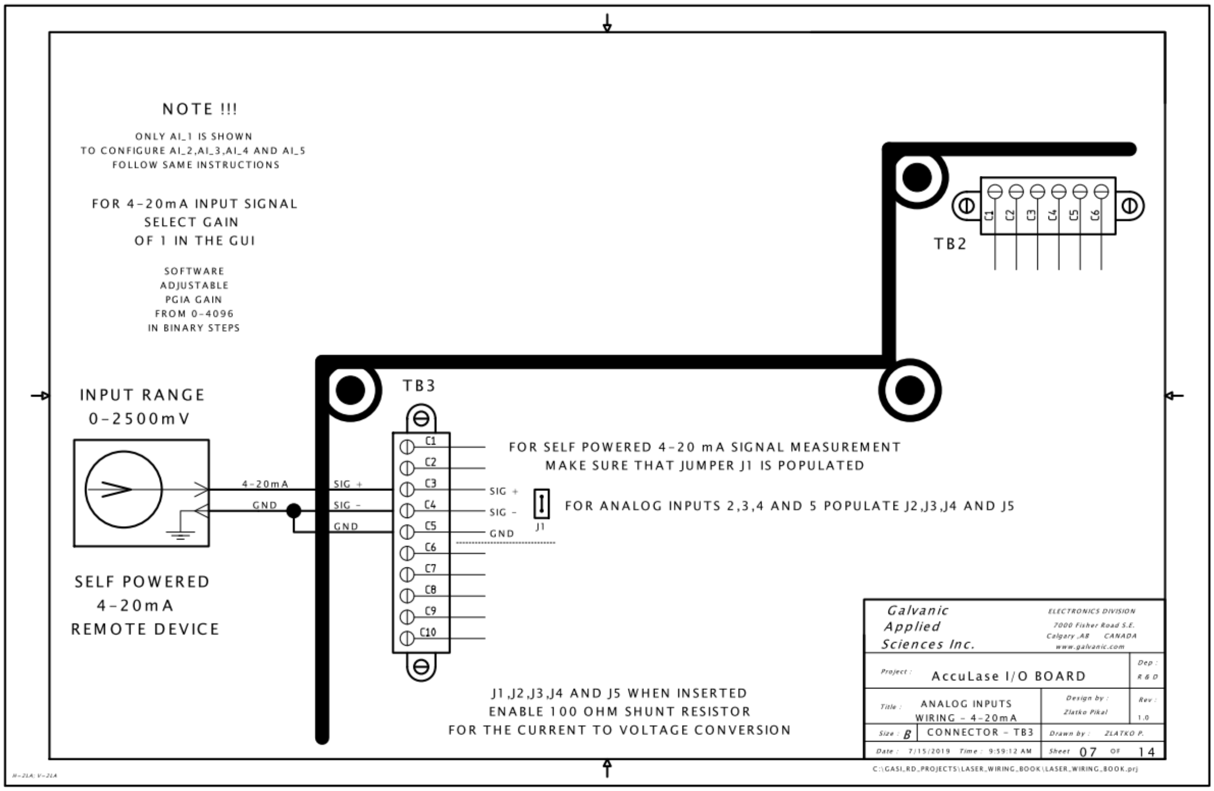


Figure 100: Analog Input Wiring (Self Powered 4-20mA Remote Device)

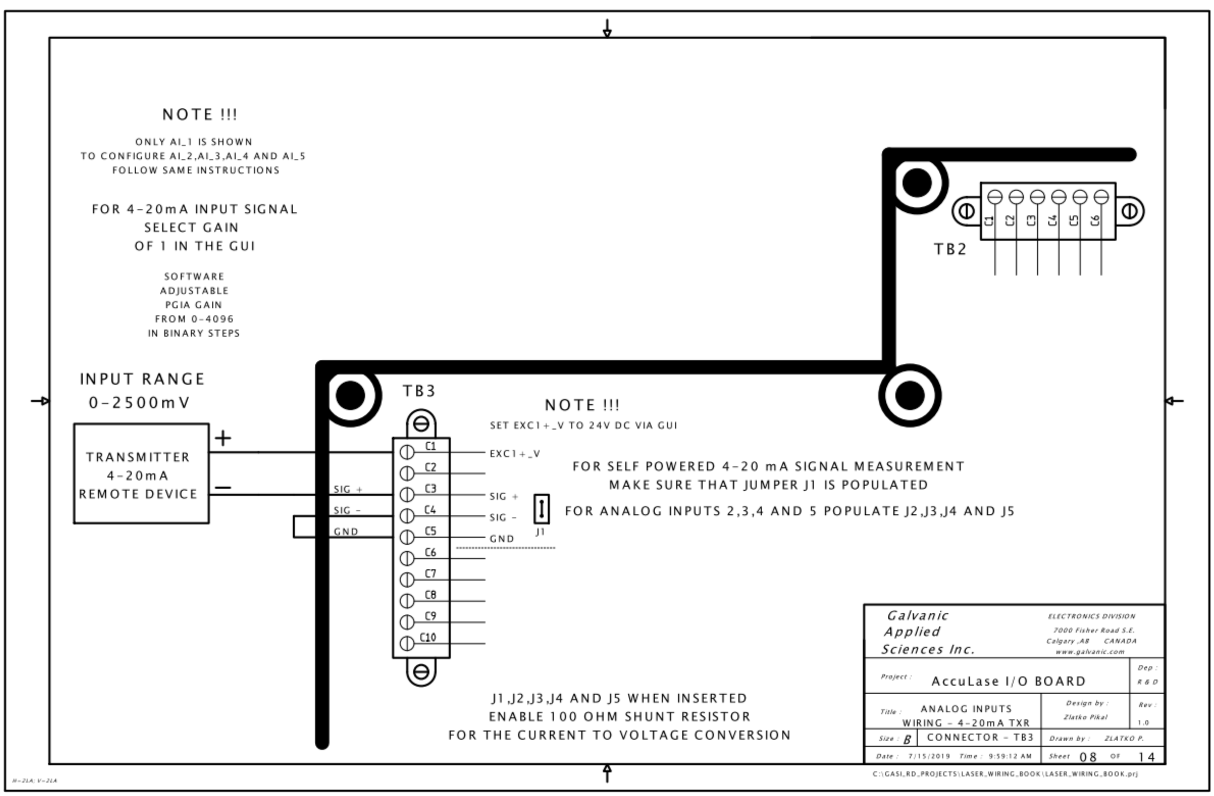


Figure 101: Analog Input Wiring (Transmitter 4-20mA Remote Device)

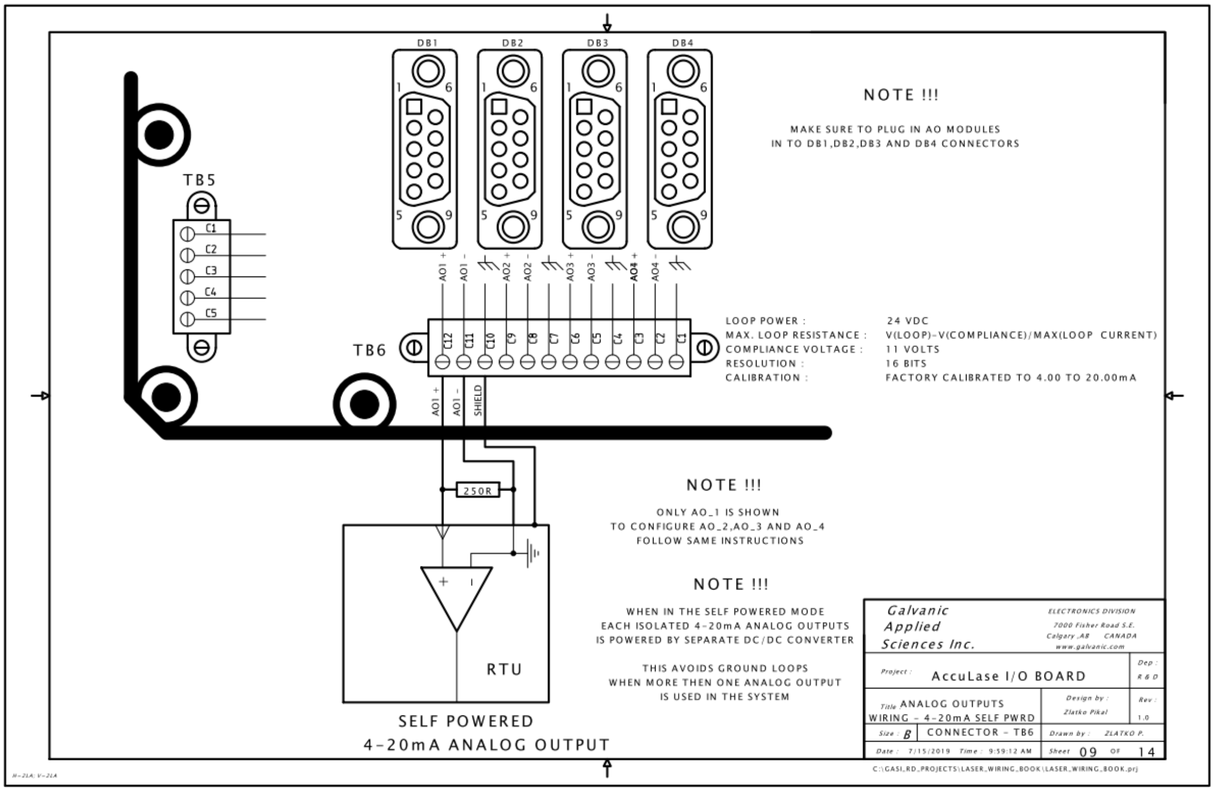


Figure 102: Analog Output Wiring

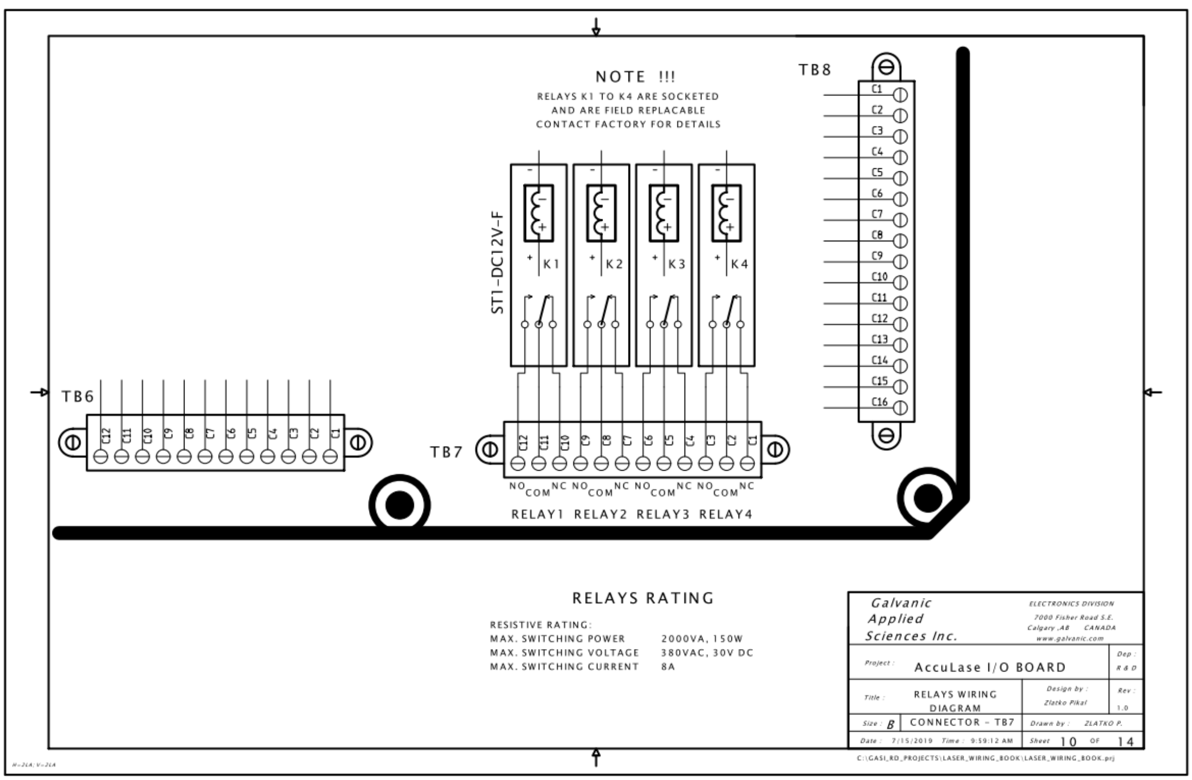


Figure 103: Relay Outputs Wiring

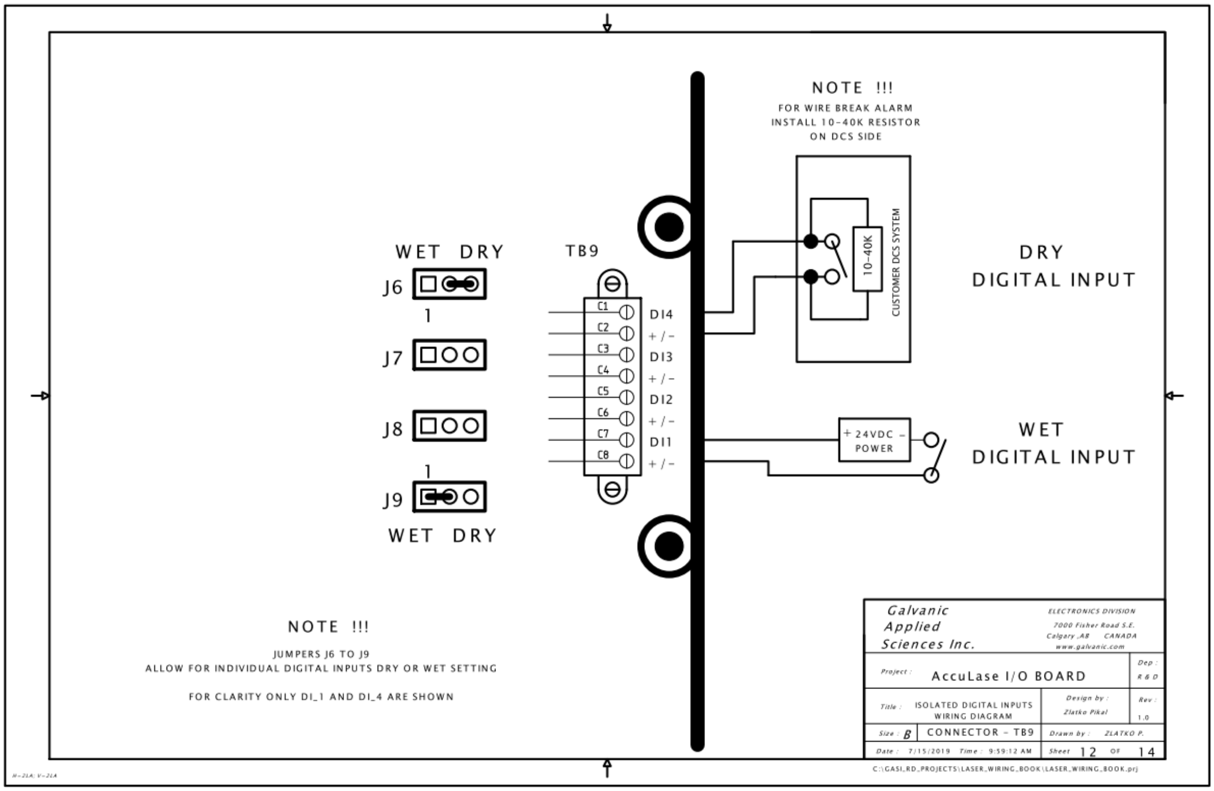


Figure 104: Digital Inputs Wiring

Section 8 Specifications

Performance:

H_2S Range / LDL	0 to 500 ppmv / 0.15ppmv
CO_2 Range / LDL	0 to 5 vol% / 50 ppmv
H_2O Range / LDL	0 to 500 ppmv / 5 ppmv
Accuracy	+/- 2% Full Scale
Repeatability	+/- 2% Full Scale
Linearity	+/- 2% Full Scale
Response Time	T_{90} 30 seconds (including sample conditioning system)
Method	Tunable Diode Laser Absorption Spectroscopy (TDLAS)

Environment:

Temperature / Humidity	-20 to 50°C (-4 to 122°F) / 0 to 95% Relative Humidity (Non-Condensing)
Installation	Indoors or Suitable Enclosure
Dimensions	**Zone 1 / Div. 1 Models:** 914mm x 1016mm x 279mm (36” x 40” x 11”) **Zone 2 / Div. 2 Models:** 1333mm x 635mm x 324mm (52.5” x 25” x 12.8”)
Weight	**Zone 1 / Div. 1 Models:** 86kg (190 lb) **Zone 2 / Div. 2 Models:** 45kg (100 lb)
Enclosure	**Zone 1 / Div. 1 Models:** Cast Aluminum **Zone 2 / Div. 2 Models:** Stainless Steel or Painted Steel

Utilities:

Power / Consumption	**Zone 1 / Div. 1 Models:** 110 – 240VAC, 110W / 10-32 VDC, 80W **Zone 2 Model:** 230VAC, 230W **Div. 2 Model:** 110 – 240VAC, 110W
Sample / Calibration Gas Flow Rate	1000 to 3000 cc /min
Required Calibration Gases	Zero Gas (Pure Methane); Span Gas (H_2S, CO_2, and/or H_2O in balance of methane)

Communications:

Analog Outputs	4 x 4-20mA (Self Powered)
Analog Inputs	2 x 4-20mA (Loop or Self Powered)
Digital Outputs	4 x SPDT Relays
Digital Inputs	4 x Discrete Inputs
Modbus	TCP / IP or RS485 Serial Communication
Human Machine Interface	5.7” Colour LCD local display with keypad operation
Remote GUI	Local Area Network, Web Browser-Based (no software installation required)

Certifications

CEC / NEC	Class I Div. 1 Groups BCD T3 Class I Div. 2 Groups BCD T3
ATEX / IECEx Zone 1	II 2G Ex db [ia] op pr IIB + H_2 T3 Gb
ATEX / IECEx Zone 2	II 3G Ex ec nC IIB + H_2 T3 Gc

Section 9 Spare Parts

WARNING SUBSTITUTION OF ANY COMPONENT WITH UNAUTHORIZED PARTS MAY IMPAIR SUITABILITY OF EQUIPMENT FOR HAZARDOUS LOCATIONS

Part Number	Description
123-5X6	Membrane Filter
123-500	O-ring for Membrane Filter
5267T32	Laser Cell O-ring, Viton
BA2286	110-240 VAC Laser Enclosure Heater (D1 model only)
BA2958	Solenoid Valve 12 VDC
BA3206	230 VAC Laser Enclosure Heater (Z2 model only)
BA7442	110-240 VAC Laser Enclosure Heater (Z1 model only)
CPA 200 T3 100	120 or 240 VAC Laser Enclosure Heater (D2 model only)
J161-FP-GB2	ATEX/IECEx External Vacuum Pump (Z1 and Z2 models)
R221-FP-RA1	CSA/UL External Vacuum Pump (D1 and D2 models)
MC3200	Laser Optics Sleeve (must be ordered with AF3065 if original AF3175 installed)
MPU4673-N838	Internal Vacuum Pump (D1 and D2 models)
PT3042	IO Peripheral Board
PT3044	USB to Serial Expansion Card
PT3048	UCII Controller Board
PT3050	UCII Display Board
RK3140	Internal Vacuum Pump Diaphragm Kit
SA2992	IECEx Remote Keypad and Connector (Z1 model only)
SA3147	Remote Keypad and Connector (D1, D2 and Z2 models)
	5x20 Ceramic Fuse 3.15A Time Lag
	5x20 Ceramic Fuse 5A Time Lag