SpectraSensors™

SS500/SS2000/SS3000
Gas Analyzers

Operator's Manual
H_2O and/or CO_2 in Natural Gas

SS500/SS2000/SS3000
Gas Analyzers

Operator's Manual

H_2O and/or CO_2 in Natural Gas

This manual applies to firmware version:
v2.41

Products of

SpectraSensors

11027 Arrow Route
Rancho Cucamonga, CA 91730
Tel: 800.619.2861
Fax: 909.948.4100
www.spectrasensors.com

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

4: Operating the Analyzer

5: Serial Port Communications

Appendix A: Troubleshooting

Appendix B: Specifications

THIS PAGE INTENTIONALLY LEFT BLANK

List of Figures

List of Tables

THIS PAGE INTENTIONALLY LEFT BLANK

1 - INTRODUCTION

SpectraSensors SS500/SS2000/SS3000 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 pay close attention to the details of the installation and operation. This manual contains a comprehensive overview of the SS500/SS2000/SS3000 analyzer and step-by-step instructions on:

- Inspecting the Analyzer and SCS
- Installing the Analyzer and SCS
- Powering Up the Analyzer
- Operating the Analyzer
- Serial Port Communications
- Powering Down the Analyzer
- Troubleshooting

Who Should Read This Manual

This manual should be read and referenced by anyone installing, operating, or having 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 SS500/SS2000/SS3000 analyzers. This manual has been written to address the most common options and accessories. Read each section in the manual carefully so you can quickly and easily install and operate the analyzer.

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

Special Symbols Used in This Manual

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

This icon denotes a warning statement. Warning statements indicate a potentially hazardous situation which, if not avoided, may result in serious injury or death.

Failure to follow all directions may result in fire.

Class IIIb radiation product. When open, avoid exposure to beam.

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

Important information concerning the installation and operation of the analyzer.

General Warnings and Cautions

Following are general warnings and cautions to observe when servicing 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 sampler and prescribed safety precautions before operating the Sample Conditioning System.

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

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

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

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

Class IIIb invisible laser radiation. When open, avoid exposure to beam. Conforms to provisions of US 21 CFR1040 10. Class I laser product. Refer servicing to the manufacturer's qualified personnel.

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

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

Do not hold or carry the analyzer by the measurement heads or sample cells. Doing so may result in optical misalignment affecting the performance of the sensor.

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

If equipment is used in a manner not specified by the manufacturer, the protection provided by the manufacturer may be impaired.

SpectraSensors Overview

SpectraSensors, Inc. (SSI) is a leading manufacturer of state-of-the-art electro-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) with the purpose of commercializing space-proven measurement technologies initially developed at JPL.

About the Gas Analyzers

The SS500/SS2000/SS3000 are 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 in 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.

An appropriate 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 stream at the time of sampling. Most SS500/SS2000/SS3000 analyzer systems are configured for use at extractive natural gas sampling stations.

Difference between the SS500, SS2000, and SS3000

The SS500 and SS2000 are single-channel analyzers used predominantly for measuring H_2O or CO_2 in pipeline natural gas. The SS2000 is simply a higher resolution version of the SS500 (for performance specifications, see Table B–1 on page B–1, Table B–2 on page B–2, or Table B–3 on page B–3). The SS3000 is a dual-channel version of the SS2000 and is usually configured to measure H_2O and/or CO_2 in the same or separate pipeline natural gas sample streams (for performance specifications, see Table B–4 on page B–13).

How the Analyzers Work

The SS500/SS2000/SS3000 analyzers employ tunable diode laser absorption spectroscopy (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 other

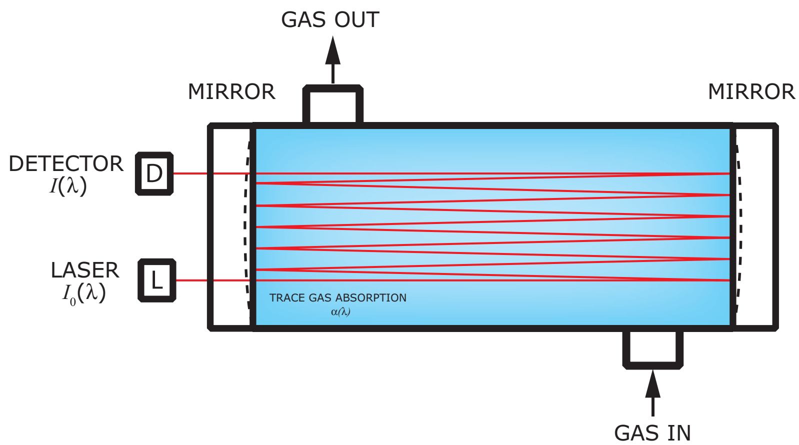


Figure 1–1 *Schematic of a typical laser diode absorption spectrometer.*

through which the laser beam can pass, as shown in 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 SS500/SS2000/SS3000 analyzers, sample gas flows continuously through the sample cell ensuring that the sample is always representative of the flow in the main pipe.

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 l (cell length $\times$ number of passes), is given by

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

where N represents the species concentration. Thus, the ratio 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

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

Figure 1–2 shows 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 systems relative insensitivity to mirror contamination). The positive slope of the raw data results from ramping the current to tune the laser, which not only

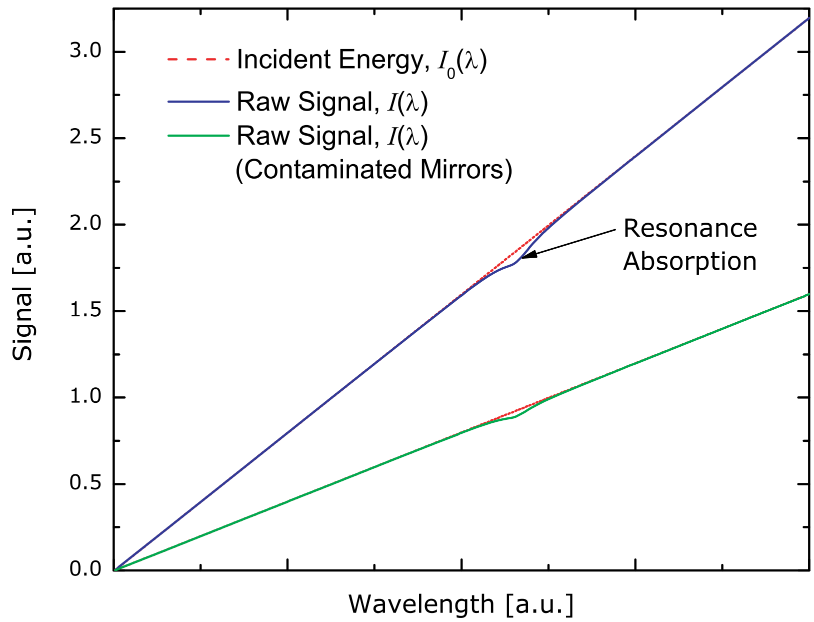


Figure 1–2 *Typical raw signal from a laser diode absorption spectrometer with and without mirror contamination.*

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, as shown in Figure 1–3. 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.

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.

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 choosing a different optimum diode

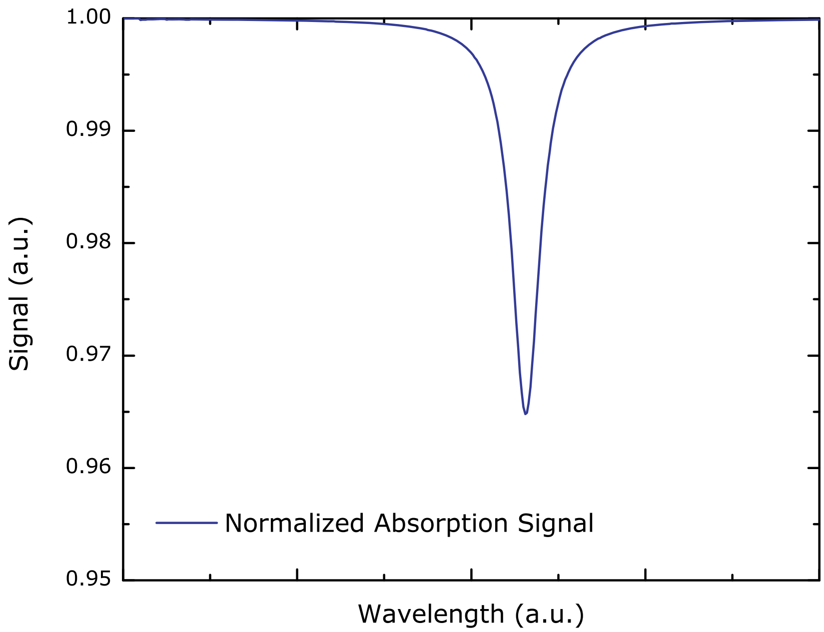


Figure 1–3 *Typical normalized absorption signal from a laser diode absorption spectrometer.*

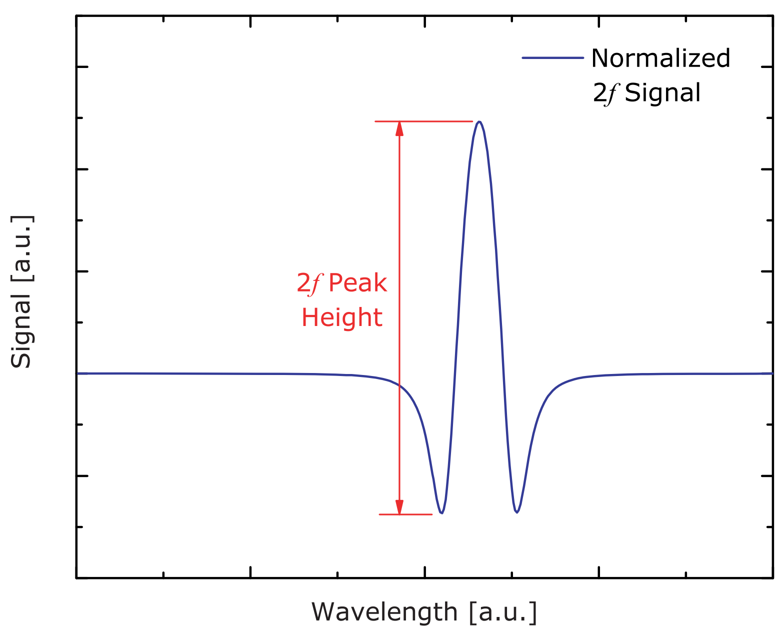


Figure 1–4 *Typical normalized 2f signal where the species concentration is proportional to the peak height.*

laser wavelength between 700-3000nm which provides the least amount of sensitivity to background stream variations.

The SpectraSensors TDL analyzers are the most reliable gas analyzer platform with the lowest total cost of ownership. This is a result of using highly reliable optical telecommunications-type diode lasers, stainless steel hardware, and coated optical reflectors. The SpectraSensors analyzers also operate with the absence of any moving parts, tolerance to condensation of process liquids and accumulation of particulates from gas stream that eliminates requirements for field calibration and frequent maintenance.

2 - INSTALLATION

This section describes the processes used to initially install and configure your SS500, SS2000, or SS3000 and optional sample conditioning system (SCS). Once the analyzer arrives, you should take a few minutes to examine the contents before installing the unit. This section discusses:

- What Should be Included in the Shipping Box
- Inspecting the Analyzer and SCS
- Installing the Analyzer and SCS.

What Should be Included in the Shipping Box

The contents of the crate should include:

- The SpectraSensors SS500, SS2000, or SS3000
- This Operator's Manual with instructions on installing and operating the analyzer
- One (SS500 or SS2000) or two (SS3000) external serial cable(s) 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 and SCS

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.

Installing the Analyzer and SCS

Installing the analyzer is relatively easy requiring only a few steps that, when carefully followed, will ensure proper mounting and connection. This section includes:

- Hardware and Tools for Installation
- Mounting the Analyzer
- Connecting Electrical Power to the Analyzer
- Connecting the Output Signals
- Connecting the Gas Lines

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:

- Membrane separator filter (if not included)
- Pressure regulator (if not included)
- 1/2″ Unistrut® (or equivalent) bolts and spring nuts
- Stainless steel tubing (SpectraSensors recommends using 1/4″ O.D. x0.035″ wall thickness, seamless stainless steel tubing)
- 1/2″ conduit hubs
- Conduit
- Source of plant nitrogen gas (4 SCFH) for purge unit(s), if applicable
- 1/4″ lag bolts or 1/4″ machine screws and nuts

Tools:

- Hand drill and bits
- Tape measure
- Level
- Pencil
- Socket wrench set
- Screw driver
- Crescent wrench
- 9/16″ open-end wrench

Mounting the Analyzer

The SS500/SS2000/SS3000 analyzer is manufactured for wall or Unistrut® (or equivalent) metal framing installations. Depending on your application and configuration, the analyzer may come premounted on a SCS panel to be mounted on a wall or unistrut framing, or without a panel requiring mounting via the standard electronics enclosure tabs. Refer to the layout diagrams in Appendix B for detailed mounting dimensions.

When mounting 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 mount 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.

To mount the analyzer:

1. Select a suitable location to mount the analyzer. Choose a shaded area or use an optional analyzer hood (or equivalent) to minimize sun exposure.

   SpectraSensors analyzers are designed for operation within the specified ambient temperature range of –4 °F to 122 °F (–20 °C to 50 °C). Intense sun exposure in some areas may cause the analyzer temperature to exceed the maximum.

2. Locate the mounting holes on your unit.
3. For wall installations, mark the centers of the top mounting holes.
4. Drill the appropriate size holes for the screws you are using.
5. Hold the analyzer in place and fasten with the top screws.
6. Repeat for the bottom mounting holes.

Once all four screws are tightened the analyzer should be very secure and ready for the electrical connections.

Connecting Electrical Power to the Analyzer

The analyzer will be configured for 100/240 VAC @ 50/60 Hz 1∅ input or optionally 9–16 VDC or 18–32 VDC input. Check the manufacturing data label or the terminal block labels to determine the power input requirements. All work must be performed by personnel qualified in electrical conduit installation. Conduit seals should be used where appropriate in compliance with local regulations.

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

Careful consideration should be taken when grounding. Properly ground the unit by connecting ground leads to the grounding studs provided throughout the system that are labeled with the ground symbol ⏚.

Depending on the analyzer configuration, the electrical wiring can typically be connected to the analyzer through a conduit hub located at the bottom right or left of the electronics enclosure.

To connect electrical power to the analyzer:

1. Open the electronics enclosure door. Take care not to disturb the electrical assembly inside.

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

2. Run conduit from the power distribution panel to the conduit hub on the electronics enclosure labeled for power input.

Conduit seals should be used where appropriate in compliance with local regulations.

Because the breaker in the power distribution panel or switch will be the primary means of disconnecting the power from the analyzer, the power distribution panel should be located in close proximity to the equipment and within easy reach of the operator, or within 10 feet of the analyzer.

An approved switch or circuit breaker rated for 15 amps should be used and clearly marked as the disconnecting device for the analyzer.

3. For AC systems, pull ground, neutral and hot wires (#14 AWG minimum) into the electronics enclosure. For DC systems, pull ground, plus and minus wires.

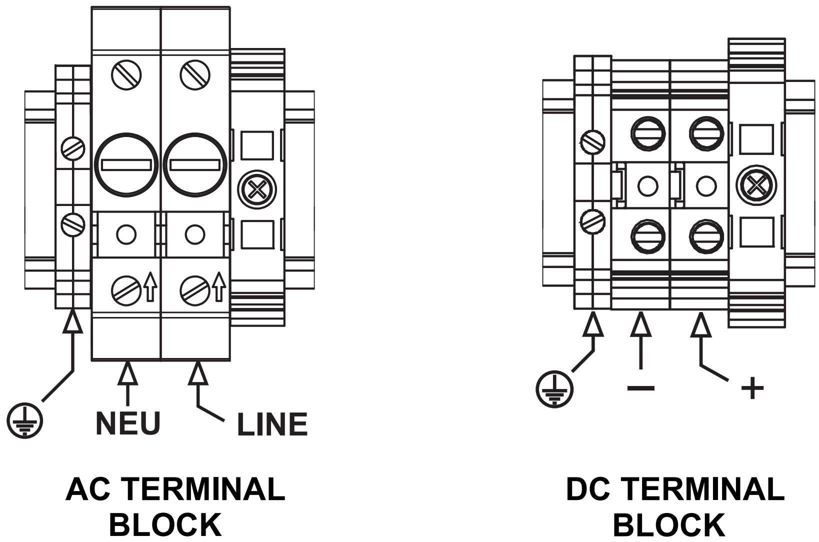


Figure 2–1 *AC and DC connection terminal blocks in electronics enclosure.*

4. Strip back the jacket and/or insulation of the wires just enough to connect to the power terminal block.
5. For AC systems, attach the neutral and hot wires to the power terminal block by connecting the neutral wire to the terminal marked "NEU," the hot wire to the terminal marked "LINE," as shown in Figure 2–1. For DC systems, connect the minus wire to the terminal marked "–," and the positive wire to the terminal marked "+," as shown in Figure 2–1.
6. Connect the ground wire to the ground terminal marked ⏚.
7. Close and tighten the electronics enclosure door.

Connecting the Output Signals

The 4-20 mA current loop and serial output(s) are supplied from the mating terminal block (TB2) located inside the analyzer electronics enclosure as shown in Figure 2–2, Figure 2–3, Figure 2–4 or Figure 2–5. By default, the 4-20 mA current loop output is factory set to source current.

*The 4-20 mA current loop output is factory set to source current. To change the 4-20 mA current loop output from source to sink, see **"To change the 4-20 mA board from source to sink"** on page 2-12.*

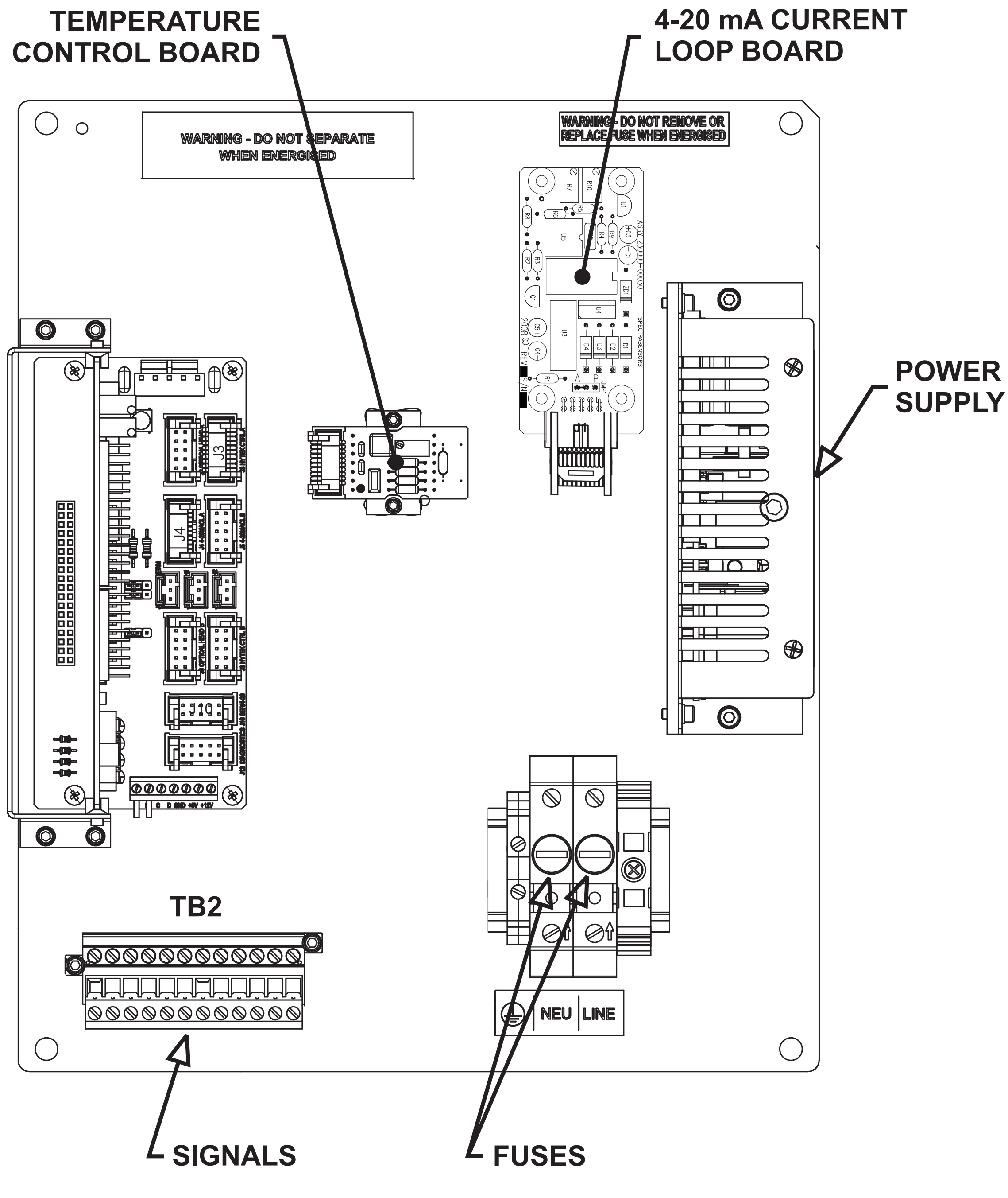


Figure 2–2 *Electronics control board (AC) for single-channel systems (SS500/SS2000).*

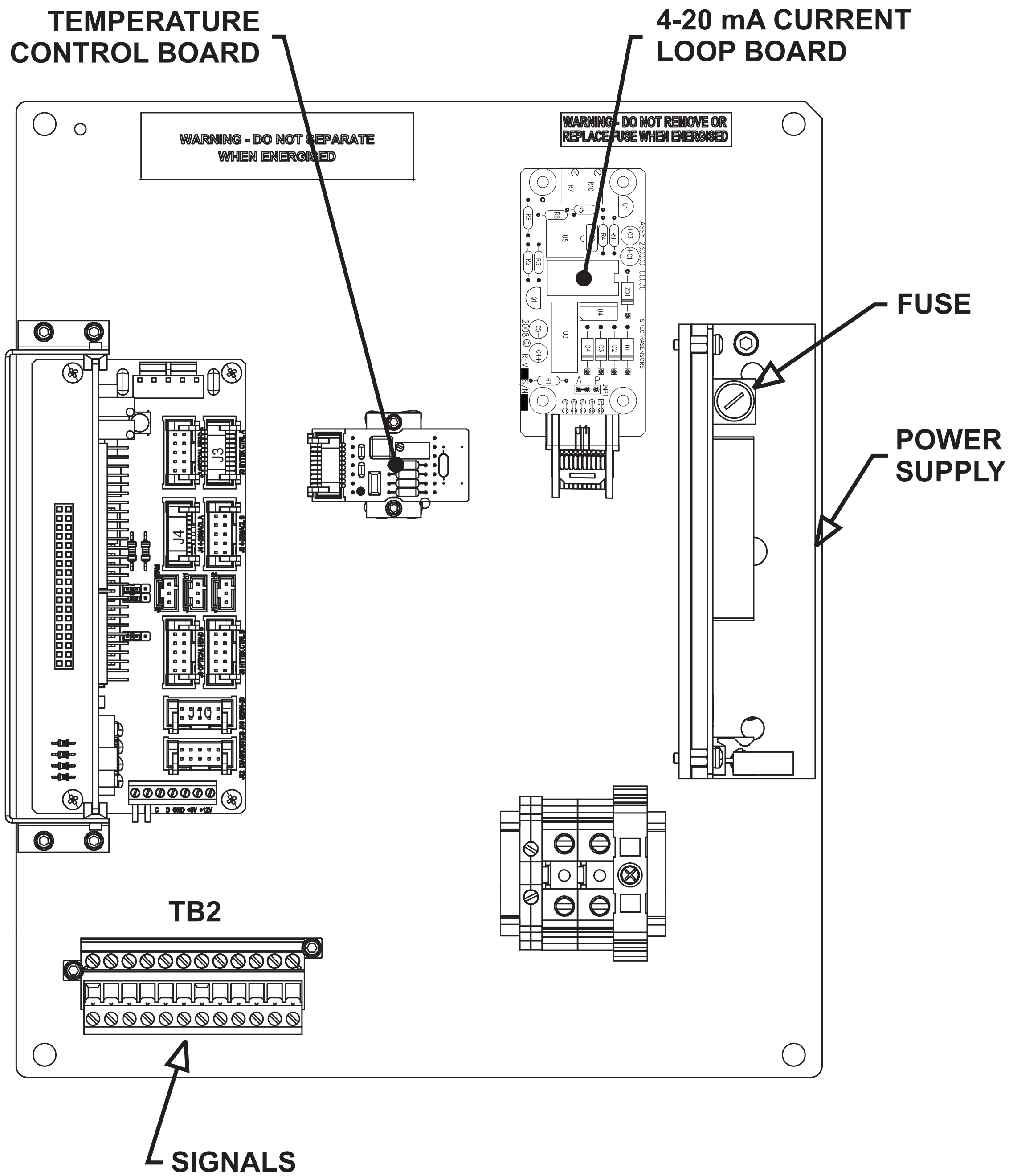


Figure 2–3 *Electronics control board (DC) for single-channel systems (SS500/SS2000).*

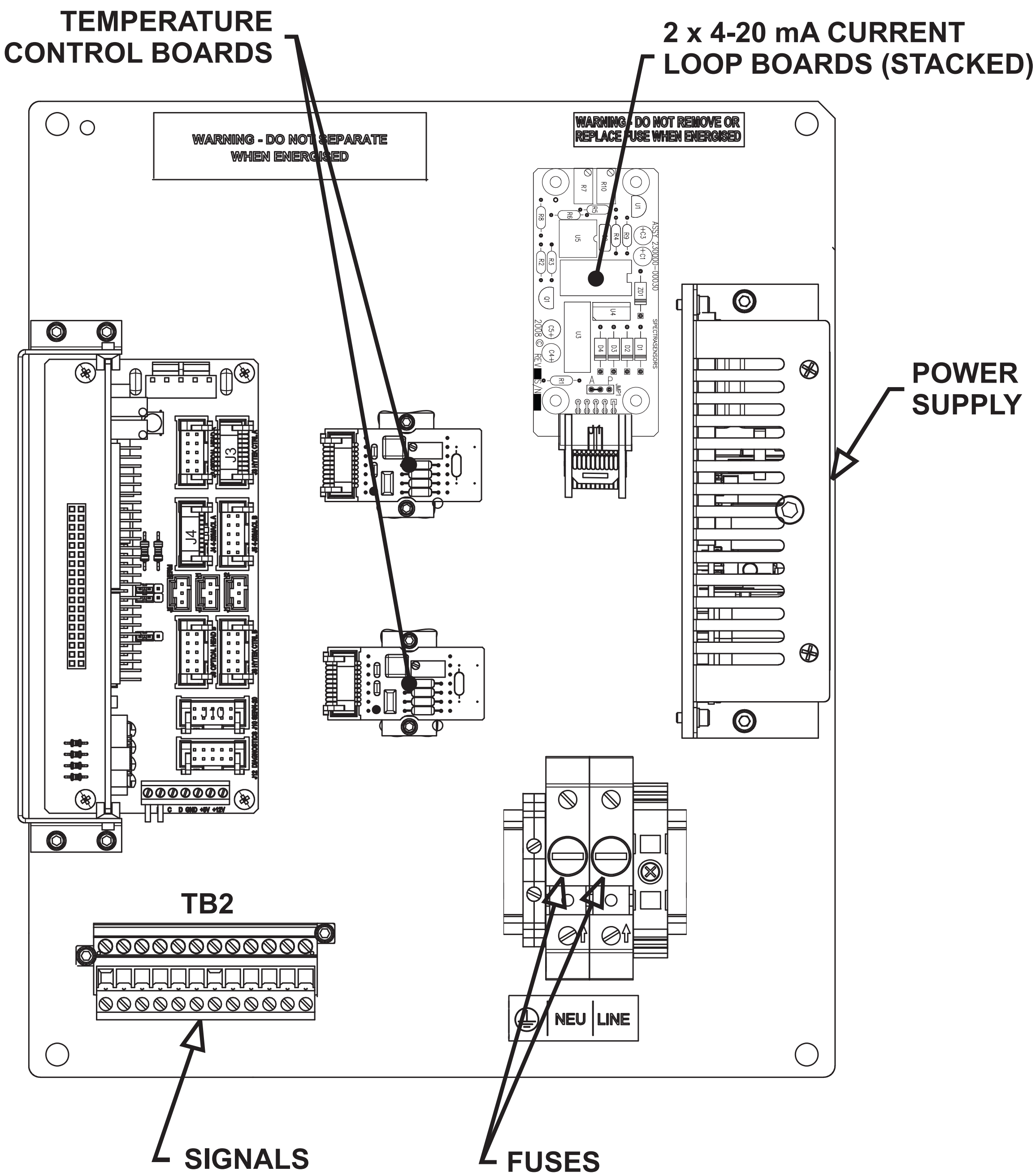


Figure 2–4 *Electronics control board (AC) for dual-channel systems (SS3000).*

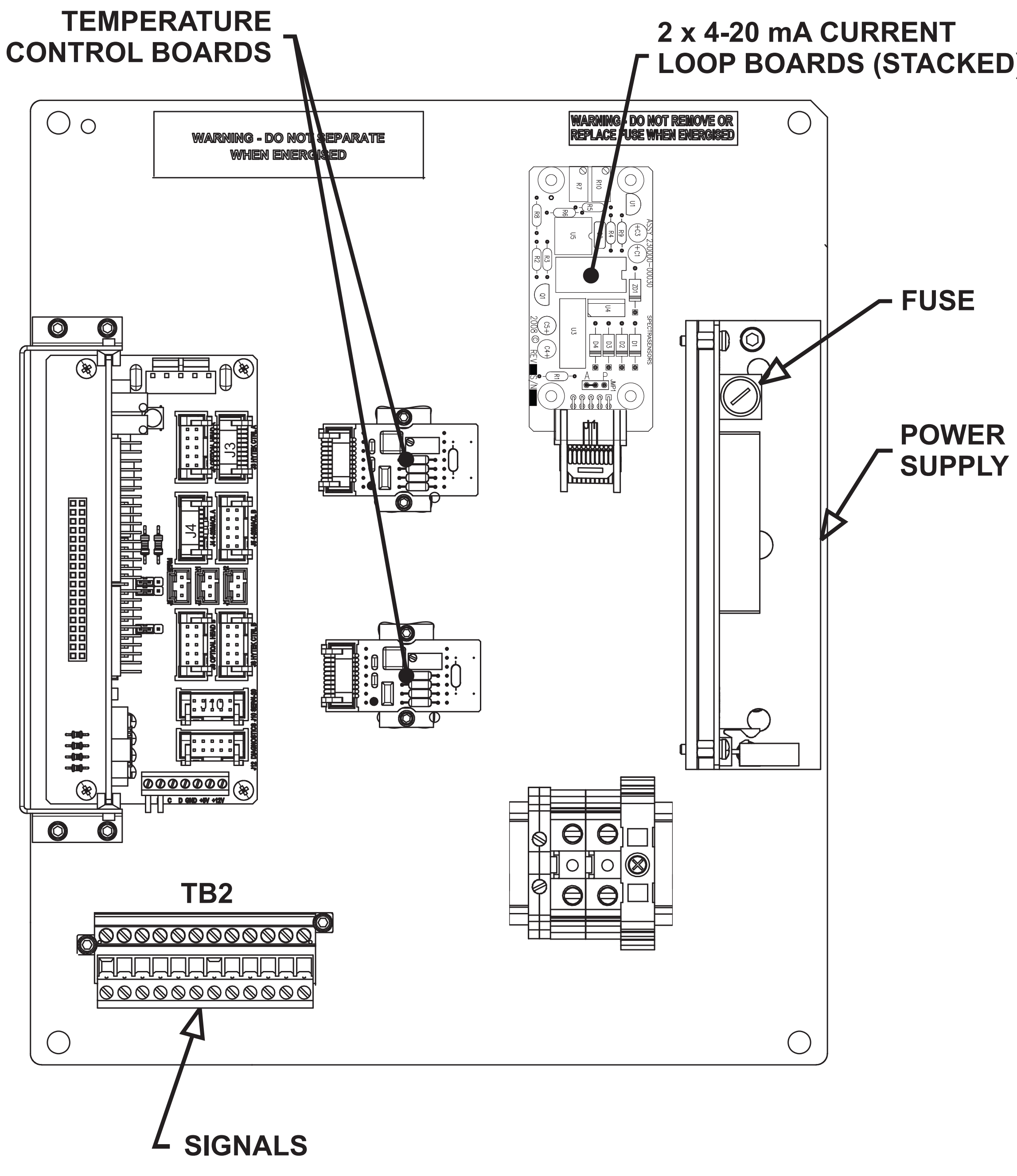


Figure 2–5 *Electronics control board (DC) for dual-channel systems (SS3000)..*

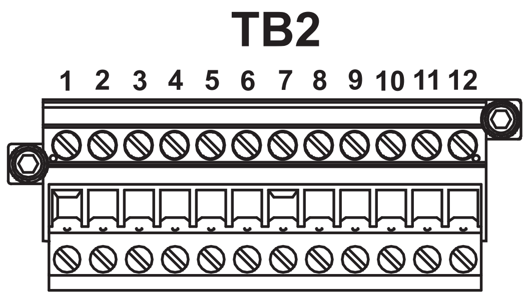


Figure 2–6 *Mating terminal block (TB2) in electronics enclosure for connecting signal cables.*

Connections can be made with customer-supplied cables for the current loop(s) and factory-supplied cable for the serial connection(s). Consult the wiring diagram in Figure B–7 on page B–10.

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

To connect the output signals:

1. Disconnect power to the analyzer and open the electronics enclosure cover. Take care not to disturb the electrical assembly inside.
2. Run conduit from the signal/alarm receiving station to the conduit hub on the electronics enclosure labeled for signal connections.

Conduit seals should be used where appropriate in compliance with local regulations.

3. Pull the customer-supplied cable(s) for the current loop(s) and the SpectraSensors external serial cable(s) (included in the shipping box) through the conduit into the electronics enclosure.
4. Strip back the jacket and insulation of the current loop and serial cables just enough to connect to the mating terminal block (TB2), shown in Figure 2–6. The mating terminal block can be pulled up and removed from its base to make the cable connection process easier.
5. Connect the 4-20 mA current loop signal wires to the appropriate terminals, as indicated in Table 2–1.

Table 2–1 *Output signal connections.*

Terminal	Description	D-Conn	Color
1	Ch. A Serial RX	Pin-3	Black
2	Ch. A Serial TX	Pin-2	Red
3	COM Serial Ground	Pin-5	Shield
4	Ch. B Serial RX	Pin-3	Black
5	Ch. B Serial TX	Pin-2	Red
6	Ch. A Current Loop +		
7	Ch. A Current Loop -		
8	Ch. B Current Loop +		
9	Ch. B Current Loop -		
10	N/C		
11	N/C		
12	N/C		

6. Connect the serial cable wires to the appropriate terminals according to Table 2–1. For reference, Table 2–1 also shows the corresponding pin numbers for configuring a nine-pin Sub-D connector for connection to a computer serial port.
7. Reinsert the mating terminal block into its base and verify that each connection is secure.
8. Close and tighten the electronics enclosure cover.
9. To complete the connections, connect the other end of the current loop wires to a current loop receiver and each external serial cable to a serial port on your computer.

Changing the 4-20 mA Current Loop Mode

Note that changing of the current loop mode may negate specific hazardous area certifications. Contact your factory service representative for details.

By default, the 4-20 mA current loop output is factory set to source current. In some instances it may be necessary to change the 4-20 mA current loop output in the field from source to sink. The work must be performed by personnel qualified in electronics assembly.

To change the 4-20 mA board from source to sink:

1. Disconnect power to the analyzer and open the electronics enclosure cover. Take care not to disturb the electrical assembly inside.
2. Locate the 4-20 mA board(s) in the center of the electronics enclosure, as shown in Figure 2–2, Figure 2–3, Figure 2–4 or Figure 2–5.
3. Unscrew the four mounting screws.
4. Disconnect the 10-pin (J1) connector from the 4-20 mA board and remove the board from the back panel.
5. Desolder the jumper (JMP1), shown in Figure 2–7, connecting the center hole to point “A.”
6. Clean the jumper (JMP1) area with solvent to remove residual flux, etc.
7. For 4-20 mA sink, carefully re-solder the jumper to connect the center hole with point “P.”
8. Repeat as necessary, steps 3-7, for any remaining 4-20 mA boards.
9. Reinstall the board(s) on the panel and connect the 10-pin (J1) connector(s).
10. Reconnect power to the analyzer. Confirm the 4 mA (min.) and 20 mA (max.) points (see **“To scale the current loop signal”** on page 4-18).
11. Close and tighten the electronics enclosure cover.

Connecting the Gas Lines

Once you have verified that the analyzer is properly wired, you are ready to connect the sample supply, sample return, and sample bypass (if applicable). Consult the layout and flow diagrams in Appendix B for guidance. All work must be performed by technicians qualified in pneumatic 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 installing the SCS.

SpectraSensors recommends using 1/4” O.D x 0.035” wall thickness, seamless stainless steel tubing.

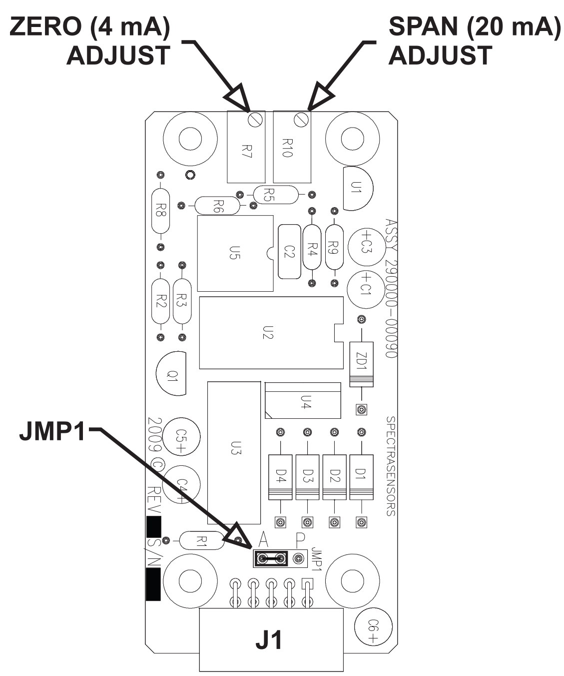


Figure 2–7 *4-20 mA output board.*

To connect the sample supply line:

1. First, confirm that the sample probe is correctly installed at the process supply tap and that the sample probe isolation valve is closed.

The process 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.

2. 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).
3. 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).
4. Determine appropriate tubing route from the field-pressure reducing station to the SCS.
5. Run stainless steel tubing from the field-pressure reducing station (set for the specified inlet pressure) to the sample supply port of the SCS. 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.
6. Connect the inlet tube to the SCS using the 1/4” stainless steel compression-type fitting provided.
7. 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.
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.

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 SCS 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 SCS using the 1/4” stainless steel compression-type 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.

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

7. Be sure to vent the bypass return port and pressure relief vent port (if applicable) in a similar fashion when the unit is in use.

Conditioning the SCS 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 and SCS are 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.

THIS PAGE INTENTIONALLY LEFT BLANK

3 - SAMPLE CONDITIONING SYSTEM (SCS)

Personnel should have a thorough understanding of the operation of the SS500/SS2000/SS3000 Analyzer and the procedures presented here before operating the sample conditioning system.

The process sample at the sample tap may be at a high pressure. A field-pressure reducing regulator is located at the sample tap to reduce the sample pressure and enable operation of the sample conditioning system at a low pressure. Use extreme caution when operating the sample probe isolation valve and field-pressure reducing regulator.

The process sample at the sample tap may be at a high pressure. Make sure that the field-pressure reducing regulator is equipped with an appropriate pressure relief valvle.

SS500/SS2000/SS3000 systems may be ordered with an optional integral Sample Conditioning System (SCS). Each SCS has been specifically designed to deliver a sample stream to the analyzer that is representative of the process stream at the time of sampling. To ensure the integrity of the sample stream and its analysis, care must be taken to install and operate the SCS properly. Therefore, any personnel intending to operate or service the analyzer and SCS should have a thorough understanding of the process application and the design of the analyzer and SCS.

Most problems experienced with sample systems tend to result from operating the system differently than intended. In some cases, the actual process conditions may be different than originally specified (e.g. flow rates, presence of contaminants, particulates, or condensables that may only exist under upset conditions). By establishing understanding of the application and the design of the system, most issues can be avoided altogether or easily diagnosed and corrected ensuring successful normal operation.

If there are any remaining questions concerning the design, operation, or maintenance of the SCS, contact your factory service representative.

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 SCS.

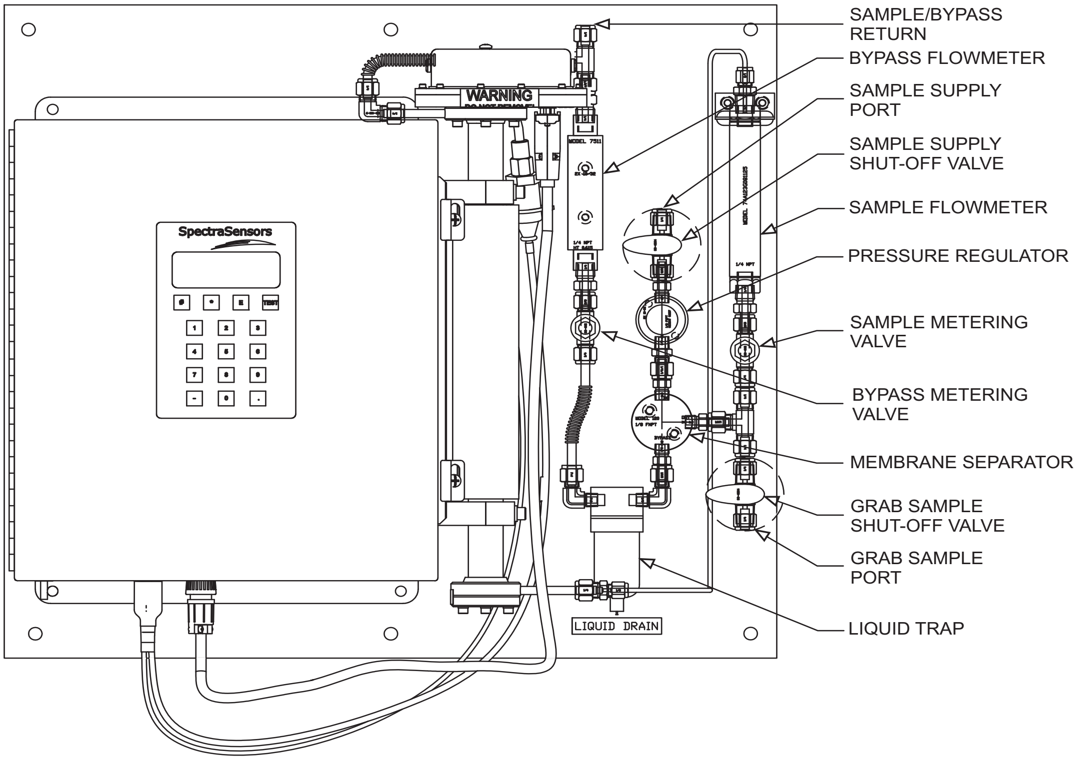


Figure 3–1 *Typical full-featured, single-channel SCS (SS500/SS2000).*

About the SCS

The system drawings and schematics used in this manual are for illustration purposes only. Always refer to your particular as-built drawings for your specific system configuration and specifications.

For a typical full-featured SCS, as shown in Figure 3–1, sample gas enters the sample conditioning unit [at the specified supply pressure set by a customer-supplied upstream regulator] via the sample supply port, passes through a shut-off valve, pressure regulator [set at 10 psig (0.7 barg)] that maintains constant pressure in the measurement cell, and membrane separator where any liquid in the stream is removed. Liquid removed by the membrane separator passes through the bypass loop and collects in a coalescing filter. A continuous flow (set to the specified level by a metering valve and flowmeter) not only flushes the liquid from the membrane separator but also maintains flow through the sample lines which reduces sample variation.

The flow exiting the bypass loop is combined with the flow exiting the measurement cell and sent out the sample return port to be vented to a safe location.

Checking the SCS Installation

Before operating the system for the first time, a careful check of the installation of the entire SCS from the sample probe to the flare/vent is recommended.

To perform SCS installation checks:

1. Confirm that the sample probe is correctly installed at the process supply tap and that the sample probe isolation valve is closed.
2. 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 counterclockwise).
3. Confirm that the relief valve vent line is properly installed from the field-pressure reducing station to the low-pressure flare (or atmospheric) connection.
4. If applicable, confirm that the sample probe and field-pressure reducing station are properly traced and insulated without any exposed surfaces.
5. If applicable, confirm that the field run electric-traced sample transport tubing is installed correctly (no exposed tubing or pockets), terminated properly at each end, and that each line has been purged clean and pressure tested.
6. Confirm that all valves are closed.
7. Confirm that the AC power is available to the electrically traced sample tubing (if applicable) and analyzer but that the local switches are off.
8. Confirm that the field analog and alarm signal wiring is interconnected properly (see **"To connect the output signals"** on page 2-10).
9. Confirm that the low-pressure flare or atmospheric vent is properly connected, if applicable.
10. Confirm that the analyzer house atmospheric vent is properly installed, if applicable.
11. Confirm that all sample system tubing has been thoroughly leak checked.

Starting up the SCS

After the SCS installation has been thoroughly checked, you are ready to begin preparing for initial SCS startup.

To perform SCS installation checks:

1. Confirm that the sample probe is correctly installed at the supply tap and that the sample probe isolation valve is closed.
2. 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 counterclockwise).
3. Confirm that the relief valve at the field-pressure reducing station has been set to the specified setpoint. The relief valve is located on the pressure reducing regulator at the process sample tap.

Although the relief valve may have been preset, the setpoint must be confirmed prior to operation of the sample system. To confirm or reset the relief valve, it must be removed from the pressure reducing regulator and connected to an adjustable pressure source (refer to the manufacturer's instructions for details on setting the relief valve). After the relief valve is re-installed, all connections must be leak checked.

4. Confirm that the relief valve vent line is properly installed from the field-pressure reducing station to the low-pressure flare (or atmospheric) connection.
5. Confirm that all valves are closed.
6. Confirm that the AC power is available to the analyzer but that the local switch is off.
7. Confirm that the field analog and alarm signal wiring is connected properly (see **"To connect the output signals"** on page 2-10).
8. Confirm that the low-pressure flare or atmospheric vent is properly connected.
9. Confirm that the analyzer house atmospheric vent is properly installed, if applicable.
10. Confirm that all sample system tubing has been thoroughly leak checked.

Starting up the SCS

After the SCS installation has been thoroughly checked, you are ready to begin preparing for initial SCS startup.

To prepare for SCS startup:

1. If applicable, apply AC power to the electric-traced sample transport tubing at the tracer control system.

If applicable, personnel should have a thorough understanding of the operation of the tracer power supply and control system before operating the SCS.

2. If applicable, confirm that the sample supply line electric tracer temperature controller at the tracer control system is set to the temperature specified.
3. If applicable, confirm proper heating of the sample supply tubing.
4. Confirm that all sample system shut-off valves are closed.
5. Confirm that the sample bypass and analyzer flowmeter metering valves are closed (adjustment knobs turned clockwise). Do not over-tighten the metering valves or damage could occur.

To start up the field-pressure reducing station:

The process 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.

1. Confirm that the sample probe isolation valve is closed.
2. Confirm that the pressure regulator at the field-pressure reducing station is closed (adjustment knob turned fully counterclockwise).
3. Open the low-pressure flare or atmospheric vent header shut-off valve for the relief valve vent from the field-pressure reducing station.

The low-pressure flare or atmospheric vent header shut-off valve must be "car-sealed" open and tagged as a relief valve vent so that this valve will not be closed unless the SCS is not in operation.

4. Slowly open the sample probe process shut-off valve at the sample supply tap.

5. Slowly open the pressure regulator at the field-pressure reducing station (adjustment knob turned clockwise) and set the pressure regulator to the specified pressure.

The pressure reducing regulator is designed to provide "bubble-tight" shut off when the pressure setpoint has been reached. However, if "bubble tight" shut off does not occur when the downstream sample line is isolated, the pressure at the outlet of the regulator will slowly increase until the pressure setpoint of the relief valve is reached and the excess pressure is vented by the relief valve. Although this situation is not intended, it does not cause a significant problem and startup of the SCS can continue without maintenance performed on the pressure regulator.

To start up the sample bypass stream on process sample:

1. Open the sample supply port shut-off valve.
2. Confirm the sample supply pressure.
3. Open the low-pressure flare or atmospheric vent header shut-off valve for the combined sample bypass and measurement cell effluent from the SCS.
4. Open the bypass flowmeter metering valve to establish sample flow from the sample probe and set the metering valve to the specified value.
5. Confirm that the sample supply pressure under flowing conditions is approximately set to the specified pressure.

Although the exact supply pressure setpoint is not critical, the pressure at the sample system should be within 5 psig of the specified supply pressure setpoint. There may be a difference between the pressure readings at the sample tap and inside the SCS due to the pressure drop in the sample transport line under flowing conditions. If the pressure at the SCS under flowing conditions is not sufficiently close to the specified setpoint, it will be necessary to readjust the pressure regulator setpoint at the field-pressure reducing station to provide the required supply pressure with the specified sample bypass flow.

To start up the analyzer on process sample:

1. Open the sample metering valve to approximately the specified flow.
2. If required, adjust the pressure regulator at the field-pressure reducing station to the specified setpoint.

3. Adjust the sample metering valve to the specified flow.

The adjustment setpoints of the analyzer metering valves and pressure regulator at the field-pressure reducing station 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 analyzer performance. If you are unable to attain the specified sample flow rate, contact your factory sales representative.

4. Confirm the sample flow and pressure setpoints and readjust the metering valves and pressure regulator at the field-pressure reducing station to the specified setpoints, if necessary.
5. Confirm the sample bypass flow and readjust the bypass metering valve to the specified setpoint, if necessary. The SCS is now operating with the process sample.
6. Power up the analyzer according to the procedure given in **"To power up the analyzer"** on page 4-1.

Personnel should have a thorough understanding of the operation of the SS500/SS2000/SS3000 analyzer before operating the SCS.

Shutting Down the SCS

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 SCS.

The process sample at the sample tap is at a high pressure. A pressure reducing regulator is located at the sample tap to reduce the sample pressure and enable operation of the SCS at a low pressure. Use extreme caution when operating the sample probe isolation valve and field-pressure reducing regulator.

To isolate the analyzer for short-term shutdown:

The analyzer can be isolated from the process sample tap for short-term shutdown or maintenance of the analyzer without requiring the shutdown of the field-pressure reducing station.

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 SCS.

Although the pressure reducing regulator at the process sample tap is designed for "bubble-tight" shut off, this condition may not occur after the system has been in operation for an extended period. Isolation of the SCS from the field-pressure regulator will discontinue sample flow and may cause the pressure at the outlet of the field-pressure regulator to slowly increase if "bubble-tight" shut off of the pressure regulator does not occur. The slow pressure increase will continue until the pressure setpoint of the relief valve is reached and the excess pressure is vented by the relief valve. Although this situation is not intended, it does not cause a significant problem if the SCS is only isolated for a short period. Only a small amount of process sample will be vented when the relief valve opens because the pressure regulator will continue to act as a flow restriction.

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

1. Close the sample supply shut-off valve.

2. Allow the sample to flow until all residual gas has dissipated from the lines as indicated by no flow on the sample and sample bypass flowmeters.
3. Close the low-pressure flare or atmospheric vent header shut-off valve for the combined sample bypass and measurement cell effluent from the SCS.
4. Turn off power to the analyzer.

If the system will not be out of service for an extended period, it is advised that power remain applied to the sample transport line electric tracer, if applicable.

To isolate the analyzer for long-term shutdown:

If the analyzer is to be out of service for an extended period, the analyzer must be isolated at the process sample tap.

The process sample at the sample tap may be at a high pressure. A pressure reducing regulator is located at the sample tap to reduce the sample pressure and allow operation of the SCS at a low pressure. Use extreme caution when operating the sample probe isolation valve and field-pressure reducing regulator.

The sample transport line must be vented to the low-pressure flare (or atmospheric vent) header through the bypass flowmeter to avoid pressure surges. The procedure given in the following steps can be followed regardless of whether or not the SCS has been isolated from the process tap as described in the previous section.

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

1. Open (or confirm open) the low-pressure flare (or atmospheric vent) header shut-off valve for the effluent from the SCS.
2. Confirm flow in the sample bypass flowmeter (the actual flow is not critical).
3. Close the sample probe process shut-off valve at the sample supply process tap.
4. Allow pressure in the field-pressure reducing regulator to dissipate until only a low residual pressure is indicated on the pressure gauge at the field station.

5. Close the field-pressure reducing regulator (adjustment knob turned fully counterclockwise).
6. Close the sample supply shut-off valve.
7. Close the sample bypass flowmeter metering valve (adjustment knob turned clockwise). Do not over-tighten the metering valve or damage could occur.
8. Close the sample flowmeter metering valve (adjustment knob turned clockwise). Do not over-tighten the metering valve or damage could occur.
9. Close the low-pressure flare (or atmospheric vent) header shut-off valve for the relief valve vent from the field-pressure regulator.
10. Close the low-pressure flare or atmospheric vent header shut-off valve for the sample bypass and measurement cell effluent from the SCS.
11. Turn off power to the analyzer.
12. Turn off the AC power to the sample tracer, if applicable, at the power distribution panel.

Although power could be shut off to the sample supply electric tracer, it is advisable to allow this line to remain heated unless the SCS is to be out of service for an extended period or maintenance is required on the line.

Periodic SCS Maintenance

Due to the chemical properties of the process samples, care must be taken to repair or replace components with proper materials of construction. Maintenance personnel should have a thorough knowledge and understanding of the chemical characteristics of the process before performing maintenance on the SCS.

The status of the SCS should be checked regularly to confirm proper operation (pressures, flows, etc.) and detect potential problems or failures before damage occurs. If maintenance is required, isolate the part of the system to be serviced by following the appropriate procedure under **"Shutting Down the SCS"** on page 3-8.

All coalescing filter elements should be checked periodically for loading. Obstruction of a filter element can be observed by a decreasing supply pressure or bypass flow. After observation for some time, a regular schedule can be determined for replacement of filter elements.

Although some liquid may carry over during normal operation, a coalescing filter at the sample supply port of the SCS should prevent any liquid proceeding through the SCS. All coalescing filters should be checked regularly for liquid carry over.

If liquid is observed in a filter housing, the filter should be cleaned and the filter element replaced. In addition, the membrane in the membrane separator should also be checked and possibly replaced.

No other regularly scheduled maintenance should be required for the system.

Preventive and Demand SCS Maintenance

Due to the chemical properties of the process samples, care must be taken to repair or replace components with proper materials of construction. Maintenance personnel should have a thorough knowledge and understanding of the chemical characteristics of the process before performing maintenance on the SCS.

The performance of the SCS and individual components should be monitored regularly so that maintenance may be performed on a scheduled basis so that a failure does not take the system out of operation. However, preventive and demand maintenance will be required when components and parts deteriorate or fail as a result of continuous use.

The SCS is designed for convenient removal and replacement of component parts. Complete spare components should always be available. In general, if a problem or failure occurs, the complete part should be removed and replaced to limit system down time. If possible, components may be repaired (replacement of seats and seals, etc.) and then reused.

Under a process upset condition, it is possible for liquid to enter the sample probe and sample transport tubing. Normally, this liquid should purge from the sample transport line and be trapped in a coalescing filter at the sample supply port of the SCS.

If the sample line does not appear to completely clear during normal operation, it may be necessary to clean the sample transport line to remove any liquid that may adhere to the wall of the tubing. The sample transport line must be disconnected at both ends to allow cleaning. After cleaning, the line should be purged dry with air or nitrogen before the system is placed back in operation.

The system must be taken out of service during any cleaning of the sample transport line.

All filters should be checked regularly for obstruction. Obstruction of filter elements can be observed by a decreasing supply pressure or bypass flow. If liquid is observed in a filter housing or the filter is otherwise obstructed, the filter should be cleaned and the filter element replaced.

THIS PAGE INTENTIONALLY LEFT BLANK

4 - 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, checking for leaks, and starting up the SCS following the procedure outlined in **"Starting up the SCS"** on page 3-4, you are ready to power up the analyzer.

See Figure 2–2, Figure 2–3, Figure 2–4 or Figure 2–5 for locating fuses. If you need to replace a fuse, use only the same type and rating of fuse as the original.

To power up the analyzer:

1. Power up the analyzer by energizing the circuit to the analyzer.
2. The analyzer goes through an initialization period counting down from 15 while showing the firmware version, release date and measurement type [Dual Peak (DP) or Direct Measurement (DM)] on the bottom line.

```
Initializing...

           15
v2.40  10-08-08  DM
```

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

```
    <NORMAL MODE>
H2O: 1.0256lb/mmscf

P: 954.4mb T: 76.1F
```

4. Enable **Peak Tracking** following the procedure outlined in **"To change parameters in Mode 2 or Mode 3"** on page 4-8.
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.
2. If the analyzer is going to be shut down for a short period of time for routine maintenance, isolate the analyzer from the SCS by following the procedure under **"To isolate the analyzer for short-term shutdown"** on page 3-8.
3. If the analyzer is going to be shut down for a long period of time, follow the procedure under **"To isolate the analyzer for long-term shutdown"** on page 3-9. It is recommended to also disconnect the power completely from the analyzer to prevent potential damage from lightning strikes.

Operating the Analyzer from the Keypad

The keypads enable the operator to modify measurement units, adjust operational parameters, and perform diagnostics. During normal operation, the LCDs continuously display the measured components' concentrations, sample cell temperatures, and sample cell pressures.

The SpectraSensors keypad is shown in Figure 4–1. To activate any functions on the keypad, press the mode key **#** followed by a number on the keypad to specify a mode.

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

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**, **3**, **4**, **5**, or **6**) to activate a mode. The following section explains each mode and the corresponding information that displays on the LCD.

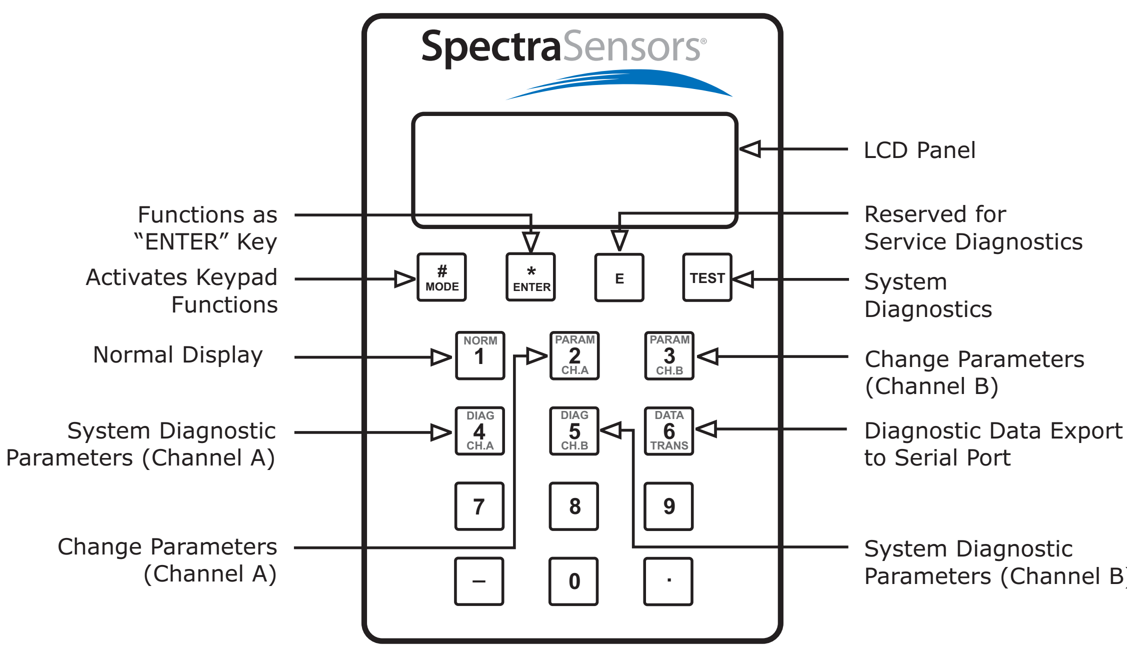


Figure 4–1 *SS500/SS2000/SS3000 keypad.*

Mode 1: (Normal Mode)

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

+ **1**

The measurements displayed are:

- **H2O** — Concentration of CHA in units selected in **Mode 2**.
- **CO2** — Concentration of CHB in units selected in **Mode 3** (SS3000 only).
- **P** — Pressure in the sample cell in units selected in **Mode 2**.
- **T** — Temperature in the sample cell in units selected in **Mode 2**.

```
    <NORMAL MODE>
H2O: 1.0256lb/mmscf

P: 954.4mb T: 76.1F
```

Mode 2: (Set Parameter Mode - Channel A)

Enables user to view and change measurement parameters for Channel A. Press the **#** key followed by the **2** key. The LCD prompts for a numeric

+ **2**

```
 <SET PARAMETER MODE>
Enter password

v2.40  08-12-08  DM
```

password.

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

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

Follow the procedure under **"To change parameters in Mode 2 or Mode 3"** on page 4-8 for viewing and changing any of the parameters.

Mode 3: (Set Parameter Mode - Channel B)

Enables user to view and change measurement parameters for Channel B. Press the **#** key followed by the **3** key. The LCD prompts for a numeric

+ **3**

```
 <SET PARAMETER MODE>
Enter password

v2.40  08-12-08  DM
```

password.

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

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

Follow the procedure under **"To change parameters in Mode 2 or Mode 3"** on page 4-8 for viewing and changing any of the parameters.

Mode 4: (System Diagnostic Parameters - Channel A)

Displays system diagnostic data for Channel A. 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: (System Diagnostic Parameters - Channel B)

Displays system diagnostic data for Channel B. These values may be useful when troubleshooting the system. Press the **#** key followed by the **5** key. A

+ **5**

brief wait screen will appear as the diagnostic data for Channel B is queried.

```
<Diagnostic for CHB>

   Please wait...
```

```
PP2F:8190 PkDf:47.00
Powr:2028 PkD1:47.00
Indx: 253 T:    50.7
Zero: -16 P:   955.7
```

The diagnostic parameters in **Mode 4** or **Mode 5** displayed are:

- **PP2F:** Shows the value of the concentration signal in A/D counts. A normal range is 0 to 8190 depending on the concentration.
- **Powr:** Shows the laser power detected at the absorption peak in A/D counts. Acceptable values are between 1000 and 2000. A number below 1000 may indicate that either the optics need to be cleaned or there is an alignment problem. A value below 200 will cause a **Power Fail Error**.
- **Indx:** Shows the position of the absorption peak within the wavelength scan. It should normally be at 290 with the peak tracking turned on. Typically, values outside of the range of 241 to 339 indicate a **Spectrum Fail Error** condition.
- **Zero:** Shows the detector signal value when the laser is turned off. It should be in the range of -50 to +50. Outside of this range, a **Null Fail Error** displays.
- **PkDf:** The factory laser current set point in mA that matches the target absorption line.
- **PkD1:** The laser current set point after adjustment by the peak-tracking software. It should be within a few mA of the **PkDf** value. If the analyzer is experiencing problems, one of the first troubleshooting steps should be to check the peak tracking. **Tracking Fail** may be displayed if **PkD1** differs by more than 4 mA

from **PkDf**. For more information on troubleshooting these issues, see **"To reset the Peak Tracking Function"** on page A-5.

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 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**

For the single-channel systems, the LCD displays the system test data. For

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

dual-channel systems, a selection of channel must first be made. For viewing

```
     <TEST MODE>
Enter a selection
1
1=H2O 2=CO2
```

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

```
  <H2O SYSTEM TEST>
Laser Power: OK
PT Sen: OK Trak: OK
Spectr: OK Null: OK
```

Channel B data, press the **2** key followed by the ***** key.

```
  <CO2 SYSTEM TEST>
Laser Power: OK
PT Sen: OK Trak: OK
Spectr: OK Null: OK
```

Changing Measurement and Control Parameters

In **Mode 2** or **Mode 3**, all of the pertinent measurement and control parameters can be viewed and changed. Refer to Table 4–1 for a list of parameters and value ranges.

To change parameters in Mode 2 or Mode 3:

1. Press the **#** key followed by the **2** (**Mode 2** - Ch. A) or **3** (**Mode 3** - Ch. B) key. The LCD prompts for a numeric password.

```
 <SET PARAMETER MODE>
Enter password

v2.40  08-12-08  DM
```

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

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

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.

Table 4–1 *Measurement and control parameters.*

Parameter	Setting	Function
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	*Not applicable for SS500/SS2000/SS3000*	
Low Power Warning	User Set 200 – 4999 Default = 200	Sets the DC power level below which the analyzer will issue a **Low Power Warning**
DO Alarm Setup	*Not applicable for SS500/SS2000/SS3000*	
Alarm Setpoint	*Not applicable for SS500/SS2000/SS3000*	
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
Pipeline Pressure	0 – 999999	Sets pipeline pressure used to calculate dew point
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

Table 4–1 *Measurement and control parameters.*

Parameter	Setting	Function
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

Measurement and Control Parameters Defined

S Factor

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

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 4-16].

S Factor Offset

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

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 4-16].

Spectrum Average

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

The **# Spectrum Average** parameter sets the number of scans that the analyzer averages for when determining the concentration. Averaging over multiple scans lowers noise in the measurement but inherently increases the 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.

Logger Rate

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

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**.

Peak Tracking

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

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**).

Low Power Warning

```
<SET PARAMETER MODE>
Low Power Warning
4
Enter a value
```

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

4-20 mA Alarm Action

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

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.

4-20 mA % Test

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

The **4-20 mA % Test** parameter enables keypad 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 keypad control of the current loop and returns to the current loop output tracking the concentration value.

4 mA Value

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

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.

20 mA Value

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

The **20 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 20 mA on the current loop output. Typically this will be the full-scale value for which the analyzer was calibrated.

Temperature Unit

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

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.

Pressure Unit

```
 <SET PARAMETER MODE>
Pressure Unit

0:mb1:Torr2:Pa3:psia
```

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.

Concentration Unit

```
 <SET PARAMETER MODE>
Concentration Unit
0
0:ppmv 1:lb 2:DP
```

The **Concentration Unit** parameter designates the display units for the measured concentration. There are three choices: **0** for ppmv, **1** for lb/MMscf, and **2** (moisture systems only) for dew point (calculated at the **Pipeline Pressure** set below and displayed in the **Temperature Unit** set above). For percentage level analyzers, the choices are: **0** for ppmv and **1** for %.

For moiusture systems, adding a **1** in front of the display unit value assigns dew point to the 4-20 mA output. For example, a value of **10** would display ppmv on the LCD, but the value of the 4-20 mA output would correspond to dew point, scaled according to the minimum and maximum values set with **4 mA Value** and **20 mA Value**, respectively.

Pipeline Pressure (if applicable)

```
 <SET PARAMETER MODE>
Pipeline Pressure
0.00000
Enter a value
```

On moisture systems, the **Pipeline Pressure** parameter sets the pressure (in mbar) for the calculation of dew point.

Modbus Address

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

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.

Modbus Mode

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

The **Modbus Mode** parameter sets the communications protocol for the RS232 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 7-1; **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.

User Analyzer ID

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

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

User Sample ID

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

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

User Component ID

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

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

User Password

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

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

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

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

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

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

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 4-20].

   SpectraSensors recommends validating the analyzer using only H_2O & CO_2 in CH_4. 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 (H_2O & CO_2 in CH_4) 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 or Mode 3"** on page 4-8 to enter the new values.

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 signal is most conveniently scaled and calibrated at the receiving end (RTU, flow computer, etc.). To scale the receiver's output, the

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

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 or Mode 3"** on page 4-8).
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 Ch. A DC signal drops below the level set by the **Low Power Warning** parameter.
- **Low Power Warning B**: this warning occurs when the Ch. B DC signal drops below the level set by the **Low Power Warning** parameter.

Faults/Alarms

Alarm and fault messages appear on the front panel LCD. The **General Fault Alarm** is triggered by system faults which cause the current loop to respond according to the **4-20 mA Alarm Action** setting. 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 Ch. A measurement cell exceeds the specified maximum operating levels.
- **Track Fail Error**: this fault occurs when the Ch. A peak tracking function is out of range [**PkDf** (factory set midpoint) and **PkD1** (peak track midpoint) differ by more than 4 counts].
- **Power Fail Error B**: this fault occurs when the Ch. B DC signal becomes too weak for a reliable measurement typically as a result of mirror contamination.
- **Null Fail Error B**: this fault occurs if the Ch. B detector signal value is out of the range of -50 to +50 when the laser is turned off.
- **Spectrum Fail Err B**: this fault occurs when the system is unable to adequately fit a curve to the measured Ch. B 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 B**: this fault occurs when the pressure and/or temperature in the Ch. B measurement cell exceeds the specified maximum operating levels.
- **Track Fail Error B**: this fault occurs when the Ch. B peak tracking function is out of range [**PkDf** (factory set midpoint) and **PkD1** (peak track midpoint) differ by more than 4 counts].

See Appendix B 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. Switch the check gas or validation gas valve to validation gas.
3. 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 analyzer performance. If you are unable to attain the specified sample flow rate, contact your factory sales representative.

4. Make a measurement after the gas flows for approximately five minutes or when the values on the LCDs settle.
5. After validation, switch the check gas or validation gas valve back to sample flow.
6. 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 H_2O in CH_4. Bottles of test gas with certified concentrations of approximately 20% and 80% of full scale should be used 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 (H_2O in CH_4 or *CO_2 in CH_4) 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.

THIS PAGE INTENTIONALLY LEFT BLANK

5 - SERIAL PORT 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, & 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 quicker access to HyperTerminal, save a HyperTerminal shortcut to the desktop.

3. Once HyperTerminal is activated, the **Connection Description** window appears, as shown in Figure 5–1. 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 5–2. 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. Click **OK**.
6. Once the port is chosen, the **COM Properties** window appears. Make sure the COM properties for the port selected reflect those shown in Figure 5–3 (9600 baud, 8 data bits, 1 stop bit, no parity, and no flow control).
7. Click **OK** to establish the connection.

Once connected, the data will start streaming through the Hyperterminal Window as shown in Figure 5–4.

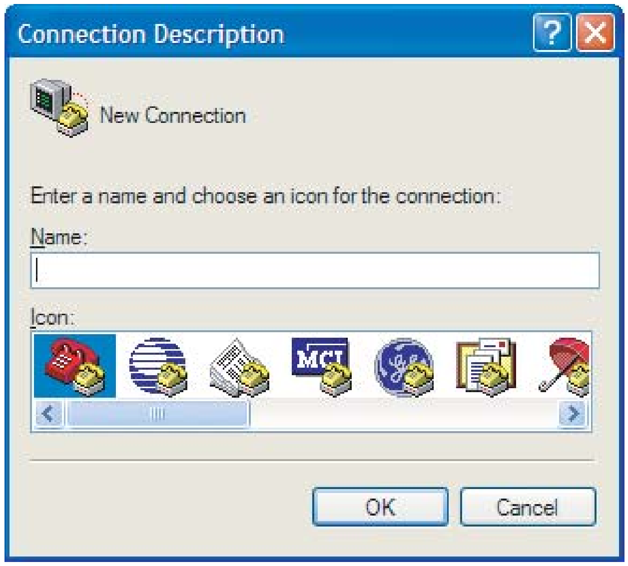


Figure 5–1 *Connection Description window.*

Figure 5–2 *Connect To window.*

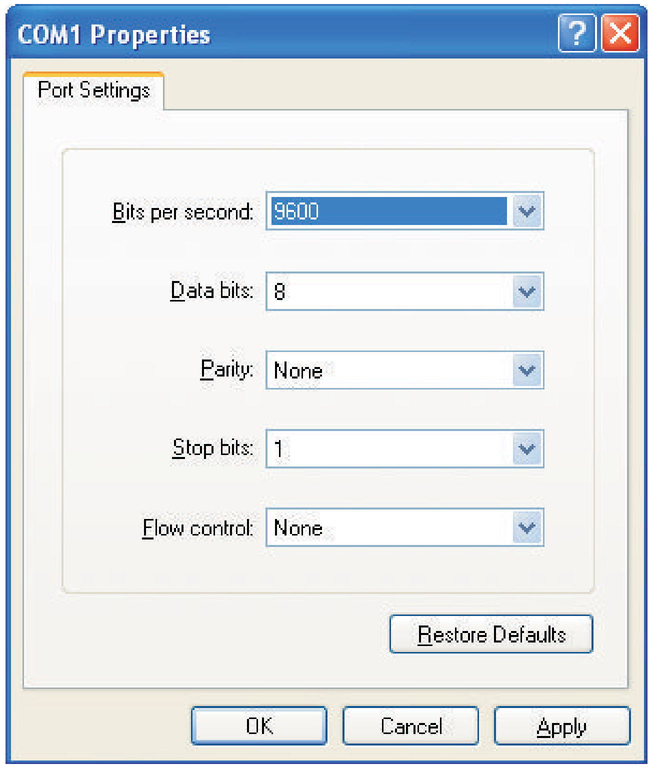


Figure 5–3 *COM Properties window.*

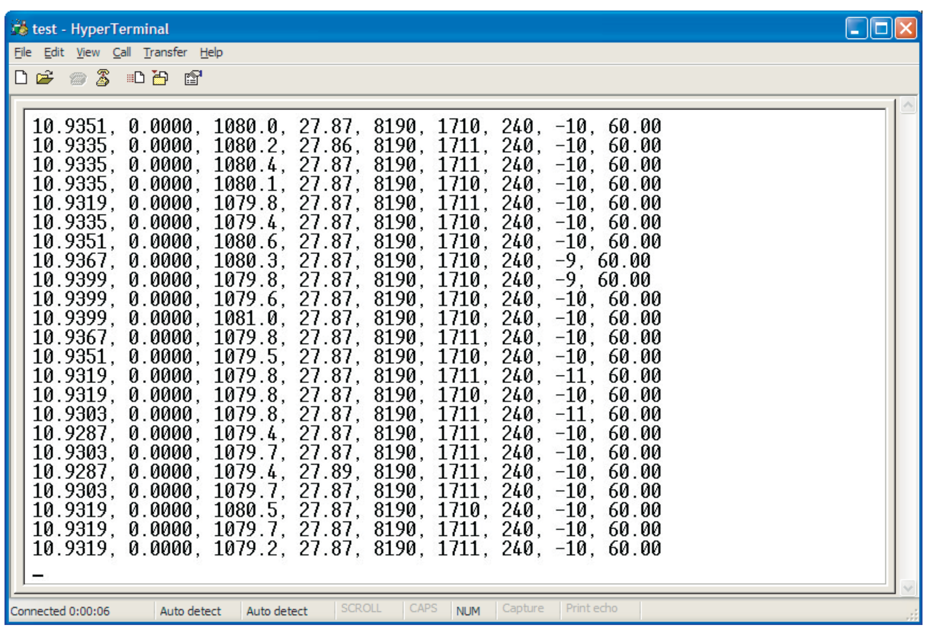


Figure 5–4 *Hyperterminal window with streaming data.*

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
- **Reference Peak PP2F** (only for DP systems)
- **Reference Peak Powr** (only for DP systems)
- **Reference Peak Indx** (only for DP systems)
- **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.*

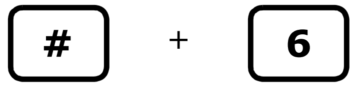
To capture and save data from the serial port:

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**.

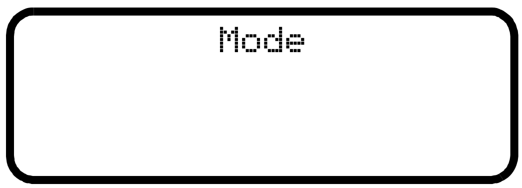
To read diagnostic data with HyperTerminal:

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 5-1.
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 and the screen displays:



4. Press the **#** key followed by the **1** key to return to **Mode 1**.
5. Once normal operation resumes, wait approximately three minutes 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 5–5.

You can import the stored data file into a spreadsheet program such as Microsoft Excel® to plot the data (see **"Viewing Diagnostic Data with Microsoft Excel"** for more information.

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.

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 5–7a.
2. The **Text Import Wizard** should open. Choose the **Delimited** option and click **Next**, as shown in Figure 5–7b.
3. Under **Delimiters**, choose the **Tab** and **Space** options, check the **Treat Consecutive Delimiters as One** box, as shown in Figure 5–8a, and then click **Finish** to display the spreadsheet. The first few

```
SpectraSensors HardHat:  v2.31  Single  08-08-08  DM

Idx     DC      AC
0       3181    3830
1       2699    3727
2       2007    3493
3       1359    3207

<<Information Deleted>>

509     3150    4095
510     3153    4095
511     3157    4095


Computational Statistics  v2.31  Single  08-08-08  DM

Ambient counts after averaging
  Voltage: -1368    Temperature: -1532   Pressure: -206

ac counts after averaging
  Peak      Index: 240   Raw Count: 4095
  Left  Dip Index: 240   Raw Count: 4095
  Right Dip Index: 278   Raw Count: -4095
  pp2f (peak minus average of dips): 8190

dc counts after averaging
  raw at peak index:         2025
  computed at peak index:    1714
  raw at [peak index - 140]: 736   index: 100
  raw at [peak index + 140]: 2692   index: 380
  laser off, zero level:     -10
  dc level (computer power at peak - zero level):  1724
  Lf_response (rcalb * dc level):  6616712

Calculated values
  Supply Voltage:   4.588 volts
  Concentration:   10.9129 ppmv
  Temperature:     27.1 C
  Pf_MidShift:     0.0000
  Pressure:      1076.9 mb

Settings
  Phase: 90
  Midpoint: 60.0000
  Ramp amplitude: 35
  Imod: 8
  Rcalb: 3.838000E+03
  Zero Offset (ppmv): 0.000000E+00
  ValueFct(x1000): 1000
  Value   (ppmv):422.00
  PA 1: 1.000E+00
  PA 2: 0.000E+00
  PA 3: 0.000E+00
  PA 4: 0.000E+00
  c0 Coeff: 0.00000E+00
  c1 Coeff: 1.00000E+00
  c2 Coeff: 0.00000E+00
  c3 Coeff: 0.00000E+00
  Peak Index Location: 290
  Xleftvmr: 240
  Xrightvmr: 340
  Left Dip Range: 100
  Right Dip Range: 100
  DC Left Range: 140
  DC Right Range: 140
  Null Fail Error Range Min: -50
  Null Fail Error Range Max: 50
  mA Index Scale: 0.03030303
  Peak Track Range Min: 3
  Peak Track Range Max: 70
  Peak Track Num Avgs: 3600
  Peak Track Con Value: 10
  Peak Track Con Value: 95
  Peak Track Temp Min: -5
```

Figure 5–5 *Sample diagnostic data output.*

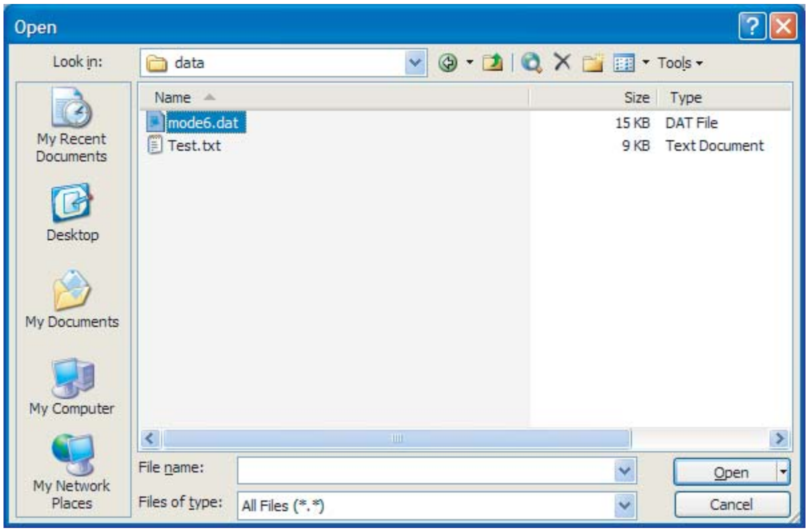
```
 Peak Track Temp Max: 60
  PT Matrix: 1
  fc0 Background Coeff: 1.00000E+00
  fc1 Background Coeff: 0.00000E+00
  fc2 Background Coeff: 0.00000E+00
  fc3 Background Coeff: 0.00000E+00
  fp0 Background Corr: 1.00000E+00
  fp1 Background Corr: 0.00000E+00
  fp2 Background Corr: 0.00000E+00
  fp3 Background Corr: 0.00000E+00
  pp2f Direction: 1
  Ref Peak Range Min: -180
  Ref Peak Range Max: -80
  Ref PeakTo Dip Range: -100
  Serial Number: 100000000
  S Factor: 1.00000
  S Factor Offset: 0.00000
  # Spectrum Average: 4
  Logger Rate: 4
  Peak Tracking: 0
  DO Alarm Setup: 0
  Alarm Setpoint(ppmv): 430.0
  4-20mA Alarm Action: 0
  4-20mA % Test: 101
  4 mA Value (ppmv): 0.000
  20 mA Value (ppmv): 422.000
  Temperature Unit: 0
  Pressure Unit: 0
  Concentration Unit: 0
  Pipeline Pressure: 0.00
  Modbus Address: 0
  Modbus Mode: 0
  User Analyzer ID: 0
  User Sample ID: 0
  User Component ID: 0

Constants
  Kf_ValuefactorFactor: 0.001000
  Null Point:  6

Diagnostics
   ppmv:       10.9129
   PP2F:       8190
   Power:      1714
   PkDf:       60.0000
   PkDl:       60.0000
   Index:       240
   Zero:        -10
```

Figure 5–6 *Sample diagnostic data output (continued).*

a)



b)

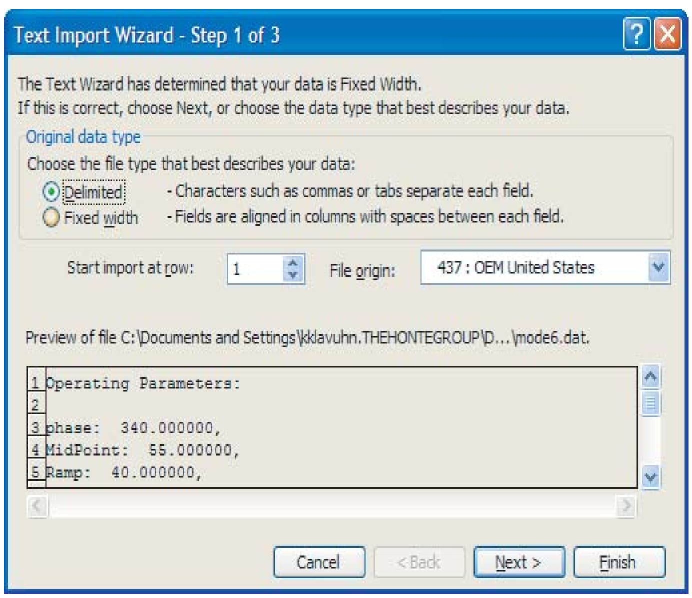
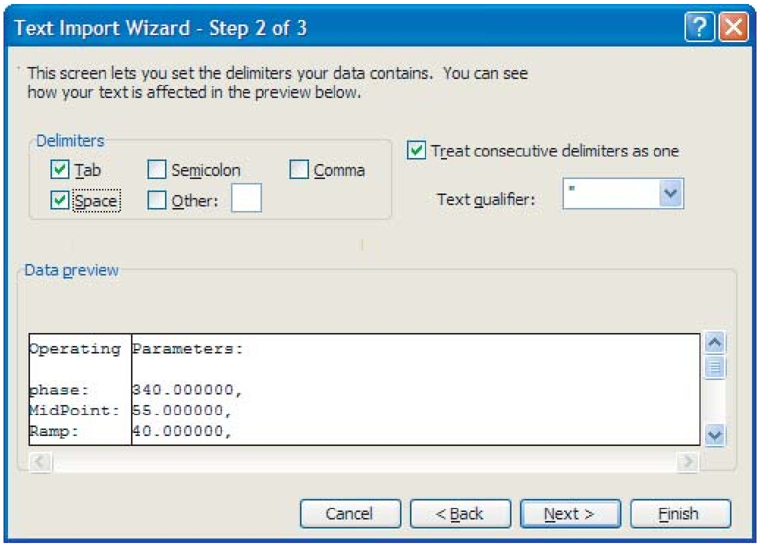


Figure 5–7 *a) Opening a data file in Excel. b) Setting data type in Text Import Wizard.*

a)



b)

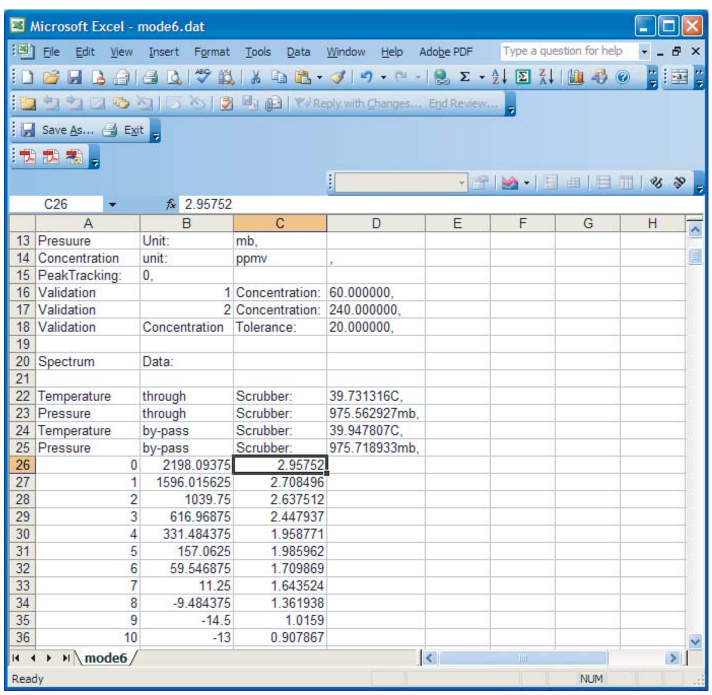


Figure 5–8 *a) Setting Tab and Space as delimiters. b) Highlighting imported data for plotting in Excel.*

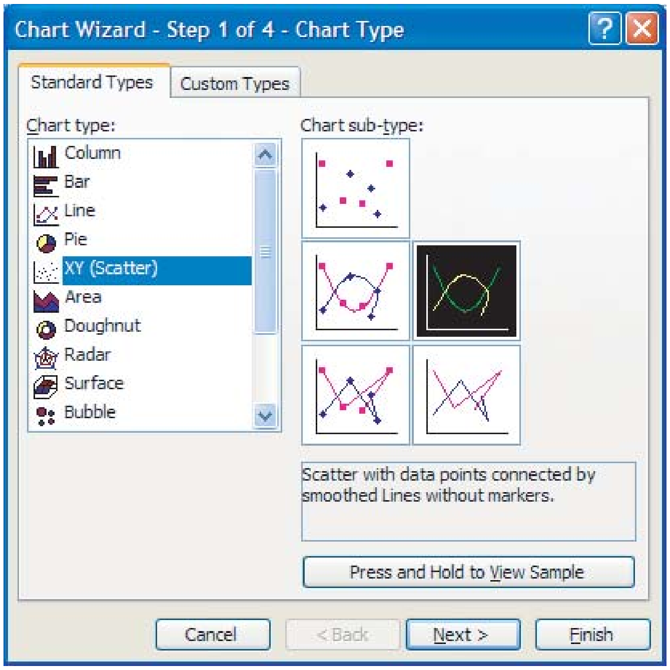


Figure 5–9   *Chart Wizard - Step 1 window.*

lines look like the normal serial output data received before the **Mode 6** command was entered. Look for the three columns of numbers at the bottom of the file.

4. Click on the upper right cell of the three columns, as shown in Figure 5–8b. Hold the **Shift** key down while pressing the **End** key followed by the **Down Arrow** key to highlight the third column. Keep holding down the **Shift** key and press the **End** key followed by the **Left Arrow** key to select the three columns by 512 rows.

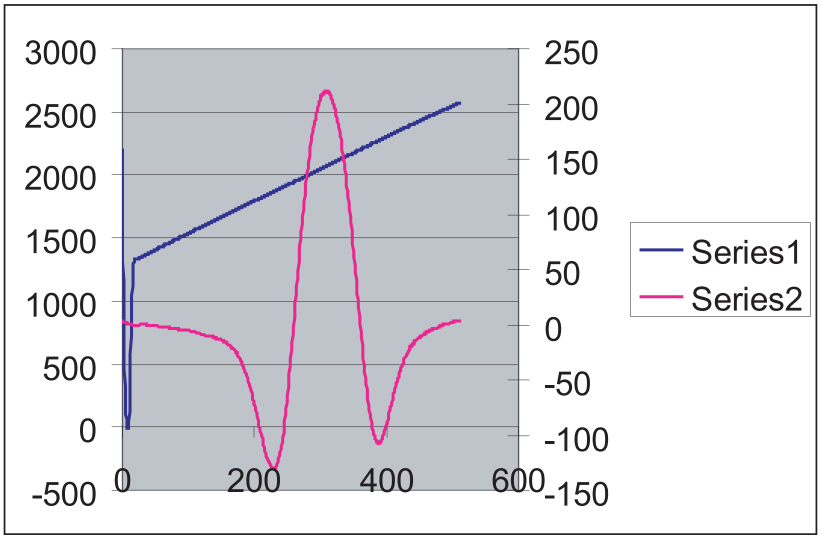
5. Click the **Chart Wizard** button  on the **Task Bar**. The **Chart Wizard** should open, as shown in Figure 5–9.

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 5–10a. If the $2f$ 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 5–10b. Click **OK** to rescale the plot.

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*

a)



b)

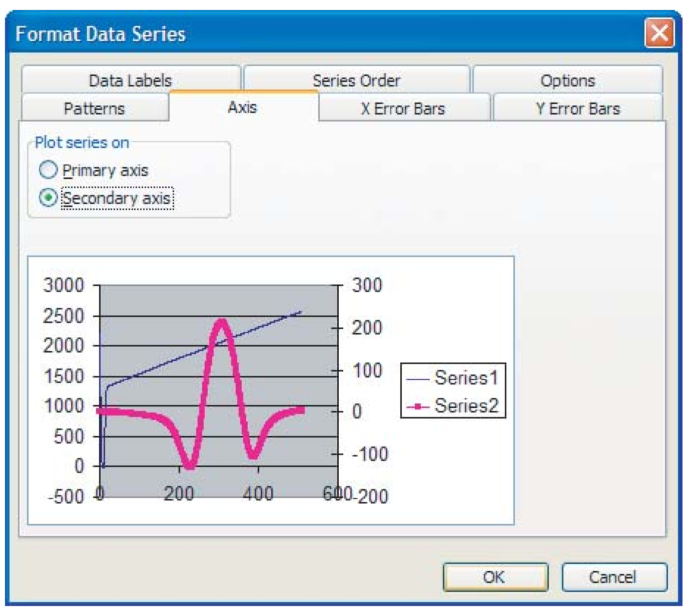


Figure 5–10 *a) Data file plot in Excel. b) Format Data Series window.*

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 transmission mode is set by the user via the **Modbus Mode** parameter. See **"To change parameters in Mode 2 or Mode 3"** on page 4-8. Note that 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 5–1 on page 5–15 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. For example, 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, repectively. 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 and Alarms”** on page 2-7.
2. Power up the analyzer (see **“Powering Up the Analyzer”** on page 4-1).
3. Press the **#** key followed by the **2** key (Channel A) or the **#** key followed by the **3** key (Channel B). The LCD prompts for a numeric

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

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

Mode - Channel A) or **Mode 3** (Set Parameter Mode - Channel B).

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 5–1 *Modbus register map .*

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
PkD1	7005	47009	Float	Read	0	0
Firmware Version	7057	47113	Float	Read	0	0
S Factor	7101	47201	Float	R/W L1[a]	0	9
S Factor Offset	7102	47203	Float	R/W L1[a]	-9	9
Pipeline Pressure	7104	47207	Float	R/W L1[a]	0	9999.9
4 mA Value	7105	47209	Float	R/W L1[a]	0	1000000
20 mA Value	7106	47211	Float	R/W L1[a]	0	1000000
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	Short	Read	0	0
Powr	3002	43002	Short	Read	0	0
Indx	3003	43003	Short	Read	0	0
Zero	3004	43004	Short	Read	0	0
# Spectrum Average	3201	43201	Short	R/W L1[a]	1	240
Logger Rate	3202	43202	Short	R/W L1[a]	1	299
Peak Tracking	3203	43203	Short	R/W L1[a]	0	2
4-20 mA Alarm Action	3204	43204	Short	R/W L1[a]	0	3
Temperature Unit	3205	43205	Short	R/W L1[a]	0	1
Pressure Unit	3206	43206	Short	R/W L1[a]	0	3
Concentration Unit	3207	43207	Short	R/W L1[a]	0	2
Modbus Device Address	3208	43208	Short	R/W L1[a]	0	250
Modbus Mode	3209	43209	Short	R/W L1[a]	0	2
4-20mA % Test	3211	43211	Short	R/W L1[a]	0	101
Low Power Warning	3212	43212	Short	R/W L1[a]	200	4999
User Password	3213	43213	Short	R/W L1[a]	0	9999
Password	4999	44999	Short	R/W	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.
- **PkD1** – midpoint current (mA) of laser scan 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.
- **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.
- **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
- **User Analyzer ID** – user defined numeric analyzer ID.
- **User Sample ID** – user defined numeric sample ID.
- **User Component ID** – user defined numeric component ID.
- **PP2F** – (counts) concentration signal.
- **Powr** – (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 units.
- **Pressure Unit** – sets the pressure units.
- **Concentration Unit** – sets the concentration units.
- **Modbus Address** – user assigned numeric address identifying analyzer to Modbus host system.
- **Modbus Mode** – sets the Modbus communication protocol type.
- **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**.
- **User Password**– sets Level 1 password.
- **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.

THIS PAGE INTENTIONALLY LEFT BLANK

Appendix A: Troubleshooting

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 your sales representative for service.

Gas Leaks

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

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 x0.035” 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 SCS.

periodically leak-tested, 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.

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** will result.
2. If mirror contamination is suspected, see **“Cleaning the Mirrors”** on page A-2.

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 Error** 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.

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

The sample cell assembly contains a low-power, 10 mW MAX, CW Class IIIb invisible laser with a wavelength between 700-3000 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.

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
- Marker
- Flashlight

To clean the mirrors:

1. Power down the analyzer following the procedure outlined in **"To power down the analyzer"** on page 4-2.
2. Isolate the analyzer from the sample bypass flow by following the procedure outlined in **"To isolate the analyzer for short-term shutdown"** on page 3-8.
3. If possible, purge the system with nitrogen for 10 minutes.
4. 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.

5. Gently remove the mirror assembly from the cell by removing the 6 socket-head cap screws and set on a clean, stable and flat surface
6. Look inside the sample cell at the top mirror using a flashlight to ensure that there is no contamination on the top mirror.

Due to its proximity to the optical head, SpectraSensors does not recommend cleaning the top mirror. If the top mirror is visibly contaminated, contact your factory service representative.

7. 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.
8. Put on clean acetone-impenetrable gloves.
9. 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."
10. Place a few drops of isopropanol onto the mirror and rotate the mirror to spread the liquid evenly across the mirror surface.

11. 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.

12. 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.

13. Carefully replace the mirror assembly onto the cell in the same orientation as previously marked making sure the o-ring is properly seated.

14. Tighten the 6 socket-head cap screws evenly with a torque wrench to **13 in-lbs**.

Excessive Sampling Gas Temperatures and Pressures

The embedded software is designed to produce accurate measurements only within the allowable cell operating range (see Appendix B). Pressures and temperatures outside these ranges will trigger a **P/T Fail Error** fault.

If the pressure, temperature, or any other readings on the LCD appear suspect, they should be checked against the specifications (see Appendix B).

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.

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 Error** is displayed, the peak tracking function should be reset.

To check the PkDf and PkD1 values:

For Channel A, press the **#** key followed by the **4** key to enter **Mode 4** (System Diagnostic Parameters - Channel A) or press the **#** key followed by the **5** key

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

to enter **Mode 5** (System Diagnostic Parameters - Channel B). A brief wait screen will appear as the diagnostic data for Channel B is polled.

```
 <Diagnostic for CHB>

    Please wait...
```

```
PP2F:8190 PkDf:47.00
Powr:2028 PkD1:47.00
Indx: 253 T:    50.7
Zero: -16 P:   955.7
```

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

To reset the Peak Tracking Function:

1. Press the **#** key followed by the **2** key (Channel A) or the **#** key followed by the **3** key (Channel B). The LCD prompts for a numeric

```
 <SET PARAMETER MODE>
Enter password

v2.40  08-12-08  DM
```

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

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

Mode - Channel A) or **Mode 3** (Set Parameter Mode - Channel B).

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).

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–1 before contacting your sales representative for service.

Service Contact

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

Customer Service
4333 W Sam Houston Pkwy H Suite 100
Houston, TX 77043-1223

Domestic 1-800-619-2861 option #2
International +1-713-300-2700 option #2
service@spectrasensors.com

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–1 *Potential instrument 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)	Is the power source good? (100-250 VAC @ 50-60 Hz, 9-16 VDC, 18-32 VDC).
	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.**
	Verify Power Fail Errorure by pressing **# 4** and checking the DC value. If it is greater than 200, then the **Power Fail Error** fault is spurious. Return to **# 1** and see if the fault has changed.
	Check the inlet and outlet tubes to see if they are under any stress. Remove the connections to the inlet and outlet tubes and see if the power goes up. Perhaps the existing tubing needs to be replaced with stainless steel flexible tubing.
	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-3.

Table A–1 *Potential instrument problems and solutions (Continued).*

Symptom	Response
Null Fail Error	Verify **Null Fail Error** fault by pressing **# 4** or **# 5** and checking the zero reading is outside the range of -50 to 50. If not, the **Null Fail Error** fault is spurious. Return to #1 and see if the fault has changed.
	Move the jumper JMP1 on the HC12 main board next to the pre-pot.
	Press **# 6** to capture diagnostic data and send the file to SpectraSensors.
Spectrum 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.**
	Turn the analyzer off for 30 seconds and then turn it on again.
	Reset the peak tracking.
	Press **# 6** to capture diagnostic data and send the file to SpectraSensors.
P/T Fail Error	Check that the actual pressure in the measurement cell is within specification (see Appendix B).
	If the pressure reading is incorrect, check that the pressure/temperature cable is tight. 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 (see Appendix B).
	If the temperature reading is incorrect, check that the pressure/temperature cable is tight. 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 –40 °C indicates an open circuit).

Table A–1 *Potential instrument problems and solutions (Continued).*

Symptom	Response
Track Fail Error	Press **# 4** or **# 5** and see if **PkDf** and **PkD1** differ by more than 4, otherwise erroneous fault.
	Reset the peak tracking.
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 (black wires are ground).
	Check connections on display communication and power cables.
Strange characters appear on front panel display	Check connections on display communication cable.
No reading on device connected to current loop	Make sure that connected device can accept a 4-20 mA signal. The analyzer is set to source current.
	Make sure the device is connected to the correct terminals on the green connector (see Figure 2–6 on page 2–10).
	Check the open circuit voltage (35-40 VDC) across the current loops terminals on the green connector (see Figure 2–6 on page 2–10).
	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.

Table A–1 *Potential instrument problems and solutions (Continued).*

Symptom	Response
Pressing keys on front panel do not have specified effect	Check connections on keypad cable.
Current loop is stuck at 4 mA or 20 mA	Check display for fault message. If alarm has been triggered, reset the alarm.
	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 HC12 main board. Return to factory for service.
Reading seems to always be high by a fixed amount	See **"Adjusting Analyzer Reading to Match Specific Standard(s)"** on page 4-16.
	Capture diagnostic data and send the file to SpectraSensors (see **"To read diagnostic data with HyperTerminal"** on page 5-4).
Reading seems to always be high by a fixed percentage	See **"Adjusting Analyzer Reading to Match Specific Standard(s)"** on page 4-16.
	Capture diagnostic data and send the file to SpectraSensors (see **"To read diagnostic data with HyperTerminal"** on page 5-4).
Reading seems to always be low by a fixed amount	See **"Adjusting Analyzer Reading to Match Specific Standard(s)"** on page 4-16.
	Capture diagnostic data and send the file to SpectraSensors (see **"To read diagnostic data with HyperTerminal"** on page 5-4).
Reading seems to always be low by a fixed percentage	See **"Adjusting Analyzer Reading to Match Specific Standard(s)"** on page 4-16.

Table A–1 *Potential instrument problems and solutions (Continued).*

Symptom	Response
Reading is erratic or seems incorrect	Check for contamination in the sample system, especially if the readings are much higher than expected.
	Capture diagnostic data and send the file to SpectraSensors (see **"To read diagnostic data with HyperTerminal"** on page 5-4).
Reading goes to "0"	If **4-20 mA Alarm Action** is set to 0, look on display for a fault message.
Reading goes to full scale	If **4-20 mA Alarm Action** is set to 1, look on display for a fault message.
	Gas concentration is greater than or equal to full scale value.
Serial Output is displaying garbled data	Make sure the computer COM port is set for 9600 baud, 8 data bits, 1 stop bit, no parity, and no flow control.
	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 that the cable is plugged into.
LCD does not update. Unit is locked up.	Switch off power, wait 30 seconds, and then switch power back on.
Reading goes to "0"	If **4-20 mA Alarm Action** is set to **0**, look on display for a fault message (see **"To change parameters in Mode 2 or Mode 3"** on page 4-8).
	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 a fault message (see **"To change parameters in Mode 2 or Mode 3"** on page 4-8).
	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 instrument problems and solutions (Continued).*

Symptom	Response
Serial output is providing no data	Make sure the computer COM port is set for 19200 baud, 8 data bits, 1 stop bit, no parity, and no flow control.
	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.	Switch off power, wait 30 seconds, and then switch power back on.

THIS PAGE INTENTIONALLY LEFT BLANK

Appendix B: Specifications

Table B–1 *SS500 moisture in natural gas analyzer specifications.*

Performance	
Concentration (H_20)[a]	2–20 lbs/MMSCF (42–422 ppmv)
Repeatability	±0.5 lb/MMSCF (±10 ppmv)
Response time[b]	Display updates every second
Application Data	
Environmental Temperature Range	-4 to 122 °F (-20 to 50 °C) Standard 14 to 140 °F (-10 to 60 °C) Optional
Environmental Relative Humidity	80% for temperatures up to 31°C MAX
Altitude	Up to 4000 m
Sample Inlet Pressure	25–30 psig (1.7–2.1 barg)
Cell Operating Pressure	−4.5 to 10 psig (−0.3 to 0.7 barg)
Sample Flow Rate	1–2 CFH (0.5–1.0 LPM)
Contaminant Sensitivity	None for gas phase glycol, methanol, amines, hydrogen sulfides or mercaptans.
Electrical & Communications	
Input Voltages[c]	100–240 VAC, 50/60 Hz 9–16 VDC or 18–32 VDC
Current	1 A @ 120 VAC, 0.5 A @ 240 VAC 1.6 A @ 24 VDC, 3.2 A @ 12 VDC
Outputs	Generic RS232 or Gould/Daniel Modbus 4–20mA Loop (concentration only)
LCD Display	Concentration, cell pressure, cell temperature
Physical Specifications	
Size	457 mm H x 406 mm W x 140 mm D (18" H x 16" W x 5.5" D)
Weight	Approx. 25 lbs (11.5 Kg)
Sample Cell Construction	316L Series Polished Stainless Steel
Area Classification	
Certification	CSA Class I, Division 2, Groups C & D

a. Consult factory for alternative ranges.
b. Software adjustable.
c. Supply voltage not to exceed ±10% of nominal. Transient over-voltages according to category II.

Table B–2 *SS2000 moisture in natural gas analyzer specifications.*

Performance	
Concentration (H_20)[a]	0.5–20 lbs/MMSCF (10–422 ppmv)
Repeatability	±0.2 lb/MMSCF (±4 ppmv)
Response time[b]	Display updates every second
Application Data	
Environmental Temperature Range	-4 to 122 °F (-20 to 50 °C) Standard 14 to 140 °F (-10 to 60 °C) Optional
Environmental Relative Humidity	80% for temperatures up to 31°C MAX
Altitude	Up to 4000 m
Sample Inlet Pressure	25–30 psig (1.7–2.1 barg)
Cell Operating Pressure	–4.5 to 10 psig (–0.3 to 0.7 barg)
Sample Flow Rate	1–2 CFH (0.5–1.0 LPM)
Contaminant Sensitivity	None for gas phase glycol, methanol, amines, hydrogen sulfides or mercaptans.
Electrical & Communications	
Input Voltages[c]	100–240 VAC, 50/60 Hz 9–16 VDC or 18–32 VDC
Current	1 A @ 120 VAC, 0.5 A @ 240 VAC 1.6 A @ 24 VDC, 3.2 A @ 12 VDC
Outputs	Generic RS232 or Gould/Daniel Modbus 4–20mA Loop (concentration only)
LCD Display	Concentration, cell pressure, cell temperature
Physical Specifications	
Size	457 mm H x 406 mm W x 140 mm D (18" H x 16" W x 5.5" D)
Weight	Approx. 25 lbs (11.5 Kg)
Sample Cell Construction	316L Series Polished Stainless Steel
Area Classification	
Certification	CSA Class I, Division 2, Groups C & D

a. Consult factory for alternative ranges.
b. Software adjustable.
c. Supply voltage not to exceed ±10% of nominal. Transient over-voltages according to category II.

Table B–3 *SS2000 carbon dioxide in natural gas analyzer specifications.*

Performance	
Concentration (CO_2)[a]	0–10%
Repeatability	±0.2%
Response time[b]	Display updates every second
Application Data	
Environmental Temperature Range	-4 to 122 °F (-20 to 50 °C) Standard 14 to 140 °F (-10 to 60 °C) Optional
Environmental Relative Humidity	80% for temperatures up to 31°C MAX
Altitude	Up to 4000 m
Sample Inlet Pressure	25–30 psig (1.7–2.1 barg)
Cell Operating Pressure	–4.5 to 10 psig (–0.3 to 0.7 barg)
Sample Flow Rate	1–2 CFH (0.5–1.0 LPM)
Contaminant Sensitivity	None for gas phase glycol, methanol, amines, hydrogen sulfides or mercaptans.
Electrical & Communications	
Input Voltages[c]	100–240 VAC, 50/60 Hz 9–16 VDC or 18–32 VDC
Current	1 A @ 120 VAC, 0.5 A @ 240 VAC 1.6 A @ 24 VDC, 3.2 A @ 12 VDC
Outputs	Generic RS232 or Gould/Daniel Modbus 4–20mA Loop (concentration only)
LCD Display	Concentration, cell pressure, cell temperature
Physical Specifications	
Size	457 mm H x 406 mm W x 140 mm D (18" H x 16" W x 5.5" D)
Weight	Approx. 25 lbs (11.5 Kg)
Sample Cell Construction	316L Series Polished Stainless Steel
Area Classification	
Certification	CSA Class I, Division 2, Groups C & D

a. Consult factory for alternative ranges.
b. Software adjustable.
c. Supply voltage not to exceed ±10% of nominal. Transient over-voltages according to category II.

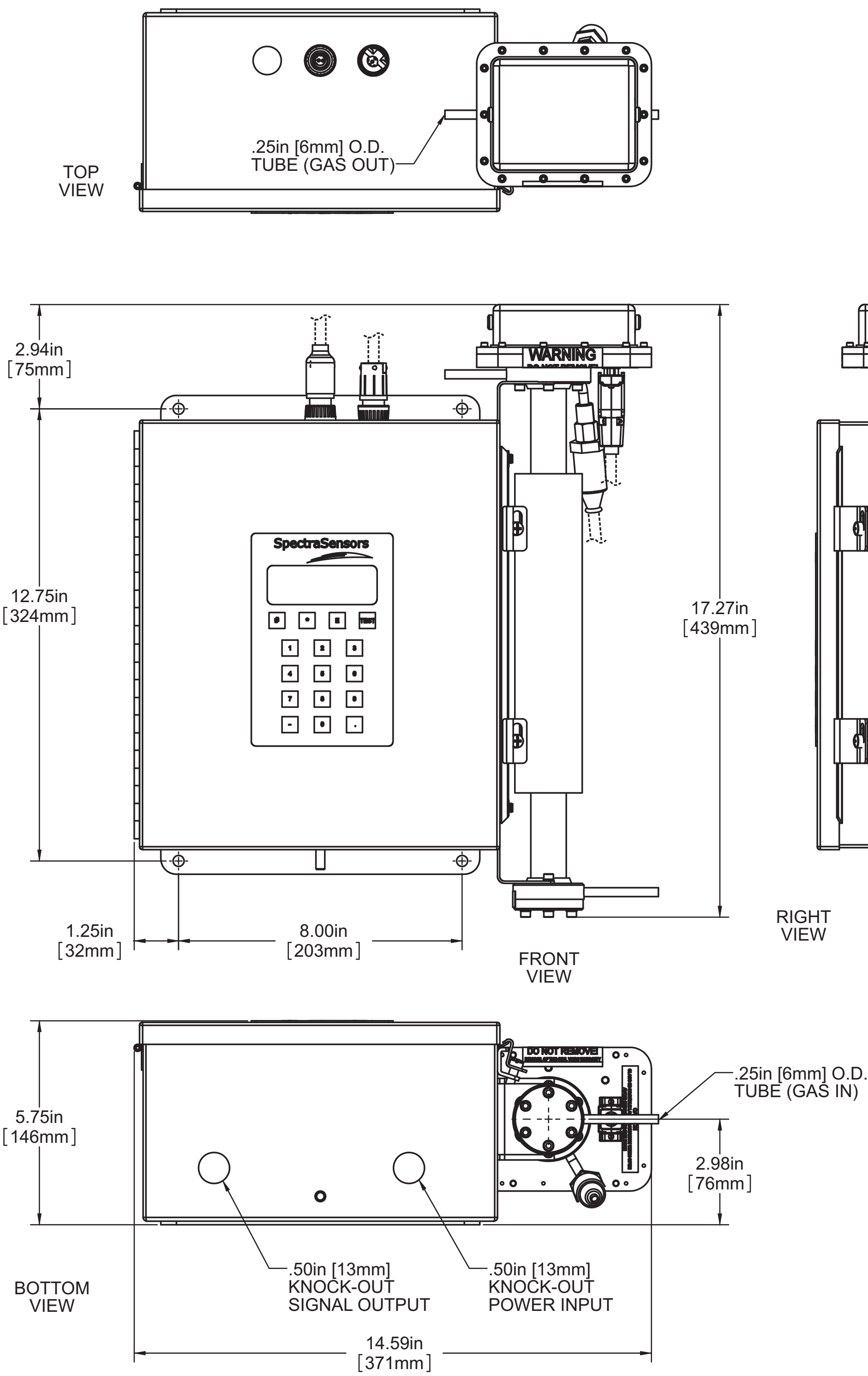


Figure B–1 *SS500/SS2000 0.8-m cell (moisture) outline and mounting dimensions.*

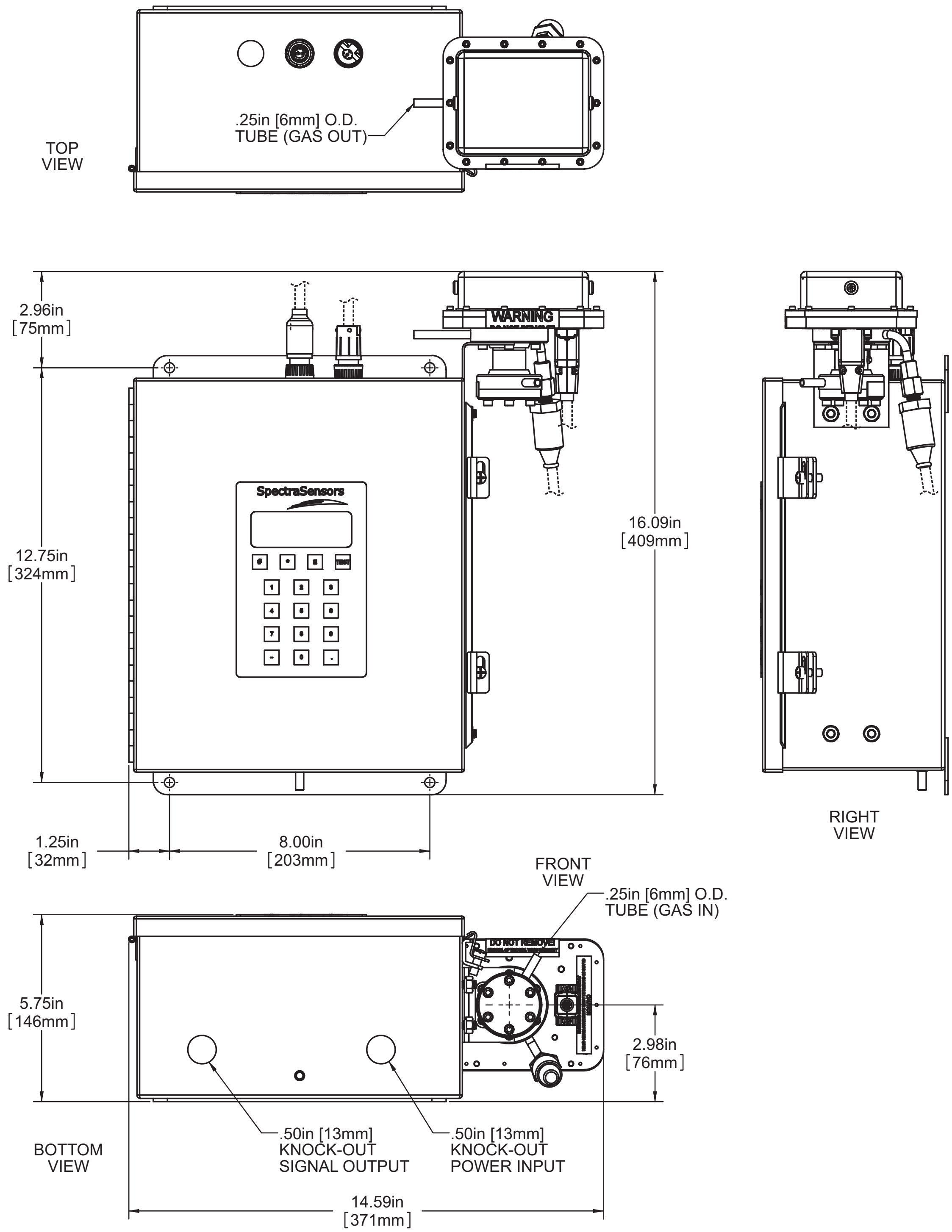


Figure B–2 *SS500/SS2000 0.1-m cell (carbon dioxide) outline and mounting dimensions.*

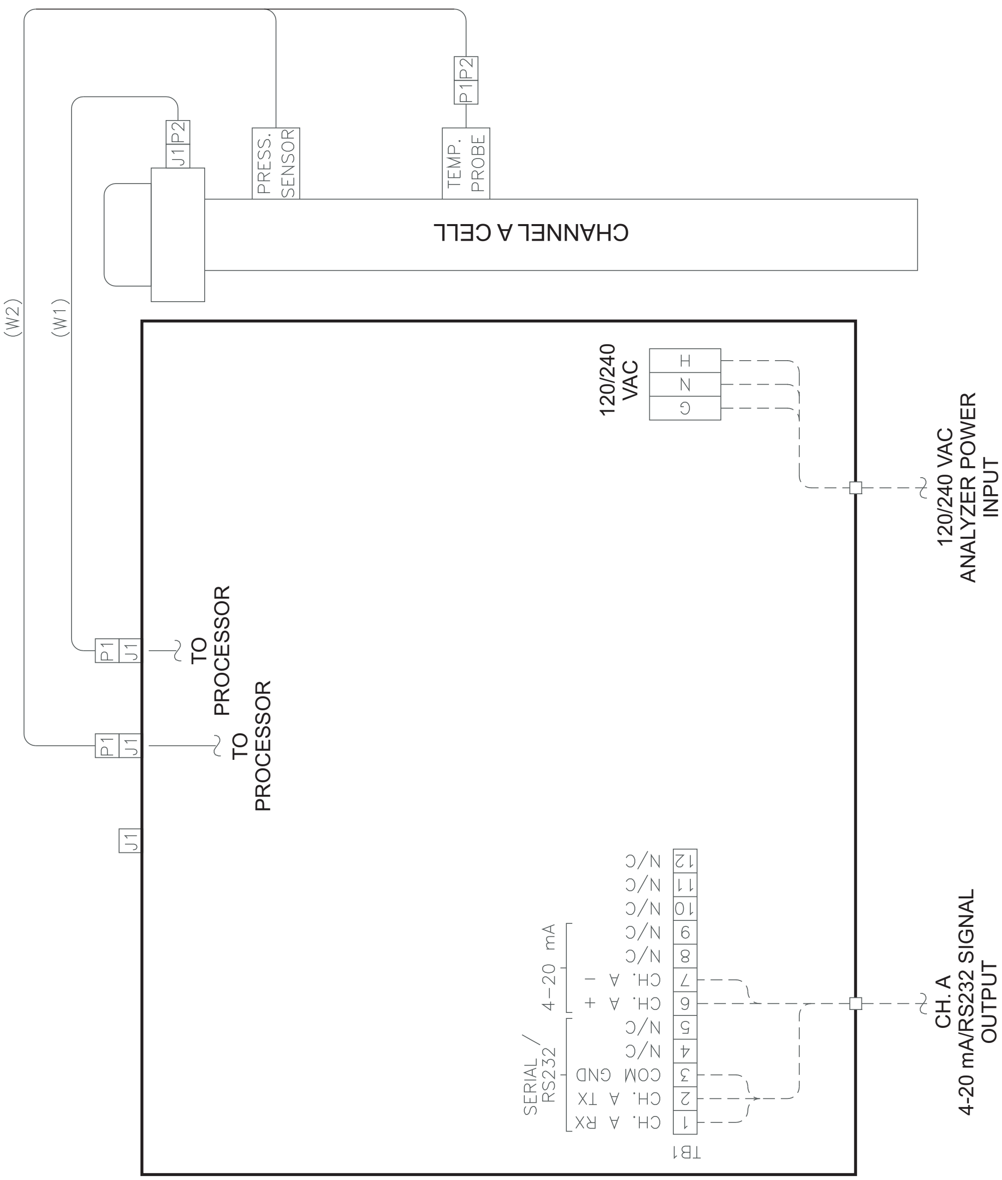


Figure B–3 *Electrical schematic for SS500/SS2000.*

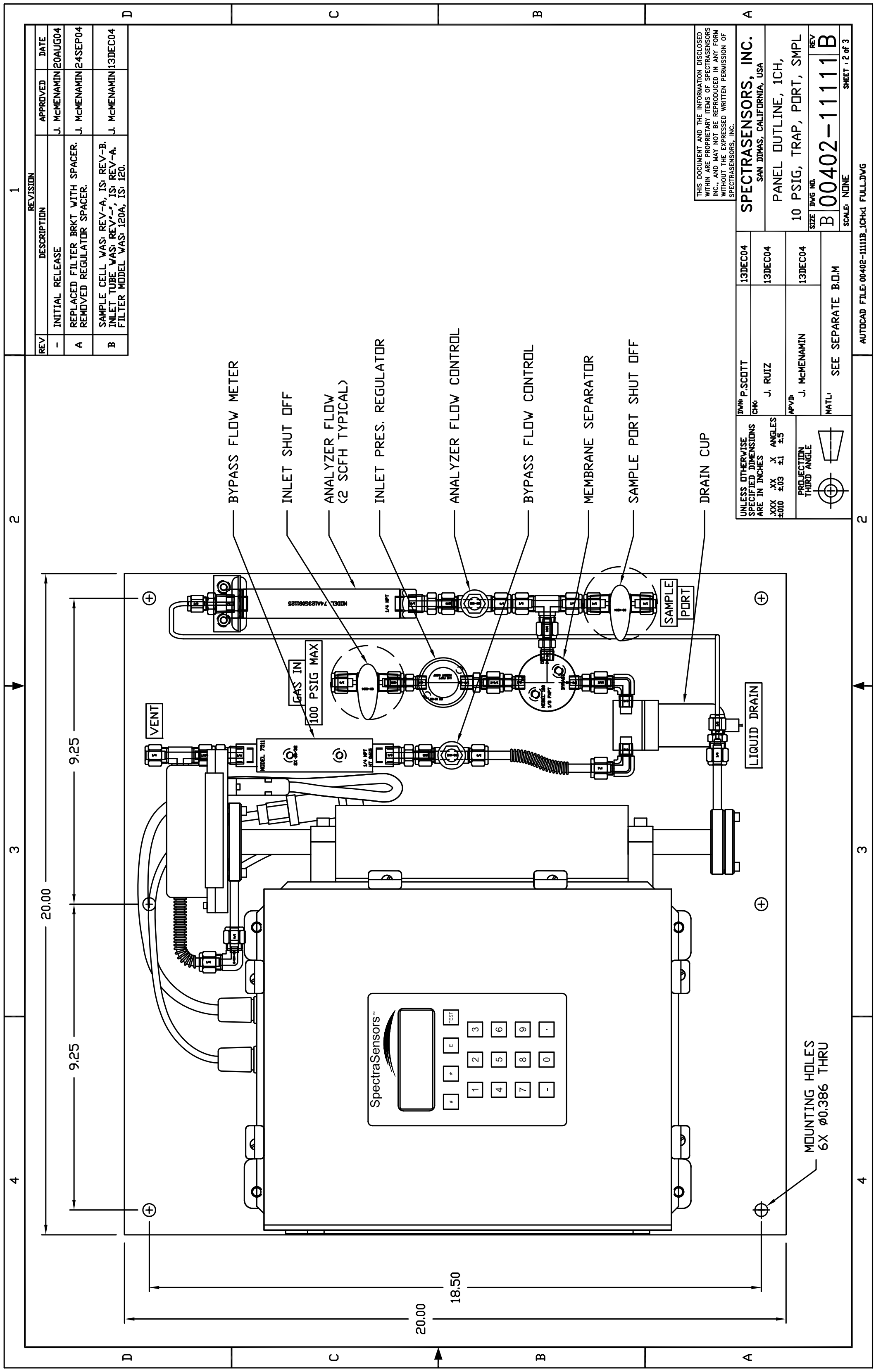


Figure B–4 *Drawing of typical full-featured single-channel SCS (SS500/SS2000).*

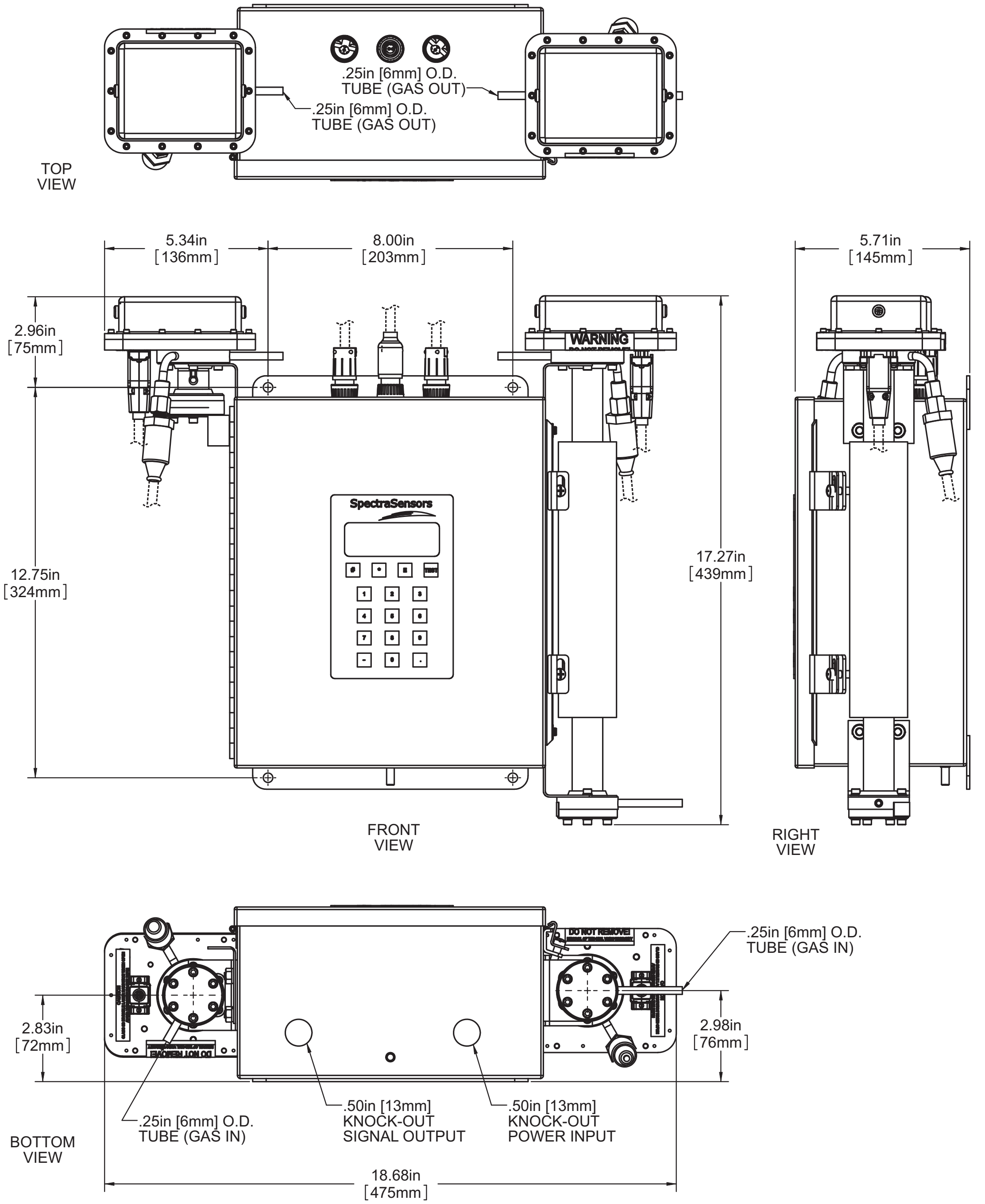


Figure B–5 *SS3000 0.8-m/0.1-m cells (moisture/carbon dioxide) outline and mounting dimensions.*

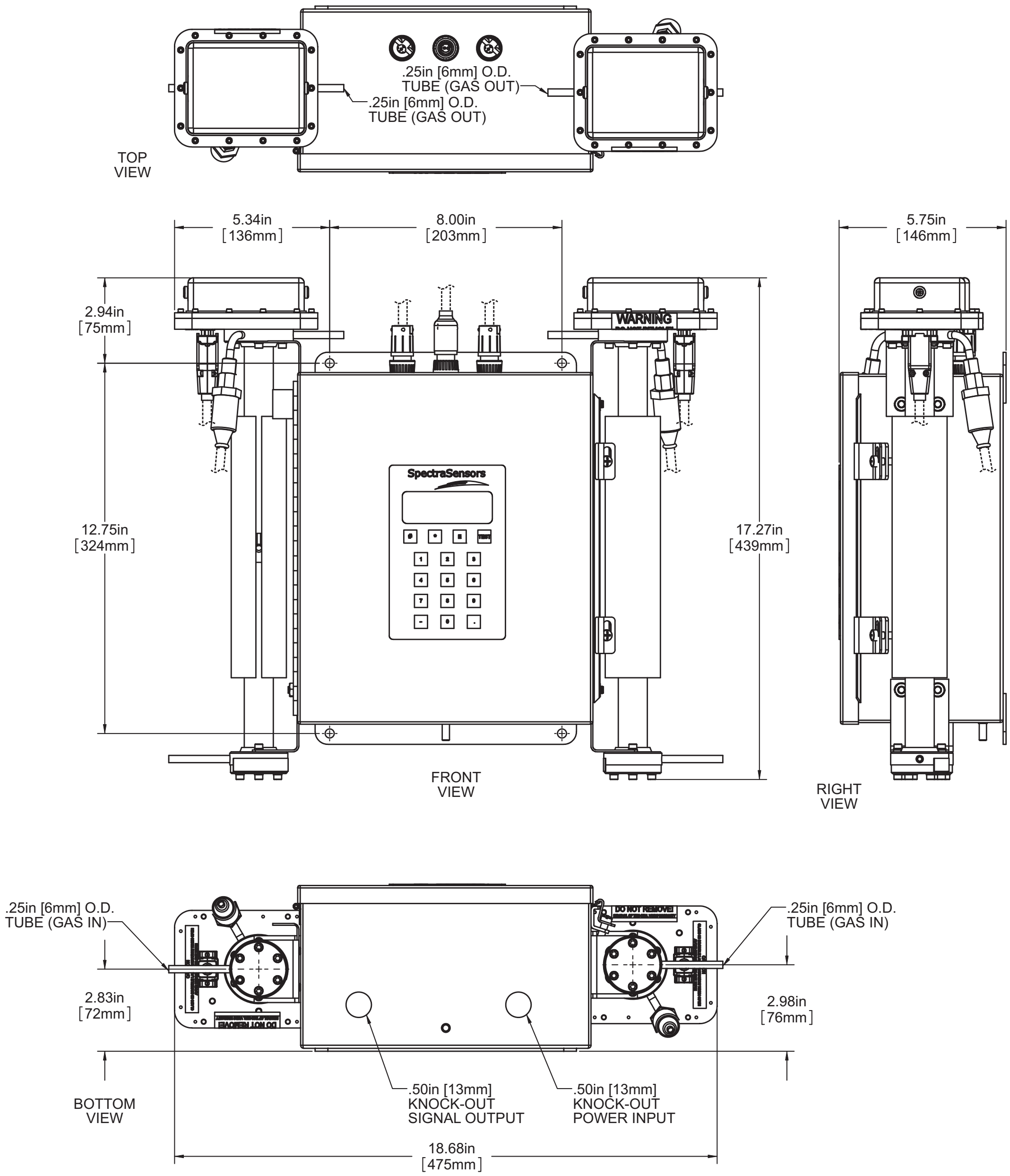


Figure B–6 *SS3000 0.8-m/0.8-m cells (moisture/moisture) outline and mounting dimensions.*

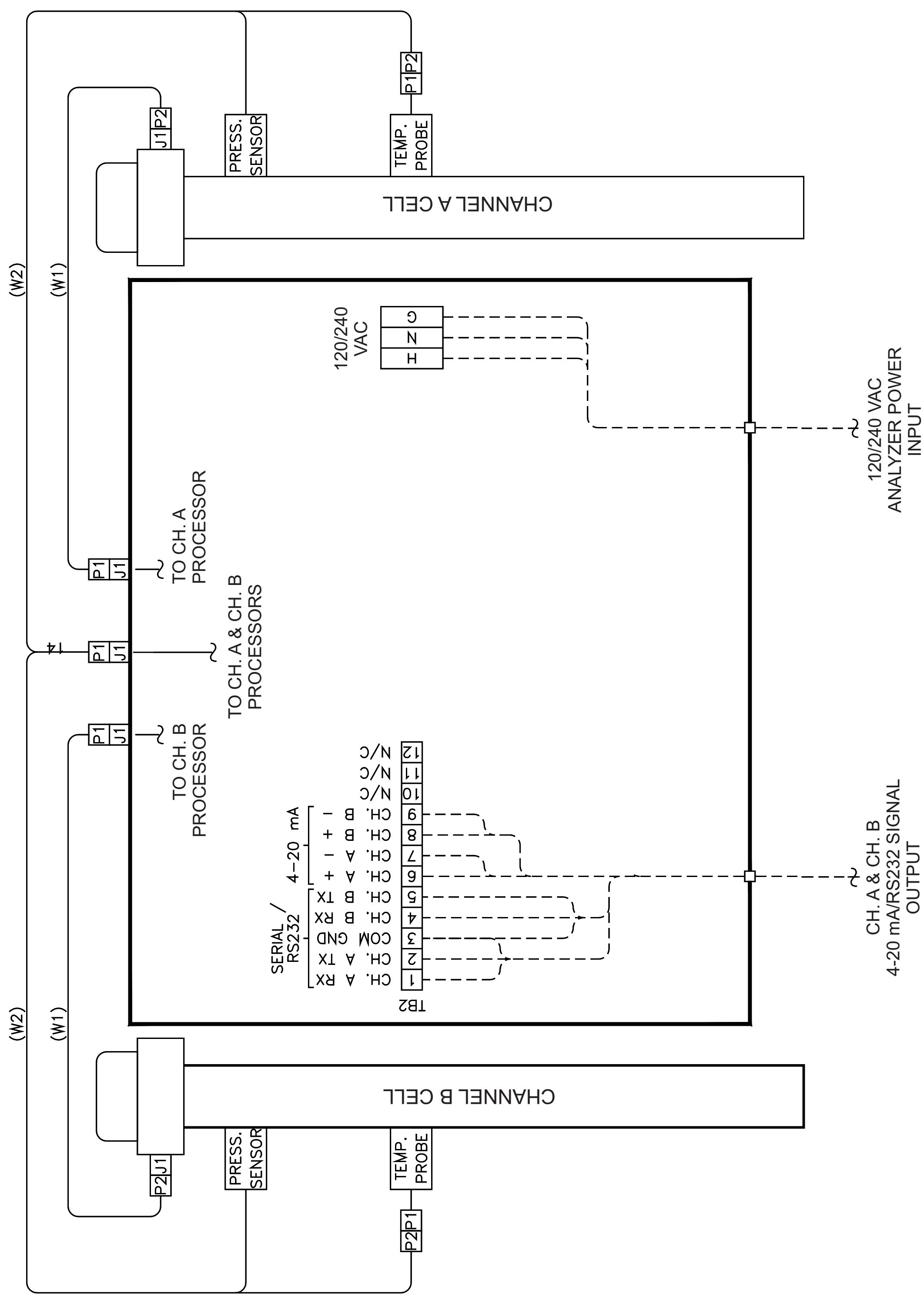


Figure B–7 *Electrical schematic for SS3000.*

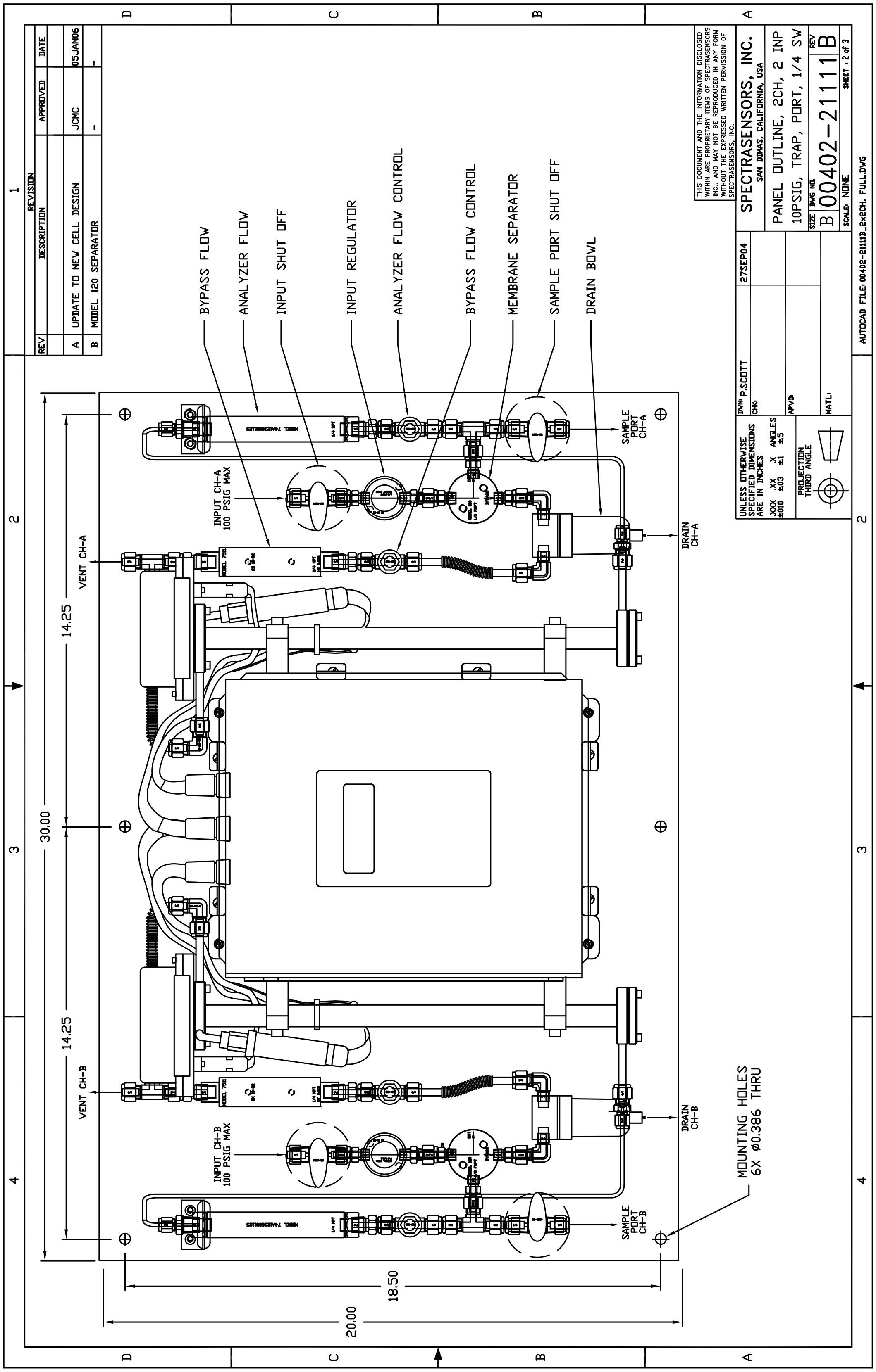


Figure B–8 *Drawing of typical full-featured dual-channel, dual-stream SCS (SS3000).*

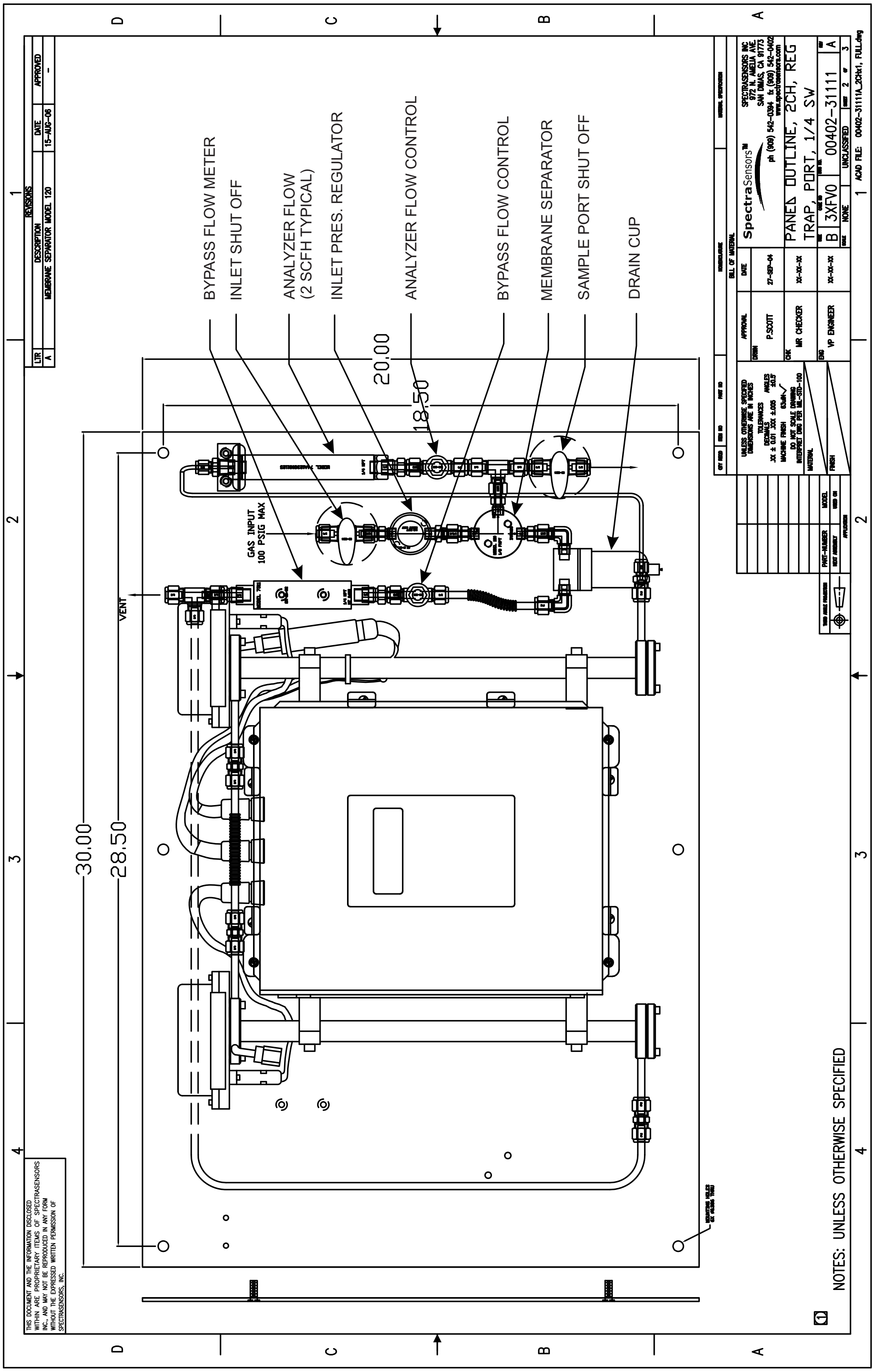


Figure B–9 *Drawing of typical full-featured dual-channel, single-stream SCS (SS3000).*

Table B–4 *SS3000 moisture and carbon dioxide in natural gas analyzer specifications.*

Performance	
Concentration (H_2O)[a]	0.5–20 lbs/MMSCF (10–422 ppmv) 2–20 lbs/MMSCF (42–422 ppmv)
Repeatability	±0.2 lb/MMSCF (±4 ppmv) ±0.5 lb/MMSCF (±10 ppmv)
Concentration (CO_2)[b]	0–10%
Repeatability	±0.2%
Response time[c]	Display updates every second
Application Data	
Environmental Temperature Range	-4 to 122 °F (-20 to 50 °C) Standard 14 to 140 °F (-10 to 60 °C) Optional
Environmental Relative Humidity	80% for temperatures up to 31°C MAX
Altitude	Up to 4000 m
Sample Inlet Pressure	25–30 psig (1.7–2.1 barg)
Cell Operating Pressure	–4.5 to 10 psig (–0.3 to 0.7 barg)
Sample Flow Rate	1–2 CFH (0.5–1.0 LPM)
Contaminant Sensitivity	None for gas phase glycol, methanol, amines, hydrogen sulfides or mercaptans.
Electrical & Communications	
Input Voltages[d]	100–240 VAC, 50/60 Hz 9–16 VDC or 18–32 VDC
Current	1 A @ 120 VAC, 0.5 A @ 240 VAC 1.6 A @ 24 VDC, 3.2 A @ 12 VDC
Outputs	Generic RS232 or Gould/Daniel Modbus 4–20mA Loop (concentration only)
LCD Display	Concentration, cell pressure, cell temperature
Physical Specifications	
Size	457 mm H x 406 mm W x 140 mm D (18" H x 16" W x 5.5" D)
Weight	Approx. 27 lbs (12.3 Kg)
Sample Cell Construction	316L Series Polished Stainless Steel
Area Classification	
Certification	CSA Class I, Division 2, Groups C & D

a. Consult factory for alternative ranges.
b. Consult factory for alternative ranges.
c. Software adjustable.
d. Supply voltage not to exceed ±10% of nominal. Transient over-voltages according to category II.

Spare Parts

Below is a list of spare parts for the H_2O and/or CO_2 in Natural Gas analyzer with recommended quantities for 2 years of operation. Due to a policy of continuous improvement, parts and part numbers may change without notice. Not all parts listed are included on every analyzer. When ordering, please specify the system serial number to ensure that the correct parts are identified.

Table B–5 *Replacement parts for SS500/SS2000/SS3000 H_2O and/or CO_2 in Natural Gas analyzers.*

Part Number	Description	2 YR QTY
	Electronics	
01902-17106	External Serial Cable	-
01902-13000	Temperature Control Board	-
01902-14000	4-20 mA Current Loop Board	-
01902--16500	Power Supply, 120/240 VAC 50/60 Hz, CSA	-
01902-30011	Keypad Assembly	-
01902-31000	Display Assembly	-
01902-17102	Pressure Transducer Assembly	-
	Maintenance	
02199-00001	Spares Kit, (o-rings, fuses), (Domestic U.S.)	1
02199-00005	Spares Kit, (o-rings, fuses), (International)	-
02199-00007	Cleaning Kit (Domestic U.S.)	-
61000-02193	Membrane & O-Ring, Membrane Separator	2
28000-02057	Membrane Separator Cover O-ring, Viton	1
	Sample Conditioning Systems	
61303-042S4	Ball Valve, 1/4” TF (SS)	2
61322-10102	Pressure Regulator, 0-10 PSIG, 1/8 FNPT (SS)”	-
61016-71208	Membrane Separator, 1/4” FNPT (SS)	-
61341-00214	Flowmeter (No Valve), 4.2 SFCH, 1/4” FNPT (SS)	-
61341-00114	Flowmeter (No Valve), 2.6 SFCH, 1/4” FNPT (SS)	-
61305-004MG	Metering Valve, 1/4” TF (SS)	-
61321-25254	Pressure Regulator, 0–25 psig, 1/4” FNPT (SS)	-
61015-10003	Liquid Trap, Aluminum Head, 1/8” FNPT	-

INDEX