

# 4000/4100

Automatic Process UV Spectrophotometer for Industrial On-Line Analysis

## OPERATION MANUAL

P/N: FPA4100MAN (T422001)

Revision 4

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## **NOTICES**

This system is covered by a limited warranty. A copy of the warranty is included with this manual. The operator is required to perform routine maintenance as described herein on a periodic basis to keep the warranty in effect. For routine maintenance procedures, refer to Section 8.

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.

The system and various components in the system are the subject of pending patent applications.

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

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## Safety Symbols used in Manual



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



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



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



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

## Important Safety Guidelines for the FPA 4000/4100 Series Field Programmable Analyzer System

Please read the following warnings and cautions carefully before using the FPA 4000/4100 Series Field Programmable Analyzer System

 **WARNING** This equipment must be used as specified by the manufacturer; or overall safety will be impaired.

## 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.

THIS WARRANTY AND ITS REMEDIES ARE IN LIEU OF ALL OTHER WARRANTIES OR CONDITIONS EXPRESSED OR IMPLIED, ORAL OR WRITTEN, EITHER IN FACT OR BY OPERATION OF LAW, STATUTORY OR OTHERWISE, INCLUDING BUT NOT LIMITED TO, WARRANTIES OR CONDITIONS OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WHICH SELLER SPECIFICALLY DISCLAIMS.

Seller's obligation under this warranty shall not arise until Buyer notifies Seller of the defect. Seller's sole responsibility and Buyer's sole and exclusive remedy under this warranty is, at Seller's option, to replace or repair any defective component part of the product upon receipt of the Product at Seller's production facility, transportation charges prepaid or accept the return of the defective Product and refund the purchase price paid by Buyer for that Product. If requested by Buyer, Seller will use its best efforts to perform warranty services at Buyer's facility, as soon as reasonably practicable after notification by the Buyer of a possible defect provided that Buyer agrees to pay for travel time, mileage from the Seller's facility or travel costs to the airport / train station closest to Buyer's facility plus all other travel fees, hotel expenses and subsistence.

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.

#### **Limitation of Remedy and Liability**

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 4000/4100 Series Spectrophotometer Overview**

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The FPA 4000/4100 Series Spectrophotometer is a microprocessor controlled precision industrial instrument that performs on line, chemical analysis of a gaseous or fluid sample stream in an industrial environment. The analyzer employs a dual wavelength measurement technique and is suitable for measuring either low ppm or percent concentrations. The range of measurement depends upon the compound being measured and the sample stream conditions. The FPA 4000 operates in the visible part of the spectrum while the FPA 4100 operates in the ultraviolet part of the spectrum.

When analyzing a sample, the instrument:

- Automatically measures the absorbance of the process stream flowing through a sample cell
- Calculates the sample concentration in user defined units
- Automatically displays the result on the front panel and outputs the value

The FPA 4000/4100 Series Spectrophotometer is designed to be easy to use, provides impressive uptime, requires little maintenance, and is designed for long life even under continuous use. It is ideal for achieving laboratory precision in the real world of unattended process and environmental applications.

## 1.1 Basis of Operation

### 1.1.1 Introduction to Absorbance Measurements

The FPA 4000/4100 Series Spectrophotometer is an absorbance spectrophotometer which employs Beer's law (equation 1-1) to measure the concentration of the sample:

$$A = -\log(T) = -\log(I/I_0) = abc \quad 1-1$$

Where:

- A* is the absorbance of the sample
- T* is the transmittance of the sample
- I<sub>0</sub>* is the intensity of light hitting the sample
- I* is the intensity of light passing through the sample
- a* is molar absorbance of the compound(s) in the sample
- b* is the path length
- c* is the concentration of the compound of interest in the sample

A compound absorbs radiation at a specific wavelength or at several wavelengths. As an example, benzene absorbs radiation at 254 nm and its concentration in a solution or a gas can be measured from the absorbance at that wavelength. A spectrophotometer can measure the absorbance of light in a gas or solution, usually employing the visible or ultraviolet region of the spectrum. These devices achieve sufficiently accurate results with an optical bandpass filter to select one or more wavelengths of light to measure light absorption of the compound of interest in the sample path. Photometric analysis is a direct method of measurement; the sample to be measured must exhibit a characteristic absorption band in the wavelength region defined by the bandpass filter. The concentration of a broad range of compounds can be measured by the spectrophotometer and the concentration range that the system can monitor is dependent on the absorption coefficient of the analyte.

Table 1-1 reviews common definitions and principles pertaining to spectrophotometry.

**Table 1-1: Spectrophotometry Definitions and Principles**

Absorbance (A)	The logarithm (base 10) of the reciprocal of the transmittance (T)
Absorption band	A region of the absorption spectrum in which the absorbance passes through a maximum
Absorption coefficient	A measure of the absorption of radiant energy from an incidental beam as it traverses an absorbing medium according to Bouguer's Law (more frequently referred to as Lambert's Law) $P/P_0 = e^{-ab}$
Absorption spectrum	A plot of absorbance against wavelength
Absorptivity (a)	The absorbance divided by the product of the concentration of the substance and the sample pathlength
Beer's Law	The absorbance of a homogenous sample containing an absorbing substance is directly proportional to the concentration of the absorbing substance
Bouguer's Law (Lambert's Law)	The absorbance of a homogenous sample is directly proportional to the thickness of the sample in the optical path
* Reference ASTM E131-92a	



## 1.1.2 Dual Wavelength Technique

Absorbance is measured simply by comparing light intensity or power ( $I$  or  $P$ ) transmitted through the sample to the incident intensity or radiant power ( $I_0$  or  $P_0$ ). From a strictly theoretical standpoint, measuring the incident and transmitted light intensity at a single, relevant wavelength will yield accurate results. However, in practical terms, the measurement of a single wavelength is affected by two phenomena:

- The difficulty in measuring the incident intensity or power at the point where it enters the sample.
- Real world solutions, especially process streams frequently contain turbidity.

While turbidity typically does not exhibit any characteristic absorption, it will, however reduce the radiant power being transmitted through the medium. In a single wavelength measurement, it is impossible to discriminate between the effects of turbidity and the absorbance of the sample. The effect of turbidity at single and dual wavelengths is illustrated in Figure 1-2.

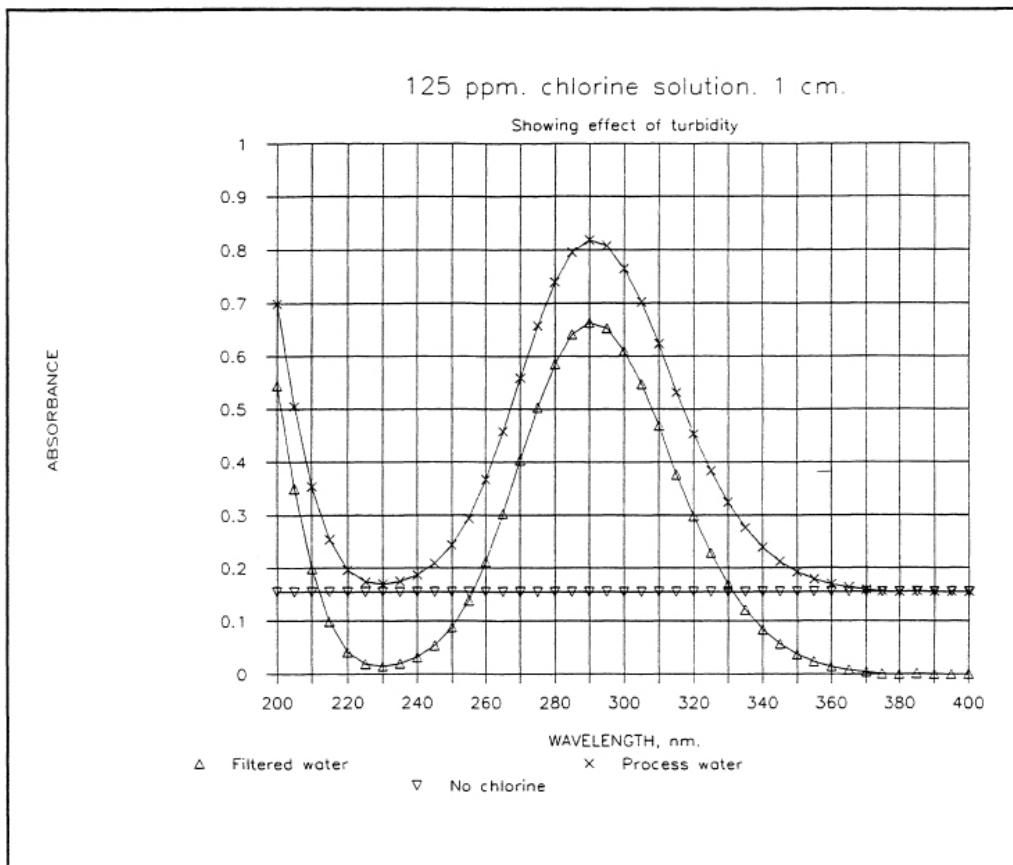
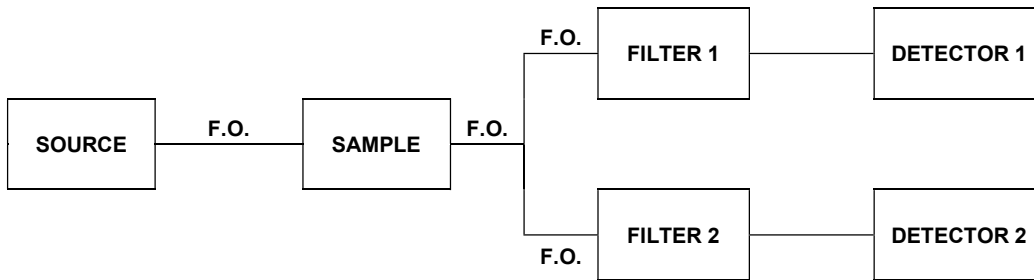


Figure 1-2: The Effect of Turbidity

In the dual wavelength technique, a second or *reference* measurement is taken at a wavelength which lies outside the absorption bands of the test sample. This method automatically eliminates the incident intensity or power term from the measurement equation, while also compensating for turbidity. The result is an accurate measurement of absorption at the characteristic wavelength of the sample under analysis. Figure 1-3 presents a block diagram of the components of the analyzer.



F.O. = Fiber Optic

**Figure 1-3: Schematic Diagram of Spectrophotometer**

Light from the source passes through a fiber optic to the sample chamber. Incident light travels through the fiber optic bundle to the sample cell window, and then through the sample to a second cell window. The transmitted light then travels to the detector region via another fiber optic bundle. The fiber optic bundle is split into two; and the light is directed to bandpass filters for the two wavelengths and then to a photodetector for measurement. A real-time analog signal from each photodetector is digitized and passed to the microprocessor for analysis.

## 1.2 Contents of this Manual

This manual contains the following information:

- **Section 1:** *40001/4100 Series Spectrophotometer Overview* presents introductory information about spectrophotometry and the system.
- **Section 2:** *Components of the Spectrophotometer* includes a detailed discussion about the hardware and software for the system.
- **Section 3:** *Installation-Hardware* describes unpacking the system, installing it in the facility and interfacing with other devices.
- **Section 4:** *Software and Drivers Installation* explains how the spectrophotometer is interfaced to the personal computer.
- **Section 5:** *Operating the Spectrophotometer via the Controller Module* describes the role of the keypad controller.
- **Section 6:** *The Graphical User Interface* presents a detailed discussion of the various aspects of the application program on the personal computer.
- **Section 7:** *Operating the System* discusses routine operation of the spectrophotometer.
- **Section 8:** *Maintenance and Troubleshooting* includes a discussion of required maintenance activities and presents information that is useful in diagnosing problems with the system.
- **Section 9:** *Wiring Book* includes information about interfacing auxiliary components such as relays, solenoids, etc. to the controller module.
- **Section 10:** *Spare Parts* lists a number of items which may be required to maintain operation of the spectrophotometer.
- **Section 11:** *Specifications* presents the specifications for the spectrophotometer.

## Section 2 Components of the Spectrophotometer

---

### 2.1 Introduction

The spectrophotometer includes a controller module and a photonics module which are connected via a local area network (LAN). The source, which is located in the photonics module, provides the light which is delivered to the flow cell via a fiber optic cable. The light that is transmitted by the sample is delivered to the detector via a second fiber optic cable and is monitored at the appropriate wavelength (and at a reference wavelength to monitor the turbidity) to determine the absorbance of the sample and the concentration of the compound of interest.

The overall operation of the system is governed by a *configuration* which includes a broad range of system parameters, timing sequences and related information. The configuration is generated via the application program on the personal computer and is described in detail in Chapter 6. A discussion about the generation of a *configuration* and overall operation of the system is provided in Chapter 7. In addition to the generation of the *configuration*, the application program includes a log to monitor calibration data, analytical results and instrument conditions (e.g. alarms).

The *configuration* that has been generated by the application program can be saved (and retrieved) and must be downloaded to the controller module for operation. A LCD display on the controller module and a hand held keypad provide a broad range of instrumental conditions, as well as the absorbance and concentration. In addition, the operator can calibrate the system via the keypad. Use of the LCD display and keypad are described in Chapter 5.

## 2.2 Photonics Module

The photonics module contains a single printed circuit board (Figure 2-1) which contains the source, detector block assembly, associated electronics, DC power input and an interface to the controller module. Wiring diagrams for the photonics module are provided in Chapter 9.

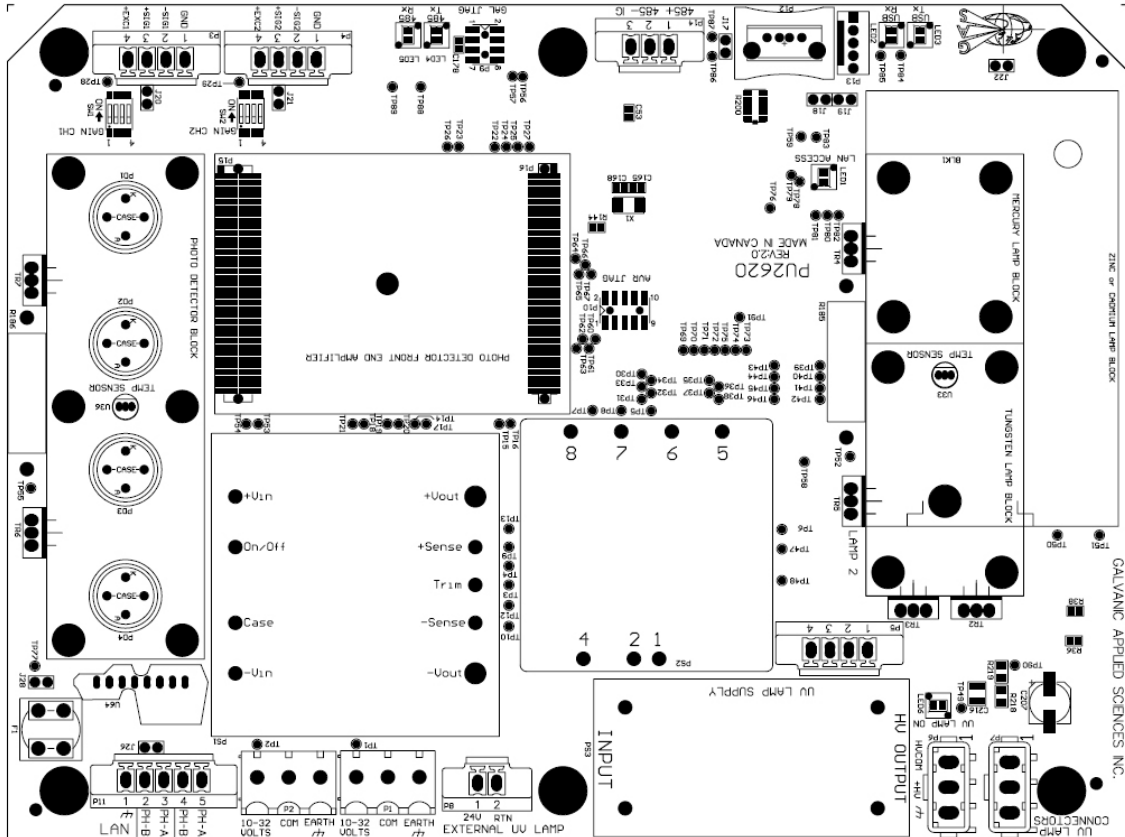


Figure 2-1: The Photonics Module Printed Circuit Board

## 2.2.1 Sources

The spectrophotometer can be configured with a Tungsten, Mercury (254 nm), Mercury/Biphosphor (280 nm), Zinc (214 nm) or Cadmium (228 nm) lamp, depending on the wavelength required for the application. The tungsten lamp provides a continuum in the visible region of the spectrum; the indicated wavelengths for the other lamps refer to the strongest wavelength provided by the lamp.

### 2.2.1.1 FPA 4000

The FPA 4000 is fitted with 2 Tungsten lamps to provide visible radiation as shown in Figure 2-2. The user can select the lamp to be used via the application program. The lamps are connected to P5 on the printed circuit board and will need to be replaced on a periodic basis, see Section 8.1.6 for details.

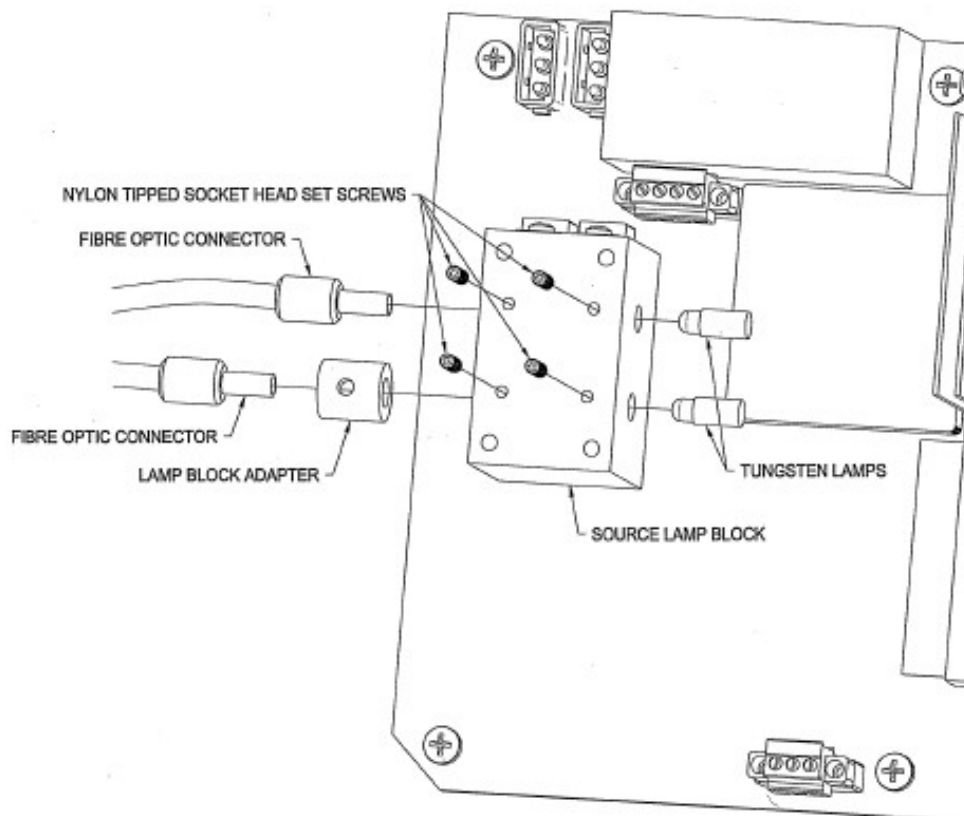
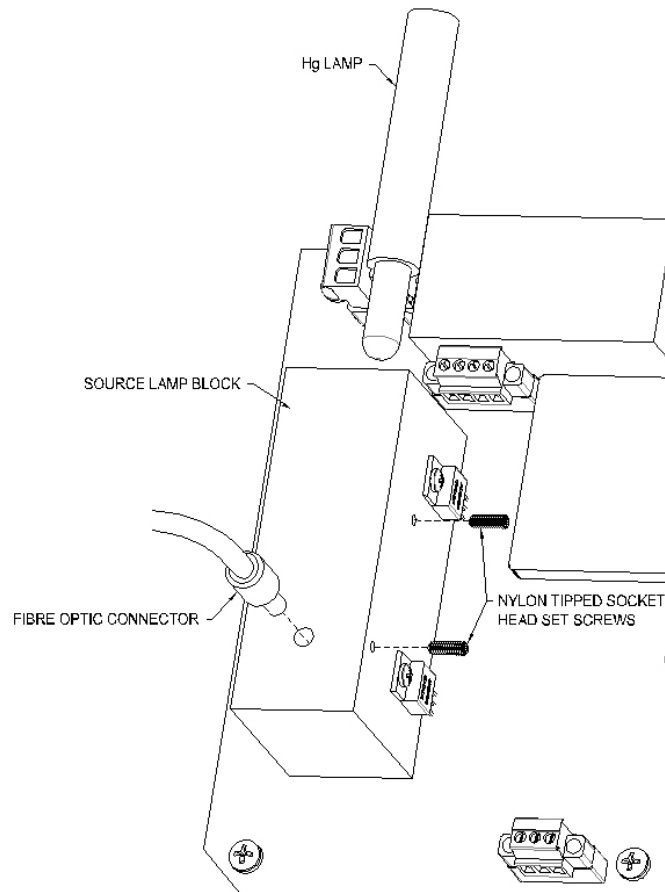


Figure 2-2: Source Block Detail - Tungsten Lamps

### 2.2.1.2 FPA 4100

The FPA4100 Spectrophotometer uses a Mercury, Mercury/Phosphor, Zinc or Cadmium source lamp to provide UV light. The lamp is selected on the basis of the optimum wavelength for the application.

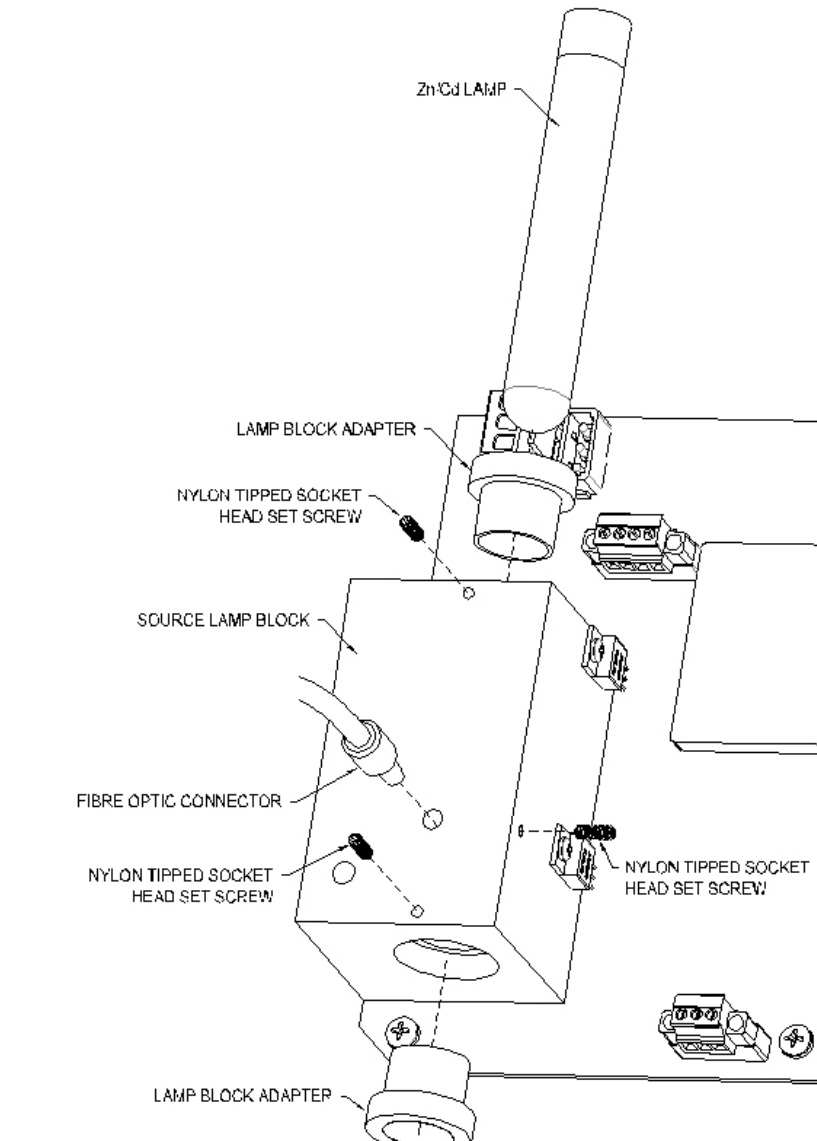
The Mercury or Mercury/Phosphor lamp is fitted into the source block and held in position by a #5-40 nylon tipped set screw that is located between the two power transistors which are used to heat and maintain the temperature of the source block (Figure 2-3). The source is fitted with a plug which fits into socket P7 which is located on the Photonics printed circuit board.



**Figure 2-3: The Hg, Hg/Phosphor Lamp Assembly**

PS3 must be installed for the Mercury and Mercury/Phosphor lamps and must not be installed for the Zinc or Cadmium lamps. The appropriate power supply for the lamp is installed at the factory.

The Zinc and Cadmium lamps are similar and held in position by two set screws on the side as shown in Figure 2-4.



**Figure 2-4: The Zn/Cd Lamp Assembly**

A small temperature sensor is mounted on the board and protrudes into the source block housing. The sensor is set to maintain the temperature of the source block at 60°C.

A red indicating LED labeled LED6 is located on the photonics module board. When this LED is ON, power is being supplied to the lamp. Note that during startup of the analyzer, the lamp will not come on until the UV block is within 5°C of the setpoint.

The lamp will need to be replaced on a periodic basis, see Section 8.1.6 for details.

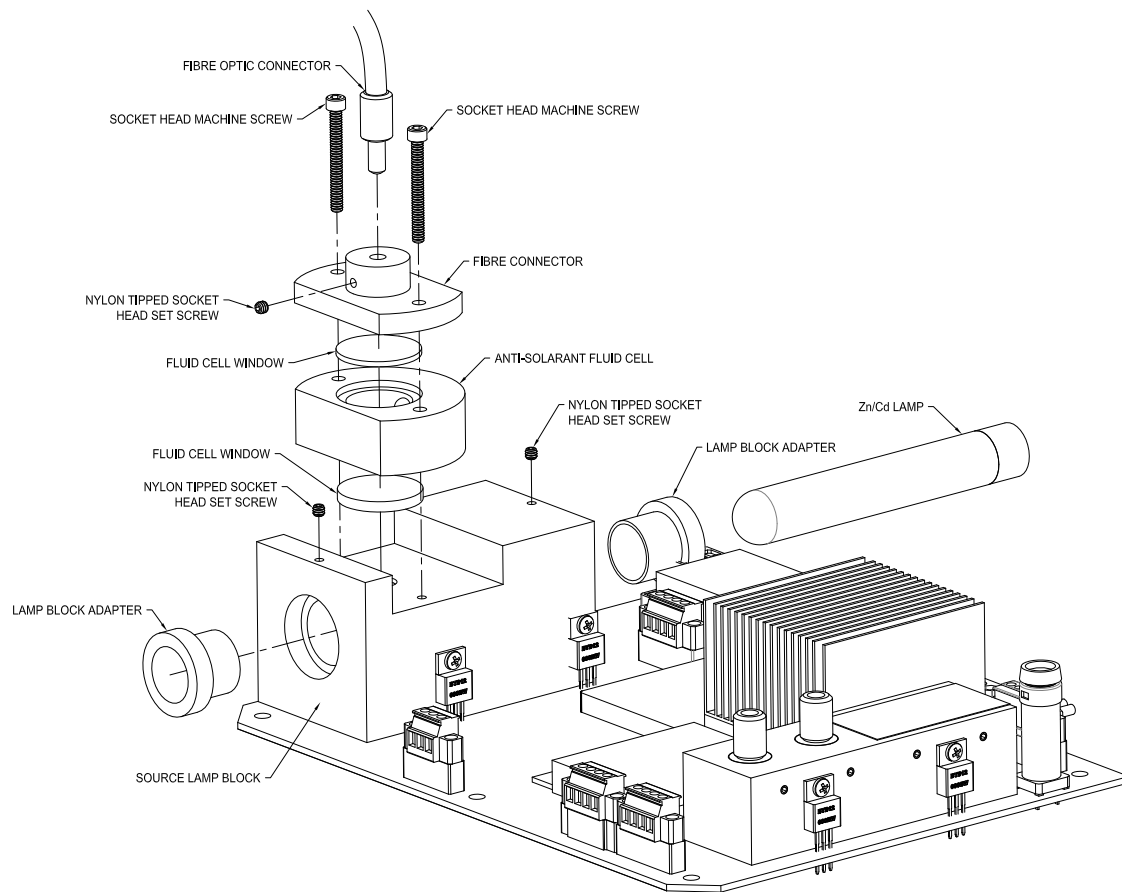


## 2.2.2 Fiber Optic Bundles

A variety of fiber optic bundles are employed to transmit light from the source to the cell and from the cell to the detector module. Figure 2-5 depicts the details of the fiber optic connector and how it is connected to the cell.

### Figure 2-5: Fiber Optic Bundles and Cell Assembly

- If tungsten lamps are employed, a cable with two terminals is attached to the source assembly and a single terminal is attached to the cell to transmit the light to the sample cell. The fiber optic cable is designed to transmit visible light.
- If a mercury, cadmium or zinc lamp is used, a cable with a single terminal at each end is used to transmit light from the source to the sample cell. The fiber optic cable is designed to transmit UV light.
- A cable with two terminals at one end and a single terminal at the other end is used to connect the sample cell to the detector assembly. The cable is selected to transmit UV or visible light as appropriate.
- If a Zinc or Cadmium lamp is used, the source block will be fitted with an anti-solarant chamber (Figure 2-6). The anti-solarant chamber contains a solution which will block the deep UV light and prevent it from damaging the fiber optic cable.



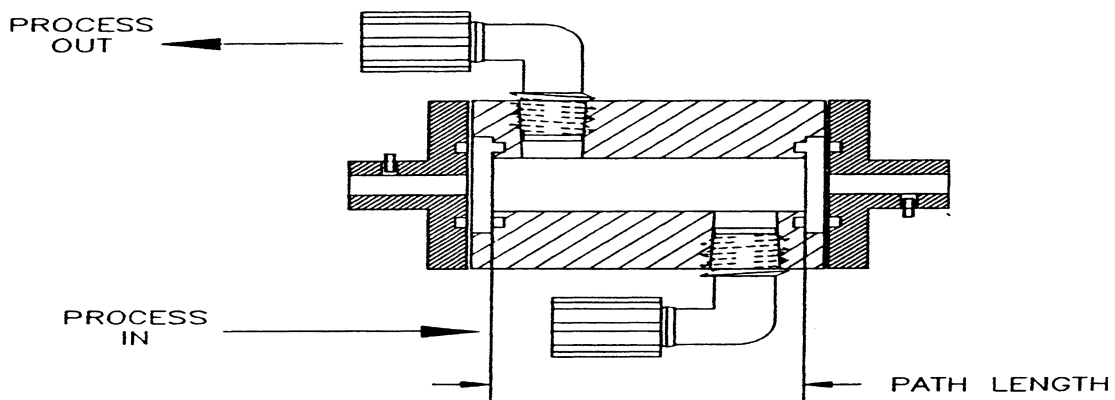
**Figure 2-6: Anti-Solarant Chamber**

The fiber optic bundles are connected to the source and detector via two ¼" #5-40 set screws.

## 2.2.3 Cell Assembly

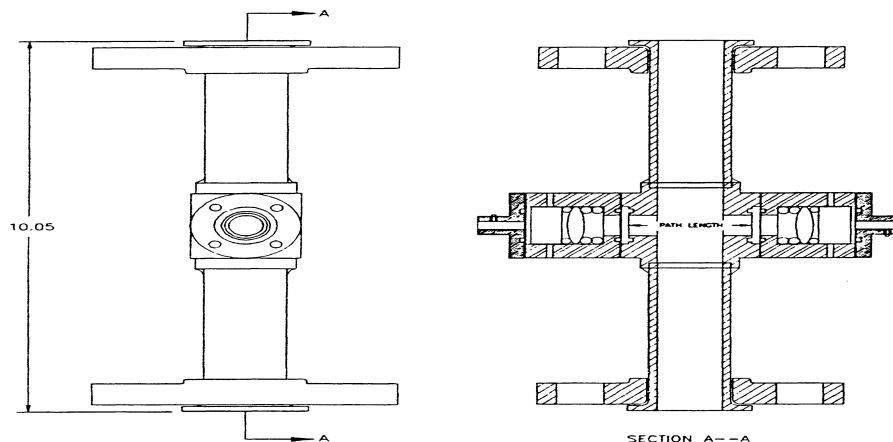
The Sample Cell assembly holds the sample during analysis and calibration. During analysis, the sample flows through the sample cell while during calibration the calibrant flows through the same sample cell. Either preprogrammed purge times (if automated calibration) or sufficient time must be used to ensure that the sample and the calibrant are purged before and after calibration. The standard sample cell assembly (shown in Figure 2-7) consists of:

- Cell body, which is usually a cylinder with 1/2" NPTF fittings (316 SS) or 1/4" NPTF (Kynar) to accept either 1/4", 3/8", 1/2" or 6 mm or 12 mm compression tube fittings for connection to sample tubing.
- Windows, SI-UV, which have O-ring seals on both sides.
- Collimator lens assembly.
- Fiber optics retainer at both ends (the whole assembly is sealed by means of 2 1/2" 10-32 SCHS at each end).



**Figure 2-7: Measurement Cell, Standard Assembly.**

A pipeline mounted cell, shown in Figure 2-8, is available. This cell is available for 0.5", 1.5" and 2" pipelines with ASA 150, ASA 300 or DIN standard cap flanges (Figure 2-8).



**Figure 2-8: Standard Cell, Pipeline Mounted**

Standard cells are pressure rated for 350 psig and 200°C, and cells can be engineered for higher temperatures, pressure ratings and chemically compatible cases. Cell pressure and temperature options can be employed to automatically compensate for changes in the pressure and/or temperature for gas phase measurement.

If desired, the cell can be mounted in an oven to heat the sample to avoid condensation or crystallization of sample or to simply stabilize sample temperature. Pipeline mounted cells are available with flanges to fit 0.5", 1" or 2" sample lines and have pathlengths available from 0.5 to 10 cm. By-pass cells can be provided with pathlengths from 0.25 cm to 50 cm.

Up to eight streams can be monitored by the system.

## 2.2.4 Detector Assembly

The Detector block assembly (Figure 2-9) transmits light returning from the cell to the photodetectors.

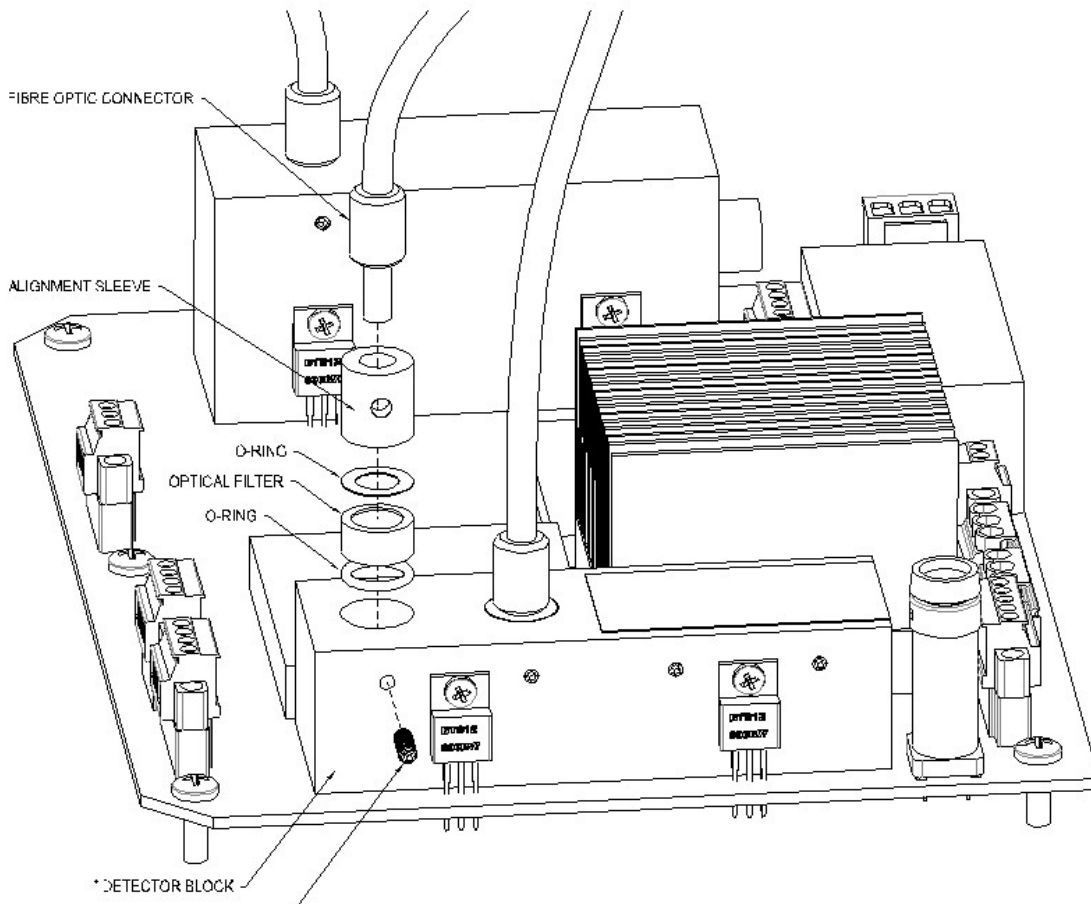


Figure 2-9: Detector Assembly

The block includes:

- Temperature sensor - Measures the temperature of the detector block.
- Detector block heater - Heats the block to a temperature specified during analyzer.
- Fiber optic mounting sleeves - Holds the bandpass filters in place and aligns the fiber optic couplings and filters with the photodetectors.
- Nylon tipped set screws - Secures the detector fiber optic couplings and mounting sleeves to the detector block.
- O-ring spacers - Provide cushioned support for optical filters while keeping them perpendicular to the light. The size and number of the O-rings are adjusted according to the thickness of the filter.
- Optical bandpass filters - Select the desired wavelength range for photometric analysis. The appropriate filter for the application is installed at the time of manufacture of the spectrophotometer.

The photodetector block has 4 sockets. A standard application uses two sockets, one for the analytical measurement and one for the reference measurement. Channels 1 and 2 use high gain amplifiers (from  $10 \times 10^6$  to  $250 \times 10^6$  gain) while channels 3 and 4 use low gain amplifiers (from  $1 \times 10^6$  to  $13.5 \times 10^6$  gain). The channels that are used will depend on the lamp used, the optical filters used and the intensity of each signal.

## 2.2.5 Photodetectors

Photodetectors are mounted on the photonics printed circuit board and measure the intensity of the light after it has passed through the sample and appropriate filter. The photometric signal is converted into an electric signal that is amplified and processed.

## 2.2.6 Pressure Transducer and Temperature Transducer

If a gas cell is employed, a pressure transducer and a temperature sensor are installed to allow for pressure and temperature correction. The Pressure Transducer is connected to the photonics board via P3, and the Resistance Temperature Device is connected via P4. The gas temperature and pressure will only be displayed if the Pressure/Temperature Compensation option is selected in the application program and is set during manufacture. It will be shown under F2 Status on the LCD display and on the *Photonics Data* tab of the *View* page in the application program on the personal computer.

## 2.2.7 Preamplifier Board

The preamplifier card is used to multiply the low level light signal so that it can be further amplified by the system. The board is shown in Figure 2-10. The card consists of 5 dipswitches for each channel that can be set to obtain a desired level of multiplication.

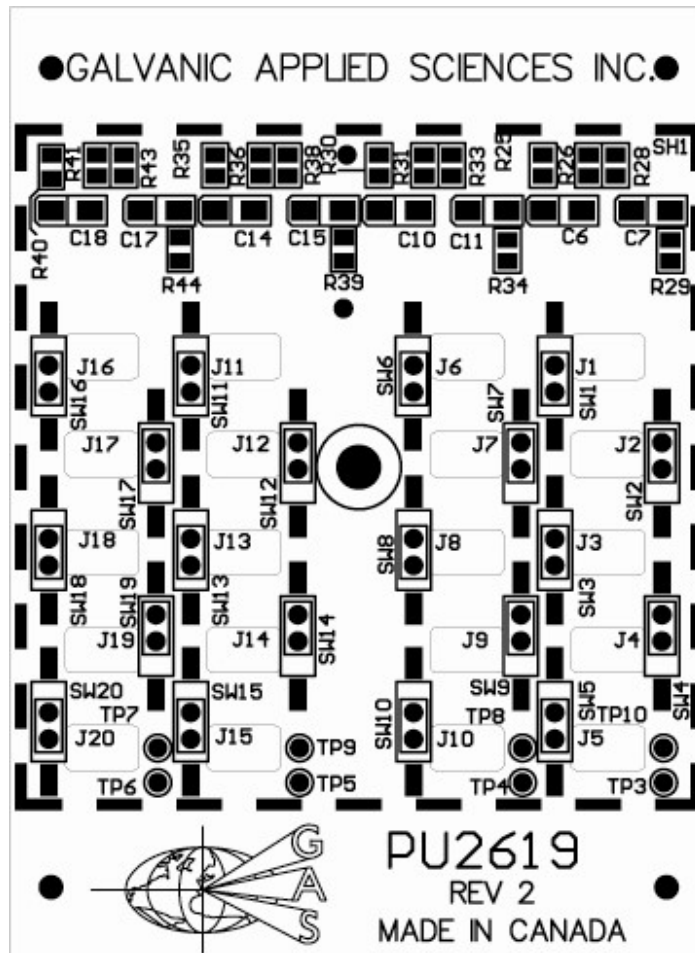


Figure 2-10: Preamplifier Board

## 2.2.8 Photonics Enclosure

The photonics enclosure includes conduit holes for the local area network cable to the controller module, Source and Detector fiber optics and USB port. The conduit ports are fitted with glands and should be sealed for Class 1, Div. 1 operation.

## 2.3 Controller Module

### 2.3.1 Main Controller Board

The main controller board is shown in Figure 2-11.

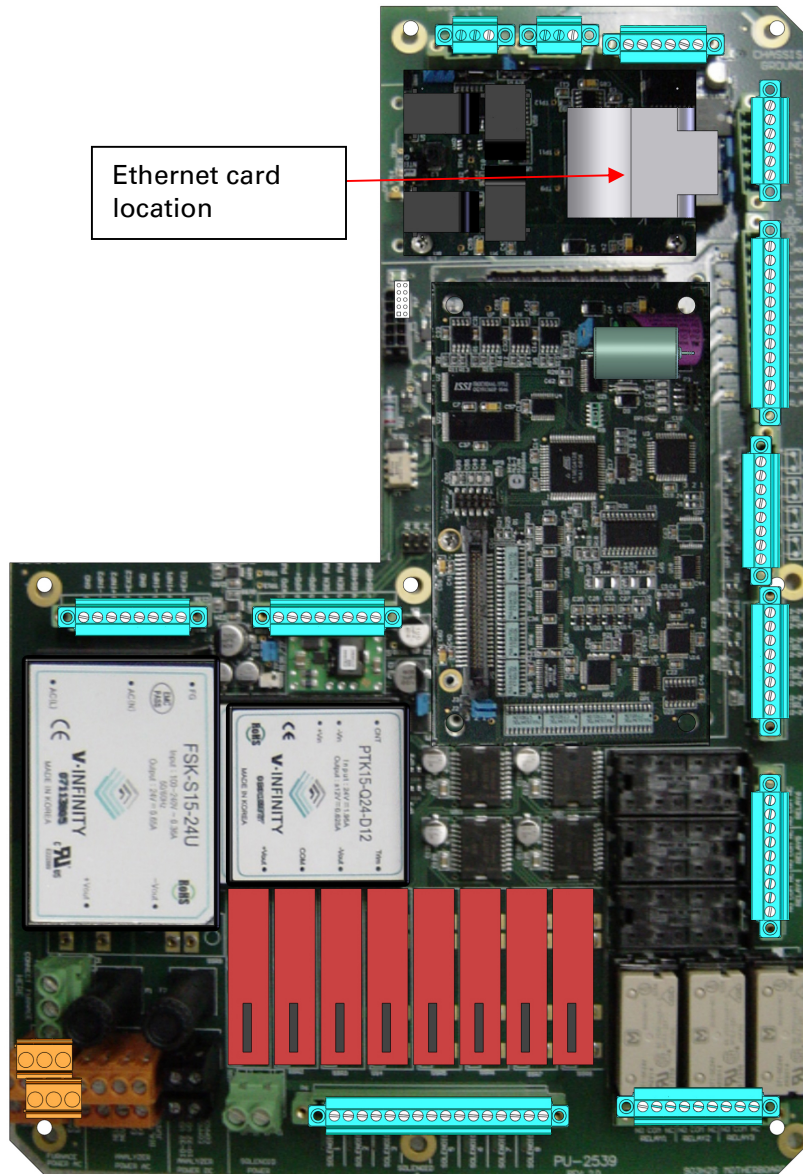


Figure 2-11: Main (I/O) Board

The main controller board includes the following:

- AC power inputs (the working AC voltage range is 100 -240 VAC) - P3,P5
- DC power inputs (the working DC voltage range is 10 – 32 VDC) - P4, P5
- Power Supply, which provides DC power at +5V, +24V.
- 6 isolated analog outputs - P11 (4-20 mA)
- 2 Non isolated analog inputs - P19
- 2 isolated analog inputs - P12
- 6 relays - P7 and P8 (maximum switching power = 2000 VA, 250 V, maximum switching voltage = 350 VAC, 30DC, maximum switching current = 8 A)
- 8 solenoid drivers - P6 - If the AC power supply is employed, the spectrophotometer employs the AC solenoid drivers which are black. If the DC power supply is employed, the spectrophotometer employs the DC solenoid drivers which are Red.
- 4 Wet contact digital inputs - P9 (for remote wiring, remote calibration request, etc.)
- 4 Dry contact digital inputs - P10 (for internal wiring only)
- Isolated RS-485 Port - P16
- High Speed LAN port - P15 for connection to photonics module
- System memory
- System clock battery

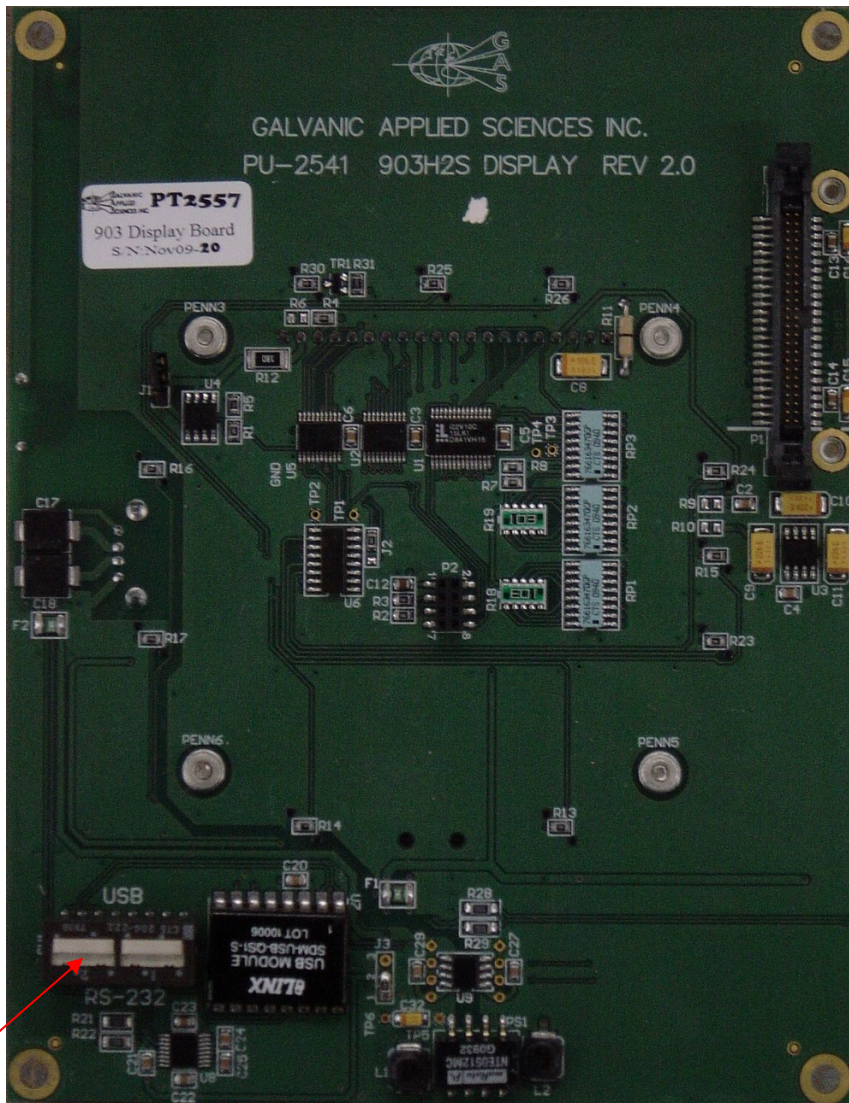
### **2.3.2 Ethernet Card (optional)**

The optional Ethernet card attaches to the main controller board and allows for remote GUI access (Figure 2-11).

### **2.3.4 LCD Display Board**

The LCD display board (Figure 2-12) is mounted on the inside of the front panel of the controller module.





USB/RS232 switch

Figure 2-12: Display Board

The liquid crystal display on the display board provides status information about the spectrophotometer. In the default display mode, the board has three zones: the top of the display contains 4 status indicators (**Abs**, **RUN**, **STATE** and **TIME**), the central part of the display presents the calculated concentration value and the bottom of the display presents the definition of the four function keys (soft keys) which are used in conjunction with the keypad (Section 2.3.5). When the function keys are employed, a number of different menus are presented which allow the user to view a range of instrument settings. If the security password is entered, the system can be calibrated and some parameters can be edited as described in Chapter 5.

The Display board also includes 10 status indicator LED's and houses the isolated USB port for computer / spectrophotometer communication.

### **2.3.5 The Keypad**

The keypad allows the user to make changes to the analyzer without using the application software on the personal computer. The keypad is intrinsically safe, meaning that it can be used even in a class 1 division 1 area without first having to declassify the area. This means that changes can be made to the analyzer quickly and easily on site. The keypad consists of a total of 20 keys. Eleven of these keys are simple numerical keys, marked with the numbers 0 through 9 plus a decimal key. These keys are used for entering in new numerical values. The nine additional keys are used for functions outlined in detail in Chapter 5.

### **2.3.6 Controller Enclosure**

The controller module enclosure includes conduit holes for the local area network cable to the photonics module as well as power inlets, analog and serial signals. The conduit ports are fitted with glands and should be sealed for Class 1, Div. 1 operation.

## Section 3 Installation - Hardware

---

### 3.1 Unpacking

When the system arrives, inspect the packaging for external signs of damage. If there is any obvious physical damage, request that the carrier's agent be present when the unit is unpacked. It is recommended that you retain the shipping container so that it may be used for future shipment of the unit, if necessary.

Remove the analyzer from the package and verify that all parts indicated on the packing list are present and are not damaged. If a component is damaged or missing, notify the carrier and Galvanic Applied Sciences, Inc. (or your local representative) immediately and follow the shippers instructions for damage claims.

## 3.2 Environmental Requirements

### 3.2.1 Electrical Requirements

The power input is 90-240 V AC 50/60 Hz and 10-36 V DC. The power consumption is 30 W at 24 V DC. The system should be grounded to a true ground.

The system meets Class 1, Div. 2, Groups B, C, DT4.

### 3.2.2 Temperature

The system is designed to be operated at ambient temperatures (10-55°C) without an enclosure. Galvanic offers complete analyzer shelters from sun shades to complete buildings. Please contact Galvanic Applied Sciences, Inc. (or your local representative) for additional information.

### 3.2.3 Space Requirements

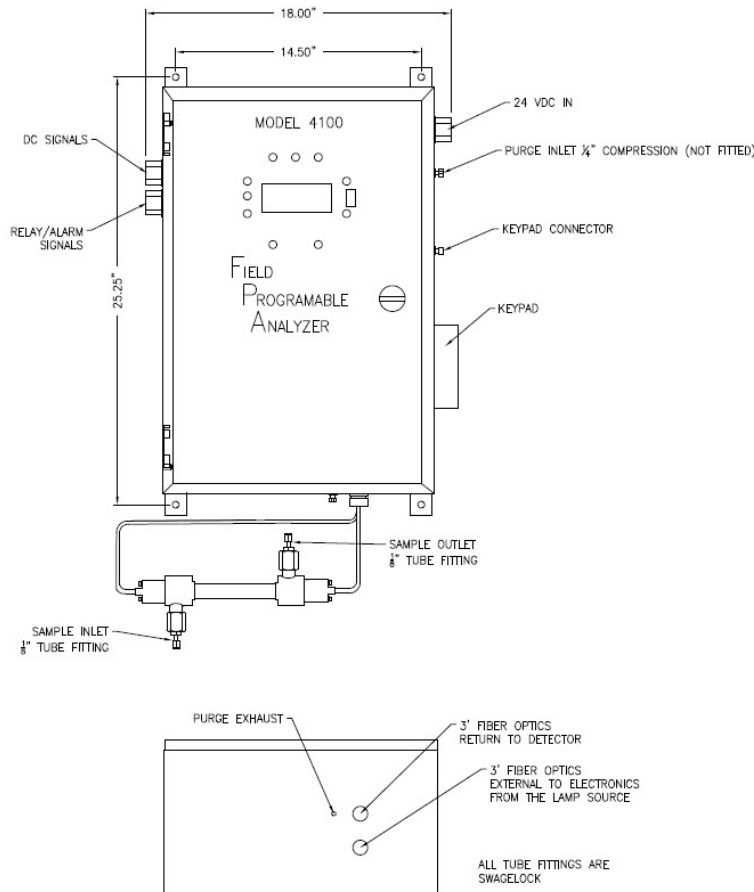
The dimensions of the control module and photonics module are presented in Table 3-1.

**Table 3-1: Dimensions of Control Module and Photonics Module**

<b>Dimensions (Nominal)</b>	Fiberglass Enclosure Control Module 14 9/16"H x 12 9/16"W x 8"D Photonics Module 12 9/16"H x 14 9/16"W x 8"D
	Explosion Proof Enclosure Control Module 17 3/8"H x 13 3/8"W x 8 7/16"D Photonics Module 16 1/4"H x 16 1/4"W x 8 15/16"D
<b>Weight</b>	Fiberglass Enclosure Control Module 15 lbs (6.8 kg) Photonics Module 20 lbs (9.1 kg)
	Explosion Proof Enclosure Control Module 56 lbs (25.5 kg) Photonics Module 80 lbs (36.2 kg)

### 3.3 Locating the Spectrophotometer in the Facility

The overall dimensions of the analyzer, and location of AC/DC conduits, fiber optic and feed throughputs is presented in Figure 3-1 and 3-2. The analyzer should be mounted as close as possible to the process stream.. In addition, ensure that sufficient space is provided for a personal computer and a printer (optional). Be sure that there is enough clearance around the unit so that the door can open at least 90 degrees.



**Figure 3-1: FPA Class I Div 2 analyzer dimensions**

The cell should be as close as possible to the analyzer. If the cell is located at a significant distance from the photonics module, there may be a drop off in the observed intensity of the source and/or the transmitted light. In addition, if the distance is excessive, the sample that is being monitored may not accurately reflect the actual status of the process stream.

The analyzer must be mounted upright. The height at which the unit is mounted should allow for easy access to the keypad and easy viewing of the display.

### 3.4 Mounting and Plumbing the Cell

Mount the measurement cell in a rigid position such that the sample inlet is at the bottom so the sample will flow upward through the cell.

**NOTICE**

**Do not rely on the sample feed and return tubing to support the cell permanently.**

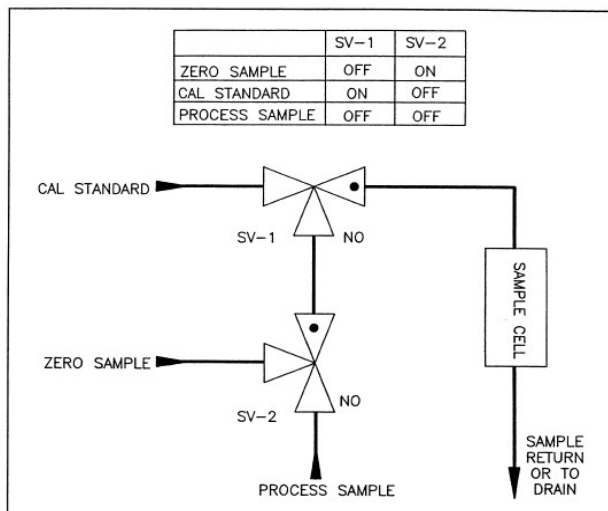
- The *Standard Bypass* style cell should be mounted horizontally with the sample inlet at the bottom. The cell should be secured in place with suitable brackets or straps. It can accept 0.25", 0.375", 0.5 or 6 mm or 12 mm compression tube fittings for connection to sample tubing.
- The *Pipeline* style cell is usually supported by the pipe to which it is attached. Be sure to install proper gaskets and use the correct bolts for the flanges supplied. Orient the cell so that sample will flow upward through the cell in order to reduce any possibility of a void forming in the cell. This cell is used with ½", 1", 1 1/2" or 2" pipelines with ASA 150 ASA 300 or DIN standard cap flanges.

Additional information about the sample cell assembly is presented in Section 2.2.3.

**CAUTION**

**The sample connections to the cell should have manual shutoff valves and a drain cock to simplify removal of the cell for cleaning or other maintenance.**

There should be a provision for either manually or automatically introducing the calibration sample and the zero sample into the cell in order to periodically calibrate the instrument. Figure 3-3 shows an appropriate valve configuration. If electric valves are installed, it is good practice to also provide manual override valves.



**Figure 3-3: Valve Configuration and Control for Introducing Auto Calibration Sample and Zero Calibration**

## 3.5 Installing the Fiberoptic Bundles

### 3.5.1 Description of the Bundles

Two fiber optic bundles are supplied with the 4000/4100 Spectrophotometer:

- a) The fiber optic connecting the source to the cell:
  - If the system is configured for UV using a Mercury, Mercury Biphosphor, Cadmium or Zinc lamp (4100 Spectrophotometer), the fiber optic bundle used to connect the source block to the measurement cell has a single spigot at each end.
  - If the system is configured for VIS and has a Tungsten lamp (4000 Spectrophotometer), the fiber optic bundle used to connect the source block to the measurement cell has two spigots at one end (bifurcated) and a single spigot at the other end.
- b) The fiber optic connecting the cell to the detector block has a single spigot at the end that is inserted into the cell and two spigots that are to be inserted into the detector module with each of the spigots having a larger diameter (0.25").

#### **NOTICE**

**If the unit includes a heated cell compartment, the fiber optic bundles will already be installed and fitted to the measurement cell.**

### 3.5.1 Connecting the Fiberoptics Bundle from the Source Block to the Measurement Cell

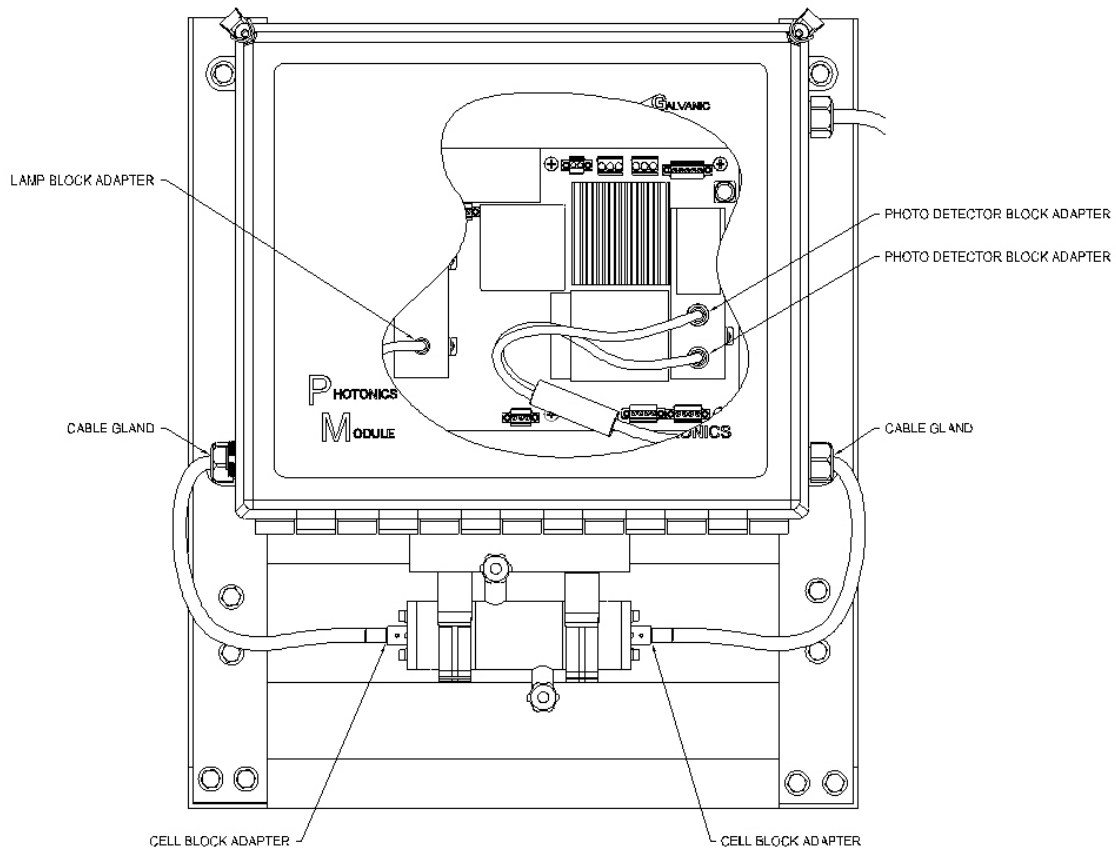
#### **NOTICE**

**The fiber optic bundles that are provided with the unit should reach the sample cell without stretching or kinking and should be routed so that they will not be bumped or damaged during day to day operations. It is good practice to allow a foot or two of slack fiber optic cable at the cell.**

In some cases, the fiber optic bundles may be connected to the source and the detector and all that is required is to feed the bundles through the conduits and connect to the measuring cell as described in the steps below.

To connect the Fiberoptics Bundle from the Source Block to the Measurement Cell:

- a) Fit the Source to Cell fiber optic bundle as shown in Figure 3-4. For the 4000 Spectrophotometer, the bifurcated end of the cable should be located inside the photonics module. For the 4100 Spectrophotometer, the two ends are equivalent.



**Figure 3-4: Fiber Optic Bundle Routing, Cell Detail**

- b) Fit the fiber optic cable into the opening on the fiber optics retainer block which is located on top of the source block as shown in Figure 3-4.

**CAUTION** The ends of the fiber optic bundle are easily scratched. Take care not to damage them during handling. In addition, do not allow the bundles to twist or bend sharply at any time.

- c) Push firmly until the shoulder is firmly seated against the block.
- d) Using the 1/16" hexagonal Allen wrench that is supplied, tighten the #5-40 set screw.

**CAUTION** Do not overtighten the set screws.

- e) Feed the fiber optics bundle through the 1/2" conduit hub on the right-hand side of the enclosure.



**NOTICE**

If the unit is being installed in a hazardous location, it may be necessary to use sealed fittings.

- f) Using suitable support for the bundle such as a cable tray or flexible conduit, route the fiber optic bundle to the measurement cell.
- g) Insert the spigot into the fiber retaining ring of the measurement cell as shown in Figure 3-5.

**Figure 3-5: Fiber Optic Bundle Routing, Cell Detail**

- h) Tighten both of the 1/4" #5-40 set screws. These screws are located at a 90° angle to each other.

### **3.5.2 Connecting the Fiber Optics Bundle from the Measurement Cell to the Detector Block**

**NOTICE**

You must start at the Detector Block End.

- a) Take the end of the fiber optic bundle with the two spigots and connect the spigot labeled number 1 to the left-hand sleeve of the detector block and connect the spigot labeled number 2 to the right-hand sleeve of the detector block.
- b) Pass the fiber optic bundle through the terminal hub.

**NOTICE**

If the unit is being installed in a hazardous location, you may need to use sealed fittings.

- c) Using suitable support for the bundle such as a cable tray or flexible conduit, route the fiber optic bundle to the measurement cell.
- d) Insert the spigot into the fiber retaining ring of the measurement cell as shown in Figure 3-4.
- e) Tighten both of the 1/4" #5-40 set screws. These screws are located at a 90° angle to each other.

## 3.6 Electrical Installation

### 3.6.1 General Wiring Information



**Make sure power mains are OFF before beginning to wire the system. Do not power up the system until you are instructed to.**

It is suggested that main power cutoff switches are installed near each module.

Be certain to follow all appropriate electrical codes and to attach a proper earth ground to the spectrophotometer.

### 3.6.2 Input Power Wiring - Controller Module

The controller module operates on 90-240 V AC and 10-32 V DC (the DC power can be provided by a customer supplied AC/DC converter). The spectrophotometer does not need both AC and DC power to run as it can run on either AC or DC. The ability to use either AC or DC is provided so that if the AC power fails, the DC power supply would take over without the spectrophotometer being powered down.

The AC power should be connected to P3 on the main board and the DC power should be connected to P4 on the main board as shown in Figure 3-6. The cables should be routed through the *Power* conduit on the bottom of the module.

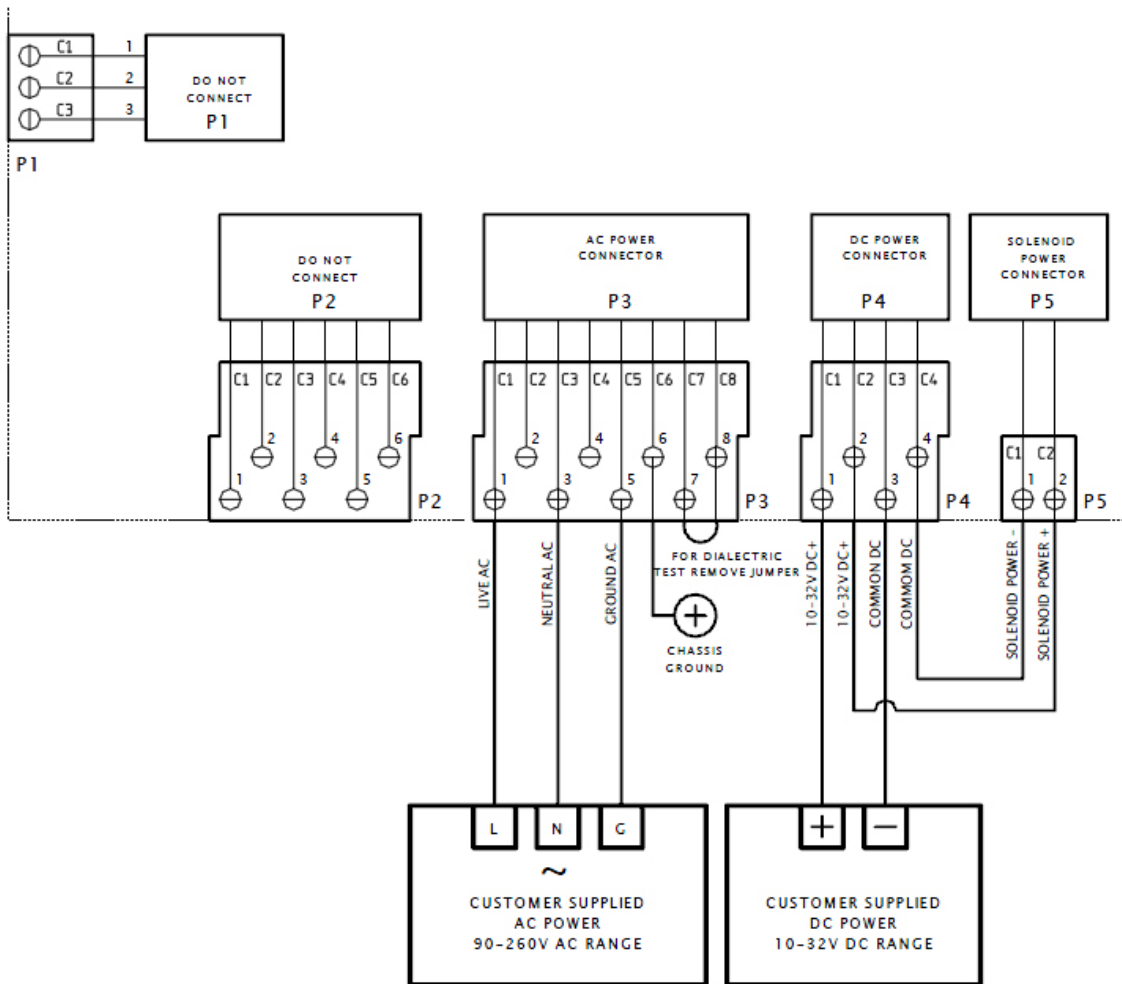


Figure 3-6: Input Power Wiring – Controller Module

**NOTICE**

The controller can operate in a dual redundant power mode. In case of an AC power supply failure, the module analyzer will continue to operate on the DC power. The controller uses AC power source as a primary (if both power supplies are on, the analyzer is drawing current from the AC source).

**WARNING**

If the dual redundant power system is employed, DC solid state relays are used (DC solid state relays are coloured red) and DC power is connected to the Solenoid power connector P5 on the main board.

### 3.6.3 Input Power Wiring - Photonics Module

The photonics module operates on 12-32 V DC (the DC power can be provided by a customer supplied AC/DC converter). The power should be wired to P1 on the main board as shown in Figure 3-7 using #18 AWG to #14 AWG wire which is routed through the conduit port. P1 and P2 are equivalent and the power can be connected to either position. If desired, two different power supplies can be connected to P1 and P2 to ensure that system operation is maintained in case of a power supply problem. If DC power is not available at site, Galvanic Applied Sciences offers an AC/DC converter option. In this case, the AC power will be connected to terminals located inside the photonics module enclosure.

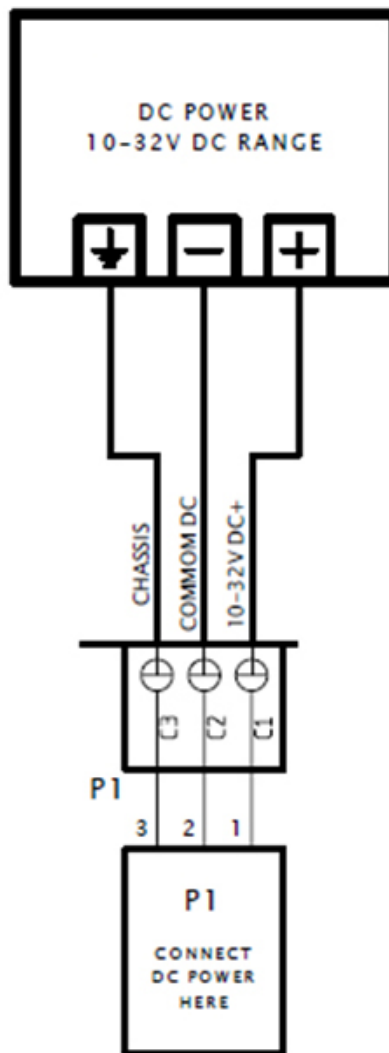


Figure 3-7: Input Power Wiring – Photonics Module

The power cable should be routed through the *Power* conduit at the bottom of the module. Be certain to follow all appropriate electrical codes and to attach a proper earth ground to the spectrophotometer.

### 3.6.4 Digital Input Lines

There are four digital input lines through which dry external commands may be applied to the instrument and four digital input lines through which wet commands can be applied to the spectrophotometer. The digital inputs may be used to accept alarm inputs from an external device (such as a pressure switch) or to command various analyzer sequences to be run. The digital inputs can be configured in the application program as described in Section 6.6.3.

The wet inputs are made on P9 of the controller board (Figure 3-8) and the dry inputs are made on P10 of the main board in the controller module (Figure 3-9). The cables should be routed through the *Alarm Relays* conduit on the bottom of the module.

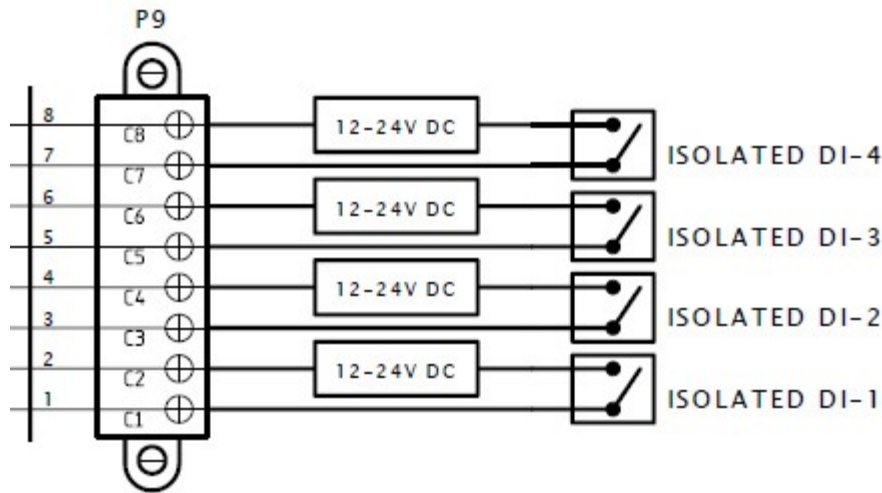


Figure 3-8: Digital Inputs (Wet) Wiring Diagram

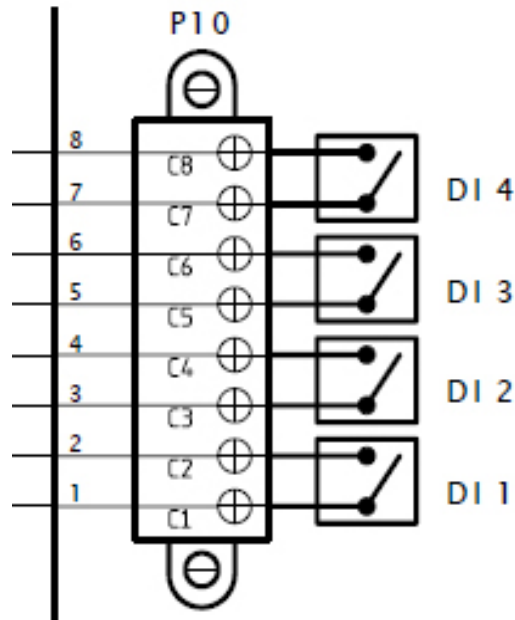


Figure 3-9: Digital Inputs (Dry) Wiring Diagram

### 3.6.5 Digital Output Lines

There are six relays and eight solenoid drivers through which the system can send commands to external devices. The solenoid drivers are connected via connector P6 on the Main board (Figure 3-10) in the Controller module. The relays are connected via connectors P7 and P8 Main board in the Controller module (Figure 3-11). The cables for the relays should be routed through the *Alarm Relays* conduit on the bottom of the module and the cables for the solenoids should be routed through the *Solenoids* conduit.

**⚠ WARNING**

For the FPA4000/4100 controller DC version, DC solid state relays should be used (DC solid state relays are red in colour) and DC power is connected to the P5 solenoid power connector.

**⚠ WARNING**

For the FPA4000/4100 controller AC version AC solid state relays are used (AC solid state relays are black in colour) and AC power is connected to the P5 solenoid power connector.

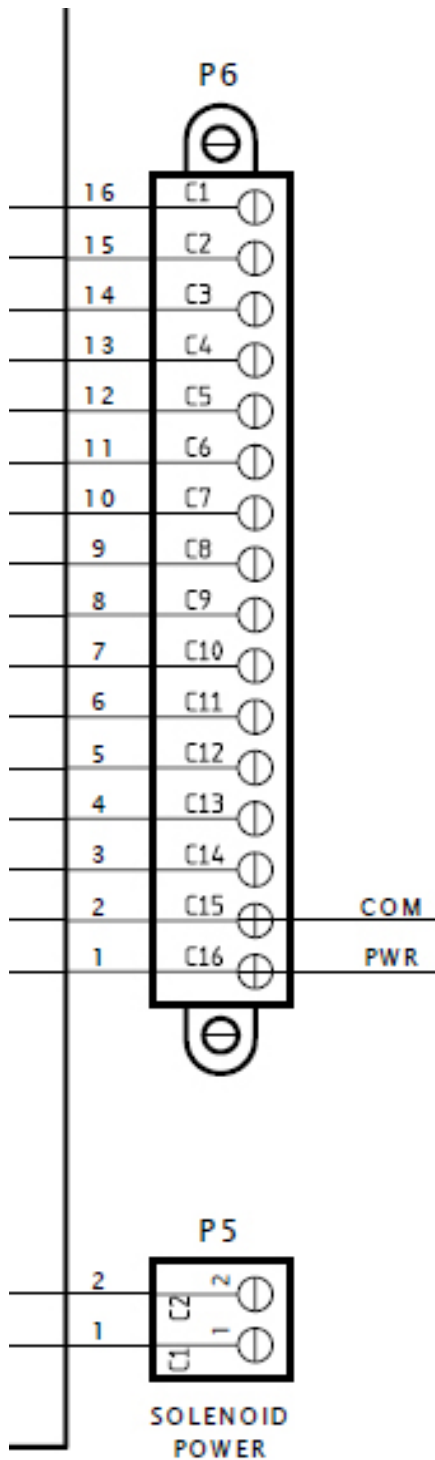


Figure 3-10: Digital Output - Solenoid Drivers

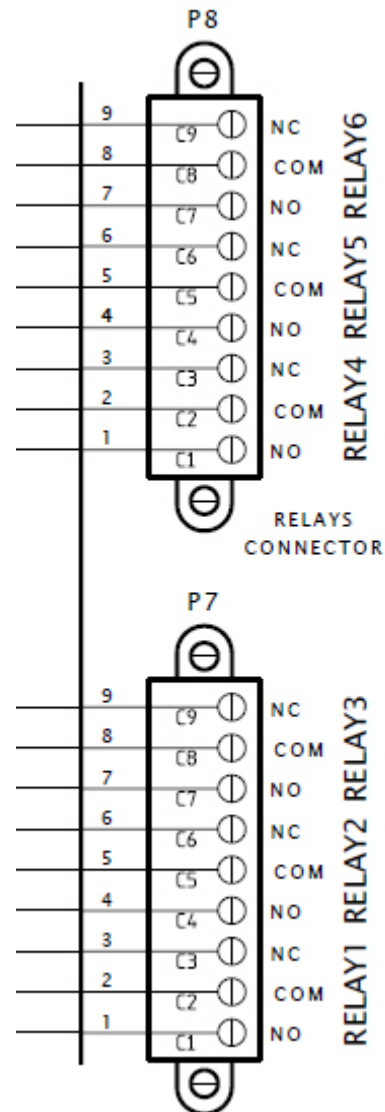
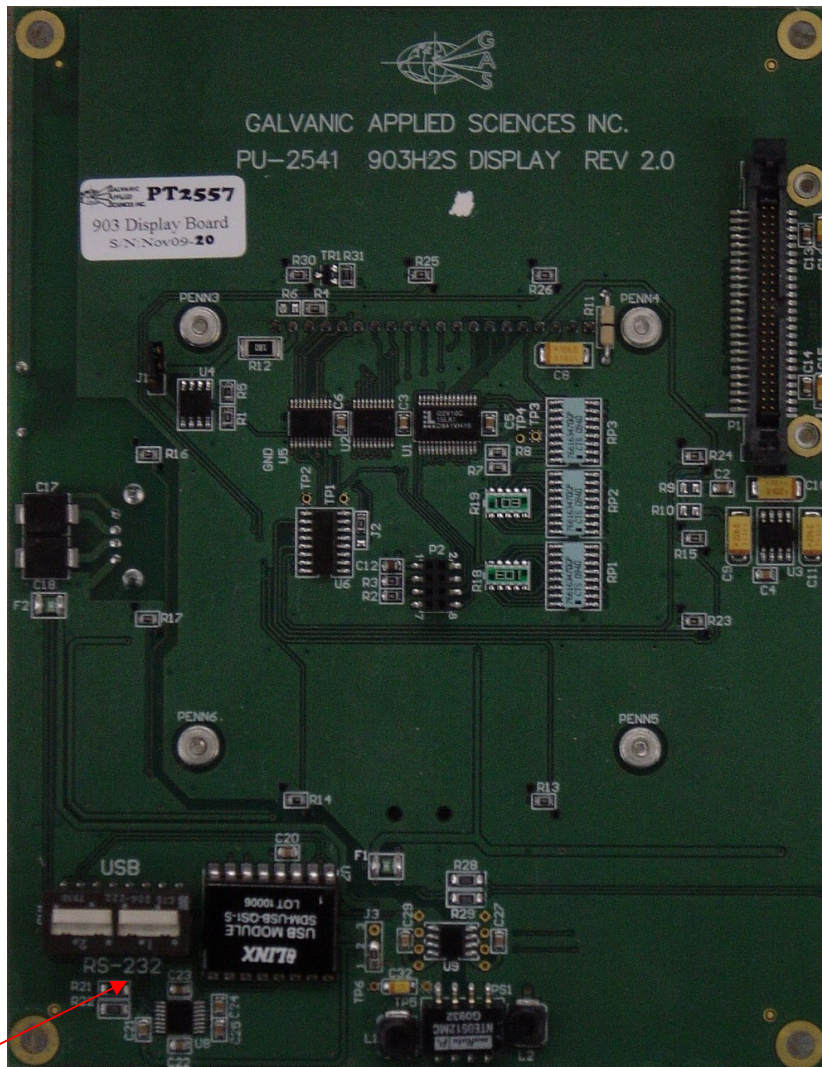


Figure 3-11: Digital Output - Relays

### 3.7 Communication between Components of the System

The control module and the photonics module are connected via a LAN link which allows the two units to be separated by a distance of up to 150 meters. The LAN cable connector is on the right side of the photonics module and the underneath of the control module as shown in Figures 3-1 and 3-2.

A personal computer can be connected to the controller module via USB or RS232. The default connection method is via a USB connection, and the instrument is configured in that mode when shipped. If it is necessary to use an RS-232 connection, it is necessary to change Dipswitch SW1 on the display board (Figure 3-12). An optional Ethernet card is available which allows remote connection from the personal computer to the analyzer via a local area connection.



USB/RS232 switch

Figure 3-12: USB/RS232 Switch



The mode of interaction between the computer and the spectrophotometer is selected by via the *Communications setup* page in the application software which is accessed by the **Setup Communications** button on the main window. See Section 4.5.2 for details.

The handheld keypad is connected to the system via the socket on the socket on the front panel.

After all components have been installed, power up the system.

## 3.8 Communication with External Devices

The spectrophotometer can be interfaced to external devices via USB, RS-232, RS-485 and Ethernet.

### 3.8.1 USB

A computer with a USB port can be connected into the USB port on the front panel. The Rx and Tx LED's will be illuminated when the spectrophotometer is receiving or transmitting information.

### 3.8.3 RS-485

The isolated RS-485 port (P16) is shown in Figure 3-13.

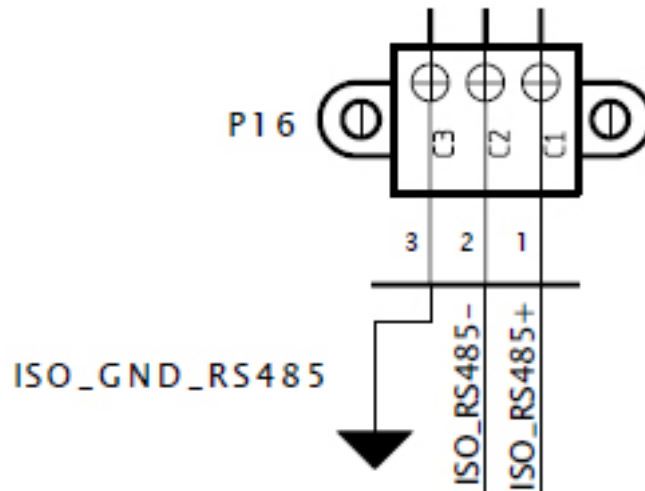


Figure 3-13: Isolated RS-485 Port

### 3.8.4 Ethernet Connection (optional)

The optional Ethernet card (Figure 3-14) allows GUI access to the analyzer via a local area network. This option is useful for remote analyzer diagnostics and trouble shooting

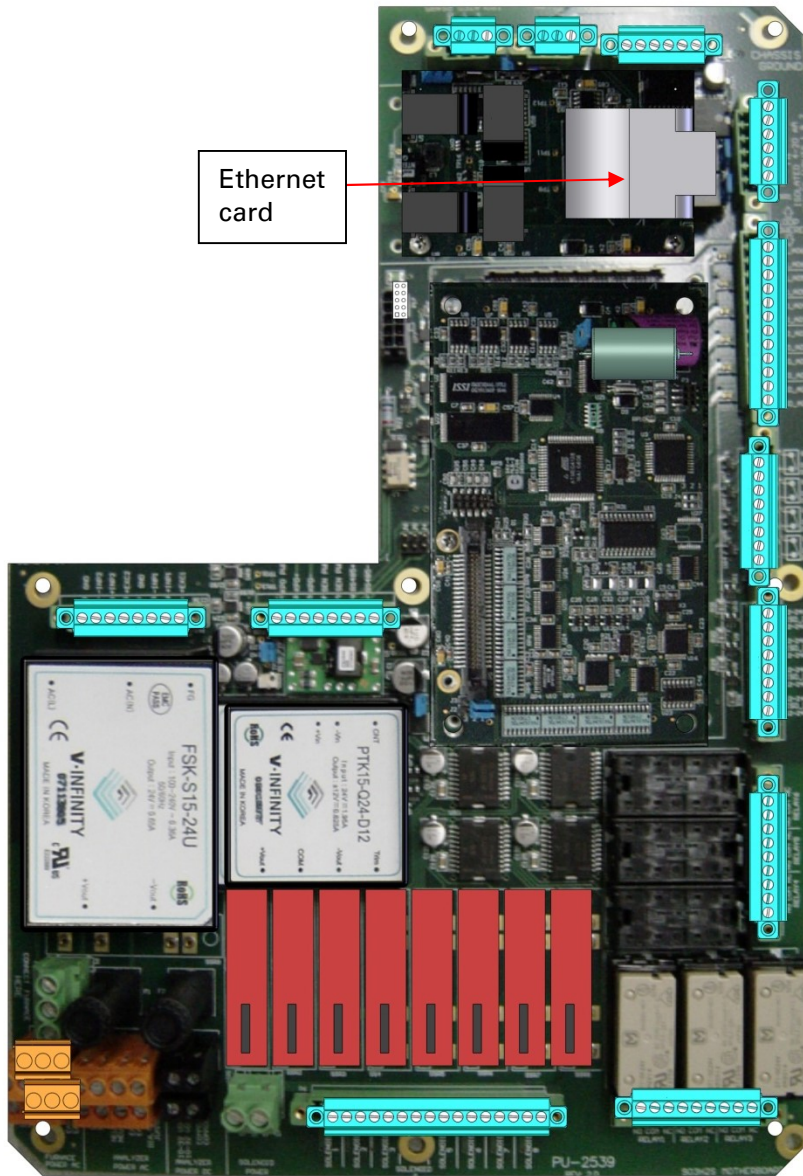


Figure 3-14: Main Board



## Section 4 Software and Drivers Installation

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### 4.1 System Requirements

Table 4-1 shows the system requirements for the FPA 4000/4100 Graphical User Interface.

**Table 4-1: Computer Requirements for the FPA 4000/4100 Graphical User Interface**

<b>Parameter</b>	<b>Requirement</b>
Operating System	System Microsoft® Windows™ 2000, XP, Vista and Windows 7
Memory	Minimum 512MB
Disk Drives	A CD ROM drive is required to read the installation disk, and a minimum of 20 MB of space is required for installation on the PC hard drive. More space will be required to save analyzer configurations and archive data.
Serial/USB Port	The FPA 4000/4100 can be connected to the PC via either a 9-pin male serial connector or via a standard USB cable (included with the analyzer). The COM port used to connect to the FPA 4000/4100 cannot be used for any other purposes; otherwise connecting to the FPA 4000/4100 will not be possible.

### 4.2 Software Installation - Graphical User Interface (GUI)

The FPA 4000/4100 Graphical User Interface (GUI) that is included with the spectrophotometer allows the operator to configure all aspects of the spectrophotometer's operation and perform analyses. The GUI is capable of communicating with the analyzer through USB, RS-232 (serial), or High Speed LAN (Ethernet). The GUI requires a Microsoft Windows compatible PC, with Windows 2000 or newer operating system installed.

## 4.3 Installation of USB Drivers

### NOTICE

This section describes the overall installation protocol if USB drivers are employed. The format of Figures 4-1 to 4-3 may be slightly different for various Windows operating systems. If you are not using USB drivers, change the position of the dip switch on the display board of the controller unit as described in Section 3.7 and proceed to Section 4.4.

The spectrophotometer can communicate with the computer via the Universal Serial Bus (USB) or RS-232. The default method is USB; if RS-232 is employed, it will be necessary to change the position of a dip switch on the display board of the controller unit as described in Section 3.7.

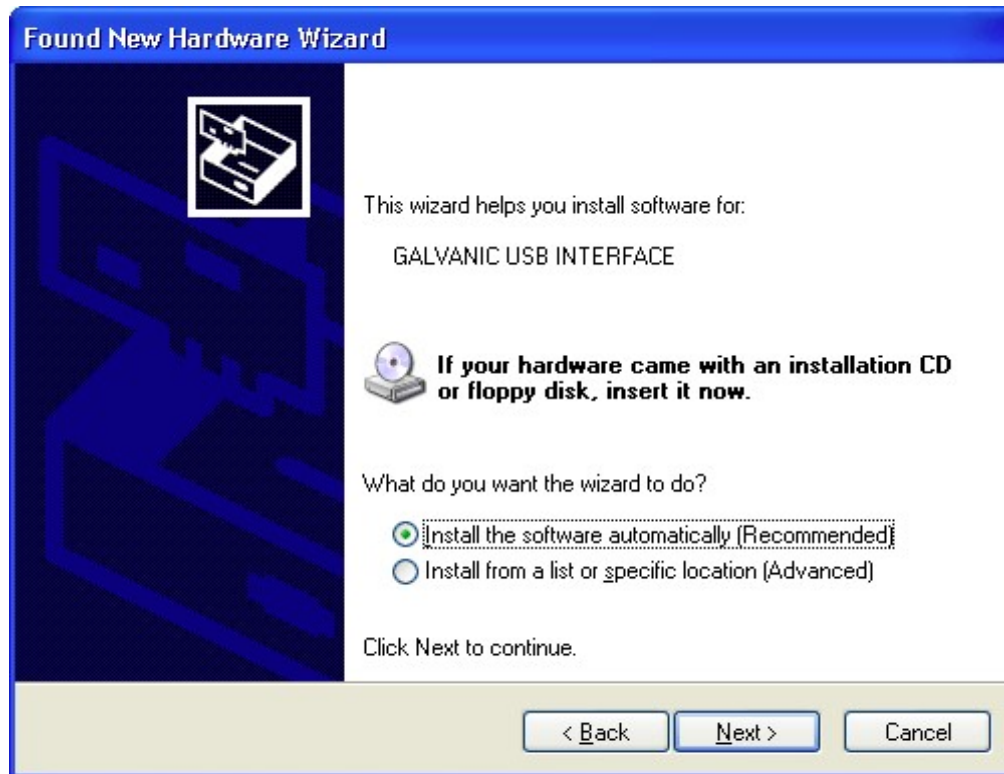
To install USB drivers:

- a) Ensure that the USB cable has been connected to the control module and the PC and that both systems are powered up. Windows will immediately detect new hardware.
- b) If the PC is running Windows, a balloon notifying the user that Windows has found new hardware (**4000/4100 Analyzer**) will appear in the taskbar, and then a window similar to that shown in Figure 4-1 will be presented.



Figure 4-1: Windows USB Installation Screen 1

- c) Select **No, Not This Time** and then press **Next** to present Figure 4-2.



**Figure 4-2: Windows Installation Screen 2**

- d) Select **Install the Software Automatically (Recommended)** radio button and then press **Next**. Windows will search for the driver files that it needs. Once it finds them, Figure 4-3 will be presented.



**Figure 4-3: Windows Installation Screen 3**

- e) Select **Continue Anyway**. This will allow the installation of the driver to continue. It will copy the required files, and then bring up one final window. Select **Finish** to complete the installation.
- f) Once the first installation is complete, the PC will identify a second piece of hardware (4000/4100 Analyzer) that it needs drivers for. Repeat the above procedure to install this second set of drivers. Once this set of drivers has installed, a balloon will appear in the taskbar indicating that the hardware is installed correctly and is ready to use.



## 4.4 Installing the Application Software

If the setup utility does not automatically load:

- a) Press the **Start** button and then select **Run** from the *Start* menu.
- b) Type in the drive designation for the drive containing the compact disk (e.g. **D :**) followed by **setup.exe**.
- c) Press **Enter** and follow the instructions given.

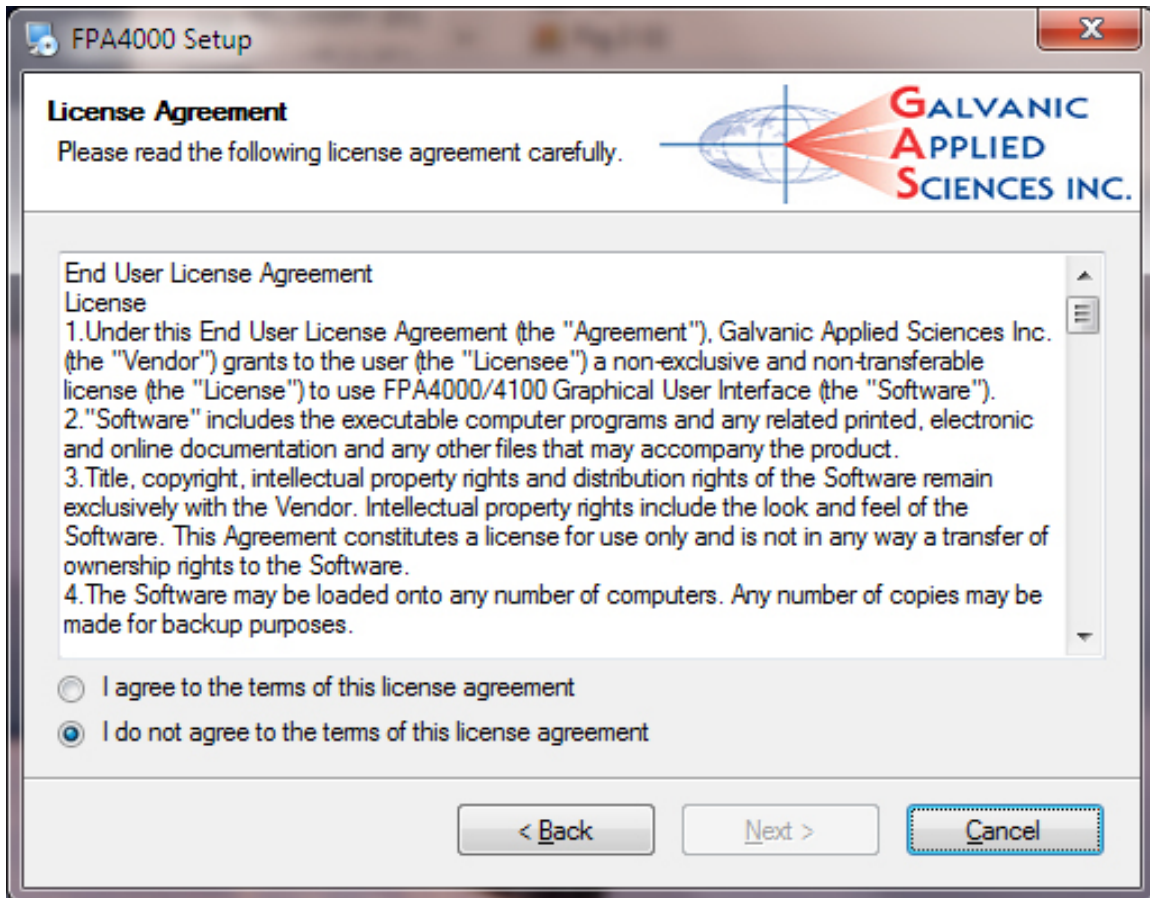
To install the application software:

- a) Access the application program on the CD and start it. The *Welcome* dialog box (Figure 4-4) will be presented.



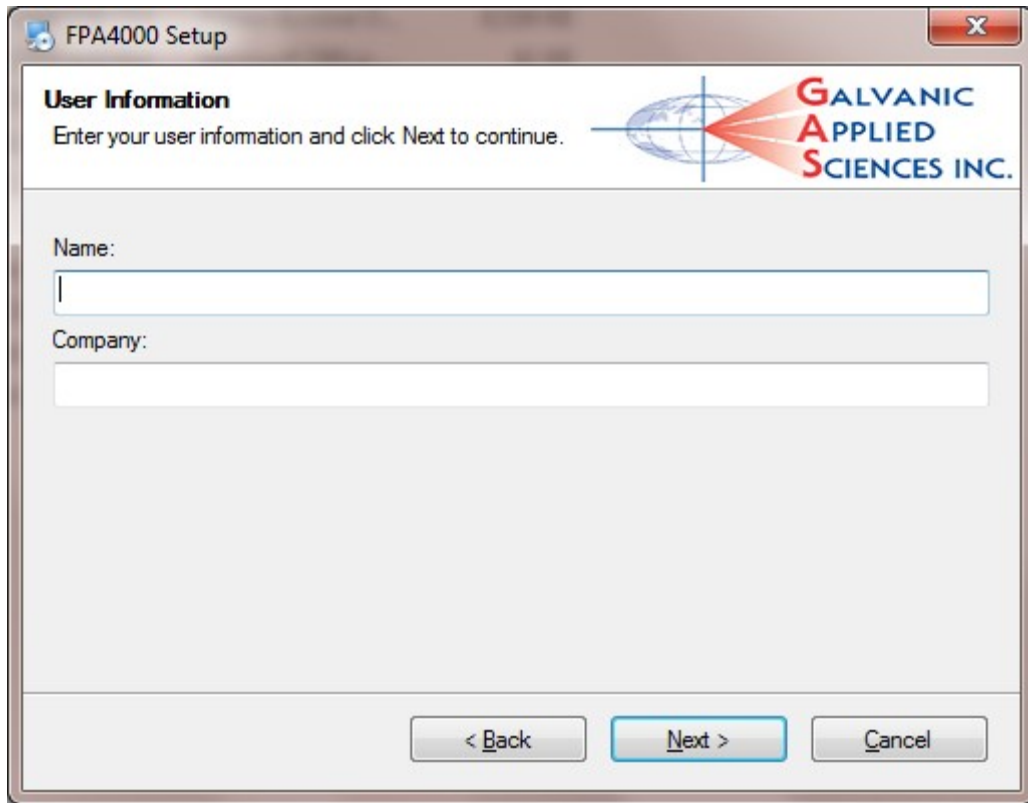
Figure 4-4: Welcome Dialog Box

- b) Press the **Next** button to present the *License Agreement* dialog box (Figure 4-5).



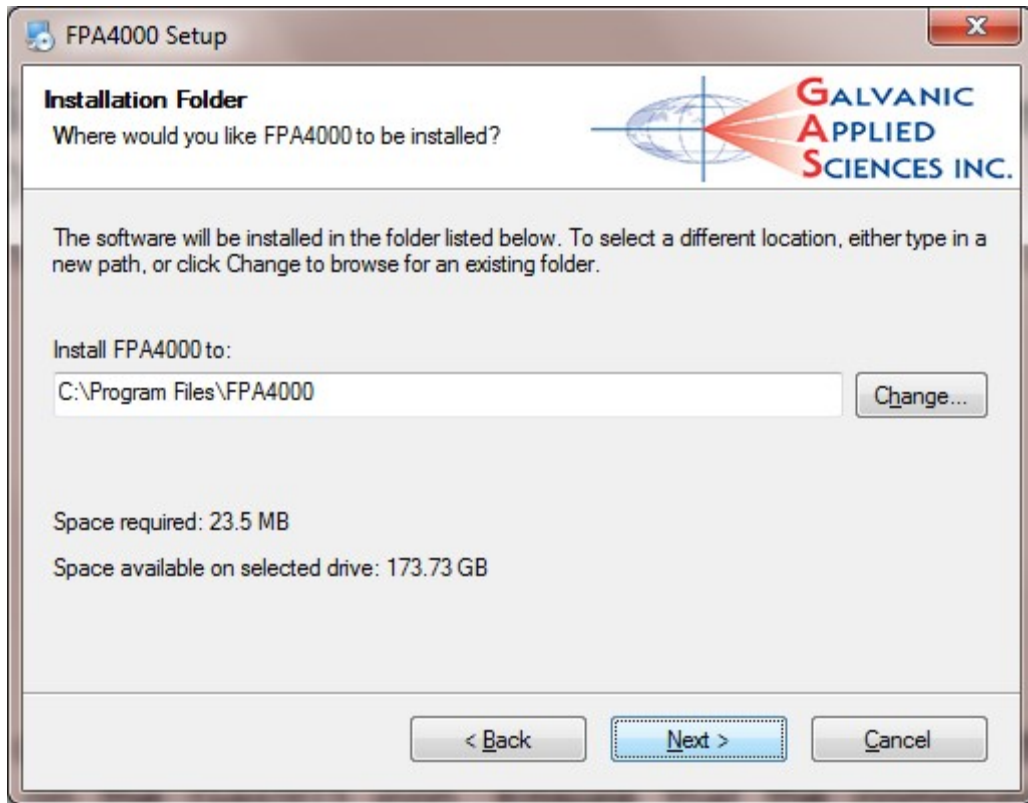
**Figure 4-5: License Agreement Dialog Box**

- c) Review the agreement and select the *I agree to the terms of this license agreement* radio button. The *Next* button will be activated.
- d) Press the **Next** button to access the *User Information* dialog box (Figure 4-6).



**Figure 4-6: User Information Dialog Box**

- e) Enter your name and company name; then press **Next** to access *the Installation Folder* dialog box (Figure 4-7).

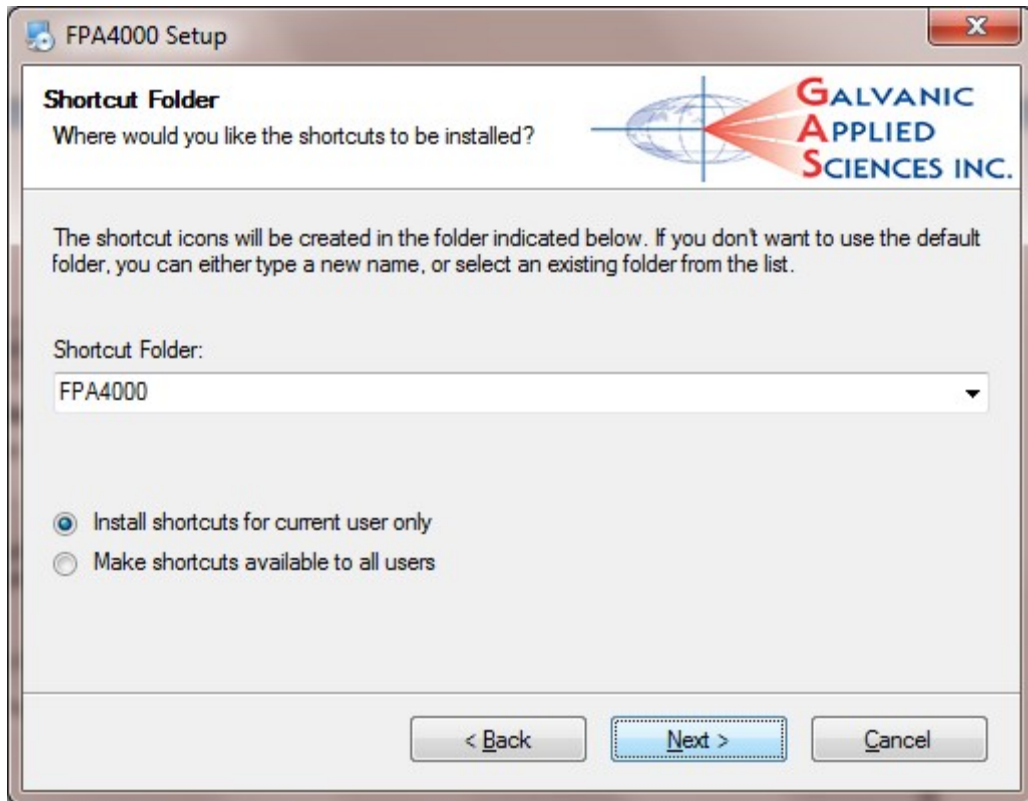


**Figure 4-7: Installation Folder Dialog Box**

- f) Indicate the folder in which the software should be loaded and press **Next** to access the Shortcut Folder dialog box (Figure 4-8).

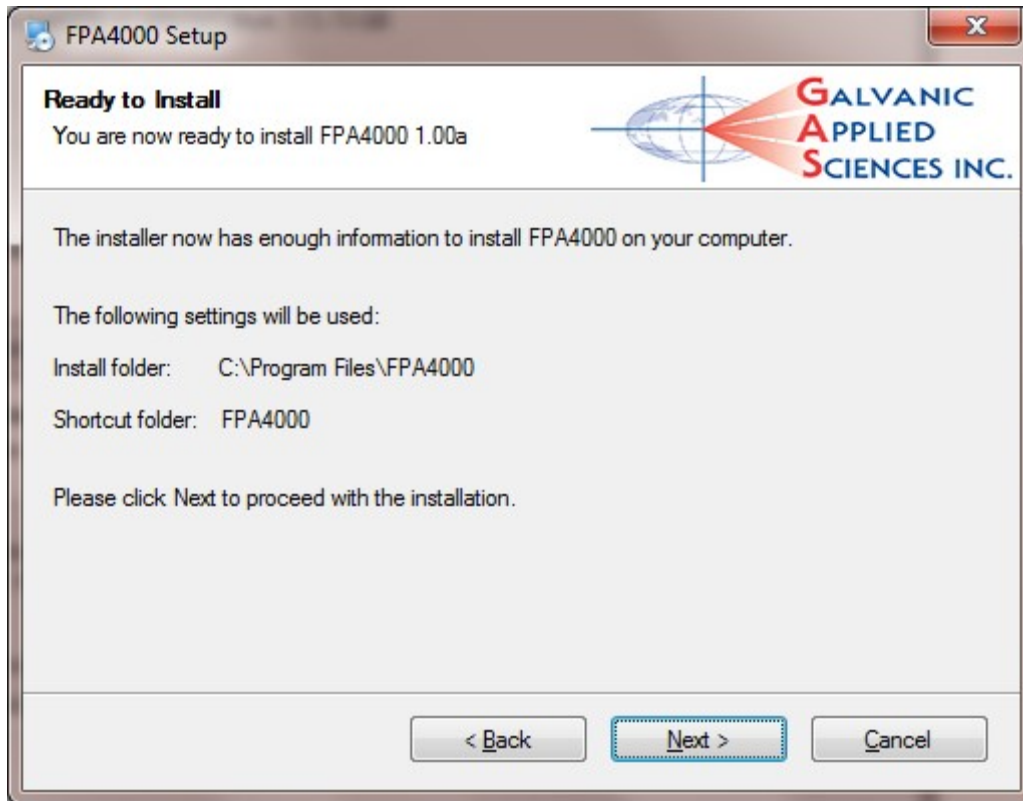
**NOTICE**

It is recommended that the default location be used.



**Figure 4-8: Shortcut Folder Dialog Box**

- g) Indicate the shortcut folder to be used for the shortcut icon, select the desired shortcut option and press **Next** to present the *Ready to Install* dialog box (Figure 4-9).



**Figure 4-9: Ready to Install Dialog Box**

- h) Press **Next**. The application software will be installed. A green stripe will indicate the progress of the installation (Figure 4-10) and the *Installation Successful* dialog box (Figure 4-11) will be presented at the conclusion of the installation.

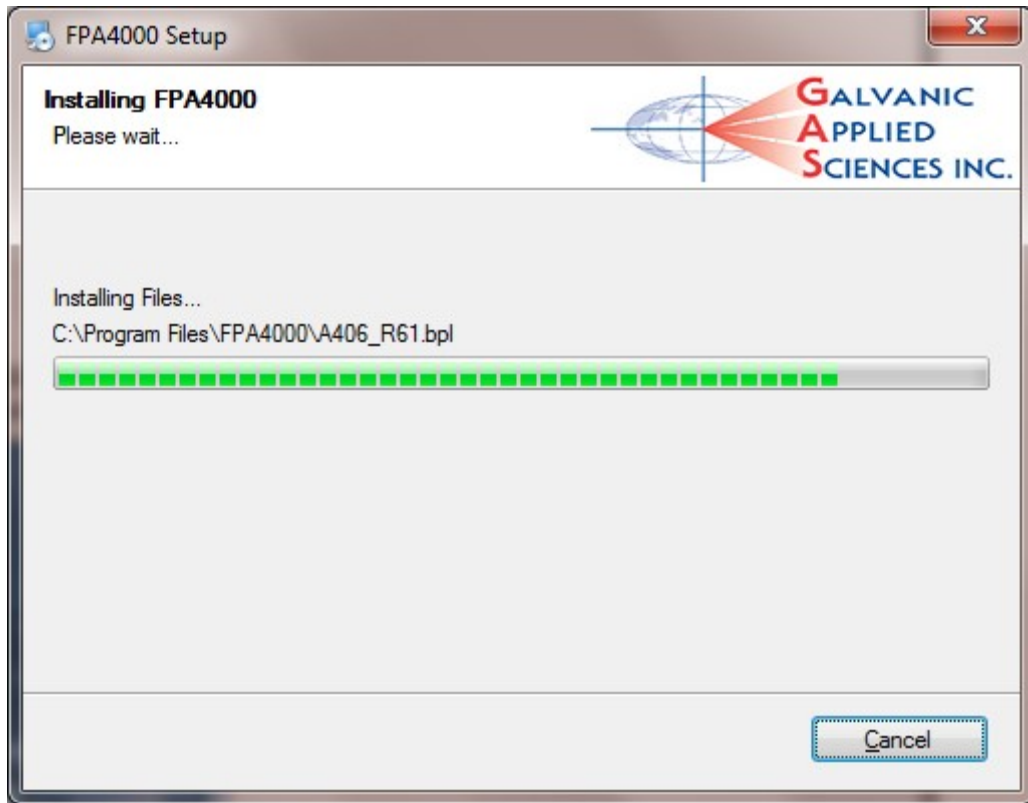
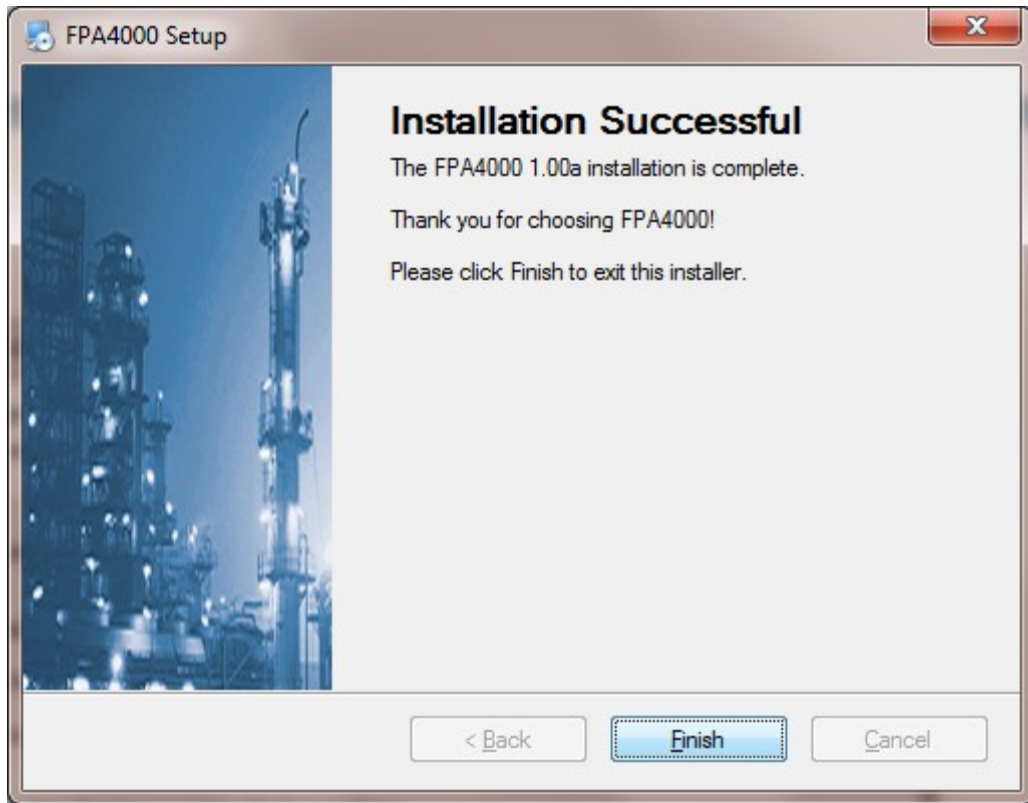
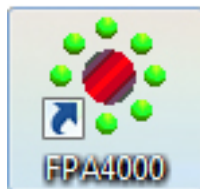


Figure 4-10: Installing Dialog Box



**Figure 4-11: Installation Complete Dialog Box**

- i) An icon for the system (Figure 4-12) will be located in the directory that you indicated in Figure 4-8. If you want to place an icon on the desktop so it can be readily accessed, select *Start menu/all programs*, right click on *FPA4000* and choose **Send to desktop**.



**Figure 4-12: FPA4000 Icon**



## 4.5 Connecting the FPA 4000/4100 to the PC

### 4.5.1 Starting the Application Program

The application program is started by pressing the FPA4000 icon (Figure 4-12). During initialization, the display shown in Figure 4-13 is presented and when the initialization is complete, the main window (Figure 4-14) is presented.

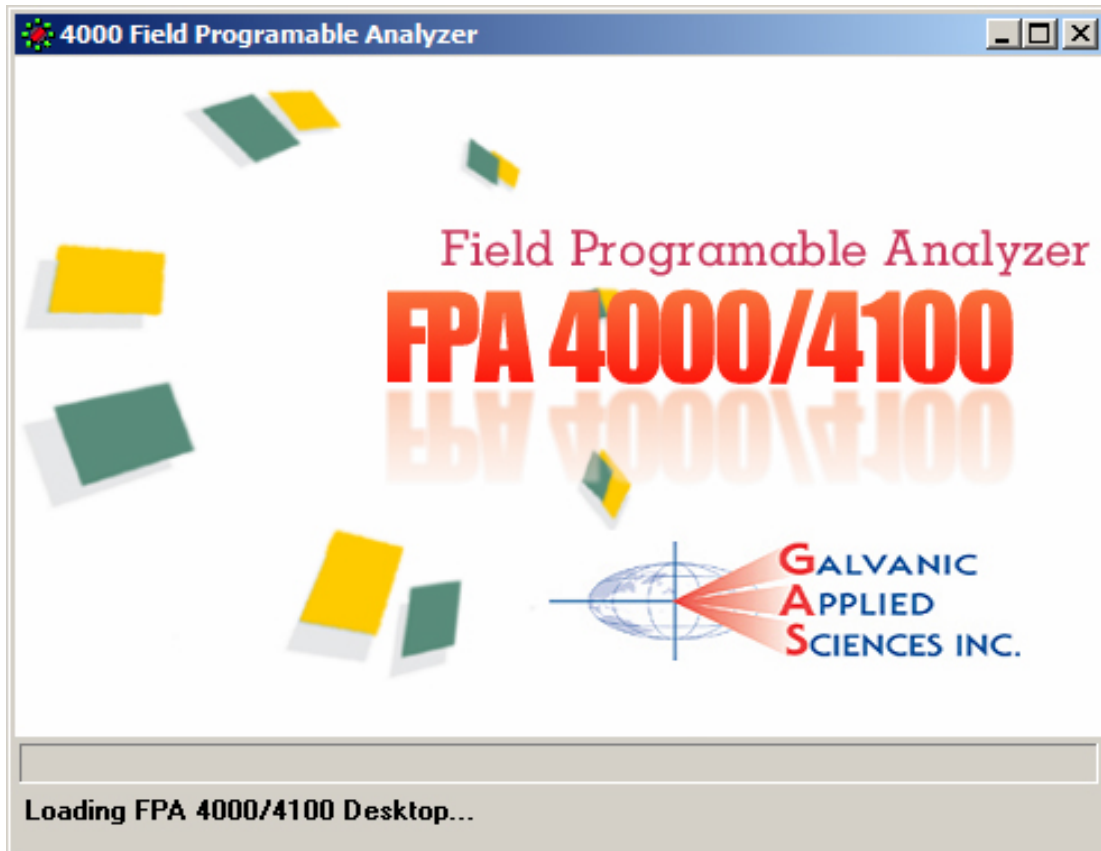


Figure 4-13: Opening Screen

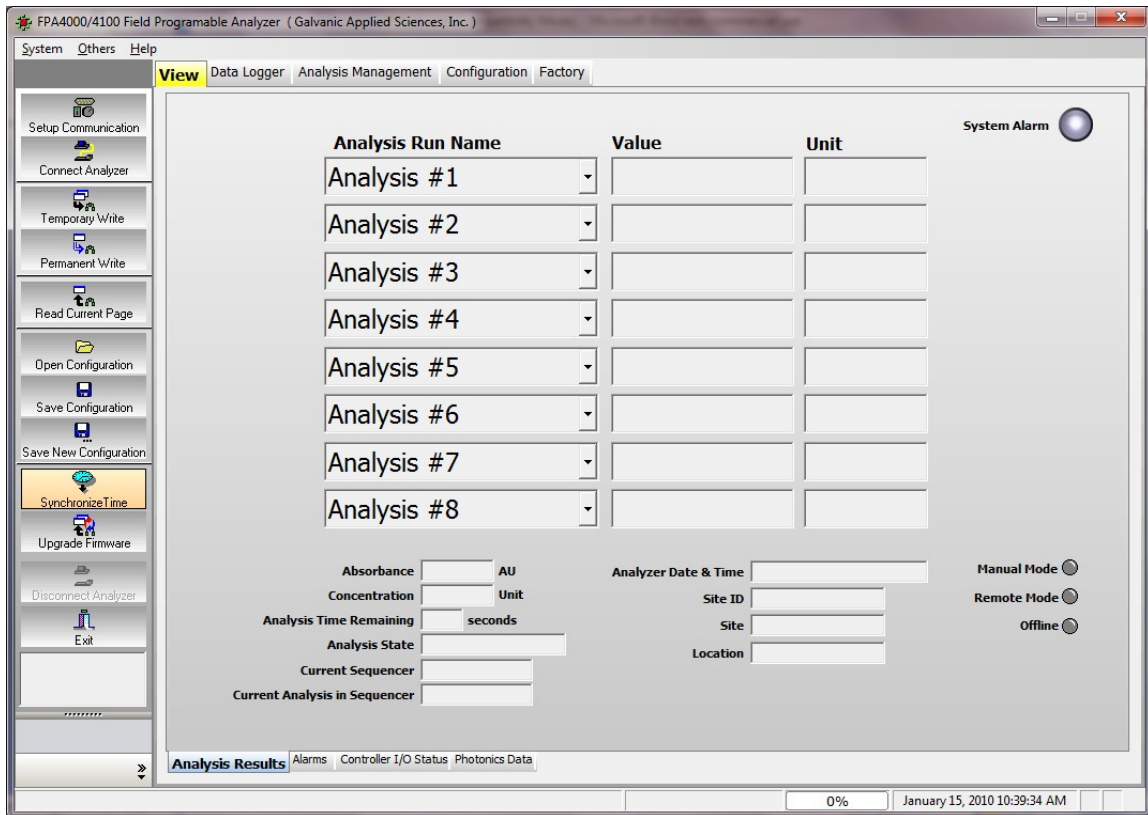


Figure 4-14: Main Window 4000/4100 Application Software

## 4.5.2 Selecting Communications Parameters

To establish communication parameters between the computer and the 4000/4100 Spectrophotometer, press the *Setup Communication* button on the left row of buttons to present the *Communications Setup* dialog box (Figure 4-15). The format of this dialog box is dependent on the connection type, as described below.



**Figure 4-15: Communications Setup Dialog Box - Com Port Direct**

The left side of the *Communication Setup* dialog box is common to all connection types.

- **Connection Type** - Indicate the communication mode from the drop down menu. The right side of the window will present the appropriate parameters to be edited which are described below.
- **Timeouts** - The *Backoff Timer* tells the GUI how much time, in ticks (one tick is 55 milliseconds), to wait for a response from the FPA 4000/4100 before retrying to contact the analyzer.

If the communication link between the 4000/4100 Spectrophotometer and the PC is slow or unreliable it may be because of a long distance between the PC and the system, and it may be necessary to increase the *Backoff Timer* and/or *Retries* values allow for a successful communications link. It will likely be necessary to increase the backoff timers if you are using Ethernet to communicate.

- **Communications Options** - If you are using Modbus, set the address (valid range from 1 to 255). Alternatively, put a checkmark in the **All Stations** checkbox, which will cause the GUI software to poll all possible Modbus addresses.

The right side of the *Communication Setup* dialog box is dependent on the *Connection Type* entry.

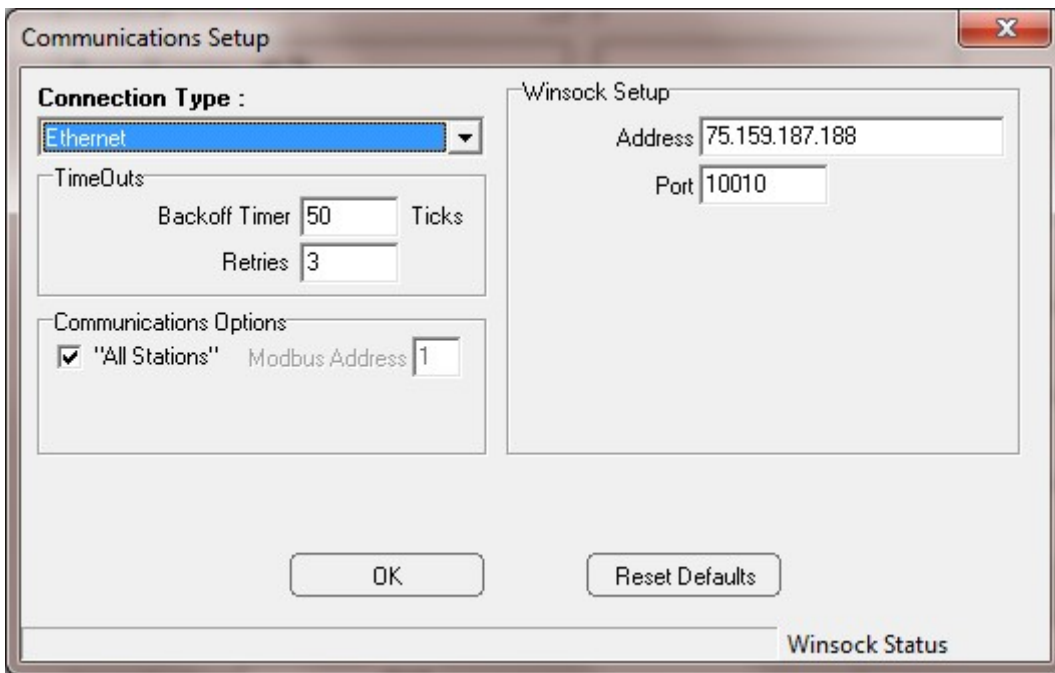
a) Com Port Direct

When *Com Port Direct* is selected, the dialog box is as shown in Figure 4-15.

This communications program will automatically list all available Com ports and the user should select the correct COM port from the drop-down menu. If you are using RS232 or USB, the baud rate should be set at 57600. Leave all other configuration parameters at their default settings. If a valid USB port is found, the number of the port will be displayed just above the OK button in the *Communications Dialog* setup box.

b) Ethernet

When *Ethernet* is selected, the dialog box is as shown in Figure 4-16.



**Figure 4-16: Communications Setup Dialog Box - Modem**

The IP address can be assigned to the card by using a device installer. The IP address has to be provided by the customer's IT department.

### 4.5.3 Connecting the Analyzer

#### NOTICE

Ensure that the communications cable is correctly connected to both the computer and the instrument.

Press the **Connect Analyzer** button to establish communication between the computer and the analyzer.

If the communications settings are correct, the bottom line of the display will appear at the bottom of the screen, showing the logon progress (Figure 4-17). The left traffic light refers to receipt of data by the computer and the right traffic light refers to transmission of data by the computer.

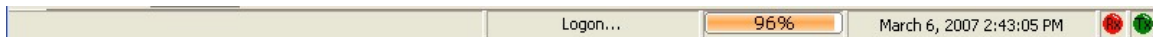


Figure 4-17: Logon Progress

If communications is unsuccessful, ensure that:

- the correct communication mode has been selected
- the correct parameters have been chosen
- the cable is securely connected to both the PC and the 4000/4100 Spectrophotometer.

If these do not result in a successful connection, please contact your local IT department or Galvanic Applied Sciences' technical support for assistance.

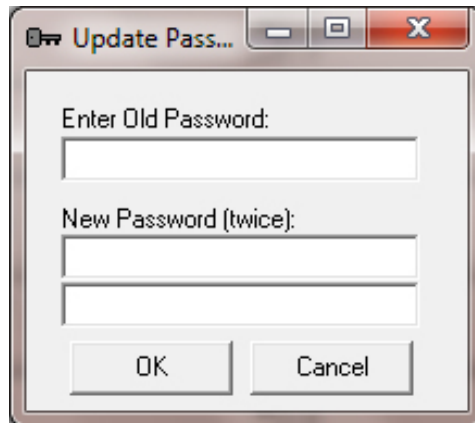
Once the progress indicator reaches 100%, the display will present the *Select Mode* dialog box (Figure 4-18) asking if the user wants to enter *Read-Only* or *Update* mode and the bottom box on the Tools list on the left side of the display will indicate *Logged on FPA controller* in a yellow background.



Figure 4-18: Select Mode Dialogue Box

**Read Only** - The user can view the various screens and review all the settings of the analyzer, but cannot write any changes to these settings to the analyzer.

**Update** - Update mode allows the user to edit system parameters, establish configurations, etc. If this mode is selected, the user is prompted for a password. The password for the Update mode is set by default to '2222'. The password can be changed by accessing *Change Password* on the *Others* menu to present the dialog box shown in Figure 4-19. Enter the present password and then enter the new password two times.



**Figure 4-19: Update Password Dialog Box**

If the user originally logs onto the 4000/4100 in *Read Only* mode, it is possible to enter update mode by going to the *Tools* menu and selecting **Update**. This will bring up the *Password Request* dialog box. If the correct password is entered, the spectrophotometer will then be in *Update* mode.

## Section 5 Operating the Spectrophotometer via the Controller Module

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### 5.1 Introduction

The front panel of the controller module includes a series of LEDs and a LCD display which provides information about the status of the spectrophotometer (Figure 5-1). A hand held keypad is used to select the information to be displayed and edit various parameters (the overall operation of the system is governed by a configuration which is generated via the application program on the PC and downloaded to the spectrophotometer).



Figure 5-1: The Front Panel of the Controller Module

## 5.2 The LCD Display

The main page of the LCD display panel (Figure 5-2) contains three discrete regions:

- The top line presents the **Abs**, **RUN**, **STATE**, and **TIME** status indicators (Section 5.2.1).
- The center of the screen shows the calculated concentration for the most recent run.
- The bottom of the screen defines the active function keys (soft keys) for the hand held controller (Section 5.2.2).

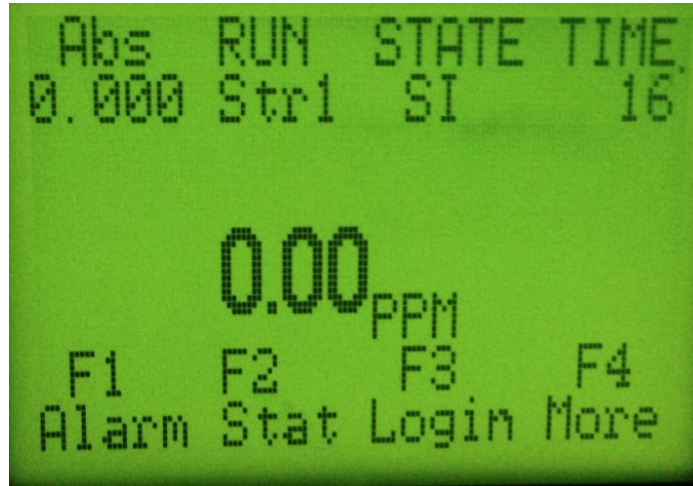


Figure 5-2: The LCD Display (Main Page)



## 5.2.1 Status Indicators

- The **Abs** indicator indicates the current absorbance (A).
- The **RUN** indicator indicates which Analysis Type the spectrophotometer is currently running. The Analysis Types are defined in the discussion of the *Analysis Management* tab in Section 6.5.2.
- The **STATE** indicator provides the code for the state the spectrophotometer is currently in. There are five possible codes, as described in Table 5-1.

**Table 5-1: STATE Codes**

PURGE	This is the time allowed for fresh sample to enter the measurement cell after a stream has been switched (such as for auto calibration, auto zero or switching measured streams).
IDLE	The spectrophotometer is not making a measurement. This code is seen on power up or if a manual sequence is enabled for a single run then stops. It will also be presented if the analyzer sequencers are not configured or enabled.
SI	Sample Interval. This is used is the standard analysis mode where results are collected to calculate the concentration for the sample indicated in the RUN indicator.
CalZ	Calibrate Zero Absorbance. A zero sample is introduced to the analyzer and a new zero absorbance is calculated.
CalS	Calibrate Standard. A standard is introduced to the analyzer and a new calibration coefficient (Abs*Path) is calculated.

- The **Time** indicator displays a countdown of the time remaining on the current state. The time indicator does not change in the IDLE state.

## 5.2.2 The Function Keys and Menus

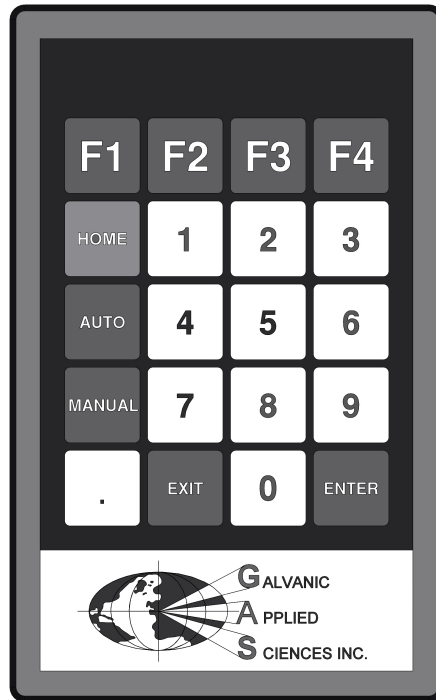
The bottom portion of the LCD includes four function keys (soft keys) that indicate the function keys on the keypad used to access these pages. The definition of each key on the main page (Figure 5-2) is presented in Table 5-2 and the corresponding menus are described in detail in Section 4.4.

**Table 5-2: Function Key Definitions on Main Page**

F1 (Alarm)	Presents the <b>ALARMS</b> page which lists all active alarms.
F2 (Stat)	Presents the <b>STATUS</b> page which lists parameters that describe the status of various components of the spectrophotometer
F3 (Login)	Presents the <b>LOGIN</b> page to allow the user to log in/off Requests the system password to allow for editing of various parameters.
F4 (More)	Presents the <b>MORE</b> page which is used to view a broad range of system parameters.

## 5.3 Using the Handheld Keypad

The handheld keypad is used in conjunction with the LCD display to access the menus that present a variety of system parameters. The keypad is shown in Figure 5-3.



**Figure 5-3: The Keypad**

The keypad consists of a total of 20 keys. Eleven of these keys are simple numerical keys, marked with the numbers 0 through 9 plus a decimal key and four keys are used to select F1-F4. The role of the non-numerical keys are defined in Table 5-3.

The general commands available from the keypad are indicated in Table 5-3. In some cases, function keys will provide other options, as discussed when specific menus are described.

**Table 5-3: The Defined Keys on the Keypad**

F1	From the main page, it allows the user access to the Alarm page. The F1 key is also used as a page up ( <b>PGUP</b> ) function key to scroll through multiple menu screens if required. As in the default screen, the F1 key may be used to select sub-menus.
F2	From the main page, it allows the user to access the Status page. On other menus, it is used as the <b>UP</b> key to move up from an item in the menu list to the next one.
F3	From the main page, it allows the user to access the Login page. On other menus, it is used as the <b>DOWN</b> key to move down from an item in the menu list to the previous one.
F4	From the main page, it allows the user to access the Menu page. On other menus, it is used as the page down ( <b>PGDN</b> ) key to move up from one page in the menu list to the next.
Home	Pressing this key will present the main page
Auto	Pressing this key will put the spectrophotometer into automated mode.
Manual	Pressing this key will put the spectrophotometer into manual mode.
Exit	Exits any other menu screen and returns to the default display screen.
Enter	While editing any editable menu item, pressing ENTER will cause the spectrophotometer to accept the newly entered value.

When a sub-menu is presented, the top line of the menu will be highlighted and can be moved via F2 or F3. Some menus have more than a single page; individual pages can be accessed by F1 or F4. In some instances, selecting an entry allows for editing of that entry, in other instances a new page is presented (e.g. selecting Photonics Hardware on the *More* menu).

### 5.3.1 The ALARMS Page

If F1 is selected from the main screen, a list of all alarms is presented (e.g. Off-line). The Alarm LED will be lit when an alarm condition has been detected.

### 5.3.2 The STATUS Page

If F2 is selected from the main page, the first page of the STATUS page is presented (Figure 5-4). The PD Temp entry will be highlighted.

STATUS			
PD Temp (C)			58.44
UV Temp (C)			44.75
Measure %			13.30
Reference %			29.96
UV Lamp On			N
F1	F2	F3	F4
		Down	PgDn

**Figure 5-4: Status Page (First Page)**

If F3 is pressed, the highlight will move to the UV Temp line and F2 (Up) will be activated. If F4 is pressed, additional parameters will be displayed as shown in Figure 5-5.

STATUS			
UV Lamp On			N
VIS Lamp 1 ON			Y
VIS Lamp 1 %			87.00
VIS Lamp 2 ON			N
VIS Lamp 2 %			0.00
F1	F2	F3	F4
PgUp	Up	Down	PgDn

**Figure 5-5: Status Page (Continuation Page)**

The items on the STATUS F2 pages are defined in Table 5-4.

**Table 5-4: Description of Status Menu Entries**

Item	Description
PD Temp	Temperature of the photodetector block.
UV Temp	Temperature of the UV lamp block
Measure %	Corrected percentage level of measure channel
Reference %	Corrected percentage level of reference channel
UV Lamp On	Status of UV lamp
Vis Lamp on	Status of Vis lamp1
Vis lamp %	Relative intensity of Vis lamp 1
Vis Lamp 2 On	Status of Vis lamp 2
Vis Lamp 2%	Relative intensity of Vis lamp 2

This page will vary depending on the lamp(s) that is installed. These parameters are not editable by the user.

### 5.3.3 The LOG IN Page

If F3 is selected, the display will present the LOG IN page (Figure 5-6), which is used to enter the password. The password is set by default to '2222' and can be changed by accessing *Change Analyzer Logon Password* on the *Global Parameters* tab of the *Configuration* page of the application software (Section 6.6.2).

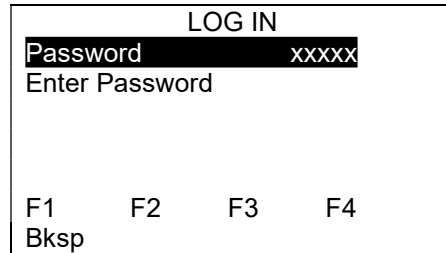


Figure 5-6: Log In Page

Enter the password (a series of X's will appear on the top line) and press **ENTER** on the keypad when the password is complete. F1 serves as the backspace key to present the Menu (Section 5.3.4). To escape from log in mode, press **Home** on the keypad. If an invalid password is entered; the X's will disappear and the prompt for the password will reappear.

### 5.3.4 The MENUS Page

If F4 is pressed or the password is entered, the display will present the **Menus** (Figure 5-7 and 5-8), which contain a variety of instrumental parameters. If the password has been entered, some of the items on the menu can be edited via the keypad, as described below. The second Menu Page is accessed via F4.

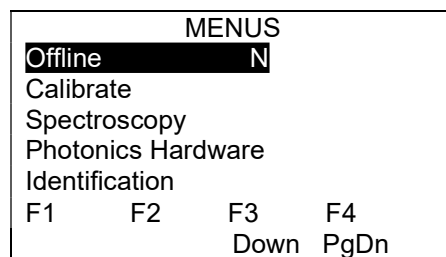


Figure 5-7: The Menu Page (First Page)

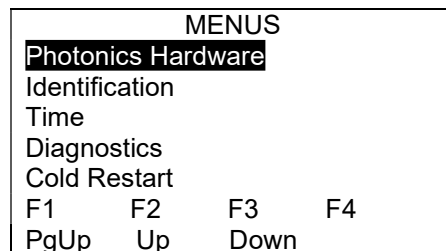


Figure 5-8: The Main Page (Continuation)

### 5.3.4.1 OFFLINE

The *Offline* entry indicates the status of the spectrophotometer.

If *Offline* is selected and you have logged onto the system, F1 will be defined as Y(es) and will place the system offline and F2 will be defined as N(o) and will not place the system offline. After the appropriate selection has been made, press **ENTER** on the keypad. . .

When the spectrometer is off line, the **OFFLINE** LED on the front panel will be illuminated and an Alarm will be issued.

### 5.3.4.2 CALIBRATE

The **Calibrate** entry presents the sub-page shown in Figure 5-9.

CALIBRATE			
Cal Standard			200
Calibrate Zero			
Calibrate Standard			
Last Cal Z 21 Dec 2009			
Last Cal S 11 Dec 2009			
F1	F2	F3	F4
	Up	Down	

**Figure 5-9: Calibrate Sub-page**

If you have logged onto the system, the concentration of the calibration standard can be entered. In addition, a calibration of the Zero or the standard can be performed.

#### **NOTICE**

If the calibration standard is edited via this page and/or either calibration is performed, the data remains in the spectrophotometer and is not automatically transferred to the application program on the computer. To transfer the data to the computer, press the Read Current Page button on the main screen of the application program.

#### **NOTICE**

The system must be put into manual mode before it can be calibrated on demand. To put the analyzer in manual mode, LOGIN to the analyzer and then press the MANUAL button on the keypad. The MANUAL LED will flash, indicating the the analyzer is in manual mode. To take the analyzer out of MANUAL mode, press the AUTO key.

### 5.3.4.3 SPECTROSCOPY

The **Spectroscopy** entry presents a number of basic photometric measurements (Figure 5-10 and 5-11). The second page is accessed via F4. This information cannot be edited.

SPECTROSCOPY			
Transmiss	0.999996		
Absorbance	1.526947e-5		
Measure %	13.3157		
Ref %	29.9960		
Meas MV	322.866		
F1	F2	F3	F4
	Up	Down	PgDn

Figure 5-10: Spectroscopy Sub-Page (First Page)

SPECTROSCOPY			
Absorbance	1.526947e-5		
Measure %	13.3157		
Ref %	29.9960		
Measure mV	322.866		
Meas mV	749.852		
F1	F2	F3	F4
	Up	Down	PgUp

Figure 5-11: Spectroscopy Sub-Page (Continuation)

### 5.3.4.4 Photonics Hardware

The **Photonics Hardware** entry presents information that describes the configuration of the system (Figure 5-12 and 5-13). The second page is accessed via F4. This information cannot be edited.

SPECTROSCOPY			
Unit ID	Vis		
Cell ID	Unknown		
Cell Path	Unknown		
Lamp ID	Tungsten		
Fiber Bundle	Vis		
F1	F2	F3	F4
	Up	Down	PgDn

Figure 5-12: Photonics Hardware Sub-Page (First Page)

SPECTROSCOPY			
<b>Fiber Bundle</b>	<b>Vis</b>		
Filter 1	450		
Filter 2	N/A		
Filter 3	810		
Filter 4	N/A		
F1	F2	F3	F4
	Up	Down	PgUp

Figure 5-13: Photonics Hardware Sub-Page (Continuation)

### 5.3.4.5 Identification

The **Identification** entry provides serial number and other information (Figure 5-14 to 5-16). This information is taken from the application program.

IDENTIFICATION			
<b>Controller</b>			
Model Cell ID	FPA4100		
Serial No.	Unset		
Firmware	04020105		
Unit ID	Unknown		
F1	F2	F3	F4
	Up	Down	PgDn

Figure 5-14: Photonics Hardware Sub-Page (First Page)

IDENTIFICATION			
<b>Site</b>	<b>Galvanic</b>		
Location	Calibration Lab		
Photonics			
Model	FPA4000Vis		
Serial No	0947FPA400		
F1	F2	F3	F4
PgUp	Up	Down	PgDn

Figure 5-15: Photonics Hardware Sub-Page (Continuation Page)

IDENTIFICATION			
Photonics			
Model	FPA4000Vis		
Serial No	0947FPA4000		
Firmware	05020105		
Unit ID	Vis		
F1	F2	F3	F4
PgUp	Up	Down	

Figure 5-16: Photonics Hardware Sub-Page (Second Continuation Page)



### 5.3.4.6 TIME

The **Time** entry is used to set the time and date information (if Log in has been entered) and presents on the spectrophotometer.

TIME			
Year	2009		
Month	Dec		
Day of Month	21		
Hour	8		
Minute	14		
F1	F2	F3	F4
	Down	PgDn	

Figure 5-17: Time Sub-Page (First Page)

TIME			
Day of Month	21		
Hour	8		
Minute	14		
Seconds	44		
Day of Week	Monday		
F1	F2	F3	F4
Pg Up	Up	Down	

Figure 5-18: Time Sub-Page (Second Page)

The month and day of the week are entered via the numeric value (e.g. January =1, Monday = 1).

### 5.3.4.7 Diagnostics

If the operator is logged in, the *Diagnostics* option can be toggled to ON or OFF. If the Diagnostics option is selected, a series of hardware diagnostics will be performed when the analyzer is powered up. If Diagnostics is not selected, the hardware diagnostics will not be performed.

### 5.3.4.8 Cold Reset

The **Cold Reset** command will wipe all configuration parameters to factory default. This will take about 1 minute and the analyzer will reboot.

## 5.5 LED'S on Front Panel

The front panel of the controller module includes 10 status indicators and includes the isolated USB to connect the spectrophotometer to an external device. The role of the LED's is described in Table 5-5.

**Table 5-5: LED Definitions**

LED Label	Colour	Function
LAN ACCESS	Green (blinks)	Blinks green to indicate communication between the controller module and the photonics module.
MANUAL MODE	Red (Solid)	<ul style="list-style-type: none"> <li>• Off - the analyzer is running an automatic sequence.</li> <li>• Blinking - The analyzer is in manual mode.</li> <li>• Solid - The analyzer is in remote mode (such as from a sequence request via a DI or the GUI)</li> </ul>
BUSY	Green (blinks)	When an instruction is written to the flash via keypad or through the application program, the LED blinks during this operation. The analyzer will continue to function normally during this operation.
Tx USB	Green (blinks)	Blinks green if the unit is transmitting data via the USB connection.
Rx USB	Red (blinks)	Blinks red if the unit is receiving data via the USB connection.
Alarm	Red (solid)	When lit, this LED indicates that at least one alarm has been triggered.
Off Line	Yellow (blinks)	Blinks yellow if the unit is in Off line mode.
Warning	Red (solid) Red (blinks)	This LED is lit for three purposes. On start-up, if there is a problem with the primary or backup firmware, this LED will light to indicate copying of a good copy of the firmware from one storage location to the other. It also lights during a memory-wipe process. If the LED is blinking red, it means that the system is currently in <i>Direct Board Control Enable</i> mode, which is triggered through the application program.
Keypad	Blue	This LED will blink when an input is made from the keypad.
Ser Com	Green (blinks)	This LED will blink if the RS 232, RS485, USB or Ethernet port is communicating.

## 5.6 USB Port

The USB port on the front panel can be used to interface the controller module to a personal computer. The Tx LED will be lit when the spectrophotometer is transmitting to the USB port and the Rx LED will be lit when the spectrophotometer is receiving data from the USB device.

## Section 6 The Graphical User Interface

### 6.1 Introduction

The graphical user interface (GUI) is provided to enter information and obtain results from the analyzer. When the communication between the analyzer and the computer is established, the *Analysis Results* tab of the *View* page will be displayed as shown in Figure 6-1.

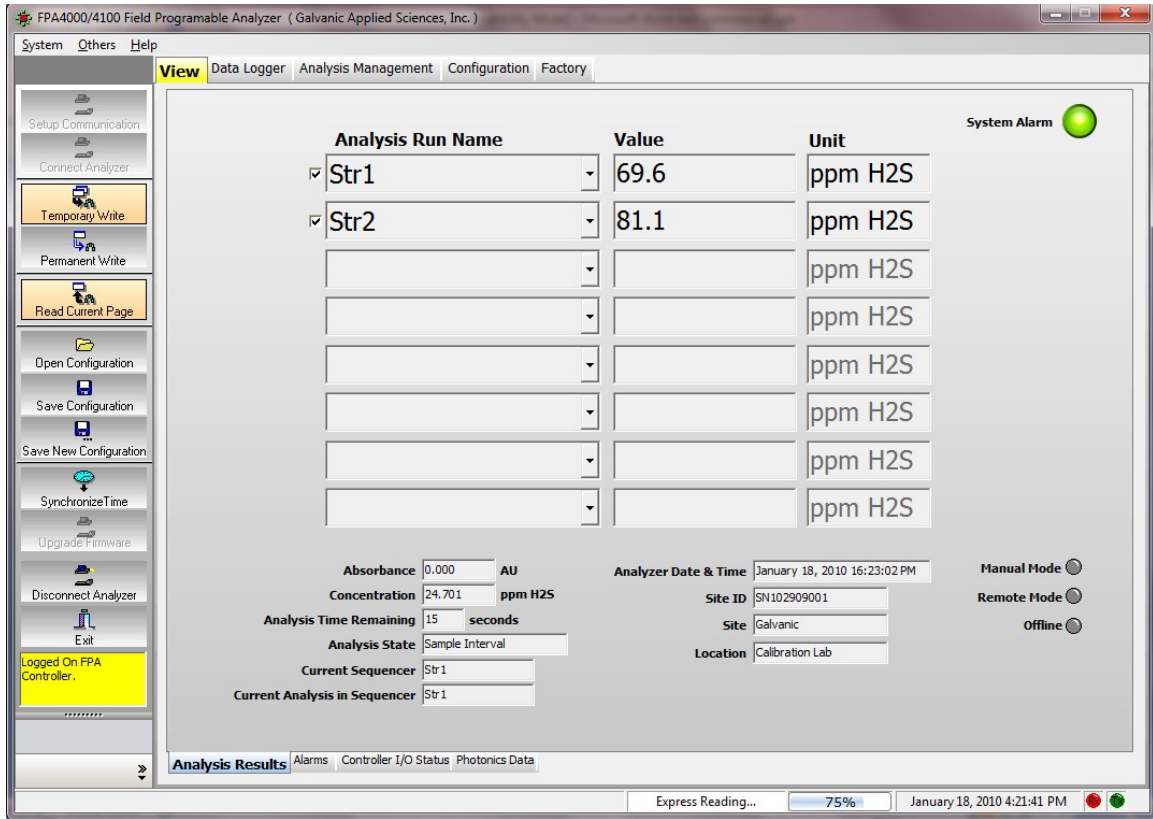


Figure 6-1: The View Page - Analysis Results Tab

The overall collection of parameters that define the operation of the instrument is termed a **Configuration**. A configuration is generated via the various tabs on the pages of the PC and is sent to the analyzer module for operation. Once a configuration has been generated, it can be saved and retrieved as desired as described below.

The application program includes the following:

- **Toolbar** - The tool buttons on the left side of the window access a variety of system functions and tasks related to the reading and writing of analytical methods (Section 6.2).
- **Pages** - A series of pages (*View*, *Data Logger*, *Analysis Management*, *Configuration* and *Factory*) that describe a component of the application program. Each page includes a series of tabs that provide information about a specific aspect of the application program (Section 6.3-6.7).
- **Menu Bar** - The menu bar accesses a variety of miscellaneous aspects of the program including exiting the system, changing the password, accessing the manual and the wiring book and the *About* dialog box, which provides the version number.
- **Status Line** - The status line indicates the present operation of the system.

## 6.2 The Toolbar

**Setup Communication** - Used to establish communication parameters (see Section 4.5).

**Connect Analyzer** - Used to interface the computer with the analyzer (see Section 4.5).

**Temporary Write** - Write the configuration changes in the active screen to the volatile memory of the analyzer. As you edit the tabs, this button allows you to store and view the analyzer configuration and its behavior before you decide if the change is to be kept on a permanent basis.

### NOTICE

**Data written to RAM via the temporary write function will be erased when the analyzer is shut down. As you go through the tabs and make the desired changes, this button allows you to store and view your spectrophotometer configuration and its behavior before you make a final decision. If you switch the power off to the analyzer or perform a Reboot, the analyzer will revert to its original configuration and all the changes will be lost. To prevent this from happening, make sure that the desired changes are saved with the Permanent Write button.**

**Permanent Write** - Writes configuration changes to the flash memory of the analyzer. When all the desired changes have been made and saved to the spectrophotometer by using the **Temporary Write** button; now is the time to make them permanent. When the **Permanent Write** button is pressed, a command to the spectrophotometer will be sent that will start the process of copying data from RAM to the hard drive on the spectrophotometer. This process takes about 30 seconds to complete.

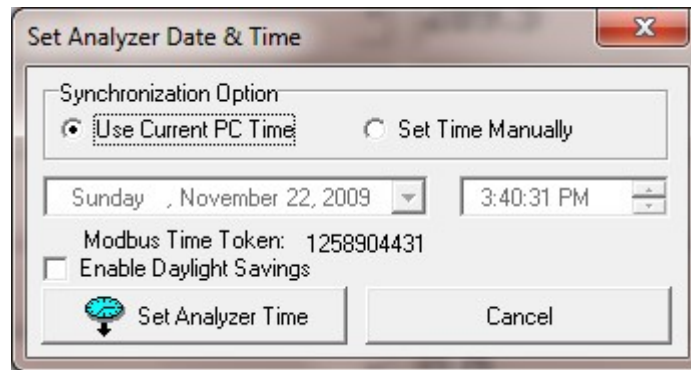
**Read Current Page** - Reads back all the data points on the current screen. Pushing this button allows the user to check and ensure that any changes written to the analyzer have been accepted.

**Open Configuration** - Accesses a dialog box to select the file that contains the desired system configuration parameters (\*.cfg).

**Save Configuration** - Saves present configuration using the existing name (\*.cfg). If the configuration has not been previously saved, a dialog box to enter the desired name and folder will be presented.

**Save Configuration as** - Presents a dialog box to enter the desired name and folder for the configuration (\*.cfg).

**Synchronize Time** - Presents the *Set Analyzer Date & Time* dialog box (Figure 6-2). Indicate if you want to use the time on the PC or set the time manually. If you select the manual option, the date and time fields are activated.



**Figure 6-2: Set Analyzer Date & Time Dialog Box**

**Upgrade Firmware** - Updates the analyzer with the latest firmware. Additional information will be provided when an update is provided by Galvanic Applied Sciences.

**Disconnect Analyzer** - Disconnects the spectrophotometer from the computer.

**Exit** - Closes program.

## 6.3 The View Page

The *View* page (Figure 6-1) includes four tabs, the *Analysis Results* tab, the *Alarms* tab, the *Controller I/O Status* tab and the *Photonics Data* tab.

### 6.3.1 The Analysis Results Tab

The *Analysis Results* tab presents the present data and a variety of parameters.

The upper part of the tab presents the last reported concentration for each of the streams that have been selected. Up to eight streams can be monitored. To select a stream for monitoring, press the ▼ arrow on the *Analysis Run Name* field to present a list of streams that can be monitored and click on the desired stream. To deselect a stream, click on the check mark to the left of the *Analysis Run Name* field. The unit field information is selected on the *Configuration* page, *Global Parameters* tab (Section 6.6).

The lower part of the tab provides the following information:

- **Absorbance** - The present absorbance, updated every 3 seconds.
- **Concentration** - The present concentration, updated every 3 seconds.
- **Time Remaining** - Period of time before the next concentration report.
- **Analysis State** - The type of sample being analyzed (calibration sample, blank, process).
- **Current Sequencer** - Name of configuration that is presently used for analysis.
- **Current Analysis in Sequencer** - Name of stream that is presently being analyzed.
- **Analyzer Date and Time** - Shows the current date and time on the analyzer. It is important that the time and data on the analyzer and the application program be identical so that the archived data has the correct time stamp. If the times/dates are not in agreement, ensure that the PC's time and date is correct, and then press the **Synchronize Time** button (Section 6.2).
- **Site ID** - Serial Number of Analyzer (set on *Configuration* page, *Global Parameters* tab, Section 6.6).
- **Site** - Location of Unit (set on *Configuration* page, *Global Parameters* tab, Section 6.6).
- **Location** - Additional information re location (set on *Configuration* page, *Global Parameters* tab, Section 6.6).

The *System Alarm* in the upper right corner indicates the overall status of the system. If it is green, all components are working in a satisfactory basis. If a fault is determined, the indicator will turn red. Alarms are listed in detail on the *Alarms* tab (Section 6.3.2).

The *Manual Mode*, *Remote Mode* and *Offline* LEDs indicate the system status, one will be lit.

## 6.3.2 Alarms Tab

The *Alarms* tab (Figure 6-3) presents the current status of the alarms for the *Analyses*, *Analog Inputs*, *Photonics Module* and a variety of other functions.

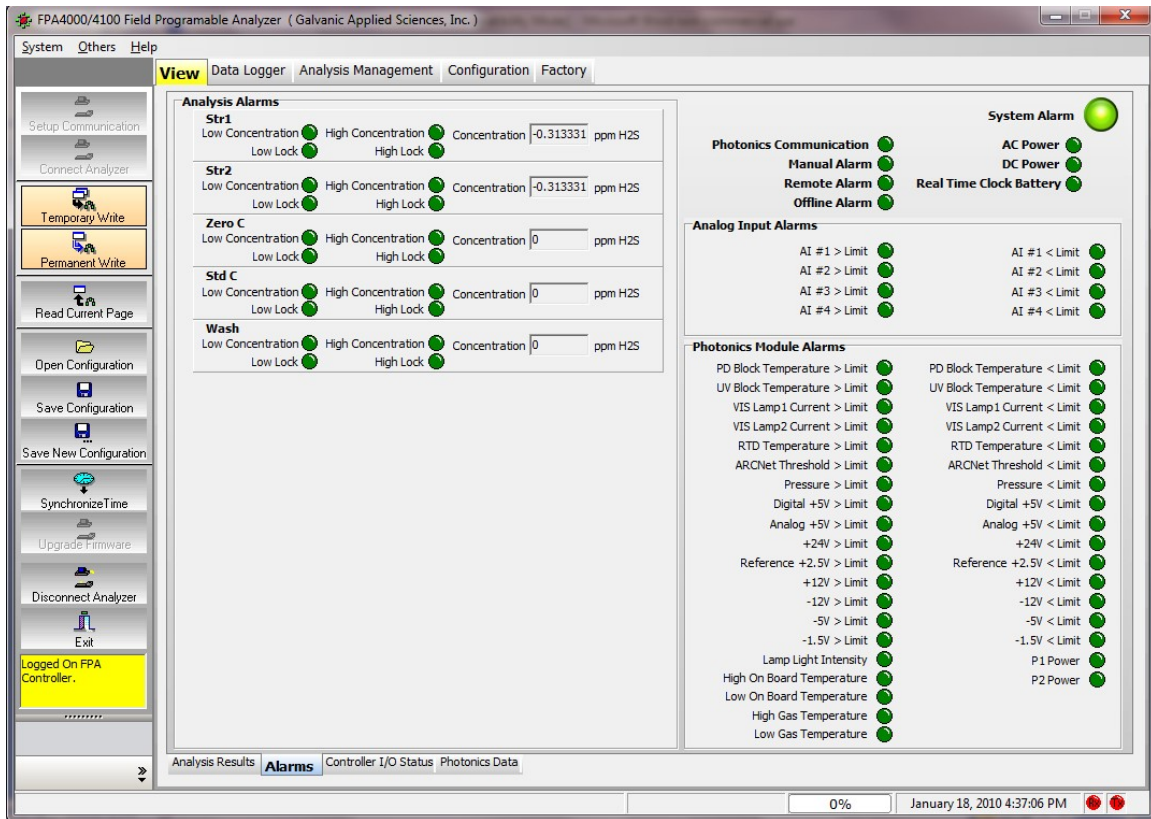


Figure 6-3: View Page - Alarms Tab



On this tab a green LED indicates that the function is operating properly (i.e. within the parameter limits) and a red LED indicates that a fault or problem has been detected.

a) Analysis Alarms

Alarms are provided for each stream, the wash stream and the calibration stream.

The *High Concentration (Low Concentration)* alarms are warnings that the concentration is not within the range indicated by the levels set on the *Analysis Management* page, *Analysis Type Configuration* tab (Section 6.5.2). The *Concentration* presented is the last reported concentration for that stream. This alarm will send an alarm to any relays and/or solenoids that have been indicated on the *Analysis Type Configuration* tab.

The *High Lock Concentration (Low Lock Concentration)* alarms are warnings that the concentration is not within the lock concentration range on the *Analysis Management* page, *Analysis Type Configuration* tab (Section 6.5.2). This alarm will lock the analyzer in whatever stream it is currently in when it is triggered and will send an alarm to any relays and/or solenoids that have been indicated on the *Analysis Type Configuration* tab.

b) Global Alarms

The *Global* alarms are the eight alarms in the upper right corner are non-analysis related alarm parameters that affect all streams identically. These alarms are related to hardware and other physical parameters that affect the operation of the analyzer. In many cases, the set point for these global alarms is user configurable.

c) Analog Input Alarms

The *Analog Input Alarms* field shows the current status of the four input alarms. The circle beside each of the relay titles indicates the status of that alarm. The levels are set on the *Configuration* page, *Analog Input* tab (Section 6.6.5.1).

d) Photonics Module Alarms

The *Photonics Module Alarms* fields show the current status of a variety of photonics issues. The circle beside each of the relay titles indicates the status of that alarm. The levels are set on the *Factory* page (Section 6.7).

### 6.3.3 Controller I/O Status Tab

The *Controller I/O Status* tab (Figure 6-4) presents the status for various inputs, outputs, relays and solenoids. For instance, the Discrete Input 1 (Dry Contact) may be used as a temperature switch. If the associated indicator is illuminated, it means that the indicated oven has not reached its optimal temperature yet and will show up on the alarm list when viewed on the analyzer display.

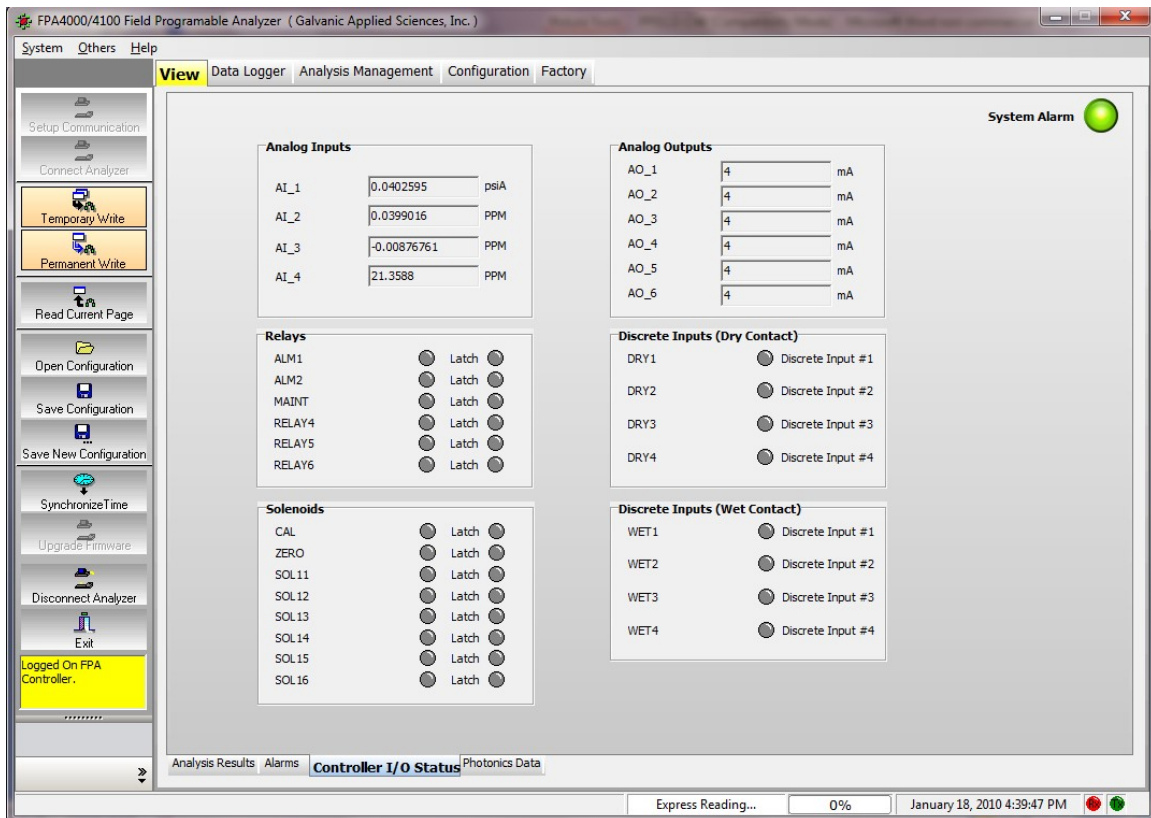


Figure 6-4: View Page - Controller I/O Status Tab

The *Analog Inputs* fields show the current output of the four analog inputs on the 4000/4100 electronics board. Analog inputs can be configured from the application program using the *Analog Inputs* of the *Configuration* page (Section 6.6.5).

The *Analog Outputs* field shows the current output of the six analog outputs on the 4000/4100 electronics board. Analog outputs can be configured from the application program using the *Analog Output* of the *Configuration* page (Section 6.6.6).

The *Relays* field shows the current status of the six relays. The circle beside each of the relay titles indicates the status of that relay. A red colour means that the relay has been triggered, be it by an alarm or some other trigger, while a grey colour means that the relay has not been triggered.

The *Solenoids* field shows the current status of the solenoid drivers on the FPA 4000/4100 electronics board. If the analyzer is not configured with any solenoids, this box can be ignored. A grey circle beside a solenoid label indicates that the solenoid is de-energized, while a red circle indicates that the solenoid is energized.

The *Discrete Inputs (Dry Contact)* field shows the current status of the four discrete inputs on the FPA 4000/4100 electronics board which do not require external power to operate. These discrete inputs can be such things as low-pressure switches, oven temperature sensors or buttons used to initiate specific runs. Setting up discrete inputs is described in Section 6.6.3.

The *Discrete Inputs (Wet Contacts)* field shows the current status of the four discrete inputs on the FPA 4000/4100 electronics board which require external power to operate. These discrete inputs can be such things as remote calibration etc. A red circle beside a discrete input label indicates that the particular discrete input has been triggered, while a green circle indicates that the particular discrete input has not been triggered. Setting up discrete inputs is described in Section 6.6.3.

### 6.3.4 Photonics Data Tab

The *Photonics Data* tab (Figure 6-5) presents a broad range of data regarding the photonics module. This data cannot be edited by the user.

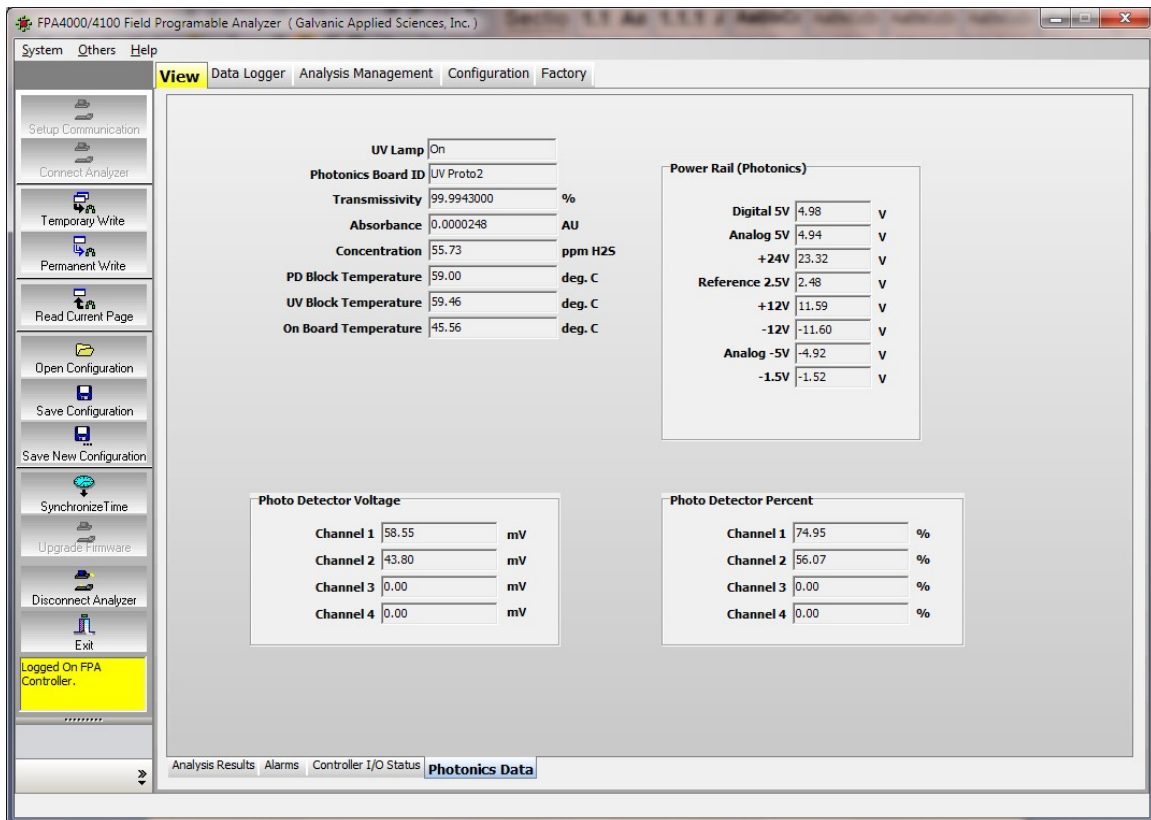
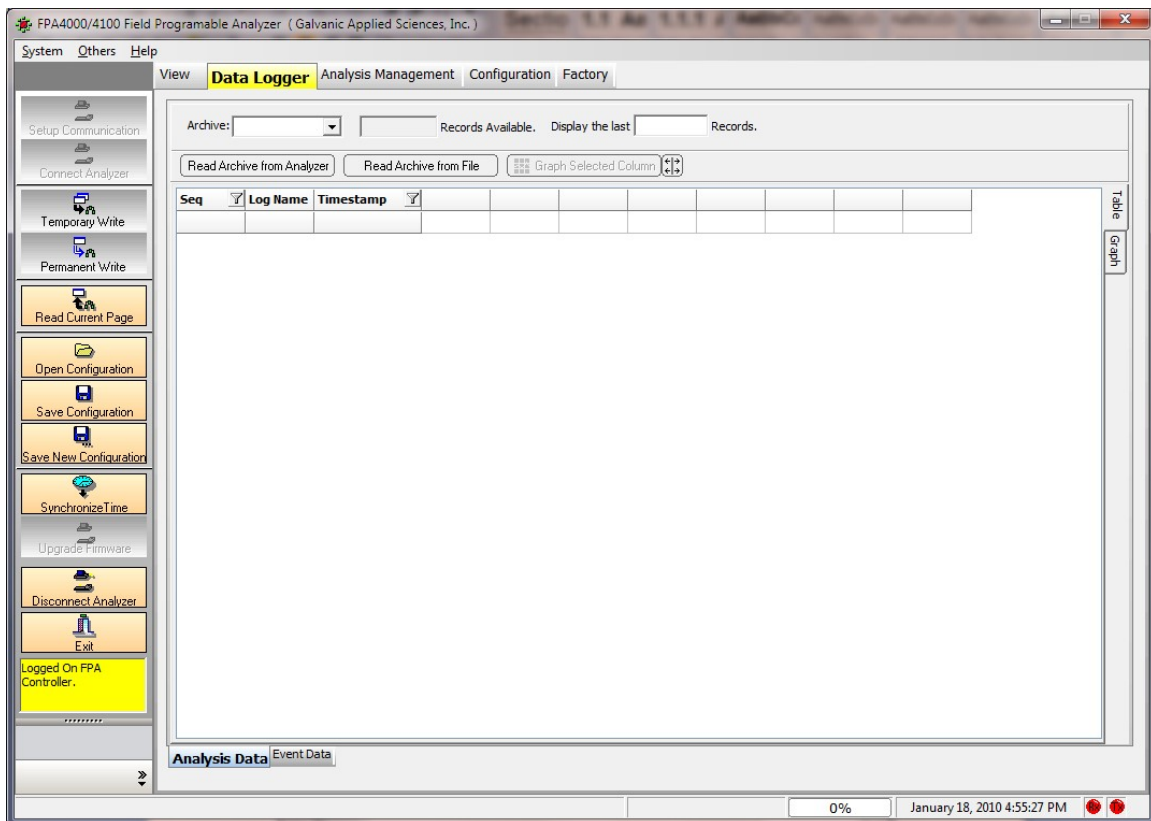


Figure 6-5: View Page - Photonics Data Tab

## 6.4 The Data Logger Page

### 6.4.1 Analysis Data Tab

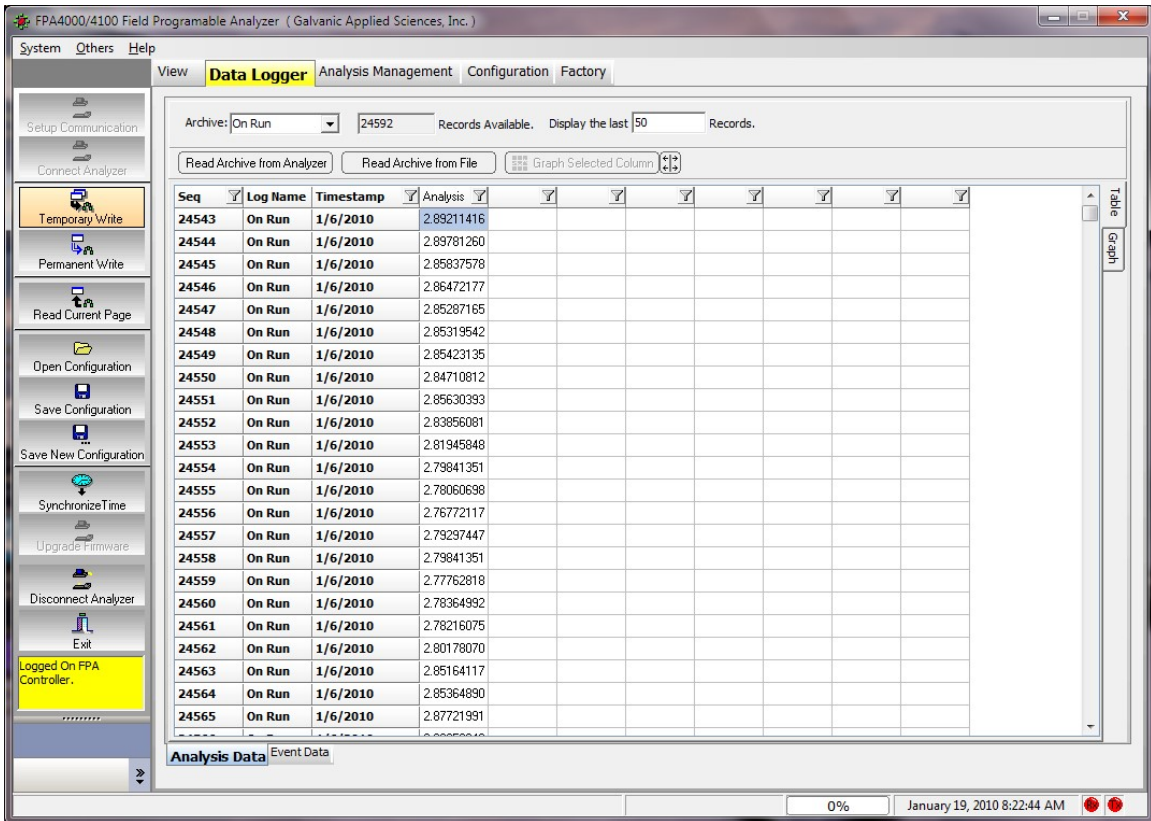
The *Analysis Data* tab presents data related to the analyzer's operation, including live concentration data, hourly averages, and other important data. When this screen is first accessed, the screen appears as shown in Figure 6-6.



**Figure 6-6: Data Logger Page - Analysis Data Tab**

Data must be retrieved from the analyzer or a file before it can be manipulated by using the *Read Archive from Analyzer* or the *Read Archive from File* button. The archive on the 4000/4100 spectrophotometer may be quite large, so retrieving data from the archive can take several minutes, especially if the PC is connected to the spectrophotometer via a serial connection.

The *Archive* drop down menu is provided to allow the user to select the time period for which the archived data to be presented (*On Run, Hourly, Daily, Periodic 1, Periodic 2*). If the *On Run* selection is employed, the data will be entered into the log immediately after the end of each run. The field immediately to the right of this menu shows how many records are stored in the currently selected archive. To retrieve data out of this archive, enter a value in the *Display the last \_\_\_\_\_ Records* field and press **Enter**. A typical display is shown in Figure 6-7. The time period for *Periodic 1* or *Periodic 2* is selected on the *Configuration* page, *Data Logger Setup* tab (Section 6.6.7).



**Figure 6-7: The Analysis Data Screen with Data**

The *Seq* column lists the sequence number for each run in the log.

The *Log Name* tells the user which log the data came from; this is useful when the data is exported. To look at another log, select the desired log from the *Archive* pull down menu. For more information on the various types of logs, see Section 6.6.7.

The *Timestamp* column shows the date and time when the data in a given row was obtained. To the right of the grey columns are columns containing data from each stream (e.g. if six streams are being analyzed in each run, six columns will be populated). The first row in the archive has data labels that identify exactly what data is in each column.

The column widths can be automatically scaled to fit the data by pressing the *Auto-Size*



*Columns* button at the top of the screen. This will present time and date that the data was collected (an example is shown in Figure 6-8). The archive is set up at the factory to log the data points of the most interest to operators, though the archive is fully configurable to log many more data points (Section 6.6.7).

The screenshot shows the 'Data Logger' window of the FPA4000/4100 Field Programmable Analyzer. The window title is 'FPA4000/4100 Field Programmable Analyzer (Galvanic Applied Sciences, Inc.)'. The 'Data Logger' tab is active, showing a table of analysis data. The table has columns for 'Seq', 'Log Name', 'Timestamp', and 'Analysis 1 Current Concentration'. The data is sorted by timestamp, showing records from 1/6/2010 10:07:54 AM to 1/6/2010 10:18:54 AM. The 'Analysis 1 Current Concentration' column is auto-sized to fit the data. The status bar at the bottom shows '0%' and 'January 19, 2010 8:23:40 AM'.

Seq	Log Name	Timestamp	Analysis 1 Current Concentration
24543	On Run	1/6/2010 10:07:54 AM	2.89211416244507
24544	On Run	1/6/2010 10:08:24 AM	2.89781260490417
24545	On Run	1/6/2010 10:08:54 AM	2.85837578773499
24546	On Run	1/6/2010 10:09:24 AM	2.86472177505493
24547	On Run	1/6/2010 10:09:54 AM	2.85287165641785
24548	On Run	1/6/2010 10:10:24 AM	2.85319542884827
24549	On Run	1/6/2010 10:10:54 AM	2.85423135757446
24550	On Run	1/6/2010 10:11:24 AM	2.84710812568665
24551	On Run	1/6/2010 10:11:54 AM	2.85630393028259
24552	On Run	1/6/2010 10:12:24 AM	2.83856081962585
24553	On Run	1/6/2010 10:12:54 AM	2.81945848464966
24554	On Run	1/6/2010 10:13:24 AM	2.79841351509094
24555	On Run	1/6/2010 10:13:54 AM	2.78060698509216
24556	On Run	1/6/2010 10:14:24 AM	2.76772117614746
24557	On Run	1/6/2010 10:14:54 AM	2.7929744720459
24558	On Run	1/6/2010 10:15:24 AM	2.79841351509094
24559	On Run	1/6/2010 10:15:54 AM	2.77762818336487
24560	On Run	1/6/2010 10:16:24 AM	2.78364992141724
24561	On Run	1/6/2010 10:16:54 AM	2.78216075897217
24562	On Run	1/6/2010 10:17:24 AM	2.80178070068359
24563	On Run	1/6/2010 10:17:54 AM	2.8516411781311
24564	On Run	1/6/2010 10:18:24 AM	2.85364890098572
24565	On Run	1/6/2010 10:18:54 AM	2.87721991539001

**Figure 6-8: Analysis Data Screen with Auto-sized Columns**

The length of time per archive is somewhat subjective because it depends on how many items are entered into each archive. 512 K of storage is available and the period of time for which data can be stored data depends on how many items are logged. If the maximum number of data points per archive tab are saved (seven data points), you can get about 1800 archives for each point. How much time this represents will depend on how often you log the data. For example, if you log an hourly average, you will get ~1800 hours of data; if you log a point every 30 seconds then you will get 15 hours of data.

### 6.4.1.1 Filtering Data

The data table can be filtered to show only certain data by clicking on the funnel icon in the header on the *Seq*, *Time Stamp* and *Live* columns. Data can be filtered by date in the time stamp column, and by using one of six numerical operators in any column containing numerical data. The two types of filtering will be covered separately.

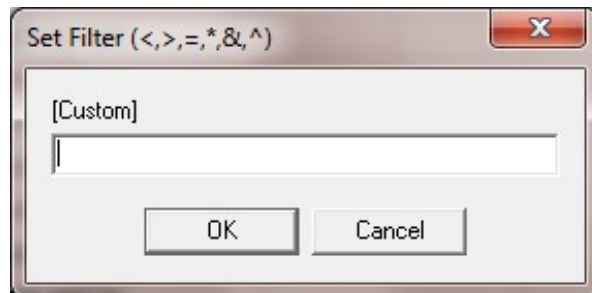
#### a) Filtering Data by Date (Time Stamp Column only)

If you click on the funnel icon on the right hand side of the *Timestamp* column header a drop down menu containing the following will be presented:

- **All** - Turns off any current filtering of data by date (all data will be presented)
- **Custom** - Presents a dialog box to enter the desired start and stop dates
- **Today** - Presents data collected today
- **Yesterday** - Presents data collected yesterday
- **This Month** - Presents data collected this month
- **Last Month** - Presents data collected last month

#### b) Filtering Data Numerically

Numerical data filtering allows the analyst to develop an algebraic relationship to filter the data (e.g. all data above 400 or all data below 200). This method of filtering works best in the *Sequence Number* column, although it can be used in any column that contains numerical data. In the header of the column to be filtered, clicking on the funnel icon on the right hand side of the header will cause a pull down menu to appear. The menu contains the options *All* and *Custom*. Selecting *All* will cause any current numerical filtering of data to be cleared while selecting *Custom* will present the dialog box shown in Figure 6-9.



**Figure 6-9: Set Filter Dialog Box**

The operators listed in Table 6-1 can be used to establish a filter:

**Table 6-1: Numerical Filters**

<b>Operator</b>	<b>Name</b>	<b>Function</b>
>	Greater Than	When this operator is used in conjunction with a number, the data will be filtered such that only data greater in value than the number entered will be displayed. For example, if the expression ">1000" was entered into the dialogue box, the column will be filtered such that only data with values greater than 1000 will be displayed.
<	Less Than	When this operator is used in conjunction with a number, the data will be filtered such that only data lower in value than the number entered will be displayed. For example, if the expression "<1000" was entered into the dialogue box, the column will be filtered such that only data with values less than 1000 will be displayed.
=	Equal to	When this operator is used in conjunction with a number, the data will be filtered such that only data that is EXACTLY equal to the number entered will be displayed. For example, if "=1000" was entered into the dialog box, only data exactly equal to 1000 will be displayed.
*	Ending Digits	When this operator is used in conjunction with a number, the data will be filtered such that only data ending in the number entered will be displayed. For example, if "**25" was entered, the column will be filtered such that only data ending in 25 (e.g. 9.2929292925, 1.00000025, etc) will be displayed.
^	And	When this operator is used to join a string of numbers together, the data will be filtered such that only data being exactly equal to each number in the string will be displayed. For example, if the expression "1^5^7^12" was entered into a list of data containing the whole numbers from 1 to 20, the only numbers in the list that would pass through this filter would be the numbers 1, 5, 7, and 12.
&	Both functions fulfilled	When this operator is used to join two or more other operators in a string, the data will be filtered such that only data that fulfills all of the operators' conditions will be displayed. For example, if the user wished to display all of the data with values between 7 and 8, he/she could type ">7&<8" into the dialogue box. Note, of course, that this would filter out values of exactly 7 and exactly 8.



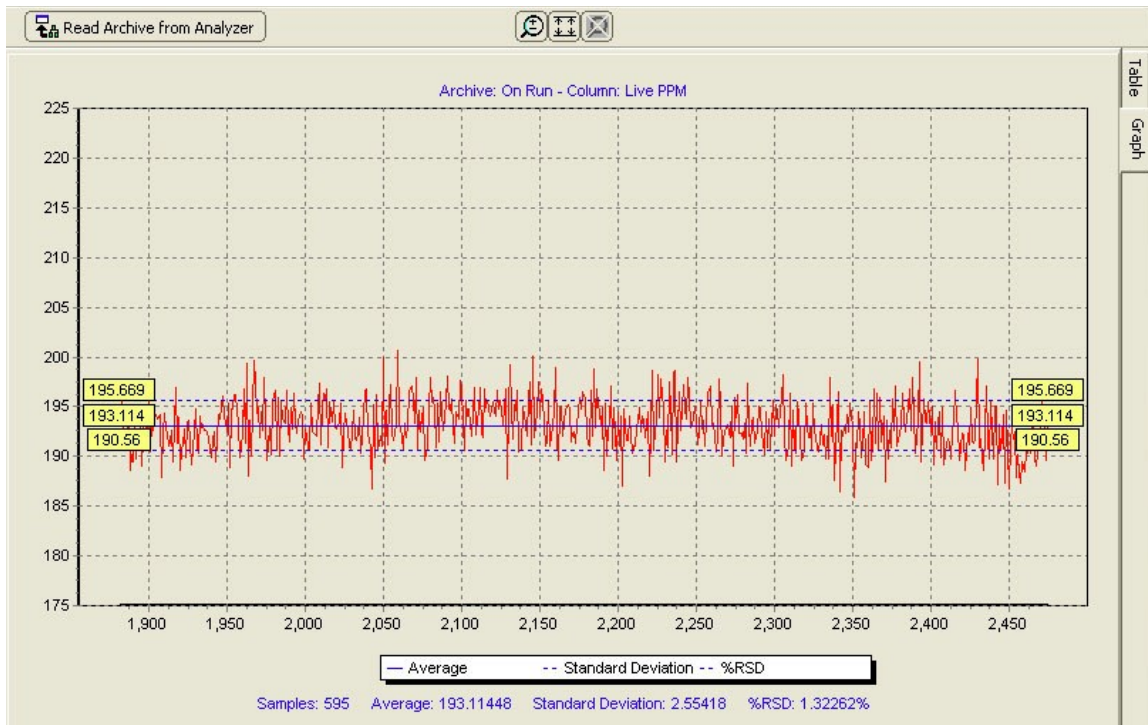
### 6.4.1.2 Loading and Exporting Data

The application program provides a number of options for exporting or saving data, which are accessed via the right mouse button:

- **Load from File** - loads a previously saved proprietary data file (.dcar). A dialog box is presented to select the desired file.
- **Save to File** - saves the data to a Galvanic proprietary format (.dcar). A dialog box is presented to indicate the name of the file and where it should be stored. This file can only be viewed from the FPA 4000/4100 GUI software.
- **Save as Packet CSV**- saves the file as a CSV file. A dialog box is presented to indicate the name of the file and where it should be stored. This command saves only the archive data that is presently viewed in the data logger.
- **Save as Legal CSV** - saves the file as a CSV file. A dialog box is presented to indicate the name of the file and where it should be stored. This command saves the data from all tabs (On Run, Hourly, Daily, Periodic 1 and Periodic 2).
- **Save as XLS** - saves the data as an XLS file which can be opened in Microsoft Excel.
- **Copy Selection to Clipboard** - allows the user to copy a selection from the data table to the clipboard to be pasted into another program such as Microsoft Excel.
- **Copy Image to Clipboard** - copies an image of the table to the clipboard that can be pasted into an image-editing program or into a Microsoft Word document.

### 6.4.1.3 Graphing Data

The data in the data columns can be graphed by left clicking and highlighting the desired portion of a given data column. Once the data of interest has been selected, click the *Graph Selected Column* button. This will create a graph that shows the trend in the selected data which can be viewed by pressing the graph tab on the right side of the screen. An example of a graph is shown in Figure 6-10.






**Figure 6-10: A Typical Graphic Presentation of Selected Data**

There are 3 blue lines on the graph. The solid blue line in the middle shows the average of the selected data, while the 2 dashed blue lines above and below the central line show one standard deviation away from the mean in each direction. The solid blue line is labeled in yellow boxes at both ends of the chart with the numerical value of the average. The dashed blue line above the average is labeled with the numerical value of the average plus 1 standard deviation, and the dashed line below is labeled with the numerical value of the average minus 1 standard deviation. The numerical values of the statistics including the number of data points (samples), the average, the standard deviation, and the standard deviation, in percent, relative to the average are below the plot.

The three buttons above the plot provide the functions listed in Table 6-2.

**Table 6-2: Graph Tools**

Button	Name	Function
	Zoom	Toggles <i>Zoom</i> mode on and off. When the button is clicked, left clicking on the chart will zoom in on a section of the chart, centered on the clicked location. Right clicking will zoom out on a section of the chart, again centered on the clicked location. When zoomed in on the data, the user can scroll left, right, up and down using the arrow keys on the computer's keyboard.
	Auto-scale	Automatically adjusts the y-axis scale so that all data within the zoomed in selection can be seen.
	Cancel Auto-scale	Cancels all zooms and returns to the auto-scaled graph originally produced when the data was first graphed.

A number of tools are available by right clicking on the plot; these are described in Table 6-3.

**Table 6-3: Graph Right Click Options**

Menu Option	Sub-Option	Function
Set Scale	Scale to Data	Set scale when a graph is first made.
	Scale Manually	Brings up a dialog box that allows the user to set the minimum and maximum value for the y-axis scale.
Print		Prints the chart to the printer of the user's choice.
Copy to Clipboard		Copies the chart to the clipboard as an image to allow the user to paste it into another application, such as Microsoft® Word™.
Preferences	Set Trace Colour	Allows the user to set the colours used for both the data and the statistics lines on the chart.
	Reset Default Colour	Resets all colours to their defaults: red for data, blue for statistics, and grey for the background.
	Invert Scrolling	Inverts the function of the arrow keys while zoomed in on data (i.e. down key moves up, left moves right, etc).
	Print Orientation	Allows the user to select whether the chart will be printed in landscape or portrait mode. The default is landscape.
	Print Sizing	Allows the user to select whether the printed chart will be scaled to fit the selected size of paper, or kept in the onscreen proportions. The default is scaled to fit.

## 6.4.2 The Event Data Tab

The *Event Data* tab keeps track of all of the various conditions (alarms, power on/off, configuration changes, discrete input conditions, etc.) that occur as the analyzer runs.

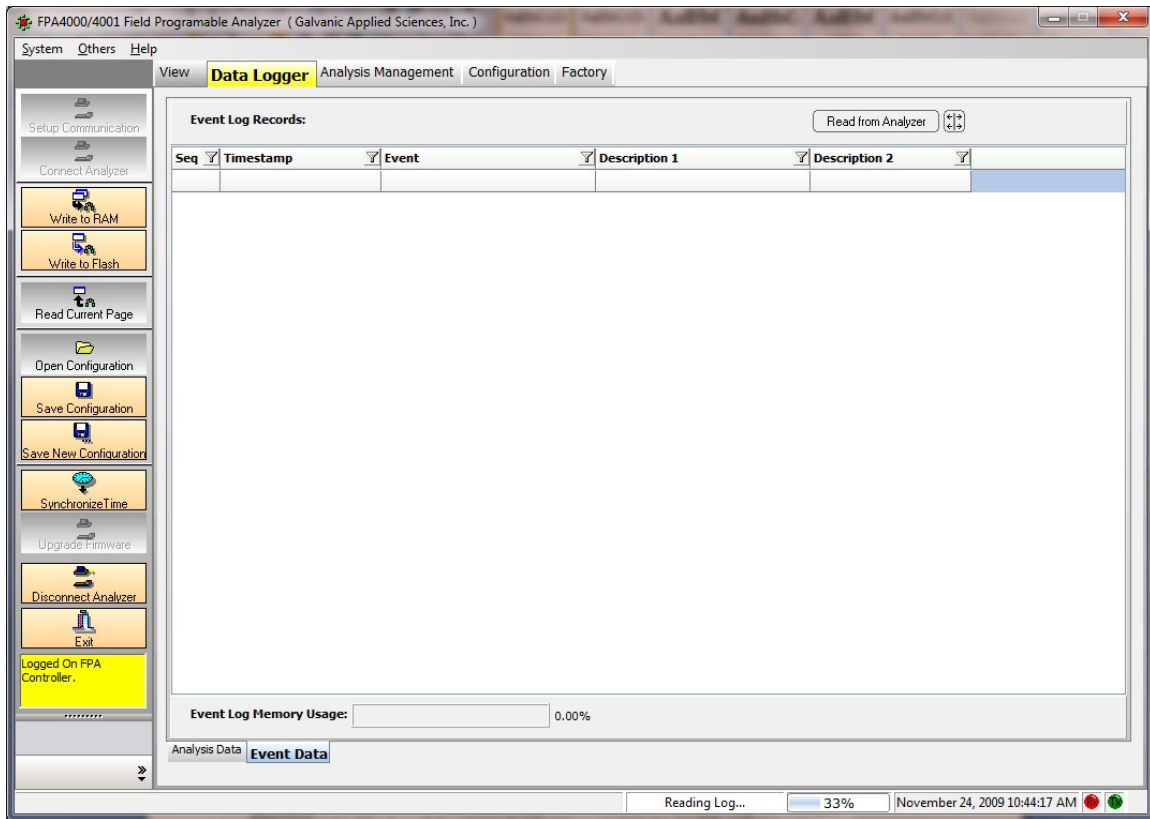


Figure 6-11: Data Logger Page - Event Data Log

The *Event Data* log is primarily used as a troubleshooting aid. If issues start occurring with the analyzer, looking at the *Event Log* can help to track down the source of the issue. The *Event Log* also gives a record of the types of alarms that have occurred during operation of the analyzer, and when exactly they occurred. To obtain a full list of all of the Event Log records from the analyzer, press the *Read from Analyzer* button at the top of the screen.

Records in the *Event Data* log can be sorted by date using a procedure that is similar to that described in Section 6.4.1.1. Since the *Event Data* log does not contain numerical data, numerical sorting is not possible. However, it is possible to sort the *Event Data* log according to the type of event that caused data to be recorded in the Event Data log. For example, if the user wished to show all the alarms that had been triggered in the 4000/4100 since it began operating, it is possible to filter the event column using the parameter “=Alarm”. This will show all alarms stored in the Event Data log. A typical log is shown in Figure 6-12.

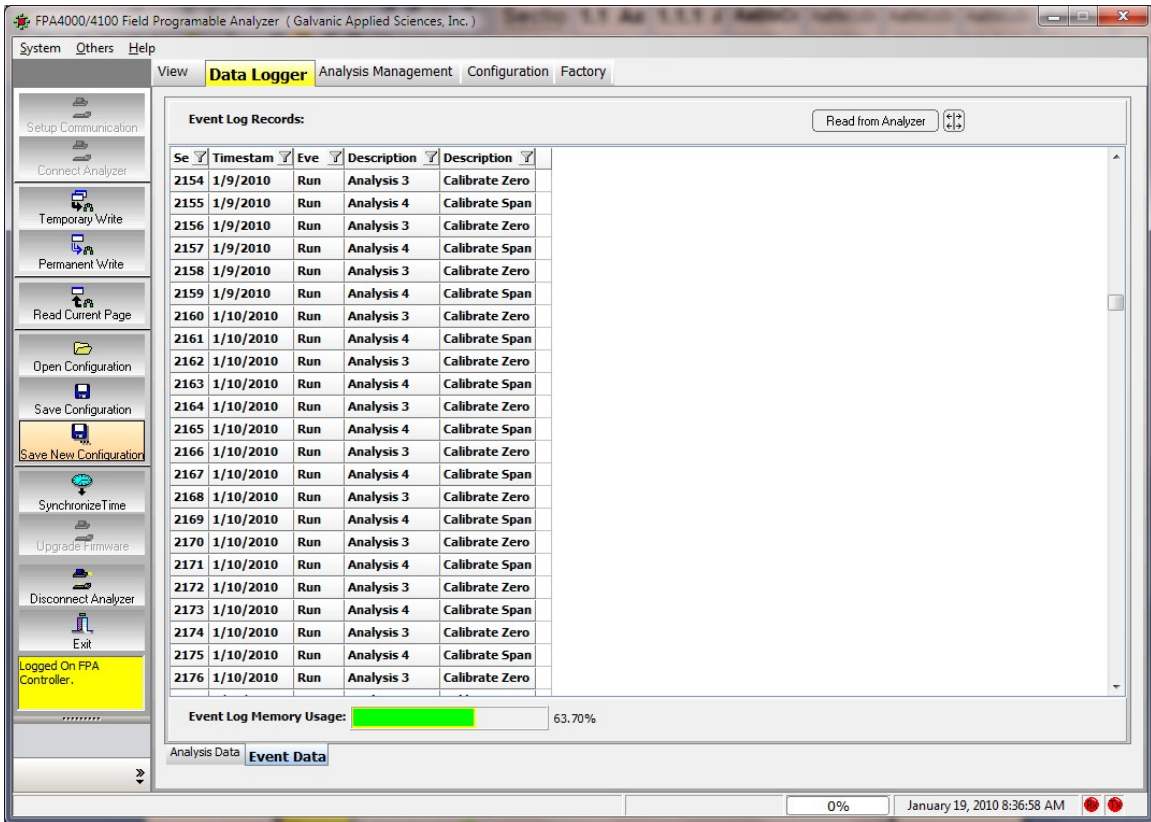


Figure 6-12: Event Log

## 6.5 The Analysis Management Page

### 6.5.1 Overview

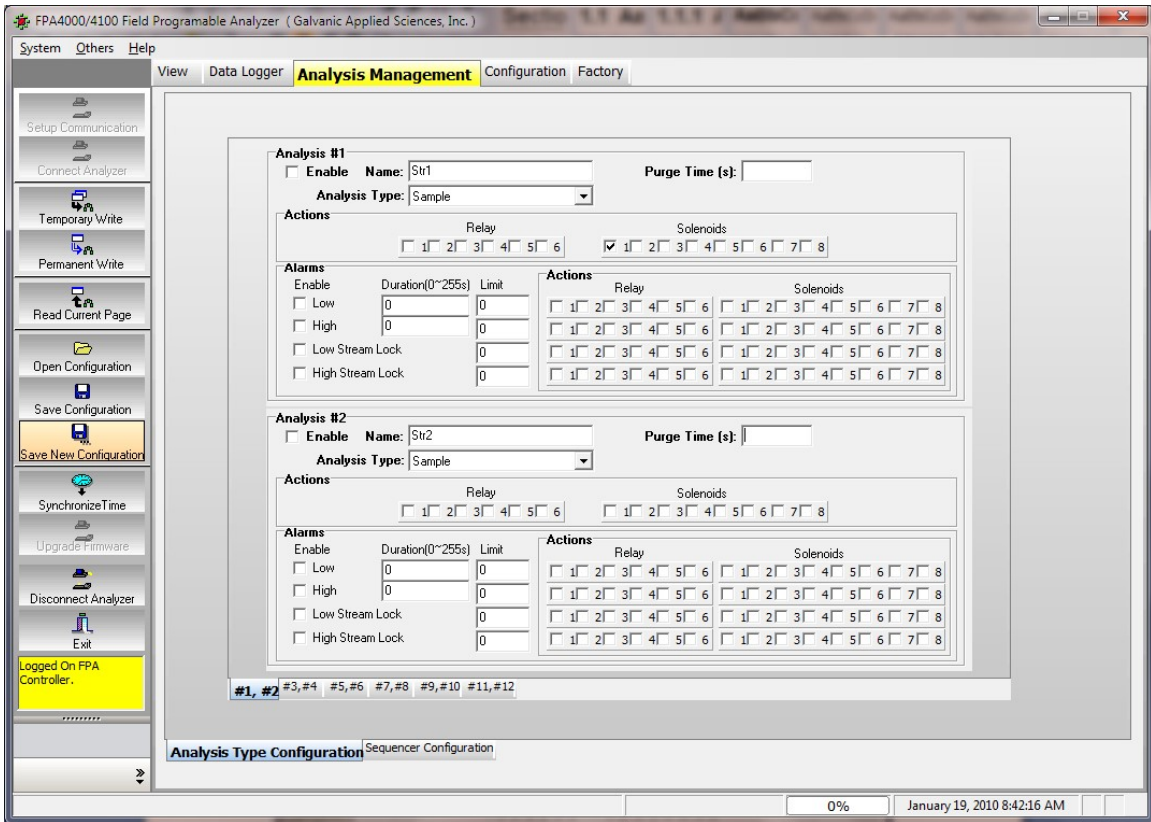
The *Analysis Management* page is used to establish parameters for each of the analysis that the system should perform and the sequence of operations. The operator must be in *Update* mode to edit parameters.

When a change is made on a tab on the *Analysis Management* page, it is **NOT** automatically downloaded to the analyzer module. It is necessary to save the change using the *Temporary Write* or *Permanent Write* button to download the change to the analyzer. If you go to another tab or page without using one of the *Write* buttons, the change will not be sent to the analyzer.

The application program is designed to stay in synchronization with the spectrophotometer at all times. The spectrophotometer always acts as a primary data holder. The application program automatically refreshes the tabs when it opened with the data from the spectrophotometer. Therefore if a change is made to any data inside a tab and then the user switches to another tab without sending changes to the unit, all changes made in the previous tab will be lost due to the fact the information was not first sent to the spectrophotometer.

### 6.5.2 Analysis Type Configuration Tab

The *Analysis Type Configuration* tab (Figure 6-13) is used to indicate information about each specific stream.



**Figure 6-13: Analysis Management Page - Analysis Type Configuration Tab**

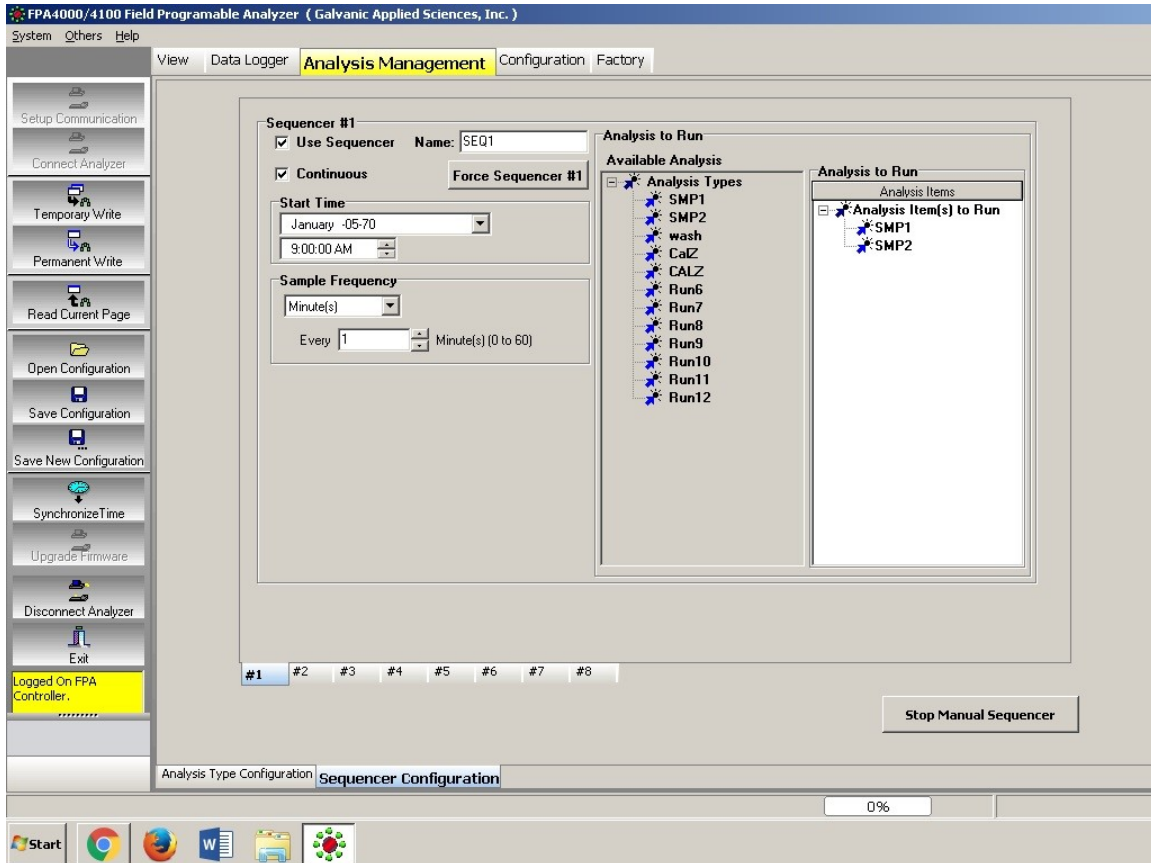
To indicate that a given stream should be employed, place a check mark in the *Enable* box. Indicate the name of the stream, the desired purge time and the analysis type using the drop down menu (Sample, Wash, Cal Zero Abs and Cal Std).

The *Actions* field is used to select the Relays and/or Solenoids that are to be employed in the analysis of this stream. The Relays and Solenoids are defined on the *Configuration* window (Section 6.6.4).

The *Alarms* field is used to indicate if an alarm should be issued if the level for that stream is above (below) the high (low) limit. The user should indicate the limit and the duration of the alarm. If the system should be locked if the level of that stream is above (below) a user specified level, the lock level field should be selected and the limit indicated. Select the relays and/or solenoids to triggered if the upper, lower, or either lock limit is reached.

## 6.5.3 Sequencer Configuration Tab

The *Sequencer Configuration* tab (Figure 6-14) is used to establish run sequences. Up to eight different sequences can be generated. Each sequence is generated via a separate tab.



**Figure 6-14: Analysis Management Page - Sequencer Configuration Tab**

The left side of the tab is used to indicate the time parameters that define the operation of the specific sequence.

The **Force Sequencer** button is used to run the selected sequence regardless if it is enabled or not. Pressing the button will immediately interrupt the current analysis and start a new one. The **Stop Manual Sequencer** button is used to stop the forced sequence and return to the normal sequence.

If the sequence is to be used, place a check mark in the *Use Sequencer* box, indicate the desired start date/time and indicate the desired frequency. As an alternative, select the *Continuous* check box, which will cause the sequence to run on a continuous basis (the date/time and frequency fields will be removed from the tab).



The right side of the tab is used to indicate the analyses to be run when this sequence is activated. To setup a sequence, place the mouse cursor on the desired analysis type in the *Available Analysis* column and drag it to the *Analysis Items to Run* heading in the *Analysis to Run* column. A sequence can include Samples, Washes, Calibration Zero Abs, and Calibration Standards as desired to meet the specific needs of the facility. When an analysis is run, the actions indicated in the analysis (e.g. triggering a relay for a high limit) will be performed as appropriate.

A typical sequence is shown in Figure 6-15.

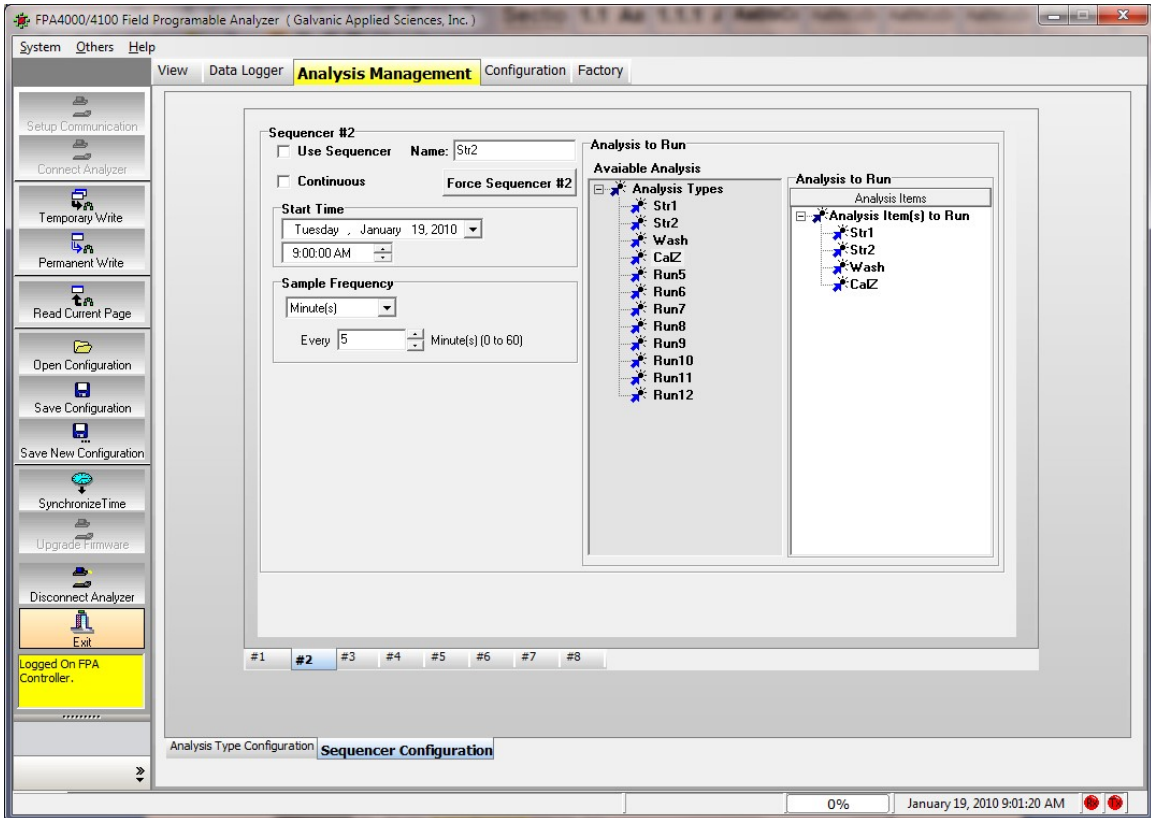


Figure 6-15: A Typical Sequence

**NOTICE**

An analysis type must be enabled on the *Analysis Configuration* tab to before it can be added to a sequence.

## 6.6 Configuration Page

The *Configuration* Page (Figure 6-16) includes a series of tabs that are provided to set up a broad range of system parameters.

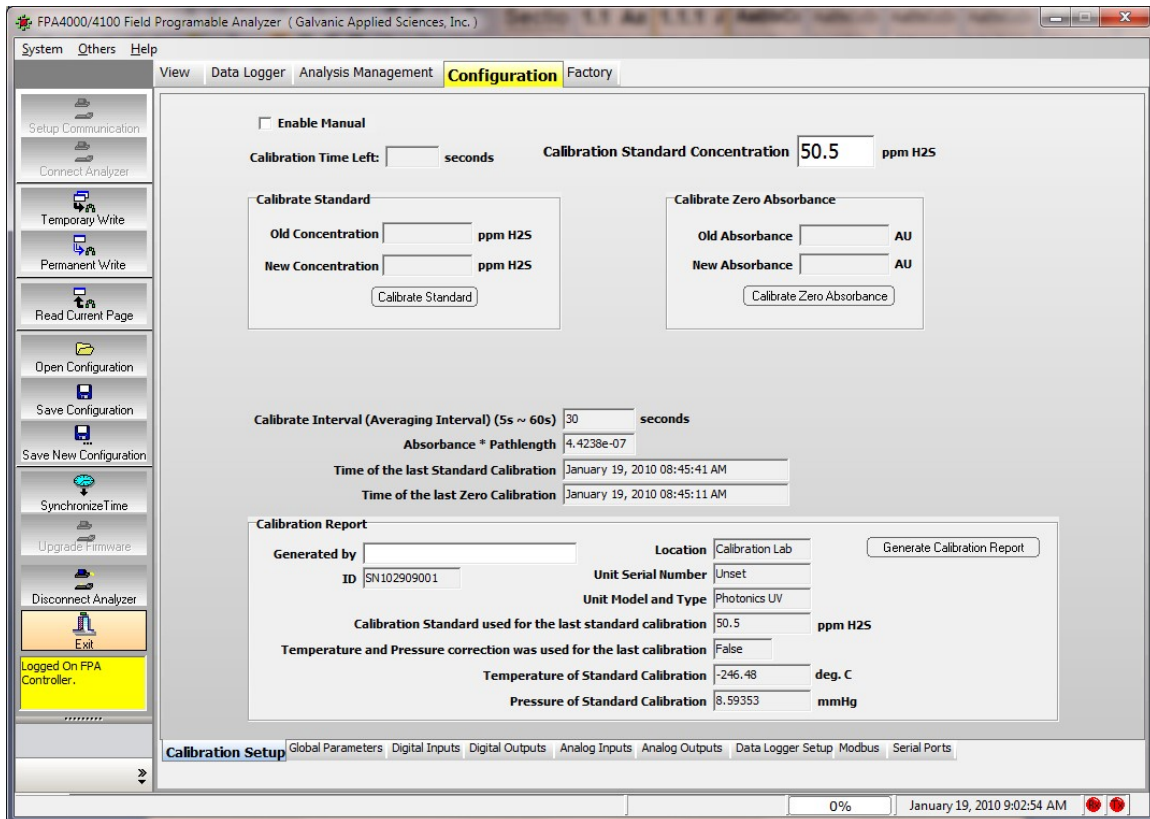


Figure 6-16: Configuration Page - Calibration Setup Tab

The *Configuration Setup* tab allows the user to:

- Establish calibration parameters and generate calibration reports (Section 6.6.1)
- Setup global parameters (Section 6.6.2)
- Setup input and output parameters (Sections 6.6.3 to 6.6.6)
- Format the data logger (Section 6.6.7)
- Establish the Modbus format (Section 6.6.8)
- Setup serial ports (Section 6.6.9)

## 6.6.1 Calibration Setup Tab

The *Calibration Setup* tab (Figure 6-16) is used to calibrate the system and provides information about the most recent calibration. The upper part of the tab is used for calibration, while the lower part describes the conditions for the most recent calibration.

To calibrate the system:

- a) Place a check mark in the *Enable Manual* check box.
- b) Enter the units for the calibration standard (e.g. ppm, mg/L).
- c) Place the blank (zero standard) in the sample cell and press the *Calibrate Zero Absorbance* button. The system will analyze the blank and report the new concentration of the blank. This value should be compared to the value for the old blank; if a significant difference is observed, determine the reason for the variance.
- d) Place the calibration standard in the sample cell and press the *Calibrate Standard* button. The system will analyze the sample and report the new concentration of the standard in the *Calibrate Standard* field. This value should be compared to the value for the old standard; if a significant difference is observed, determine the reason for the variance.

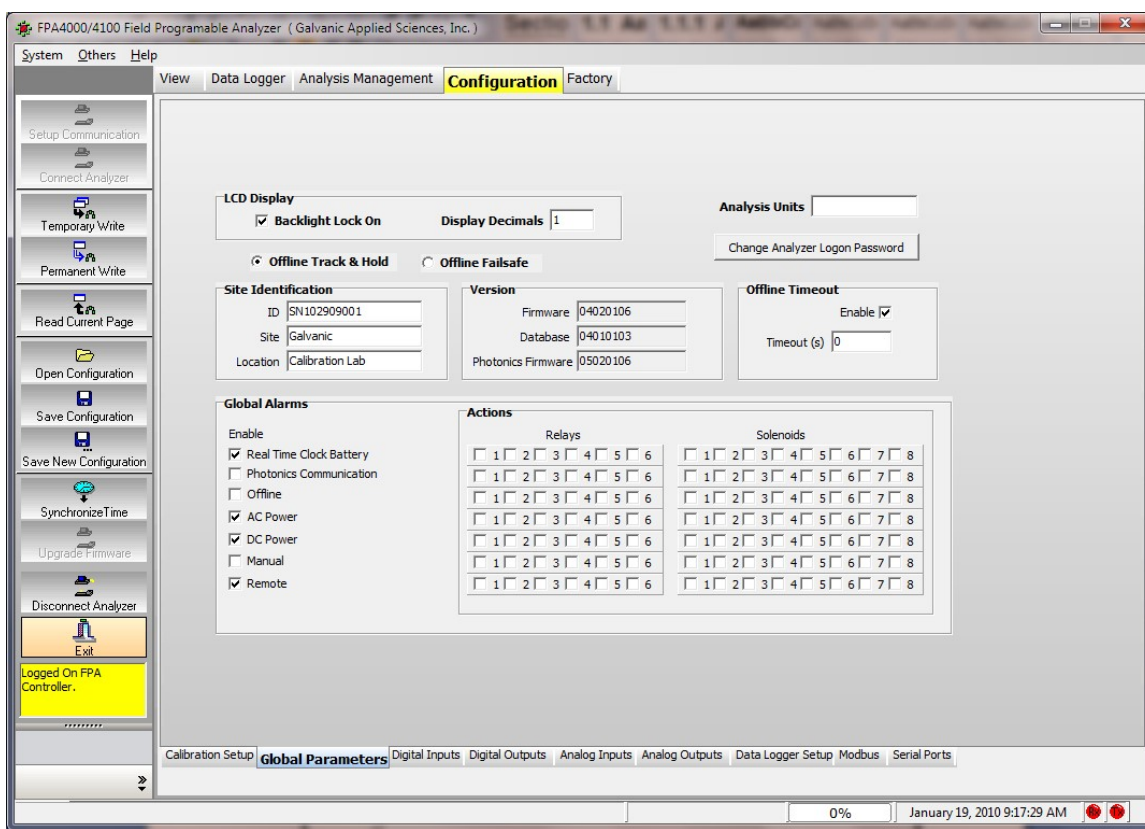
### NOTICE

**If the analyzer is equipped with automatic calibration and/or automatic zero, the appropriate solenoids will be activated to automatically introduce zero or calibration standard to the cell, and the associated purge times will be used.**

The information in the lower half of the tab is not editable by the user (except for the *Generated by* field). To obtain a hard copy report, press the **Generate Calibration Report** button, which presents the calibration information for the standard.

## 6.6.2 Global Parameters Tab

The *Global Parameters* tab (Figure 6-17) is used to establish a variety of system settings. In general, these pages are employed when the system is initially set up and are not used on a routine basis.



**Figure 6-17: Configuration Page - Global Parameters Tab**

- a) **LCD Display** - If the Backlight on the LCD display panel is to remain on at all times, place a check mark in the *Backlight Lock On* check box.
- b) **Display Decimals** - Indicate the number of figures after the decimal point that should be presented on the LCD display (e.g. 2 is entered, the display would present two figures after the decimal (e.g. 23.45) and the final value would be rounded to the nearest value (e.g.23.452 would read 23.45, 23.458 would read 23.46).
- c) **Analysis Units** - Enter the units that should be used to define the concentration (e.g. ppm, mg/L).
- d) **Change Password** - Presents a dialog box to select a new password. The user is prompted to enter the old password and the new password, which should be entered two times to ensure that it is entered accurately. The password must be numeric and should consist of no more than 4 characters.
- e) The **Offline Track & Hold** radio button - is used to indicate that the analog outputs should hold the last reading when the spectrophotometer is offline.
- f) The **Offline Failsafe** radio button - is used to indicate that when the analyzer is offline the analog outputs will go to the failsafe value setup in the *Analog Outputs* tab (default setting is 3 mA).

- g) **Version** - Indicates the present version of the firmware, database and photonics firmware. These fields cannot be edited by the operator.
- h) **Offline timeout** - Bypass mode is a mode of the analyzer that disables any outputs that may be triggered by alarms and is useful for doing service work that may result in inadvertent triggering of alarms. However, for normal operation, it is essential that bypass mode be disabled. This field is used indicate the period of time for which the bypass mode should be kept active after the last keypad button push. By default, this is set to 450 sec, and is disabled. When the instrument is in bypass mode, the output from all analog outputs goes either fail safe value of track and hold depending on how it is setup on the *Global* page.
- i) **Global Alarms** - Indicate the desired global alarms by checking the box to the left of the descriptor and place checkmarks for the relay(s) and/or solenoids that should be activated if the alarm is triggered.

### 6.6.3 Digital Inputs Tab

The *Digital Inputs* tab (Figure 6-18) is used to indicate the desired activity when a signal is sent to the system from an external digital input. There are eight digit inputs (four dry contacts and four wet contacts). Dry contacts do not require external power to operate, while Wet contacts require external power. Setting up discrete inputs is described in Section 6.5.2.

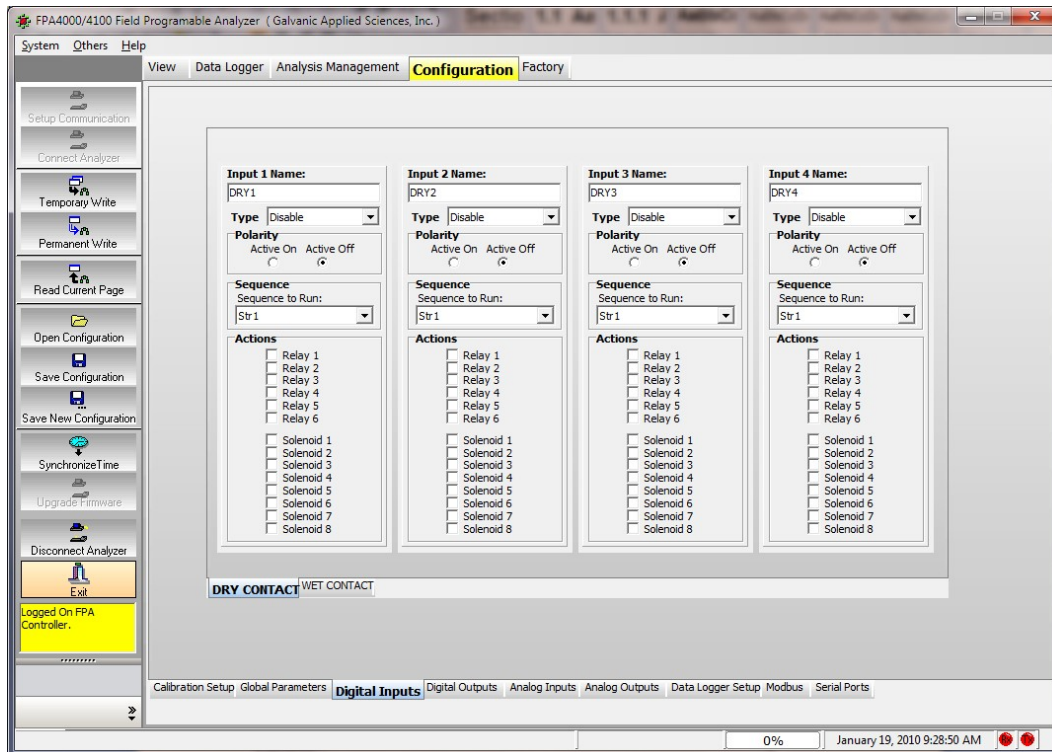


Figure 6-18: Configuration Page - Digital Inputs Tab

**Input Name** - Enter the desired name.

**Type** - Indicate the type of action that should be performed when the signal is inputted. The choices are *Disable*, *Alarm* and *Run Analysis*.

**Polarity** - Indicate the polarity of the input by selecting the appropriate radio button.

**Sequence** - The sequence field is used to indicate the sequence that will be activated by the inputting of the signal.

**Actions** - Indicate the relay(s) and/or solenoid(s) that are to be used to annunciate the alarm.

## 6.6.4 Digital Output Tab

The *Digital Outputs* tab (Figure 6-19) is used to indicate the nature of the digital outputs.

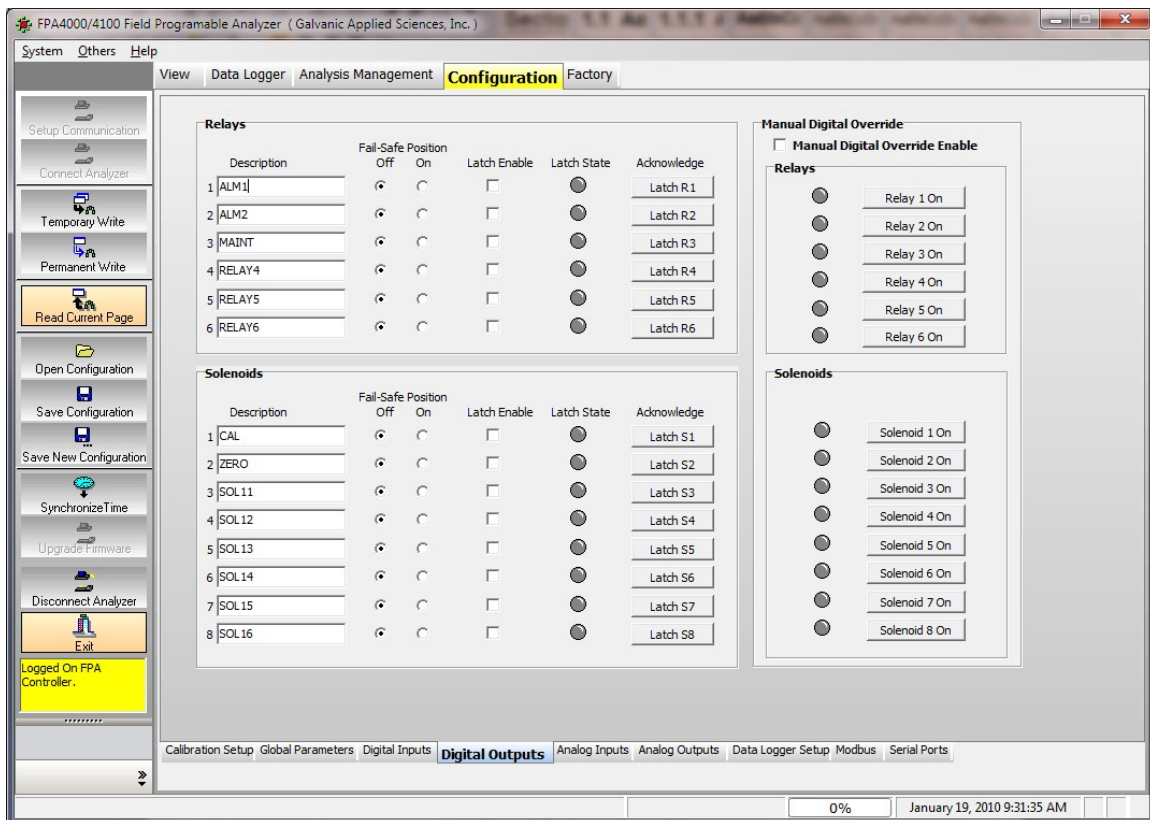


Figure 6-19: Configuration Page - Digital Output Tab

The information for each relay and solenoid is identical.

**Description** - Indicate the desired name for the output (up to six characters). The descriptor will appear on the LCD display.

**Fail-Safe Position** - The *Fail-Safe* position is the position that the output will default to if the output is not be triggered and is also the position that the relays will switch to while the 4100/4100 spectrophotometer is in bypass mode. The *Fail - Safe* position can either be **Off** or **On**. By default the fail-safe position for both relays and solenoids is off. If an output whose fail-safe position is on is triggered by an alarm or some other event, the output will then go to the off position.

**Latch Enable** -The *Latch Enable* feature allows the user to latch certain outputs. If an output is latched, the output will stay in its triggered position until the user clears the latch, regardless of whether or not the event that triggered the output has cleared.

**Latch State** - The state of a latch is indicated by the coloured circle under the title **Latch State**. A grey circle indicates that the output is not latched, while a red circle indicates that the output is latched.

**Acknowledge** - A latched output can be cleared by pressing the **Acknowledge** button. This is only possible after the condition that caused alarm latch has been removed.

The *Manual Digital Override* fields are used to indicate that you want the ability to manually control a relay (solenoid). To employ this feature, place a checkmark in the *Manual Digital Override Enable* box.

A grey circle indicates that the relay (solenoid) has not triggered, while a red circle indicates that the relay (solenoid) has been triggered. Press the corresponding *Relay (solenoid) #x* to toggle the output between off and on. This feature is useful for testing the analyzer outputs to the control room or DCS.

## 6.6.5 Analog Inputs Tab

The *Analog Inputs* tab (Figure 6-20) is divided into two main sections, *Analog Inputs #1-4* which relate to the four analog inputs and the *Analog Inputs Alarm* section which relate to the relays/solenoids that could be triggered.

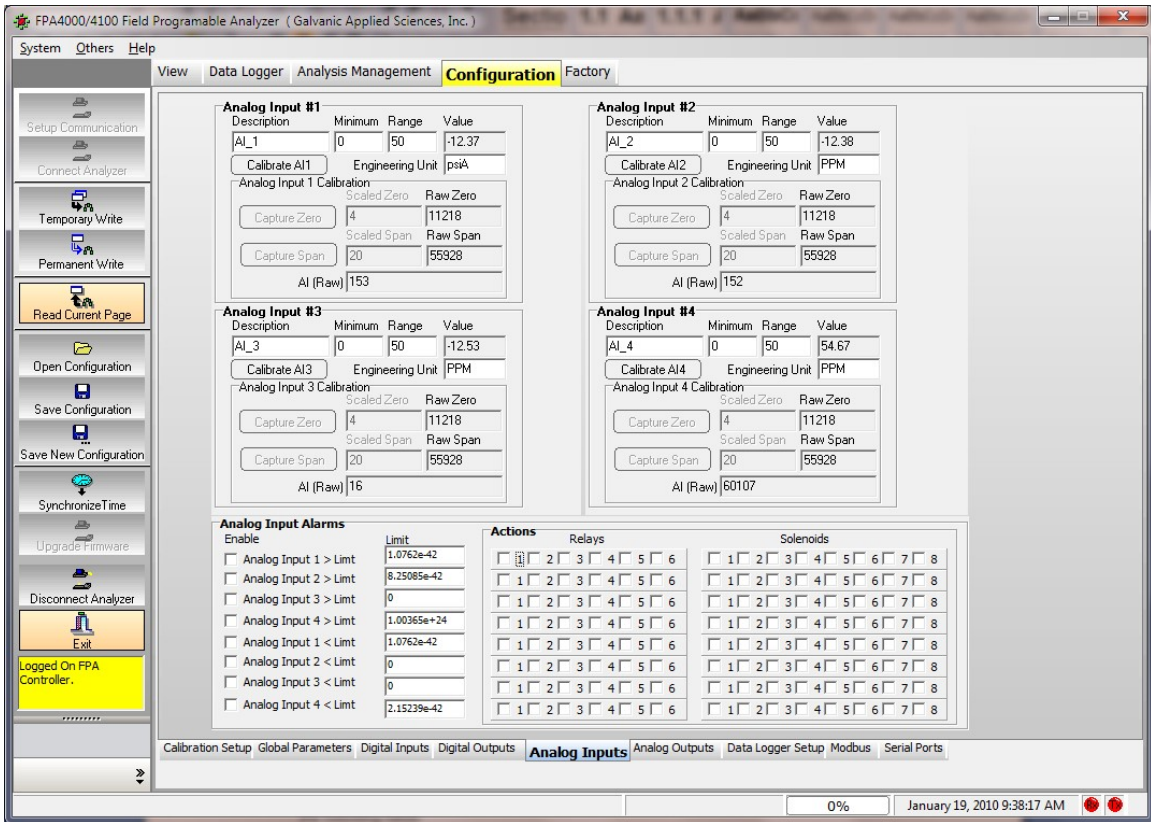


Figure 6-20: Configuration Page - Analog Inputs Tab

### 6.6.5.1 Analog Input

There are four available analog inputs to use which can be edited as required. Each contains the following fields:

**Description** - The *Description* field is used to name the analog input and can be up to six characters. The *Analog Input* descriptor given will appear under the *Analog Inputs* section on the *Status* Tab and on the analyzer LCD display.

**Minimum** -The lower limit of the range (typically zero).

**Range** - The maximum or span limit of the range.

**Value** - The calculated range value for a given 4 – 20 mA input.

**Engineering Unit** - Used to enter units that correspond to the type of analog input (e.g. ppm, %, psig, etc.).

**Calibrate A. I. #** - The **Calibrate A. I. #** button is used to calibrate the Analog input. Once the button is pressed, the greyed out *Scaled Zero* and *Scaled Span* fields will turn white and will allow data input into those fields.



**Capture Zero** - The *Capture Zero* button is used to capture the A/D bits that are associated with a 4mA input during the calibration of the analog input.

**Scaled Zero** - The *Scale Zero* field is where the zero value or the range would be entered. For a 4 – 20 ma range, the 4 mA value would be entered.

**Raw Zero** - The *Raw Zero* field shows the A/D bit count for the 4mA input.

**Capture Span** - The **Capture Span** button is used to capture the A/D bits that are associated with a 20mA input during the calibration of the analog input.

**Scaled Span** - The *Scale Span* field is where the span value or the range would be entered. For a 4 - 20 ma range, the 20 mA value would be entered.

**Raw Span** - The *Raw Span* field shows the A/D bit count for the 20 mA input.

**AI Raw** - The AI Raw field shows the current raw bits reading on the AD of the analog input.

### 6.6.5.2 Analog Inputs Alarm Field

The *Analog Inputs Alarm* field is used to activate the relay (solenoids) to issue an alarm if the appropriate items are above (below) the selected limit. To use this feature, place a check mark to the left of the desired input, enter the limit and check the desired relay (solenoid).

### 6.6.6 Analog Outputs Tab

The *Analog Output* tab (Figure 6-21) is used to set up each of the analog outputs and calibrate them. All six analog outputs are equivalent.

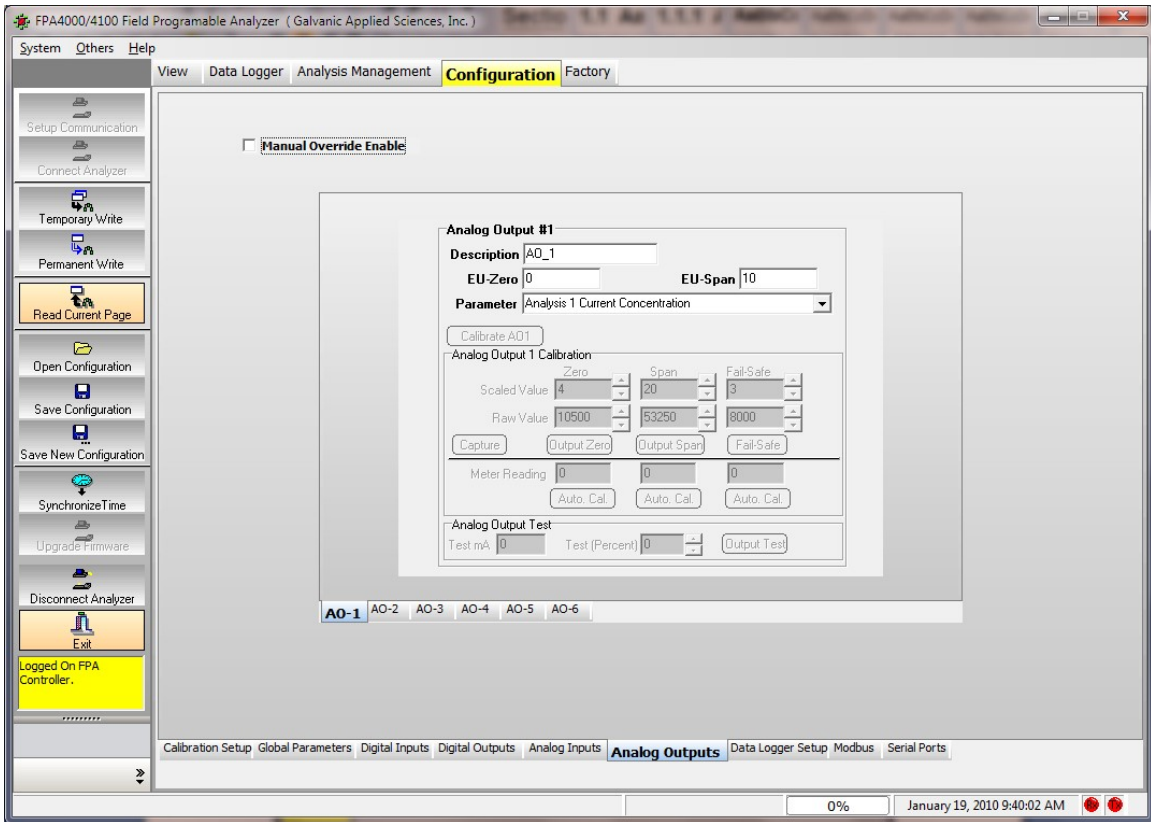


Figure 6-21: Configuration Page - Analog Output Tab

### 6.6.6.1 Establishing Analog Output Information

The upper portion of the tab is used to enter general information about the analog outputs:

**Description** - The *Description* can be up to a maximum of 6 alphanumeric characters.

**EU Zero** and **EU Span** - These fields are used to enter the desired zero and range of the analog output.

**Parameter** - The drop down menu is used to indicate the parameter that should be monitored.

## 6.6.6.2 Calibrating Analog Outputs

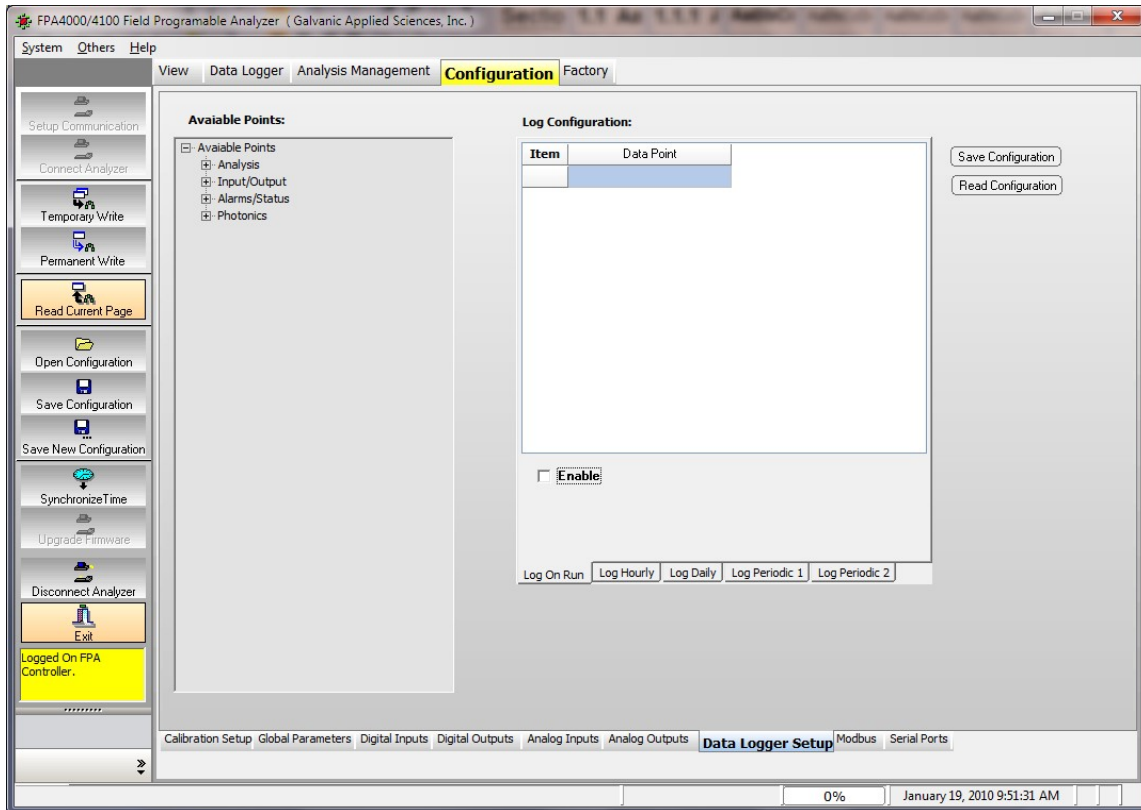
To calibrate analog outputs, a multimeter set to measure milliamps must be connected across the analog output, and the analog output must be powered, as the 4000/4100 motherboard does not provide power to the analog outputs. When the analog output is correctly powered, a green LED will glow on the electronics board next to the AO terminal block. The Calibration range is from 3-23 mA.

To calibrate an analog output (e.g. AO1):

- a) Check the *Manual Over Ride Enable* box at the top left of the page.
- b) Connect the multimeter to the AO1 terminal block on the right side of the motherboard.
- c) Press the **Calibrate** button on the *Analog Output* tab (Figure 6-12). In the *AnalogOutput 1 Calibration* box, there are six user-adjustable fields, the *Scaled Value* for zero, span, and fail-safe are used to indicate what the currents should be output to the analog output when the data point being sent to the analog output has a value equal to its minimum or maximum output value or when the analyzer is in bypass (failsafe) mode.
- d) Calibrate the fail-safe position. The fail-safe position is the value that the analog output will output when the analyzer is in bypass mode, and is a value outside the standard scaled range of the analog output. For example, if the analog output is scaled to output 4 to 20 milliamps, the fail-safe value could be 3 or 21 milliamps. To calibrate the fail-safe position, press the **Fail-Safe** button. This will cause the analyzer to output the fail safe value to the multimeter. Enter the number from the multimeter in the “meter reading” field and press the auto-calibrate button. This will automatically calibrate the output to read exactly 3 mA.
- e) Calibrate the zero position (4 mA). To calibrate the zero, press the **Output Zero** button. This will cause the analyzer to output 4 mA to the multimeter. At this point the reading will not be exactly 4 mA. Enter the number from the multimeter in the “meter reading” field and press the auto-calibrate button. This will automatically calibrate the output to read exactly 4 mA.
- f) Calibrate the full scale position (20 mA). To calibrate the full scale, press the **Output Span** button. This will cause the analyzer to output 20 mA to the multimeter. At this point the reading will not be exactly 20 mA. Enter the number from the multimeter in the “meter reading” field and press the auto-calibrate button. This will automatically calibrate the output to read exactly 20 mA.
- g) Once the fail safe position, zero and span are calibrated, press the **Capture** button.
- h) Test that the output works correctly using the **Analog Output Test** box. Enter a value between 0 and 100 into the **Test (Percent)** field and ensure that the reading on the multimeter is the same as the reading in the **Test mA** field. If it is not, the calibration is not correct and needs to be changed. If it is, the calibration is correct.
- i) When the calibration is complete, use the **Temporary Write** and/or **Permanent Write** function on the toolbar to send the new calibration values to the analyzer.

## 6.6.7 Data Logger Setup Tab

The *Data Logger Setup* tab (Figure 6-22) is used to indicate the data and frequency that is transmitted to the log and is used to configure the FPA 4000/4100 spectrophotometer log values in data points other than those set up at the factory.

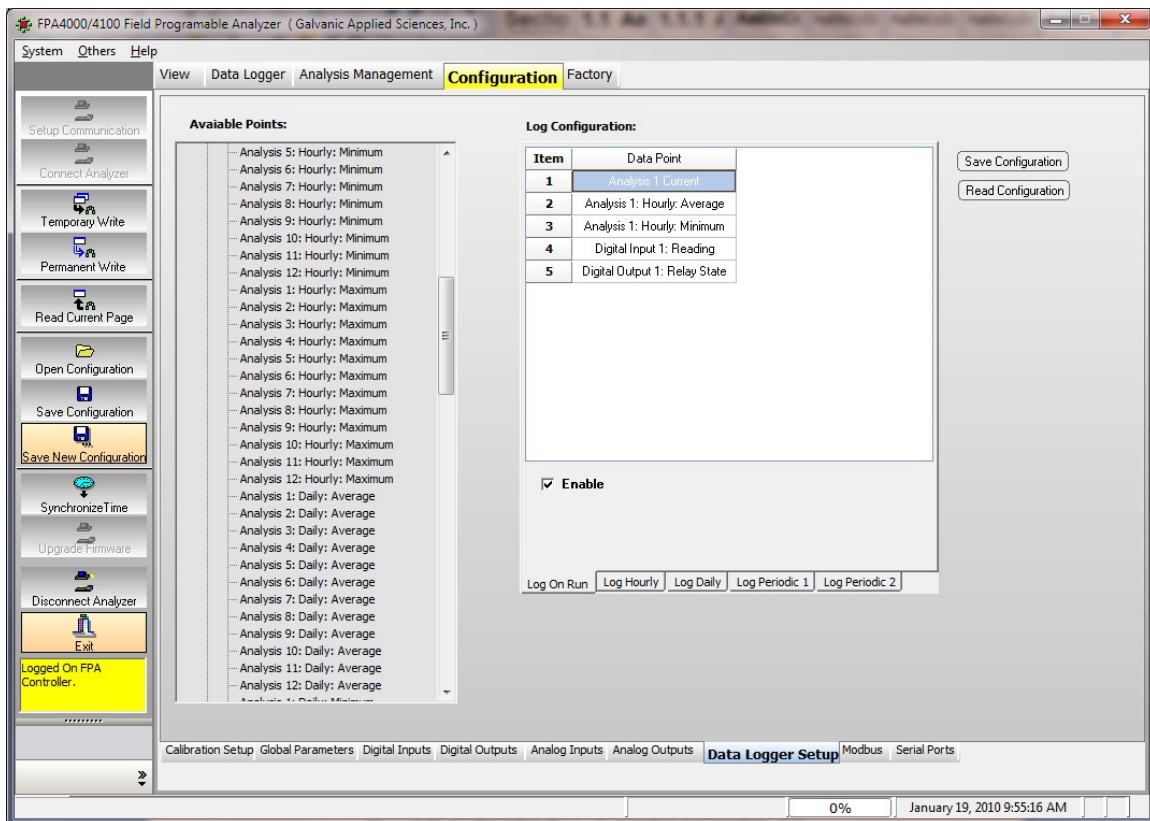


**Figure 6-22: Configuration Page - Data Logger Setup Tab**

- a) Indicate the frequency that data is to be collected. Five logs are available; to edit the desired log, select the appropriate tab and check the **Enable** box:
- **Log On Run** - the values of the data points logged in this log will update after every completed analysis cycle.
  - **Log Hourly** - the values of the data points logged in this log will update every hour. The log is updated at the top of every hour (e.g. 3:00 PM, 4:00 PM, 5:00 PM, etc).
  - **Log Daily** - the values of the data points logged in this log will update every day. A field is provided to enter the hour at which the data is to be saved (data can only be saved at a specific hour (e.g. 11:00, not 11:05). Enter a value of 0 (midnight) to 23 (11 PM) in this column and press the **Enter** key to save the value.
  - **Log Periodic 1 and 2** - can be used to log data at the user's desired frequency. A field is provided to enter the desired interval (in seconds from 10-3600 seconds). Press the **Enter** key to save the value.

- b) Indicate the items to be entered in the log. The left hand side of the *Log Setup* tab provides a tree that contains 4 nodes; within each of these nodes are is a list of data points that can be logged.
- **Analyses** – allows for selection of Current Concentration, Hourly Average, Hourly Minimum, Hourly Maximum, Daily Average, Daily Minimum, Daily maximum for each analysis.
  - **Input/Output** - allows for selection of digital Input reading
  - **Alarms** - allows for selection of AC Power, DC Power, Digital Input (Alarms), Digital Output (Relay State , Solenoid State) and Latch State (Relay and Solenoids).
  - **Photonics** - allows for selection of a number of detector parameters such as Power, Temperature, Pressure, Transmissivity, Absorbance and Concentration.

To expand a node left click on the (+) icon to the left of the node label. This will expand the node to show all of the data items within that node. To add any data item into a log, left click on the item of interest, and while holding the left mouse button down, drag the item into the desired log. Once the left mouse button has been released, the item should become a row in the table for the log. Once all of the desired parameters have been dragged to the *Log Configuration* section, press the **Save Configuration** button to write the log configuration to the analyzer. A typical log is shown in Figure 6-23.

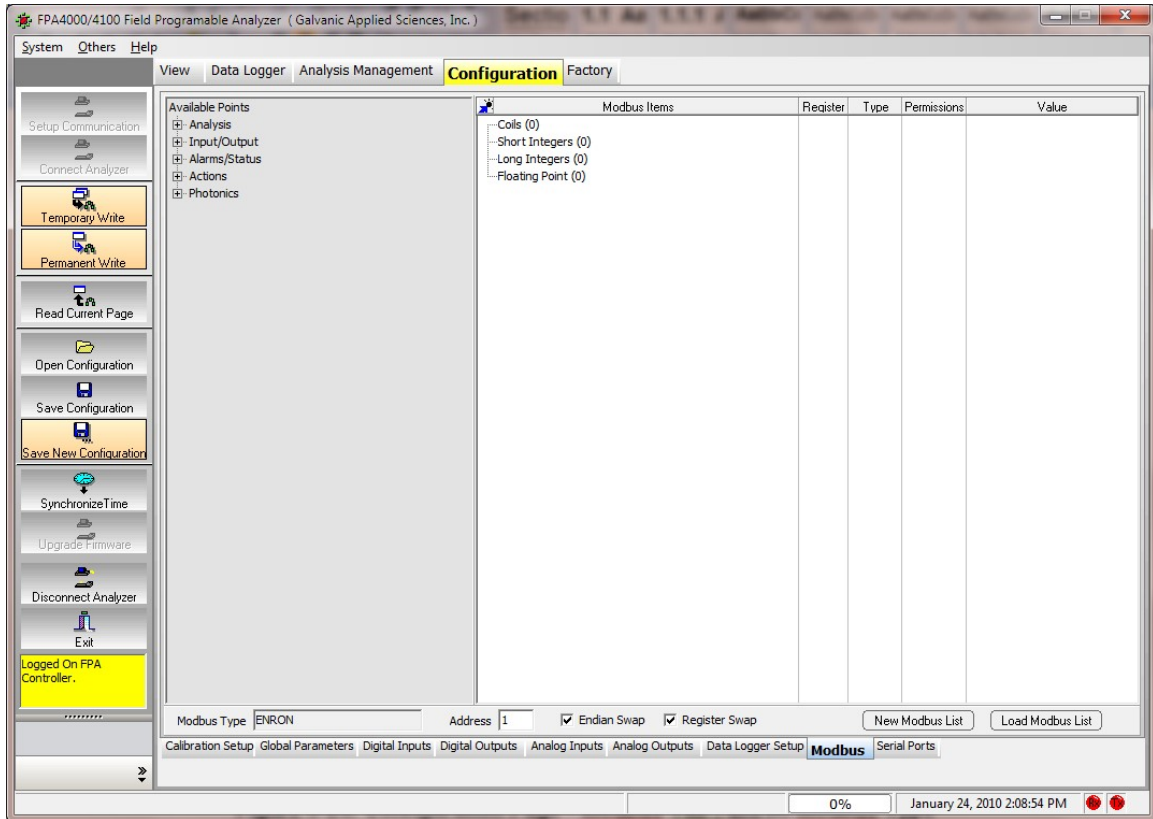


**Figure 6-23: Configuration Page - Typical Data Logger Setup Tab**

To remove an item from any log configuration, simply right click on the row to be removed, and then select the **Delete Item** option from the popup menu that appears.

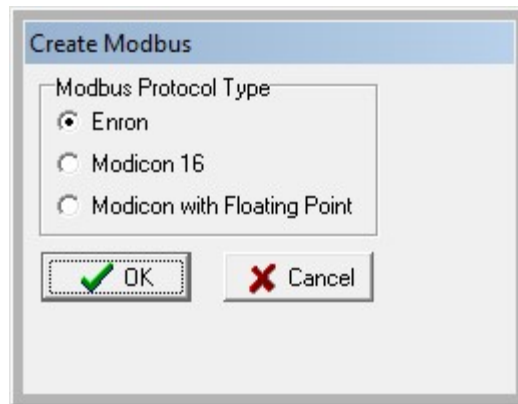
## 6.6.8 Modbus Tab

The *Modbus* tab allows the user to set up the 4000/4100 analyzer to output data in 3 varieties of MODBUS communication protocol - *Enron*, *Modicon 16*, and *Modicon Floating Point*. As there are a large number of possible configurations for Modbus, and every user may desire a slightly different configuration, this manual will only cover the basics of Modbus configuration. If the user requires assistance in setting up a Modbus configuration, the Service Department at Galvanic Applied Sciences Inc. will be pleased to assist in configuring the unit as desired.



**Figure 6-24: Configuration Page - Modbus Tab: Enron Modbus Type**

To set up a new Modbus list, press the **New Modbus List** button at the bottom of the tab to present the *Create Modbus* dialog box (Figure 6-25).



**Figure 6-25: Create Modbus Dialog Box**

Select the desired type of Modbus list and press **OK**. The bottom line of the tab (Figure 6-24) will indicate the protocol type. The user should indicate the desired Modbus address for the analyzer into the *Address* field and indicate if *Endian Swap* and *Register Swap* are desired.

*Endian Swap* and *Register Swap* are used to manipulate how the data is transmitted and they only apply to Modicon Modbus data. In Modicon Modbus, floating point numbers are transmitted in 2 16 bit words. *Endian Swap* determines if the most significant bit is transmitted first or if the least significant bit is transmitted first for each word. *Register swap* determines if the portion of the number before the decimal place is transmitted in the first word or if the portion of the number after the decimal place is transmitted in the first word.

The various items on the *Available points* listing on the left side of the tab can be accessed by clicking on the + sign. The items in this listing can be used to populate the Modbus items list on the right side of the tab.

- The *Analysis* group includes the Current Concentration, Hourly Average, Hourly Minimum, Hourly Maximum, Daily Average, Daily Minimum and Daily Maximum for each analysis.
- The *Digital Input* group includes the reading for digital inputs.
- The *Alarms* group includes a variety of alarm states for various hardware functions, and High and Low Concentrations and High and Low lock for each analysis, Digital Input alarms, Digital Outputs (Relays and Solenoids), Latch states and various Photonics alarms.
- The *Actions* group includes a variety of system status options.
- The *Photonics* group includes a variety of photonics status options.

### 6.6.8.1 The Enron Modbus Protocol

An *Enron Modbus* list contains 4 nodes on the Modbus tree, **Coils**, **Short Integers**, **Long Integers**, and **Floating Point** (Figure 6-19). Coils are Boolean data points which have a value of either 0 or 1. To that end, data points entered into the Coils node would usually be data points that are simple status indicators, indicating the status of a given alarm, input, or output. If the value of the data point is 0, the status of the logged alarm, relay, etc, would be off, and if the value is 1, the status would be on. Short integers are 16 bit whole numbers with either positive or negative sign. Long integers are 32 bit whole numbers with either positive or negative sign. Floating point values are also 32 bit numbers, but unlike the integers they do not have a sign, but they do have decimal points.

### 6.6.8.2 The Modicon 16 Protocol

A *Modicon 16 Modbus* list contains 4 nodes on the Modbus tree (Figure 6-21). They are **Output Status**, **Input Status**, **Input Register**, and **Output Register**. The Input and Output Status nodes contain Boolean data points. Data points in the Output Status node are able to be written to, so the Output Status node can contain data points such as stream requests. If the value in a given stream was changed from 0 to 1, the analyzer would then initiate that stream. Data points in the Input Status node are read-only, so this node would contain data points such as alarm, input, and output status that cannot be changed remotely.

Input Registers are data points that are read-only outputs of analyzer data, such as calculated concentration. Please note that Modicon 16 only outputs data as 16 bit numbers, so the display of decimal points in this type of Modbus list is not possible.

Output Registers contains non-Boolean data points that can be written to remotely. These might include such things as the calibration concentration and gain factor.

Modbus Items	Register	Type	Permissions	Value
Output "Coils" Status (0)				
Input Status (0)				
Input Register (0)				
Output "Holding" Register (0)				

Figure 6-26: Modbus Items - Modicon 16

### 6.6.8.3 Modicon with Floating Point Protocol

The Modicon with Floating Point (MODICON 32) list contains 4 main nodes on the Modbus tree (Figure 6-22). However, the Input and Output Registers contain sub-nodes. They are **Register Short**, **Register Long**, and **Register Float**. Thus, the input and output registers can output data in 16-bit, 32-bit, or 32-bit with floating point in the Modicon with Floating Point Modbus list.

Modbus Items	Register	Type	Permissions	Value
Output "Coils" Status (0)				
Input Status (0)				
Input Register (0)				
Input Register Short (0)				
Input Register Long (0)				
Input Register Float (0)				
Output "Holding" Register (0)				
Holding Register Short (0)				
Holding Register Long (0)				
Holding Register Float (0)				

Figure 6-27: Modbus Items - Modicon with Floating Point Protocol



## 6.6.9 Serial Ports Tab

The *Serial Ports* tab (Figure 6-28) shows the configuration of the 3 main communications ports on the FPA 4000/4100 analyzer – the *Front Panel Serial Port (RS-232)*, the *ISO 485 Port (RS-485)*, and the *MODEM Port (RS-232)*). The front panel serial port cannot be changed. It is hard coded to 57600, 8, None, 1. The settings for the RS 485 and RS 232 ports must be set according to the external device that will be used to communicate with the analyzer.

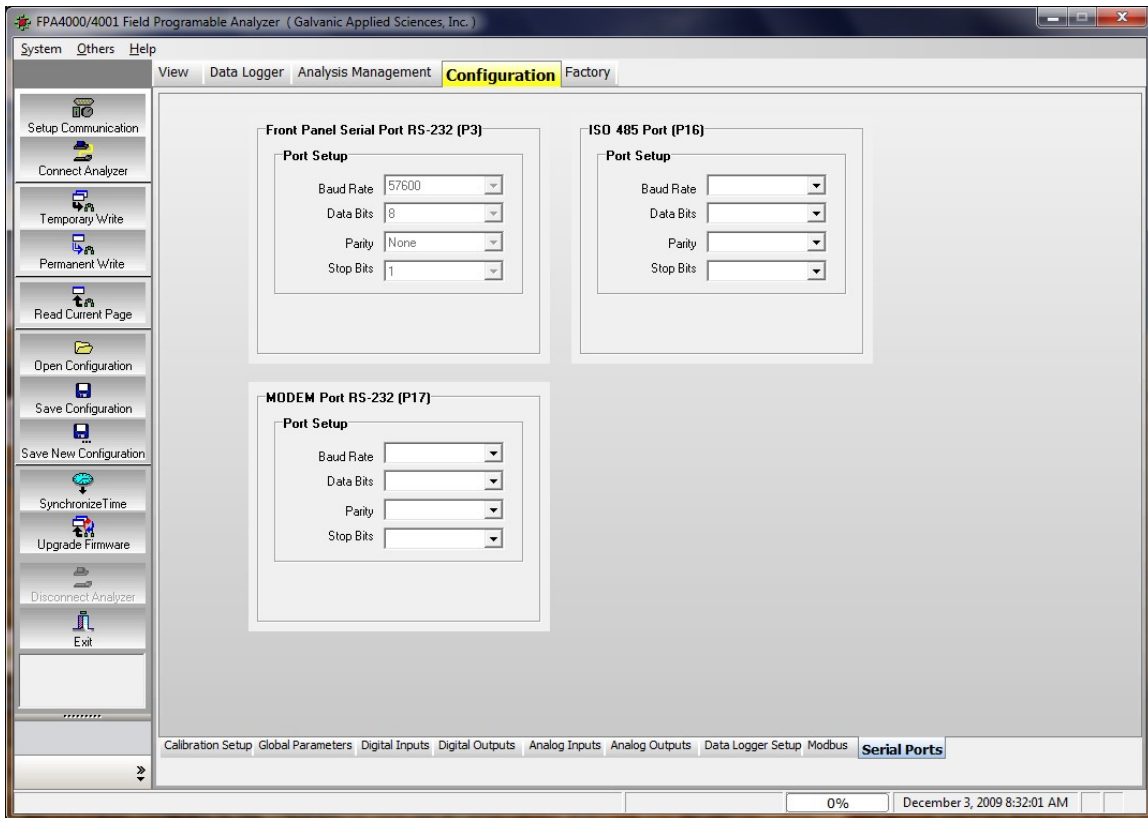


Figure 6-28: Configuration Page - Serial Ports Tab

## 6.7 Factory Page

The *Factory* page accesses a variety of parameters that are set during manufacture and is password protected. This page is not accessible to the user.

## Section 7 Operating the System

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### 7.1 Introduction

The operation of the spectrophotometer is defined by a *configuration*, which contains the parameters required to perform the desired measurements. A configuration consists of two types of parameters, those which are instrument specific and those which are application specific. The configuration is generated via the application program on the personal computer and must be downloaded to the spectrophotometer for use. It can be saved and retrieved as desired in the same manner as other Windows files. In addition, the operator can retrieve the present configuration from the spectrophotometer to the personal computer, edit it as desired and then download back it to the spectrophotometer.

The spectrophotometer can operate in manual mode or in automated mode:

- In manual mode, the user can monitor a variety of instrumental parameters, perform a calibration on demand, or run predefined sequences on demand.
- In automated mode, the system will perform the desired operations (analyzing a sample, washing the cell, calibrating the system using a standard and calibrating the zero point analyses) on a time programmed basis selected by the operator or on a continuous basis. The data will be stored in the controller module of the spectrophotometer and can be downloaded to the computer as desired.

This role of this chapter is to lead the operator through the establishment of a typical configuration and its use in data collection. It assumes that the system has been installed as described in Chapter 3 (i.e. all input and output devices have been interfaced, the communications parameters have been established the spectrophotometer has been connected to the personal computer and the *Update* mode has been selected.

While the configuration is established by the application program on the personal computer, the keypad on the spectrophotometer can be used to monitor a broad range of instrument parameters. The use of the keypad is presented in Chapter 5. In addition, a series of LED's on the panel of the controller module provide information about the status of the spectrophotometer.

This chapter presents an overview about:

- Editing a Configuration (Section 7.2)
- Calibrating the System (Section 7.3)
- Running Analyses (Section 7.4)
- Viewing Data (Section 7.5)

## 7.2 Editing a Configuration

### 7.2.1 Accessing the Active Configuration

A configuration is generated as a part of the manufacturing, QA and final acceptance steps and is stored in the controller module when the unit is shipped to the end user.

If you want to edit the active configuration that is in the controller module, log on to the system in *Update* mode. When you log on to the analyzer, the information for that page will be automatically read to the computer. When you switch tabs or pages, the information is also automatically read. This should ensure that you have the most recent information on the computer at all times.

Configuration(s) can be stored on the personal computer using the **Save Configuration** or **Save New Configuration** buttons. A saved configuration can be opened via the **Open Configuration** button.

Once a configuration has been opened or generated on the PC, can be edited as desired (see Chapter 4 for details) and saved via the **Permanent Write** button.

### 7.2.2 Selecting Parameters in a Configuration

The configuration contains a broad range of parameters and settings that govern the operation of the system. These fall in to two general groups:

- Parameters and settings that are closely related to the desired measurement, such as setting the high or low alarm limits, how the data is reported, the start time or the sample frequency. These may be changed by the user from time to time.
- Parameters and settings that are changed relatively infrequently once they are set, such as the relay assigned to a specific alarm.

Chapter 4 includes a detailed discussion of each parameter that can be set. In this chapter we will provide a short review of items that the operator is likely to edit in the normal operation of the system. For the sake of brevity, we will not include items that are set infrequently. For specifics, the operator should refer to the appropriate section of Chapter 4.

### 7.2.2.1 Selecting the Operations in a Configuration

A configuration may consist of four different analysis types: analyzing a sample, washing the cell, calibrating using a standard and calibrating the zero point. Each type is defined using an *Analysis* field on the *Analysis Type Configuration* tab on the *Analysis Management* page (Figure 7-1). Up to 12 analyses types can be generated.

The form is titled "Analysis #1" and contains the following sections:

- Enable:**  **Name:**
- Purge Time (s):**
- Analysis Type:**
- Actions:**
  - Relay:**  1  2  3  4  5  6
  - Solenoids:**  1  2  3  4  5  6  7  8
- Alarms:**
  - Enable:**  **Duration(0~255s):**  **Limit:**
  - Low
  - High
  - Low Stream Lock
  - High Stream Lock
- Alarms Actions:**
  - Relay:**  1  2  3  4  5  6
  - Solenoids:**  1  2  3  4  5  6  7  8

Figure 7-1: An Analysis Field

An analysis field should be completed for each analysis type to be performed. The analysis type is selected via the drop down menu, a check mark should be placed in the *Enable* box for each type and the purge time indicated. If alarms are desired; indicate the limits, duration and the relays/solenoids to be employed. Detailed information about completing the *Analysis* field are described in Section 6.5.2.

**NOTICE**

When you have completed editing a tab, press the Temporary Write button before going to another tab or page.

## 7.2.2.2 Setting up the Sequence of Operations

The *Sequence* tab (Figure 7-2) defines the order of analysis items to be performed and the frequency that they are to be performed. Check the *Use Sequencer* box and indicate if the sequence should be performed on a continuous basis or a timed basis (if a timed basis is desired, select the *Start Time* and *Frequency*). The desired analysis types are selected by dragging them to the *Analysis to Run* column (drag the item to the *Analysis items* heading; it will be placed at the bottom of the list). To remove an item from the list, highlight it and press the **Del** key. Up to eight sequences can be generated in a configuration. Detailed information about completing the *Sequence* tab is presented in Section 6.5.3.

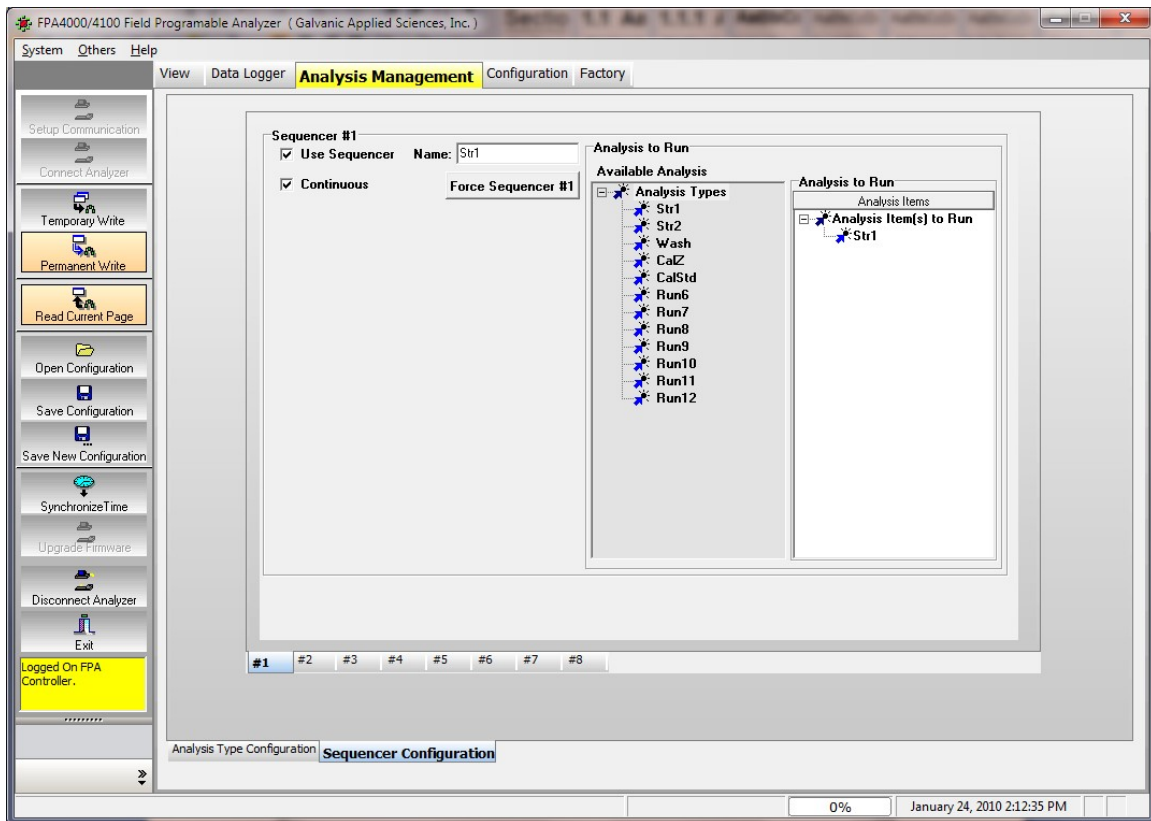


Figure 7-2: Completed Sequencer Tab

### 7.2.2.3 Setting Other Parameters

A number of other parameters such as the LCD display information and the *Analysis Units* can be set on the *Global Parameters* tab of the *Configuration* page (Figure 7-3). Various tabs on the *Configuration* page can be used to establish inputs and outputs (Section 6.6).

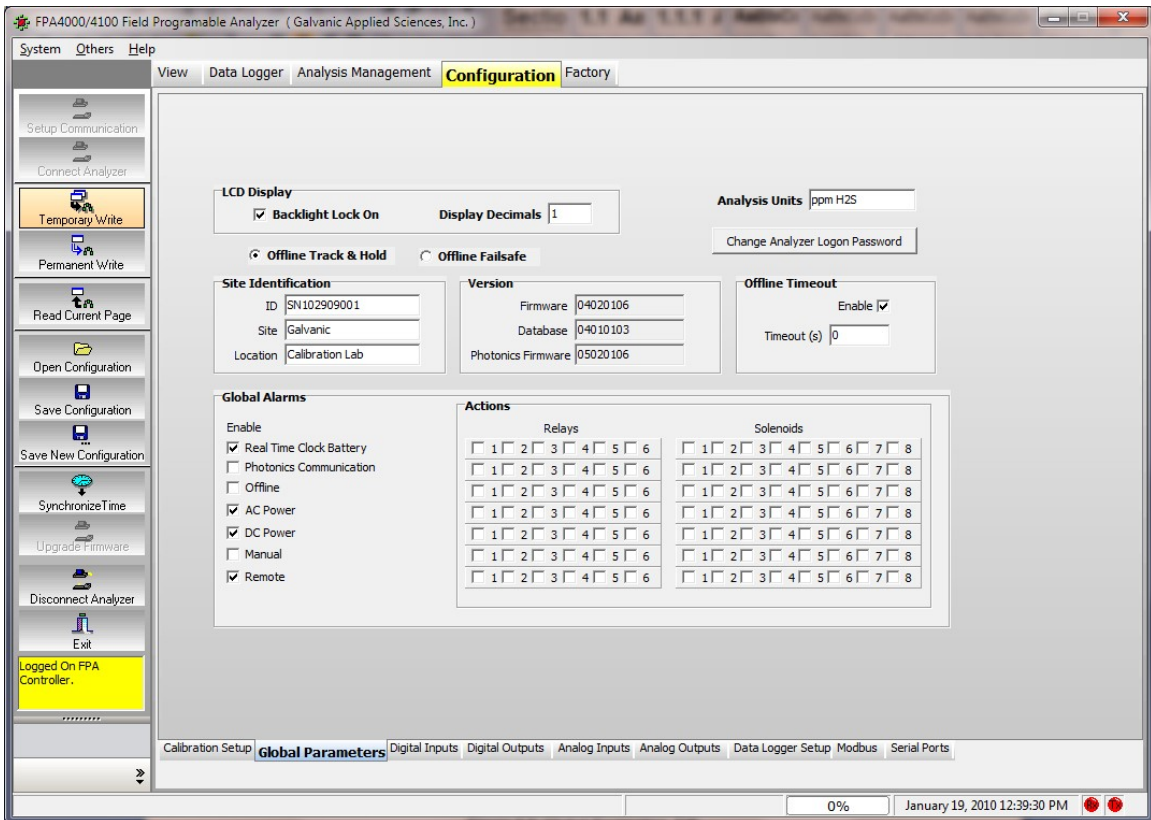


Figure 7-3: Global Parameters Tab

## 7.2.3 Selecting the Data Logger Format

The Data Logger is used to present the data on the computer. The format is selected via the *Data Logger Setup* tab (Figure 7-4) of the *Configuration* page. A broad range of parameters can be displayed including analytical data, input and output data, alarm status and Photonics data. The data can be presented on an “On Run” basis or a periodic basis selected by the user. An item is placed in the *Log Configuration* field by dragging it from the available points (each category can be expanded to list all of the items by pressing the + sign). Each of the tabs can be edited on an independent basis, so the operator can generate a log which contains both “On Run” data and data at specific time intervals. A typical log format is shown in Figure 7-5; if you have selected hourly or daily items from the list, they will appear on the appropriate tab. Press the *Save Configuration* button when you are finished.

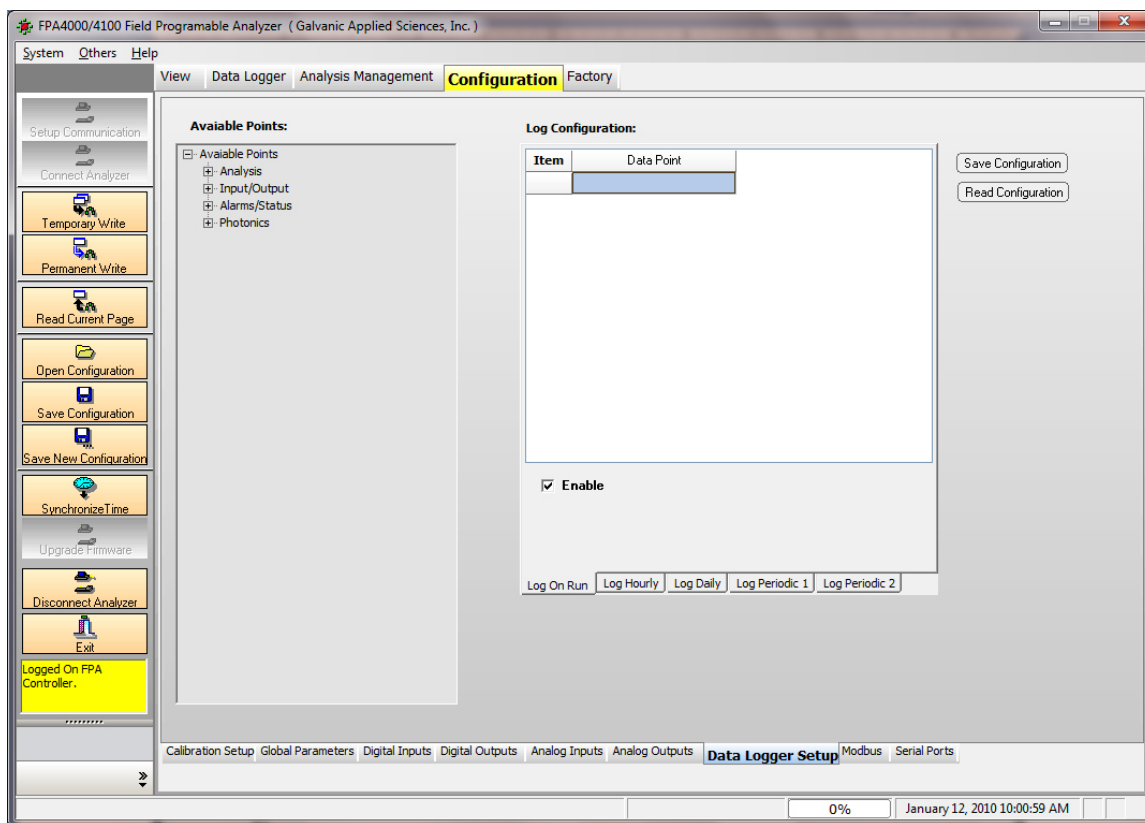


Figure 7-4: Data Logger Setup Tab

Pressing the *Save Configuration* button adjacent to the *Log Configuration* field executes a permanent write to the analyzer only for the *Data Logger* setup. The *Data Logger* setup has its own save/write mechanism separate from the main *Configuration* file.

**Log Configuration:**

Item	Data Point
1	Analysis 1 Current
2	Digital Input 1: Reading
3	Digital Output 1: Relay State

Enable

Log On Run   Log Hourly   Log Daily   Log Periodic 1   Log Periodic 2

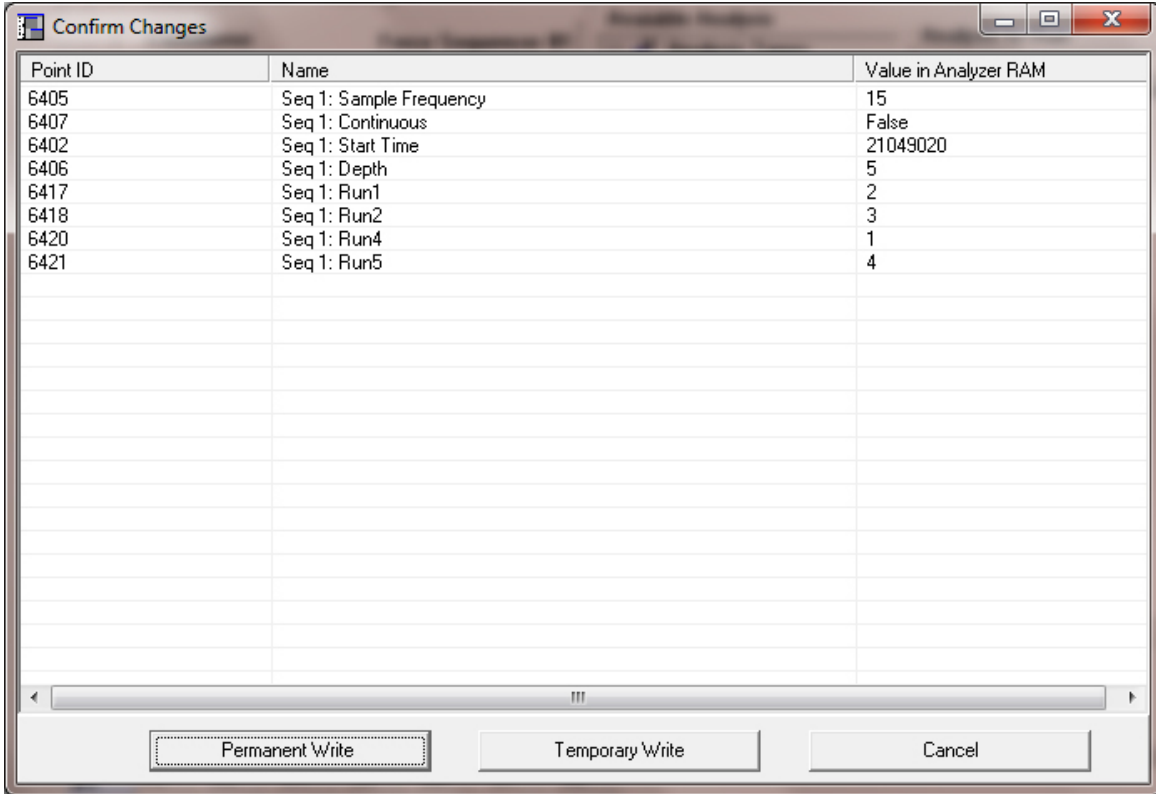
Save Configuration  
Read Configuration

**Figure 7-5: Completed Log Configuration Field**

### 7.2.3 Saving the Configuration

After the configuration has been generated, it must be saved and downloaded to the spectrophotometer. Press the *Temporary Write* button, then press the *Permanent Write* button to present the *Confirm Changes* dialog box, which lists the changes that you have made (Figure 7-6). Some of the information in this dialog box is pre-coded for use in the controller module, but it is worthwhile to check that the items that you have changed are on the list.





**Figure 7-6: Confirm Changes Dialog Box**

If the proposed changes are correct, press **Permanent Write** to download the settings to the spectrophotometer. An information stripe will be presented on the display to indicate the progress of the downloading.

## 7.3 Calibrating the System

The spectrophotometer can be calibrated on a manual basis or as a part of the automated operation. Calibrating the system on a manual basis can be done via the computer or the hand held keypad.

### 7.3.1 Via the Application Program

To calibrate the system:

- a) Access the *Calibration Setup* tab of the *Configuration* page (Figure 7-7).

The screenshot shows the 'Configuration' window for the FPA4000/4100 Field Programmable Analyzer. The 'Configuration' tab is active, and the 'Calibration Setup' sub-tab is selected. The interface includes a left-hand menu with various system management options. The main area contains calibration parameters and a report generation section.

**Configuration Parameters:**

- Enable Manual
- Calibration Time Left: [ ] seconds
- Calibration Standard Concentration: 50.5 ppm H2S
- Calibrate Standard:
  - Old Concentration: [ ] ppm H2S
  - New Concentration: 50.6022 ppm H2S
  - Calibrate Standard button
- Calibrate Zero Absorbance:
  - Old Absorbance: [ ] AU
  - New Absorbance: 0.0120199 AU
  - Calibrate Zero Absorbance button
- Calibrate Interval (Averaging Interval) (5s ~ 60s): 30 seconds
- Absorbance \* Pathlength: 0.00023753E
- Time of the last Standard Calibration: January 11, 2010 10:23:42 AM
- Time of the last Zero Calibration: January 11, 2010 10:27:13 AM

**Calibration Report:**

Generated by	[ ]	Location	Calibration Lab	Generate Calibration Report
ID	SN102909001	Unit Serial Number	Unset	
		Unit Model and Type	Photonics UV	
		Calibration Standard used for the last standard calibration	50.5 ppm H2S	
		Temperature and Pressure correction was used for the last calibration	False	
		Temperature of Standard Calibration	-246.537 deg. C	
		Pressure of Standard Calibration	8.63579 mmHg	

**Navigation:** Calibration Setup | Global Parameters | Digital Inputs | Digital Outputs | Analog Inputs | Analog Outputs | Data Logger Setup | Modbus | Serial Ports

**Status:** 0% | January 11, 2010 10:26:36 AM

Figure 7-7: Calibration Setup

- b) Check the *Enable Manual* check box.
- c) Press the **Calibrate Zero Absorbance** button. The display will indicate *Calibrating Zero* below the *Calibrate Standard* field box and the spectrophotometer will perform that action. Upon completion, the new value will be reported, *Calibrate Zero Successful* will be indicated below the *Calibrate Standard* field box and the *Time of the last Zero Calibration* field will be updated.

**NOTICE**

**If the system is in manual mode, and the zero standard needs to be introduced to the cell, ensure that a sufficient period of time is allowed to pass to fully purge the cell. If the system is automated, then the purge times will be executed as per Analysis Management.**

- d) Enter the concentration of the standard in the *Calibration Standard Concentration* field.
- e) Press the **Calibration Standard** button. The display will indicate *Calibrating Standard* below the *Calibrate Standard* field box and the spectrophotometer will perform that action. Upon completion, the new value will be reported, *Calibrate Standard Successful* will be indicated below the *Calibrate Standard* field box and the *Time of the last Standard Calibration* field will be updated.

**NOTICE**

**If the system is in manual mode, and the calibration standard needs to be introduced to the cell ensure that a sufficient period of time is allowed to pass to fully purge the cell. f the system is automated, then the purge times will be executed as per Analysis Management.**

- f) If desired, a Calibration report can be generated by pressing the **Generate Calibration Report** button in the *Calibration Report* field.

### 7.3.2 Via the Keypad

- a) Log in (press F3) and enter the password.
- b) Press the Manual button on the keypad.
- c) Press **F4** to access the first menu page (Figure 7-8).

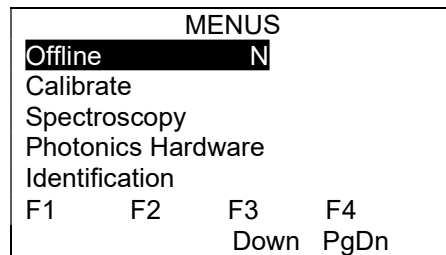


Figure 7-8: The Menu Page (First Page)

- d) Press **F3** to access the *Calibrate* page (Figure 7-9)

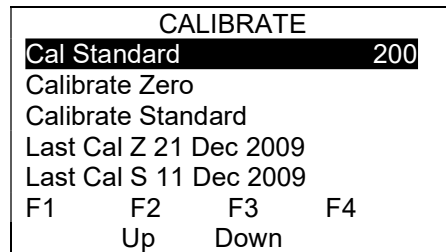


Figure 7-9: Calibrate Sub-page

If you have logged onto the system, the concentration of the calibration standard can be entered. In addition, a calibration of the Zero or the standard can be performed.

#### **NOTICE**

**If the calibration standard is edited via this page and/or either calibration is performed, the data remains in the spectrophotometer and is not automatically transferred to the application program on the computer. To transfer the data to the computer, press the Read Current Page button on the main screen of the application program.**

## 7.4 Running Analyses

When the configuration is transferred to the spectrophotometer, all the conditions are automatically set and the system will perform the operations as indicated on the sequencer configuration page.

The *View* page (Figure 7-10) presents the status of the spectrophotometer.

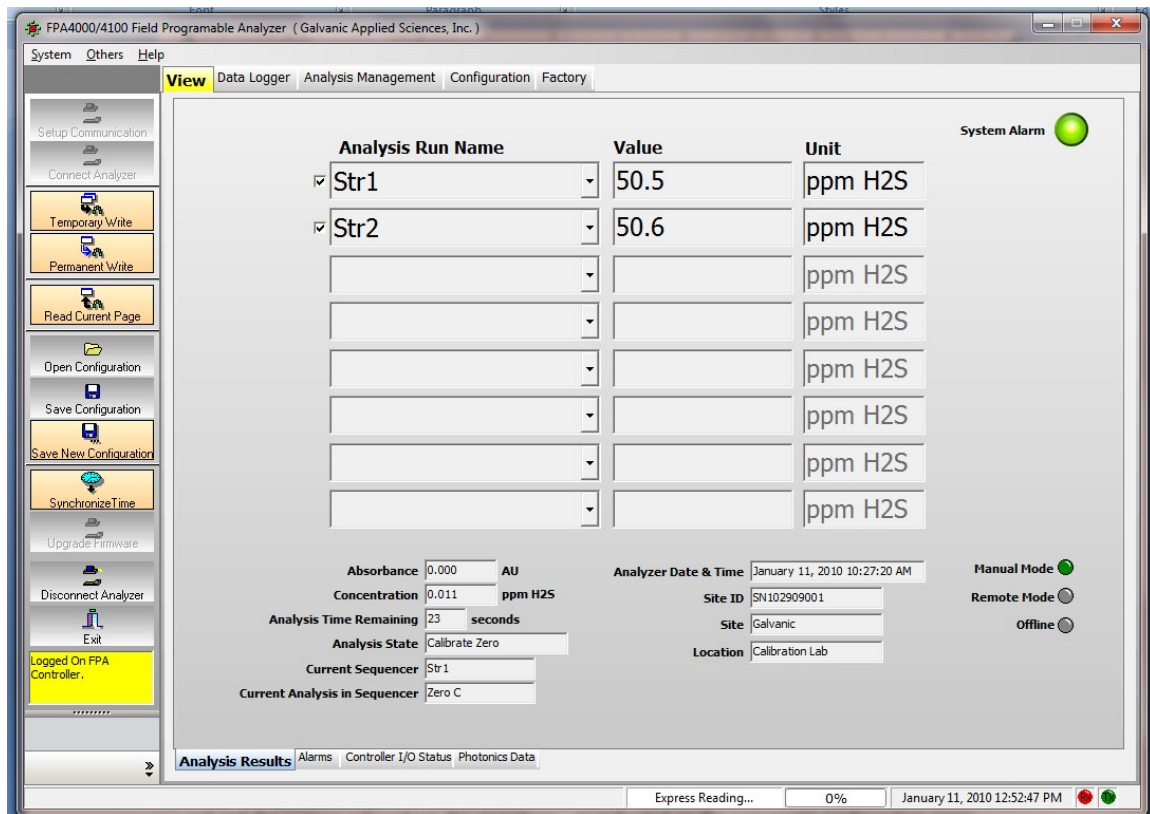


Figure 7-10: Analysis Results

## 7.5 Viewing Data

To view the active data log, press the **Read Archive from Analyzer** button on the *Analysis Results* tab of the *Data Logger* page. A typical log is presented in Figure 7-11. As an alternative, stored data can be viewed using the **Read Archive from File** button.

The screenshot shows the 'Data Logger' page of the FPA4000/4100 Field Programmable Analyzer software. The interface includes a menu bar (System, Others, Help), a toolbar with various control buttons, and a main data table. The table displays a list of archived data points with columns for sequence number, log name, timestamp, and analysis results. The 'Archive' dropdown is set to 'Hourly', and '150' records are available, with the last 31 records displayed.

Seq	Log Name	Timestamp	Analysis	Analysis	Analysis						
120	Hourly	1/10/2010	50.5362930	50.4849319	50.5876541						
121	Hourly	1/10/2010	50.5867233	50.5704850	50.6029815						
122	Hourly	1/10/2010	50.5595500	50.4931221	50.6029281						
123	Hourly	1/10/2010	50.4947166	50.4555397	50.5338935						
124	Hourly	1/10/2010	50.5396156	50.4675712	50.6044349						
125	Hourly	1/10/2010	50.5331459	50.5121803	50.5541114						
126	Hourly	1/10/2010	50.5770416	50.5676612	50.5864257						
127	Hourly	1/10/2010	50.4984588	50.4150352	50.6052017						
128	Hourly	1/10/2010	50.4854888	50.4135208	50.5778541						
129	Hourly	1/10/2010	50.4946823	50.3872528	50.5887985						
130	Hourly	1/10/2010	50.5001602	50.4162445	50.5708580						
131	Hourly	1/10/2010	50.5107574	50.4379692	50.6108703						
132	Hourly	1/10/2010	50.4884223	50.4067955	50.5649032						
133	Hourly	1/10/2010	50.4893074	50.4140396	50.5606384						
134	Hourly	1/10/2010	50.5006637	50.3264846	50.6368217						
135	Hourly	1/11/2010	50.5307044	50.4213294	50.6429939						
136	Hourly	1/11/2010	50.5049324	50.4051551	50.5709648						
137	Hourly	1/11/2010	50.5085487	50.4485931	50.6318740						
138	Hourly	1/11/2010	50.5259284	50.4484558	50.6305885						
139	Hourly	1/11/2010	50.4956283	50.3730926	50.5885963						
140	Hourly	1/11/2010	50.4955673	50.3884277	50.5877952						
141	Hourly	1/11/2010	50.5064201	50.3863754	50.6593742						
142	Hourly	1/11/2010	50.5204696	50.4265403	50.6582565						

Figure 7-11: Archived Data

If desired you can save this data in a variety of formats by right clicking and selecting the appropriate format. Data can be filtered to present only those data points that meet user defined criteria (Section 6.4.1.1).



If you press the  button, expanded information will be presented (Figure 7-12).

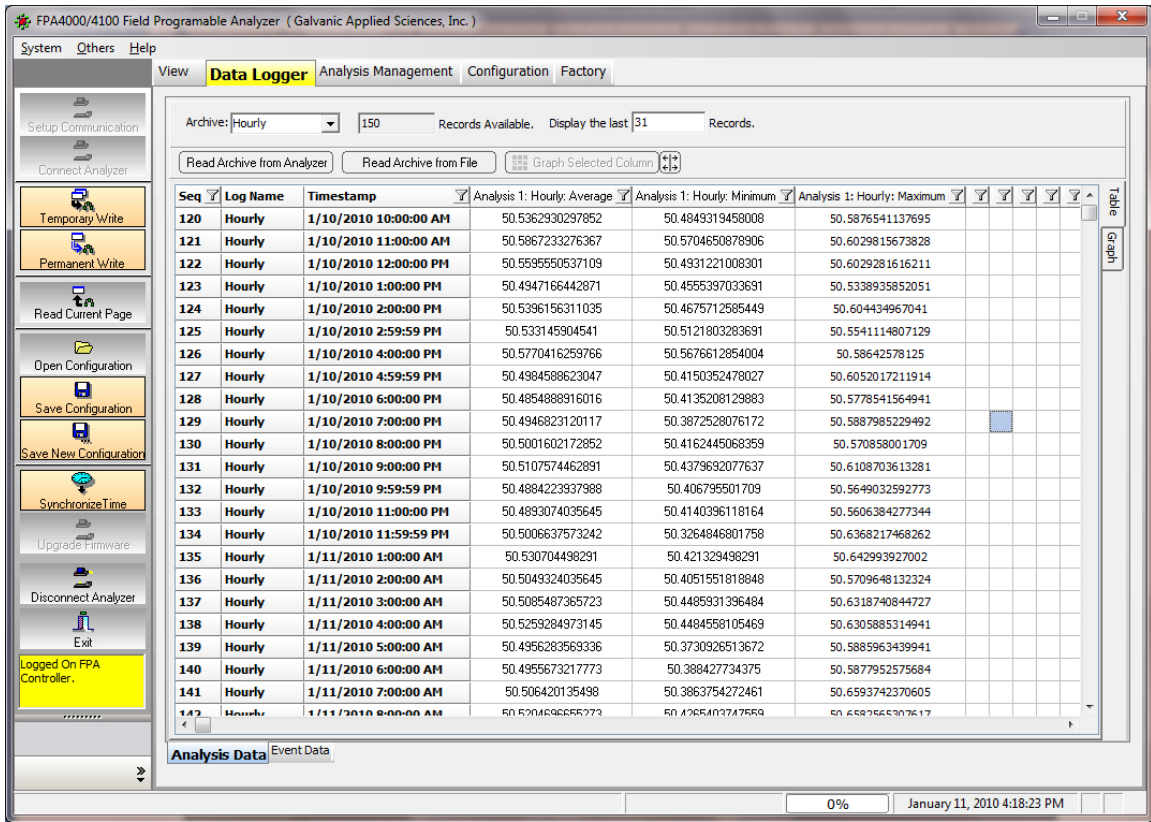
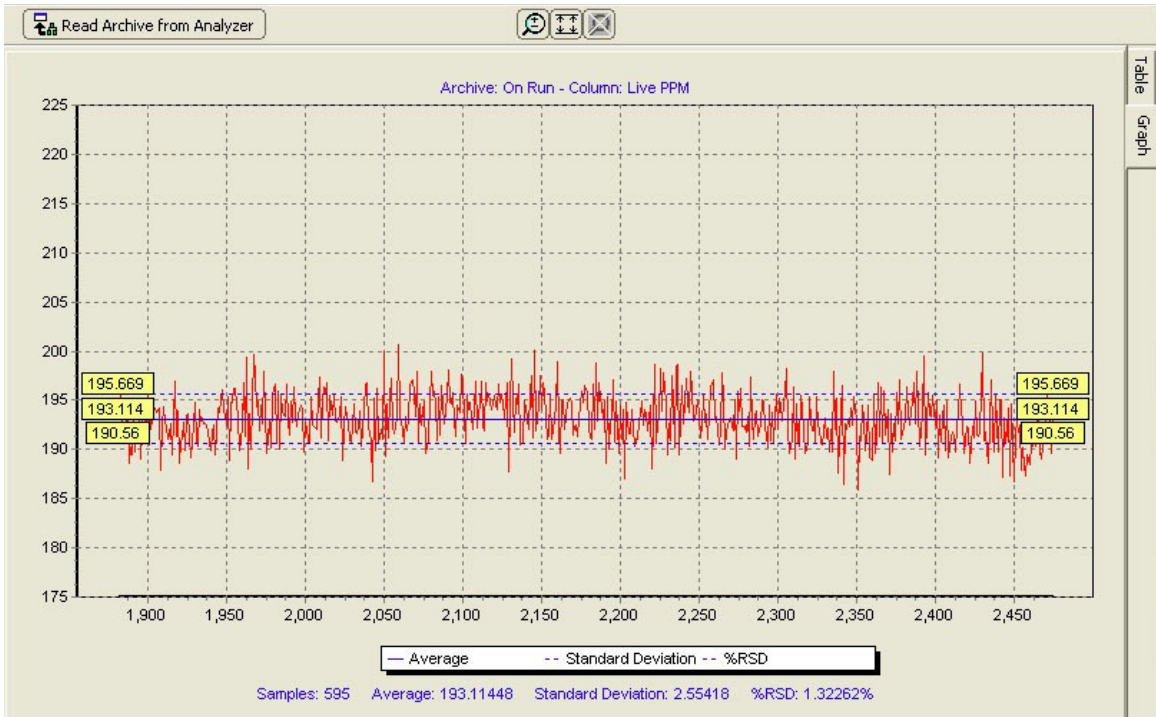


Figure 7-12: Expanded Data

The *Graph* tab presents a plot of the data as a function of time (Figure 7-13). The parameter to be presented should be highlighted as shown in Figure 7-12.



**Figure 7-13: Graphed Data**

A listing of the events can be obtained via the *Event Data* tab. A typical event data screen is shown in Figure 7-14.



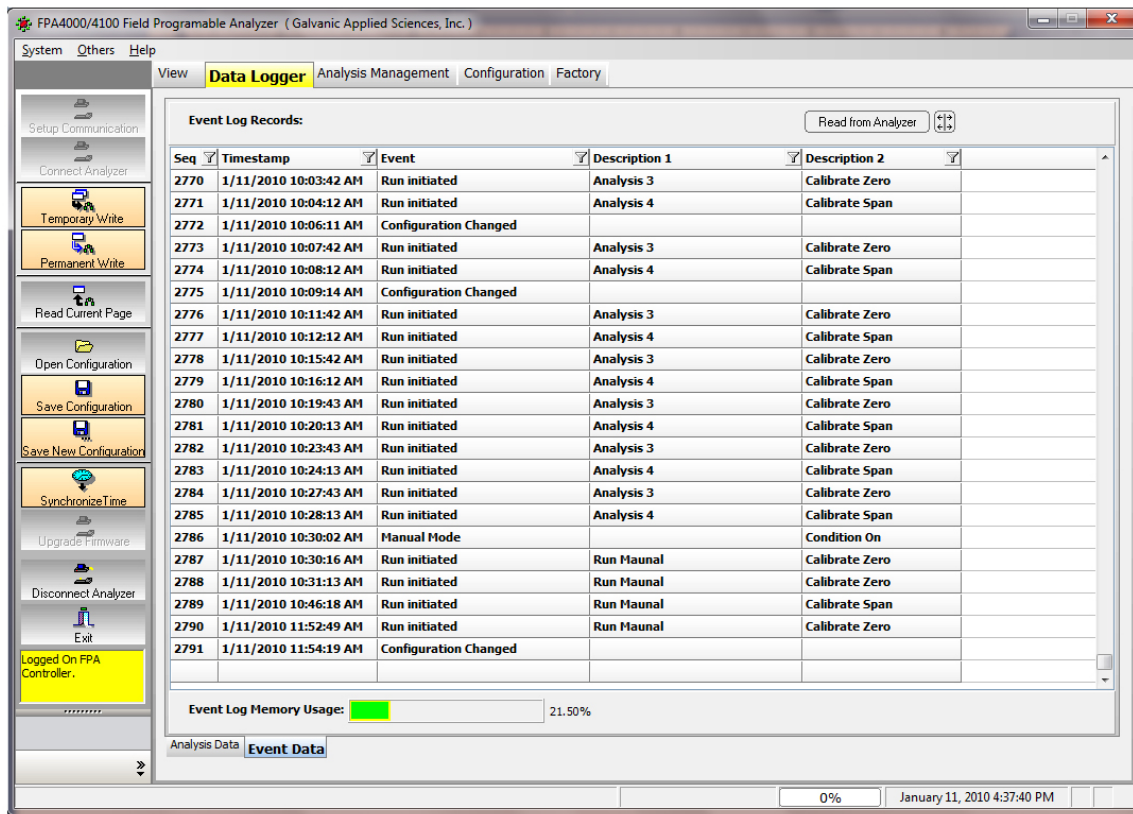


Figure 7-14: Event Log

## Section 8 Maintenance, Shutdown and Troubleshooting

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### 8.1 Maintenance

This section describes a series of maintenance procedures that should be performed on a routine basis to optimize the performance and ensure long term, safe operation of the spectrophotometer. The suggested frequency for each activity indicated below is based on the “typical operation” of the system and is dependent on a variety of factors such as the nature of sample.

#### 8.1.1 Cleaning the System

The exterior surfaces of the system should be cleaned with a cloth using water with a mild detergent on a periodic basis. If foreign material is accidentally spilled on the system, it should be removed immediately. If a mild detergent is not able to remove the foreign material, an organic solvent such as methanol or isopropanol can be used.

#### 8.1.2 Routine Inspection

On a daily basis, the following activities should be performed:

- Check for leaks. If a leak is observed, resolve the issue before continuing.
- Inspect fittings; if solid material is deposited on a fitting, tighten (replace) the fitting before continuing.
- Inspect all tubing and Fiber Optics Cables. If defective tubing or cables are found (e.g. kinks, bends, discoloration or deterioration), replace the tubing.

#### 8.1.3 Scheduled Maintenance

Table 8-1 lists the scheduled maintenance procedures for the spectrophotometer. Over time, it is likely that the user will determine an appropriate schedule that meets the specific application of the spectrophotometer and it may be necessary to adapt this schedule to your particular situation. As an example of this issue, it should be noted that strong acids, alkalis and oxidizing agents will act on the cell windows and some organic compounds may affect O-rings.

**Table 8-1: Maintenance Schedule**

Interval	Item	Operation	Section
Weekly	Instrument calibration	Calibrate	8.1.4
Annually	O-rings in Cell	Clean, Inspect and replace	8.1.5
As needed	Lamp	Replace	8.1.6
As needed	Optical Filters	Replace	8.1.7

## 8.1.4 Calibration

Calibration can be performed on manual basis (Section 6.6.1) or as a part of an automated sequence (Section 6.5.3). When the system is calibrated, both the zero standard and the calibration standard should be employed. Typically, the composition of the calibrant should be as close as possible to that of the stream that is being monitored (i.e. the calibrant should contain the same compound as the stream and the concentration should be close to what is “normally“ expected).

If the calibrant and the stream being monitored are not similar in terms of the compounds and the concentration, ensure that the:

- cell is thoroughly flushed before analytical measurements are taken.
- calibrants and sample stream are miscible.
- calibrants and the sample stream do not react.
- calibrants are thermally stable.
- calibrants will not decompose over time.

### **NOTICE**

**The frequency of calibration is dependent on the need of accuracy of the application. At a bare minimum, the system should be calibrated on a weekly basis.**

## 8.1.5 Cell Cleaning and O-Ring Replacement

The cells should be cleaned and the O-rings replaced on an annual basis or more often if severe buildup is observed inside the cell.

The following tools are required for Cell Cleaning and O-ring replacement:

- 5/32" and 1/16" Allen (Hexagonal) Wrenches
- 5/8" Open End Wrench
- Cotton Swabs
- A solvent that will dissolve materials that have been deposited in the cells and/or on the O-rings.

To clean the cells and replace O-rings:

- a) Place the instrument on standby (it is suggested that you leave the spectrophotometer on to eliminate the need to wait for the lamp start up period before collecting data).
- b) Close off the sample and return lines to the cell.
- c) Use a 1/16" hexagonal wrench to loosen the retaining screws that hold the fiber optic couplings in place and remove the couplings from the cell. Tie back the fiber optic cables so they are out of the way while working on the cell.

### **CAUTION**

**The ends of the fiberoptic cable can be scratched easily. Take care not to damage them during handling. Also, do not allow the bundles to twist or bend sharply at any time.**

**CAUTION** Wear UV protective eyewear when working with UV emitting light sources.

- d) Drain the cell using the return line (if it can be used as a drain) or through a drain valve if there is one. Observe proper chemical handling procedures for the substances in use.
- e) Disconnect the feed and return lines from the cell, and take the cell to a work bench for disassembly and cleaning.

**NOTICE** In some instances, it may be more convenient to leave the cell in position for maintenance.

- f) Remove the endplates from the cell by loosening the 4 screws that hold each plate in place (Figure 8-1). There is a window disc sandwiched behind each endplate; which should be treated carefully (i.e. do not allow it to be scratched or dropped).

#### Figure 8-1: Endplate

- g) Clean the window discs and the O-rings by soaking them in an appropriate solvent (if there is excessive build-up of solid material, it may be useful to soak the discs in an ultrasonic bath or install new ones). After the window disks are clean, rinse with the solvent normally used for the analysis. Alcohols or acetone are typically used to clean windows and O-rings.
- h) Clean the inside of the cell with lint free tissues (e.g. Kim-Wipes) soaked in an appropriate solvent. After the O-rings are clean; rinse with the solvent normally used for the separation.
- i) Replace the O-rings. If new rings are used, make certain that they are made from the same material (e.g., Silicone, Teflon, etc.) as the old ones.
- j) Reassemble the cell. First finger-tighten the endplate bolts and then snug them up evenly.

- k) Reconnect the supply lines if they were disconnected.
- l) Open the supply and return valves and check for leaks. Purge and fill the cell.
- m) Install the fiber optic couplings into the mating connectors on the cell, and lightly tighten the retaining screws just enough to hold the couplings in place.

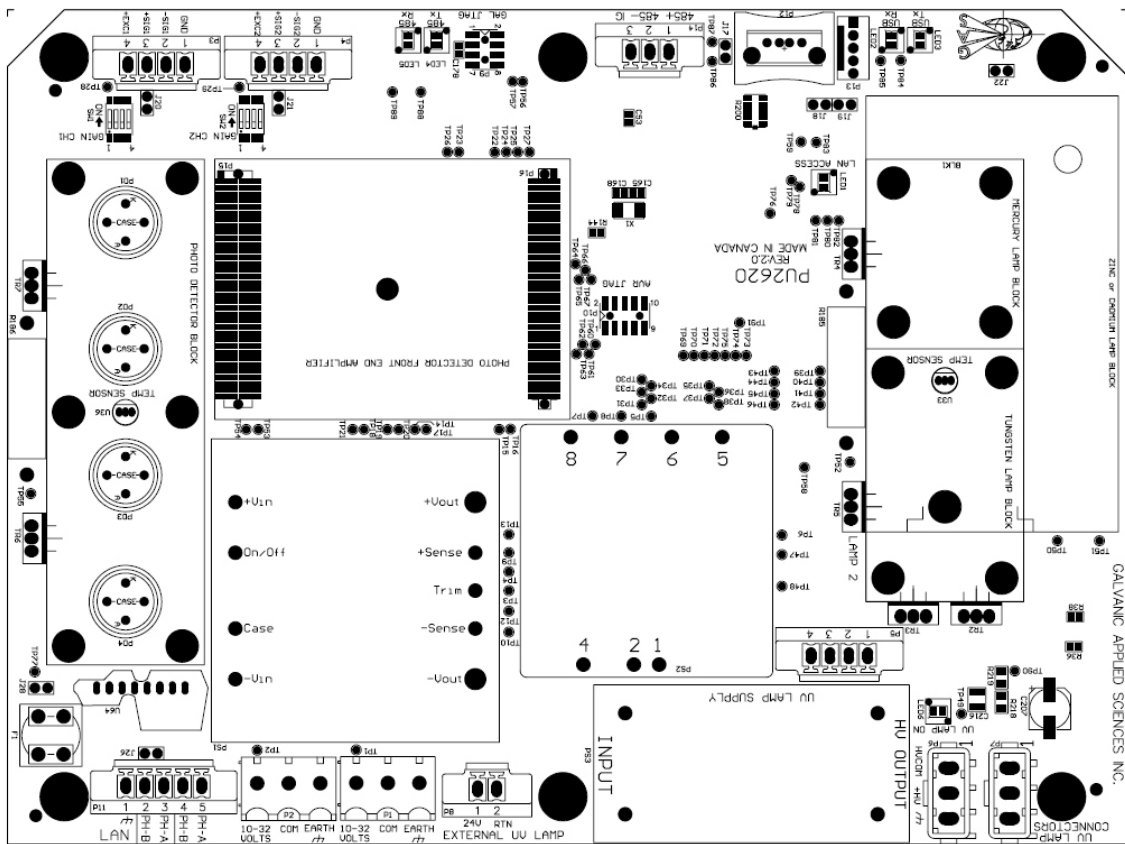
## 8.1.6 Lamp Replacement



**DO NOT handle the lamp by the envelope. Hold the lamp using the lamp metal holder. Handling the lamp by the envelope will cause a fingerprint to be "burned" into the envelope and will result in a reduction of the source lamp performance. As an alternative, white cotton gloves or optical tissues can be used.**

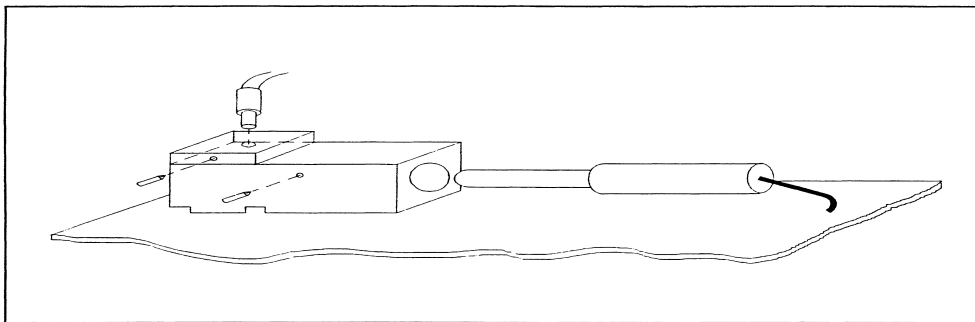
To replace the lamp:

- a) Place the instrument in standby mode and power down.
- b) Open the photonics module. The source is located in the upper right corner of the printed circuit board (Figure 8-2). There are four different lamp types: Mercury, Tungsten, Zinc, and Cadmium. The Mercury and Tungsten lamps are small and are mounted using 1 set screw. The Zinc and Cadmium lamps are larger lamps and are mounted using 2 set screws.

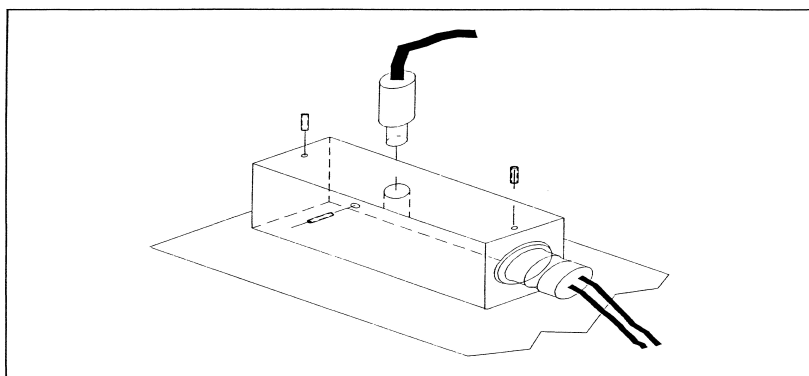


**Figure 8-2: Photonics Printed Circuit Board**

- c) Using the hexagonal Allen key, loosen the #5-40 set screw(s) holding the lamp in the source block (Figure 8-3, 8-4).



**Figure 8-3: Mounting of the Mercury Lamp**



**Figure 8-4: Mounting the Zinc and Cadmium Lamps**

- d) Remove the lamp plug from the socket (Tungsten - P5, Mercury, Zinc, Cadmium - P7).
- e) Remove the lamp from the housing.
- f) Carefully, insert the new lamp into the housing.
- g) Insert the lamp plug into the appropriate socket.
- h) Turn on the power to the spectrophotometer and let it warm up for one-half hour.
- i) Use **F2** on the keypad or the *Photonics Data* tab on the *View* page in the application program to see the detector output %.
- j) Observe the detector output and adjust the position of the arc lamp by gently sliding it back and forth and also rotating it gently until a maximum peak output value is obtained.
- k) Once the optimum position of the lamp has been determined, secure the lamp by tightening the #5-40 set screw(s).

**NOTICE**

**The lamp will not turn on until the UV block is 5 degrees below the temperature set point.**

- l) Once the lamp has been on for a minimum of ½ hour, the analyzer can be re-zeroed and re-calibrated.

## 8.1.7 Optical Filter Replacement

### NOTICE

This procedure should be necessary only under unusual circumstances and should be performed only under the recommendation of Galvanic Applied Sciences.

There are two filters in the instrument in the detector block. If more than one filter is to be changed, it is good practice to work only on one at a time. After any filter is replaced, it is essential that the analyzer be re-zeroed and recalibrated.

To replace filters:

- a) Power down the photonics module.
- b) Open the door to the photonics module. The photo detector block is us in the upper left hand corner of the printed circuit board (Figure 8-1). Detail of the block is shown in Figure 8-5.

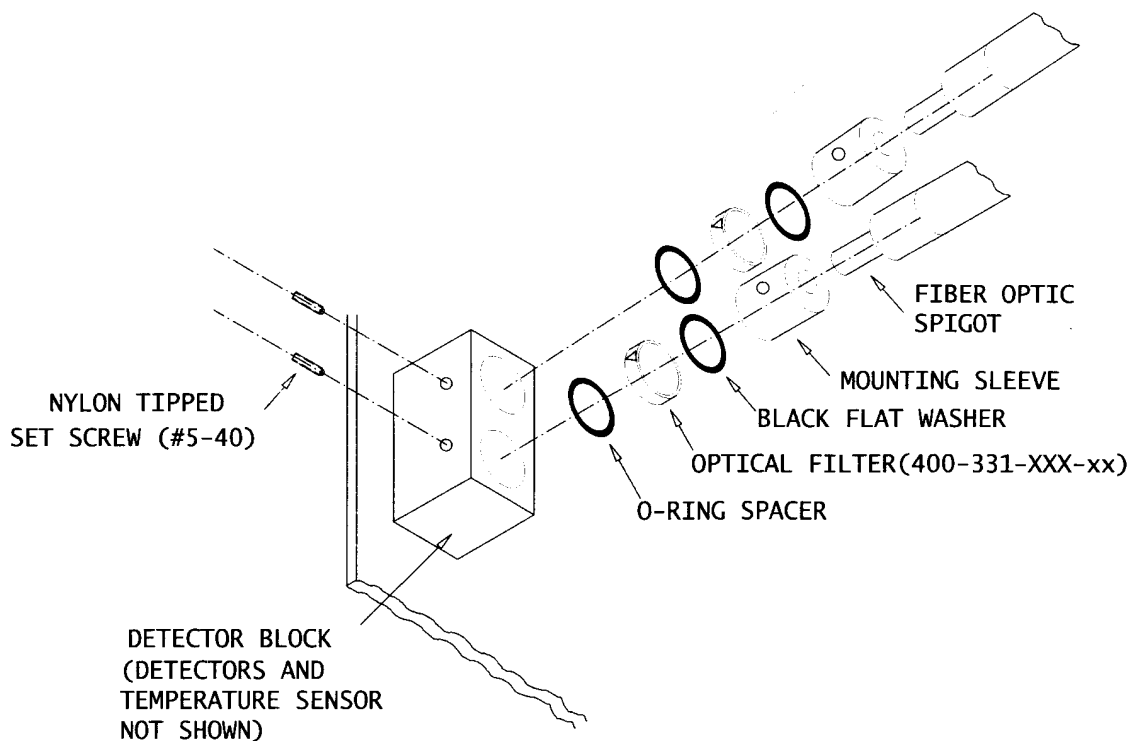


Figure 8-5: Detail of Detector Block

### WARNING

The detector block is hot. Allow it cool before proceeding.



- c) Using a 1/16" hex wrench, loosen the nylon-tipped screw that secures a fiber optic coupling to the detector block and slide the coupling out of the block and out of the way.
- d) Remove the set screw and retain for reassembly.
- e) Slide out the retaining sleeve, being careful not to touch the filter located just behind it. Use a cotton-tipped applicator to reach in and slide out the sleeve.
- f) Remove the outer O-ring from the filter cavity using the cotton tipped applicator to lift and slide out the O-ring.
- g) Remove the filter from the cavity. Be very careful not to scratch either surface of the filter. Use masking tape or another low adhesive material attached to the end of a pencil or applicator.

**CAUTION**

**Both surfaces of the filter are delicate and can be damaged by contact with a metallic instrument or with adhesives such as cellophane tape. Use masking tape or a rubber-tipped suction instrument to remove the filter from its cavity.**

- h) If necessary, remove the rear O-ring from the cavity using a cotton-tipped applicator, being careful not to damage the surface of the photodetector located at the rear of the filter cavity.

**NOTICE**

**The thickness of the rear O-rings depend on the thickness of the filter itself. In some cases, more than one O-ring may be used to achieve correct spacing. If replacing a filter with one of the same thickness, the old O-rings may be reused, otherwise use the O-rings supplied with the new filter.**

- i) Slide the rear O-ring into the cavity so that it is vertical and is seated against the photodetector at the back.
- j) If the new filter has a small arrow printed on the outside rim, insert the filter so the arrow points down the barrel of the cavity toward the photodetector at the back.
- k) If there is no arrow, insert the filter so that the mirrored surface faces out of the cavity.
- l) Use a clean cotton-tipped applicator to gently push the filter so that it remains vertical, positioned up against the rear O-ring at the back of the cavity.
- m) Slide the front flat O-ring into the cavity so that it is vertical and up against the filter. Refer to Figure 8-5.
- n) Position the retaining sleeve so that the hole for the set screw points up, and so that the hole itself will be closer to the filter than to the front of the block. Slide the sleeve into the cavity. There should be very slight resistance just before the sleeve snugs up against the O-rings and filter. Do not force the sleeve. If it doesn't fit flush with the front surface of the detector block, the filter or one of the O-rings may have fallen out of position.

## 8.1.8 Replacing Fuses

There are three fuses in the system, two on the main board in the controller module (Figure 8-6) and one on the printed circuit board in the photonics module (Figure 8-7).

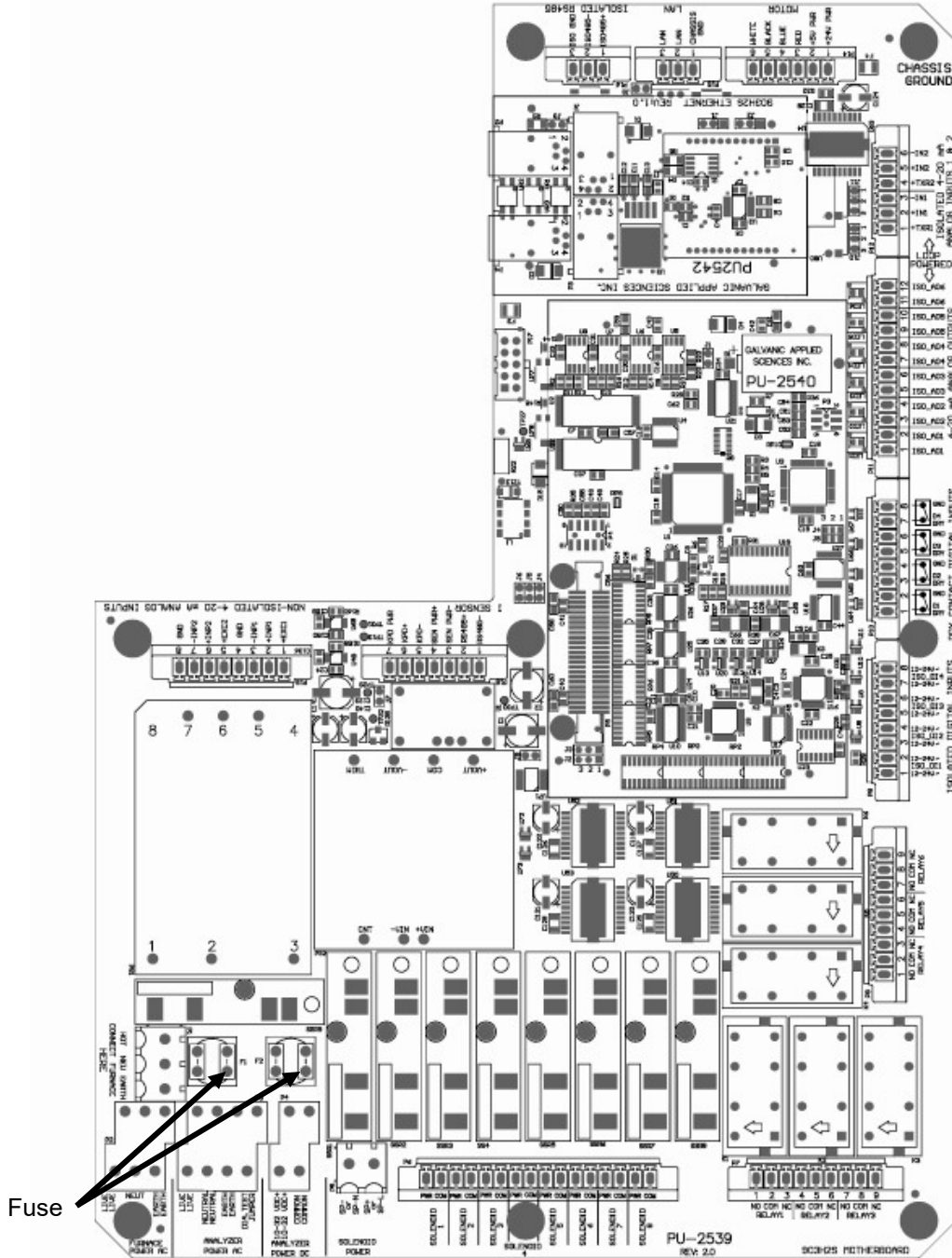


Figure 8-6: Location of Fuses on Main Board, Controller Module

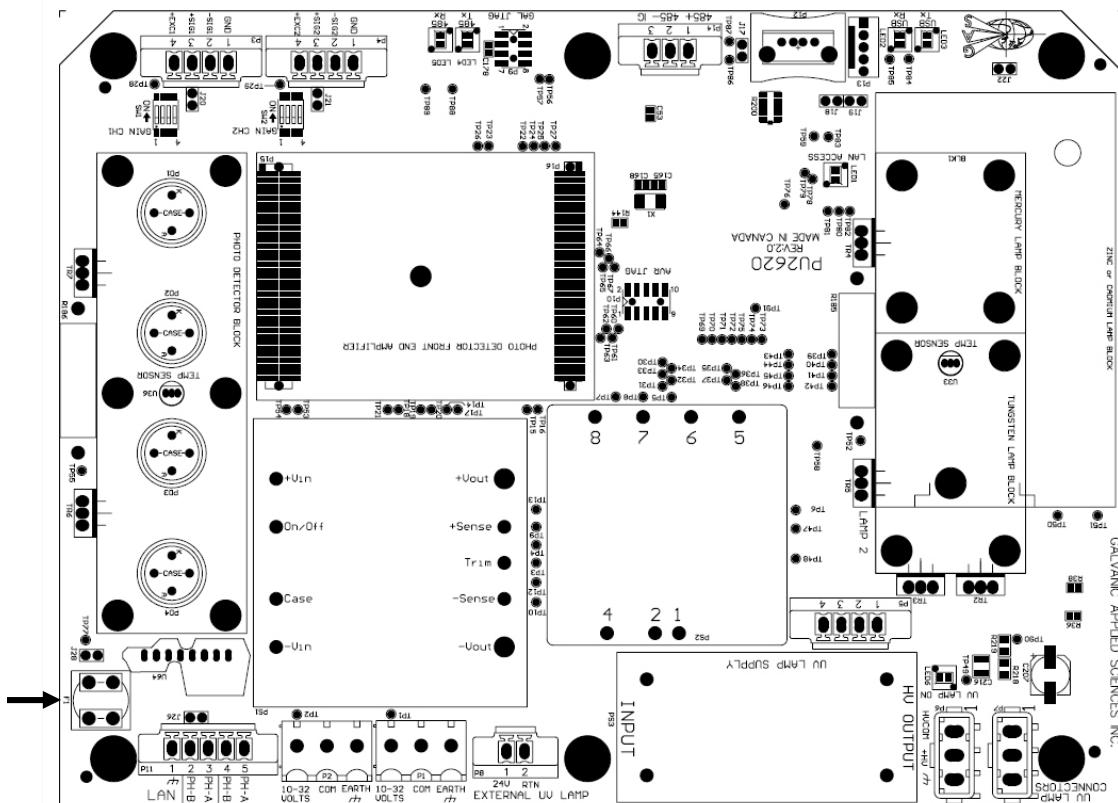


Figure 8-7: Location of Fuses on Printed Circuit Board, Photonics Module



If you replace a fuse, make certain that the power to the module is turned off.

Always replace the defective fuse with one of the same rating. If the fuse blows again, contact Galvanic Applied Sciences.

## 8.2 Shutdown

Since the spectrophotometer cell may contain fluids which could degrade the cell and lead to decreased performance, extended periods of inactivity require a more complex shut down process than intermittent overnight and Restart shutdown. This section describes both procedures, along with restarting procedures for each.

### 8.2.1 Short-term Shutdown

If the analyzer is going to be shut down overnight or for a weekend, it should be placed in the stand-by mode by pressing **MANUAL** on the keypad. It is necessary to be logged in first before the Manual and Auto buttons become active.

### 8.2.2 Restarting After Short-term Shutdown

To restart the analyzer after a short-term shutdown simply press **AUTO** after logging in and start a calibration or analysis cycle, or resume automatic operation.

### 8.2.3 Extended Shutdown

If the instrument is going to be shut down for more than three days, purge the cell and all the fluid lines. If the analyzer is to be shut down for a month or longer, clean and inspect the reaction cell and the windows and leave the cell filled with clean solvent or gas compatible with the analysis stream. If solvent or gas is not available, then the cell can be left empty.

### 8.2.4 Restarting After Extended Shutdown

Before restarting the analyzer, drain and purge the lines with appropriate gas or solutions. It is good practice to initialize and recalibrate the instrument at this time, then simply start an analysis cycle, or resume automatic operation.

## 8.3 Troubleshooting

### 8.3.1 Overview

Troubleshooting refers to the steps to determine the cause of a problem. The spectrophotometer includes number of systems (e.g. lamp, cell, detectors) and role of troubleshooting is to determine which system is responsible for the problem. As an example of this point, if the signal from a sample is smaller than what is expected, the following problems might be the cause:

- A cell window might be dirty or there may be air in the cell.
- A detector sensor might be defective.
- The calibration sample was not correct.
- The wrong configuration may be employed (e.g. you changed a parameter on the computer and it was not downloaded to the spectrophotometer module).

The most efficient method of determining the cause of the problem is to perform a systematic investigation into each potential cause. It is useful to develop a standard sample and analyze it on a periodic basis using a configuration that you know is good, as part of a troubleshooting protocol. The results should be compared to previously obtained results; if small differences are obtained, it may be possible to highlight a problem before it becomes serious. If any operating parameter appears to differ significantly from that which was obtained in a previous run, the cause for the difference should be looked into before additional runs are performed.

The keypad provides status on a number of components of the system and it may be worthwhile to monitor these as a function of time. If small differences are noted, it may be possible to highlight a problem before it becomes serious, especially if a trend is observed. As an example of this point, the intensity of the lamp can be monitored and the lamp replaced before a serious problem is observed.

The *Event Data* tab on the *Data Logger* page of the application program may also be a very useful tool in the troubleshooting process as it includes information about abnormal events that have occurred with the spectrophotometer, as well as information about the various inputs and outputs. The spectrophotometer related messages (e.g. Photonics Reference Low, DC Power Alarm, Communications error) may provide a starting point to diagnose the problem.

If the *Diagnostics* command on the keypad (Section 5.3.4.7) is turned on, a series of hardware diagnostics will be performed when the analyzer is powered up. This information may provide useful information to assist in troubleshooting.

When you contact Galvanic Applied Sciences regarding a problem, please provide as much information as possible, including what the system was doing before the problem was observed, any error messages, any abnormal events that were noted, anything which you feel may be of assistance in troubleshooting, the system serial number and software revision. If the error message or problem can be reproduced, please indicate all actions that were done to reach the message or problem.

## 8.3.2 Software and Firmware Errors

In the event of a suspected firmware or software error:

- Log any error messages.
- Reboot the spectrophotometer and then attempt to operate the system.
- Download the configuration from the computer (if you have changed it).
- Contact Galvanic Applied Sciences if rebooting the system does not correct the problem.

## 8.3.3 Troubleshooting Guide

The following series of troubleshooting checklists are provided to assist the operator in determining the cause of a problem and suggests possible remedies. The problems described below are selected on the basis that they are likely occurrences in normal operation that can be readily resolved by the user. It is not an all-inclusive list, if you encounter problems that cannot be resolved using this troubleshooting section, please contact your local Galvanic Applied Sciences technical support representative.

When you contact Galvanic Applied Sciences regarding a problem, please provide as much information as possible, including what the system was doing before the problem was observed, any error messages, any abnormal events that were noted, anything which you feel may be of assistance in troubleshooting, the system serial number and software revision. If the error message or problem can be reproduced, please indicate all actions that were done to reach the message or problem.

### 8.3.3.1 The System Does Not Power Up or Shuts Down Automatically

Possible Cause	Remedy
No power to unit	Ensure that power is provided to both the Photonics module and Controller module
Blown fuse	Check fuses (2 in controller unit, one in photonics module) see Section 8.1.8

### 8.3.3.2 Communication Problems

Possible Cause	Remedy
LAN cable not secure	Check LAN cable
USB cable computer to controller not secure	Check USB cable
Incorrect communications parameters	See Section 4.5.2

### 8.3.3.3 Display is not Illuminated or Keys do not Function

Possible Cause	Remedy
Power not provided to system	Ensure that power is provided to both the Photonics module and Controller module
Blown fuse	Check fuses (2 in controller unit, one in photonics module), see Section 8.1.8
Defective display	Contact Galvanic Applied Sciences

### 8.3.3.4 Cannot Calibrate Standard or Zero

Possible Cause	Remedy
Parameters are not set properly	Check parameters
Standard (Zero) not properly prepared	Regenerate standard (zero)
Calibration valve not working correctly	Check/replace valve
Defective lamp	Replace lamp
Dirty cell or air in cell	Clean cell
Defective fiber optic or fiber optic connection	Check connection or replace fiber optic

### 8.3.3.5 Noisy Signal

Possible Cause	Remedy
Parameters are not set properly	Check parameters
Standard (Zero) not properly prepared	Regenerate standard (zero)
Dirty cell or air in cell	Clean cell
Defective lamp	Replace lamp
Dirty cell or air in cell	Clean cell
Defective fiber optic or fiber optic connection	Check connection or replace fiber optic

## 8.3.4 Using System Alarms

### 8.3.4.1 The Alarms Tab

The *Alarms* tab (Figure 8-8) presents a large number of indicators describing the status of the system. In each instance a green LED indicates that the condition is met (not an alarm) while a red LED indicates that there is an issue to be resolved.

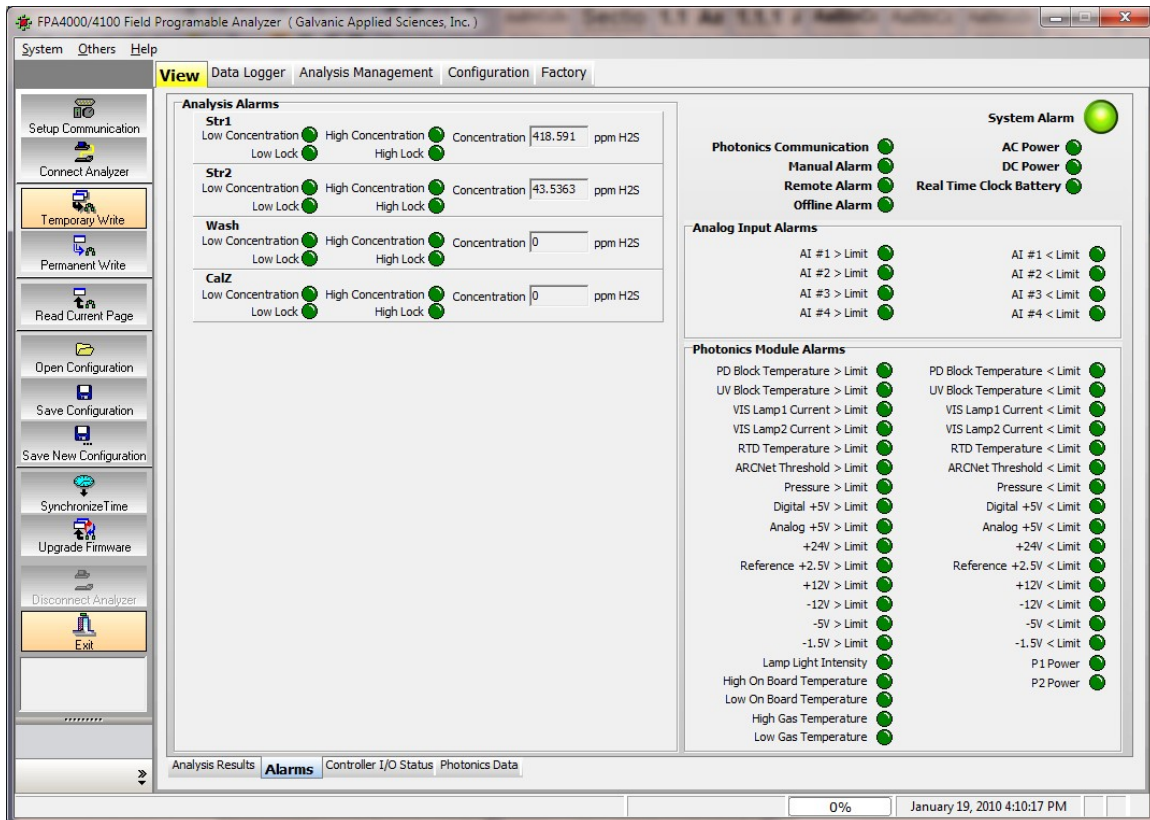


Figure 8-8: Alarms Tab - View Page



The *Analysis Alarms* on the left side refer to the analytical results with respect to the values that were set on the *Analysis Type Configuration* tab of the *Analysis Management* page (Section 6.5.2) and may indicate an application issue rather than an instrumental issue (i.e. the concentration is too high).

The *System* alarms in the top field on the right side are discussed in Table 8-2.

**Table 8-2: System Alarms**

<b>Alarm</b>	<b>Remedy</b>
System Alarm	<ul style="list-style-type: none"> <li>• A system alarm is active.</li> <li>• Check alarms list to find out cause of alarm.</li> </ul>
Photonics Communication	<ul style="list-style-type: none"> <li>• The controller cannot communicate with the photonics module.</li> <li>• Check power to the photonics module.</li> <li>• Ensure proper cable is used for communication between controller module and photonics module.</li> </ul>
Remote Alarm	<ul style="list-style-type: none"> <li>• The analyzer is being controlled remotely, either by a discreet input or from the GUI.</li> </ul>
Offline Alarm	<ul style="list-style-type: none"> <li>• The analyzer has been set to offline.</li> <li>• A photonics communication alarm will also cause the analyzer to go to the offline state.</li> </ul>
AC Power	<ul style="list-style-type: none"> <li>• The AC power supply has failed or is not connected.</li> </ul>
DC Power	<ul style="list-style-type: none"> <li>• The DC power supply has failed or is not connected.</li> </ul>
Real Time Clock Battery	<ul style="list-style-type: none"> <li>• The real time clock is set outside of the limits.</li> <li>• Synchronize the analyzer time from the GUI.</li> <li>• Battery may need replacement.</li> </ul>

If an *Analog Input* alarm is triggered, check the analog input device. The alarm levels are set on the *Analog Inputs* tab of the *Configuration* page (Section 6.6.5).

The *Photonics Module* alarms are discussed in Table 8-3.

**Table 8-3: Photonics Module Alarms**

<b>Alarm</b>	<b>Remedy</b>
PD Block Temperature > Limit	<ul style="list-style-type: none"> <li>• The PD block is too hot</li> <li>• Check ambient temperature</li> <li>• Check PD block setpoint</li> </ul>
PD Block < Limit	<ul style="list-style-type: none"> <li>• The PD block is too cold</li> <li>• Check ambient temperature</li> <li>• Check the heater circuit</li> </ul>
UV Block Temperature > Limit	<ul style="list-style-type: none"> <li>• The UV block is too hot</li> <li>• Check ambient temperature</li> <li>• Check PD block setpoint</li> </ul>
UV Block Temperature < Limit	<ul style="list-style-type: none"> <li>• The UV block is too cold</li> <li>• Check ambient temperature</li> <li>• Check the heater circuit.</li> </ul>
VIS Lamp (1 or 2) Current > Limit (Lamp type will be indicated)	<ul style="list-style-type: none"> <li>• The lamp is burned out</li> <li>• Replace lamp</li> </ul>
VIS Lamp (1 or 2) Current < Limit (Lamp type will be indicated)	<ul style="list-style-type: none"> <li>• The lamp current is too high.</li> <li>• Consult factory</li> </ul>
RTD Temperature > Limit	<ul style="list-style-type: none"> <li>• The temperature of the sample is too low</li> <li>• This alarm is only used when temperature compensation is used</li> </ul>
RTD Temperature < Limit	<ul style="list-style-type: none"> <li>• The temperature of the sample is too high</li> <li>• This alarm is only used when temperature compensation is used</li> </ul>
ARCNet Threshold > Limit	<ul style="list-style-type: none"> <li>• The threshold limit for the LAN communication is not set correctly.</li> <li>• Consult factory</li> </ul>
ARCNet Threshold < Limit	<ul style="list-style-type: none"> <li>• The threshold limit for the LAN communication is not set correctly.</li> <li>• Consult factory</li> </ul>
Pressure > Limit	<ul style="list-style-type: none"> <li>• The sample pressure is too high.</li> <li>• This alarm is used only when pressure compensation is used.</li> </ul>
Pressure < Limit	<ul style="list-style-type: none"> <li>• The sample pressure is too high.</li> <li>• This alarm is used only when pressure compensation is used.</li> </ul>
Digital +5V > Limit	<ul style="list-style-type: none"> <li>• Any power rail alarms indicate a board level problem</li> <li>• Replace photonics module or consult factory</li> </ul>
Digital +5V > Limit	<ul style="list-style-type: none"> <li>• Any power rail alarms indicate a board level problem</li> <li>• Replace photonics module or consult factory</li> </ul>

Alarm	Remedy
Analog +5V > Limit	<ul style="list-style-type: none"> <li>• Any power rail alarms indicate a board level problem</li> <li>• Replace photonics module or consult factory</li> </ul>
Analog +5V > Limit	<ul style="list-style-type: none"> <li>• Any power rail alarms indicate a board level problem</li> <li>• Replace photonics module or consult factory</li> </ul>
+24 V > Limit	<ul style="list-style-type: none"> <li>• Any power rail alarms indicate a board level problem</li> <li>• Replace photonics module or consult factory</li> </ul>
+24 V < Limit	<ul style="list-style-type: none"> <li>• Any power rail alarms indicate a board level problem</li> <li>• Replace photonics module or consult factory</li> </ul>
Reference +2.5 V > Limit	<ul style="list-style-type: none"> <li>• Any power rail alarms indicate a board level problem</li> <li>• Replace photonics module or consult factory</li> </ul>
Reference +2.5 V < Limit	<ul style="list-style-type: none"> <li>• Any power rail alarms indicate a board level problem</li> <li>• Replace photonics module or consult factory</li> </ul>
+12 V > Limit	<ul style="list-style-type: none"> <li>• Any power rail alarms indicate a board level problem</li> <li>• Replace photonics module or consult factory</li> </ul>
+12 V < Limit	<ul style="list-style-type: none"> <li>• Any power rail alarms indicate a board level problem</li> <li>• Replace photonics module or consult factory</li> </ul>
-12 V > Limit	<ul style="list-style-type: none"> <li>• Any power rail alarms indicate a board level problem</li> <li>• Replace photonics module or consult factory</li> </ul>
-12 V < Limit	<ul style="list-style-type: none"> <li>• Any power rail alarms indicate a board level problem</li> <li>• Replace photonics module or consult factory</li> </ul>
-5 V > Limit	<ul style="list-style-type: none"> <li>• Any power rail alarms indicate a board level problem</li> <li>• Replace photonics module or consult factory</li> </ul>
-5 V < Limit	<ul style="list-style-type: none"> <li>• Any power rail alarms indicate a board level problem</li> <li>• Replace photonics module or consult factory</li> </ul>

<b>Alarm</b>	<b>Remedy</b>
-1.5 V > Limit	<ul style="list-style-type: none"> <li>• Any power rail alarms indicate a board level problem</li> <li>• Replace photonics module or consult factory</li> </ul>
-1.5 V < Limit	<ul style="list-style-type: none"> <li>• Any power rail alarms indicate a board level problem</li> <li>• Replace photonics module or consult factory</li> </ul>
High On Board Temperature	<ul style="list-style-type: none"> <li>• The ambient temperature is too high</li> <li>• Check ambient temperature</li> </ul>
Low On Board Temperature	<ul style="list-style-type: none"> <li>• The ambient temperature is too low.</li> <li>• Check ambient temperature</li> </ul>
High Gas Temperature	<ul style="list-style-type: none"> <li>• The temperature of the sample is too low</li> <li>• This alarm is only used when temperature compensation is used</li> </ul>
Low Gas Temperature	<ul style="list-style-type: none"> <li>• The temperature of the sample is too high</li> <li>• This alarm is only used when temperature compensation is used</li> </ul>
P1 Power	<ul style="list-style-type: none"> <li>• The primary power supply has failed</li> <li>• Check power supply to analyzer</li> </ul>
P2 Power	<ul style="list-style-type: none"> <li>• The secondary power supply has failed.</li> <li>• Check power supply to analyzer</li> </ul>

### 8.3.4.2 Controller I/O Status Tab

The *Controller I/O Status* tab (Figure 8-9) refers to settings made on the *Analog Inputs* tab (Section 6.6.5), *Analog Outputs* tab (Section 6.6.6), *Digital Inputs* tab (Section 6.6.3) and the *Digital Outputs* tab (Section 6.6.4) of the *Configuration* page (Section 6.6). An alarm may refer to a problem in the input or output device and may indicate an application issue rather than an instrumental issue.

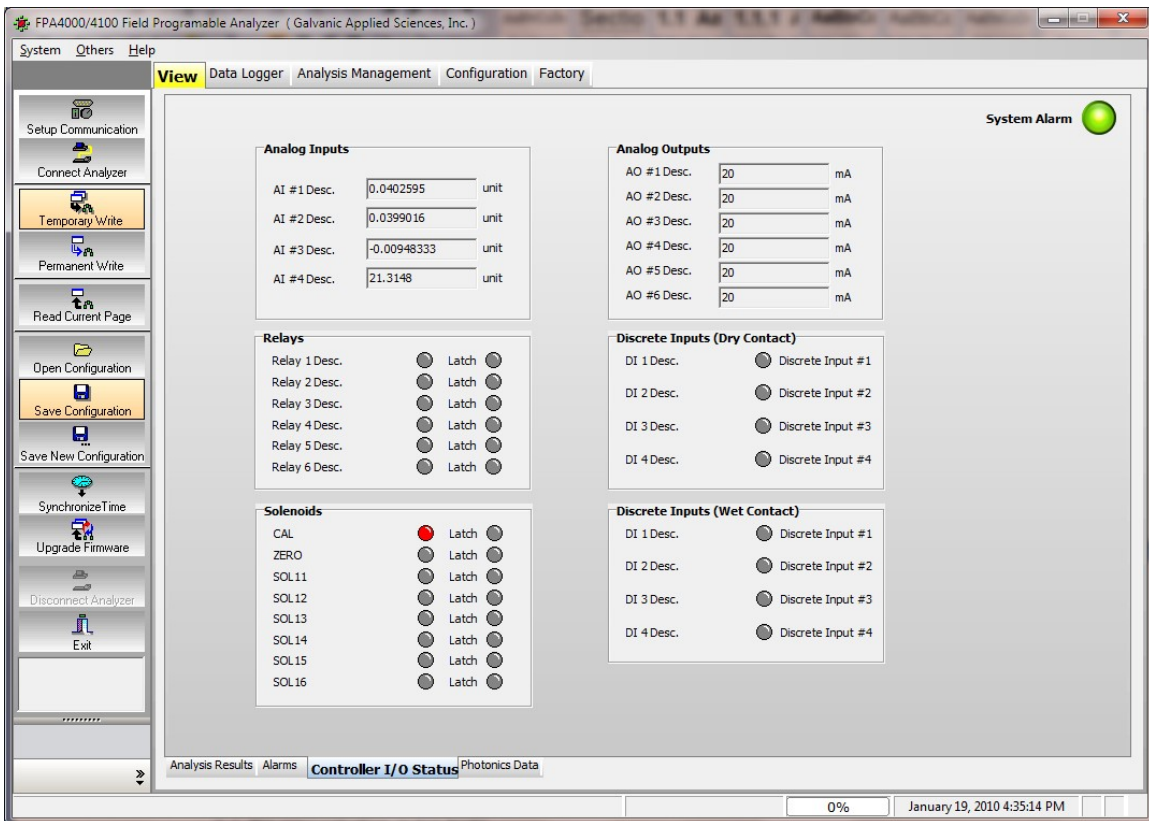


Figure 8-9: Controller I/O Status Tab

### 8.3.4.3 Photonics Data Tab

The *Photonics Data* tab (Figure 8-10) contains data describing various components of the photonics module.

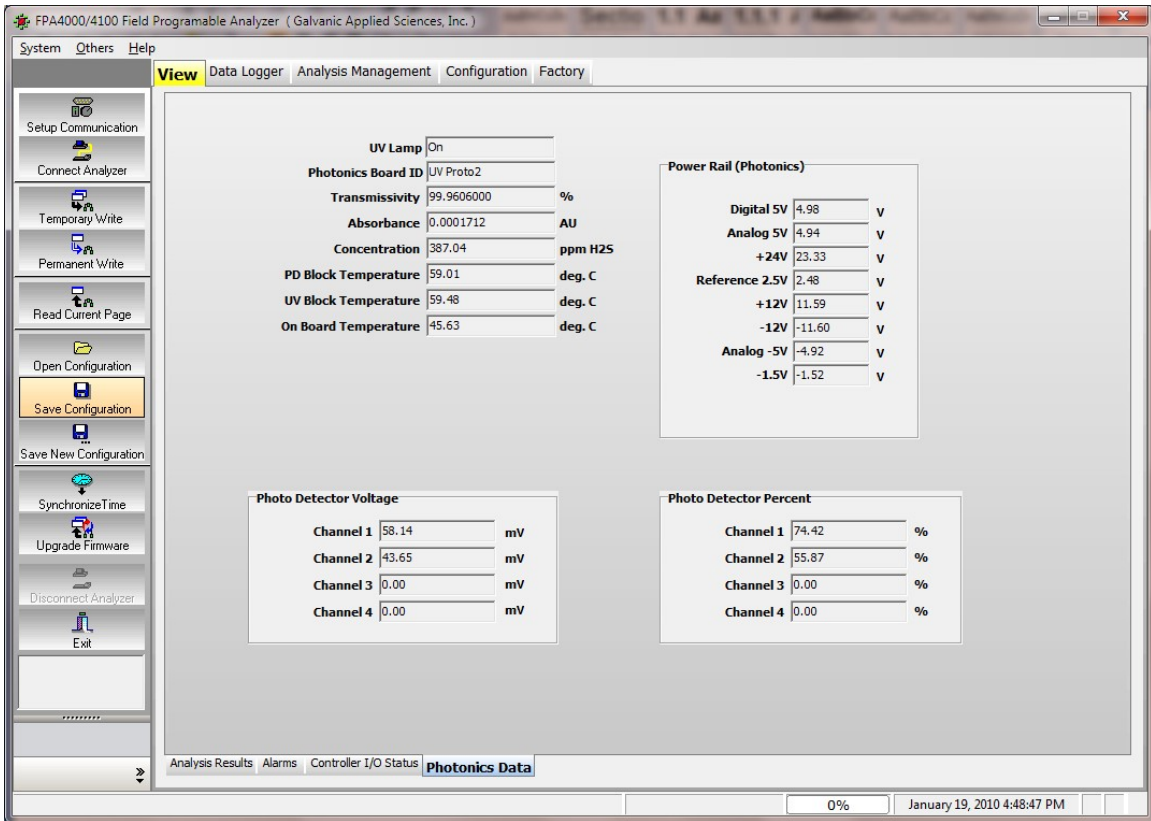


Figure 8-10: Photonics Data Tab

### 8.3.5 Q.A. Documentation

A 4000/4100 Analyzer Q.C. Documentation sheet (Figure 8-11) is generated with each system as a part of the formal quality assurance protocol. The most critical issue to track is the "Measure Adjusted Sensor Output %" and the "Reference Adjusted Output %". Ideally these values are between 50% and 75%. If they are out by 20% of the factory value then this could be cause for concern such as dirty cell, deteriorating lamp intensity. This parameter can be obtained from the *Photo Detector Percent* fields on the *Photonics Data* tab of the *View* menu (Section 6.3.4).



Revision:  
1.0  
Revision Date:

### FPA 4000/4100 Analyzer Q.C. Documentation

Customer Information			
Customer:			
Address:			
City:		Province / State:	
Zip/PC:		Country:	
Contact:		Phone:	
P.O. No:		S.O. No:	
Controller Module			
Controller S.N:		Controller Firmware Version:	
Database Version:		G.U.I. Version:	
Input Voltage:			
Area Classification:			
Photronics Setting			
Photronics S.N:		Photronics Firmware Version:	
Database Version:		G.U.I. Version:	
Input Voltage:			
Area Classification:			
Channel 1 Measure:		Ch. 1 Hardware Gain:	
Channel 2 Reference:		Ch. 2 Hardware Gain:	
Channel 3: ( Not Used )		Ch. 1 PGIA Gain:	
Channel 4: ( Not Used )		Ch. 2 PGIA Gain:	
Measurement Component:		Light Source:	
Absorbance x Path Length:		Measure Gain Adjust:	
Measure Zero Offset:		Reference Gain Adjust:	
Reference Zero Offset:		Measure Raw Sensor mV:	
Measure Adjusted Sensor Output (%):		Reference Raw Sensor mV:	
Reference Adjusted Sensor Output (%):			
Technician:			
Date: (mm/dd/yy)			

**Figure 8-11: Analyzer Q.C. Documentation**



## Section 9 Wiring Book

**NOTICE**

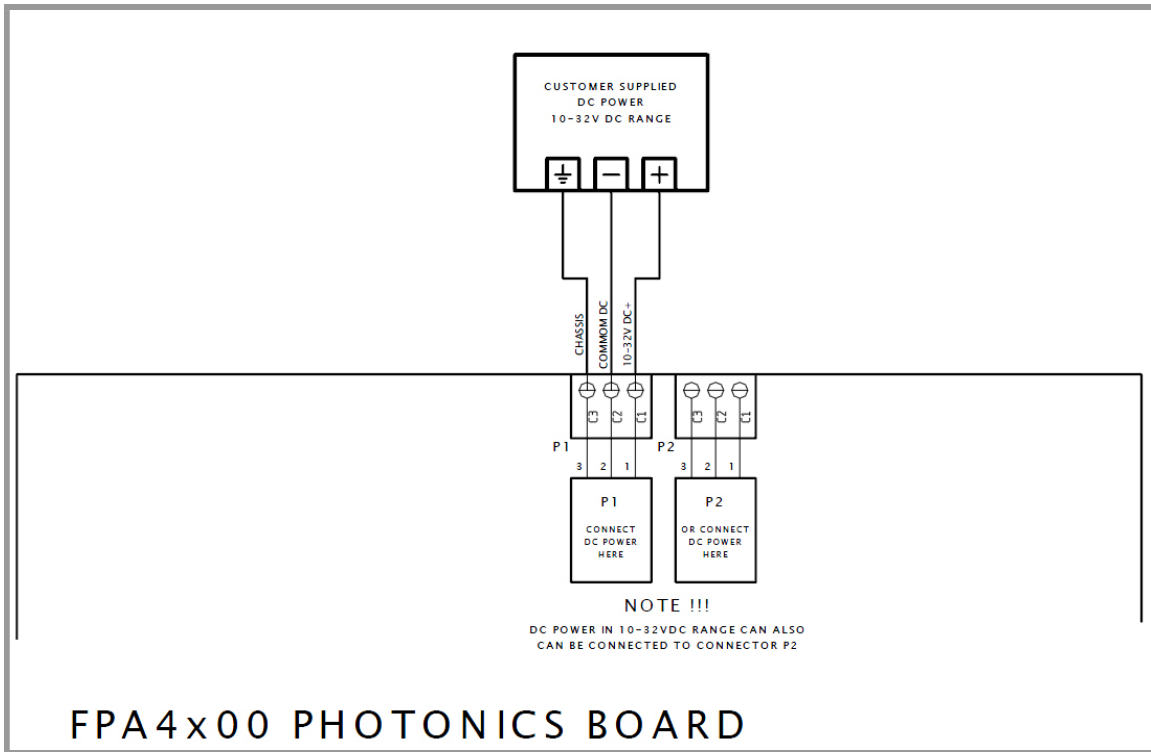
The wiring book can be accessed by selecting **Wiring Book** on the Help menu of the application program

### 9.1 Photonics Module

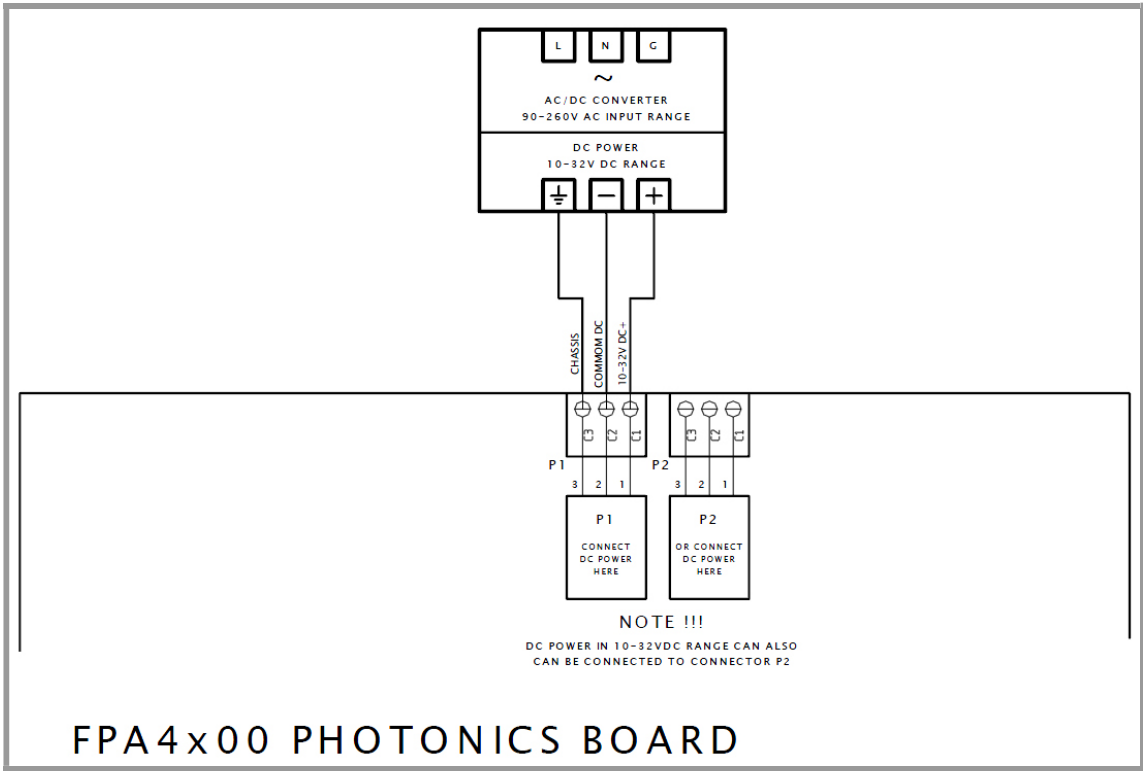
The wiring book for the Photonics Module is described in Table 9-1.

**Table 9-1: Wiring Book, Photonics Module**

<b>Wiring Diagram for</b>	<b>Connector(s)</b>	<b>Figure</b>
DC POWER	P1, P2	9-1
AC POWER	P1, P2	9-2
AC & DC POWER	P1, P2	9-3
PRESSURE TRANSDUCER	P3	9-4
RTD	P4	9-5
TUNGSTEN LAMPS	P5	9-6
MERCURY UV LAMPS	P6, P7	9-7
ZINC AND CADMIUM UV LAMPS	P6, P7, P8	9-8
ISOLATED 2.5 MBITS/S LAN PORT	P11	9-9
ISOLATED RS-485 PORT	P14	9-10
PRESSURE TRANSMITTER	P3	9-11



**Figure 9-1: DC Power Wiring Diagram - Photonics Module**



**Figure 9-2: AC Power Wiring Diagram - Photonics Module**

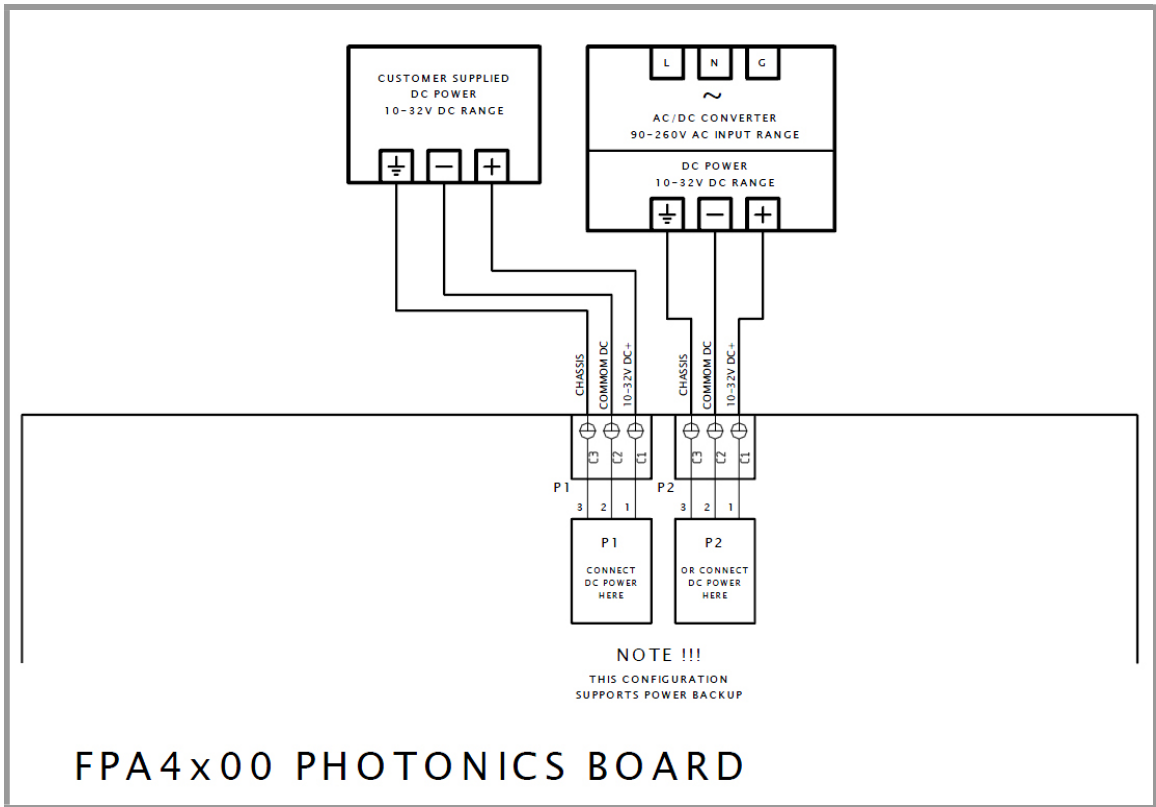
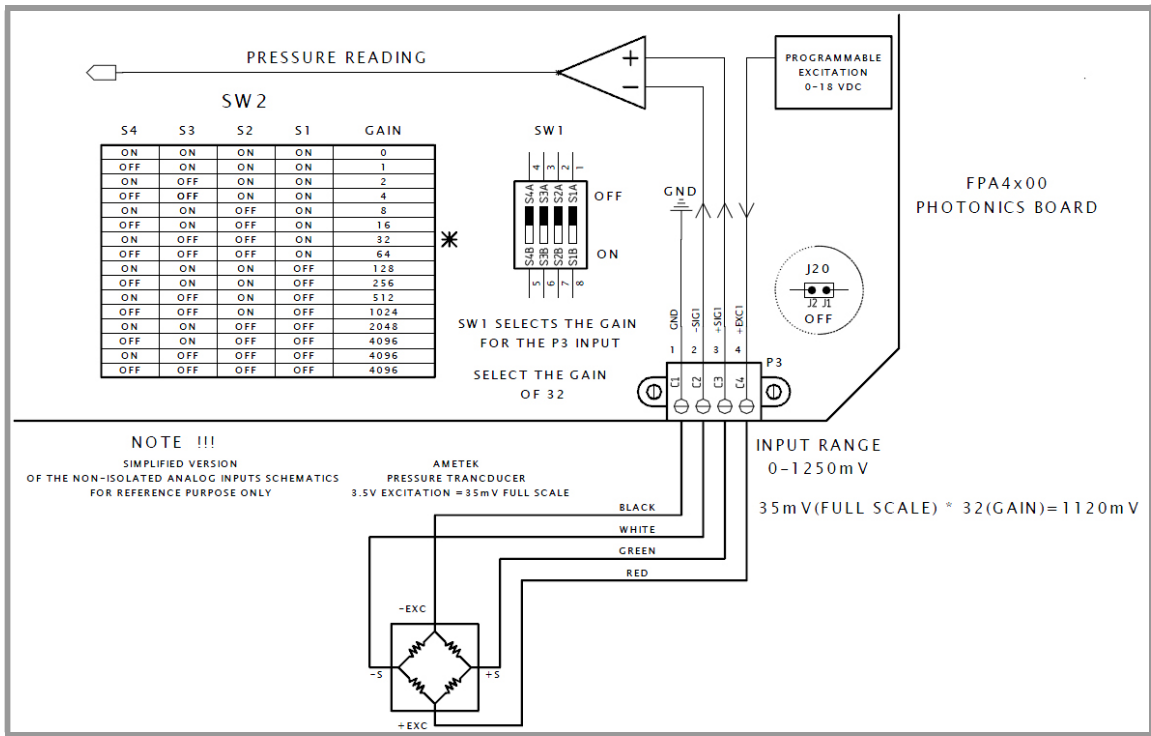


Figure 9-3: AC & DC Power Wiring Diagram - Photonics Module



**Figure 9-4: Pressure Transducer Wire Diagram - Photonics Module**

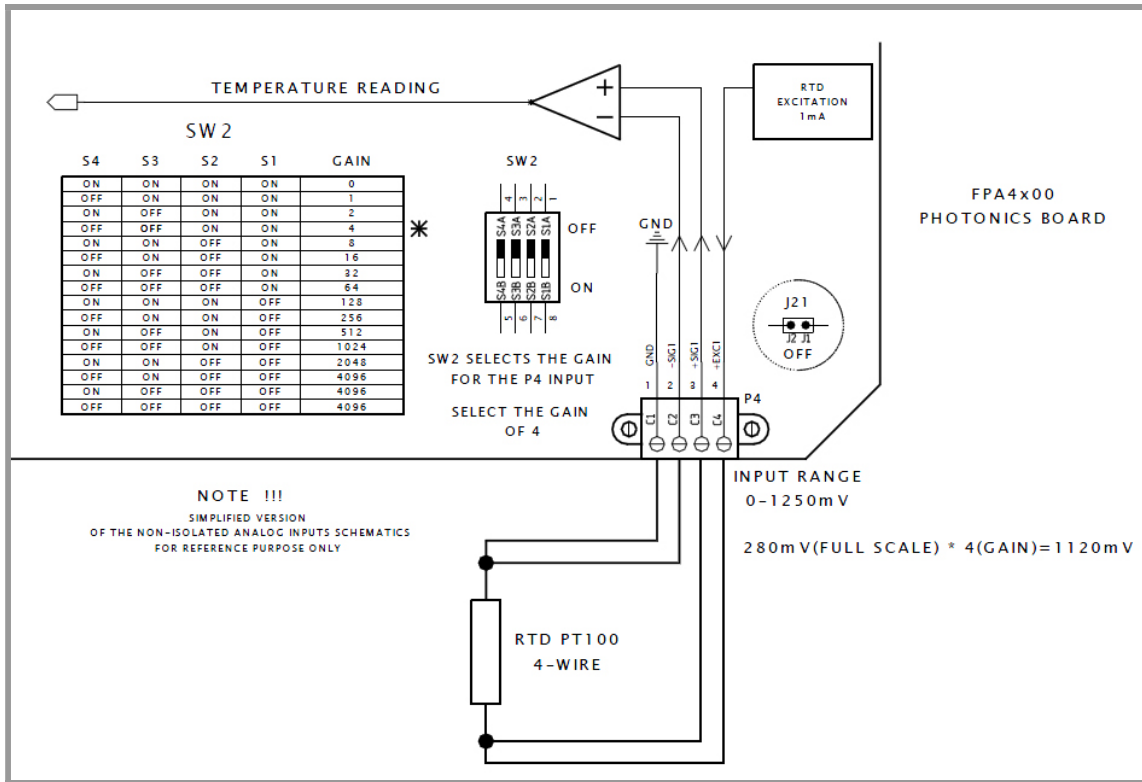


Figure 9-5: RTD Wiring Diagram - Photonics Module

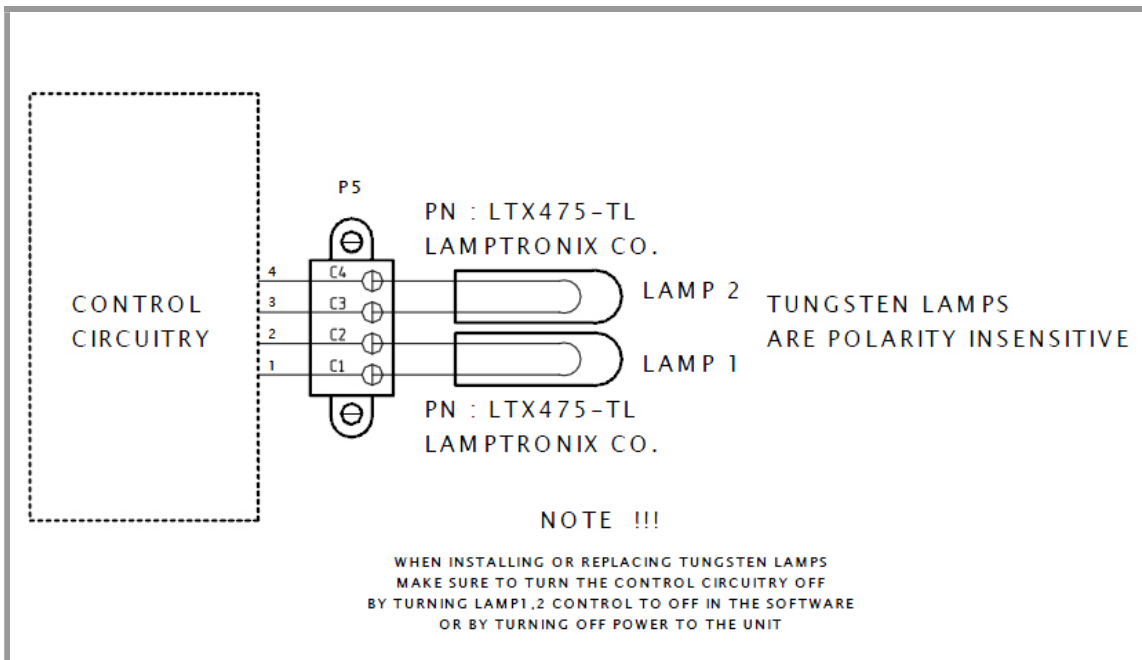
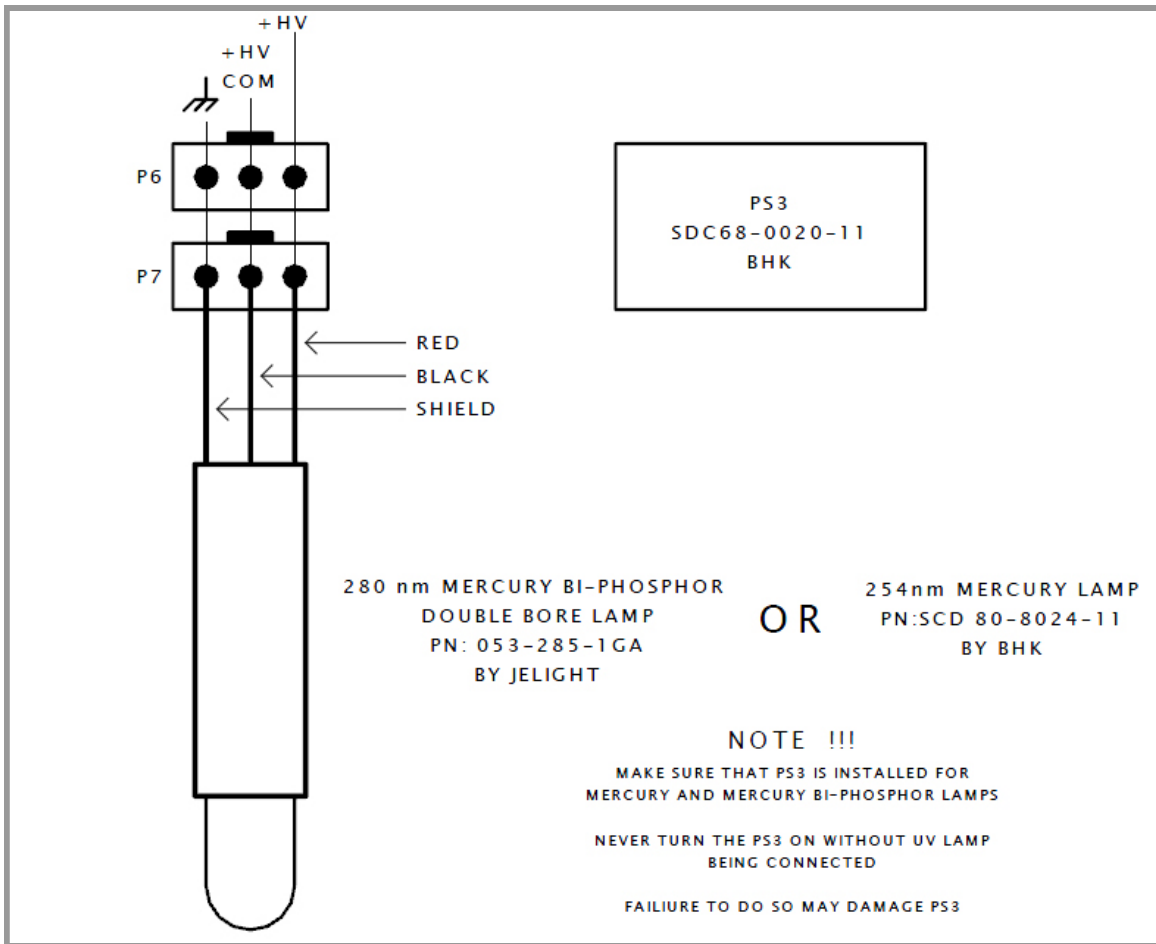
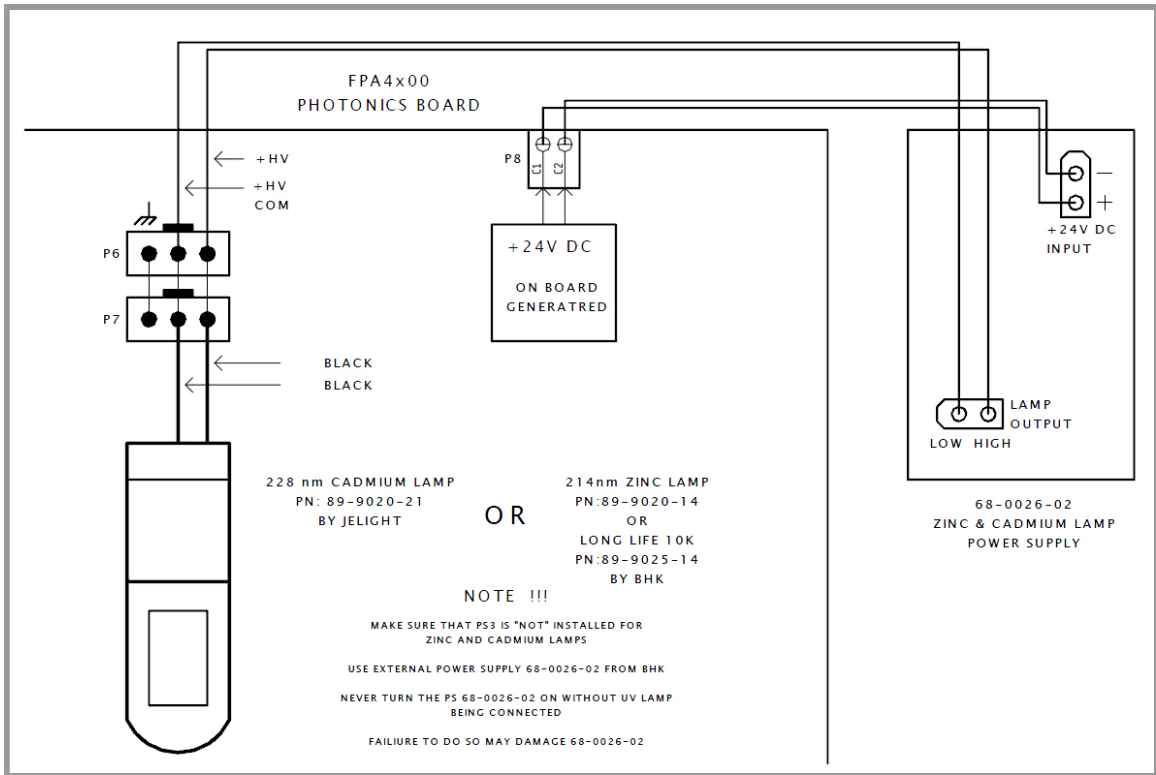


Figure 9-6: Tungsten Lamps Wiring Diagram - Photonics Module

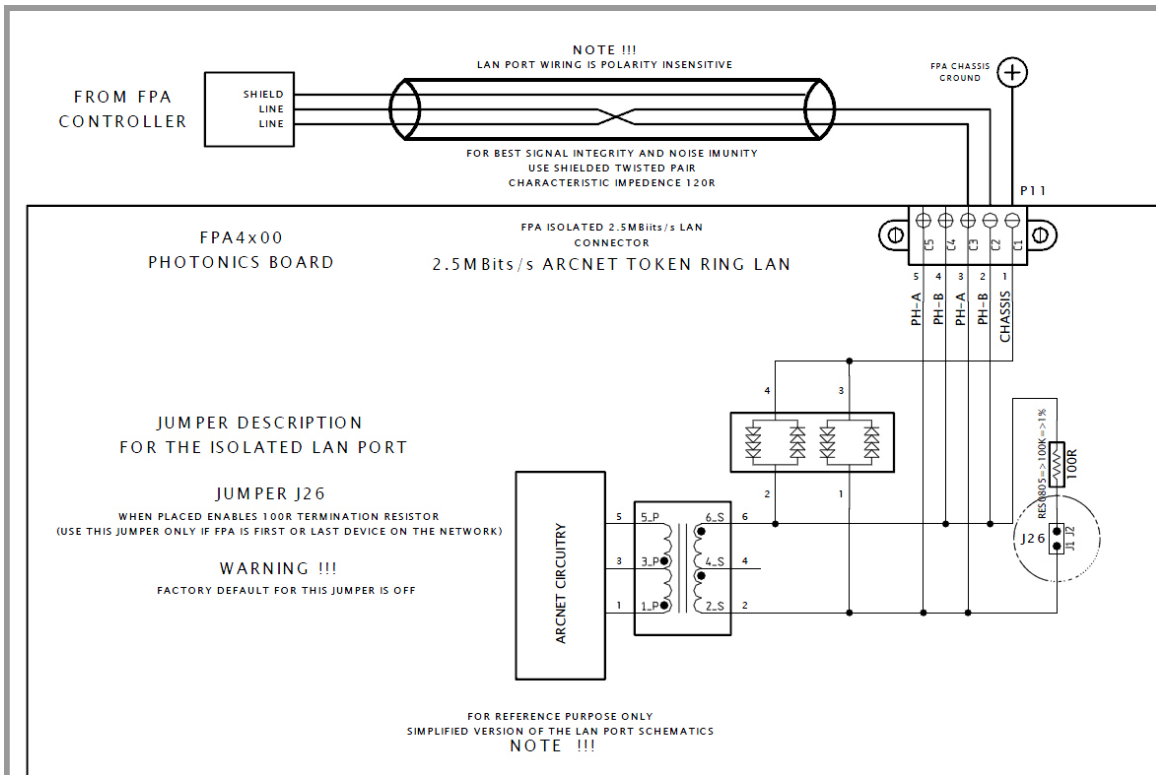


**Figure 9-7: Mercury UV Lamps Wiring Diagram - Photonics Module**

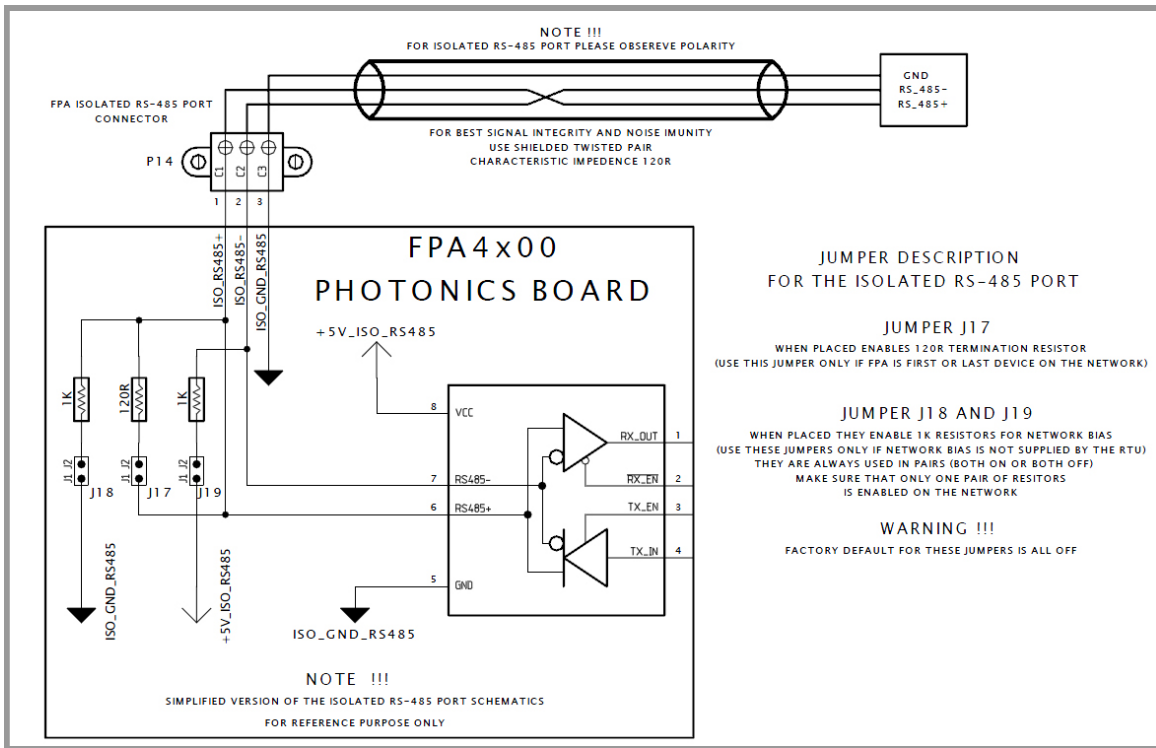


**Figure 9-8: Zinc and Cadmium Lamps Wiring Diagram**





**Figure 9-9: Isolated 2.5 Mbps LAN Port - Photonics Module**



**Figure 9-10: Isolated RS-485 Port - Photonics Module**

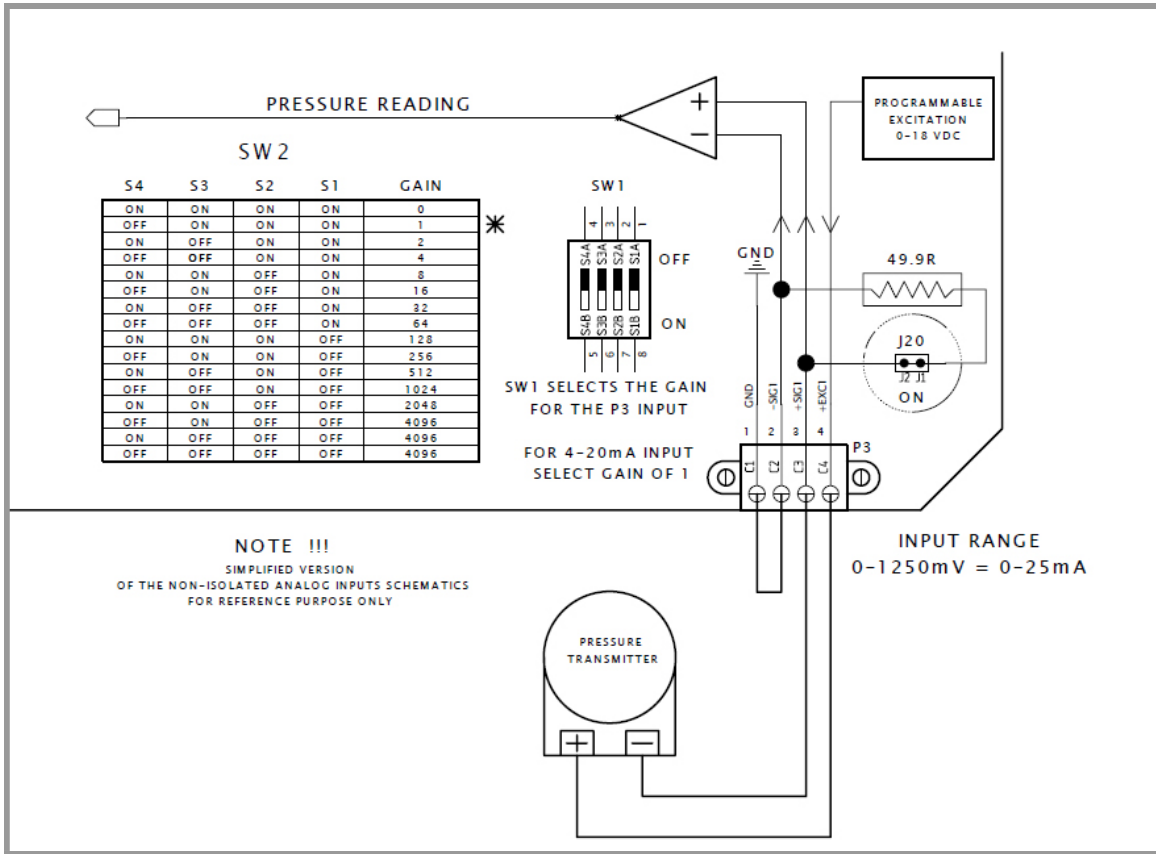


Figure 9-11: Pressure Transmitter Wiring Diagram - Photonics Module

## 9.2 Controller Module

The wiring book for the Controller Module is described in Table 9-2.

**Table 9-2: Wiring Book, Controller Module**

<b>Wiring Diagram for</b>	<b>Connector(s)</b>	<b>Figure</b>
DC POWER	P4, P5	9-12
AC POWER	P3,P5	9-13
AC & DC POWER	P3, P4, P5	9-14
SOLENOID DRIVERS	P5, P6	9-15
RELAYS	P7,P8	9-16
DIGITAL INPUTS (ISOLATED)	P9	9-17
DIGITAL INPUTS (DRY)	P10	9-18
ISOLATED 4-20 mA OUTPUTS	P11	9-19
ISOLATED 4-20 mA INPUTS	P12	9-20
ISOLATED 2.5 MBITS/S LAN PORT	P15	9-21
ISOLATED RS-485 PORT	P16	9-22
RS-232 PORT TO ETHERNET CABLE	P17	9-23
DIVISION 1 (KEYPAD)	P18	9-24
DIVISION 2 (KEYPAD)	P18	9-25
NON ISOLATED 4-20 MA INPUTS	P19	9-26

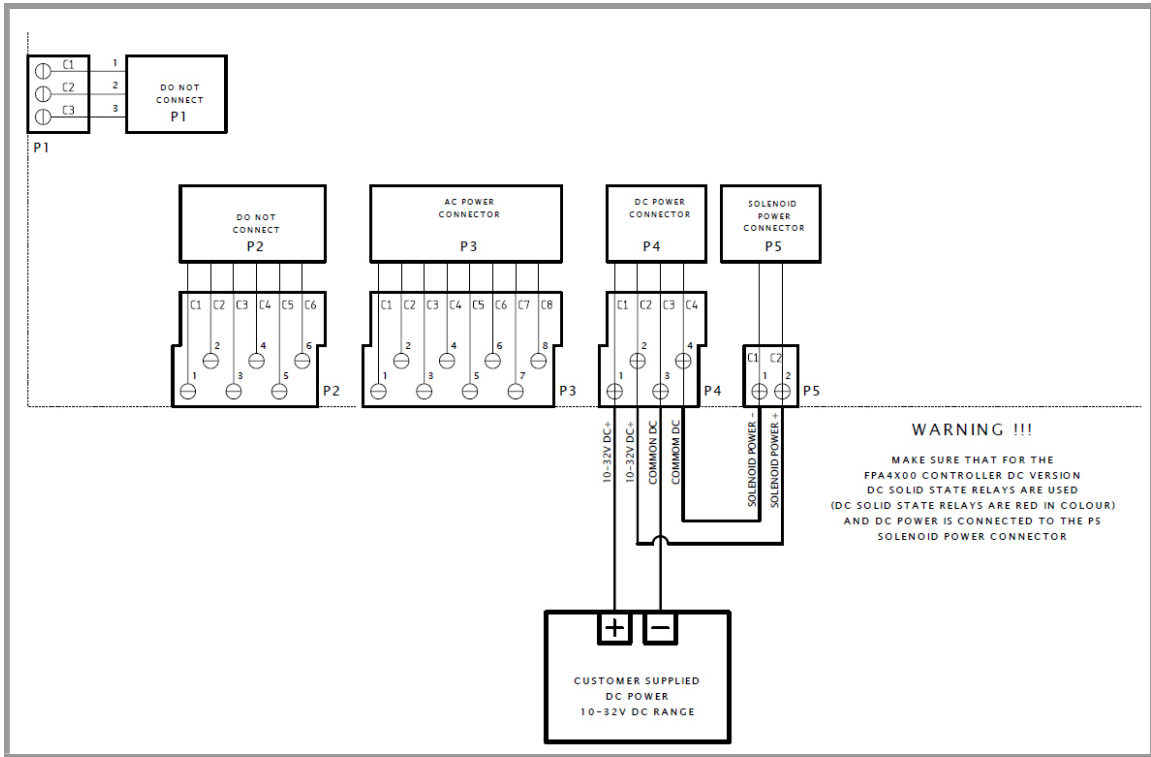


Figure 9-12: DC Power Wiring Diagram - Controller Module

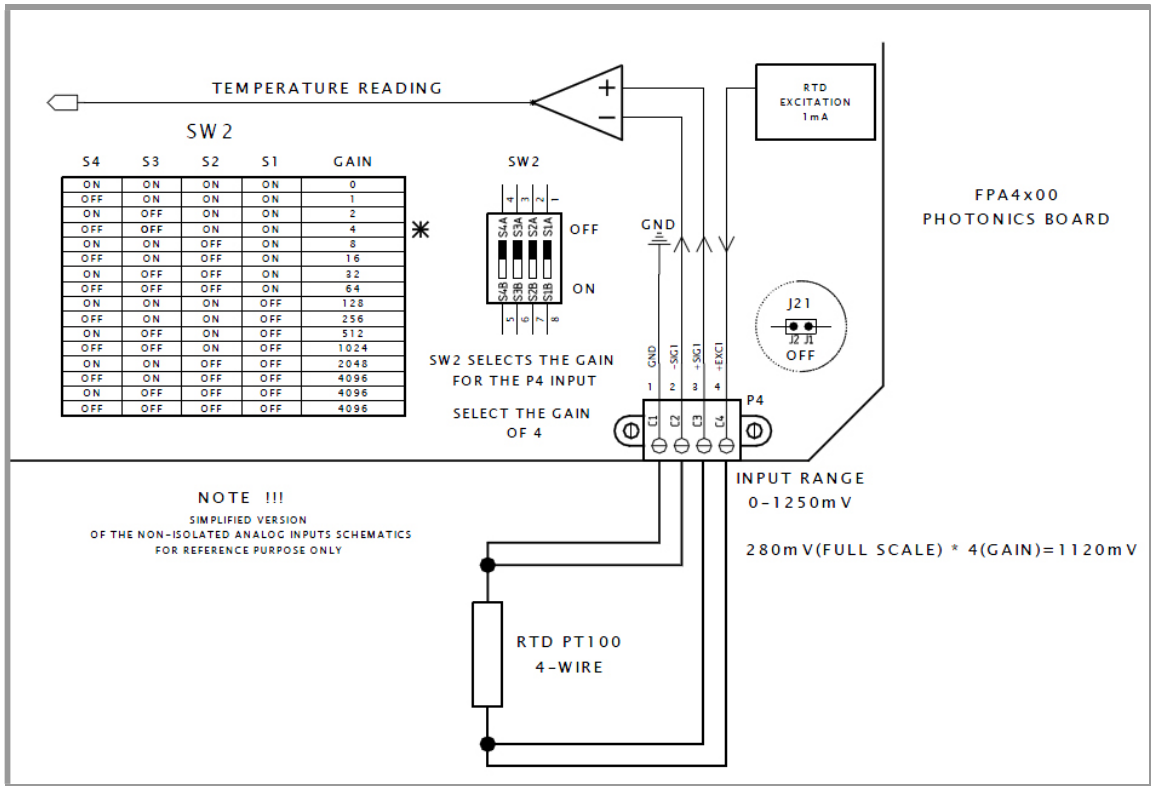


Figure 9-13: AC Power Wiring Diagram - Controller Module

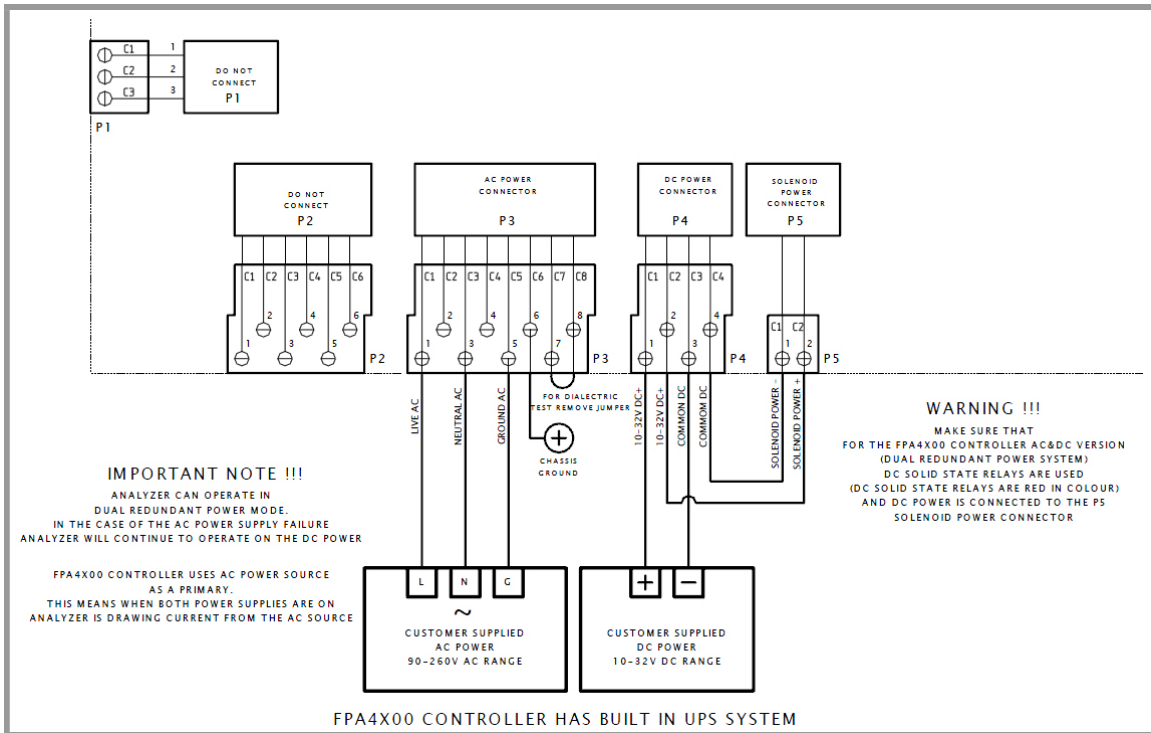


Figure 9-14: AC and DC Power Wiring Diagram - Controller Module

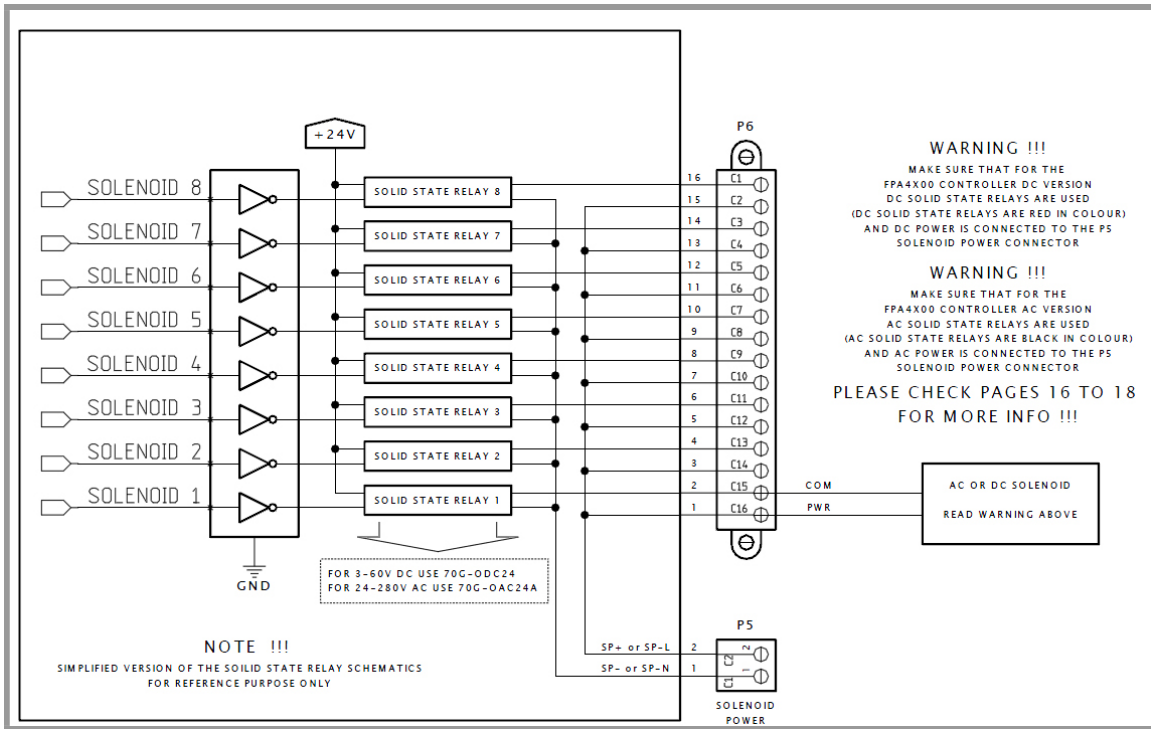
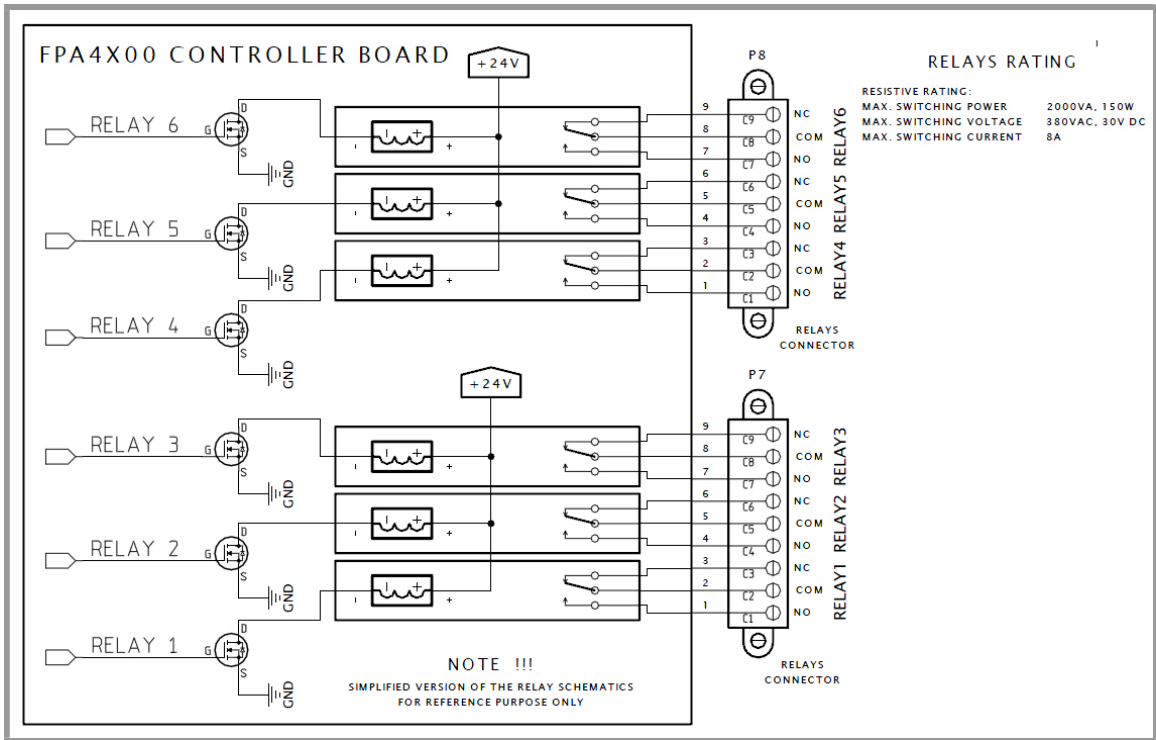
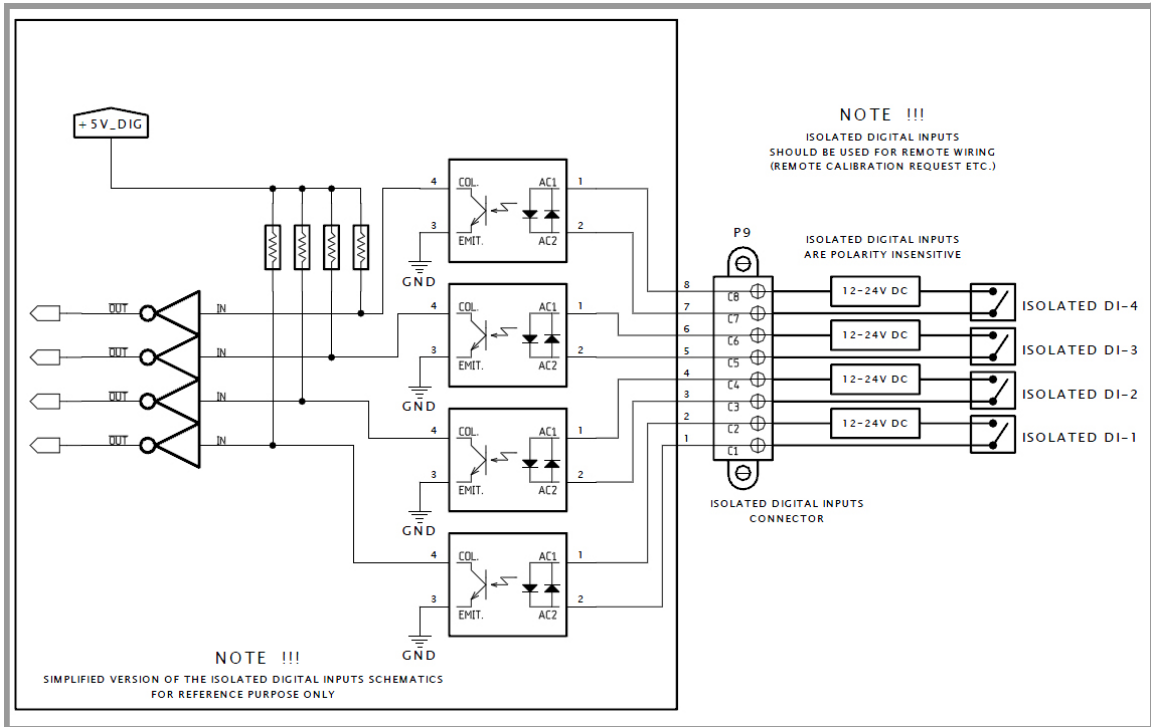


Figure 9-15: Solenoid Drivers Wiring Diagram - Controller Module

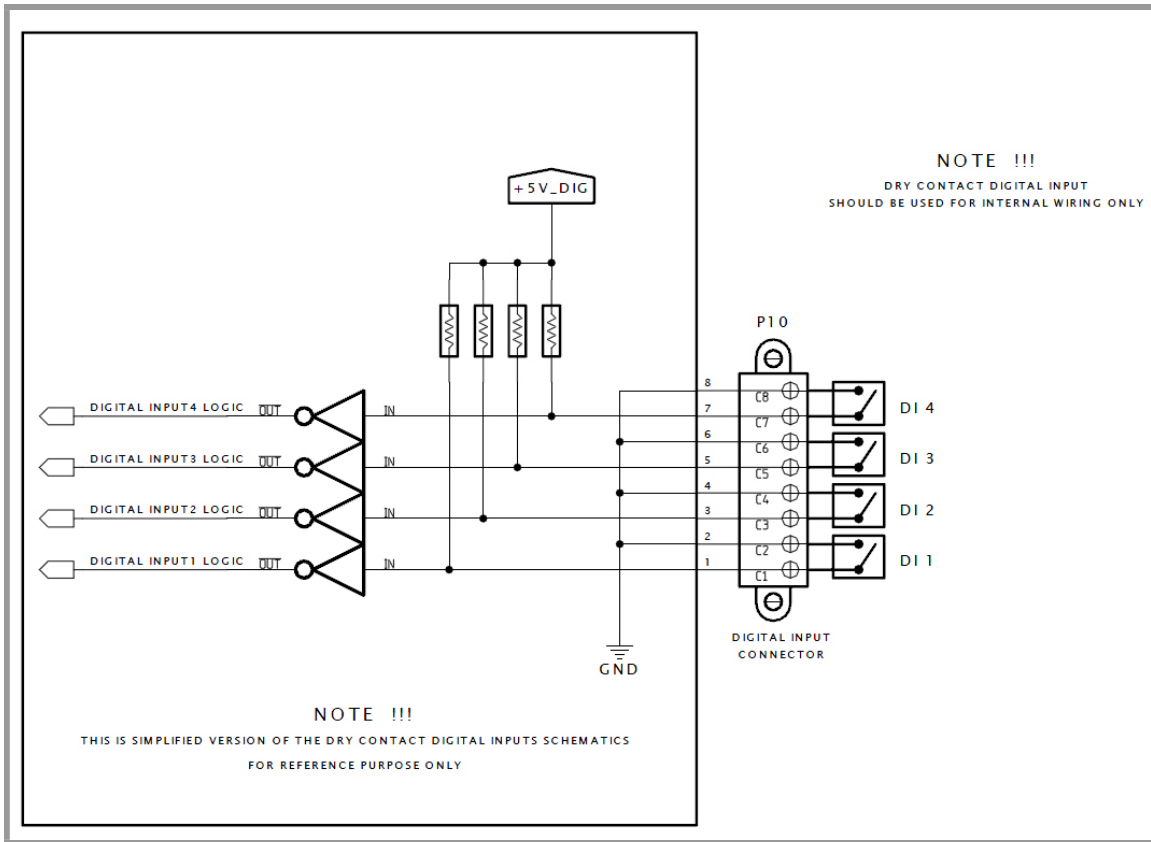




**Figure 9-16: Relays Wiring Diagram - Controller Module**



**Figure 9-17: Digital Inputs (Isolated) Wiring Diagram - Controller Module**



**Figure 9-18: Digital Inputs (Dry) Wiring Diagram - Controller Module**

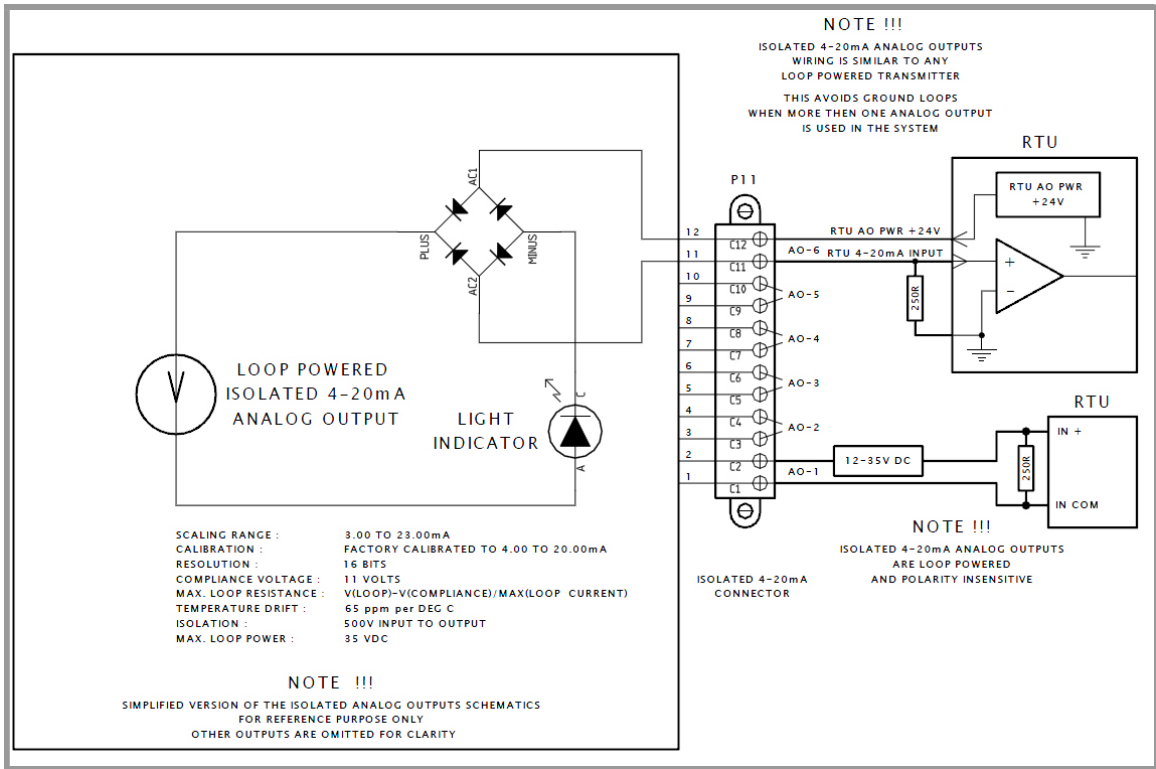


Figure 9-19: Isolated 4-20 mA Outputs Wiring Diagram - Controller Module

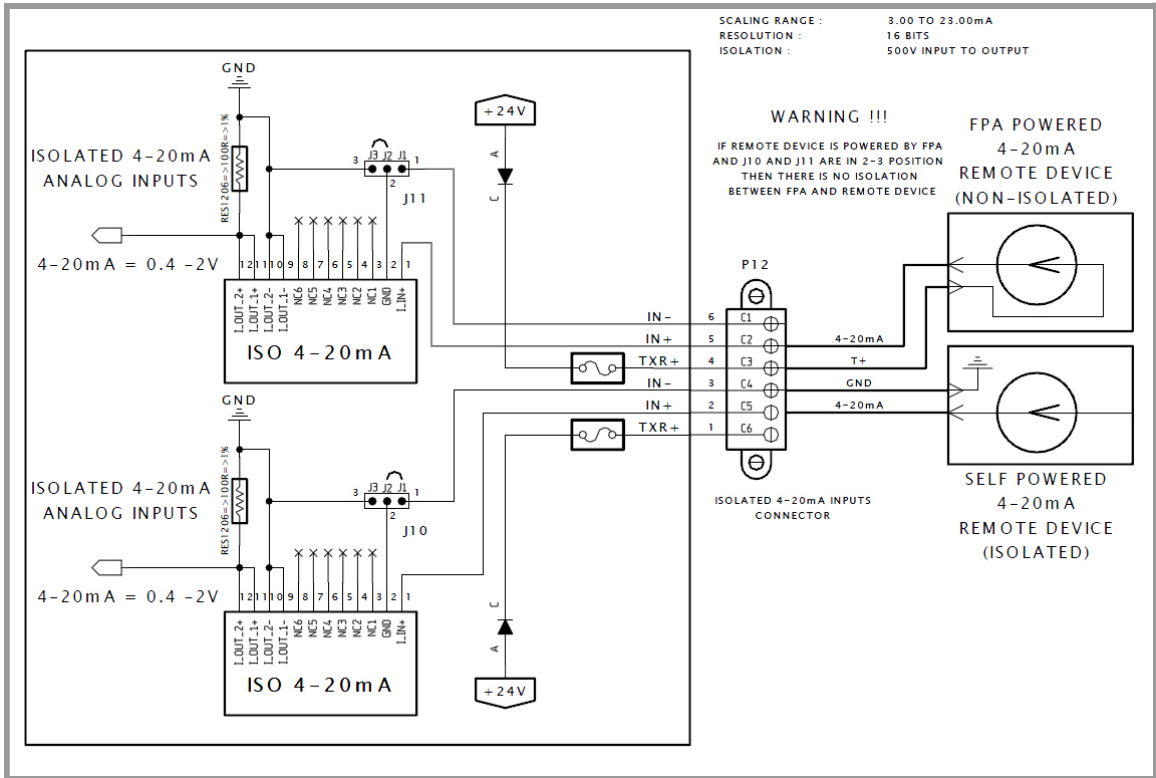
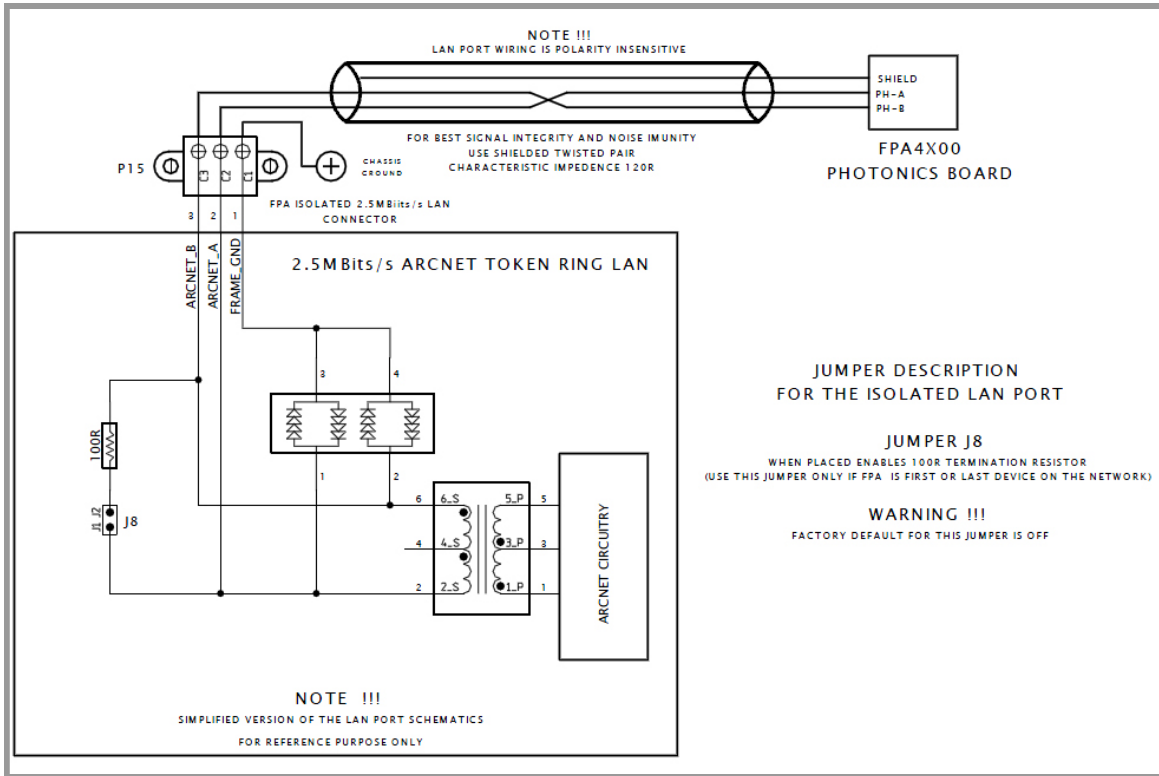


Figure 9-20: Isolated 4-20 mA Inputs Wiring Diagram - Controller Module



**Figure 9-21: Isolated 2.5 Mbps/S LAN Port Wiring Diagram - Controller Module**

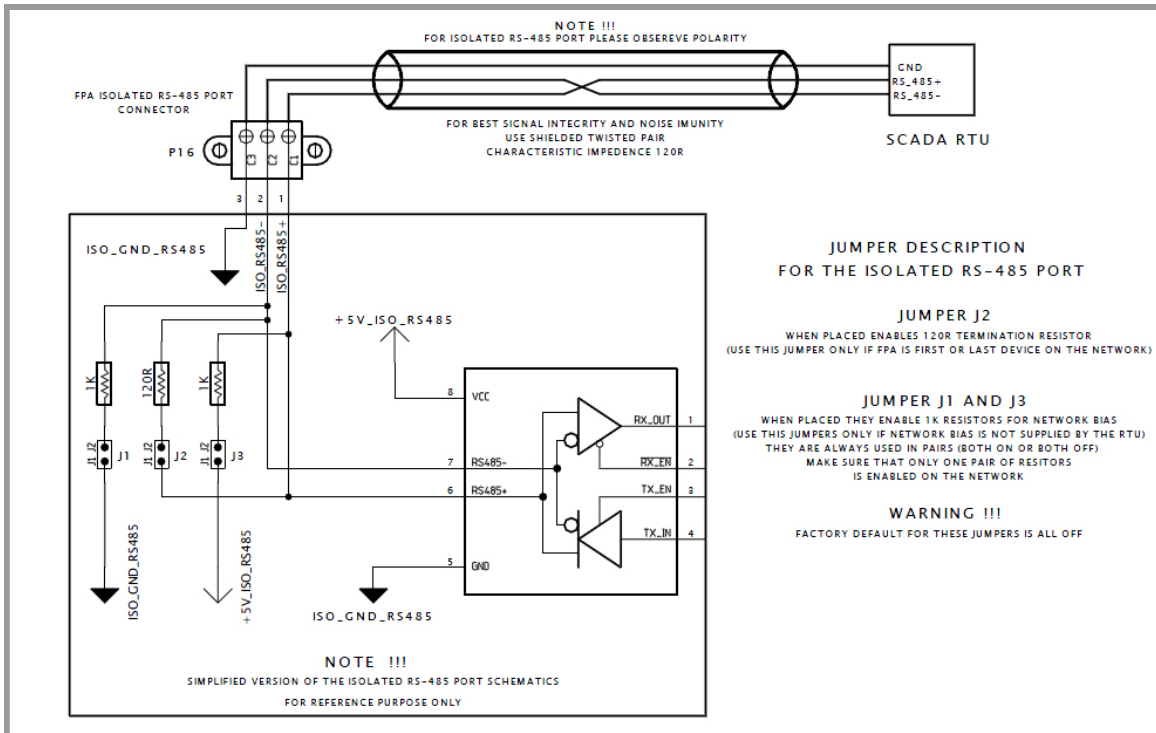


Figure 9-22: Isolated RS-485 Port Wiring Diagram - Controller Module

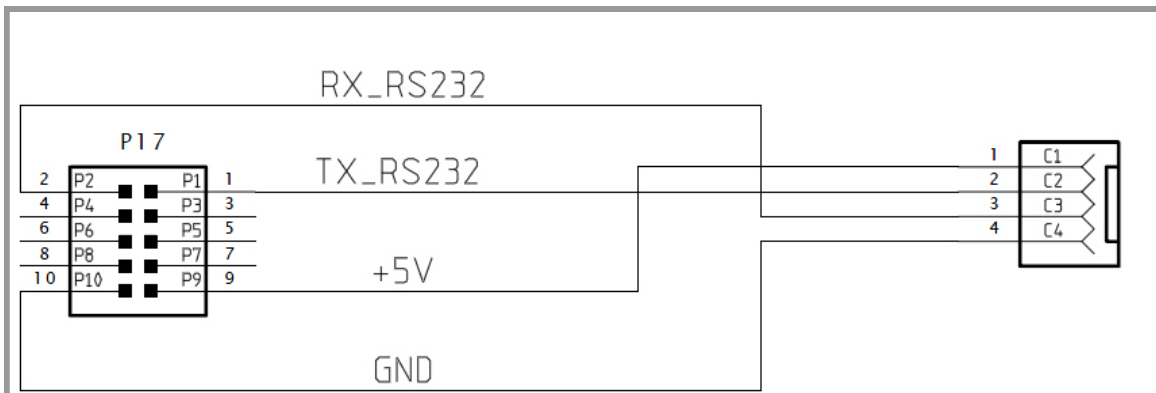


Figure 9-23: RS-232 Port to Ethernet Cable Wiring Diagram - Controller Module

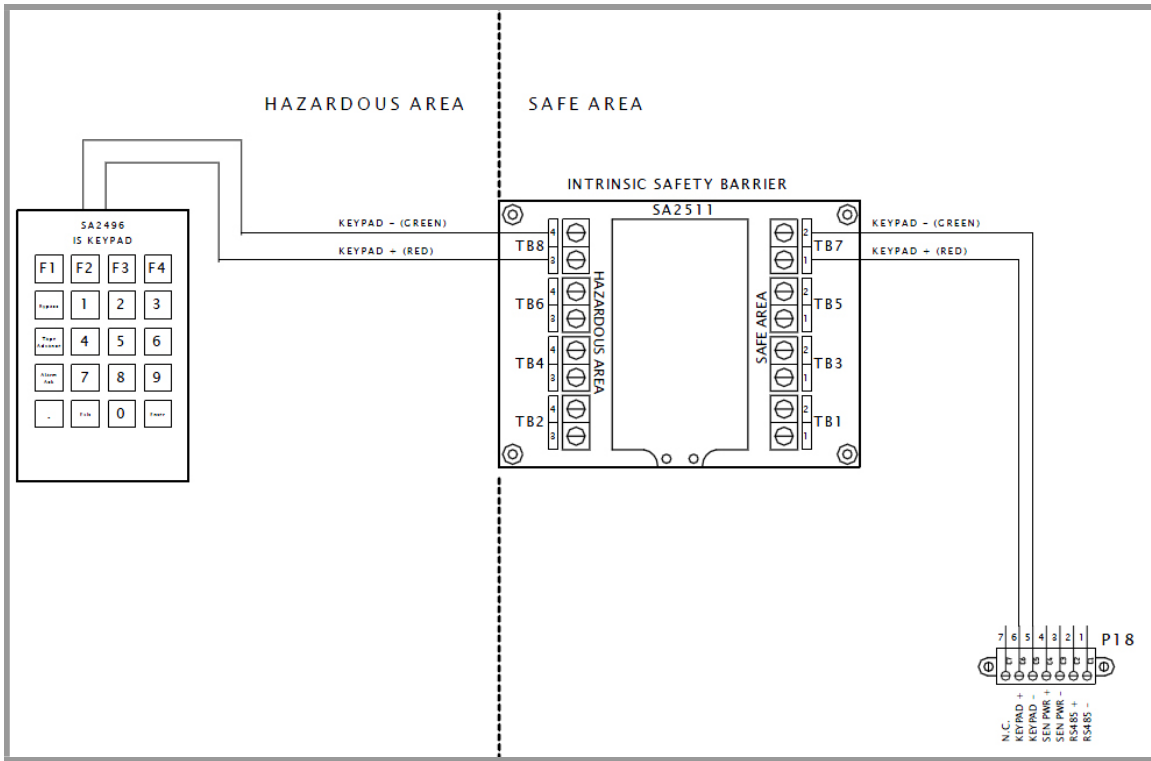


Figure 9-24: Keypad (Division 1) Wiring Diagram - Controller Module

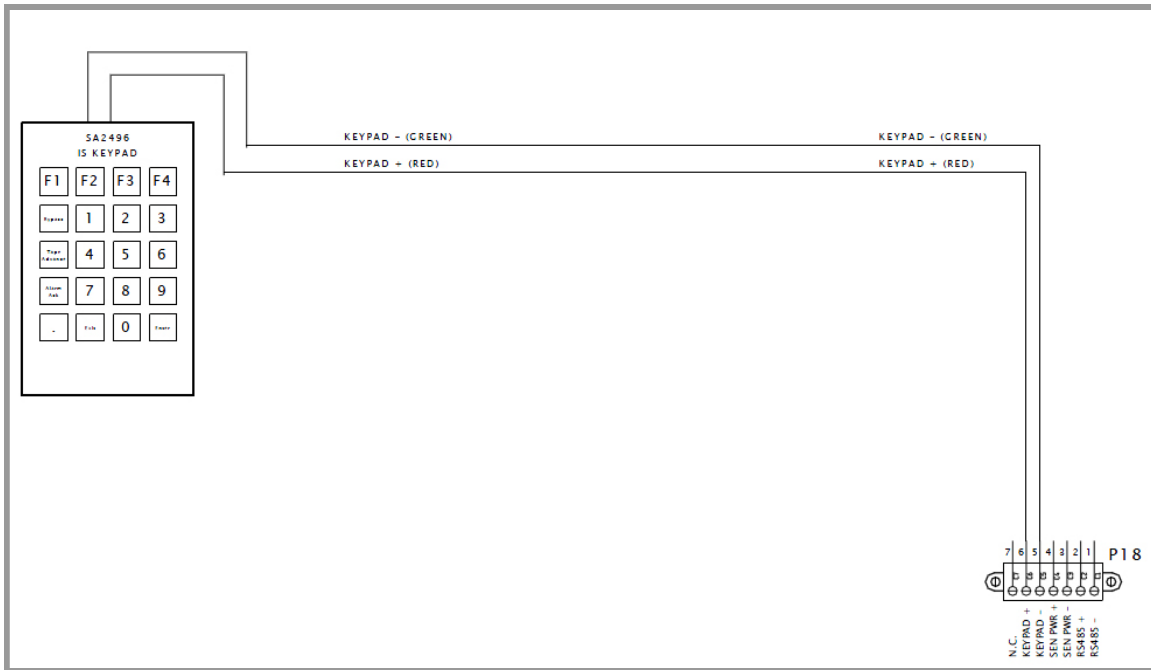
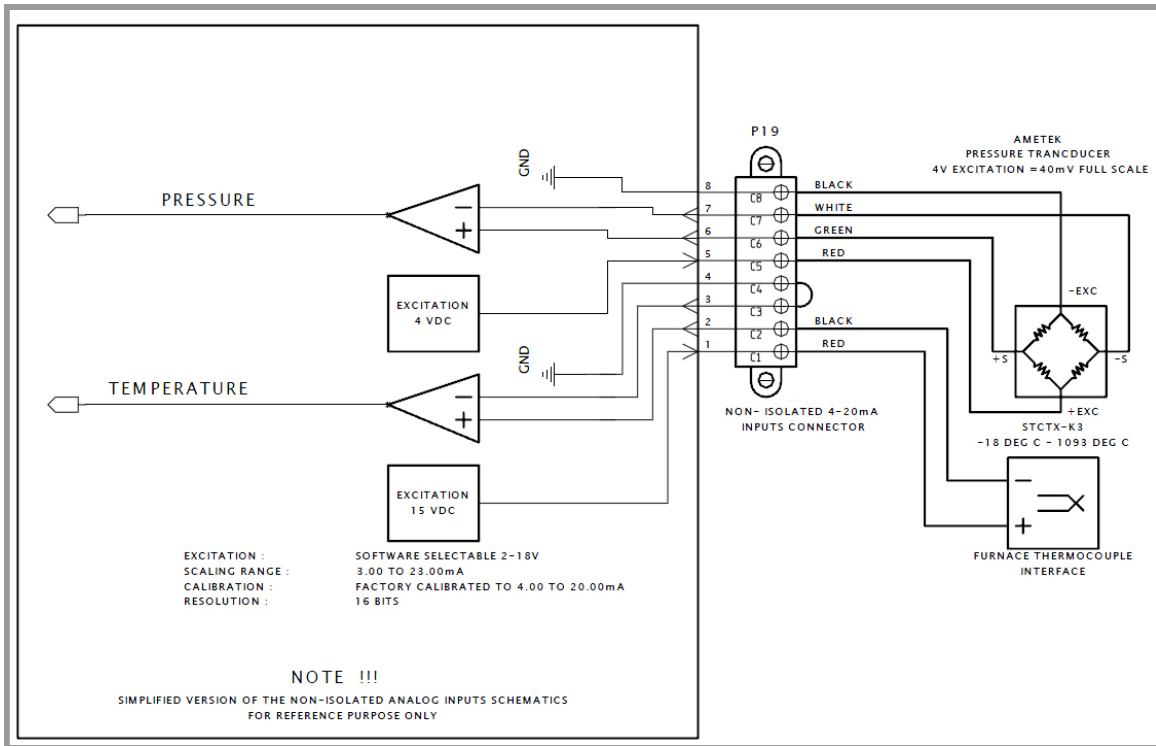


Figure 9-25: Keypad (Division 2) Wiring Diagram - Controller Module





**Figure 9-26: Non Isolated 4-20 mA Inputs - Controller Module**

## Section 10 Spare and Maintenance Parts

---

The following items can be ordered as required:

<b>Cat. No.</b>	<b>Description</b>
100-121	O-ring, Teflon® coated Silicone
100-122	O-ring, Silicone
100-123	O-ring, Kalrez
T422001	FPA 4000/4100 User's Manual (extra copies)
100-021.1.1	Cell Window (BK-7)
100-021.2.1	Cell Window (IR-12)
100-021.3.1	Cell Window (SI-UV) [4100]
400-311	Source, Tungsten lamp
100-311	Source, Mercury arc
100-312	Source, Cadmium arc
100-313	Source, Bi-Phosphor arc
100-314	Source, Zinc arc
100-331	Optical Filter, bandpass UV (as specified)
100-332	Optical Filter, bandpass VIS/NIR (as specified)
BA2530	USB-USB Cable
BA2531	USB-RS232 Cable
SA2781	FPA-Keypad
PT2622	FPA-Photonics Board
PT2557	FPA-Display Board
PT2555	FPA-Controller Mother Board

## Section 11      **Technical Specifications**

---

<b>Performance</b>	
Range	Low ppm to low % levels depending upon measurement
Linearity	± 1% of full scale
Repeatability	±1% of full scale
Response Time	T 90 30 seconds

<b>Functions</b>	
Streams	One (1) stream (standard), with up to 8 streams (optional)
Auto / Manual Mode	AUTO mode: analyzer runs in predefined sequence. MANUAL mode: user can select any stream to run.
Automatic Temperature and Pressure Correction	For gaseous measurements.
Auto Zero	
Auto Calibration	
Auto Wash	

<b>Communications / Interface</b>	
Outputs	6 - isolated 4-20mA user scalable and programmable (16 Bits of resolution).
	6 - Relay contact SPDT (form C) 8 Amps 220VDC max. – user programmable.
	8 - Solenoid drivers, 3A max. – user programmable
	1 - USB or RS-232 Serial Port
	1 – RS-232 Serial Port
	1 – RS-485 Serial Port (Isolated)
	Ethernet (optional)
	All Serial Ports are MODBUS compatible.
	10 Visual indicators (LED) for quick status and large graphics display.
	4 Dry contact inputs user programmable
Inputs	4 Wet inputs – for remote calibration etc. user programmable
	Two isolated 4-20 mA inputs to permit the FPA units to be communication hub for other devices which do not have that capacity
	Intrinsically safe keypad with 20 keys for easy menu navigation.

<b>Instrument Specifications</b>	
Ambient	10 to 55°C (without enclosure)
Power Consumption	30W @ 24 V DC
Power Input	90 to 240V AC and 10 to 36VDC
Electrical	Class 1, Div.1, B,C,DT4.
Electronics	Dual processor design using an intelligent photonics sensor.
	Sensor is using 24 bit AD converter to achieve greatest sensitivity and incorporates temperature stabilization.
	Real time clock for accurate time required actions
	Field upgradable firmware.
Dimensions (Nominal)	Fiberglass Enclosure Control Module 14 9/16"H x 12 9/16"W x 8"D Photonics Module 12 9/16"H x 14 9/16"W x 8"D
	Explosion Proof Enclosure Control Module 17 3/8"H x 13 3/8"W x 8 7/16"D Photonics Module 16 1/4"H x 16 1/4"W x 8 15/16"D
Weight	Fiberglass Enclosure Control Module 15 lbs (6.8 kg) Photonics Module 20 lbs (9 kg)
	Explosion Proof Enclosure Control Module 56 lbs (25.5 kg) Photonics Module 80 lbs (36.25 kg)
Software	Windows based software for configuration and monitoring. Software includes advanced configurable features for stream switching, automatic calibration, and cleaning options.
Memory	Field programmable memory. Firmware for unit can be upgraded in the field.
Data Logging	Up to 10 months of concentration data logs. 512 Kbytes non-volatile memory for data logging and audit trail.
	Logs stored in Excel form

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