SpectraSensors™

Operator's Manual

SS500 / SS2000 / SS3000

Moisture and Carbon Dioxide Analyzers

OPERATOR'S MANUAL

Products of

SpectraSensors™

972 North Amelia Avenue
San Dimas, CA 91773
Tel: 800.619.2861
Fax: 909.542.0402
www.spectrasensors.com

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ABOUT THIS MANUAL

The SpectraSensors (SS) 500/2000/3000 products are high-speed, extremely reliable extractive analyzers used to measure the concentrations of moisture (H_2O) or carbon dioxide (CO_2) in natural gas. This manual contains a comprehensive overview of SpectraSensors, the SS500, SS2000, and SS3000 analyzers, and step-by-step instructions on:

- Getting started once you receive the analyzer
- Installing the analyzer
- Powering up the analyzer
- Operating the analyzer
  - Reading diagnostic data
  - Powering down the analyzer
- Troubleshooting

Who Should Read This Manual

This manual should be read and referenced by the person who will install, operate, or have contact with the analyzer.

How to Use This Manual

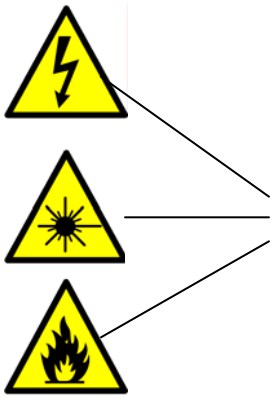
Take a moment to familiarize yourself with this Operator's Manual by reading the Table of Contents (TOC).

Read each section in the manual carefully so you can quickly and easily install and operate the analyzer.

The manual includes images, tables, and charts that provide a visual understanding of the analyzer and its functions. The manual also uses special symbols to make you aware of potential hazards, important information, and valuable tips. Pay close attention to this information.

Special Symbols Used in This Manual

This manual uses the following symbols to represent potential hazards, caution alerts, and important information associated with the analyzer. Every symbol has significant meaning that you should heed:



WARNING (electrical, laser, and flammable): Failure to follow directions may result in bodily harm or worse.

CAUTION: Failure to follow all directions may result in damage or malfunction of the analyzer.

IMPORTANT NOTE: Important information concerning the installation and operation of the analyzer.

General Warnings and Cautions

Explosion hazard. Substitution of components may impair suitability for Class 1, Div. 2.

Explosion hazard. Do not connect or disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

Use damp cloth to clean display and keypad to avoid static electricity discharge.

Do not exceed 10 PSIG in sample cell. Damage to cell window may result.

Do not hold or carry the analyzer by the measurement heads or sample cells. Doing so may cause optical alignment problems affecting the performance of your sensor.

Class 3B invisible laser radiation. When open, avoid exposure to beam. Conforms to provisions of US 21 CFR1040 10. Class I laser product. Refer servicing to manufacturer-qualified personnel.

When selecting an analyzer, the total system design must be considered to ensure safe, trouble-free performance. Function, sizing, proper installation, operation, and maintenance are beyond the control of SpectraSensors and are the responsibilities of the system designer and user.

Always disconnect the main power to the instrument before attempting any repair.

Read and understand all instructions before attempting to operate the instrument. Observe all caution notes and warning labels.

SPECTRASENSORS OVERVIEW

SpectraSensors is located in San Dimas, California, a short distance away from the California Institute of Technology's Jet Propulsion Laboratory where the basic technology behind the products was developed. This technology was first utilized for accurate measurements of gases in the Earth's atmosphere in the early 1980s, and recently was incorporated into miniaturized and space-qualified instruments for Mars research. SpectraSensors obtained the commercial rights to this NASA technology and is now offering state-of-the-art gas sensors for commercial applications. SpectraSensors has been manufacturing H_2O and CO_2 analyzers for the natural gas industry since 2001.

About the Natural Gas Sensors

The SS500, SS2000, and SS3000 are Tunable Diode Laser (TDL) absorption spectrometers operating in the near-infrared (near-IR) wavelength region. Each sensor contains a TDL light source and detector configured to allow high sensitivity in a compact package. It also contains microprocessor-based electronics and software that incorporates advanced operational and data-processing algorithms.

Each analyzer is designed for use at natural gas sampling stations, extractive analysis installations, or wherever fast response and high-accuracy measurements are required over a wide measurement range. It is a high-performance instrument capable of measuring H_2O and CO_2 in methane and other gases without regard to corrosive gases and contamination from other gas phase constituents in the stream.

Several patents protect the TDL absorption technology incorporated in SpectraSensors' series of analyzers.

Difference Between the SS500, SS2000, and SS3000

The SS500 and SS2000 are single channel H_2O analyzers. The SS2000 is a high-accuracy version of the SS500 (see **Table 1** on page 10). The SS2000 (see **Table 2** on page 11) has a detection limit of 0.5 lbs/mmscf. The SS500 has a detection limit of 2 lbs/mmscf). The SS2000 is also available as a CO2 analyzer. The analyzer software measures the amount of laser light absorbed by the target molecules. This method provides reliable readings because of the very specific wavelength that is being analyzed. The laser, detector, software, and electronics are extremely fast with four measurements taken every second. Other than the detection limits, the SS500 and SS2000 analyzers function the same.

The SS500 and SS2000 are housed in three (optional) enclosures:

- Explosion-proof aluminum National Electrical Manufacturers Association (NEMA) 7, 4 (150 lbs.)
- Stainless steel NEMA 4x (25 lbs.)
- Fiberglass NEMA 4x (15 lbs.)

The SS3000 analyzer (See **Table 3** on page 13.) is a dual-channel version of the SS2000. It is capable of measuring H_2O in two streams or H_2O and CO_2 in the same stream using the SpectraSensors' tunable laser technology. The analyzer is equipped with an optional single

gas inlet (common to both flow cells) or two gas inlets (separate gas streams for each flow cell).

The SS3000 is housed in two (optional) enclosures:

- Explosion-proof aluminum NEMA 7, 4x – single or dual gas inlets (200 lbs.)
- Stainless steel NEMA 4x – single and dual gas inlets (27 lbs.)

How the Analyzer Works

The analyzer detects the presence of contaminants that form corrosives, helping to prevent dangerous leaks or potentially catastrophic ruptures. The analyzer uses a robust, TDL that emits near-IR light that passes through the gas in the sample cell of the analyzer (see **Figure 1**). The analyzer scans the laser wavelength across the range where H_2O or CO_2 molecules absorb the laser light or energy, reducing the amount of light that passes through to the detector. The ratio of the light absorbed by the water vapor line to the light on the detector when the wavelength is off the water line is proportional to the water vapor concentration. The higher the concentration of H_2O or CO_2 present in the gas sample, the more absorption of light. This ratio is further corrected for variations in temperature and pressure in the measurement cell. Because the analyzer measures the absorption in the volume of the gas, the measurement is more accurate than surface-based sensors that are subject to surface contamination.

More specifically, the SS500, SS2000 (see **Figure 2** on page 9) and SS3000 (see **Figure 3** on page 12) analyzers measure the H_2O and CO_2 by monitoring their absorption of laser light at specific wavelengths in the near-IR wavelength region near 2μm. The human eye responds to light in the range of approximately 0.4μm (deep violet) to 0.8μm (deep red), but most molecules respond to light at longer wavelengths that are invisible to the human eye (the infrared region). By using a laser that operates precisely at a wavelength where H_2O or CO_2 (many other gases can also be measured using this technique) absorb light, it is possible to determine accurately the abundance of the gas by measuring the amount of light that the molecules absorb.

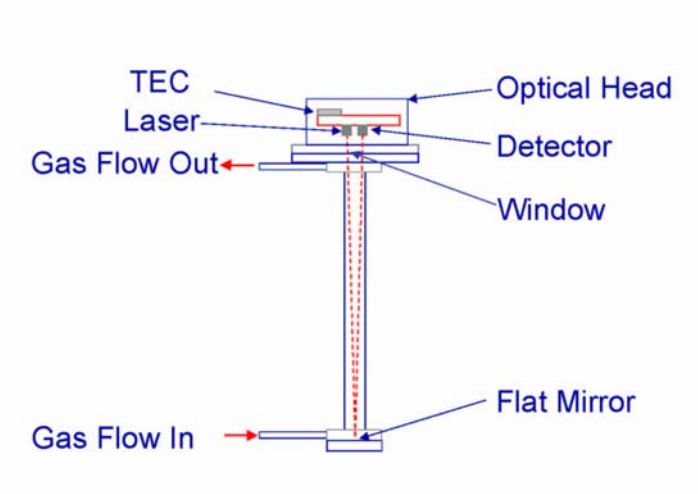


Figure 1: Laser sample cell

GETTING STARTED

When the analyzer arrives, you should take a few preliminary steps before installing the unit. This section discusses:

- How to best unpack the analyzer
- What should be included in the shipping box
- How to inspect the analyzer

This section also provides images of the analyzer and specifications for reference.

Unpacking the Analyzer

Analyzers housed in a stainless steel or fiberglass enclosure arrive in a tightly sealed box. If the analyzer is ordered without a sample conditioning panel, it will arrive in the box bolted to a plywood panel to protect it during shipping. Use a 7/16" socket wrench to undo the bolts and remove the analyzer from the plywood. Save the plywood and other packing materials for use should you need to return the analyzer to the factory.

The analyzer housed in an explosion-proof aluminum enclosure arrives on a pallet. This analyzer weighs more than 150 lbs and you may need to transport it to its mounting location with mechanical assistance (see **Figure 4** and **Figure 5** on page 15 and 16).

What Should be Included in the Shipping Box

The contents of the box or contents on the pallet should contain:

- The SpectraSensor 500, 2000, or 3000 analyzer
- Operator's Manual to install and operate the analyzer
- External serial cable to connect the analyzer to a computer to receive and transmit data **(two cables for the SS3000)**
- SpectrumPlot II software CD and instructions to perform diagnostic functions for the analyzer

If any of these contents are missing, contact your sales representative.

Inspecting the Analyzer

For the analyzer housed in a stainless steel or fiberglass enclosure, place the analyzer on a flat surface (analyzer housed in explosion-proof aluminum enclosure keep intact) and carefully inspect the analyzer for dents, dings, or general damage. Inspect the inlet and outlet connections for damage, such as bent tubing. Report any damage to the carrier.

The analyzer comes specially ordered with unique model number configurations (MNC) and accessories (see **Table 4** on page14). These configurations are useful in identifying the power requirements. Cross-check the MNCs noted on the label displayed at the top left side of the analyzer with the MNCs for your specific model. The model number, serial number,

and power on the analyzer should match the MNCs. If they do not match, contact your sales representative.

SS500/SS2000

Figure 2: Main external components on the SS500/SS2000 analyzer (shown in NEMA 4X stainless steel enclosure)

SS500
Mid-Sensitivity Moisture Analyzer

Specifications

Performance

Moisture Concentration (H_2O)*	2 to 20 lbs/MMSCF Nat. Gas 42-422 ppmv
Accuracy (H_2O)	±2% of reading or ±10 ppmv, NIST Traceable
Dew/Frost Point	-58˚ to -20˚F (-50˚ to -29˚C)
Response time**	Display updates 0.25-2 seconds (software adjustable)

* Consult factory for alternative ranges

** Flow Rate Dependant - Sample cell volume is 0.005 ft^3. Time to displace cell volume at a flow of 2 scfh is ~10 sec.

Environmental Range

Temperature	-4˚ to 122˚F (-20˚ to 50˚C)
Inlet Pressure	10 to 25 PSIA, **10 PSIG Maximum** (70-170 kPa Abs, **70 kPaG Maximum**)
Sample Cell Construction	316L Series Polished Stainless Steel
Sample Flow Rate	0.2 to 20 SCFH (100-10,000 cc/min)
Contaminant Sensitivity	None for gas phase glycol, methanol, amines, hydrogen sulfides or mercaptans

Power Requirements

Input Voltage	100-240 VAC, 50-60 HZ Standard 9-16 VDC or 18-32 VDC Optional
Current	1 amp maximum @ 120VAC 1.6A @ 24VDC, 3.2A @ 12 VDC

Physical Specifications

Outputs	Streaming RS-232 or optional Modbus (all parameters), 4-20mA loop (concentration only)
LCD Display	Concentration, Cell Pressure and Cell Temperature
Enclosure Type	NEMA 4X – Fiber Reinforced Plastic NEMA 4X – Stainless Steel Optional
Size (NEMA 4x)	18”H x 16”W x 5.5”D (457mm H x 406mm W x 140mm D)
Weight	w/FRP Enclosure - Approx. 13lbs (6Kg) w/SS Enclosure - Approx. 25lbs (11.5Kg)

Area Classification

Certification (stainless steel enclosure only)	CSA Class I, Division 2, Groups C and D, Temp Code T3C

Table 1: Specifications of the SS500 analyzer

SS2000
Moisture/Carbon Dioxide Analyzer

Specifications

Performance	
Moisture Concentration (H_2O)*	0.5 to 20 lbs/MMSCF Nat. Gas 10-422 ppmv
Accuracy (H_2O)	±2% of reading or ±4 ppmv, NIST Traceable
Dew/Frost Point	-76˚ to -20˚F (-60˚ to -29˚C)
Carbon Dioxide Concentration (CO_2)*	0-10%
Accuracy (CO_2)	± 2% of reading, or ±400 ppmv, whichever is greater
Response time**	Display updates 0.25-2 seconds (software adjustable)

* Consult factory for alternative ranges

** Flow Rate Dependant - Sample cell volume is 0.005 ft^3. Time to displace cell volume at a flow of 2 scfh is ~10 sec.

Environmental Range	
Temperature	-4˚ to 122˚F (-20˚ to 50˚C)
Inlet Pressure	10 to 25 PSIA, **10 PSIG Maximum** (70-170 kPa Abs, **70 kPaG Maximum**)
Sample Cell Construction	316L Series Polished Stainless Steel
Sample Flow Rate	0.2 to 20 SCFH (100-10,000 cc/min)
Contaminant Sensitivity	None for gas phase glycol, methanol, amines, hydrogen sulfides or mercaptans

Power Requirements	
Input Voltage	100-240 VAC, 50-60 HZ Standard 9-16 VDC or 18-32 VDC Optional
Current	1 amp maximum @ 120VAC 1.6A @ 24VDC, 3.2A @ 12 VDC

Physical Specifications	
Outputs	Streaming RS-232 or optional Modbus (all parameters), 4-20mA loop (concentration only)
LCD Display	Concentration, Cell Pressure and Cell Temperature
Size (NEMA 4X)	18”H x 14.8”W x 5.8”D (457mm H x 376mm W x 135mm D)
Weight (NEMA 4X)	Approx. 25lbs (11.5Kg)

Area Classification	
Certification (stainless steel enclosure only)	CSA Class I, Division 2, Groups C and D, Temp Code T3C

Table 2: Specifications of the SS2000 analyzer

SS3000

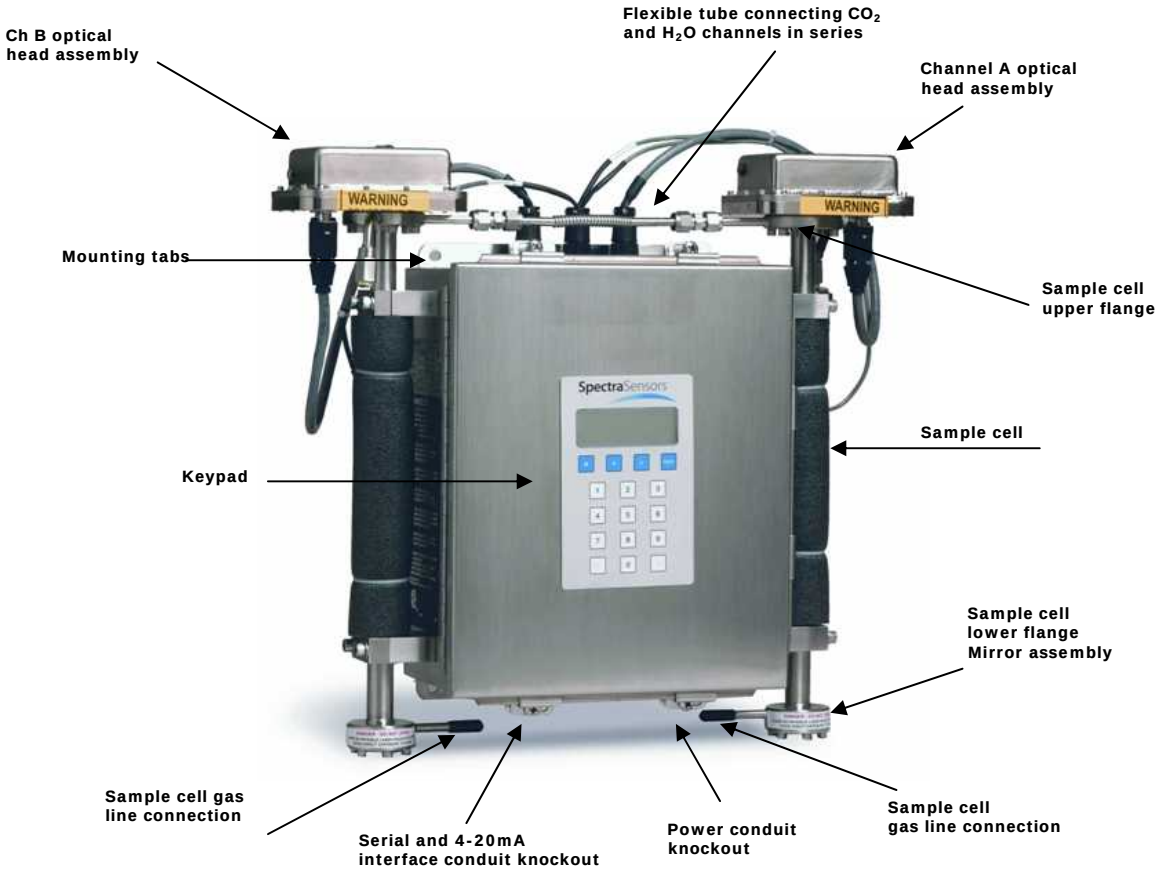


Figure 3**:** Main external components on the SS3000 analyzer (shown with single sample inlet)

SS3000
Dual Channel Gas Analyzer

Specifications

Performance

Moisture Concentration (H_2O)*	0.5 to 20 lbs/MMSCF Nat. Gas 10-422 ppmv
Accuracy (H_2O)	±2% of reading or ±4 ppmv, NIST Traceable
Dew/Frost Point	-76˚ to -20˚F (-60˚ to -29˚C)
Carbon Dioxide Concentration (CO_2)*	0-10% in Natural Gas
Accuracy (CO_2)	± 2% of reading, or ±400 ppmv, whichever is greater
Response time**	Display updates 0.25-2 seconds (software adjustable)

* Consult factory for alternative ranges

** Flow Rate Dependant - Sample cell volume is 0.005 ft^3. Time to displace cell volume at a flow of 2 scfh is ~10 sec.

Environmental Range

Temperature	-4˚ to 122˚F (-20˚ to 50˚C)
Inlet Pressure	10 to 25 PSIA, **10 PSIG Maximum** (70-170 kPa Abs, **70 kPaG Maximum**)
Sample Cell Construction	316L Series Polished Stainless Steel
Sample Flow Rate	0.2 to 20 SCFH (100-10,000 cc/min)
Contaminant Sensitivity	None for gas phase glycol, methanol, amines, hydrogen sulfides or mercaptans

Power Requirements

Input Voltage	100-240 VAC, 50-60 HZ Standard 9-16 VDC or 18-32 VDC Optional
Current	1 amp maximum @ 120VAC 1.6A @ 24VDC, 3.2A @ 12 VDC

Physical Specifications

Outputs – two of each	Streaming RS-232 or optional Modbus (all parameters), 4-20mA loop (concentration only)
LCD Display	Concentration, Cell Pressure and Cell Temperature
Size (NEMA 4X)	18”H x 17.5”W x 5.8”D (457mm H x 444mm W x 147mm D)
Weight (NEMA 4X)	Approx. 27lbs (12.3Kg)

Area Classification

Certification (stainless steel enclosure only)	CSA Class I, Division 2, Groups C and D, Temp Code T3C

Table 3**:** Specifications of the SS3000 analyzer

SS500 Single Channel Laser Analyzer Model Number Configurations

Single-Channel Analyzer

Housing

1		Non-hazardous stainless steel enclosure (NEMA 4X)	(non-CSA)
2		Explosion-proof aluminum enclosure (NEMA 7, 4)	(non-CSA)
3		Class 1, Div. 2 stainless steel enclosure (NEMA 4X)	
4		Fiberglass enclosure (NEMA 4X)	(non-CSA)

Measured Component

0		H2O range 2 - 20 lbs/MMSCF (42-420 ppmv)	
9		Other	

Background Gas

1		Natural Gas or Methane	
2		Air or Nitrogen	
9		Other	(must be group C or D for CSA)

Power Supply

1		Universal 100/250 VAC, 50/60 Hz	
2		18-32 V DC	
3		9-16 V DC	

SS500- | | | **1** | **1** | | |

SS2000 Single Channel Laser Analyzer Model Number Configurations

Single-Channel Analyzer

Housing

1		Non-hazardous stainless steel enclosure (NEMA 4X)	(non-CSA)
2		Explosion-proof aluminum enclosure (NEMA 7, 4)	(non-CSA)
3		Class 1, Div. 2 stainless steel enclosure (NEMA 4X)	
4		Fiberglass enclosure (NEMA 4X)	(non-CSA)

Measured Component

1		H2O range 0.5 - 20 lbs/MMSCF (10-420 ppmv)	
2		CO2 range 0-10%	
9		Other	

Background Gas

1		Natural Gas or Methane	
2		Air or Nitrogen	
9		Other	(must be group C or D for CSA)

Power Supply

1		Universal 100/250 VAC, 50/60 Hz	
2		18-32 V DC	
3		9-16 V DC	

SS2000- | | | **1** | **1** | | |

SS3000 Dual Channel Laser Analyzer Model Number Configurations

Dual-Channel Analyzer

Housing

1		Non-hazardous stainless steel enclosure (NEMA 4X)	(non CSA)
2		Explosion-proof aluminum enclosure (NEMA 7)	(non CSA)
3		Class 1, Div. 2 stainless steel enclosure (NEMA 4X)	

Gas 1

1		H2O range 0.5 - 20 lbs/MMSCF (10-420 ppmv)	
2		CO2 range 0-10%	
9		Other	

Gas 2 (1=None, see SS2000)

2		H2O range 0.5 - 20 lbs/MMSCF (10-420 ppmv)	
3		CO2 range 0-10%	
9		Other	

Gas Inlet(s)

1		Single gas inlet (Common to both flow cells)	
2		Two gas inlets (Separate gas streams for each flow cell)	

Background Gas

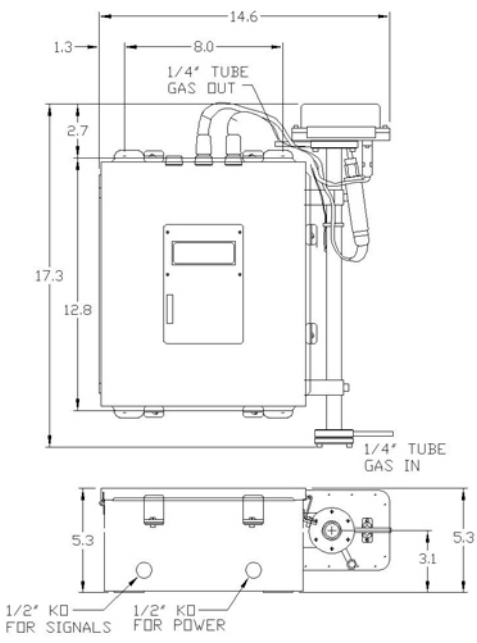
1		Natural Gas or Methane	
2		Air or Nitrogen	
9		Other	(must be group C or D for CSA)

Power Supply

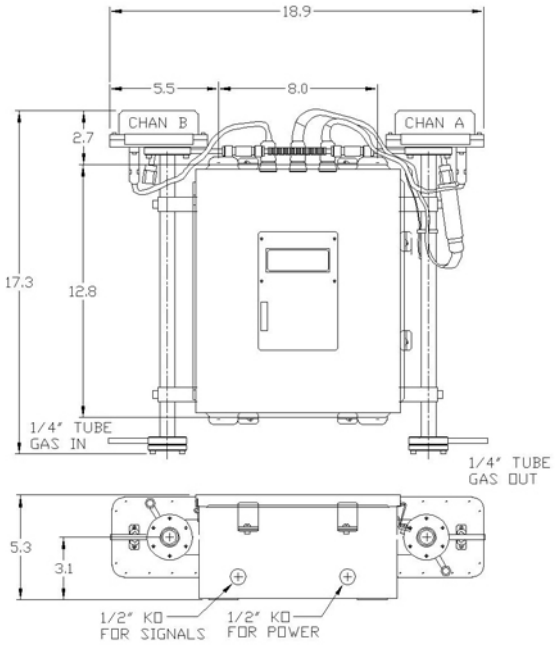
1		Universal 100/250 VAC, 50/60 Hz	
2		18-32 V DC	
3		9-16 V DC	

SS3000- | | | | | | |

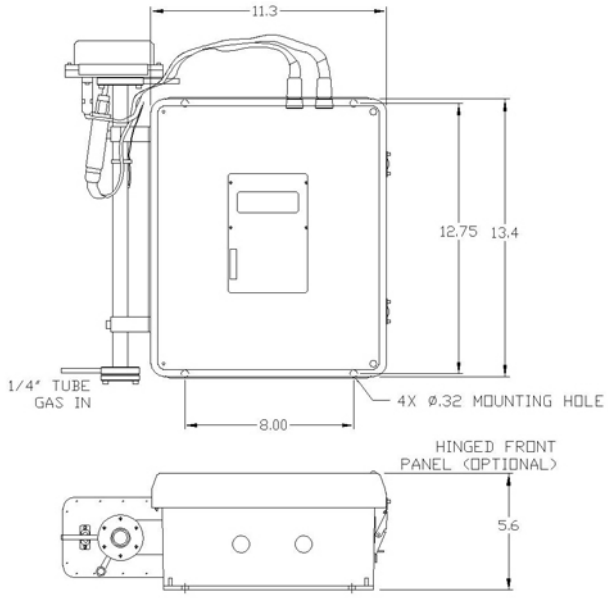
Table 5**:** SS500, SS2000, and SS3000 MNCs



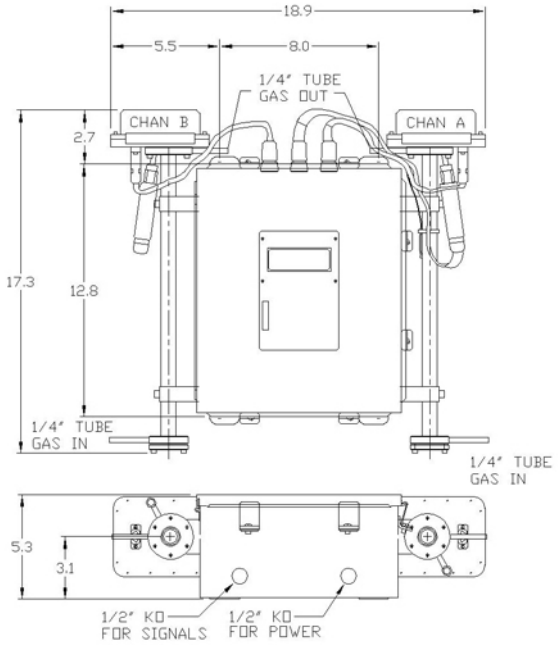
SS500/SS2000



SS3000 SINGLE INPUT



SS500 FIBERGLASS ENCLOSURE



SS3000 DUAL INPUT

Figure 4: The series of analyzers and enclosures

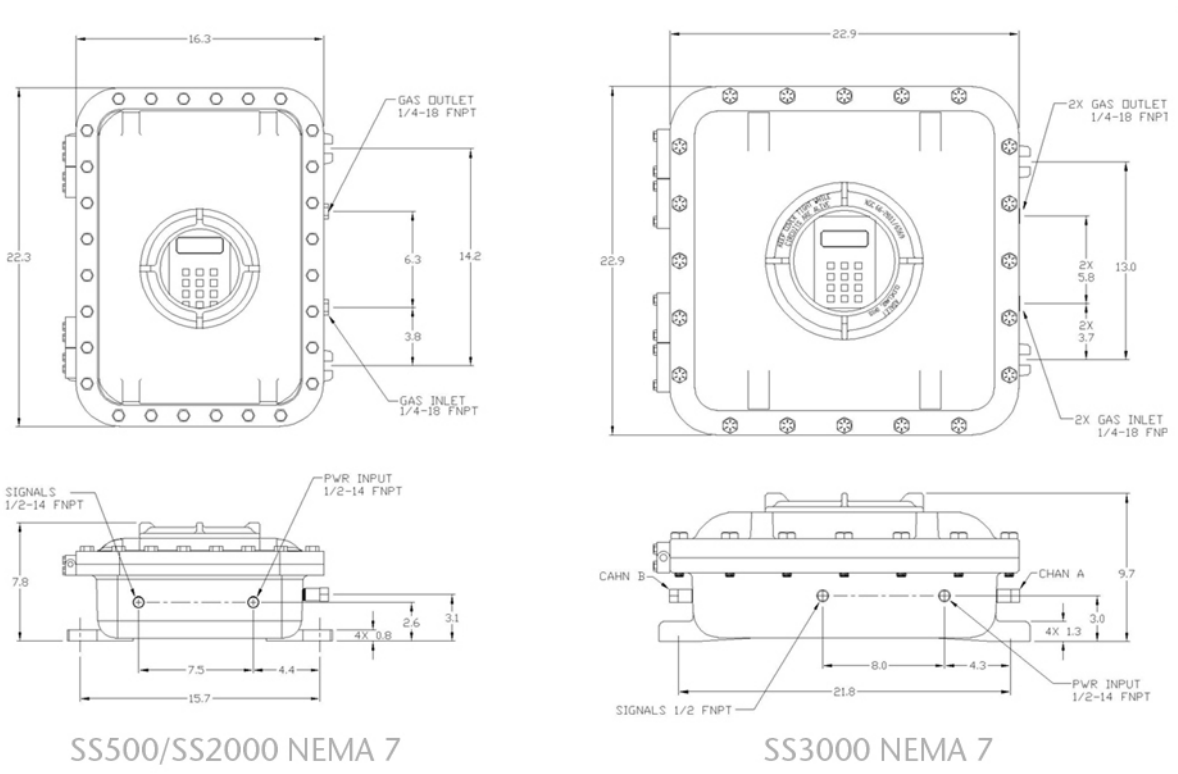


Figure 5: The series of analyzers with XP enclosures

INSTALLING THE ANALYZER

Installing the analyzer requires several steps to ensure it is mounted and connected correctly. This section discusses:

- Tools and hardware needed for installation
- Mounting the analyzer
- Connecting the gas lines
- Connecting the electrical power
- Connecting the output signals
- Powering up the analyzer
- Receiving and reading the data

After completing these steps, the analyzer will be ready for operation.

Avoid jolting the instrument by dropping it or banging it against a hard surface as this could disturb the optical alignment. Do not attempt to pick up the instrument using the sample cell as a handle; it is easily damaged.

Hardware and Tools for Installation

Depending on the model, you may need the following hardware and tools to complete the installation process:

Hardware you may need:

- Membrane separator filter
- Stainless steel compression fittings
- ¼" male pipe thread fitting
- Stainless steel tubing
- ½" conduit hub
- Conduit

Tools you may need:

- ¼" lag bolts or ¼" machine screws
- Drill
- Tape measure
- Leveler
- Pencil
- Socket wrench

Mounting the Analyzer

To set up the analyzer, bolt the unit to a wall or flat surface. Minimizing the gas volume of the sample system and using stainless steel tubing optimizes performance. Mount the analyzer to a location that is free of vibrations.

The most critical mounting issue is to mount the analyzer so that the inlet and outlet lines reach the inlet and outlet connections on the chassis and still maintain flexibility so that the sample lines are not under excessive stress.

To mount the analyzer:

1. Select a location to mount the analyzer.
   The analyzer has four mounting tabs with a .3" hole in each tab (two at the top of the analyzer and two at the bottom).
2. Mark the hole in one of the top tabs with a pencil. (See Figure 6.)
3. Mark the other top tab 8" over from the first.
4. Drill the appropriate size holes for the screws you are using.
5. Hold the analyzer in place and insert the top screws.
6. Repeat the same steps noted above for the bottom tabs.
7. Tighten all four screws. The analyzer should be very secure.

The analyzer is now ready to be connected to the inlet and outlet sampling gas lines.

Figure 6: Mounting tab (identical on each rear corner of enclosure at the top and bottom)

Protect the analyzer from overheating in the sun. Shield it with a shade or a cover.

Connecting the Gas Lines

An analyzer housed in a stainless steel or fiberglass enclosure comes equipped with ¼" outside diameter inlet and outlet tubes. Connect these tubes using compression fittings made of stainless steel.

An analyzer housed in an explosion-proof aluminum enclosure comes equipped with ¼" female NPT flame arrestors. Connect these tubes using male NPT swage connector fittings made of stainless steel (see **Figure 7**).

It is important to capture a representative sample of gas from the pipeline. The gas sample must be captured and filtered through a sample-conditioning panel. For more information, refer to the American Petroleum Institute's "Manual of Petroleum Measurement Standards," Chapter 14, Section 1 – Natural Gas Samples for Custody Transfer. Complete sample conditioning panels, including membrane separator filters, are available from SpectraSensors in a variety of configurations. Please contact your sales representative for more information.

The inlet line should be equipped with a membrane separator filter to prevent liquid from entering the sample cell and possibly accumulating on the internal optics. The internal optical elements must remain clean for proper readings.

To connect the gas lines:

1. Run a stainless steel tube (do NOT use a plastic tube) from the outlet of the membrane separator filter to the inlet of the analyzer.
2. Connect a stainless steel tube to the inlet tube of the analyzer using a compression-type union fitting. (For analyzer in explosion-proof aluminum enclosure, connect the tube to the ¼" female NPT fitting on the side of the enclosure.)
3. Connect a stainless steel tube from the analyzer outlet to vent in a safe area.
4. Be sure there is no stress on the tubing when it is aligned to the analyzer.
5. Open the shutoff valve on the inlet line.
6. Check all connections for gas leaks using less than 10 pounds per square inch gauge (PSIG). SpectraSensors recommends using a liquid leak detector.

The pressure in the sample cell must not exceed 10 PSIG. Higher pressure will cause catastrophic damage to the analyzer. It's recommended that you avoid having restrictions on the output vent line of the sample cell and that a pressure relief valve be used on the input line in case of regulator failure.

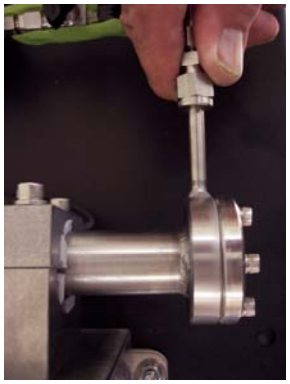


Figure 7: Sample cell gas line connection

Connecting Electrical Power to the Analyzer

Before attaching the wiring to the analyzer, make sure all power to the wires is off.

Failure to properly ground the analyzer can create a high-voltage shock hazard.

You can connect electrical power to the analyzer through the ½" power conduit knockout located at the bottom right side of the analyzer. The analyzer is equipped with either a universal power supply that accommodates both U.S. (115 VAC @ 60 Hz) and European (240 VAC @ 50 Hz) AC power configurations, or a DC input power supply for either 9-16 VDC or 18-32 VDC. Check the manufacturing data label or the terminal block labels to determine the power configuration of your analyzer.

To connect electrical power to the analyzer:

1. Open the enclosure door. Do not to disturb the electrical assembly inside.
2. Install a ½" NEMA 4X-rated conduit hub. For analyzers in an explosion-proof aluminum enclosure, thread the conduit directly into the enclosure. Be sure to use the supplied conduit seals as required by code.
3. Run conduit from the power-source panel to the conduit hub. Since the breaker or switch in the power panel will be the primary way of disconnecting the power from the unit, the power panel should be located within 10 feet of the analyzer. The analyzer should be on a circuit that is protected at 15 amps or less.
4. Pull ground, neutral, and hot wires into the electrical enclosure. For 12- or 24-volt systems, pull ground, plus, and minus.
5. Attach the neutral and hot wires to the power terminal strip by connecting the AC neutral wire to the terminal marked "NEU," the hot wire to the terminal marked "LINE" (see **Figure 9** on page 21), the DC minus line to the terminal marked "-", and the positive line to the terminal marked "+"(see **Figure 8** on page 21)
6. Connect the ground wire to the ground contact in the lower right corner of the enclosure (see **Figure 10** on page 22).

Power Supply Recommendations

The analyzer is standard-equipped with a universal power supply that accommodates all AC power configurations between 100 and 240 VAC.

DC power supplies (9-16 VDC or 18-32 VDC) are optional.

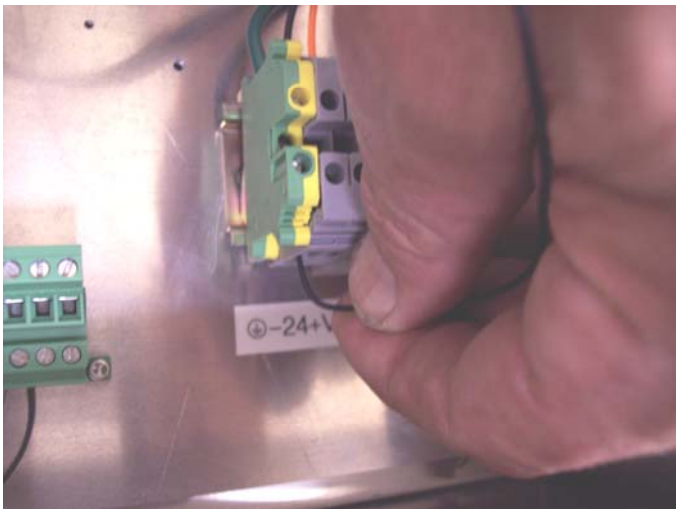


Figure 8**:** For 12- or 24-volt systems, connect DC minus line to terminal marked "-" and positive line to terminal marked "+."

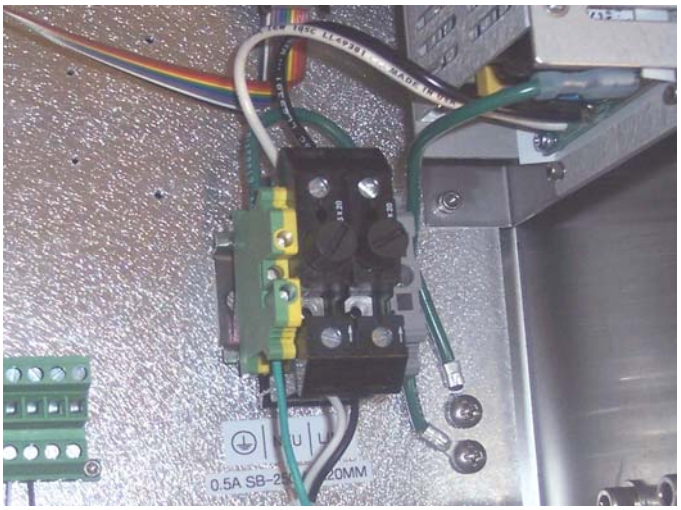


Figure 9**:** Connect AC neutral wire to terminal marked "NEU," and hot wire to terminal marked "LINE."

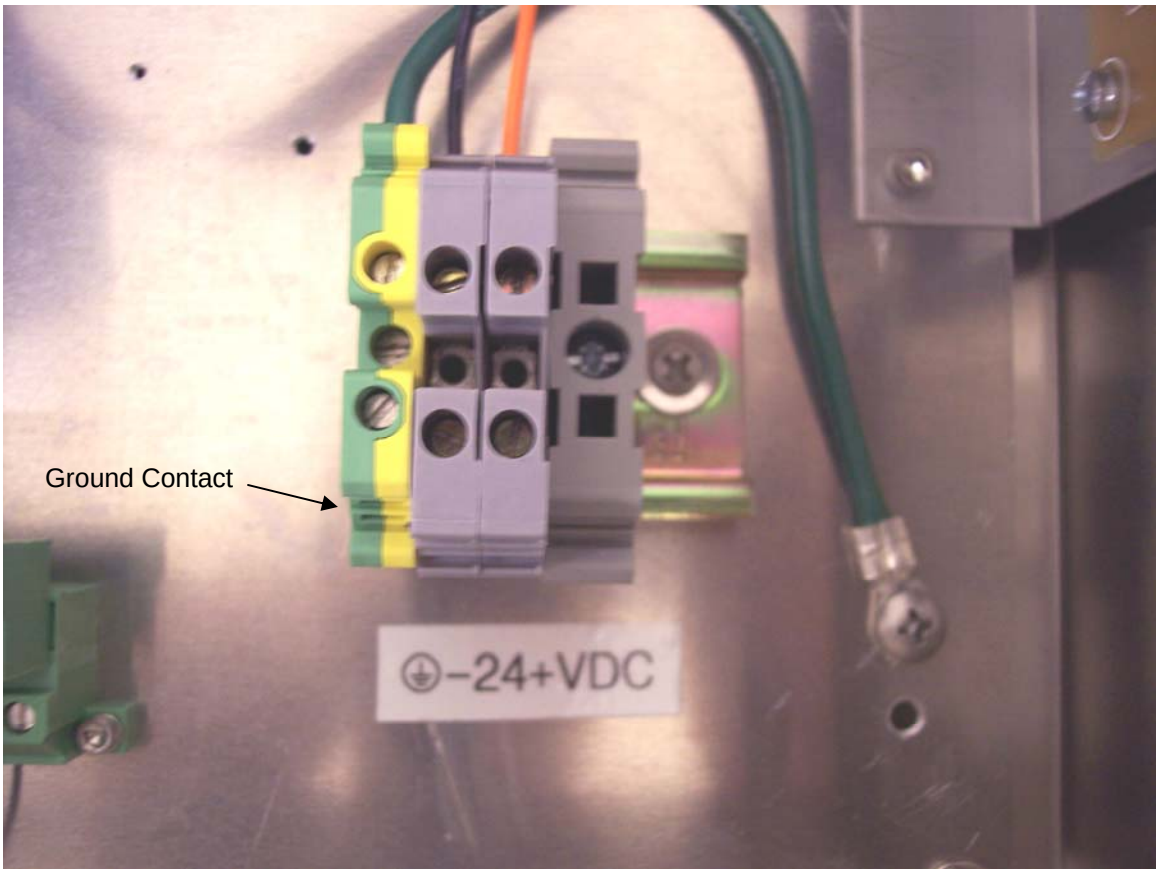


Figure 10**:** Connect the ground wire to the ground contact in the lower right corner of the enclosure.

Connecting the Output Signals

The 4-20mA (milliampere) current loop and serial outputs are supplied from a mating terminal block inside the analyzer. Connections can be made with customer-supplied cables running into the enclosure through a ½" conduit connected to the ½" knockout on the bottom left side of the analyzer.

Be sure power to the analyzer is turned off before opening the gas sensor enclosure and making any connections.

The 4-20mA current loop outputs are factory set to source current.

To connect the 4-20mA output:

1. Disconnect power from the analyzer and open the enclosure cover. Do not to disturb the electrical assembly inside.
2. Install a ½" conduit hub into the knockout located at bottom left side of the analyzer (see **Figure 11** on page 24). The conduit hub should be rated NEMA 4X.

3. Run conduit from your signal-receiving station to the conduit hub.
4. Pull the signal cable through the conduit into the enclosure.
5. Strip back the jacket and insulation of the signal cable just enough to connect to the mating terminal block.
   The mating terminal block can be pulled up from its base to make the cable connection easier (see **Figure 12** on page 24). **Table 5** shows the terminal number for each of the output signals. Note that there is a single ground connection shared by the serial signals (pin-3). The table also shows the corresponding pin number on the nine-pin Sub-D connector of a computer serial port. Use a separate cable for each channel.
6. Connect the output wires to the desired terminals (see **Figure 13** on page 24).
7. Reinsert the matting terminal block into the base and verify that the terminals are tight (see **Figure 14** on page 25).
8. Close and tighten the enclosure cover.

After power-up, you can scale the current loop receiver using the procedure outlined in a later section of this manual.

Terminal	Description	D-Con
1	Ch. A Serial RX	Pin-3
2	Ch. A Serial TX	Pin-2
3	COM Serial Ground	Pin-5
4	Ch. B Serial RX	Pin-3
5	Ch. B Serial TX	Pin-2
6	Ch. A Current Loop +	
7	Ch. A Current Loop -	
8	Ch. B Current Loop +	
9	Ch. B Current Loop -	

Table 4: Output signal connections

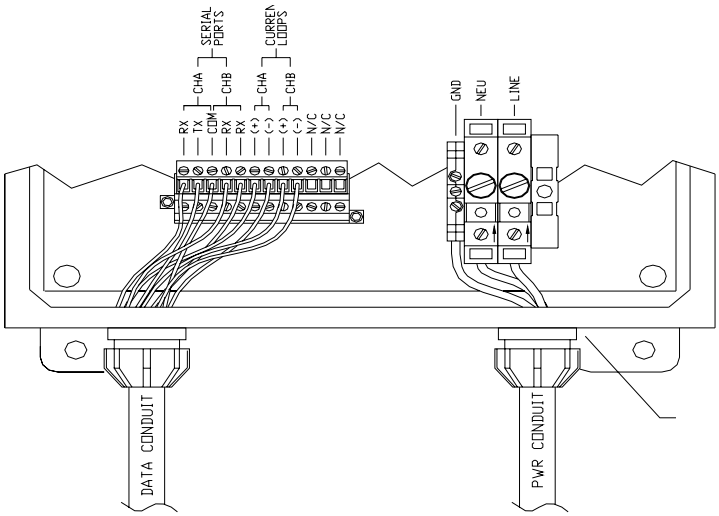


Figure 11: Signal and power connection diagram showing customer supplied conduits and hubs.

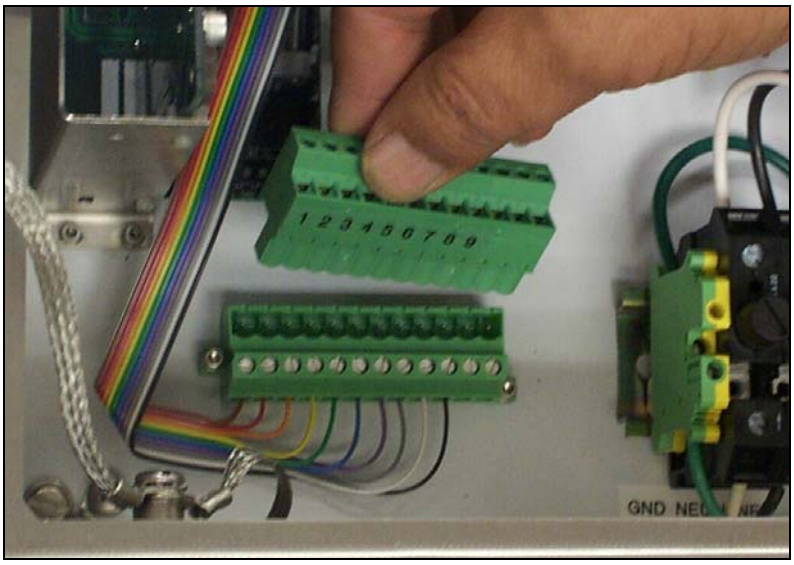


Figure 12**:** Remove the mating terminal block from base by hand

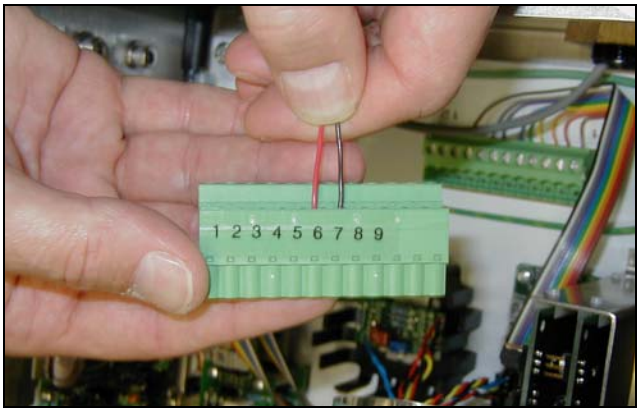


Figure 13**:** Insert signal wires into terminals

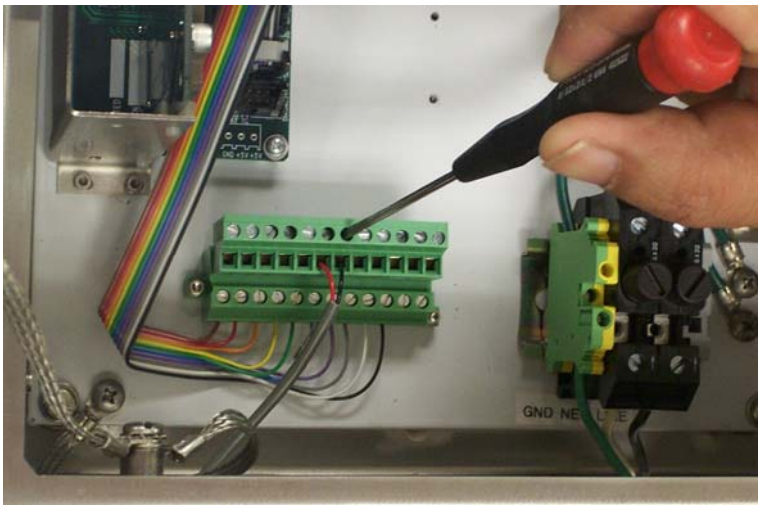


Figure 14**:** Replace block on base and check to make sure all terminals are connected tightly.

To connect the serial output (SS500, SS2000, and SS3000 Channel A)

1. Feed the wire ends of the SpectraSensor external serial cable (included in the shipping box) through the ½" knockout located on the bottom left side of the analyzer.
2. Remove the green terminal block connector.
3. Insert the black wire (RX) into terminal 1.
   For the SS3000, Channel B, insert the black wire into terminal 4.
4. Insert the red wire (TX) into terminal 2.
   For the SS3000, Channel B, insert the red wire into terminal 5.
5. Insert the shield wire (ground) into terminal 3.
   Same for the SS3000.
6. Tighten the terminal block connector screws.
7. Replace the green terminal block connector.
8. To complete the connection, attach the other end of the external serial cable to the serial port connector located on the back of your computer.

Powering Up Sequence

After mounting the analyzer, connecting the gas sampling lines and checking for leaks, and connecting the (optional) output signal wires, you are ready to power up the analyzer.It is possible to apply AC power or DC power (9-16 or 18-32) before the gas lines are connected to ensure the analyzer is functional, but ambient air contains levels of water vapor that are much higher than the instrument is designed to measure. Therefore, valid H_2O readings cannot be obtained until sample gas is flowing through the sample cell.

There are two fuses located inside the black terminal blocks at the bottom right-hand side of the chassis (AC-powered unit). For the DC-powered analyzer, there is one fuse located on the power supply. If you need to replace a fuse, use only the same type and rating of fuse as the original.

Power up the Analyzer:

Power up the analyzer by energizing the circuit to the analyzer.

The system goes through a 15-second initialization period. The LCD on the keypad displays the word "**Initializing**" and then starts counting down from 15. The keypad does not respond during this time. Allow three additional minutes for the analyzer to stabilize before recording measurements.

Continuous updates of the measurement parameters displaying on the LCD indicate that the analyzer is operating normally (see **Figure 15**). The LCD displays four lines, the third of which is blank.

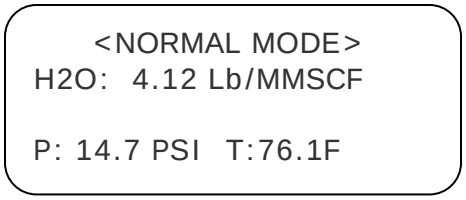


Figure 15**:** LCD on the keypad displays normal operational mode <Normal Mode>

Receiving Serial Data (RS-232 Output)

The RS-232 output transfers a string of data from the analyzer to a serial device. The serial device is typically a computer terminal running HyperTerminal, which is a program included with Microsoft® Windows® that allows for capturing serial port data.

SpectraSensors also provides a single software program, SpectrumPlot II, which allows an operator to perform all of the diagnostic functions for SpectraSensors' moisture analyzers. Refer to the instruction sheet included in the shipping box for more information. For analyzers with the ModBUS option, refer to the instruction sheet included in the shipping box.

To launch the HyperTerminal program, go to your computer desktop and click on the following:

- My Computer icon (usually located on the top, left side of desktop)
- C drive
- Program files
- Windows NT
- Hypertrm.exe

For quick access to HyperTerminal:

- Either save a HyperTerminal shortcut to the desktop or:
- From the **Start** menu located at the bottom left side of your computer desktop, click **Search**.
- Type in “hypertrm” in the **For files or folders** search dialog box.

Once HyperTerminal is activated, choose a name to save file as and any icon. The system prompts for Port Settings. Choose the appropriate port to which your analyzer is connected. The Port Settings should reflect the configurations in **Figure 16**.

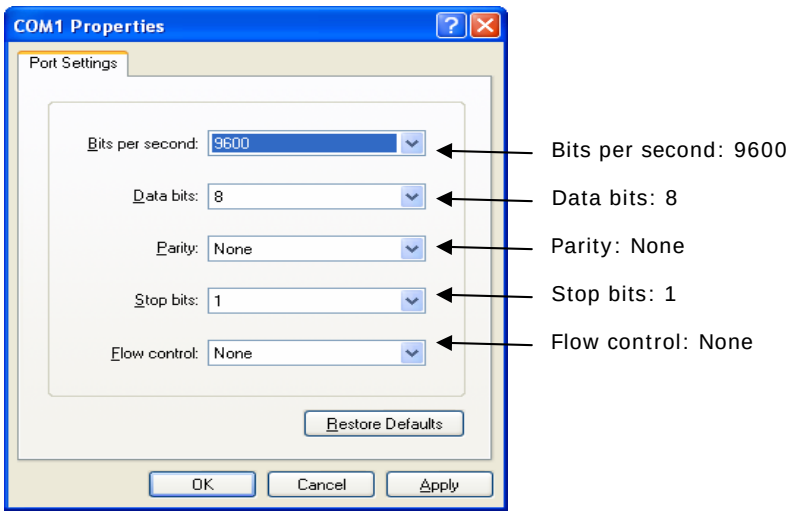


Figure 16: COM port settings

Reading the Data

If the analyzer is connected to the serial device as described on page 22, the data can be reviewed. The data string is space-delimited with a carriage return at the end of each line. The application arranges the data output in a column format from left to right in the following order (**Figure 17**):

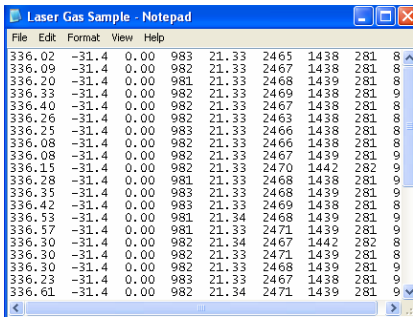


Figure 17: Data output

- Channel A concentration
- Dew Point in Sample Cell
- Channel B concentration
  (zero if Channel B is not present)
- Pressure
- Temperature
- PP2F value
- Power value
- Peak Position (Index)
- Null (Zero)

*For saving this data to a text file see Reading Diagnostic Data With HyperTerminal.

Calibrating the Analyzer is not Required

There is no need to adjust parameters (RCalb or Zero Offset) in the field other than the measurement units. SpectraSensors calibrates the analyzer to a National Institute of Standards and Technology-traceable standard. Unlike aluminum oxide or electrolytic sensors that are in contact with the sample gas, SpectraSensors uses a non-contact form of measurement that shines through the sample cell; no sensors come into contact with the gas. In addition, drift or contamination from contaminants, such as glycols or amines in the gas phase, is not possible.

However, zero offset drift may occur with any Spectrasensors analyzer that contains desiccant in the optical head. Depending on the environment, the ability for the desiccant to absorb moisture may reduce over time, most likely after the recertification interval of three years. For correct procedures to adjust the zero offset, see troubleshooting.

Note that any calibrations must be performed with the same type of background gas that is used in normal operation. For example, the natural gas analyzer cannot be calibrated using moisture in nitrogen or air standard. It must be calibrated using moisture in natural gas.

OPERATING THE ANALYZER

The SS500, SS2000, and SS3000 are specifically designed to measure levels of H_2O and CO_2 in a gas stream. They also report the temperature and pressure of the sample gas in the sample cell.

Although an analyzer can easily be dismounted and moved from one sampling station to another, it is designed to be a stationary measuring device. It should be securely mounted during normal operation. For portable applications, use the SS1000 instead.

Opening the main enclosure cover is required for installation only. Thereafter, you will rarely need to open the cover of the main enclosure for inspection or maintenance. Subsequent to installation, do not open the enclosure for this purpose unless directed to do so by a service representative. Do not open the sample cell assembly.

The laser housing labels on the flanges of the sample cell warn about exposure to laser radiation inside. Never open the sample cell unless the analyzer power is turned off.

The optical head and "Warning" sticker on the optical head assembly have seals on them to prevent inadvertent tampering with the device. Do not attempt to compromise the seal of the optical head assembly. Doing so will result in loss of device sensitivity and inaccurate measurement data. Repairs can then only be handled by the factory and are not covered under warranty.

Using the Keypad

The keypad allows the operator to modify certain parameters that control the analyzer, like change measurement units and calibration, and perform diagnostics. However, once the analyzer is installed and operating normally, there should be no need to alter the operational parameters. The LCD continuously displays measurements of H_2O and/or CO_2, temperature, and sample cell pressure. For dual channel H_2O systems, the LCD displays Channel A and Channel B.

Keypad Instructions

To activate any functions on the keypad, press the mode key **#**, and then press a number on the keypad to specify a mode or press the **test** key to display system test parameters (see **Figure 18** on page 30).

You must press the mode key # before pressing a number or function key to trigger a response from the keypad.

When you press the mode key **#**, the word **MODE** displays on the LCD. At this point, the analyzer waits for you to press a second key.

The ***** key functions as the "enter" key. The analyzer saves the displayed parameter value when you press this key. Always press ***** after entering a value on the keypad unless the entry was made in error.

If you do make an error, press **#1** to return to the normal mode without saving.

Modes and Functions Defined

Use the keypad to access the following modes by pressing the mode key **#** first and then pressing a number (1, 2, 3, 4, 5, or 6) to activate a mode or **test** for error status information. The mode definitions are:

- **Mode 1** - Normal display mode
- **Mode 2** - Provides change of parameters for Channel A
- **Mode 3 -** Provides change of parameters for Channel B **(SS3000 only)**
- **Mode 4** - Displays system diagnostic parameters for Channel A
- **Mode 5** - Displays system diagnostic parameters for Channel B **(SS3000 only)**
- **Mode 6** - Outputs spectra and calculations to serial ports
- **Mode Test** displays system error status

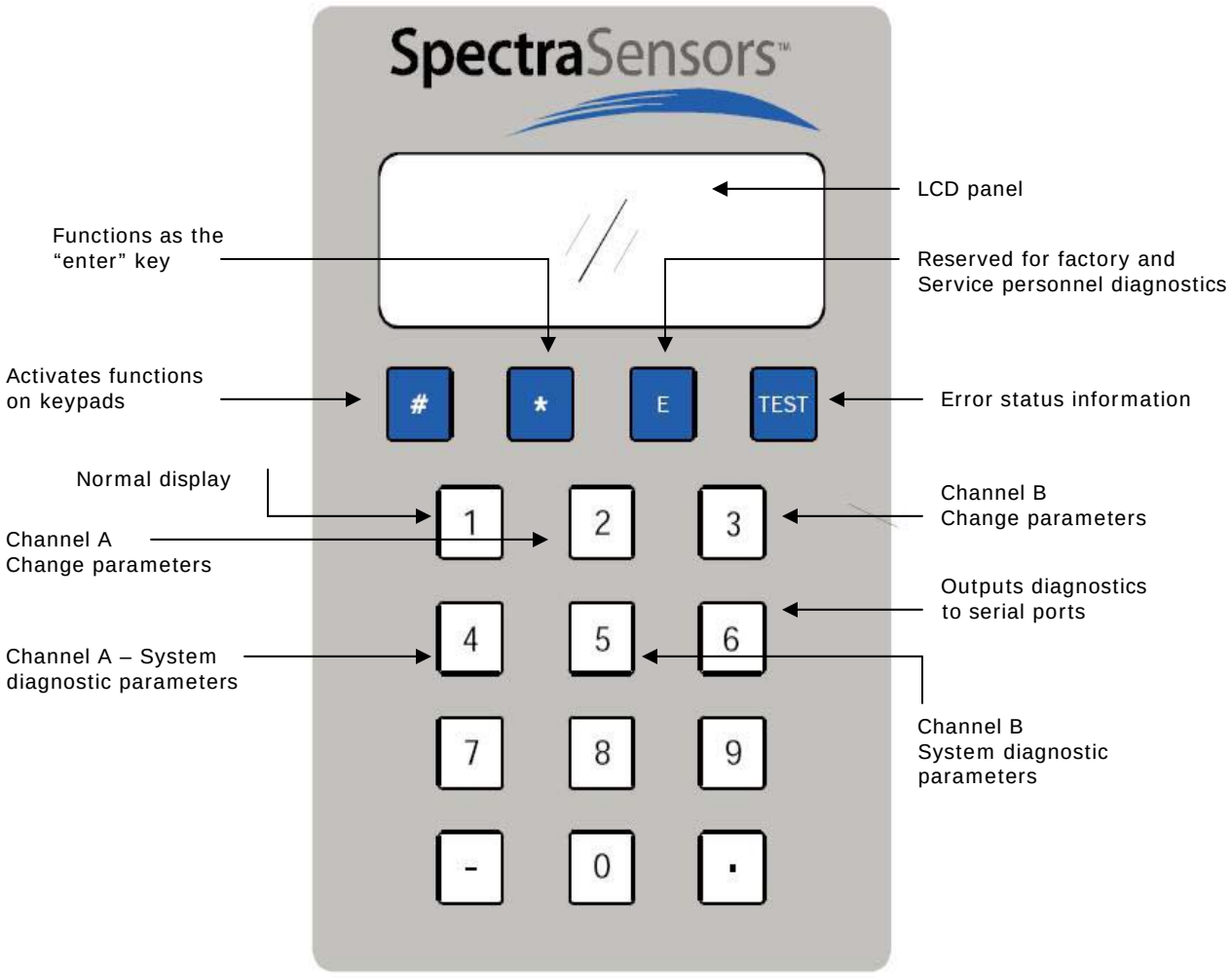


Figure 18: SS500/2000/3000 keypad

Using Modes and Functions

The following section explains each mode and the information that displays on the LCD.

Mode 1: Normal Display: Continuously displays updated measurements.

+ **1**

<NORMAL MODE>
ChA: 4.12 Lb/MMSCF

P: 14.7 PSI T: 76.1F

SS500/SS2000

<NORMAL MODE>
ChA: 4.12 Lb/MMSCF
ChB: 1.33
P: 14.7 PSI T: 76.1F

SS3000

ChA: Water vapor concentration in units selected in Mode 2.

Note that for the SS500 units the display will show <1.8 lb/mmscf (<38ppmv) when concentrations are below the lower limit of measurement

ChB: Concentration (H_2O or CO_2 depending on model number) in units selected in Mode 3.

P: Pressure in the Channel A sample cell in units selected in Mode 2.

T: Temperature in the Channel A sample cell in units selected in Mode 2.

Mode 2: Channel A Measurement Parameter Change: Allows you to view and change Channel A (usually H_2O) measurement parameters (see **Table 6** on page 32).

+ **2**

After pressing the **#** key and then the **2** key, the LCD prompts for a numeric password.

Enter the user password (**3142**) on the keypad, then press the ***** key to enter the number.

<SET PARAMETER MODE>
Spectrum Average
4
Enter a Value

SS500/SS2000/SS3000-Channel A

<REMOTE SET PARA>
Spectrum Average
4
Enter a Value

SS3000-Channel B

The user password is 3142, the first four digits of the value of π. Although the user password allows the calibration to be changed by setting the Zero Offset or RCalb parameters, this is not recommended. The factory calibration should not need to be changed in the field. Before attempting to change the calibration, contact the factory for advice on calibration changes.

This matrix provides the Channel A (usually H_2O) measurement parameters, which can be viewed and changed by following the instructions previously noted.

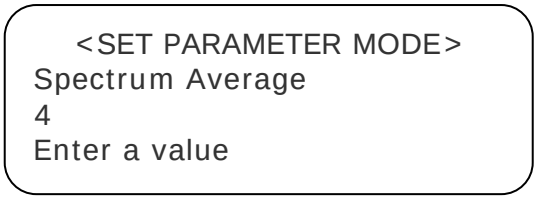
Parameter	Setting	Function
Spectrum Average	1 – 10 default = 4	Sets the number of scans that are averaged for each display reading.
RCalb*	3000 – 5000 H_2O 500 – 1500 CO_2	Sets the gain calibration for H_2O or CO_2 measurements.
Alarm Action	0 or 1	Determines if the concentration values go to full scale or “0” on an alarm condition.
Zero Offset*	0 – 100 ppmv for H_2O, 0 - 1% for CO_2	Sets the zero offset for H_2O or CO_2 measurements.
Logger Rate	1 – 300 readings default = 4	Sets the display and current loop integration time to match data logging interval.
Temperature unit	0 or 1	Sets the display unit for temperature.
Pressure unit	0,1,2, or 3	Sets the display unit for pressure.
Concentration unit	0 or 1	Sets the display unit for the water concentration.
Peak Tracking	0 – 2	Sets peak tracking capability to be off, on, or reset.

*Parameter affects the calibration

Table 5: Typical values for parameter set points

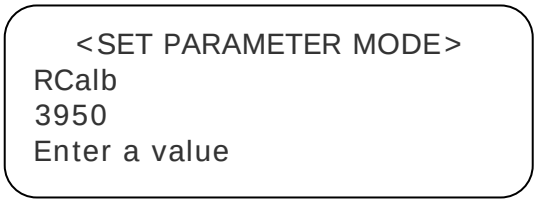
Changing parameters for Mode 2.

Spectrum Average



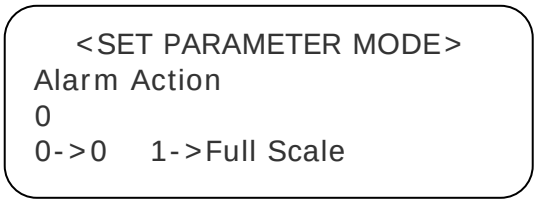
This value is the number of scans that the analyzer averages for a spectrum calculation. The more spectra averaged, the less the noise, but the longer the response time. Each scan adds about 0.25 seconds to the response time. For example, if the Spectrum Average is set to "4," an updated concentration value will be calculated about once per second. Enter a value from 1 to 10. Pressing the ***** key enters the value and cycles the LCD to the next parameter.

RCalb



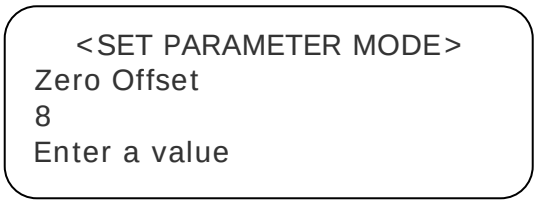
RCalb is the gain calibration factor for the concentration measurement. This number should not be changed from the factory setting unless calibration equipment is available and a full calibration procedure is followed. Press the * key to enter the value and cycle to the next parameter.

Alarm Action



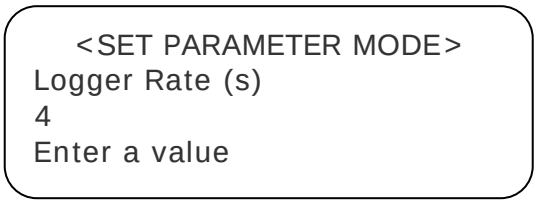
This parameter determines whether the current loop output value is set to "0" or "Full Scale" in the event of an alarm condition. Press the value for the action desired and then press the ***** key to enter the value and cycle the LCD to the next parameter.

Zero Offset



For concentration measurements, it is necessary to compensate for small amounts of background gas that absorb some laser light and introduce an offset into the measurements. This number should not be changed from the factory setting unless calibration equipment is available and a full calibration procedure is followed. For zero offset adjustments, consult factory. For both H_2O and CO_2 channels, the zero offset is in PPMV. Press the * key to enter the value and cycle to the next parameter.

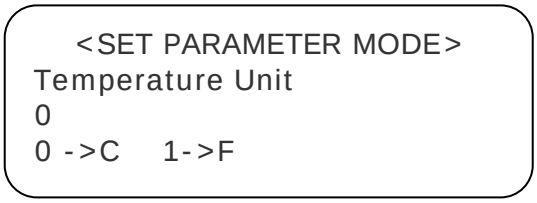
Logger Rate



For applications where an external data logger is used, use the logger rate to set the averaging period used by the analyzer to match the data logger rate. The display and the current loop output will have a value equal to the average of the concentration over the last interval determined by the Logger Rate. For example, if the Spectrum Average is set to “4”, there will be a new measurement of concentration taken every one second (Spectrum Average * 0.25sec). By setting the logger rate to “60”, the display value and current loop output will average over the previous 60 seconds. If the data logger samples the loop current each 60 seconds, it will always see the average concentration over the interval since its last sample.

Enter a numeric value (in readings) and press the ***** key to enter the value and cycle to the next adjustable parameter.

Temperature Unit



Choose either “C” or “F.” to have the analyzer display data in a specific temperature unit. The default value is the standard unit of measurement in the region the analyzer is being used. Press the value for the units you desire. Pressing the ***** key enters the value and cycles to the next parameter.

Pressure Unit

<SET PARAMETER MODE>
Pressure Unit
3
Enter a value

The Pressure Unit parameter, which measures absolute pressure, provides four choices for displaying the pressure measurement:

- **0** for millibar
- **1** for Torr
- **2** for Pascal
- **3** for PSIA

Pressing the ***** key enters the value and cycles the LCD to the next parameter, Concentration Unit.

Concentration Unit

<SET PARAMETER MODE>
Concentration Unit
1
0:ppmv 1:lb/mmscf

This parameter provides two options for displaying water concentration units:

- **0** for ppmv
- **1** for Lb/mmscf

Pressing the ***** key enters the value and cycles the LCD to the next parameter.

Note: This parameter is disabled for the CO_2 unit, which always displays in percentage.

Peak Tracking

<SET PARAMETER MODE>
Peak Tracking
1
0:Df 1:Track 2:Reset

The peak tracking function allows the software to continuously adjust the laser current to keep the water absorption peak at the center of the scan. In most cases, the peak tracking should be left on (set to 1). If “tracking error” is displayed or PkD1 is more than four counts different from PkDf, reset the peak tracking feature by pressing 2.

This parameter provides three options to control peak tracking:

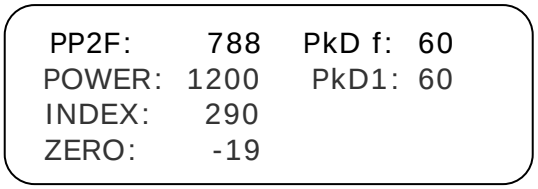
- **0** to shut off peak tracking
- **1** to turn on peak tracking
- **2** to reset peak tracking

Pressing the ***** key enters the value. This is the last parameter. Press the mode key **#** followed by **1** to return to Normal mode.

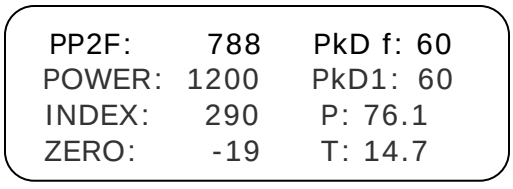
Mode 3: Measurement Parameter Change for Channel B: Mode 3 allows the operator to access and change parameters for the second channel (either CO_2 or H_2O) in the same manner Mode 2 is used to alter the parameters for the first channel. The menus for Mode 2 and Mode 3 are identical. **(Model 3000 only)**

On a Model SS500 or SS2000, the Normal mode displays.

Mode 4: System Diagnostic Parameters for Channel A: Mode 4 displays system diagnostic data for Channel A. These values may be useful when troubleshooting the system.



SS500/2000



SS3000

PP2F: Shows the value of the concentration signal in A/D counts. A normal range is 0 to 6000 depending on the concentration of water present.

Power: Shows the laser power detected at the absorption peak in A/D counts. Acceptable values are between 300 and 3000. A number below 1000 may indicate that either the optics need to be cleaned or there is an alignment problem. A value below 300 will cause a "Power Fail error."

Index: Shows the position of the absorption peak within the wavelength scan. It should normally be at 290 with the peak tracking turned on. Values outside of the range of 241 to 339 indicate a Spectrum Fail error condition.

Zero: Shows the detector signal value when the laser is turned off. It should be in the range of –40 to +40. Outside of this range, a "Null Fail error" displays.

PkDf: The factory laser current setpoint in mA that matches the target absorption line.

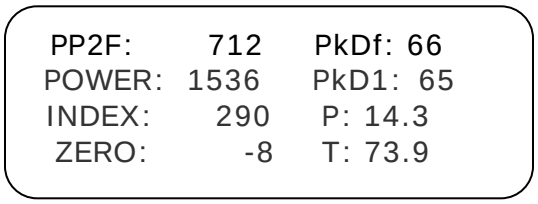
PkD1: The laser current setpoint after adjustment by the peak-tracking software. It should be within a few mA of the PkDf value. If the analyzer is experiencing problems, one of the first troubleshooting steps should be to check the peak tracking.

"Tracking error" may be displayed if PkD1 differs by more than 4 mA from PkDf.

For more information on troubleshooting these issues, see Troubleshooting on page 45.

Mode 5: System Diagnostic Parameters for Channel B: Displays the System Diagnostic Parameters for Channel B **(Model SS3000 only).**

The description and normal ranges are the same as for Mode 4.



SS3000

If you select this mode in an SS500 or SS2000, the analyzer will return to Normal mode.

Mode 6: Diagnostic Data Download: Used to transfer diagnostic data to the serial ports and read the individual data points of both the DC and 2F spectra that the instrument analyzes to calculate the gas concentration.

Viewing these data can be helpful in diagnosing problems with the analyzer. The data points, along with intermediate calculation results, are output to the serial ports whenever

Mode 6 is selected. The data for Channel A is output on the Channel A serial port and the data for Channel B (in Model SS3000 analyzers) is output on the Channel B serial port.

Mode Test: The **TEST** key provides basic diagnostic test results for laser power, pressure, and temperature sensors, and the infrared spectrum that the system records for analysis.

The LCD displays the following for a SS3000:

```
        <TEST MODE>
ENTER SELECTION

1= CHA   2= CHB
```

In the case of a SS500/SS2000 single channel system, this screen is not shown and one of the screens below displays instead.

To view the Channel A data, press **# 1** and the LCD displays the following:

```
      <CHA SYSTEM TEST>
LASER POWER: OK
P,T SENSORS:   OK
SPECTR:OK       NULL:OK
```

To view the Channel B data, press **# 2** and the LCD displays the following:

```
      <CHB SYSTEM TEST>
LASER POWER: OK
P,T SENSORS:   OK
SPECTR:OK       NULL:OK
```

If a failure is detected, the LCD displays "FAIL" for that component. If the LCD displays a failure for one or more of the components, refer to the Troubleshooting section.

Scaling and Calibrating the Loop Signal

The 4-20mA current loop signal is most conveniently scaled and calibrated at the receiving end (RTU, flow computer, etc.). The analyzer's current loop output is forced to 4mA and 20mA and the receiver is adjusted to read "0" or full scale (usually 20 lb/mmscf).

Be sure to work in a non-hazardous area while handling this connector.

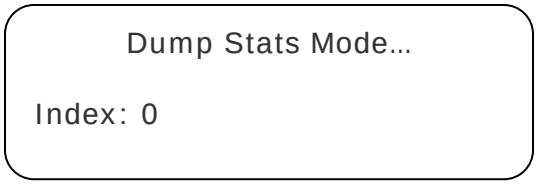
To Scale the Current Loop Signal:

1. Make sure the current loop is connected and the receiver is set for the analyzer to source the current.
2. Force the analyzer into an error condition by disconnecting the small inline circular connector on the cable coming from beneath the insulation on the sample cell. When the cable is disconnected, the display shows **P/T Fail Error** and the moisture concentration changes to either **0** or **full scale**.
3. Changing the **Alarm Action** setting changes the display and output states. To change the **Alarm Action** settings, enter the **Set Parameter** mode by pressing the **#** key and then the **2** key (for Mode 2). When prompted for a password, press **3142** and the ***** key to enter the number.
4. Press the ***** key multiple times until **Alarm Action** displays.
5. Press the **1** mode to force the loop current to 20mA, or **0** to set the loop current to 4 mA when an **Error** is present.
6. Press the ***** key to enter the setting. Press the **#** key and then press the **1** key to return to the display of **P/T Fail Error**.
7. Adjust the receiver calibration control to read the appropriate value. **4 mA always represents zero concentration.**
8. Reset the **Alarm Action** to the opposite state and adjust the receiver calibration controls for the new state. If needed, repeat steps 5–8 to obtain an accurate calibration over the range.
9. After obtaining an accurate calibration, reconnect the temperature connector to restore the normal function of the analyzer.

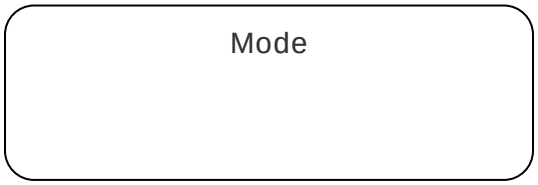
Reading Diagnostic Data With HyperTerminal

Any computer terminal program that works with the RS-232 serial port can capture the serial port data. The HyperTerminal program included with Microsoft Windows® is a typical example of such a program. Before entering Mode 6, the serial port should be connected to the computer used for monitoring the serial port and the output stream should be showing on the screen. The number of seconds between each line of data output should be the Spectrum Average number set in Mode 2 divided by 4. The factory default setting of Spectrum Average of 4 gives a line of output each second. To save the data from the serial port, use the capture feature on the terminal program. (For HyperTerminal, use the **Transfer/Capture Text** function and enter a file name to identify the data you want to capture.) Once capturing is in place, enter Mode 6.

Press **# 6**, which displays:



The index counts by 50's from 0 to 511 in a few seconds and the screen displays:



Press **1** to return to normal operation. When normal operation resumes, stop the capture of the serial data. (For the HyperTerminal program, press **Transfer/Capture Text/Stop**.) You can import this file into a spreadsheet program such as Microsoft® Excel® to plot the data. See the next section for more information.

At the end of the spectrum data, a section displays the intermediate calculations. This information is important to retain if the analyzer needs to be returned to the factory for troubleshooting.

Reading Diagnostic Data with Microsoft Excel

A spreadsheet program such as Microsoft Excel can view the data collected in the Mode 6 data dump. The data file is space-delimited and tab-delimited.

To import the file into Excel:

1. In Excel, click **Open** and choose the name of the spectrum file saved in Mode 6. Be sure to select File type "all" (*.*).
2. The Text Import Wizard opens; choose the **Delimited** option and click **Next**.
3. Choose **Tab** and **Space** options, along with selecting the **Treat consecutive delimiters as one box**, and then click **Finish**. The spreadsheet displays. The first few lines look like the normal serial output data received before the Mode 6 command was entered in the SS2000. Look for the row that has the cells: **Idx—DC-AC**.
4. Move the cursor to the first cell under **AC**. Select the three columns by 512 rows. (Hold the shift key down and press the **End** key. Hold the shift key down and press the **Down arrow** key. This highlights the **AC** column.) Keep holding down the shift and press **End**, then left arrow. This should highlight all three columns.
5. Click the **Chart Wizard** button  on the Task Bar.
   The **Chart Wizard** displays.
6. Choose the **X-Y (scatter)** chart type and click **Finish**.
   A graph of the spectrum displays. If the lower-red curve is very flat, double click on it, select the **Axis** tab, and select **Plot series on Secondary Axis** (see **Figure 19** on page 41).

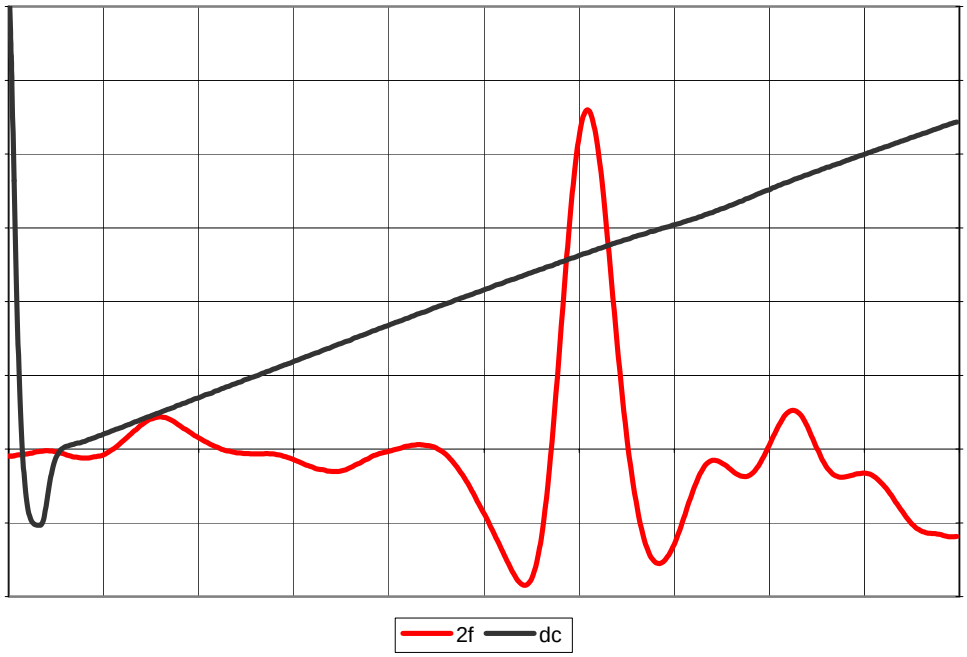


Figure 19: Mode 6 data dump displayed in graphical format using Excel

Using SpectrumPlot II Software

Using a single program, SpectrumPlot II, you can perform the following diagnostic functions for SpectraSensors' moisture analyzers:

- Continuously viewing the serial output stream
- Capturing downloaded data
- Viewing and saving captured data
- Viewing previously archived data

System requirements:

- Windows 98®, 2000®, XP® operating systems
- Serial Com Port
- > 1024 x 768 screen resolution

To install the software:

1. Load the SpectrumPlot CD-ROM onto your computer.
2. In the CD-ROM drive, double-click the **Installer** folder.
3. Run setup by double-clicking **setup.exe**.
   The installation screen displays.
4. Choose where to install the program.
   The default is C:\Program Files\SpectrumPlot_v2.
5. Click **Finish**.

To operate the software:

1. Connect the analyzer to your computer via a serial cable to receive data.
2. In the SpectrumPlot directory chosen during installation, double-click **SpectrumPlot_v2.exe**.
   The application should also add a shortcut to the Start menu.
3. Select whether you would like to receive data through the serial port.

   Yes, the application prompts for a COM port and streaming data should be visible in the textbox. This data contains both measurement and diagnostic data.

   No, the application is ready to view previously saved spectrum data.

The application will indicate an error if it can't access the COM port (another program may be using it). It will timeout if data isn't received within 30 seconds (no error indication).

4. To view spectrum, press **Clear** to first clear the graph and then press **# 6** on the analyzer keypad. Two plots display, **DC** on the left and **2F** on the right (see **Figure 20** on page 43).
5. Return to Normal mode **1**, otherwise the application will time out if data isn't received within a 30 seconds. In this case any initiated command such as "Open" will take place after 30 seconds.
6. To save the data, press the **Save** button, choose **Directory**, and specify file name.
7. To print the graphs, press the **Print** button.
8. To open a previously saved spectrum, press the **Open** button and choose **File**.

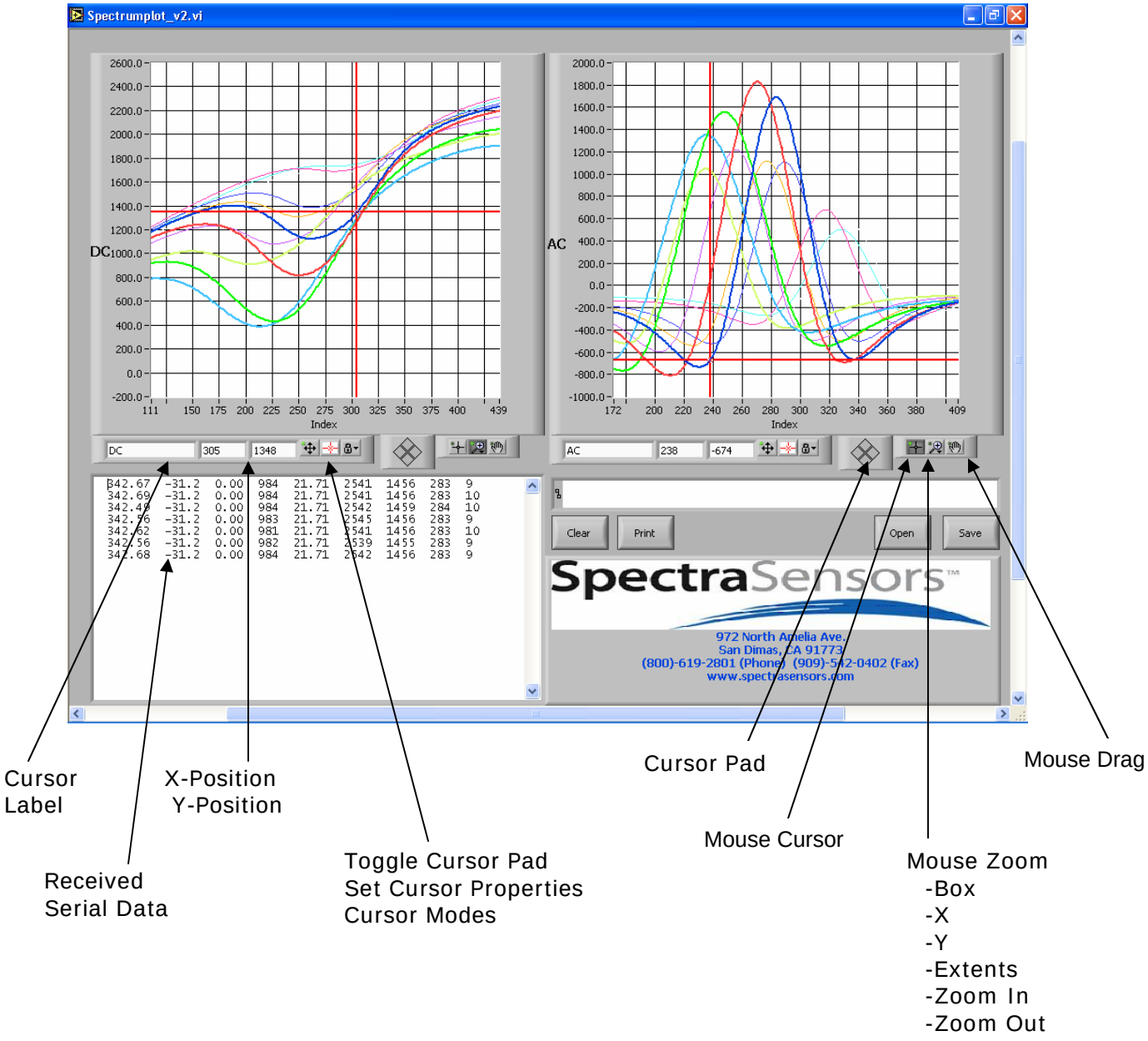


Figure 20: SpectrumPlot view

For additional functions and troubleshooting, please refer to the software instructions included on the Spectrum Plot software c.d.

How to Avoid Contaminating the Analyzer

Contamination in the gas sampling lines can contaminate the optics and absorption cell and cause problems. To keep the sampling lines clean and improve response at very low moisture:

1. Make sure that a membrane separator filter is installed ahead of the analyzer and operating. Replace the membrane if necessary. Small amounts of glycol or amine in the gas phase should not cause problems as they will be swept out of the sample region by the gas flow and they do not affect the measurement in any way. If liquid enters the cell and accumulates on the internal optics, a “Power Fail Error” displays.
2. Press **#** and then **TEST** on the keypad to activate the Test mode. Test mode will indicate a failure in laser power if the mirrors become contaminated.
3. Disconnect the gas sampling inlet line from the analyzer.
4. Wash the sampling line with alcohol or acetone and blow dry with mild pressure from a dry air or nitrogen source. It may be necessary to heat the lines for a few minutes to clear residual solvent from the lines.
5. Reconnect the gas sampling.

The sample cell assembly contains a low-power Class 3B invisible laser. Never open the sample cell flanges or the optical assembly unless the power is turned off.

Disconnecting or Powering-Down the Analyzer

To power-down the analyzer, disconnect power from the gas sensor circuit. There is no specific sequence beyond that step for shutting down the analyzer.

If the analyzer is going to be shut down for some time, it is recommended that the sampling gas line shut-off valve be turned off as well. Also, disconnect power to prevent damage from lightning strikes.

TROUBLESHOOTING

This section presents recommendations and solutions to common problems, such as gas leaks, high humidity, excessive sampling gas temperatures and pressures, electrical noise, and peak tracking problems. If your analyzer does not appear to be hampered by one of these related problems, see the **Table 7** on page 51.

Gas Leaks

Probably the most common cause of erroneous measurements is outside air leaking into the inlet sampling line. It is recommended the inlet lines be periodically leak-tested, especially if the analyzer has been relocated or if the analyzer has been replaced or returned to the factory for service and the sample lines have been reconnected. Never use plastic tubing of any kind for a sample line because water vapor can permeate the plastic lines.

Do not exceed 10 PSIG in the sample cell. Damage to the cell window may result.

High Humidity

High humidity or condensation of water in the sample lines may cause temporary high readings. If the analyzer is exposed to these conditions for long periods, sampling lines may take a long time to completely dry out. Allow sufficient time for the walls of the sample cell to dry completely so that the analyzer can return to its ability to make accurate measurements.

Humidity levels higher than expected may be caused by leaks in the sample system or tubing leading to the analyzer. All wetted parts should be made of stainless steel wherever possible. Materials such as vinyl, rubber, or PVC will dramatically impair the instrument's measurement performance and will interfere with accuracy. Pressure regulators installed upstream of the analyzer should be of high quality and fitted with stainless steel diaphragms.

Any hygroscopic material (dust or glycol) in the lines or sample cell can further increase the time needed to return the measurements to normal levels.

Contamination and long exposure to high humidity are valid reasons for periodically cleaning the gas sampling lines (as outlined in the How to Avoid Contaminating the Analyzer).

Excessive Sampling Gas Temperatures and Pressures

Errors can arise from sample cell temperature and pressure that exceed the ranges allowed by the software. These ranges are 0.7 to 1.7 bar (10.3 to 25.0 PSIA) for pressure and –20° to +50°C (4 to 122 °F) for temperature. Inlet sampling gas temperatures and pressures

must stay within these ranges in order to obtain accurate measurements. **P/T Fail Error** displays on the LCD outside this range.

If the pressure, temperature, or other readings on the LCD are suspect, they should be checked against the specifications in the Specifications sections starting on page 10.

Electrical Noise

High levels of electrical noise can interfere with laser operation and cause it to become unstable. Always connect the analyzer to a properly grounded power source.

Verification of Offset Parameter

If it seems the concentration values are off by a fixed amount above actual, the zero offset parameter may need to be adjusted. There are two ways to check if the zero offset parameter needs to be adjusted. The first is by using a dry gas sample (<1ppmv) consistent with the background gas the analyzer was designed to measure. The second way to perform a zero offset adjustment is by using a very reliable and efficient desiccant dryer. If and only if the analyzer reads more than four ppmv is it necessary to make any zero offset adjustments to the analyzer. Zero offset adjustments are made in whole ppmv increments. Access the parameter "Zero Offset" and add the amount measured to the existing value. For example, if after the reading on the analyzer stabilizes and it reads four and the current offset is eight, then the "Zero Offset" parameter should be changed to 12. For more information contact service at the factory.

Peak Tracking Reset Procedure

The analyzer's software is equipped with a peak tracking function that keeps the laser scan centered on the water vapor absorption peak. Under some circumstances, the peak-tracking function can get lost and lock on to the wrong peak. A large difference in the values of PkDf and PkD1 on the display in the Diagnostic Mode 4 can indicate such a problem. If the difference between PkDf and PkD1 is more than 4, or Tracking Error is displayed, the peak tracking function should be reset. To reset the peak tracking function for Channel A and B:

1. Enter the user parameter Mode **2**
2. Enter customer password: **3142**
3. Press the ***** key until the peak tracking parameter appears
4. Enter **2** (reset) to turn off the peak tracking
5. Press the ***** key to enter change
6. Press **# 1** to return to Normal mode

For Channel B, use the same procedure above except use Mode **5** to read the diagnostic data and use Mode **3** to set the parameters. This should restore the peak tracking function.

Instrument Problems

If the instrument does not appear to be hampered by gas leaks, high humidity, excessive sampling gas temperatures and pressures, electrical noise, or a peak tracking problem, refer to the Instrument Problems matrix before contacting your representative for service.

How to Resolve Potential Instrument Problems	
Symptom	**Response**
Non-Operation (at start up):	Is the power connected to both the analyzer and power source? Is the switch on?
Non-Operation (after start up):	Is the power source good? (100 to 250 VAC @ 50-60 Hz, 9-16 VDC, 18-32 VDC).
	Check fuse(s).
	Contact sales representative for further troubleshooting.
Power Fail Error	Verify power failure by pressing **# 4** and checking the DC value. If it is greater than 500, then the Power Failure is spurious. Return to **# 1** and see if the error has changed.
	If the power is less than 50, turn off the power to the unit and check the optical head cables for a loose connection. **Do not disconnect or reconnect any optical head cables with the power connected.**
	Check the inlet and outlet tubes to see if they are under any stress. Remove the connections to the inlet and outlet tubes and see if the power goes up. Perhaps the existing tubing needs to be replaced with stainless steel flexible tubing.
	Capture a data dump (**# 6**) and send the file to SpectraSensors.
	Possible Alignment problem.
	Possible mirror contamination issue, contact sales representative for service information.

How to Resolve Potential Instrument Problems	
Symptom	**Response**
Display shows Null Failure	Verify Null failure by pressing **# 4** and checking the zero reading is outside the range of –40 to 40. If not, the Null Fail is spurious. Return to **1** and see if the error has changed.
	Move the jumper JMP1 on the HC12 main board next to the Pre-pot.
	Capture a data dump (**# 6**) and send the file to SpectraSensors.
Spectrum Fail Error	Verify Spectrum Failure by pressing **# 4** and checking the index value. If it is within a few counts of xleftvmr or xrightvmr, then it is a real Spectrum Failure.
	Check optical head cable connections. **Do not disconnect or reconnect any optical head cables with the power connected.**
	Turn the analyzer off for 30 seconds and then turn it on again.
	Reset the peak tracking.
	If the index is within a few counts of xleftvmr, then decrease the midpoint value by three mA. (This is most likely if the unit is either very hot or very cold compared to the normal operating temperature.)
	If the index is within a few counts of xrightvmr, then increase the midpoint value by three mA. (This is most likely if the unit is either very hot or very cold compared to the normal operating temperature.)
	Capture a data download (**# 6**) and send the file to SpectraSensors.
Front panel display is not lighted and no characters appear	Check for correct voltage on terminal block input. Observe polarity on DC powered units.
	Check for correct voltage after fuses.

How to Resolve Potential Instrument Problems	
Symptom	**Response**
	Check for 5VDC on red wires and 12VDC on yellow wires from power supply (black wires are ground).
	Check connections on display cable.
Front panel display is not lighted and characters appear	Check for 4.3 VDC on pin 15 of J2 going to the display.
Strange characters appear on front panel display	Check connections on display cable.
Pressing keys on front panel do not have specified effect	Check connections on keypad cable.
No reading on device connected to current loop	Make sure that connected device can accept 4-20 mA signal from SpectraSensors. The analyzer can only source current.
	Make sure the device is connected to the correct pins on the green connector.
	Check the open circuit voltage across the current loops pins 6 and 7 (Pins 8 and 9 as well for the SS3000) on the green connector.
	Replace the current loop device with a milliampere meter and look for current between 4 mA and 20 mA. A voltmeter connected across a 250-ohm resistor can be used instead of the milliampere; it should read between 1 and 5 volts.
	On two channel units, swap the cables to the two current loop boards and see if the problem moves from one channel to the other.
Reading is stuck at 4-mA or 20-mA	Check display for error message.

How to Resolve Potential Instrument Problems	
Symptom	**Response**
	On the current loop board, check the voltage between the end of the resistor R1 closest to the jumper and ground. If the water reading is high, the voltage should be near 1VDC. If the water reading is low, the voltage should be near 4.7VDC. If not, the problem is probably on the HC-12 main board. Return to factory for service.
Reading seems to always be high by a fixed concentration	Increase the value of Zero Offset by the amount the reading is high in ppmv (1 Lb/mmscf = 21.1 ppmv). This will lower the reading.
	If the Zero Offset needs to be increased above 40, then the optical head is probably leaking and the unit must be returned to the factory for repair.
	See Verification of Offset Parameter.
Reading seems to be high by a fixed percentage of concentration	Increase the value of RCalb by the same percentage that the reading is high.
Reading is erratic or seems incorrect	Check for contamination in the sample system, especially if the readings are much higher than expected.
	Capture a data dump (**# 6**) and send the file to SpectraSensors.
Reading goes to “0”	If **Alarm Action** is set to **0**, look on display for an error message.
Reading goes to full scale	If **Alarm Action** is set to **0**, look on display for an error message.
	Gas concentration is greater than or equal to full scale value.
Serial Output is displaying garbled data	Make sure the computer COM port is set for 9600 baud, 8 data bits, 1 stop bit, no parity, and no flow control.
Serial Output is providing no data	Make sure the computer COM port is set for 9600 baud, 8 data bits, 1 stop bit, no parity, and no flow control.

How to Resolve Potential Instrument Problems	
Symptom	**Response**
	Make sure the connections are good. Verify the correct pin connections with an ohmmeter.
	Make sure the cable is plugged into the correct COM port that is selected by the terminal program.
PT Fail Error	Verify actual error by pressing **# 1** until the error message does not change.
	Check that the middle cable on the top of the unit is tight. Remove and reconnect the cable.
	If the pressure reading is incorrect, check the connector on the pressure transducer. Check the pressure connector on the backplane board.
	If the temperature reading is incorrect, check the connector on the cell temp sensor. Check the temp connector on the backplane board. (Note: A temp reading greater than 150C indicates a short circuit on the temp-sensor leads; a reading of less than –40°C indicates an open circuit).
LCD does not update. Unit is locked up.	Switch off power, wait 30 seconds, and then switch power back on.

Table 6: Instrument problems matrix

Service Contact

If the troubleshooting solutions do not resolve the problem, contact your sales representative. Also contact your sales representative for a Return Materials Authorization Number before returning the analyzer to the factory. Your representative can diagnose whether the analyzer can be serviced on-site or should be returned to the factory.

Disclaimers

SpectraSensors accepts no responsibility for consequential damages arising from the use of this equipment. Liability is limited to replacement and/or repair of defective components.

Warranty

The manufacturer warrants the items delivered shall be free from defects (latent and patent) in material and workmanship for a period of one year after delivery to the Buyer. The Buyer's sole and exclusive remedy under this warranty shall be limited to repair or replacement. Defective goods must be returned to the manufacturer and/or its distributor for valid warranty claims. This warranty shall become inapplicable in instances where the items have been misused or otherwise subjected to negligence by the Buyer.

Notwithstanding any other provision of this contract, no other warranties, whether statutory or arising by operation of law, expressed or implied, including but not limited to those of merchantability or fitness for particular purpose, shall apply to the goods or services hereunder, other than the repair and replacement warranty above. Seller shall in no event be liable to Buyer or any third party for any damage, injury or loss, including loss of use or any direct or indirect incidental or consequential damages of any kind.

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