



# SERVOTOUGH SpectraScan (2400) Gas Analyzer



# User Manual

Part Number: Revision: Language: 02400001A 1 US English



The SpectraScan Analyzer is manufactured by Precisive LLC of Boston , MA, USA who assume responsibility for the product performance with regard to software and set up using appropriate gas mixtures for calibration. The methodology is patent protected and is the Intellectual Property of Precisive LLC.

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# **1 ABOUT THIS MANUAL**

## 1.0 Introduction

This manual provides information about the Servomex SpectraScan Gas Analyzer. TCP/IP enabled, the Servomex SpectraScan Gas Analyzer can monitor process gases remotely, unattended for extended periods of time.

This manual presents all safety considerations of the Servomex SpectraScan Gas Analyzer first, and then provides instructions for unpacking, mounting and connecting the unit. An installation checklist ensures all the required tasks are performed. The verification test confirms span accuracy upon installation, and includes the zeroing procedure which may be repeated periodically. Short maintenance and troubleshooting sections are included in this manual. Product specifications are given in the appendix at the end of this manual.

Before installing or operating your Servomex SpectraScan Gas Analyzer, carefully read and familiarize yourself with System Safety. In addition, observe and obey all Hazard Notices and Symbols provided for your safety throughout this manual.



# 1.1 Symbols and Notices Used in this Manual

This manual contains attention symbols and notices which should be observed to ensure personal safety, as well as to protect the product and the connected equipment. Hazard notices are accompanied with text that identifies the hazard, advises you to avoid the hazard, and/or the probable consequences of NOT avoiding the hazard. Where applicable, within the notice box or near the paragraph text, the appropriate IEC or ISO symbol is used. Attention notices provide useful information pertinent to the operation of the analyzer.

The following notices are displayed throughout Servomex documentation:

## 1.1.1 Hazard Notices

Read this manual and ensure that you fully understand its content before you attempt to install, use or maintain the analyzer. Important safety information is highlighted in this manual as WARNINGS and CAUTIONS and NOTES, which are used as follows;



WARNING

Warnings highlight specific hazards which, if not taken into account, may result in personal injury or death.

## CAUTION

Cautions highlight hazards which, if not taken into account, can result in damage to the analyser or to other equipment or property.

NOTES
This highlights information which it is useful for you to be aware of (for example, specific operating conditions, and so on).

## 1.1.2 Hazard Labels Statement

Hazard labels indicate possible hazardous areas and identify the potential hazard on the analyzer. Hazard labels are applied to the access areas of the analyzer to caution the following:

- Exposure to hazardous chemicals (gases, process materials or by-products, solvents/solutions) or physical conditions (heat or excessive cold) that may result in injuries
- Exposure to electrical energy that may cause electric shock or death
- Exposure to high temperatures that may cause injuries

See Table 1 IEC and ISO Symbols on page 8 for definition of symbols.

## 1.1.3 IEC and ISO Symbols

The following symbols may be found on the Servomex SpectraScan Gas Analyzer and in the documentation:

Definition of Symbols Found on the Analyzer and in this Manual			
	$\bigcirc$ $\perp$		
On (Supply)	Off (Supply)	Protective Earth (Ground)	Protective Conductor Terminal
IEC 60417, No. 5007	IEC 60417, No. 5008	IEC 60417, No. 5017	IEC 60417, No. 5019
	$\bigtriangledown$	$\rightarrow$	
Caution, hot surface	Equipotentiality	Frame or Chassis Terminal	Double or Reinforced Insulation
ISO 3684, No. 6043	IEC 60417, No. 5021	IEC 6041, No. 5020	IEC 6041, No. 5172
	$\sim$	$\sim$	з 🔨
Direct Current IEC 60417, No. 5031	Alternating Current IEC 60417, No. 5032	Both Direct and Alternating Current IEC 60417, No. 5033	Three-phase Alternating Current
	Caution, refer to		
Caution, risk of electric shock ISO 3864, No.B.3.6	accompanying documents ISO 3864, No.B.3.1	Out position of a bi- stable push control IEC 60417, No 5269	In position of a bi- stable push control IEC 60417, No 5268

Table 1 - Definition of Symbols Found on the Analyzer

## 2 SYSTEM OVERVIEW

This chapter introduces the Servomex SpectraScan Gas Analyzer and explains its basic principle of operation.

## 2.0 Introduction to the Analyzer

The Servomex SpectraScan Gas Analyzer is a non-contact, light absorption based gas analyzer capable of ppm to percent level concentration monitoring of multiple gas compounds. The system consists of a light spectrometer, a flow-through sample cell, a single-element photo-detector and the supporting electronics. The spectrometer uses a unique tunable Fabry-Perot assembly that provides wavelength scanning with high optical throughput. An advanced spectral processing algorithm computed in the embedded electronics provides highly accurate and robust quantitative measurements.

The analyzer is configured and calibrated for a specific wavelength analysis region(s) depending on the application for which it is intended. It is designed to be a dedicated on-line monitoring system that is "plug and play," not requiring any on-site configuration or calibration. The specific system configuration and calibration is denoted by the application code "-xyz" that can be found in the Calibration Verification Sheet delivered with the analyzer.

Example applications of the Servomex SpectraScan Gas Analyzer include:

Hydrocarbon gas composition monitoring Petrochemical process monitoring Specialty and chemical gas process and blending monitoring Catalysis and combustion process monitoring

## 2.1 Measurement Principle

When a gas sample is introduced in the gas cell, the light radiation provided by a broadband light source is partially absorbed by the gas species present. The light absorption occurs at specific frequencies and magnitudes depending on the gas compound and the concentration of that compound. The Servomex SpectraScan spectrometer module scans the wavelength and measures the true absorption spectra and compares them with the pre-loaded calibration spectra. The on-board analysis algorithm computes the gas concentrations in real-time, which can then be output through the MODBUS TCP/IP protocol.

In principal, the absorption spectrum of each compound is unique which acts as a "fingerprint" for identification or speciation analysis. In addition, the magnitude of the absorption is a function of the number of molecules of the gas. With a known path length, pressure and temperature, the magnitudes of the absorption spectra are then used to compute volumetric concentrations. This *first principle* based technique provides accurate and robust measurements with minimal span and baseline drifts.

The analyzer employs an internal pressure transducer to measure the sample pressure in real-time enabling pressure variation corrections. The flow cell is heated to a constant temperature (default value is 60°C) with a sample preheat module to maintain both sample and optical sensor temperature at a constant calibrated temperature, thereby ensuring measurement accuracy and stability despite sample and environmental variations.

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## **3 SYSTEM SAFETY**

A primary concern of Servomex is to ensure a safe working environment for all users of our system. The Servomex SpectraScan Gas Analyzer meets the following classifications;

#### Hazardous Location Classification:

Classification and Rating
Class 1, Division 2, Groups A,B,C and D, T4
Class 1, Zone 2, AEx nA nC nL IIC T4 Gc
Class 1, Zone 2, Ex nA nC nL IIC T4 Gc
II 3G Ex ic nA nC IIC T4 Gc
IP66
ITS12ATEX
Ambient Temperature Rating: -20 < Tamb < 50°C (-4 to 122°F)

#### **Table 2 - Hazardous Location Ratings**

It is essential that all users become aware of the hazards associated with the start-up, operation and maintenance of this analyzer. Servomex SpectraScan users must observe all prescribed safety guidelines and adopt good general work practices to adequately protect themselves, fellow workers and the unit. Only trained and experienced users should start, operate and/or maintain the Servomex SpectraScan Gas Analyzer.



The following general safety precautions must be observed during all phases of installation and operation of this analyzer. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of intended use of the unit and may impair the protection provided by the analyzer, exposing the user to the risk of injury or death and possibly causing damage to the analyzer. Servomex assumes no liability for the customer's failure to comply with these requirements.

# 3.0 General Precautions

#### DO NOT SUBSTITUTE PARTS OR MODIFY THIS ANALYZER

Do not install substitute parts or perform any unauthorized modification to the analyzer. Return the analyzer to Servomex for service and repair to ensure that all safety features are maintained.

#### SERVICE BY QUALIFIED PERSONNEL ONLY

There are no user serviceable components in the analyzer. Component replacement and internal adjustments must be made by qualified Servomex representatives only.



#### **GROUNDING THE PRODUCT**

This product is grounded through the grounding conductor of the power cabling to the ground lug inside the enclosure. This grounding is essential for safe operation. Upon loss of the protective ground connection, all accessible conductive parts (including knobs and controls that may appear to be insulated) can render an electrical shock. Dangerous voltages are contained within this analyzer. All electrical fittings and cables must be of the type specified, and be in good condition, and all electrical fittings must be properly connected and grounded. All cables entering the analyzer (24 VDC or 120/240 VAC power and communication) must be separately jacketed as they enter the analyzer to prevent mis-wiring.





symbol for ground

## USING THE PROPER POWER CABLING

This product is designed to be hardwired and has a 24 VDC model and a 120/240 VAC model. Use only power cabling that is in good condition and which meets the input power requirements specified in this manual. The power cabling used, whether for 24 VDC operation or for 120-240 VAC operation, must use a 3 conductor cable that is jacketed separately from the communications cable. The ground wire in this 3 conductor cable must be electrically connected to the earth ground lug in the analyzer. See Section 5.0.4 *Power Requirements* on page 26 and Table 13 - Electrical Specifications on page 72 for more information. Also see Table 4 - Wire Types on page 35.



## USING THE PROPER POWER SOURCE

This product is configured at the factory to operate from a 24 VDC or 120-240 VAC power source, depending on the model. See labelling on the analyzer to determine which power source to use. Ensure that the power supplied to the analyzer is appropriate for the configuration of analyzer being installed. See Section 5.0.4 *Power Requirements* on page 26 for more information.



#### **USE THE PROPER FUSE**

Use only a fuse of the correct type, voltage rating, and current rating, as specified for your product. See Table 13 - Electrical Specifications on page 72 and Figure 6 - SpectraScan Interior Diagram on page 33 for more information.

#### DO NOT OPERATE IN EXPLOSIVE ATMOSPHERES

To avoid explosion, do not operate this product in an explosive environment unless it has been specifically certified for such operation. If it has been certified for such operation, carefully follow the guidelines set forth in the Material Safety Data Sheets for the explosive chemical, as well as the product labelling on the Servomex SpectraScan Gas Analyzer.



#### HIGH VOLTAGE DANGER

Assume high voltage is present in the cable and in the analyzer whenever a power cord is connected.



#### USE PROPER FITTINGS AND TIGHTENING PROCEDURES

All connection fittings must be consistent with Servomex SpectraScan Gas Analyzer specifications, and compatible with the intended use of the unit. Assemble and tighten fittings according to manufacturer's directions. See Section 5.0.5 Fittings Requirements on page 26 for more information.

#### CHECK FOR LEAK-TIGHT FITTINGS

Carefully check all connections to ensure leak-tight installation.

#### **OPERATE AT SAFE INLET PRESSURES**

Never operate at pressures higher than the rated maximum and minimum pressure. See Section 3.4.3 Over Pressurizing on page 18 and Table 11 - Sampling System Specifications on page 71 for more information.

#### **KEEP THE UNIT FREE OF CONTAMINANTS**

Do not allow contaminants to enter the unit before or during use. Contamination such as dust, dirt, lint, glass chips, or metal chips may permanently damage the unit.

#### ALLOW PROPER WARM-UP TIME

The unit's gas cell is temperature-controlled and will only meet measurement accuracy specifications when sufficient time is allowed for the unit to meet and stabilize to the designed operating temperature. Warm-up time for the unit is approximately 30 minutes to 2 hours depending on the ambient temperature. The analyzer temperature shall be stable (default value is 60°C) prior to performing any measurement. The red "Warm-up" LED on the display extinguishes and the green "Run" LED lights when the unit has reached operating temperature.

#### MAINTAIN INGRESS PROTECTION

The Servomex SpectraScan unit has been tested to an Ingress Protection level of IP66, Type 4. In order to maintain this rating, a suitable 1" conduit connector must be used that will not compromise the existing IP Rating.

## 3.1 WARNINGS AND CAUTIONS

This apparatus is suitable for use in Hazardous Locations as defined in *Table* 2 - Hazardous Location Ratings on page 12, or unclassified locations.



LOSS OF SYSTEM INTEGRITY: Exposure to some chemicals may degrade the sealing properties.

WARNING







#### WARNING

**EXPLOSION HAZARD:** The ac and dc source must be located in an unclassified area.

## WARNING



**SYSTEM SAFETY:** This analyzer is typed as permanently connected equipment and as such, must include a switch or circuit–breaker in the installation. This switch must be supplied and installed by the customer (not provided by Servomex. It must be suitably located and easily reached, and must be marked as the disconnecting device for the equipment.



## WARNING

**EXPLOSION HAZARD:** Do not disconnect while the circuit is live unless the area is known to be free of ignitable concentrations of flammable gases or vapours.



## WARNING

**EXPLOSION HAZARD:** Substitution of components may impair suitability for class 1, division 2 and class 1, zone 2 installations.



## WARNING

**EXPLOSION HAZARD:** Do not use screws that exceed the maximum screw penetration depth in any threaded holes.

# 3.2 Suitability of Application

It is the customer's responsibility to determine the suitability of the Servomex SpectraScan Gas Analyzer for a given purpose. Servomex makes no representation that potential hazards presented here or elsewhere are the only hazards associated with this product and its start-up, operation or maintenance.

## 3.3 **Operator Training**

All users should be fully trained in all applicable safety and emergency procedures. At a minimum:

- Safe work practices and procedures
- Electrical safety
- Chemical safety and procedures for handling hazardous materials
- Proper use of personal protective equipment (PPE)

## 3.4 Analyzer Hazards

The Servomex SpectraScan is designed to be safe. The following hazards are unavoidably present when operating or servicing the Servomex SpectraScan Gas Analyzer. All personnel connected to the operation, installation or maintenance of the Servomex SpectraScan Gas Analyzer must be familiar with the hazards intrinsic to the analyzer's environment:

- Gases
- Heated Equipment
- Over Pressurizing
- Electrical Safety
- Electrostatic Discharge
- Ergonomic Considerations

## 3.4.1 Gases



Imminent Danger of Personal Injury or Death: The Servomex SpectraScan Gas Analyzer is designed and can be configured to analyze some flammable or explosive gas mixtures. Do not use this unit with flammable or explosive gases unless it has been specifically certified for that application.

WARNING

NOTE
Consult the gas manufacturer's Material Safety Data Sheets (MSDS) for further details on the storage, use, and safe handling procedures applicable for these gases.

## 3.4.2 Heated Equipment

The gas cell in the Servomex SpectraScan Gas Analyzer will be heated to a temperature that is higher than the gas being sampled to avoid condensation on the optical windows in the gas cell.



## WARNING

**Burn Hazard:** The gas cell, though insulated, may be extremely hot. Use caution when handling the gas cell, sample lines or other heated equipment.

## 3.4.3 **Over Pressurizing**

## CAUTION

**Equipment Damage:** Restricting the gas flow on either the intake or the exhaust side may cause the gas cell to over pressurize, causing damage to the analyzer. Care should be taken to remove any port caps or other flow barriers before connecting any sample line or switching on the analyzer. Also make sure the exhaust routing is appropriate for your specific application.

When the gas is to be sampled from a pressurized source, such as a pressurized line, a pressure relief mechanism should be employed so as not to force or restrict the flow of gas into the unit.

## CAUTION

**Equipment Damage:** Pressure relief mechanism should be employed when sampling gas from a source other than the ambient in order to avoid damage to the analyzer.

#### 3.4.4 Electrical Safety

The Servomex SpectraScan Gas Analyzer is powered by voltages that could pose a hazard to the user. Before any maintenance work is performed, disconnect power from the analyzer and turn off the gas supply. Follow standard electrical safe work practices to prevent injuries.



WARNING

**Electrical Hazard, Personal Injury and Equipment Damage:** Do NOT perform maintenance on an energized or gas supplied analyzer. When performing maintenance on the unit, it is necessary to disconnect the power source from the unit, and turn off the gas supply lines (sample gas and zero gas).



WARNING

**SYSTEM SAFETY:** This analyzer is typed as permanently connected equipment and as such, must include a switch or circuit–breaker in the installation. This switch must be supplied and installed by the customer (not provided by Servomex) must be suitably located and easily reached, and must be marked as the disconnecting device for the equipment.

## 3.4.5 Electrostatic Discharge



**Electrical Hazard, Personal Injury and Equipment Damage:** The control of ESD is critical when performing maintenance on the Servomex SpectraScan Gas Analyzer. To control ESD, users should wear ESD wrist straps and other grounding equipment between the analyzer and the skin. The wrist straps should be tested for ground continuity often. Also, ground the analyzer (through the frame chassis or the control rack) to protect against:

WARNING

- Damage to sensitive electronic components, such as circuit boards
- Electrostatic discharge
- User injuries from electrical shock when contact is made with the energized equipment.

#### 3.4.6 Ergonomic Considerations

Ergonomic hazards are conditions that could result in harm to the operator or technician due to the physical circumstances of operating or servicing the analyzer. Ergonomic hazards of the Servomex SpectraScan Gas Analyzer include:

- Lifting the analyzer
- Stretching or maintaining an awkward position



## WARNING

**Personal Injury:** The Servomex SpectraScan Gas Analyzer weighs approximately 30 lbs (14Kg), presenting the possibility of personal injury if care is not taken when lifting and moving this unit.

# **4 UNPACKING THE ANALYZER**

## 4.0 **Component List**

A standard Servomex SpectraScan Gas Analyzer is delivered with the following components:

- Servomex SpectraScan Gas Analyzer unit
- Installation Manual
- Calibration Verification Sheet

# 4.1 Removing the Analyzer from the Shipping Container



## WARNING

**Personal Injury:** The Servomex SpectraScan Gas Analyzer weighs approximately 30 lbs (14Kg), presenting the possibility of personal injury if care is not taken when lifting and moving this unit.

## NOTE



Do NOT discard any packaging material. All of the original packaging material is required to return the unit to Servomex. The use of unsuitable packaging material during shipping will void the analyzer's warranty.

## To remove the system from the shipping box, perform the following steps:

- 1. Open the top flaps on the cardboard shipping box and fold them out of the way.
- 2. Lift the unit together with the inner packaging materials, keeping the shock absorbing foam pieces around the unit.
- 3. Set the unit (with the inner packaging still around it) on a flat workbench or table.
- 4. Carefully remove the foam packaging, the plastic bag and the desiccant (if applicable) from the unit.
- 5. Return all of the packaging material to the box and store in a safe place for future use.

# 4.2 Inspection

Servomex has carefully packed the Servomex SpectraScan Gas Analyzer with the intent of reaching its destination in perfect operating condition. Upon unpacking the unit, check for defects, cracks, broken connectors, etc, to be certain that damage has not occurred during shipment.

If you find any damage, notify your freight carrier and Servomex immediately.

# **5 MOUNTING CONSIDERATIONS**

# 5.0 Environmental Requirements

The following considerations are described in this section:

- Dimensions, Weight and Ventilation
- Operating Temperature, Humidity and Pressure
- Combustion Hazard
- Power Requirements
- Fittings Requirements



Figure 1 - The Servomex SpectraScan Gas Analyzer

#### 5.0.1 Dimensions, Weight and Ventilation

The Servomex SpectraScan Gas Analyzer weighs approximately 30 lbs (14kg) and is designed to be wall mounted. It requires a space 17  $\frac{1}{4}$ " wide, 12" high (top to bottom) with an additional 6" of clearance around the bottom for piping and electrical connections, and 7" wide (front to back) with an additional 10  $\frac{1}{2}$ " clearance out the front to allow opening of the cover (when installing electrical connections, or to make internal repairs or component replacements).



Dimensions of the mounting holes along the top and bottom edges of the analyzer are given in Figure 2 below. The Servomex SpectraScan Gas Analyzer must be mounted with eight 3/8"-16 x 1" UNC bolts and matching lock washers and nuts.



Figure 2 - Hole Dimensions of the Servomex SpectraScan Gas Analyzer

See Figure 3 - I/O panel of the Servomex SpectraScan Gas Analyzer on page 24 for a view of the bottom of the analyzer, showing electrical and pipe connections.

	NOTE
(lug	The sample, power and signal connections require at least 6" of clearance for safe operation.



## WARNING

**Personal Injury:** The Servomex SpectraScan Gas Analyzer weighs approximately 30 lbs (14Kg), presenting the possibility of personal injury if care is not taken when lifting and moving this unit.

The Servomex SpectraScan Gas Analyzer should be mounted in a well-ventilated area.



WARNING

**Personal Injury:** Operate the Servomex SpectraScan Gas Analyzer in a wellventilated area to prevent the build-up of potentially harmful gases. Do NOT vent sample cell exhaust into an area where it may be inhaled.

## 5.0.2 **Operating Temperature, Humidity and Pressure**

The Servomex SpectraScan Gas Analyzer can operate in a wide range of ambient temperature and humidity, as shown in Table 14 - Environmental Specifications on page 72. The analyzer should be operated in a non-condensing environment to avoid condensation on the optical windows in the gas cell.

In addition to the ambient considerations, the Servomex SpectraScan Gas Analyzer has specific requirements for the sample gas and zero gas being piped into it. Both sample gas and zero gas have the same acceptable flow rate, pressure, humidity and temperature ranges. See Table 11 - Sampling System Specifications on page 71. Refer to the Applications Manual for more sample pressure recommendations.

There are overpressure considerations for the sample and zero gases entering the analyzer to avoid injury and damage to the unit. See Section 7.0.3 *Sampling Gas from a Pressurized Source* on page 51.

The sample and zero gas must be clean and free of particulates. A 10 micron particulate filter on the supply side is recommended.

## 5.0.3 Combustion Hazard

The Servomex SpectraScan Gas Analyzer is rated for certain combustible environments. Ensure that the installation location of the analyzer aligns with the certifications listed on the product's labelling.

## 5.0.4 **Power Requirements**

The system is designed for 24 VDC operation. An optional AC Power Module can be installed at the factory for use with 100-240 VAC. The main power board is fused for use with a 24 VDC supply. Refer to Table 13 - Electrical Specifications on page 72 for more detailed information.

## 5.0.5 Fittings Requirements

The Servomex SpectraScan Gas Analyzer comes standard with ¼" male Swagelok<sup>®</sup> tube fittings on the sample inlet and exhaust ports. Only ¼" female Swagelok<sup>®</sup> tube fittings should be used on the incoming and outgoing sample lines, to mate with the Servomex SpectraScan sample inlet and exhaust ports. Use of stainless steel tubing for the incoming and outgoing sample lines is recommended. Instructions for installing the female Swagelok tube fittings onto the incoming and outgoing sample lines are provided in Section 7 SAMPLE GAS CONNECTIONS on page 49.

Other fitting sizes and styles are available from Servomex to be installed on the inlet and exhaust ports as a special order. The underlying connector is a <sup>1</sup>/<sub>4</sub>" NPT.

#### CAUTION

Equipment Damage: Provide adequate support for the tubing. The weight of the tubing must not exert torque on the gas cell as it may cause the fittings to fail and leak.

All of the fittings requirements for the Servomex SpectraScan Gas Analyzer are summarized below.

Connector on the Analyzer	Required Fittings to Mate with Analyzer	Additional Comments
Sample Inlet And Exhaust Ports: ¼" male Swagelok <sup>®</sup>	$^{1}\!$	10 micron particulate filter on the inlet side is recommended.
Electrical Conduit: 1" female	1" male conduit	Must maintain Ingress Protection level of IP66, Type 4.
Purge Ports (use is optional): 1⁄4" female NPTF	<sup>1</sup> ⁄4" male NPTF	Either side can be used as inlet.

#### Table 3 - Standard Fittings Used on the Servomex SpectraScan Gas Analyzer

## 5.1 Mounting Procedure

1. After choosing the appropriate space and structure for the Servomex SpectraScan Gas Analyzer by satisfying all of the *Environmental Requirements* on page 23, prepare the unit for mounting by clearing the mounting space, readying the analyzer (consider its weight and if you will need an assistant to support it while mounting), and having the mounting hardware and appropriate tools nearby.



## WARNING

**Personal Injury:** The Servomex SpectraScan Gas Analyzer weighs approximately 30 lbs (14Kgs), presenting the possibility of personal injury if care is not taken when lifting and moving this unit.

-	NOTE
	The Servomex SpectraScan Gas Analyzer must be mounted with eight 3/8"- 16 x 1" UNC bolts and matching lock washers and nuts.

- 2. Consider the order of installation: mount the analyzer onto the mounting surface first; then make electrical connections inside the box with the cover open.
- 3. Place the Servomex SpectraScan Gas Analyzer on the mounting structure and align the eight mounting holes with holes in the structure. Support the analyzer if necessary.
- 4. Install eight 3/8"-16 x 1" UNC bolts through the mounting holes and through lock washers, and secure with eight nuts. Tighten securely.

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# **6 ELECTRICAL CONNECTIONS**

All of the required electrical connections are described in this section:

**Electrical Power Source** 

Communication over Ethernet TCP/IP

NOTE
The Servomex SpectraScan Gas Analyzer must be mounted with eight 3/8"- 16 x 1" UNC bolts and matching lock washers and nuts.



WARNING

Personal Injury or Death: Wiring of the analyzer must be in accordance with local regulations.

Emissions Class A: Equipment used in establishments other than domestic, and those directly connected to a low voltage supply which supplies buildings for domestic purposes.

USA: This analyser complies with Part 15 of the FCC Rules for Class A equipment. It is not suitable for operation when connected to a public utility power supply that also supplies residential environments.

## 6.0 I/O Panel Layout



Figure 3 - I/O panel of the Servomex SpectraScan Gas Analyzer

_	NOTE
	The sample, power and signal connections require at least 6" of clearance for safe operation.

The **Red** Circle in the figure above identifies the conduit fitting through which the power, communication and external stream switching solenoid valve cables are to be connected.

The **Green** Circle in the figure above identifies where the sample inlet and exhaust lines are to be connected.

The **Blue** Circles in the figure above identifies where the optional purge lines can be installed.



Figure 4 - Analyzer with Cover Open

## 6.0.1 Component Layout



Figure 5 - Interior of the Servomex SpectraScan Gas Analyzer

~	NOTE
	See Figure 6 for detail of SpectraScan internal components



Figure 6 - SpectraScan Interior Diagram

## 6.1 Electrical Power Requirements

The Servomex SpectraScan Gas Analyzer operates at 24 VDC or 100-240 VAC depending on the model configuration. Be sure to adhere to the Power Rating Label on the analyzer to determine which power source to use, and connect the correct power source.

SERIAL #: 123456   24 VDC	123456 14, IP66 14, IP66 5 A, B, C and D T4, Type 4 - EXPLOSION HAZARD
SERVIAL #: 123420   24 VDC :, 5A Maximum Pressure 50 psia   Class I, Zone 2 Ex n IIC 14, IP66 Class I, Zone 2 AEx n IIC 14, IP66   Class I, Zone 2 AEx n IIC 14, IP66 Class I, Zone 2 AEx n IIC 14, IP66   Class I, Zone 2 AEx n IIC 74, IP66 Class I, Zone 2 AEx n IIC 74, IP66   Class I, Zone 2 AEx n IIC 74, IP66 Class I, Zone 2 AEx n IIC 74, IP66   Class I, Zone 2 AEx n IIC 74, IP66 Class I, Zone 2 AEx n IIC 74, IP66   Class I, Zone 2 AEx n IIC 74, IP66 Class I, Zone 2 AEx n IIC 74, IP66   Class I, Zone 2 AEx n IIC 74, IP66 Class I, Zone 2 AEx n IIC 74, IP66   Class I, Zone 2 AEx n IIC 74, IP66 Class I, Zone 2 AEx n IIC 74, IP66   Class I, Zone 2 AEx n IIC 74, IP66 Class I, Zone 2 AEx n IIC 74, IP66   Class I, Zone 2 AEx n IIC 74, IP66 Class I, Zone 2 AEx n IIC 74, IP66   DO NOT DISCONNECT WHILE CIRCUIT IS LIVE UNLESS AREA IS KNOWN TO BE NON-HAZARDOUS.   DISCONNECT BEFORE SERVICING Caution: To be installed by gualified personnel only.   Class I, To be Installed by Qualified personnel only. Class December 2000000000000000000000000000000000000	123430 4, IP66 74, IP66 5 A, B, C and D 74, Type 4 - EXPLOSION HAZARD
24 VDC, 5A Maximum Pressure 50 psia Class I, Zone 2 Ex n IIC 14, IP66 Class I, Zone 2 AEx n IIC 14, IP66 Class I Division 2, Groups A, B, C and D 14, Type 4 Tamb: -20C to +50C <u>WARNING - EXPLOSION HAZARDO</u> DO NOT DISCONNECT WHILE CIRCUIT IS LIVE UNLESS AREA IS KNOWN TO BE NON-HAZARDOUS. DISCONNECT BEFORE SERVICING Caution: To be installed by qualified personnel only.	ia 4, IP66 T4, IP66 s A, B, C and D T4, Type 4 <u>- EXPLOSION HAZARD</u>
Maximum Pressure 30 paia Class I, Zone 2 Ex n IIC 74, IP66 Class I, Zone 2 AEx n IIC 74, IP66 Class I Division 2, Groups A, B, C and D T4, Type 4 Tamb: -20C to +50C <u>WARNING - EXPLOSION HAZARD</u> DO NOT DISCONNECT WHILE CIRCUIT IS LIVE UNLESS AREA IS KNOWN TO BE NON-HAZARDOUS. DISCONNECT BEFORE SERVICING Caution: To be installed by qualified personnel only.	ia 4, 1P66 74, 1P66 s A, B, C and D 14, Type 4 <u>- EXPLOSION HAZARD</u>
Class I, Zone Z AE n IIC 14, IP66 Class I, Zone Z AE n IIC 14, IP66 Class I Division 2, Groups A, B, C and D T4, Type 4 Tamb: -20C to +50C WARNING - EXPLOSION HAZARD DO NOT DISCONNECT WHILE CIRCUIT IS LIVE UNLESS AREA IS KNOWN TO BE NON-HAZARDOUS. DISCONNECT BEFORE SERVICING Caution: To be installed by qualified personnel only.	- EXPLOSION HAZARD
Class I Division 2, Groups A, B, C and D T4, Type 4 Tamb: -20C to +50C WARNING - EXPLOSION HAZARD DO NOT DISCONNECT WHILE CIRCUIT IS LIVE UNLESS AREA IS KNOWN TO BE NON-HAZARDOUS. DISCONNECT BEFORE SERVICING Caution: To be installed by qualified personnel only.	s A, B, C and D T4, Type 4
Tamb: -20C to +50C WARNING - EXPLOSION HAZARD DO NOT DISCONNECT WHILE CIRCUIT IS LIVE UNLESS AREA IS KNOWN TO BE NON-HAZARDOUS. DISCONNECT BEFORE SERVICING Caution: To be installed by qualified personnel only.	- EXPLOSION HAZARD
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Figure 7 - Example Rating Label



**SYSTEM SAFETY:** This analyzer is typed as permanently connected equipment and as such, must include a switch or circuit–breaker in the installation. This switch must be supplied and installed by the customer (not provided by Servomex) must be suitably located and easily reached, and must be marked as the disconnecting device for the equipment.

## WARNING



Electrical Shock and Equipment Damage: The main circuit board in the analyzer must have the proper fuse installed prior to connecting power. Installing the wrong fuse in main circuit board may result in electric shock or death and may result in damage to the analyzer. To avoid injury and equipment damage, ensure the proper fuse is used. See Table 13 - Electrical Specifications on page 72. Servomex provides the proper fuse and two spares with every analyzer.

See Figure 6 - SpectraScan Interior Diagram on page 33.
# 6.2 Wiring

All cables entering the analyzer (24 VDC or 120/240 VAC power and communication) must be separately jacketed as they enter the analyzer to prevent miss-wiring. The power cabling used, whether for 24 VDC operation, or for 120-240 VAC operation, must use a 3 conductor cable. The ground wire in this 3 conductor cable must be electrically connected to the earth ground lug in the analyzer.

Connection	Wire type
Power (AC)	600V, 3 wire, 16AWG, Jacketed Insulation must be rated to at least 75°C
Power (DC)	600V, 3 wire, 16AWG, Jacketed
Ethernet (TCP/IP)	CAT 5 Standard 300V
Solenoids (DC)	600V, 3 wire, 18AWG
RS485 Data	Data Cable 24 AWG, 300V
Optional Heater	600V, 3 wire, 18AWG

Table 4 - Wire Types

### 6.2.1 Power Wiring: 24 VDC



Figure 8 - Wiring the SpectraScan with 24 VDC

To connect 24 VDC supply power to the analyzer, perform the following steps: (Refer to Figure 8)

- 1. Open the cover of the SpectraScan using a large, flat-headed screwdriver turn the latch ¼ turn counter-clockwise, and open the cover.
- 2. Bring a 3 conductor, separately jacketed cable with 24V supply into the enclosure through the conduit fitting. Make sure that the power is not on (wires are not live) at this point.



WARNING

Maintain Ingress Protection: The Servomex SpectraScan unit has been tested to an Ingress Protection level of IP66, Type 4. In order to maintain this rating, a suitable 1" conduit connector must be used that will not compromise the existing IP Rating.

- 3. Strip the cable jacketing back and secure the jacketed portion of the cable to the anchor point provided inside the enclosure using a cable tie. Be sure to leave enough slack in the cable so the red and black wires reach the power terminal block on the main board and the green wire reaches the ground lug on the enclosure wall.
- 4. Strip 10mm (0.4") of insulation from the positive (red) and negative (black) leads of the cable, and also from the ground (green) wire.
- 5. Connect the positive (red) cable to the positive side of the terminal block on the main PCB and the negative (black) cable to the negative side of the input power terminal block.
- 6. Connect Earth Ground:
  - a. Connect the green wire to the earth ground lug on the enclosure wall.
  - b. Check the two factory installed ground wires, at both ends, for loose connections; resolve any that are found. Ensure that both are secured to the enclosure anchor point with a cable tie. The factory installed ground wires are:
    - i. PCB to earth ground
    - ii. Enclosure lid to earth ground
- 7. Close and latch the cover.

### 6.2.2 Power Wiring: 120-240 VAC



Figure 9 - Wiring the SpectraScan with 120-240Vac

### To connect 100-240 Vac power to the analyzer, perform the following steps:

(Refer to Figure 9)

- 1. Open the cover of the SpectraScan using a large, flat-headed screwdriver turn the latch ¼ turn counter-clockwise, and open the cover.
- 2. Bring a 3 conductor, separately jacketed cable with AC supply into the enclosure through the conduit fitting. Make sure the wires are not live at this point.



Maintain Ingress Protection: The Servomex SpectraScan unit has been tested to an Ingress Protection level of IP66, Type 4. In order to maintain this rating, a suitable 1" conduit connector must be used that will not compromise the existing IP Rating.

WARNING

- 3. Strip the cable jacketing back and secure the jacketed portion of the cable to the anchor point provided inside the enclosure using a cable tie. Be sure to leave enough slack in the cable so the ends reach the input terminals on the AC Power Module.
- 4. Strip 10mm (0.4") of insulation from the line (black), neutral (white) and ground (green) leads of the cable.
- 5. Connect Earth Ground:
  - a. The terminal tabs on the AC Power Module have three positions:
    - Down: terminal locked closed
    - Middle: terminal closed with spring tension
    - Up (or to the left): terminal locked open
  - b. Connect the ground (green) wire to the Earth Ground terminal on the AC Power Module. Do not disturb the factory installed power-supply-to-earth-ground wire that is also inserted into the Earth Ground terminal on the AC Power Module.
  - c. Check all three factory installed ground wires, at both ends, for loose connections; resolve any that are found. Ensure two of the wires are secured to the enclosure anchor point with a cable tie. The three factory installed ground wires are:
    - i. Power supply to earth ground
    - ii. PCB to earth ground (secured at anchor point)
    - iii. Enclosure lid to earth ground (secured at anchor point)
- 6. Connect the neutral (white) wire to the Neutral terminal on the AC Power Module.
- 7. Connect the line (black) wire to the Line terminal on the AC Power Module.
- 8. Close and latch the cover.



# 6.3 Communication Connection

Figure 10 - Connecting the Ethernet TCP/IP communication cable

*To connect the communication cable to the analyzer, perform the following steps:* (Refer to Figure 10)



WARNING

**Electrical Hazard, Personal Injury and Equipment Damage:** Do NOT perform any internal service on an energized or gas supplied analyzer. When performing maintenance on the unit, it is necessary to disconnect the power source from the unit, and turn off the gas supply lines (sample gas and zero gas).

- 1. Turn off the main power, disconnect and turn off all gas supply lines that are connected.
- 2. Open the cover of the SpectraScan using a large, flat-headed screwdriver turn the latch ¼ turn counter-clockwise, and open the cover.
- 3. Bring the communication cable into the enclosure through the conduit fitting.



**Maintain Ingress Protection:** The Servomex SpectraScan unit has been tested to an Ingress Protection level of IP66, Type 4. In order to maintain this rating, a suitable 1" conduit connector must be used that will not compromise

the existing IP Rating.

WARNING

- 4. Plug the communication cable into the network jack on the front edge of the PCB, as shown.
- 5. Secure the cable to the anchor points provided inside the enclosure using cable ties.
- 6. Close and latch the cover.
- 7. Restore power and gas supply, as applicable.

# 6.4 Spectrascan Networking and Software Configuration

#### 6.4.1 Ethernet and TCP/IP

#### Getting an IP address using DHCP

As delivered, the instruments are configured as DHCP clients. This means each instrument's IP addresses given to it by an external DHCP server, typically a router running on your network. The IP address is assigned dynamically when the instrument is powered up. To enable networking and get a dynamic IP address, do the following:

- 1. Attach the instrument to your network via Ethernet cable to the connector labelled "ETHERNET" on the instrument's system board.
- 2. Make sure your network has a DHCP server running.
- 3. When the instrument is powered up, it will issue a request for an IP address via DHCP. The DHCP server will answer the request and provide an IP address to the instrument. The instrument will remember that IP address for as long as it remains powered up.

Note that the IP address assigned via DHCP will be lost if the instrument is powered down. The next time you power up the instrument it may get the same IP address, or it may get a different one depending upon the exact details of your network's configuration.

#### 6.4.2 Finding the IP address of your instrument

Each instrument is programmed with a hostname. The hostname is of the form "oxsXXXXX", where XXXXXX is the six-digit serial number assigned to the instrument. The serial number is printed on a label attached to the bottom mount-plate in the vicinity of the stepper motor (Figure 11 - Location of the serial number tag). The serial number is identified by the prefix S/N.



Figure 11 - Location of the serial number tag



NOTE

The location of serial number tag is circled in red. If you look carefully, you can see this instrument's serial number is 100072. Therefore, this instrument's hostname is "oxs100072".

Once you know the hostname of your instrument, you may find its IP address in the following way:

- 1. On a Windows PC attached to the same sub-network as the instrument, open an MS DOS command prompt.
- 2 In the command prompt, type "nslookup <hostname>", where <hostname> is the instrument's hostname as described above.
- 3. Nslookup will return all information about the instrument pertinent to networking, including the IP address it has been assigned.

#### 6.4.3 Setting a static IP address

Some customers prefer to assign a static IP address to their instruments. Assigning a static IP address requires that you have physical access to the system board.

Connecting to the system board via RS-232 requires the following items:

- Windows PC
- A special serial cable from Servomex. On one end this cable is terminated by a connector mating to the RS-232 connector on the system board. On the other end, the cable is terminated by a DB-9 connector.
- If your computer does not have an RS-232 port, you will need an RS-232 to USB converter. The RS-232 side of the converter should be terminated with a DB-9 connector.
- A terminal program running on your PC, such as Hyperterm or PuTTY.

You may configure your instrument to use a static IP address in the following way:

1. Open the instrument, and locate the MPU debug connector. The connector is shown in Illustration 2. This connector provides access to the MPU via an internal RS-232 port.



Figure 12 - Location of debug RS-232 connector on MPU

- 2. Connect a Windows PC to the MPU debug connector using the SpectraScan RS-232 cable (and an RS-232 to USB converter, if required).
- 3. On your PC, determine which COM port is associated with the serial connection. Do this by opening the Windows device manager and looking at the COM port configuration.
- 4. On your PC, run your terminal program and configure it to use the COM port you found in the device manager. Also configure the terminal program with the following settings:
  - Baud rate = 115200
  - Data bits = 8
  - Stop bits = 1
  - Parity = None
  - Flow control = None. (No software nor hardware flow control.)
- 5. In the terminal program, start a terminal session to the MPU. Hit <return> a few times and you will get a command prompt from the MPU. The command prompt is "#".
- 6. At the command prompt, type the command "ip-config" followed by <return>. When the program starts it will tell you the current IP configuration of the unit. Also, if the unit is already configured for static IP address, it will give you the option to leave the program.
- 7. Next, the program will give you three options to modify the IP address settings. Choose option 2, "static IP".
- 8. The program will
- 9. When prompted, type in your desired IP address is DD.DD.DD.DD format. (Here, DD signifies the digits comprising each of the four decimal numbers making up the IP address.)
- 10. Next, you will be prompted for the desired netmask. Enter it using the DD.DD.DD.DD format.

- 11 .Next, you will be prompted for the desired gateway address. Enter it using the DD.DD.DD.DD format.
- 12. Next, you will be prompted for the desired broadcast address. Enter it using the DD.DD.DD.DD format.
- 13 .Finally, you will be asked to reboot and accept the changes, or to cancel. If you have entered all information correctly, choose reboot. The system will then store the new IP configuration data, shut down, and then restart.
- 14. The system requires roughly 1 minute to reboot. Once the system has rebooted, you will be presented with a command prompt, "#".
- 15. You may now disconnect the RS-232 cable from the MPU debug port and close the instrument.

A screenshot showing a typical session is shown in Illustration 3 below. In this session, an instrument is configured to use the static IP address 192.168.0.29 with netmask 255.255.255.0, gateway 192.168.0.1 and broadcast IP address 192.168.0.255.

🖉 COM6 - PuTTY
IP ADDRESS CONFIGURATION SCRIPT
Current IP address assignment
<pre>lo0: flags=8049<up,loopback,running,multicast> mtu 33192</up,loopback,running,multicast></pre>
Routing tables
Internet: Destination Gateway Flags default 192.168.0.1 UG 127.0.0.1 127.0.0.1 UH 192.0.0.0/8 link#2 U 192.168.0.1 link#2 UHL Select IP address assignment: - (1) for Dynamic assignment (DHCP) - (2) for Static assignment - (3) for Exit 2 Current configuration: Static IP address: Netmask:
Gateway IP address:
Broadcast IP address:
Do you want to continue (yes/no) yes Enter static IP address: 192.168.0.29 Enter netmask: 255.255.255.0 Enter gateway IP address: 192.168.0.1 Enter broadcast IP address: 192.168.0.255 REBOOT REQUIRED Hit enter to reboot or ctrl=C to abort:

# Figure 13 - Sample session in which a static IP address is set using PuTTY to communicate with the MPU.

#### 6.4.4 RS-422 connection

The RS-422 link uses a 4-wire connection, 2 wires for receive and 2 wires for transmit. The RS-422 port supports only a point-to-point link. Do not bridge the receive and transmit pairs – the instrument cannot be used in multi-drop bus configurations.

Connecting the instrument's RS-422 port to an external RS-422 device requires a 5 conductor cable. The cable should include two twisted pairs for the receive and transmit data, and a single wire for data ground. The configuration is shown in Drawing 1. Connection to the system board is made using the connector labelled "RS-485" at the corner of the board.



Figure 14 - Identification of RS-422 signals in instrument

This is shown in Illustration 4. Connect the cable to the individual push-down connectors as shown in the figure. (NOTE: Although the board label says "RS-485", this port will not function in multi-drop bus mode. It will only work as a point-to-point link with a 4-wire RS-422 device.)



Figure 15 - Location of RS-422 connector on system board

The RS-422 port parameters are as follows:

- Baud rate = 57600
- Data bits = 8
- Stop bits = 1
- Parity = None

#### 6.4.5 Modbus register

The SpectraScan communicates to the external controller via Modbus. The instrument acts as a Modbus server, the external controller is the client. Modbus runs either over RS-422 or Ethernet interfaces. The instrument is configured in the following way:

- Modbus protocol: RTU
- Modbus device address = 1

The Modbus register map used by the SpectraScan is shown below.

MODBUS REGISTER MAP			
Register Address	Units	Description	Data Type
		Coils (Read/Write)	
1	0/1	Perform re-zero: "coil" on (bit set) = RE-ZERO (plus purging)	1-bit register
		Discrete Inputs (Read-Only)	
10001	FAULT/NO-FAULT	Operational Status: On (bit-set) = FAULT	1-bit register
10002	ON/OFF	Gas Cell Low-temperature indicator: On (bit-set) = HIGH	1-bit register
10003	ON/OFF	Gas Cell High-temperature indicator: On (bit-set) = LOW	1-bit register
10004	ON/OFF	Gas-Cell Purge Status: On (bit-set) = PURGING	1-bit register
10005	ON/OFF	Gas-Cell Re-zeroing Status: On (bit-set) = RE-ZEROING	1-bit register
		Input Registers (Read-Only)	
30001	0 - MAX-ERROR (TBD)	Operational Condition: 0 = healthy; otherwise error condition	16-bit integer
30002	0 - 64k-1	Watchdog Counter	16-bit integer
30003-30004	major.minor	SW Version Control	32-bit floating-point (IEEE 754)
30005-3006	atm	Gas Cell Pressure (in atmospheres)	32-bit floating-point (IEEE 754)
30007-30008	°C	Gas Cell Temperature (in centigrade)	32-bit floating-point (IEEE 754)
30009-30010	0 - 110%	Light source intensity (NOTE: could exceed 100% of rated intensity)	32-bit floating-point (IEEE 754)
30011-30012	%	Channel-1 Reading	32-bit floating-point (IEEE 754)
30013-30014	%	Channel-2 Reading	32-bit floating-point (IEEE 754)
30015-30016	%	Channel-3 Reading	32-bit floating-point (IEEE 754)
30017-30018	%	Channel-4 Reading	32-bit floating-point (IEEE 754)
30019-30020	%	Channel-5 Reading	32-bit floating-point (IEEE 754)
30021-30022	%	Channel-6 Reading	32-bit floating-point (IEEE 754)
30023-30024	%	Channel-7 Reading	32-bit floating-point (IEEE 754)
30025-30026	%	Channel-8 Reading	32-bit floating-point (IEEE 754)
30027-30038	BTU/SCF	BTU (CV)	32-bit floating-point (IEEE 754)
30029-30030	TBD	Baseline noise	32-bit floating-point (IEEE 754)
		Holding Registers (Read/Write)	
40001	1 - 120 seconds	Prediction beam averaging time	16-bit integer
40002	1 - 120 seconds	Zeroing beam averaging time	16-bit integer
40003	1 - 120 seconds	Purge averaging time	16-bit integer
40004	1-100	Moving Average Window Size	16-bit integer
40005-40006	>0	Channel-1 Span Correction	32-bit floating-point (IEEE 754)
40007-40008	> 0	Channel-2 Span Correction	32-bit floating-point (IEEE 754)
40009-40010	>0	Channel-3 Span Correction	32-bit floating-point (IEEE 754)
40011-40012	> 0	Channel-4 Span Correction	32-bit floating-point (IEEE 754)
40013-40014	>0	Channel-5 Span Correction	32-bit floating-point (IEEE 754)
40015-40016	> 0	Channel-6 Span Correction	32-bit floating-point (IEEE 754)
40017-40018	> 0	Channel-7 Span Correction	32-bit floating-point (IEEE 754)
40019-40020	>0	Channel-8 Span Correction	32-bit floating-point (IEEE 754)
40021-40022	>0	Channel-9 Span Correction	32-bit floating-point (IEEE 754)

Table 5 - SpectraScan Modbus register

# 7 SAMPLE GAS CONNECTIONS



Figure 16 – Typical Gas Connection Configuration

NOTE
The specific configuration of sample, purge and zero gases may vary depending on application.

# 7.0 Sample Line Connections

#### 7.0.1 Sampling Ports

Both sample intake and exhaust ports are fitted with male ¼" Swagelok® compression tube fittings. Only properly mated, female ¼" Swagelok® compression fittings should be used on the sample intake and exhaust lines.

#### CAUTION

**Equipment Damage:** Restricting the gas flow on either the intake or the exhaust side may cause the gas cell to over pressurize, causing damage to the analyzer. Care should be taken to remove any port caps or other flow barriers before connecting any sample line or switching on the analyzer. Also make sure the exhaust routing is appropriate for your specific application.

#### CAUTION

**Equipment Damage:** Provide adequate support for the tubing. The weight of the tubing must not exert torque on the gas cell as it may cause the fittings to fail and leak.

#### 7.0.2 Preparing Sample Gas Lines

Instructions for installing female <sup>1</sup>/<sub>4</sub>" Swagelok<sup>®</sup> tube fittings on the sample incoming and exhaust lines:

- 1. Insert the tubing into the ¼" female Swagelok<sup>®</sup> tube fitting. Tubing should rest firmly on the shoulder of the fitting. The nut should be finger tight.
- 2. Hold the fitting body with a backup wrench and tighten the nut  $1\frac{1}{4}$  turns.

#### 7.0.3 Sampling Gas from a Pressurized Source

When the gas is to be sampled from a pressurized source, such as a pressurized line, a pressure relief mechanism should be employed so as not to force or restrict the flow of gas into the unit.

Refer to the Applications Manual for sample pressure recommendations. See Table 11 - Sampling System Specifications on page 71 for allowable pressure, temperature and flow rate.



### WARNING

**Personal Injury and Equipment Damage:** Sample allowable pressure must not be exceeded, or may cause the gas cell to over pressurize. Care should be taken to review Table 11 - Sampling System Specifications on page 71.

#### CAUTION

**Equipment Damage:** Restricting the gas flow on either the intake or the exhaust side may cause the gas cell to over pressurize. Care should be taken to remove any port caps or other flow barrier before switching on the analyzer. Also make sure the exhaust routing is appropriate for your specific application.

#### CAUTION

**Equipment Damage: Pressure** relief mechanism should be employed when sampling gas from a source other than the ambient in order to avoid damage to the analyzer.

#### 7.0.4 Cleanliness of Sample Stream

#### CAUTION

**Equipment Damage:** The sample stream must be clean of particles that could block the light path and potentially accumulate on the windows, and potentially damage the unit. It is ultimately the user's responsibility to ensure a clean sample stream. We recommend an inline 10 micron particulate filter for most applications. Contact Servomex for more information.

### 7.0.5 Stream Switching Using External Solenoid Valves

The Servomex SpectraScan Gas Analyzer is equipped with three relays connected to the 24 VDC supply, which may be used to control external solenoid valves for the purpose of stream switching.

By default, the first two relays are used for automatic zeroing: upon initiating, a software "zero" command the relays energize, providing 24 VDC power to external solenoid valves. Upon completion of the zeroing process, the relays return to their default "0" state. The analyzer supplies power to the solenoid valves at the following specifications:

Voltage: 24 VDC

Maximum current: 0.5 A



WARNING

**Personal Injury:** Solenoids that will be driven from the Servomex SpectraScan solenoid output must be safety agency approved.

The diagram below depicts the recommended pipe work and electrical connections to utilize the stream switching relays. Note that solenoid labels "NC" and "NO" denote **normally closed** and **normally open** respectively. Solenoid lines 1, 2, 3 and 4 should be connected to the rightmost connector bank on the front-edge of the PCB, to connector ports SOL1, GND, SOL2, and GND respectively, as shown in the diagram below. Cables should be anchored with cable ties inside the enclosure and exit the enclosure through the electrical conduit (along with the power and communication cables).



Figure 17 - Recommended Connections for Inlet Stream Switching

### 7.0.6 **Procedure for Connecting the Sample Lines**

Refer to Figure 16



**Electrical Hazard, Personal Injury and Equipment Damage:** Do NOT perform any internal service on an energized or gas supplied analyzer. When performing maintenance on the unit, it is necessary to disconnect the power source from the unit, and turn off the gas supply lines (sample gas and zero gas).

WARNING

- 1. Turn off the main power disconnect and turn off all gas supply lines.
- 2. Remove the port caps and any other obstructions from the sample path (inlet and exhaust ports).
- 3. Install the appropriate fittings on the sample supply and exhaust lines (see *Preparing Sample Gas Lines* on page 50).
- 4. Install a pressure relief mechanism if necessary (if sampling from a pressure other than ambient).
- 5. Ensure a clean sample stream install a 10 micron particulate filter on the inlet side of the sample plumbing if necessary.
- 6. Install/connect stream switching lines and solenoids if applicable.
- 7. Connect sample supply and exhaust lines to the Servomex SpectraScan sample inlet and exhaust ports.
- 8. Ensure proper sample gas and zero gas temperature and conditioning. In general, sample conditioning is application dependent, see the *Application data* for more specific information. However, samples entering the Servomex SpectraScan Gas Analyzer must be "clean and dry" free of liquids and particulates. Sample cell is heated to 60°C. Any sample above 50°C may have condensation or overheating risks.

#### CAUTION

**Equipment Damage:** The sample stream must be clean of particles that could block the light path and potentially accumulate on the windows, and potentially damage the unit. It is ultimately the user's responsibility to ensure a clean sample stream. We recommend an inline 10 micron particulate filter for most applications. Contact Servomex for more information.

- 9. Check sample path (lines and connections) and zero gas path for leaks, by alternately turning one on and the other off. Repair or replace to resolve any leaks that are found; the Servomex SpectraScan Gas Analyzer must be operated in a leak-free environment.
- 10. Turn on the main power (at the disconnect).
- 11. Set supply and exhaust valves in the proper configuration for remote operation.

# 7.1 Enclosure Purge Connections

#### 7.1.1 Purging of Enclosure Compartment

Certain installations may require the use of purge gas to flow through the enclosure. There are two female ¼" NPTF ports located on the analyzer for this purpose. (See Figure 3). To add a purge to the enclosure, remove the plugs installed at the factory on the purge inlet and purge outlet ports (either port can be used for inlet or outlet). Connect purge gas lines to the ports using male ¼" NPTF connectors, or use fittings to adapt the purge ports on the analyzer to the connected to a continuous supply of clean and dry inert gas such as nitrogen or air. The other port should be connected to an exhaust line for the purge gas. Make sure the exhaust line is open, open the purge gas line, and check for leaks.



#### WARNING

**Personal Injury or Death:** Do not connect sample lines to the purge fittings as you could fill the enclosure and local area with potentially harmful or explosive gases, exposing the user and others in the vicinity to the risk of injury or death.

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## 8 INSTALLATION CHECKLIST

The following list gives a brief summary of all the steps needed to correctly install the Servomex SpectraScan Gas Analyzer. It is not a substitution of the procedures, precautions and hazard definitions that appear elsewhere in this document.

NOTE
Read this manual in its entirety before attempting to perform any operations on the Servomex SpectraScan system.

- 1. Reviewed *System Safety* beginning on page 12.
- 2. Unpacked Servomex SpectraScan Gas Analyzer from shipping crate and inspected for damage.
- 3. Chose appropriate mounting space and structure considering all *Environmental Requirements* beginning on page 23.
- 4. Mounted the analyzer securely on the mounting structure.
- 5. Connected power source and communication cabling.
- 6. Connected sample inlet and exhaust lines, zero gas supply line and stream switching circuitry as applicable.
- 7. Tested all gas paths for leaks and resolved.
- 8. Connected enclosure purge system (optional) and tested for leaks.
- 9. Supply gases properly conditioned for temperature, pressure, cleanliness and flow rate.
- 10. Supply and exhaust valves and electrical power disconnect are set in the proper configuration for remote operation.

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### 9 VERIFICATION

The purpose of this procedure is to verify span accuracy upon installation of the Servomex SpectraScan Gas Analyzer. This procedure is also performed at periodic intervals throughout the effective life of the unit. This procedure has three parts: Setup, Zeroing and Span Verification. Zeroing is a measurement on a zero (inert) gas. Span verification is a measurement on the customer's trusted, certified mixture(s).

### 9.0 Procedure

#### 9.0.1 Setup

- 1. Communicate with the analyzer via Modbus/TCP: Refer to the Modbus register map in the Applications Manual to be used to configure customer's Modbus Master Program (not provided by Servomex.)
- 2. Ensure that the Servomex SpectraScan Gas Analyzer is sufficiently warmed-up.

**Warm-up:** The unit's interior is temperature-controlled and will only meet measurement accuracy specifications when sufficient time is allowed for the unit to meet and stabilize to the designed operating temperature. The red "Warm-Up" light on the display will remain on until the unit is warmed-up. Warm-up time for the unit is approximately 30 minutes to 2 hours depending on the ambient temperature. Do not begin to take data until the "Warm-up" light goes off and the "Run" light (green) comes on. LED codes are as follows:

LED Label on System Cover	Functional Description
Power	Lights green when power is connected.
Warm-up	Lights red while warming up, goes out when operational temperature is reached.
Run	Lights green when operational temperature is reached.
Fault	Lights red when a fault is detected in the system.

#### Table 6 - Diagnostic LED Indications

### 9.0.2 Zeroing

#### See

Stream Switching Using External Solenoid Valves on page 52 for information on controlling the external valves.

- 1. Purge the cell with the appropriate zero gas: turn off the sample gas and turn on the zero gas (through software). Refer to the Application data for the appropriate Zero gas specifications.
- 2. Make sure that the gas cell is completely purged with the Zero gas by allowing an extra amount of time in purging (See Table 12 Response Time Versus Gas Flow Rate).
- 3. Initiate the command "Zero" from Modbus Master or controller. (On the Test HMI software, a "Zero" toggle is on the "Configuration" tab.)

#### 9.0.3 Span Verification

Purge the cell with your trusted, certified mixture of sample gas, or *verification mixture* as follows:

- 1. Connect the verification gas of choice to the sample inlet supply line if sourcing verification gas from a cylinder.
- 2. Turn off the zero gas and turn on the sample gas (either through software in the case of automated sample-switching configuration or manually).
- 3. Start collecting data.
- 4. Wait until data values from the analyzer stabilize. See Table 12 Response Time Versus Gas Flow Rate for more information.
- 5. Record values. Compare data with known values of your trusted, certified verification mixture.
- 6. Complete Verification procedure or adjust span values as needed (see next section below).

### 9.1 **Re-spanning**

The customer may modify the factory set span values (default values of "1") for any measurement channel. This span modification can be done via Modbus/TCP. The span values are multiplied with the original measured values to produce the final measurement values. For example, adjusting the span value of a certain channel to 1.05 would adjust the measurement value up by 5%. Similarly, adjusting the span value to 0.95 would adjust the measurement value down by 5%. Note that the new span values are NOT stored in the analyzer's memory, rather, it relies on the Modbus master program (customer control system) to supply the information.

### **10 MAINTENANCE**

The Servomex SpectraScan Gas Analyzer is designed to be maintenance free for extended periods of time. In a normal installation, it will operate unattended in its intended environment for 18 months with no physical intervention. Typically every 18 months, the spectrometer light source needs to be replaced.

Recommended maintenance and operation verification of the Servomex SpectraScan Gas Analyzer consists of:

- > Monthly re-zeroing (performed remotely through software).
- Light source assembly replacement (every 18 months or when light indicator shows < 40% output). The replacement procedure is described in Section 10.0.</p>
- > Gas cell window replacement if necessary when prompted by fault signal.

# 10.0 Light Source Assembly Replacement Procedure

Light source replacement is recommended every 18 months or when the light indicator shows < 40% output. Neither the light source nor its circuit board can be repaired.

The light source assembly is a small circuit board with a light source under it, which attaches to the top of the sensor head via a mounting hole for the light source and four bolts with lock washers.

Access only requires peeling back a corner of the blue bag surrounding the cell, and Velcro makes this easy. Removal of the assembly is executed by disconnecting its connector and removing the four bolts that hold it into place. Heat sink compound is applied to the light source prior to inserting it into the cell.



**Electrical Hazard, Personal Injury and Equipment Damage:** Do not perform maintenance on an energized or gas supplied analyzer. When performing any procedure that involves opening the unit, it is necessary to disconnect the power source from the unit, and turn off the gas supply lines (sample gas and zero gas).

WARNING

- 1. Turn off all gas supply lines and turn off power to the analyzer before performing any service procedure.
- 2. Open the cover of the SpectraScan using a large, flat-headed screwdriver turn the latch <sup>1</sup>/<sub>4</sub> turn counter-clockwise, and open the cover.
- 3. Expose the light source assembly from underneath the blue bag:

Refer to Figure 5 - Interior of the Servomex SpectraScan Gas Analyzer on page 33 to identify the location of the light source assembly.

4. Peel back the cover by opening the Velcro on the upper and right edges of the blue bag, as shown in Figure 18.





5. Remove the connector with the green wires from the bottom edge of the light source circuit board as shown in Figure 19. The black connector has a squeeze tab to prevent accidental release of the connector.



Figure 19 - The Light Source Circuit Board

- 6. Using a 3/32" hex wrench, loosen and remove the four bolts and four lock washers at the corners of the light source circuit board. Lift the blue light source circuit board up and out of its mounting hole. This circuit board with the light source on the other side of it is the light source assembly (see Figure 20).
- 7. The light source assembly shall be replaced as a whole. It shall not be reduced to smaller components or repaired. The old assembly can be discarded in accordance with appropriate local regulations.



Figure 20 - The Light Source Assembly

8. Apply heat sink around the perimeter of the new light source, and push the assembly back into the mounting hole provided on the sensor head, making sure to orient it properly (connector end toward I/O panel).



Figure 21 - Mounting Hole for Light Source

- 9. Replace the four bolts and four lock washers to secure the circuit board to the sensor head. Tighten the bolts in a cross pattern.
- 10. Replace the connector back into its socket on the light source circuit board. The tab will snap in place to lock the connector into position.
- 11. Re-close the blue bag by sealing the Velcro strip along its edges.
- 12. Close the cover and lock by rotating the latch.

- 13. Turn on power and gas supply.
- 14. Wait for at least 30 minutes and until the cell temperature stabilizes at the set operating temperature (indicated by the green "Run" light on the display).
- 15. Perform Verification (refer to Section 9 Verification).

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# **11 TROUBLESHOOTING**

See Table 6 - Diagnostic LED Indications for a general description of each indicator status. Below are some common problems/symptoms and possible causes.

Problem	Possible cause(s)
Power LED not lit	No or insufficient power. Check Fuse
Warm-up light still lit after 2 hours of warm up period	Environment is too cold to allow stabilization at the operating temperature
Negative concentration reading	Zeroing on sample gases or insufficient purging prior to zeroing
Excessive drift	Analyzer has not fully warmed up or sensor head temperature is higher than its intended operating temperature (default 60° C)
Unable to communicate with the analyzer	Incorrect IP address
Low light indicator (<50%)	Dirty windows or light source has degraded
No measurement response or unchanging measurement values	Unconnected or improperly connected sample line, blocked flow
Slow measurement response	Low flow rate due to blockage

#### Table 7 - Troubleshooting

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# **12 APPENDIX A: PRODUCT SPECIFICATIONS**

# 12.0 Measurement Specifications

Measurement Technique	Light absorption spectroscopy
Gas Cell Volume / Path Length	100 mL / 35 cm
Zero Drift	<0.2% of full scale (FS) per month (typical)
Intrinsic Error (Accuracy)	<1% FS (typical). Higher accuracy available upon request
Repeatability	<0.1% (typical)

### Table 8 – Measurement Specifications



# 12.1 Physical Specifications



Size	17.25"x 12" x 7" deep
Weight	28 lbs. (14 kg)
Installation	Wall Mounted See <i>Dimensions, Weight and Ventilation</i> on page 24 for installation considerations
Vibration Immunity	Resistant to low amplitude vibration

#### Table 9 – Physical Specifications

# 12.2 Communications Specification

Communication	Modbus TCP/IP Ethernet

#### **Table 10 - Communications Specifications**
# 12.3 Sampling System Specifications

Item	Value	
Allowable Flow Rate	0 to 15 ltr/min (higher ranges available upon request)	
Allowable Gas Cell Pressure	0 to 30 psig (standard) 0 to 80 psig (optional) <i>Refer to product labelling for model-specific information.</i>	
Allowable Sample Temperature and Humidity	0 to 50°C (32 to 122°F) standard 5 to 95% rH non-condensing Contact Servomex for higher temperature requirement	
Material Of Wetted Parts	Nickel plated or anodized aluminium gas cell, (stainless steel gas cell is optional) Stainless steel tubing and fittings, Viton O-rings, BK7/quartz/sapphire/CaF2/ZnSe optical windows	

Table 11 - Sampling System Specifications

FLOW RATE	T90 (SECONDS)	T95 (SECONDS)	T99 (SECONDS)
0.5 SLM	25	35	60
1 SLM	20	25	40
5 SLM	4	5	6

Table 12 - Response Time Versus Gas Flow Rate

## 12.4 Electrical Specifications

Power Rating and Fuse Information				
Base Input Power	24 Vdc, 5.0 A max			
Optional Input Power	100-240 Vac (+/-) 10%, 50-60 Hz, 3.0 A max*			
Fuse (24Vdc replaceable)	125V, 10A			

#### **Table 13 - Electrical Specifications**

\*See Table 4 - Wire Types on page 35 for important wire rating information.

### 12.5 Environmental Specifications

Ambient Operating Temperature/Humidity Range	-20 to 50°C (-4 to 122°F) (5 – 95% rH non-condensing)	
System Cooling	None required	
Storage/Shipping Temperature/Humidity	-20 to +60°C (-4 to 140°F)	
Range	(5 – 95% rH non-condensing)	
Altitude	0 – 2000m (0 – 6560 ft)	
Overvoltage Category	Category II	
Pollution Degree	Pollution Degree 3	
Dust Protection Rating (Except for Gas Sample Path)	IP rating = 66 (unit interior is protected against dust)	

Table 14 - Environmental Specifications

## 12.6 Manual Revision History

Draft	Description	Effective Date
0	Initial Release	May-13

#### **13 INDEX**

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## **14 CONTACT DETAILS**

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NOTE

All analyzers returned to Servomex or one of its appointed agents for servicing, or any other purpose must be accompanied by a completed decontamination certificate.