Model 5100 Analyzer
User Manual

REGISTERED ISO 9001 MANAGEMENT SYSTEM

AMETEK

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90648VE Rev. V

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Safety Notes

WARNINGS, CAUTIONS, and NOTES contained in this manual emphasize critical instructions as follows:

An operating procedure which, if not strictly observed, may result in personal injury or environmental contamination.

An operating procedure which, if not strictly observed, may result in damage to the equipment.

Important information that should not be overlooked.

Electrical Safety

Hazardous voltages are present in the analyzer housings when power is applied to the system. Always shut down power source(s) before performing maintenance or trouble-shooting. Only a qualified electrician should make electrical connections and ground checks.

Any use of the equipment in a manner not specified by the manufacturer may impair the safety protection originally provided by the equipment.

THIS EQUIPMENT IS SUITABLE FOR USE IN CLASS 1, DIVISION 2, GROUPS ABCD OR NON-HAZARDOUS LOCATIONS ONLY.

EXPLOSION HAZARD - Substitution of components may impair suitability for Class I, Division 2

Grounding

Instrument grounding is mandatory. Performance specifications and safety protection are void if instrument is operated from an improperly grounded power source.

Verify ground continuity of all equipment before applying power.

Sample Gas

Potential hazards of the sample gas should be taken into consideration before connecting the sample to the analyzer. Personal protective equipment and proper ventilation should be used if sample gas is toxic, flammable, or corrosive. Check the sample line and all connections for leaks before powering up. Consult plant safety personnel for appropriate exhaust venting guidelines for specific sample gas type.

Warning Labels

These symbols may appear on the instrument in order to alert you of existing conditions.

PROTECTIVE CONDUCTOR TERMINAL
(BORNIER DE L'ECRAN DE PROTECTION)
Schutzerde

CAUTION - Risk of electric shock
(ATTENTION-RISQUE DE DÉCHARGE ÉLECTRIQUE)
Achtung - Hochspannung Lebensgefahr

CAUTION - (Refer to accompanying documents)
(ATTENTION-SE RÉFERER AUX DOCUMENTS JOINTS)
Achtung (Beachten Sie beiliegende Dokumente)

CAUTION - Hot Surface
(ATTENTION-SURFACE CHAUDE)
Achtung - Heiße Oberfläche

Environmental Information (WEEE)

This AMETEK product contains materials that can be reclaimed and recycled. In some cases the product may contain materials known to be hazardous to the environment or human health. In order to prevent the release of harmful substances into the environment and to conserve our natural resources, AMETEK recommends that you arrange to recycle this product when it reached its “end of life”.

Waste Electrical and Electronic Equipment (WEEE) should never be disposed of in a municipal waste system (residential trash). The **Wheelie Bin** marking on this product is a reminder to dispose of the product properly after it has completed its useful life and been removed from service. Metals, plastics, and other components are recyclable and you can do your part by doing one of the following steps:

- When the equipment is ready to be disposed of, take it to your local or regional waste collection administration for recycling.
- In some cases, your “end of life” product may be traded in for credit towards the pur-chase of new AMETEK instruments. Contact your dealer to see if this program is avail-able in your area.
- If you need further assistance in recycling your AMETEK product, contact our office listed in the front of the instruction manual.

Secondary Process Seals Requirement

”This instrument is supplied with a **primary process seal only** *(single seal device) in accordance with ANSI/ISA 12.27.01-2003. Proper installation of this instrument requires a* **secondary process seal** *if failure of the primary process seal could allow process fluids to enter the conduit or field wiring system. The maximum process gas pressure and temperature that will be applied to the secondary seal are 10 psig (170KPa) and 140°F (60°C).*

For more information refer to ANSI/ISA 12.27.01-2003, the 2008 NEC (clauses 501.15 (F) (3) (CI Div 1/2), and 505.16 (E) (3) (CI Zone 1/2)) or the 2009 CEC Part 1 Rules 18-092 (CI Zone 0), 18-108 (CI Zone 1), 18-154 (CI Zone 2), J18-108 (CI Div1), and J18-154 (CI Div2).

Electromagnetic Compatibility (EMC)

Read and follow the recommendations in this section to avoid performance variations or damage to the internal circuits of this equipment when installed in harsh electrical environments.

The various configurations of the Model 5100 Analyzer should not produce, or fall victim to, electromagnetic disturbances as specified in the European Union's EMC Directive. Strict compliance to the EMC Directive requires that certain installation techniques and wiring practices are used to prevent or minimize erratic behavior of the Analyzer or its electronic neighbors. Below are examples of the techniques and wiring practices to be followed.

In meeting the EMC requirements , the various Analyzer configurations described in this manual rely heavily on the use of metallic shielded cables used to connect to the customer's equipment and power. Foil and braid shielded I/O and DC power cables are recommended for use in otherwise unprotected situations. In addition, hard conduit, flexible conduit, and armor around non-shielded wiring also provides excellent control of radio frequency disturbances. However, use of these shielding techniques is effective only when the shielding element is connected to the equipment chassis/earth ground at both ends of the cable run. This may cause ground loop problems in some cases. These should be treated on a case-by-case basis. Disconnecting one shield ground may not provide sufficient protection depending on the electronic environment. Connecting one shield ground via a 0.1 microfarad ceramic capacitor is a technique allowing high frequency shield bonding while avoiding the AC-ground metal connection. In the case of shielded cables the drain wire or braid connection must be kept short. A two-inch connection distance between the shield's end and the nearest grounded chassis point, ground bar or terminal is highly recommended. An even greater degree of shield performance can be achieved by using metallic glands for shielded cable entry into metal enclosures. Expose enough of the braid/foil/drain where it passes through the gland so that the shield materials can be wrapped backwards onto the cable jacket and captured inside the gland, and tightened up against the metal interior.

Inductive loads connected to the low voltage "Alarm Contacts" are not recommended. However, if this becomes a necessity, adhere to proper techniques and wiring practices. Install an appropriate transient voltage suppression device (low voltage MOV, "Transzorb," or R/C) as close as possible to the inductive device to reduce the generation of transients. Do not run this type of signal wiring along with other I/O or DC in the same shielded cable. Inductive load wiring must be separated from other circuits in conduit by using an additional cable shield on the offending cable.

In general, for optimum protection against high frequency transients and other disturbances, do not allow installation of this Analyzer where its unshielded I/O and DC circuits are physically mixed with AC mains or any other circuit that could induce transients into the Analyzer or the overall system. Examples of electrical events and devices known for the generation of harmful electromagnetic disturbances include motors, capacitor bank switching, storm related transients, RF welding equipment, static, and walkie-talkies.

Laser and Optical Radiation Information

The Model 5100 analyzer uses one of two classes of laser diodes:

1. Class 1 - Safe under all conditions of normal use. For the wavelengths used in the 5100 HD, the maximum optical output power for this class is 10 milliwatts.

2. Class 3b – The beam must not be viewed directly, but diffuse reflections from matte surfaces do not pose a hazard. For the wavelengths used, the maximum optical output power for this class is 500 milliwatts.

The following wavelengths may be used, depending on the gas being measured:

1. 1575 nm (nanometers)

2. 1581 nm

3. 1854 nm

4. 2004 nm

This product was certified to standard IEC 60825-1, Issued: 2014/05/15 Ed: 3 Safety of laser products – Part 1: Equipment classification and requirements

CAUTION – USE OF CONTROLS OR ADJUSTMENTS OR PERFORMANCE OF PROCEDURES OTHER THAN THOSE SPECIFIED HEREIN MAY RESULT IN HAZARDOUS RADIATION EXPOSURE

BEFORE REMOVING ANY ANALYZER COVERS, OR PERFORMING MAINTENANCE OF ANY KIND ON THE ANALYZER, ENSURE THAT THE ANALYZER IS POWERED OFF. DO NOT REMOVE ANY PART OF THE SAMPLE CELL OR DISCONNECT ANY OPTICAL COMPONENTS UNLESS THE ANALYZER IS POWERED OFF.

WARRANTY AND CLAIMS

We warrant that any equipment of our own manufacture or manufactured for us pursuant to our specifications which shall not be, at the time of shipment thereof by or for us, free from defects in material or workmanship under normal use and service will be repaired or replaced (at our option) by us free of charge, provided that written notice of such defect is received by us within twelve (12) months from date of shipment of portable analyzers or within eighteen (18) months from date of shipment or twelve (12) months from date of installation of permanent equipment, whichever period is shorter. All equipment requiring repair or replacement under the warranty shall be returned to us at our factory, or at such other location as we may designate, transportation prepaid. Such returned equipment shall be examined by us and if it is found to be defective as a result of defective materials or workmanship, it shall be repaired or replaced as aforesaid. Our obligation does not include the cost of furnishing any labor in connection with the installation of such repaired or replaced equipment or parts thereof, nor does it include the responsibility or cost of transportation. In addition, instead of repairing or replacing the equipment returned to us as aforesaid, we may, at our option, take back the defective equipment, and refund in full settlement the purchase price thereof paid by Buyer.

Process photometric analyzers, process moisture analyzers, and sampling systems are warranted to perform the intended measurement, only in the event that the customer has supplied, and AMETEK has accepted, valid sample stream composition data, process conditions, and electrical area classification prior to order acknowledgment. The photometric light sources are warranted for ninety (90) days from date of shipment. Resale items warranty is limited to the transferable portion of the original equipment manufacturer's warranty to AMETEK. If you are returning equipment from outside the United States, a statement should appear on the documentation accompanying the equipment being returned declaring that the goods being returned for repair are American goods, the name of the firm who purchased the goods, and the shipment date.

The warranty shall not apply to any equipment (or part thereof) which has been tampered with or altered after leaving our control or which has been replaced by anyone except us, or which has been subject to misuse, neglect, abuse or improper use. Misuse or abuse of the equipment, or any part thereof, shall be construed to include, but shall not be limited to, damage by negligence, accident, fire or force of the elements. Improper use or misapplications shall be construed to include improper or inadequate protection against shock, vibration, high or low temperature, overpressure, excess voltage and the like, or operating the equipment with or in a corrosive, explosive or combustible medium, unless the equipment is specifically designed for such service, or exposure to any other service or environment of greater severity than that for which the equipment was designed.

The warranty does not apply to used or secondhand equipment nor extend to anyone other than the original purchaser from us.

THIS WARRANTY IS GIVEN AND ACCEPTED IN LIEU OF ALL OTHER WARRANTIES, WHETHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION AND WARRANTIES OF FITNESS OR OF MERCHANTABILITY OTHER THAN AS EXPRESSLY SET FORTH HEREIN, AND OF ALL OTHER OBLIGATIONS OR LIABILITIES ON OUR PART. IN NO EVENT SHALL WE BE LIABLE UNDER THIS WARRANTY OR ANY OTHER PROVISION OF THIS AGREEMENT FOR ANY ANTICIPATED OR LOST PROFITS, INCIDENTAL DAMAGES, CONSEQUENTIAL DAMAGES, TIME CHANGES OR ANY OTHER LOSSES INCURRED BY THE ORIGINAL PURCHASER OR ANY THIRD PARTY IN CONNECTION WITH THE PURCHASE, INSTALLATION, REPAIR OR OPERATION OF EQUIPMENT, OR ANY PART THEREOF COVERED BY THIS WARRANTY OR OTHERWISE. WE MAKE NO WARRANTY, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF FITNESS OR OF MERCHANTABILITY, AS TO ANY OTHER MANUFACTURER'S EQUIPMENT, WHETHER SOLD SEPARATELY OR IN CONJUNCTION WITH EQUIPMENT OF OUR MANUFACTURE. WE DO NOT AUTHORIZE ANY REPRESENTATIVE OR OTHER PERSON TO ASSUME FOR US ANY LIABILITY IN CONNECTION WITH EQUIPMENT, OR ANY PART THEREOF, COVERED BY THIS WARRANTY.

EC Declaration of Conformity

Manufacturer's Name: AMETEK, Inc., Process Instruments
Manufacturer's Address: Process & Analytical Instruments Division
150 Freeport Road
Pittsburgh, PA, 15238 USA
Phone: 412-828-9040 Fax: 412-826-0686

declares that the product:

Product Name: Model 5100 Analyzer (General purpose version)

Conforms to the following directives:

EMC Directive 2004/108/EC using the following standards:

EN 61326-1 Radio Frequency Emissions

EN50011 (CISPR 11)	Radiated and Conducted, Class A, Group 2, ISM Device
EN61000-3-2	Harmonic Current Emissions
EN61000-3-3	Voltage Fluctuation / Flicker

EN61326-1 Immunity

EN61000-4-2	Electrostatic Discharge, 4kV/8kV, contact/air
EN61000-4-3	Radiated Radio Frequencies, 80MHz-1GHz 10V/m, 1.4-2.0GHz 3V/m, 2.0-2.7GHz 1V/m
EN61000-4-4	Electrical Fast Transient/Burst, 1kV/2kV
EN61000-4-5	Surge, 1kV to Shields, 1kV/2kV AC Differential/Common
EN61000-4-6	Conducted Radio Frequencies, 3 V/rms
EN61000-4-8	Magnetic Immunity 30A/m
EN61000-4-11	Voltage Dips and Variations, 100%, 95%, 60% and 30%

Pressure Equipment Directive 97/23/EC:
Article 3, Paragraph 3

Low Voltage Directive 2006/95/EC using the following standard:

EN61010-1	Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory use Part 1

Manufacturer's Address in Europe:
AMETEK GmbH
Rudolf-Diesel-Strasse 16
D-40670 Meerbusch Germany
Contact: Dr. Jurgen Gassen

Mark Coppler
Sr. Compliance Engineer
AMETEK Process & Analytical Instruments Division

CE
2010

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MODEL 5100 ANALYZER

Tunable Diode Laser Spectroscopy Theory

Tunable Diode Laser Absorption Spectroscopy (TDLAS) is a spectroscopic technique that uses a diode laser as the light source. The technology is extremely selective. The laser line is very narrow in frequency so it can probe water vapor without interference from other gases. It works according to the fundamental principles of Beer's Law. The Law indicates that for a constant path length, the intensity of the incident light energy traversing an absorbing medium diminishes exponentially with concentration.

$$\mathbf{Ln\ [I°/I] = S*L*N}$$

Where:

I is the measurement of beam intensity when tuned to the absorbing wavelength of the analyte gas

I° is the reference measurement or beam intensity when tuned away from the analyte absorbing wavelength

S is the fundamental absorption line strength and is a fixed constant

L is the path length of the beam through the sample and is a fixed constant

N is the number of water molecules contained in the beam path passing through the sample

So, by measuring the intensity of the laser both before and after absorption by the analyte, the number of analyte molecules in the sample can be determined since all of the other terms in the equation are constant.

Figure 1-1. Model 5100 Analyzer.

Overview

The Model 5100 Analyzer from AMETEK uses a direct-measure extractive tunable diode laser system to measure the analyte concentration of certain gases of interest. The compact unit includes a fully-enclosed optics and sampling conditioning system as well as continuous on-board analyte verification. Communication is both analog and digital including Ethernet and Modbus options. The calibrated range of the analyzer is 5 to 2500 PPMV.

Components

The Model 5100 analyzer consists of four distinct modular components:

- Electronics Enclosure
- Laser Fiber Optics Compartment (not user-accessible)
- Customer Connection Box
- Sampling System

Electronics Enclosure

The electronics enclosure houses the electronics, display, and reference cell and is made of stainless steel and built to withstand harsh environments (IP65). Included in the electronic enclosure are:

- Customer Connection Board
- Interface Board
- MCU Board
- Power Supply
- RTD for reference cell temperature
- Solid State Relay
- Sample Cell Pressure Sensor
- Reference Cell
- Detector Board
- AC Mains Supply
- Ethernet/LAN Connector

User Interface

The user interface is a Vacuum Fluorescent Display (VFD) with 4 lines x 20 characters and alphanumeric keypad. It is part of the electronics enclosure.

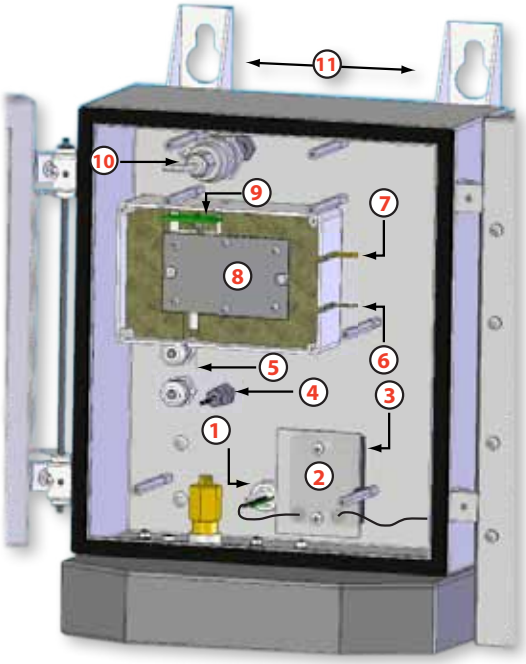


Figure 1-2a.
Electronics Enclosure, boards removed.

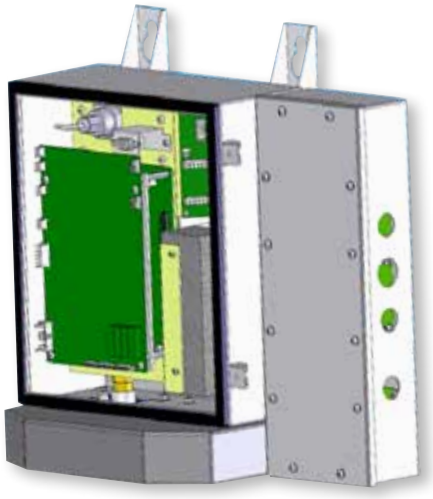
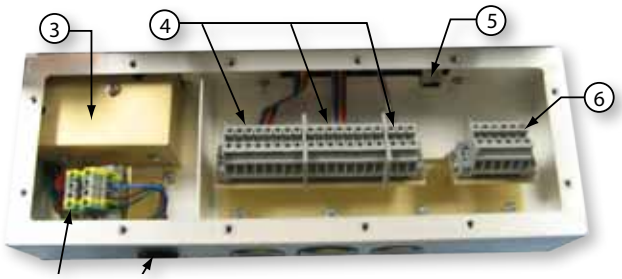


Figure 1-2b.
Electronics Enclosure, includes boards.

1. Sample Cell Heater Power (optional)
2. Guard
3. Solid State Relay
4. Sample Cell Temperature Sensor
5. Laser Fiber Optics
6. RTD Leads
7. Heater Leads (optional)
8. Reference Cell
9. Detector Board
10. Sample Cell Pressure Sensor
11. Mounting Rails

Customer Connection Box

The customer connection box is a separate enclosure that houses the terminal strip which provides customer I/O, communication and relay alarm connectivity, the RJ45 Ethernet connector, and the AC mains supply.



1. Power Conduit Entry
2. Power Terminal Block
3. EMI Filter
4. Customer Connections
5. Ethernet Connection
6. Unlanded Conductors

Figure 1-3. Customer Connection Box.

Laser Fiber Optics Compartment

This compartment houses the laser, fiber optics and GRIN lens, detector and microprocessor. It is not user-accessible.

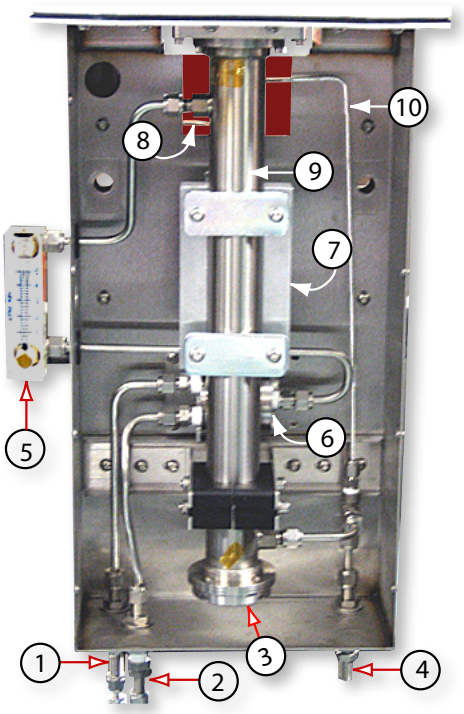
- Laser Module (Laser, TEC, Thermistor)
- Detector Module (InGaAs Detector and pre-amp)

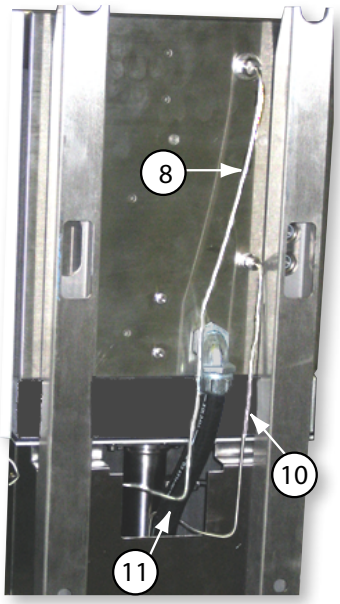
Sampling System

The sampling system is housed in a non-sealed, stainless steel enclosure located below the electronics enclosure and laser fiber optics compartment. The sample system includes:

- Sample Cell
- Liquid Separator
- Cell Temperature Sensor
- Pressure Sensor
- Heater (optional)
- Flowmeter (external)

The sample inlet port, liquid filter drain and the exhaust port are located on the bottom outside of the enclosure.





1. Sample Inlet
2. Liquid Filter Drain
3. Mirror
4. Exhaust Port
5. Flowmeter
6. Liquid Separator
7. Sample Cell Heater (optional)
8. Cell Temperature Sensor (RTD)
9. Sample Cell
10. Cell Pressure Sensor
11. Sample Cell Heater Power Conduit

Figure1-4a and 1-4b.Inside and back of Model 5100 analyzer.

Controller / Communications

All analyzer functions are controlled by microprocessors housed within the electronics enclosure. These include:

- (1) Non-isolated Analog Input (4 to 20 mA or 1-5 Volts)
- (1) Isolated discrete 24VDC Input
- (1) Isolated 4-20 mA Output
- (4) Relay Contacts
- (2) RTD Inputs
- Reference Cell
- Piezo-Resistive Transducer Input
- (3) Solid State Relay Drives (PWM)
- (3) Serial Ports: (1) RS-232, (2) RS-485
- 100 Mbs Ethernet Port
- MQX RTOS and Modbus capability

The Model 5100 analyzer is configured, and analyzer parameters are set, using either the analyzer display, keypad and function keys, or using an external PC.

- 4-line x 20-character VFD provides analyte concentration, system operating parameters, system messages, and alarm conditions.
- 20-button keypad on the front of the unit is used to set or change operating parameters and system values.
- Serial interface to an external PC.

Sample Cell

The sample cell consists of :

- Sample tube
- Gold-front surfaced mirror
- Detector
- GRIN lens
- Laser

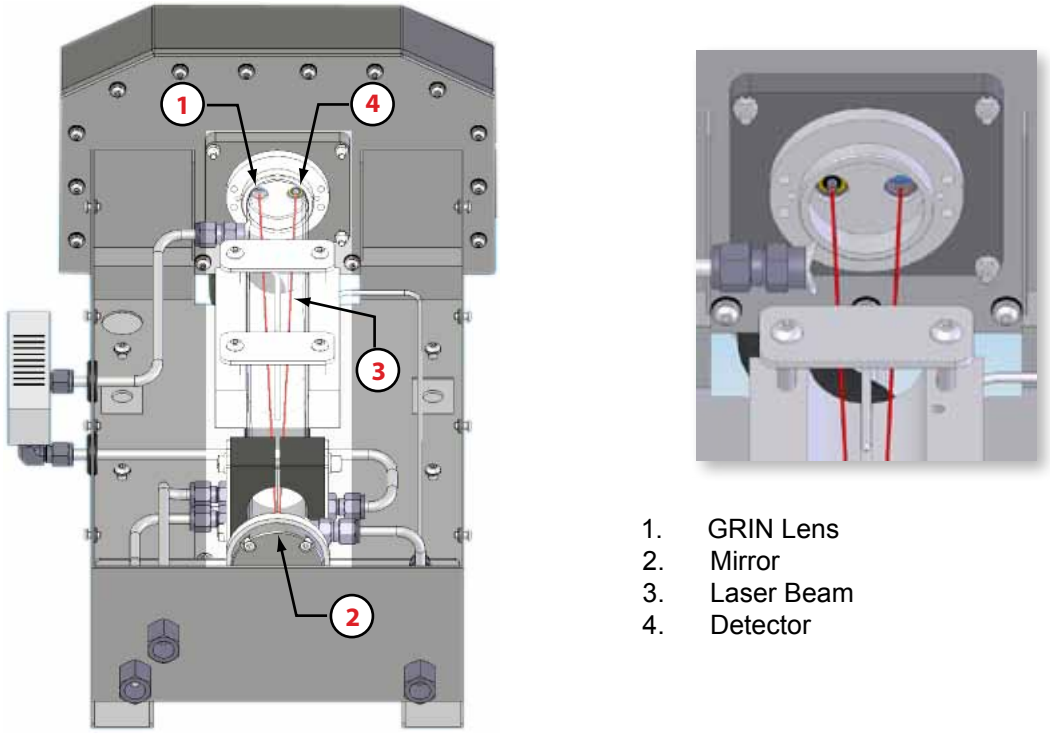


Figure 1-6. GRIN Lens and Detector. Sample Cell.

Detector

Two light-sensitive detectors are typically used, one for the sample cell and one for the reference. The detectors output a voltage proportional to the intensity of the light striking the active area. The type of detectors used varies depending on the wavelength, which in turn depends on the analyte(s).

GRIN Lens

GRIN is short for graded-index or gradient index. One of the most important advantages of GRIN lenses compared to classical lenses is that the optical surfaces of GRIN lenses are flat. This is very important for creating a good quality joint between the lens and the fiber optics. The GRIN lens in the TDLAS focuses the laser/fiber-optics package to detect the best signal.

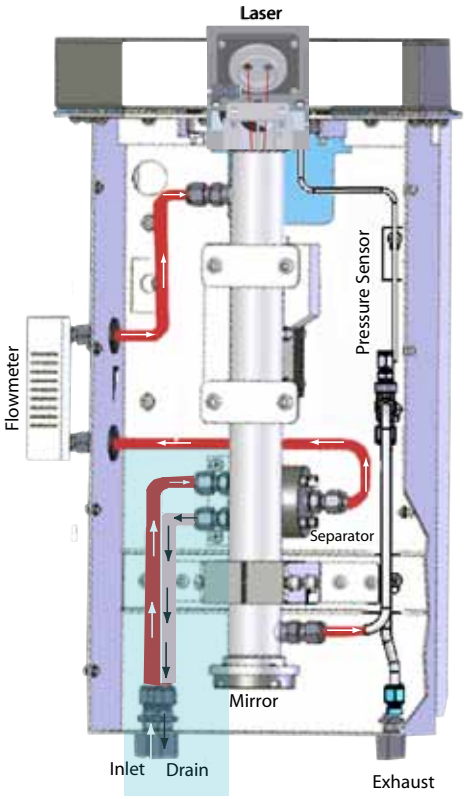
Gas Flow

Sample System

The Model 5100 Analyzer sample system enables the analyzer to make reliable measurements at low concentrations.

Gas molecules absorb energy at specific wavelengths. By transmitting a beam of light through the gas sample and tuning the laser beam's wavelength to the correct absorption line and then measuring the absorption of that beam by TDLAS, the concentration of the analyte over the beam's path length can be determined.

By rapidly scanning the wavelengths across the absorption line, a minute portion of the laser power transmitted through the sample is then monitored by the detector. When the radiation wavelength is set to a value farther away from the analyte spectral line, the power transmitted by the laser to the detector is higher than when the radiation wavelength is set to a closer value. Measuring the relative amplitudes of on- and off-line transmission will determine the analyte concentration along the path followed by the laser beam.



Sample Flow

The sample gas enters the sample system through the sample Inlet (Figure 1-7), flows through the liquid Separator where any impurities are filtered out, through the external Flowmeter which displays sample flow, and into the Cell to be scanned. While sample flows through the cell, the GRIN lens focuses the laser beam to scan the sample. The beam travels down through the cell to the Mirror where it is reflected back toward the Detector which then monitors it. The sample continues flowing through the cell, past the Pressure Sensor which monitors the sample inlet pressure before flowing through the exhaust tubing to the Exhaust vent.

Figure 1-7 also shows the flow used to clean the filter trap in the separator when both the valve between the sample inlet and the separator, and the valve on the drain outside the sample box are open.

Figure 1-7. Sample flow.

Measurement

Fiber optics conduct the laser beam through the GRIN lens to the sample cell. When the beam reaches the mirror at the end of the cell, it is reflected so that it continues upward back through the cell until it enters the detector. The detector converts the information from the beam into an electrical signal that is transmitted to the microprocessor. The software then processes the signal and determines the analyte concentration.

Reference cell

The Model 5100 analyzer comes standard with a reference in the electronics enclosure. Fiber-optic cables couple the energy from the laser to both the sample cell and this internal reference. This setup allows the 5100 to provide reliable measurements for the sample gas and a continuous reference measurement to validate that the analyzer is operating properly.

Options

Several options/accessories are available for the Model 5100 Analyzer. They include:

- Cell Heater
- Heated Sample Line
- Sample Probes
- Heated Pressure Reducers
- Back Pressure Regulators

Contact the factory for more information on these options.

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SPECIFICATIONS

Methodology

Turnable Diode Laser Absorption Spectroscopy

Wavelength Ranges

Application specific, typical examples are:

H2O	1854 nm
CO2	2004 nm
H2S	1575 nm
O2	760 nm

Analyzer Range

Application specific, typical examples are:

H2O	5-2500 ppmv
	0-500 ppmv
	0-100 ppmv
CO2	0-10%
H2S	0-5%
O2	0-100%

Response Time:

< 2 seconds photometric (excludes sample system lag time)

Accuracy/Repeatability/Linearity:

Application specific, typical examples are:

H2O +/- 4ppm, or 2% (whichever is greater)
CO2 +/- 0.1%
H2S +/- 0.1%
O2 +/- 0.1%
These are typical examples, not an exhaustive listing. Range and accuracy will vary with sample cell path length. Consult factory for other ranges.

Ambient Temperature Range:

-20 C to +50 C (-4 F to +104 F)

Ambient Humidity Range:

0 to 90%, non-condensing

Sample Cell Pressure Range:

10 - 25 psia (70-170 kPa)

Physical:

HxWxD: 34.2” x 17.1” x 8.3” (87 cm x 43.4 cm x 21.2 cm)
Approximately 55 lbs (25 Kg)

Enclosure:

304 Stainless Steel, Aluminum fiber optics enclosure, IP 65, NEMA Type 4 (except sample cell enclosure)

Maximum Altitude:

6567 ft (2000 meters)

Pollution Degree:

2

Sample Flow Rate:

1 - 10 SLPM recommended

Power Requirements:

120 VAC (108-132 V) or 240 VAC (216-264 V); 47-63 Hz, 25 Watts (w/o optional sample cell heater), 105 Watts (w/sample cell heater), 1 amp max.

Inputs:

One non-isolated analog input configurable as 1-5 VDC or 4-20 mA (typically a pressure transmitter used for dewpoint calculation)

One optically isolated discrete DC input

Front panel keypad

Outputs:

4 line x 20 character alphanumeric VF display.

Fast Ethernet (IEE802.3)

RS485 Serial Port, isolated (supports Modicon Modbus RTU)

RS232 Serial Port, non-isolated (Service use only)

One isolated 4-20 mA output (internally or externally powered)

Four dry relay contacts (contact rating 30 volts AC, 60 volts DC, 100 VA resistive)

Approvals and Certifications

NEC/CEC
Class I, Div 2, Groups A, B, C, D,
Class II, Div 2, Groups F & G,
Class III, Div 2

INSTALLATION AND START-UP

Read this entire chapter before installing the Model 5100 Analyzer. Failure to do so may impair protection against fire, electric shock and injury originally provided by this equipment. Do not use this analyzer in a manner not specified in this manual.

This equipment is suitable for use in Class 1, Division 2, Groups A through D or Non-Hazardous locations only.

The operations in this chapter should be performed only by qualified service personnel experienced in electrical safety techniques. Never service the analyzer unless power has been removed.

This chapter contains information on the installation and setup of the Model 5100 Analyzer including:

- Analyzer Requirements:
  - Location
  - Mounting
  - Wiring
  - Sample Pressure Requirements

- Installation Connections:
  - User-Supplied Items
  - Gas Connections
  - Signal Connections
  - Communication Connections
  - Alarm Relay Connections
  - User Interface
  - Initial Startup

Analyzer Requirements

Location

The Model 5100 Analyzer is a wall-mounted unit; ensure that there is adequate clearance when mounting and select a readily accessible position for the analyzer to allow for routine maintenance. The location should be free from excessive vibration and the ambient temperature should be -20 °C to 50 °C (-4 °F to 122 °F) without external heating or cooling.

- Allow a minimum of 8 inches (20.3 cm) on both sides of the unit for space for system output cables and the AC mains supply conduit.
- Allow a minimum of 4 inches (10.2 cm) on the top of the unit to allow access to mounting hardware should the unit need to be removed from the wall.
- Provide adequate clearance at the bottom of the unit for routing of gas supply line and vent lines.
- The access door to the sample unit swings out when opened and requires an additional of 12-1/2” (31.75 cm) for clearance.


NOTE

Do not operate the analyzer in direct sunlight as this can raise the internal temperature of the analyzer significantly above the ambient temperature.

Mounting Requirements


NOTE

Avoid mounting the analyzer in extremely dirty environments or where it will be subject to large amounts of electromagnetic interference.

Mounting Hardware: (2) 1/2” x 1.00 L (M6 x 25 mm L) hex bolts

Dimensions

Please see Figure 3.1 on the following page.

Figure 3-1. Model 5100 Analyzer dimensions showing mounting holes.

General Wiring and Conduit Requirements

- All wiring conductor ratings should be for the minimum temperature required for the analyzer but not less that 50° C (122° F).
- Follow all applicable electrical codes for your location.
- Use only applicable NEMA-approved conduit fittings or cable fittings to maintain NEMA rating. If not using a conduit entry, leave the factory NEMA-approved plugs intact. Never leave any holes unplugged.
- Follow proper grounding, shielding, and noise protection practices.
- Use twisted-pair cable with an overall braided shield, or twisted-pair cable in rigid metal conduit for all communication wiring.
- For AC mains supply wiring, use between 12 and 14 American Wire Gauge (AWG) or equivalent metric between 3.3 mm^2 and 2.1 mm^2.
- Do not add any additional conduit entry holes.

EMC Grounding, Shielding and Noise Protection

For EMC purposes, do not leave cable shields disconnected at either or both ends of the cable under any circumstance.

Use twisted-pair cable in rigid metal conduit or twisted-pair cable with an overall braided shield. All cable shields or conduits connecting to the analyzer must be chassis-grounded.

EMC grounding method

Chassis earth bonding
Although the Model 5100 Analyzer includes a terminal for ground connection at the mains terminal block, the path of the installation's ground conductor may not provide an adequate path for draining radiated and conducted EMI or that path may provide an additional way for transients to be induced back into the analyzer as those transients are led to ground. Therefore, it is recommended that the user install a grounding braid or wire from the ground terminal on the outside of the customer Connection box to a good earth ground.

Shield Ring Method
Connect all shields for the conduit entry (other than power) to a supplied shield terminal ring. Place the shield ring under the conduit nut. Crimp the shields from all cables for the conduit entry to a female quick disconnect and then push it onto the tab that sticks out of the conduit shield ring. Keep shields as short as possible.

Ground Stud Method
Connect all cable shields for the conduit entry hole to the grounding stud closest to the conduit entry hole.

Transient and RFI interference

Transient and noise protectors on I/O connections (communications, current outputs, etc.) are intended to act as a last line of defense against unwanted transient and RFI interference.

- Follow proper installation practices. Inductive loads connected to the analyzer must have transient suppressors installed at the inductive loads.
- For optimum noise protection, connect the analyzer mains supply wiring to a circuit separate from any that could introduce transients into the system.

Secondary Process Seals Requirement

"This instrument is supplied with a **primary process seal only** *(single seal device) in accordance with ANSI/ISA 12.27.01-2003. Proper installation of this instrument requires a* **secondary process seal** *if failure of the primary process seal could allow process fluids to enter the conduit or field wiring system. The maximum process gas pressure and temperature that will be applied to the secondary seal are 10 psig (170 KPa) and 140°F (60°C)*

It is the user's responsibility to provide Secondary Process Seals to prevent process fluids from migrating through the cable or conduit system to an unclassified area. The seals must be installed on all four (4) conduit entry ports to the analyzer at the customer-connection box to vent gas/fluids to a location where they can be handled safely.

Connecting the Model 5100 Analyzer to the AC Mains Power

There is no power switch or circuit breaker on the Model 5100 Analyzer. It must be protected by installing it on a circuit-protected line, maximum 15 Amps, with a switch or circuit breaker close to the unit and within easy reach of an operator. Use the 1/2” conduit entry port in the customer connection box for the AC mains supply wiring.

NOTE

Mark the switch or circuit breaker as the disconnecting device.

NOTE

The Model 5100 Analyzer supports 100-250 VAC, 50/60 Hz.

Connections to the Model 5100 Analyzer are made at the power entry terminal block. It is located in the customer connection box (Figure 3-2).

- Remove the cover of the customer connection box by loosening the 12 screws holding it in place and lifting the cover upward and away from the box.
- Locate the power entry terminal block to make connections to the AC power line.
- Thread the AC mains supply wiring through the conduit entry port on the customer connection box and connect as shown in Figure 3-2.

NOTE

Maximum wire size is 10 AWG. Stripping length is 0.312” (8 mm).

Mains supply connections to the terminal block are as follows:

Line = Line connection
Neutral = Neutral connection (USA)
Ground = Ground connections

Connect wiring per Figure 3-2.

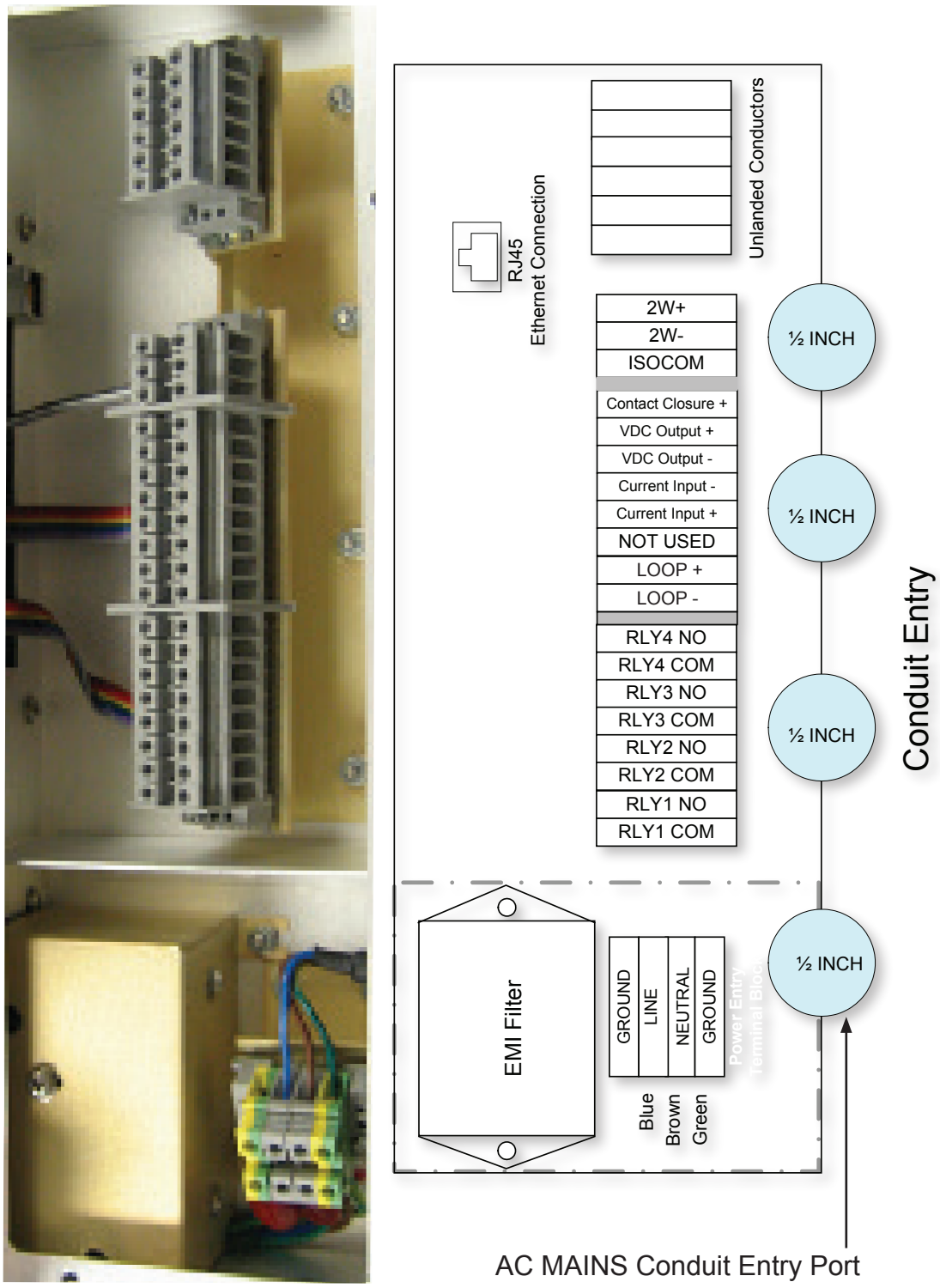


Figure 3-2. Inside customer connection box. AC Mains connections.

Consult plant safety personnel for appropriate exhaust venting guidelines for specific sample gas type.

User-Supplied Items

Interconnect Wiring

The user must supply all wiring for serial communication, analog output (max loop resistance <900 Ohms), and alarm relays. Recommended wire is 22 gauge, twisted/shielded pair.

External Sample Tubing

Recommended sample gas input tubing is 1/4" compresson (6mm OD metric version), stainless steel. Sample input tubing length should be as short as possible.

Secondary Process Seals

Secondary process seals must be used on all four (4) conduit entry points at the customer connection box to prevent gas/liquids from venting to non-classified locations.

Sample Pressure Requirements

AMETEK recommends pressure settings between -4.7 and 10 PSIG.

Minimum input pressure:	-4.7 PSIG	(-31.3 kPa) (10.2 PSIA)
Maximum pressure:	10 PSIG	(68.7 kPa) (24.7 PSIA)

A sample cell pressure sensor located in the electronics box is used to maintain inlet pressure (Figure 1-2a).

Inlet pressure must be kept at less than 69 kPa (10 PSIG). If a regulator is necessary on the natural gas line to maintain required sample inlet pressure, must be suitable for the type of sample stream and the area classification.

Check inlet pressure and flow rate on a weekly basis to ensure correct pressure.

Gas Connections

Locate the analyzer as close as possible to the sample source and install a main process shut-off valve at the sample tap. All connections to the Model 5100 Analyzer are made using 1/4" compression (6mm metric option) fittings. These fittings are located at the bottom of the unit. They include: sample inlet, liquid separator drain, and sample exhaust.

When connecting the sample line, keep the amount of time that the analyzer gas fittings are left open to less than a minute.

1. Remove the caps from the sample inlet fitting and exhaust fitting. Keep the fitting caps in case you have to ship the analyzer or if it has to be disconnected for an extended period of time.

2. Connect the sample input tube to the analyzer sample inlet valve.

3. Connect the exhaust tube to the analyzer exhaust. The exhaust must be vented to an appropriate vent system.

All sample outlets should exhaust to atmospheric pressure, either outside or into a vent, not into the workplace. It is the customer's responsibility to ensure potentially hazardous samples are removed safely and to supply all necessary pipe work to connect the exhaust to a suitable location. To prevent condensation in the exhaust draining back to the analyzer ensure a continuous downward gradient on the line, or fit a suitable trap to the line.

4. The separator inside the sample section removes entrained liquids and particulates from the gas before it passes through the sample cell. For this reason, the bypass or drain valve is left **OPEN** to allow the residue to exit the analyzer. Ensure that the valve is turned slightly to the **OPEN** position.

If the bypass or drain valve is closed, water build-up can damage the separator.

Check the filter on the liquid separator for contamination every two weeks and replace if necessary. Once you determine a pattern as to how long the filter can be used, you can adjust the time interval between replacements. Check and, if necessary, replace after any known process event.

5. Check all sample input and exhaust fittings for leaks.

I/O, Communication, and Alarm Relay Connections

All end-user input/output signal, communication, and alarm relay contact connections are made through the customer connection box (Figure 3-2) on the side of the electronics enclosure.

CAUTION

Disconnect the power from the analyzer before wiring to the customer connection box. Open the cover on the customer connection box by removing the 12 screws that hold the cover in place. Lift upward and pull away from the box.

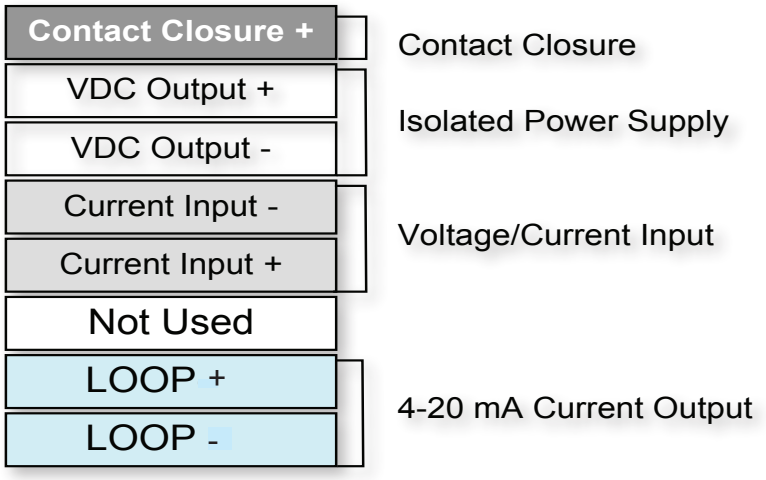


Figure 3-3. I/O signal connections inside customer connection box.

I/O Signals

Contact Connection

CAUTION

Be sure to observe polarity when connecting current output devices to these terminals.

- Using the contact input, there are two methods to connect a switch contact to the I/O ports:
  - using the internal power supply
  - using an external power supply

NOTE

*The internal isolated power supply terminals are **VDC Output +** and **VDC Output -**. The voltage is 24 VDC and the current rating is ± 42 mA.*

- **Connection using Internal Power Supply**
  Using the internal power supply (+VID), connect one side of the switch to **VDC Output +** and the other side of the switch to **Contact Closure +** (Fig 3-4).

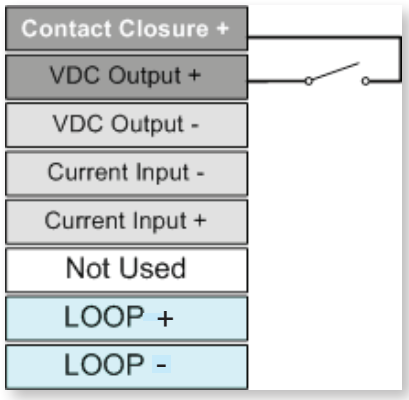


Figure 3-4. Terminal configuration using internal power source.

CAUTION

*If using an external power supply, the maximum input voltage between **Contact Closure +** and **VDC Output -** is 24 volts.*

- **Connection using External Power Supply**
  Using an external power supply, connect the negative (-) terminal of the power supply to **VDC Output -**. Connect one side of the switch to the positive (+) terminal of the power supply, and the other side of the switch to **Contact Closure +** (Figure 3-5).

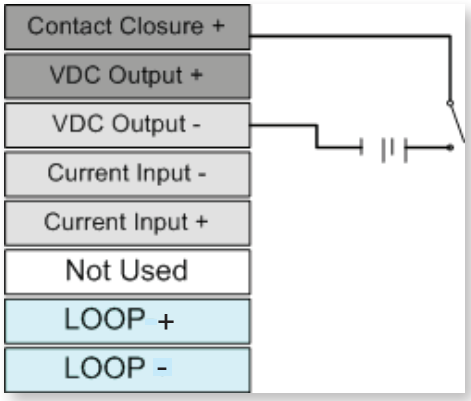


Figure 3-5. Terminal configuration using external power source.

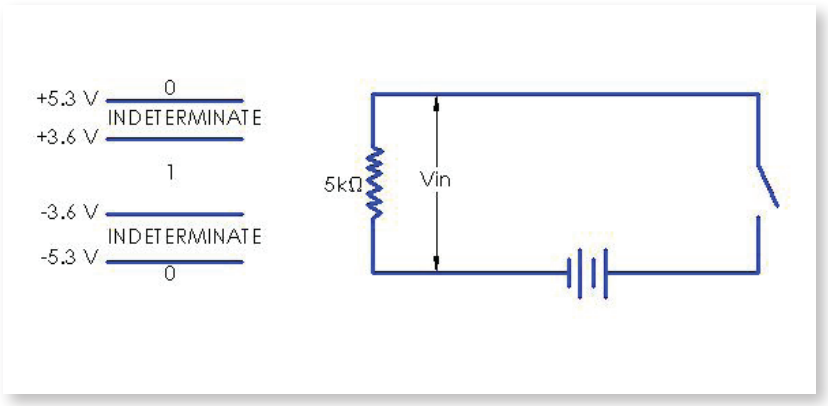


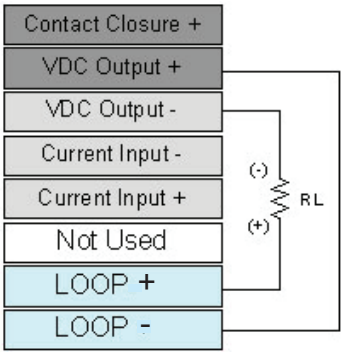
Figure 3-5a. Voltage In.

NOTE

The input impedance is 5kΩ. Logic "0" input requires the input voltage to be equal to or greater than +5.3v or less than or equal to -5.3v, not to exceed ±24v. Logic "1" input requires less than or equal to +3.6v or greater than or equal to -3.6v, not to exceed ±24v.

Current Loop Output Connection

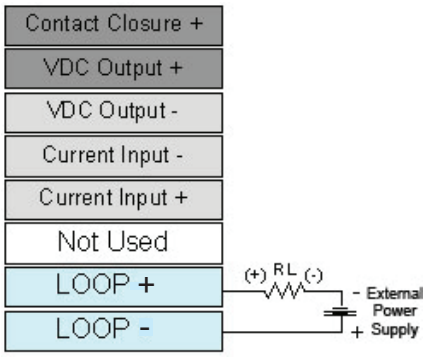
There are two methods that can be used to connect the output current loop to the I/O ports.



Connection using Internal Power Supply

Using the internal power supply (VDC Output +), connect the VDC Output + terminal to the positive (+) side of the load. From the negative (-) side of the load, connect to the terminal labeled LOOP +. Jumper the LOOP - terminal to the VDC Output - terminal (Figure 3-6a).

Figure 3-6a. Connection using Internal Power Supply.

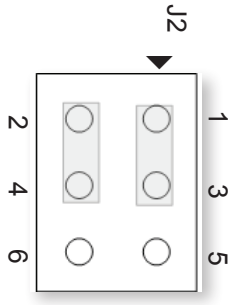


Connection using External Power Supply

Using the external power supply, connect the LOOP + terminal to the negative (-) side of the load. Connect the positive (+) side of the load to the positive (+) side of the external power supply. Connect the negative (-) side of the external power supply to the LOOP - terminal (Figure 3-6b).

Figure 3-6b. Connection using External Power Supply.

Analog Input - Voltage/Current



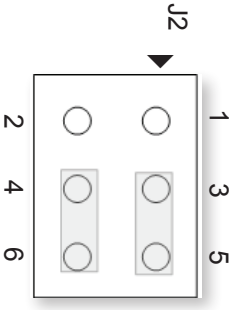
Voltage Input

On the analog board find Header J2, place jumpers between Pins 1 and 3, and between Pins 2 and 4 (Figure 3-7a). Connect the positive (+) input to the Current Input + terminal and the negative (-) input to the Current Input - terminal.

Figure 3-7a. J2 jumper configuration when using Voltage input. (Pin 1 is located next to the arrow by J2)

NOTE

Input resistance is 2.5 K Ohms. Maximum input voltage is 6.25 Volts.



Current Input

On the analog board find Header J2, place jumpers between Pins 3 and 5, and between Pins 4 and 6 (Figure 3-7b). Connect the positive (+) side of the current source to the Current Input + terminal and the negative (-) side to the Current Input - terminal.

Figure 3-7b. J2 jumper configuration when using Current input. (Pin 1 is located next to the arrow by J2)

NOTE

Current input range is 4-20 mA. Input resistance between Pins 4 and 5 is 100 Ohms.

RS-485 Communication Connection

The RS-485 communication port is used specifically with Modbus-RTU that is used to communicate with DSC or a Modbus master computer.

2-Wire Connection

The RS-485 uses a 2-wire connection:

2W+
2W-
ISOCOM

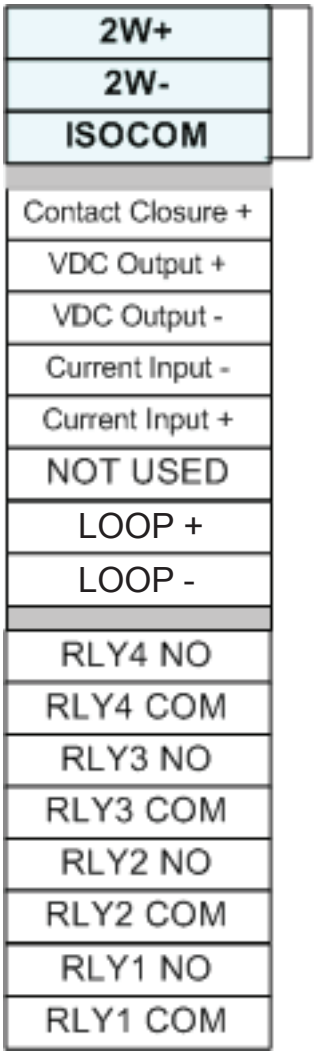


Figure 3-8. RS-485 terminal block connections.

1. Thread the cable or conduit through the entry port on the side of the customer connection box and connect the wiring to the RS-485 communications terminal.
2. Connect all the 2-wire pluses (+) and all the 2-wire minuses (-) in parallel with all the devices in a daisy-chain fashion, including all the analyzers on the network and the host computer. In addition, on the host computer connect the “receive” and “transmit” terminal block connections. Be sure to use twisted-pair cable for all connections. See Figure 3-8.
3. ISOCOM is the ground connection.

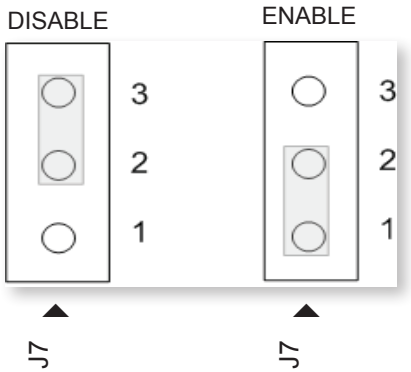


Figure 3-9. J7 Jumper positions on MCU board for enable and disable RS-485 termination resistors. (Pin 1 is located next to arrow by J7)

2-Wire Termination Resistor

The Model 5100 Analyzer electrical box is equipped with a termination resistor that can be used for the last unit on the network. Jumper J7 on the MCU board allows you to place a 120-Ohm termination resistor into the RS-485 circuit. See Figure 3-9.

Relay Alarms

There are four (4) relay alarms available for the Model 5100 Analyzer. The relays are configured in the software. The settings available for the alarms are: Disable, Concentration, Data Valid, System Alarm, and Normally Open/Normally Closed (NO/NC).

Figure 3-10. Relay alarm connections inside customer connection box.

1. Disconnect the power from the analyzer and remove the cover on the customer connection box by removing the 12 screws that hold the cover in place.

2. Thread the cable or conduit through the entry port on the side of the customer connection box near the relay connection terminals and connect the wiring to the relay terminals. See Figure 3-10.

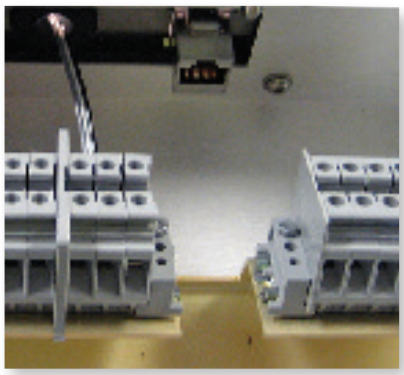
NOTE

Ratings for the Relay Alarms are as follows: Contact rating is 100 VA max, 1.0 A switching, 2.5 A max carry, 60 VDC/30 VAC max switching.

Ethernet Cable Connections

When using the Ethernet interface on the Model 5100 Analyzer, the minimum requirement for the Ethernet cable is a CAT 5e (maximum 100 m) cable to connect the analyzer to the network. The maximum distance between the analyzer and the hub is 100 m. For outdoor analyzer installations, hazardous locations, and/or lengths greater than 100 m, special requirements may be necessary. Contact your network administrator for more information.

To install the Ethernet cable follow the steps below:



1. Disconnect the power from the analyzer and remove the cover on the customer connection box by removing the 12 screws that hold the cover in place.
2. Route the Ethernet cable through the cable entry port (Figure 3-2) and into the box.
3. Plug the cable into the LAN RJ45 connector.
4. Route the cable to the network connection in the plant and connect it.

User Interface

Overview of Keypad

The Model 5100 Analyzer keypad (Figure 3-11) is used to access menus, sub-menus and system values, and to set-up analyzer parameters.

Menus

Press **ENTER** to access the menus.

Figure 3-11. Model 5100 Analyzer keypad and sampling screen.

ALARM	Used to define alarm output settings.
ANALOG RANGE	Used to scale the 4 to 20 mA output in proportion to the analyte concentration.
TEST CONFIG	Used to define device and communication settings.

Navigation Keys

BKSP	Used to reverse navigate.
ENTER	Used to select or to confirm an entry.
SPACE	Used to enter "-" (minus) for negative numbers.
Arrow Keys	Scroll up, down, left, and right through menu items and system value lists.
Number Keys (0 through 9)	Enter values. Use the period (.) to enter numbers that require a decimal point.

To select an item, use the arrow keys to scroll through the menu items until the small arrowheads point to your choice as shown in Figure 3-12. When you come to the end of the selections under that menu item, the display will go back to the top of the list.

Figure 3-12. Small arrowheads point to your choice.

Once you access the menu you want, use the arrow keys to scroll through the menu until the desired item is between the arrowheads. Press **ENTER** to select the menu item. Depending on the selected menu item, either more menus will be displayed or you can enter data at that point. Follow the instructions on the display.

Except where otherwise noted:

- Press **ENTER** Select a menu item and to confirm an entry.
- Press **BKSP** To exit without saving or entering data.

  (Any changes made will not be saved.)

  To go back through previous levels, one level at a time, until the display returns to the normal operation screen, when browsing the menu list.

Overview of Display

The default display has four lines (Figure 3-12):

- Line 1 Sample concentration
- Line 2 Status message
- Line 3 Alarm message
- Line 4 Alarm value

There is also a series of blips after the “status” message (Sampling . . . .) that repeat to indicate the analyzer is functioning.

Initial Start-Up

1. Open the main sample shutoff valve at the source.

2. AMETEK recommends you adjust the sample inlet pressure to between -4.5 PSIG and 10 PSIG.

Maximum inlet pressure is 10 PSIG. Damage can occur if higher pressures are introduced into the analyzer.

3. Turn on the AC power at the source. Boot-up information will appear on the analyzer display followed by the operation screen. Lines 3 and 4 of the display will flash various messages and alarm conditions at start-up.

4. When the sample flow starts, the analyzer will adjust to normal operating mode.

5. Adjust the inlet valve so that approximately 2 l/min of sample is flowing through the analyzer.

6. Use the software to set up your analyzer parameters (See Chapter 4 of this manual).

USER INTERFACE

The user interface consists of the display screen on the front of the Model 5100 Analyzer and the keypad. Use the arrow keys, BKSP, ENTER, SPACE, numbers, and period to set the parameters for your analyzer.

Figure 4-1a. Keypad and display for the Model 5100 Analyzer.

NOTE

Cell Pressure and Cell Temperature on the LED display during sampling are not user-definable. They are the real-time pressure and temperature for the analyzer.

Figure 4-1b. Display for alarm condition.

Model 5100 Analyzer Menu Map

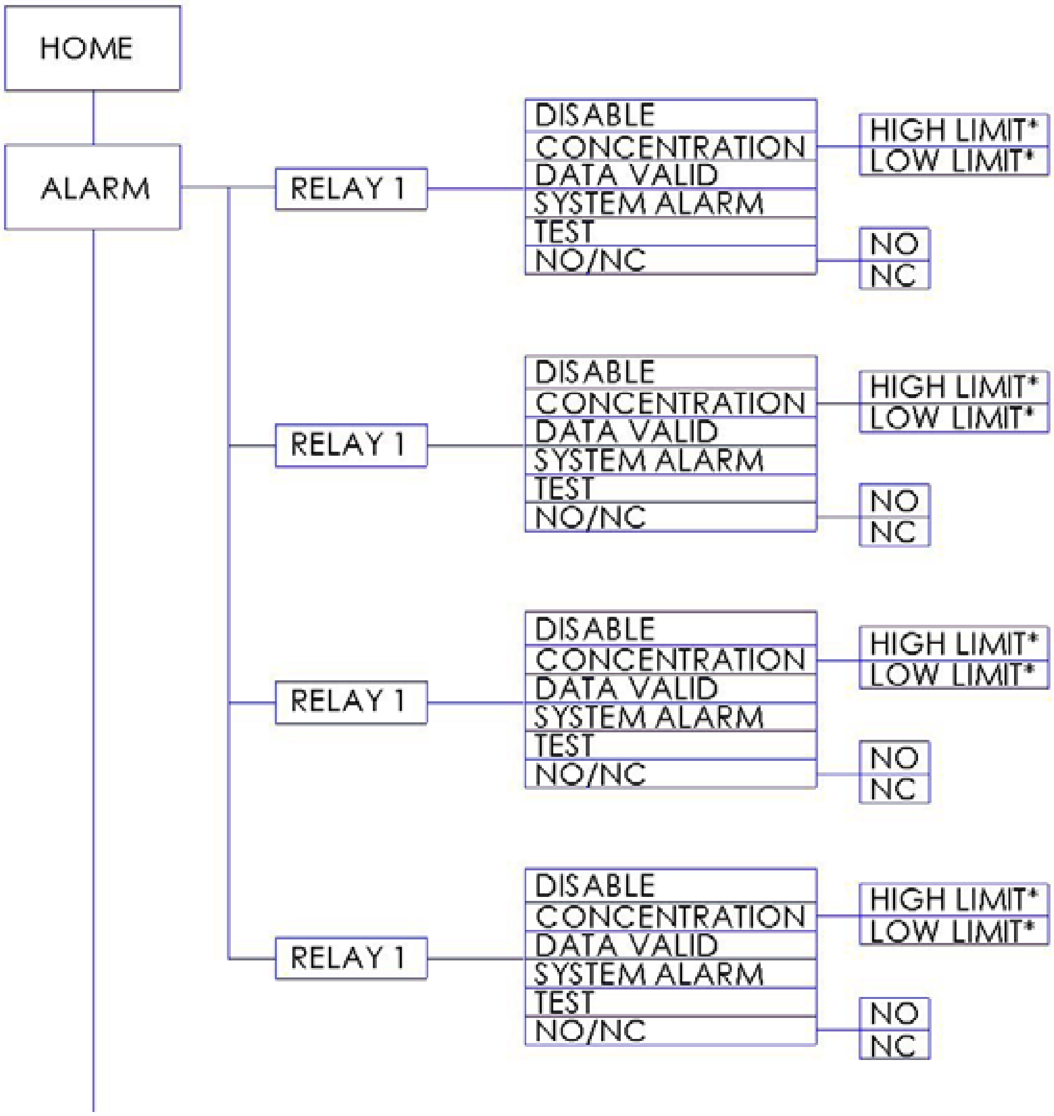


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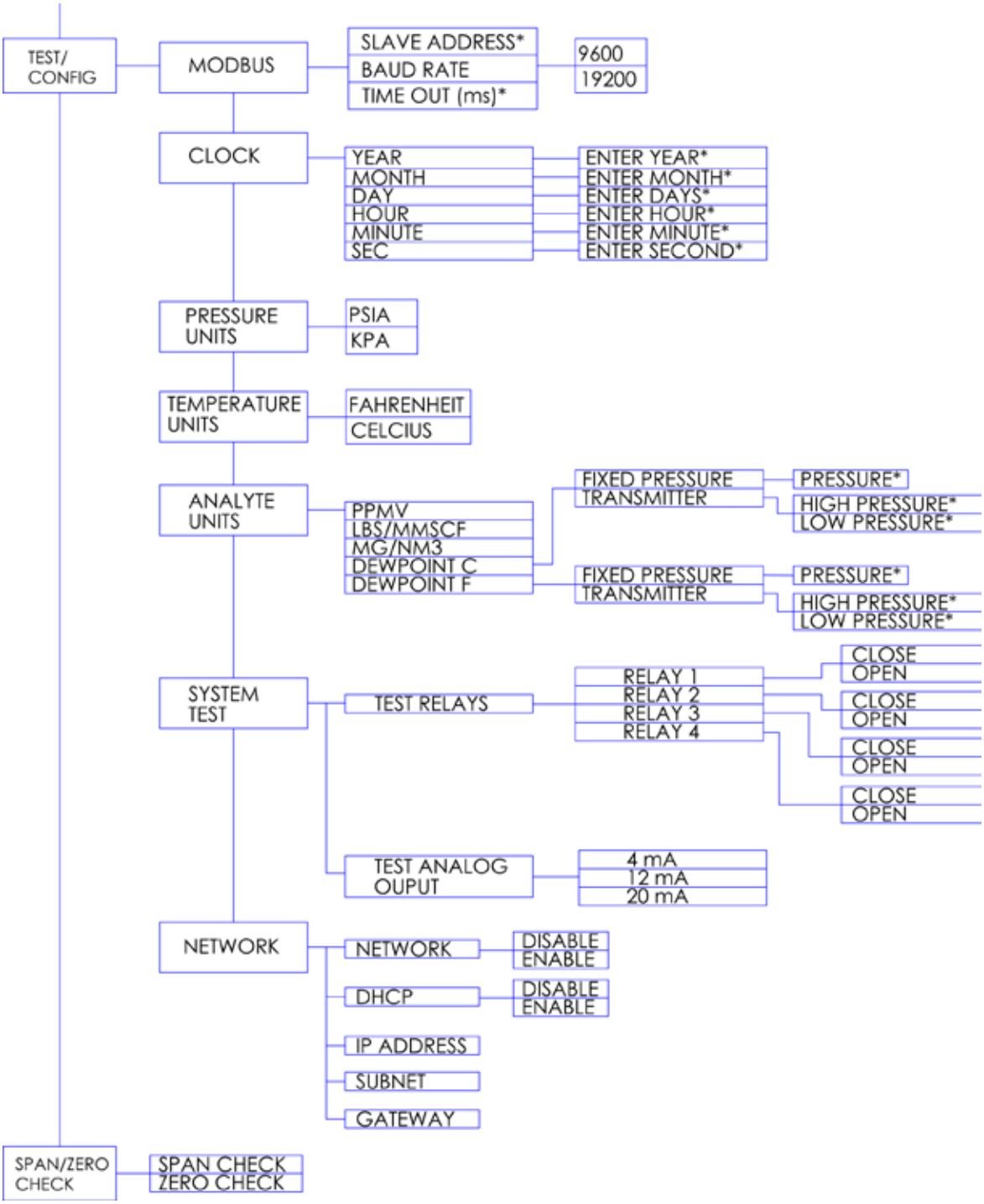
Figure 4-2.
Menu map for the
Model 5100 Analyzer


TEST/ CONFIG
MODBUS
SLAVE ADDRESS*
BAUD RATE
TIME OUT (ms)*
9600
19200
CLOCK
YEAR
MONTH
DAY
HOUR
MINUTE
SEC
ENTER YEAR*
ENTER MONTH*
ENTER DAYS*
ENTER HOUR*
ENTER MINUTE*
ENTER SECOND*
PRESSURE UNITS
PSIA
KPA
TEMPERATURE UNITS
FAHRENHEIT
CELCIUS
ANALYTE UNITS
PPMV
LBS/MMSCF
MG/NM3
DEWPOINT C
DEWPOINT F
FIXED PRESSURE TRANSMITTER
PRESSURE*
HIGH PRESSURE*
LOW PRESSURE*
FIXED PRESSURE TRANSMITTER
PRESSURE*
HIGH PRESSURE*
LOW PRESSURE*
SYSTEM TEST
TEST RELAYS
RELAY 1
RELAY 2
RELAY 3
RELAY 4
CLOSE
OPEN
CLOSE
OPEN
CLOSE
OPEN
CLOSE
OPEN
TEST ANALOG OUPUT
4 mA
12 mA
20 mA
NETWORK
NETWORK
DISABLE
ENABLE
DHCP
DISABLE
ENABLE
IP ADDRESS
SUBNET
GATEWAY
SPAN/ZERO CHECK
SPAN CHECK
ZERO CHECK

Alarm

The Alarm Key defines alarm settings for each of the 4 relays available.

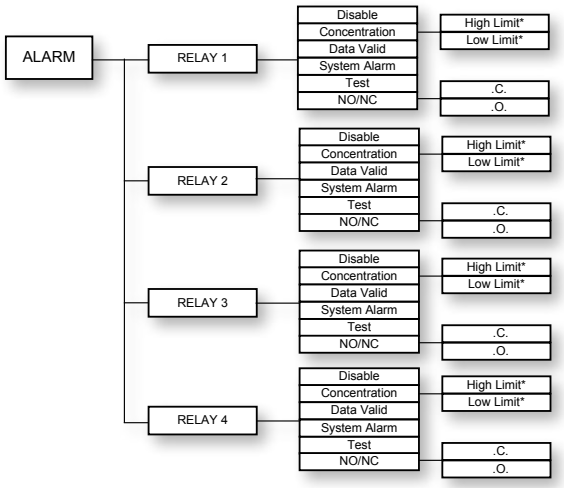


Figure 4-3. Main menu for the Alarm key.

Disable

Select this alarm function to disable the alarm for the associated relay.

Concentration

Select this alarm function to set the limits for the concentration.

- *High Limit*
  Select and then enter the value for the **High Limit** for the Concentration alarm.
- *Low Limit*
  Select and then enter the value for the **Low Limit** for the Concentration alarm.

Data Valid

Select this alarm function to set the alarm to recognize corrupt data.

System Alarm

Select this function to trigger an alarm when the system malfunctions.

Test

Select this function to test the relay alarm settings.

NO/NC

Select this function to define the default relay position.

- NC = Normally Closed
- NO = Normally Open

Analog Range

The **Analog Range** key defines your 4 to 20 mA output setting. Use this setting to scale the 4 to 20 mA output. The 4 to 20 mA output is proportional to the analyte concentration.

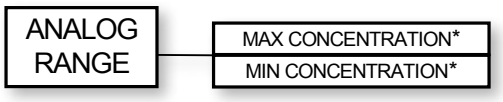


Figure 4-4. Main menu for Analog Range key.

Max Concentration

Enter the analyte reading equivalent to 20 mA.

Min Concentration

Enter the analyte reading equivalent to 4 mA.

Example:
To scale the analog output to represent a 0 to 100 PPMV range enter the following settings:

Max Concentration	100
Min Concentration	0

Test Config

The **Test Config** key is used to define device and communication settings.

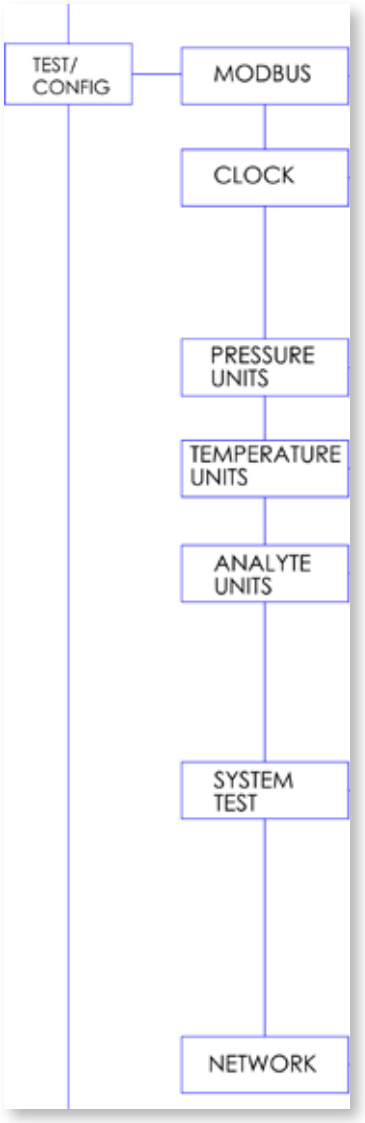


Figure 4-5. Main menu for Test Config key.

Modbus

Selects the communication setup. The Modbus protocol transmission mode implemented is Remote Terminal Unit (RTU) with the analyzer operating as a slave device.

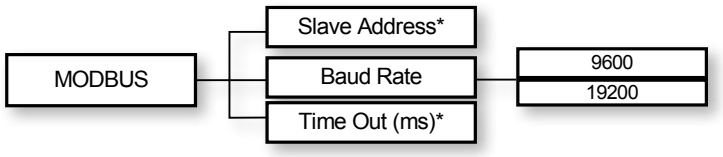


Figure 4-6. Menu for Modbus key.

- *Slave Address*
  Enter the **Slave Address**.

- *Baud Rate*
  Select the baud rate at which you transfer data (9600 or 19200). The default is 9600.

- *Time Out (ms)*
  Enter the time out in milliseconds.

Modbus interface parameters must be set up to establish communication. Use the Modbus registers to obtain specific input/output data.

NOTE

Modbus Registers can be found at the end of this chapter.

Clock

Use the **Clock** function to set the clock on your analyzer.

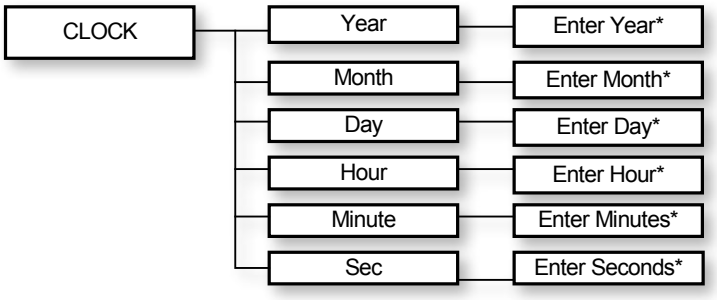


Figure 4-7. Menu for the Clock key.

Year
Select **Year** and enter the 4-digit value for the year.

Month
Select **Month** and enter the numerical value for the month.

Day
Select **Day** and enter the numerical value for the day.

Hour
Select **Hour** and enter the numerical value for the hour using the 24-hour clock.

Minute
Select **Minute** and enter the numerical value using the 24-hour clock.

Sec
Select **Sec** and enter the numerical value for the seconds.

Press Disply Units

Use the **Press Disply Units** function to select the unit of pressure for the cell to display on the user interface LED when sampling. Select either psia or kPa.

Figure 4-8a. Menu for the Pressure Display Unit key.

Temp Disply Units

Use the **Temp Disply Units** function to select the unit of temperature for the cell to display on the user interface LED when sampling. Select either Celsius (°C) or Fahrenheit (°F).

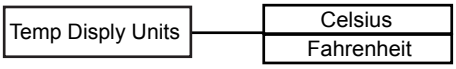


Figure 4-8b. Menu for the Temperature Display Unit key.

Moisture Units (for water vapor applications)

Use the **Moisture Unit** function to select the unit of measurement for the analyzer.

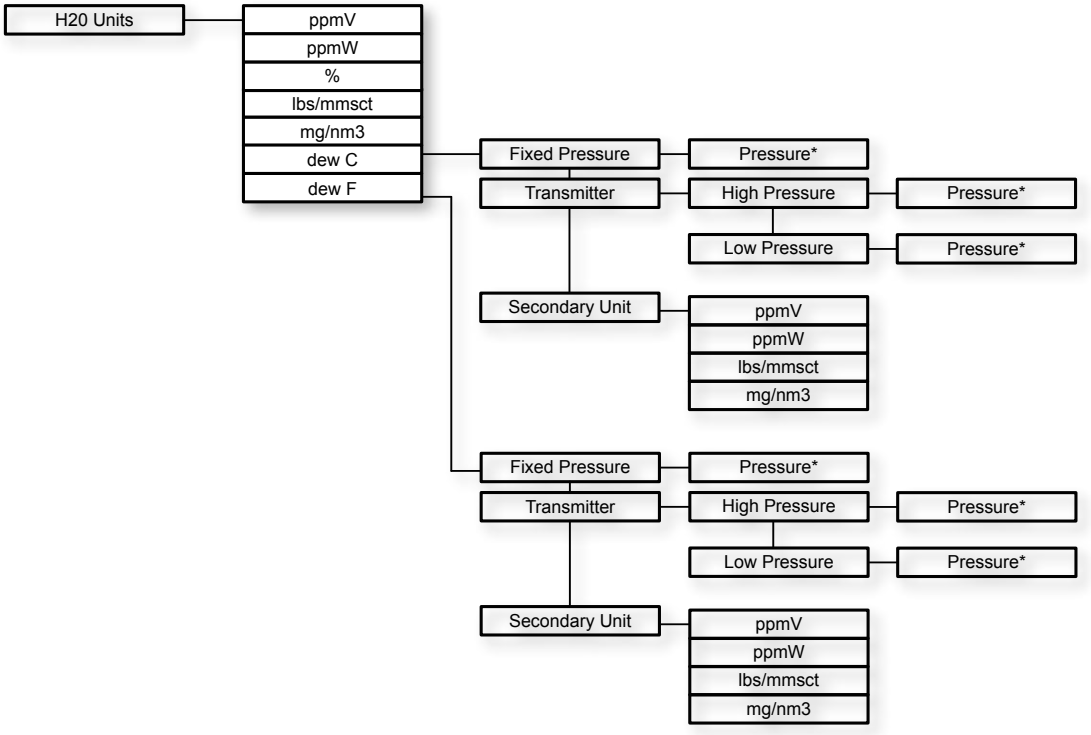


Figure 4-9. Menu for the Moisture Unit key.

Select the unit for the moisture readings from the list. Press **Enter**.

If you choose either **Dew Point C** (dewC) or **Dew Point F** (dewF), you must also select one of the following:

Fixed Pressure	Enter the process pressure
Transmitter	Enter **High Pressure** and a **Low Pressure**
Secondary Unit	Choose moisture unit: ppmV, lb/mmscf, or mg/nm^3

NOTE

If you change the moisture units, remember to make any necessary changes to the Alarm and Analog Range settings.

System Test

Use the **System Test** Key to perform tests on various components of the analyzer.

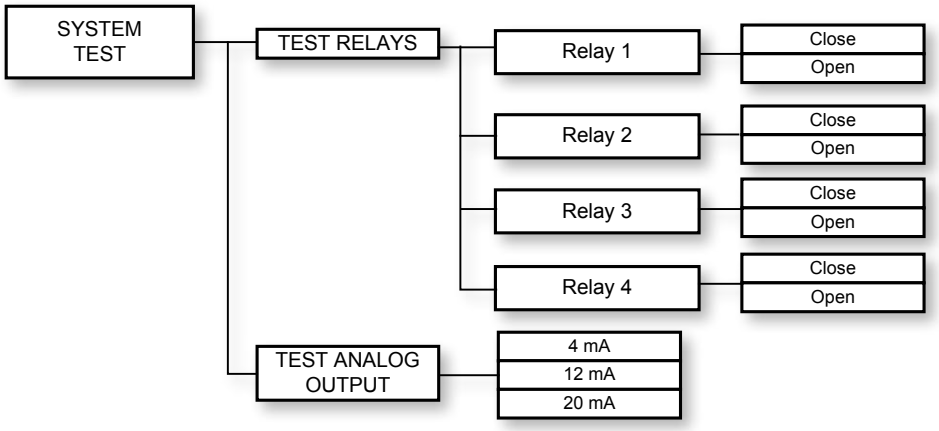


Figure 4-10. Menu for the System Test key.

Test Relays

Tests the relay contacts by toggling them **Close** / **Open**.

Test Analog Output

Tests the analog output by allowing the user to set outputs to 4, 12 or 20 mA.

Network

The **Network** Key enables the Model 5100 Analyzer to communicate over an Ethernet network to view data, diagnostics, or backing up/restoring the analyzer configuration.

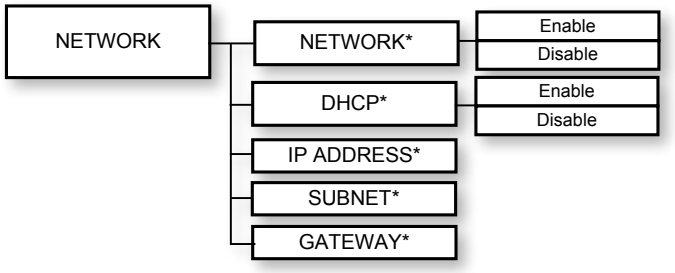


Figure 4-11. Menu for the Network key.

Network

Enables or disables the Ethernet network. Select **Enable** or **Disable**.

DHCP

Dynamic Host Configuration Protocol (DHCP). Choose **Enable** to open the communication protocol or **Close** to disable it.

IP Address

Defines the network of the analyzer and is a required parameter. Enter the IP address for your network.

Subnet

Defines the subnet to which the analyzer belongs. Analyzers in the same subnet can communicate locally without going through a router (Gateway). Enter your network subnet.

Gateway

This function defines the Gateway IP address for the network to allow local network traffic to be sent to another network. Enter the Gateway address.

ZERO and SPAN Check Functions

The analyzer may be zeroed and/or spanned as necessary. This is accomplished by using the keypad.

When zeroing it is important that the gas applied is known to represent a zero level (of the analyte), in the correct background. For span gas, the concentration of the analyte must be accurately known; and must also be in the correct background. For both cases the gas must applied long enough to allow the instrument reading to stabilize before performing the zero or span.

To begin, the analyzer should be in normal operating mode, and sampling. Press the ENTER key, and the main menu selections will appear on the display:

Scroll down to the “Span/Zero Check” menu selection using the down-arrow key:

Press ENTER to activate this selection.

The following screen will be displayed:

To perform a Span Check, scroll to that selection and press ENTER. The following screen will be displayed (for H2O in this example):

If you do not want to perform the span, press the NO key. To proceed with the span, press the YES key.

To change the target value to match the applied analyte concentration, press the enter key. The screen below will appear, prompting you for the new value.

The following screen is displayed:

The passcode is “123”. It is not necessary to press ENTER after typing the passcode. The software will perform the span automatically once “123” is keyed. If the password is incorrect, the software will display the message “Incorrect Passcode”.

After spaning, the analyzer will return to the “Span/Zero Check” screen.

To perform the Zero Check, the steps are the same, beginning with selecting “Zero Check”.

The following screen appears:

Press “YES” to proceed as for the span.

Modbus Registers

Data Type	Description	MB Starting Regs	MB Reg Size
uint	IP Address	13	2
uint	IB Subnet Mask	15	2
uint	Gateway	17	2
uint16	DHCP Enable: 1=disabled, 2=enabled	21	1
uint16	TCP Enable: 0=disabled, 1=enabled	22	1
char[20]	Software Version	26	10
char[20]	Model Name	36	10
uint	Internal UART1 Baud Rate (Modbus)	46	2
uint	Internal UART2 Baud Rate (Display)	48	2
uint	External UART1 Baud Rate (RS232)	50	2
uint	External UART2 Baud Rate	52	2
int16	Parity: 0=none, 1=even, 2=odd	56	1
int16	Stop Bits: 1=1 stop bit, 2=2 stop bits	57	1
uint16	Modbus Address	58	1
uint16	Modbus Port: 0=disable, 1=enable	59	1
uint	Modbus Timeout (ms)	60	2
char[20]	System Time	62	10
char[20]	System Date	72	10
int16	Parameter used to request a state machine change: 1=not ready, 2=measure, 3=zero, 4=span, 5=zero hold, 6=span hold, 7=idle	82	1
char[20]	Concentration Unit of Measure for Analyte 1	83	10
int16	Float Format Index: 0=comma as decimal, 1=period as decimal	93	1
uint16	0=MM\DD\YYYY, 1=MM-DD-YYYY	94	1
char[10]	Pressure Unit of Measure (case sensitive) Valid strings include: psi, psia, in H2O, inHg, bar, cmH2O, kg/cm2, kPa, mbar, micron, mmHg, oz/in2, torr, atm	95	5
char[10]	Temp Unit of Measure (case sensitive) Valid strings include: degreeC, degreeF, degreeK	100	5
uint	Data Valid: 0=not valid, 1=valid	105	2
int16	0=line-lock mode, 1=sample, 2=calib	107	1
int16	Pressure and Temp Compensation: 0=none, 1=pressure, 2=temperature, 3=both	108	1
uint	Bit-Mapped System Alarms	109	2
uint	Bit-Mapped System Alarms	111	2
uint	Bit-Mapped System Alarms	113	2
uint	Bit-Mapped Concentration Alarms	115	2
int16	System Status: 0=everything OK, Not 0=something wrong	117	1

Data Type	Description	MB Starting Regs	MB Reg Size
int16	System State: 100=not ready, 201=measure run, 502=idle, 600=diag	118	1
float	External 4-20 mA Input 1	123	2
float	Current Ouput 1	125	2
float	Current Output 1 Offset	127	2
uint16	Current output 1 Parameter	129	1
float	Current Output 1 Span	130	2
int16	Current Output 1 Output Type: 0=4-2 mode, 1=0-20 mode *If over-range enable (ANAOUT1OR=1)* 0=3.78 to 20.5; 1=0 to 20.5 *High or Low values can also be set by fault value. See Fault option* (ANAOUT1F)	132	1
uint16	Current Output 1 Over-Range Enable 0=disabled, 1=enabled	133	1
uint16	Current Output 1 Fault Option 0=no fault, 1=low fault, 2=high fault If High fault (2): High End of Range becomes 22 mA; Output Ratio becomes 1 If Low fault (1) AND in 4-20 mode (ANAOUT1T=0) Low End of Range becomes 3 mA Output Ratio becomes 0	134	1
float	Current Output 2	135	2
float	Current Output 2 Offset	137	2
uint16	Current Output 2 Parameter	139	1
float	Current Output 2 Span	140	2
int16	Current Output 2 Output Type: 0=4 to 20 mode, 1=0 to 20 mode *If over-range enable (ANAOUT2OR=1)* 0=3.78 to 20.5, 1=0 to 20.5 *High or low values can also be set by fault value. See Fault option* (ANAOUT2F).	142	1
uint16	Current Output 2 Over-Range Enable: 0=disabled, 1-enabled	143	1
uint16	Current Output 2 Fault Option 0=no fault, 1=low fault, 2=high fault If High fault (2): High End of Range becomes 22 mA; Output Ratio becomes 1 If Low fault (1) AND in 4-20 mode (ANAOUT2T=0) Low End of Range becomes 3 mA Output Ratio becomes 0	144	1
uint16	Relay 1: 0=open, 1=closed	145	1

Data Type	Description	MB Starting Regs	MB Reg Size
uint16	Relay 1 Delay Holds the relay output for this set amount of time.	146	1
uint16	Relay 1 Function: 0=disabled, 1=concentration, 3=data valid, 4=system alarm	147	1
uint16	Relay 1 Source The source parameter number used to evaluate the relay function.	148	1
float	Relay 1 Value The value used to evaluate the relay function.	149	2
uint16	Relay 2: 0=open, 1=closed	151	1
uint16	Relay 2 Delay Holds the relay output for this set amount of time.	152	1
uint16	Relay 2 Function: 0=disabled, 1=concentration, 3=data valid, 4=system alarm	153	1
uint16	Relay 2 Source The source parameter number used to evaluate the relay function.	154	1
float	Relay 2 Value The value used to evaluate the relay function.	155	2
uint16	Relay 3: 0=open, 1=closed	157	1
uint16	Relay 3 Delay Holds the relay output for this set amount of time.	158	1
uint16	Relay 3 Function: 0=disabled, 1=concentration, 3=data valid, 4=system alarm	159	1
uint16	Relay 3 Source The source parameter number used to evaluate the relay function.	160	1
float	Relay 3 Value The value used to evaluate the relay function.	161	2
uint16	Relay 4: 0=open, 1=closed	163	1
uint16	Relay 4 Delay Holds the relay output for this set amount of time.	164	1
uint16	Relay 4 Function: 0=disabled, 1=concentration, 3=data valid, 4=system alarm	165	1
uint16	Relay 4 Source The source parameter number used to evaluate the relay function.	166	1
float	Relay 4 Value The value used to evaluate the relay function.	167	2
boolean	Master Enable for All Relays: 0=disabled, 1=enabled	169	1

Data Type	Description	MB Starting Regs	MB Reg Size
char[20]	Analyte 1 Name	170	10
float	Analyte1 Concentration	180	2
float	Analyte 1 Band High-Limit Band 1	182	2
float	Analyte 1 Band Low-Limit Band 1	184	2
float	Analyte 1 Band High-Limit Band 2	186	2
float	Analyte 1 Band Low-Limit Band 2	188	2
float	Analyte 1 Band High-Limit Band 3	190	2
float	Analyte 1 Band Low-Limit Band 3	192	2
float	Analyte 1 Band High-Limit Band 4	194	2
float	Analyte 1 Band Low-Limit Band 4	196	2
char[20]	Analyte 2 Name	198	10
float	TEC Temperature Value	210	2
float	Cell RTD 1 Filtered Value	231	2
float	Cell Set Point	233	2
float	Calibration Temperature for Concentration Compensation	237	2
float	Calibration Pressure for Concentration Compensation	239	2
uint	Decimal Places to use for displaying Analyte 1	252	2
boolean	Normally Closed indicator for Relay 1: 1=normally closed, 0=normally open	256	1
boolean	Normally Closed indicator for Relay 2: 1=normally closed, 0=normally open	257	1
boolean	Normally Closed indicator for Relay 3: 1=normally closed, 0=normally open	258	1
boolean	Normally Closed indicator for Relay 4: 1=normally closed, 0=normally open	259	1
uint	Temporary Cache to mirror warnings in SYSALARM1	262	2
uint	Temporary Cache to mirror warnings in SYSALARM2	264	2
uint	Temporary Cache to mirror warnings in SYSALARM3	266	2
uint16	Analog Output 1: 0=follow source during cal 1=hold output during cal	280	1
uint16	Analog Output 2: 0=follow source during cal 1=hold output during cal	281	1
float	Reference Laser Power (Power at Calib)	300	2
float	Laser Power	304	2
float	Reference Concentration of the reference cell at	306	2

Data Type	Description	MB Starting Regs	MB Reg Size
boolean	if FALSE, use ANAIN1S, else use ANAIN1EU	308	1
float	Max Pressure allowed in PPMV to Dew Point	309	2
float	Min Pressure allowed in PPMV to Dew Point	311	2
float	Dew Point Coeff[0]	314	2
float	Dew Point Coeff[1]	316	2
float	Dew Point Coeff[2]	318	2
float	Dew Point Coeff[3]	320	2
float	Transmitter Pressure	324	2
float	User Analog Input 1 Span	326	2
float	User Analog Input 1 Offset	328	2
float	User Analog Input Fixed Substitute Value	332	2
float	RTD2 (Reference Cell Temperature)	336	2
float	PRESX1 Analog Input Filtered Value	344	2
float	Pressure Transducer 1 Scale	346	2
float	Pressure Transducer 1 Offset	348	2
float	Minimum Concentration	379	2
float	Maximum Concentration	381	2
float	Heater Set Point	504	2

Alarm Messages

Condition	Alarm Message	Causes
Tec temperature high	“TEC Hi Limit Alrm”	Laser temperature is above the setpoint
Tec temperature low	“TEC Lo Limit Alrm”	Laser temperature is below the setpoint
Cell temperature high	“Cell Hi Limit Alrm”	Sample cell temperature is above the setpoint
Cell temperature low	“Cell Lo Limit Alrm”	Sample cell temperature is below the setpoint
Cell Pressure high	“Pres Hi Limit Alrm”	Sample cell pressure is above the setpoint
Cell Pressure low	“Pres Lo Limit Alrm”	Sample cell pressure is below the setpoint
Concentration Band 1 alarm	“Conc. Band 1”	Concentration is outside Band 1 (set in Relay1)
Concentration Band 2 alarm	“Conc. Band 2”	Concentration is outside Band 2 (set in Relay2)
Concentration Band 3 alarm	“Conc. Band 3”	Concentration is outside Band 3 (set in Relay3)
Concentration Band 4 alarm	“Conc. Band 4”	Concentration is outside Band 4 (set in Relay4)
Concentration out of range	“Conc. Out of range”	Concentration is outside of calibration range
Concentration reading is invalid	“Data Invalid”	• In line-lock mode • Any of the system alarm • Low light intensity • Low moisture in reference cell
Low light intensity	“Low light intensity”	
Low reference concentration	“Low ref conc.”	
Internal error	“Internal error”	• File system error • Memory error • I/O communication error
Failed to initialize laser board	“Det init failed”	Attempt to initialize the laser board fails

WEB INTERFACE

Ethernet Connection

Use an Ethernet cable to connect the Model 5100 Analyzer to the network. The minimum requirement for the Ethernet cable is a CAT 5e. The maximum distance between the analyzer and the hub is 100 m.

To install the Ethernet cable follow the steps below:

1. Disconnect the power from the analyzer and remove the cover on the customer connection box.
2. Route the Ethernet cable through the cable entry port and into the box.
2. Plug the cable into the LAN RJ45 connector.
3. Route the cable to the network connection in the plant and connect it.

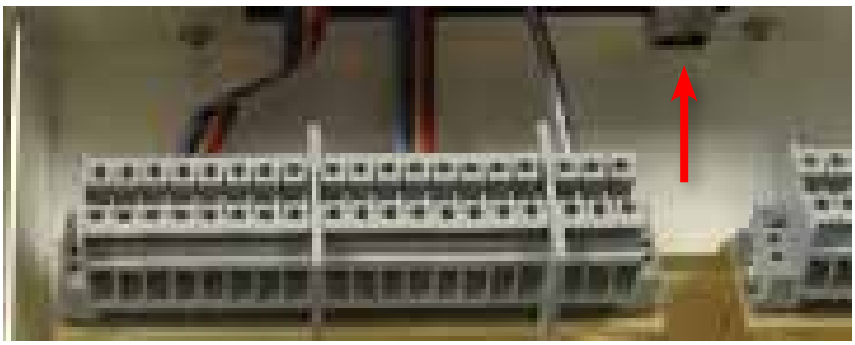


Figure 5-1. Ethernet Connection (upper right corner)

To connect to the 5100/5100HD Analyzer web interface, you need to know the IP Address used by your network. The IP Address can be found by using the analyzer display to navigate to TEST CONFIG, then Network, then IP Address.

Web Interface Connection

NOTE

Once you have the **IP Address***, you can access the analyzer from any computer on the network.*

- Open any browser (Internet Explorer, Netscape, etc.) and type the **IP Address** into the address box and click **Return**.

Example:

http://10.52.236.54

The 5100 web interface **Home** page opens (Figure 5-2).

The **Home** page displays a graphic of the analyzer indicating current parameters:

- Reference Temperature
- Sample Cell Temperature
- Laser Temperature
- Sample Cell Pressure

Figure 5-2. Model 5100 analyzer web interface Home screen.

Web Interface Screen

The web interface screen is divided into four distinct areas:

1. *Status Bar*
   Displays the state of the analyzer including:
   - Status (Line Lock or Sampling)
     Line Lock - system is determining peak position for signal at reference cell
     Sampling - System is collecting data through sample cell
   - Analyte Concentration
   - Sample Cell Pressure
   - Sample Cell Temperature

2. *Active Display Window*
   This window changes based on the **Menu Button** selected.

3. *Menu Buttons*
   - Home
   - Alarms
   - Trends
   - Spectra
   - Settings

4. *Alarm and Warning Banner*
   Displayed below the **Status Bar.** All active alarm and warning conditions are displayed.

Conditions and Messages

The Model 5100 Analyzer Web Interface is shipped from the factory without password protection, allowing all configurable parameters to be changed.

Trend and spectral data are stored in temporary memory. For security reasons, temporary data cannot be stored directly on a computer or network.

*To maintain a record of any information displayed on the screen, use the computer screen capture function (***Print Screen** *key) or other screen capture methods to copy and then paste the image from the Clipboard into another program to be saved.*

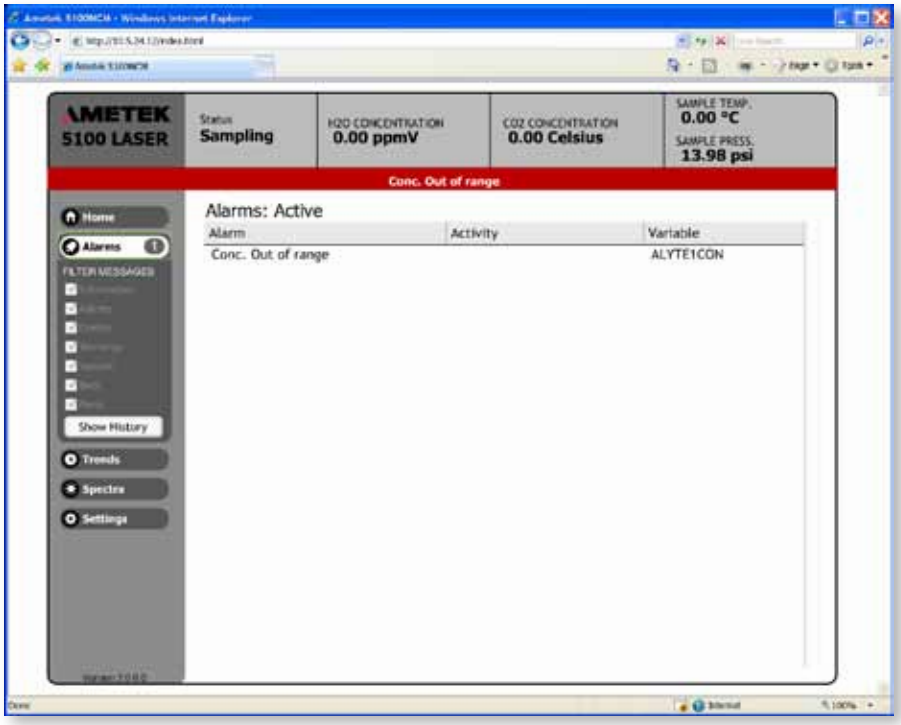
Any recycling of power, whether intentional or unintentional, will result in loss of saved data.

Alarm Menu

Click the **Alarms** button to access the **Alarms** and the **Alarms:History** sub-menus.

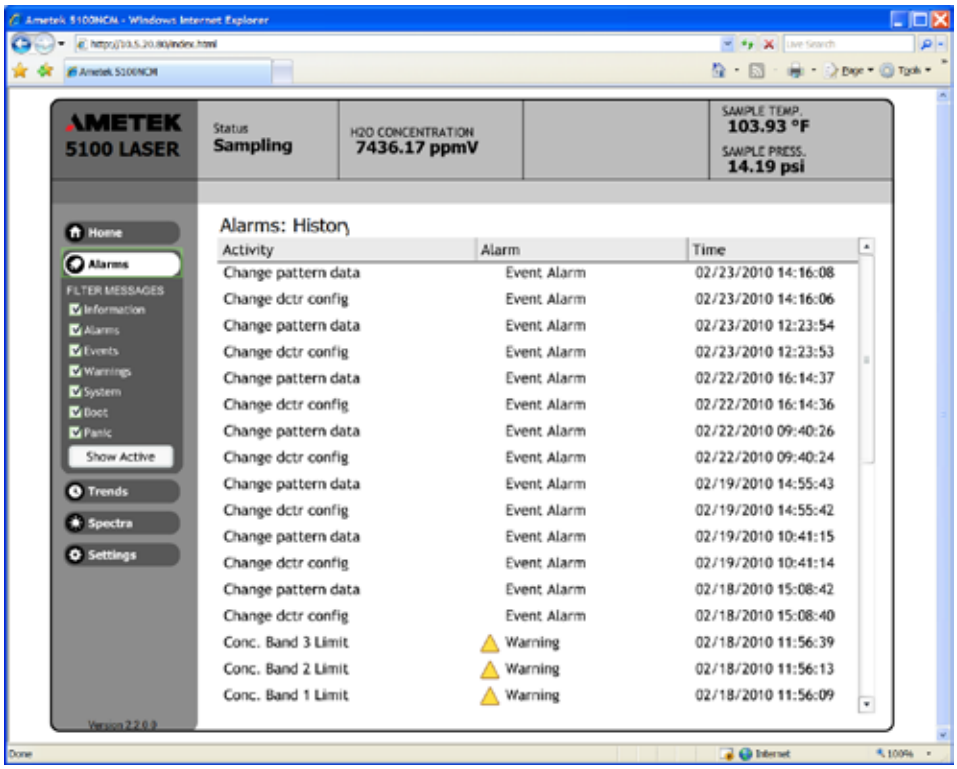
Alarms

The Alarms window displays any active analyzer alarm condition as determined by the built-in Diagnostics. A maximum of 15 active alarms and warnings can be displayed. If there are more than 15, you can use the scroll arrows to go through the list. The most recent event is at the top of the list. If there are no active alarms, the screen will be empty.



Alarms:History

The Alarms History window displays a history of Alarms and Warnings that have been reset along with the time and date that the alarm was triggered. The activity that caused the alarm, warnings, system and other events can be displayed using the check boxes for the Alarm Filter Messages. This screen is Read-only.



Trends Menu

Click the **Trends** button to access parameters (Figure 5-5) for:

- **Sample Cell Temperature**
- **Sample Cell Pressure**
- **Analyte Concentration**
- **Reference Temperature**
- **Laser Temperature**

Trend intervals for parameters are available in 30-second, 300-second or 1800-second data points.

NOTE

The analyzer stores 3600 parameter data points in temporary memory before overwriting the data. At 30-second intervals this is 1800 minutes or 30 hours; and at 1800 seconds this is 1800 hours (75 days).

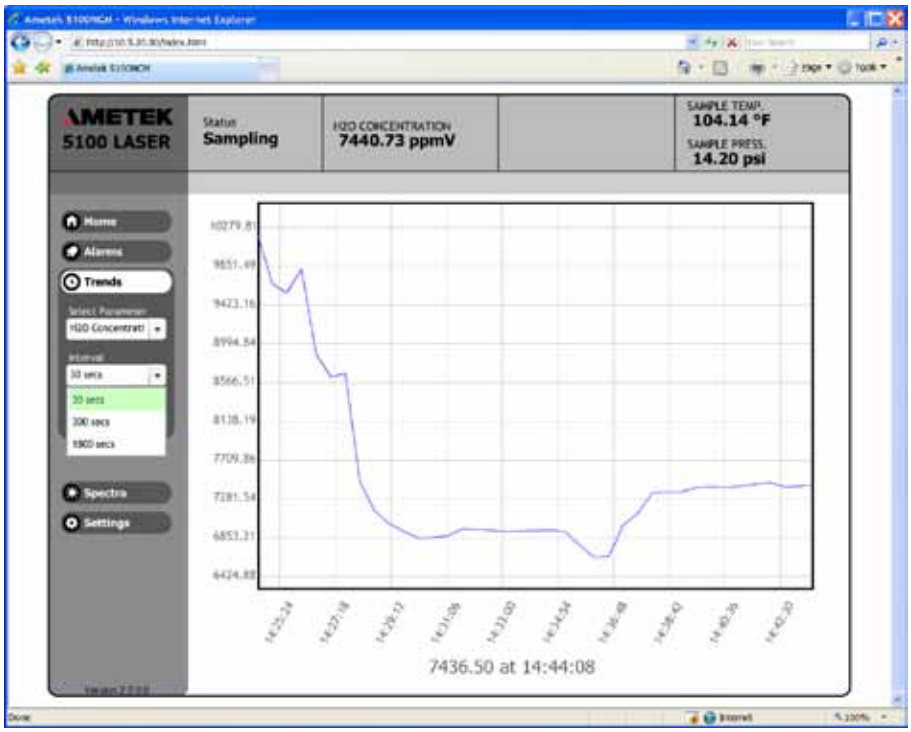
The **Trends** window displays the most recent data held in short-term memory at the upper-right edge of the Trend chart. Since data cannot be saved, use the **Print Screen** key or other sceen capture methods to copy and paste data screens for troubleshooting.

NOTE

Click the **Get Trend** *button to refresh the display with the most recent data, after changing the interval or selecting a different parameter.*

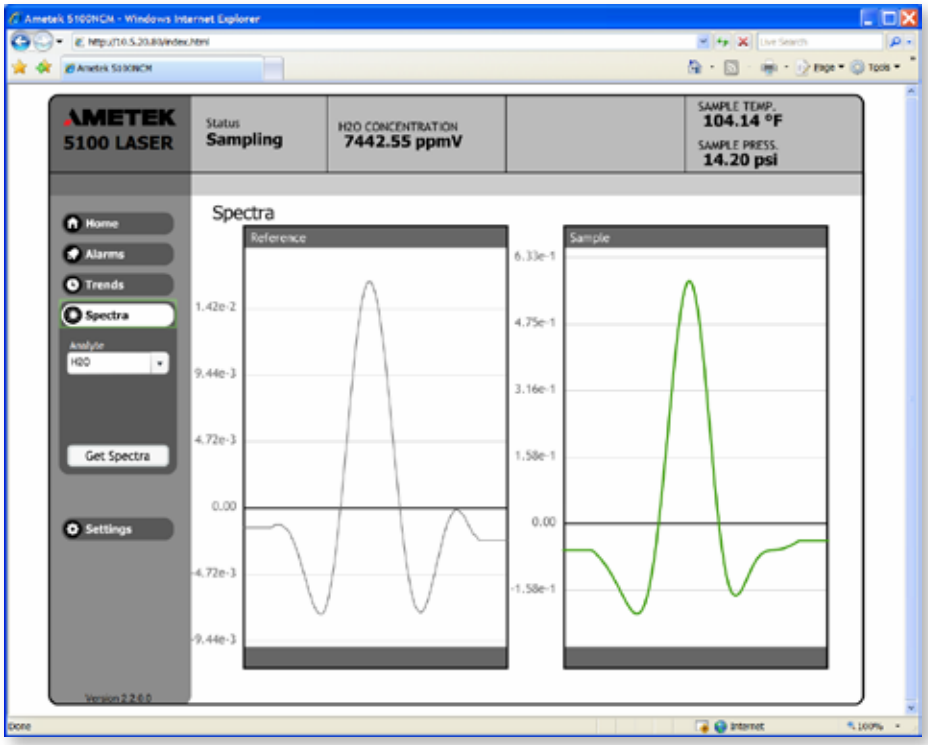
Click on the down arrow to the right of the select Parameter window to view a different trend:

Click on the down arrow to the right of the interval window to change the time interval for the current trend:



Spectra Menu

Click the **Spectra** button to view live spectrum and **Reference** spectrum side by side in the display window.



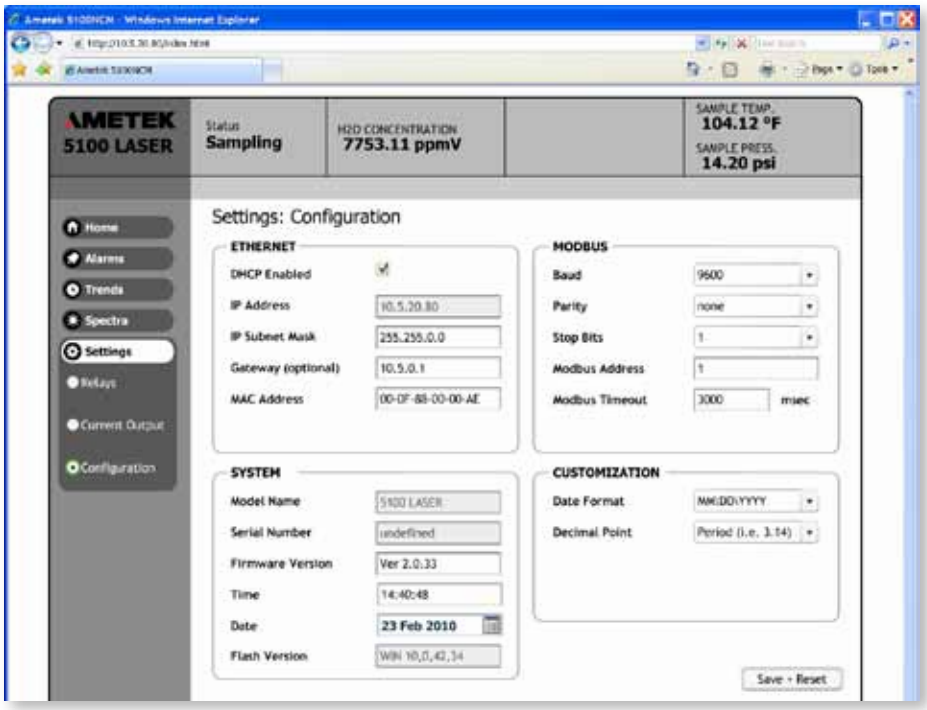
Settings Menu

Click the **Settings** button to access the sub-menus for setting up parameters to control analyzer operation. The sub-menus are:

- **Relays**
- **Current Output**
- **Configuration**

CAUTION

Analyzer settings were configured at the factory to meet specified customer requirements. Changing these parameters may prevent the analyzer from operating as specified.



Settings:Relays

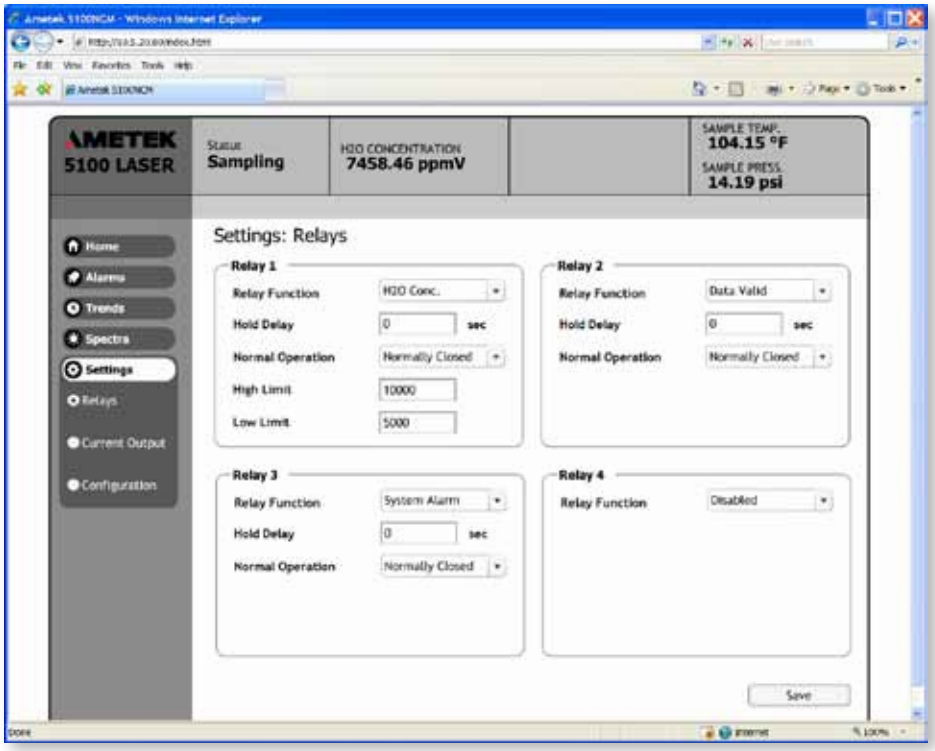
Using the Relay display window, you can set up parameters for up to four relays.

Each relay supports alarms for the following:

- *Concentration Limits*
  High and Low limits

- *Data Valid*
  Indicates the instrument data is valid.

- *System Alarm*
  Triggers to indicate a system alarm condition.

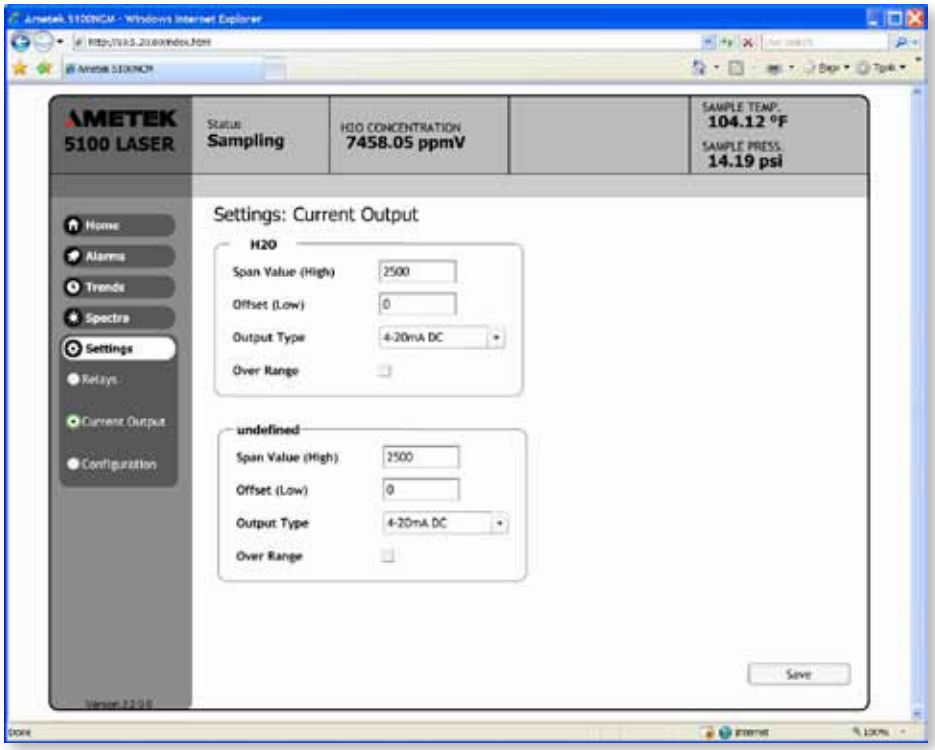


NOTE

Changes are not saved to the instrument until the "Saved" button is pressed.

Settings: Current Outputs

Use the **Current Output** display window to set the parameters for a single current output.



- *Span Value (High)*
  Enter the span value.

- *Offset (Low)*
  Enter the value for the offset.

- *Output Type*
  4-20 mA DC
  0-20 mA DC

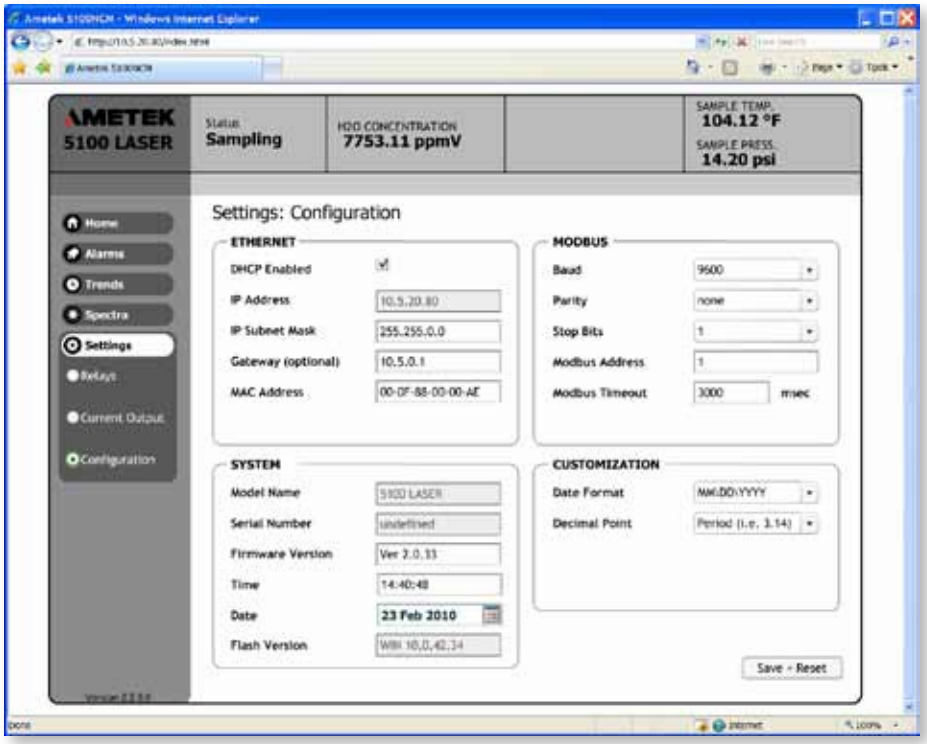
- *Over Range Check Box*

NOTE

Changes are not saved to the instrument until the "Save" button is pressed.

Settings: Configuration

Use the **Configuration** display window to identify system and communication settings.



Ethernet

- *DHCP (Dynamic Host Configuration Protocol) Enabled*
  IP address is obtained from a DHCP server on the network. If no DHCP server is found, it defaults to 169.254.1.1

- *IP Address*
  Cannot be modified when DHCP is checked. When DHCP is not checked a static IP address can be assigned.

- *IP Subnet Mask*
  Defines the subnet to which the analyzer belongs. You can communicate with devices in the same Subnet locally without going through a router.

- *Gateway* or “Router” (optional)
  Allows local network traffic to be sent to another network. Setup this parameter only if communicating from outside the internal network.

- *MAC* (Media Access Control) Address
  Identifies your computer’s unique physical address. This is a unique ID assigned at the factory.

System

There are only two user-defined items on this display:

- *Time*
  The local instrument time can be set here.

- *Date*
  You can use the calendar icon to select the correct date.

Modbus

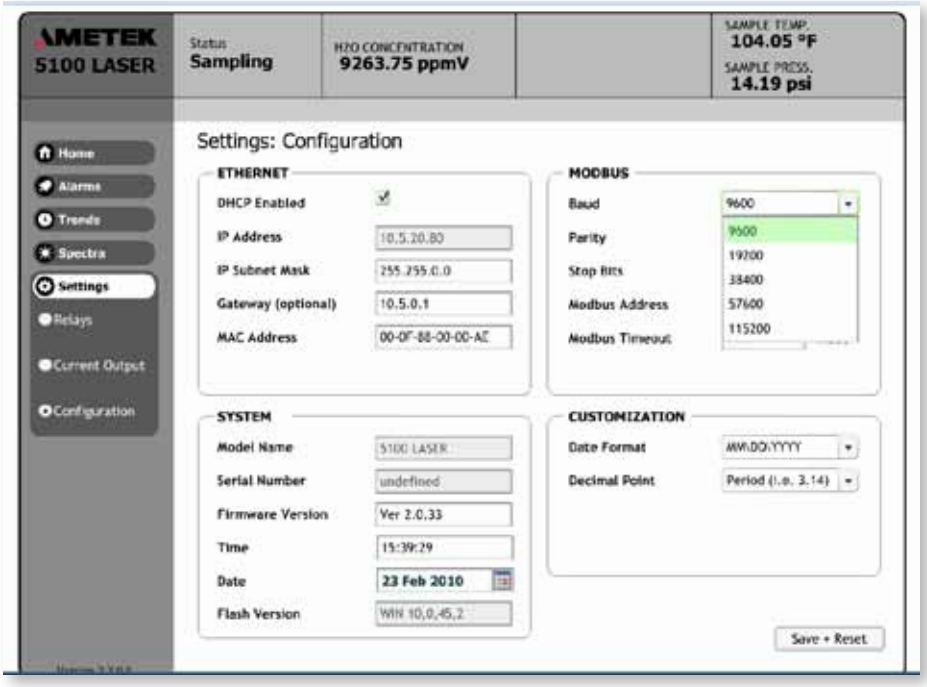
- *Baud*
  Use the drop-down list box, select the baud rate.

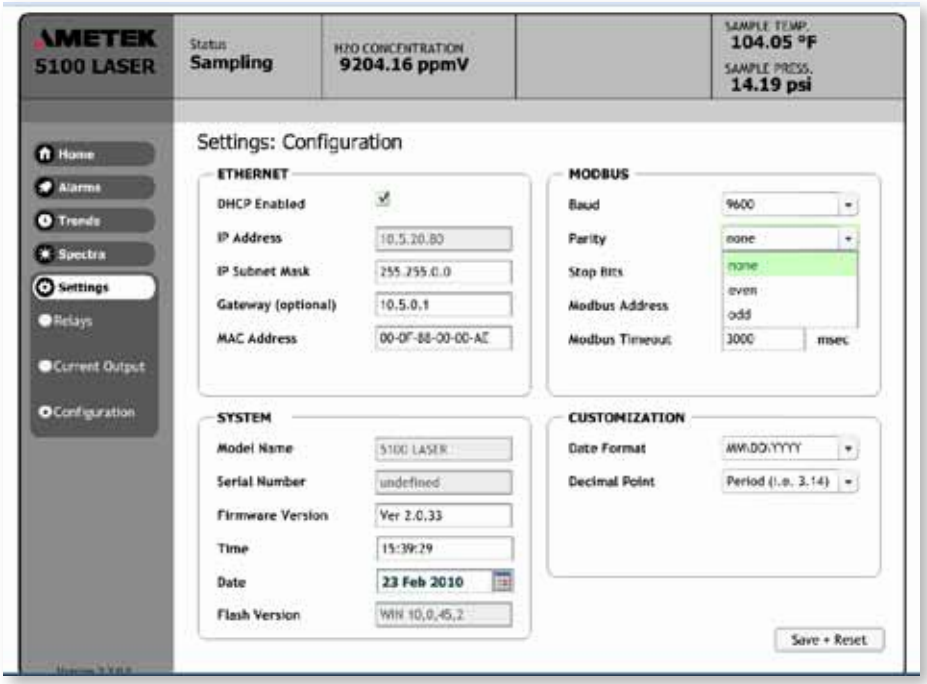
- *Parity*
  Use the drop-down list boc to select parity.

- *Stop Bits*
  Use the drop-down list box to select stop bits.

- *Modbus Address*
  Enter the Modbus address for the instrument.

- *Modbus Timeout*
  Enter the number of milliseconds (msec) before Modbus communication will time out.





Customization

- *Date Format*
  Use the drop-down list box to select the date format.

- *Decimal Point*
  Use the drop-down list box to select either decimal point or period.

NOTE

Changes are not saved to the instrument until the "Save + reset" button is pressed. The instrument will reset and communications will need to be reestablished from the browser window. Please note that the IP address may change when the instrument is restarted if DHCP is chosen as the IP address type.

MAINTENANCE

Separator

NOTE

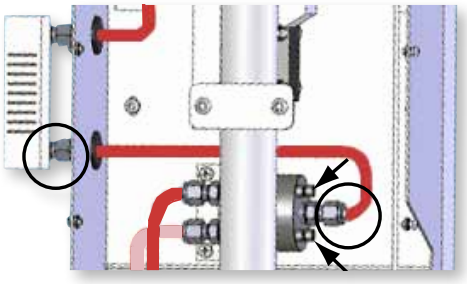
Check the filter on the liquid separator for contamination every two weeks and replace if necessary. Once you determine a pattern as to how long the filter can be used, you can adjust the time interval between replacements. Check and, if necessary, replace after any known process event.

The separator inside the sample section removes entrained liquids and particulates from the gas before it passes through the sample cell. For this reason, the bypass or drain valve is left OPEN to allow the residue to exit the analyzer. Ensure that the valve is turned slightly to the OPEN position.

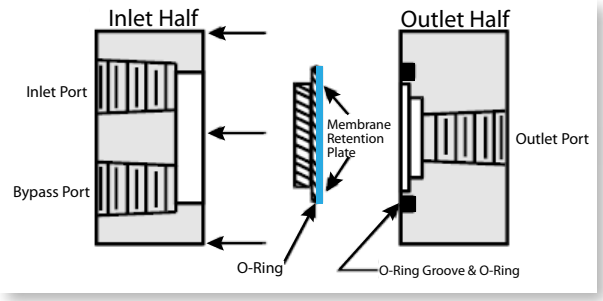
Figure 6-2. Fittings to loosen.

Instructions

Tools Required: 9/16" open-end wrench, 5/32" hex wrench, Membrane Replacement Kit (AMETEK PN#39126JE) and O-Ring Replacement Kit (AMETEK PN#76146TE).



1. Use the 9/16" wrench to loosen the fitting on the inlet side of the flowmeter and the outlet side of the separator (Figure 6-2). Slide the loose section of tubing to the right, so that it is clear of the separator outlet.
2. Use the 5/32" hex wrench to remove the four (4) socket head cap screws that hold the outlet half of the separator in place.
3. Gently maneuver until the outlet half of the separator comes free (Figure 6-3).



4. Locate the O-ring and membrane filter (Figure 6-3) and replace with the new ones.
5. Replace the outlet half of the separator and attach with the four screws.
6. Position the fittings to the flowmeter and the outlet port of the separator and hand tighten to hold.
7. Use the 9/16” wrench to tighten the fittings ensuring that the tubing is in place.

Figure 6-3. Membrane and O-ring in separator.

GRIN Lens and Detector Lens

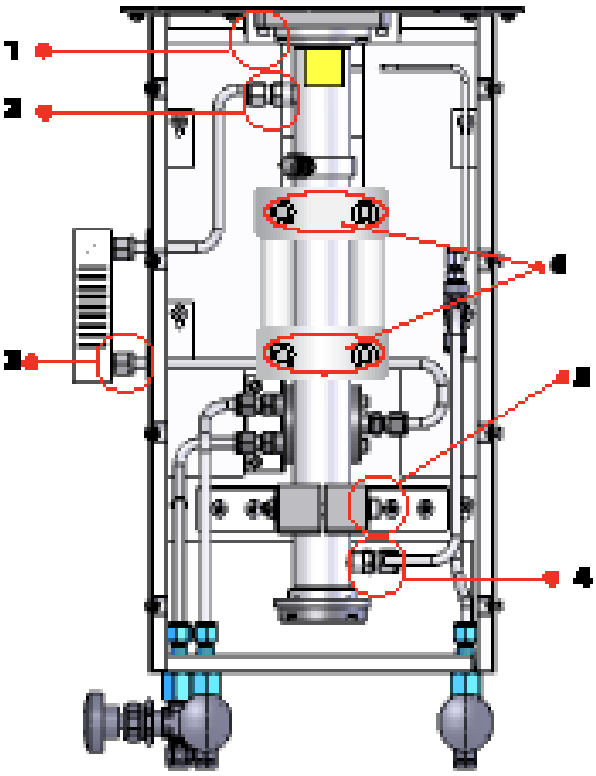
Fiber optics conduct the laser beam through the GRIN lens into the sample cell; the beam is reflected using a mirror onto the deflector. If the GRIN lens and/or detector lens is dirty, it will reduce the efficiency of the signal. The GRIN lens and detector lie between the Fiber Optics Compartment and the sample cell enclosure with part of the lens and detector in each section. The sample cell tube must be removed to reach the lenses to clean it.

Instructions

Tools Required: 3mm hex wrench, 9/16" and 7/16" open-end wrenches, cotton swab, alcohol.

NOTE

Refer to Figure 6-4 for disconnection locations.



1. Use the 3mm hex wrench to remove the four (4) socket head cap screws that hold the top of the sample tube to the bottom of the sample cell block.
2. Use the 9/16" wrench to loosen and remove the fitting that attaches the tubing from the top of the flowmeter to the sample tube.
3. Loosen the fitting that holds the tubing entering the bottom loop of the flowmeter (9/16" wrench).
4. Loosen and remove the sample cell exhaust fitting from the sample cell tube (9/16" wrench).
5. Remove the 2 screws that hold the sample cell tube to the sample cell clamp.

Figure 6-4. Disconnect locations for the sample cell tube.

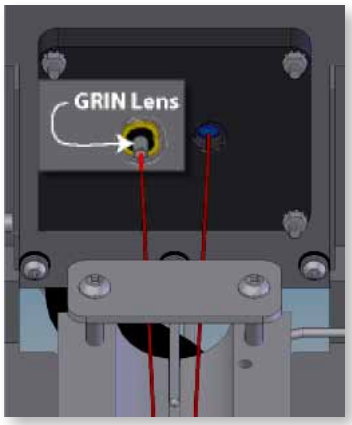


Figure 6-5. GRIN lens on the left. Detector lens on the right

6. Gently pull down on the sample tube about an inch. The GRIN lens will be visible on the left-hand side where the tube was removed (Figure 6-5). Dip the cotton swab in the alcohol and squeeze out the excess. Gently swab the GRIN lens and detector lens.

7. Refit the sample cell tube to the sample cell block and attach using the 3mm hex wrench and the four socket head cap screws.

8. Reattach the fitting and tubing that connect from the top of the flowmeter using the 9/16” wrench. Do not tighten all the way.

9. Hand-tighten the fitting and tubing to the bottom of the flowmeter.

10. Reattach the sample cell exhaust fitting and tubing to the sample cell tube. Hand-tighten.

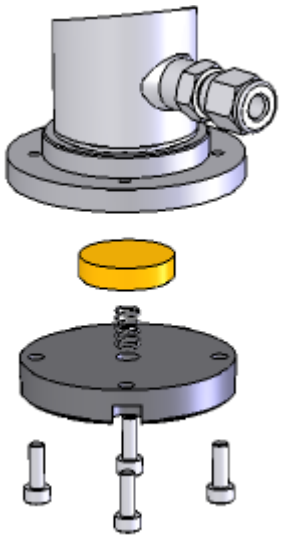
11. Go back and tighten each of the fittings so that the sample cell tube is positioned correctly in the sample cell block. Tighten the screws that hold the sample cell tube to the sample cell clamp.

Mirror

The mirror is located under the cap at the end of the sample cell tube. It is 1-inch in diameter and 6 mm thick, with a reflective (gold) side that faces the sample cell, and a dull or matte side that faces the cap. The mirror should only be cleaned when recommended by an Ametek Service engineer. The gold surface of the mirror is very fragile and will be damaged if not handled properly.

Instructions

Tools Required: 3mm hex wrench, methanol



1. Use the 3mm hex wrench to remove the four (4) socket head cap screws that attach the cap to the bottom of the sample cell tube.
2. Once the cap is removed, you will be able to see a small compression spring that holds the mirror against the sample tube. Carefully remove this spring and set aside. Do not misplace the spring.
3. Holding the mirror around the edge, carefully clean the reflective (gold) side by rinsing with methanol.

   Once the mirror has been cleaned, replace with the reflective (gold) side facing the sample cell. Position the compression spring against the mirror to hold it against the tube and attach the cap using the four socket head cap screws.

Figure 6-1. Mirror