Sistemas de Controlo e Medida

SS1000 MANUAL

JUNHO 2013

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SpectraSensors®

SS1000
Gas Analyzer

Operator's Manual

4900002079 rev. B 3-23-12

SS1000
Gas Analyzer

Operator's Manual

This manual applies to firmware versions:
v2.50

Products of

SpectraSensors

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Revision History

Revision	Engineering Order	Date
B	EO14724	3/19/12

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1 - INTRODUCTION

SpectraSensors' SS1000 products are high-speed, diode-laser based extractive analyzers designed for extremely reliable monitoring of very low (trace) to standard concentrations of specific components in various background gases. In order to ensure that the analyzer performs as specified, it is important to closely review the installation and operation sections of this manual. This manual contains a comprehensive overview of the SS1000 and step-by-step instructions on:

- Inspecting the analyzer
- Installing the analyzer
- Powering up the analyzer
- Operating the analyzer
- Serial port communications
- Powering down the analyzer
- Troubleshooting the system

Who Should Read This Manual

This manual should be read and referenced by anyone installing, operating or having direct 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**.

There are a number of options and accessories available for the SS1000. This manual has been written to address the most common options and accessories. Images, tables and charts have been included to provide a visual understanding of the analyzers and its functions. Special symbols are also used to provide the user with key information regarding the system configuration and/or operation. Pay close attention to this information.

General Warnings and Cautions

Instructional icons are provided in this manual to alert the user of potential hazards, important information and valuable tips. Following are the symbols and associated warning and caution types to observe when servicing the analyzer.

General notes and important information concerning the installation and operation of the analyzer.

*Warning statement for **hazardous voltage**. Contact may cause electric shock or burn. Turn off and lock out system before servicing.*

Failure to follow all directions or substitution of components may result in explosion.

Failure to follow all directions may result in fire.

***INVISIBLE LASER RADIATION** - Avoid exposure to beam. Class 3b Radiation Product. Refer servicing to the manufacturer-qualified personnel.*

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

Maximum voltage and current specifications for the fuse closest to label.

Conventions Used in this Manual

In addition to the symbols and instructional information, this manual is created with "hot links" to enable the user to quickly navigate between different sections within the manual. These links include table, figure and section references and are identified by a pointing finger cursor when rolling over the text. Simply click on the link to navigate to the associated reference.

SpectraSensors Overview

SpectraSensors, Inc. (SSI) is a leading manufacturer of technologically advanced elctro-optic gas analyzers for the industrial process, gas distribution and environmental monitoring markets. Headquartered in Houston, Texas, SSI was incorporated in 1999 as a spin-off of the NASA/Caltech Jet Propulsion Laboratory (JPL) for the purpose of commercializing space-proven measurement technologies initially developed at JPL.

About the Gas Analyzers

The SS1000 includes tunable diode laser (TDL) absorption spectrometers operating in the near- (IR-A, 0.75-1.4 μm) to short-wavelength infrared (IR-B, 1.4-3 μm). Each compact sensor consists of a TDL light source, sample cell and detector specifically configured to enable high sensitivity measurement of a particular component within the presences of other gas phase constituents in the stream. The sensor is controlled by microprocessor-based electronics with embedded software that incorporates advanced operational and data processing algorithms.

A sample conditioning system may also be included with the system that has been specifically designed to deliver an optimum sample stream that is representative of the process systems stream at the time of sampling. Most SS1000s are configured for use at extractive natural gas sampling stations.

How the Analyzers Work

The SS1000 employs tunable diode laser absorption spectro-scopy (TDLAS) to detect the presence of trace substances in process gases. Absorption spectroscopy is a widely used technique for sensitive trace species detection. Because the measurement is made in the volume of the gas, the response is much faster, more accurate and significantly more reliable than traditional surface-based sensors that are subject to surface contamination.

In its simplest form, a diode laser absorption spectrometer typically consists of a sample cell with a mirror at one end, and a mirror or window at the opposite end, through which the laser beam can pass. Refer to Figure 1–1. The laser beam enters the cell and reflects off the mirror(s) making one or more trips through the sample gas and eventually exiting the cell where the remaining beam intensity is measured by a detector. With the SS1000, sample gas flows continuously through the sample cell ensuring that the sample is always representative of the flow in the main pipe.

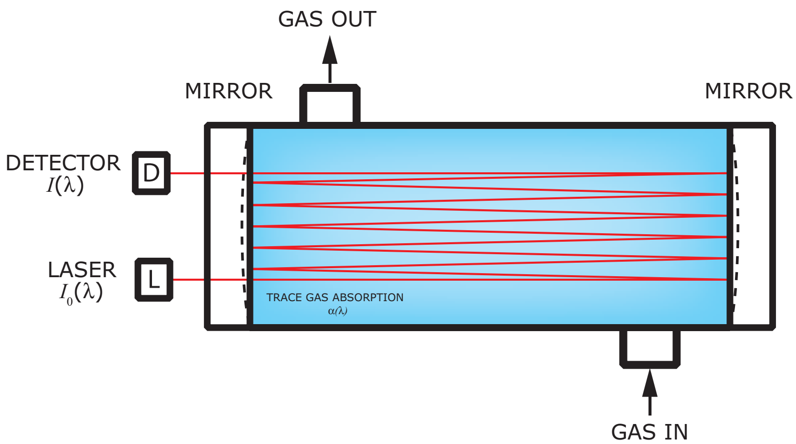


Figure 1–1 *Schematic of a typical laser diode absorption spectrometer*

Due to their inherent structure, the molecules in the sample gas each have characteristic natural frequencies (or resonances). When the output of the laser is tuned to one of those natural frequencies, the molecules with that particular resonance will absorb energy from the incident beam. That is, as the beam of incident intensity, $I_0(\lambda)$, passes through the sample, attenuation occurs via absorption by the trace gas with absorption cross section $\sigma(\lambda)$. According to the Beer-Lambert absorption law, the intensity remaining, $I(\lambda)$, as measured by the detector at the end of the beam path of length / (cell length x number of passes), is given by

$$I(\lambda) = I_0(\lambda)\exp[-\sigma(\lambda)lN] \ , \tag{1}$$

where N represents the species concentration. Thus, the ration of the absorption measured when the laser is tuned on-resonance versus off-resonance is directly proportional to the number of molecules of that particular species in the beam path, or

$$N = \frac{-1}{\sigma(\lambda)l}\ln\left[\frac{I(\lambda)}{I_0(\lambda)}\right] \ . \tag{2}$$

Figure 1–2 shows the typical raw data from a laser absorption spectrometer scan including the incident laser intensity, $I_0(\lambda)$, and the transmitted intensity, $I(\lambda)$, for a clean system and one with contaminated mirrors (shown to illustrate the system's relative intensity to mirror contamination). The positive slope of raw data results from ramping the current to tune the laser, which not only increases the wavelength with current, but also causes the corresponding output power to increase. By normalizing the signal by the incident intensity, any laser output fluctuations are cancelled, and a typical, yet more pronounced, absorption profile results. Refer to Figure 1–3.

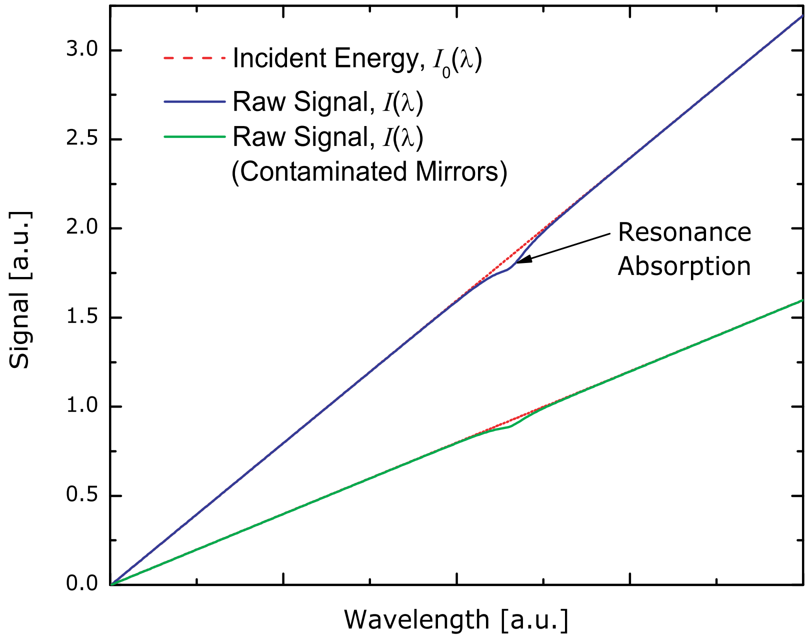


Figure 1–2 *Typical raw signal from a laser diode absorption spectrometer with and without mirror contamination*

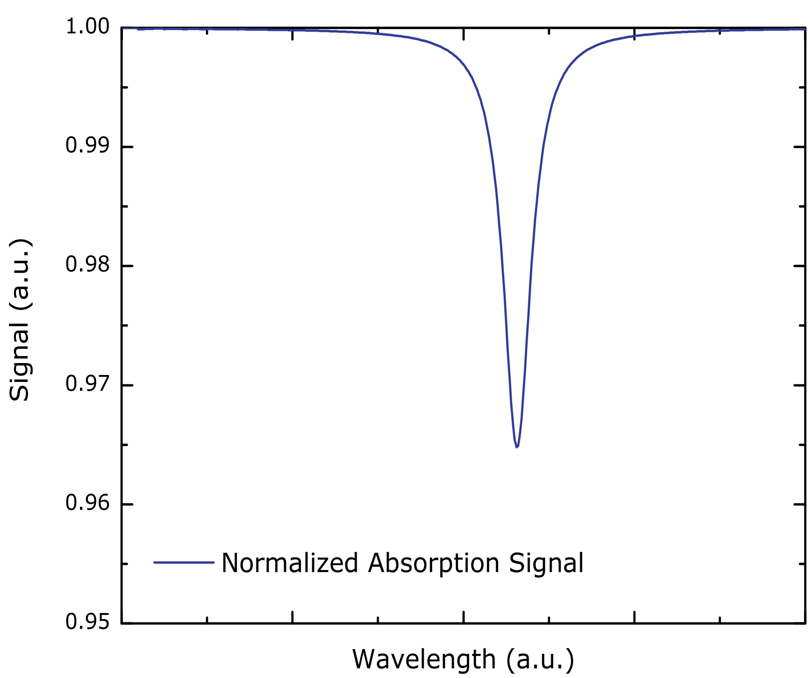


Figure 1–3 *Typical normalized absorption signal from a laser diode absorption spectrometer*

Note that contamination of the mirrors results solely in lower overall signal. However, by tuning the laser off-resonance as well as on-resonance and normalizing the data, the technique self calibrates every scan resulting in measurements that are unaffected by mirror contamination.

Wavelength Modulation Spectroscopy (WMS) Signal Detection

SpectraSensors takes the fundamental absorption spectroscopy concept a step further by using a sophisticated signal detection technique called wavelength modulation spectroscopy (WMS). When employing WMS, the laser drive current is modulated with a kHz sine wave as the laser is rapidly tuned. A lock-in amplifier is then used to detect the harmonic component of the signal that is at twice the modulation frequency ($2f$), as shown in Figure 1–4. This phase-sensitive detection enables the filtering of low-frequency noise caused by turbulence in the sample gas, temperature and/or pressure fluctuations, low-frequency noise in the laser beam or thermal noise in the detector.

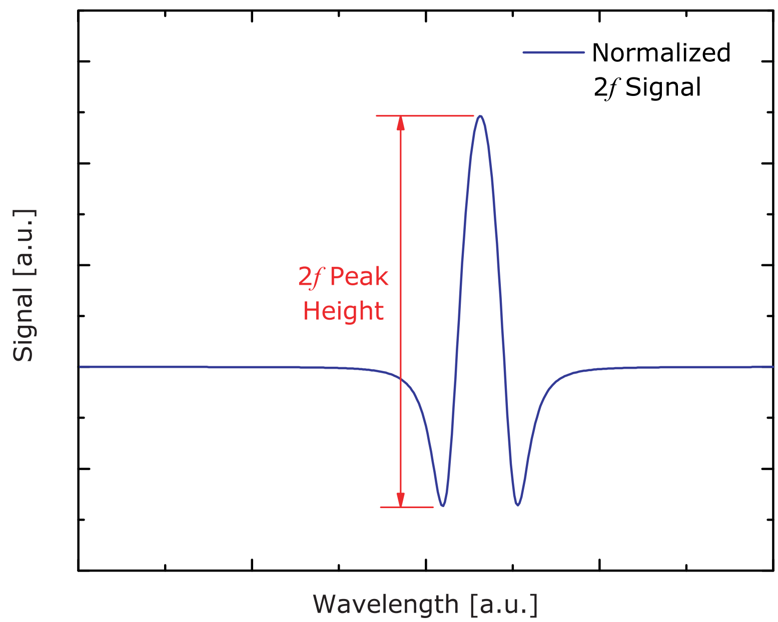


Figure 1–4 *Typical normalized $2f$ signal where the species concentration is proportional to the peak height*

With the resulting low-noise signal and use of fast post-processing algorithms, reliable parts per million (ppm) or parts per billion (ppb) detection levels are possible (depending on target and background species) at real-time response rates (on the order of 1 second).

All SpectraSensors TDL gas analyzers employ the same design and hardware platform. Measuring different trace gases in various mixed hydrocarbon background streams is accomplished by selecting a different optimum diode laser wavelength between 700-3000nm, which provides the least amount of sensitivity to background stream variations.

2 - INSTALLATION

Installing the analyzer is relatively easy requiring only a few steps that, when carefully followed, will ensure proper mounting and connection. Once the analyzer arrives, you should take a few minutes to examine the contents before installing the unit.

What Should be Included in the Shipping Box

The contents of the box should include:

- The SpectraSensors SS1000
- This Operator’s Manual with instructions on setting up and operating the analyzer
- Carrying case
- Membrane separator filter (installed)
- 100–240 VAC, 50/60 Hz battery charger
- Quick-connect fittings for inlet and outlet tubes
- One external serial cable to connect the analyzer to a computer
- Additional accessories or options as ordered

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

Inspecting the Analyzer

Unpack and place the unit on a flat surface. Carefully inspect all enclosures for dents, dings, or general damage. Inspect the inlet and outlet connections for damage, such as bent tubing. Report any damage to the carrier.

Avoid jolting the instrument by dropping it or banging it against a hard surface. Do not attempt to pick up the instrument using the sample cell. Either action may disturb the optical alignment.

Hardware and Tools for Installation

Depending on the particular model, the configuration of accessories and options ordered, you may need the following hardware and tools to complete the installation process.

Hardware:

- Heated pressure regulator (if inlet pressure is >10 psig or no probe regulator exists)

- Stainless steel tubing or flexible stainless steel tubing (SpectraSensors recommends using 1/4" O.D. x 0.035" wall thickness, seamless stainless steel tubing)

Tools:

- 7/16" open-end wrench
- 9/16" open-end wrench

Setting up the Analyzer

The SS1000 analyzer is manufactured for temporary installation at a sampling point. Place the analyzer at a location relatively free of vibration and close to the sampling point. Choose a shaded area or use an optional analyzer hood (or equivalent) to minimize sun exposure. Refer to the diagrams in Appendix B for detailed dimensions.

When setting up the analyzer, be sure not to position the instrument so that it is difficult to operate adjacent devices. Allow 3 feet of room in front of the analyzer and any switches.

It is critical to set up the analyzer so that the inlet and outlet lines reach the inlet and outlet connections on the chassis while still maintaining flexibility so that the sample lines are not under excessive stress.

Connecting the Gas Lines

Once the analyzer has been suitably place, you are ready to connect the sample supply and sample return lines. All work must be performed by technicians qualified in pneumatic tubing.

In order to capture a representative sample of gas, the sample must be captured from the pipeline using a probe equipped with a standard or heated field-pressure reducing 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.

The sample supply port on the analyzer is equipped with a membrane separator filter to prevent liquid from entering the sample cell and accumulating on the internal optics.

To connect the sample supply line:

1. The analyzer comes with a 1/8″ quick-connect fitting for the sample supply and a 1/4″ quick-connect fitting for the sample return. Attach these fittings to the analyzer.
2. Confirm that the sample probe is correctly installed at the supply tap and that the sample probe isolation valve is closed.

The sample at the sample tap may be at a high pressure. Use extreme caution when operating the sample probe isolation valve and field-pressure reducing regulator.

All valves, regulators, switches, etc. should be operated in accordance with site lock-out/tag-out procedures.

3. Also, confirm that the field-pressure reducing station is installed properly at the sample probe and that the pressure regulator at the field-pressure reducing station is closed (adjustment knob turned fully counter-clockwise).
4. Check that the relief valve vent line is properly installed from the field-pressure reducing station to the low-pressure flare (or atmospheric vent connection).
5. Determine appropriate tubing route from the field-pressure reducing station to the analyzer.
6. Run stainless steel tubing from the field-pressure reducing station (set for the specified inlet pressure) to the sample supply port of the analyzer. Bend tubing using industrial grade benders, check tubing fit to ensure proper seating between the tubing and fittings. Fully ream all tubing ends. Blow out the lines for 10–15 seconds with clean, dry nitrogen or air prior to making the connection.
7. Connect the inlet tube to the analyzer using the 1/8″ stainless steel compression-type quick connect fitting provided.
8. Tighten all new compression fittings 1-1/4 turns with a wrench from finger tight. For connections with previously swaged ferrules, thread the nut to the previously pulled up position, then tighten slightly with a wrench. Secure tubing to appropriate structural supports as required.
9. Check all connections for gas leaks. SpectraSensors recommends using a liquid leak detector.

Do not exceed 10 psig (0.7 barg) in sample cell. Damage to cell may result.

10. While gas is flowing, briefly open the bypass valve on the membrane separator filter to clear out any liquids that may have accumulated during startup.

To connect the sample return:

1. Confirm that the low-pressure flare or atmospheric vent header shut-off valve is closed.

All valves, regulators, switches, etc. should be operated in accordance with site lock-out/tag-out procedures.

2. Determine appropriate tubing route from the analyzer to the low-pressure flare or atmospheric vent header.
3. Run stainless steel tubing from the sample return port to the low-pressure flare or atmospheric vent header connection. Bend tubing using industrial grade benders, check tubing fit to ensure proper seating between the tubing and fittings. Fully ream all tubing ends. Blow out the lines for 10–15 seconds with clean, dry nitrogen or air prior to making the connection.
4. Connect the sample return tube to the analyzer using the 1/4” stainless steel compression-type quick connect fitting provided.
5. Tighten all new fittings 1-1/4 turns with a wrench from finger tight. For connections with previously swaged ferrules, thread the nut to the previously pulled up position, then tighten slightly with a wrench. Secure tubing to appropriate structural supports as required.
6. Check all connections for gas leaks. SpectraSensors recommends using a liquid leak detector.

Conditioning the Tubing

Newly installed systems invariably have some trace contaminants and/or are intended for measuring trace amounts of gas constituents that tend to cling to system walls resulting in erroneous readings if the constituents are not in equilibrium with the system walls. Therefore, once the analyzer is completely connected, the entire system (i.e., from the sample source valve to the vent or return) should be conditioned by flowing sample gas through the system for up to 12 hours (or until reading stabilizes) after the system is powered up and before actual readings are taken. Progress of the system conditioning can be monitored via the gas concentration readings. Once the gas constituents have reached equilibrium with the system walls, the readings should stabilize.

Connecting Electrical Power to the Analyzer

The analyzer comes equipped with a fully charged internal battery. Battery life is approximately 12 hours under normal operating conditions. A 100–240 VAC, 50/60 Hz battery charger is supplied with the analyzer. To recharge the battery, plug the charger cable into the jack on the back of the analyzer under the serial port.

Connecting the Output Signals

The serial output is supplied from the serial port located on the back of the analyzer below the on/off switch. The analyzer can be connected to a serial port on a computer with the factory-supplied external serial cable. If the receiving computer has only a USB port available, a USB-to-serial adapter can be used. Refer to the Spare Parts list for recommended parts.

3 - Operating the Analyzer

The analyzer is designed to be a stationary measuring device. It should be securely mounted during normal operation.

The laser housing labels on the flanges of the sample cell warn about exposure to laser radiation inside. Never open the sample cell unless directed to do so by a service representative and the analyzer power is turned off.

The optical head has a seal and “WARNING” sticker 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 performed by the factory and are not covered under warranty.

Powering Up the Analyzer

After mounting the analyzer, connecting the power wires, connecting the gas lines, connecting the (optional) output signal wires and checking for leaks, you are ready to power up the analyzer.

See Figure B–1 or Figure B–2 for locating fuses. If you need to replace a fuse, use only the same type and rating of fuse as the original, as listed in Table A–1.

To power up the analyzer:

1. Power up the analyzer by pressing the power rocker switch to ‘ON’.
2. The analyzer goes through an initialization period counting down from 14 while showing the firmware version and release date.

```
Initializing...

            14
HC12         v2.50-xxxx
```

3. After initialization, the LCD displays the **Normal Mode** screen with four lines (the third of which is blank for single-channel units). An example is shown below.

```
    <NORMAL MODE>
ANA: 1.0%

P: 954.4mb T: 76.1F
```

4. Enable **Peak Tracking** following the procedure outlined in **"To change parameters in Mode 2"** on page 3-9.
5. Continuous updates of the measurement parameters displaying on the LCD indicate that the analyzer is operating normally.

Powering Down the Analyzer

It may be necessary to power down the analyzer for problem solving or maintenance reasons. An approved switch or circuit breaker rated for 15 amps should have been installed and clearly marked as the disconnecting device for the analyzer.

To power down the analyzer:

1. Switch off the power to the analyzer using the switch or circuit breaker designated as the disconnection device for the equipment.

Operating the Analyzer from the Keypad

The keypad enables the operator to modify measurement units, adjust operational parameters and perform diagnostics. During normal operation, the LCD continuously displays the measured components' concentrations, sample cell temperatures, and sample cell pressures.

The SpectraSensors keypad is shown in Figure 3–1. To activate any functions on the keypad, press the mode key **#** followed by a number on the keypad to specify a mode.

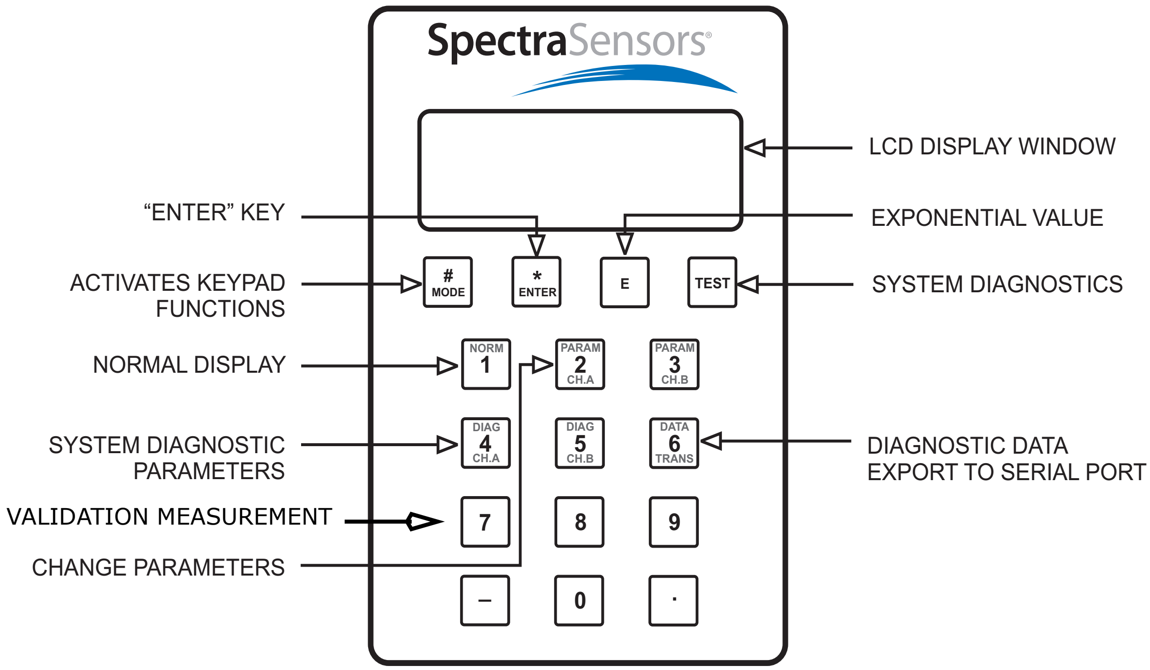


Figure 3–1 *SS1000 analyzer keypad*

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

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

Mode 2 sets the parameters in the system. In this mode, 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 the **#** key followed by the **1** key to return to **Mode 1** without saving.

Modes Defined

Use the keypad to access the following modes by pressing the key **#** key first followed by a number (**1**, **2**, **4**, **6** or **7**) to activate a mode. The following section explains each mode and the corresponding information that displays on the LCD.

Mode 1: (Normal Mode)

Mode 1 continuously displays updated measurements. Press the **#** key followed by the **1** key.

+ **1**

```
   <NORMAL MODE>
ANA: 1.0%

P: 954.4mb T: 76.1F
```

The measurements displayed are:

- **ANA**: Particular analyte concentration measured in the sample cell (in units) selected in **Mode 2**.
- **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: (Set Parameter Mode)

Mode 2 enables the user to view and change measurement parameters. Press the **#** key followed by the **2** key.

+ **2**

```
 <SET PARAMETER MODE>
Enter password

HC12      v2.50-xxxx
```

The LCD prompts for a numeric password. Enter the user password (**3142**) on the keypad, then press the ***** key to enter the number. The following is displayed on the LCD.

```
<SET PARAMETER MODE>
Main Matrix
0
0:A 1:B 2:C 3:D
```

Follow the procedure under **"To change parameters in Mode 2"** on page 3-9 for viewing and changing any of the parameters.

Mode 3: (Not Used)

Mode 4: (System Diagnostic Parameters)

Displays system diagnostic data. These values may be useful when troubleshooting the system. Press the **#** key followed by the **4** key.

+ **4**

```
PP2F:8190 PkDf:34.00
Powr:2538 PkD1:34.00
Indx: 301
Zero: -24
```

Mode 5: (Not Used)

Mode 6: (Diagnostic Data Download)

Used to transfer diagnostic data to the serial port and read the individual data points of both the **DC** and **2*f*** spectra that the instrument analyzes to calculate the gas concentration. Viewing these data can be helpful in diagnosing problems with the analyzer. Press **#** key followed by the **6** key.

+ **6**

The data points, along with intermediate calculation results, are output to the serial port(s) whenever **Mode 6** is selected.

Mode 7: (Validation Measurement)

Mode 7 is used to set the system for validation measurement. The settings for this mode are controlled by the Validation Matrix parameter. Press the **#** key followed by the **7** key.

+ **7**

```
     <NORMAL MODE>
ANA: 4.0256ppmv    (V)

P: 954.4mb    T: 76.1F
```

The measurements displayed are:

- **ANA**: Particular analyte concentration measured in the sample cell (in units) selected in **Mode 2**.
- **P**: Pressure in the sample cell in units selected in **Mode 2**.
- **T**: Temperature in the sample cell in units selected in **Mode 2**.

While the system is in validation mode, (V) will display to the right of the analyte type on the LCD. Refer to **"Validating the Analyzer"** on page 3-21 for instructions on performing a manual validation measurement.

Mode 8: (Not Used)

Mode TEST: (System Test)

Provides basic diagnostic test results indicating that the laser power, pressure/temperature sensors, and the infrared spectrum that the system records for analysis are all nominal. Press the **#** key followed by the **TEST** key.

+ **TEST**

The LCD displays the system test data.

```
    <SYSTEM TEST>
Laser Power: OK
PT Sen: OK Trak: OK
Spectr: OK Null: OK
```

For viewing the data, press the **1** key followed by the ***** key.

```
  <ANA SYSTEM TEST>
Laser Power: OK
PT Sen: OK Trak: OK
Spectr: OK Null: OK
```

Changing Measurement and Control Parameters

In **Mode 2**, all of the pertinent measurement and control parameters can be viewed and changed. Refer to Table 3–1 for a list of parameters and value ranges. The parameters are listed in the order viewed during **Mode 2** operation.

Table 3–1 *Measurement and control parameters*

Parameter	Setting	Function
Main Matrix	0, 1, 2, 3	Sets the calibration matrix (A, B, C, D) that is used when Mode 1 is pressed
Validation Matrix	0, 1, 2, 3	Sets the calibration matrix (A, B, C, D) that is used when Mode 7 (H_2O) or Mode 8 (CO_2) is pressed
S Factor	User Set -99 – 99 Default = 1	Analyzer response adjustment to match calibration standard in the field.
S Factor Offset	User Set -999999 – 999999 Default = 0	Analyzer offset adjustment to match calibration standard in the field.
# Spectrum Average	1 – 240 Default = 4	Sets the number of scans averaged for each measurement
Logger Rate	1 – 300 readings Default = 4	Sets the number of measurements to include in a running average
Peak Tracking	0, 1, 2	Sets peak tracking capability to off, on, or reset
DO Alarm Delay	User Set 0 – 30000 Default = 0	Sets the number of consecutive readings concentration must be above setpoint before triggering a **High Concentration Alarm**
Low Power Warning	User Set 200 – 4999 Default = 200	Sets the DC power level below which the analyzer will issue a **Low Power Warning**

Table 4-1 *Measurement and control parameters (Continued)*

Parameter	Setting	Function
DO Alarm Setup	0 – 8 or 100 – 108	Sets the functionality of the secondary digital output (if applicable)
Alarm Setpoint	0 – 999999	Sets the threshold for the **High** (or **Low**) **Concentration Alarm**
4-20 mA Alarm Action *	0, 1, 2 or 3	Sets the current loop state upon alarm condition
4-20 mA % Test *	0 – 101	Sets the 4-20 mA output to a percentage of full scale
4 mA Value	0 – 999999	Sets the ppmv value that will correspond to 4 mA
20 mA Value	0 – 999999	Sets the ppmv value that will correspond to 20 mA
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, 1 or 2	Sets the display unit for concentration
Concen Unit Convert	0-999999	Sets a custom conversion multiplier for the Concentration Unit. Zero uses the default conversion.
Pipeline Pressure	0 – 999999	Sets pipeline pressure used to calculate dew point
4-20 mA Value Action	0 or 1	Sets the behavior of the analog output when the analyzer is in Validation Measurement Mode.
Modbus Address	User Set 0 – 250	Sets Modbus address for the analyzer
Modbus Mode	User Set 0, 1, or 2	Sets type of Modbus protocol
Analyzer ID	User Set 0 – 2147483647	Customer definable value for analyzer ID
Sample ID	User Set 0 – 2147483647	Customer definable value for sample ID
Component ID	User Set 0 – 2147483647	Customer definable value for component (analyte) ID
User Password	0 – 9999 Default = 3142	Sets Level 1 access password

* Custom configuration

To change parameters in Mode 2:

1. Press the **#** key followed by the **2** (**Mode 2**) key.

```
 <SET PARAMETER MODE>
Enter password

HC12      v2.50-xxxx
```

The LCD prompts for a numeric password.

2. Enter the user password (**3142**) on the keypad, then press the ***** key to enter the number. The following displays on the LCD.

```
 <SET PARAMETER MODE>
Main Matrix
0
0:A 1:B 2:C 3:D
```

3. Starting with the first parameter, enter a new value and/or press the * key to store the value and cycle to the next parameter.

4. When finished changing or viewing the measurement and control parameters, press the **#** key followed by the **1** key to return to **Mode 1** and normal operation.

Measurement and Control Parameters Defined

The following section defines the measurement and control parameters set in the system. The parameters are shown in alphabetical order for easy reference. Refer to Table 3–1 on page 3–7 to review the parameter order listed during **Mode 2** configuration.

Spectrum Average

The **# Spectrum Average** parameter sets the number of scans that the analyzer averages when determining concentration. Averaging over multiple scans lowers noise in the measurement, but inherently increases response time. Each scan adds about 0.25 seconds to the response time. For example, if **# Spectrum Average** is set to “4,” an updated concentration value will be calculated about once every second.

```
 <SET PARAMETER MODE>
# Spectrum Average
16
Enter a value
```

4-20 mA Alarm Action (Custom configurations only)

The **4-20 mA Alarm Action** parameter determines the current loop state upon an alarm condition. Enter **0** (low) for the current loop to assume a low state (4 mA), **1** (high) for the current loop to assume a high state (20 mA), **2** (track and hold) for the current loop to hold the last valid measurement value, or **3** (no control) for the current loop to continue to track the concentration value upon an alarm condition.

```
 <SET PARAMETER MODE>
4-20 mA Alarm Action
0
0:L 1:H 2:T&H 3:None
```

4-20 mA % Test (Custom configurations only)

The **4-20 mA % Test** parameter enables control of the current loop output for testing and calibration purposes. The value entered represents a percent of scale value where zero equals 4 mA and full scale equals 20 mA. Thus, the current loop output, i, is given by

$$i = R(20\text{ mA} - 4\text{ mA}) + 4\text{ mA} \quad ,$$

where R is the **4-20 mA % Test** parameter value. Entering **101** turns off the control of the current loop and returns to the current loop output tracking the concentration value.

```
 <SET PARAMETER MODE>
4-20 mA % Test
101
Enter a % (101=Off)
```

After setting the desired value, press # **Mode** and **1** to initiate control of the current loop to the value entered.

4-20 mA Val Action (Custom configurations only)

The 4-20 mA Val Action parameter sets the behavior of the analog output signal while the analyzer is in Validation Measurement Mode. If **0** is chosen, the analog output will stay at the last known value while the analyzer is in

Validation Measurement Mode. If **1** is chosen, the analyzer will update the analog output with the Validation Measurement Mode values.

```
 <SET PARAMETER MODE>
4-20mA Val Action
0
0:Hold 1:Measure
```

4 mA Value

The **4 mA Value** parameter sets the concentration value [in ppmv or dew-point temperature (in temperature units selected with the **Temperature Unit** parameter)] that corresponds to 4 mA on the current loop output. Typically this will be 0.000.

```
 <SET PARAMETER MODE>
4 mA Value
0.00000
ppmv or DewPoint F/C
```

20 mA Value

The **20 mA Value** parameter sets the concentration value [in ppmv or dew-point temperature units selected with the **Temperature Unit** parameter)] that corresponds to 20 mA on the current loop output. Typically this will be the full-scale value for which the analyzer was calibrated.

```
 <SET PARAMETER MODE>
20 mA Value
100.000
ppmv or DewPoint F/C
```

Analyzer ID

The **Analyzer ID** parameter assigns a numeric identification to the data enabling SCADA or DCS systems to associate data with a particular analyzer.

```
 <SET PARAMETER MODE>
Analyzer ID
0
Enter a value
```

Component ID

The **Component ID** parameter assigns a numeric identification to the data enabling SCADA or DCS systems to associate the data with a particular analyte/component.

```
 <SET PARAMETER MODE>
Component ID
0
Enter a value
```

Concen Unit Convert

The Concen Unit Convert parameter allows a custom conversion multiplier to be used instead of the analyzer default conversion for the Concentration Unit. On moisture system, this custom conversion does not apply if Dew Point is chosen as the Concentration Unit.

```
 <SET PARAMETER MODE>
Concen Unit Convert
0.000
0:Off >0:Multiplier
```

Concentration Unit

The **Concentration Unit** parameter designates the display units for the measured concentration. For percentage level analyzers (non-CO_2):

- **0** for ppmv
- **1** for %
- **2** for mg/sm^3

```
 <SET PARAMETER MODE>
Concentration Unit
0
0:ppm 1:lb 2:DP 3:mg
```

DO Alarm Delay

The **DO Alarm Delay** parameter sets the number of measurements to delay the high concentration alarm before it becomes active.

```
 <SET PARAMETER MODE>
DO Alarm Delay
4
Enter a value
```

DO Alarm Setup

The **DO Alarm Setup** parameter sets the functionality of the secondary digital output.

```
 <SET PARAMETER MODE>
DO Alarm Setup
1
Enter a value
```

Enter the value corresponding to the desired functionality according to Table 3–2.

Table 3–2*Secondary digital output functionality*

	Setting	Functionality
Normally Energized	0	Always Activated
	1	High Concentration Alarm
	2	Low Concentration Alarm
	3	Power Fail Error
	4	PT Fail Error
	5	Spectrum Fail Error
	6	Null Fail Error
	7	Track Fail Error
	8	Power Warning

Table 2-2 *Secondary digital output functionality (Continued)*

	Setting	Functionality
Normally Deenergized	100	Always Deactivated
	101	High Concentration Alarm
	102	Low Concentration Alarm
	103	Power Fail Error
	104	PT Fail Error
	105	Spectrum Fail Error
	106	Null Fail Error
	107	Track Fail Error
	108	Power Warning

*Option **0** is intended to be used as a power failure alarm for the analyzer for AC or DC power only. If selected while the analyzer is on, the relay will also be on. If the analyzer loses power, the relay will turn off.*

Logger Rate

For applications where an external data logger is employed, use the logging rate to set the number of measurements to include in the running average. The display and the current loop output will each have a value representing the running average of the concentration over a number of measurements equal to **Logger Rate**.

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

Low Power Warning

The **Low Power Warning** parameter sets the level at which the analyzer will issue a Low Power Warning.

```
 <SET PARAMETER MODE>
Low Power Warning
200
Enter a value
```

Main Matrix

On some systems, more than one calibration is needed to handle multiple analyte ranges or background variations. Up to four calibrations matrices can be loaded into the analyzer each using a letter designation (A, B, C or D). The Main Matrix parameter sets the active calibration matrix when Mode 1 is pressed.

```
 <SET PARAMETER MODE>
Main Matrix
0
0:A 1:B 2:C 3:D
```

Modbus Address

The **Modbus Address** parameter sets the analyzer address for when the analyzer is used as a Modbus device. Addresses from 1 to 250 can be used.

```
 <SET PARAMETER MODE>
Modbus Address
1
Enter a value(1-250)
```

Modbus Mode

The **Modbus Mode** parameter sets the communications protocol for the RS-232 port. There are three choices: **0** for turning the Modbus capabilities off and defaulting to generic serial output as described in **"Receiving Serial Data (RS-232 Output)"** on page 4-1; **1** for enabling the analyzer to respond to

Gould Modbus RTU function codes 3, 6 and 16; and **2** for enabling the analyzer to respond to Daniel Modbus RTU function codes 3, 6 and 16.

```
 <SET PARAMETER MODE>
Modbus Mode
0
0:Off 1:GMR 2:DMR
```

Peak Tracking

The peak tracking function is a software utility that continuously adjusts the laser current to keep the absorption peak of the measured component at the center of the scan. There are three choices: **0** for no peak tracking, **1** for peak tracking (default), or **2** to reset the peak tracking function. In most cases, the peak tracking should be left on (i.e., **Peak Tracking** set to **1**).

```
 <SET PARAMETER MODE>
Peak Tracking
1
0:Off 1:Track 2:Rst
```

Pressure Unit

The **Pressure Unit** parameter designates the display units for the measured absolute pressure in the cell. There are four choices: **0** for millibar, **1** for Torr, **2** for kPa, and **3** for psia.

```
 <SET PARAMETER MODE>
Pressure Unit

0:mb1:Torr2:Pa3:psi
```

Sample ID

The **Sample ID** parameter assigns a numeric identification to the data enabling SCADA or DCS systems to associate the data with a particular sample point.

```
 <SET PARAMETER MODE>
Sample ID
0
Enter a value
```

S Factor

The **S Factor** parameter is a user definable value that enables adjustment (without affecting the factory calibration) of the analyzer response (or slope) in the field [see **"Adjusting Analyzer Reading to Match Specific Standard(s)"** on page 3-18].

```
 <SET PARAMETER MODE>
S Factor
1.00000
Enter a value
```

S Factor Offset

The **S Factor Offset** parameter is a user definable value that enables adjustment (without affecting the factory calibration) of the analyzer offset in the field [see **"Adjusting Analyzer Reading to Match Specific Standard(s)"** on page 3-18].

```
 <SET PARAMETER MODE>
S Factor Offset
0.00000
Enter a value (ppmv)
```

Temperature Unit

The **Temperature Unit** parameter designates the display units for the measured cell temperature. There are two choices: **0** for degrees Celsius and **1** for Fahrenheit. The default value is the standard unit of measurement in the region the analyzer is being used.

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

User Password

The **User Password** parameter sets the Level 1 access password. The default password is 3142.

```
<SET PARAMETER MODE>
User Password
3142
Enter password
```

Validation Matrix

On some systems, more than one calibration is needed to handle multiple analyte ranges or background variations. Up to four calibrations matrices can be loaded into the analyzer each using a letter designation (A, B, C or D). The Validation Matrix parameter sets the active calibration matrix that is used when Mode 7 is pressed.

```
<SET PARAMETER MODE>
Validation Matrix
0
0:A 1:B 2:C 3:D
```

Adjusting Analyzer Reading to Match Specific Standard(s)

In some instances, the user may wish to adjust the analyzer reading to match the concentration (or concentrations) of a specific standard (or standards). The **S Factor** and **S Factor Offset** parameters are used to adjust the analyzer output in the field without affecting the factory calibration. Both parameters are used when samples from two different concentration standards are available, whereas only the **S Factor Offset** parameter is used when a sample from only one concentration standard is available.

The value of the **S Factor** parameter, S, is determined by

$$S = \frac{C_2 - C_1}{A_2 - A_1} ,$$

where C_1 is the certified concentration of standard No. 1, C_2 is the certified concentration of standard No. 2, A_1 is the measured concentration (analyzer reading) of standard No. 1, and A_2 is the measured concentration (analyzer reading) of standard No. 2.

The **S Factor Offset** parameter, O, is determined by

$$O = C_1 - (S \cdot A_1) \;,$$

where $S = 1$ when a sample from only one concentration standard is available.

To adjust the analyzer reading:

1. Validate the analyzer using one or two concentration standards [see **"Validating the Analyzer"** on page 3-21].

   SpectraSensors recommends validating the analyzer using only the analyte/component mixed in the validation gas specified on the analyzer calibration report. Bottles of test gas with certified concentrations of approximately 20% and 80% of full scale are recommended for two point validation. For single point validation, a bottle with a certified concentration of approximately 50% of full scale should be used.

   When procuring a gas standard, make sure the background gas is that specified or a mix that closely resembles the contents of the process stream and have the gas standard certified to better than the specified precision of the analyzer, if possible.

2. Calculate the **S Factor** and/or **S Factor Offset** parameter(s) using the equations above.
3. Follow the procedure under **"To change parameters in Mode 2"** on page 3-9 to enter the new values.
4. Confirm the new values by re-measuring the bottle(s) of test gas.

Scaling and Calibrating the Current Loop Signal

The 4-20 mA current loop funtion is available through optional hardware. Contact your local sales representative for more information.

The 4-20 mA current loop signal is most conveniently scaled and calibrated at the receiving end (RTU, flow computer, etc.).

The 4-20 mA current loop is factory set as the source unless otherwise specified. Contact your sales representative if a change is required.

To scale the receiver’s output, the analyzer’s current loop output is set to 4 mA and 20 mA and the receiver is adjusted to read “0” and “Full Scale,” respectively.

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

To scale the current loop signal:

1. Make sure the current loop to be adjusted is connected and the receiver is set for the 4-20 mA board to source the current.
2. Set the current loop output to 4 mA by setting the **4-20 mA % Test** parameter to zero (see **“To change parameters in Mode 2”** on page 3-9).
3. Adjust the receiver calibration control to read the appropriate value. The current loop output of 4 mA corresponds to the concentration value set by the **4 mA Value** parameter.
4. Set the current loop output to 20 mA by setting the **4-20 mA % Test** parameter to 100.
5. Adjust the receiver calibration control to read the appropriate value. The current loop output of 20 mA corresponds to the concentration value set by the **20 mA Value** parameter.
6. If desired, repeat by setting the **4-20 mA % Test** parameter, *R*, to any value between 0 and 100 and confirm that the output, i, agrees with $i = R(20\ \text{mA} - 4\ \text{mA}) + 4\ \text{mA}$.
7. When finished, reset the **4-20 mA % Test** parameter to 101.

Warnings

- **Low Power Warning**: This warning occurs when the DC signal drops below the level set by the **Low Power Warning** parameter.

Faults/Alarms

The **High Concentration Alarm** or **Low Concentration Alarm** is triggered when the measured concentration is above or below, respectively, the level set in **Mode 2**. The **General Fault Alarm** is triggered by system faults that also cause the current loop to respond according to the **4-20 mA Alarm Action** setting. The particular fault is indicated by a message on the front panel LCD. System faults include one or more of the following:

- **Power Fail Error**: This fault occurs when the DC signal becomes too weak for a reliable measurement typically as a result of mirror contamination.

- **Null Fail Error**: This fault occurs if the detector signal value is out of the range of -50 to +50 when the laser is turned off.
- **Spectrum Fail Error**: This fault occurs when the system is unable to adequately fit a curve to the measured signal, typically as a result of DC signal saturation in the absence of absorbing gas in the measurement cell, too much noise in the signal or an unexpected gas mixture in the measurement cell.
- **PT Fail Error**: This fault occurs when the pressure and/or temperature in the measurement cell exceeds the specified maximum operating levels.
- **Track Fail Error**: This fault occurs when the peak tracking function is out of range [**PkDf** (factory set midpoint) and **PkD1** (peak track midpoint) differ by more than 4 counts].

Alarm and fault messages appear on the front panel LCD. See Appendix A for recommendations and solutions to common problems resulting in a system fault.

Validating the Analyzer

Validation of the analyzer using an appropriate gas standard can be done manually on systems equipped with a check gas or validation gas port.

To validate manually (if applicable):

1. Connect a bottle of validation gas to the check gas or validation gas port (at the specified supply pressure).
2. Press **#(Mode) 7** to set the validation measurement mode.

When the validation mode is enabled through Mode 7, "(V)" will be displayed to the right of the designated analyte type on the LCD.

3. Close the upstream measurement cell isolation valve.
4. Open the check gas or validation gas shut-off valve.
5. Adjust the sample flowmeter metering valve to the specified flow for the measurement cell.

The adjustment setpoints of the analyzer flowmeters and pressure regulators will be interactive and may require readjustment multiple times until the final setpoints are obtained.

The analyzer system has been designed for the sample flow rate specified. A lower than specified sample flow rate may adversely affect system performance. If you are unable to attain the specified sample flow rate, contact your factory sales representative.

6. Make a measurement after the gas flows for approximately five minutes or when the values on the LCDs settle.
7. After validation, press **#(Mode) 1** to return to normal mode.
8. Close the check gas or validation gas shut-off valve.
9. Open the upstream measurement cell isolation valve.
10. Adjust the sample flowmeter metering valve to the specified flow for the measurement cell, and to return to normal operation.

SpectraSensors recommends validating the analyzer using only the analyte mixed in the validation gas specified on the analyzer calibration report. Bottles of test gas with certified concentrations of approximately 20% and 80% of full scale are recommended for two point validation. For single point validation, a bottle with a certified concentration of approximately 50% of full scale should be used.

When procuring a gas standard, make sure the background gas is that specified or a mix that closely resembles the contents of the process stream and have the gas standard certified to better than the specified precision of the analyzer, if possible.

Calibrating the Analyzer

Calibrating the analyzer is typically not required under normal circumstances. SpectraSensors calibrates each analyzer to a National Institute of Standards and Technology (NIST) traceable standard before shipping the unit to the end user. Because SpectraSensors analyzers use a non-contact form of measurement, they are relatively insensitive to contamination, are quite rugged and virtually maintenance free ensuring years of reliable service.

4 - SS1000 Serial Communications

Receiving Serial Data (RS-232 Output)

When the **Modbus Mode** parameter is set to **0**, the analyzer is configured to transfer a string of data from the analyzer to a serial device via the RS-232 output. The receiving device is typically a computer terminal running HyperTerminal, which is a program included with Microsoft® Windows® 95, 98, and XP that enables serial communication and the viewing, capturing and storage of serial port data and messages.

To launch HyperTerminal:

1. On your Windows desktop, click **Start** followed by **Run** (usually located in the lower right side of the Start Menu).
2. Type **Hypertrm.exe** and hit **Return** to launch HyperTerminal.

For faster access to HyperTerminal, save a HyperTerminal shortcut to the desktop.

3. Once HyperTerminal is activated, the **Connection Description** window appears, as shown in Figure 4–1. Type in a **Filename** (where the terminal session settings will be stored for future recall) and click on any icon. Click **OK**.
4. The **Connect To** window appears prompting for a connection, as shown in Figure 4–2. Click the **Menu Arrow** under **Connect Using** to view the choices.
5. Click on the appropriate port to which your analyzer is connected (COM1, COM2, COM3, etc.) as established under **"Connecting the Output Signals"** on page 2-5.
6. Click **OK**.
7. Once the port is chosen, the **COM Properties** window appears. Make sure the COM properties for the port selected reflect those shown in Figure 4–3 (9600 baud, 8 data bits, 1 stop bit, no parity, and no flow control).
8. Click **OK** to establish the connection.

Once connected, the data will start streaming through the Hyperterminal Window as shown in Figure 4–4.

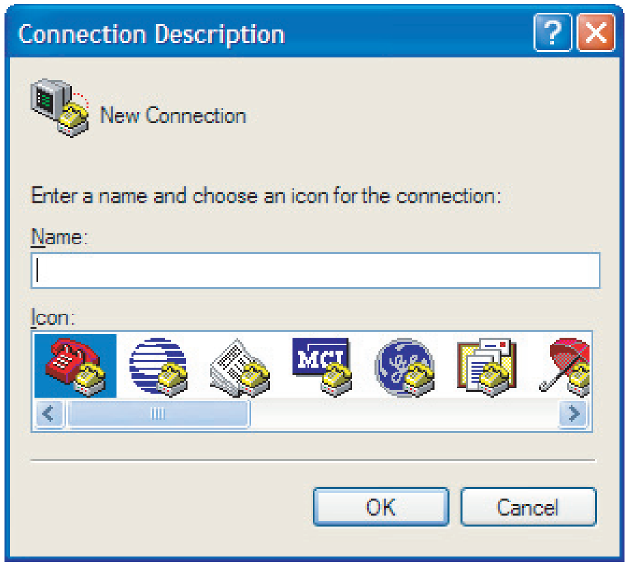


Figure 4–1 *Connection Description window* [v2.50]

Figure 4–2 *Connect To window* [v2.50]

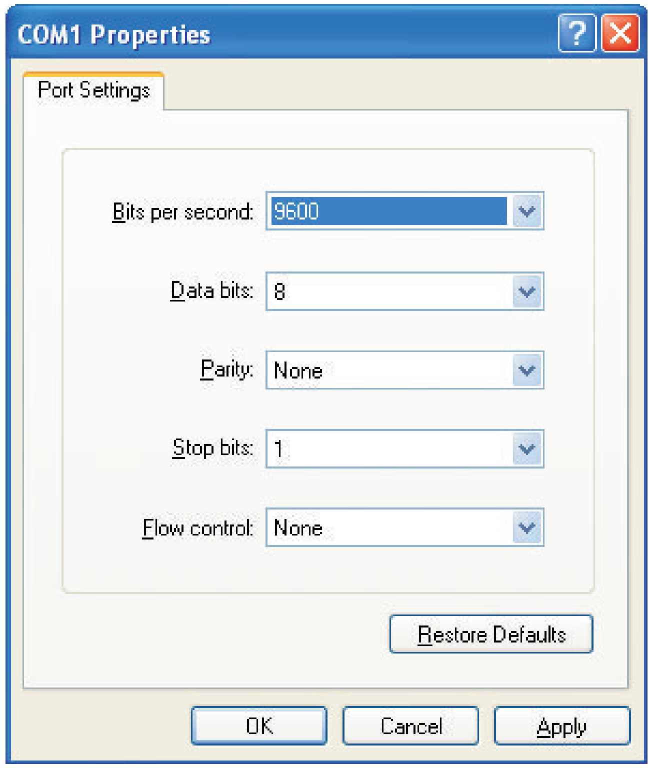


Figure 4–3 *COM Properties window* [v2.50]

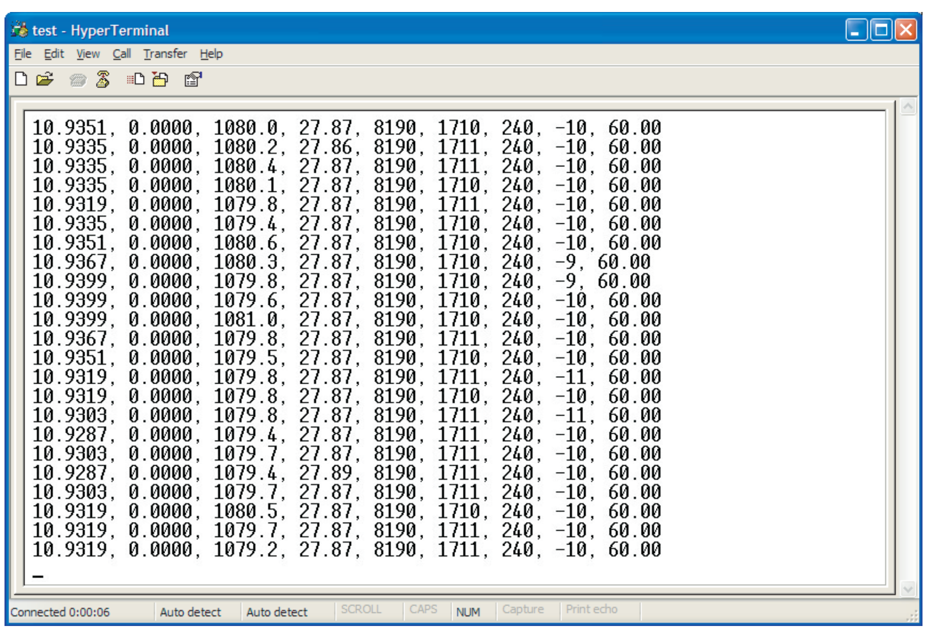


Figure 4–4 *Hyperterminal window with streaming data* [v2.50]

The data string is comma and space delimited with a carriage return and includes:

- **Concentration**: Analyte concentration (user selected units)
- **Pressure**: Cell pressure (user selected units)
- **Temperature**: Cell temperature (user selected units)
- **PP2F**: Magnitude of concentration signal (counts)
- **Powr**: DC signal at absorption peak (counts)
- **Indx**: Position of absorption peak in scan
- **Zero**: Detected signal with laser turned off (counts)
- **PkD1**: Present midpoint value (mA)

*The number of seconds between each line of data output should be the **# Spectrum Average** number set in **Mode 2** or **Mode 3** divided by 4.*

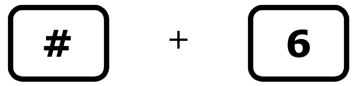
To capture and save data from the serial port:

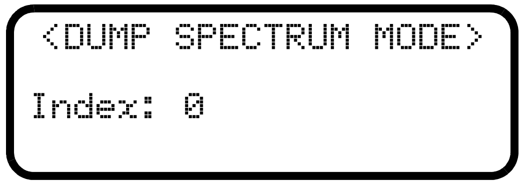
1. To save the data from the serial port, use the **Transfer/Capture Text** function and enter the **Filename** to where you would like to store the captured data.
2. To stop the capture of the serial data, click on **Transfer/Capture Text/Stop**.

To read diagnostic data with HyperTerminal:

1. Before entering **Mode 6**, make sure the serial port on the computer used for serial communication is connected to the analyzer and the output stream is showing on the screen as described in **"To launch HyperTerminal"** on page 4-1.
2. To save the data from the serial port, use the **Transfer/Capture Text** function and enter the **Filename** to where you would like to store the captured data.

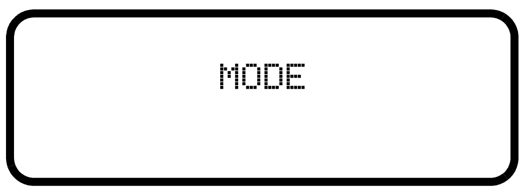
3. Once capturing is in place, enter **Mode 6** by pressing **#** key followed by the **6** key.





The index shown on the LCD display counts by 50's from 0 to 511 in a few seconds. The analyzer will continue to dump Mode 6 data until instructed to stop. The screen above will repeat itself for each data dump. Once sufficient data has been captured, press the "MODE" key at any time to discontinue.

When the analyzer completes the current dump, the following screen displays:



4. Press the **#** key followed by the **1** key to return to **Mode 1**.
5. Once normal operation resumes, allow appropriate time for data streaming, then stop the capture of the serial data. To stop the capture of the serial data, click on **Transfer/Capture Text/Stop**. The resulting data files contain the downloaded data as shown in Figure 4–5.

To import the stored data file into a spreadsheet program such as Microsoft Excel® to plot the data, refer to **"Viewing Diagnostic Data with Microsoft Excel"** for instructions.

Viewing Diagnostic Data with Microsoft Excel

A spreadsheet program such as Microsoft Excel can import the data collected in the **Mode 6** data dump for viewing and plotting.

```
211.6678, 0.0000, 1006.9, 24.98, 2154, 2078, 340, -10, 60.00
211.1581, 0.0000, 1006.6, 24.98, 2137, 2078, 340, -9, 60.00
210.6408, 0.0000, 1007.6, 24.98, 2128, 2078, 340, -10, 60.00

HC12 v2.50-B525 CO2 Single

Current Mode: Main Stream
Current File: 0 (0:A 1:B 2:C 3:D)

Settings
Phase: 300
Midpoint: 60.0000
Ramp amplitude: 35.0000
Imod: 8.000
Rcalb: (A)4.000000E+01 (B)4.000000E+01 (C)4.000000E+01 (D)4.000000E+01
Zero Offset (ppmv): (A)0.000000E+00 (B)0.000000E+00 (C)0.000000E+00 (D)0.000000E+00
Min Range (ppmv): 0.000
Max Range (ppmv): 422.00
Min Pressure (mbar): 700
Max Pressure (mbar): 1700
P a1 Coeff: (A)1.000E+00 (B)1.000E+00 (C)1.000E+00 (D)1.000E+00
P a2 Coeff: (A)0.000E+00 (B)0.000E+00 (C)0.000E+00 (D)0.000E+00
P a3 Coeff: (A)0.000E+00 (B)0.000E+00 (C)0.000E+00 (D)0.000E+00
P a4 Coeff: (A)0.000E+00 (B)0.000E+00 (C)0.000E+00 (D)0.000E+00
NL a0 Coeff: (A)0.00000E+00 (B)0.00000E+00 (C)0.00000E+00 (D)0.00000E+00
NL a1 Coeff: (A)1.00000E+00 (B)1.00000E+00 (C)1.00000E+00 (D)1.00000E+00
NL a2 Coeff: (A)0.00000E+00 (B)0.00000E+00 (C)0.00000E+00 (D)0.00000E+00
NL a3 Coeff: (A)0.00000E+00 (B)0.00000E+00 (C)0.00000E+00 (D)0.00000E+00
Xleftvmr: 240
Xrightvmr: 340
Null Fail Range Min: -50
Null Fail Range Max: 50
Peak Track Num Avgs: 3600
Serial Number: 100000000
Main Matrix: 0
Validation Matrix: 0
S Factor: 1.00000
S Factor Offset: 0.00000
# Spectrum Average: 4
Logger Rate: 4
Peak Tracking: 0
DO Alarm Delay: 0
Low Power Warning: 200
DO Alarm Setup: 0
Alarm Setpoint(ppmv): 430.0
4-20mA Alarm Action: 0
4-20mA % Test: 101
4 mA Value: 0.000
20 mA Value: 422.000
Temperature Unit: 0
Pressure Unit: 0
Concentration Unit: 0
Concen Unit Convert: 0.000
Pipeline Pressure: 0.00
4-20 mA Val Action  : 0
```

Figure 4–5 *Sample Mode 6 data output* [v2.50]

```
Modbus Address: 1
Modbus Mode: 0
User Analyzer ID: 0
User Sample ID: 0
User Component ID: 0

Peak Index Location: 290
mA Index Scale: 0.06835938
Peak Track Range Min: 3
Peak Track Range Max: 70

Constants
Null Point: 6

SpectraSensors HardHat
IdxDCAC
0    3157  -325
1    2679  -269
2    1992  -264
3    1348  -254
4    844   -238
5    490   -218
6    263   -197
7    125   -176
8    49    -156
9    11    -138
10   -4    -120
11   -10   -104
12   -10   -90
13   10    -125
14   65    257
15   114   982
16   145   1573
17   156   1917
18   158   2325
19   156   2957
20   157   3604
21   161   4095
22   165   4095
23   171   4095
24   178   4095
25   184   4095
26   191   4095
27   197   4095
28   203   4095
29   208   4095
30   214   4095
31   219   4095
32   225   4095
33   229   4095
34   235   4095
35   239   4095
36   244   4095
37   250   4095
38   254   4095
39   260   4095
40   264   4095
41   270   4095
42   274   4095
43   278   4095
```

Figure 5-5 *Sample diagnostic data output* [v2.50] *(Continued)*

To import the data file into Excel:

1. In Excel, click **Open** and choose the name of the spectrum file saved while in **Mode 6**. Be sure to select **All Files (*.*)** under **Files of type:** while searching, as shown in Figure 4–6.

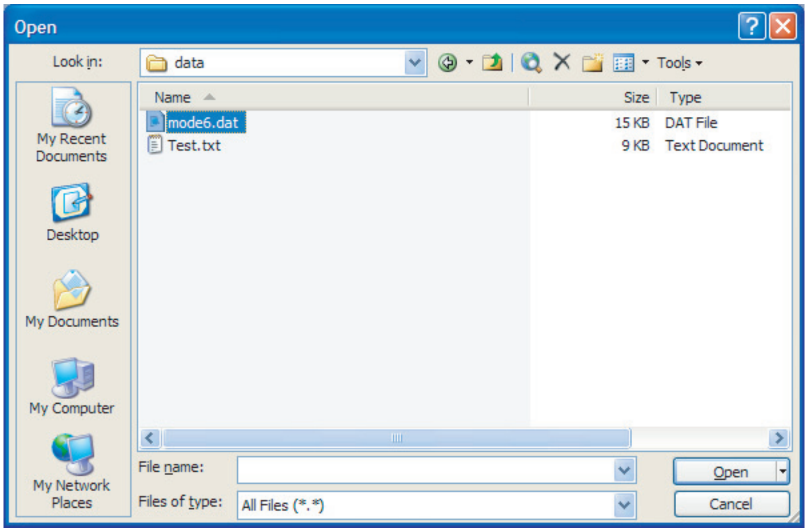


Figure 4–6 *Opening a data file in Excel*

2. The **Text Import Wizard** should open. Choose the **Delimited** option and click **Next**, as shown in Figure 4–7.

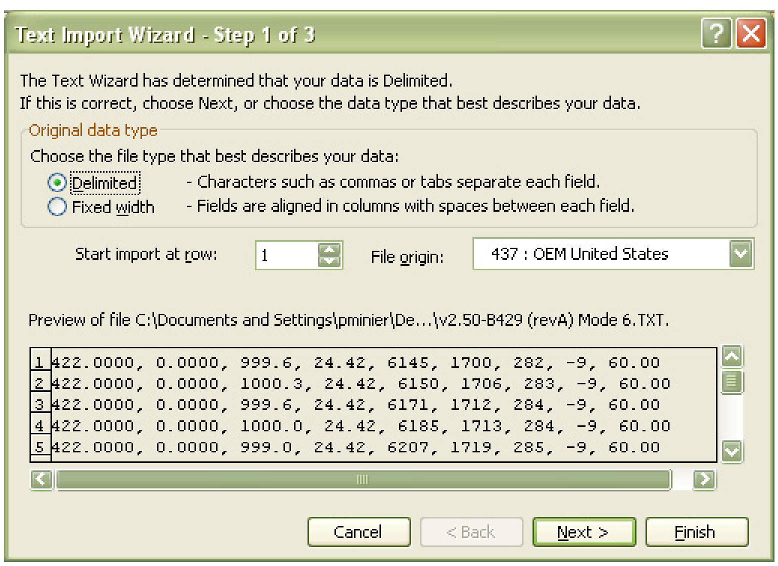


Figure 4–7 *Setting data type in Text Import Wizard*

3. Under **Delimiters**, choose the **Tab** and **Comma** options, check the **Treat Consecutive Delimiters as One** box, as shown in Figure 4–8, and then click **Finish** to display the spreadsheet.

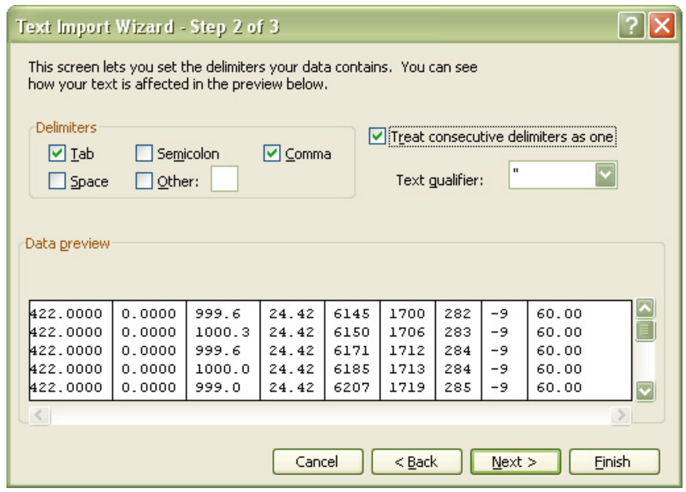


Figure 4–8 *Setting Tab and Comma as delimiters*

The first few lines look like the normal serial output data received before the **Mode 6** command was entered. Look for the three columns of numbers, as shown in Figure 4–9.

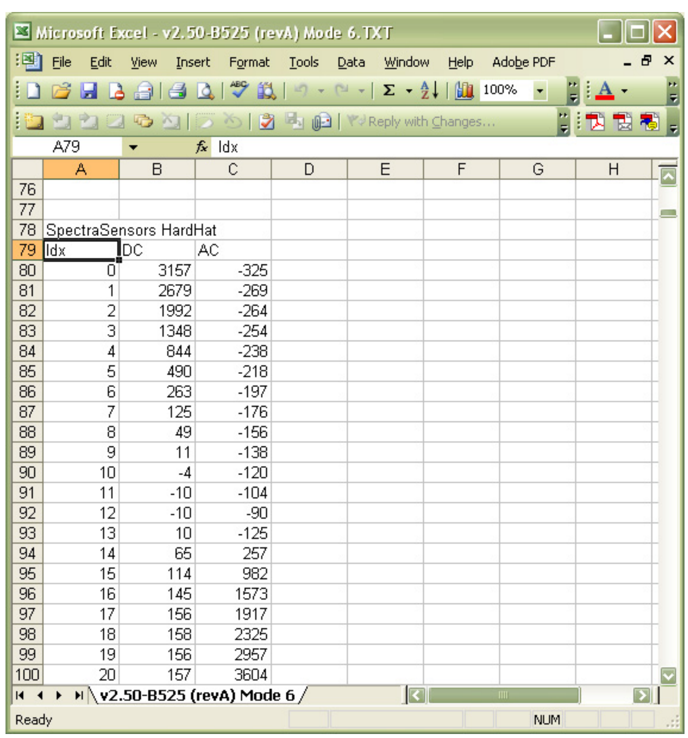


Figure 4–9 *Highlighting imported data for plotting in Excel*

4. Click on the upper left cell with the “Idx” header, as shown in Figure 4–9. Hold the **Shift** key down while pressing the **Control** key followed by the **Right Arrow** key to highlight all three columns in the row. Hold the **Shift** and **Control** key down again and press the **Down Arrow** key to highlight all 512 rows.

5. Click the **Chart Wizard** button on the **Task Bar**. The **Chart Wizard** should open, as shown in Figure 4–10.

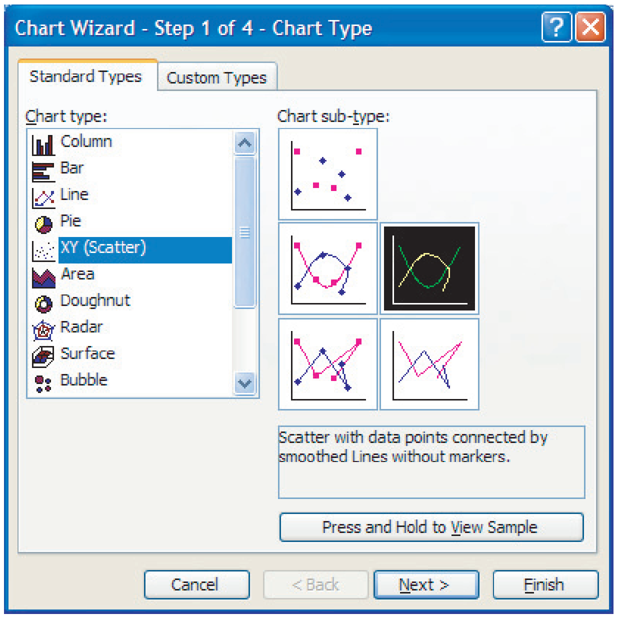


Figure 4–10 *Chart Wizard - Step 1 window*

6. Choose the **X-Y (Scatter)** chart type and the **Smoothed Lines Without Markers** sub-type. Click **Finish** to display a graph of the spectrum, as shown in Figure 4–11.

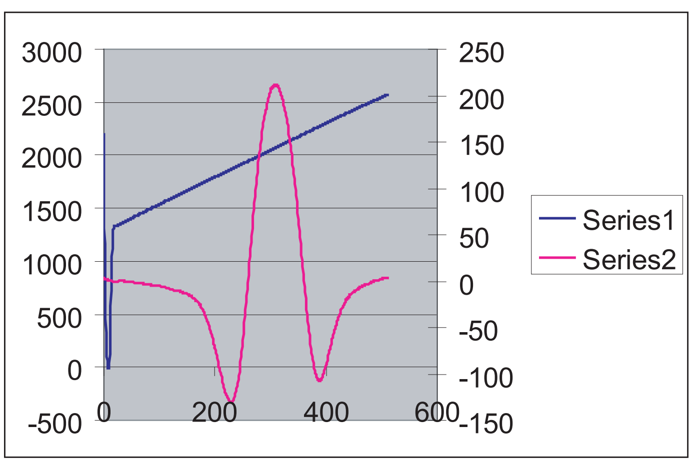


Figure 4–11 *Data file plot in Excel*

If the **2*f*** curve appears flat, double click on it to get to the **Format Data Series Window**. Select the **Axis** tab, and select **Plot Series on Secondary Axis**, as shown in Figure 4–12. Click **OK** to rescale the plot.

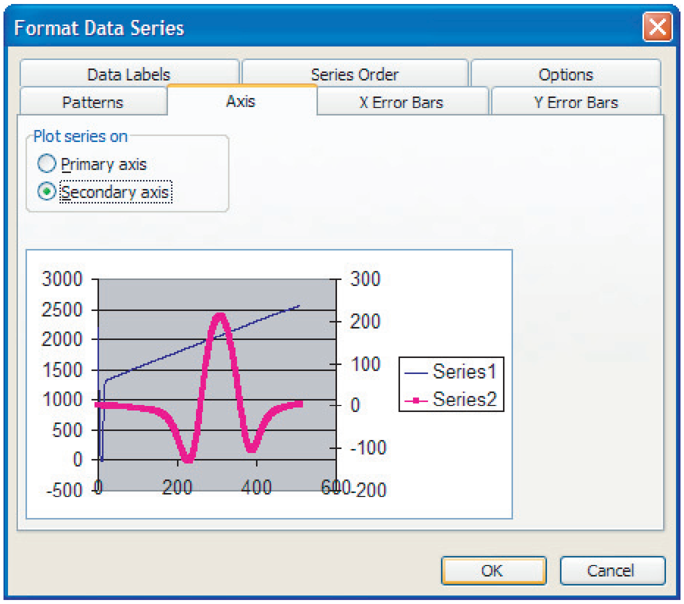


Figure 4–12 *Format Data Series window*

Modbus Communications Protocol

Modbus is a serial communications protocol published by Modicon in 1979 for use with its programmable logic controllers (PLCs). It has become a *de facto* standard communications protocol in industry, and is now the most commonly available means of connecting industrial electronic devices. Modbus is used extensively in leu of other communications protocols because it is openly published and royalty-free, relatively easy to deploy, and capable of moving raw bits or words without placing many restrictions on vendors.

Modbus enables communication between many devices connected to the same network, for example, a supervisory computer with a remote terminal unit (RTU) in supervisory control and data acquisition (SCADA) systems.

The SpectraSensors analyzer acts as a slave in a master/slave(s) network of devices. It can receive queries from a master and send responses back using either Gould Modbus RTU protocol or Daniel Extended Modbus RTU protocol.

Framing/Protocol

The transmission mode used to communicate is either Gould Modbus RTU or Daniel Modbus RTU with port parameters 9600 (baud rate), 8 (data bits), 1 (stop bit), no (parity), and none (flow control/handshake).

The Modbus option is determined by the user via a front-panel configuration parameter as follows:

- Set Modbus Mode = **0** to disable Modbus mode and to enable the Generic Serial mode
- Set Modbus Mode = **1** to enable Gould Modbus RTU mode
- Set Modbus Mode = **2** to enable Daniel Modbus RTU mode

The generic serial output (HyperTerminal) is disabled if either Gould or Daniel Modbus is selected.

Functions

Available functions are 0x03 (read holding registers), 0x06 (write to a single register), 0x10 (write to multiple registers), and 0x2B (read device identification).

Addressing

The analyzer's Modbus slave node address can be in the range of 0-250 with the default being 1. All analyzers will respond to an address of 0, so this address can be used to interrogate a single unit when its address is unknown or to determine its address.

See Table 4–1 on page 4–15 for register definitions for both Gould and Daniel Modbus modes. Be aware that for Gould Modbus the table follows the convention of identifying the register with an offset of 40001. Therefore, the actual value transmitted in the starting register field of the command is the listed register value minus 40001, e.g. register 47001 is addressed as 7000.

Reading/Writing in Daniel Modbus Mode

Daniel Modbus supports three types of registers: short integer, long integer and floating point. Each “short integer” register is two bytes in length and will contain an integer value. Each “long integer” register is four bytes in length and will contain an integer value and each “floating point” register is four bytes in length and will contain a floating point value.

Reading/Writing in Gould Modbus Mode

Gould Modbus supports three types of variable data, short integer, long integer and floating point, but all registers are addressed as word (two byte) registers. A “short integer” value is contained in one register whereas a “long integer” or

"floating point" value requires two contiguous registers. The registers are defined as Read or Read/Write.

Use caution when writing to registers as changing the value of a writable register may affect the calibration of the analyzer.

An appropriate password must be downloaded to the password register prior to writing to most registers. The User Level 1 (L1) user password **3142** will allow access to those registers which have been pre-defined as user configurable. Other writable registers can only be downloaded or changed by SpectraSensors support personnel using a User Level 2 (L2) password.

Endianness

Endianness, often referred to as *byte order*, is the ordering of individually addressable sub-units (words, bytes, or even bits) within a longer data word. Byte orders with the *most* versus *least* significant byte first are called big-endian and little-endian, respectively. In SpectraSensors analyzers, all bytes are stores big-endian. Thus, for floating point and long-integer data types, the byte order will look like:

HighWord-HighByte	HighWord-LowByte	LowWord-HighByte	LowWord-LowByte

Note that floating point values follow the IEEE Standard for Floating-Point Arithmetic (IEEE 754-2008).

To enable Modbus communications:

1. Confirm that the serial cable has been properly connected. See **"Connecting the Output Signals"** on page 2-5.
2. Power up the analyzer (see **"Powering Up the Analyzer"** on page 3-1).
3. Press the **#** key followed by the **2** key (H_2O) or the **#** key followed by the **3** key (CO_2).

The LCD prompts for a numeric password. Enter the user password (**3142**) on the keypad and the following displays on the LCD.

```
 <SET PARAMETER MODE>
Main Matrix
0
0:A 1:B 2:C 3:D
```

Press the * key to enter the number to enter **Mode 2** (Set Parameter Mode - H_2O) or **Mode 3** (Set Parameter Mode - CO_2).

4. Press the * key repeatedly until the **Modbus Address** parameter is displayed.

```
 <SET PARAMETER MODE>
Modbus Address
1
Enter a value(1-250)
```

5. Enter the desired **Modbus Address** and press the * key to store the value and cycle to the **Modbus Mode** parameter.

```
 <SET PARAMETER MODE>
Modbus Mode
0
0:Off 1:GMR 2:DMR
```

6. Enter the desired **Modbus Mode** and press the * key to store the value.
7. Press the # key followed by the **1** key to return to **Mode 1**.The analyzer is now ready to receive Modbus queries.

Table 4–1 *Modbus register map* [v2.50]

Parameter	Daniel Reg.	Gould Reg.	Data Type	Action	Min	Max
Concentration	7001	47001	Float	Read	0	0
Temperature	7002	47003	Float	Read	0	0
Pressure	7003	47005	Float	Read	0	0
Supply Voltage (DC)	7004	47007	Float	Read	0	0
PkD1 (Current Midpoint)	7005	47009	Float	Read	0	0
Firmware Version	7057	47113	Float	Read	0	0
S Factor	7101	47201	Float	R/W L1[a]	-99	99
S Factor Offset (ppmv)	7102	47203	Float	R/W L1[a]	-999999	999999
Alarm Setpoint (ppmv, lb or %)	7103	47205	Float	R/W L1	0	999999
Pipeline Pressure (mb)	7104	47207	Float	R/W L1[a]	0	9999.9
4 mA Value (ppmv)	7105	47209	Float	R/W L1[a]	0	999999
20 mA Value	7106	47211	Float	R/W L1[a]	0	999999
Concen Unit Convert	7107	47213	Float	R/W L1	0	999999
Alarm Flags	5001	45001	Long	Read	0	0
Analyzer ID	5101	45201	Long	R/W L1[a]	0	2.0E9
Sample ID	5102	45203	Long	R/W L1[a]	0	2.0E9
Component ID	5103	45205	Long	R/W L1[a]	0	2.0E9
PP2f	3001	43001	Integer	Read	0	0
Power	3002	43002	Integer	Read	0	0
Index	3003	43003	Integer	Read	0	0
Zero	3004	43004	Integer	Read	0	0
# Spectrum Average	3201	43201	Integer	R/W L1[a]	1	240
Logger Rate	3202	43202	Integer	R/W L1[a]	1	299
Peak Tracking	3203	43203	Integer	R/W L1[a]	0	2
4-20 mA Alarm Action	3204	43204	Integer	R/W L1[a]	0	3
Temperature Unit	3205	43205	Integer	R/W L1[a]	0	1
Pressure Unit	3206	43206	Integer	R/W L1[a]	0	3
Concentration Unit	3207	43207	Integer	R/W L1[a]	0	2
Modbus Device Address	3208	43208	Integer	R/W L1[a]	0	250
Modbus Mode	3209	43209	Integer	R/W L1[a]	0	2
DO Alarm Setup	3210	43210	Integer	R/W L1[a]	0	108

Table 4–1 *Modbus register map* [v2.50]

Parameter	Daniel Reg.	Gould Reg.	Data Type	Action	Min	Max
4-20mA % Test	3211	43211	Integer	R/W L1[a]	0	101
Low Power Warning	3212	43212	Integer	R/W L1[a]	200	4999
User Password	3213	43213	Integer	R/W L1[a]	0	9999
DO Alarm Delay	3214	43214	Integer	R/W L1[a]	0	30000
Main Matrix	3215	43215	Integer	R/W L1	0	3
Validation Matrix	3216	43216	Integer	R/W L1	0	3
4-20 mA Val Action	3217	43217	Integer	R/W L1	0	1
Password	4999	44999	Integer	R/W L0	0	9999

a. Write privilege requires User Level 1 (L1) password to be downloaded to the **Password** register.

Modbus Accessible Parameter Definitions

- **Concentration**: Current live concentration in selected engineering units.
- **Temperature**: Current live temperature of the gas sample in selected engineering units.
- **Pressure**: Current live pressure reading of the gas sample in selected engineering units atmospheric.
- **Supply Voltage**: The current live supply voltage to the analyzer board.
- **PkD1(Current Midpoint)**: The current midpoint value being used in the analyzer when peak tracking is turned on.
- **Firmware Version**: Firmware version running in the analyzer.
- **S Factor**: Slope adjustment enabling the analyzer to be tuned to match a specific calibration standard without affecting the factory calibration.
- **S Factor Offset**: Offset adjustment enabling the analyzer to be tuned to match a specific calibration standard without affecting the factory calibration.
- **Alarm Setpoint**: Triggers a digital output alarm when the concentration is lower than (exceeds) the set point. (Only for relay configured units)
- **Pipeline Pressure**: Sets the pressure used in calculating dew point. The pressure unit is mb when setting this parameter via Modbus communications and as set by the **Pressure Unit** parameter when setting via the front panel.

- **4 mA Value (ppmv)**: Controls the low range of the 4-20 mA output.
- **20 mA Value (ppmv)**: Controls the high range of the 4-20 mA output.
- **Concen Unit Convert**: If set to 0, the default conversion factor for Concentration Unit is used, but if set to a value, this will be the value used for the conversion factor (multiplier) that is used.
- **Alarm Flags**: Long integer register identifying the status of each individual alarm in the analyzer as follows:

  Bit 0 = 1, general fault condition exists
  Bit 1 = 1, Null Fail Error condition exists
  Bit 2 = 1, Spectrum Fail Error condition exists
  Bit 3 = 1, PT Fail condition exists
  Bit 4 = 1, Power Fail Error condition exists
  Bit 5 = 1, Track Fail Error condition exists
  Bit 6 = 1, Concentration is over user defined limit
  Bit 7 = 1, Power Warning condition exists
- **Analyzer ID**: User defined numeric analyzer ID.
- **Sample ID**: User defined numeric sample ID.
- **Component ID**: User defined numeric component ID.
- **PP2F (counts)**: Value of the concentration signal.
- **Power (counts)**: Laser power detected at the absorption peak.
- **Indx**: Position of the absorption peak along scan.
- **Zero (counts)**: Detected signal level with laser off.
- **# Spectrum Average**: Number of scans averaged for each measurement.
- **Logger Rate**: Running average of the concentration reading.
- **Peak Tracking**: Turns peak tracking on and off.
- **4-20 mA Alarm Action**: Sets 4-20 mA signal reaction to alarm condition.
- **Temperature Unit**: Sets the temperature measurement units.
- **Pressure Unit**: Sets the pressure measurement units.
- **Concentration Unit**: Sets the concentration measurement units.
- **Modbus Address**: User assigned numeric address identifying analyzer to Modbus host system.
- **Modbus Mode**: Sets the Modbus communication protocol type.
- **DO Alarm Setup**: Sets function of the secondary digital output.
- **4-20 mA % Test**: User set relative output of 4-20 mA current loop.

- **Low Power Warning**: Sets the level at which the analyzer will issue a Low Power Warning.
- **DO Alarm Delay**: Sets the number of consecutive readings concentration must be above setpoint before triggering a **High Concentration Alarm**.
- **Main Matrix**: Picks the current calibration matrix that is used when Mode 1 is pressed and when parameters are changed. Up to four calibrations can be saved.
- **Validation Matrix**: Picks the current calibration matrix that is used when Mode 7 (Ch A) or Mode 8 (Ch B) is pressed.
- **4-20 mA Val Action**: For custom configurations. When Mode 7 (Ch A) or Mode 8 (Ch B) is pressed, the analyzer will either hold the last known value for the analog output or update the analog output with the validation measurements.
- **Password**: Password required to change register settings. In the above table those registers denoted as R/W L1 can be modified if the User Level 1 password is downloaded to this register.
- **User Password**: Sets Level 1 password.

Appendix A: Troubleshooting the SS1000 Analyzer

Class 3B invisible laser radiation when open. Avoid exposure to the beam. Never open the sample cell unless directed to do so by the factory service representative and the analyzer power is turned off.

The optical head has a seal and "WARNING" sticker 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 performed by the factory and are not covered under warranty.

This section presents recommendations and solutions to common problems, such as gas leaks, contamination, excessive sampling gas temperatures and pressures, and electrical noise. If your analyzer does not appear to be hampered by one of these related problems, contact SpectraSensors for service.

Gas Leaks

Probably the most common cause of erroneous measurements is outside air leaking into the sample supply line.

Do not use plastic tubing of any kind for sample lines. Plastic tubing is permeable to moisture and other substances which can contaminate the sample stream. SpectraSensors recommends using 1/4" O.D x 0.035" wall thickness, seamless stainless steel tubing.

Process samples may contain hazardous material in potentially flammable and/or toxic concentrations. Personnel should have a thorough knowledge and understanding of the physical properties and safety precautions for the sample contents before operating the analyzer.

SpectraSensors recommends periodically leak-testing the supply lines, especially if the analyzer has been relocated or has been replaced or returned to the factory for service and the sample lines have been reconnected.

Membrane Separator Filter

The analyzer comes equipped with a membrane separator filter that separates out entrained liquids from the sample gas. If moisture accumulation is

suspected, briefly open the bypass valve on the membrane separator filter to clear out any liquids. Refer to Figure A–1.

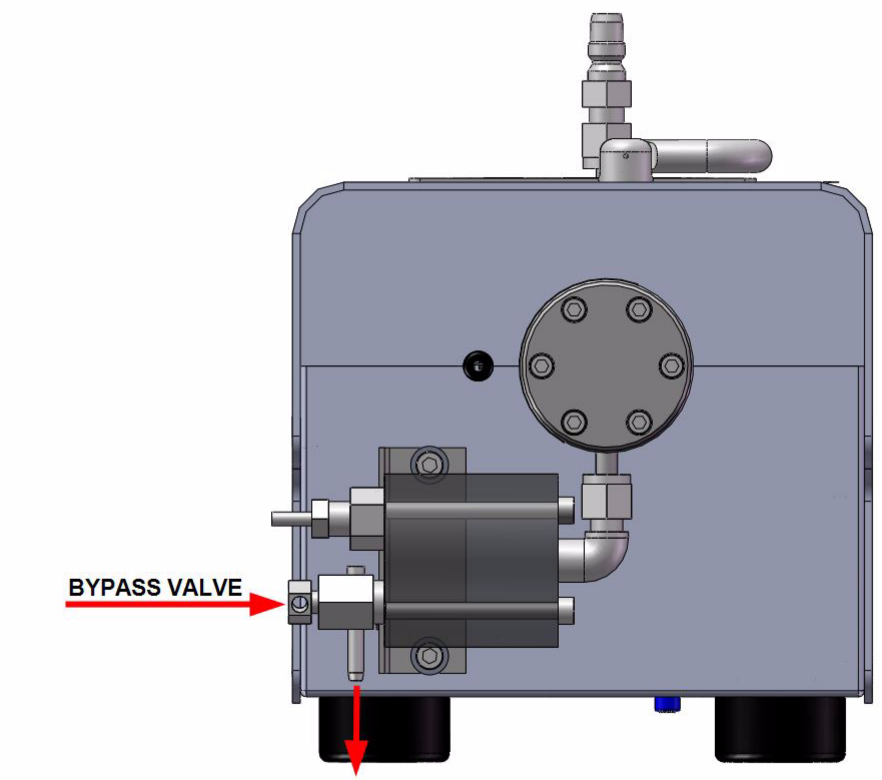


Figure A–1 *SS100 bypass valve*

If measured moisture concentration levels are higher than actual or an excess amount of wet gas has passed through the filter, the membrane may need to be replaced.

To replace the membrane:

1. Detach the 1/8″ inlet tubing and the 1/4″ compression fitting from the sample supply port on the analyzer.
2. Unscrew the two 10-32 socket head cap screws that attach the filter to the analyzer.
3. Once detached, remove the four socket head cap screws in the filter body.
4. Open the filter body and replace the membrane.
5. Reassemble the filter body and attach the filter to the analyzer.
6. Connect the 1/8″ inlet tubing and the 1/4″ compression fitting to the sample supply port on the analyzer.
7. Tighten all new compression fittings 1-1/4 turns with a wrench from finger tight. For connections with previously swaged ferrules, thread

the nut to the previously pulled up position, then tighten slightly with a wrench. Secure tubing to appropriate structural supports as required.

8. Check all connections for gas leaks. SpectraSensors recommends using a liquid leak detector.

Do not exceed 10 psig (0.7 barg) in sample cell. Damage to cell may result.

Contamination

Contamination and long exposure to high humidity are valid reasons for periodically cleaning the gas sampling lines. Contamination in the gas sampling lines can potentially find its way to the sample cell and deposit on the optics or interfere with the measurement in some other way. Although the analyzer is designed to withstand some contamination, it is recommended to always keep the sampling lines as contamination free as possible.

To keep the sampling lines clean:

1. Make sure that a membrane separator filter (included with most systems) is installed ahead of the analyzer and operating normally. Replace the membrane if necessary. If liquid enters the cell and accumulates on the internal optics, a **Power Fail Error** fault will result.
2. If mirror contamination is suspected, see **"Cleaning the Mirrors"** on page A-3.
3. Turn off the sample valve at the tap in accordance with site lock-out, tag-out rules.
4. Disconnect the gas sampling line from the supply port of the analyzer.
5. Wash the sampling line with alcohol or acetone and blow dry with mild pressure from a dry air or nitrogen source.
6. Once the sampling line is completely free of solvent, reconnect the gas sampling line to the supply port of the analyzer.
7. Check all connections for gas leaks. SpectraSensors recommends using a liquid leak detector.

Cleaning the Mirrors

If contamination makes its way into the cell and accumulates on the internal optics, a **Power Fail** alarm will result. If mirror contamination is suspected,

please consult with your factory sales representative before attempting to clean the mirrors. If advised to do so, use the following procedure.

The sample cell assembly contains a low-power, 10 mW MAX, CW Class 3b invisible laser with a wavelength between 750-3000 nm. Never open the sample cell flanges or the optical assembly unless the power is turned off.

Do not attempt to clean the cell mirror until you have consulted with your factory service representative and have been advised to do so.

Tools and supplies:

- Lens cleaning cloth (Cole Parmer® EW-33677-00 TEXWIPE® Alphawipe® Low-Particulate Clean Room Wipes or equivalent)
- Reagent-grade isopropanol (ColeParmer® EW-88361-80 or equivalent)
- Small drop dispenser bottle (Nalgene® 2414 FEP Drop Dispenser Bottle or equivalent)
- Acetone-impenetrable gloves (North NOR CE412W Nitrile Chemsoft™ CE Cleanroom Gloves or equivalent)
- Hemostat (Fisherbrand™ 13-812-24 Rochester-Pean Serrated Forceps)
- Bulb blower or dry compressed air/nitrogen
- Torque wrench
- Permanent marker
- Non-outgassing grease
- Flashlight

To clean the mirrors:

1. Power down the analyzer by pressing the power rocker switch to ‘OFF’.

The sample cell assembly contains a low-power, 20 mW MAX, CW Class 3b invisible laser with a wavelength between 750-3000 nm. Never open the sample cell flanges or the optical assembly unless the power is turned off.

2. Carefully mark the orientation of the mirror assembly on the cell body.

Careful marking of the mirror orientation is critical to restoring system performance upon reassembly after cleaning.

3. Gently remove the mirror assembly from the cell by removing the 6 (0.8-m measurement cell) socket-head cap screws and set on a clean, stable and flat surface.

The sample cell assembly contains a low-power, 10 mW MAX, CW Class 3b invisible laser with a wavelength between 750-3000 nm. Never open the sample cell flanges or the optical assembly unless the power is turned off.

Always handle the optical assembly by the edge of the mount. Never touch the coated surfaces of the mirror.

4. Look inside the sample cell at the top mirror using a flashlight to ensure that there is no contamination on the top mirror.

SpectraSensors does not recommend cleaning the top mirror. If the top mirror is visibly contaminated, contact your factory service representative.

5. Remove dust and other large particles of debris using a bulb blower or dry compressed air/nitrogen. Pressurized gas duster products are not recommended as the propellent may deposit liquid droplets onto the optic surface.

6. Put on clean acetone-impenetrable gloves.

7. Double fold a clean sheet of lens cleaning cloth and clamp near and along the fold with the hemostats or fingers to form a "brush."

8. Place a few drops of isopropanol onto the mirror and rotate the mirror to spread the liquid evenly across the mirror surface.

9. With gentle, uniform pressure, wipe the mirror from one edge to the other with the cleaning cloth only once and only in one direction to remove the contamination. Discard the cloth.

Never rub an optical surface, especially with dry tissues, as this can mar or scratch the coated surface.

10. Repeat with a clean sheet of lens cleaning cloth to remove the streak left by the first wipe. Repeat, if necessary, until there is no visible contamination on the mirror.
11. Carefully replace the mirror assembly onto the cell in the same orientation as previously marked making sure the o-ring is properly seated.
12. Tighten the 4 socket-head cap screws evenly with a torque wrench to **17 in-lbs** (0.8-m measurement cell).

Excessive Sampling Gas Temperatures and Pressures

The embedded software is designed to produce accurate measurements only within the allowable cell operating range (refer to **"SS1000 moisture in natural gas analyzer specifications"** on page B-1). Pressures and temperatures outside these ranges will trigger a **P/T Fail** alarm.

If the pressure, temperature, or any other readings on the LCD appear suspect, they should be checked against the specifications (refer to specifications for your analyzer).

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.

Instrument Problems

If the instrument does not appear to be hampered by gas leaks, contamination, excessive sampling gas temperatures and pressures, or electrical noise, refer to Table A–2 at the end of this chapter before contacting your sales representative for service.

Peak Tracking Reset Procedure

The analyzer's software is equipped with a peak tracking function that keeps the laser scan centered on the absorption peak. Under some circumstances, the peak tracking function can get lost and lock onto the wrong peak. If the difference between **PkDf** and **PkD1** is more than 4, or **Track Fail** fault is displayed, the peak tracking function should be reset.

To check the PkDf and PkD1 values:

1. Press the **#** key followed by the **4** key to enter **Mode 4** (System Diagnostic Parameters).

```
PP2F:8190 PkDf:34.00
Powr:2538 PkD1:34.00
Indx: 301
Zero: -24
```

2. Compare the values for **PkDf** and **PkD1.** If the difference is more than 4, reset the peak tracking function.

To reset Peak Tracking:

1. Press the **#** key followed by the **2** key. The LCD will prompt for a numeric password.

```
 <SET PARAMETER MODE>
Enter password

v2.50  03-12-12  DM
```

   Enter the user password (**3142**) on the keypad, then press the ***** key to enter **Mode 2** (Set Parameter Mode).

2. Press the ***** key to cycle through the screens until the **Peak Tracking** parameter appears.

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

3. Press **2** (RESET) followed by the ***** key. The peak tracking function will cycle off then on and reset.
4. Press the mode key **#** followed by **1** to return to **Mode 1** (Normal Mode).

Checking the Fuses

The main fuse is located on the back panel of the analyzer, as shown in Figure B–1. An additional fuse is located on the DC to DC converter board inside the housing, as shown in Figure B–2. If you need to replace a fuse, use only the same type and rating of fuse as the original as listed in Table A–1.

Table A–1 *Fuse specifications*

DWG Ref.	Description	Rating
F1	Miniature Fuse, 5 x 20 mm, Time Delay	250VAC/3.00A
F2	Miniature Fuse, 5 x 20 mm, Time Delay	250VAC/3.15A

Note: Refer to Figure B–1 or Figure B–2 for fuse locations.

Removing the Cover

If necessary, the analyzer cover can be removed by first unscrewing the ten cover screws, as shown in Figure B–1, and gently lifting the cover off the system taking care not to damage the display and keypad cables.

The display and keypad cables are attached to the electronics inside the housing. Care must be taken when removing the cover to avoid damaging the cables or connectors. If disconnecting the cables is necessary, be sure to reconnect each one with the proper orientation. When reattaching the cover make sure the cables are not pinched between the body and the cover.

Disconnect the display and keypad cables if necessary to gain access to the internal components.

Packing

SpectraSensors' SS1000 analyzers and auxiliary equipment are shipped from the factory in a reusable Pelican case. All inlets and vents are capped and protected when packaged for shipment.

If the equipment is to be shipped or stored for any length of time, it should be packed in the original packaging when shipped when shipped from the factory. If analyzer has been installed and or operated (even for purposes of a demonstration), the system should first be decontaminated (purged with an inert gas) before powering down the analyzer.

Process samples may contain hazardous material in potentially flammable and/or toxic concentrations. Personnel should have a thorough knowledge and understanding of the physical properties of the sample and prescribed safety precautions before installing, operating or maintaining the analyzer.

To prepare the analyzer for shipment or storage:

1. Shut off the process gas flow.
2. Allow all residual gas to dissipate from the lines

3. Connect a purge supply, regulated to the specified sample supply pressure, to the sample supply port.
4. Confirm that any valves controlling the sample flow effluent to the the low-pressure flare (or atmospheric vent) are open.
5. Turn on the purge supply and purge the system to clear any residual process gases.
6. Turn off the purge supply.
7. Allow all residual gas to dissipate from the lines.
8. Close any valves controlling the sample flow effluent to the low-pressure flare (or atmospheric vent).
9. Disconnect power to the system.
10. Disconnect all tubing and signal connections.
11. Cap all inlets and outlets to prevent foreign material such as dust or water from entering the system) using the original fittings supplied as part of the packaging from the factory.
12. Pack the equipment in the original packaging in which it was shipped. If the original packaging material is no longer available, the equipment should be adequately secured (to prevent excessive shock or vibration) within a weather-proof enclosure.

Storage

The packaged analyzer should be stored in a sheltered environment that is temperature controlled between -20°C (-4°F) and 50°C (122°F), and should not be exposed to direct sun, rain, snow, condensing humidity or corrosive environments.

Service Contact

If the troubleshooting solutions do not resolve the problem, contact customer service.

Customer Service

4333 W Sam Houston Pkwy N, Suite 100
Houston, TX 77043-1223

Domestic: 1-800-619-2861 option #2

International: +1-713-300-2700 option #2

Email: service@spectrasensors.com

Return Materials Authorization

If returning the unit is required, obtain a **Return Materials Authorization (RMA) Number** from customer service before returning the analyzer to the factory. Your service representative can determine 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.

Table A–2 *Potential SS1000 analyzer problems and solutions*

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)	Check to confirm internal battery cables are connected.
	If the system is using an AC charger rather than the internal system battery for power, check to confirm green LED on the charger is on.

Table A-1 *Potential SS1000 analyzer problems and solutions (Continued)*

Symptom	Response
Non-Operation (after start up) (Continued)	Check fuse(s). If bad, replace with equivalent amperage, slow-blow fuse.
	Contact a factory sales representative for service information.
Power Fail Error	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.
	Press **# 6** to capture diagnostic data and send the file to SpectraSensors.
	Possible alignment problem. Contact a factory sales representative for service information.
	Possible mirror contamination issue. Contact a factory sales representative for service information. If advised to do so, clean the mirrors by following the instructions under **"To clean the mirrors"** on page A-4.
PT Fail Error	Check that the actual pressure in the measurement cell is within specification.
	Check the connector on the pressure transducer. Check the pressure connector on the backplane board.
	Check that the actual temperature in the measurement cell is within specification. For systems with a heated enclosure, check that the temperature in the measurement cell is within +/- 5 °C of the specified enclosure temperature.

Table A-1 *Potential SS1000 analyzer problems and solutions (Continued)*

Symptom	Response
PT Fail Error (Continued)	Check the connector on the cell temperature sensor. Check the temperature connector on the backplane board. (Note: A temperature reading greater than 150 °C indicates a short circuit on the temperature sensor leads; a reading of less than −30 °C indicates an open circuit).
Front panel display is not lit and no characters appear	Check for correct voltage on terminal block input. Observe polarity on DC powered units.
	Check for correct voltage after fuses.
	Check for 5 VDC on red wires, 12 VDC on yellow wires, and 24 VDC on orange wires from power supply.
	Check connections on display communication and power cables.
Strange characters appear on front panel display	Check connections on display communication cable.
Pressing keys on front panel do not have specified effect	Check connections on keypad cable.
Not getting enough flow to the sample cell.	Check both the micro filter and membrane separator for contamination. Replace if necessary.
	Check if supply pressure is sufficient.
No reading on device connected to current loop	Check the open circuit voltage (35-40 VDC) across the current loops terminals.
	Replace the current loop device with a milliampere meter and look for current between 4 mA and 20 mA. A voltmeter connected across a 249-ohm resistor can be used instead of the milliampere meter; it should read between 1 and 5 volts.
Current loop is stuck at 4 mA or 20 mA	Check display for error message. If alarm has been triggered, reset the alarm.

Table A-1 *Potential SS1000 analyzer problems and solutions (Continued)*

Symptom	Response
Current loop is stuck at 4 mA or 20 mA (Cont'd)	On the current loop board, check the voltage between the end of resistor R1 closest to the jumper and ground. If the concentration reading is high, the voltage should be near 1 VDC. If the concentration reading is low, the voltage should be near 4.7 VDC. If not, the problem is probably on the ARM9 main board. Return to factory for service.
Reading seems to always be high by a fixed amount	Capture diagnostic data and send the file to SpectraSensors (see **"To read diagnostic data with HyperTerminal"** on page 4-4).
Reading seems to always be high by a fixed percentage	Capture diagnostic data and send the file to SpectraSensors (see **"To read diagnostic data with HyperTerminal"** on page 4-4).
	Check that Peak Tracking is enabled (see **"To change parameters in Mode 2"** on page 3-9).
Reading displays 0.0 or seems relatively low	Capture diagnostic data and send the file to SpectraSensors (see **"To read diagnostic data with HyperTerminal"** on page 4-4).
Reading is erratic or seems incorrect	Check for contamination in the sample system, especially if the readings are much higher than expected.
Reading is erratic or seems incorrect (Cont'd)	Capture diagnostic data and send the file to SpectraSensors (see **"To read diagnostic data with HyperTerminal"** on page 4-4).
Reading goes to "0"	Gas concentration is equal to zero.
Reading goes to full scale	If **4-20 mA Alarm Action** is set to **1**, look on display for an error message (see **"To change parameters in Mode 2"** on page 3-9).
	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 19200 baud, 8 data bits, 1 stop bit, no parity, and no flow control.

Table A-1 *Potential SS1000 analyzer problems and solutions (Continued)*

Symptom	Response
Serial output is providing no data	Make sure the analyzer is operating in **Mode 1** and readings are being displayed on the LCD.
	Make sure the computer COM port is set for 19200 baud, 8 data bits, 1 stop bit, no parity, and no flow control.
Serial output is providing no data (Continued)	Be sure no other programs are using the COM port selected.
	Make sure the connections are good. Verify the correct pin connections with an ohmmeter.
	Make sure to select the correct COM port into which the cable is plugged.
LCD does not update. Unit is locked up for more than 5 minutes.	Switch off power, wait 30 seconds, and then switch power back on.

Appendix B: Specifications

Table B–1 *SS1000 moisture in natural gas analyzer specifications*

Performance		
Concentration (H_20)[a]	**Medium Precision** 40-422 ppmv, 40-1055 ppmv, 40-2110 ppmv (2-20 lbs., 2-50 lbs., 2-100 lbs/MMscf)	**High Precision** 0-422 ppmv, 0-1055 ppmv, 0-2110 ppmv (0.5-20 lbs., 0.5-50 lbs., 0.5-100 lbs/MMscf)
Repeatability	±10 ppmv or ±2% of reading	±4 ppmv or ±2% of reading
Response time[b]	0.25-2 seconds	
Application Data		
Environmental Temperature Range	-20° to 50 °C (-4° to 122 °F)	
Environmental Relative Humidity	80% for temperatures up to 31°C MAX	
Altitude	Up to 4000 m	
Cell Pressure Range	700-1400 mbara	
Sample Flow Rate	0.1-10 L/min (0.2 to scfh)	
Contaminant Sensitivity	None for gas phase glycol, methanol, amines, hydrogen sulfides or mercaptans.	
Electrical & Communications		
Power Supply	100-240 VAC, 50-60 Hz - *Standard* 12-Volt, sealed lead-acid battery Approx. 8 hours usage time per charge	
Max. Current	0.5A @ 120 VAC during recharging	
Outputs	RS-232 - all parameters	
LCD Display	Concentration, cell pressure, cell temperature	
Physical Specifications		
Size	438 mm H x 108 mm W (17-1/4” x 4-1/4”)	
Weight	Approx. 25 lbs (11.5 Kg)	
Sample Cell Construction	316L Series Polished Stainless Steel - *standard*	
Area Classification		
Certification	Non-hazardous (certified) locations - General Purpose	

a. Consult factory for alternative ranges.
b. Software adjustable.

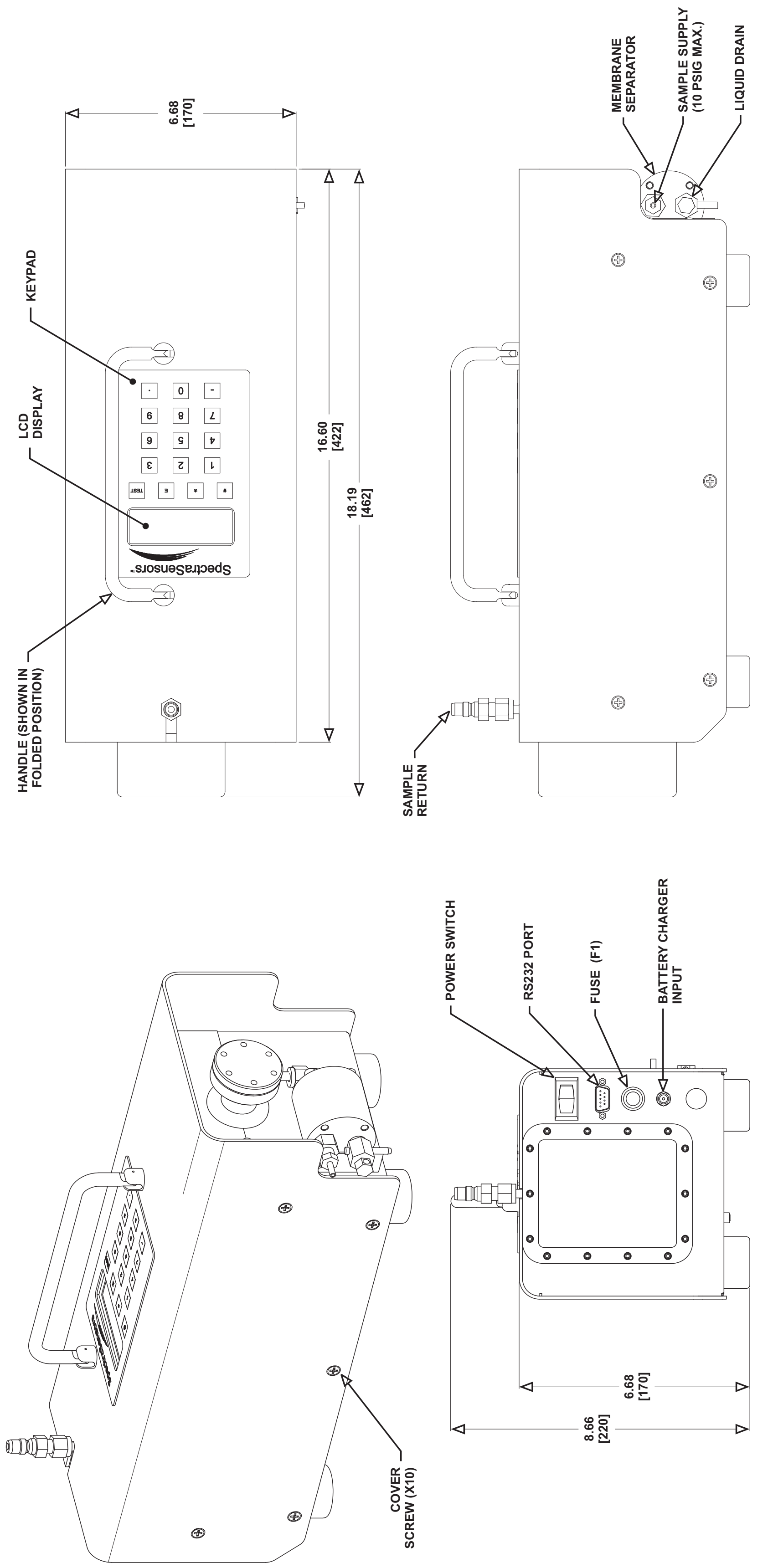


Figure B–1 *SS1000 analyzer external features*

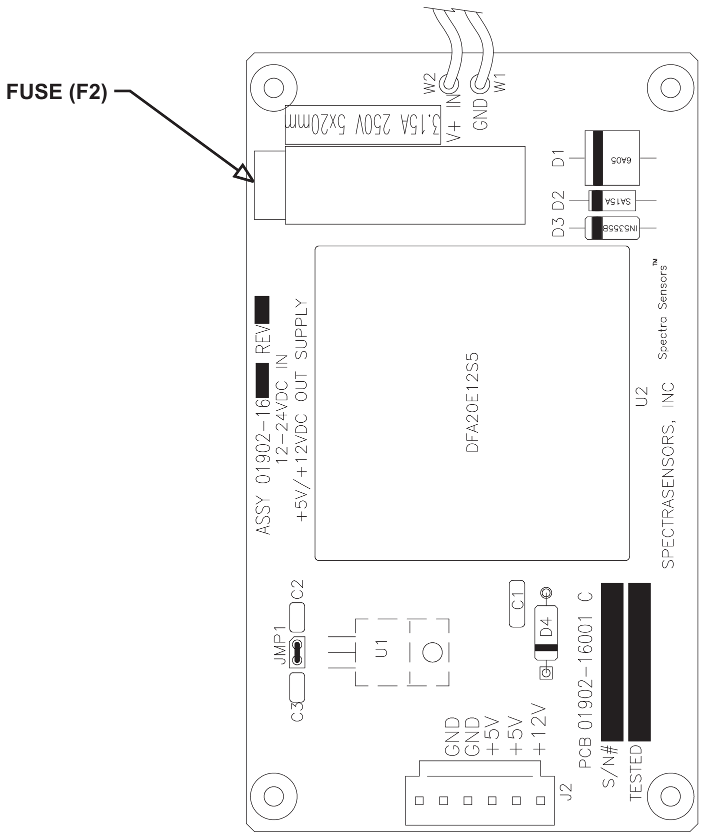


Figure B–2 *Fuse location on DC to DC converter*

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