BA02281C/66/EN/01.23
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Products | Solutions | Services

Operating Instructions
SS2100 TDLAS Gas Analyzer

Endress+Hauser
People for Process Automation

Table of Contents

1 Introduction

1.1 Document function

This operating instruction contains information required to install and operate the SS2100 TDLAS Gas Analyzer and electronics. This manual also provides a components overview and installation requirements for connecting the SS2100 electronics. It is important to closely review the sections of this manual to ensure the analyzer performs as specified.

1.2 Designated use

Endress+Hauser's SS2100 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 a variety of background gases.

Use of the device for any purpose other than that described poses a threat to the safety of people and of the entire measuring system and is therefore not permitted. The manufacturer is not liable for damage caused by improper or non-designated use.

1.2.1 How to use this manual

There are a number of options and accessories available for the SS2100. 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 operation. Pay close attention to this information.

1.3 Symbols used

1.3.1 Warnings

Structure of Information	Meaning
⚠ WARNING **Causes (/consequences)** Consequences of non-compliance (if applicable) ▸ Corrective action	This symbol alerts you to a dangerous situation. Failure to avoid the dangerous situation can result in a fatal or serious injury.
⚠ CAUTION **Causes (/consequences)** Consequences of non-compliance (if applicable) ▸ Corrective action	This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or more serious injuries.
NOTICE **Cause/situation** Consequences of non-compliance (if applicable) ▸ Action/note	This symbol alerts you to situations which may result in damage to property.

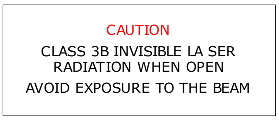
1.3.2 Safety symbols

Symbol	Description
	Hazardous voltage and risk of electric shock.
	INVISIBLE LASER RADIATION - Avoid exposure to the beam. Class 3R Radiation Product. Refer servicing to manufacturer-qualified personnel.

1.3.3 Informational symbols

Symbol	Meaning
	**Permitted:** Procedures, processes or actions that are permitted.
	**Forbidden:** Procedures, processes or actions that are forbidden.
	**Tip:** Indicates additional information.
	Reference to documentation
	Reference to page
	Reference to graphic
▶	Notice or individual step to be observed
1., 2., 3. ...	Series of steps
↳	Result of a step

1.3.4 Symbols on this device

Symbol	Description
	The warning label will be affixed to the front side of all analyzer enclosures that contain sample gas. Hazards may vary by stream composition. One or more of the following conditions may apply: **Flammable**. Gases used in the processing of this analyzer may be extremely flammable. Any work in a hazardous area must be carefully controlled to avoid creating any possible ignition sources (e.g., heat, arcing, sparking, etc.). **Toxins**. Endress+Hauser analyzers measure a variety of gases, including high-level H_2S. Follow all safety protocols governing toxic gases and potential leaks. **Inhalation**. Inhaling toxic gases or fumes may cause physical damage or death.
	Technicians are expected to follow all safety protocols established by the customer that are necessary for servicing or operating 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 or operation on process equipment located in hazardous areas.
	The High Voltage symbol alerts people to the presence of electric potential large enough to cause injury or damage. In certain industries, high voltage refers to voltage above a certain threshold. Equipment and conductors that carry high voltage warrant special safety requirements and procedures. Turn off and lock out system before servicing.
	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.

1.4 Standard documentation

All documentation is available:

- On the USB provided with the analyzer
- Endress+Hauser's website: www.endress.com

Each analyzer shipped from the factory is packaged with documents specific to the model that was purchased. This document is an integral part of the complete document package, which also includes:

Part Number	Document Type	Description
TI01667C	SS2100 Technical Information	Planning aid for your device. This document contains information for the analyzer including system design with sample conditioning components and inlet/outlet points, certificates and approvals, and product technical data.
XA02750C	SS2100 Safety Instructions	Requirements for installing or operating the SS2100 TDLAS Gas Analyzer related to personnel or equipment safety.
XA02751C	2-pack and 3-pack Safety Instructions	Safety Instructions for the SS2100 2-pack and 3-pack TDLAS Gas Analyzer for multiple analytes.
GP01177C	Description of Device Parameters (FS 5.16)	Provides the user with an overview of the FS 5.16 firmware functionality.
GP01180C	Description of Device Parameters (NS 5.14)	Provides the user with an overview of the NS 5.14 firmware functionality.
GP01181C	Description of Device Parameters (HC12)	Provides the user with an overview of the PP2f (HC12) firmware functionality.

For additional instruction manuals, please refer to the following:

- For custom orders, go to the Endress+Hauser website for the list of local sales channels who can provide the requested order-specific documentation:

  https://endress.com/contact

  or

  https://addresses.endress.com/
- For standard orders, go to the Endress+Hauser website to download the published documentation: www.endress.com

1.5 Manufacturer address

Endress+Hauser
11027 Arrow Route
Rancho Cucamonga, CA 91730
United States
www.endress.com

1.6 Glossary

Term	Description
2-wire	In a 2-wire current loop, the transmitter, DC power supply, and PLC are connected in series. Not only are the 2 wires providing power for the transmitter, but they are also the signal lines.
4-20 mA	An analog current loop for process control applications, used to carry signals from process instrumentation to PID controllers, SCADA systems, and programmable logic controllers (PLCs). They are also used to transmit controller outputs to the modulating field devices such as control valves.
Acceptance testing	A test conducted to determine if the requirements of a specification or contract are met. It may involve chemical tests, physical tests, or performance tests.
Analog to digital converter (ADC)	A system that converts an analog signal, into a digital signal so that it can be read and processed by a microcontroller.
Analyte	A substance whose chemical constituents are being identified and measured.
Bend radius (BR)	The minimum radius one can bend a pipe, tube, sheet, cable or hose without kinking it, damaging it, or shortening its life.
Calibration	A process in which a known amount of various gases are used to produce an accurate analyte reading.
Capacitance	The ratio of the change in electric charge of a system to the corresponding change in its electric potential.
Connectorization	An electrical connector for terminating a shielded cable and connecting the cable to regularly arranged contact pins.
CW laser	Continuous wave laser, as opposed to a pulsed laser, have an uninterrupted beam that gives a nominally constant output over a set interval.
Density	The mass of a substance is its mass per unit volume.
Differential	TDLAS technology based on subtracting one spectrum from another. A dry spectrum, the response from a sample when the analyte of interest has been completely removed, is subtracted from the wet spectrum, the response from the sample when the analyte is present. The remainder is a spectrum of the pure analyte.
Divert valve	A divert valve is located between a chromatograph (gas or liquid) and the source of a mass spectrometer, and acts to either allow the flow from the chromatograph to enter the source or not.
Fermentation	The chemical breakdown of a substance by bacteria, yeasts, or other microorganisms, typically involving effervescence and the giving off of heat.
HART communication protocol	A hybrid analog+digital industrial automation open protocol. Its most notable advantage is that it can communicate over legacy 4–20 mA analog instrumentation current loops, sharing the pair of wires used by the analog-only host systems.
Heat sink	A passive heat exchanger that transfers the heat generated by an electronic or a mechanical device to a fluid medium, often air or a liquid coolant, where it is dissipated away from the device, thereby allowing regulation of the device's temperature.
Infrared (IR)	Electromagnetic Radiation (EMR) with wavelengths longer than those of visible light.
Input/output (I/O)	The communication between an information processing system, such as a computer, and the outside world, possibly a human or another information processing system. Inputs are the signals or data received by the system and outputs are the signals or data sent from it.
Ion	Atomic, molecular, or radical species with a non-zero net electric charge.
Laser	A device that emits light through a process of optical amplification based on the stimulated emission of electromagnetic radiation.

Term	Description
Lockout/tagout	Proper lockout/tagout (LOTO) practices and procedures safeguard workers from hazardous energy releases. OSHA's Lockout/Tagout Fact sheet → describes the practices and procedures necessary to disable machinery or equipment to prevent hazardous energy release. The OSHA standard for The Control of Hazardous Energy (Lockout/Tagout) (29 CFR 1910.147 →) for general industry outlines measures for controlling different types of hazardous energy. The LOTO standard establishes the employer's responsibility to protect workers from hazardous energy. Employers are also required to train each worker to ensure that they know, understand, and are able to follow the applicable provisions of the hazardous energy control procedures.
Modbus	Data communications protocol originally published by Modicon in 1979 for use with its programmable logic controllers.
Modbus TCP/IP (also Modbus-TCP)	The Modbus RTU protocol with a TCP interface that runs on Ethernet. The Modbus messaging structure is the application protocol that defines the rules for organizing and interpreting the data independent of the data transmission medium.
Modbus RTU over RS485	The Modbus protocol used on top of a serial line with an RS-485 physical interface.
Non-differential	TDLAS technology in which TDL spectroscopy measurements are made directly from the sample.
Permeation tube (perm tube)	A sealed cylinder of a permeable material with an analyte of interest inside. The analyte slowly permeates through the walls of the tube at a rate governed by temperature and tube geometry. Permeation tubes (perm tubes) are a preferred method for delivering precise concentrations from ppb to high ppm.
pH	A scale used to specify the acidity (0-7 pH) or basicity (7-14 pH) of an aqueous solution.
Probe	A physical device used to connect electronic test equipment to items under test.
Relay	An electrically operated switch consisting of a set of input terminals for a single or multiple control signals, and a set of operating contact terminals. The switch may have any number of contacts in multiple contact forms, such as make contacts, break contacts, or combinations thereof.
RS232	Standard for serial communication transmission of data. Once standard for PCs, connections for modems, printers, data storage, etc.
RS485	Also known as TIA-485 (A), EIA 485; standard defining the electrical characteristics of drivers and receivers for use in serial communications systems. Supports local networks and multi-drop communications links.
Soldering	A process in which two or more items are joined together by melting and putting a filler metal (solder) into the joint, the filler metal having a lower melting point than the adjoining metal.
Spectrometer	A scientific instrument used to separate and measure spectral components of a physical phenomenon.
Spectroscopy	A study of the absorption and emission of light and other radiation by matter, as related to the dependence of these processes on the wavelength of the radiation.
Stream composition	The makeup of the materials within a specific stream.
TSP	Technical Special Project; an Endress+Hauser term for custom orders.
Vent to atmosphere	The intentional and controlled release of gases containing alkane hydrocarbons - predominately methane - into earth's atmosphere.
Vent to flare (flaring)	The controlled burning that takes place during production and processing of gas.
Wavelength	The spatial period of a periodic wave. The distance over which the wave's shape repeats.
Wavelength modulation spectroscopy (WMS)	A derivative form of absorption spectroscopy that has been increasingly applied for measurements in harsh environments due to its improved sensitivity and noise-rejection capabilities over direct absorption. Used by TDLAS analyzers.

2 Safety

Each analyzer shipped from the factory includes safety instructions and documentation to the responsible party or operator of the equipment for the purpose of installation and maintenance. This manual should be read and referenced by anyone installing, operating or having direct contact with the analyzer.

⚠ WARNING

Technicians are expected to be trained and follow all safety protocols that have been established by the customer in accordance with the area hazard classification to service or operate the analyzer.

- ▶ This may include, but is not limited to, toxic and flammable gas monitoring protocols, lockout/tagout procedures, the use of personal protective equipment (PPE) requirements, hot work permits and other precautions that address safety concerns related to the use and operation of process equipment located in hazardous areas.

2.1 Personnel qualifications

Personnel must meet the following conditions for mounting, electrical installation, commissioning and maintenance of the device. This includes, but is not limited to:

- Be suitably qualified for their role and the tasks they perform:
  - Installation, commissioning, operation and maintenance of the measuring system may be carried out only by specially trained technical personnel.
  - Technical personnel must be authorized by the plant operator to carry out the specified activities. Technical personnel must have read and understood these Operating Instructions and must follow the instructions contained herein.
  - Electrical connections may be performed only by an electrical technician.
- Be trained in explosion protection.
- Be familiar with national and local regulations and guidelines (e.g., CEC, NEC ATEX/IECEx or UKEX).
- Be familiar with lockout/tagout procedures, toxic gas monitoring protocols and PPE (personal protection equipment) requirements.
- Faults at the measuring point may only be rectified by authorized and specially trained personnel.

⚠ WARNING

Substitution of components is not permitted.

- ▶ Substitution of components may impair intrinsic safety.
- ▶ Repairs not described in the Operating Instructions provided must be carried out only directly at the manufacturer's site or by the service organization.

2.2 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.

2.2.1 Exposure to process gas

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 opening any part of the sample system.

2.2.2 Exposure to toxic gas (H_2S)

Use the following procedure if the SS2100 analyzer included a safety purge kit as ordered. If there has been any suspected leak from the sample system and accumulated SCS enclosure, do the following:

1. Purge the SCS enclosure to remove any potentially toxic gas.
2. Test the H_2S levels of the SCS enclosure using the port from the safety purge kit to ensure the purge has cleared any toxic gas.
3. If no gas leak is detected, open the SCS enclosure door.

If the SS2100 analyzer was not purchased with a safety purge, purging enclosure as explained in the above procedure is not possible. Instead, purchase a portable or fixed H_2S detector and test at the breather drain or open the enclosure with the detector at hand to determine if there is a leak.

CAUTION

- ▶ Follow all safety protocols governing toxic gases and potential leaks.

2.2.3 Electrocution hazard

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

   WARNING

   - ▶ Complete this action before performing any service that requires working near the main input power or disconnecting any wiring or other electrical components.
   - ▶ If service must be performed with power engaged (gain adjustment, etc.), note any live electrical components and avoid all contact with them.

2. Only use tools with a safety rating for protection against accidental contact with voltage up to 1000V (IEC 900, ASTF-F1505-04, VDE 0682/201).

2.2.4 Laser safety

The SS2100 TDLAS Gas Analyzer is a Class 1 laser product, which poses no threat to equipment operators. The laser internal to the analyzer controller is classified Class 3B and could cause eye damage if the beam is viewed directly.

WARNING

- ▶ Before servicing, shut off all power to the analyzer.

2.2.5 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).

2.3 Product safety

The SS2100 TDLAS Gas Analyzer is designed in accordance with good engineering practice to meet state-of-the-art safety requirements, has been tested, and left the factory in a condition in which it is safe to operate.

It meets general safety standards and legal requirements. It also complies with the EU directives listed in the specific EU Declaration of Conformity. Endress+Hauser confirms this by affixing the CE mark to the analyzer system.

2.3.1 General

- Adhere to all warning labels to prevent damage to the unit.
- Do not operate the device outside the specified electrical, thermal and mechanical parameters.
- Only use the device in media to which the wetted materials have sufficient durability.
- Modifications to the device can affect the explosion protection and must be carried out by staff authorized to perform such work by Endress+Hauser.
- Install the controller circuit wiring according to the Canadian Electrical Code (CEC) respective National Electrical Code (NEC) using threaded conduit or other wiring methods in accordance with NEC articles 501 to 505, or IEC 60079-14.
- Install the device according to the manufacturer's instructions and regulations.
- The flameproof joints of this equipment are outside the minimums specified in IEC/EN 60079-1 and shall not be repaired by the user.

Only open the controller cover if the following conditions are met:

- An explosive atmosphere is not present
- All device technical data is observed (see nameplate)

- An electrostatic charge (e.g., caused by friction, cleaning or maintenance) is avoided on the attached stainless steel nameplate, if present, and on painted metallic housings that are not integrated into the local potential equalization (ground) system

In potentially explosive atmospheres:

- Do not disconnect any electrical connections while the equipment is energized.
- Do not open the connection compartment cover when energized or the area is known to be hazardous.

2.3.2 General pressure

The system is designed and tested with appropriate margins to ensure that is it safe under normal operating conditions, which include temperature, pressure, and gas content. The operator is responsible for ensuring that the system is shut off when these conditions are no longer valid.

2.3.3 Electrostatic discharge

The coating and the adhesive label is non-conducting and may generate an ignition capable level of electrostatic discharge under certain extreme conditions. The user should ensure that the equipment is not installed in a location where it may be subjected to external conditions, such as high pressure steam, which may cause a build-up of electrostatic charges on non-conducting surfaces. To clean the equipment, use only a damp cloth.

2.3.4 Chemical compatibility

Never use vinyl acetate or acetone or other organic solvents to clean the analyzer housing or labels.

2.3.5 Canadian Registration Number

In addition to the requirements above for general pressure safety, Canadian Registration Number (CRN) systems must be maintained using CRN approved components without any modification to the sample conditioning system (SCS) or analyzer.

2.4 Workplace safety

As the user, you are responsible for complying with the following safety conditions:

- Installation guidelines
- Local standards and regulations
- Regulations for explosion protection

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.

2.5 Operational safety

Before commissioning the entire measuring point:

1. Verify that all connections are correct.
2. Ensure that electrical cables and hose connections are undamaged.
3. Do not operate damaged products, and protect them against unintentional operation.
4. Label damaged products as defective.

During operation:

1. If faults cannot be rectified, products must be taken out of service and protected against unintentional operation.
2. Keep the door closed when not carrying out service and maintenance work.

2.6 Lifting provisions for the analyzer

Due to the analyzer's size and weight (configurations can weigh approximately 90 to 154 kg [200 to 340 lbs] with sample conditioning system), the use of a forklift, pallet jack, etc. to lift or move the analyzer is recommended. If the analyzer is to be lifted by hand, designate multiple individuals and distribute the weight among personnel to avoid injury.

Before removing from the crate, move the analyzer as close as possible to the final installation location. Never lift the analyzer by the electronics enclosure. Always carry the load using one of the following points/methods (refer to Mounting the analyzer →):

- Mounting points
- Support beneath instrument (best used when employing a forklift)

⚠ CAUTION

- ▶ Always use a lifting truck or a forklift to transport the analyzer. Two people are needed for the installation.
- ▶ Ensure all equipment used for lifting/moving the analyzer is rated for the weight load.
- ▶ Lift the device by the recessed grips.

3 Product description

The SS2100 TDLAS Gas Analyzers are tunable diode laser (TDL) absorption spectrometers 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 constituents in the stream. The sensor is controlled by microprocessor-based electronics with embedded software that incorporates advanced operational and data processing algorithms.

The SS2100 TDLAS Gas Analyzer is typically comprised of two main enclosures; the analyzer electronics and the sample conditioning system (SCS). On the front panel of the analyzer electronics, the keypad and LCD display serve as the user interface to the analyzer. Some systems may also have a keypad cover. The analyzer control electronics drive the laser, collect the signal, analyze the spectra and provide measurement output signals.

The figure below shows two sample SS2100 analyzer configurations from front view.

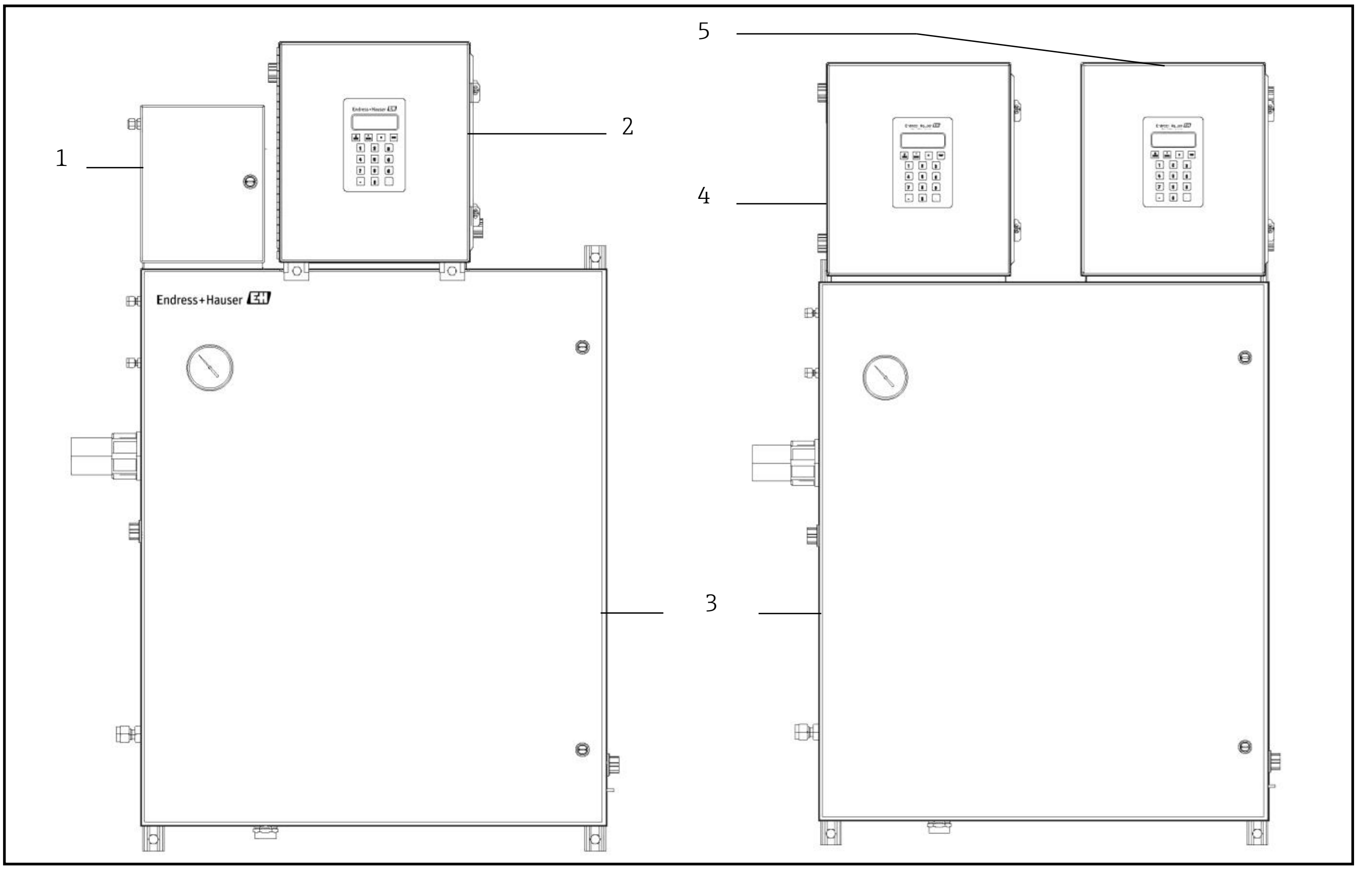


Fig 1. SS2100 TDLAS Gas Analyzer for single analyte (left) and multiple analytes (right), front view

1. *Solenoid valve junction box for trace applications (when applicable)*
2. *Analyzer electronics for single analyte systems*
3. *Sample conditioning system enclosure*
4. *Analyzer A for H_2S (2-pack and 3-pack multiple analyte systems)*
5. *Analyzer B for H_2O and CO_2 (2-pack and 3-pack multiple analyte systems)*

3.1 How Endress+Hauser TDLAS Gas Analyzers work

The Endress+Hauser SS2100 analyzers employ SpectraSensors tunable diode laser absorption spectroscopy (TDLAS) to detect the presence of substances in process gases. Absorption spectroscopy is a widely used technique for sensitive component detection. Because the measurement is made in the gas stream, the response is faster, more accurate, and more reliable than traditional surface-based sensors that are subject to contamination.

In its simplest form, a diode laser absorption spectrometer typically consists of a sample cell with a window or mirror at one end, through which the laser beam can pass, and a mirror at the opposite end. The figure below shows 0.8 m cell and 8 m/28 m cell cross-sections with indicators for standard components and access. The laser beam enters the cell and reflects off the mirror(s) making multiple passes through the sample gas and eventually exiting the cell where the remaining beam intensity is measured by a detector. With the SS2100 analyzers, sample gas flows continuously through the measurement cell ensuring that the sample is always representative of the flow in the process main pipe.

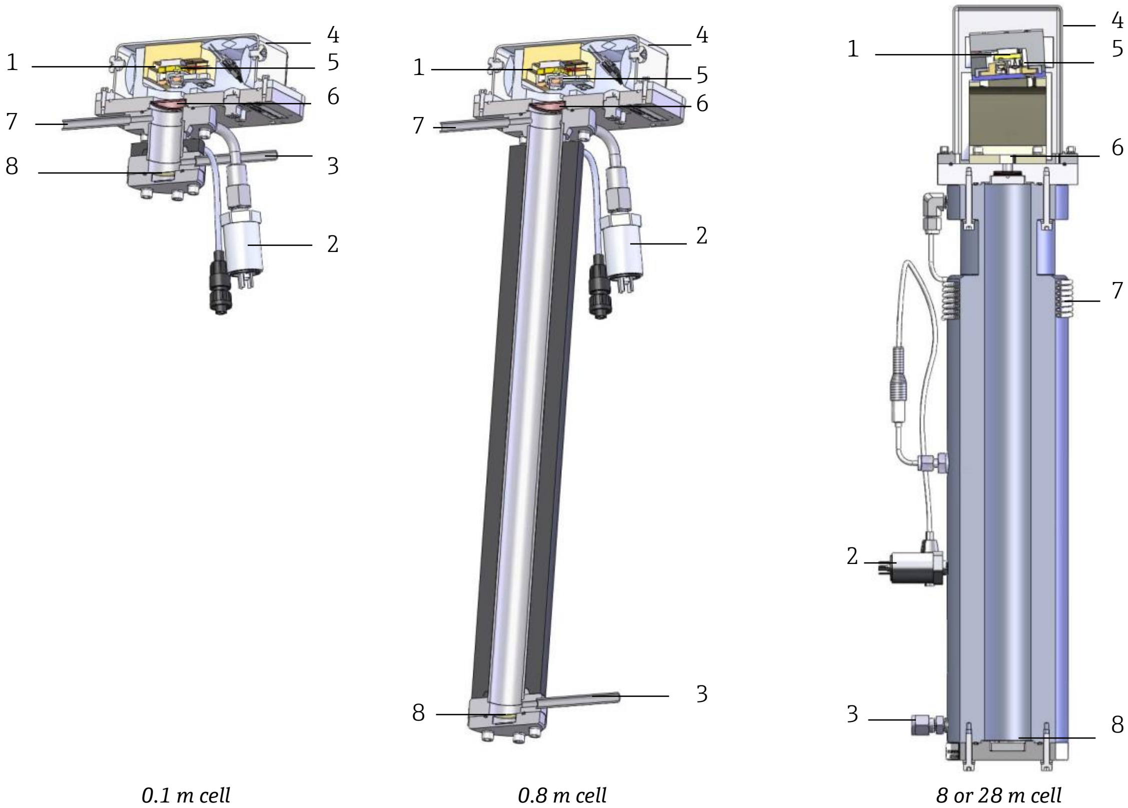


Fig 2. Schematic of a typical laser diode absorption spectrometer

1. *Laser*
2. *Pressure sensor*
3. *Outlet*
4. *Optical head*
5. *Detector*
6. *Window/near mirror*
7. *Inlet*
8. *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

$$I(\lambda) = I_0(\lambda)\exp\left[-\sigma(\lambda)lN\right]$$

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

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

Below, figure 3 shows the typical raw data from a laser absorption spectrometer scan including the incident laser intensity, I_0 (λ), and the transmitted intensity, I(λ), 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 the figure below.

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. As a result, self-calibration allows for measurements that are unaffected by mirror contamination.

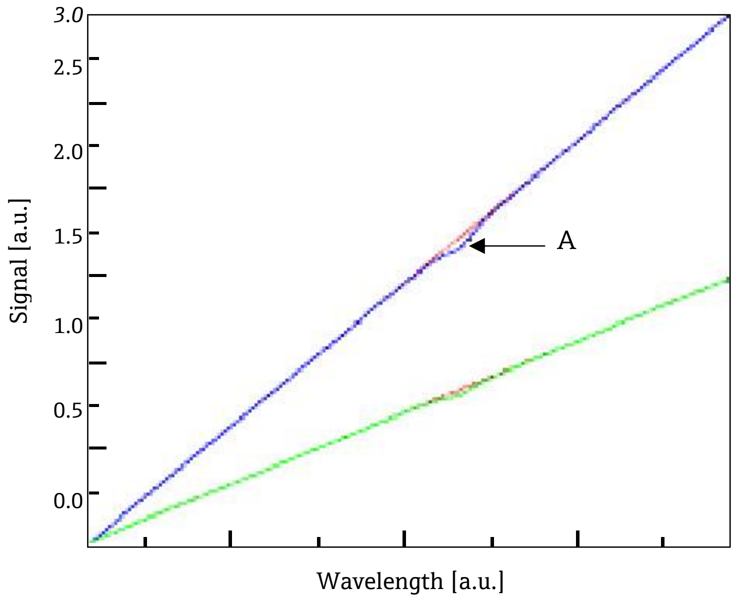


Fig 3. Typical raw signal from a laser diode absorption spectrometer with and without mirror contamination

A. Resonance absorption
B. Red line: incident energy $I_0(l)$
Blue line: raw signal, I (l)
Green line: raw signal, I (l) (contaminated mirrors)

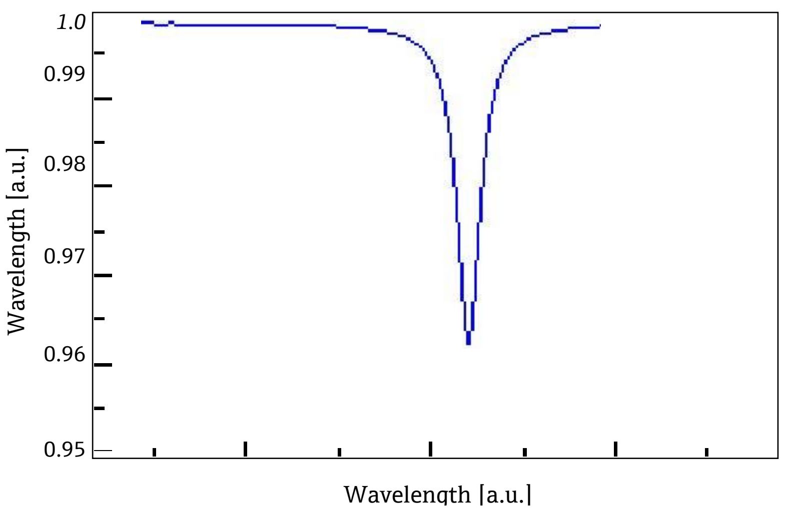


Fig 4. Typical normalized signal from a laser diode absorption spectrometer

3.1.1 Non-differential TDLAS

In all SS2100 TDLAS Gas Analyzers, non-differential TDLAS is designed for higher concentration analytes, including H_2S, H_2O, NH_3, CO_2, C_2H_2, and others. In non-differential systems, spectroscopy measurements are made directly from the sample without subtracting the wet spectrum from the dry spectrum as described below for differential systems. Endress+Hauser non-differential models do not include a dryer or scrubber for measurement validation.

3.1.2 Differential TDLAS

Differential TDLAS is featured in the SS2100 TDLAS Gas Analyzers for trace measurements, including low concentrations of hydrogen sulfide (H_2S), moisture (H_2O), and ammonia (NH_3). This technology involves subtracting one spectrum from another. A dry spectrum, the response from a sample when the analyte of interest has been completely removed, is subtracted from the wet spectrum, the response from the sample when the analyte is present. The remainder is a spectrum of the pure analyte. This technology is used for very low or trace measurements and is also useful when the background matrix changes over time.

3.1.3 Wavelength modulation spectroscopy (WMS) signal detection

Endress+Hauser takes absorption spectroscopy a step further by using a sophisticated signal detection technique called wavelength modulation spectroscopy (WMS). With WMS, the laser drive current is modulated with a kHz sine wave as the laser is rapidly tuned. An amplifier is then used to boost the harmonic component of the signal that is twice the modulation frequency (2*f*), as shown in the figure below. This phase-sensitive detection enables the filtering of low-frequency noise caused by turbulence, temperature, or pressure fluctuations in the sample gas, low-frequency noise in the laser beam or thermal noise in the detector.

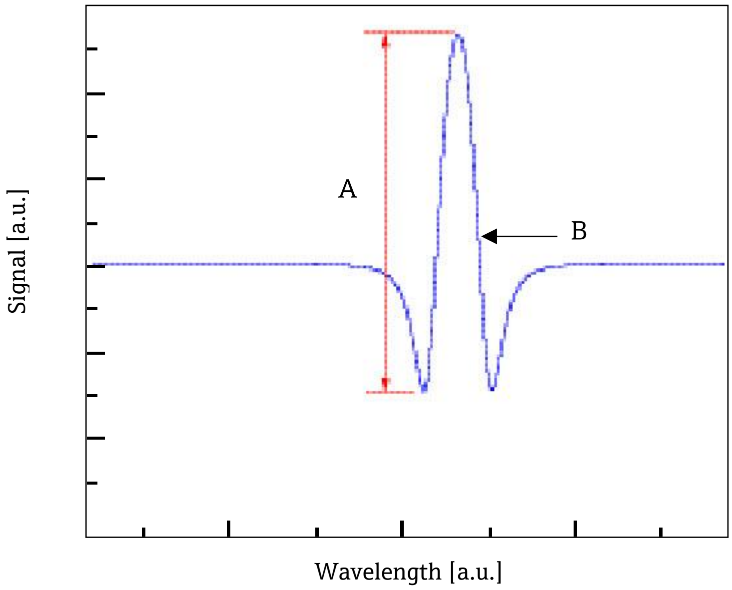


Fig 5. Typical normalized 2f signal showing species concentration proportional to height

A. 2f peak height
B. Normalized 2f signal

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 to 3000 nm, which provides the least amount of sensitivity to background stream variations.

3.2 SS2100 TDLAS Gas Analyzer model types

The SS2100 TDLAS Gas Analyzers are separated into differential or non-differential systems. In some cases, the SS2100 includes a permeation validation system for generating a known analyte concentration.

SS2100 TDLAS Gas Analyzers are comprised of two main enclosures; the analyzer electronics and the sample conditioning system (SCS). On the front panel of the analyzer electronics, the keypad and LCD display serve as the user interface to the analyzer. Some systems also have a keypad cover. The analyzer control electronics drive the laser, collect and analyze the spectra, and provide measurement outputs. Inside the analyzer electronics enclosure is the electronics assembly. Fuses are located on the electronics control board.

Housed inside the SCS are the measurement cell, heater, and sample system components to control flow and pressure for the measurement cell and the bypass loop. Power is connected to the analyzer from a 120 VAC, 240 VAC, or 24 VDC power source. The sample supply, sample return, and instrument air are connected on the opposite side of the enclosure.

3.2.1 The non-differential SS2100 TDLAS Gas Analyzer

The non-differential Endress+Hauser SS2100 TDLAS Gas Analyzers measure higher concentrations of analytes, including H_2O, CO_2, H_2S, NH_3, and C_2H_2.

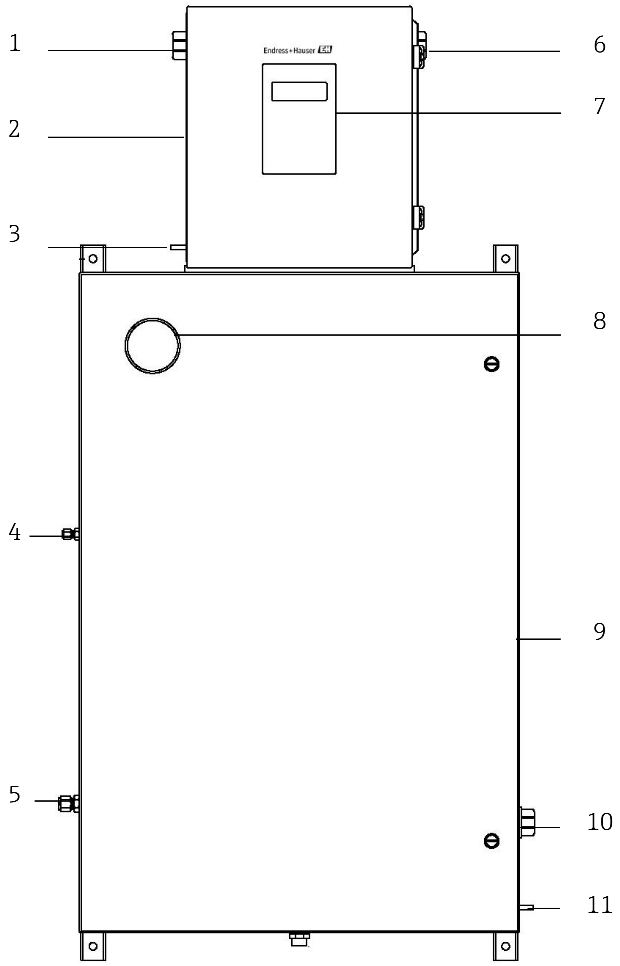


Fig 6. SS2100 non-differential analyzer, front view

1	Signal wiring	5	Sample return	9	Sample conditioning system
2	Analyzer electronics enclosure	6	Signal wiring	10	Heater power
3	Analyzer power	7	LCD display and keypad	11	Chassis ground
4	Sample supply	8	Temperature indicator		

3.2.2 The differential SS2100 analyzers for trace measurements

The SS2100 TDLAS Gas Analyzer for trace measurements features specialized equipment for mitigating and measuring these analytes. Permeation validation is a method for validating low H_2O and NH_3 measurements. For information on using permeation validation, see Permeation validation →. For information on servicing the scrubber for trace measurements, see Replacing the scrubber →.

Differential system for hydrogen sulfide (H_2S)

The Endress+Hauser SS2100 TDLAS Gas Analyzer for trace hydrogen sulfide (H_2S) features a differential TDLAS system. Below a sample SS2100 analyzer for H_2S is shown from the front view.

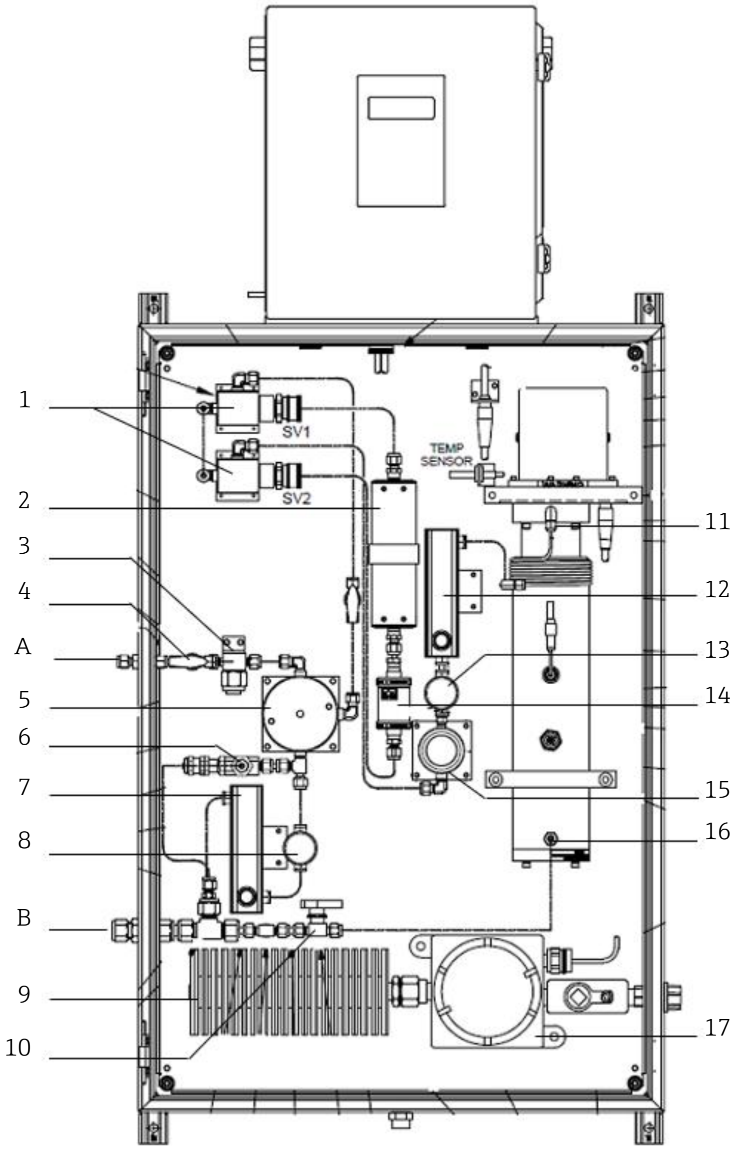


Fig 7. SS2100 analyzer for hydrogen sulfide (H_2S), front view

1	Solenoid valves (air-operated valves optional)	4	Sample/reference gas on/off	11	Cell inlet port
2	Analyte scrubber	5	Membrane separator	12	Analyzer flow indicator and control
3	Filter	6	Pressure relief valve	13	Analyzer pressure gauge
		7	Bypass flow indicator and control	14	Scrubber indicator
		8	Bypass pressure gauge	15	Pressure regulator
A	Sample supply, ~207 kPa (~30 psig)	9	Heater	16	Cell outlet port
B	Sample return, to safe area	10	Vent gas on/off	17	Temperature controller

The SS2100 TDLAS Gas Analyzer for H_2S features specialized equipment for mitigating and measuring this particular analyte. For information on servicing the H_2S scrubber indicator, see Servicing the H_2S scrubber →.

Differential system for trace moisture (H_2O) and ammonia (NH_3)

The Endress+Hauser SS2100 TDLAS Gas Analyzers for trace moisture (H_2O) and ammonia (NH_3) feature a differential TDLAS system. These systems also require external solenoid housing to prevent temperature fluctuations within the sample conditioning system.

Endress+Hauser SS2100 TDLAS Gas Analyzers for trace moisture (H_2O) and ammonia (NH_3) include a permeation tube and scrubber for measurement validation. If your SS2100 analyzer is configured for trace ammonia (NH_3), the permeation tube has been shipped separately and must be installed prior to commissioning the analyzer. See Installing the permeation tube for NH_3 systems →.

Below a sample SS2100 analyzer for H_2O is shown from the front view.

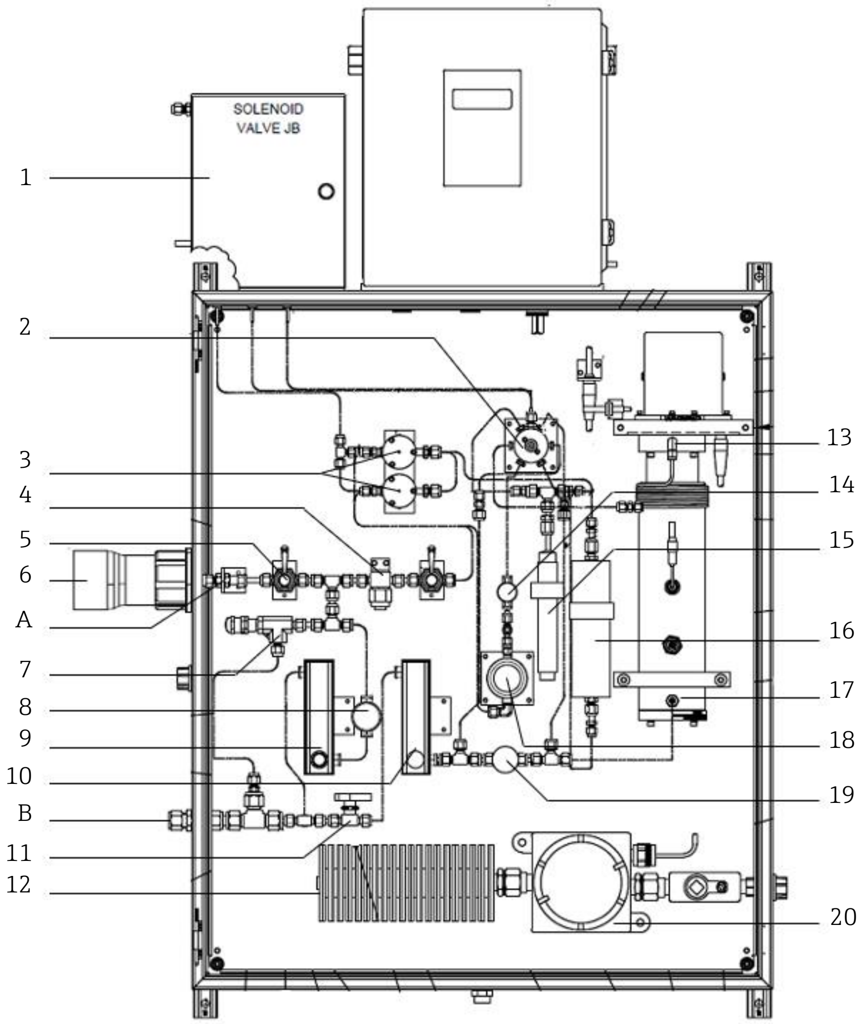


Fig 8. SS2100 analyzer for trace measurements, including H_2O and NH_3

1 *Solenoid valve junction box*
2 *6-way valve*
3 *Air-operated 3-way valve*
4 *Filter*
5 *Diaphragm valve*

A *Sample supply, ~207 kPa (~30 psig)*
B *Sample return, to safe area*

6 *Heat trace boot*
7 *Pressure relief valve*
8 *Pressure gauge*
9 *Bypass flow indicator and control*
10 *Analyzer flow indicator and control*
11 *Vent gas on/off*
12 *Heater*

13 *Cell inlet port*
14 *Filter*
15 *Permeation tube*
16 *Scrubber*
17 *Cell outlet port*
18 *Pressure regulator*
19 *Metering valve*
20 *Temperature controller*

3.2.3 SS2100 TDLAS Gas Analyzers for multiple analytes

2-pack and 3-pack system

The Endress+Hauser SS2100 2-pack and 3-pack TDLAS Gas Analyzers for multiple analytes feature a differential TDLAS system. 2-pack and 3-pack analyzer systems are designed for use with extractive natural gas sampling stations.

SS2100 2-pack systems generally contain one analyzer for H_2S measurements (analyzer A) and one analyzer dedicated to measurements for H_2O or another analyte (analyzer B). SS2100 3-pack systems also contain two electronic enclosures. In the 3-pack system, analyzer A is dedicated to H_2S measurements while analyzer B typically reads H_2O and CO_2 measurements.

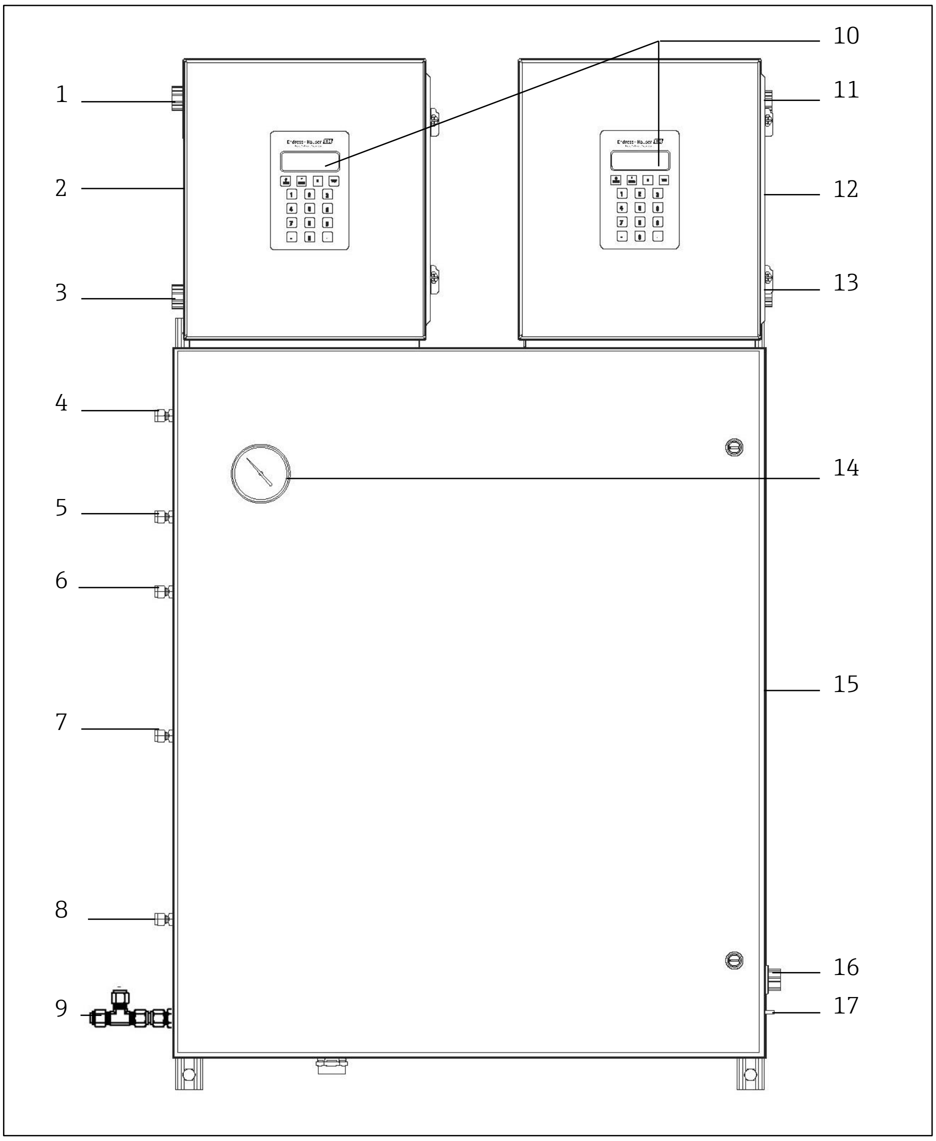


Fig 9. SS2100 2-pack and 3-pack analyzer external structure, front view

1 *Signal wiring*
2 *Analyzer A electronics enclosure*
3 *Analyzer power*
4 *Instrument air inlet (optional)*
5 *Validation gas inlet (optional)*
6 *High H_2S purge (optional)*
7 *Sample supply*
8 *Sample return*
9 *Enclosure purge vent (optional)*
10 *LCD display and keypad*
11 *Signal wiring*
12 *Analyzer B electronics enclosure*
13 *Analyzer power*
14 *Temperature indicator*
15 *Sample conditioning system*
16 *Heater power*
17 *Enclosure ground*

2-pack and 3-pack systems with OXY5500

The Endress+Hauser SS2100 2-pack and 3-pack with OXY5500 TDLAS Gas Analyzers for multiple analytes feature a differential TDLAS system. Most 3-pack analyzer systems are configured for use at extractive natural gas sampling stations.

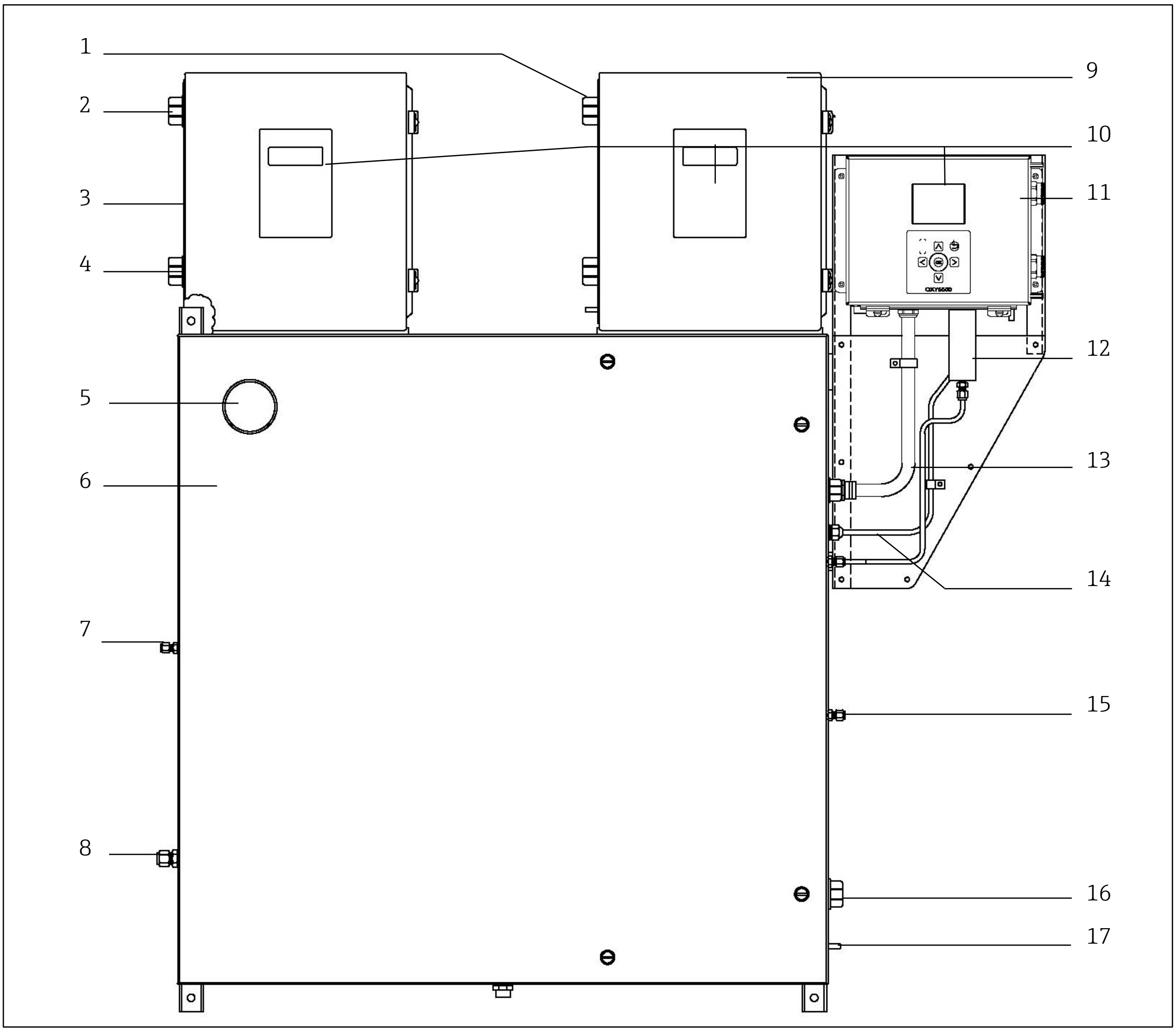


Fig 10. SS2100 2-pack and 3-pack with OXY5500 analyzer external structure, front view

1 *H_2O/CO_2 analyzer signal wiring*
2 *H_2S analyzer signal wiring*
3 *H_2S (analyzer A) electronics enclosure*
4 *H_2S analyzer power*
5 *Temperature indicator*
6 *Sample conditioning system*
7 *Sample supply*
8 *Sample return*
9 *H_2O/CO_2 (analyzer B) electronics enclosure*
10 *LCD display and keypad*
11 *O_2 (analyzer C–OXY5500) electronics enclosure*
12 *O_2 pressure sensor*
13 *O_2 probe*
14 *RTD probe*
15 *O_2 calibration inlet*
16 *Heater power*
17 *Enclosure ground*

4 Incoming product acceptance and identification

Once the analyzer arrives, you should take a few minutes to examine the contents of the container before installing the unit.

4.1 Scope of delivery

The contents of the crates include:

- The Endress+Hauser SS2100 analyzer
- The SS2100 Safety Instruction
- External serial cable(s) to connect the analyzers to a computer to receive and transmit data
- Additional accessories or options as ordered

If any of these contents are missing, refer to Service →.

4.2 Inspecting the analyzer

Before removing the crate, make sure the analyzer is placed in close proximity to the installation site. Refer to Installation → for installation site requirements.

Remove top and sides of crate and carefully inspect all enclosures for dents, dings or general damage. Inspect the supply and return connections for damage. Report any damage to the carrier.

⚠ CAUTION

▶ Avoid jolting the instrument by dropping it or banging it against a hard surface which may disturb the optical alignment.

The analyzer may be configured with additional accessories and options. If there is any discrepancy with the order, refer to Service →.

4.3 Determining firmware version

When the analyzer is powered on for the first time, the firmware version will display on the system LCD display for approximately seven seconds. Refer to *Powering Up the Analyzer* in the Description of Device Parameters → for this analyzer for operational instructions. The firmware version for each analyzer is also listed on the analyzer calibration certificate.

PRODUCT MODEL	PP2f Firmware (HC12)	FS Firmware	NS Firmware
SS2100, SS2100a, SS2100i-1, SS2100i-2	Not used	Used for differential analyzers	Used for non-differential analyzers
2-pack/3-pack	Used on Analyzer B, or right-side analyzer electronics	Used on analyzer A, or left-side analyzer electronics	Not used, except on some special orders

5 Installation

This chapter describes the procedure to mount and install your SS2100 analyzer. Refer to the Description of Device Parameters → for system programming and operation information.

Installing the analyzer requires steps that when carefully followed ensure proper mounting and connection. The steps are outlined in the following sections:
- Mounting the analyzer
- Connecting electrical power
- Connecting signals and alarms
- Connecting the gas lines

⚠ CAUTION

The safety of the analyzer is the responsibility of the installer and the organization they represent. Incorrect transportation can cause injury and damage the device.
- ▶ Always use a lifting truck or a fork-lift to transport the analyzer. Two people are needed for the installation.
- ▶ Ensure all equipment used for lifting/moving the analyzer is rated for the weight load.
- ▶ Lift the device by the recessed grips.

5.1 Site requirements and installation conditions

The SS2100 analyzer can be installed on a wall. Consider the following when choosing an appropriate location for the analyzer:
- Choose a shaded area or use an optional analyzer hood (or equivalent) to minimize sun exposure to the fully mounted analyzer.
- Position the instrument so it is not difficult to operate adjacent devices. Allow 1 m (3 feet) of space in front of the analyzer.
- Ensure that supply and return lines reach the supply and return connections on the sample system enclosure. Maintain flexibility in the sample and return lines so that the lines are not under excessive stress.
- The breaker in the power distribution panel or switch will be the primary means of disconnecting the power from the analyzer. Therefore, the power distribution panel or switch should be located in close proximity to the equipment and within easy reach of the operator. A switch or circuit breaker shall not interrupt a protective earth ground.
- Before removing the analyzer from the crate, move the analyzer as close as possible to the final installation location.

⚠ CAUTION

Intense sun exposure in some areas may cause the analyzer temperature to exceed the maximum.
- ▶ Endress+Hauser analyzers are designed for operation within the specified ambient temperature range.

5.1.1 Dimensions

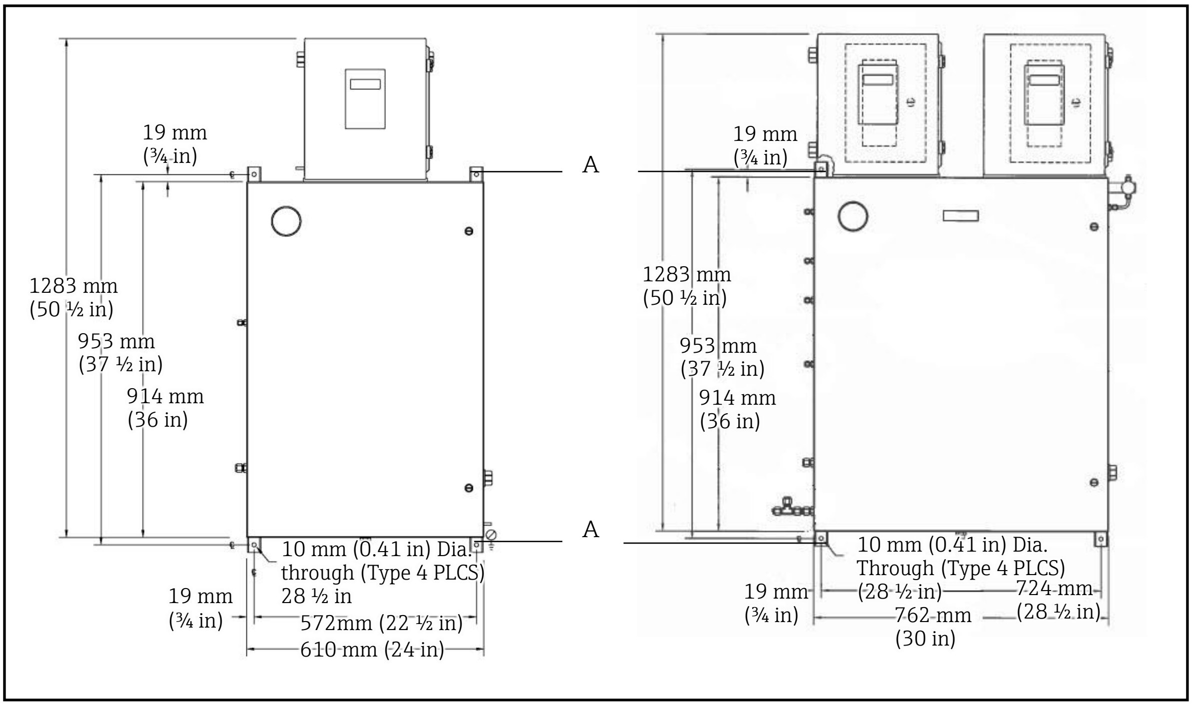


Fig 11. Mounting points for the SS2100 TDLAS Gas Analyzer, designated with A (both sides)

5.2 Hardware and tools for installation

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

Hardware

- Mounting hardware (e.g., spring nuts, ⅜ in x 1 ½ in machine screws and nuts)

  Bolts or screws used for wall-mounting the SS2100 must be able to support four times the weight of the instrument (approximately 59 to 154 kg [or 130 to 340 lbs] with sample system).

- Stainless steel tubing (¼ in O.D. x 0.035 in wall thickness, seamless stainless steel tubing is recommended)
- ¾ in conduit
- ¾ in conduit hubs
- Pressure regulator (if not included)
- Membrane separator filter, if applicable
- Source of plant nitrogen gas (4 scfh) for purge unit(s), if applicable

Tools

- Hand drill and bits
- Tape measure
- Level
- Pencil
- 9/16 in socket wrench
- Screwdriver
- 9/16 in open-end wrench
- Heat gun (optional—for heat trace bundle)
- Pliers
- Conduit sealant (see Application of conduit lubricant →)

5.3 Mounting the analyzer

The SS2100 is manufactured for wall installations. The analyzer is constructed with four mounting brackets, two on the top of the SCS cabinet and two on its bottom. Refer to the drawing of lifting and mounting points → and the layout diagrams in your as-built drawings or Technical data and drawings → for detailed mounting dimensions.

CAUTION

- It is critical to mount the analyzer so that the supply and return lines reach the supply and return 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. Refer to Site requirements and installation conditions →.
2. Locate the mounting holes on your unit. Refer to the as-built drawings for your device.
3. For wall installations, mark the centers of the top mounting holes.
4. Drill the appropriate size holes for the screws or concrete studs you are using.
5. Hold the analyzer in place and fasten with the top screws.
6. Repeat for the bottom mounting holes.

Once the analyzer is secured, it is ready for electrical connections.

5.4 Connecting electrical power

Depending on your configuration, your analyzer will be configured for 120 VAC or 240 VAC at 50/60 Hz single-phase input, or optional 24 VDC input. Check the rating label to determine the power input requirements.

The electrical power for the SS2100 analyzer is connected through the conduit hub on the lower right side of the electronics enclosure, and signal wiring is connected through the upper left side of the electronics enclosure. Electrical power for the SS2100 2-pack and 3-pack systems for multiple analytes is connected to the analyzer through the conduit hub(s) located at the bottom right and left of the electronics enclosures. Units with an enclosure heater have an additional power connection through a conduit hub located at the bottom right of the sample conditioning system heated enclosure. Refer to your as-built drawings.

Before connecting electrical power, review and follow all warnings and cautions.

CAUTION

Interconnection of the analyzer enclosure and sample system enclosure shall be accomplished using wiring methods approved for Class 1, Division 2 hazardous locations as per the Canadian Electrical Code (CEC) Appendix J and the National Electric Code (NEC) Article 501, or methods described in the Standard IEC/EN 60079-0 and IEC/EN 60079-14.

- The installer is responsible for complying with all local installation codes.
- Certified glands and cables should be used where appropriate in compliance with local regulations.

Endress+Hauser Class I Division 2 analyzers use a non-incendive protection method, and as such all portions of the local installation codes apply.

- The maximum allowed inductance to resistance ratio (L/R ratio) for the field wiring interface must be less than 25 μH/Ω. The maximum total loop capacitance shall be 0.27 microfarads.
- An approved switch or circuit breaker rated for 15 amps should be used and clearly marked as the disconnecting device for the analyzer.
- The power distribution panel or switch should be located in close proximity to the equipment and within easy reach of the operator. A switch or circuit breaker shall not interrupt a protective earth ground.
- All electrical work must be performed by qualified personnel.

5.4.1 Protective chassis and ground connections

Before connecting any electrical signal or power, the protective and chassis grounds must be connected. Requirements for the protective and chassis grounds are as follows:

- Protective and chassis grounds must be of equal or greater size than any other current-carrying conductors, including the heater located in the sample conditioning system.

- Protective and chassis grounds must remain connected until all other wiring is removed.
- Insulated protective and chassis ground wiring must use the green and yellow color.
- Protective grounding wire current carrying capacity must be at minimum the same as the main supply.
- Earth bonding/chassis ground shall be at least 12 AWG (4 mm^2).

Green-and-yellow insulation shall only be used for:
- Protective earth conductors
- Protective bonding conductors
- Potential equalization conductors for safety purposes
- Functional earth

⚠ WARNING

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

▶ 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 ⏚.

Refer to the following drawings for grounding locations:
- Chassis ground location: external drawing of the SS2100 2-pack and 3-pack →
- Analyzer electronics protective ground locations:
  - H_2S analyzer electronics board (AC) →
  - H_2S analyzer electronics board (DC) →
  - H_2O, NH_3 analyzer electronics board (AC) →
  - H_2O, NH_3 analyzer electronics board (DC) →
  - 2-pack and 3-pack analyzer B (H_2O, CO_2) electronics board (AC) →
  - 2-pack and 3-pack analyzer B (H_2O, CO_2) electronics board (DC) →

5.4.2 Connecting power to the analyzer

Before connecting power, refer to the wiring diagrams in your as-built drawings or Technical data and drawings →.

For SS2100 2-pack and 3-pack systems for multiple analytes, follow the instructions below for analyzer A, the H_2S analyzer. Once complete, follow the connection instructions for analyzer B →, the H_2O or CO_2 analyzer.

⚠ WARNING

Hazardous voltage and risk of electric shock. Failure to properly ground the analyzer may create a high-voltage shock hazard.

▶ Before attaching the wiring to the analyzer, ensure all power to the wires is off. Turn off and lock out system power before opening the electronics enclosure and making any connections.

▶ The 120 VAC or 240 VAC power option is designed for single phase electric power only. The single pole input fuse protection is not designed for split phase electric power input.

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

To connect power to the analyzer

1. Open the SS2100 electronics enclosure door. Take care not to disturb the electrical assembly inside.
2. Run conduit from the power distribution panel to the conduit hub on the analyzer electronics enclosure labeled for power input.
3. Pull wires into the electronics enclosure:
   - **For AC systems:** Pull ground, neutral and hot wires.
   - **For DC systems:** Pull ground, positive and negative wires.
4. Strip back the jacket or insulation of the wires just enough to connect to the power terminal block.
5. Attach the wires to the power terminal block:
   - **For AC systems:**
     a. Connect the neutral wire to the terminal marked “DT4” or “NEU.”
     b. Connect the hot wire to the terminal marked “L1.”
     c. Connect the ground wire to the safety ground terminal marked with ⏚.
   - **For DC systems:**
     a. Connect the negative wire to the terminal marked “-.”

b. Connect the positive wire to the terminal marked “+,” as shown in in the figure below.

c. Connect the ground wire to the safety ground terminal marked with ⏚.

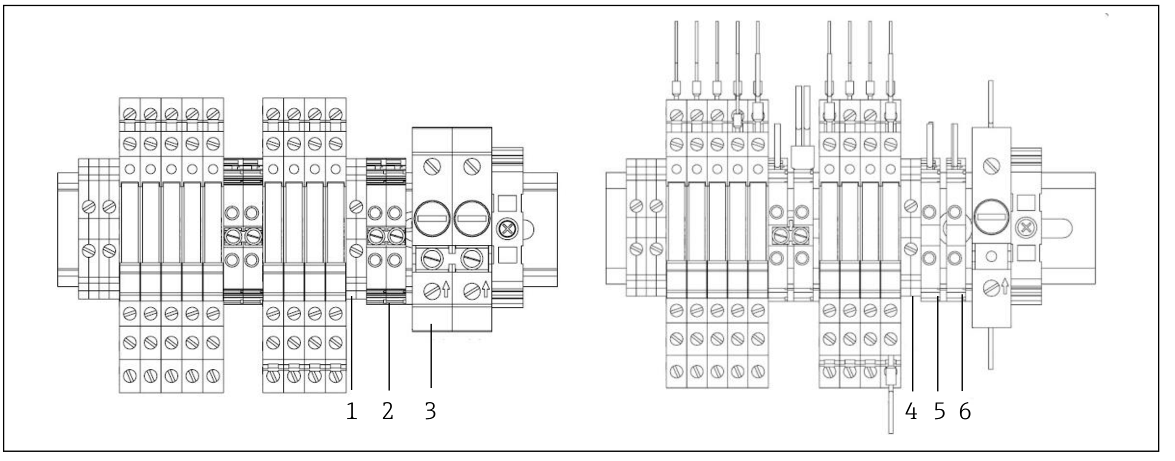


Fig 12. Single phase (120 VAC/240 VAC) connection terminal block (left) and 24 DC connection terminal block (right)

1. *Ground*
2. *Neutral*
3. *Line 1/Hot*
4. *Ground*
5. *Negative (-)*
6. *Positive (+)*

Connecting power to Line 1 also powers solenoids, if included.

6. Apply necessary conduit seals.
7. Close and tighten the analyzer electronics enclosure door.

To connect power to analyzer B for 2-pack and 3-pack systems

⚠ WARNING

Hazardous voltage and risk of electric shock.

- Before attaching the wiring to the analyzer, ensure all power to the wires is off. Turn off and lock out system power before opening the electronics enclosure and making any connections.
- The 120 VAC or 240 VAC power option is designed for single phase electric power only. The single pole input fuse protection is not designed for split phase electric power input.
- Conduit seals should be used where appropriate, and in compliance with local regulations.

1. Open the analyzer B electronics enclosure door. Take care not to disturb the electrical assembly inside.
2. Run conduit from the power distribution panel to the conduit hub on the analyzer B electronics enclosure labeled for power input.
3. Pull wires into the electronics enclosure:
   - **For AC systems:** Pull ground, neutral and hot wires.
   - **For DC systems:** Pull ground, positive and negative wires.
4. Strip back the jacket or insulation of the wires just enough to connect to the power terminal block.
5. Attach the wires to the power terminal block:
   - **For AC systems:**
     a. Connect the neutral wire to the terminal marked “NEU.”
     b. Connect the hot wire to the terminal marked “LINE.”
     c. Connect the ground wire to the safety ground terminal marked with ⏚.
   - **For DC systems:**
     a. Connect the negative wire to the terminal marked “-.”
     b. Connect the positive wire to the terminal marked “+,” as shown in in the figure below.
     c. Connect the ground wire to the safety ground terminal marked with ⏚.

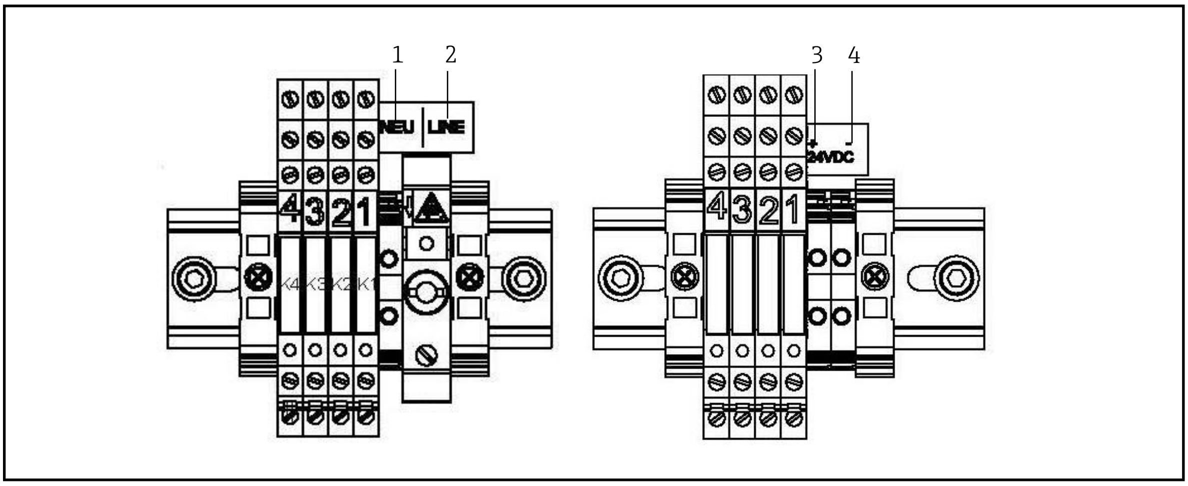


Fig 13. AC (left) and DC (right) connections for the electronics control board terminal block in analyzer B electornics enclosure

1. *Neutral*
2. *Line/Hot*
3. *Positive (+)*
4. *Negative (–)*

6. Close and tighten the analyzer electronics enclosure door.

5.4.3 Connecting power to the sample conditioning system (SCS) enclosure heater

Units with an enclosure heater have an additional power connection through a conduit hub located at the bottom right side of the SCS enclosure. Refer to SS2100 TDLAS Gas Analyzer model types →.

⚠ WARNING

Hazardous voltage and risk of electric shock.

- ▶ Failure to properly ground the analyzer may create a high-voltage shock hazard.
- ▶ Conduit seals should be used where appropriate, and in compliance with local regulations.

⚠ CAUTION

Ensure that power requiments listed on the heater controller match the power supplied to the heater controller.

- ▶ If there is a discrepancy, notify the local authority before connecting power to the heater controller.

To connect electrical power to the enclosure heater

1. Open the heated sample conditioning system (SCS) enclosure door.
2. Open the power terminal box inside the SCS enclosure, as shown below.

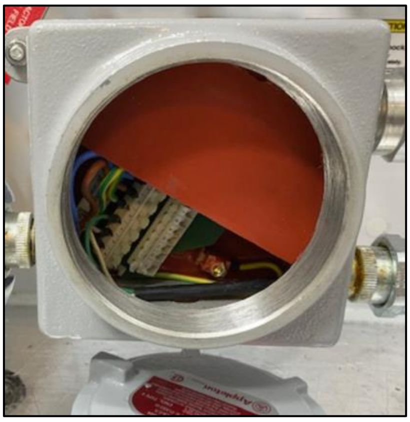


Fig 14. AC connection terminal block for enclosure heater

3. Run conduit from the power distribution panel to the conduit hub on the lower right side of the heater controller enclosure labeled for power input. Refer to Application of conduit lubricant →.

4. Pull ground, neutral and line (hot) wire (#14 AWG minimum) into the power terminal box inside the heater controller enclosure.
5. Strip back the jacket or insulation of the wires just enough to connect to the power terminal block.
6. Attach the neutral and hot wires to power terminals 4, 5, and 6. Terminals 1, 2, and 3 are connected to the heater in the factory.
   a. Connect the ground wire ⏚ to terminal 4.
   b. Connect the neutral wire to terminal 5.
   c. Connect the line (hot) wire to terminal 6, as shown below.

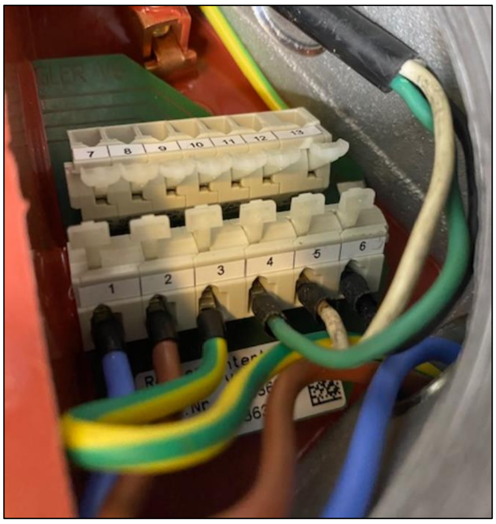


Fig 15. AC connection terminal block for enclosure heater

1. *Blue: neutral*
2. *Brown: line 1/hot*
3. *Green/yellow: ground*
4. *Green: ground*
5. *White: neutral*
6. *Black: line/hot*

7. Close the power terminal box and latch the heated enclosure door.

5.4.4 Application of conduit lubricant

To ensure proper installation, using STL8 thread lubricant on all conduit screw threads and tapped openings is recommended. STL8 thread lubricant is a lithium-based, anti-galling substance with excellent adhesion that maintains rain-tightness and grounding continuity between conduit fittings. This lubricant has proven effective between parts made of dissimilar metals, and is stable in temperatures from −28 °C to 148 °C (−20 °F to 300 °F).

⚠ CAUTION

- ▶ Do not use this lubricant on exposed current-carrying parts.
- ▶ Eyes: May cause minor irritation.
- ▶ Skin: May cause minor irritation.
- ▶ Ingestion: Relatively non-toxic. Ingestion may result in a laxative effect. Ingestion of substantial quantities may cause lithium toxicity.

To apply conduit lubricant

1. Holding the fitting piece at one end, generously apply the STL8 lubricant on the threaded surface (at least five threads wide) as shown below.

Fig 16. Applying conduit lubricant

2. Screw the pipe thread onto the conduit fitting until the lubricated threads are engaged.

5.4.5 Connecting signals and alarms

The SS2100 analyzer uses the 4-20 mA board for signal and alarm communication. The 4-20 mA current loop and serial output are connected to terminal blocks (TB2) located inside the analyzer electronics enclosure (refer to the drawing Terminal block TB2 →).

The **Assignable Alarm** and **General Fault Alarm** trigger SPDT relays are located inside the analyzer electronics enclosure as shown in Technical data and drawings →.

The **General Fault Alarm** relay for each channel is configured to be fail-safe (normally energized) so the dry contact will open in the event of power loss or **General Fault Alarm**. Thus, the cables for each General Fault Alarm should be wired to the common and NO terminals.

By default, the relay for the **Assignable Alarm** is the normally de-energized **Concentra Low Alarm** with the dry contact changing state on alarm. Refer to *DO Alarm Setup* in the Description of Device Parameters → to change the **Assignable Alarm** configuration. The Assignable Alarm output can be wired for OPEN or CLOSED depending on which terminals are used normally open (NO) or normally closed (NC).

Connections can be made with customer-supplied cables for the current loops and alarms and factory-supplied cables for the serial connections. Consult the wiring diagram in Technical data and drawings → or your as-built drawings.

Signals and alarms in the 2-pack and 3-pack analyzer systems

In the SS2100 2-pack and 3-pack systems for multiple analytes, the **Concentra High Alarm** (analyzer A), **Assignable Alarm** (analyzer B) and **General Fault Alarm** trigger SPDT relays are located inside the respective analyzer electronics enclosures.

The relays for the **Concentration High Alarm** (analyzer A for H_2S) and **Assignable Alarm** (analyzer B for H_2O/CO_2) are configured to be normally de-energized with the dry contact changing state on alarm. The **Concentration High Alarm** (H_2S) and **Assignable Alarm** (H_2O/CO_2) outputs can be wired for OPEN or CLOSED depending on which terminals are used normally open (NO) or normally closed (NC).

For SS2100 2-pack and 3-pack systems for multiple analytes, follow the instructions below to connect signals and alarms for analyzer A. Once complete, follow the instructions for connecting alarms and signals for analyzer B.

⚠ CAUTION

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, refer to 4-20 mA board adjustments →.

Hazardous voltage and risk of electric shock.

▶ Ensure power to the analyzer is turned off before opening the electronics enclosure and making any connections.
▶ Certified glands and cables should be used where appropriate in compliance with local regulations.
▶ Conduit seals should be used where appropriate in compliance with local regulations.

To connect the signal and alarm cables

1. Disconnect power from 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 input/output. Refer to Application of conduit lubricant → and your as-built drawings or Technical data and drawings →.
3. Pull the following customer-supplied cables into the enclosure:
   - Current loop
   - Alarms
   - Digital input
   - Ethernet
   - Serial cable

   No connections are required for the analyzer to run and function properly. Only make connections for signals that will be used for communication with the analyzer.

   The external serial cable included in the shipping container is provided for service and troubleshooting purposes and is not intended for permanent installation.
4. Strip back the jacket and insulation of the current loop output and serial cables just enough to connect to the terminal block. The terminal block can be pulled up and removed from its base to make the cable connection process easier.

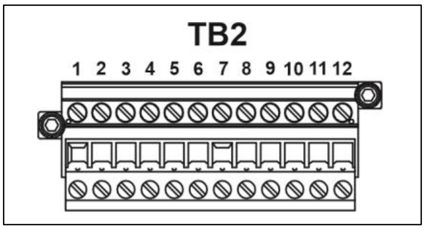


Fig 17. Terminal block TB2 in electronics enclosure for signal cable connection

5. Connect the 4-20 mA current loop signal wires to the appropriate terminals, as indicated in the table below.

Terminal	Description	D-Conn	Color
1	Serial RX (analyzer A)	Pin-3	Black
2	Serial TX (analyzer A)	Pin-2	Red
3	COM Serial Ground	Pin-5	Shield
4	N/C[1]		
5	N/C[1]		
6	N/C[1]		
7	Current Loop + (CH A)		
8	Current Loop - (CH A)		
9	Current Loop + (CH B)		
10	Current Loop - (CH B)		
11	Digital Input		
12	Digital Input		

[1] N/C = No connection

6. Connect the serial cable wires to the appropriate terminals according to the above table. For reference, the table also shows the corresponding pin numbers for configuring a nine-pin Sub-D connector for connection to a computer serial port.
7. Re-insert the terminal block into its base and verify that each connection is secure.
8. Strip back the jacket and insulation of the alarm cables just enough to connect to the alarm relays.
9. Connect the cables:
   - **General Fault Alarm:** connect to the common and normally open (NO) terminals on the corresponding relay shown in your as-built drawings or Drawings →.
   - **Assignable Alarm:** connect to the common and NO or normally closed (NC) terminals (for OPEN or CLOSED, respectively, when activated) on the corresponding relay shown in your as-built drawings or Drawings →.
   - **Concentra High Alarm:** connect to the common and NO or normally closed (NC) terminals (for OPEN or CLOSED, respectively, when activated) on the corresponding relay shown in your as-built drawings or Drawings →.
10. Close and tighten the electronics enclosure cover.
11. To complete the connections, connect the other end of the current loop wires to a current loop receiver, the external serial cable to a serial port on your computer and the alarm cables to the appropriate alarm monitors.

To connect the signal and alarm cables for analyzer B for 2-pack and 3-pack systems

1. Disconnect power from 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 in the upper right-hand corner of the analyzer B electronics enclosure labeled for signal input/output. Refer to Application of conduit lubricant → and your as-built drawings or Technical data and drawings →.
3. Pull the following customer-supplied cables into the enclosure:
   - Current loop
   - Alarms

   The external serial cable included in the shipping container is provided for service and troubleshooting purposes and is not intended for permanent installation.
4. Strip back the jacket and insulation of the current loop output and serial cables just enough to connect to the terminal block. The terminal block can be pulled up and removed from its base to make the cable connection process easier.

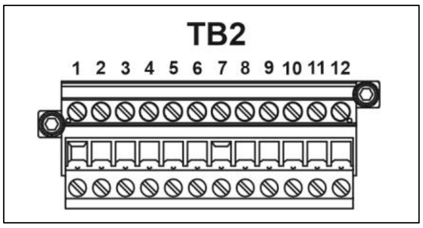


Fig 18. Terminal block TB2 in electronics enclosure for signal cable connection

5. Connect the 4-20 mA current loop signal wires to the appropriate terminals, as indicated in the table below.

Terminal	Description	D-Conn	Color
2 and 3-pack, and 3-pack + OXY5500 system signal and alarm connections (analyzer B)			
1	Serial RX (CH A)	Pin-3	Black
2	Serial TX (CH A)	Pin-2	Red
3	COM Serial Ground (CH A)	Pin-5	Shield
4	Serial RX (CH B)	Pin-3	Black
5	Serial TX (CH B)	Pin-2	Red

Terminal	Description	D-Conn	Color
6	Serial Ground (CH B)	Pin-5	Shield
7	Current Loop + (CH A)		
8	Current Loop – (CH A)		
9	Current Loop Ground (CH A)		
10	Current Loop + (CH B)		
11	Current Loop – (CH B)		
12	Current Loop Ground (CH B)		

6. Connect the serial cable wires to the appropriate terminals according to the above table. For reference, the table also shows the corresponding pin numbers for configuring a nine-pin Sub-D connector for connection to a computer serial port.
7. Re-insert the terminal block into its base and verify that each connection is secure.
8. Strip back the jacket and insulation of the alarm cables just enough to connect to the alarm relays.
9. Connect the cables:
   - **General Fault Alarm:** connect to the common and normally open (NO) terminals on the corresponding relay shown in your as-built drawings or Drawings →.
   - **Assignable Alarm:** connect to the common and NO or normally closed (NC) terminals (for OPEN or CLOSED, respectively, when activated) on the corresponding relay shown in your as-built drawings or Drawings →.
10. Close and tighten the electronics enclosure cover.
11. To complete the connections, connect the other end of the current loop wires to a current loop receiver, the external serial cable to a serial port on your computer and the alarm cables to the appropriate alarm monitors.

Refer to the Description of Device Parameters → for setting up the optional Ethernet connection if installed. In rare cases, adjusting the 4-20 mA board may be needed before continuing connections. Refer to 4-20 mA board adjustments →.

5.4.6 Heat trace bundle sleeve

The heat trace bundle sleeve, manufactured by others, is an option for the SS2100 analyzer and 2-pack system. When heat trace is ordered as an option for the SCS, the following is provided:

- A conduit hole sized for a ¾ in hub, sealed with a Type 4X Hoffman plug
- A heat trace bundle sleeve for the heat trace bundle to enter the SCS

NOTICE

- ▶ The customer is responsible for installing the heated tube bundle according to the manufacturer's instructions.
- ▶ All electrical connections must be made in a junction box supplied by the customer and installed external to the SCS enclosure per site requirements.
- ▶ Interconnection of the heat trace bundle and enclosure shall be accomplished using wiring methods approved for Class I, Division 2 hazardous locations as per the Canadian Electrical Code (CEC) Appendix J and the National Electric Code (NEC) Article 501, or methods described in the Standard IEC/EN 60079-0 and IEC/EN 60079-14. The installer is responsible for complying with all local installation codes.

The heat-shrinkable entry seal Model NUS-4X supplied by Endress+Hauser provides a waterproof fitting where the heat trace bundle enters the SCS enclosure. This seal consists of a three-part assembly; a rigid plastic nylon nut, an O-ring and the heat-shrinkable molded area.

Tools needed

- Adjustable spanner wrench
- Heat gun
- RTV sealant
- Cable cutter

To install the heated line seal

1. From the inside of the enclosure, place the rigid plastic nylon threaded nut through the access hole to the exterior so that the nut flanged end is up against the inside of the enclosure.
2. From the outside of the enclosure, place the O-ring over the nut threaded end and position against the enclosure.
3. Screw the shrinkable, internally threaded nose onto the rigid nut and tighten using an appropriate sized spanner wrench.

Refer to the heat trace bundle manufacturer website for instructions on installing the heat trace bundle.

5.5 Connecting the gas lines

Once you have verified that the analyzer is functional and that the analyzer circuit is de-energized, you are ready to connect the sample and return gas lines. These include:

- Supply line
- Sample bypass return
- Sample return
- Pressure relief vent, if applicable
- Validation source, if applicable
- Purge supply, if applicable
- Instrument air supply

Consult your as-built drawings and the drawings in Technical data and drawings →🖹 for guidance.

⚠ WARNING

Process samples may contain hazardous material in potentially flammable and 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.
- ▶ All following work must be performed by technicians qualified in pneumatic tubing.

Using electro-plated coated ¼ in O.D x 0.035 in wall thickness, seamless stainless steel tubing is recommended. The SS2100 for trace analytes utilize SilcoTek SN2000 coated tubing. SN2000-coated tubes may be used for the sample supply. Coated tubing is not needed for instrument air, nitrogen, or sample return. Refer to your as-built drawings or Technical data and drawings →🖹 for supply and return port locations.

5.5.1 Instrument air

In the SS2100 TDLAS Gas Analyzer, instrument air or nitrogen is used for two purposes:

- Pnuematically drives air-operated solenoid valves in the SCS
- If safety purge option is installed, instrument air or nitrogen purges the SCS

When air-operated valves are used in the analyzer, they should be supplied with instrument air or nitrogen filtered with a 5 micron particulate filter. If lubrication oil, aerosols, or other liquids are present in the air, they must be removed using an appropriate coalescing filter.

Pressure should be set within the range indicated on the analyzer tag at the instrument air inlet. Refer to the specifications and system drawings in your as-built drawings or Technical data and drawings →🖹. If no pressure setting is listed, pressure should be maintained between 4.5 barg (65 psig) and 10.34 barg (150 psig).

There are no special requirements for ventilation of the analyzer. Refer to SS2100 TDLAS Gas Analyzer Maintenance →🖹 and Instrument troubleshooting →🖹 for more information related to maintenance or troubleshooting.

5.5.2 Connecting the sample supply line

⚠ WARNING

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 sample reducing pressure regulator.
- ▶ Consult sample probe manufacturer instructions for proper installation procedures.
- ▶ All valves, regulators, switches, etc. should be operated in accordance with site lockout/tagout procedures.
- ▶ Do not exceed 0.7 barg (10 psig) in the sample cell. Damage to cell may result.

Preparing to connect the sample supply line

Before connecting the sample supply line, do the following:

- Ensure the sample probe is correctly installed at the process supply tap.
- Confirm the sample probe isolation valve is closed.
- Confirm the field pressure reducing station is installed properly at the sample probe.
- Ensure the pressure regulator at the field pressure reducing station is closed (adjustment knob turned fully counterclockwise) and the relief valve vent line is properly installed to the low pressure flare or atmospheric vent connection.
- Determine an appropriate tubing route from the field pressure reducing station to the SCS.
- Ensure the field pressure reducing station is set to the specified supply pressure in your as-built drawings or Technical data and drawings →.

To connect the sample supply line

1. Run silco-coated (as applicable), stainless steel tubing from the field pressure reducing station to the sample supply port of the SCS.
2. Prepare the stainless steel tubing:
   - Bend tubing using industrial grade benders.
   - Check tubing fit to ensure proper seating between the tubing and fittings.
   - Fully ream all tubing ends.
3. Blow out the line for 10 to 15 seconds with clean, dry nitrogen or air.
4. Connect the sample supply tube to the SCS using the ¼ in stainless steel compression-type fitting provided.
5. When using a heat trace sample bundle, refer to manufacturer instructions for heat trace bundle installation.
6. Secure and tighten fittings:
   - Tighten all new fittings 1¼ 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.
7. Check all connections for gas leaks using a liquid leak detector.

5.5.3 Connecting the sample return line

⚠ CAUTION

- ▶ All valves, regulators, switches, etc. should be operated in accordance with site lockout/tagout procedures.
- ▶ Do not exceed 0.7 barg (10 psig) in the sample cell. Damage to cell may result.

Preparing to connect the sample return line

Before connecting the sample supply line, do the following:

- ▶ Confirm that the low pressure flare or atmospheric vent header shut-off valve is closed.
- ▶ Determine appropriate tubing route from the SCS to the low pressure flare or atmospheric vent header.

To connect the sample returns

1. Run stainless steel tubing from the sample return ports to the low pressure flare or atmospheric vent header connection.

2. Prepare the stainless steel tubing:
   - Bend tubing using industrial grade benders.
   - Check tubing fit to ensure proper seating between the tubing and fittings.
   - Fully ream all tubing ends.
3. Blow out the line for 10 to 15 seconds with clean, dry nitrogen or air.
4. Connect the sample return tubes to the SCS using the ½ in or ¼ in stainless steel compression-type fittings provided.

   In certain applications, vents from the analyzer system (relief vent/bypass vent/cell vent) may have individual ¼ in tubing connections. These vents should be routed to an atmospheric vent or low pressure flare header. In other applications, the previously mentioned analyzer system vents are routed to a common ½ in tubing connection within the sample conditioning system. This common vent should be routed to an atmospheric vent or low pressure flare header.

5. Secure and tighten fittings:
   - Tighten all new fittings 1 ¼ 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 using a liquid leak detector.
7. Vent any pressure relief vent ports (if applicable) and DBB valve vent ports (if applicable) in a similar fashion when the unit is in use.

5.5.4 Connecting the pneumatic valve source (when applicable)

Preparing to connect the pneumatic valve source

Before connecting the sample supply line, determine an appropriate tubing route from the customer-supplied instrumentation air or nitrogen control gas source to the SCS. Expected pressure at SCS shall be between 4.1 barg (60 psig) to 6.9 (80 psig).

To connect the pneumatic valve source

1. Run stainless steel tubing from the customer supplied regulator (3.4 barg [50 psig] minimum to 6.9 barg [100 psig] maximum) to the pneumatic valve instrument air supply port.
2. Prepare the stainless steel tubing:
   - Bend tubing using industrial grade benders.
   - Check tubing fit to ensure proper seating between the tubing and fittings.
   - Fully ream all tubing ends.
3. Blow out the lines for 10 to 15 seconds with clean, dry nitrogen or air prior to making the connection.
4. Connect the control gas tube to the SCS using the ¼ in stainless steel compression-type union fitting provided.
5. Secure and tighten fittings:
   - Tighten all new fittings 1 ¼ 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 using a liquid leak detector.

5.5.5 Connecting the bypass return

⚠ CAUTION

- ▶ Refer to the as-built drawings to determine if this procedure is applicable to your configuration.
- ▶ All valves, regulators, switches, etc. should be operated in accordance with site lockout/tagout procedures.
- ▶ Do not exceed 0.7 barg (10 psig) in the sample cell. Damage to cell may result.

Preparing to connect the bypass return

Before connecting the sample supply line, do the following:

- ▶ Confirm that the low pressure flare or atmospheric vent header shut-off valve is closed.
- ▶ Determine appropriate tubing route from the SCS to the low pressure flare or atmospheric vent header.

To connect the bypass return

1. Run stainless steel tubing from the sample return ports to the low pressure flare or atmospheric vent header connection.
2. Prepare the stainless steel tubing:
   - Bend tubing using industrial grade benders.
   - Check tubing fit to ensure proper seating between the tubing and fittings.
   - Fully ream all tubing ends.
3. Blow out the line for 10 to 15 seconds with clean, dry nitrogen or air.
4. Connect the sample return tubes to the SCS using the ¼ in stainless steel compression-type fittings provided.
5. Secure and tighten fittings:
   - Tighten all new fittings 1 ¼ 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 using a liquid leak detector.
7. Ensure all pressure relief vent ports are vented in a similar fashion when the unit is in use (if applicable).

5.5.6 Connecting the validation gas

For systems with an optional manual validation port and without a permeation validation system, an appropriate validation gas source will need to be connected to the SCS.

⚠ CAUTION

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

Preparing to connect the validation gas

Before connecting the validation gas, determine appropriate tubing route from the customer-supplied validation gas source to the SCS.

To connect the validation gas

1. Run stainless steel tubing from the validation source (regulated to the specified pressure) to the “Validation Gas” supply port.
2. Prepare the stainless steel tubing:
   - Bend tubing using industrial grade benders.
   - Check tubing fit to ensure proper seating between the tubing and fittings.
   - Ream all tubing ends.
3. Blow out the lines for 10–15 seconds with clean, dry nitrogen or air prior to making the connection.
4. Connect the validation source tube to the SCS using the ¼ in stainless steel compression-type fittings provided.
5. Secure and tighten fittings:
   - Tighten all new fittings 1 ¼ 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 using a liquid leak detector.
7. Repeat for additional validation gases (if applicable).

5.5.7 Conditioning the SCS tubing

Newly installed systems may have trace contaminants or gas constituents that cling to tubing. When measuring trace amounts of gas constituents, these contaminants can result in erroneous readings if the constituents are not in equilibrium with the tubing.

Once the analyzer and SCS are completely connected, the entire system must be conditioned from the sample source valve to the vent or return. Conditioning the SCS tubing is performed by flowing sample gas through the system for up to 12 hours (or until the reading stabilizes) after the system is powered up and before actual readings are taken.

Progress of the system conditioning can be monitored from the gas concentration readings. Once the gas constituents have reached equilibrium within the system tubing, the readings stabilize. For more information on the sample conditioning system, refer to Sample conditioning system →.

6 Sample conditioning system

The sample conditioning system (SCS) is designed to deliver a vapor sample that is free of particulates and liquids and is representative of the process at the time of sampling to the analyzer. The SCS also delivers the sample at optimal temperature, pressure and flow rate to the measurement cell. 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 operating or maintaining the analyzer must have a thorough understanding of the design and function of the SCS.

⚠ WARNING

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 sample conditioning system at a low pressure.
- ▶ Use extreme caution when operating the sample probe isolation valve and field pressure reducing regulator.
- ▶ Personnel should have a thorough understanding of the operation of the analyzer and the procedures presented here before operating the sample conditioning system (SCS).

Process upsets, unknown or unexpectedly high concentrations of liquids or particulate contaminants, high or low sample pressures or temperatures can cause excessive maintenance, failure of the SCS, or damage to the analyzer measurement cell. By understanding the function and limitations of each component in the SCS and performing regular monitoring of the system function, most problems can be avoided or diagnosed and corrected to ensure normal operation.

⚠ CAUTION

Process samples may contain hazardous material in potentially flammable and 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.

6.1 Sample conditioning system overview

Endress+Hauser TDLAS gas analyzers are designed for extractive sampling rather than in situ applications. This allows for filtration, temperature, pressure and flow control of the sample to protect the optical components of the system, and provides for ease of maintenance without shutting down the process.

Components used in the SCS are described in this section. Please refer to as-built drawings and Technical data and drawings → for system drawings for your analyzer configuration. If there are any remaining questions concerning the design, operation, or maintenance of the SCS, contact Service →.

Endress+Hauser sample conditioning systems are designed to filter incoming gas, as well as control pressure and flow to the analyzer. The SCS uses a 7 micron particulate filter and a membrane separator that removes entrained liquids or particles from the natural gas stream before they enter the analyzer. Because Endress+Hauser analyzers are immune to vapor phase contaminants found in natural gas, using the particulate filter and membrane separator prevents any contamination of the analyzer.

The membrane separator is a three-port device operating on most analyzers except the SS2100 for trace moisture and ammonia. When gas enters the separator inlet, only the vapors will pass through the membrane to the outlet. The outlet flow passes through a flow control valve and a flow meter to the analyzer. Blocked liquids or particles can be flushed from the separator housing out the bypass port.

If the correct probe and regulator is used at the sample extraction point, and the sample transport line is heated to prevent condensation, no liquids or particles should reach the SCS. Under normal conditions, the membrane separator will remove very little liquid, if any. The main purpose of the separator will be to protect the analyzer in the case of an upset condition.

Besides filtering the incoming gas, the SCS is also responsible for controlling flow and pressure to the analyzer. An instrument grade pressure regulator is used to set the final pressure of the gas before it enters the analyzer. There is one flow meter for the flow path to the analyzer and one flow meter for the flow path of the bypass. The flow meters have a built-in flow controller to set flow rates to the recommended values (see SS2100 specifications → for proper flow and pressure settings).

Typically the SCS is assembled inside a stainless steel enclosure which is insulated and heated using a temperature controller. This ensures that the sample remains in a stable vapor phase and improves the measurement performance.

In some cases other types of components are included in the SCS, such as coalescing filters, liquid knock-outs, pumps, heaters, and other components that are application dependent. Refer to Drawings → for a general overview of the system configuration.

6.1.1 Sample regulators at the probe

The pressure of the sample gas is reduced at the sample probe, or sometimes reduced in the probe itself, to minimize transport lag time in sample delivery to the analyzer. A guard filter is used to protect the regulator from larger particulates in the sample.

Refer to the following diagram showing the interface of the probe and the analyzer system. The analyzer system provided by Endress+Hauser is represented by the blue dashed outline. The probe and field pressure reducing station may also be supplied by Endress+Hauser, but is separate from the analyzer system.

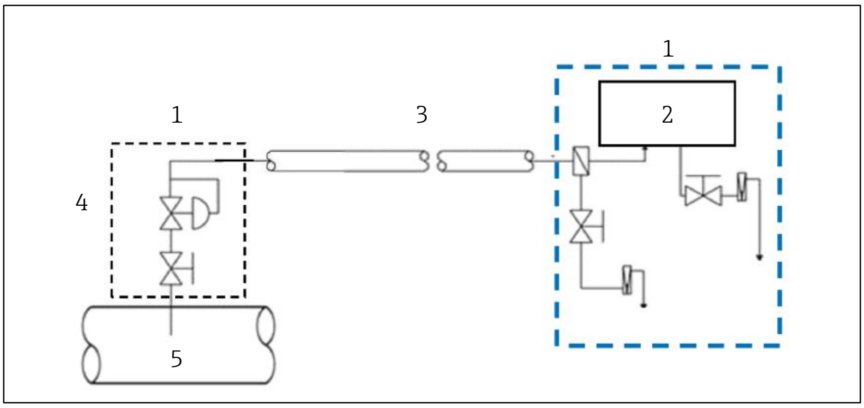


Fig 19. Sample regulators at probe

1. *Heated enclosure*
2. *Endress+Hauser TDLAS Gas Analyzer*
3. *Heat trace*
4. *Regulator*
5. *Probe*

6.1.2 Sample conditioning system filters

A guard filter is typically installed at the inlet to the SCS with a fine element to protect the flow controllers, flow meters and pressure regulators from fine particulates.

A bypass filter with a fritted metal, glass fiber or polymetric membrane filter may also be in place to remove larger quantities of particulates or entrained liquids and mists. Some filters may fit with liquid knock-out traps to protect the system from free liquids.

Accumulation of liquids in these filters, or a steady flow of liquid from a liquid knock-out trap, should be investigated and corrected immediately as this is generally an abnormal condition.

6.1.3 Sample regulator heaters

In most applications, the process sample is at high pressure. When the pressure is reduced, the sample cools due to the Joule-Thompson effect. The amount of cooling varies greatly depending on the application, but oftentimes must be offset using a heated sample regulator to prevent condensation of some sample components. Sample probe regulators can be electrically or steam heated. Some probes have the pressure reducing valve parts inserted into the process piping, so that the Joule-Thompson cooling is offset by warming from the flowing sample. Note that for these probes to work correctly, the process gas must be flowing anytime the sample is flowing or liquid condensation may collect in the sample transport line, or even freeze up the sample probe regulator. Refer to the as-built drawings for the proper regulator pressure setting.

6.1.4 Sample transport tubing

Sample transport tubing must be made of an appropriate material, which may be coated, and of an appropriate diameter for the application. The sample transport tubing may be heat-traced to prevent sample condensation or to prevent fluctuations in measurement due to changes in ambient temperature.

6.1.5 Sample bypass flow control

A sample flow control valve and flow meter are provided to maintain a flow of fresh sample to the SCS even during system shut-down. The flow control valve is a needle valve and should be closed very gently and carefully if used to shut off flow completely to avoid damaging the valve. If the bypass flow meter has a glass tube, perform an occasional check for evidence of liquid in the tube. If liquid is found in the bypass or sample cell flow meter tubes, investigate and correct immediately.

6.1.6 SCS pressure regulator

All Endress+Hauser TDL cells are limited to a maximum 0.7 barg (10 psig) pressure. To ensure that this pressure is not exceeded, a pressure regulator is provided inside the sample system.

6.1.7 Sample flow controller

A sample flow controller is provided with the SCS in which a flow control needle valve and flow meter similar to the sample bypass are used. Typically a flow control needle valve and flow meter similar to the sample bypass are used, but in some cases a differential flow controller is used. As with the bypass flow control valve, if the flow control needle valve and flow meter must be used for sample shut-off, close the valve gently and carefully to avoid damage.

6.1.8 Scrubber

All trace measurement applications require the use of a scrubber. Typically, these devices are switched into the flowing sample going to the measurement cell to remove the trace moisture component. A spectrum of the sample gas free of H_2O is acquired and saved in the analyzer controller memory. This is the “dry” spectrum. The scrubber is then bypassed and the sample spectrum is acquired with H_2O in the sample. This is the “wet” spectrum. The analyzer controller subtracts the dry spectrum from the wet spectrum and the concentration of trace moisture is measured. The same dry spectrum is typically used for 10 to 30 minutes, depending on logic programmed into the controller before a new dry spectrum is acquired.

The automatic valves that control switching the sample stream into the scrubber or bypassing the scrubber are pneumatically operated valves.

6.1.9 Validation systems

System validation is accomplished in the SS2100 trace moisture and trace ammonia analyzer by the use of a permeation device. Refer to Validation for trace moisture (H_2O) or ammonia (NH_3) analyzers →.

6.1.10 Sample return and vent

Tunable diode laser spectroscopy is inherently sensitive to sample pressure in the measurement cell, so all Endress+Hauser analyzers are calibrated for a range of sample pressures. Most applications benefit from operation at low pressures instead of high pressures. Sometimes the analyzer is designed to vent the sample to atmosphere or an atmospheric pressure return system. Return to a flare or other sample return must recognize the pressure limitations of the cell and also the calibration of the analyzer.

6.1.11 SCS heaters

Differential analyzers have heated SCS enclosures. One reason for this is to avoid condensation of sample components. In cases such as trace measurements, temperature stability of the sample measurement cell is critical to the measurement. In these applications, the temperature control is very precise and a PID temperature controller is used to maintain very close tolerance on the temperature of the system.

6.2 Checking the SCS installation

The integral SCS is factory set with the appropriate pressures, flow rates, and enclosure temperature, as indicated in the as-built drawings or Technical data and drawings →. However, 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. Purging the transport line to confirm that no dust, particulates or liquids were trapped during installation is recommended.

To perform SCS installation checks, confirm the following:

- If a sample probe is used with the analyzer, the sample probe is correctly installed at the process supply tap and that the sample probe isolation valve is closed.
- If a field pressure reducing station is used with the analyzer, the field pressure reducing station is installed properly at the sample probe.

  An optional sample probe or field pressure reducing station may be provided by Endress+Hauser or through a third party. This is not included in a standard configuration.

- 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 has been preset at the factory, the setpoint must be confirmed prior to operation of the sample system. To confirm the relief valve setting, refer to Relief valve setting →.

- The relief valve vent line is properly installed from the field pressure reducing station or the SCS to the low pressure flare or atmospheric connection.
  - ► Route a ¼ in tube from the relief valve vent to an atmospheric vent or low pressure flare vent.
- If applicable, the sample probe and field pressure reducing station are properly heat-traced and insulated without any exposed surfaces.
- The field run electric heat-traced sample transport tubing is installed correctly:
  - ► There is no exposed tubing or pockets.
  - ► Tubing is terminated properly at each end.
  - ► Tubing has been purged clean and pressure tested.
- All valves are closed and all switches are off.
- Power is available to:
  - ► Electrically traced sample tubing (if applicable)
  - ► Analyzer
  - ► SCS
- Local switches are off.
- The field analog and alarm signal wiring is interconnected properly (see Connecting signals and alarms →).
- The low pressure flare or atmospheric vent is properly connected, if applicable.

  In certain applications, vents from the analyzer system (relief vent/bypass vent/cell vent) may have individual ¼ in tubing connections. These vents should be routed to an atmospheric vent or low pressure flare header. In other applications, the previously mentioned analyzer system vents are routed to a common ½ in tubing connection within the sample conditioning system. This common vent should be routed to an atmospheric vent or low pressure flare header.

- The analyzer house atmospheric vent is properly installed.
- All sample system tubing has been thoroughly leak checked.

6.3 Starting up the SCS

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

NOTICE

- Personnel should have a thorough understanding of the operation of the tracer power supply and control system before operating the SCS.
- Do not overtighten the metering valves or damage could occur.
- For trace H_2O and NH_3 systems, refer to Permeation validation → for additional information.

To prepare for SCS startup, confirm the following power and gas supplies are closed or off:

- All AC power switches for the analyzer and SCS are off.
- Power to the electric-traced sample transport tubing at the tracer control system is applied.
- If applicable, the sample supply line electric tracer temperature controller at the tracer control system is set to the temperature specified in the as-built drawings and that the sample supply line tracer is heating to the appropriate temperature.
- The sample probe isolation valve is closed.
- The pressure regulator at the field pressure reducing station is closed (adjustment knob turned fully counterclockwise).
- All sample system shut-off valves are closed.
- Sample bypass and analyzer flow meter metering valves are closed (adjustment knob turned clockwise).

6.3.1 Starting heating components

CAUTION

- The SCS enclosure door should remain closed during the entire start-up procedure.
- If the SCS enclosure exceeds 65 °C (149 °F), damage to the system can occur. **Shut down the system immediately.**
- The entire analyzer system is calibrated for operation at the enclosure temperature specified. Measurements should be considered valid only when the enclosure is at the specified temperature.

To start up the sample system heater

1. Turn on AC power to the sample system heater.
2. Monitor the SCS enclosure thermometer during the warm-up period for 5 to 8 hours to confirm that the sample system enclosure temperature does not exceed 65 °C (149 °F).

To start up the heated trace SCS

1. Energize power to the SCS and allow it to warm up to a level close to the SCS sample temperature setpoint.
2. Start the sample flow.
3. Allow the system temperature to stabilize for a minimum of 5 to 8 hours, preferably overnight.
4. Energize power to the analyzer controller and ignore any error messages that are seen on the display during the temperature stabilization period.
5. Once the analyzer has been allowed to thermally stabilize, be sure to enable Peak Tracking and any other software features as directed in the Description of Device Parameters →.

6.3.2 Starting the field pressure reducing station

A field pressure reducing station or sample probe may be provided by Endress+Hauser or through a third party. This is not included in a standard configuration. Refer to manufacturer's instructions for starting the field pressure reducing station.

CAUTION

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. Although the exact supply pressure

setpoint is not critical, the pressure at the sample system should be within 0.35 barg (5 psig) of the specified supply pressure setpoint.

- If the pressure at the SCS under flowing conditions is not sufficiently close to the specified setpoint, readjust the pressure regulator setpoint at the field pressure reducing station. This will provide the required supply pressure with the specified sample bypass flow.

6.3.3 Starting the process sample

To start up the sample bypass stream on process sample

1. Ensure the low pressure flare or atmospheric vent header shut-off valve is opened for the bypass flow effluent from the SCS.
2. Open the sample supply shut-off valve.
3. Open the bypass flow meter control valve to establish sample flow from the sample probe and set the flow meter control valve to the specified value. Refer to your as-built drawings or Drawings →.

   ⚠ CAUTION

   - Do not open the cell flow meter at this point.

4. Confirm that the sample supply pressure under flowing conditions is set to the approximate specified pressure. Refer to the as-built drawings or Technical data and drawings →.

⚠ CAUTION

- Check the flow meter to ensure no liquid, solids, etc. are flowing through the bypass valve. If substances are present, shut down the system and purge the lines.

To start up the analyzer on process sample

⚠ CAUTION

- Do not adjust the pressure regulator, flow controllers, or temperature of the SCS if red-tagged or the calibration of the validation flow will be lost. If you suspect the settings of the sample conditioning system have been altered, refer to Service →.
- 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, refer to Service →.

This procedure can be completed during the system warm-up process.

1. Ensure the low pressure flare or atmospheric vent header shut-off valve is opened for the sample flow effluent from the SCS.
2. Open the cell supply and cell return shut-off valves. Refer to your as-built drawings for exact locations.

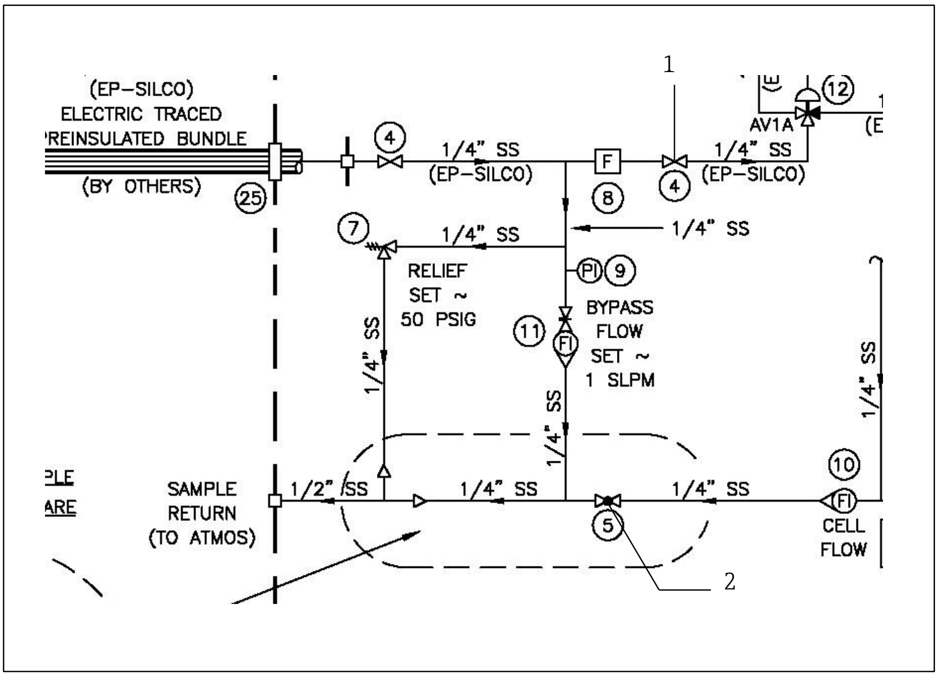


Fig 20. Cell supply and return shut-off valves

1. *Cell supply shut-off valve*
2. *Cell supply return*

3. If required, adjust each sample pressure regulator to the specified setpoint for each measurement cell.
4. Adjust the sample flow meter control valve(s) to the specified flows for the measurement cells.

   The adjustment setpoints of the analyzer flow meters and pressure regulators are iterative and may require readjustment multiple times until the final setpoints are obtained.

5. Confirm the sample flow and pressure setpoints. Re-adjust the metering valves and pressure regulator at the field pressure reducing station to the specified setpoints, if necessary.
6. Confirm the sample bypass flow and readjust the control/bypass metering valve to the specified setpoint, if necessary.

   The SCS is now operating with the process sample.

7. Power up the analyzers according to the procedure provided under *Powering up the analyzer* in the Description of Device Parameters →.

   CAUTION

   ▶ Allow the system a minimum of 5 to 8 hours (preferably overnight) to ensure stabilization. During this time, the system will emit a variety of alarms. This is normal. If the alarms do not resolve themselves by the end of the warm-up period, contact Service →.

8. After sufficient warm-up time, confirm that the sample system enclosure is heated to the specified temperature (see your as-built drawings or Technical data and drawings →) by observing the temperature reading on the analyzer display.

7 Validation for trace moisture (H_2O) or ammonia (NH_3) analyzers

The information contained in this chapter is provided for systems designed to detect moisture or ammonia. Permeation validation is available on all trace measurement systems, including trace moisture and ammonia.

7.1 Validation methods

Endress+Hauser's TDLAS gas analyzers use one of two methods to validate low moisture or ammonia measurements; a permeation validation system and a dynamic dilution.

Permeation validation systems provide a convenient and reliable method of validating the performance of the analyzer, without the need for elaborate blending systems and certified standards that might be impossible to obtain in the field. However, the analyzer accuracy and repeatability is not based on, certified, or tested using the installed permeation device. Endress+Hauser has found that permeation devices generally do not generate more stable, repeatable or accurate trace moisture or ammonia mixes than the dynamic dilution stations used in our factory to calibrate the analyzer.

In a dynamic dilution, a certified blend of gas can be diluted using precision flow controllers to produce the desired concentration of trace moisture or ammonia in the actual sample gas.

The concentration measured during calibration, Cp, is related to the certified permeation rate of the device, Rp, by a system constant, Kp, using the equation:

Kp = Cp/Rp

This equation requires that the following conditions be met:

- Sample temperature is stable and equal to the temperature at calibration
- Sample flow is stable and equal to the flow at calibration
- Sample pressure at the permeation device is stable and equal to the pressure at calibration

Setting the Kp value

The system constant Kp is determined at the factory when the analyzer is calibrated. Using the system constant, the permeation device can be replaced with another permeation device using a different permeation rate, and the correct new permeation concentration will be calculated by the analyzer software. The system constant Kp will be consistent over the life of the analyzer provided the temperature, sample flow rate and pressure of the system are not changed from the factory settings. Refer to the Description of Device Parameters → for information on calculating and resetting the Kp value.

7.2 Permeation tubes for validation of trace H_2O or NH_3 measurements

The permeation tube is designed to continuously release a fixed rate of analyte, for example 2000 ng/min at 50 °C, as in the diagram of the perm tube below. The analyte released is continuously mixed with the dry process gas at 3000 sccm during validation mode (refer to settings for Mode 7 in the analyzer Description of Device Parameters →). This will result in a calibration mixture of Cp in parts per million (ppm) by volume, as long as the return is at atmospheric pressure.

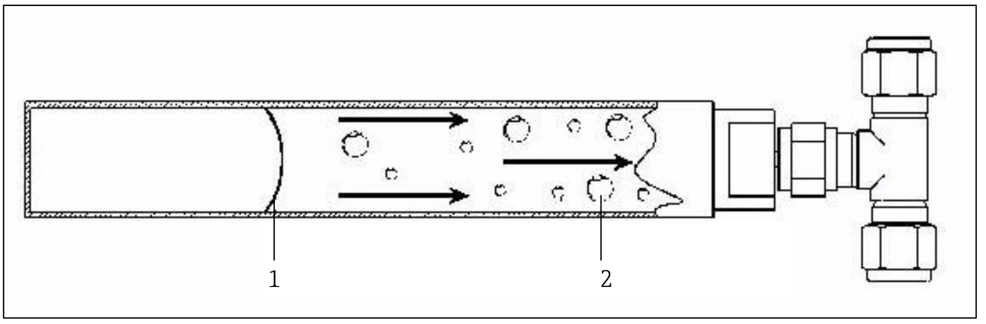


Fig 21. Permeation tube cross section

1. *Membrane*
2. *Water vapor/ammonia*

The permeation tube connects to a "T" assembly between port 6 and 3 of the six-way valve (refer to the following figure). During normal operation, a portion of the process gas return flows through the "T" and carries the excess analyte released from the permeation device to vent. When the system is switched to validation, the six-way valve allows the dry process gas (flowing at 3000 sccm) through the "T" in the opposite direction, carrying the mixed validation gas into the sample cell. Refer to settings for Mode 7 in the analyzer Description of Device Parameters → for more information.

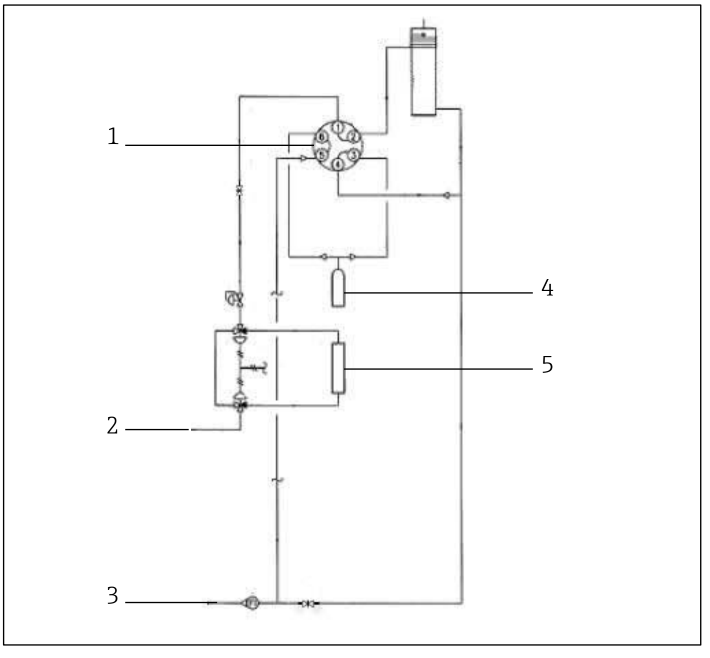


Fig 22. Flow diagram of differential sample system with permeation tube validation

1. *Flow shown in "off" position*
2. *Sample supply*
3. *Sample return*
4. *Permeation tube*
5. *Scrubber*

The concentration of pollutant obtained in ppm by volume may be computed using the following formula:

$$C = \frac{K\ x\ P}{F} \qquad \text{K (Water)} = 1.358,\ \ \text{K (Ammonia)} = 1.437$$

where:

- C = concentration of ppm in volume

- F = carrier gas flow rate in ML/minute at 1 atm and 25 °C
- P = permeation rate of the perm tube in nanograms/minute at the temperature of the perm tube (environment temperature)

The entire flow system is maintained at constant elevated temperature (typically 50 °C to 60 °C or 122 °F to 140 °F).The constant temperature not only minimizes species adsorption/desorption and prevents condensation, but in combination with the regulated sample supply pressure and controlled flow rates, ensures a constant mixture of Cp in parts per million (ppm) by volume.

NOTICE

The permeation rate and resultant water or ammonia content of the validation flow have been carefully calibrated at the factory.

- ▶ DO NOT adjust the pressure regulator, flow controllers or temperature of the sample conditioning system (SCS) if red-tagged or the calibration of the validation flow will be lost.
- ▶ If you suspect the settings of the sample conditioning system have been altered, refer to Service →.
- ▶ Refer to your as-built drawings or Technical data and drawings → for the calibrated output of the validation flow.

The flow components in the sample system are marked with red tags and the message: FACTORY SET - DO NOT FIELD ADJUST.

- ▶ Due to the required conditions, the sample flow pressure regulator, flow control valve and needle valve are factory set and should not be adjusted in the field.
- ▶ The components have been set to give the required flow rate at the conditions described in the drawings provided with the analyzer.
- ▶ Changing any of these settings voids the certification of the permeation system and changes the measured concentration during validation.
- ▶ The sample flow meters are NOT intended to be used for setting the flows in the field. The measurement accuracy of the flow meters is not sufficient to reproduce the factory flow rates in the event the flow rates are inadvertently changed or require a change.

The analyzer system is calibrated for operation at the enclosure temperature and sample flow rate specified.

- ▶ Measurements should be considered valid only when the enclosure is at the specified temperature and sample flow rate. After opening the sample system enclosure door to check settings, allow at least 1 to 2 hours for the temperature to re-stabilize before validating.

7.3 Installing the permeation tube for NH_3 systems

For ammonia systems, the permeation tube is shipped separately from the analyzer and sample system enclosure to prevent ammonia from accumulating in the sample system during transport and storage. Follow these instructions to install the ammonia perm tube.

⚠ CAUTION

- ▶ Use caution when removing the permeation device absorber. Endress+Hauser recommends removing the absorber from the permeation device in a well-ventilated area, preferably outdoors. Once opened, there is no significant risk of exposure.
- ▶ Retain plug cap, absorber and packaging removed from permeation device in case the analyzer is temporarily shutdown for any reason. Refer to Shutting down the SCS →.

Hardware and tools

- Permeation tube for NH_3 analyzer
- VCR gasket (P/N 6100002079)
- ⅝ in wrench
- ¾ in wrench

Installing the NH_3 permeation tube

1. Remove the permeation tube with attached absorber and VCR gasket from the packaging.
2. Remove the absorber from the permeation tube.
3. Remove the plug cap installed in the SCS for the permeation tube to be installed.

Fig 23. Removing the plug cap for permeation tube installation

4. Remove the existing gasket from the permeation device and replace with the new VCR gasket.
5. Install the permeation device into the analyzer sample conditioning system in the area provided and tighten fitting nuts.

Fig 24. Tightening the perm tube fittings

6. Confirm proper support for the VCR adapter on the 'T' during installation. Endress+Hauser recommends securing the VCR adapter fitting with a wrench while tightening the connection.
7. Proceed with normal start-up and commissioning instructions.

7.4 Replacing the permeation tube

The permeation tube has a certification period of one year. The device may be used longer than this period if a factory certified validation concentration (Cp) is not required. Over time the permeation tube will lose water and the validation concentration will drop. At this point, the permeation tube must be replaced.

NOTICE

▶ During permeation tube replacement, the flow through the sample bypass can be maintained, if desired.

To replace the permeation device

1. Open the SCS door.
2. Block in the sample flow using the diaphragm valve upstream of the scrubber:
   a. While watching the cell flow meter, allow all flow to come to zero.
   b. Block in the sample cell vent to prevent backflow into the cell and permeation device.
3. Loosen the connections on the inlet and outlet of the permeation device, and remove the permeation device.
4. Install the new permeation device, carefully tightening the connections once in place.
5. Enter the new permeation rate into the analyzer:
   a. Make a note of the permeation rate in ng/min (Rp) shown in the vendor certification provided with the permeation device.
   b. From the analyzer keypad, press #2, enter the customer password (3142) and press the * key.
   c. Continue pressing the * key until the Val Perm Rate Rp parameter displays.
   d. Enter the new Rp and press *.

   ℹ If recalculation is required, refer *To recalculate the system constant* in the Description of Device Parameters →📖.

   e. Press #1 to return to Normal Measurement Mode.
6. Re-start the sample flow:
   a. Open the cell vent valve.
   b. Open the sample inlet valve.

7. Close the SCS door.

NOTICE

The sample system will require 5 to 8 hours to stabilize the temperature of the new permeation device.

- Endress+Hauser does NOT recommend validating the analyzer during the temperature stabilization period.

New permeation devices may take up to 21 days to fully stabilize the validation concentration.

- It may be necessary to increase the Validation Allowance parameter setting during this period to prevent Validation Fail alarms.
- Refer to the parameter settings in the firmware operations chapter of the Description of Device Parameters → for instructions.
- If a stable validation concentration is not reached within 21 days, please contact Service →.

7.5 Permeation tube storage

The permeation tube should be stored in a sheltered environment that is temperature-controlled above 0 °C (32 °F), and should not be exposed to direct sun, rain, snow, condensing humidity or corrosive environments.

7.6 Using validation gas

If your SS2100 TDLAS Gas Analyzer does not have a permeation tube, follow the instructions for Connecting the validation gas →.

8 SS2100 TDLAS Gas Analyzer maintenance

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 →🗎.

All filter elements should be checked periodically for loading. Obstruction of a filter element can be observed by a decreasing supply pressure or bypass flow. If loading of a filter is observed, the filter should be cleaned and the filter element replaced. Refer to filter maintenance →🗎 for instruction. After observation for some time, a regular schedule can be determined for replacement of filter elements.

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

⚠ CAUTION

- 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.

Class 3B invisible laser radiation when open.

- Avoid exposure to the beam. 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.

8.1.1 Preventative and on-demand SCS maintenance

Preventive and on-demand maintenance is required when components and parts deteriorate or fail as a result of continuous use. The performance of the entire SCS and individual components should be monitored regularly so that maintenance may be performed on a scheduled basis to prevent a failure that could take the system out of operation.

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. Some components may be repaired (replacement of seats and seals, etc.) and then reused. For product and spare parts ordering information, please visit www.endress.com or contact your local sales center.

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 upstream of the analyzer.

If the sample supply 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 should be purged dry with air or nitrogen before the system is placed back in operation.

NOTICE

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

If liquid contaminates the analyzer SCS, a filter element may become obstructed leading to a decreasing supply pressure or bypass flow. If obstruction of a filter is observed, the filter should be cleaned and the filter element replaced.

To perform a regular SCS status check

These steps should be performed only if there is a suspected problem with the analyzer. Performing this check will cause reading errors for up to 4 hours while the enclosure temperature stabilizes.

NOTICE

Opening the door may affect the temperature reading until the temperature is stabilized.

- Do not leave the SCS door open any longer than absolutely necessary. Endress+Hauser recommends no more than 60 seconds.
- For additional information, contact Service →.

1. Open the SCS door.
2. Read and record the flow meter settings while the gas is flowing.
3. Close the SCS door.
4. Compare the current readings with the past readings to determine any variations. Reading levels should remain consistent.
5. If reading levels decrease, check the filters.

To check filters

1. Shut down the system following the procedure in Shutting down the SCS →.
2. Inspect, repair or replace the filter as required. Refer to Replacing filters →.
3. Restart the system following the procedure in Starting up the SCS →.

8.1.2 Preventing 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.

NOTICE

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

To keep sample lines clean

1. Make sure that a filter (included with most systems) is installed ahead of the analyzer and operating normally. Replace, if necessary. If liquid enters the cell and accumulates on the internal optics, a **Laser Power too Low** fault will result.
2. If mirror contamination is suspected, see Cleaning the mirrors →.
3. Turn off the sample valve at the tap in accordance with site lockout/tagout rules.
4. Disconnect the gas sampling line from the sample 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 sample supply port of the analyzer.
7. Check all connections for gas leaks. Using a liquid leak detector is recommended.

8.2 Shutting down the SCS

Situations may occur that require the shutdown of some or all of the SCS. These circumstances may include short-term shutdown for maintenance or repairs, for example, or a long-term shutdown of the system for packing and storing.

⚠ WARNING

Process samples may contain hazardous material in potentially flammable and 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.

⚠ WARNING

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.
- All valves, regulators, switches, etc. should be operated in accordance with site lockout/tagout procedures.

8.2.1 Isolating the measurement cell for short-term shutdown

The analyzer can be isolated from the primary sample bypass section for short-term shutdown or maintenance of the analyzer while allowing the sample bypass flow to continue in a steady-state mode.

Due to the high pressure of the process sample, it is advisable to allow the sample bypass flow to continue during short-term isolation of the analyzer. Continuing sample bypass flow allows the field pressure regulator to continue normal operation without possible overpressure and activation of the relief valve in the event the pressure regulator leaks when the downstream flow is discontinued.

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 and the sample system enclosure heater.

⚠ WARNING

- Never purge the analyzer with air or nitrogen while the system is powered up.
- Do not over-tighten the control valve(s) or damage could occur.

To isolate the measurement cell for short-term shutdown

1. Close the sample flow meter control valve(s) (adjustment knob turned clockwise) for each measurement channel.
2. Close the cell supply and cell return shut-off valves. Refer to your as-built drawings.
3. Allow any residual gas to flow out of the measurement cells.
4. Close the bypass supply shut off valve.
5. Close any low pressure flare or atmospheric vent header shut-off valve for the effluent from each measurement cell. Refer your as-built drawings.

8.2.2 Isolating the SCS for short-term shutdown

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

⚠ WARNING

Process samples may contain hazardous material in potentially flammable and 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. To prevent this, isolate the sample at the probe or vent the sample to a safe location.

To isolate the SCS for short-term shutdown

1. Isolate the analyzer from the bypass following the procedure under To isolate the measurement sample cell for short-term shutdown →.
2. Close the sample supply shut-off valve to the SCS.
3. Allow the sample bypass to flow until all residual gas has dissipated from the lines as indicated by no flow on the sample bypass flow meter.
4. Close the low pressure flare or atmospheric vent header shut-off valve for the effluent from the sample return.
5. 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 and the sample system enclosure heater.

8.2.3 Isolating the process sample tap for long-term shutdown

If the SCS will be out of service for an extended period, it must be isolated at the process sample tap.

⚠ WARNING

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.
- ▶ All valves, regulators, switches, etc. should be operated in accordance with site lockout/tagout procedures.

The sample transport line must be vented to the low pressure flare or atmospheric vent header through the bypass flow meter 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.

To isolate the process sample tap for long-term shutdown

1. Isolate the analyzer from the bypass following the procedure under To isolate the measurement sample cell for short-term shutdown →.
2. Confirm flow in the sample bypass flow meter (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. If applicable, close the low pressure flare or atmospheric vent header shut-off valve for the relief valve vent from the field pressure regulator.
7. Close the sample supply shut-off valve to the SCS.
8. Leave the sample bypass flow meter control valve open.
9. Close the low pressure flare or atmospheric vent header shut-off valve for the effluent from the sample bypass.
10. Turn off power to the analyzer.
11. Turn off the AC power to the SCS heater and the sample tracer 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.

8.2.4 Purging the analyzer for shipment or relocation

If the analyzer is configured for differential measurements, purge the system with power "on" to ensure dry and wet portions of SCS are properly purged.

To purge the analyzer for shipment/relocation

1. Complete the procedure Isolating the process sample tap for long-term shutdown →.
2. Turn off the power to the analyzer and sample system.
3. Disconnect the sample tubing at the inlet to the analyzer.
4. Connect clean, dry nitrogen to the sample inlet. Set to 2 barg (30 psig).
5. Open the low pressure flare or atmospheric vent header shut-off valve for the effluent from the sample bypass.
6. Allow the analyzer to purge for 20 minutes.
7. Shut off the nitrogen purge and disconnect.
8. Close the low pressure flare or atmospheric vent header shut-off valve for the effluent from the sample bypass.
9. Cap off all connections.

8.3 4-20 mA board adjustments

8.3.1 Changing the 4-20 mA current loop mode

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

⚠ WARNING

Hazardous voltage and risk of electric shock.

▶ Turn off and lock out system power before opening the electronics enclosure and servicing.

Changing the current loop mode may negate specific hazardous area certifications.

▶ Contact Service → for details.

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

1. Disconnect power from the analyzer and open the electronics enclosure cover. Take care not to disturb the electrical assembly inside.
2. Locate the relay control board in the upper right of the electronics enclosure:
   - For SS2100 or analyzer A, refer to the drawings of the H_2S elecronics for AC systems → or H_2S elecronics for DC systems →
   - For analyzer B of 2-pack and 3-pack systems, refer to the drawings of the H_2O and CO_2 electronics for AC systems → or H_2O and CO_2 electronics for DC systems → for analyzer B.

   For more information, see Technical data and drawings →.
3. Remove the jumper (JMP1), shown in the figure below, connecting the center pin/hole to point "A." Needle nose pliers may be required to remove the jumper.

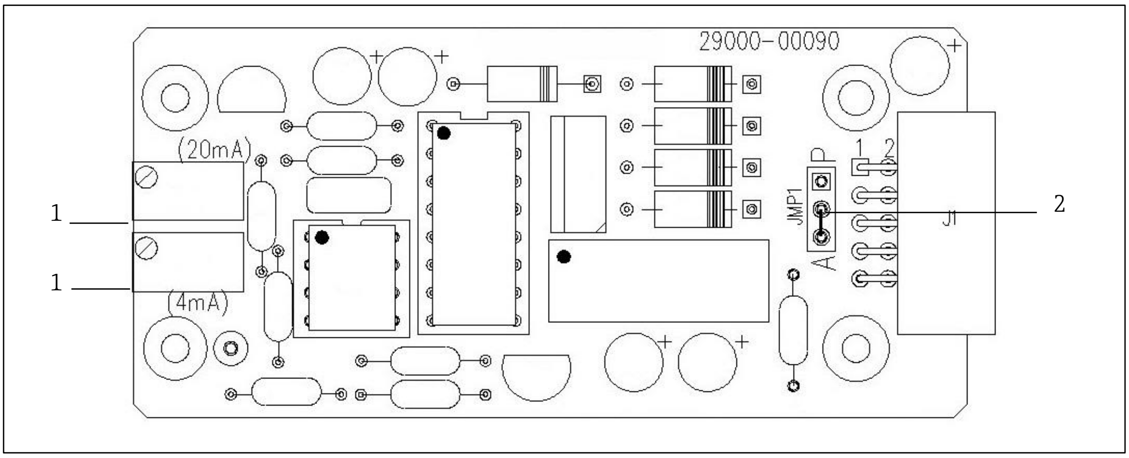


Fig 25. Analyzer 4-20 mA board

1. *Potentiometer*
2. *Jumper (JMP1)*

4. For 4-20 mA sink, carefully replace the jumper to connect the center hole/pin with point “P.”
5. Reconnect power to the analyzer.
6. Close and tighten the electronics enclosure cover.
7. Confirm the 4 mA (minimum) and 20 mA (maximum) points. Refer to the following programming instructions.

8.3.2 Calibrating the 4-20 mA analog output

Perform this instruction for SS2100 analyzers and for analyzer A in SS2100 2-pack analyzer systems.

1. Connect a calibrator and digital multi-meter into the circuit.
2. On the analyzer keypad, press **#2 (Mode 2)**, the password (3142) and *****.
3. Continue pressing the * key until the 4-20 mA Test parameter displays.

<SET PARAMETER MODE>
AO 4-20 mA Test
0.00000
Enter a value (%)

4. Enter the desired percentage of full scale and press *****.
   a. Set 4-20 mA Test = 0; this displays the 4 mA on the AO circuit when #5 (Mode 5) is pressed.
   b. Set 4-20 mA Test = 50; this displays the 12 mA on the AO circuit when #5 is pressed.
   c. Set 4-20 mA Test = 100; this displays the 20 mA on the AO circuit when #5 is pressed.
5. Press # and 1 to return to Normal Mode.
6. For 2-pack systems, continue with the instructions below.

To calibrate the analog output (analyzer B)

1. Connect a calibrator and digital multi-meter into the circuit.
2. On the analyzer keypad, press **#2** (**Mode 2**), the password (3142) and *****.
3. Continue pressing the ***** key until the **4-20 mA % Test** parameter displays.

<SET PARAMETER MODE>
AO 4-20 mA Test
0.00000
Enter a value (%)

4. Set the current loop output to 20 mA by setting 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 to confirm that the output, *i*, agrees with *i*=*R*(20 mA - 4 ma) + 4 mA.
7. When finished, reset the **4-20 mA % Test** parameter to 101.
8. Press **#** and **1** to return to Normal Mode.

8.3.3 Testing and adjusting the 4-20 mA zero and span

Follow these instructions to test and andjust the 4-20 mA zero and span on all SS2100 analyzers and systems.

1. Press #5 (Mode 5) and note the 4-20 mA Test parameter setting displayed on the analyzer.

<TEST 4-20MA MODE>

4-20 mA output is at
0.0% or 4.0 mA

2. Adjust the potentiometers on the end of the board to change the zero and span readings. Refer to the drawing of the 4-20 mA board →.
3. Press # and 1 to return to Normal Mode.

For more information on the analyzer programming, refer to the Description of Device Parameters →.

8.4 Mirror maintenance

If contamination makes its way into the cell and accumulates on the internal optics, a **Laser Power Low Alrm** fault will result. If mirror contamination is suspected, please refer to Service → before attempting to clean the mirrors. If advised to do so, use the following procedure.

The procedure for cleaning the mirror is broken into three parts:
- Purging the sample conditioning system and removing the mirror assembly
- Cleaning the mirror
- Replacing the mirror and components

Before performing this task, carefully review the warnings and notices below.

⚠ WARNING

INVISIBLE LASER RADIATION – The sample cell assembly contains a low-power, 10 mW maximum, 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.

Process samples may contain hazardous material in potentially flammable and 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.
- ▶ All valves, regulators, switches, etc. should be operated in accordance with site lockout/tagout procedures.

This procedure should be used ONLY when necessary and is not part of routine maintenance.
- ▶ To avoid compromising the system warranty, contact service before cleaning mirrors. Refer to Service →.

8.4.1 Determining the type of cell mirror

Measurement cells will come equipped with either a glass or stainless steel mirror. Before determining whether to clean or replace the mirror, identify the type of measurement cell being used in the analyzer. There are four types of measurement cells; 0.1 m, 0.8 m, 8 m and 28 m. Refer to the figure below.

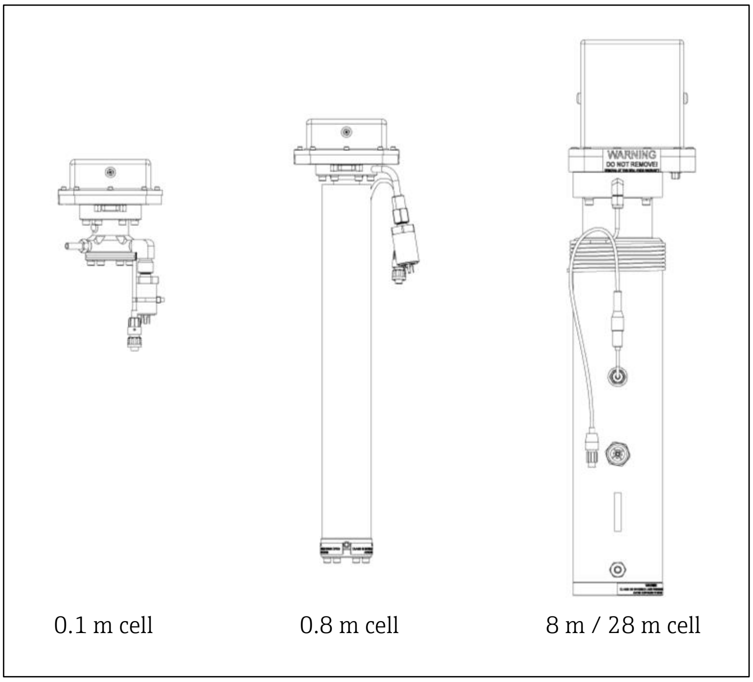
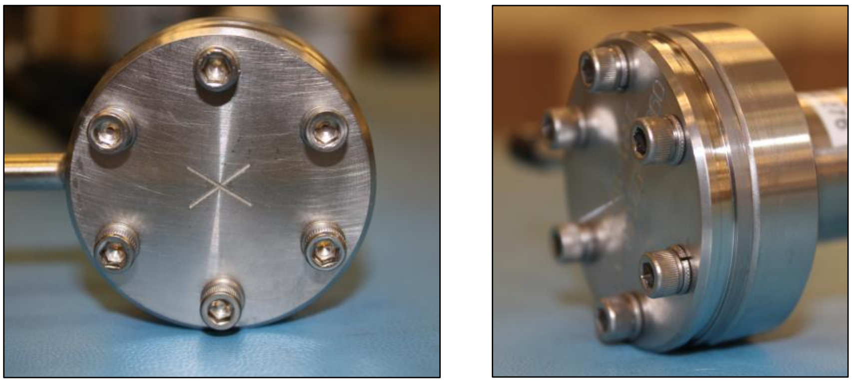


Fig 26. Measurement cell types

Stainless steel mirrors are used with 0.1 m and 0.8 m measurement cells only. They have been identified with either an "X" engraved on the outside bottom of the mirror or a groove around the rim of the mirror. Glass mirrors can be used on any size cell.

To determine the type of mirror being used for the system cell, feel at the bottom of the cell for the engraved “X” marking or the side of the mirror for a groove, as in the images below.

- If the bottom surface is smooth, a glass mirror is being used.
- If the bottom surface is rough or engraved, or a groove on the side of the mirror is detected, a stainless steel mirror is being used.



Figs 27 and 28. Stainless steel mirror marking: mirror with engraved X (left), mirror with grooved rim (right)

NOTICE

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

To clean the mirror, refer to the following instructions. To replace a stainless steel mirror, refer to Replacing a mirror →.

8.4.2 Cleaning the mirror

Tools and materials

- Lens cleaning cloth (Cole-Parmer® EW-33677-00 TEXWIPE® Alphawipe® Low-Particulate Clean Room Wipes or equivalent)
- Reagent-grade isopropyl alcohol (Cole-Parmer® 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 ink marker
- Non-outgassing grease
- Flashlight

NOTICE

▶ Endress+Hauser does not recommend cleaning the top mirror. If the top mirror is visibly contaminated, refer to Service →.

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

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

▶ Pressurized gas duster products are not recommended for cleaning components. The propellant may deposit liquid droplets onto the optic surface.

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

To clean the mirror, follow the instructions for purging the sample conditioning system and removing the mirror assembly, cleaning the mirror, and replacing the mirror, below.

⚠ WARNING

INVISIBLE LASER RADIATION – The sample cell assembly contains a low-power, 10 mW maximum, 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.

Purge the sample conditioning system and remove the mirror assembly

1. Power down the analyzer following the procedure outlined in *Powering Down the Analyzer* in the Description of Device Parameters → for this analyzer.
2. Isolate the SCS from the process sample flow. Refer to Isolating the process sample tap for long-term shutdown →.
3. If possible, purge the system with nitrogen for 10 minutes.
4. Carefully mark the orientation of the mirror assembly with a permanent ink marker on the cell body.
5. Gently remove the mirror assembly from the cell by removing the four (4) (28 m or 8 m measurement cell) or six (6) (0.1 m or 0.8 m measurement cell) socket-head cap screws and set on a clean, stable and flat surface.

Clean the mirror

1. Using a flashlight, examine the top mirror inside the sample cell to ensure that there is no contamination on it.
2. Using a bulb blower or dry compressed air/nitrogen, remove dust and other large particles of debris.
3. Put on clean acetone-impenetrable gloves.
4. 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."
5. Place a few drops of isopropyl alcohol onto the mirror and rotate the mirror to spread the liquid evenly across the mirror surface.
6. 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.
7. Repeat with a clean sheet of lens cleaning cloth to remove the streak left by the first wipe.
8. Repeat step 7, if necessary, until there is no visible contamination on the mirror.

Replace mirror and components

1. Carefully replace the mirror assembly onto the cell in the same orientation as previously marked.
2. Add a very thin layer of non-outgassing grease to the O-ring.
3. Replace the O-ring and ensure it is properly seated.
4. Tighten the socket-head cap screws evenly with a torque wrench to 30 in-lbs (28 m or 8 m measurement cell) or 13 in-lbs (0.1 m or 0.8 m measurement cell).
5. Restart the system following the procedure in Starting up the SCS →.

8.4.3 Replacing a mirror

If your system is configured with a stainless steel mirror in the 0.1 m or 0.8 m measurement cell, use the following instructions for replacing the mirror. If stainless steel mirrors are replacing another type 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 →.

⚠ WARNING

Process samples may contain hazardous material in potentially flammable and 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.
- ▶ All valves, regulators, switches, etc. should be operated in accordance with site lockout/tagout procedures.

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.

NOTICE

- Always handle the optical assembly by the edge of the mount. Never touch the optical surfaces of the mirror.
- Endress+Hauser does not recommend cleaning the top mirror. If the top mirror is visibly contaminated, contact Service →.

To replace a stainless steel mirror, follow the instructions for purging the sample conditioning system and removing the mirror assembly, and replacing the mirror, below.

Purge the sample conditioning system and remove the mirror assembly

1. Power down the analyzer following the procedure outlined in the section called *Powering Down the Analyzer* in the Description of Device Parameters →.
2. Isolate the analyzer from the sample bypass flow by shutting off the appropriate valve(s) and pressure regulator. Disconnect the sample supply and return tubes from the analyzer.
3. Purge the measurement cell with nitrogen for 10 minutes.
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.
5. Confirm the need to replace mirror due to contamination. If yes, set mirror aside and following remaining steps. If no, restore the mirror to the measurement cell.

Replace the mirror

1. Put on clean acetone-impenetrable gloves.
2. Obtain the new stainless steel mirror.

Fig 29. Stainless steel mirror

3. Check the O-ring. If a new O-ring is needed, apply grease on fingertips and then to the new O-ring.
4. Place newly greased O-ring into the groove around the outside of the mirror taking care not to touch the mirror surface.
5. Carefully place the new stainless steel mirror onto the cell making sure the O-ring is properly seated.
6. Tighten the socket-head cap screws evenly with a torque wrench to 13 in-lbs.
7. Restart the system following the procedure in Starting up the SCS →.

8.5 Replacing a fuse

If you need to replace a fuse, use only the same type and rating of fuse as the original as listed in the fuse specifications table below. Select the replacement solenoid fuse (F2) based on the number of solenoids installed on the analyzer.

Fuses are located on the electronics control board, as shown in Drawings →. The spare part kits for fuses are shown in the tables below.

8.5.1 Fuse specifications

Drawing	Reference	Voltage	Description	Rating
Fuse specifications for SS2100 systems, analyzer A				
H_2S/analyzer A electronics (AC) →	11 (Fuse 1)	120 VAC	1 Solenoid, Miniature Fuse, 5 x 20 mm, Time Delay	250 VAC 0.25 A
			2 Solenoids, Miniature Fuse, 5 x 20 mm, Time Delay	250 VAC 0.4 A
			3 Solenoids, Miniature Fuse, 5 x 20 mm, Time Delay	250 VAC 0.8 A
	12 (Fuse 2)		Miniature Fuse, 5 x 20 mm, Time Delay	250 VAC 0.8 A
	11 (F1)	240 VAC	1 Solenoid, Miniature Fuse, 5 x 20 mm, Time Delay	250 VAC 0.125 A
			2 Solenoids, Miniature Fuse, 5 x 20 mm, Time Delay	250 VAC 0.25 A
			3 Solenoids, Miniature Fuse, 5 x 20 mm, Time Delay	250 VAC 0.4 A
	12 (F2)		Miniature Fuse, 5 x 20 mm, Time Delay	250 VAC 0.8 A
H_2O, NH_3 electronics (AC) →	11 (Fuse 1)	120 VAC	1 Solenoid, Miniature Fuse, 5 x 20 mm, Time Delay	250 VAC 0.25 A
			2 Solenoids, Miniature Fuse, 5 x 20 mm, Time Delay	250 VAC 0.4 A
			3 Solenoids, Miniature Fuse, 5 x 20 mm, Time Delay	250 VAC 0.8 A
	12 (Fuse 2)		Miniature Fuse, 5 x 20 mm, Time Delay	250 VAC 0.8 A
	11 (F1)	240 VAC	1 Solenoid, Miniature Fuse, 5 x 20 mm, Time Delay	250 VAC 0.125 A
			2 Solenoids, Miniature Fuse, 5 x 20 mm, Time Delay	250 VAC 0.25 A
			3 Solenoids, Miniature Fuse, 5 x 20 mm, Time Delay	250 VAC 0.4 A
	12 (F2)		Miniature Fuse, 5 x 20 mm, Time Delay	250 VAC 0.5 A
H_2S/analyzer A electronics (DC) → H_2O, NH_3 electronics (DC) →	11 (F1)	24 VDC	1 Solenoid, Miniature Fuse, 5 x 20 mm, Time Delay	250 VAC 0.63 A
			2 Solenoid, Miniature Fuse, 5 x 20 mm, Time Delay	250 VAC 1.25 A
			3 Solenoid, Miniature Fuse, 5 x 20 mm, Time Delay	250 VAC 2.0 A
	8 (F2)		Miniature Fuse, 5 x 20 mm, Time Delay	250 VAC 1.6 A
Fuse specifications for 2 and 3-pack systems, analyzer B (H_2O/CO_2 analyzer)				
H_2O, CO_2 / analyzer B	8	120 VAC	Miniature Fuse, 5 x 20 mm, Time Delay	250 VAC 0.8 A

Drawing	Reference	Voltage	Description	Rating
electronics (AC) →		240 VAC		
H_2O, CO_2 / analyzer B electronics (AC) →	8	120 VAC	Miniature Fuse, 5 x 20 mm, Time Delay	250 VAC 0.8 A
		240 VAC		
H_2O, CO_2 / analyzer B electronics (DC) →	7	24 VDC	Miniature Fuse, 5 x 20 mm, Time Delay	250 VAC 1.6 A

8.5.2 Replacing a fuse

1. Power off the system and close the sample supply valve.
2. Open the electronics enclosure. Refer to Technical data and drawings → for fuse location.
3. Using a flat-head screwdriver, remove the fuse screw turning counterclockwise as shown in the figure below.

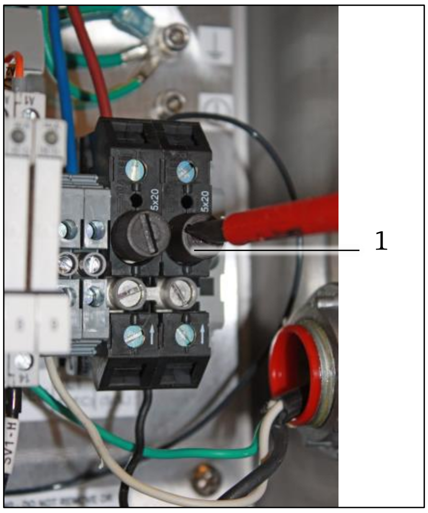


Fig 30. Unscrewing a fuse cover (1)

4. Remove the fuse cover and fuse.
5. Remove the fuse from the cover and replace with a new fuse as shown in the figure below. Refer to fuse specifications →.

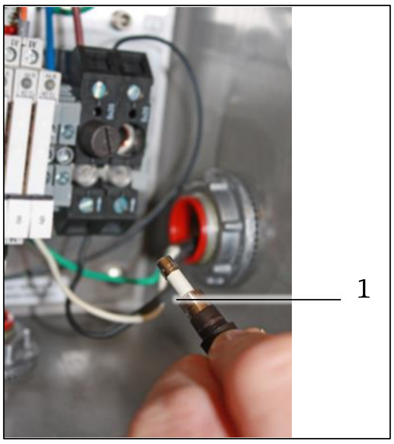


Fig 31. Replacing a fuse (1)

6. Insert the new fuse into the screw cover and replace into the fuse opening.

7. Use the screwdriver to turn the fuse cover clockwise until tight. Do not overtighten.
8. Repeat steps for each fuse to be replaced.
9. Close enclosure door and apply power to the analyzer.

8.6 Filter maintenance

8.6.1 Replacing the membrane separator

Use the following steps to replace a membrane separator.

1. Shut down the system following the procedure in Shutting down the SCS →.
2. Close the sample supply valve.
3. Unscrew the cap from the membrane separator.

If the membrane filter is dry:

4. Check if there are any contaminants or discoloring of the white membrane. If yes, the filter should be replaced.
5. Remove the O-ring and replace the membrane filter.
6. Replace the O-ring on top of the membrane filter.
7. Place the cap back onto the membrane separator and tighten.
8. Check upstream of the membrane for liquid contamination and clean and dry out before re-opening the sample supply valve.

If liquid or contaminants are detected on the filter:

4. Drain any liquids and clean with isopropyl alcohol.
5. Clean any liquids or contaminants from the base of the membrane separator.
6. Replace the filter and the O-ring.
7. Place the cap onto the membrane separator and tighten.
8. Check upstream of the membrane for liquid contamination and clean and dry out before re-opening the sample supply valve.
9. Restart the system following the procedure in Starting up the SCS →.

8.6.2 Cleaning the filter

Use the following steps to clean the filter:

1. Shut down the system following the procedure in Shutting down the SCS →.
   a. Power off the analyzer.
   b. Close the sample supply valve.
2. Open the SCS enclosure door.
3. Remove the filter:
   a. Unscrew the four screws with a 5/23 in screwdriver from the base of the filter.
   b. Remove the filter unit from the analyzer for disassembly.
   c. Unscrew and remove the filter cap.
   d. Remove the top O-ring.
4. Clean the filter:
   a. Check if there are any contaminants or solid components blocking the metal filter.
   b. Drain any contaminants found and clean with isopropyl alcohol.
   c. Replace the top O-ring.

5. Return the components:
   a. Place the filter cap back into position and tighten.
   b. Place the filter unit into the analyzer and tighten the base with the four screws.
6. Check upstream of the membrane for liquid contamination.
7. Clean and dry out before opening the sample supply valve.
8. Close enclosure door and return the analyzer to operation following the procedure in Starting up the SCS →.

8.7 Replacing the pressure sensor

A pressure sensor may need to be replaced in the field as a result of one or more of the following conditions:

- Loss of pressure reading
- Incorrect pressure reading
- Pressure sensor not responding to pressure change
- Physical damage to the pressure sensor

Refer to the following information to replace the pressure sensor:

- On a 8 m or 28 m cell →
- On a 0.1 or 0.8 m cell →

Tools and materials

- Acetone-impenetrable gloves (North NOR CE412W Nitrile Chemsoft™ CE Cleanroom Gloves or equivalent)
- $^{9}/_{16}$ in wrench
- ⅞ in wrench
- $^{9}/_{64}$ in Allen wrench
- Flat-head screwdriver
- Phillips-head screwdriver
- Metal pick
- Military grade stainless steel PTFE tape (or equivalent)
- Dry nitrogen
- Isoproypl alcohol

⚠ CAUTION

Isopropyl alcohol can be hazardous.

▶ Follow all safety precautions when in use and thoroughly wash hands prior to eating.

8.7.1 Replacing the pressure sensor on an 8 m or 28 m cell

This procedure is broken into four parts:

- Purge the system and powering down
- Disconnect relevant components
- Replace the pressure sensor
- Reconnect components and performing a leak test

Purge the system and power down

1. Close the external flow of gas to the sample conditioning system at the sample inlet.
2. Purge the system by connecting dry nitrogen to the sample inlet. Allow the SCS to purge for 5 to 10 minutes.
3. Close the nitrogen flow.
4. Power off the system. Refer to the Description of Device Parameters → for this analyzer for *Powering down the analyzer*.
5. Open the door to the SCS enclosure. Refer to the SCS interior images → below.

Disconnect components

1. Remove the optical cable harness using a flat-head screwdriver.
2. Disconnect the measurement cell inlet using a $^{9}/_{16}$ in wrench.

3. Disconnect the measurement cell outlet using a ${}^{9}/_{16}$ in wrench.
4. Disconnect the thermistor cable at the circular connector.
5. Remove the pressure sensor cable from the circular connector inside the enclosure.

   For newer model pressure transducers with quick-disconnects, detach the pressure sensor cable from the pressure sensor at the connector using a Phillips-head screwdriver. Do not remove the black connector from the cable inside the enclosure.

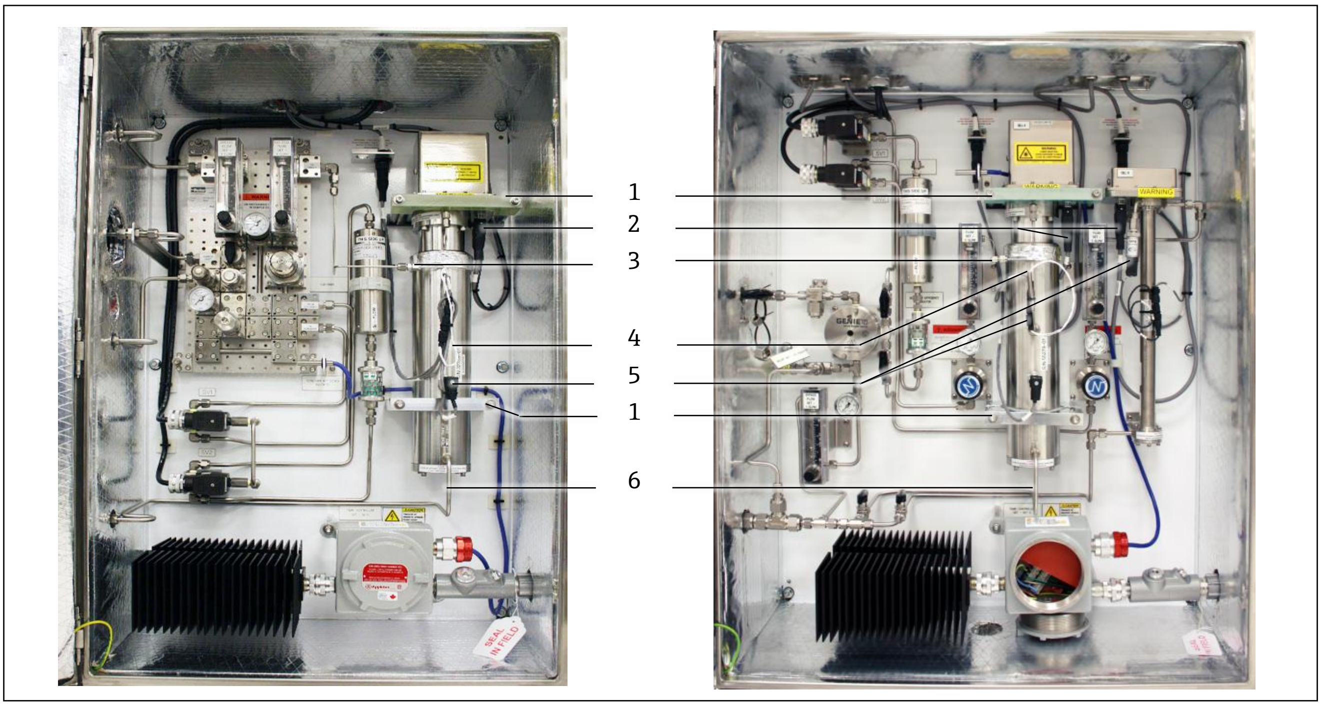


Fig 32. SS2100 SCS cabinet interior (left) and SS2100 2-pack SCS interior (right)

1. *Mounting bracket*
2. *Optical cable harness*
3. *Measuring cell input (8/28 m cell)*
4. *Thermistor cable*
5. *Pressure sensor/cable*
6. *Measuring cell outlet*

6. Unmount the cell from the bracket by removing the four securing screws (two on top, two on the bottom) using a ${}^{9}/_{64}$ in Allen wrench.
7. Place the measurement cell on a clean, flat surface with the pressure sensor facing up. Refer to the figure below.

   NOTICE

   ▶ Orient the measurement cell to prevent any debris from entering the cell.

Fig 33. Removed measurement cell with pressure sensor oriented up

8. Holding the cell firmly with one hand, use a $7/8$ in wrench to remove the old (to be replaced) pressure sensor as shown below.

Fig 34. Removing the old pressure sensor

9. Turn the ⅞ in wrench counterclockwise to loosen the pressure sensor until it is able to be removed.

Replace the pressure transducer

1. Remove excess seal tape from the threads at the opening and check for galling.

⚠ CAUTION

- Tip the measurement cell forward so that any loose debris falls to the flat surface and not back inside the cell.
- Threads showing signs of galling indicate a possible leak. Refer to Service → to arrange for repair.

Fig 35. Removing excess seal tape from flange

2. Put on acetone-impenetrable gloves and remove the mirror end cap from the cell using the $^{9}/_{64}$ in Allen wrench.
3. Check the mirror for any signs of debris. If found, refer to Cleaning the mirror → to remove.
4. Check for tape fragments inside the cell and remove with a swab as shown below.

Fig 36. Removing excess seal tape from inside measurement cell

5. Remove the new pressure sensor from the packaging. Retain the black connector cap on the sensor. Do not remove the cap.
6. Wrap stainless steel PTFE tape around the threads at the top of the pressure sensor, beginning from the base of the threads to the top, approximately three times taking care to avoid covering the top opening.

Fig 37. Replacing the seal tape

7. Holding the cell steady, insert the new pressure sensor into the threaded opening.

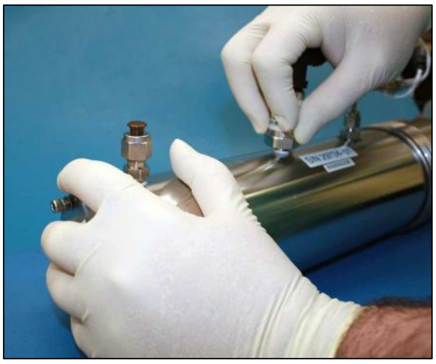


Fig 38. Replacing the pressure sensor

8. Hand-tighten the pressure sensor clockwise into the opening until no longer moving freely.
9. Holding the cell in place, turn the sensor clockwise with a ⅞ in wrench until tight. Two or three threads on the pressure sensor should still be visible.

   NOTICE

   ▶ Make sure the black connector at the end of the pressure sensor is facing towards the head or the base of the measurement cell to facilitate connection. Refer to the figure below.

Fig 39. New pressure sensor installed

Reconnect components and perform leak test

1. Remove the black connector from the pressure sensor and discard.
2. Connect the new harness/cable to the new pressure sensor.

NOTICE

- If the newer model pressure sensor cable is currently installed in the SCS, a new cable may not be required. If no new cable is installed, re-attach the existing cable in place of step 6.

3. Mount the cell to the mounting brackets using a $^9/_{64}$ in Allen wrench with the pressure sensor facing out towards the cabinet door.
4. Reconnect the cell inlet and cell outlet using a $^9/_{16}$ in wrench.
5. Reconnect the thermistor connector.
6. Connect the new pressure sensor harness and cable to the circular connector.
7. Reconnect the optical cable harness.
8. Close the door to the SCS enclosure.
9. Conduct a leak test to determine that the new pressure sensor is not leaking.

⚠ CAUTION

- Do not allow cell to exceed 0.7 barg (10 psig) or damage could occur.
- For any questions related to leak testing the pressure sensor, refer to Service →.

Power on the system and run validation

1. Turn the system power on. Refer to the Description of Device Parameters → for this analyzer for *Powering up the analyzer*.
2. Run a validation on the analyzer. Refer to the Description of Device Parameters → for instructions on *Validating the Analyzer*.
   a. If the system passes, the pressure sensor replacement is successful.
   b. If the system does not pass, refer to Service → for instruction.

8.7.2 Replacing the pressure sensor on a 0.1 or 0.8 m cell

Use the following instruction to replace a pressure sensor on a 0.1 m or 0.8 m measurement cell. This procedure is broken into four parts:

- Purge the system and powering down
- Disconnect relevant components
- Replace the pressure transducer
- Reconnect components and performing a leak test

Tools and materials

- $^9/_{16}$ in wrench
- $^7/_8$ in wrench
- $^9/_{64}$ in Allen wrench
- Flat-head screwdriver
- Phillips-head screwdriver
- Metal pick
- Military grade stainless steel PTFE tape (or equivalent)
- Dry nitrogen
- Isoproypl alcohol

⚠ CAUTION

Isopropyl alcohol can be hazardous.

- Follow all safety precautions when in use and thoroughly wash hands prior to eating.

Purge the system and power down

1. Close the external flow of gas to the sample conditioning system at the sample inlet.
2. Purge the system by connecting dry nitrogen to the sample inlet. Allow the SCS to purge for 5 to 10 minutes.
3. Close the nitrogen flow.

4. Power off the system. Refer to the Description of Device Parameters → for this analyzer for *Powering down the analyzer*.
5. Open the door to the SCS enclosure. Refer to the image of the S2100 SCS cabinet interior →.

Disconnect components

1. Remove the optical cable harness using a flat-head screwdriver.
2. Disconnect the cell inlet using a 9/16 in wrench.
3. Disconnect the cell outlet using a 9/16 in wrench.
4. Disconnect the thermistor cable at the circular connector.
5. Remove the pressure transducer cable from the circular connector inside the enclosure.

   For newer model pressure transducers with quick-disconnects, detach the pressure transducer cable from the pressure sensor at the connector using a Phillips-head screwdriver. Do not remove the black connector from the cable inside the enclosure.
6. Remove the cell from the bracket by removing the four securing screws (two on top, two on the bottom) using a 9/64 in Allen wrench. Place the measurement cell on a clean, flat surface with the pressure sensor facing up.

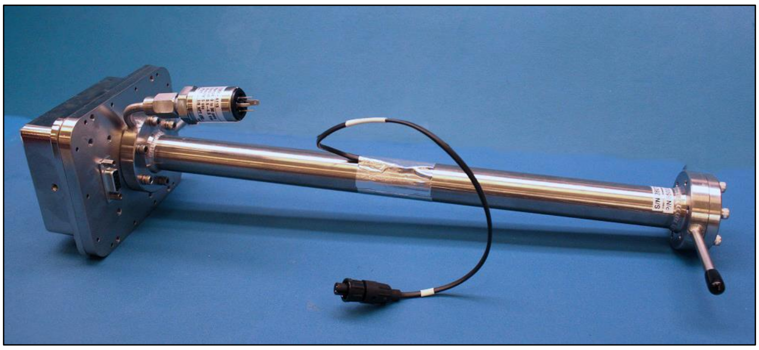


Fig 40. Removed 0.8 m measurement cell with pressure sensor face up

NOTICE

▶ Orient the measurement cell to prevent any debris from entering the cell.

7. Using a 9/16 in wrench, secure the flange while using a 7/8 in wrench to remove the old pressure sensor as in the figure below.

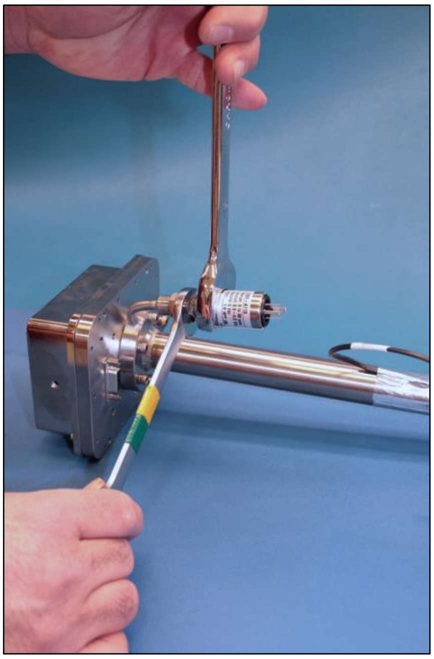


Fig 41. Removing the old pressure sensor

8. Hold the wrench on the flange stable and parallel to the surface. Do not move.
9. Turn the ⅞ in wrench counterclockwise to loosen the pressure sensor until it is able to be removed.

Replace the pressure sensor

1. Remove excess seal tape from the flange opening and threads and check threads for galling.

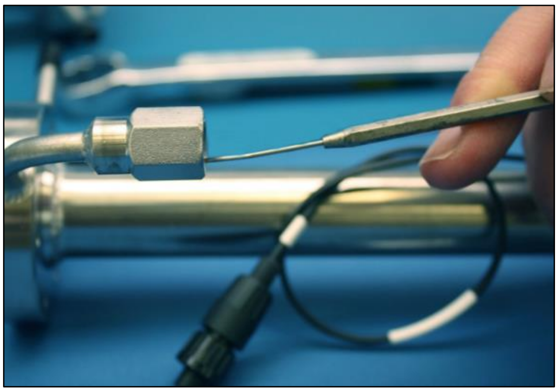


Fig 42. Removing excess seal tape from flange

⚠ CAUTION

Threads showing signs of galling indicate a possible leak.

- ▶ Refer to Service → to arrange to return for repair.

2. Remove the new pressure sensor from the packaging. Retain the black connector cap on the sensor. Do not remove the cap.
3. Wrap stainless steel PTFE tape around the threads at the top of the pressure sensor, beginning from the base of the threads to the top, approximately three times taking care to avoid covering the top opening.

Fig 43. Replacing the seal tape

4. Insert the new pressure sensor into the threaded flange keeping the sensor parallel to the surface for proper fitting.
5. Hand-tighten the pressure sensor turning it counterclockwise into the flange until no longer moving freely.

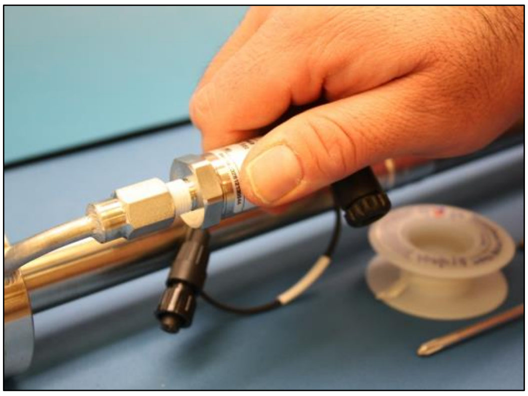


Fig 44. Replacing the pressure sensor

6. Using the ⁹⁄₁₆ in wrench to hold the flange in place, turn the sensor clockwise with a ⅞ in wrench until tight. Two or three threads on the pressure sensor should still be visible.

NOTICE

- Make sure the black connector at the bottom of the pressure sensor is facing up from the measurement cell.

Fig 45. Newly installed pressure sensor positioning

7. Remove the black connector from the pressure sensor and discard.
8. Connect the new harness/cable to the new pressure sensor.

   If the new model pressure sensor cable is currently installed in the SCS, reattach the cable to the pressure sensor after the cell has been remounted.

Reconnect components and perform leak test

1. Mount the cell to the mounting brackets using a ⁹⁄₆₄ in Allen wrench with the pressure sensor facing forward.
2. Reinstall cell inlet and cell outlet using a ⁹⁄₁₆ in wrench.
3. Reconnect the thermistor.
4. Connect the new pressure sensor harness and cable to the terminal relay block.
5. Reconnect the optical cable harness.
6. Close the door to the SCS enclosure.
7. Connect the sample inlet.
8. Conduct a leak test to determine that the new pressure sensor is not leaking.

⚠ CAUTION

- Do not allow cell to exceed 0.7 barg (10 psig) or damage could occur.
- For any questions related to leak testing the pressure sensor, refer to Service →.

Power on the system and run validation

1. Turn the system power on. Refer to the Description of Device Parameters → for this analyzer for *Powering up the analyzer*.

2. Run a validation on the analyzer. Refer to the Description of Device Parameters → for instructions on *Validating the Analyzer*.
   a. If the system passes, the pressure sensor replacement is successful.
   b. If the system does not pass, refer to Service → for instruction.

8.8 Scrubber maintenance for H_2S systems

The H_2S scrubber contains material that gradually loses its scrubbing ability with use. The lifetime of the material depends on how much analyte flows through the scrubber (gas composition) and how often (switching frequency). Thus, scrubber lifetime is application specific.

The Endress+Hauser SS2100 analyzer systems predict the remaining scrubber capacity by using the actual H_2S concentration measurements and dry cycle durations to calculate how much cumulative H_2S has been removed by the scrubber. Scrubber lifetimes have been simulated for typical natural gas and fuel gas applications. As shown in the figure below, under normal operating conditions a 2 inch scrubber in a natural gas application with an average H_2S concentration of 4 ppmv will last for many years, whereas a 3 inch scrubber in a fuel gas application with an average H_2S concentration of 100 ppmv would be expected to last approximately 190 days.

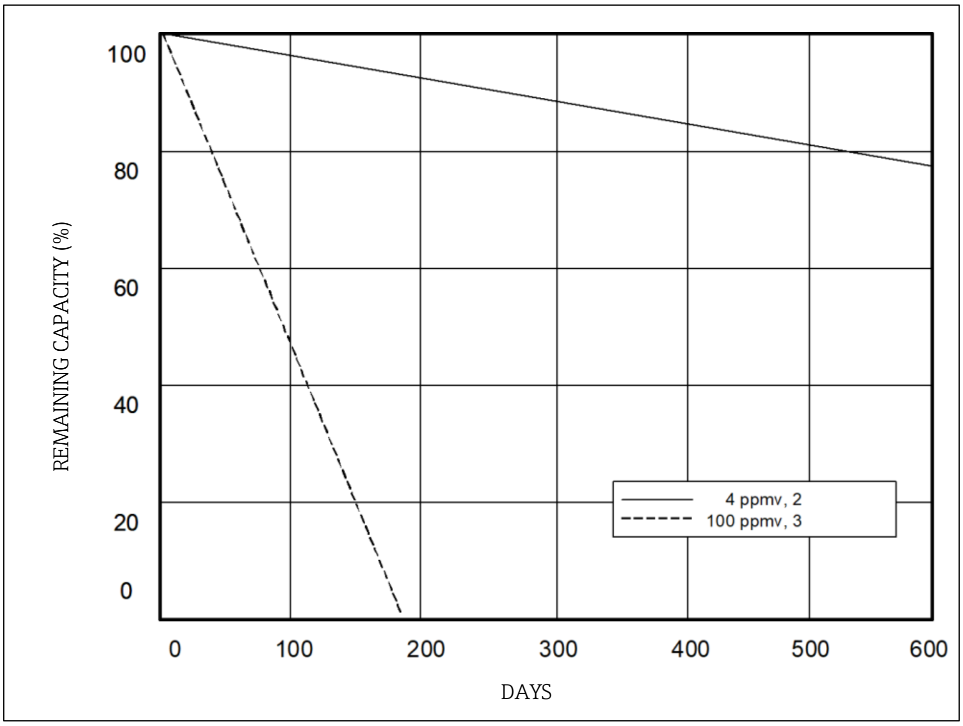


Fig 46. Predicted scrubber lifetime based on average H_2S load

As an added precaution for H_2S systems, a scrubber efficiency indicator is mounted at the outlet of the scrubber as shown in the scrubber and scrubber efficiency indicator image →. The powder material in the scrubber efficiency indicator changes color from turquoise to dark grey if there is any H_2S breakthrough. Alternatively, regular validation of the system with an appropriate gas standard will indicate when the scrubber needs to be replaced.

NOTICE

▶ When specifying gas standards, indicate H_2S in methane balance. For a measured range of 0 to 20 ppm, a concentration of 4 to 16 ppm is recommended.

The system will activate a **New Scrubber Alarm** fault, which triggers the **General Fault Alarm** to indicate when it is time to replace the scrubber and scrubber efficiency indicator. Once the scrubber and scrubber efficiency indicator have been replaced, reset the scrubber lifetime monitor with the **New Scrub Installed** parameter and the **General Fault Alarm** with the Reset option for the **General Alarm DO** parameter (see *To change parameters in Mode 2* in the Description of Device Parameters → for your analyzer).

If scrubber replacement is necessary, refer to Replacing the scrubber →. Replacement scrubbers, scrubber efficiency indicators, and other replacement parts can be ordered by the part numbers listed on www.endress.com.

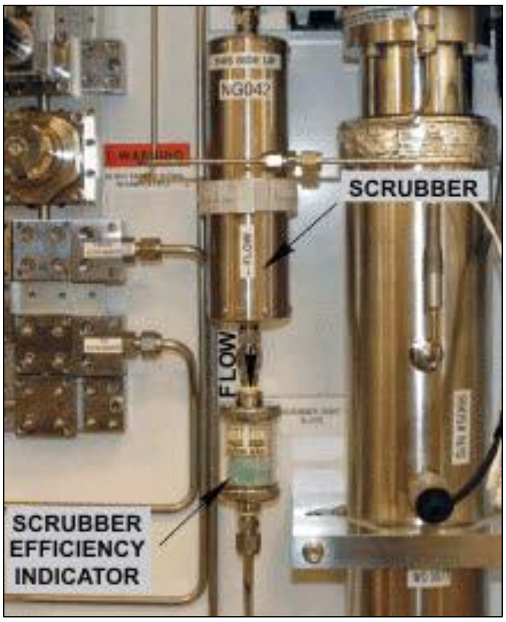


Fig 47. Scrubber and scrubber efficiency indicator

Figs 48 and 49. H_2S scrubber efficiency indicator before breakthrough (left) and after breakthrough (right)

8.8.1 Replacing the scrubber efficiency indicator

⚠ CAUTION

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.
- ▶ All valves, regulators, switches, etc. should be operated in accordance with site lockout/tagout procedures.

To replace the scrubber efficiency indicator

1. Remove the old scrubber efficiency indicator:
   a. Close the sample supply shut-off valve.
   b. Allow all residual gas to dissipate as indicated by no flow on the sample bypass flow meter.

   c. Unscrew the compression nuts on the inlet end of the scrubber and scrubber efficiency indicator assembly.
2. Install the new scrubber efficiency indicator:
   a. Insert the inlet and outlet tubes into the compression fittings of a new scrubber and scrubber efficiency indicator assembly.
   b. Ensure both scrubber and scrubber efficiency indicator are oriented correctly, according to the flow pattern shown in the image of the scrubber and scrubber efficiency indicator →.
   c. Tighten all new fittings 1 ¼ 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.
3. Reset the alarm and scrubber monitor (see *To change parameters in Mode 2* in the Description of Device Parameters → for your analyzer):
   a. Reset the scrubber lifetime monitor with the **New Scrub Installed** parameter.
   b. Reset the **General Fault Alarm** with the Reset option for the **General Alarm DO** parameter.
4. Restart the SCS.
5. Check all connections for gas leaks. Using a liquid leak detector is recommended.
6. Re-validate the system with an appropriate gas standard following the instructions under *Validating the Analyzer* in the Description of Device Parameters → for your analyzer.
7. Purge the scrubber and scrubber efficiency indicator assembly with nitrogen to remove all flammable gas and cap the inlet and outlet.

⚠ CAUTION

H_2S scrubbers and scrubber indicators contain Copper (II) Oxide [CAS# 1317-38-0] and basic cupric carbonate [CAS# 12069-69-1], which are harmful if swallowed and toxic to aquatic organisms.

▶ Handle with care and avoid contact with the internal substances.

8.8.2 Replacing the scrubber

To replace the sample conditioning system scrubber, please visit www.endress.com or contact your local sales center.

1. Power off the analyzer and close the sample supply valve.
2. Open the SCS enclosure door.
3. Using a wrench, loosen the fitting at the top and bottom of the scrubber.

   NOTICE

   ▶ The VCR metal gasket face seal fitting is currently used on low moisture systems only.

4. Remove the retainer clip gasket and place in a safe location.
5. Remove the scrubber.
6. Secure the retainer clip gasket to the new scrubber unit.
7. Insert the new scrubber into the analyzer.
8. Connect the nuts at the top and bottom of the scrubber to finger tight.
9. Using a wrench, tighten the nuts ⅛ in turn from finger tight.

8.8.3 Disposal of used scrubbers and scrubber efficiency indicators

⚠ CAUTION

Depleted H_2S scrubbers and scrubber indicators contain predominantly Copper (II) Sulfide [CAS# 1317-40-4] with some remaining Copper (II) Oxide [CAS# 1317-38-0] and basic cupric carbonate [CAS# 12069-69-1].

▶ These substances are odorless dark powders that require few special precautions other than avoiding contact with the internal substances, keeping the scrubber tightly sealed, and protecting the contents against humidity.
▶ Discard used scrubber and scrubber indicator in an appropriate leak-proof receptacle.

8.9 Replacing the dryer for H_2O and NH_3 systems

For product and spare parts ordering information, please visit www.endress.com or contact your local sales center.

To replace the dryer

1. Using a wrench, loosen the fitting at the top and bottom of the dryer.
2. Remove the retainer clip gasket and place in a safe location. The VCR metal gasket face seal fitting is currently used on low moisture systems only.
3. Remove the dryer.
4. Secure the retainer clip gasket to the new dryer unit.
5. Insert the new dryer into the analyzer.
6. Connect the nuts at the top and bottom of the dryer to finger tight.
7. Using a wrench, tighten the nuts ⅛ turn from finger tight.

8.10 Heat trace sleeve bundle

The heat trace bundle sleeve, manufactured by others, is an option for the Endress+Hauser analyzer. Refer to the optional heat trace drawings power in your as-built drawings or in Drawings →.

8.10.1 Removing the heat trace bundle

If heat trace has been installed for the analyzer SCS:

1. Turn off external power to the heat trace bundle.
2. Disconnect the heat trace bundle wiring at the customer provided junction box.
3. Carefully remove the heat trace bundle from the SCS cabinet.

9 Instrument troubleshooting

This section presents recommendations and solutions to common problems, such as gas leaks, contamination, excessive sampling gas temperatures and pressures, and electrical noise along with instruction for basic maintenance tasks. If your analyzer demonstrates other issues, contact Service. Refer to Service →.

⚠ WARNING

Class 3B invisible laser radiation when open.

- Avoid exposure to the beam. Never open the sample cell unless directed to do so by a service representative and the analyzer power is turned off.

NOTICE

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.

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.

9.1 Warnings and errors

9.1.1 Gas leaks

A common cause of erroneous measurements is outside air leaking into the sample supply line. It is recommended the supply lines be periodically leak tested, especially if the analyzer has been relocated or has been replaced or returned to the factory for service and the supply lines have been reconnected.

NOTICE

Plastic tubing is permeable to moisture and other substances which can contaminate the sample stream.

- Do not use plastic tubing of any kind for sample lines. Using ¼ in O.D. x 0.035 in wall thickness, seamless stainless steel tubing is recommended.

⚠ WARNING

Process samples may contain hazardous material in potentially flammable and 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.

9.1.2 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. Refer to Preventing contamination →.

9.1.3 Excessive sampling gas temperatures and pressure

The embedded software is designed to produce accurate measurements only within the allowable cell operating range (see SS2100 specifications →). Pressures and temperatures outside this range will trigger a **Pressure Low Alarm**, **Pressure High Alarm**, **Temp Low Alarm**, or **Temp High Alarm** fault. For information on systems alarms, refer to the Description of Device Parameters →.

NOTICE

The cell temperature operating range for analyzers that are equipped with heated enclosures is equal to the enclosure temperature setpoint ±5 °C.

- If the pressure, temperature, or any other readings on the LCD appear suspect, they should be checked against the specifications →. Refer to the Description of Device Parameters → for more information on system faults and alarms.

9.1.4 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. Refer to Protective chassis and ground connections →.

9.1.5 Resetting peak tracking

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 **PeakTk Restart Alarm** is displayed, the peak tracking function should be reset. Refer to the Description of Device Parameters → for this analyzer for instruction.

9.1.6 Relief valve setting

The relief valve is preset at the factory at 50 psig and should not require adjustment.

NOTICE

- Improper adjustment in the field could prevent the proper operation of the relief valve and sample conditioning system. Refer to Service →.

To adjust the relief valve setting

1. Confirm that the relief valve at the field pressure reducing station has been set to the specified setpoint. Refer to the as-built drawings for the required settings for your analyzer.
2. Remove the relief valve from the pressure reducing regulator and connect to an adjustable pressure source. Refer to the manufacturer's instructions for details related to setting the relief valve.
3. Re-install the relief valve.
4. Check all connections for gas leaks using a liquid leak detector.

9.2 Troubleshooting symptoms

If the instrument does not appear to be hampered by issues described earlier in this chapter, refer to the table below before contacting Service →.

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? (120 or 240 VAC at 50 to 60 Hz, 24 VDC.)
	Check fuse(s). If bad, replace with equivalent fuse. Refer to Replacing a fuse →.
	Refer to Service →.
Laser Power Low Alrm fault	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.
Laser Power Low Alrm fault (continued)	Refer to the Description of Device Parameters → for this analyzer to capture diagnostic data and send the file to Service. Refer to Service → for service information.
	Possible alignment problem. Refer to Service → for service information.
	Possible mirror contamination issue. Refer to Service → for service information. If advised to do so, clean the mirrors by following the instructions under Cleaning the mirror →.
	Capture diagnostic data and send the file to Endress+Hauser (see *To read diagnostic data with HyperTerminal* in the Description of Device Parameters →).
Pressure Low Alarm or **Pressure High Alarm** fault	Check that the actual pressure in the measurement cell is within specification →.
	If the pressure reading is incorrect, check that the pressure/temperature cable on the bottom of the electronics enclosure is tight. Check the connector on the pressure transducer. Check the pressure connector on the backplane board.
Temp Low Alarm or **Temp High Alarm** fault	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.
	If the temperature reading is incorrect, check that the pressure/temperature cable on the bottom of the electronics enclosure 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).

Symptom	Response
Power Fail	Refer to the Description of Device Parameters → for your analyzer for instructions to capture diagnostic data and submit to Endress+Hauser. Refer to Service →.
Null Fail	Refer to the Description of Device Parameters → for your analyzer for instructions to capture diagnostic data and submit to Endress+Hauser. Refer to Service →.
Spectrum Fail	Reset the Peak Tracking function. Refer to the Description of Device Parameters → for your analyzer for instructions.
	Refer to the Description of Device Parameters → for your analyzer for instructions to capture diagnostic data and submit to Endress+Hauser. Refer to Service →.
Track Fail	Reset the Peak Tracking function. Refer to theDescription of Device Parameters → for your analyzer for instructions.
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.
System stuck in **Fit Delta Exceeds Limit** restart for greater than 30 minutes	Refer to Service →.
Not getting enough flow to the sample cell	Check both the micro filter and membrane separator for contamination. Replace if necessary. Refer to Filter maintenance →.
	Check if supply pressure is sufficient.
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. Refer to Changing the 4-20 mA current loop mode →.
	Make sure the device is connected to the correct terminals (see signal cable connections →).
	Check the open circuit voltage (35 to 40 VDC) across the current loops terminals (see signal cable connections →).
	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.
	Capture diagnostic data and send the file to Endress+Hauser (see *To read diagnostic data with HyperTerminal* in the Description of Device Parameters → for this analyzer).
Current loop is stuck at 4 mA or 20 mA	Check display for error message. If alarm has been triggered, reset the alarm. Refer to the Description of Device Parameters → for information on alarms.
Current loop is stuck at 4 mA or 20 mA (Continued)	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

Symptom	Response
	should be near 4.7 VDC. If not, the problem is probably on the main electronics board. Return to the factory for service, refer to Factory return →.
Reading seems to always be high by a fixed amount	Capture diagnostic data and send the file to Endress+Hauser (see *To read diagnostic data with HyperTerminal* in the Description of Device Parameters → for this analyzer).
	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 does not have specified effect	Check connections on keypad cable.
Reading seems to always be high by a fixed percentage	Capture diagnostic data and send the file to Endress+Hauser (see *To read diagnostic data with HyperTerminal* in the Description of Device Parameters → for this analyzer).
	Check that Peak Tracking is enabled (see *To change parameters in Mode 2* in the Description of Device Parameters → for this analyzer).
Reading displays 0.0 or seems relatively low	Capture diagnostic data and send the file to Endress+Hauser (see *To read diagnostic data with HyperTerminal* in the Description of Device Parameters → for this analyzer).
Reading is erratic or seems incorrect	Check for contamination in the sample system, especially if the readings are much higher than expected.
	Make sure the computer COM port is set for 19200 baud, 8 data bits, 1 stop bit, no parity, and no flow control.
	Capture diagnostic data and send the file to Endress+Hauser (see *To read diagnostic data with HyperTerminal* in the Description of Device Parameters → for this analyzer).
Reading goes to "0"	If **4-20 mA Alarm Action** is set to **2**, look on display for an error message (see *To change parameters in Mode 2* in the Description of Device Parameters → for this analyzer).
	Gas concentration is equal to zero.
Reading goes to full scale	If **4-20 mA Alarm Action** is set to **1**, look on display for an error message (see *To change parameters in Mode 2* in the Description of Device Parameters → for this analyzer).
	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.
	Make sure the connections are good. Verify the correct pin connections with an ohmmeter.
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.
Serial output is providing no data (continued)	Be sure no other programs are using the COM port selected.
	Make sure the connections are good. Verify the correct pin connections with an ohmmeter.

Symptom	**Response**
	Make sure to select the correct COM port into which the cable is plugged.
	Make sure the analyzer is operating in **Mode 1** and readings are being displayed on the LCD.
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.
Not getting enough flow to the sample cell	Check the micro filter and membrane separator for contamination. Replace if necessary. Refer to Filter maintenance → .
	Check if supply pressure is sufficient.

10 Service

10.1 Packing, shipment, and storage

Endress+Hauser analyzer systems and auxiliary equipment are shipped from the factory in appropriate packaging. Packaging for this type of analyzer typically consists of a wooden crate. All inlets and vents are capped and protected when packaged prior to shipment.

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

⚠ WARNING

Process samples may contain hazardous material in potentially flammable and 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. Purge the system:
   a. Connect a purge supply, regulated to the specified sample supply pressure, to the sample supply port.
   b. Confirm that any valves controlling the sample flow effluent to the low pressure flare or atmospheric vent are open.
   c. Turn on the purge supply and purge the system to clear any residual process gases. For differential systems, make sure to purge the scrubber for several dry cycles.

      Dry cycles can be initiated by pressing the **#** key followed by the **2** key to enter **Mode 2**, and then pressing the **#** key followed by the **1** key to return to **Mode 1**.
   d. Turn off the purge supply.
   e. Allow all residual gas to dissipate from the lines.
4. Close any valves controlling the sample flow effluent to the low pressure flare or atmospheric vent.
5. Disconnect power to the system.
6. Disconnect all tubing and signal connections.
7. Cap all inlets, outlets, vents, conduit or gland openings (to prevent foreign material such as dust or water from entering the system) using the original fittings supplied as part of the packaging from the factory.
8. Pack the equipment in the original packaging in which it was shipped, if available. If the original packaging material is no longer available, the equipment should be adequately secured (to prevent excessive shock or vibration). Refer to Service → for any questions related to packaging.
9. If returning the analyzer to the factory, complete the Decontamination Form provided by Endress+Hauser and attach to the outside of the shipping package as instructed before shipping. Refer to Factory return → for the Decontamination Form.

10.1.1 Storage

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

10.2 Service

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

10.2.1 Before contacting Service

Before contacting Service, prepare the following information to send with your inquiry:
- Analyzer serial number (SN)
- Contact information
- Description of the problem or questions

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

10.2.2 Factory return

If returning the analyzer or components is required, obtain a **Service Repair Order** (**SRO**) **number** from Service before returning to the factory. Service can determine whether the analyzer can be serviced on site or should be returned to the factory. All returns should be shipped to:

Endress+Hauser
11027 Arrow Route
Rancho Cucamonga, CA 91730
United States

10.2.3 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.

10.3 Disclaimers

Endress+Hauser accepts no responsibility for consequential damages arising from the use of this equipment. Liability is limited to replacement or repair of defective components.

This manual contains information protected by copyright. No part of this guide may be photocopied or reproduced in any form without prior written consent from Endress+Hauser.

10.4 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.

11 Technical data and drawings

11.1 SS2100 specifications

Measurement data	
Target components	SS2100: H_2O, H_2S, CO_2, NH_3, C_2H_2 2-pack: H_2S+H_2O or H_2S+CO_2 in Natural Gas 3-pack: H_2S+H_2O+CO_2 in Natural Gas
Principle of measurement	Tunable diode laser absorption spectroscopy (TDLAS)
Measurement ranges	See applicable Application Note. Refer to the Technical Information (TI) → for a complete list of Application Notes.
Repeatability	See applicable Application Note. Refer to the Technical Information (TI) → for a complete list of Application Notes.
Application data	
Ambient temperature range	Standard: −20 °C to 50 °C (−4 °F to 122 °F) Optional: −10 °C to 60 °C (14 °F to 140 °F)
Heated SCS enclosure	50 °C (122 °F) 60 °C (140 °F) — optional
Environmental relative humidity	5% to 95%, non-condensing
Altitude	Up to 2000 m
Sample cell pressure range	800 to 1200 mbara - standard 950 to 1700 mbara - optional
Maximum cell pressure	70 kPag (10 psig)
Pressure to sample cabinet	140 to 350 kPag (20 to 50 psig)[1]
Sample flow rate	0.5 to 4.0 slpm (1 to 8.5 scfh)[1]
Bypass flow rate	0.5 to 1 slpm (1.1 to 2.2 scfh)
Recommended validation	Binary cal gas bottle with methane or nitrogen background (nitrogen optional with auto-validation) or permeation tube (trace H_2O and trace NH_3 only).
Contaminant sensitivity	None for gas phase glycol, methanol, amines, or mercaptans.

[1] Application dependent

Electrical and communication	
Input power, electronics enclosure	120 or 240 VAC ±10%, 50 to 60 Hz; 200W 18 to 24 VDC, 1.6A max - optional
Input power, sample conditioning system (SCS)	SCS Input Power - 120VAC or 240VAC, 200W or 400W maximum[1]
Contact rating (inductive load)	250 V, 3 A N.O. contact, 1.5 A N.C. contact 24 V, 1A N.O. and N.C. contact
Analog communication	Isolated Analog channels, 120 ohms at 24 VDC maximum Outputs: Qty 2 4-20 mA (measurement value)
Serial communication	Analyzer A (H_2S): RS232C and ethernet Analyzer B (Channel 2 and 3: H_2O or CO_2): RS232C or ethernet (TSP only)
Digital signals	Outputs: Qty 5 Hi/Lo alarm, general fault, validation fail[1], validation 1 active[1], validation 2 active[1] Inputs: Qty 2 flow alarm[1], validation request[1]
Protocol	Modbus Gould RTU or Daniel RTU or ASCII
Diagnostic value examples	Detector power (mirror health), spectrum reference comparison and peak tracking (spectrum quality), cell pressure and temperature (overall system health)
LCD display	Concentration, cell pressure and temperature, diagnostics
Physical	
Electronics enclosure type	Type 4X 304 or 316L stainless steel
Sample system enclosure(s)	Type 4X 304 or 316L stainless steel
Typical analyzer dimensions	**SS2100 Analyzer:** 1285 mm H x 610 mm W x 394 mm D (50.6 x 24 x 15.5 inches) **SS2100 Trace Analyzer:** 1285 mm H x 762 mm W x 394 mm D (50.6 x 30 x 15.5 inches) **SS2100 2-pack and 3-pack:** 1285 mm H x 762 mm W x 394 mm D (50.6 x 30 x 15.5 inches)
Analyzer weight	Approximately 90 to 130 kg (200 to 300 lbs)
Sample cell construction	316L series polished stainless steel
Number of sample cells	1, 2 or 3

[1] Configuration dependent

Certification	
Analyzer (electronics and laser)	**SS2100:** Class I, Division 2, Groups A, B, C, D, T3/T3C, Type 4X and IP66 Class I, Zone 2 IIC T3/T3C **SS2100 2-pack and 3-pack:** Class I, Division 2, Groups B, C, D, T3/T3C, Type 4X and IP66 Class I, Zone 2 IIB+H_2 T3/T3C

For a complete listing of new or updated certificates and manuals, please visit the product page at www.endress.com.

11.2 Drawings

The following section contains generic drawings for typical system builds. Always refer to your as-built drawings for complete information about your system.

11.2.1 SS2100 H_2S systems (differential analyzer)

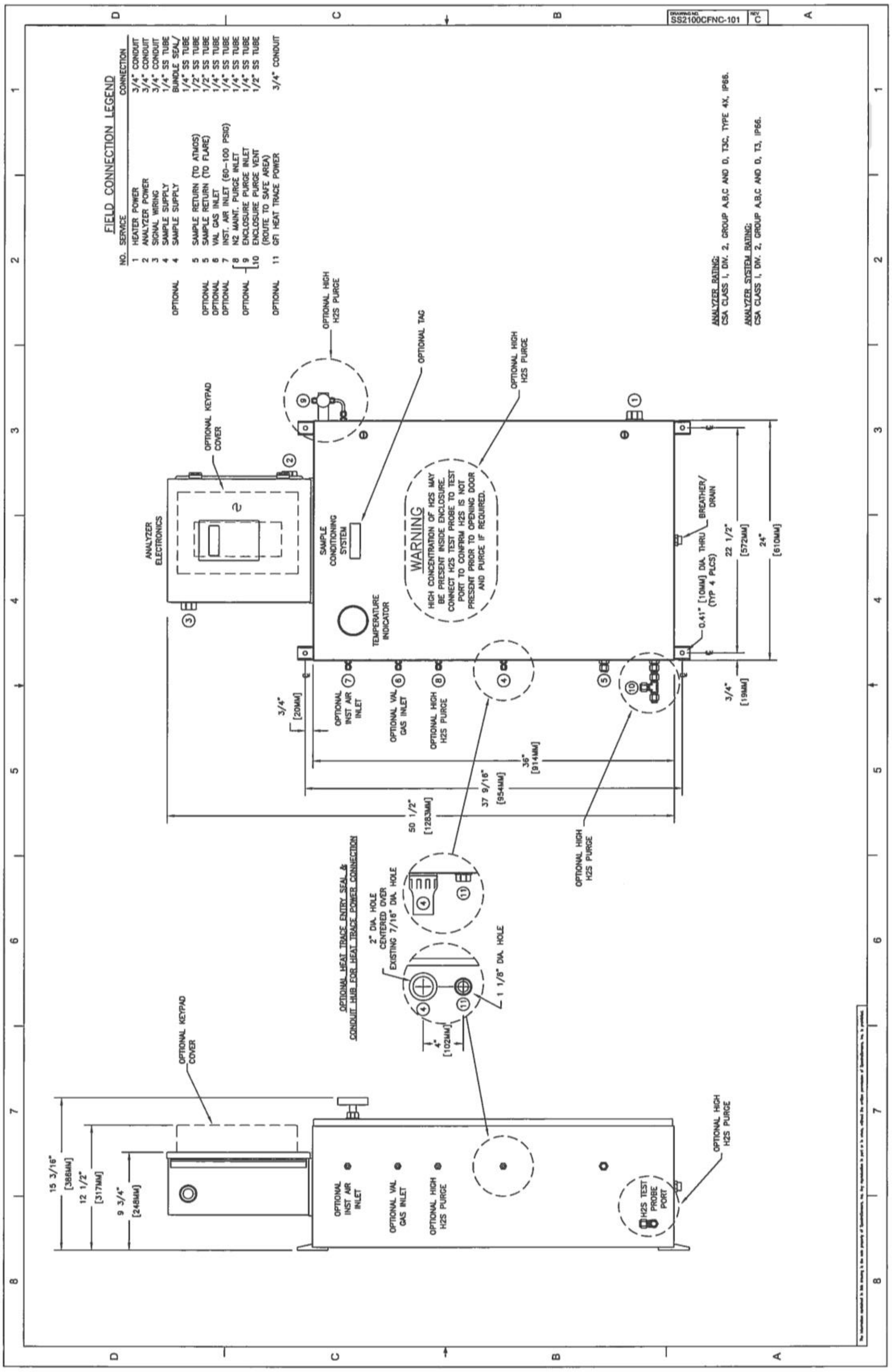


Fig 50. Outline and mounting dimensions (front view) of SS2100 analyzer for H_2S

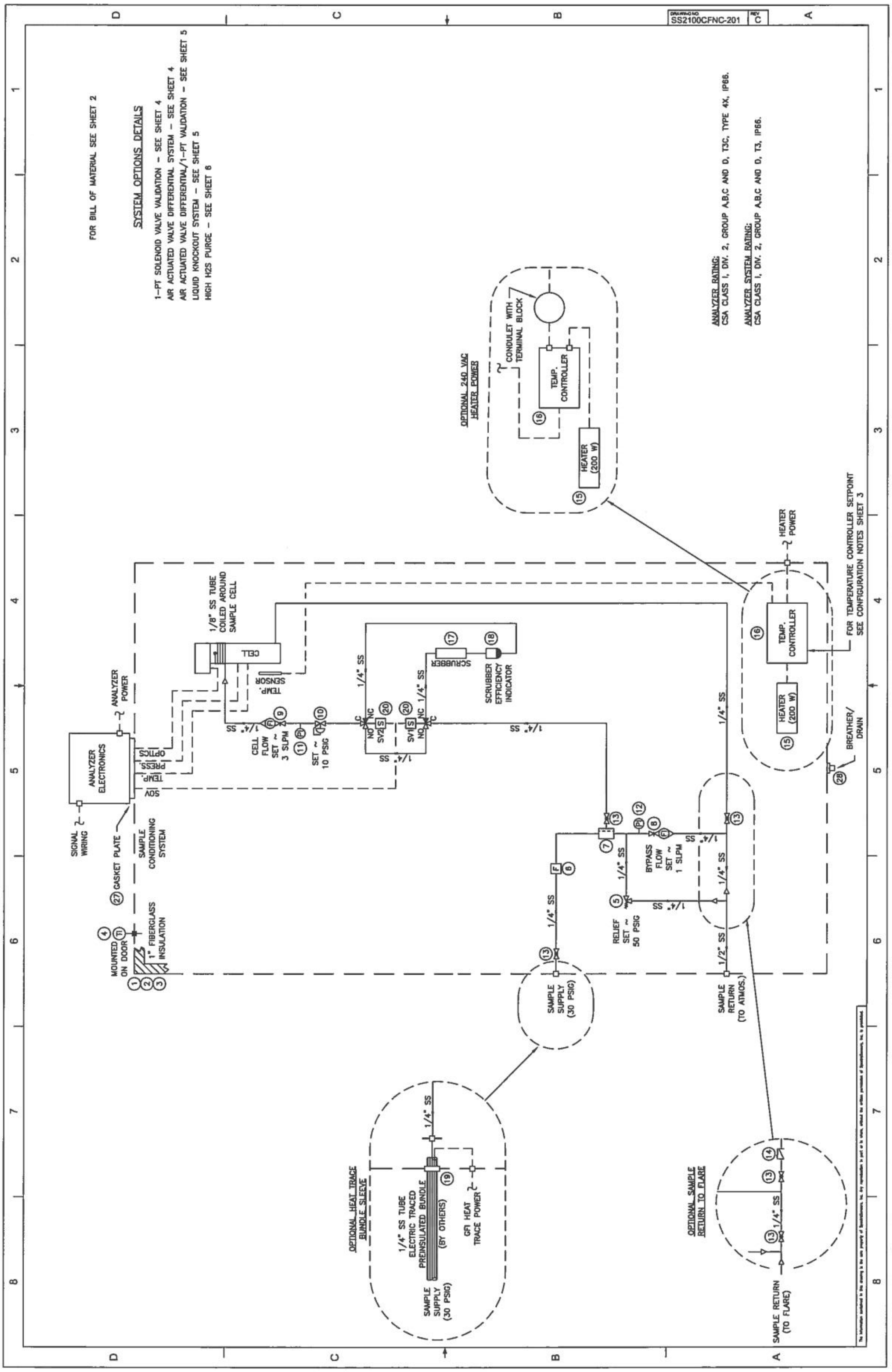


Fig 51. SCS schematic of SS2100 analyzer for H_2S

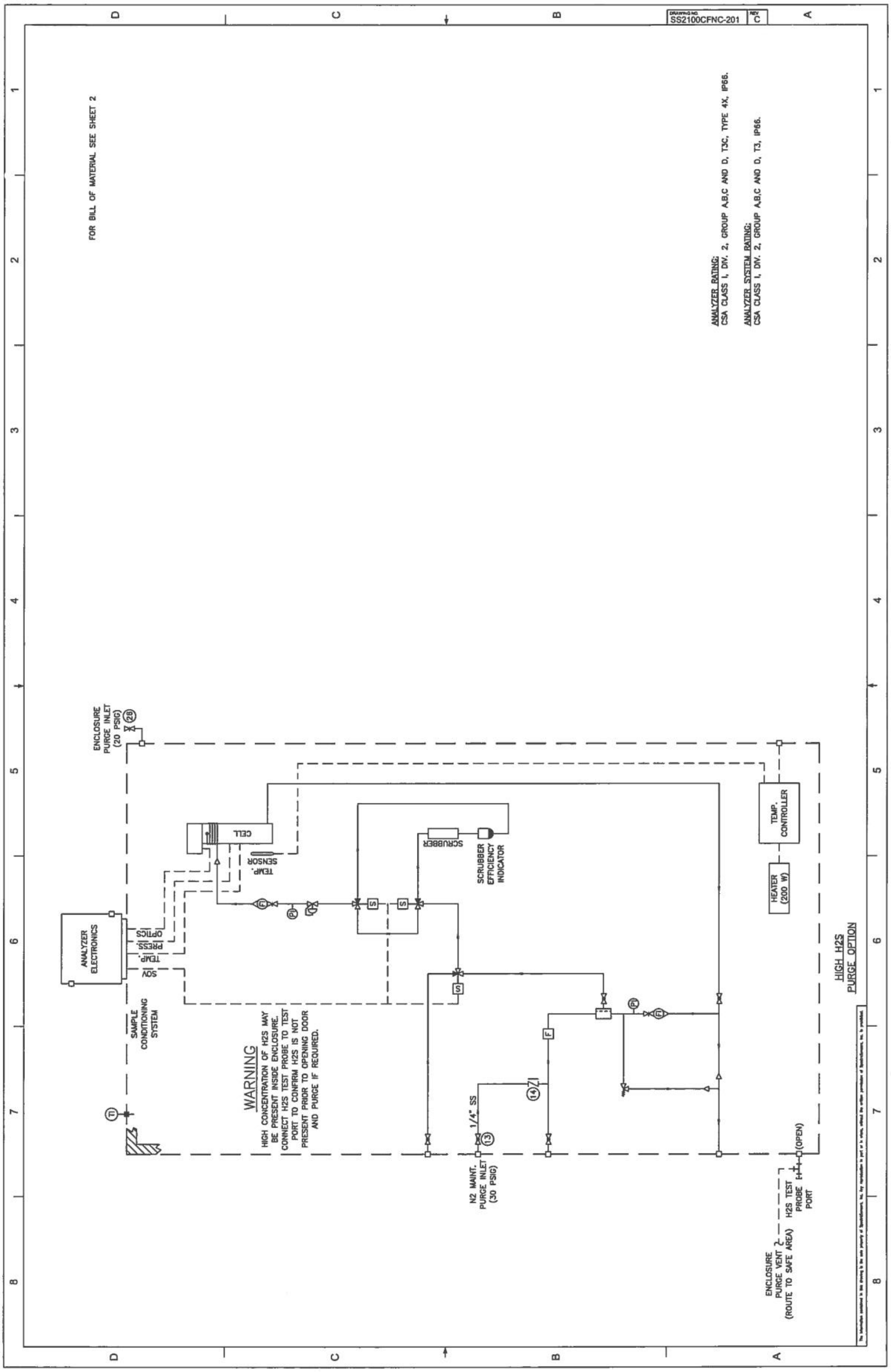


Fig 52. SCS schematic of SS2100 analyzer for H_2S - high H_2S purge

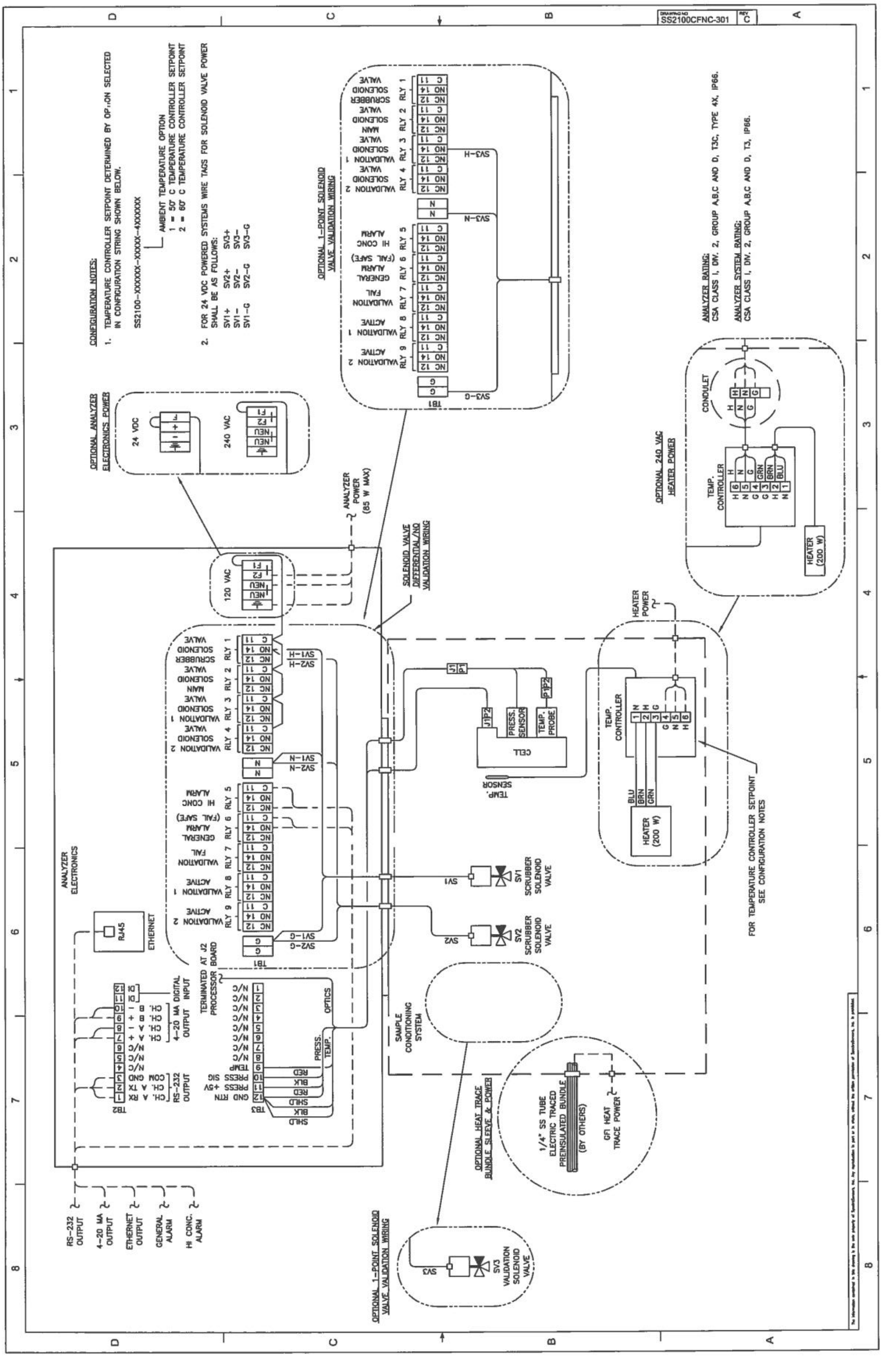


Fig 53. Power and signal wiring diagram of SS2100 analyzer for H_2S

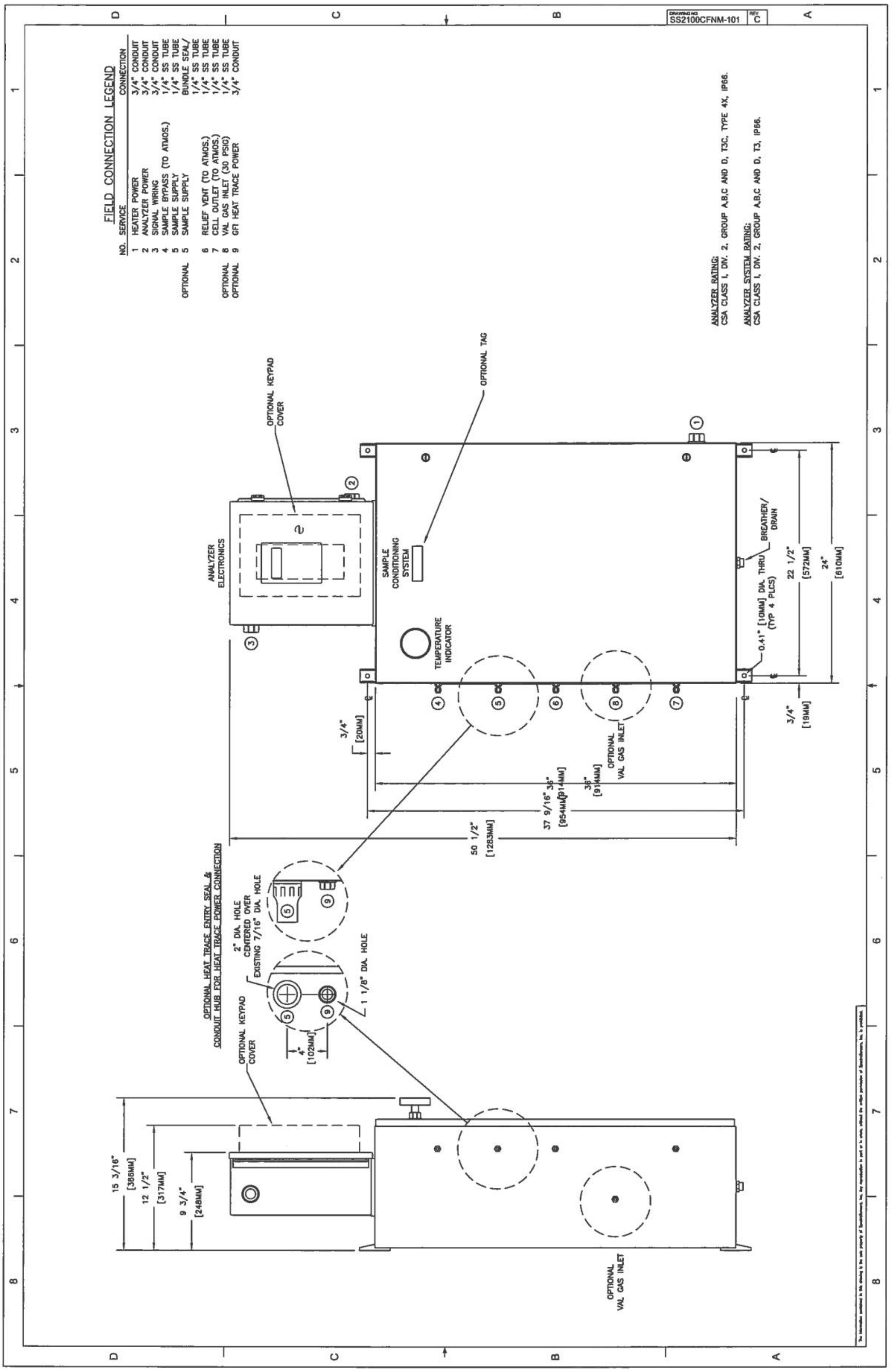


Fig 54. Outline and mounting dimensions – optional heat trace / high H_2S purge

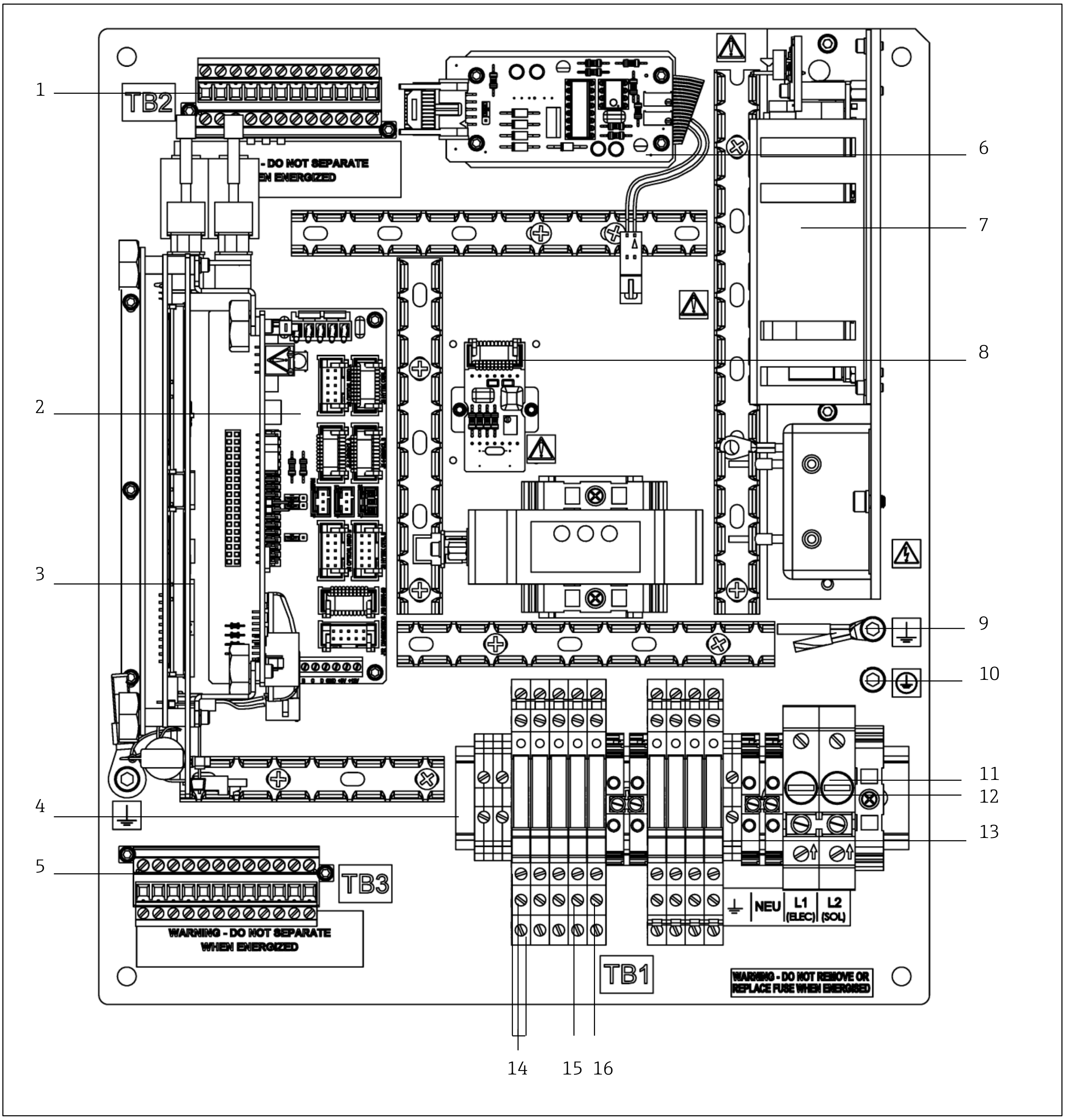


Fig 55. H_2S analyzer electronics board (AC) showing signal terminal block and alarm relays

1. *Terminal block (TB2), output signals*
2. *Backplane*
3. *Arm 9 control board stack*
4. *Alarm/signal relays*
5. *Terminal block (TB3), input pressure/temperature*
6. *Relay driver and 4-20 mA control board stack*
7. *Power supply*
8. *Hytek temperature controller*
9. *Component ground*
10. *Protective ground*
11. *Fuse (F1)*
12. *Fuse (F2)*
13. *Customer ground*
14. *Normally open (NO), common, normally closed (NC) (left to right)*
15. *General fault alarm*
16. *Assignable alarm*

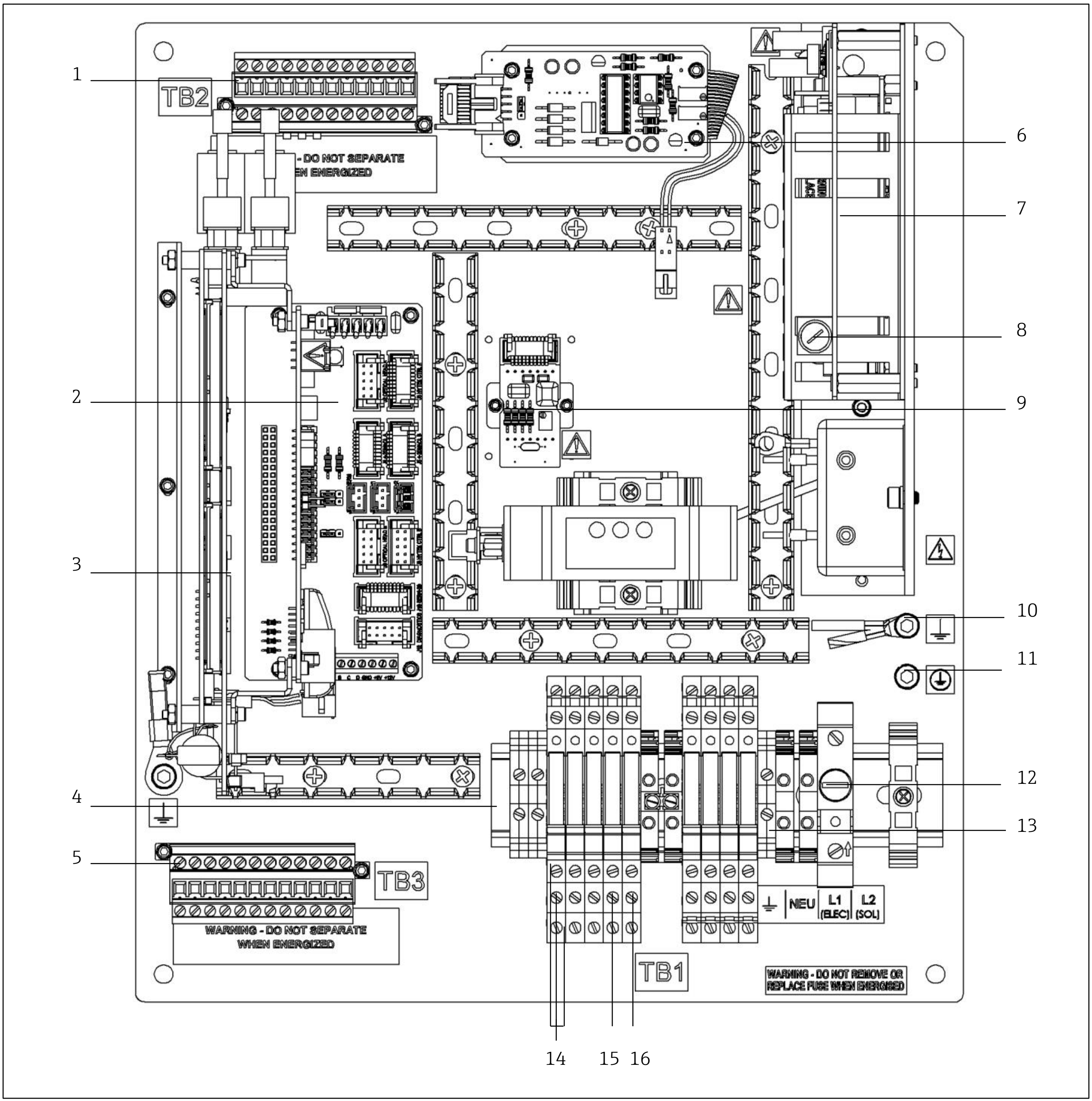


Fig 56. H_2S analyzer electronics board (DC) showing signal terminal block and alarm relays

1. *Terminal block (TB2), output signals*
2. *Backplane*
3. *Arm 9 control board stack*
4. *Alarm/signal relays*
5. *Terminal block (TB3), input pressure/temperature*
6. *Relay driver and 4-20 mA control board stack*
7. *Power supply*
8. *Fuse (F2)*
9. *Hytek temperature controller*
10. *Component ground*
11. *Protective ground*
12. *Fuse (F1)*
13. *Customer ground*
14. *Normally open (NO), common, normally closed (NC) (left to right)*
15. *General fault alarm*
16. *Assignable alarm*

11.2.2 SS2100 trace H_2O and NH_3 systems (differential analyzer)

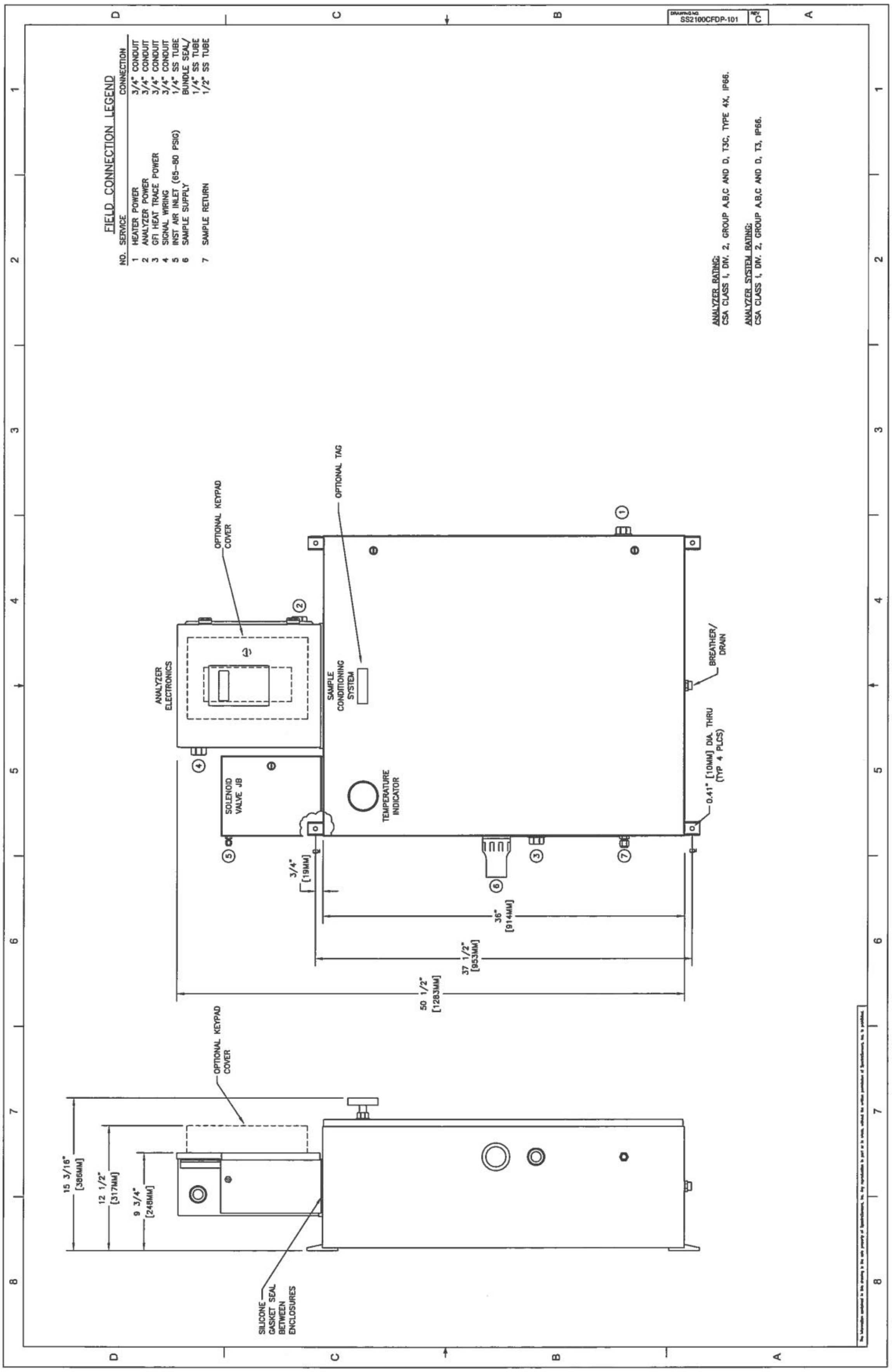


Fig 57. Outline schematic (front view) of SS2100 analyzer for trace moisture or ammonia (solenoids to side of electronics)

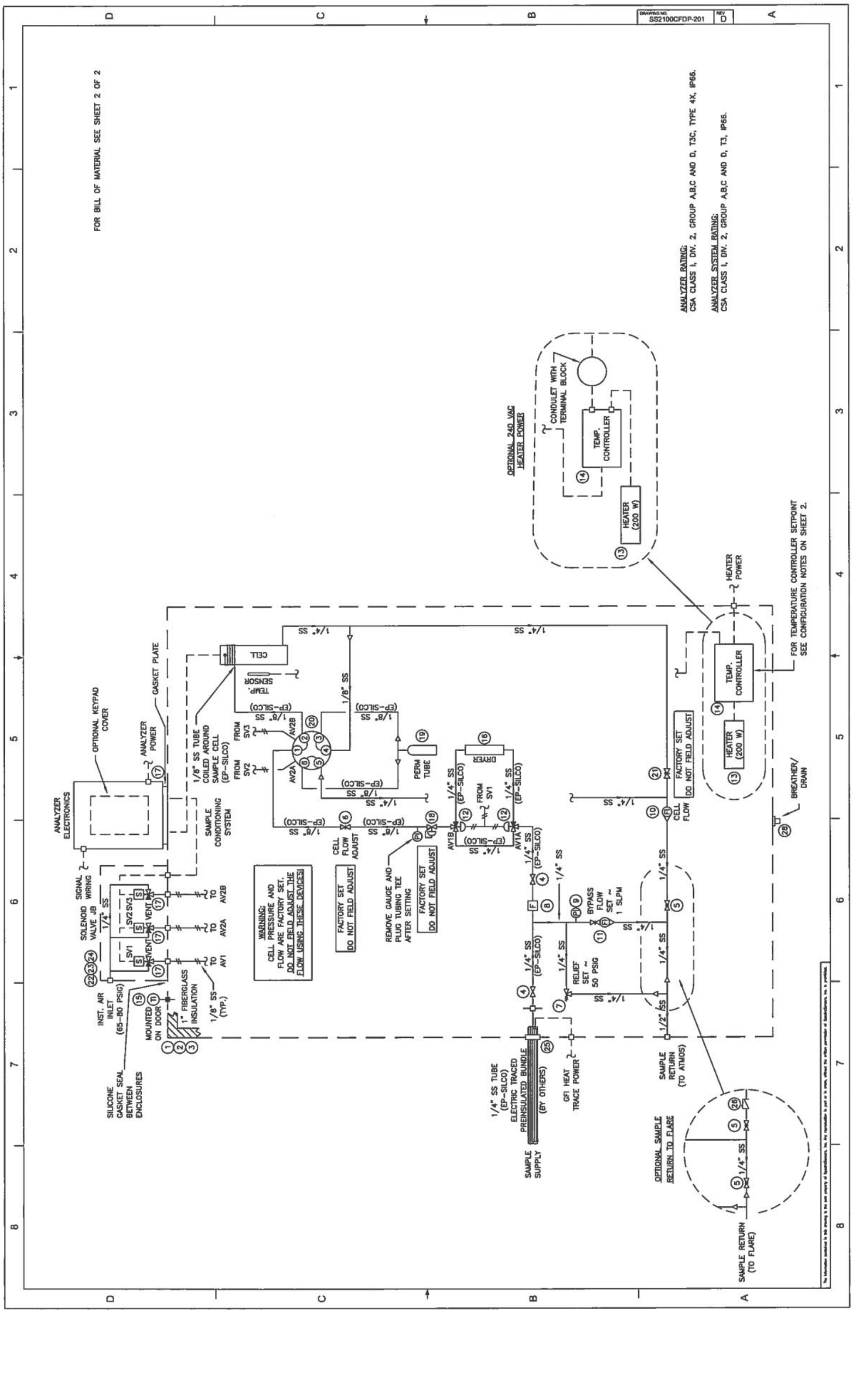


Fig 58. Wiring diagram of SS2100 analyzer for trace moisture or ammonia (solenoids to side of electronics)

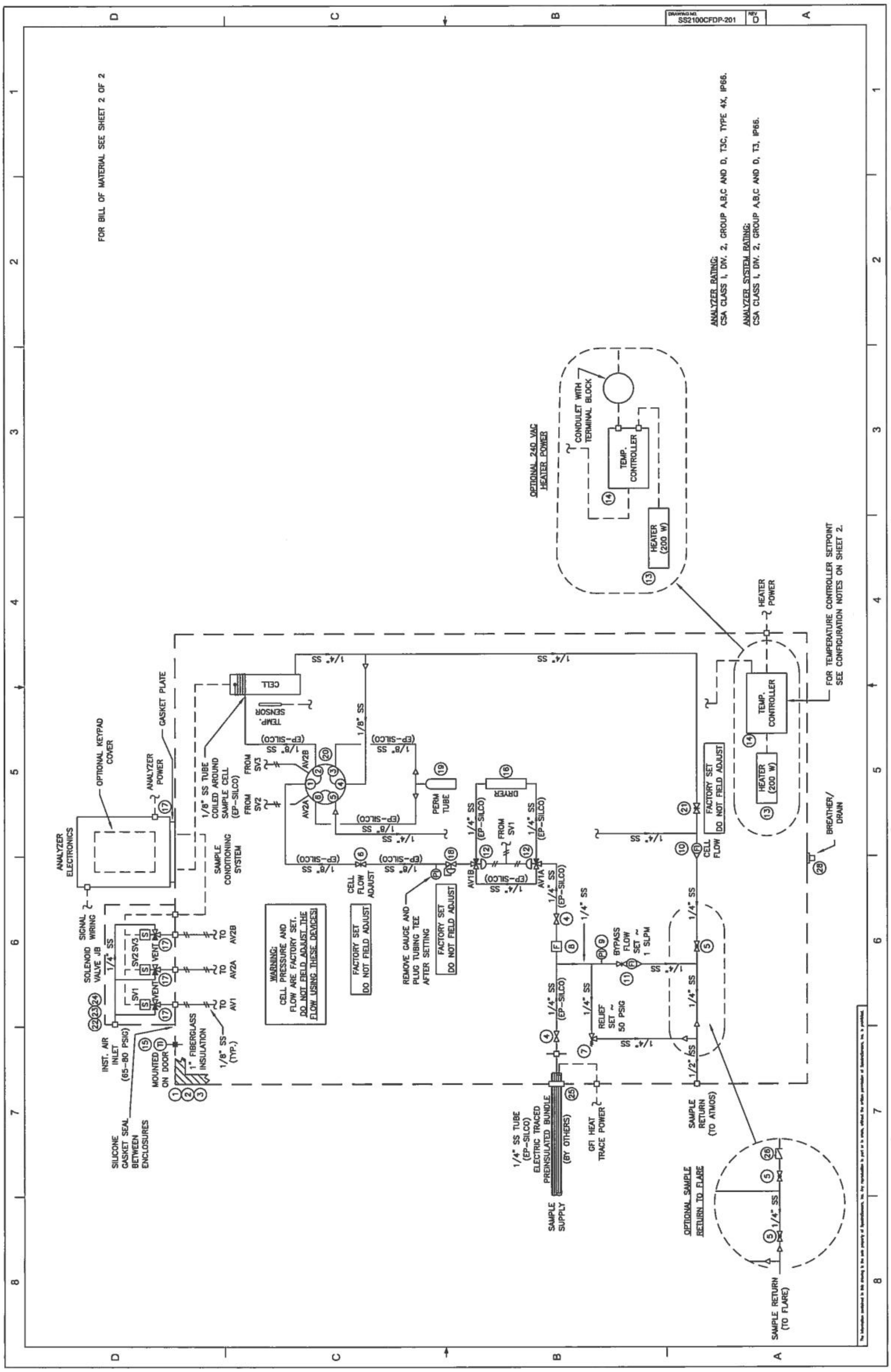


Fig 59. Wiring diagram of SS2100 analyzer for trace moisture or ammonia (solenoids to side of electronics)

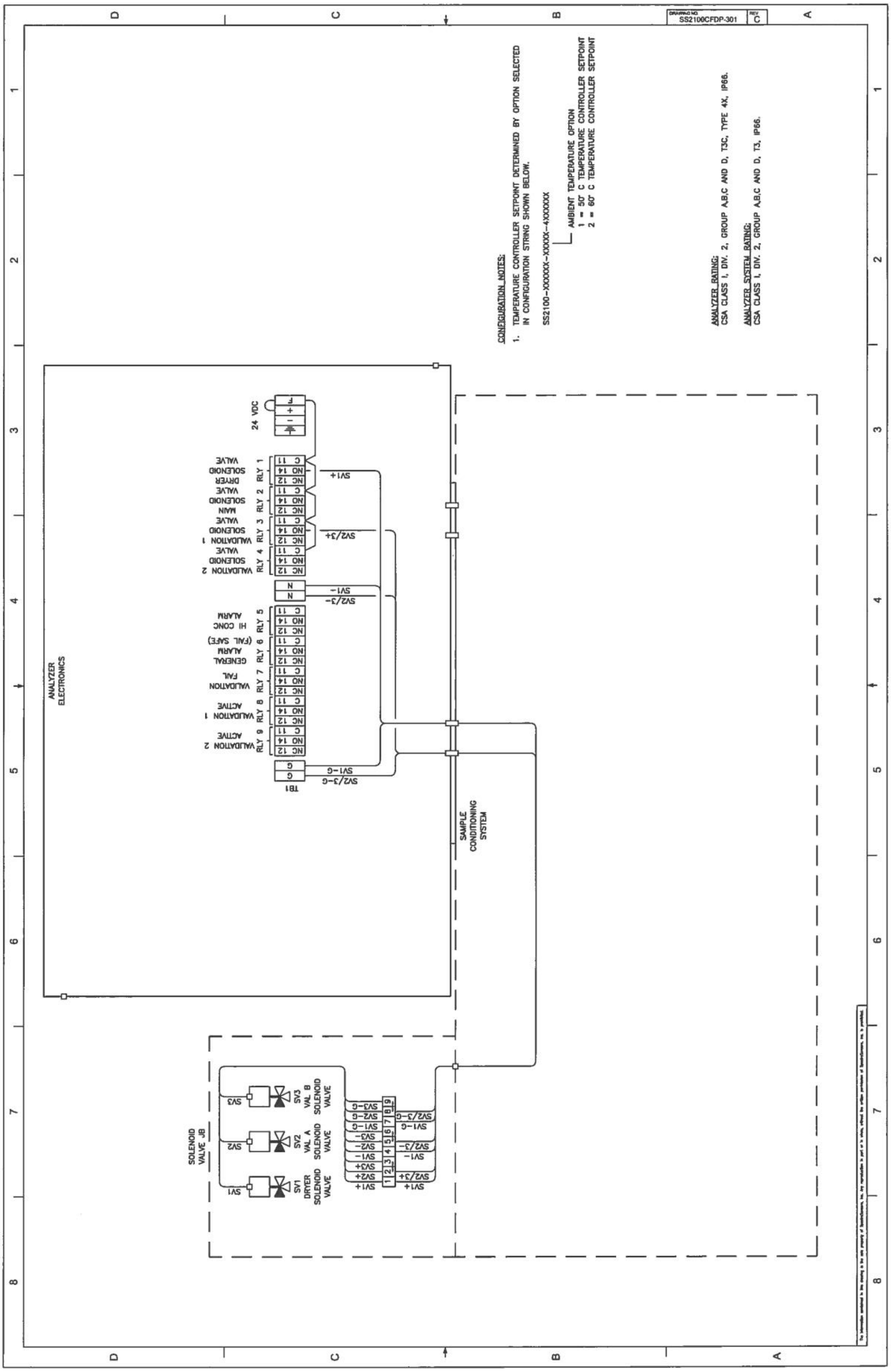


Fig 60. Electrical schematic of SS2100 analyzer for trace moisture or ammonia (solenoids to side of electronics)

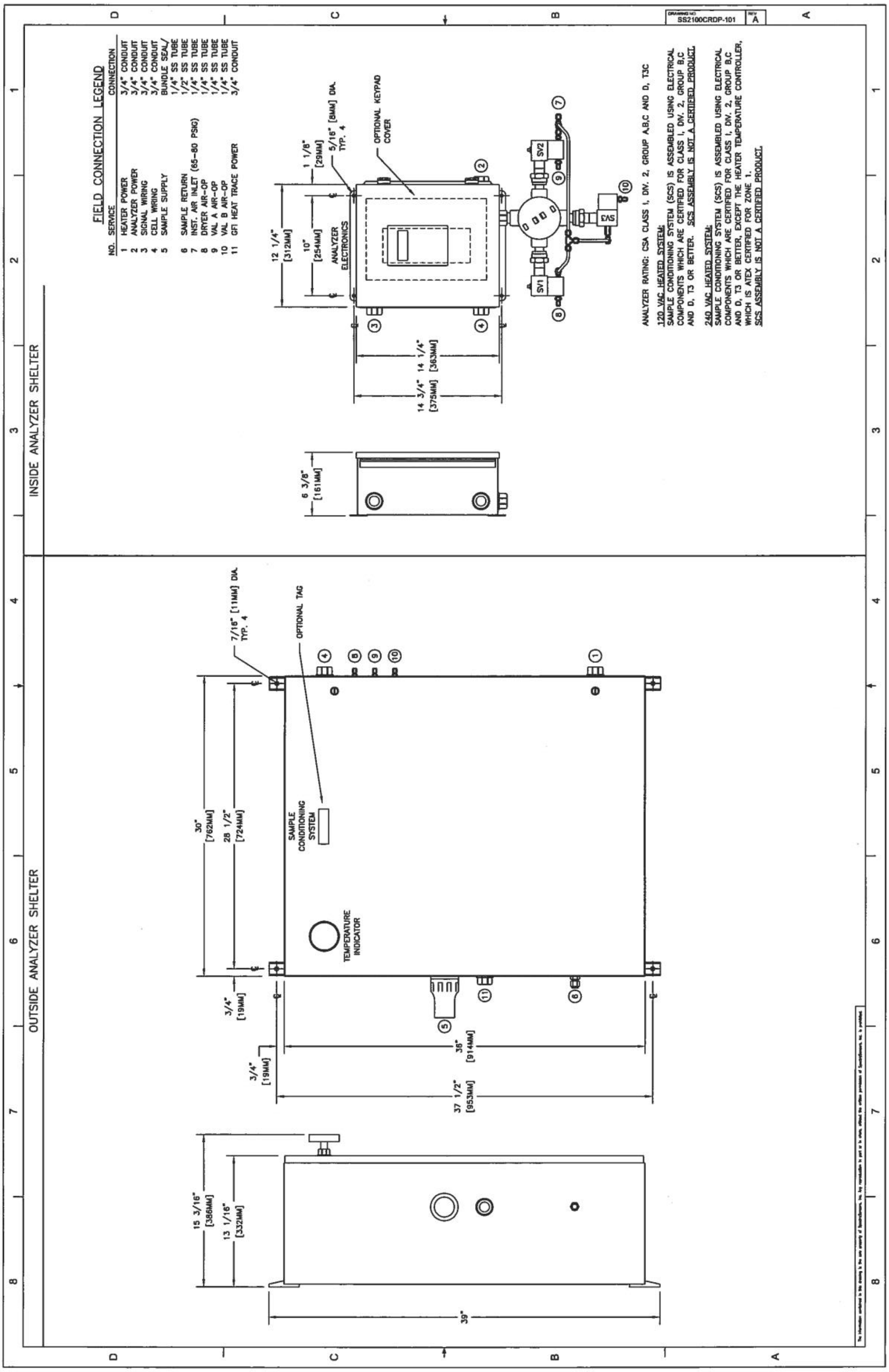


Fig 61. Remote mount configuration: outline schematic (front view) of SS2100 analyzer for trace moisture or ammonia (solenoids below electronics)

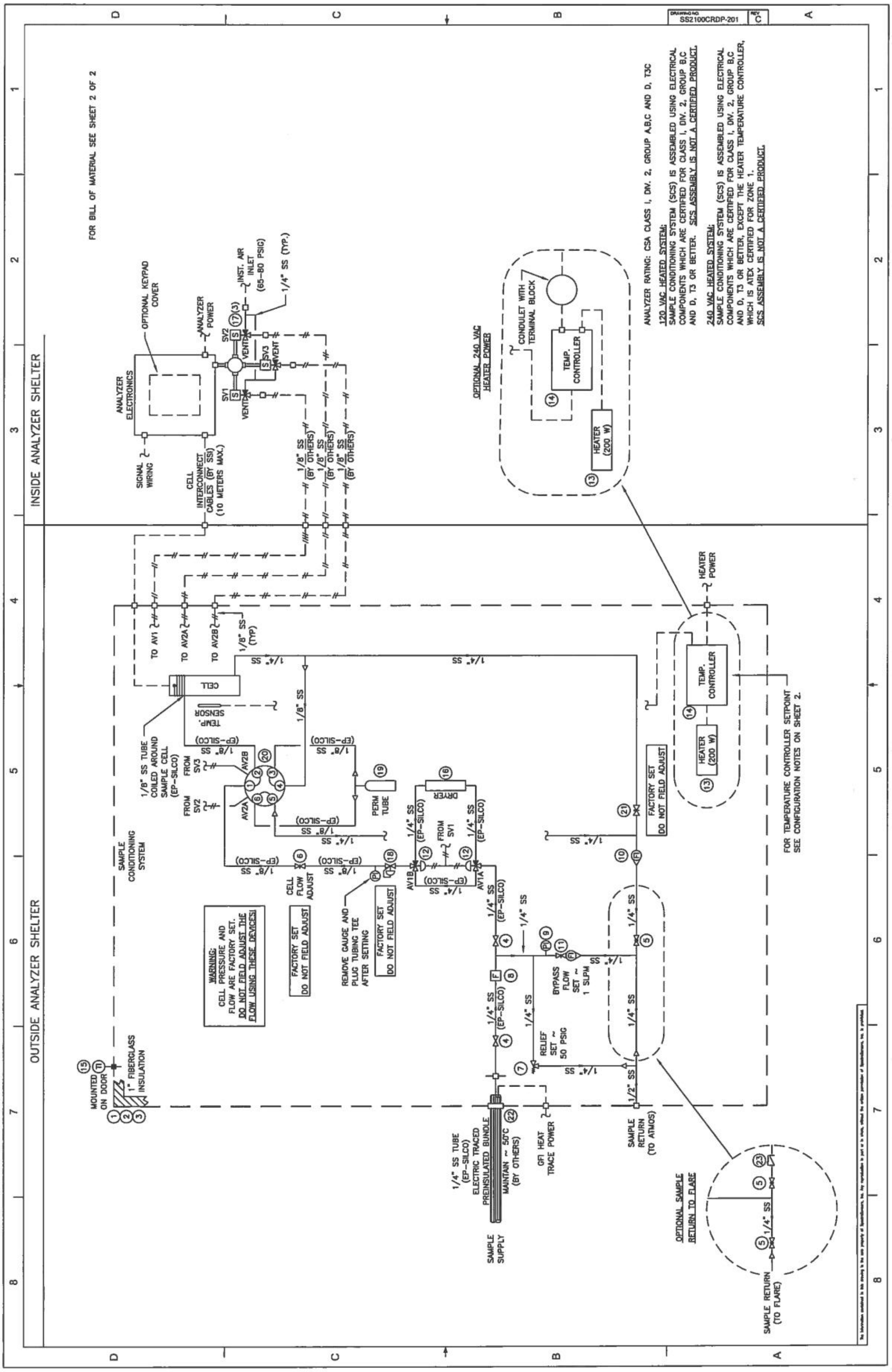


Fig 62. Remote mount configuration: flow schematic of SS2100 analyzer for trace moisture or ammonia (solenoids below electronics)

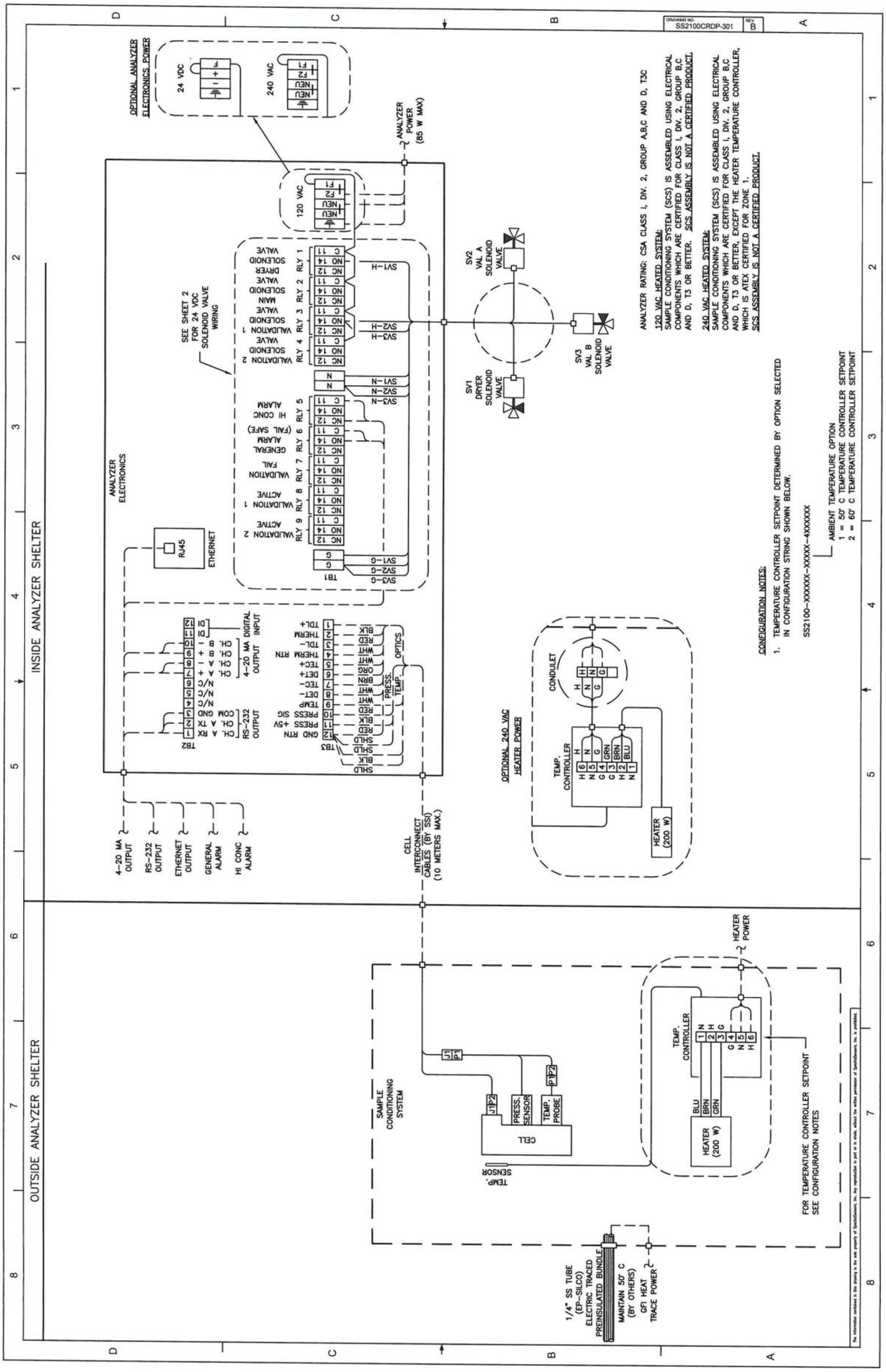


Fig 63. Remote mount configuration: wiring schematic of SS2100 analyzer for trace moisture or ammonia (solenoids below electronics)

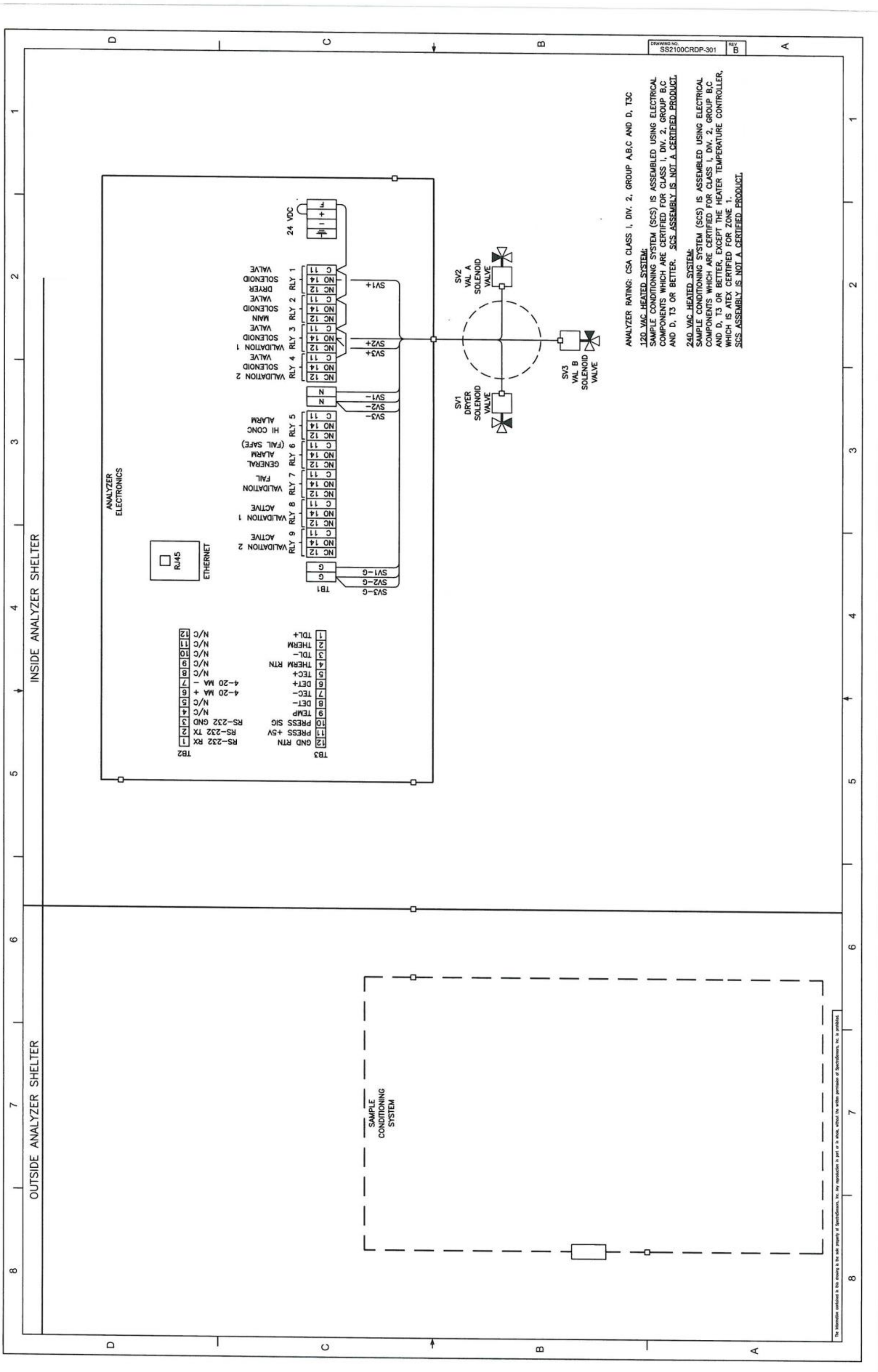


Fig 64. Remote mount configuration: electrical schematic of SS2100 for trace moisture analyzer or ammonia (solenoids below electronics)

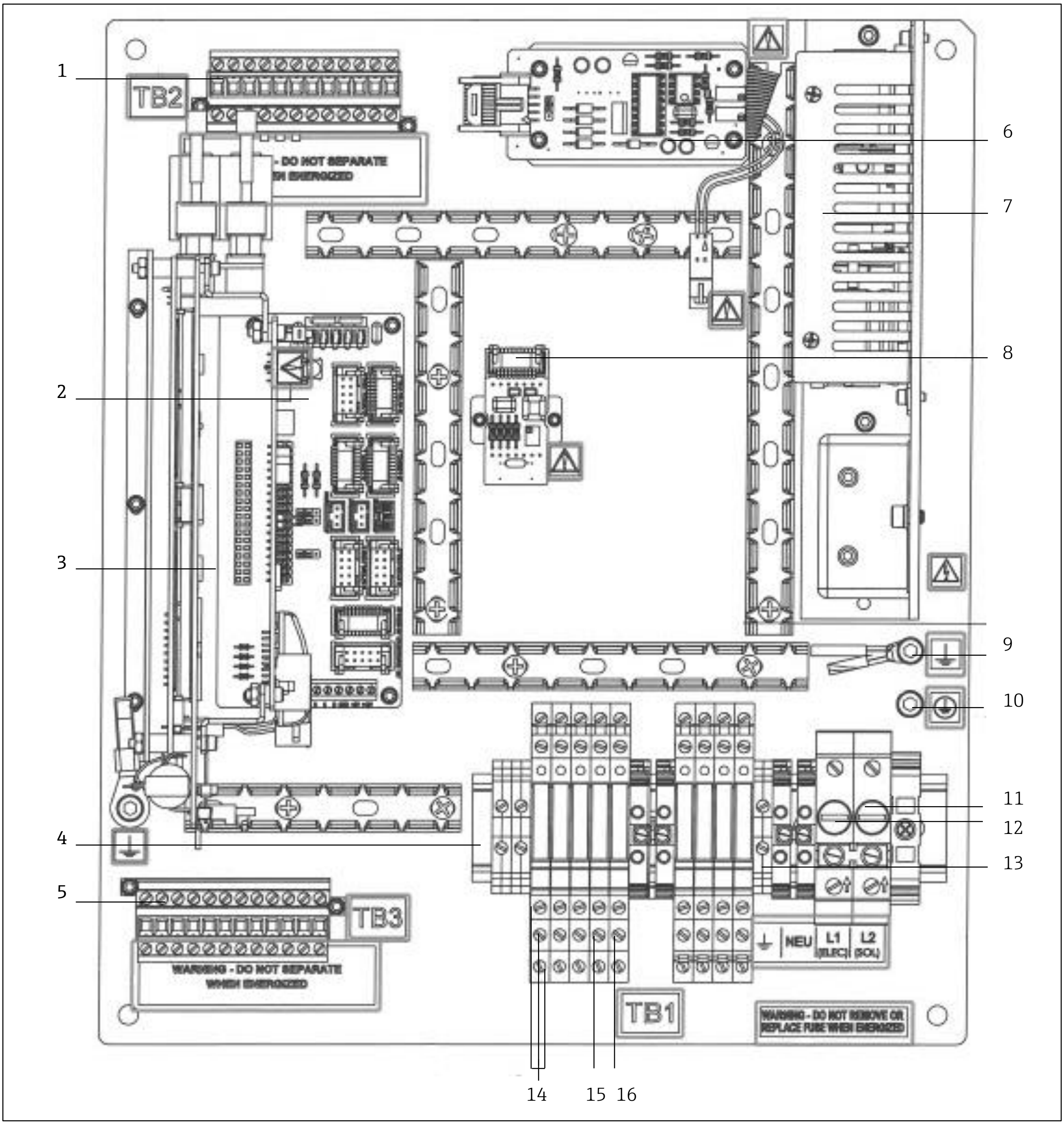


Fig 65. H_2O, NH_3 analyzer electronics board (AC) showing signal terminal block and alarm relays

1. *Terminal block (TB2), output signals*
2. *Backplane*
3. *Arm 9 control board stack*
4. *Alarm/signal relays*
5. *Terminal block (TB3), input pressure/temperature*
6. *Relay driver and 4-20 mA control board stack*
7. *Power supply*
8. *Hytek temperature controller*
9. *Component ground*
10. *Protective ground*
11. *Fuse (F1)*
12. *Fuse (F2)*
13. *Customer ground*
14. *Normally open (NO), common, normally closed (NC) (left to right)*
15. *General fault alarm*
16. *Assignable alarm*

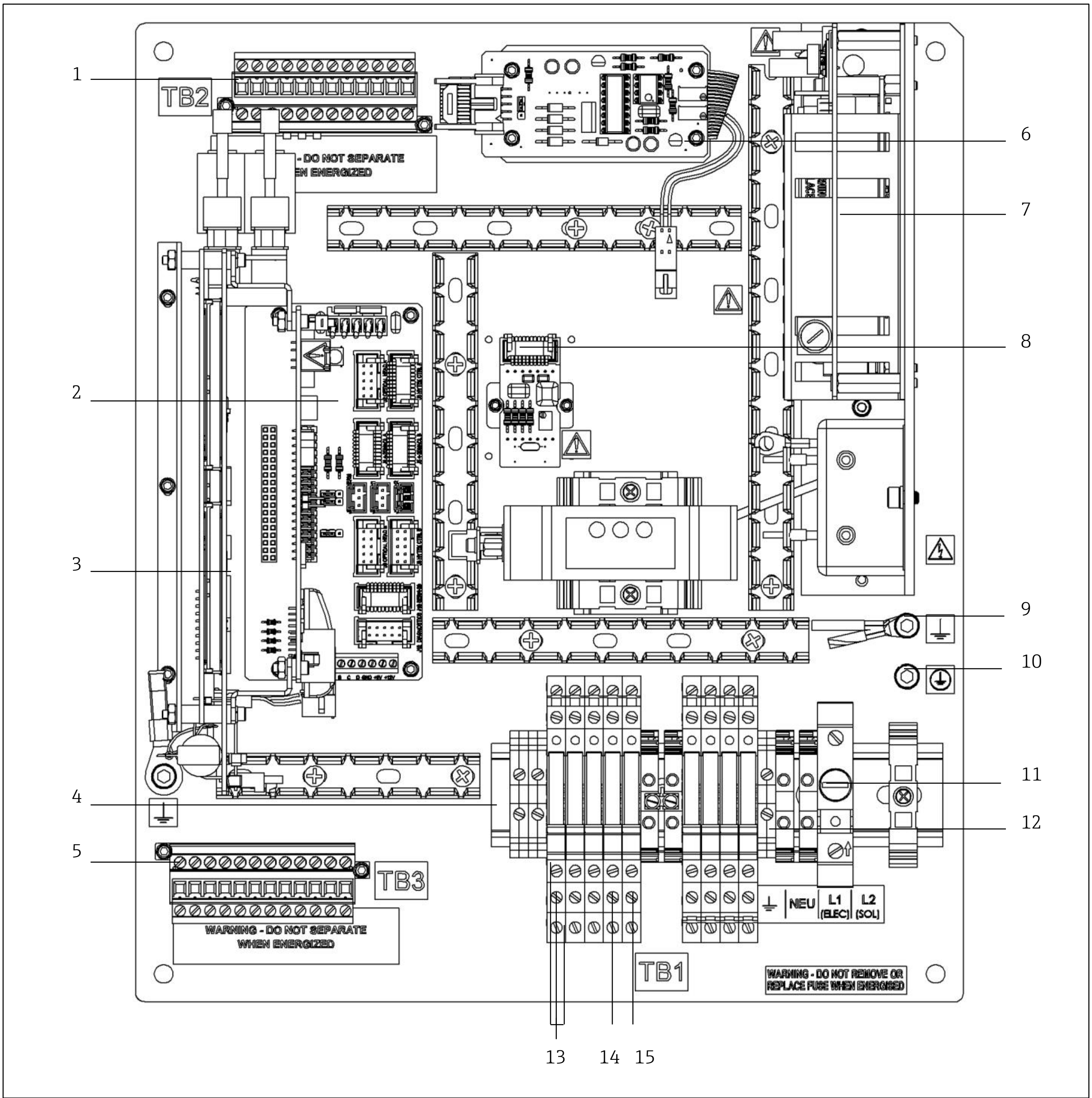


Fig 66. H_2O, NH_3 analyzer electronics board (DC) showing signal terminal block and alarm relays

1. *Terminal block (TB2), output signals*
2. *Backplane*
3. *Arm 9 control board stack*
4. *Alarm/signal relays*
5. *Terminal block (TB3), input pressure/temperature*
6. *Relay driver and 4-20 mA control board stack*
7. *Power supply*
8. *Hytek temperature controller*
9. *Component ground*
10. *Protective ground*
11. *Fuse*
12. *Customer ground*
13. *Normally open (NO), common, normally closed (NC) (left to right)*
14. *General fault alarm*
15. *Assignable alarm*

11.2.3 SS2100 non-differential systems

Refer to as-built drawings for dimensions, flow diagrams, and wiring schematics. As-built drawings are shipped with each custom analzyer.

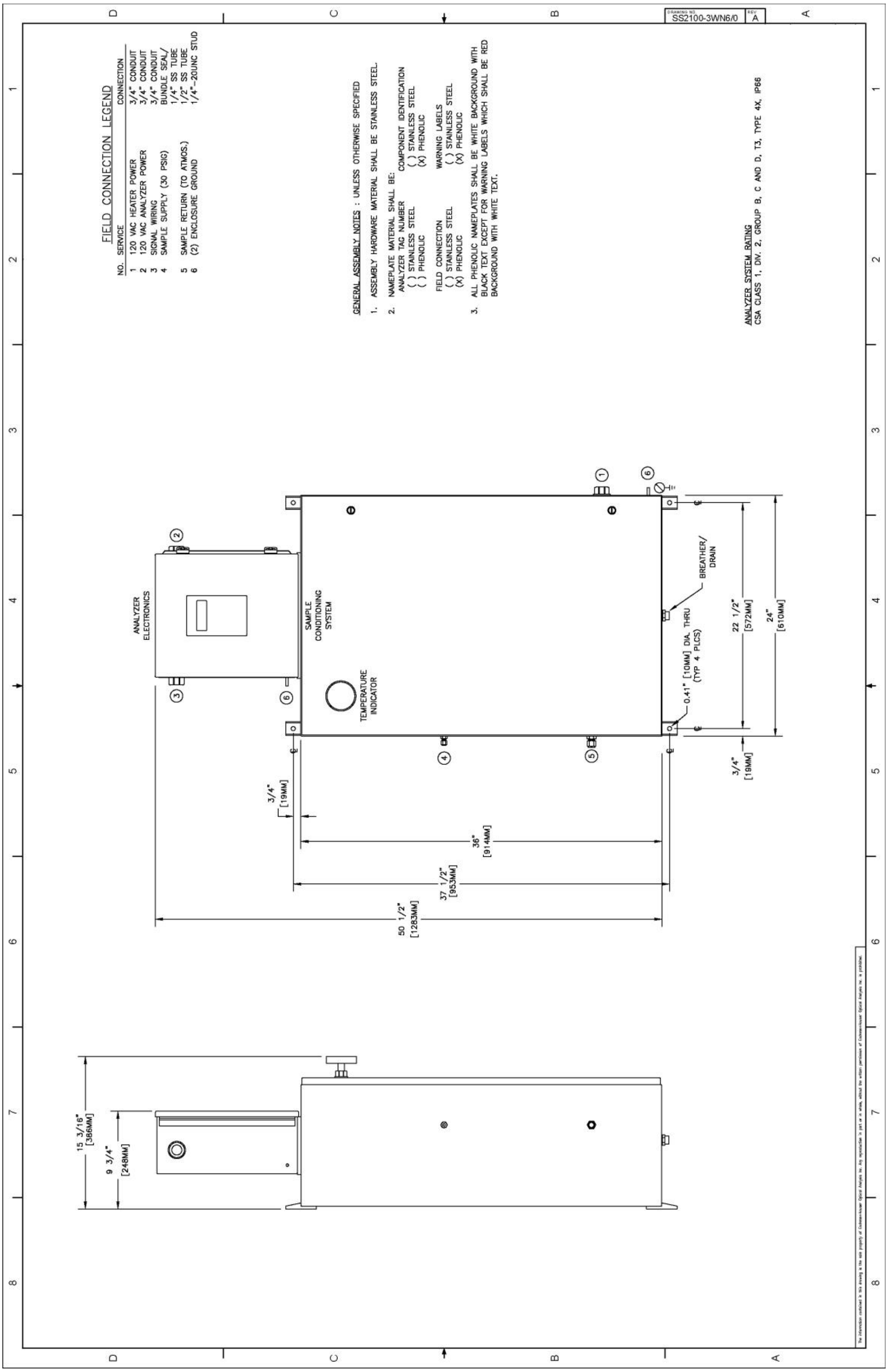


Fig 67. Outline and mounting dimensions (front view) of the non-differential analyzer (fixed mount, conventional)

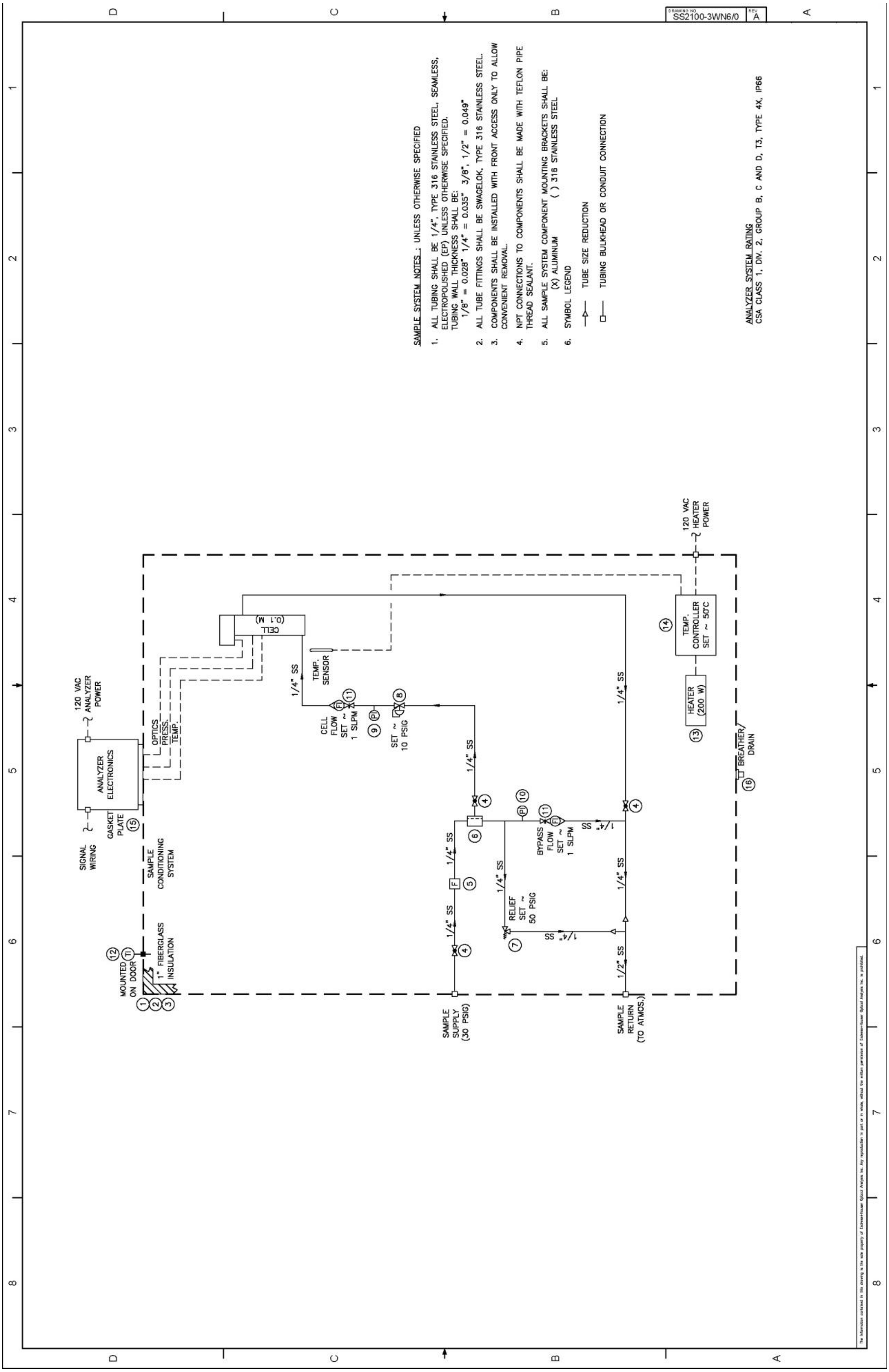


Fig 68. SCS schematic of non-differential analyzer (fixed mount, conventional)

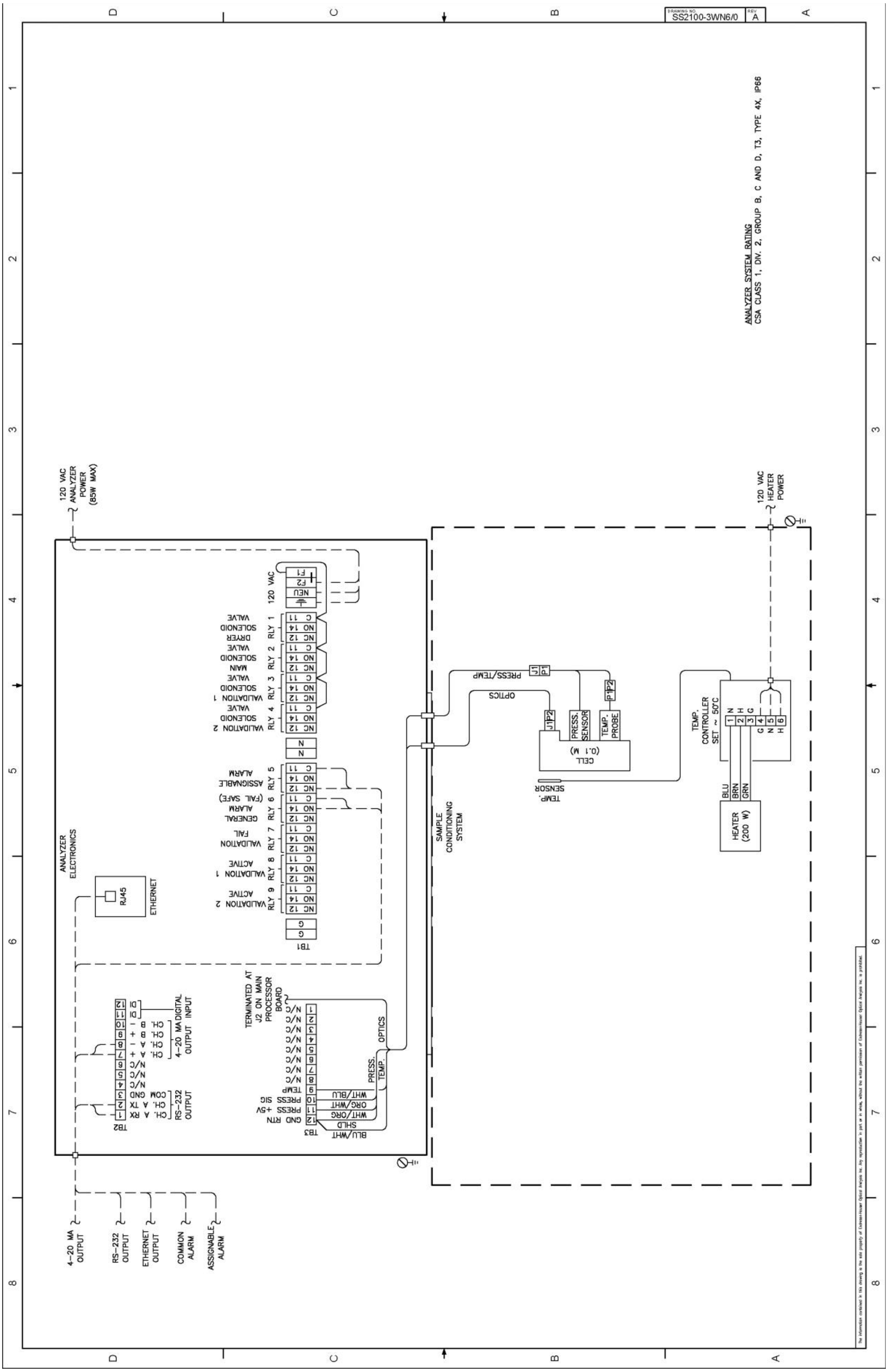


Fig 69. Power and signal wiring for SS2100 non-differential system (fixed mount, conventional)

SS2100 non-differential electronics

The SS2100 non-differential analyzer systems contain ARM9 control boards in their analyzer electronics enclosures. For drawings of ARM9 control boards, see the drawing for the H_2S electronics for AC systems → or the drawing for the H_2S electronics for DC systems →. See Determining firmware version → for specifics about electronics, and as-built drawings for dimensions, flow diagrams, and wiring schematics.

11.2.4 SS2100 2-pack system

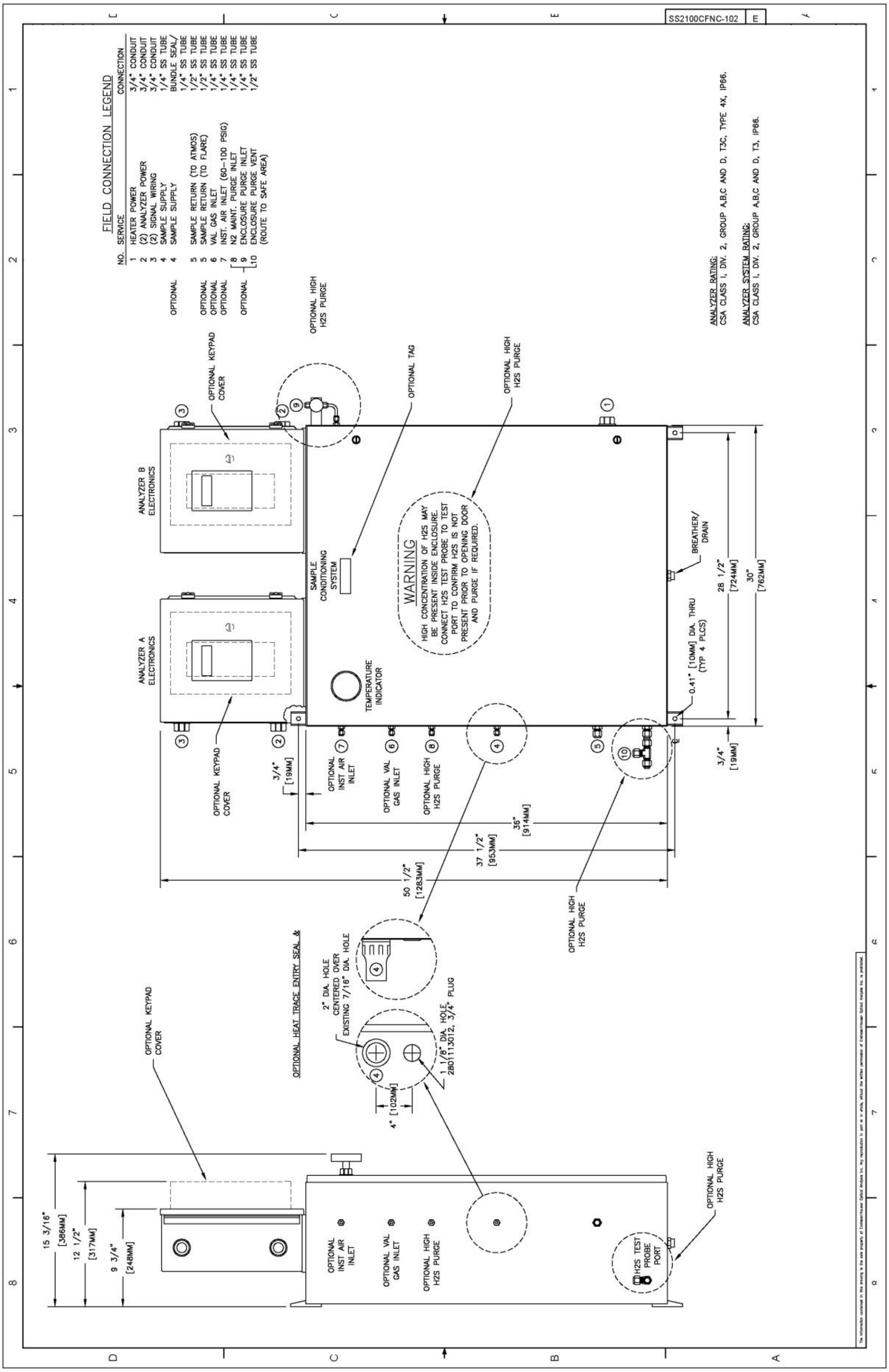


Fig 70. Outline and mounting dimensions (front view) of 2-pack analyzer (fixed mount, conventional)

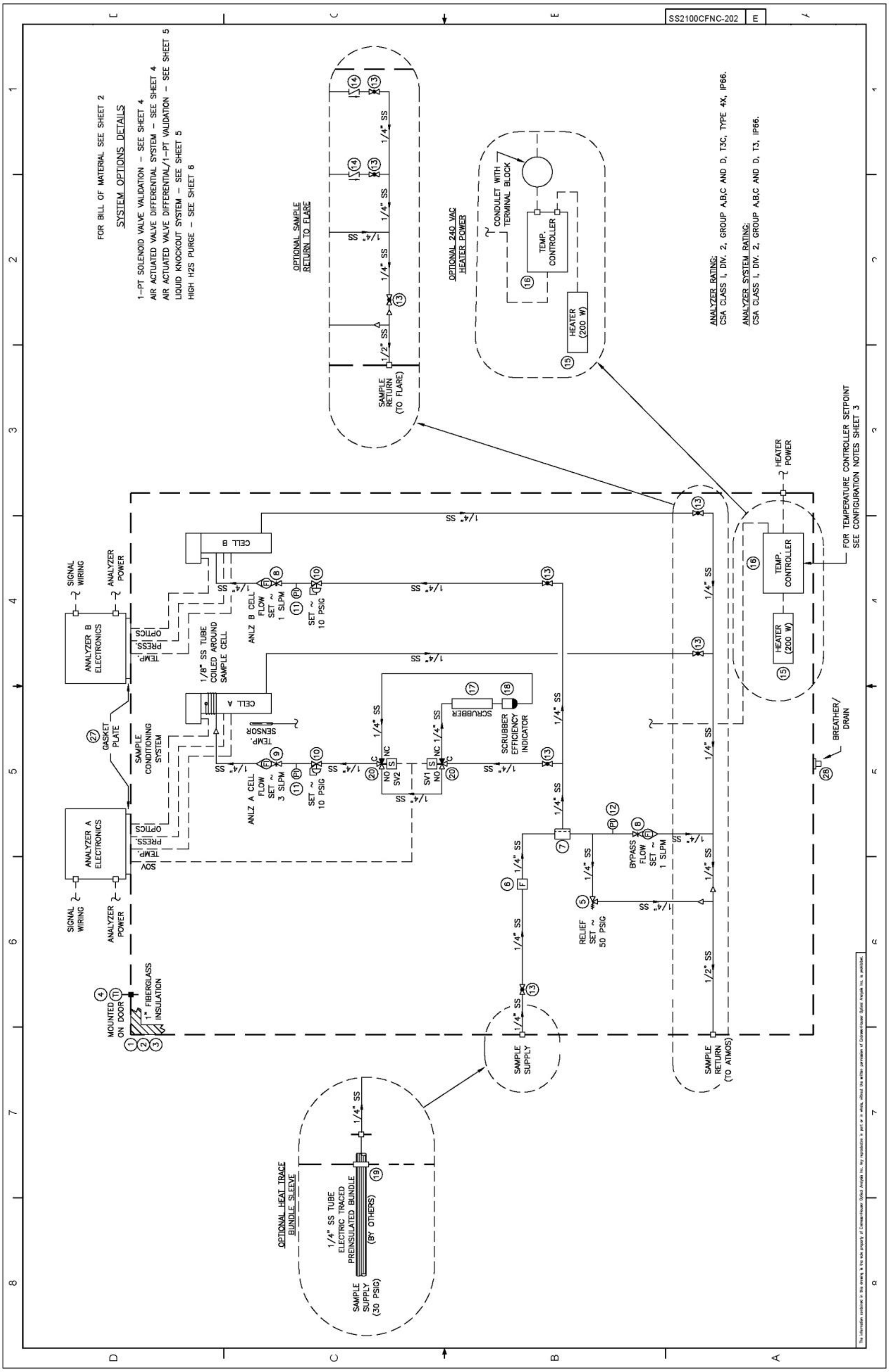


Fig 71. SCS schematic of 2-pack analyzer systrem (fixed mount, conventional)

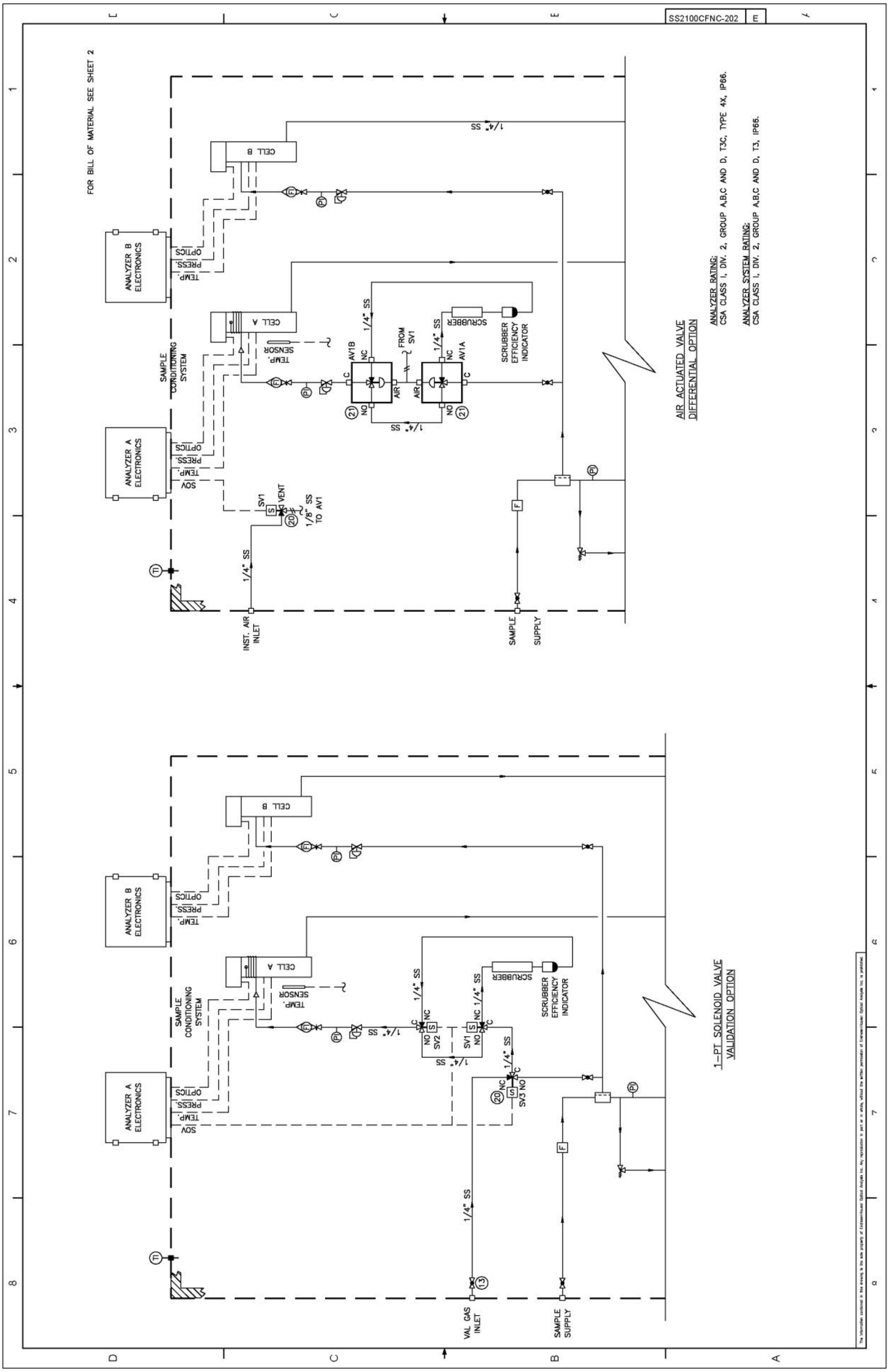


Fig 72. 2-pack SCS schematic of 1 pt. solenoid valve, validation, air-actuated valve differential option (fixed mount, conventional)

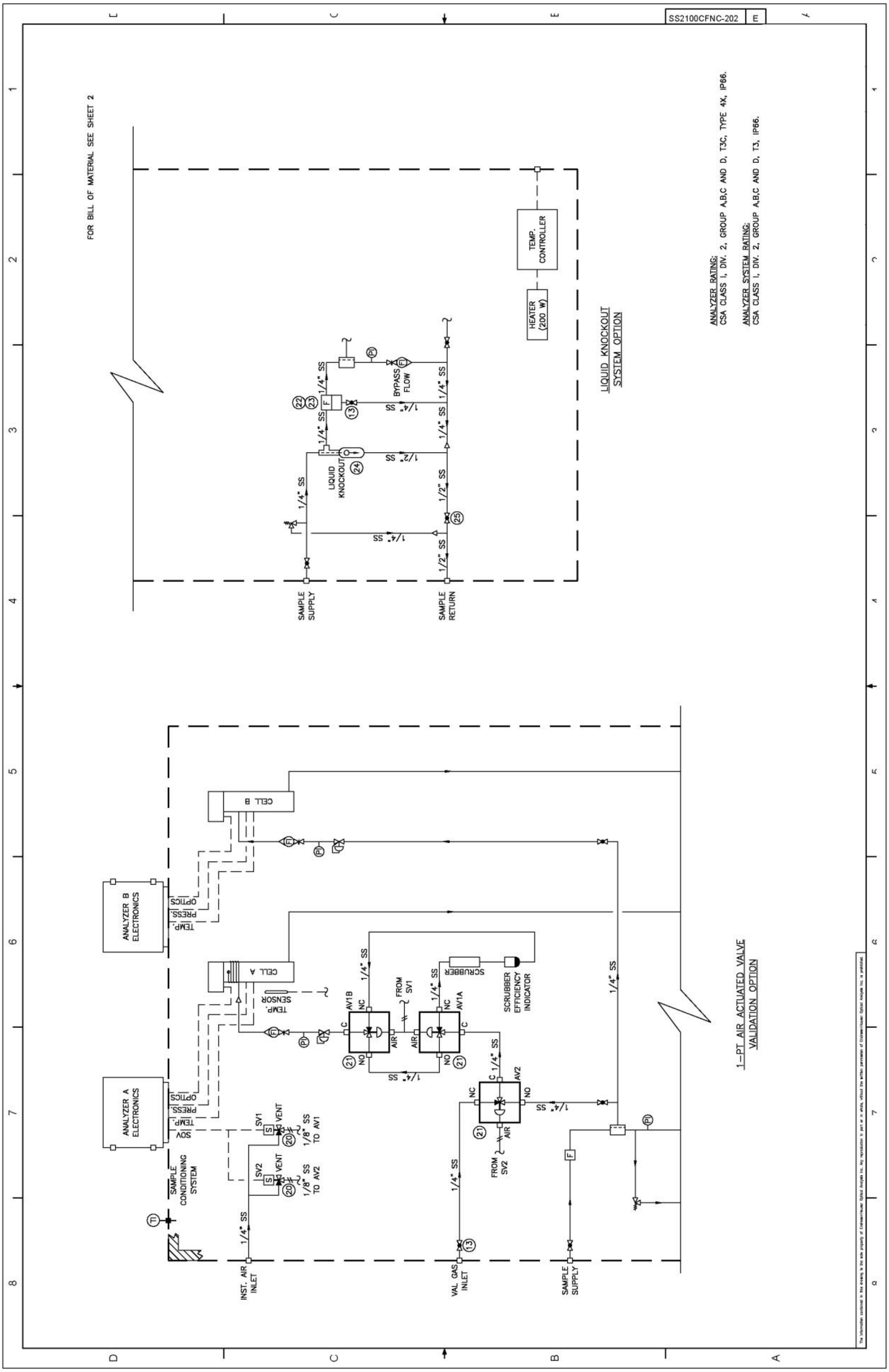


Fig 73. 2-pack SCS schematic of 1 pt. air-actuated valve, validation, liquid knock-out options (fixed mount, conventional)

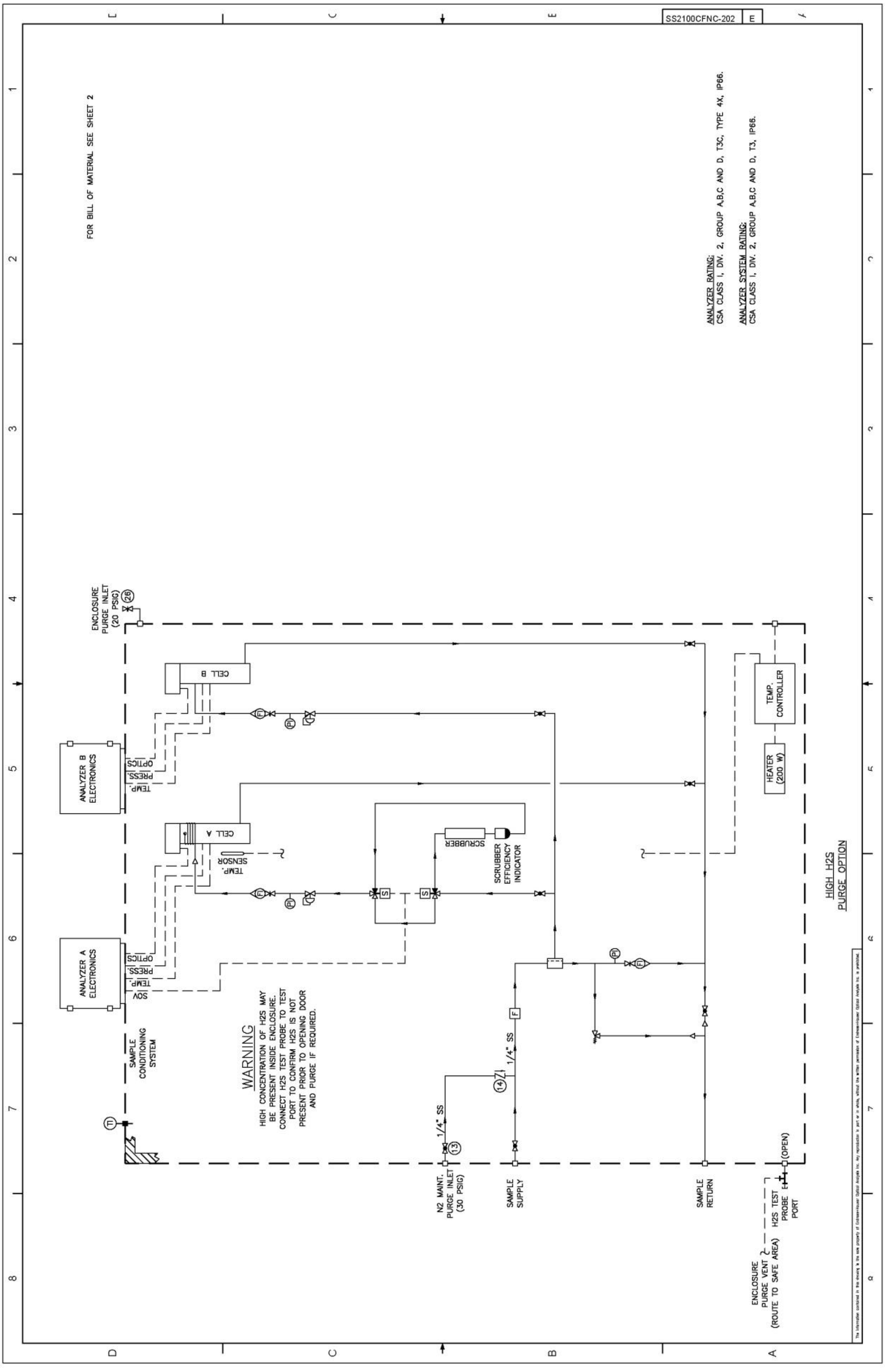


Fig 74. 2-pack SCS schematic, fixed mount, non-validation, high H2S purge option

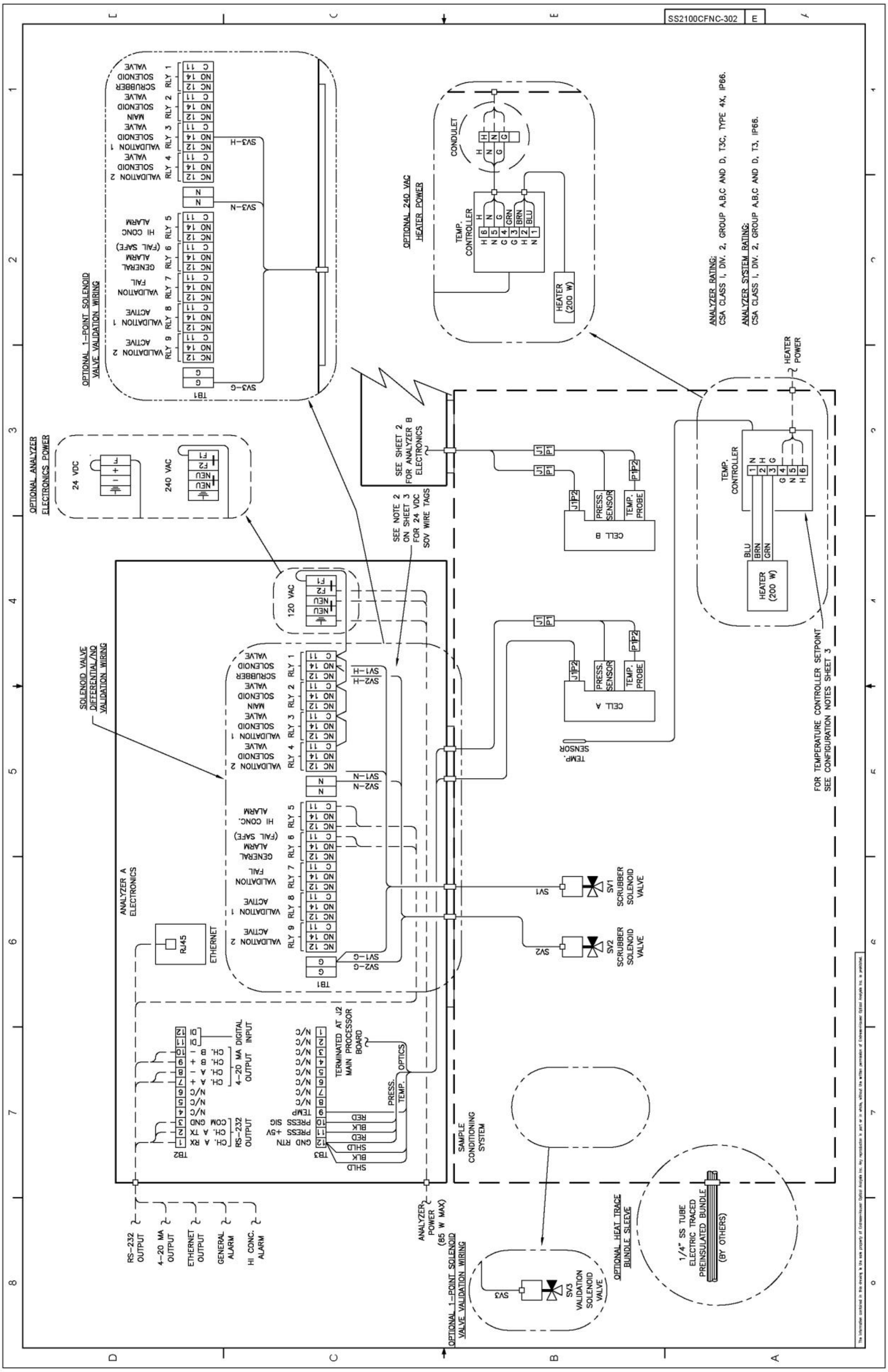


Fig 75. 2-pack power and signal wiring for optional 1 pt. solenoid valve, validation, heater/electronics power (fixed mount, conventional)

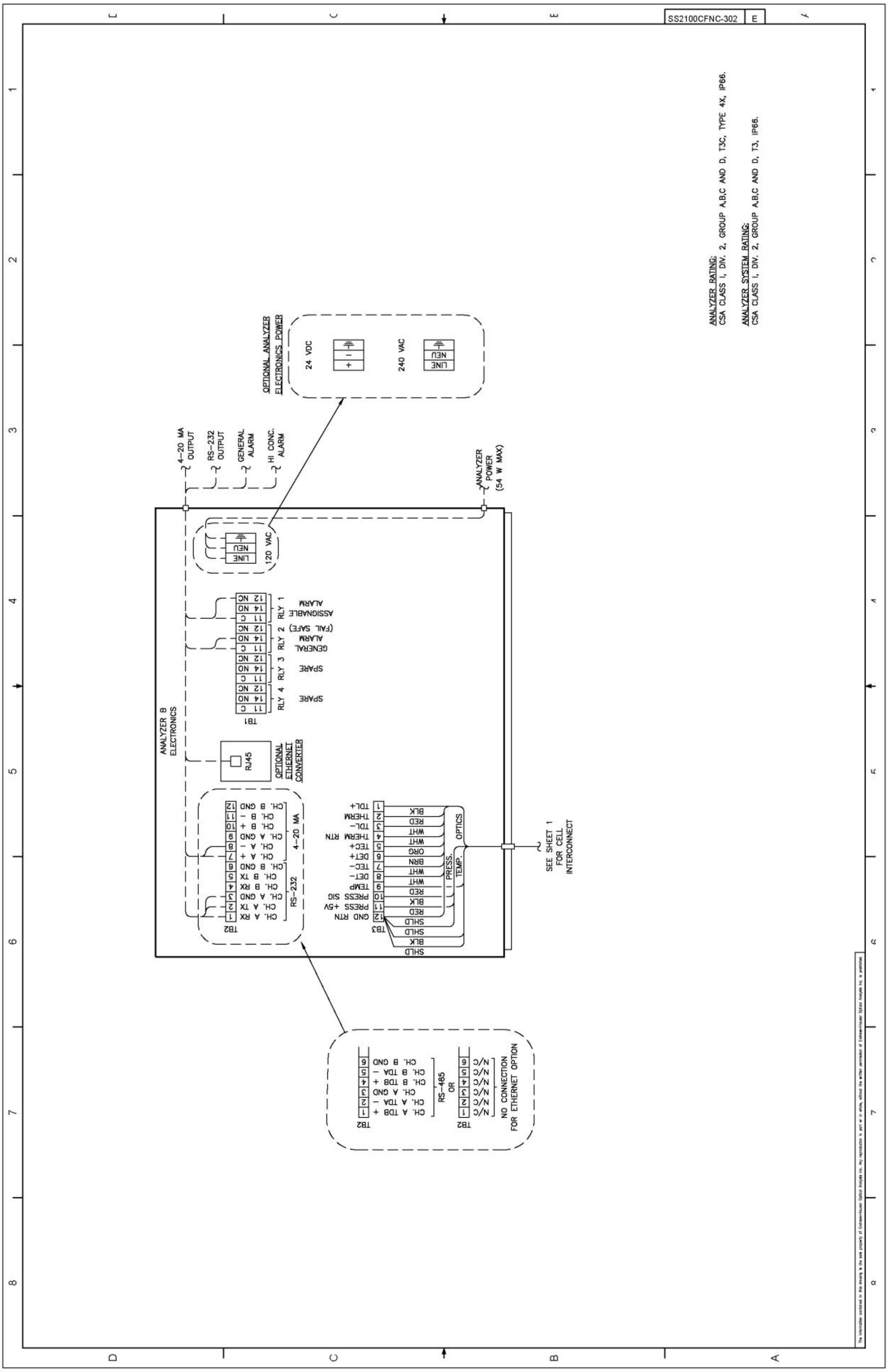


Fig 76. 2-pack power and signal wiring diagram, fixed mount, non-validation, optional analyzer electronics port

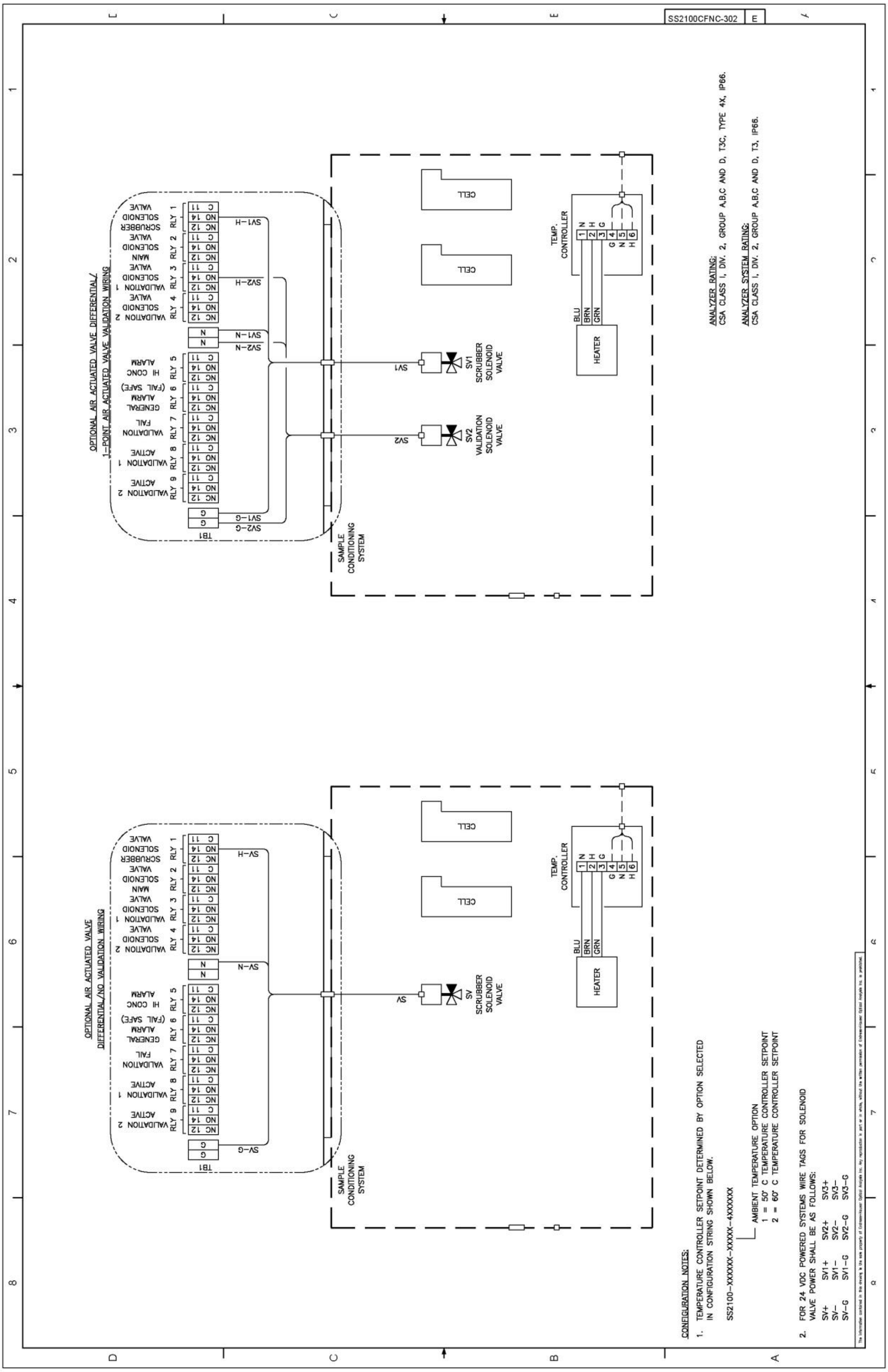


Fig 77. 2-pack power and signal wiring diagram, fixed mount, non-validation, optional air-actuated valve

11.2.5 SS2100 3-pack system

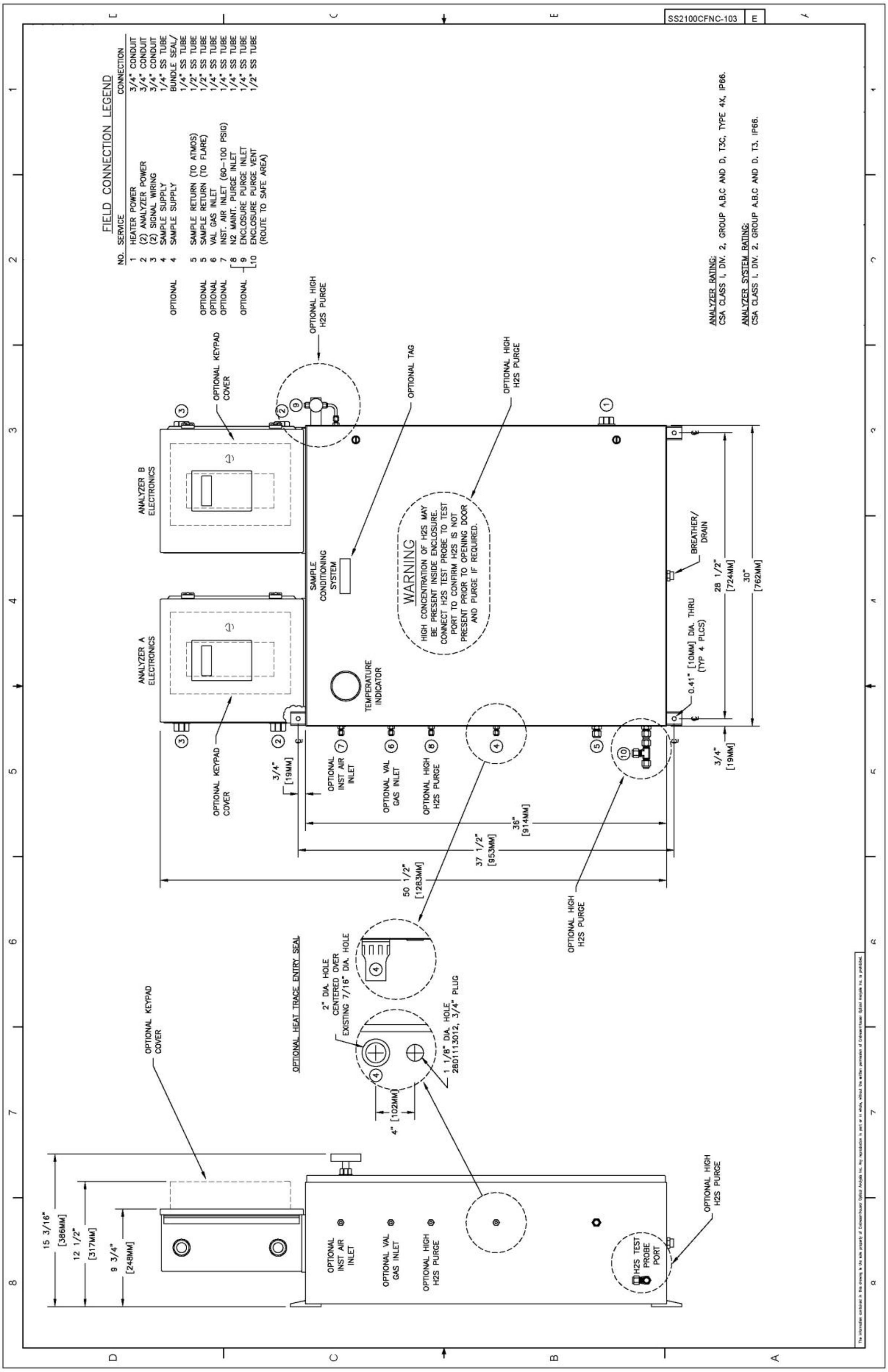


Fig 78. 3-pack outline and mounting dimensions (front view), fixed mount, conventional

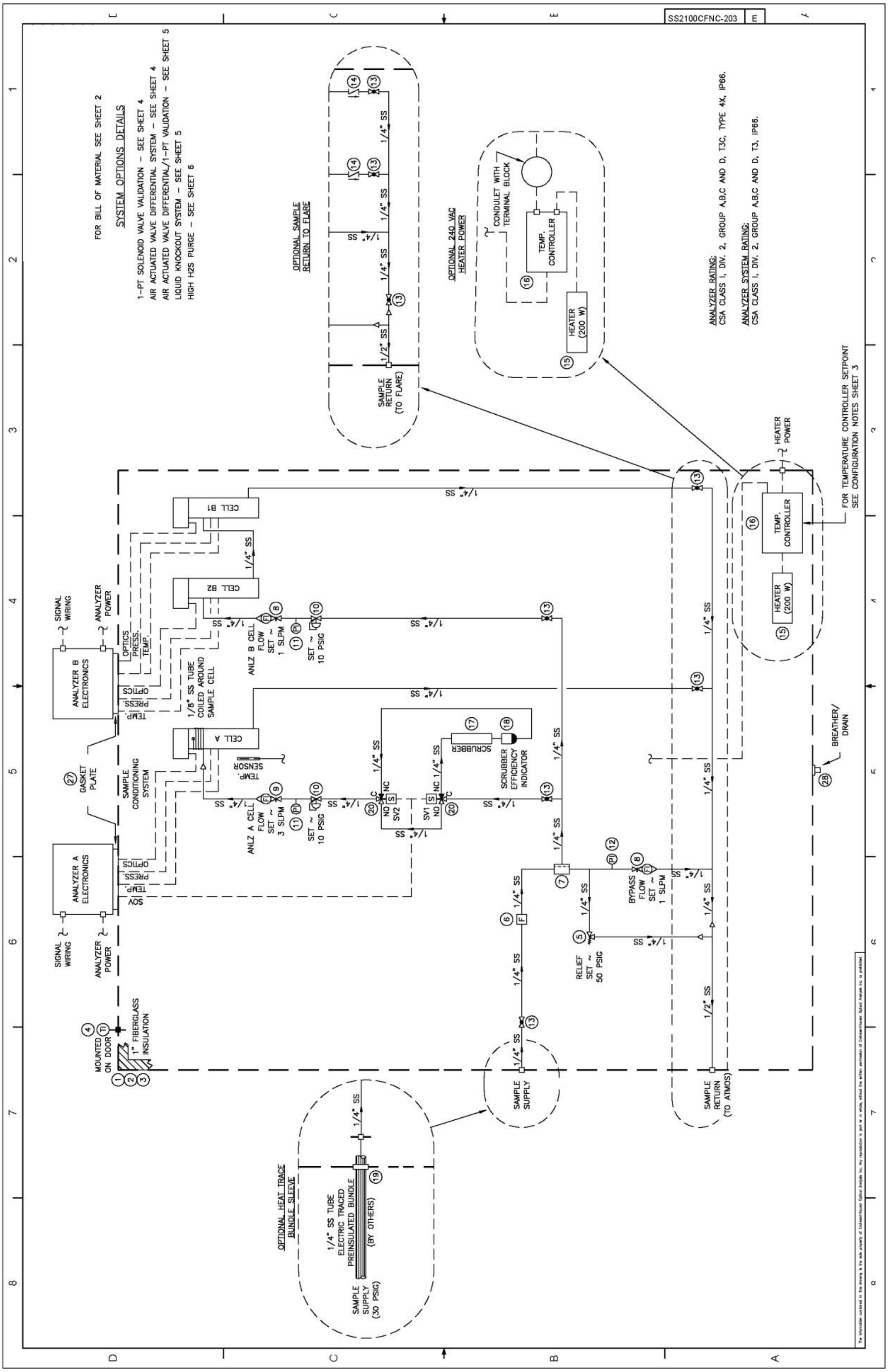


Fig 79. 3-pack SCS schematic, fixed mount, conventional

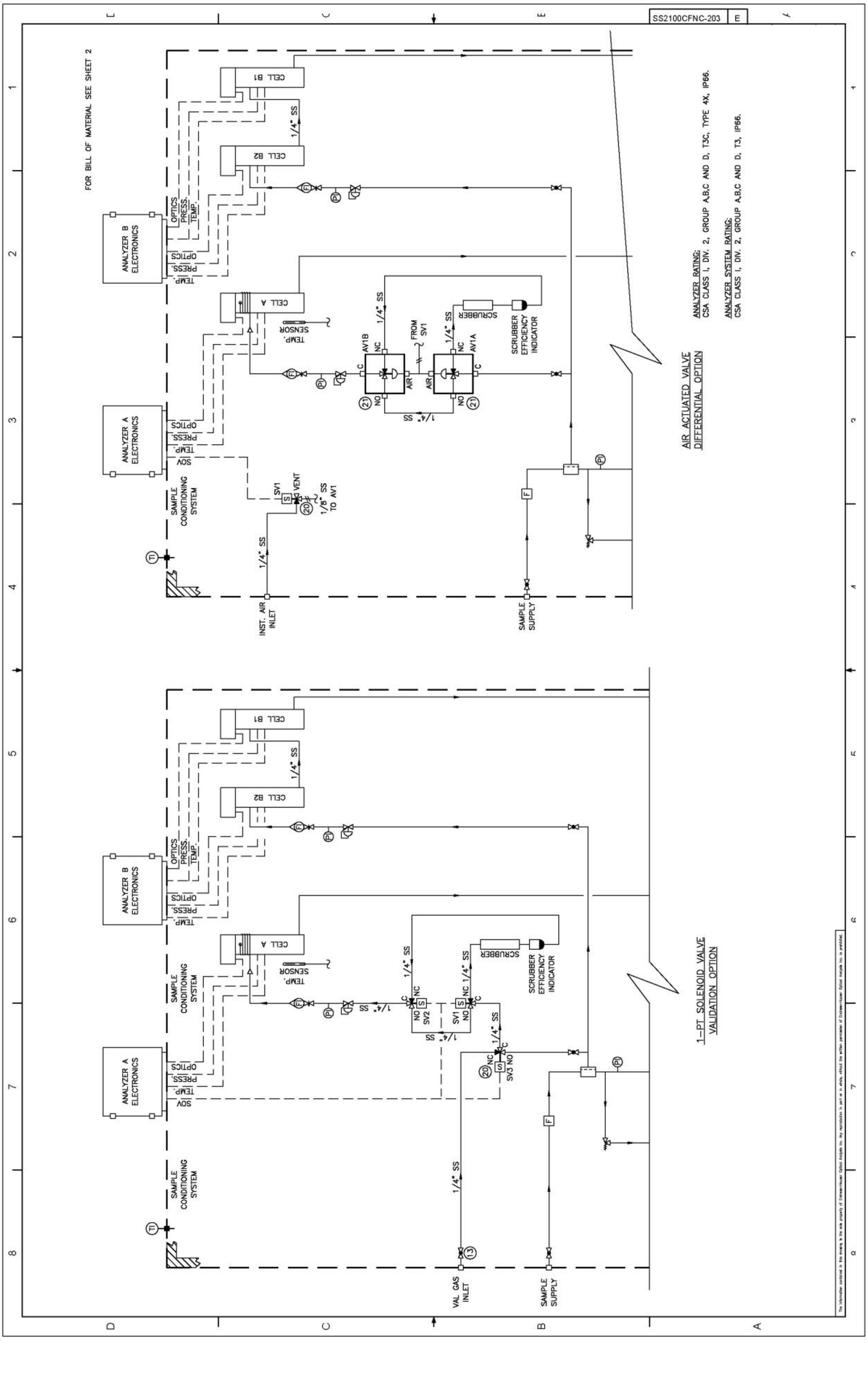


Fig 80. 3-pack SCS schematic of 1 pt. solenoid valve, validation, air-actuated valve differential option (fixed mount, conventional)

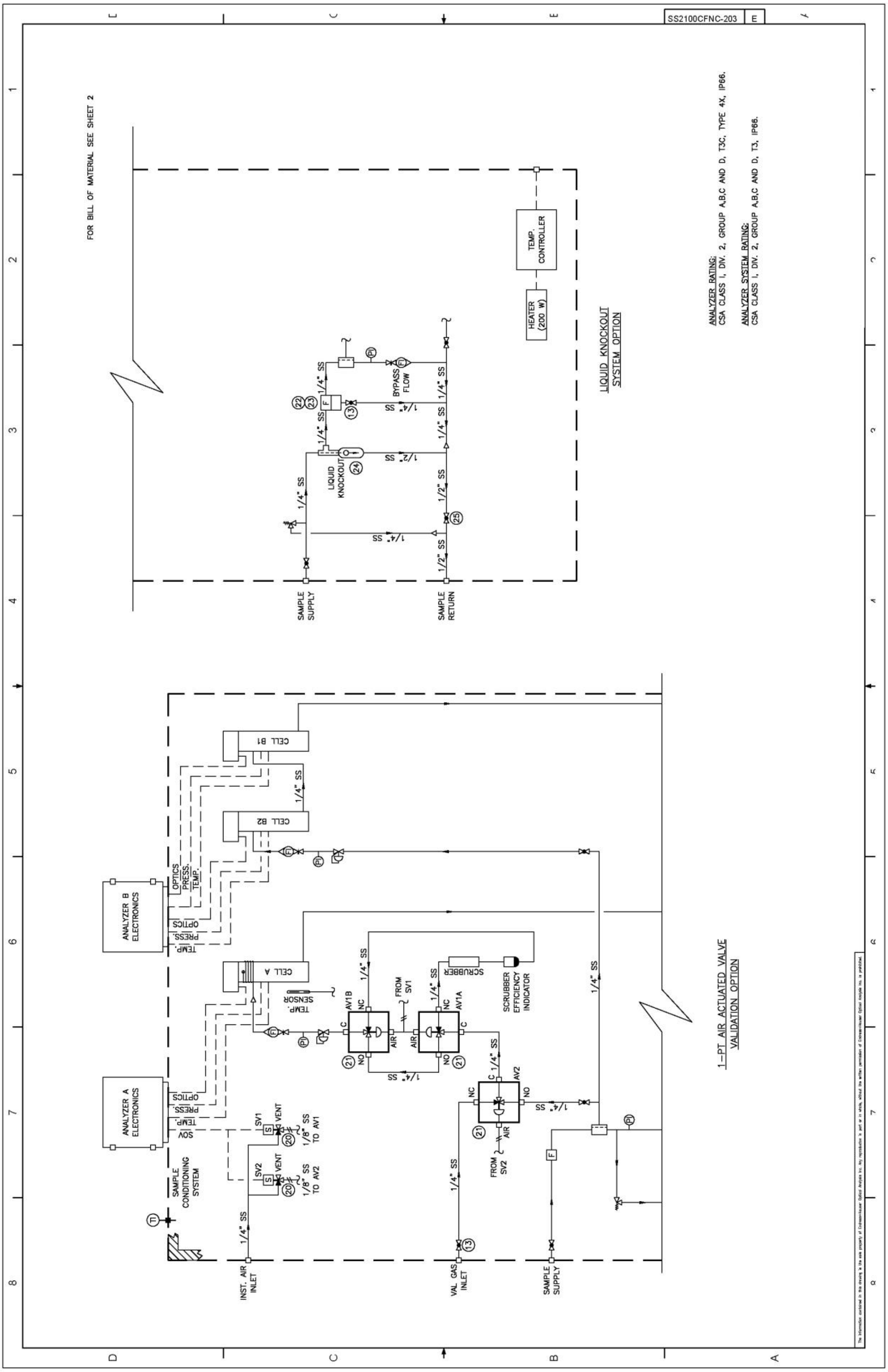


Fig 81. 3-pack SCS schematic of1 pt. air-actuated valve, validation, liquid knock-out options (fixed mount, conventional)

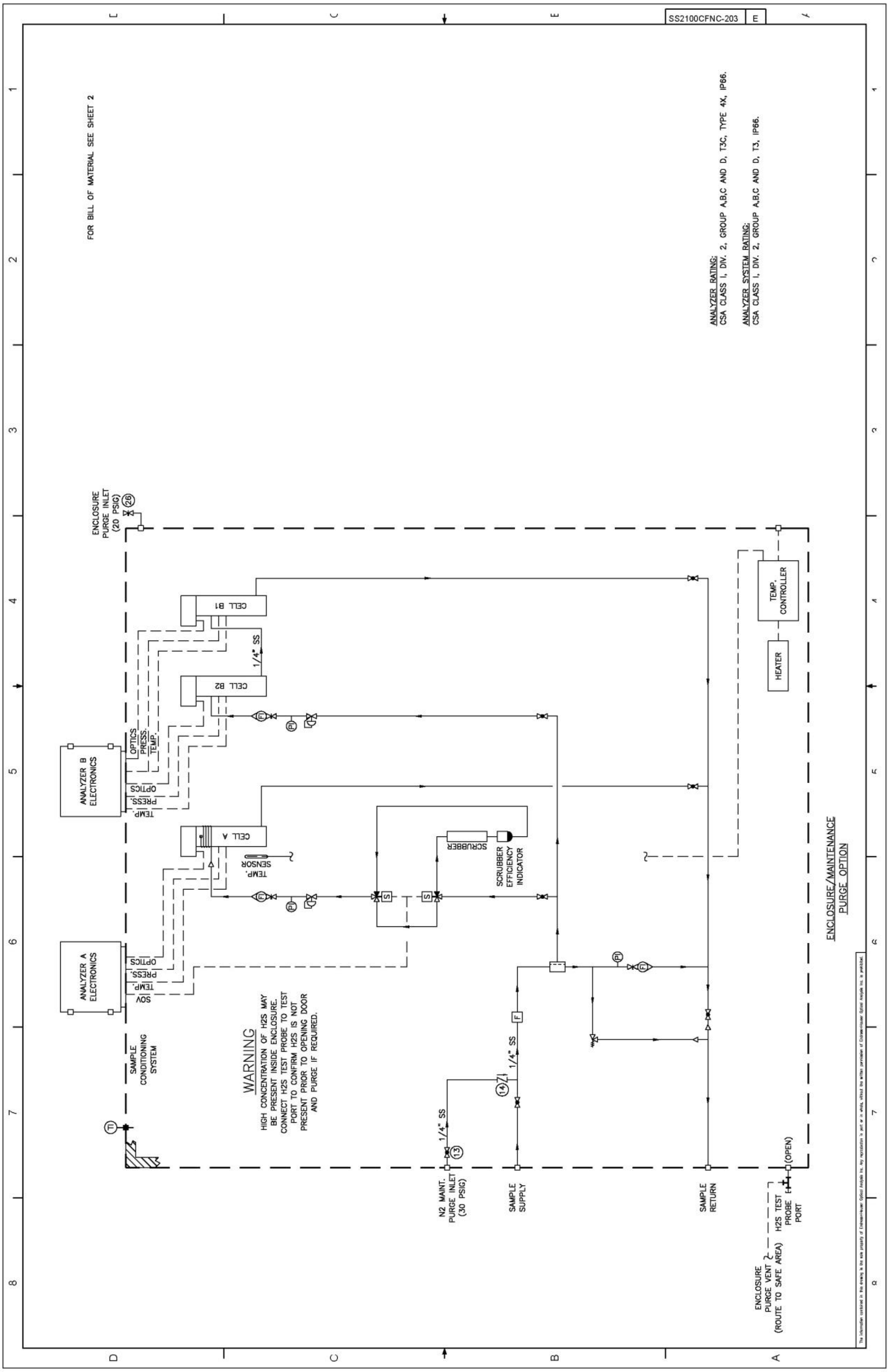


Fig 82. 3-pack SCS schematic with maintenance purge option (fixed mount, conventional)

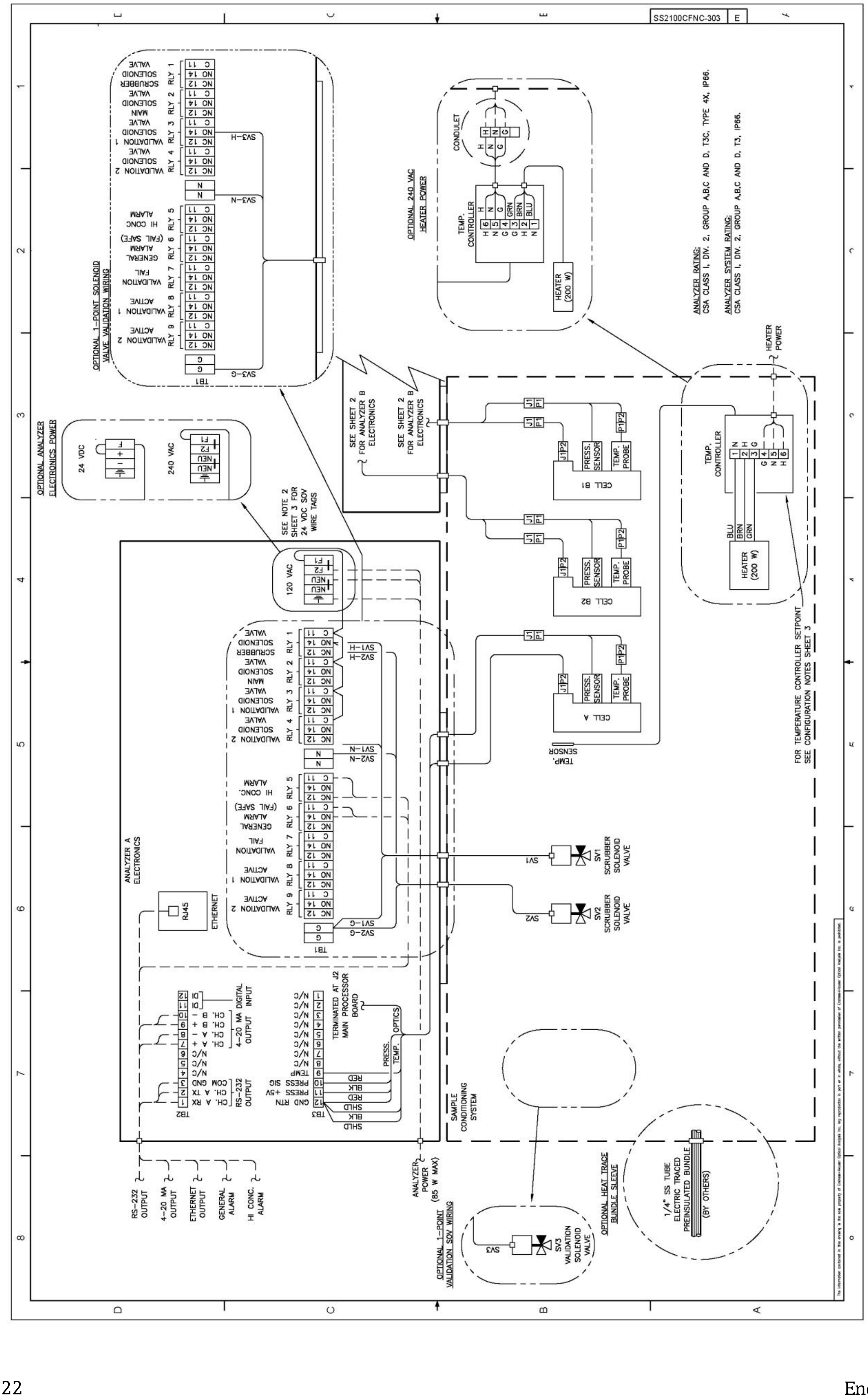


Fig 83. Power and signal wiring with optional 1 pt. solenoid valve, validation, heater/electronics power (fixed mount, conventional)

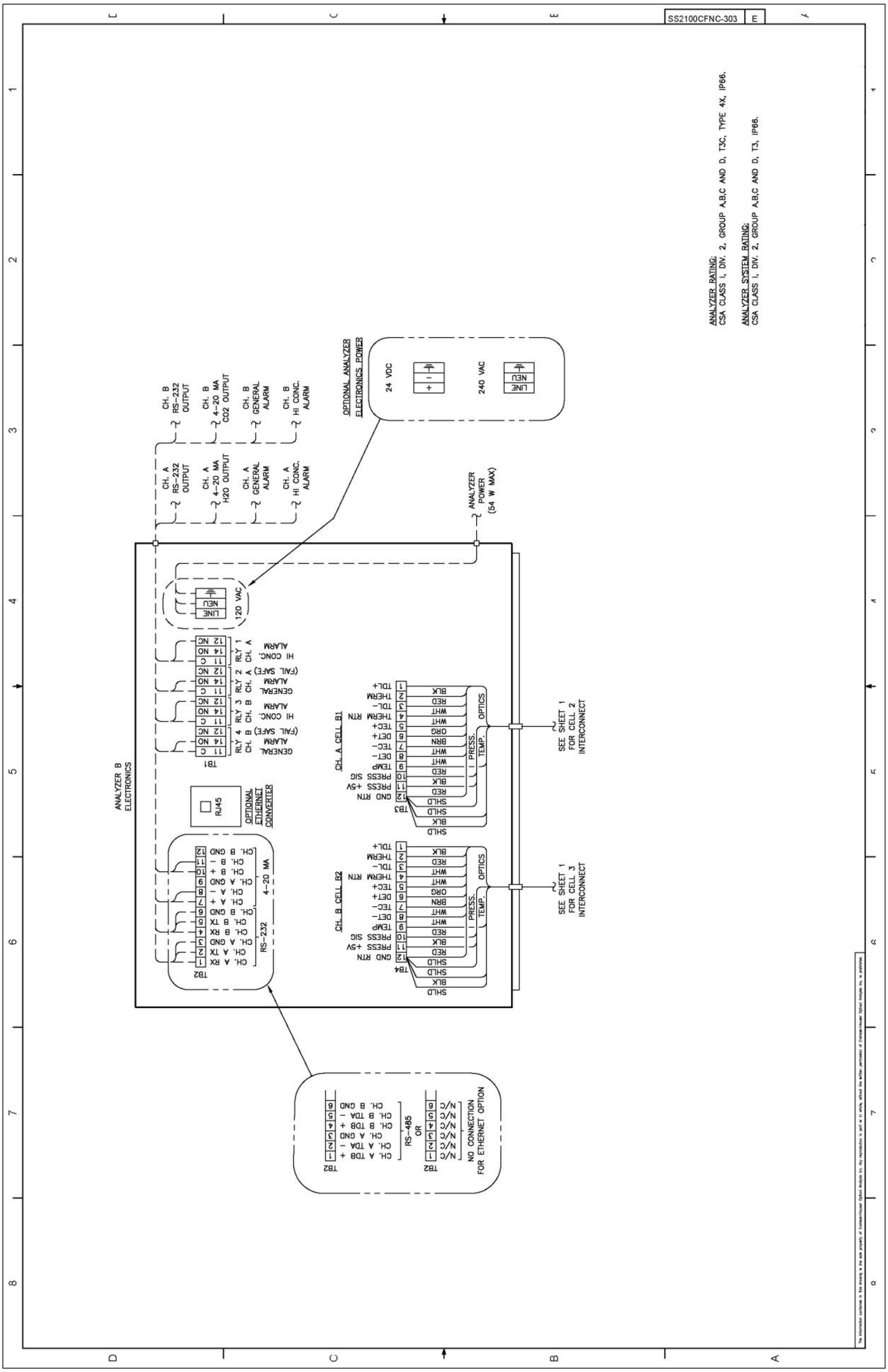


Fig 84. Power and signal wiring with optional electronics power (fixed mount, conventional)

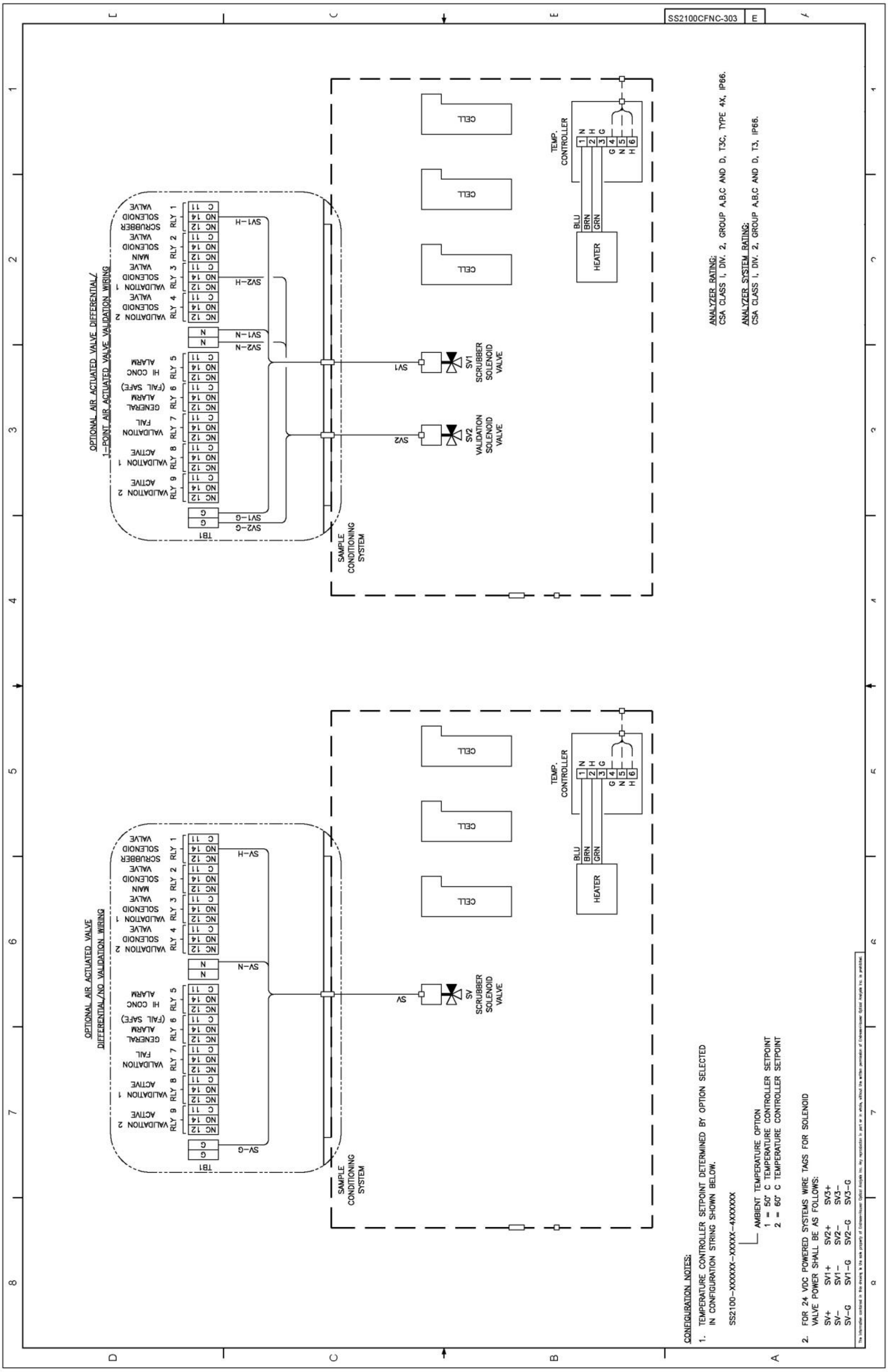


Fig 85. Power and signal wiring with optional air actuated valve differential, validation (fixed mount, conventional)

11.2.6 SS2100 2-pack and 3-pack analyzer electronics

The SS2100 2-pack and 3-pack analyzer systems contain two types of control boards in their analyzer electronics enclosures. For analyzer A electronics for H_2S measurements, see the drawing for the H_2S electronics for AC systems → or the drawing for the H_2S electronics for DC systems →. For analyzer B measurements for H_2O, CO_2, or other analytes, refer to the drawings below. See Determining firmware version → for specifics about analyzer A and analyzer B electronics, and as-built drawings for dimensions, flow diagrams, and wiring schematics.

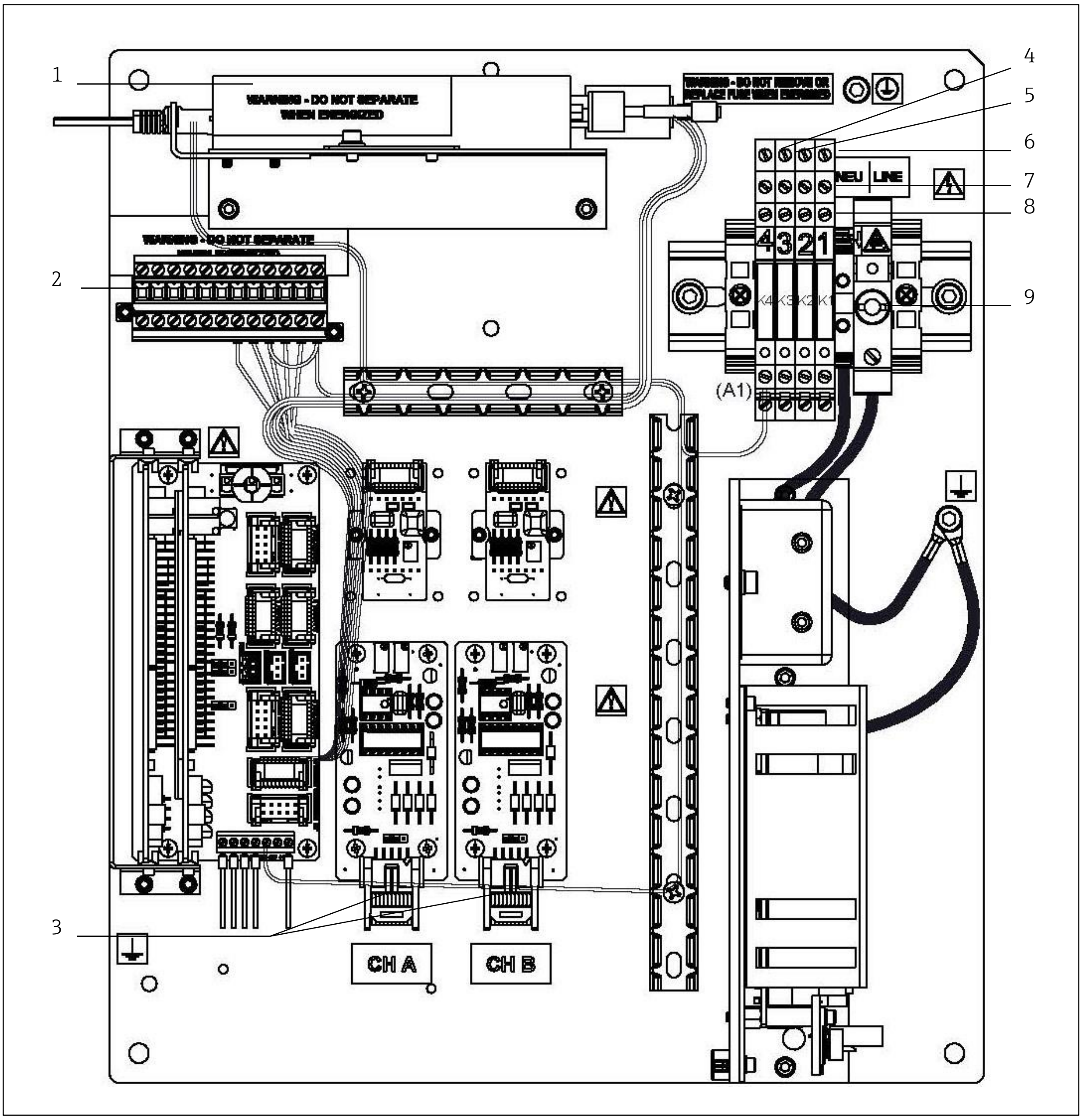


Fig 86. Analyzer B PP2f firmware electronics board (AC) showing signal terminal block and alarm relays with Ethernet connection

1. *Signal converter, RS-232 to Ethernet*
2. *Signals*
3. *4-20 mA boards*
4. *Assignable alarm*
5. *General fault alarm*
6. *Normally open (NO)*
7. *Common*
8. *Normally closed (NC)*
9. *Power input fuse*

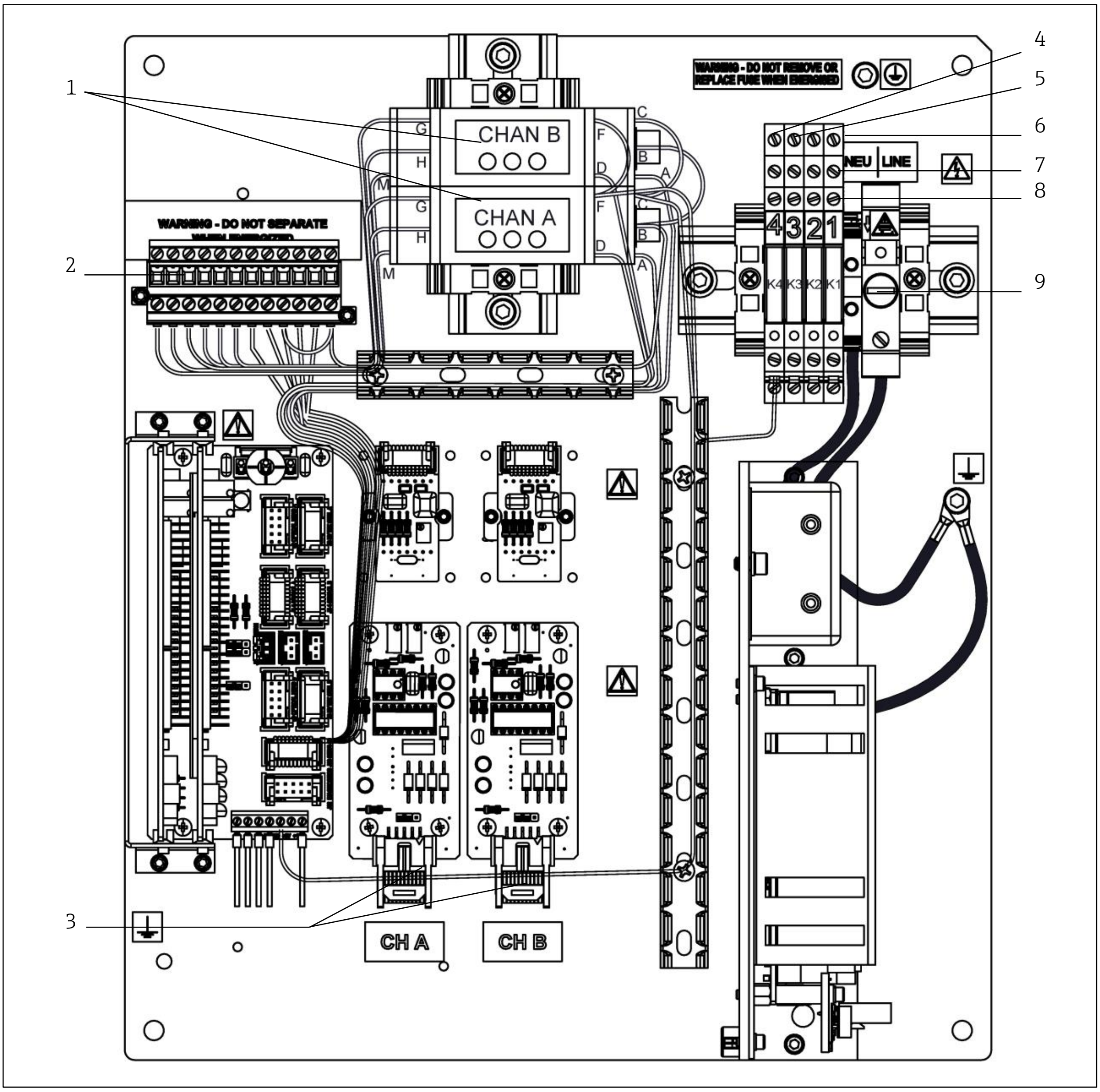


Fig 87. Analyzer B e-series electronics control board (AC) showing signal terminal block and alarm relays with RS-485 communication

1. *Signal converter, RS-232 to RS-485*
2. *Signals*
3. *4-20 mA boards*
4. *Assignable alarm*
5. *General fault alarm*
6. *Normally open (NO)*
7. *Common*
8. *Normally closed (NC)*
9. *Power input fuse*

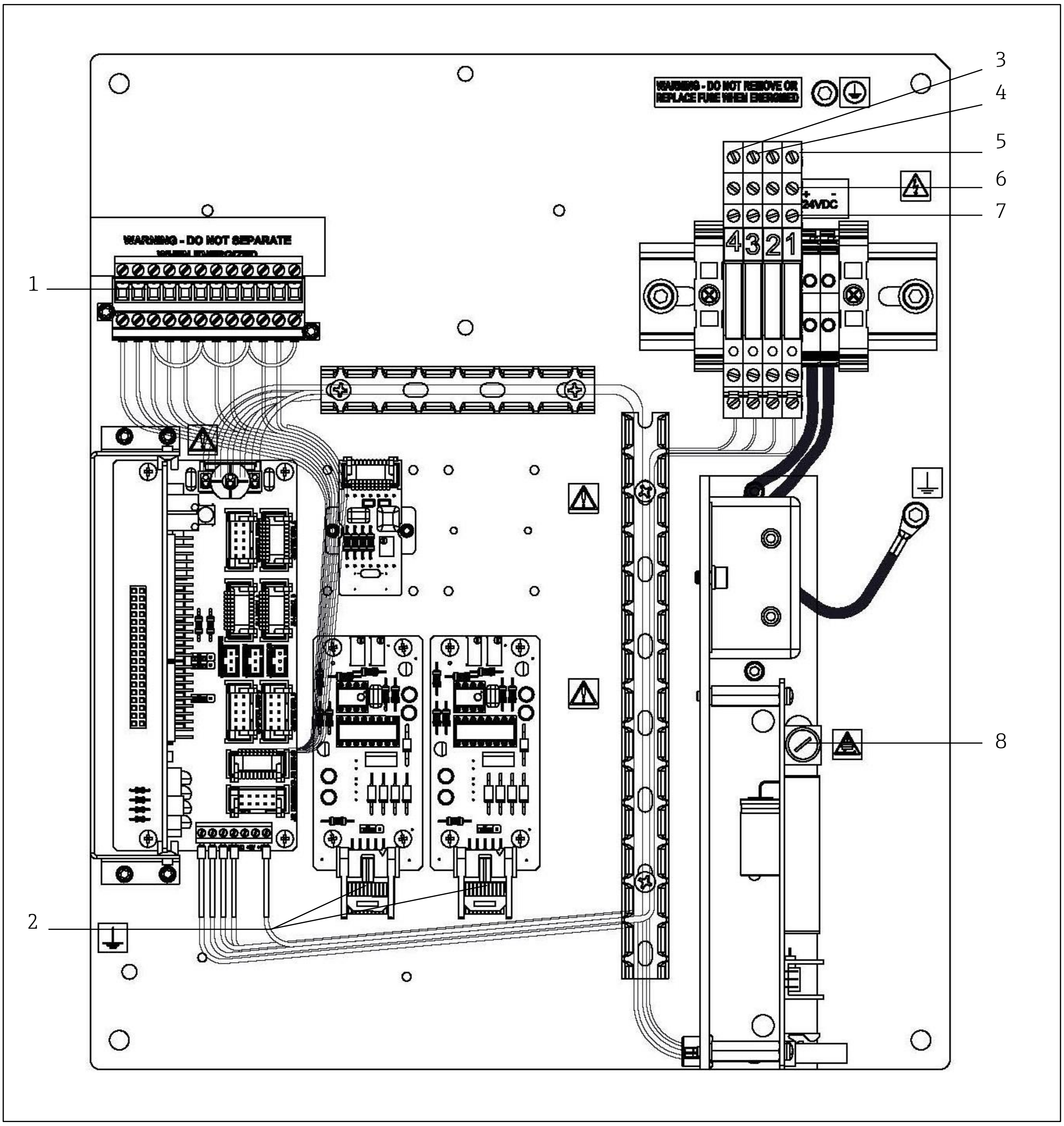


Fig 88. Analyzer B PP2f firmware electronics control board (DC) showing signal terminal block and alarm relays

1. *Signals*
2. *4-20 mA boards*
3. *Assignable alarm*
4. *General fault alarm*
5. *Normally open (NO)*
6. *Common*
7. *Normally closed (NC)*
8. *Power input fuse*