H_2S in Gas Analyzer User's Manual

T200 ATEX-IECEx H_2S in GAS Analyzer

KECO

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⚠ Warning Consists of conditions, practices or procedures that must be observed to prevent personal injury and/or equipment damage.

⚠ Caution Risk of electric shock or high temperature parts may result in injury if proper precautions are not taken.

Locating Information:

In the interest of completeness, manuals and drawings included with the analyzer may provide information pertaining to options not included with your analyzer. Information in application notes supersedes general information in these documents. Information can be located in this manual using the Table of Contents or the Index.

Table of Contents

OVERVIEW

Ex eb pxb IIB+H2 T3 Gb

Tamb -20°C to +55°C

ExVeritas 23ATEX1652X

II 2 G Ex eb pxb IIB+H2 T3 Gb

Tamb -20°C to +55°C

H2S in GAS ANALYZER
MODEL T200 ATEX-IECEx

PRIMARY ANALYZER COMPONENTS:

Component	Purpose
H2S Detector	Specifically quantifies hydrogen sulfide (H2S) content in the gas phase without interference
Flow Controller (digital)	Controls the flow rate of the Sample and Carrier

ANALYZER SETTINGS

ANALYZER CALIBRATION

Full Scale Range — See label inside analyzer's enclosure.

PRESSURE:

Sample In Pressure: — 15 psig (1.03 barg) constant pressure required. Filter/Regulator provided by others. (See analyzer Flow Diagram for max pressure)

Note: Sample gas may not have an oxygen concertation of greater than 2% V/V or an Upper Flammable Limit exceeding 80%.

Carrier In Pressure: — 15 psig (1.03 barg) constant N2 pressure required. UHP N2. Regulator provided by others. (See analyzer Flow Diagram for max pressure) MODEL 214 ONLY!

Note: The gas mixture must be below the Lower Flammable Limit.

H2S Cal Gas — 15 psig (1.03 barg). Regulator provided by others.

Note: The calibration gas mixture must be below the Lower Flammable Limit.

FLOW:

Sample (H2S) Controller Flow Meter: — Set to 115 ml/min (set at factory)

Carrier Gas Controller Flow Meter: — Set to 130 ml/min (set at factory)
Model 214 ONLY!
Note: The gas mixture must be below the Lower Flammable Limit.

TEMPERATURE:

Thermostat (OPTIONAL): Factory Set (if equipped)

PURGE:

Purge Gas Supply: Clean & Dry Nitrogen

⚠ Warning When Nitrogen is used for purge gas and analyzer is mounted inside an enclosed area such as an analyzer house, the purge vents on the Purge Controller and the Backup Vent must be tubed to outside of the enclosure to prevent asphyxiation.

Supply Purge Gas Pressure: Set to 80 psig (5.52 barg) (Regulator provided by customer),100 psig MAX at Dilution Purge Gas Pressure Regulator

Minimum Overpressure: 0.2 "WC

Maximum Overpressure: 3.3 "WC

Minimum Flow Rate:
(Start Up Purge Manual Dilution Flow) 120 SCFH (57 Liters/min)

Purge Pressure Regulator Output:
(**Purge Pressure Regulator Output)** 4 PSIG (0.28 barg)

Maximum Supply Pressure:
(**Purge Pressure Regulator Output)** 15 PSIG (1.03 barg)

Maximum Leakage Rate:
(Over-Pressured) 80 SCFH (37.75 Liters/min)

Purge Manual Dilution Time: 12 minutes

Normal Operation Purge Leakage: 5 SCFH (2.5 Liters/min)

Cabinet Pressure 0.3-0.4 inches H_2O

Special Conditions of Use:

1. Wiring connection to equipment shall be made by an IECEx Ex e entry device.

2. Equipment is approved for extended ambient range of -20°C to +55°C
3. Sample gas may not have an oxygen concertation of greater than 2% V/V.
4. Sample gas must not have Lower Flammable Limit less than 3.9% or an Upper Flammable Limit exceeding 80%
5. The calibration gas mixture must be below the Lower Flammable Limit.

ALARM SET POINTS

Sample Flow Alarm	Option, set at factory
Concentration Alarms	Option, set by user

ELECTRICAL

Electrical Power Requirements	See Analyzer Label: Typically 12/24 VDC, 2.4 watts 120 VAC, 50/60 Hz, 5 watts 230 VAC, 50/60 Hz, 11.5 watts
4-20 mA Output Loop	Self-powered
Purge Alarm (loss of Purge pressure)	Alarm Contact rated 265Volts AC/DC, 150mA max
Diagnostic Alarm (Optional)	Alarm Contact rated 250VAC 6A
Concentration Alarm (Optional)	Alarm Contact rated 250VAC 6A
Carrier Flow Alarm (Optional)	Alarm Contact rated 120VAC 0.1A
Fail Safe Power Alarm (Optional)	Alarm Contact rated 250VAC 6A

Environmental Conditions

Operating Temperature Range	32° F (0° C) to 131°F (55°C)
Used and Mounted	For Indoor and Outdoor Use

Enclosure Specifications

14 Gage, 316L SS, powder coated

Protection	NEMA 4X & IP65

PRINCIPAL OF OPERATION

The Model T200 incorporates basic principles covered by patents and patents pending.

Detection Technology

The primary detection technology has three advantages based on the chemistry and physics involved.

"No interference"

is proven by years of experience with various applications where no other chemical reaction with lead acetate has been found to darken the sensing tape except H2S. This ensures that only a sulfur-specific reaction will occur.

"Linear response"

indicates that the rate of tape darkening is linear with respect to the H2S concentration. The benefit of this response is the straight forward relationship between the measured variable and quantity units. Equipment maintenance is easier and only a single point calibration is required.

"Parts per billion sensitivity"

relates to measurements that can be made even when the H2S concentration is only one one-billionth of the total volume. This accuracy benefits the user in determining acceptable levels that can be monitored.

This detection technology is applied to a range of product applications. Mathematical formulations and field-proven results demonstrate the calculation precision that is available.

Important Fundamentals

It is important to note that a variety of fundamentally different implementations have been applied to lead acetate chemistry over the years. These fundamental selections of sample handling, optical coupling, signal detection, and information processing each have major impact on the system performance.

The following descriptions outline some of the parameters implemented by **Analytical Systems** to achieve superior performance and easy operation.

- Sample flow is tangent to KECO *Tape* to eliminate effects from porosity variations when sample is passed through the substrate
- Signal generation is based on H2S concentration only, therefore sample volumetric flow rate does not affect accuracy
- Calibration options allow flexibility to match available resources with application requirements
- Spectral correlation of the optical path for optimum impedance matching has been designed into the system.
- Conversion resolution of the signal is more than 100 times greater than with previously available technology.
- **KECO** information processing algorithms completely eliminate the effects of parameter offsets commonly referred to as ***drift*****.**
- Signal over sampling algorithms are implemented for statistical detection processing and accuracy correlation
- Full floating point precision is used to execute all information processing algorithms
- Function keys and local display provide easy operation selection and direct result display
- Diagnostic program execution and status alarms contribute to reliable on-line operation
- Plain language displays with descriptions of operation status support easy operation

Specifications

Display:	Alpha Numeric LCD 128 X 64 Pixels	
Temperature Ranges:	0°C to 50°C (operating) 0° C to 70°C (storage)	
Analog:	Isolated 4-20mA Diagnostic Alarm (optional)	
Analytical Performance:	Resolution:	1ppb
	Drift:	Nil
	Temp. Coefficient:	.01%/°C
	Analysis Time:	.75 Seconds
	Chemical Interference:	None
Area Classification:	Zone 1	
Weight:	Approximately 300 lbs	
Dimensions:	29”W x 49”H x 12”D 35”W x 49”H x 12”D with power switch and relay housing	
Power Required:	SEE LABEL	

Unit Information

A serial number tag is located inside the tape deck panel assembly. This tag provides the following information.

Model Number	Power
Serial Number	Area Classification
Range	

GENERAL SAFETY AND OPERATING INFORMATION:

This section contains general safety and operating information applicable to electrical equipment installed within hazardous locations. This information must be understood by all persons installing, using, or maintaining the electrical equipment. This information is designed to aid personnel in safe installation, operation, and maintenance of the T200 H2S in Gas Analyzer. It is not designed to replace or limit appropriate safety measures applicable to work performed by personnel. Any additional safety and operating measures that are required must be determined by and followed by personnel performing work on the electrical equipment.

⚠ Warning Deviation from the specified instructions or procedure steps can result in injury to personnel, equipment malfunction or equipment damage.

⚠ Warning Return unit to factory for any repairs or replacement of parts, customer not permitted. This will void all warranties and hazardous area certification(s).

GENERAL PRECAUTIONS:

Protective eyewear (glasses with side shields or goggles, as appropriate) must be worn when servicing any part of electrical equipment. Hot components should be allowed to cool before servicing if possible. Other appropriate equipment or clothing must be used as required by the type of work performed. All applicable regulations and procedures must be followed for the work performed. Before beginning any work on the equipment, carefully consider all the potential hazards and ensure that appropriate measures are taken to prevent injury to personnel or equipment damage.

⚠ Caution Electrical equipment components may be hot even when power is not applied. Take appropriate precautions to prevent injury from contact with hot items.

⚠ Caution Applicable permits must be obtained and appropriate precautions must be taken to prevent possible injury to personnel or equipment damage when installing or maintaining this equipment.

ELECTRICAL POWER:

KECO T200 H2S in Gas Analyzer uses AC power of 120VAC or 230 volts. See the above section labeled “Electrical Power Requirements” to determine the proper voltage for this unit. The AC power is converted to DC. Appropriate precautions must be taken to prevent sparks that may ignite combustible materials that may be present in the purge controller’s environment. Precautions must also be taken to prevent electrical shock if the electrical equipment’s enclosure being monitored by purge controller is opened.

The power to KECO T200 H2S in Gas Analyzer must be free from noise, surges, sags, and spikes for proper operation of the purge controller. AC power circuit breakers and wiring must be sized properly for the required current. All wiring installations must meet applicable electrical codes.

SYSTEM LOCATION:

The T200 H2S in Gas Analyzer must be installed in a suitable location. The T200 H2S in Gas Analyzer must not be installed in an area classification for which it is not rated and must be protected from temperature extremes. The T200 H2S in Gas Analyzer should not be mounted in an area with potentially high vibration. The T200 H2S in Gas Analyzer must be mounted in a location to permit adequate viewing of displays and indicator lights and to permit proper sample venting and purge exhaust venting.

PURGE SYSTEMS:

The T200 H2S in Gas Analyzer uses purging to ensure safe operation when installed within a hazardous location. The protective gas purge supply must be clean, dry, and free from hydrocarbons or corrosive materials. All protective gas purge supply pressures must be set correctly and enclosure doors must be closed securely.

⚠ Caution The T200 H2S in Gas Analyzer enclosure must not be opened unless power is removed from the analyzer or the area is known not to contain explosive materials.

⚠ Warning When Nitrogen is used for purge gas and analyzer is mounted inside an enclosed area such as an analyzer house, the purge vents on the Purge Controller and the Backup Vent must all be tubed and mounted outside the enclosure to prevent asphyxiation.

ENCLOSURE PURGE:

Type X purging reduces the classification within a protected electronics enclosures from Zone 1 to nonhazardous. The Purge Controller is used to provide safe control and monitoring of electrical equipment in Zone 1 hazardous areas. To prevent the possibility of fire or explosion inside the enclosure of energized electrical equipment, a protective gas supply is used to dilute potentially flammable materials to an acceptable level, creating a safe area for the electrical equipment within the enclosure. Positive pressure prevents the ingress of flammable materials in the surrounding atmosphere from entering into the enclosure, as long as positive pressure is maintained. After the electronics enclosure is purged, power will be automatically applied to the protected electrical equipment.

⚠ Warning	Failure to heed the following information may lead to equipment damage or injury to personnel.
⚠ Caution	Electrical equipment components may be hot even when power is not applied. Take appropriate precautions to prevent injury from contact with hot items.
⚠ Warning	Failure to allow adequate cooling of electrical equipment components with hot surfaces before opening the purged enclosure can lead to injury of personnel or equipment damage.
⚠ Warning	Pressurized Enclosure – Do not open when an explosive atmosphere is present unless power has been removed.
⚠ Warning	Power shall not be restored after enclosure has been opened until enclosure has been manually purged for 18 minutes at a purge supply pressure of 4 psig.
⚠ Warning	This enclosure contains inert gas and may be an asphyxiation hazard. This enclosure also contains a flammable substance that may be within the flammable limits when exposed to air.

SUPPLIES REQUIRED

Humidifier Solution - Available in quart bottles. Year Supply - approximately 8 quarts, per analyzer

KECO Tape - Lead Acetate Sensing Tape, available in 100' rolls. Year Supply - approximately 4 to 7 rolls, per analyzer (application dependent)

SPARE PARTS

A spare parts listing for your analyzer can be found the Spare Parts section of this manual.

MAINTENANCE SCHEDULE

Tape Replacement - The tape should last six weeks to three months. Replace as needed. Follow the instructions in the Maintenance section. Check the Humidifier Solution level when replacing the sensing tape.

Humidifier Solution - The humidifier solution level should always be above the tubing inside the humidifier. Follow the instructions in the Maintenance section to fill it. Simply top off the solution level for proper humidifier maintenance.

Calibration Gas Cylinders - Check as needed for adequate supply levels.

STORAGE RECOMMENDATIONS

The analyzer should be stored indoors; temperatures not exceeding 0-70 degrees Celsius, not exposed to high humidity. Desiccant pouches placed inside the enclosure may be recommended in high humidity areas.

UNPACKING INSTRUCTIONS

Upon receipt, visually inspect the shipping box for possible damage that may have occurred in shipment. Make note of any damage.

⚠ Warning Carefully remove analyzer from box/crate. **DO NOT DROP!**

⚠ Caution The analyzer itself should be inspected for any damage that may have occurred during shipment. If the analyzer has been damaged, the damage should be reported to the freight carrier at once and a freight claim filed**.**

INSTALLATION INSTRUCTIONS

⚠ Warning Before attempting to install the T200 H2S in Gas Analyzer, review all the material and all safety information in this manual and all other applicable document.

⚠ Warning Applicable permits must be obtained and appropriate precautions must be taken to prevent possible injury to personnel or equipment damage when installing the T200 H2S in Gas Analyzer.

WHAT YOU WILL NEED:

1. A pressure regulator for the Carrier Gas (for 214 only, N2) – Refer to the Analyzer Settings page at the beginning of this manual .
2. Some naphtha and nitrogen gas for use in purging the lines.
3. An H2S (or other sulfur gas) blended gas bottle with pressure regulator, with H2S concentration approximately 10% of the analyzer's full scale range, balance nitrogen (not air).
3. Stainless steel tubing and fittings as required. (See PPB Considerations for low range applications)

1. Mount Analyzer:

⚠ Caution The analyzer equipment is heavy! Maneuver it with extreme caution to avoid injury to personnel and equipment. Never attempt to move or install this product without help or lifting gear.

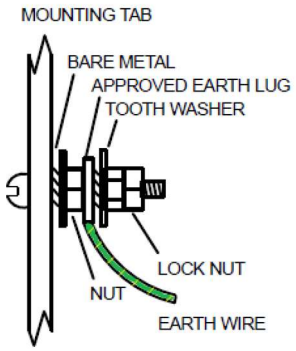
Refer to appropriate drawings & option manuals to verify procedures.

Install the cabinet according to the drawings, which are included at the end of this manual. If the analyzer is mounted outside, it is highly recommended that a roof be provided to keep the analyzer out of direct sunlight and rainfall (for the operator's convenience).

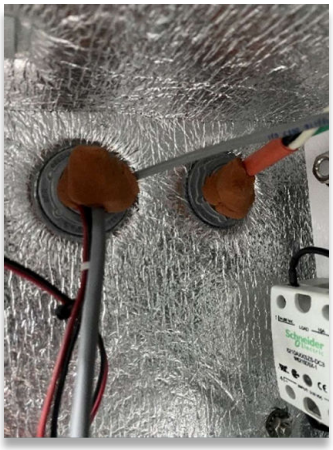
2. Electrical Connections:

> ⚠ Warning Electrical equipment is dangerous, even at low voltages. Be sure power is off before making any connections.

1. Use the Connections drawing at the end of the manual to accurately locate the entry holes. Entry holes are 1.06" plain holes. Wiring connection to equipment shall be made by an IECEx Ex e entry device.



2. Ensure proper grounding and mandatory external bonding when equipment is not installed using metallic conduit.



3. Temporarily sealing the conduit first is important when it comes time to test the enclosure purge, then permanently seal the conduit after confirming proper operation of the analyzer.

4. With the Analyzer turned off: connect power and 4-20 mA signals. Incoming power lands directly to purge controller as shown in the Wiring Diagram (pg. 1 of 2) drawing at the end of this manual. Use Wiring Diagram drawings for terminal strip locations. A table in the Appendix provides more information on the customer connections. A minimum of 16 AWG, three conductor cable should be used for power. Up to 12 AWG, three-conductor cable can be used for power. Run 20 AWG, two-conductor wire for 4-20 mA signals, remote validation and purge alarm. Refer to the Specifications page for information on power specifications.

5. After wires have been properly installed, set automatic dilution time cycle to ensure that at least five (5) times the volume of free space in the enclosure is exchanged before power is automatically applied to the electrical equipment. Refer to Startup Procedure for proper steps to set automatic dilution time cycle. Note: the number of exchanged volumes and times may be higher in some situations.

⚠ Caution Cable glands, cable and hole plugs should not be installed in a hazardous area classification for which it is not rated.

⚠ Warning This apparatus must be earth grounded.

⚠ Caution Electrical power wiring must be checked for correct size and routing.

⚠ Caution Electrical power must be free of spikes, sags, surges, or electrical noise.

3. Sample In and Sample Vent Out Tubing Connections:

⚠ Caution Purge all exterior tubing lines before connection to analyzer to clean out any liquids & contamination.

⚠ Warning Verify that components match expected pressures upstream and downstream of all sample components. Failure to do so could result in rupture causing injury and/or release of toxic substances.

Thoroughly purge all exterior tubing lines before connection to analyzer to clean out any liquids & contamination. Purge with a solvent followed by dry nitrogen.

1. SAMPLE IN: Connect 1/4” tubing to the 1/4” connections on valves or bulkhead connections:
    a. Refer to Connections drawing at the end of the Manual for specific sizing and types of connections.

    Note: The Sample Gas must be regulated at the pressure indicated on the Analyzer Settings page located at the beginning of this manual.

    NOTE: The sample in the tubing connected to the analyzer must be kept at a temperature sufficient to prevent the sample vapor from increasing to the point that the lines would become condensed. Heat tracing may be recommended.

2. SAMPLE VENT OUT: Connect 1/4" tubing to the 1/4" connections on bulkhead connection - Use ¼" tubing OR LARGER. *
   (Note: no backpressure on this connection – vent to atmosphere!)
   *See Sample Vent tubing installation instructions

The SAMPLE VENT should be vented to the outside atmosphere. When installing the SAMPLE VENT tubing from the H2S analyzer, it is important no backpressure is occurring. Backpressure will result in sporadic readings and care should be taken to be sure no backpressure exists on the SAMPLE VENT tubing.

The SAMPLE VENT tubing should be installed in such a way that rain does not enter the tubing which will cause backpressure. The SAMPLE VENT tubing should also prevent any bugs from entering the tubing which can create backpressure. Bugs may create nests in the tubing which will cause back pressure. Vent tubing that is too long will naturally create backpressure. If tubing is long so as to vent the gas to a safe area, consider shortening the vent line and installing a Fugitive Emission Unit (call Analytical Systems for more information) which will remove hydrocarbons before it is released to atmosphere.

Refer to the flow diagram drawings at the end of this manual.

4. Carrier Gas Tubing Connections (for model 214 only):

Thoroughly purge the carrier tubing before connection to the analyzer to clean out any liquids and contamination in the lines external. Purge with dry nitrogen. Connect the supply of SULFUR FREE, clean and dry gas to the CARRIER IN ¼" bulkhead tubing connector using an external regulator.

CARRIER VENT OUT: Connect 1/4" tubing to the 1/4" connections on bulkhead connection - Use ¼" tubing OR LARGER. *
(Note: no backpressure on this connection – vent to atmosphere!)
*See Sample Vent tubing installation instructions

<u>Note: The CARRIER Gas must be regulated at the pressure indicated on the Analyzer Settings page located at the beginning of this manual.</u>

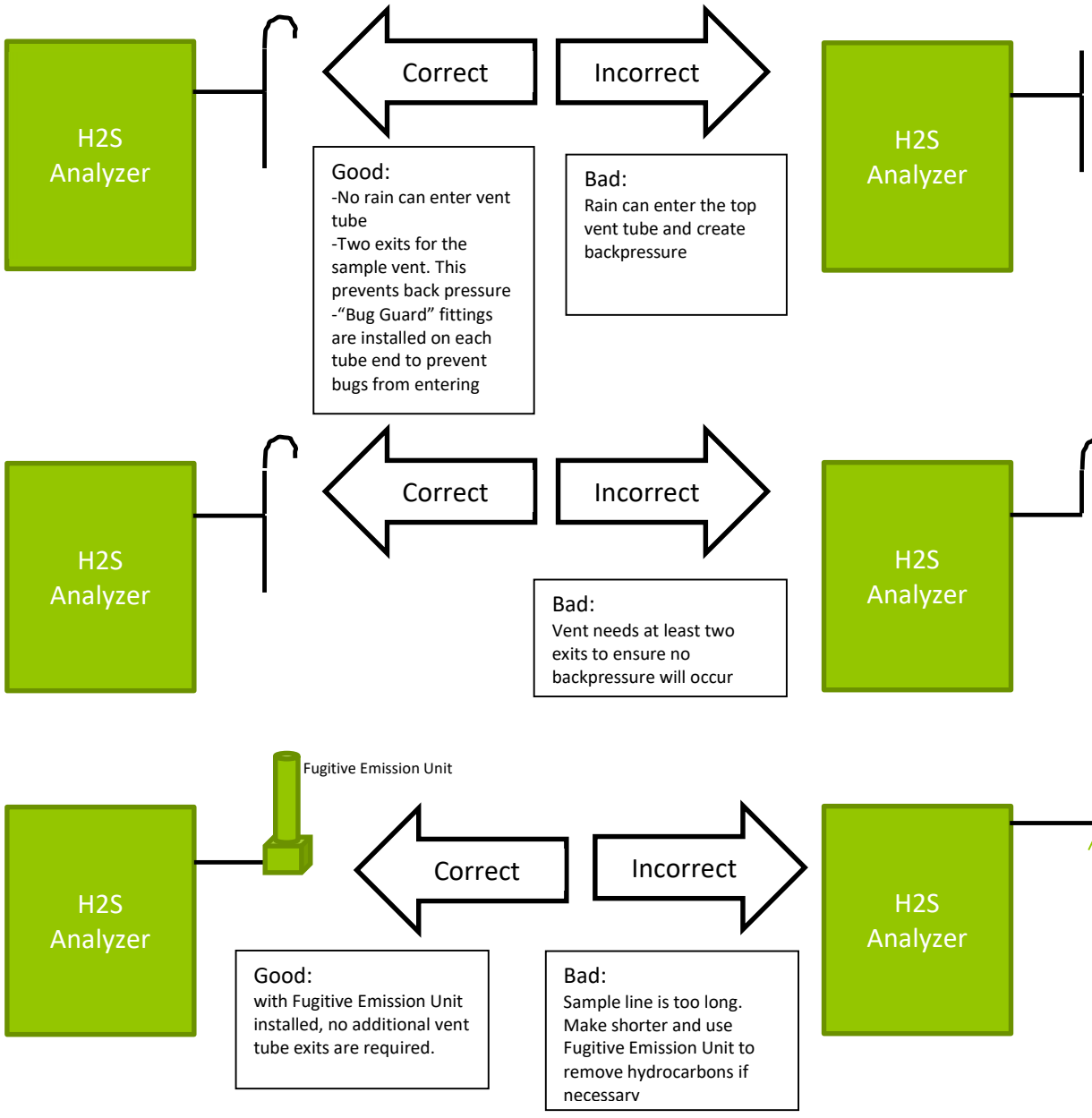
5. Purge Vent Tubing Connections:

The PURGE VENT (located on the X Purge Controller) and the BACKUP VENT (metal "can" located at the top of the analyzer enclosure) should not be restricted or blocked.

If the analyzer is mounted in an enclosed area all of these vents should vent with tubing to the outside to atmosphere to prevent buildup of Nitrogen which can lead to asphyxiation.

> ⚠ Caution When the analyzer is installed in an enclosed area (such as an analyzer house) the Purge Vent and the Backup Vent (metal “can” located on top of the analyzer enclosure) should be tubed OUTSIDE of the enclosure due to Nitrogen being vented. (If Nitrogen is used as Purge Gas) If Nitrogen is allowed the vent inside enclosed area this could cause asphyxiation.

SAMPLE VENT tubing installation illustrations



7. H2S Detector Setup – Add Humidifier Solution

Add HUMIDIFIER SOLUTION to the H2S Detector.

Complete the following steps to add humidifier solution:

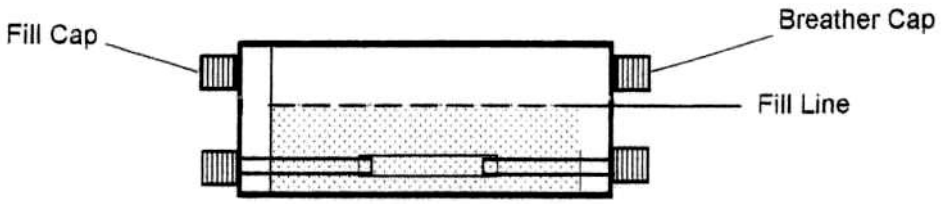
1) Loosen the two thumb screws to swing the H2S Detector open for access to the humidifier.

2) Remove the cap located on the upper left side of the humidifier. Humidifier is located on the rear of the detector tape deck panel.

3) Press air out of an empty fill bottle (shipped with the analyzer – packed in the box with humidifier solution) and insert the end of the tube through the fill cap opening into the solution to be removed. Suction out any old humidifier solution and discard.

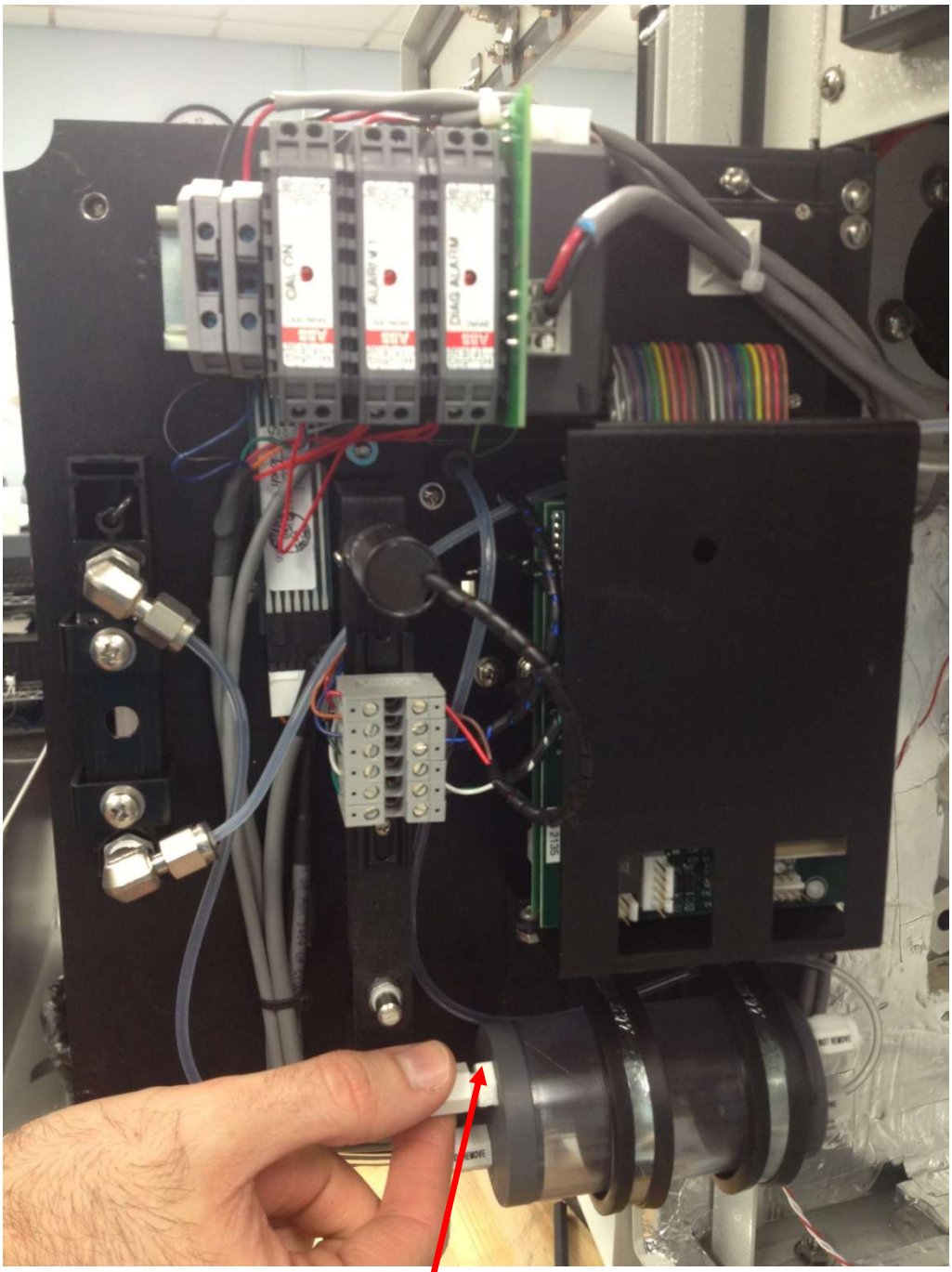
4) Using a clean fill bottle, add new humidifier solution through the fill cap opening.

⚠ Caution **DO NOT fill the humidifier solution above the level of the fill cap and breather cap.**



4) Replace the fill cap.

NOTE: Filling the humidifier with anything other than humidifier solution (5% acetic acid) can permanently damage the membrane tubing inside the humidifier and necessitate replacement.



Only open the cap labeled “fill cap” to fill the humidifier assembly with solution.

8. H2S Detector Setup –Install H2S Sensing Tape

Complete the following steps when installing a new roll of sensing tape:

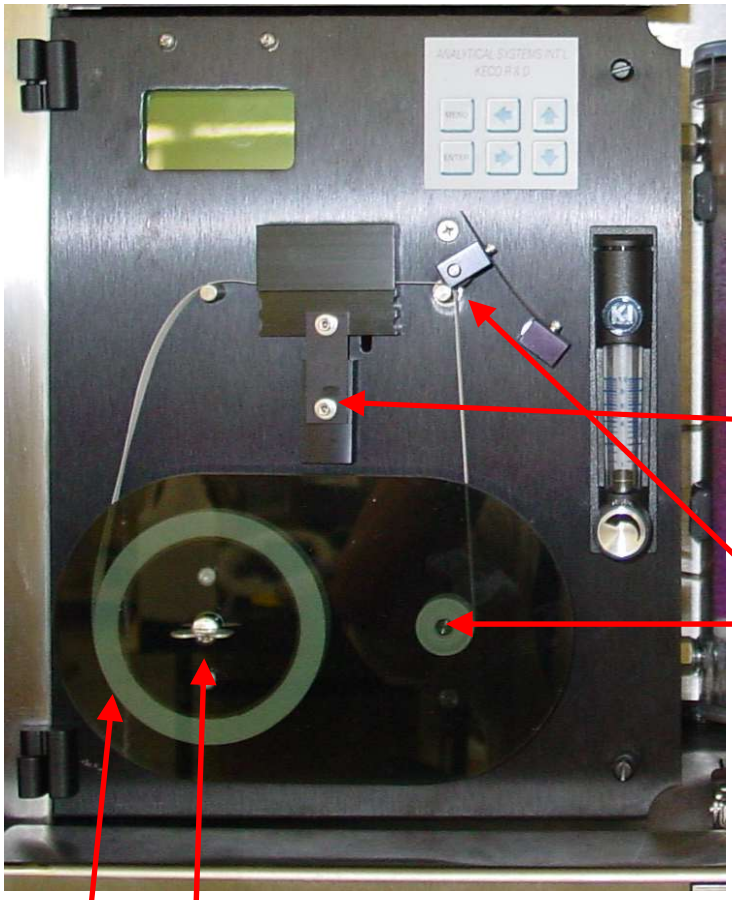
1) Remove the tape cover by holding the cover while turning the knob ¼ turn counter clockwise.

2) Place a full roll of tape on the supply hub. Leave approximately 10 inches of tape loose.

3) Depress and latch open the spring-loaded pressure block and place the loose tape in the slot. Release the pressure block (making sure it snaps back in place) and Pull about one inch of the tape through the detector head to verify that the tape is in the proper position.

4) Attach the tape to the take-up pin with a small bit of adhesive tape. Rotate the take-up pin clockwise to remove as much slack as the take-up drive will permit. The slip-clutch action of the drive will take up the balance of the slack.

5) Replace the tape cover.



3) Depress and latch open spring-loaded pressure block (see instruction #3 above)

4) Pull tape through and attach end of tape to metal pin with adhesive tape.

1) First take off tape cover

2) Place tape on left reel

INITIAL START UP (First time only) – NORMAL OPERATION MODE

The INITIAL START UP –NORMAL OPERATION MODE procedure should be used the first time the Model T200 is started up. This initial procedure includes the additional steps required in order to adjust the set points on the purge gas. Once this initial startup procedure has been completed, the START UP – NORMAL OPERATION MODE procedure in the next section of this manual should be used for all subsequent Model T200 startups.

In order for the analyzer to receive power, purge gas pressure must be applied. Type X purging reduces the classification within a protected electronics enclosures from Zone 1 to nonhazardous. Failure to maintain purge gas pressure will cause the analyzer to power off. Also, failure to maintain purge gas pressure is detected by a normally closed differential pressure switch alarm and an indicator on the side of the analyzer.

The following procedure should be performed when initially starting up the analyzer in Normal Operation Mode using nitrogen as the leakage compensation purge gas.

Failure to heed the following information may lead to injury of personnel or equipment damage.

Do not open the electrical equipment enclosure in a hazardous area even when de-energized unless area has been properly tested and is known to not contain explosive materials.

Before initially starting the equipment, electrical power wiring must be checked for correct size and routing.

The following procedure only addresses the application of power to the electrical equipment located within the purged enclosure being monitored and controlled by the Purge Controller.

When Nitrogen is used for purge gas and analyzer is mounted inside an enclosed area such as an analyzer house, the purge vents on the Purge Controller and the Backup Vent must all be tubed and mounted outside the enclosure to prevent asphyxiation.

Step 1 - Check Surrounding Area:

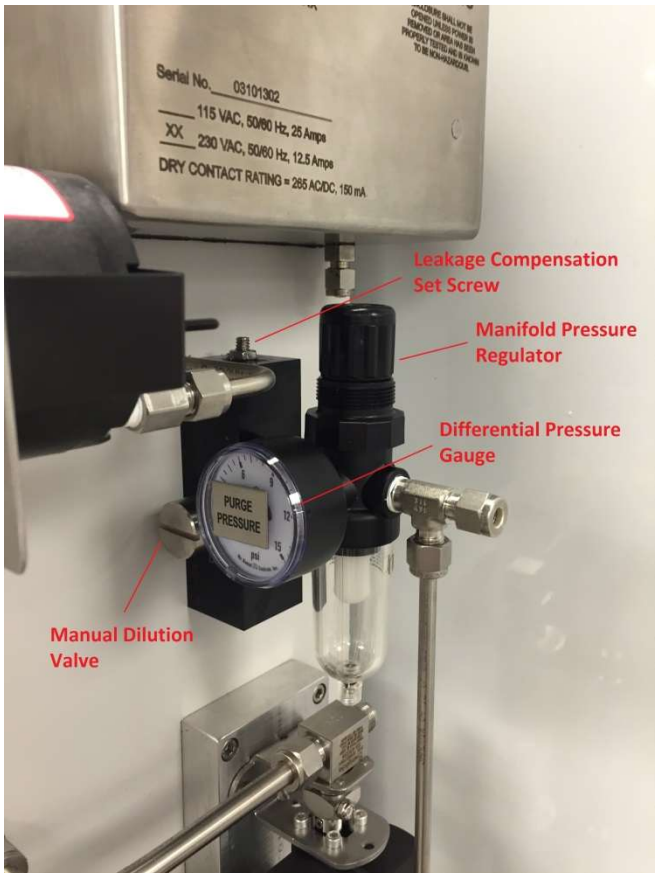
Make sure that area surrounding the T200 enclosure is known to be non-hazardous.

Step 2 - Open Door:

After it has been established that the area surrounding is non-hazardous, open the T200 enclosure door.

Step 3 – Manual Dilution Valve OFF:

Before turning on the purge protective gas supply, assure that the Manual Dilution Valve is in the OFF position.



Step 4 – Turn on purge gas supply:

After turning on the purge gas supply, adjust the Manual Leakage Kit Pressure Regulator to 4.0 psig.

Step 5 – Manual Dilution Valve ON:

After it has been established that the T200 enclosure door is open, the purge gas supply is ON, and the Manifold Pressure Regulator is set to 4.0 psig, adjust the Manual Dilution Valve to the ON position. Verify purge gas is flowing into the T200 enclosure.

⚠ Warning When Nitrogen is used for purge gas and analyzer is mounted inside an enclosed area such as an analyzer house, the purge vents on the Purge Controller and the Backup Vent must all be

tubed and mounted outside the enclosure to prevent asphyxiation.

Step 6 - Manual Dilution Valve OFF:

After it has been established that the purge gas is flowing, adjust the Manual Dilution Valve to the OFF position.

Step 7 – Close enclosure door:

After adjusting the Manual Dilution Valve to the OFF position, close and latch the T200 enclosure door.

Step 8 – Adjust Manifold Pressure Regulator:

With the enclosure door closed and latched, and with the Manual Dilution Valve in the OFF position, adjust the Manifold Pressure Regulator so that the Enclosure Pressure Gauge reads 0.30-0.40 inches of water. Typically the Manifold Pressure Regulator will be set to 5 psi when the Enclosure Pressure Gauge reads 0.30-0.40 inches H_2O.

⚠ Warning

Do not adjust the Manifold Pressure Regulator to a setting any higher than 4 psig (0.28 barg). If it is not possible to achieve a reading of 0.30-0.40 inches H_2O on the Enclosure Pressure Gauge with the Manifold Pressure Regulator set as high as 4 psig (0.28 barg), then this indicates a purge gas leak in the enclosure.

a) Check the door and gasket for damage
b) Make sure the door is properly closed a latched
c) Verify the electrical conduit connections are sealed properly

NOTE: There is a Leakage Compensation Set Screw on the top of the Manual Leakage Kit Manifold. The Leakage Compensation Set Screw and the Manifold Pressure Regulator together determine the flow rate of the purge gas during normal operation, which also determines the enclosure differential pressure.
The set point of the Leakage Compensation Set Screw has been set at the factory such that with the Manifold Pressure Regulator set to 4.0 PSI, and with the enclosure properly sealed, a differential pressure higher than 0.30-0.40 inches H_2O will be maintained. Typically, by following the Initial Start Up procedure, the Manifold Pressure Regulator should be adjusted to 4 psig to achieve a 0.30-0.40 inches H2O differential pressure.
If there is a larger than expected purge gas leak in the enclosure, the Leakage Compensation Set Screw can be adjusted to increase the purge gas flow rate to a point where the 0.30-0.40 inches H_2O of enclosure pressure is maintained. However, while the T200 will operate properly with this increase in purge gas flow, it is possible that a larger quantity of purge gas will be consumed than necessary. Therefore, it is

recommended, in the case where 0.30-0.40 inches H_2O of differential pressure cannot be achieved with the Leakage Compensation Set Screw set to the factory setting, and the Manifold Pressure Regulator set as high as 4.0 psig (0.28 barg), the best solution is to improve and/or repair the enclosure seal rather than to increase the purge gas flow rate by adjusting the Leakage Compensation Set Screw.

It is important to note that the enclosure differential pressure must be set to between 0.30 inches H_2O and 0.40 H_2O inches for the T200 to operate accurately.

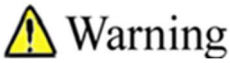
Step 9 – Proceed to the Normal Operational Mode Startup

With the Manifold Pressure Regulator now set properly, the Normal Operational Mode Startup procedure in the next section can be followed.

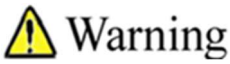
START UP – NORMAL OPERATION MODE

Prior to flowing sample through the analyzer, it is important to apply power to the analyzer and allow the internal heater to bring the enclosure up to operating temperature. In order for the analyzer to receive power, purge gas pressure must be applied. Type X purging reduces the classification within a protected electronics enclosures from Zone 1 to nonhazardous. Failure to maintain purge gas pressure will cause the analyzer to power off. Also, failure to maintain purge gas pressure is detected by a normally closed differential pressure switch alarm and an indicator on the side of the analyzer.

The following procedure should be performed when initially starting up the analyzer in Normal Operation Mode using a continuous dilution purge gas.

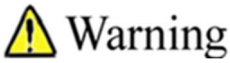


Failure to heed the following information may lead to injury of personnel or equipment damage.



Do not open the electrical equipment enclosure in a hazardous area even when de-energized unless area has been properly tested and is known to not contain explosive materials.

Before initially starting the equipment, electrical power wiring must be checked for correct size and routing.



The following procedure only addresses the application of power to the electrical equipment located within the purged enclosure being monitored and controlled by the Purge Controller.

When Nitrogen is used for purge gas and analyzer is mounted inside an enclosed area such as an analyzer house, the purge vents on the Purge Controller and the Backup Vent must all be tubed and mounted outside the enclosure to prevent asphyxiation.

Step 1 - Check Surrounding Area:

Make sure that area surrounding the T200 enclosure is known to be non-hazardous.

Step 2 - Open Door:

After it has been established that the area surrounding is non-hazardous, open the T200 enclosure door.

Step 3 – Manual Dilution Valve ON, turn on purge gas supply:

After opening the door, adjust the Manual Dilution Valve to the ON position, turn on the purge gas supply and verify purge gas is flowing into the T200 enclosure.

⚠ Warning

When Nitrogen is used for purge gas and analyzer is mounted inside an enclosed area such as an analyzer house, the purge vents on the Purge Controller and the Backup Vent must all be tubed and mounted outside the enclosure to prevent asphyxiation.

Step 4 – Close enclosure door:

After verifying that the purge gas is flowing, close and latch the T200 enclosure door.

Step 5 – Apply power to the T200:

After verifying the T200 enclosure door is closed and latched, apply power to the T200. The Purge Controller green light will start to blink.

Purge Controller Matrix

ALARM	VISUAL INDICATION	POWER DISCONNECTED
Purge pressure goes below 0.20 inches H_2O (1.00 bar)	Steady State, RED Light	Yes
Exhaust vent flow drops below safe level	Steady State, RED Light	Yes
Maintenance Switch turned to Over-Ride	Blinking, RED Light	No
During Purge Dilution Cycle Time	Blinking, GREEN Light	Yes
Normal Operation	Steady State, GREEN Light	No

Step 6 - Wait for Dilution Time:

With purge protective gas being supplied to the T200 enclosure, and the Purge Controller green light blinking, the automatic dilution time cycle will start. The automatic dilution time cycle is factory set to be long enough to ensure that at least five

(5) times the volume of free space in the enclosure of purge protective gas is exchanged before power can be automatically applied to the electrical equipment inside the T200.

Step 7 – Power automatically applied:

After the dilution purge time cycle has elapsed, and the enclosure pressure is being maintained above 0.30-0.40 inches H_2O (1.00 mbar) and the enclosure exhaust port is registering adequate flow, the green light will stop blinking and go into a steady state. Power will then automatically be applied to the electrical equipment inside the T200.

Step 8 – Manual Dilution Valve OFF:

After the power has been applied to the electrical equipment inside the T200, the protective purge gas flow rate may now be adjusted to the minimum flow rate by adjusting the Manual Dilution Valve to the OFF position. It may be necessary to slightly adjust the Manifold Pressure Regulator to achieve an enclosure pressure of 0.35-0.4 inches H_2O. The T200 is now ready for normal operation.

With power applied, verify the Temperature Controller, Carrier Flow Meter and LCD Read Out displays will come on.

NOTE: If the protective purge gas pressure becomes less than 0.2 inches H_2O or the exhaust flow drops too low, the Purge Controller green light will turn off and power to the electrical equipment inside the T200 will be automatically turned off.

Step 9 - Carrier Pressure (for model 214 only):

Set the carrier gas pressure according to the Analyzer Settings Data Sheet with an external pressure regulator. The Carrier Mass Flow Controller will automatically compensate for any pressure adjustments to provide the correct flow of N2 to the tape deck.

Note: A pressure switch set to 8 PSIG will turn off the flow controllers if the carrier gas pressure falls below the set point.

Step 10 - Sample Flow Rate and Pressure

1. First, verify the ON-LINE / MAN CAL valve is set to the ON-LINE position.

2. Set the sample pressure according to the Analyzer Settings Data Sheet with an external pressure regulator. The H2S Sample Mass Flow Controller (and Carrier gas flow controller if equipped) will automatically compensate for any pressure adjustments to provide the correct flow sample to both tape deck panels.

3. With the T200 operating normally, sample will flow through the analyzer for measurement by the Gas Detector.

If there is not enough sample pressure to provide at least 10 psig (0.7 barg) at the analyzer with the fast sweep flowing, it may be necessary to add a booster pump to the sample flow.

Step 11 - Stabilization

To complete the start up, allow sample flow, electronics & temperatures to stabilize for a few hours. An initial warm up period of a few hours is recommended before stabilization is complete.

SYSTEM INFORMATION

Sample Analysis

With sample flow on, the digital meter in the H2S Detector reads the parts per million by volume (ppmv) or parts per billion by volume (ppbv) H2S in the sample. Readings stabilizes in minutes, depending on the concentration of H2S.

Hydrogen Sulfide Scrubber/Filter

An H2S Gas Scrubber is provided to remove and H2S remaining that is vented from the H2S analyzer. The clear plastic cartridge allows observation of the absorbent as it is used up. The color progressively changes from a purple color to brown, and then white as it is consumed; replace the scrubber material before it is exhausted. No backpressure positive or negative is allowable in the vent line. Any backpressure will affect the seal where the lead acetate tape is exposed to H2S and would adversely affect operation. The vent for the gas, from the purifier, is located so that it is carried out of the cabinet by the cabinet purge flow, which vents from the bottom of the cabinet.

4-20ma Output Loop

The 4-20mA output loop is an integral part of the electronics. No special set up & operational procedures are required. 4-20mA Output loop is self-powered.

Dry Relay Concentration Alarm (Optional)

To set the Concentration Alarm follow these instructions. Refer to the drawing toward the end of this manual for identification of components for connections. Choosing ALARM from the main Menu pulls up the Alarm page. You may have two alarms in operation. The alarms are activated by choosing Y under the Alarm column. The cursor begins in the position necessary to turn on/off Alarm #1.

“In Use” shows the current value entered as the PPM level at which the alarm will be triggered.

After making the desired selection move either to the update to set the alarm point (PPM) or on to Alarm #2 if purchased. After setting either one or both of the alarms, press ENTER to save the information and then MENU to escape this page.

Diagnostic Alarm (Optional)

The Diagnostic Alarm contact will normally be closed, if the analyzer is functioning properly. If the contact remains open, it may be due to one of the following conditions, which can easily be checked:

Out of Tape – visual check

Tape dark - visual check

Tape Drive Motor Not Operating – press RESET on the Menu Page and watch for tape advance.

Illumination Source Failure – depress tape pressure block and look for glow from LED.

Processor Failure – consult factory.

Optical Sensor Failure – measure the output voltage of the optical sensor when exposed to white tape. The voltage should be 120mV ±20mV.

H2S DETECTOR

Components

This section identifies the components of the **KECO** Model 052 Detector. It also gives brief descriptions of the components and their functions.

The descriptions and corresponding drawings have been placed on facing pages to make it easier to locate components.

DISPLAY

Communicates system status to the user.

KEYPAD

Used to control the system input and functions.

PINCH ROLLER

Provides correct pressure to aid capstan in advancing tape.

CAPSTAN

Advances sensing tape through detector/pressure blocks. Guides tape to take-up pin.

DETECTOR BLOCK

Contains the photo diode used for signal measurement.

GUIDE PIN

Guides sensing tape from supply roll through detector/pressure blocks.

TAPE COVER

Protects and holds the sensing tape on the supply hub and take-up pin.

SUPPLY HUB

Holds unused portion of the roll of sensing tape.

TAKE-UP PIN

Receives and holds the used portion of the sensing tape.

PRESSURE BLOCK

Provides the illumination source (red LED) for the detection/measurement process.

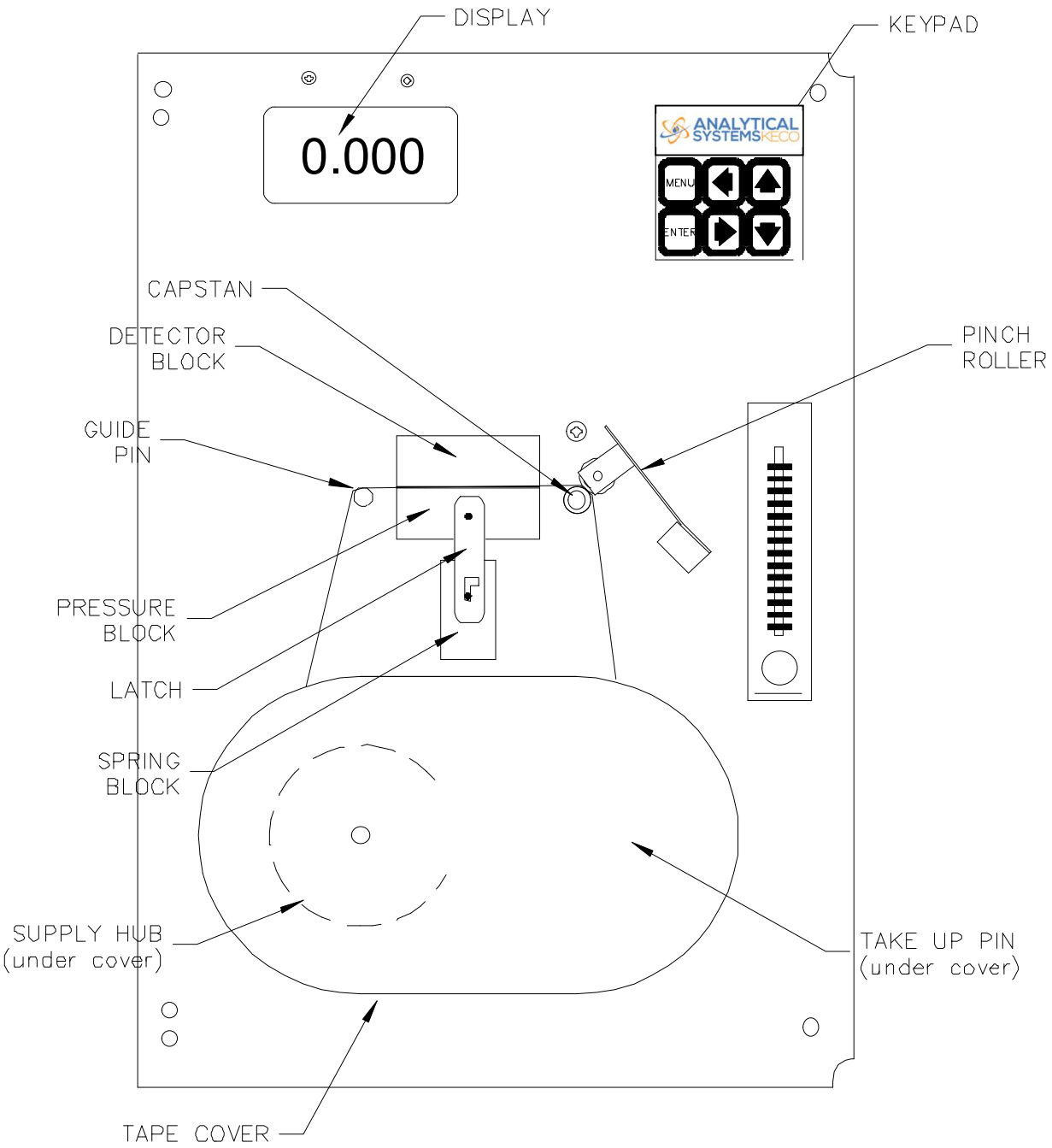
SPRING BLOCK/ LATCH

Enables operator to lock pressure block in the open position when loading new roll of sensing tape.

FLOWMETER

Measures and controls the flow rate of the incoming sample gas.

Front of H2S Detector



FLOW INDICATOR
Measures the flow rate of the incoming sample gas. Sample enters flow meter at the bottom and exits to the humidifier at the top (both through 1/8" Teflon tubing).

MOTOR
Provides power to advance the sensing tape.

DRIVE PULLEY
Moves the drive belt during tape advances.

TERMINAL BLOCKS
Provides wiring connections for all connections in the analyzer, with the exception of the keypad and display.

DRIVE BELT
Transmits rotation from the drive pulley to the take-up pulley.

TAKE-UP PULLEY
Turns the take-up pin.

HUMIDIFIER
Humidifies the incoming sample.

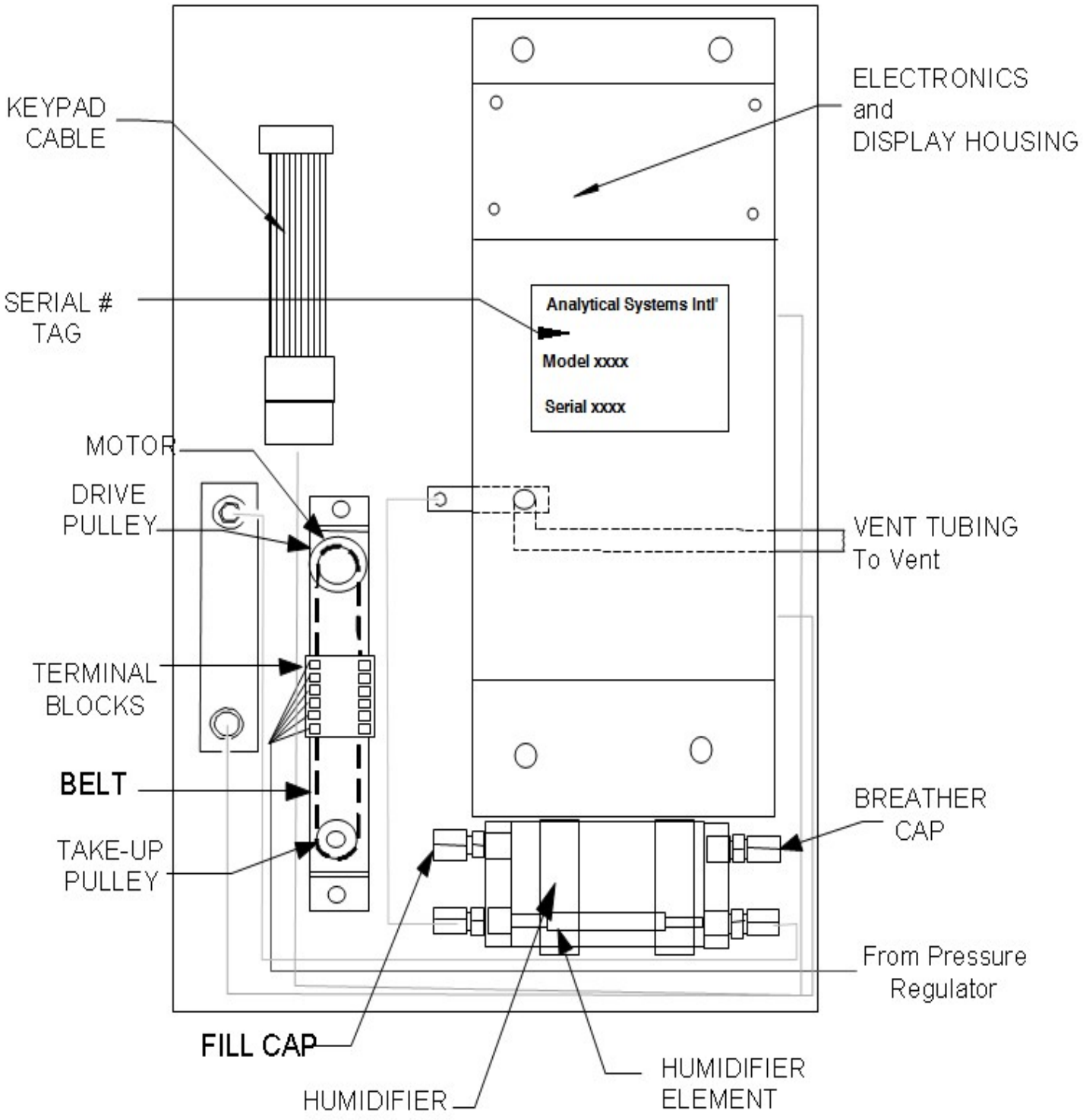
FILL CAP
Facilitates the filling of the humidifier with acetic acid, necessary for the humidification process.

BREATHER CAP
Allows the intake of air into the humidifier which prevents the occurrence of a vacuum during the humidification process. Also prevents the leakage of humidifier solution when the analyzer is in a position other than upright.

SERIAL TAG
Provides information specific to this analyzer; serial number, number, range, power and area classification. This tag may sometimes be placed on the back of the analyzer back-plate.

VENT TUBING
Provides venting of the sample gas to atmosphere after it has passed through the detector block.

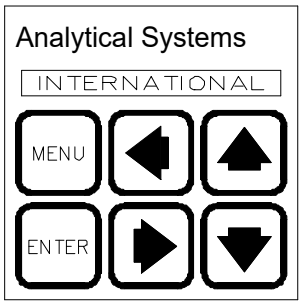
Rear of Tape Deck Panel



OPERATION

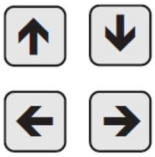
Keypad

All operations of **KECO** analyzers are accessed through the menu by use of the keypad.



The MENU key pulls up the main menu and returns you to this main menu from any other menu page.

The enter key pulls up the operating page of an option you have selected with your cursor on the main menu. It is also used to enter any numerical changes you have made to any portion of the operations. After entering the number you desire to use, press ENTER. The number you entered is then saved to memory.

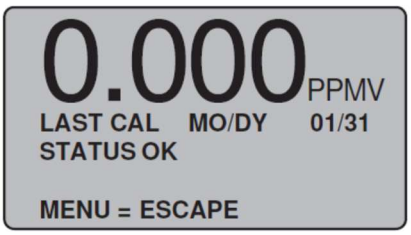


The up and down arrows are used to move your cursor about in the menu. On the operations pages, these arrows change numbers and options, while the left and right arrows move the cursor.

Title Screen

The title screen is the first screen to appear after the analyzer is powered up. This screen displays the **KECO** logo and the model number for approximately three to five seconds.

Status Screen

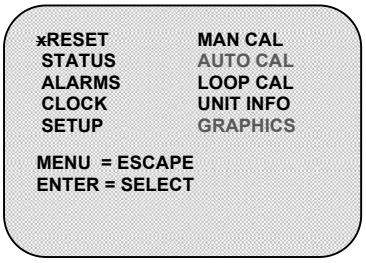


At power on, the title screen is replaced by the status screen in three to ten seconds.
The status screen shows the current measured amount of H2S present in the stream and the current status. The current status may show "Status OK" or other such pertinent system information.

Use the and to adjust the screen contrast for optimum viewing. If the screen is too dark use to brighten. If the screen is too light use to darken. With a color LCD, ENTER pressing while pressing the or will adjust the brightness.

Entering the MENU key at this point will display the main menu.

Main Menu



The main menu displays all the page options in the program. When the main menu is first displayed, the cursor will appear next to RESET. Menu screen text shown in dark gray, indicate options that are not available on all analyzers.
Move about the menu by using the up or down arrow. You may choose from:

RESET - Clears and resets alarms, stops any calibration in progress and advances the tape.

STATUS - Shows the current status of the analyzer.

ALARMS - Allows the optional alarms on the analyzer to be set, enabled or disabled. Alarms are optional. See the Alarms Option section for more information.

CLOCK - Allows the system clock to be set.

SETUP - From the SETUP screen the Tape Change, LED calibrate and other functions can be accessed.

MAN CAL - Manual Calibration page. Allows you to set and start manual calibration.

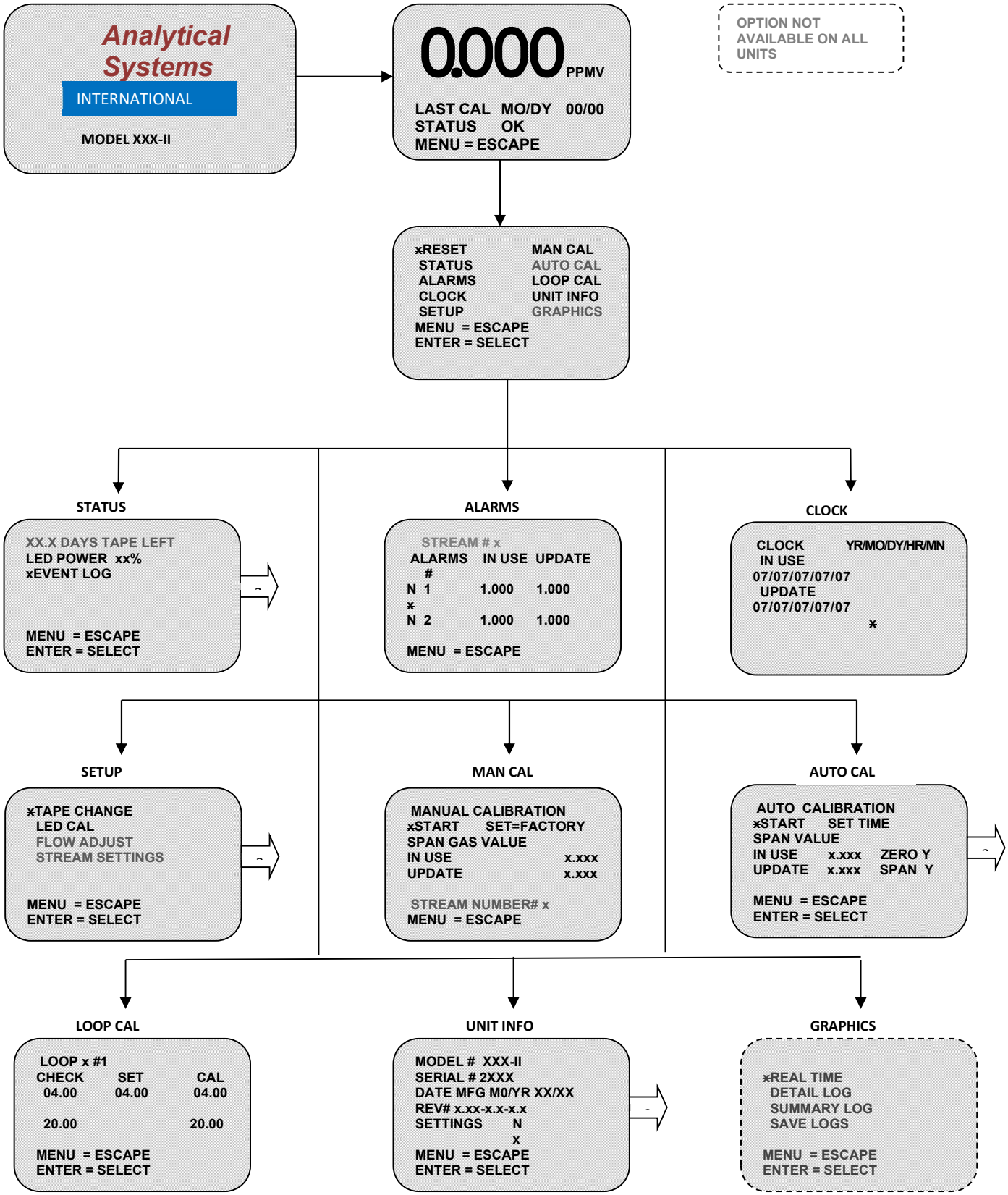
AUTO CAL - Auto Calibration page. Allows you to set timer for auto calibration. Auto Calibration is optional. See the Auto Calibration section in the Options section.

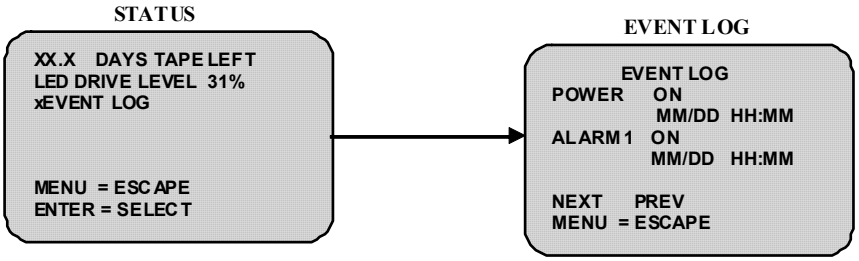
LOOP CAL - Allows you to calibrate any equipment on your 4-20mA loop. The 4-20mA loop is optional.

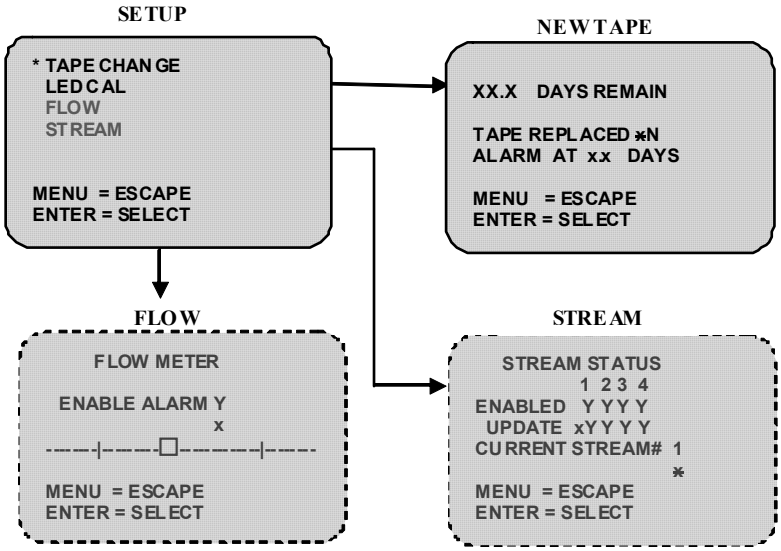
UNIT INFO - Displays all file information on this particular unit.

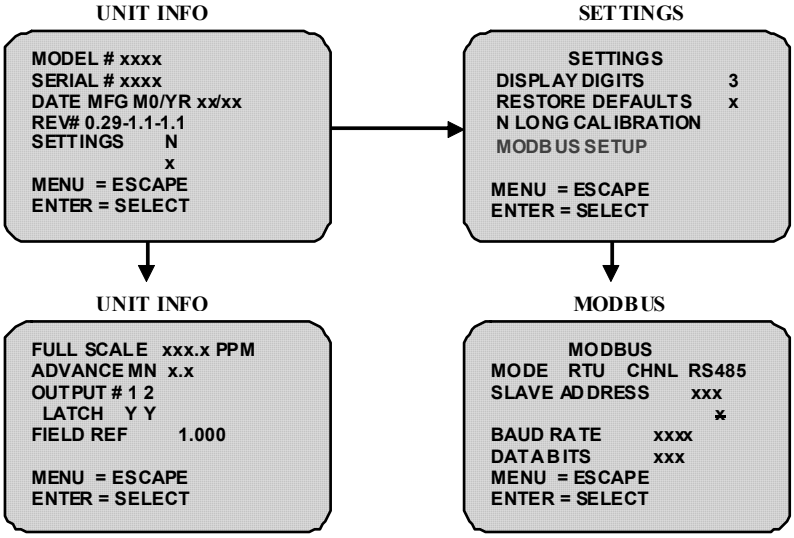
GRAPHICS - Allows graphical display of real time or historical data.

On the following pages, detailed instructions will be given on how to use each menu page. Pay particular attention to information provided in boxes.

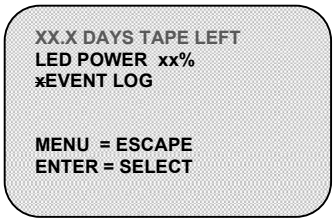

Analytical Systems
INTERNATIONAL
MODEL XXX-II
0.000 PPMV
LAST CAL MO/DY 00/00
STATUS OK
MENU = ESCAPE
OPTION NOT AVAILABLE ON ALL UNITS
xRESET
STATUS
ALARMS
CLOCK
SETUP
MAN CAL
AUTO CAL
LOOP CAL
UNIT INFO
GRAPHICS
MENU = ESCAPE
ENTER = SELECT
STATUS
XX.X DAYS TAPE LEFT
LED POWER xx%
xEVENT LOG
MENU = ESCAPE
ENTER = SELECT
ALARMS
STREAM # x
ALARMS # IN USE UPDATE
N 1 1.000 1.000
x
N 2 1.000 1.000
MENU = ESCAPE
CLOCK
CLOCK IN USE YR/MO/DY/HR/MN
07/07/07/07/07
UPDATE
07/07/07/07/07
x
SETUP
xTAPE CHANGE
LED CAL
FLOW ADJUST
STREAM SETTINGS
MENU = ESCAPE
ENTER = SELECT
MAN CAL
MANUAL CALIBRATION
xSTART SET=FACTORY
SPAN GAS VALUE
IN USE x.xxx
UPDATE x.xxx
STREAM NUMBER# x
MENU = ESCAPE
AUTO CAL
AUTO CALIBRATION
xSTART SET TIME
SPAN VALUE
IN USE x.xxx ZERO Y
UPDATE x.xxx SPAN Y
MENU = ESCAPE
ENTER = SELECT
LOOP CAL
LOOP x #1
CHECK SET CAL
04.00 04.00 04.00
20.00 20.00
MENU = ESCAPE
ENTER = SELECT
UNIT INFO
MODEL # XXX-II
SERIAL # 2XXX
DATE MFG M0/YR XX/XX
REV# x.xx-x.x-x.x
SETTINGS N
x
MENU = ESCAPE
ENTER = SELECT
GRAPHICS
xREAL TIME
DETAIL LOG
SUMMARY LOG
SAVE LOGS
MENU = ESCAPE
ENTER = SELECT


STATUS
XX.X DAYS TAPE LEFT
LED DRIVE LEVEL 31%
xEVENT LOG
MENU = ESCAPE
ENTER = SELECT
EVENT LOG
EVENT LOG
POWER ON
MM/DD HH:MM
ALARM 1 ON
MM/DD HH:MM
NEXT PREV
MENU = ESCAPE


SETUP
* TAPE CHANGE
LED CAL
FLOW
STREAM
MENU = ESCAPE
ENTER = SELECT
NEW TAPE
XX.X DAYS REMAIN
TAPE REPLACED *N
ALARM AT xx DAYS
MENU = ESCAPE
ENTER = SELECT
FLOW
FLOW METER
ENABLE ALARM Y
x
MENU = ESCAPE
ENTER = SELECT
STREAM
STREAM STATUS
1 2 3 4
ENABLED Y Y Y Y
UPDATE xY Y Y Y
CURRENT STREAM# 1
*
MENU = ESCAPE
ENTER = SELECT

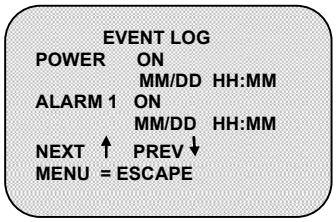

UNIT INFO
MODEL # xxxx
SERIAL # xxxx
DATE MFG M0/YR xx/xx
REV# 0.29-1.1-1.1
SETTINGS N
x
MENU = ESCAPE
ENTER = SELECT
SETTINGS
SETTINGS
DISPLAY DIGITS 3
RESTORE DEFAULTS x
N LONG CALIBRATION
MODBUS SETUP
MENU = ESCAPE
ENTER = SELECT
UNIT INFO
FULL SCALE xxx.x PPM
ADVANCE MN x.x
OUTPUT # 1 2
LATCH Y Y
FIELD REF 1.000
MENU = ESCAPE
ENTER = SELECT
MODBUS
MODBUS
MODE RTU CHNL RS485
SLAVE ADDRESS xxx
*
BAUD RATE xxxx
DATA BITS xxx
MENU = ESCAPE
ENTER = SELECT

Status



Choosing STATUS from the Main Menu pulls up the Status page. This page shows you the current status of the analyzer.

- The LED Power from the Last LED CAL is displayed.
- The three highest priority alarms are displayed.
- The ⬇ may be used to page down if there are additional alarms.
- The EVENT LOG logs events such as Alarms being triggered, Alarms being cleared, Reset functions, Calibrations started etc.
    - Press ENTER to see the two most recent events.
    - Use the UP and Down arrows to page through the events
    - Press Menu to return to the STATUS SCREEN
- Instruments with the Low Tape Alarm Option will have the number of days of tape remaining displayed. See the Low Tape Alarm Option section for more information.

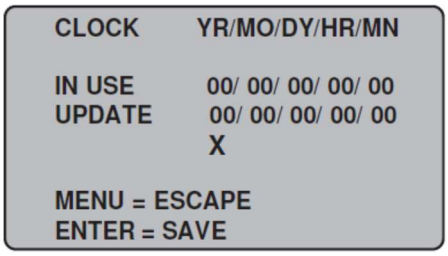


You may check the status page at any time by going to the Main Menu and selecting STATUS.

Alarms

Alarms are optional. Information on this option can be found in the Options section of this manual if you have purchased that option.

Clock

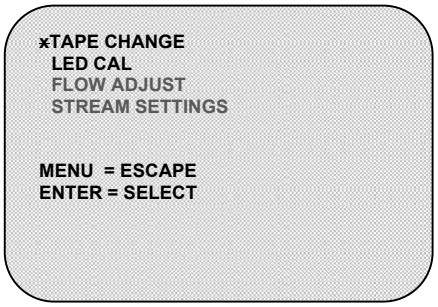


Choose CLOCK from the Main Menu to pull up the Clock page.

On this page you set the system time and date. To choose the necessary numbers, use ⬇ and ⬆
After the time and date have been correctly set,
Press ENTER to save the information to system memory.
Press MENU to return to the Main Menu.

H2S Detector with Serial Number greater than 2000 always have years in the 21'st century. If a year is "00" this indicates the year 2000. If a year is "98" this indicates the year 2098.

Setup



The Setup Screen allows setup and maintenance functions to be performed. When the SETUP screen is entered, the Analyzer is off line. If no action is taken for 5 to 6 minutes, the analyzer will automatically will return to online.

TAPE CHANGE - Use this screen when changing tape. For additional information on this function see Installing Sensing Tape in the Maintenance

- **LED CAL** - This function allows the LED light source to be calibrated to white tape. Normally the LED is calibrated when the sensing tape is replaced but the LED can be calibrated at any time by using this function. See LED Calibration in the Maintenance section.
- **STREAM SETTINGS** - If the Analyzer has multiple Ranges/Streams, use that part of the Options section.

Graphics

Graphics screens present real time and historical data in a graphical format. For more information on the Graphics option, see the Option section.

Loop Calibration

The 4-20mA output loop calibration information can be found in the set up section of this manual.

MAINTENANCE OR SERVICE PROCEDURE:

⚠ Warning Failure to heed the following information may lead to injury of personnel or equipment damage.

⚠ Warning Do not open the electrical equipment enclosure in a hazardous area even when de-energized unless area has been properly tested and is known to not contain explosive materials.

⚠ Warning Placing the Purge Controller into MAINTENANCE position disables safe operation of the system. Maintenance mode is to be used ONLY when required for maintenance or service AND ONLY if the area is known to be non-hazardous.

⚠ Caution Electrical equipment components may be hot even when power is not applied. Take appropriate precautions to prevent injury from contact with hot items.

⚠ Warning Before initially starting the equipment, electrical power wiring must be checked for correct size and routing.

⚠ Warning The following procedure only addresses the application of power to the electrical equipment located within the purged enclosure being monitored and controlled by the Purge Controller.

NOTE: Refer to all ATEX and IECEx certificates for any Special Conditions of Use. If the sign “X” is placed after the certificate number, it indicates that the equipment or protective system is subject to special conditions for safe use specified in the schedule of the certificate.

Step 1 Check Surrounding Area:

If maintenance or service must be performed with power applied to the electrical equipment within the purged analyzer enclosure, first make sure that area surrounding the 205 H2S in Crude Analyzer enclosure is known to be non-hazardous.

Step 2 Turn off Purge Gas:

Turn off purge supply gas at the Purge Pressure Regulator.

Step 3 Open Door:

With purge gas supply turned off at the Purge Pressure Regulator, open the enclosure door.

> ⚠ Caution Electrical equipment components may be hot even when power is not applied. Take appropriate precautions to prevent injury from contact with hot items.

Step 4 Perform Maintenance or Service:

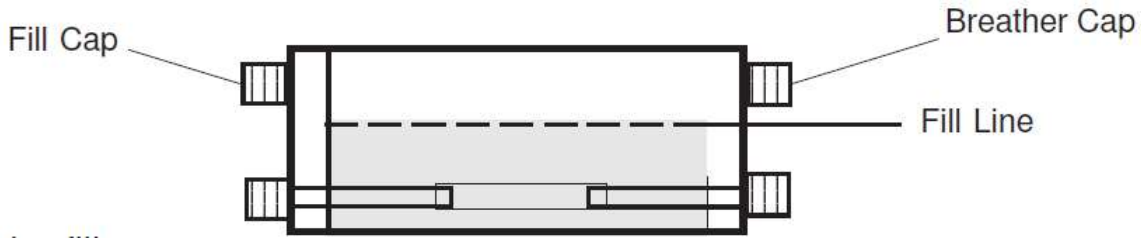
With the enclosure door opened, perform required maintenance or service.

Step 5– Proceed to the Normal Operational Mode Startup

The Normal Operational Mode Startup procedure can be followed.

PERFORMING MAINTENANCE

Filling the Humidifier with Solution



1) For proper handling and disposal, read the Humidifier Solution MSDS Datasheet in the MSDS section of this manual.
2) Remove the Fill Cap located on the upper left side of the humidifier. Never remove the Breather Cap. The humidifier is located on the rear of the tape deck panel.

3) Using a clean fill bottle, add new **KECO** humidifier solution through the fill cap opening.

> ⚠ Caution **DO NOT fill the humidifier above the level of the fill cap and breather cap.**

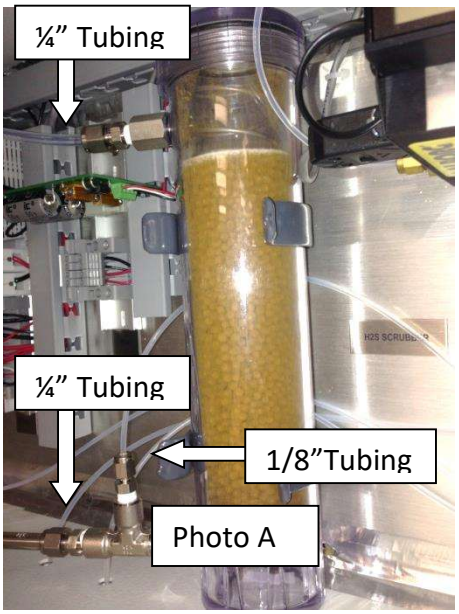
4) Replace the fill cap.

NOTE: Filling the humidifier with anything other than humidifier solution (5% acetic acid) can permanently damage the membrane tubing inside the humidifier and necessitate replacement.

5) If the Humidifier solution is contaminated, the solution should be replaced. Contaminated solution will appear very cloudy or yellow. If in doubt proceed to step 6.
6) Press air out of an empty fill bottle (shipped with the analyzer - packed in the box with humidifier solution) and insert the end of the tube through the fill cap opening into the solution to be removed. Suction out old humidifier solution and discard.
7) Begin again with step 3.

H2S Scrubber Media Replacement (if applicable)

The T200 comes equipped with an internal H2S scrubber located at the vent of the analyzer. Replacement of the media is required as the color of the H2S Scrubber Media changes from bright purple (new) to brown, to white (spent).



1.) Turn off the analyzer to prevent sample gas from escaping without being scrubbed of H2S.

2.) Disconnect the ¼" Teflon tube, ¼" Stainless Steel tube (with tygon tubing installed), and the 1/8" tube from the H2S Scrubber Assembly (See Photo A).

3.) Remove the H2S Scrubber Assembly from the analyzer.

4.) Remove the top cap by turning clockwise.

5.) Remove the spring, perforated plate, and round cloth from the H2S Scrubber Assembly; ensuring to remember the order of the parts. (See Photo B)

6.) Dispose of the spent H2S Scrubber Media.

7.) Fill the H2S Scrubber Assembly with new H2S Scrubber Media and reassemble the Scrubber Assembly.

8.) Reinstall the H2S Scrubber Assembly into the analyzer and return to normal operation.

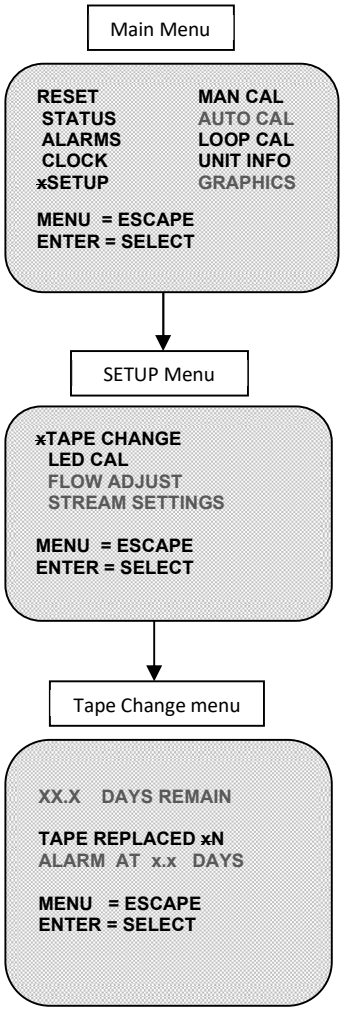
Installing Sensing Tape

The following procedure is not required to change tape. Using this procedure will prevent unnecessary alarms during tape change.

Complete the following steps when installing a new roll of sensing tape:

1) Enter the SETUP menu.
2) Enter the Tape Change Menu.

Note: After the SETUP menu is entered, the instrument is no longer reading the gas stream. Alarms associated with setup will not be activated (Tape Dark, Tape Out etc). If the instrument is left unattended in SETUP menu for 5 to 6 minutes, it will return to processing the gas stream and activate the alarms.



3) Turn off the Gas Flow at the flow meter.
4) Remove the tape cover by holding the cover while turning the knob 1/4 turn counterclockwise.

5) Depress and latch the spring-loaded pressure block.
6) Remove the old tape from the analyzer.
7) Place a full roll of tape on the supply hub. Leave approximately 10 inches of tape loose.
8) Place the loose tape in the slot.
9) Release the pressure block (making sure it snaps back in place) and pull about one inch of the tape through the detector head to verify that the tape is in the proper position.
10) Attach the tape to the take-up pin with a small bit of adhesive tape.
11) Rotate the take-up pin clockwise to remove as much slack as the take-up drive will permit. The slip-clutch action of the drive will take up the balance of the slack.
12) Replace the tape cover.
13) Press the Up Arrow to so that TAPE REPLACED in the MENU has a Y then press ENTER.
14) A screen will appear prompting for the correct conditions for an LED calibration.

a. Press the ENTER key to calibrate the LED. The tape should move about 1/8” to 1/4” and stop.

b. If an LED calibration is not desired, press the MENU key.

15) The screen will return to the Tape Change screen.

16) Press MENU to return to the SETUP screen.

17) The LED power remaining will be displayed at the bottom of the Setup Screen.

18) Press MENU to return to the main menu and begin gas sampling.

19) Press RESET on the Menu Page and check for proper tape advance. The tape should move approximately 1/8” to 1/4" and stop.

20) Follow site regulations and local laws to determine proper disposal of the used lead acetate tape. See the MSDS forms included in the manual packet.

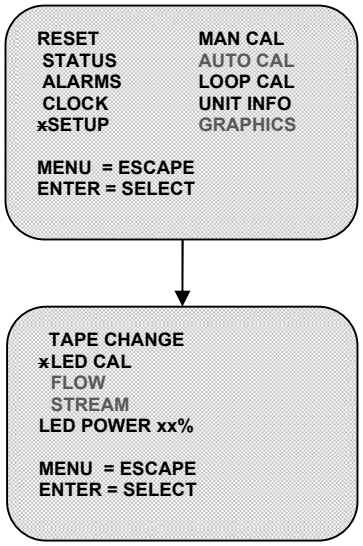
CALIBRATION

Over an extended period of time, contamination may build up in the Detector Block obscuring the LED light. Over time the LED light may become weak as well. The analyzer electronics automatically compensate for the contamination and decreasing intensity of the LED Pressure Block. Each time the tape is changed, an LED Calibration is recommended. The LED Calibration can be performed at any time.

LED Calibration (recommended)

1. Enter the SETUP Menu.

Note: After the SETUP menu is entered, the H2S Detector is no longer reading the sample. Alarms associated with setup will not be activated (Tape Dark, Tape Out, etc.). If the H2S Detector is left unattended in SETUP menu for 5 to 6 minutes, it will return to processing the gas stream and activate the alarms.



2. Turn off the flow to the analyzer.
3. Verify that white tape is in the detector.
4. Verify that the Detector Block is fully closed.
5. Place the cursor beside the LED CAL line and press ENTER.
6. A screen will appear prompting for the correct conditions for an LED calibration.
    - If an LED calibration is not desired, press the MENU key.
    - Press the ENTER key to calibrate the LED. The tape should move about 1/8” to 1/4” and stop.
5. The screen will return to the Setup screen in a few seconds.
6. The tape should move 1/8 to 1/4 inches. The result of the calibration will be displayed at the bottom of the screen.
    - The result displayed indicates the amount of LED power remaining.
    - When the amount of LED power remaining drops below 20%, LOW LED will be displayed. The Detector Block should be cleaned and/or the pressure block should be replaced at the next scheduled maintenance.
    - LOW LED does not mean that the Analyzer may not be used. The LED status is checked at each tape advance. Additional diagnostic alarms will be presented at tape advance.
    - If the LED cannot be calibrated, CAL FAIL will be displayed on the Setup Screen and on the Status line of the Status Screen. Use the RESET function to clear the CAL FAIL alarm from the Status Screen.
    - When CAL FAIL appears after an LED CAL, the reason for failure must be determined and corrected.

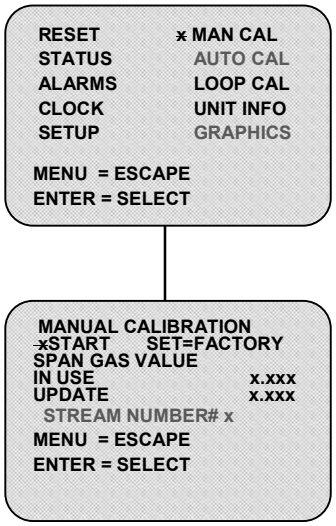
- The detector voltage on position 3 and 4 of the terminal block on the tape deck panel should be 120 +/- 20mV.

When LED calibration is complete, restart the flow to the Analyzer and press Menu to exit the Setup screen and return the Analyzer to on-line status.

Span Gas Calibration

1. From the main menu, select MAN CAL.

The Manual Calibration screen appears as shown with the cursor appearing beside START.

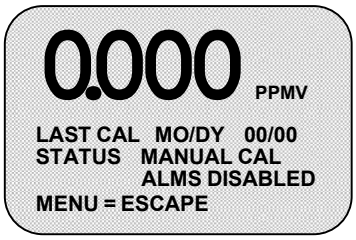


2. Use ← and/or → to move the cursor to a position beneath the first digit of the update span gas value.
3. Use ↑ and/or ↓ to set the desired span gas value.
4. ENTER to save the chosen value.

NOTE: To determine whether or not the value has been saved, look at the IN USE value after pressing ENTER. The IN USE value should be the same as the UPDATE value.

You may change the SPAN GAS VALUE as many times as necessary before beginning the calibration.

5. Verify that Calibration Gas is connected to the analyzer. Make sure Cal Gas flowmeter inside the analyzer is closed completely by turning the needle valve fully clockwise. Apply 9PSIG from Cal Gas bottle (regulator provided by others) and slowly open Cal Gas flowmeter inside the analyzer by turning the needle valve counter-clockwise to 0.3 units.



6. Use ← and/or → to move cursor back to START. ENTER to begin calibration.

When the calibration is started, the Status Screen will appear as shown. It denotes that calibration is on and that any alarms are disabled during this process. You will note the digits changing as calibration occurs.

When the calibration is complete the screen will change to show STATUS CAL COMPLETE and ALARMS DISABLED. The LAST CAL date will change to the current Month and Day. The FIELD REFERENCE value in the UNIT INFO page will reflect the new correction factor.

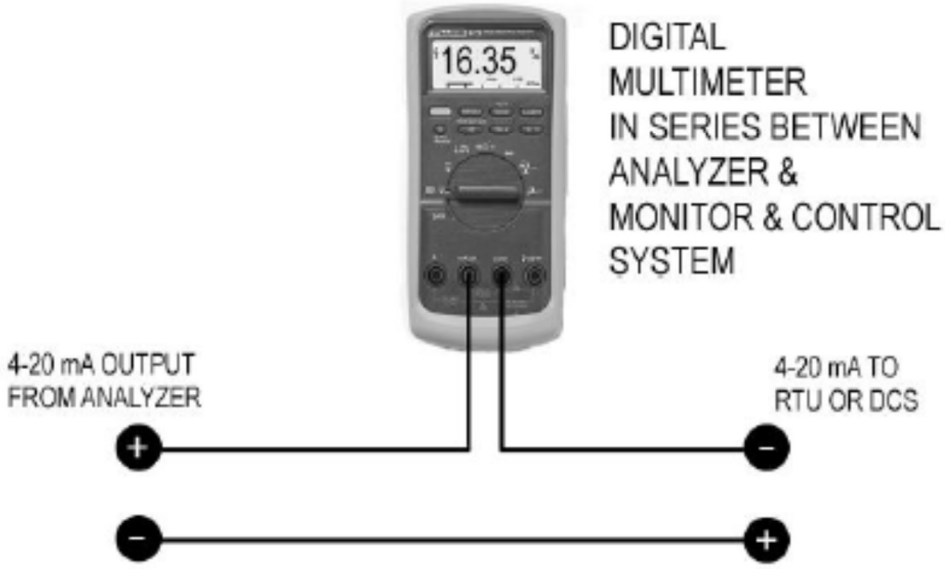
7. Wait for the reading to return to the online value.
8. Press Menu and Enter to Reset the Analyzer and enable the alarms.

The calibration process may be stopped at any time. Turn the ONLINE/MANUAL CAL valve back to ONLINE. When the reading is low enough not to cause unwanted alarms, return to the main menu and choose RESET. This will stop the calibration program, enable the alarms and advance the tape. Escaping from the calibration page DOES NOT stop calibration.

If a calibration does not produce the desired results, the analyzer may be returned to the Factory calibration by placing the cursor at SET=FACTORY and pressing ENTER. The FIELD REFERENCE will be set to 1.000 which is the FACTORY setting.

Calibration of 4-20mA Output Loop

To complete the startup, calibration of the 4-20mA loop may be required to read as close to 4.00mA on 0.00 ppm and 20.00 on full span as possible.



1. Connect a digital multimeter in series between the analyzer and the monitor and control system as shown above.
2. On the analyzer keypad, press **MENU**.
3. Move cursor to **LOOP CAL** page & press **ENTER**.
4. Move cursor to **CAL**
   4.00
   X
5. Press **ENTER**.
6. Read value on reference meter.
7. If not 4.00, enter the meter reading at the 4.00 location and press **ENTER**.

8. Verify that the meter reads 4.00 or re-enter until meter reads close to approximately 4.00.
9. Move cursor to 20.00 and repeat process.

PROBLEM SOLVING – H2S Detector

Because of the advanced state-of-the-art microprocessor and other electronic circuitry, **KECO** analyzers are not normally serviced in the field. If the instrument fails to start-up or operate properly, check the following:

Always keep these two basics in mind when trouble shooting:

1. **LOOK FOR THE OBVIOUS** - Most often problems prove to be basic and are easily corrected.
2. **CHECK OUT ONE SEGMENT OF THE SYSTEM AT A TIME** - First, prove the operation of the basic segments. Then check the operation of the entire system.

Power

Verify that the system power is properly connected, and has the correct voltage.

Humidifier

Erratic readings can result if the humidifier is not functioning properly. Verify that the humidifier is properly filled, and that the humidifier has not become contaminated. Refer to the photo of the rear of the tape for location of the humidifier. If the humidifier solution has become contaminated, drain and refill the humidifier with the proper solution. See page 2-3 for instructions on changing the humidifier solution.

Drive Motor

Verify that the motor is functioning properly. Press RESET on the Menu Page and watch for a tape advance. The tape should move approximately 1/8” to 1/4" and stop.

Pinch Roller Assembly

The Roller on the Pinch Roller should turn freely. The roller should not be touching the Tape Deck Panel. The spring on the Pinch Roller should not be bent. If the Pinch Roller is not functioning properly, it should be replaced.

Illumination Source

Verify that the illumination source is functioning properly by depressing the tape pressure block. A red glow should be noted. If there is doubt about the strength of the Illumination Source, calibrate the LED by the procedure in the Maintenance section.

Exhaust Line

Verify that the line is not blocked. Back pressure will cause erratic readings and can be evidenced by non-uniform darkening of the **KECO *Tape***.

Troubleshooting – H2S Detector

The Problem Solving section on the next pages lists common alarms and solutions. Alarms and problem solving with optional features are listed in the option section.

If you are unable to correct or determine the exact problem, call the **KECO** factory (Phone 281-516-3950). Personnel will assist you in diagnosing the problem. Have the information from the serial tag at hand when you call the factory.

INDICATION	PROBLEM	CHECK FOR	CORRECTIVE ACTION
Blurred spots on tape	Back Pressure on Vent	Vent Blockage	Remove Blockage, vent to atmosphere
Tape Darkening other Than spots	Sample leak	Leaks in sample flow path	Seal leaking connections
Dark Splotches	Pressure Block out of position	Block Position	position pressure block against tape in slot
Tape Dark Alarm 9999 Reading	Low Voltage from detector	LED on (pull down block to see light)	If no LED light, check connections and/or pressure block.
		Tape advances when RESET entered	If motor runs but tape does not advance, Increase pinch roller pressure on paper If motor does not run, check connections or replace motor
	H2S over range	Excessive dark spots with smear between spots.	Remove source of over range sample or Upgrade to higher range analyzer
	Pressure Block out of position	Dark splotches on tape	Position pressure block against tape in the slot
	Dirt in light path	Measure voltage from detector	Clean detector and pressure block and/or Calibrate LED
Tape Out Alarm 9999 Reading	High voltage from detector	Tape out of block	Install tape
		Measure voltage from detector on white tape (~0.120VDC +/- 0.010V	Recalibrate LED
LED Cal Fail	Immediately after LED calibration, the LED adjustment was at the end of the high/low adjustment range or the voltage from the detector was too unstable to calibrate.	No tape in Pressure Block	Put tape in Pressure Block
		Pressure Block not closed properly	Snap Pressure Block into position
		Weak Light Source	Replace Pressure Block
		Dirty/Weak detector	Clean/Replace Detector Block
Cal Fail	Auto Calibration Error	See the Auto Calibration Section	
OVER RANGE	H2S over range	Excessive dark spots with smear between spots.	Remove source of over range sample or Upgrade to higher range analyzer, see TAPE DARK above.

INDICATION	PROBLEM	CHECK FOR	CORRECTIVE ACTION
		Tape not advancing	Tape should advance 1/8 to ¼ inch after RESET.
		Reading is higher than Analyzer Range	See Above
		Reading is too high to display	See Above
LOW LED	During normal operation, indicates that the analyzer is able to read the tape but the detector output Is half of normal. Responsiveness may be affected.	LED not properly calibrated	Calibrate LED
	Immediately after LED cal the LED power remaining is less than 20%.	Old/weak Light source	Replace Pressure Block
		Dirty/Weak detector	Clean/Replace detector
		Tape not advancing properly	Verify that tape moves when RESET entered and that spot spacing is normal
SYSTEM ERROR	An internal error in the electronics	SYSTEM ERROR xx where xx is a Number between 10 and 99	Contact Technical Support with the Error Number

Modbus RTU Register Mapping (Optional item)

General

ASI KECO Analyzers conform to the MODBUS RTU protocol specification provided by the MODBUS Organization to implement a rich set of remote access features such as querying stream data and control over analyzer behavior. Any similarly conforming MODBUS RTU master device, such as ASI KECO SmartTalk software or a third party solution, may be used to control or query the analyzer.

This document is provided to help configure third party MODBUS RTU master devices at the Application Layer (of the OSI network model). Other layers are out of scope. This document also assumes knowledge of the MODBUS specification.

Please review the MODBUS specification at www.modbus.org for common definitions and further documentation.

1 Function Codes

The following function codes are supported:

Code	Function
0x03	Read Holding Registers
0x04	Read Input Registers
0x10	Write Multiple Registers
0x08	Diagnostic

Error codes are not defined in this document. See the MODBUS specification for error code handling.

2 Data Types

ASI KECO Analyzers use a variety of datatypes, from single boolean values, to 32-bit ANSI floating point numbers, appropriate for the context in which the data should be interpreted. MODBUS registers are strictly 16-bits each so we must construct or deconstruct the registers into the appropriate logical type. This means that multiple pieces of low-information data(booleans or bytes) may be packed into a single register or multiple registers must be used to transfer larger data(32-bit ANSI floats or arrays). All datatypes are transferred in big-endian format.

Data Type	Bit width	Number of registers	Description
int	16-bit	1	A simple integer scalar number. May be signed or unsigned. This value may also be bitmapped.
Byte[*]	8-bits times the number in brackets	The number in brackets divided by 2, rounded up.	Can be interpreted in many ways, depending on contextual meaning of the register.
ANSI float	32-bits	2	A numeric non-integer scalar value.
Word	32-bits	2	A large integer scalar number. May be signed or unsigned. This value may also be bitmapped.
Boolean or bit	1-bit	*Often grouped together	The smallest piece of logical information: True/False, On/Off, Yes/No. When grouped together, this can be a bitmap

In the following sections, registers are given a unique mnemonic identifier (an approximately human readable name in all capitals with underscores), a unique register number or numbers(in decimal), the logical data type that should be used to interpret the combination of registers and a short description of how the data is to be interpreted and used.

It is important to note that, in general, all register numbers associated with a mnemonic identifier must be queried in one message. The PROCESS_VALUE, for example is a ANSI 32-bit float, so requires a query with starting address 0 and length 2. Polling the registers numbers separately would not make sense as the data can change leaving you with an unknown value. An exception to this rule is with the various *_LOG registers and is discussed in the relevant sections below.

3 Holding Registers

Holding registers may be written (function code 0x03), read (function code 0x10) or both as noted

3.1 NXT_LOG_REG (16-bit int, Register 0)

Sets the page for data to be returned from the EVENT_LOG, DAY_LOG or SUM_LOG registers. If Bit 7 is set (0x8xxx), the value will auto-increment with each read of the log register(s).

This register is for writing only. Reading will result in an Illegal Address response.

3.2 STRM_REG (16-bit int, Register 1)

Sets the stream number for subsequent data.

This register is for writing only. Reading will result in an Illegal Address response.

3.3 CLEAR_LOG_REG (16-bit int, Register 2)

Writing a non-zero value to the second (low order) byte of this register causes all logs to be cleared. This is not qualified by STRM_REG.

This register is for writing only. Reading will result in an Illegal Address response.

3.4 RESET_REG (16-bit int, Register 3)

Writing a non-zero value to the second (low order) byte of this register causes the unit to execute the reset function. This is identical to the RESET on the analyzer's main menu.

This register is for writing only. Reading will result in an Illegal Address response.

3.5 CLOCK_REG (byte[8], Registers 4-7)

Sets or indicates the internal realtime clock of the analyzer. Invalid data will be corrected to the nearest valid value. Only the first 5 bytes are significant.

Byte	Data	Valid values
0	Year(2000-2099)	0..99 (Years 2000 to 2099)
1	Month	1..12
2	Day	1..31
3	Hour	0..23
4	Min	0..59
5-7	NA	

3.6 AUTO_CAL_REG (byte[2], Register 8)

Writing enables or disables the Auto Calibration schedule or starts an Auto Calibration cycle. To start an Auto Calibration cycle, set the second byte to 0x55.
Reading indicates the configuration of Auto Calibration, if the feature is installed on the device.
The first byte of this register is bit mapped as follows(the remaining bits and second byte may be ignored):

Bit	Data
0	Auto Calibration Span Calibration enabled
1	Auto Calibration Zero Enabled
2	NA
3	Auto Calibration Enabled

3.7 FLOW_ALARM_REG (16-bit int, Register 9)

Writing enables or disables the Flow Alarm. This alarm can only be activated if the Electronic Flowmeter Installed bit in the OPTIONS_REG register is set.
Reading indicates the Flow Alarm Enable Setting. Zero is disabled, 1 is enabled.

3.8 TAPE_ALM_REG (ANSI float, Register 10-11)

Writing sets the number of days of tape remaining when the alarm will be triggered
Reading indicates the number of days of tape remaining when the alarm should be triggered. Allowed values are 0.0 to 99.9.

3.9 AUTO_CAL_TIME_REG (byte[8], Register 12-15)

Writing sets the scheduled time of the next Auto Calibration cycle and the time between Auto Calibration cycles.
Reading indicates the scheduled time of the next Auto Cal cycle and the time between Auto Cal cycles.
The first 5 bytes indicate the time for the next Auto Cal. The last 3 bytes indicate the time between Auto-calibrations.

Byte	Data	Valid values
0	Year(2000-2099)	0..99 (Years 2000 to 2099)
1	Month	1..12
2	Day	1..31
3	Hour	0..23
4	Min	0..59
5	Auto Cal Cycle Time Days	0..99
6	Auto Cal Cycle Time Hours	0..99
7	NA	

3.10 ALM_1_LVL_REG[STRM_REG] (ANSI float, Register 16-17)

Writing sets the Alarm 1 Trigger Level.
Reading indicates the Alarm 1 Trigger Level.
Values can be between 0.0 and 9999.0.
This value is qualified by setting of the STRM_REG.

3.11 ALM_2_LVL_REG[STRM_REG] (ANSI float, Register 18-19)

Writing sets the Alarm 2 Trigger Level.
Reading indicates the Alarm 2 Trigger Level.
Values can be between 0.0 and 9999.0.
This value is qualified by setting of the STRM_REG.

3.12 ALMS_ENABLED_REG (byte[4], Register 20-21)

Writing enables or disables the concentration alarms for the individual streams.
Reading indicates if the alarms are enabled of the alarms for the streams.
Each byte(0-3) represents a single stream(1-4) respectively, and bits 0 and 1 represent Alarms 1 and 2 respectively.

3.13 SET_TO_FACTORY_REG[STRM_REG] (16-bit int, Register 22)

Writing a non-zero value as the second (low order) byte will cause the calibration (Field Reference) to be set to 1.000. Writing a zero will not affect the calibration Field Reference.
Reading this register always returns zero.
This register is qualified by the STRM_REG register.

3.14 ACTIVE_STREAM_REG (16-bit int, Register 23)

Writing sets the active stream being processed.
Reading indicates the active stream being processed.

3.15 STREAM_STAT_REG (byte[4], Register 24-25)

Writing bit 4 of each byte enables or disables the associated stream.
Reading indicates if a stream is enabled and if it is user or factory enabled.
Each byte(0-3) represents a single stream(1-4) respectively, and the bits are mapped as follows:

Bit	Owner
0	Factory
4	User
1-3, 5-7	NA

3.16 ALM_LATCH_REG (byte[2], Register 26)

Writing enables or disables the latching behavior of the concentration alarms. Writing is prohibited unless the Range Change option was purchased.
Reading indicates whether an alarm is latched for each stream.
Each byte(0-1) represents and alarm(1-2). Bits 4-7 represents streams 1-4, respectively.

3.17 RANGE_WRT_REG[STRM_REG] (ANSI float, Register 27-28)

Writing sets the range for the stream. Writing is prohibited unless the Range Change option was purchased.
Reading indicates the numeric Range in ENGR_UNITS for the stream currently set in STRM_REG.
Values from 0.05 to 9999.0. Values outside this range will be corrected to the nearest allowed value.

3.18 PASSWORD_REG (16-bit int, Register 29)

As of the date of this document, this register is not used.

4 Input Registers

Input registers may only be read with the 0x4 function code.

4.1 PROCESS_VALUE[ACTIVE_STREAM_REG] (ANSI float, Register 0-1)

Indicates the current H_2S reading of the stream presently being processed. It is not affected by STRM_REG. When the analyzer first boots up, this register will return -10000.00 until there are valid readings.

4.2 STATUS (32bit Word, Register 2-3)

Indicates the current status of the analyzer

Mnemonic	bitmask
TAPE_OUT	0x40000000
TAPE_DARK	0x20000000
OVER_RANGE	0x10000000
LOW_LED	0x08000000
STATUS_HI_CAL_ON	0x04000000
STATUS_LO_CAL_ON	0x02000000
STATUS_MAN_CAL	0x01000000
CAL_FAIL	0x00800000
CAL_COMPLETE	0x00400000
ALM1_ON	0x00200000
ALM2_ON	0x00100000
ALM1_DISABLED	0x00080000
ALM2_DISABLED	0x00040000
LOOP_OPEN	0x00020000
FLOW_ERROR	0x00010000
LOW_PRES	0x00008000
LOW_TAPE	0x00004000
LOW_BATT	0x00002000
HUMID_LOW	0x00001000
TEMPERATURE	0x00000800
AC_LOSS	0x00000400
SYSTEM_ERROR	0x00000200
CAL_FAIL_LED	0x00000100
NEW_STREAM	0x00000001

4.3 ENGR_UNITS (byte[4], Register 4-5)

Indicates the engineering units for the streams. The first byte will be the engineering units for Stream 0. The fourth byte will be the Engineering units for Stream 3.

Value	Units

0	PPMV
1	PPMW,
2	GR/V
3	mG/M
4	%V

4.4 ACTIVE_RANGE [STRM_REG] (ANSI float, Register 6-7)

Indicates the range for the active stream set in the STRM_REG register. See section 3.2 STRM_REG.

4.5 FIELD_REF_REG [STRM_REG] (ANSI float, Register 8-9)

Indicates the Field Reference value for the stream set in the STRM_REG register. Field reference is the result of the calibration process and is used to calculate stream concentration.

4.6 LAST_CAL_REG (byte[2], Register 10)

Indicates the date of last calibration.

Byte	Data	Valid values
0	Month	1..12
1	Day	1..31

4.7 SERIAL_NO_REG (16-bit int, Register 11)

Indicates the serial number.

4.8 MODEL_NO_REG (byte[8], Register 12-15)

Indicates the model designation for the analyzer.

4.9 TAPE_REMAIN_REG (ANSI float, Register 16-17)

Indicates the number of days remaining until the analyzer will run out of tape.

4.10 FLOW_RATE_REG (ANSI float, Register 18-19)

Indicates the flowrate.

Value	SCFH
100.0	0.3
133.0	0.4
66.0	0.2

4.11 ALARM_INST_REG (byte[2], Register 20)

Indicates the streams to which concentration alarms is configured. The first byte (MSB) is Alarm 1, the second is Alarm 2. Each bit represents a Stream

Bit	Stream
0	0
1	1

2	2
3	3

4.12 LED_PWR (16-bit int, Register 21)

Indicates the efficiency of the LED. 100 = Minimum voltage required for LED Drive, 0 = Maximum.

4.13 PCB_TEMP (16-bit signed int, Register 22)

Indicates the PCB Temperature form -50 to +100 Degrees C

4.14 FT_TAPE_REMAIN (ANSI float, Register 23,24)

Indicates the estimated number of Feet of Tape remaining.

4.15 MV_START (16-bit int, Register 25)

Indicates the detector output voltage in millivolts immediately after the most recent tape advance.

4.16 SW_VERSION (byte[6], Register 26-28)

Indicates the software version of the Measurement PCB (401-221) in ASCII text.

4.17 OPTIONS_REG (16-bit int, Register 29)

Indicates the options of the analyzer:

Value	Description
0x0001 through 0x0004	Proprietary or Unused, may be any value
0x0008	Electronic Flowmeter Installed
0x0010 through 0x0100	Proprietary or Unused, may be any value
0x0200	Customer adjustable Range and Alarm Latches
0x0400 through 0x8000	Proprietary or Unused, may be any value

4.18 EVENT_LOG (byte[240], Register 500-619)

Indicates events that the analyzer has recorded in a series of event log records. An event log record is 8 bytes.

byte	Name	Description
0	Id	Type of Event (see below)
1	Year	Two Digit Year >= Year 2000
2	Mon	Month (1..12)
3	Day	Day (1..31)
4	Hr	Hour (0..23)
5	Min	Minute (0..59)
6	StreamNo	0..3
7	State	1 = ON, 0 = OFF

Id Definitions for EVENT_LOG:

Name	Value
RESET	00
LED_CAL	01

POWER	02
TAPE LOW	03
TAPE CHANGE	04
TAPE DARK	05
TAPE OUT	06
FLOW ERROR	07
LOW LED	08
HUMIDIFIER LOW	09
SET FACTORY	10
TEMPERATURE	11
AC POWER LOSS	12
BATTERY LOW	13
LOW TAPE	14
OVER RANGE	15
MANUAL CAL	16
AUTO CAL	17
ALARM 1	18
ALARM 2	19
LOOP OPEN	20
CAL FAIL	21
SYSTEM ERROR	22
ALARM 1 ENABLE	23
ALARM 2 ENABLE	24
ALARM 1 LATCH	25
ALARM 2 LATCH	26
RANGE CHANGE	27
LED CAL FAIL	28
UNKNOWN	29

Event Logs are "paged" by the NXT_LOG_REG register. A "page" of Event Logs is 30 records or 240 bytes. Requesting 31 records will cause an Exception Response Illegal Address.
As long as register requests are in multiples of register size, any record or sequence of records may be requested.
Records are returned starting with the most recent.
End of file is indicated when a record begins with 0xFF.
If the event id is SYSTEM ERROR the stream number field will be an id for the error type:

10	**A/D readings not being processed in 20 seconds**
11	Power Loss caused log corruption
12	Bad communication with I/O Processor (Too many retries on SPI transmit)
13	A/D converter failed during A/D Cal
14	Too long without a Tape Advance (Elapse Spot time too long)

15	Configuration corrupt (Config Not Loaded from ds1511 NVRAM)

4.19 DAY_LOG_REG[STRM_REG] (byte[224], Register 620-731)

A Day Log Record is 14 bytes:

Bytes	Data Type	Description	Range
0-3	ANSI float	HiValue	
4-7	ANSI float	LoValue	
8-9	int	Year	0 to 99 = Year 2000 to 2099
10	char	Mon	1 to 12
11	char	Day	1 to 31
12	char	Hr	0 to 23
13	char	Min	0 to 59

Day Logs are qualified by the STRM_REG.
Day Logs are "paged" by the NXT_LOG_REG register A "page" of Day Logs is 16 records or 224 bytes.
Day Logs are qualified by the STRM_REG register. Requested data will be returned for the stream number set in the STRM_REG (0..3).
A day log record is saved every 3 minutes. When the equivalent of 9 days of records is reached, the oldest 2 days are discarded.
As long as register requests are in multiples of record size, any record or sequence of records may be requested.
Records are returned starting with the most recent.

4.20 SUM_LOG_REG[STRM_REG] (byte[224], Register 732-843)

A Summary Log Record is 14 bytes:

Byte	Data	Valid values
0	Year(2000-2099)	0..99 (Years 2000 to 2099)
1	Month	1..12
2	Day	1..31
3	Hour	0..23
4	Min	0..59
5	Auto Cal Cycle Time Days	0..99
6	Auto Cal Cycle Time Hours	0..99
7	NA	

Summary Logs are qualified by the STRM_REG.
Summary Logs are "paged" by the NXT_LOG_REG register. A "page" of Day Logs is 16 records or 224 bytes.
Summary Logs are qualified by the STRM_REG. Requested data will be returned for the stream number set in the STRM_REG (0..3).
Summary logs are Day logs compressed to a reading every 15 minutes. When the equivalent of 41 days are in the log, the oldest 12 days are discarded and 29 days remain.
As long as register requests are in multiples of record size, any record or sequence of records may be requested.

Records are returned starting with the most recent.

5 Diagnostics Function code 0x08

See the MODBUS spec for more details.

5.1 Return Query Data (code 0x00)

The data passed in the request data field is to be returned (looped back) in the response. The entire response message should be identical to the request.

5.2 Restart Communications (code 0x01)

The remote device serial line port must be initialized and restarted, and all of its communications event counters are cleared. If the port is currently in Listen Only Mode, no response is returned. This function is the only one that brings the port out of Listen Only Mode. If the port is not currently in Listen Only Mode, a normal response is returned. This occurs before the restart is executed

5.3 Listen Only Mode (code 0x04)

Forces the addressed remote device to its Listen Only Mode for MODBUS communications. This isolates it from the other devices on the network, allowing them to continue communicating without interruption from the addressed remote device. No response is returned.

6 Quick Reference

Holding Registers				
Register	**Register Contents**	**Data Type**	**Read (0x03)**	**Write (0x04**
0	NXT_LOG_REG	word		X
1	STRM_REG	word		X
2	CLEAR_LOG_REG	word		X
3	RESET_REG	word		X
4	CLOCK_REG	byte[8]	X	X
5				
6				
7				
8	AUTO_CAL_REG/Enable, Zero, Span	byte	X	X
9	FLOW_ALARM_REG	byte	X	X
10	TAPE_ALM_REG	ANSI float MSW	X	X
11				
12	AUTO_CAL_TIME_REG	byte[8]	X	X
13				
14				
15				
16	ALM_1_LVL_REG [STRM_REG]	ANSI float MSW	X	X
17				
18	ALM_2_LVL_REG [STRM_REG]	ANSI float MSW	X	X
19				
20	ALMS_ENABLED_REG	byte[4]	X	X
21				
22	SET_TO_FACTORY_REG [STRM_REG]	word	X	X
23	ACTIVE_STREAM_REG	word	X	X
24	STREAM_STAT_REG 0,1	byte[4]	X	X
25	STREAM_STAT_REG 2,3		X	X
26	ALM_LATCH_REG	byte[2]	X	X
27	RANGE_WRT_REG	ANSI float MSW	X	X
29	PASSWORD_REG	Int		

Input Registers ReadOnly (0x04)		
Register	**Register Contents**	**Data Type**
0	PROCESS_VALUE[ACTIVE_STREAM_REG]	ANSI float MSW
1	PROCESS_VALUE[ACTIVE_STREAM_REG]	
2	STATUS MSW	32 bit Word
3	STATUS LSW	
4	ENGR_UNITS	byte[4]
5		
6	ACTIVE_RANGE [STRM_REG])	ANSI float MSW
7		
8	FIELD_REF_REG [STRM_REG]	ANSI float MSW
9		
10	LAST_CAL_REG	INT
11	SERIAL_NO_REG	INT
12	MODEL_NO_REG Byte 0,1	byte[8]
13	MODEL_NO_REG Byte 2,3	
14	MODEL_NO_REG Byte 4,5	
15	MODEL_NO_REG Byte 6,7	
16	TAPE_REMAIN_REG	ANSI float MSW
17		
18	FLOW_RATE_REG	ANSI float MSW
19		
20	ALARM_INST_REG	byte[2]
21	LED_PWR	INT
22	PCB_TEMP	INT
23	FT_TAPE_REMAIN	ANSI float MSW
24		
25	MV_START	INT
26	SW_VERSION	byte[6]
27		
28		
29	OPTIONS_REG	INT
500	EVENT_LOG Id, Yr [NXT_LOG_REG]	
501	EVENT_LOG Mo,Dy [NXT_LOG_REG]	
502	EVENT_LOG Hr, Min [NXT_LOG_REG]	
503	EVENT_LOG Stream #, State [NXT_LOG_REG]	
…	…	
619	End of Bank of 30 eLog Records (120 Registers)	
620	DAY_LOG_REG HighVal	ANSI float MSW
621	DAY_LOG_REG HighVal	
622	DAY_LOG_REG Low Val	ANSI float MSW
623	DAY_LOG_REG Low Val	
624	DAY_LOG_REG Year YYYY	INT
625	DAY_LOG_REG Mon, Day	byte[2]
626	DAY_LOG_REG Hr, Min	byte[2]
…	…	

731	End of Bank of 16 Records	
732	DAY_LOG_REG HighVal	ANSI float MSW
733	DAY_LOG_REG HighVal	
734	DAY_LOG_REG LowVal MSW	ANSI float MSW
735	DAY_LOG_REG LowVal LSW	
736	DAY_LOG_REG Year YYYY	INT
737	DAY_LOG_REG Mon, Day	byte[2]
738	DAY_LOG_REG Hr, Min	byte[2]
…	…	
843	End of Bank of 16 Records	
32768	PROCESS_VALUE[StreamIndex] as 8 digit	
32769		
32770		
32771		
32772		
32773		
32774		
32775		
32776	RTS LogDataRec with data as 8 digit	
32777		
32778		
32779		
32780		
32781		
32782		
32783		
32784		
32785		
32786		
32787		
32788		
32789		
32790		
32791		
32792		
32793		
32794		
32795		
32796		
32797		

Diagnostics(function code 0x08)	
Subfunction code	Description
0x00	Return Query Data
0x01	Restart Communications
0x04	Force Listen Only

7 Examples:

7.1 PROCESS_VALUE

To query the current PROCESS_VALUE, from the analyzer with MODBUS ID 1, you would need to read(function code 0x04) 2 registers(PROCESS_VALUE is a 32-bit float, comprised of 2 16-bit registers), you would need to construct this query:

Byte #	Byte Value	Explanation
0	0x01	Unit Id / Slave Address
1	0x04	Function Code: Read Input Registers
2	0x00	MSB of Start Register (PROCESS_VALUE)
3	0x00	LSB of Start Register (PROCESS_VALUE)
4	0x00	MSB of Number of Registers
5	0x02	LSB of Number of Registers
6	0x71	MSB of CRC
7	0xCB	LSB of CRC

And you should receive this response:

Byte #	Byte Value	Explanation
0	0x01	Unit Id / Slave Address
1	0x04	Function Code: Read Input Registers
2	0x04	Number of Data Bytes to Follow
3	0x3C	MSB of ANSI float Process Value
4	0x06	
5	0xF0	
6	0x05	LSB of ANSI float
7	0x93	MSB of CRC
8	0xD6	LSB of CRC

The payload is 4 bytes: 0x3C, 0x06, 0xF0, 0x05 which can be shifted into an ANSI float at 0x3C06F005 and has a practical value of 0.008235936.

7.2 SERIAL_NO_REG

To query the SERIAL_NO_REG, from the analyzer with MODBUS ID 1, you would need to read(function code 0x04) 2 bytes from registers 11(0x0B in hex), you would need to construct this query:

Byte #	Byte Value	Explanation
0	0x01	Unit Id / Slave Address
1	0x04	Function Code: Read Input Registers
2	0x00	MSB of Start Register (SERIAL_NO_REG)
3	0x0B	LSB of Start Register (SERIAL_NO_REG)
4	0x00	MSB of Number of Registers
5	0x01	LSB of Number of Registers
6	0xB1	MSB of CRC
7	0xCB	LSB of CRC

And you should receive this response:

Byte #	Byte Value	Explanation
0	0x01	Unit Id / Slave Address

1	0x04	Function Code: Read Input Registers
2	0x02	Number of Data Bytes to Follow
3	0x08	MSB of 32-bit integer Serial Number
4	0xA5	LSB of 32-bit integer Serial Number
5	0x7E	MSB of CRC
6	0x8B	LSB of CRC

Inspecting the payload of 0x08 0xA5 tells us the Serial number of this unit is 2213.

7.3 DAY_LOG_REG

To query the DAY_LOG_REG, from the analyzer with MODBUS ID 1, you would need to read(function code 0x04) up to 224 bytes in multiples of 14 registers from register 620-731. In this example, we query for 112 register:

Byte #	Byte Value	Explanation
0	0x01	Unit Id / Slave Address
1	0x04	Function Code: Read Input Registers
2	0x02	MSB of Start Register (DAY_LOG_REG)
3	0x6C	LSB of Start Register (DAY_LOG_REG)
4	0x00	MSB of Number of Registers(112)
5	0x70	LSB of Number of Registers
6	0x30	MSB of CRC
7	0x4B	LSB of CRC

And you should receive a response starting with this(a full payload would be much longer):

Byte #	Byte Value	Explanation
0	0x01	Unit Id / Slave Address
1	0x04	Function Code: Read Input Registers
2	0xE0	Number of Data Bytes to Follow
3-224	*	Payload data
225	0xF0	MSB of CRC
226	0xC2	LSB of CRC

A single log record might appear as:

Byte #	Byte Value	Explanation
0-3	0x00000000	0.00 Hi Value, 4-byte ANSI Float
4-7	0x00000000	0.00 Lo Value, 4-byte ANSI Float
8-9	0x0013	20**19** Year, 16-bit integer
10	0x02	February, Month, char
11	0x12	19th Day, char
12	0x0F	4PM, Hour, char
13	0x09	9, Min, char

7.4 DIAGNOSTICS

See the MODBUS spec for diagnostics examples.

SUGGESTED SPARE PARTS TWO+ YEARS OPERATION

Please note: when ordering parts or supplies please advise Serial # and Model # for the Analyzer & Components.

Qty.	Part #	Description
1	K-011012	Sample Flow Controller (Digital)
1	K-011008	Carrier Flow Controller (Digital) 214 Only
1	T1420-150	120-240VAC Power Module (if equipped)
1	T1420-350	12-24VDC Power Module (if equipped)
1	T0372-001	Valve, 3-way
1	T1460-100	Electronics Assy. (Requires Analyzer Sr#)
1	T1200-500	Detector Block Assy.
4	T0234-100	Drive Belt
1	T0387-210	Flow meter
2	T1202-004	Humidifier Assy., Large
1	T0435-001	Key Pad
1	T1201-011	Pressure Block Assy.
1	T1203-011	Motor for tape Assy.
1	T1206-001	Pinch Roller Assy.

SUPPLIES FOR START-UP & ONE YEAR OPERATION

Qty.	Part #	Description
12	000098	Sensing Tape
8	T1501-100	Humidifier Solution-Quart Bottle

REPLACEMENT PARTS LIST

K-174 (Gas)	Sample Transfer Stripper Unit. Dilution Device. Specify Range & Analyzer Serial # (if equipped)
K-011012	Sample Flow Controller
K-011008	Carrier Flow Controller
T-1412-011	Display Module. Specify Range & Analyzer Serial #
T-1400-100	Electronics Assy. for H2S Detector (Requires Analyzer Sr#)
1200-500	Detector Block Assy., slit
T0234-100	Drive Belt
T0387-210	Flow meter
T1202-004	Humidifier Assy., Large

T0435-001	Key Pad
T1201-011	Pressure Block Assy.
T1203-011	Motor for tape Assy.
T1206-001	Pinch Roller Assy.

T0387-210	Flow Indicator for H2S Detector
K-011009	Flow Controller Display
K-016013	Power Supply 24 VDC
K-018011	X Purge Controller 115VAC 0.2 Setpoint
K-018014	X Purge Controller 230VAC 0.2 Setpoint

Analytical Systems KECO, LLC

281-516-3950

281-351-8925 Fax

www.liquidgasanalyzers.com

Support@kecosystems.com | Sales@kecosystems.com

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