SpectraSensors™

Operator's Manual

SS1000

SS1000
Moisture/Carbon Dioxide Analyzer

OPERATOR'S MANUAL

Products of

SpectraSensors™

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Table of Contents

FIGURES AND TABLES

Figures

Tables

About this Manual

The SpectraSensors SS1000 product is a high-speed, extremely reliable extractive analyzer 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 SS1000 analyzer, and step-by-step instructions on:

- Getting started once you receive the analyzer
- Installing the analyzer
- Powering up the analyzer
- Operating the analyzer
  - Receiving and 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

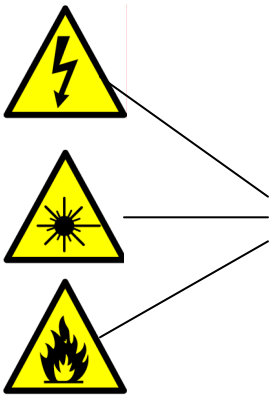
Take a moment to familiarize yourself with this Operator's Manual by reading the Table of Contents.

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

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 power down 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 SS1000 is a Tunable Diode Laser (TDL) absorption spectrometer operating in the near-infrared (near-IR) wavelength region. The 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.

The 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 or 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.

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 SS1000, (see Figure 2 on page 8) analyzer measures the H_2O or 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.

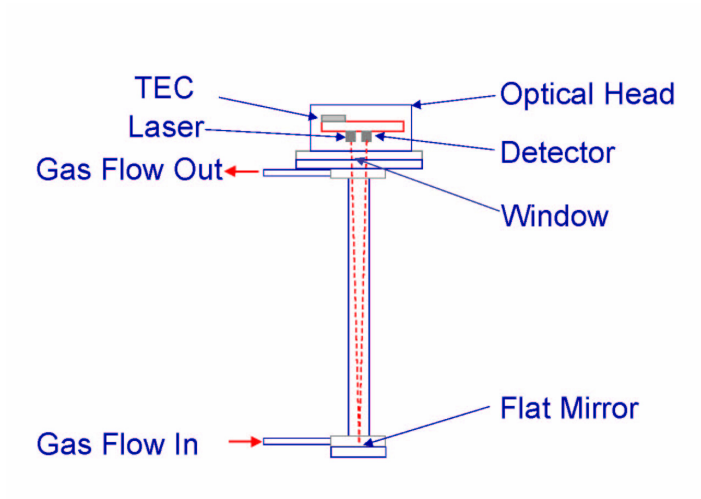


Figure 1: Laser sample cell

GETTING STARTED

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

- What should be included in the shipping box
- Inspecting the analyzer

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

What Should be Included in the Shipping Box

The contents of the box should contain:

- Carrying case for transportation
- The SpectraSensor 1000 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.
- SpectrumPlot II software CD and instructions to perform diagnostic functions for the analyzer
- Membrane separator filter (Already installed)
- AC/DC adapter for recharging the internal battery. (Battery comes fully charged from the factory)
- Quick connect fittings for inlet and outlet tubes
- Optional: heated regulator (Comes in separate package)

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

Inspecting the Analyzer

Place the analyzer on a flat surface and carefully inspect the exterior of 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 2 on page 11). These configurations are useful in identifying the specifications for your specific model. The model number should match your order. If it does not match, contact your sales representative.

SS1000

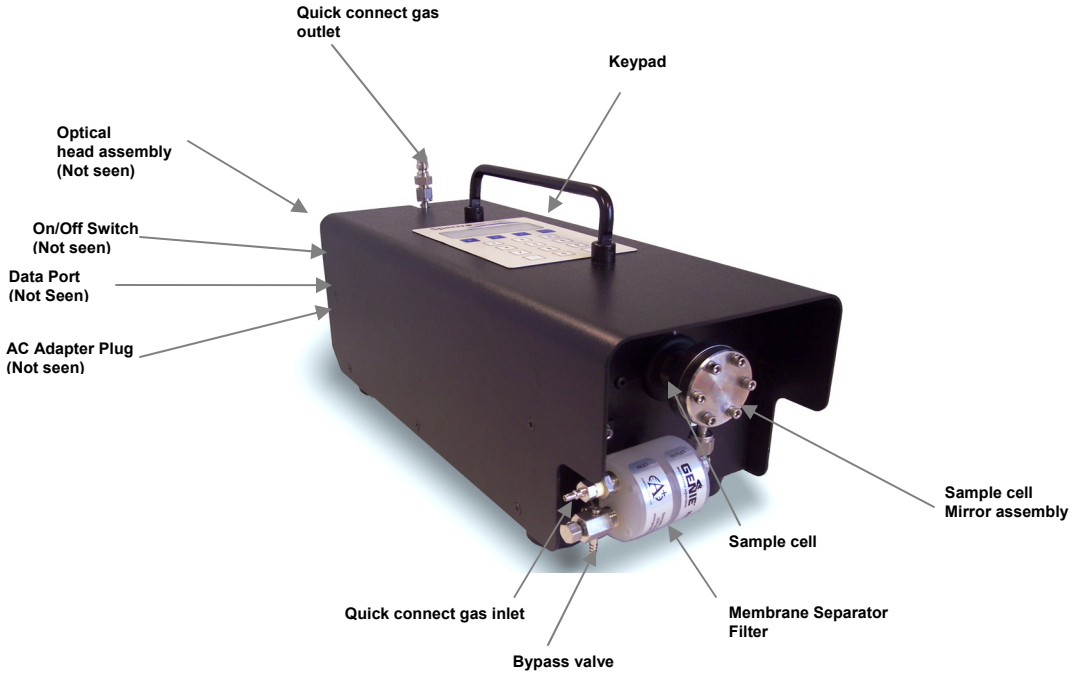


Figure 2**:** Main external components on the SS1000 analyzer

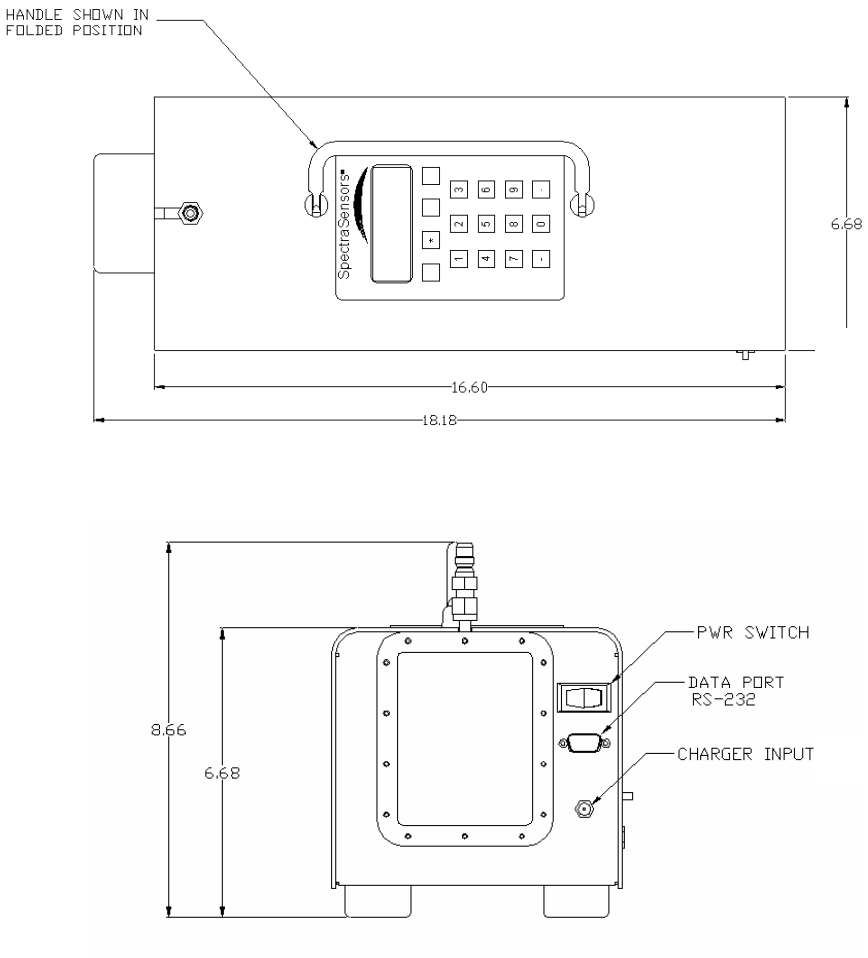


Figure 3: SS1000 dimensions

SS1000
Portable Gas Analyzer

Specifications

Performance

	(standard)	(optional)
Moisture Concentration (H_2O)*	2 to 20 lbs/MMSCF Nat. Gas 42-422 ppmv, NIST Traceable	0.5 to 20 lbs/MMSCF Nat. Gas 10-422 ppmv, NIST Traceable
Accuracy (H_2O)	±2% of reading or ±10 ppmv	±2% of reading or ±4 ppmv
Dew/Frost Point	-58° to -20°F (-50° to -29°C)	-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	100-250 VAC, 50-60 HZ
Electrical Storage	12-Volt, Sealed Lead-Acid Battery Approx. 8 hours use time per charge
Current	0.5A @ 120VAC during recharging

Physical Specifications

Outputs	RS232 – all parameters
LCD Display	Concentration, Cell Pressure and Cell Temperature
Size	Nominal 8"H x 7"W x 18"D (200 mm H x 175 mm W x 450 mm D) Includes Handle and Feet
Weight	Approx. 15lbs (6.8Kg)
Accessories	Membrane Separator, Carrying Case, Charger, Quick Connect Fittings included. Sample Conditioning Available.

Area Classification

Certification	Non-Hazardous (certified) locations – General Purpose

Table 1**:** Specifications of the SS1000 analyzer

SS1000 Portable Laser Analyzer Model Number Configurations

Portable Natural Gas Analyzer with carrying case and 100/250 VAC, 50/60 Hz charger (Suitable for use in non-hazardous areas)

Measured Component

		0					H2O range 2 - 20 lbs/MMSCF (42-420 ppmv), Accuracy ± 0.5 lbs/MMSCF
		1					H2O range 0.5 - 20 lbs/MMSCF (10-420 ppmv), Accuracy ± 0.2 lbs/MMSCF
		2					CO2 range 0-10%
		9					Other
SS1000-	5		1	1	1	1	

Probe-Regulator Assembly - removes liquid and reduces pressure; 0-10 psig output pressure

Probe Length

	4					4" Probe (typically suitable for 4" to 8" line diameter)
	7					7" Probe (typically suitable for 8" to 16" line diameter)
	9					9" Probe (typically suitable for 12" to 24" line diameter)
		Housing				
		0				No housing
		1				3/4" NPT, up to 2000 psig
		2				1" NPT, up to 3500 psig
SC401-		1		1	1	

Portable Heated Regulator Assembly - 120 VAC, 40W, 0-10 psig output pressure; 85° F

Cable Length

		5				50 ft.
SC403-	1	5	1	1	1	

Accessories

1.	Spares Kit, P/N 02199-00001 - includes fuses, o-rings and hardware
2.	Extended calibration range (up to 100lb/MMSCF H2O) P/N 00000-02015, Other ranges available (consult factory)
3.	Replacement battery charger P/N 39901-12012
4.	Instruction Manuals (up to 2 copies at no charge), P/N 01902-93001, each
5.	Quick-connect flow meter P/N 00403-90001
6.	Replacement mating quick-connect fittings (1 ea. input and output)
7.	Stainless Steel Tag, up to 2 lines of text, P/N 01910-30017
8.	Certified As-Built Drawings, P/N 00000-02014, 2 sets

Table 2: SS1000 MNCs and Accessories List

INSTALLING THE ANALYZER

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

- Hardware and tools for installation
- Setting up the analyzer
- Connecting the gas lines
- Power Supply
- Connecting the output signals
- Powering up sequence
- Calibration is not required

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

Hardware you may need:

- Stainless steel tubing or flexible stainless steel tubing
- 7/16" and 9/16" wrench for tube fitting
- Heated regulator if inlet pressure is greater than 10 PSIG or no probe regulator exists.

Setting up the Analyzer

To set up the analyzer, place it at a location that is free of vibrations near where the sample is being taken. Minimizing the gas volume of the sample system and using stainless steel tubing optimizes performance.

The most critical stage in setting up is to make sure 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.

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

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

Connecting the Gas Lines

The analyzer comes equipped with a ¼″ quick connect outlet fitting and a ⅛″ quick connect inlet fitting. Attach these fittings to the analyzer (see Figure 4).

It is important to capture a representative sample of gas from the pipeline. The gas sample must be captured from the pipeline via a probe regulator or heated pressure regulator. 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 is 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. Blowing out all the gas lines leading to the analyzer to clear lines of contamination is essential. If probe regulator or heated pressure regulator are not already permanently installed, blow gas through the opening that these will attach to for 10 to 15 seconds. After the probe regulator or heated pressure regulator is installed open the gas line and allow gas to flow again for 10 to 15 seconds.
2. Run a stainless steel tube (do NOT use a plastic tube) from the outlet of the probe regulator or heated pressure regulator to the ⅛″quick connect fitting. Before connecting to the inlet of the analyzer (membrane separator), once again blow gas through this tubing for 10 to 15 seconds to clear the tubing of any contamination. A 7/16″ wrench is needed to tighten the tube to the quick connect fitting. (A Genie Portable Insertion Probe is recommended when no probe regulator or heated pressure regulator exists).
3. Connect a stainless steel tube using an 11/16″ wrench from the analyzer outlet via the quick connect fitting to an unrestricted vent into a safe area.
4. Be sure there is no stress on the tubing when it is aligned to the analyzer.
5. Gas may now flow through the analyzer.
6. Check all connections for gas leaks using less than 10 pounds per square inch gauge (PSIG). SpectraSensors recommends using a liquid leak detector.
7. While gas is flowing, turn and open the bypass valve on the membrane separator to clear out any liquids that may have gotten trapped during startup. Be sure to return this valve to the closed position.

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.

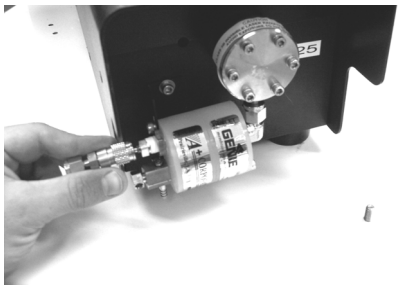


Figure 4: Sample cell gas line connection

Power Supply

The analyzer comes equipped with a fully charged internal battery. Battery life runs 12+ hours under normal conditions.

A battery charger is supplied with the analyzer that accommodates all AC power configurations between 100 and 250 VAC (50 – 60Hz). To recharge the battery, plug the charger into the jack in the back of the analyzer under the on/off switch (see Figure 5 below).

Figure 5**:** Battery charger plug

To power up the analyzer simply flip the on/off toggle switch located above the serial port.

Connecting the Output Signals

The serial output is connected through a serial port located below the on/off switch. Connections can be made with the customer-supplied serial cable running from the analyzer to the serial port on a computer (see Figure 7). See page 25 for receiving and reading data.

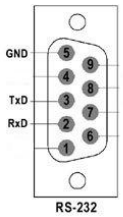


Figure 6: Serial Port Connections

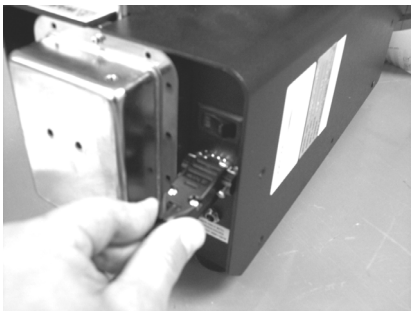


Figure 7: Serial Cable Plug-in

If the user's computer does not have a serial port but rather a USB port, a USB to serial adapter can be used. We recommend using RadioShack p/n 26-183 cable.

Powering Up Sequence

After connecting the gas sampling lines, checking for leaks, and connecting the (optional) output serial cable, you are ready to power up the analyzer. It is possible to power up the analyzer 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 is only one fuse located on the power supply. If you need to replace a fuse, use a 3.15A, 250V, 5mm x 20mm slow blow fuse. To change the fuse see Non-Operation after start up on page 34.

Power up the analyzer by switching the on/off switch to the on position.

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 8). The LCD displays four lines, the third of which is blank.

```
    <NORMAL MODE>
H2O:  4.12 Lb/MMSCF

P: 14.7 PSI  T:76.1F
```

Figure 8**:** LCD on the keypad displays normal operational mode <Normal Mode>

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 due to the desiccant in the optical head. Depending on the environment, the ability of the desiccant to absorb moisture may reduce over time. Typically, the desiccant will last for at least the recommended recertification interval of 3 years. If it is necessary to adjust the zero offset, see troubleshooting on page 33.

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 SS1000 is specifically designed to measure levels of H_2O or CO_2 in a gas stream. It also reports the temperature and pressure of the sample gas in the sample cell.

There is rarely a need to remove the cover of the main enclosure for inspection or maintenance. Do not remove 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 or CO_2, temperature, and sample cell pressure.

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 9 on page 18).

*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, 4, 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 4** - Displays system diagnostic parameters for Channel A
- **Mode 6** - Outputs spectra and calculations to serial ports
- **Mode Test** displays system error status

Modes 3 and 5 are reserved for dual channel systems such as the SS3000 and are disabled with this analyzer; if pressed the system will return to normal mode.

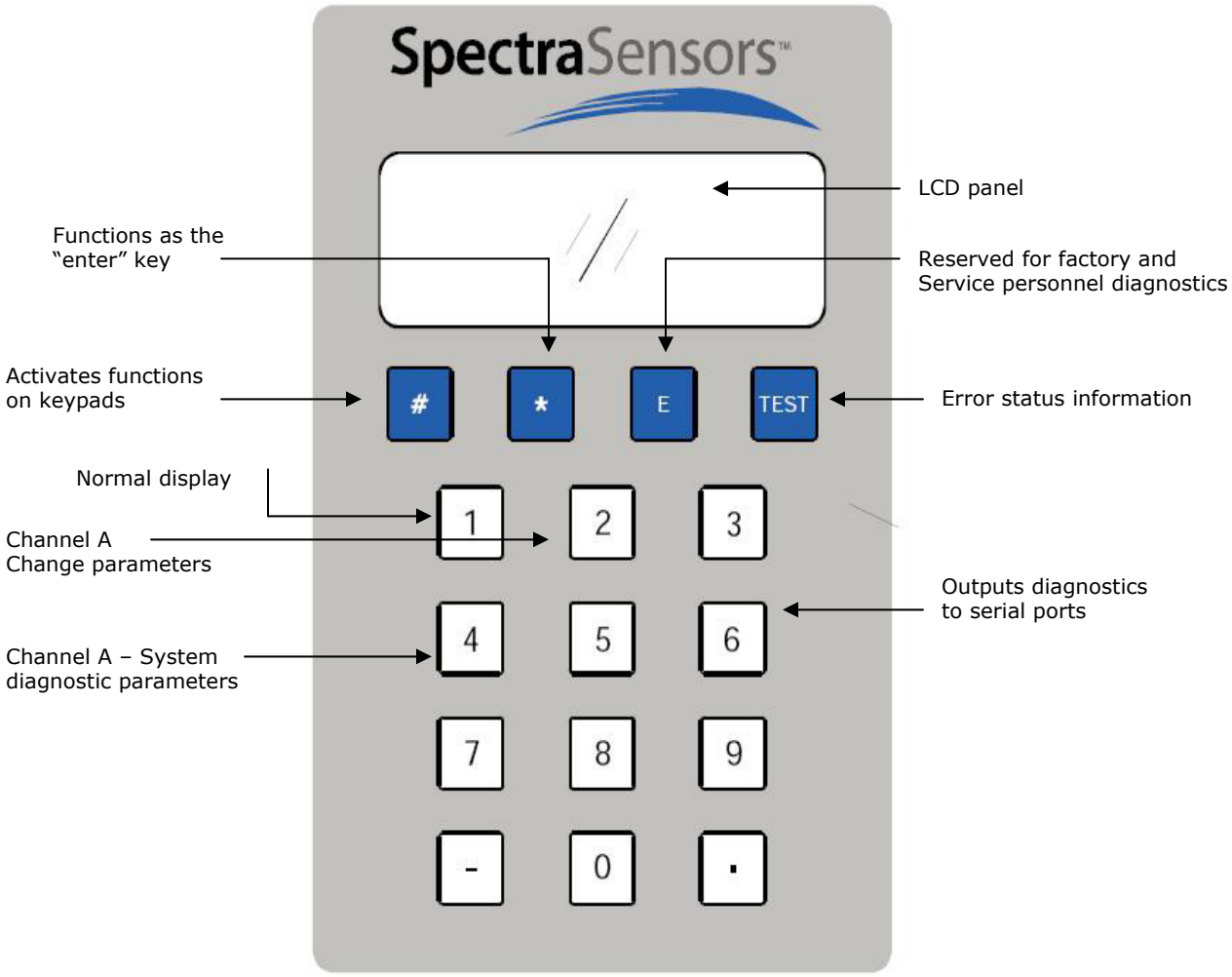


Figure 9: SS1000 keypad

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
```

ChA: Water vapor or CO_2 concentration in units selected in Mode 2.

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

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

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

Mode 2: Measurement Parameter Change: Allows you to view and change H_2O or CO_2 measurement parameters (see Table 3 on page 20).

+ **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
```

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.

Parameter Matrix for Mode 2

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% (0 – 10000 ppmv) for CO_2	Sets the zero offset for H_2O or CO_2 measurements.
Logger Rate	1 – 300 readings default = 4	Sets the display 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 3: Typical values for parameter set points

Changing parameters for Mode 2

Spectrum Average

```
<SET PARAMETER MODE>
Spectrum Average
4
Enter a value
```

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

```
<SET PARAMETER MODE>
RCalb
3950
Enter a value
```

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

```
<SET PARAMETER MODE>
Alarm Action
0
0->0    1->Full Scale
```

This parameter is used in conjunction with analyzers that have a current loop output. The SS1000 does not come equipped with a 4-20mA current loop output, so the alarm action is not functional for this reason. Press the ***** key to cycle the LCD to the next parameter.

Zero Offset

```
<SET PARAMETER MODE>
Zero Offset
8
Enter a value
```

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 analyzers, the zero offset is in PPMV. (21.1 PPMV = 1 lb/mmscf) Press the * key to enter the value and cycle to the next parameter.

Logger Rate

```
<SET PARAMETER MODE>
Logger Rate (s)
4
Enter a value
```

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 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 output value 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

```
<SET PARAMETER MODE>
Temperature Unit
0
0 ->C    1->F
```

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 (21.1 ppmv = 1 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: (Model SS3000 only)
If this mode is selected the analyzer will return to Normal mode.

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

+ **4**

```
 PP2F:     788   PkDf:  60
POWER:  1200    PkD1:  60
INDEX:    290
ZERO:     -19
```

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 needs 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 set point in mA that matches the target absorption line.

PkD1: The laser current set point 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 Fail Error" will be displayed if PkD1 differs by more than 4 mA from PkDf.

For more information on troubleshooting these issues, see Troubleshooting on page 32.

Mode 5: (Model SS3000 only).
If this mode is selected 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.

+ **6**

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.

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.

+ **TEST**

```
      <CHA 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.

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. 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 save a HyperTerminal shortcut to the desktop.

Once HyperTerminal is activated, choose a name to save file as and pick 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 10.

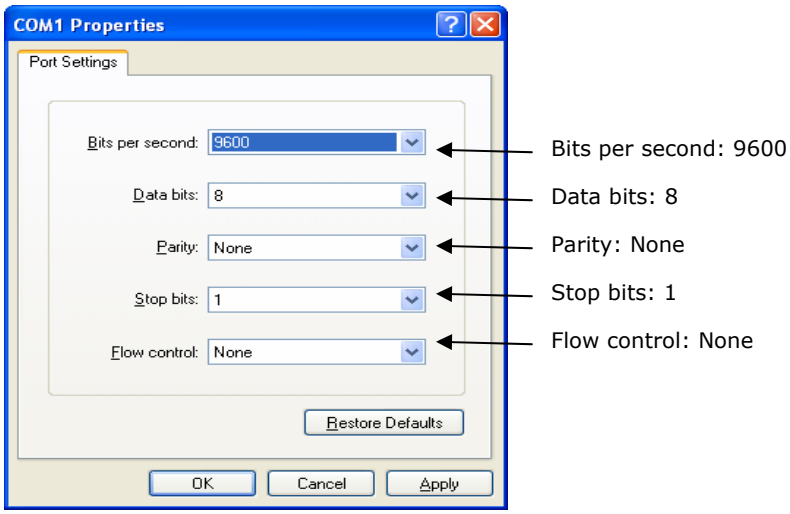


Figure 10: COM port settings

Reading the Data

If the analyzer is connected to the serial device as described on page 14, 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 11):

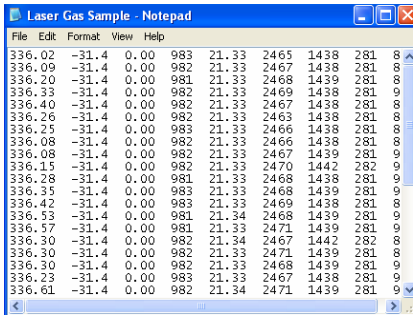


Figure 11: Data output

- 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)

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:

```
Dump Stats Mode…

Index: 0
```

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

```
Mode
```

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 12).

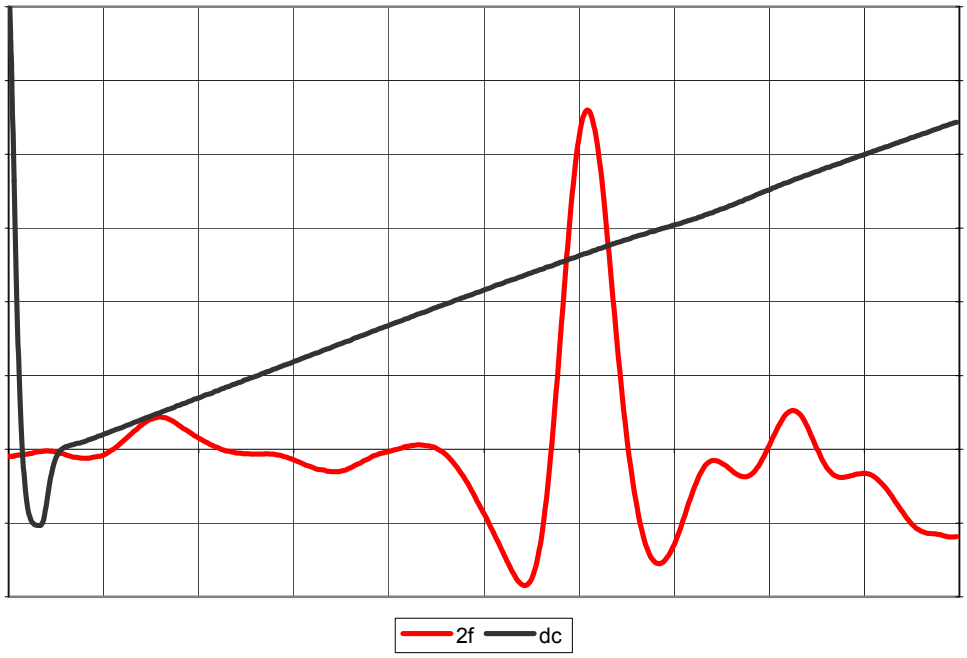


Figure 12: Mode 6 data dump displayed in graphical format using Excel

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 (If no serial port exists, a USB to serial adapter can be used. We recommend using RadioShack p/n 26-183 cable.)
- > 1024 x 768 screen resolution

To install the software:

1. Load the SpectrumPlot_v2 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 13 on page 30).
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**.

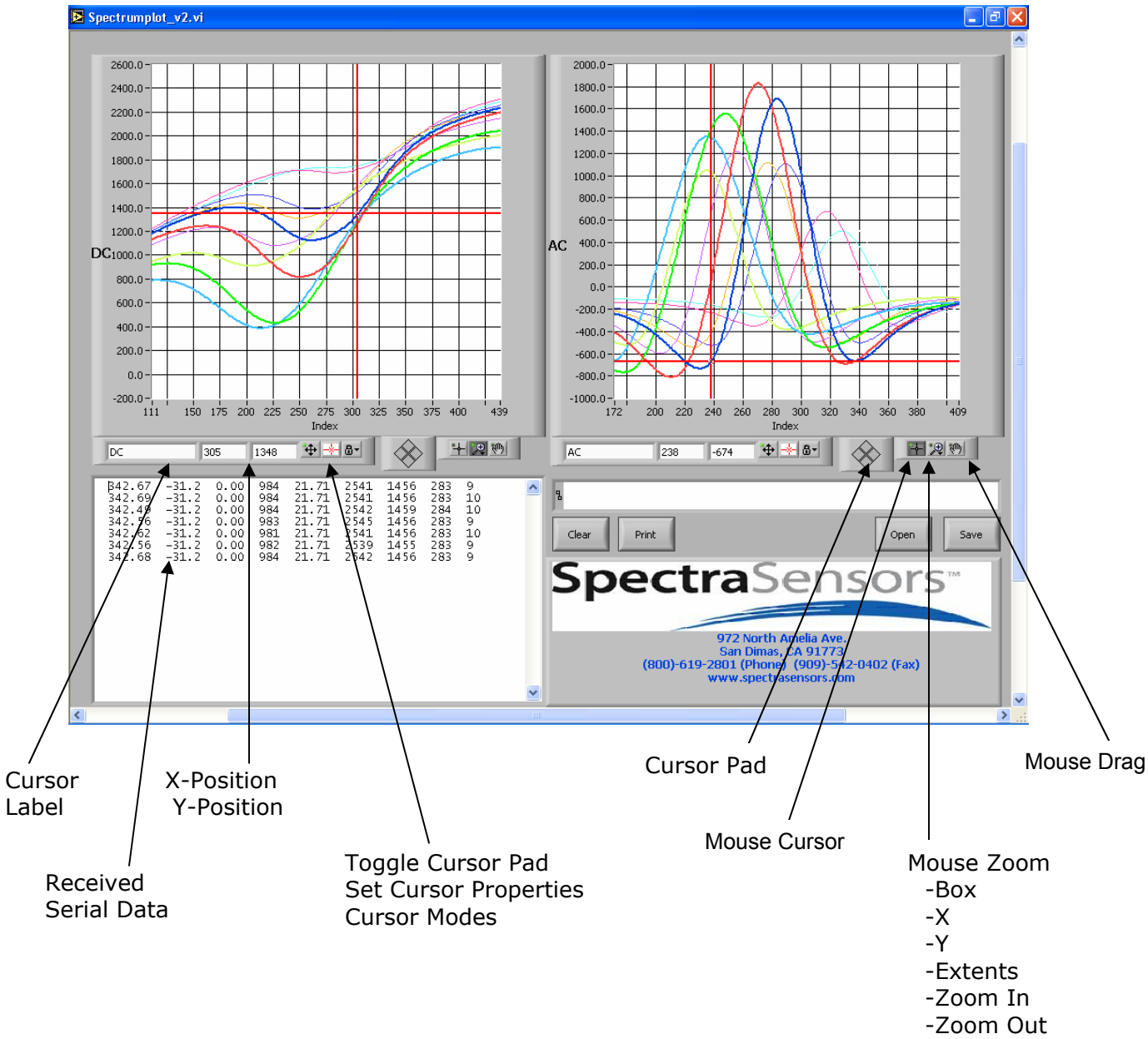


Figure 13: SpectrumPlot view

See Figure 11 on page 26 for a list of what the received serial data columns refer to. 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 sample cell and cause problems. To keep the sampling lines clean and improve response at very low moisture:

1. Replace the membrane on the membrane separator filter included with the SS1000 if necessary. See Membrane Separator Filter on page 33. 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. Normal mode will indicate this as well. If mirror contamination is suspected, consult factory.
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.

Powering-Down the Analyzer

To power-down the analyzer, turn the on/off switch to off. 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.

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 Instrument Problems on page 34.

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 on page 31).

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 section starting on page 10.

Membrane Separator Filter

The analyzer comes equipped with an onboard Genie membrane separator. The membrane separator separates out entrained liquids existing in the sample gas. The pressure should not exceed 10 psig otherwise contaminates may be forced through the filter.

If over contamination is suspected turn and open the bypass valve on the inlet while gas is flowing. Any trapped liquids on the filter will drain out. When concentration levels are higher than actual or an excess amount of wet gas passed through the filter, the membrane may need to be replaced with Genie p/n 101-505. To replace the membrane, first detach the 1/8” inlet tubing and the 1/4" swage fitting from the sample cell inlet. Next, unscrew the two 10/32” socket head cap screws that bolt the filter to the analyzer. After detached, the four socket head cap screws in the body of the filter need to be taken out in order to replace the membrane within.

Verification of Offset Parameter

If it seems the concentration values are off by a fixed amount above actual, for the entire range of the analyzer, 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 a four ppmv difference from spec 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 ppmv when measuring a zero moisture sample gas then increase the “Zero Offset” parameter by 4. If the zero offset needs to be adjusted by more than 25 from the original value, contact service at the factory.

Peak Tracking Reset Procedure/Track Fail Error

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 greater than 4 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 **Track Fail Error** is displayed, the peak tracking function should be reset. To reset the peak tracking function:

1. Enter the parameter Mode **2 (# 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

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.

* Indicates that the cover must be removed to troubleshoot by removing the ten screws that hold it in place. See **Error! Reference source not found.**.

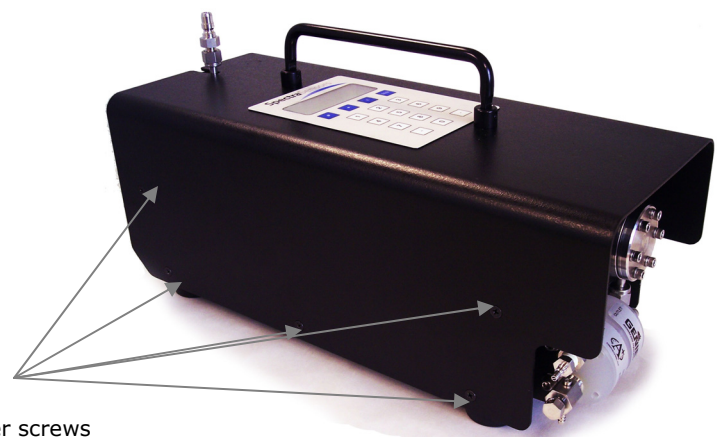


Figure 14: Ten cover screws

Before removing the cover, be sure it is an internal problem. When gently removing the cover, the display and keypad cables are attached between the main body and the cover. Yanking on the cover will result in damage to these cables. If detaching the cables is necessary, be sure to reconnect with proper orientation. When reattaching the cover do not pinch the cables between the body and the cover.

How to Resolve Potential Instrument Problems	
Symptom	**Response**
Non-Operation (at start up):	Is the switch on? Has the battery been charged recently?
Non-Operation (after start up):	*Check fuse on DC to DC converter.
	*Check for loose cables.
	Contact sales representative for further troubleshooting.

How to Resolve Potential Instrument Problems	
Symptom	**Response**
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.
	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.
	Reset peak tracking. See page 33.
	Capture a data dump (**# 6**) and send the file to SpectraSensors.
	Possible Alignment problem.
	Possible mirror contamination issue, contact sales representative for service information.
Null Fail **Error**	Verify Null failure by pressing **# 4** and checking if 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 to the alternate position.
	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.
	Turn the analyzer off for 30 seconds and then turn it on again.
	Reset the peak tracking.

How to Resolve Potential Instrument Problems	
Symptom	**Response**
	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.
PT Fail **Error**	Verify actual error by pressing **# 1** until the error message does not change.
	*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 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).
Track Fail Error	Verify the reading by pressing **# 4** and checking if PkDf and PkD1 differ by more than 4.
	Reset peak tracking. See Peak Tracking Reset Procedure on page 33.
	Capture a data download (**# 6**) and send the file to SpectraSensors.
Front panel display is not lighted and no characters appear	*Be sure battery is charged. If it is check for correct voltage on battery.
	*Check for 5VDC on red wires from power supply (black wires are ground).
	*Check connections on display cable.

How to Resolve Potential Instrument Problems	
Symptom	**Response**
	*Check for 4.3 VDC on pin 15 of J2 going to the display.
	*Reseat the display cable connection. Must cut away the spot of glue on the pins on either sides of the connection.
Strange characters appear on front panel display	*Check connections on display cable. Blow off any debris on the connection.
Pressing keys on front panel do not have specified effect	*Check connections on keypad cable.
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.
	Turn and open the bypass valve on the membrane separator while gas is flowing to blow out any trapped liquids.
	Capture a data dump (**# 6**) and send the file to SpectraSensors.
Reading goes to "0"	Look on the display for an error message. If error message, refer to the section on this table about that error.
Reading goes to full scale	Look on the display for an error message. If error message, refer to the section on this table about that error.

How to Resolve Potential Instrument Problems	
Symptom	**Response**
	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 analyzer is in Normal Mode (#1).
	Make sure the computer COM port is set for 9600 baud, 8 data bits, 1 stop bit, no parity, and no flow control.
	Verify no other programs are using that COM port.
	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.
LCD does not update. Unit is locked up.	Switch off power, wait 30 seconds, and then switch power back on.

Table 4: 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.

INDEX