BA02186C/66/EN/01.21
70193628
Valid as of version
HC12 v2.51
(Device firmware)

Operating Instruction
SS1000 TDLAS Gas Analyzer

Non-hazardous (certified) locations
General Purpose

Endress+Hauser
People for Process Automation

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1 - Introduction

Endress+Hauser's SS1000 product is a high-speed, diode-laser based extractive analyzer designed for extremely reliable monitoring of very low (trace) to standard concentrations of specific components in various background gases. In order to ensure that the analyzer performs as specified, it is important to closely review the installation and operation sections of this manual.

To operate the analyzer through firmware programming, please consult the Description of Device Parameters for instruction.

Who Should Read This Manual

This manual should be read and referenced by anyone installing, operating or having direct contact with the analyzer.

How to Use This Manual

Take a moment to familiarize yourself with this manual by reading the **Table of Contents**.

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

Standard Documentation

All documentation is available on the Endress+Hauser's website: www.endress.com.

This document is an integral part of the complete document package, which also includes:

Part Number	Document Type	Description
TI01643C	Technical Information	**Planning aid for your device.** The document contains all the technical data on the analyzer.
GP01181C	Description of Device Parameters	Provides the user with an overview of the HC12 v2.51 firmware functionality.

General Warnings and Cautions

Instructional icons are provided in this manual and various safety labels are adhered to the analyzer to alert the user of potential hazards, important information and valuable tips. Following are the symbols and associated warning and caution labels to observe when servicing the analyzer. Some of these symbols are provided for instructional purposes only and are not labeled on the system.

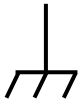
Equipment labels

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

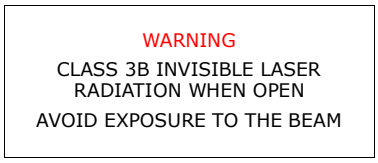
Failure to follow all directions may result in damage or malfunction of the analyzer.

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

***PROTECTIVE EARTH GROUND** - Symbol indicates the connection point of the ground wire from the main power source.*



***FUNCTIONAL EARTH GROUND** - Symbol indicates grounding points intended primarily for troubleshooting.*



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

Removing label from measurement cell optical head will void analyzer warranty.

Instructional symbols

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

Failure to follow all directions may result in fire.

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

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

Maximum voltage and current specifications for fuses.

Conventions Used in this Manual

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

About the Gas Analyzers

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

How the Analyzers Work

The SS1000 employs SpectraSensors' 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 opposite end, through which the laser beam can pass. Refer to Figure 1-1. The laser beam enters the cell and reflects off the mirror(s) making one or more trips through the sample gas and eventually exiting the cell where the remaining beam intensity is measured by a detector. With the SS1000, sample gas flows continuously through the sample cell ensuring that the sample is always representative of the flow in the main pipe.

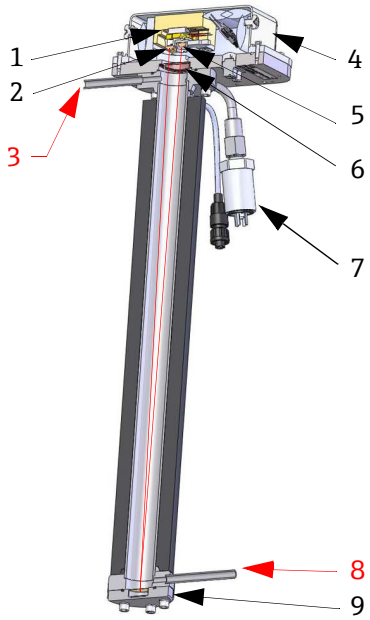


Figure 1–1 *Schematic of a typical laser diode absorption spectrometer (0.8 m measurement cell)*

1	*TEC*	*5*	*Detector*
2	*Laser*	*6*	*Window*
3	*Inlet*	*7*	*Pressure sensor*
4	*Optical head*	*8*	*Outlet*
		9	*Far mirror*

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

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

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

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

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

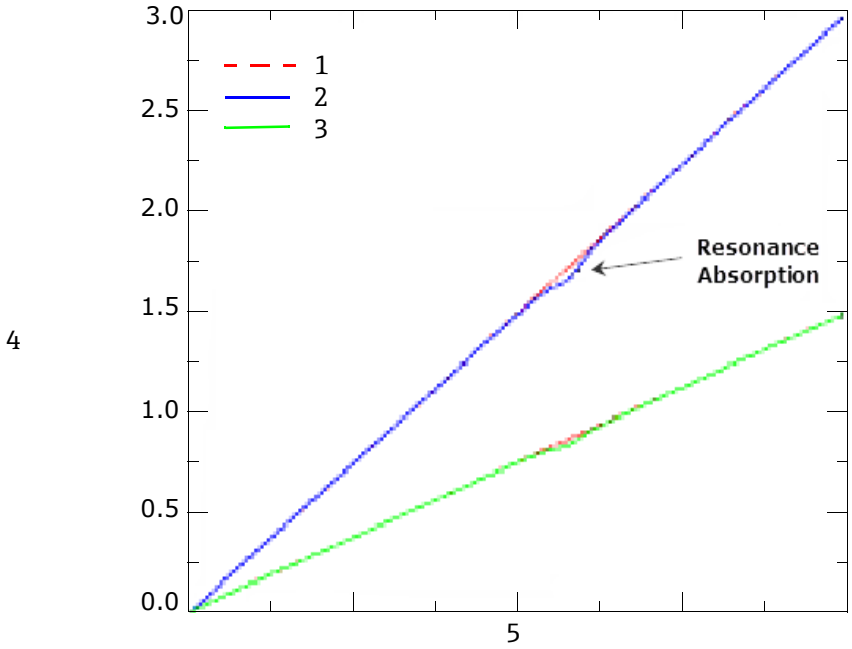


Figure 1–2 *Typical raw signal from a laser diode absorption spectrometer with and without mirror contamination*

1 *Incident energy, $I_0(\lambda)$*
2 *Raw signal, $I(\lambda)$*
3 *Raw signal, $I(\lambda)$ (contaminated mirrors)*
4 *Signal (a.u.)*
5 *Wavelength (a.u.)*

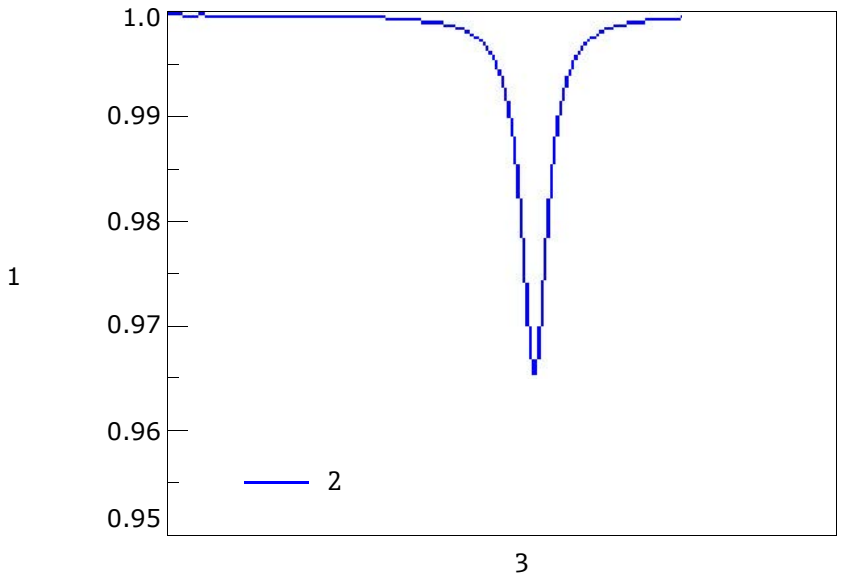


Figure 1–3 *Typical normalized absorption signal from a laser diode absorption spectrometer*

1 Signal (a.u.)
2 Normalized absorption signal
3 Wavelength (a.u.)

Wavelength Modulation Spectroscopy (WMS) signal detection

Endress+Hauser 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 ($2f$). Refer to Figure 1–4 on page 1–8. This phase-sensitive detection enables the filtering of low-frequency noise caused by turbulence in the sample gas, temperature and/or pressure fluctuations, low-frequency noise in the laser beam or thermal noise in the detector.

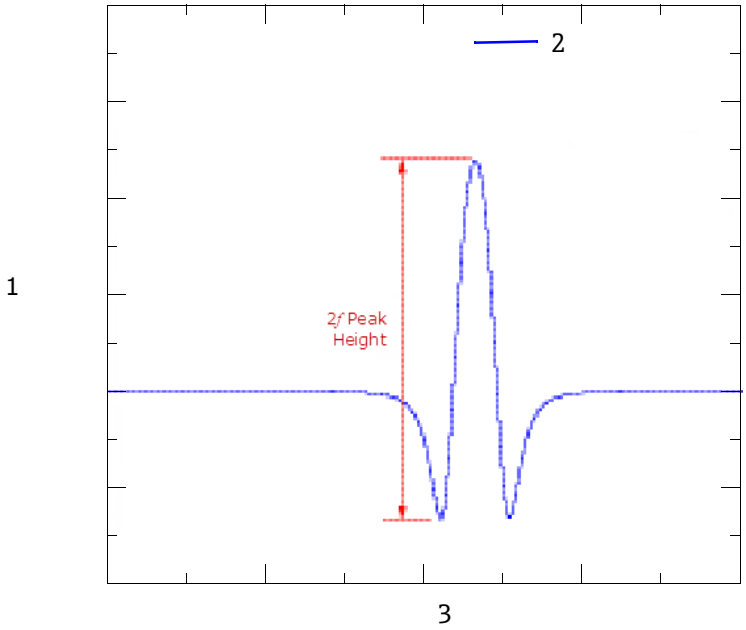


Figure 1–4 *Typical normalized 2f; species concentration is proportional to peak height*

1 Signal (a.u.)
2 Normalized absorption signal
3 Wavelength (a.u.)

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).

Measuring different trace gases in various mixed hydrocarbon background streams is accomplished by selecting a different optimum diode laser wavelength between 700-3000 nm, which provides the least amount of sensitivity to background stream variations.

Getting to Know the Analyzer

The SS1000 analyzer is used to verify H_2O measurements and for spot-checking when other methods provide questionable results. The analyzer is contained in a single light-weight portable enclosure for ease of handling. An overview of the analyzer hardware is shown in Figure 1–5 on page 1–9.

On the top of the analyzer are the LCD/keypad, which serves as the user interface to the analyzer control electronics. The analyzer control electronics drive the laser, collect the signal, analyze the spectra and provide measurement output signals.

Housed inside the metal cover enclosure is the measurement cell. The sample supply and return are connected through the side and top of the analyzer. Refer to Figure 1-5 below.

Power is provided by an internal battery, which may be recharged using the included battery charger. Battery life is approximately 12 hours. Refer to Figure A–4 on page A–5 for the electrical schematic drawing.

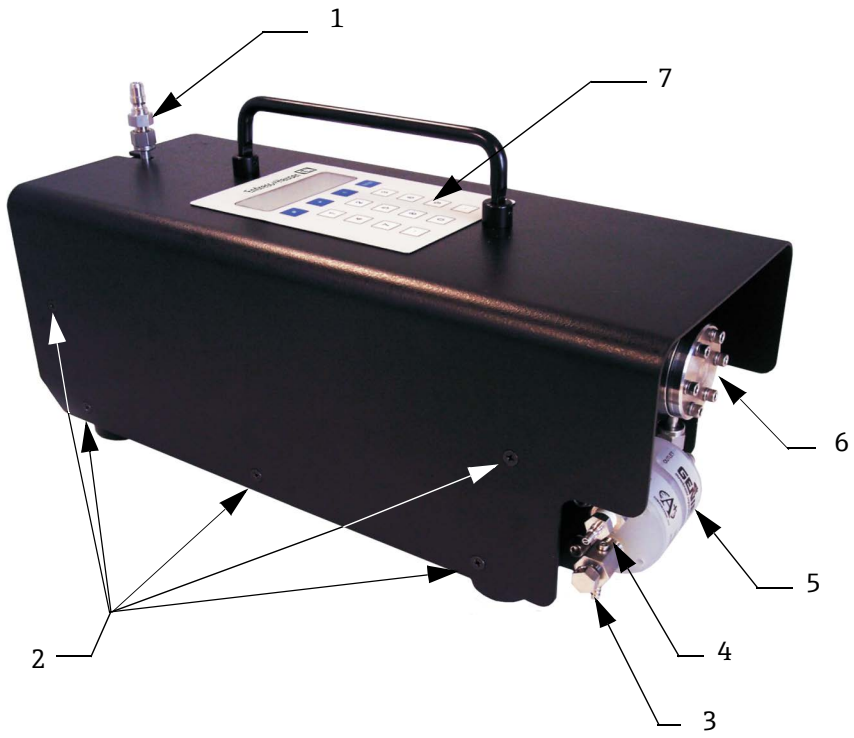


Figure 1–5 *SS1000 analyzer hardware*

1 *Sample return*
2 *Cover screws*
3 *Liquid drain and bypass valve*
4 *Sample supply port (10 PSIG maximum)*
5 *Membrane separator filter*
6 *Sample cell with mirror assembly*
7 *LCD (Display) and keypad*

Lifting/carrying the analyzer

Lift the analyzer by the handle at the top of the unit. Never lift the analyzer by the ends as the measurement cell is exposed and handling could impair the cell alignment. Refer to Figure 1–5.

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2 - SAFETY

Potential Risks Affecting Personnel

This section addresses the appropriate actions to undertake when faced with hazardous situations during or before service of the analyzer. It is not possible to list all potential hazards within this document. The user is responsible for identifying and mitigating any potential hazards present when servicing the analyzer.

Technicians are expected to follow all safety protocols established by the customer that are necessary for servicing the analyzer. This may include, but is not limited to, lockout/tagout procedures, toxic gas monitoring protocols, personal protective equipment (PPE) requirements, hot work permits and other precautions that address safety concerns related to performing service on process equipment located in hazardous areas.

Mitigating risks

Refer to the instructions for each situation listed below to mitigate associated risks.

Exposure to process gases

1. Shut off the process gas to the analyzer before any service that would require opening a part of the sample plumbing.
2. Purge the system with nitrogen.
3. Shut off the nitrogen purge before removing cover.

Follow all safety protocols governing toxic gases and potential leaks.

Electrocution hazard

1. Shut off power at the main disconnect external to the analyzer.

Complete this action before performing any service that requires working near the main input power or disconnecting any wiring or other electrical components.

2. Remove analyzer cover.

If service must be performed with power engaged (gain adjustment, etc.):

1. Note any live electrical components and avoid any contact with them.
2. Only use tools with a safety rating for protection against accidental contact with voltage up to 1000 V (IEC 900, ASTF-F1505-04, VDE 0682/201).

Explosion hazard

Any work in a hazardous area must be carefully controlled to avoid creating any possible ignition sources (e.g., heat, arcing, sparking, etc.). All tools must be appropriate for the area and hazards present. Electrical connections must not be made or broken with power on (to avoid arcing).

3 - Installation

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

What Should be Included in the Shipping Box

The contents of the box should include:

- SS1000 analyzer
- Pelican carrying case
- 100 to 240 VAC, 50/60 Hz battery charger
- Quick-connect fittings for inlet and outlet tubes
- One external serial cable to connect the analyzer to a computer
- Additional accessories or options as ordered

If any of these contents are missing, refer to **"Service"** on page B-13.

Inspecting the Analyzer

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

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

Hardware and Tools for Installation

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

Hardware

- Heated pressure regulator (if inlet pressure is >10 PSIG or no probe regulator exists)
- Stainless steel tubing or flexible stainless steel tubing (Endress+Hauser recommends using 1/4 in. O.D. x 0.035 in. wall thickness, seamless stainless steel tubing)

Tools

- 7/16 in. open-end wrench
- 9/16 in. open-end wrench

Setting up the Analyzer

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

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

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

Connecting the Gas Lines

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

In order to capture a representative sample of gas, the sample must be captured from the pipeline using a probe equipped with a standard or heated field pressure reducing regulator. For more information, refer to the American Petroleum Institute's "Manual of Petroleum Measurement Standards," Chapter 14, Section 1 - Natural Gas Samples for Custody Transfer.

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

To connect the sample supply line

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

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

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

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

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

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

To connect the sample return

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

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

2. Determine appropriate tubing route from the analyzer to the low pressure flare or atmospheric vent header.
3. Run stainless steel tubing from the sample return port to the low pressure flare or atmospheric vent header connection. Bend tubing using industrial grade benders, check tubing fit to ensure proper seating between the tubing and fittings. Fully ream all tubing ends. Blow out the lines for 10 to 15 seconds with clean, dry nitrogen or air prior to making the connection.
4. Connect the sample return tube to the analyzer using the 1/4 in. stainless steel compression-type quick connect fitting provided.
5. Tighten all new fittings 1 and 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. A liquid leak detector is recommended.

Conditioning the Tubing

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

Connecting Electrical Power to the Analyzer

The analyzer comes equipped with a fully charged internal battery. Battery life is approximately 12 hours under normal operating conditions. A 100 to 240 VAC, 50/60 Hz battery charger is supplied with the analyzer. To recharge the battery, plug the charger cable into the jack on the back of the analyzer under the serial port. Refer to the external features as shown in Figure A–1 on page A–2.

Connecting the Output Signals

The serial output is supplied from the serial port located on the back of the analyzer below the on/off switch. Refer to the external features as shown in Figure A–1 on page A–2. The analyzer can be connected to a serial port on a computer with the factory-supplied external serial cable. If the receiving computer has only a USB port available, a USB-to-serial adapter can be used. Refer to the spare parts list, Table A–2 on page A–6, for recommended parts.

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Appendix A - Specifications

Table A–1 *SS1000 H_2O in natural gas analyzer specifications*

Performance		
Concentration [1]	**Medium Precision** 40 to 422 ppmv, 40 to 1055 ppmv, 40 to 2110 ppmv (2 to 20 lbs., 2-50 lbs., 2 to 100 lbs/MMscf)	**High Precision** 0 to 422 ppmv, 0 to 1055 ppmv, 0 to 2110 ppmv (0.5 to 20 lbs., 0.5 to 50 lbs., 0.5 to 100 lbs/MMscf)
Repeatability	±10 ppmv or ±2% of reading	±4 ppmv or ±2% of reading
Response time[2]	0.25 to 2 seconds	
Application Data		
Environmental Temperature Range	-20 °C to 50 °C (-4 °F to 122 °F)	
Altitude	Up to 4000 m (13,123.36 feet)	
Sample Cell Pressure Range	700 to 1400 mbara	
Sample Flow Rate	0.1 to 10 L/min (0.2 to 21 scfh)	
Contaminant Sensitivity	None for gas phase glycol, methanol, amines, hydrogen sulfides or mercaptans.	
Electrical & Communications		
Power Supply	100 to 240 VAC, 50 to 60 Hz - *Standard* 12 Volt, sealed lead-acid battery Approximately 8 hours usage time per charge	
Maximum Current	0.5 A at 120 VAC during recharging	
Controller to Cell Cable Length	1 m (3.2 feet) - *Standard* 3 m, 5 m, 10 m (9.6, 16, 32 feet) - *Optional*	
Communication	RS-232 - all parameters	
LCD Display	Concentration, cell pressure, cell temperature	
Physical Specifications		
Dimensions	200 mm H x 175 mm W x 450 mm D (8 in. x 7 in. x 18 in.)	
Weight	Approximately 6.8 Kg (15 lbs)	
Sample Cell Construction	316L Series Polished Stainless Steel - *Standard*	
Area Classification		
Certification	Non-hazardous (certified) locations - General Purpose	

1. Refer to **"Service"** on page B-13 for alternative ranges.
2. Software adjustable.

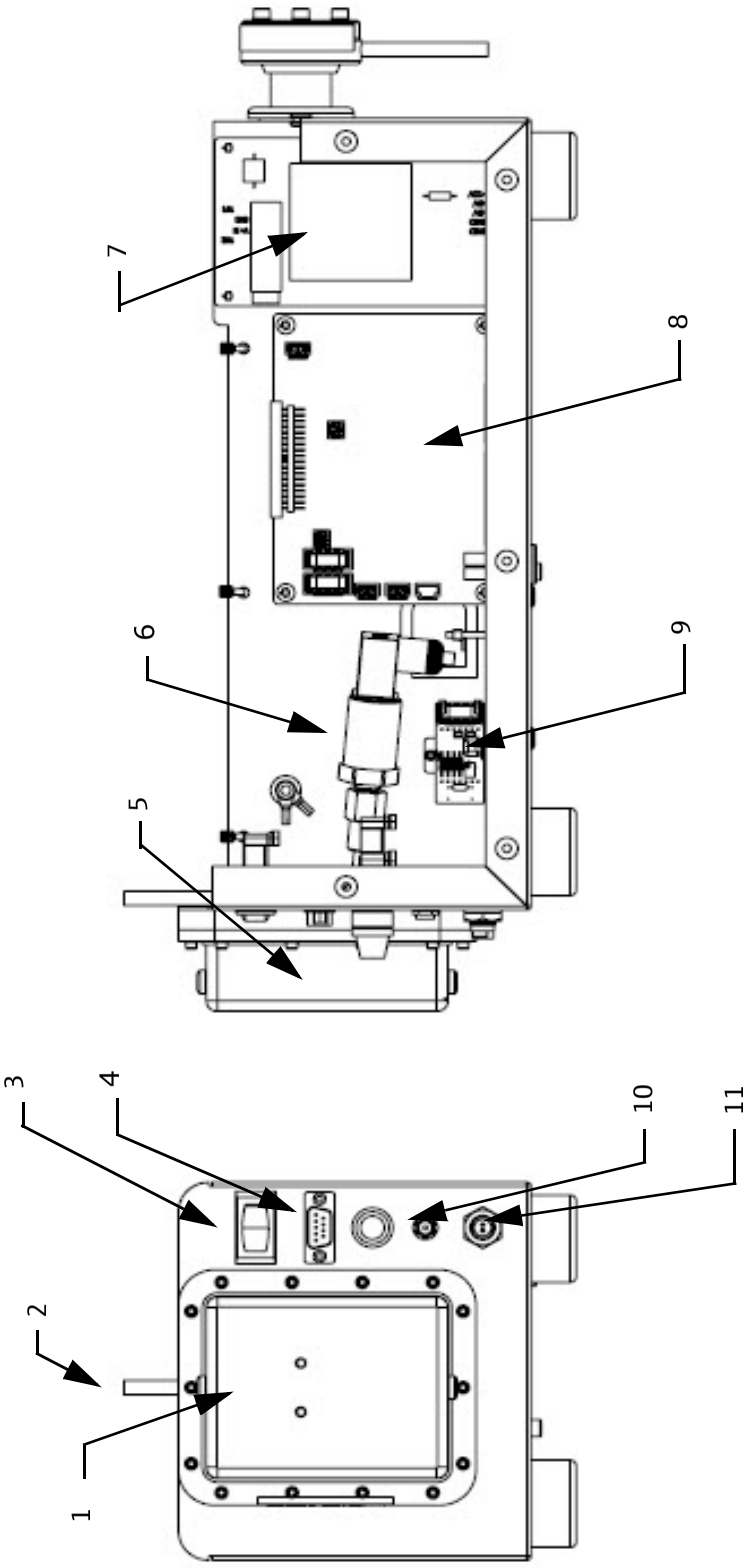

Figure A–1 *SS1000 analyzer side view; interior side view*

1 *Optical head*
2 *Sample return*
3 *Power switch (ON/OFF)*
4 *RS-232 data port*
5 *Optical head*
6 *Pressure transducer*
7 *Power supply (see Fig. A-3)*
8 *Main HC12 processing board*
9 *Hytek temperature controller*
10 *Battery charger input*
11 *Plug (4-20 mA option)*

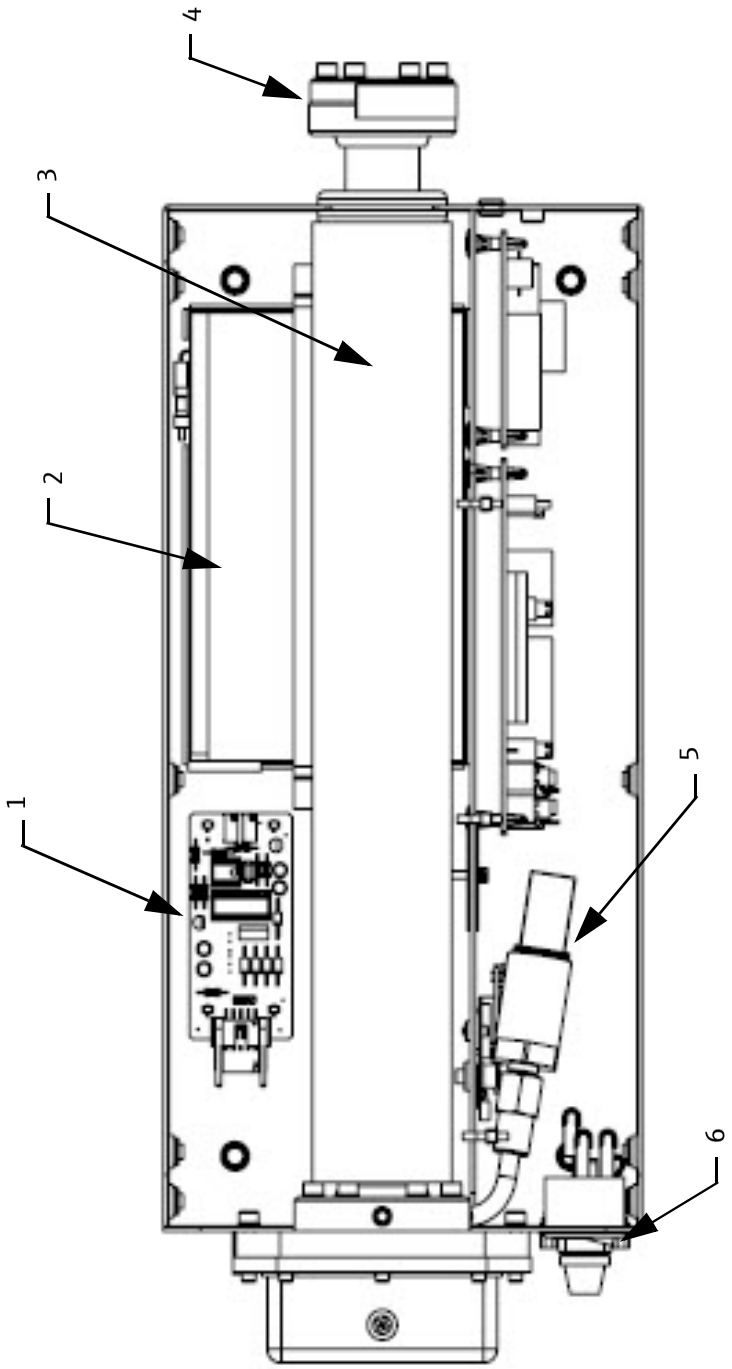

Figure A–2 *SS1000 analyzer - overhead view; cover removed*

1 4-20 mA Output board (option)
2 Battery
3 Measurement cell
4 Mirror
5 Pressure sensor
6 Fuse (F1)

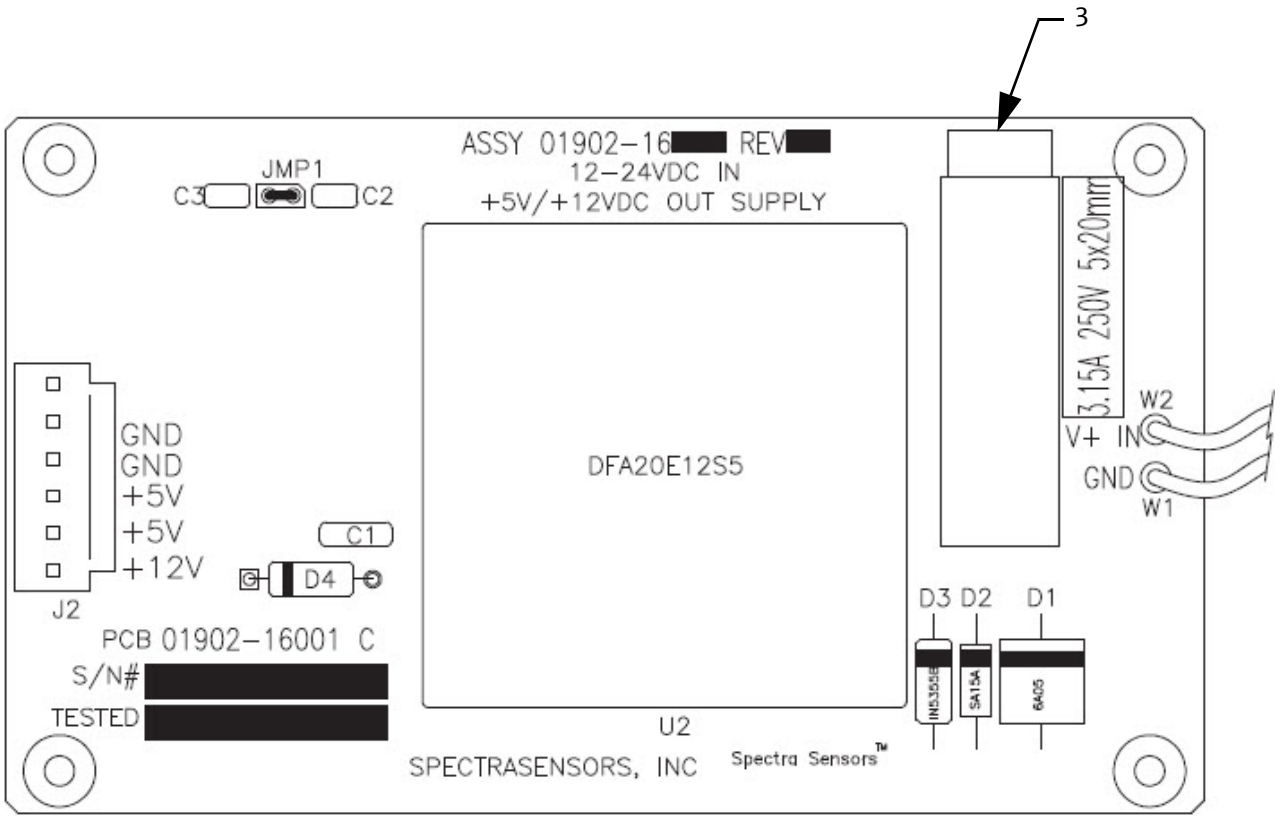

Figure A–3 *SS1000 analyzer DC board / F2 fuse location*

1 Fuse (F2)

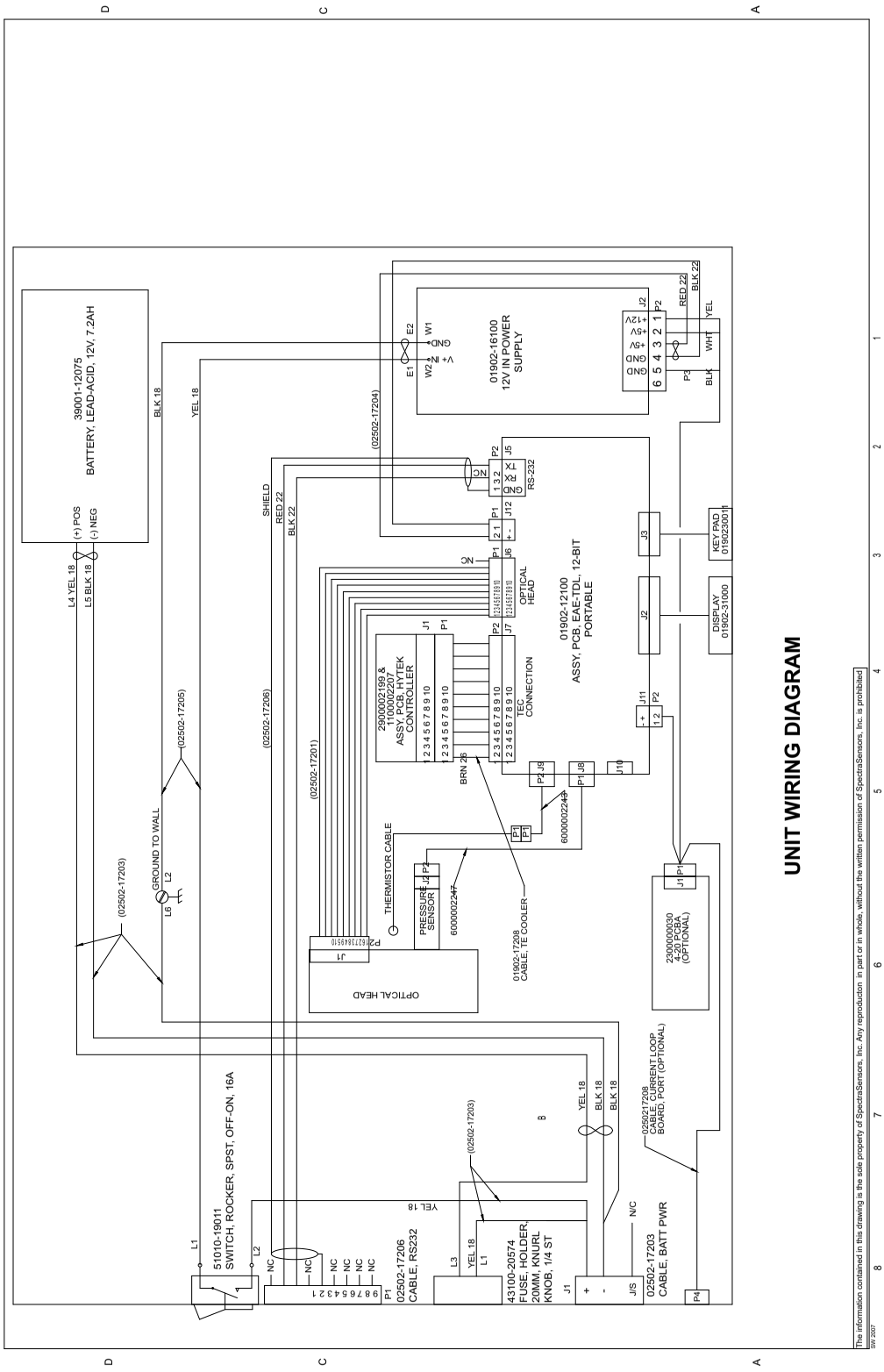

Figure A–4 *SS1000 analyzer electrical wiring diagram*

Spare Parts

Below is a list of spare parts for your customized analyzer with recommended quantities for 2 years of operation. Due to a policy of continuous improvement, parts and part numbers may change without notice.

When ordering, please specify the system serial number (SN) to ensure that the correct parts are identified.

Table A–2 *Spare parts for SS1000 analyzer*

Part Number	Description	2 Year Quantity
Analyzer		
0040390001	Quick-connect Flow Meter	-
0190216100	Power Supply, 12 VDC [1]	-
0190231000	Display Assembly [1]	-
0219900005	Kit, O-rings, Viton, 2 Pass Cell [1]	1
0219900015	Kit, Fuse, SS1000 Portable [1]	1
0250200200	Pelican Case with Custom Foam	-
0250201000	Membrane Filter Assembly with Genie 101-005-pp [1]	-
0250202000	Upgrade Kit, 4-20 mA Output Board, SS1000 [1]	-
0250230000	Cover Assembly, Includes Keypad and Display [1]	-
0900002146	Stainless Steel Mirror (0.8 m Cell)	-
3900112075	Battery, Lead Acid, 12 V, 7.2 Ah Digi-Key BP7.5-12-T2-ND [1]	-
3990112012	Charger, 12 V, 1.2 A, 120 VAC	-
6100320040	Quick-connect Fitting 1/4 in. Swagelok SS-QF4-B-400	-
6100328020	Quick-connect Fitting 1/8 in. Swagelok SS-QM2-B-200MB	-
Pressure Sensor		
5500002041	Pressure sensor, 30 PSIA, 5 V, 1/8 in. MNPT DIN4365 NACE	1
6000002247	Cable, Pressure Sensor, 5.5 feet	1
General		
0219900007	Kit, Cleaning Tools, Optical Cell (USA/Canada only)	1
1100000001	General Purpose Data Logger (4-20 mA Input, USB Output) Lascar P/N EL-USB-4	-

1. Contact Service before attempting replacement. Replacing this component without technical support could cause damage to other components. For Technical Service, refer to our website for the list of local sales channels in your area https://www.endress.com/contact.

Table A-2 *Spare parts for SS1000 analyzer (Continued)*

Part Number	Description	2 Year Quantity
General (Continued)		
BA02186C	SS1000 TDLAS Gas Analyzer Operating Instruction, additional copies	-
GP01181C	Description of Device Parameters HC12, additional copies	-
Cables		
0190217106	RS-232 Serial Data Cable	-
0190217208	Cable, TE Cooler	-
0250217201	Cable, Optical Head	-
0250217203	Cable, Battery Power	-
0250217204	Cable, Power Supply	-
0250217208	Cable, Current Loop Board	-
6000000111	Power Cord for Charger	1

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Appendix B - Maintenance and Troubleshooting

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

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

This section presents recommendations and solutions to common hardware 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, refer to **"Service"** on page B-13.

Troubleshooting resolutions in this chapter are confined to hardware operational issues only. For firmware related issues, refer to **"Standard Documentation"** on page 1-1 for the Description of Device Parameters.

Removing the Cover

If necessary, the analyzer cover can be removed by first unscrewing the ten cover screws (see Figure 1–5 on page 1–9). Gently lift the cover off the system, taking care not to damage the display and keypad cables.

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

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

Gas Leaks

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

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

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

Endress+Hauser recommends periodically leak-testing the supply lines, especially if the analyzer has been relocated or has been replaced or returned to the factory for service after which 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** fault will result.
2. If mirror contamination is suspected, see **"Mirror Cleaning or Replacement"** on page B-3.
3. Turn off the sample valve at the tap in accordance with site lock-out, tag-out rules.
4. Disconnect the gas sampling line from the supply port of the analyzer.
5. Wash the sampling line with isopropyl 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. Using a liquid leak detector is recommended.

Mirror Cleaning or Replacement

If contamination makes its way into the cell and accumulates on the internal optics, a **Power Fail** alarm will result. If mirror contamination is suspected, please consult with **"Service"** on page B-13 before attempting to clean the mirrors. If advised to do so, use the following procedure.

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

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

Tools and supplies:

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

Determining the type of cell mirror

Measurement cells will come equipped with either a glass or stainless steel mirror. The stainless steel mirrors have been identified with an "X" engraved on the external side of the mirror. Glass mirrors can be used on any size cell. To determine the type of mirror being used for the system cell:

1. Feel at the bottom of the cell for the engraved "X" marking. Refer to Figure B–1 below.

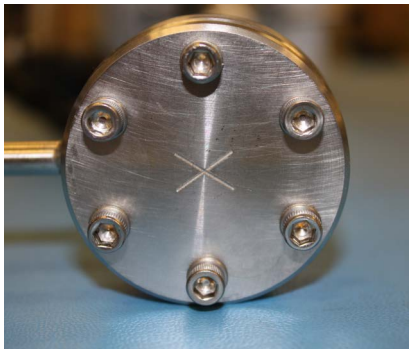

Figure B–1 *Stainless steel mirror marking*

2. If the bottom surface is smooth, a glass mirror is being used.
3. If the bottom surface is rough, or an engraving is detected, a stainless steel mirror is being used.

Do not attempt to replace a glass mirror with a stainless steel mirror or system calibration may be adversely affected.

To clean the mirror, refer to the instructions **"To clean the mirror"**. To replace a stainless steel mirror, refer to the instructions for **"To replace the stainless steel mirror"** on page B-6.

To clean the mirror

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

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

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

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

3. Gently remove the mirror assembly from the cell by removing the six socket head cap screws and set on a clean, stable and flat surface.

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

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

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

Endress+Hauser does not recommend cleaning the top mirror. If the top mirror is visibly contaminated, contact ***"Service"*** *on page B-13.*

5. Remove dust and other large particles of debris using a bulb blower or dry compressed air/nitrogen. Pressurized gas duster products are not recommended as the propellant may deposit liquid droplets onto the optic surface.
6. Put on clean acetone-impenetrable gloves.
7. Double fold a clean sheet of lens cleaning cloth and clamp near and along the fold with the hemostats or fingers to form a "brush."
8. Place a few drops of isopropyl alcohol onto the mirror and rotate the mirror to spread the liquid evenly across the mirror surface.
9. With gentle, uniform pressure, wipe the mirror from one edge to the other with the cleaning cloth only once and only in one direction to remove the contamination. Discard the cloth.

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

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

To replace the stainless steel mirror

Your system may be configured with a stainless steel mirror in the 0.8 m measurement cell. Use the following instructions to replace the mirror, if necessary.

If stainless steel mirror is replacing another version of mirror in the field, such as glass, the analyzer may need to be returned to the factory for re-calibration to ensure optimal cell function. Refer to ***"Service repair order (SRO)"*** *on page B-13.*

1. Power down the analyzer by pressing the power rocker switch to 'OFF'.
2. Isolate the analyzer from the sample bypass flow by shutting off the appropriate valve(s) and/or pressure regulator.

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

3. If possible, purge the measurement cell with nitrogen for 10 minutes.

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.

4. Gently remove the mirror assembly from the cell by removing the socket head cap screws and set on a clean, stable and flat surface.

The sample cell assembly contains a low-power, 10 mW MAX, CW Class 3b invisible laser with a wavelength between 750 to 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 optical surfaces of the mirror.

5. Confirm need to replace mirror due to contamination. If yes, set mirror aside.
6. Put on clean acetone-impenetrable gloves.
7. Obtain the new stainless steel mirror. Refer to Figure B–2.

Figure B–2 *Stainless steel mirror; mirror side up*

8. Check the O-ring.
   a. If a new O-ring is needed, apply grease on fingertips and then to the new O-ring.
   b. Place newly greased O-ring into the groove around the outside of the mirror taking care not to touch the mirror surface.
9. Carefully place the new stainless steel mirror onto the cell making sure the O-ring is properly seated.
10. Tighten the 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 (refer to Table A–1 on page A–1). Pressures and temperatures outside these ranges will trigger a **P/T Fail** alarm.

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

Membrane Separator Filter

The analyzer comes equipped with a membrane separator filter that separates out entrained liquids from the sample gas. If moisture accumulation is suspected, briefly open the liquid drain (bypass valve) on the membrane separator filter to clear out any liquids. Refer to Figure B–3.

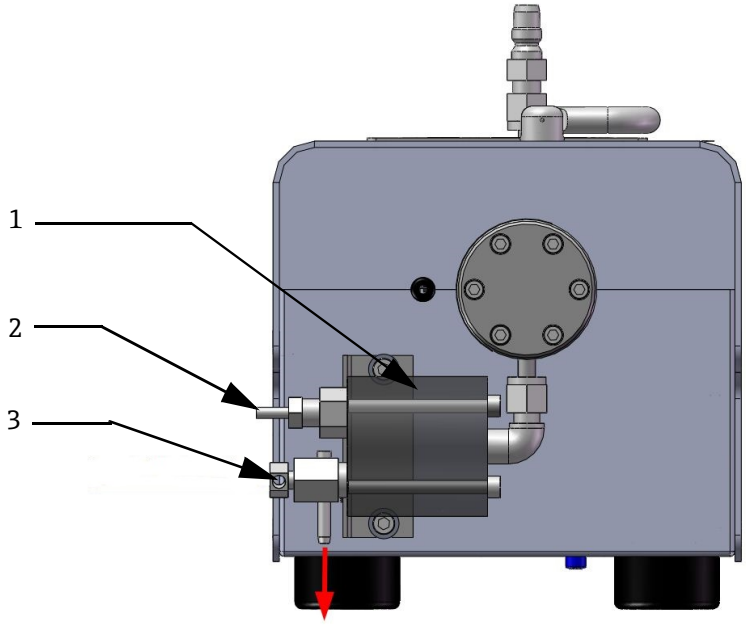

Figure B–3 *SS1000 liquid drain and bypass valve*

1 Membrane separator filter
2 Sample supply port (10 PSIG maximum)
3 Liquid drain and bypass valve

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

To replace the membrane

1. Detach the 1/8 in. inlet tubing and the 1/4 in. compression fitting from the sample supply port on the analyzer.
2. Unscrew the two 10-32 socket head cap screws that attach the filter to the analyzer.
3. Once detached, remove the four socket head cap screws in the filter body.
4. Open the filter body and replace the membrane.

5. Reassemble the filter body and attach the filter to the analyzer.
6. Connect the 1/8 in. inlet tubing and the 1/4 in. compression fitting to the sample supply port on the analyzer.
7. Tighten all new compression fittings 1 and 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. Using a liquid leak detector is recommended.

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

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.

Checking the Fuses

The main fuse is located on the back panel of the analyzer, as shown in Figure A–2 on page A–3. An additional fuse is located on the DC to DC converter board inside the housing, as shown in Figure A–3 on page A–4. If you need to replace a fuse, use only the same type and rating of fuse as the original as listed in Table B–1.

Table B–1 *Fuse specifications*

Drawing Reference	Description	Rating
F1	Miniature Fuse, 5 x 20 mm, Time Delay	250 VAC/3.00 A
F2	Miniature Fuse, 5 x 20 mm, Time Delay	250 VAC/3.15 A

Note: Refer to Figure A–2 on page A–3 or Figure A–3 on page A–4 for fuse locations.

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 B–2 on page B–10 before contacting **"Service"** on page B-13.

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

Symptom	Response
Non-Operation (at start up)	Is the power connected to both the analyzer and power source? Is the switch on?
	Check to confirm internal battery cables are connected.
	Check fuse(s). If bad, replace with equivalent amperage, slow-blow fuse. Refer to **"Checking the Fuses"** on page B-9.
	If the system is using an AC charger rather than the internal system battery for power, check to confirm green LED on the charger is on.
	Refer to **"Service"** on page B-13.
Power Fail Error	Turn off the power to the unit and check the optical head cables for a loose connection. **Do not disconnect or reconnect any optical head cables with the power connected.**
	Check the inlet and outlet tubes to see if they are under any stress. Remove the connections to the inlet and outlet tubes and see if the power goes up. Perhaps the existing tubing needs to be replaced with stainless steel flexible tubing.
	Possible alignment problem. Refer to **"Service"** on page B-13.
	Possible mirror contamination issue. Refer to **"Service"** on page B-13. If advised to do so, clean the mirrors by following the instructions under **"To clean the mirror"** on page B-4.
	Check that the actual pressure in the measurement cell is within specification.
	Check the connector on the pressure sensor. Check the pressure connector on the backplane board.

Table B-2 *Potential SS1000 analyzer problems and solutions (Continued)*

Symptom	Response
Power Fail Error (Continued)	Check that the actual temperature in the measurement cell is within specification. For systems with a heated enclosure, check that the temperature in the measurement cell is within +/- 5 °C of the specified enclosure temperature.
	Refer to **"Standard Documentation"** on page 1-1 for additional instruction.
PT Fail Error	Check the connector on the cell temperature sensor. Check the temperature connector on the backplane board. (**Note**: A temperature reading greater than 150 °C indicates a short circuit on the temperature sensor leads; a reading of less than –30 °C indicates an open circuit).
Front panel display is not lit and no characters appear	Check for correct voltage on terminal block input. Observe polarity on DC powered units.
	Check for correct voltage after fuses.
	Check for 5 VDC on red wires, 12 VDC on yellow wires, and 24 VDC on orange wires from power supply.
	Check connections on display communication and power cables.
Strange characters appear on front panel display	Check connections on display communication cable.
Pressing keys on front panel do not have specified effect	Check connections on keypad cable.
Not getting enough flow to the sample cell	Check both the micro filter and membrane separator for contamination. Replace if necessary. Refer to **"Membrane Separator Filter"** on page B-8.
	Check if supply pressure is sufficient.
No reading on device connected to current loop	Check the open circuit voltage (35 to 40 VDC) across the current loops terminals.

Table B-2 *Potential SS1000 analyzer problems and solutions (Continued)*

Symptom	Response
No reading on device connected to current loop (Continued)	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.
Reading seems to always be high by a fixed amount	Refer to **"Standard Documentation"** on page 1-1 for additional instruction.
Reading seems to always be high by a fixed percentage	Refer to **"Standard Documentation"** on page 1-1 for additional instruction.
Reading displays 0.0 or seems relatively low	Refer to **"Standard Documentation"** on page 1-1 for additional instruction.
Reading is erratic or seems incorrect	Check for contamination in the sample system, especially if the readings are much higher than expected.
	Refer to **"Standard Documentation"** on page 1-1 for additional instruction.
Reading goes to "0"	Gas concentration is equal to zero.
Reading goes to full scale	Refer to **"Standard Documentation"** on page 1-1 for additional instruction.
	Gas concentration is greater than or equal to full scale value.
Current loop is stuck at 4 mA or 20 mA	Check display for error message. If alarm has been triggered, refer to the Description of Device Parameters to 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 ARM9 main board. Refer to **"Service"** on page B-13.
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.
Serial output is providing no data	Refer to **"Standard Documentation"** on page 1-1 for additional instruction.

Table B-2 *Potential SS1000 analyzer problems and solutions (Continued)*

Symptom	Response
Serial output is providing no data (Continued)	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 for more than 5 minutes	Switch off power, wait 30 seconds, and then switch power back on.

Service

For Technical Service, refer to our website (https://endress.com/contact) for the list of local sales channels in your area.

Service repair order (SRO)

If returning the unit is required, obtain a **Service Repair Order (SRO) Number** from your Sales channel representative before returning the analyzer to the factory. Your representative can determine whether the analyzer can be serviced on site or should be returned to the factory. All returns should be shipped to:

11027 Arrow Rte.
Rancho Cucamonga, CA 91730-4866
United States of America
1-909-948-4100

Renewity returns

Returns can also be made inside the USA through the Renewity system. From a computer, navigate to http://www.us.endress.com/return and complete the online form.

Before contacting Service

Before contacting Service, prepare the following information to send with your inquiry:

- Analyzer serial number (SN)
- Contact information

- Diagnostic downloads using the procedures provided in the associated firmware manual or using AMS100 software from Endress+Hauser
- Description of the problem or questions

Access to the information above will greatly expedite our response to your technical request.

Packing

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

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

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

To prepare the analyzer for shipment or storage

1. Shut off the process gas flow.
2. Allow all residual gas to dissipate from the lines
3. Connect a purge supply (e.g., dry nitrogen), regulated to the specified sample supply pressure (refer to drawings in Appendix A), to the sample supply port.
4. Confirm that any valves controlling the sample flow effluent to the low pressure flare or atmospheric vent are open.
5. Turn on the purge supply and purge the system to clear any residual process gases.
6. Turn off the purge supply.
7. Allow all residual gas to dissipate from the lines.
8. Close any valves controlling the sample flow effluent to the low pressure flare or atmospheric vent.
9. Disconnect power to the system.
10. Disconnect all tubing and signal connections.

11. Cap all inlets, outlets, vents, conduit or gland openings (to prevent foreign material such as dust or water from entering the system) using appropriate sized fittings.
12. Pack the equipment in the pelican case in which it was shipped. Contact **"Service repair order (SRO)"** for any questions related to packaging.
13. If returning the analyzer to the factory, complete the Decontamination Form provided by Endress+Hauser **"Service repair order (SRO)"** and attach to the outside of the shipping package as instructed before shipping.

Storage

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

Disclaimers

Endress+Hauser 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

For a period of 18 months from date of shipment or 12 months in operation, whichever comes first, Endress+Hauser warrants that all products sold by it shall be free from defects in material and workmanship under normal use and service when correctly installed and maintained. Endress+Hauser's sole liability and Customer's sole and exclusive remedy for a breach of warranty is limited to Endress+Hauser's repair or replacement (at Endress+Hauser's sole option) of the product or part thereof which is returned at Customer's expense to Endress+Hauser's plant. This warranty shall apply only if Customer notifies Endress+Hauser in writing of the defective product promptly after the discovery of the defect and within the warranty period. Products may only be returned by Customer when accompanied by a return authorization reference number (SRO) issued by Endress+Hauser. Freight expenses for products returned by Customer will be prepaid by Customer. Endress+Hauser shall pay for shipment back to Customer for products repaired under warranty. For products returned for repair that are not covered under warranty, Endress+Hauser's standard repair charges shall be applicable in addition to all shipping expenses.

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