

# Total Sulfur ANALYZER MANUAL

Series 1600- II



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Identifies and describes the functions of the components of the analyzer.

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The Installation section contains information about and steps involved in installing the analyzer.

## **Section 5.....** [Operation](#)

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# Introduction

## Detection Technology\_\_\_\_\_

The primary detection technology of **Analytical Systems International** 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 H<sub>2</sub>S. 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 H<sub>2</sub>S 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 H<sub>2</sub>S 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

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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 International** to achieve superior performance and easy operation.

- Sample flow is tangent to **ASI Tape** to eliminate effects from porosity variations when sample is passed through the substrate
- Signal generation is based on H<sub>2</sub>S 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.
- **Analytical Systems International** 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

## **Technical Support**\_\_\_\_\_

**Analytical Systems Int'l** offers technical support, training, and service. Contact the factory or your local sales representative for details.

## **Product Improvement Policy**\_\_\_\_\_

**Analytical Systems International** equipment was designed and built to the performance requirements stated in the product specifications at the time of manufacture. It is **Analytical Systems Int'l** policy to perform continuous product improvement research that often results in modifications that improve the performance of **Analytical Systems Int'l** equipment. When such improvements are developed we may, from time to time, notify owners of **Analytical Systems Int'l** equipment and offer any available upgrades at reasonable prices.

## **Area Classifications**\_\_\_\_\_

**Analytical Systems Int'l** analyzers can be configured for General Purpose use or for use in any of the following NEC area classifications (with the exception of the portable unit which is for General Purpose use only). The configuration must be determined at the time of order placement.

**Class I** - Locations in which flammable gases or vapors are (or may be) present in the air in quantities sufficient to produce explosive or ignitable mixtures.

### **Division 1**

Locations in which hazardous concentrations of flammable gases or vapors exist continuously, intermittently, or periodically.

### **Division 2**

Locations in which volatile flammable liquids or gases are handled, processed, or used, but are normally kept in closed containers and can only escape due to accidental rupture. The hazardous conditions will occur only under abnormal conditions.

**Class II** - Locations that are hazardous because of the presence of combustible dust.

### **Division 1**

Locations in which explosive or ignitable amounts of combustible dust is (or may be) in suspension in the air continuously, intermittently, or periodically.

### **Division 2**

Locations where combustible dust deposits exist but are not likely to be thrown into suspension in the air, but where dust deposits may be heavy enough to interfere with safe dissipation of heat from electrical equipment or where dust may be ignited by arcs, sparks or burning material from the equipment.

# General Information

## Specifications

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<b>Display:</b>	Alpha Numeric LCD 128x64 Pixels
<b>Temperature Ranges:</b>	0°C to 50°C (operating) 0°C to 70°C (storage)
<b>Analog:</b>	Isolated 4 - 20mA
<b>Analytical Performance:</b>	Resolution: 1 ppb Accuracy: ±2% of Scale Repeatability: ± 1% of Scale Linearity: ± 1% of Scale Drift: Nil Temp. Coefficient: .01%/°C Analysis Time at Sensor: 1 Second Chemical Interference: None
<b>Area Classification:</b>	General Purpose
<b>Weight:</b>	~100 Pounds
<b>Dimensions:</b>	30"w x 13"h x 30"l
<b>Power Required (No Options):</b>	110VAC, 50/60Hz .(1000 Watts)
<b>Digital Outputs:</b>	14 Available
<b>Digital Inputs:</b>	6 Available
<b>Communication:</b>	4-20 mA Isolated Output

## Unit Information

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A serial number tag is located inside the analyzer. This tag provides the following information:

Model Number	Power
Serial Number	Area Classification
Range	

Customer service is available by phone. You should have the above information ready when you call **Analytical Systems Int'l**. This will help technicians in giving you the assistance you need.

## Supplies

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**Humidifier Solution** - 5% Acetic Acid, available in quart bottles  
Year Supply - approximately 8 quarts, per analyzer

**Analytical Systems Int'l Tape** - Lead Acetate Sensing Tape, available in 100'x1/2" rolls  
Year Supply - approximately 6 rolls, per analyzer

## Spare Parts

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A spare parts listing for your analyzer can be found in section 7 of this manual.

## Maintenance Schedule

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**Analytical Systems Int'l Tape Replacement** - The tape should last four 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.

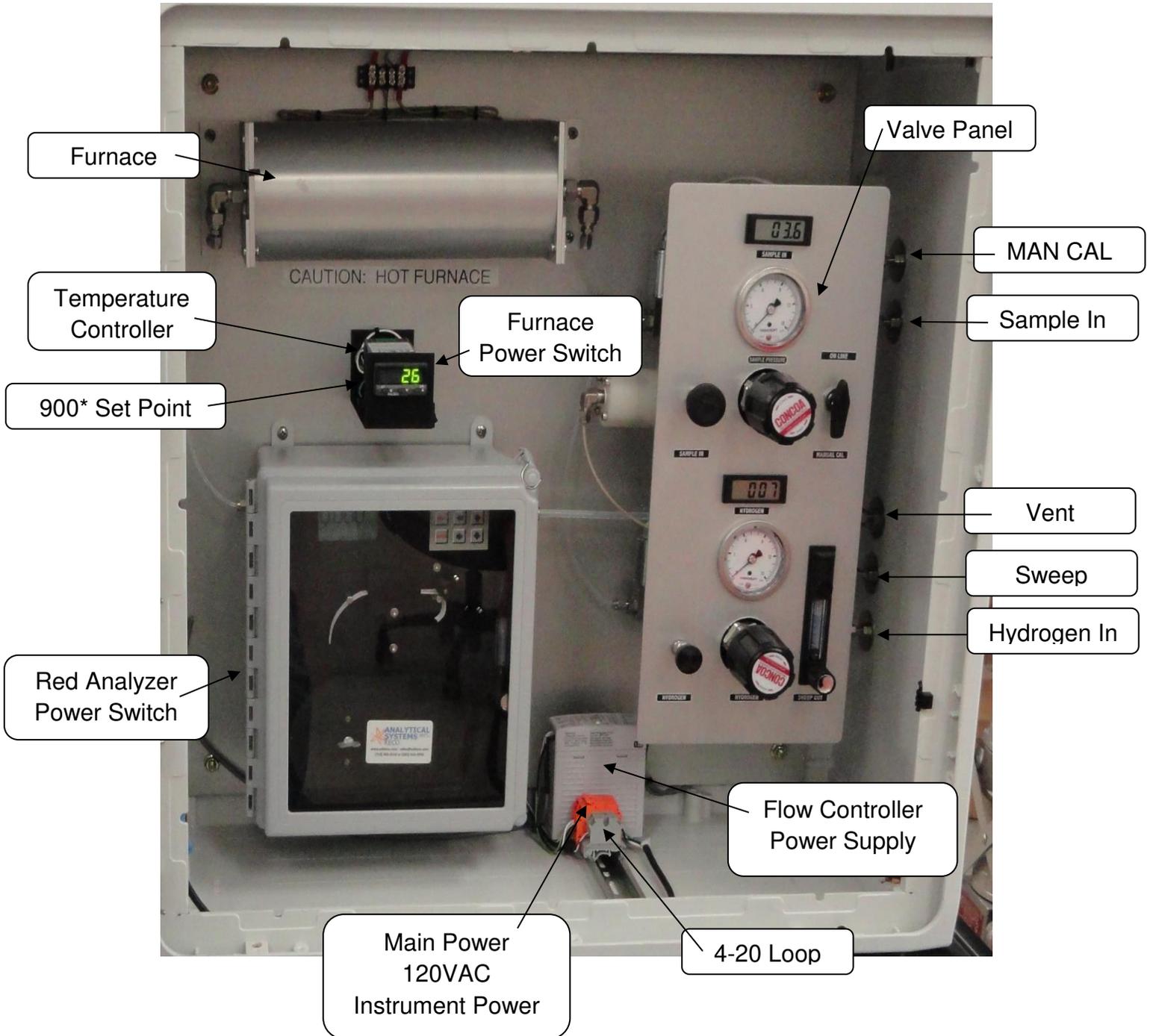
**Sample Filter Element** - Should be checked / cleaned periodically as consistent with your stream characteristics. (If your analyzer is equipped with the Liquids Removal Filter, check the filter membrane periodically. See the Options section of this manual for instructions on changing the membrane.)

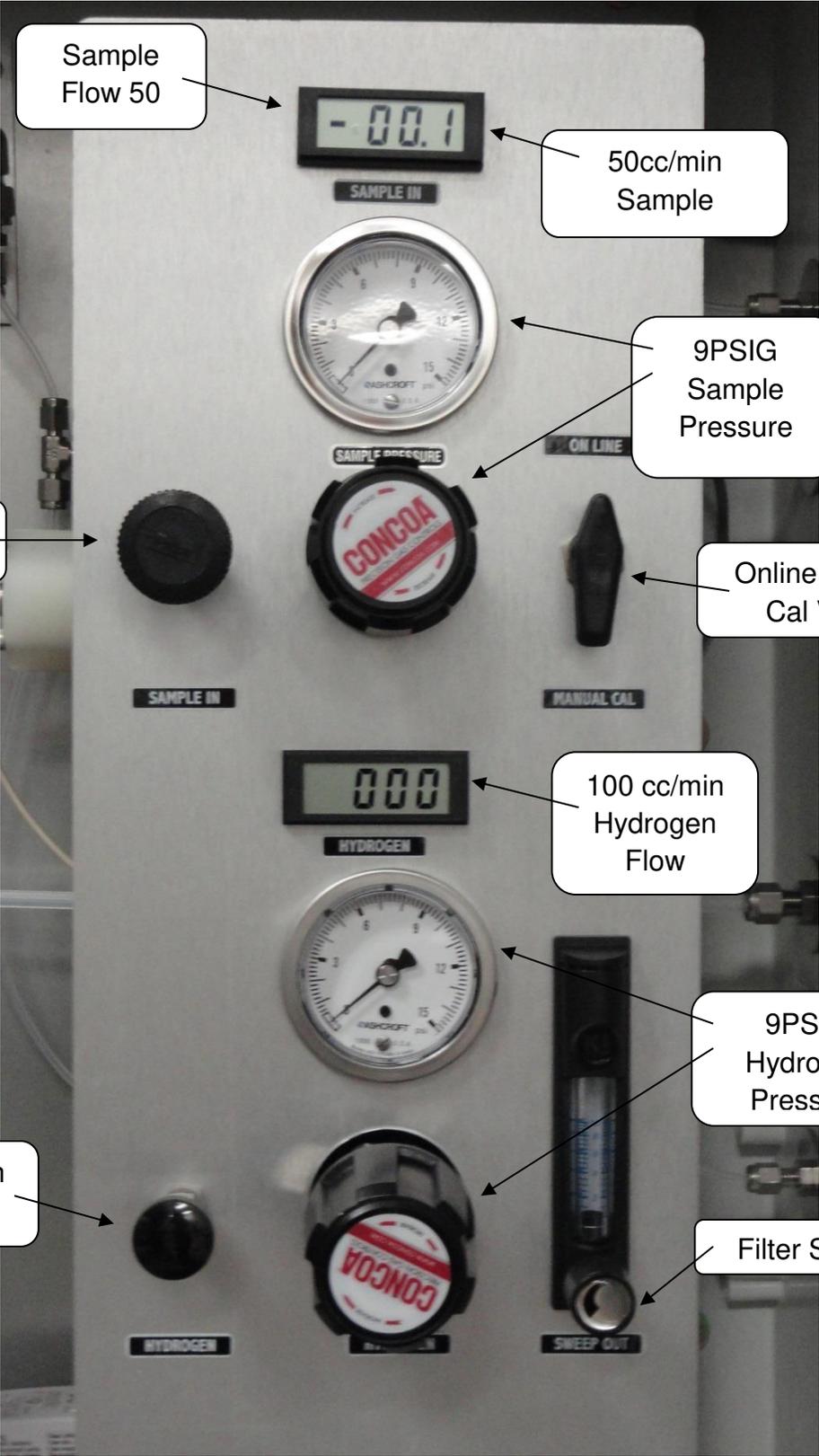
**Calibration Gas Cylinders** - Check as needed for adequate supply levels.

# Components

This section identifies the components of the **Analytical Systems Int'l** analyzer. 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\*\*\*.





Sample Flow 50

-00.1

50cc/min Sample

9PSIG Sample Pressure

9PSIG Sample Pressure

Sample On/Off

SAMPLE IN

CONCOA

ON LINE

MANUAL CAL

Online Manual Cal Valve

000

100 cc/min Hydrogen Flow

9PSIG Hydrogen Pressure

9PSIG Hydrogen Pressure

Hydrogen On/Off

SAMPLE IN

MANUAL CAL

HYDROGEN

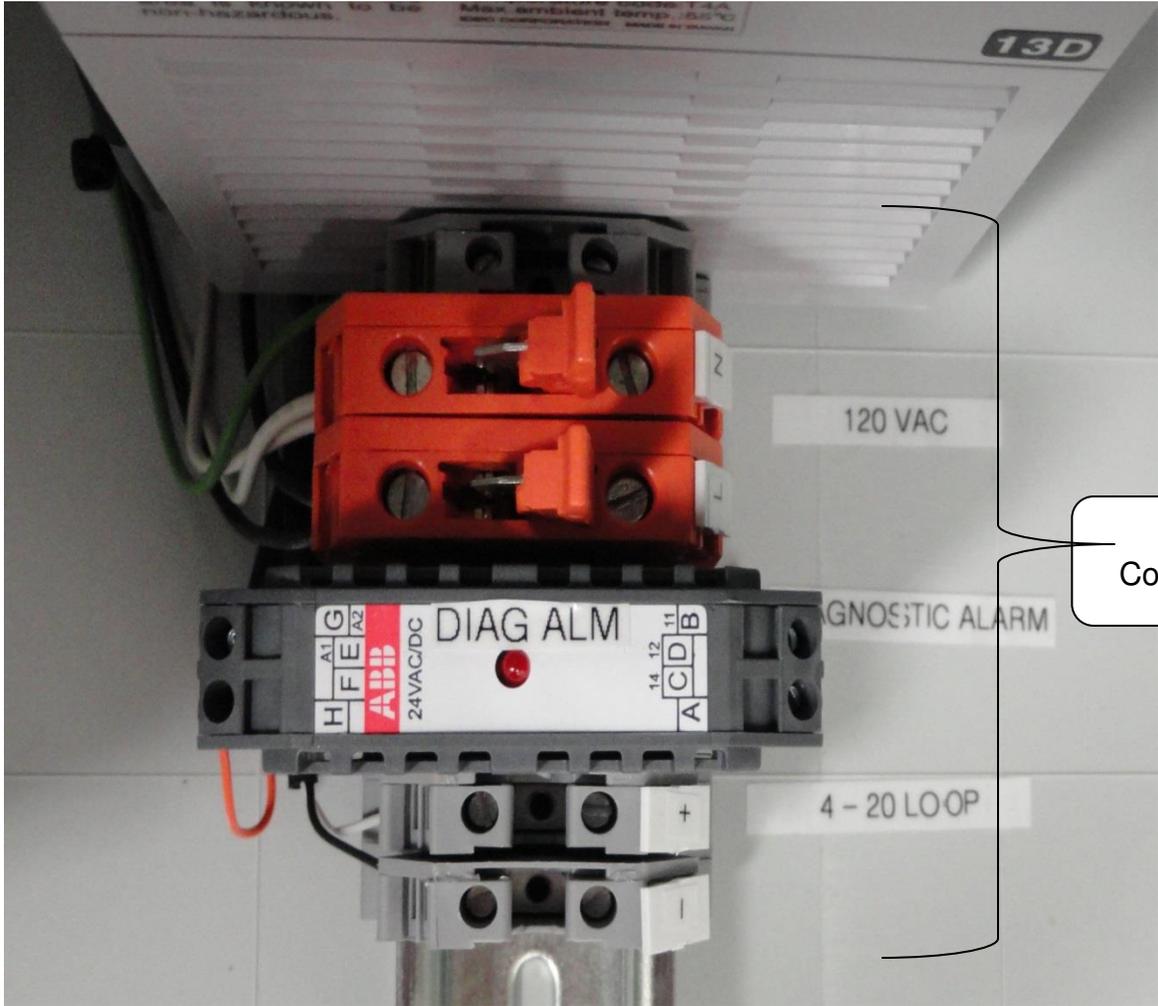
CONCOA

SWEEP OUT

Filter Sweep

HYDROGEN

SWEEP OUT



13D

120 VAC

User Connections

DIAGNOSTIC ALARM

4 - 20 LOOP

H F E A2 A1 G  
ABB  
24VAC/DC  
DIAG ALM

14 12 11 10  
A C D B

## Front of Tape Deck Panel

### **KEYPAD**

Used to control the system input and functions.

### **PINCH ROLLER**

Provides correct pressure to aid capstan in advancing tape.

### **DRIVE SHAFT**

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 the unused portion of sensing tape still on the roll.

### **TAKE-UP SHAFT**

Receives and holds the used portion of the sensing tape.

### **PRESSURE BLOCK**

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

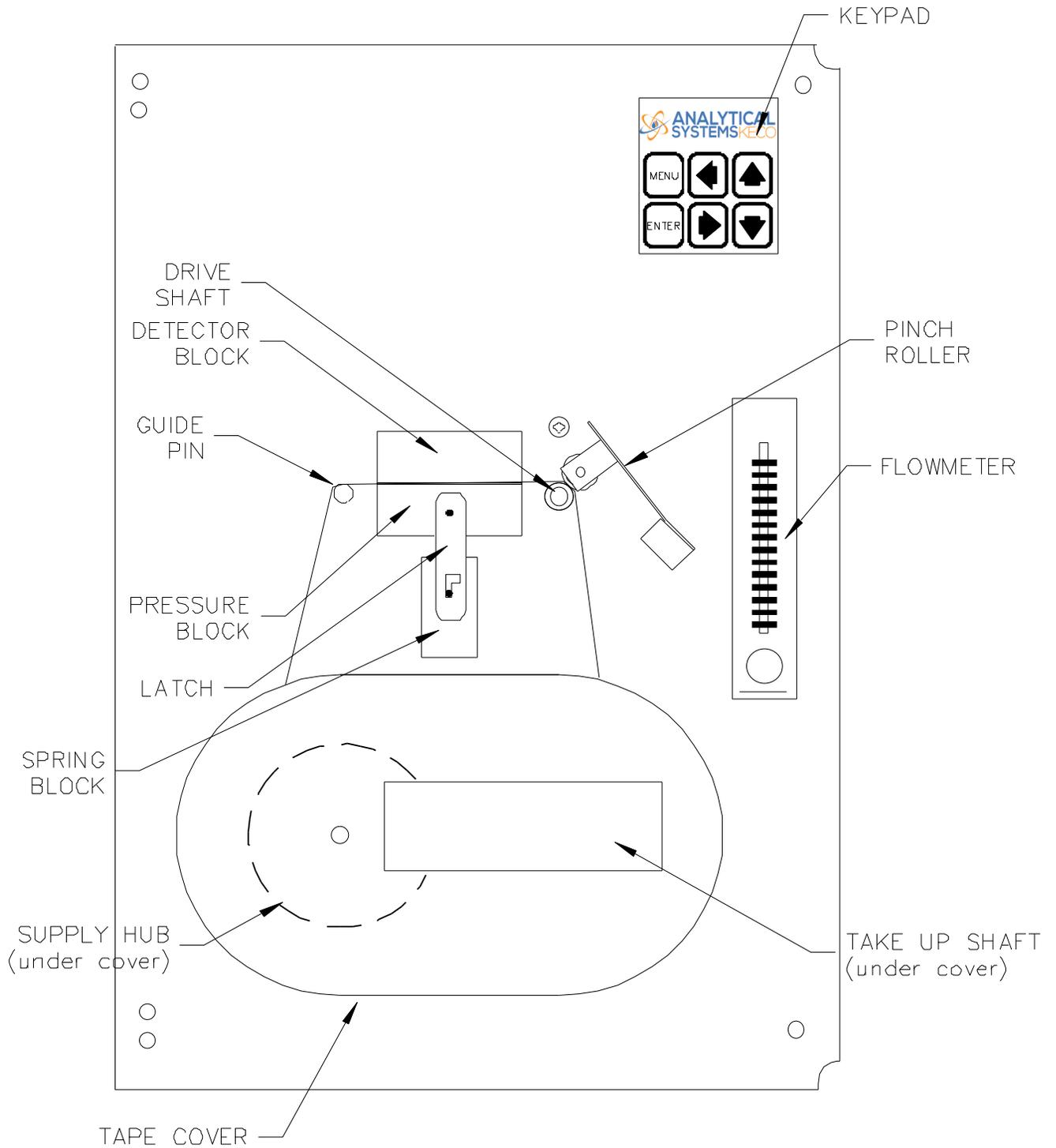
### **SPRING BLOCK/ LATCH**

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

### **FLOW METER**

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

# Front of Tape Deck Panel



## Rear of Tape Deck Panel

### **FLOW METER**

Controls and 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. It provides a clutch function by slipping as the take-up spool size increases.

### **TAKE-UP PULLEY**

Turns the take-up shaft.

### **HUMIDIFIER**

Humidifies the incoming sample.

### **FILL CAP**

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

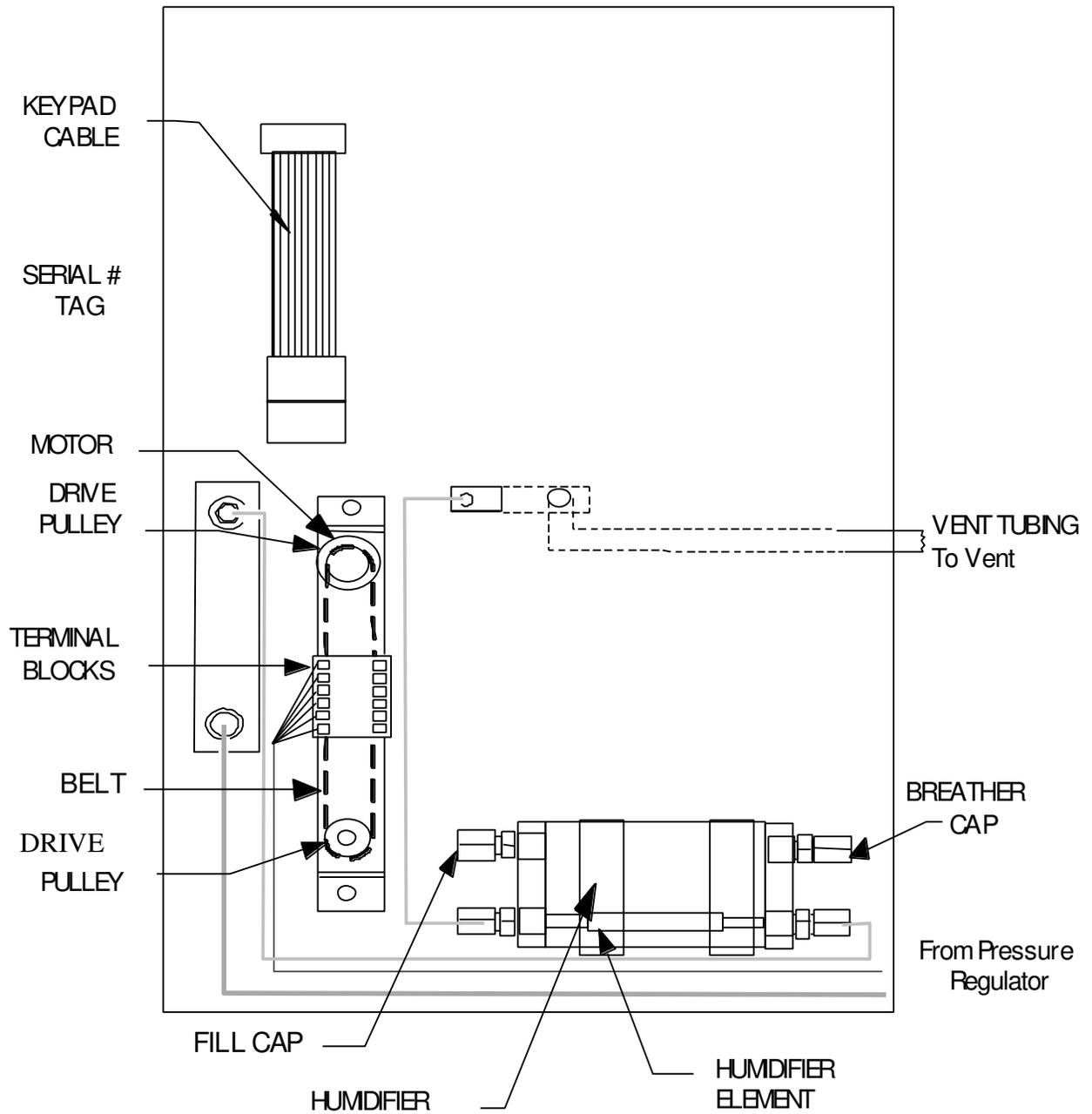
### **BREATHER CAP**

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.

### **VENT TUBING**

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

# Rear of Tape Deck Panel



# Installation

The **1600-II** Series H<sub>2</sub>S analyzers are designed for use in the following area classifications:

## General Purpose

### Unpacking

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- Upon receipt, visually inspect the shipping crate/box for possible damage that may have occurred in shipment. Make note of any damage.
- Open the crate/box.
- Remove any packing materials that may be inside the analyzer – around flow meters, etc.
- Carefully remove analyzer from crate/box. **DO NOT DROP!**
- 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.

### Location

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Determine the site location for the analyzer. Refer to the Drawings Section for exact measurements for mounting bracket spacing.

**NOTE: Vertical placement of the analyzer should be such that the display is a few inches above operator eye level.**

Mount the analyzer on the wall or pole(s) using adequate bolts for proper support.

### Humidifier Solution

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Fill the humidifier with solution. The humidifier is located behind the hinged tape deck panel and is accessible by opening the panel. See the Maintenance section for filling procedure.

### Sensing Tape Installation

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Install fresh roll of sensing tape. See the Maintenance Section for the installation procedure.

## **Power Up Analyzer** \_\_\_\_\_

Install and hook up the power cord. Make sure that the power switch is in the OFF position before plugging in the power cord. Turn on the power switch. The words **Analytical Systems Int'l** will appear on the LCD panel display and the Tape Motor should run for a second. The measurement screen will automatically appear after approximately ten seconds.

Familiarize yourself with the menu pages of the display by reading the **Operation section** of this manual. Open the instrument enclosure and locate the **Analytical Systems Int'l** keypad.

Set the correct date and time as follows:

- 1) Press the menu button on the keypad.
- 2) On the menu page, use the arrows to place the X cursor on "clock."
- 3) Press Enter.

The clock page will appear. To update date or time, place the X cursor under the number to be changed. Simply press the up or down arrow key to increase or decrease the value on the screen. Press Enter after completing the update. Press menu to escape back to the menu screen.

## **Connecting Vent** \_\_\_\_\_

Make connection for sample vent. The vent is a 1/4" connection and is to be vented to the atmosphere. Do not connect anything that will cause back pressure.

## **Alarm Connections** \_\_\_\_\_

Alarm connections on the **Analytical Systems Int'l** Analyzer instruments are mounted internally.

Refer to Alarms in the Options section for location of these connections. Care should be taken to avoid exceeding the maximum rating of these outputs, as damage to the control circuitry may occur. Follow approved wiring methods when making the connections.

# Operation

**NOTE: SEE THE MANUAL ADDENDUM FOR ADDITIONAL OPERATIONAL INFORMATION**

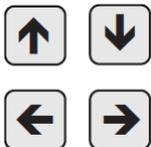
Operations of **Analytical Systems Int'l** analyzers are accessed through the menu on the keypad.



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.



## Logo Screen

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

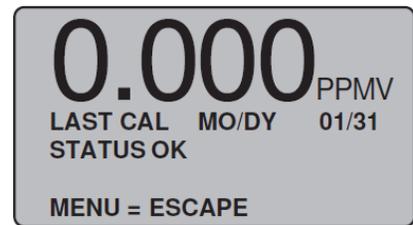


## Status Screen

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At power on, the Logo Screen is replaced by the status screen in three to ten seconds.

The status screen shows the current measured amount of H<sub>2</sub>S 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, pressing while pressing the or will adjust the brightness.

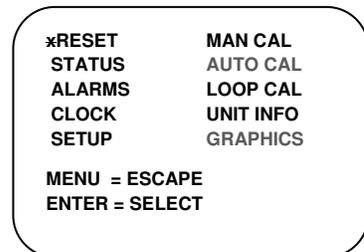
Entering the MENU key at this point will display the main menu.

## Main Menu

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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 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 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.



**0.000** PPMV  
 LAST CAL MO/DY 00/00  
 STATUS OK  
 MENU = ESCAPE

OPTION NOT AVAILABLE ON ALL UNITS

xRESET            MAN CAL  
 STATUS            AUTO CAL  
 ALARMS            LOOP CAL  
 CLOCK             UNIT INFO  
 SETUP             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  
 \*  
 N 2        1.000    1.000  
 MENU = ESCAPE  
 ENTER = SELECT

**CLOCK**  
 CLOCK            YR/MO/DY/HR/MI/SEC  
 IN USE            07/07/07/07/07  
 UPDATE           07/07/07/07/07  
 x  
 MENU = ESCAPE  
 ENTER = SELECT

**SETUP**  
 \*TAPE 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  
 ENTER = SELECT

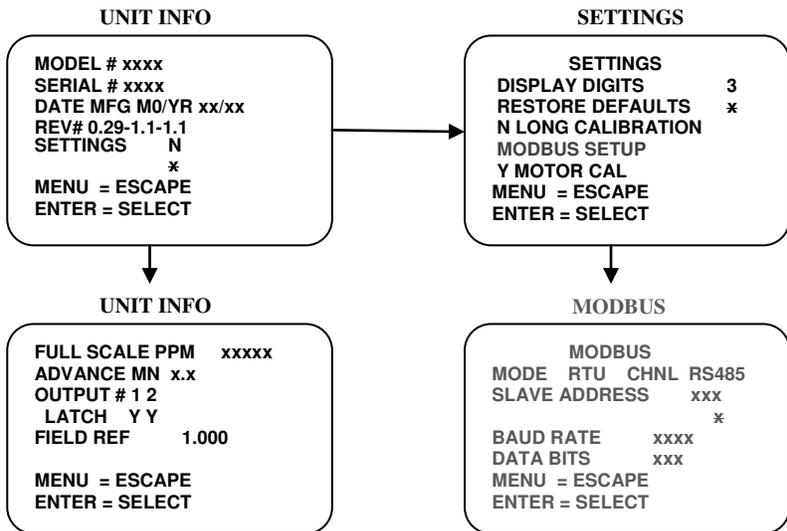
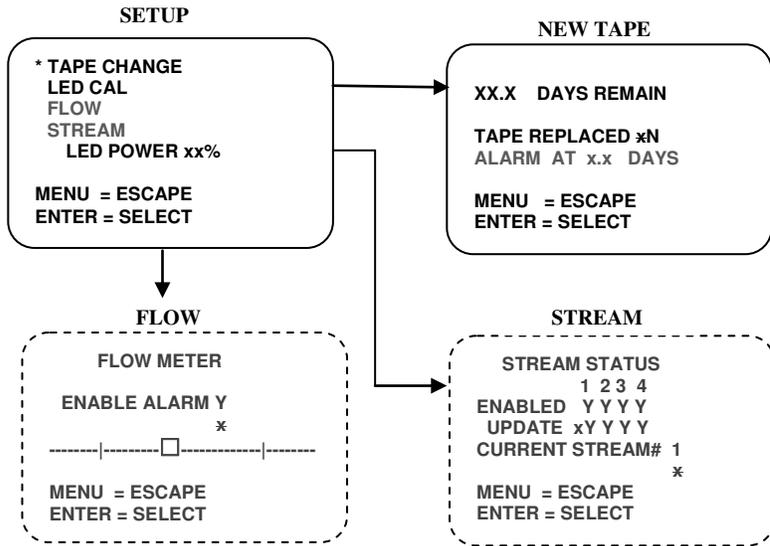
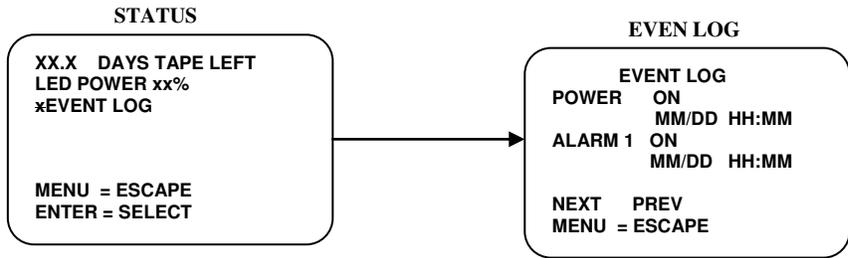
**AUTO CAL**  
 AUTO CALIBRATION  
 xSTART    SET TIME  
 SPAN VALUE  
 IN USE    x.xxx    ZERO Y  
 UPDATE    x.xxx    SPAN Y  
 MENU = ESCAPE  
 ENTER = SELECT

**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 MO/YR XX/XX  
 REV# x.xx-x.x-x.x  
 SETTINGS N  
 \*  
 MENU = ESCAPE  
 ENTER = SELECT

**GRAPHICS**  
 xREAL TIME  
 WEEK LOG  
 MONTH LOG  
 SAVE LOGS  
 MENU = ESCAPE  
 ENTER = SELECT





## Status

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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.

```
XX.X DAYS TAPE LEFT
LED POWER xx%
*EVENT LOG
```

```
MENU = ESCAPE
ENTER = SELECT
```

```
EVENT LOG
POWER ON
MM/DD HH:MM
ALARM 1 ON
MM/DD HH:MM
NEXT ↑ PREV ↓
MENU = ESCAPE
```

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

## Alarms

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

## Clock

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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  to save the information to system memory.

Press  to return to the Main Menu.

```
CLOCK YR/MO/DY/HR/MN
IN USE 00/ 00/ 00/ 00/ 00
UPDATE 00/ 00/ 00/ 00/ 00
X
```

```
MENU = ESCAPE
ENTER = SAVE
```

Analyzers with Serial Number greater than 2000 always have years in the 21<sup>st</sup> century. If a year is “00” this indicates the year 2000. If a year is “98” this indicates the year 2098.

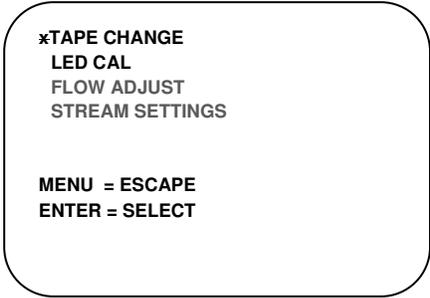
## Setup

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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.
- **FLOW ADJUST** - If the Analyzer has the Electronic Flow meter option, use that part of the Option section.
- **STREAM SETTINGS** - If the Analyzer has multiple Ranges/Streams, use that part of the Options section.



×TAPE CHANGE  
LED CAL  
FLOW ADJUST  
STREAM SETTINGS

MENU = ESCAPE  
ENTER = SELECT

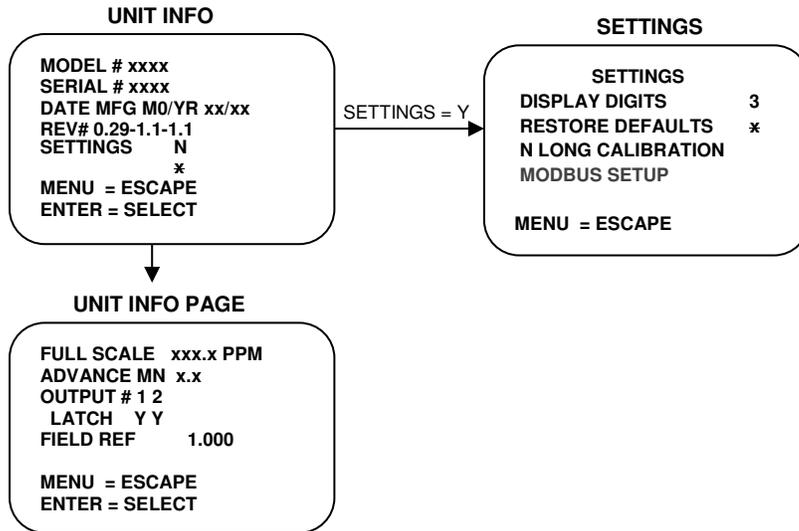
## Manual Calibration

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This function allows the analyzer to be calibrated with a known standard calibration gas. See the Maintenance section for more details.

# Unit Information

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When you choose the Unit Info page from the main menu, this page will be displayed. There are two pages containing unit information. To see the second page, press .

The information contained on these two pages was stored in the system memory at the factory. It is meaningful information that will be of help if you ever need to call the factory for help in operations or service.

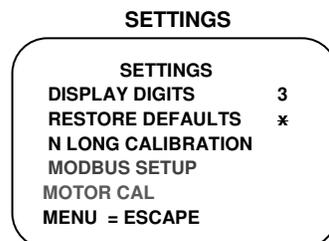
The following information is provided on the two pages:

## Page 1

<b>MODEL #</b>	The model number of this analyzer.
<b>SERIAL #</b>	The factory assigned serial number of this analyzer
<b>DATE</b>	The month and year that the analyzer was shipped.
<b>REV. #</b>	The revision number, if any, of the software version in this analyzer.

## SETTINGS:

If the  or  is used on the first page to set SETTINGS to Y and then pressing ENTER the SETTINGS menu is displayed. Functions on this screen are for advanced users only. Changing these settings should only be done in consultation with **Analytical Systems Int'l Technical Support**.



**DISPLAY DIGITS** Sets the number of decimal points to show on the Status Screen display.

<b>RESTORE DEFAULTS</b>	Restores the instrument to the Factory defaults set in the software. After defaults are restored, all user settings must be verified. Alarms, Calibration Gas Values etc.
<b>LONG CALIBRATION</b>	If this is set to Y, the next calibration will include a fundamental adjustment of the way the analyzer calculates readings.
<b>MODBUS SETUP</b>	See the Modbus Section of the Options section for information on Modbus Setup.
<b>MOTOR CAL</b>	See the Low Tape Alarm Option section for information on this function.

## Page 2

<b>FULL SCALE</b>	This is the full scale range of the analyzer ( i.e. If a range of 0 - 1 PPMV was ordered , then FULL SCALE would read 1PPMV ) If the Range Change option is installed, use the left or right arrow on the first page to change the alarm latch settings and the range. Range changes are primarily to set the scale and the 4-20mA loop output. The responsiveness and stability of the reading will be best at the range on the serial number tag.
<b>ADVANCE MN</b>	This is the maximum length of time between tape advances.
<b>OUTPUTS</b>	Displays the concentration alarm outputs on the analyzer and whether or not they are latching.
<b>FIELD REF</b>	Reference number to relate field calibration source.

## **Graphics**\_\_\_\_\_

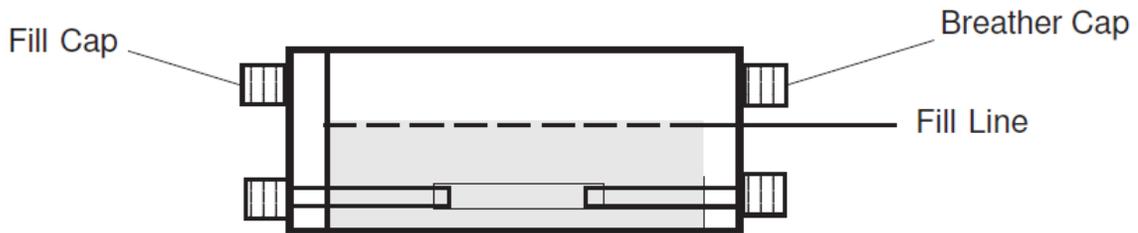
Graphics screens present real time and historical data in a graphical format. For more information on the Graphics option, see the Option section.

## **Loop Calibration**\_\_\_\_\_

The 4-20mA output loop is optional. Information on this option can be found in the options section of this manual, if you have purchased this option.

# Maintenance

## Filling the Humidifier with Solution



- 1) 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.
- 2) Using a clean fill bottle, add new **Analytical Systems int'l** humidifier solution through the fill cap opening. **CAUTION: DO NOT fill the humidifier above the level of the fill cap and breather cap.**
- 3) 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.**

- 4) 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 (5).
- 5) 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.
- 6) Begin again with step (2).

## Installing Sensing Tape

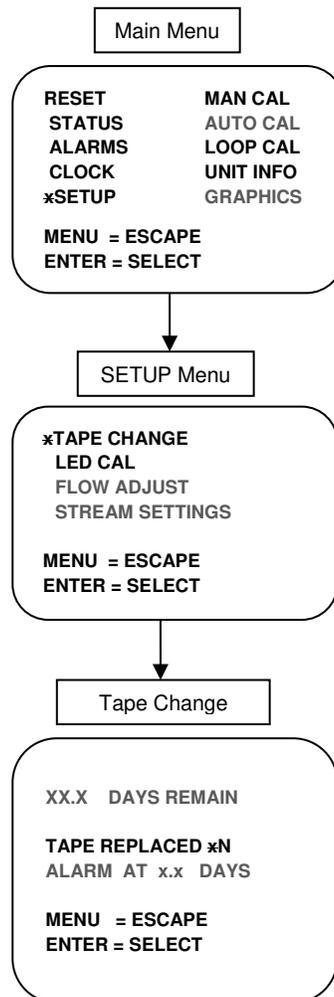
The following procedure is not required to change tape. Using this procedure will prevent unnecessary alarms during tape change and reset the tape remaining estimate. This procedure may also improve performance immediately after a new roll of tape is installed.

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 shaft with a small bit of adhesive tape.
- 11) Rotate the take-up shaft 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) Set the Analyzer flow to the desired flow rate 0.3SCFH.
- 19) Press MENU to return to the main menu and begin gas sampling.
- 20) Press RESET on the Menu Page and check for proper tape advance. The tape should move approximately 1/8" to 1/4" and stop.

## Manual Calibration

Analytical Systems Int'l Analyzers do not require periodic calibration. If calibration is required due to environmental conditions, the following procedure may be used.

1. From the main menu, select MAN CAL.



```

RESET          x MAN CAL
STATUS         AUTO CAL
ALARMS        LOOP CAL
CLOCK         UNIT INFO
SETUP         GRAPHICS

MENU = ESCAPE
ENTER = SELECT
  
```

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. Press to save the chosen value.

```

MANUAL CALIBRATION
-xSTART  SET=FACTORY
SPAN GAS VALUE
IN USE                                     x.xxx
UPDATE                                     x.xxx
  STREAM NUMBER# x
MENU = ESCAPE
ENTER = SELECT
  
```

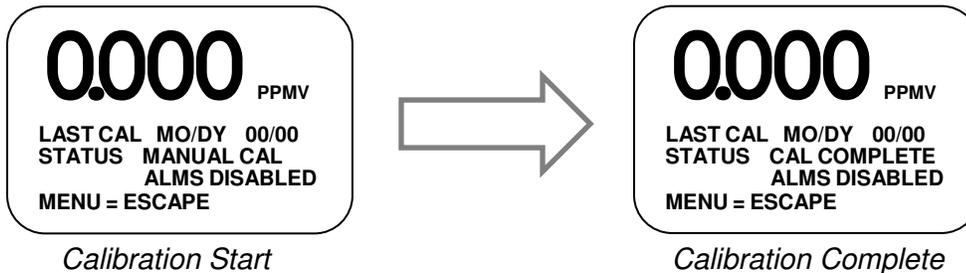
**NOTE: To determine whether or not the value has been saved, look at the IN USE value after pressing ENTER. The IN USE value should be the same as the UPDATE value.**

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

5. Use  and/or  to move cursor back to START.  to begin calibration.
6. Connect Calibration Gas to the analyzer and adjust the flow as necessary.

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. When the calibration is complete, disconnect the calibration gas and reconnect the gas to be measured.
8. Wait for the reading to return to the online value.
9. Press Menu and Enter to Reset the Analyzer and enable the alarms.

The calibration process may be stopped at any time. 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.

## LED Calibration

---

1. Enter the SETUP 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.

RESET            MAN CAL  
STATUS          AUTO CAL  
ALARMS          LOOP CAL  
CLOCK           UNIT INFO  
\*SETUP           GRAPHICS

MENU = ESCAPE  
ENTER = SELECT

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.

TAPE CHANGE  
\*LED CAL  
FLOW  
STREAM  
LED POWER xx%

MENU = ESCAPE  
ENTER = SELECT

- 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.
    - 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.
    - 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.
    - When CAL FAIL appears after an LED CAL, the reason for failure should 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.

# Problem Solving

Because of the advanced state-of-the-art microprocessor and other electronic circuitry, **Analytical Systems Int'l** 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 drawing of the rear of the tape deck (pg. 3-5) 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.

## Gas Flow

---

Verify that the flows are set as follows:

Sample Flow meter      Fully Open

*Adjust, if necessary*

## 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 **Analytical Systems Int'l Tape**.

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 **Analytical Systems Int'l factory** (Phone 281-516-3950 or Fax 281-351-8925). Personnel will assist you in diagnosing the problem. Have the information from the serial tag at hand when you call the factory.

<b>INDICATION</b>	<b>PROBLEM</b>	<b>CHECK FOR</b>	<b>CORRECTIVE ACTION</b>
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.
	Vent Blocked	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
	H <sub>2</sub> S 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		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 detector	Clean/Replace Detector Block
Cal Fail	Auto Calibration Error	See the Auto Calibration Section	

INDICATION	PROBLEM	CHECK FOR	CORRECTIVE ACTION
OVER RANGE	H <sub>2</sub> S 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.
		Tape not advancing	Tape should advance 1/8 to 1/4 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.  Immediately after LED Cal the LED power remaining is less than 20%.	LED not properly calibrated	Calibrate LED
		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

# TECHNICAL SERVICE BULLETIN

#120605

## PINCH ROLLER TROUBLESHOOTING AND REPAIR

### Tape Drive Symptoms:

#### 1. Tape not advancing or tape breaking at the Pinch Roller

This usually indicates a problem with the Pinch Roller Assembly. This problem is ***NEVER*** due to the Drive Belt or Take up Shaft.

- ✓ Verify that the Pinch Roller is not touching the front panel.
- ✓ Gently lift the roller away from the motor shaft and verify that the roller turns freely and does not have dirt, oil or debris on the roller or the Motor Drive Shaft.

If either of these checks fail, the Pinch Roller should be replaced or removed for cleaning and adjustment.

- ✓ Lightly press the Pinch Roller down on the Motor Shaft and use the RESET function from the main menu to advance the tape. If the tape advances properly, the Pinch Roller Spring is bent and the assembly should be replaced.

Tip to prolong the life of the Pinch Roller Assembly:

- ✓ When replacing tape, close the pressure block on the tape and then only lift the roller far enough from the Tape Drive Shaft to remove and insert new tape. Bending the Pinch Roller Spring excessively bends the spring and reduces pressure on the tape. (Figure 2)
- ✓ On Type-II Analyzers, the Tape Remaining estimate will be inaccurate if the tape slips in the Pinch Roller Assembly.

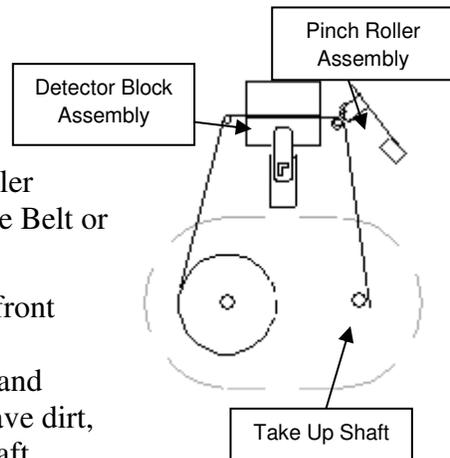


Figure 1

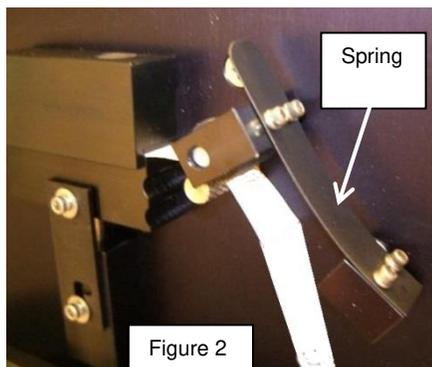


Figure 2



Figure 3

Tips for Pinch Roller Assembly Removal, inspection and repair:

- Take care to not misplace the nylon washer between the roller and the assembly. (Figure 3)
- The Roller, Roller Shaft and Motor Shaft can be cleaned with alcohol or lighter fluid. Do not use oil.
- When installing a Pinch Roller Assembly put the first #8 x 3/8" SS screw through the panel and put two #8 SS washers over the screw. The two washers help to angle the assembly away from the panel to prevent the roller from touching the panel. (Figure 4)
- After both screws are started loosely in the Pinch Roller Assembly, rotate the assembly as far as possible towards the Motor Drive Shaft and finish tightening the screws
- Verify that the hex screws are tight
- Verify that the Pinch Roller Assembly angles slightly away from the front panel. (Figure 5)

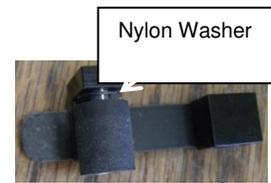


Figure 3



Figure 4



Figure 5

## 2. Tape is not wrapping on the Take Up Shaft:

- ✓ If the Drive Belt is cracked or broken, replace the Drive Belt.
- ✓ The Take Up Shaft should slide forward and backward easily and turn by hand with slight resistance. If this is not true, remove the Take Up Shaft and clean it and the bearing.
- ✓ The Take Up Shaft should not touch the tape cover when pushed all the way forward.
- ✓ The Drive Belt and pulleys may be cleaned with Alcohol or Lighter Fluid

## 3. Tape Breaks at the entry to or exit from the Detector Block:

- ✓ A screw may be loose holding the detector Plate to the Detector Block. Tighten the screws.
- ✓ If a screw is too tight holding the Detector Plate to the Detector Block the Detector Plate may become warped. Use a small file or sandpaper to smooth the warp or replace the Detector Block Assembly.



Detector Block Screws

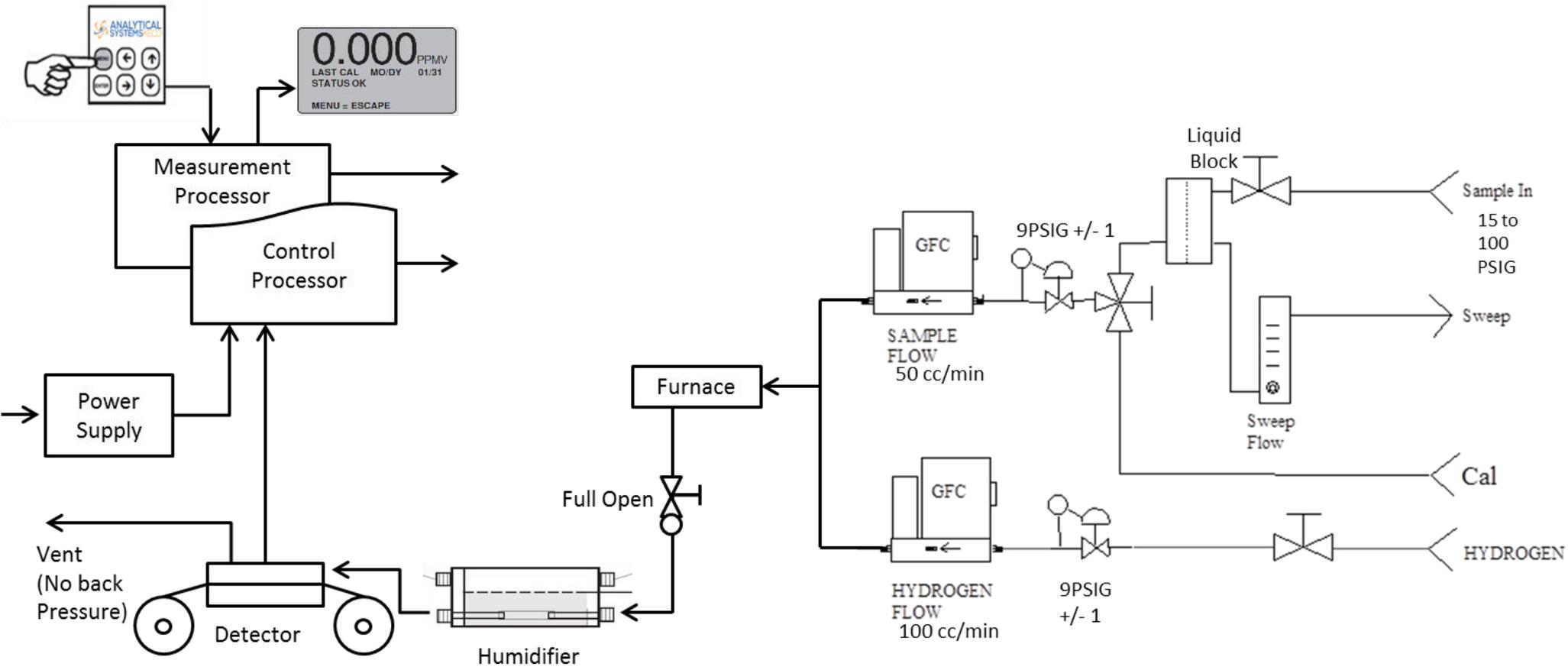
Figure 6

## 4. Tape Breaks inside the Detector Block.

- ✓ The sample gas may be too wet causing the tape to break

# **DRAWINGS**



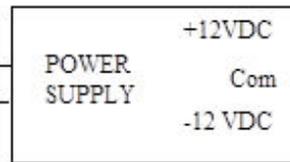
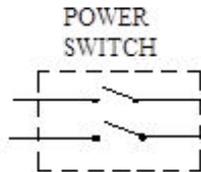


**Note:**

- Cal span gas & H2S Cylinders & associated regulators/ gauge etc. are by others.
- For ppb analysis it is critical no back pressure be applied to sample vent line or false high reading may result.

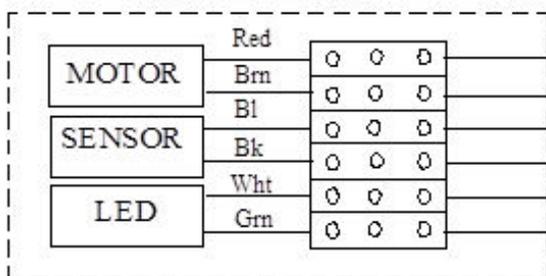
		
Title:		
SN 2180 Flow Path		
Date:	Revision:	Sheet:
08/11/14	2	1 of 1

110/220 VAC  
12/24 VDC

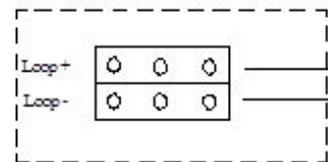


Rd +24 VDC to Alarms

TAPE DECK PANEL



OUTPUT CONNECTIONS



NOTES  
J2-2 TO J2-16 MAX 5VDC, SINK 0.005 A EACH

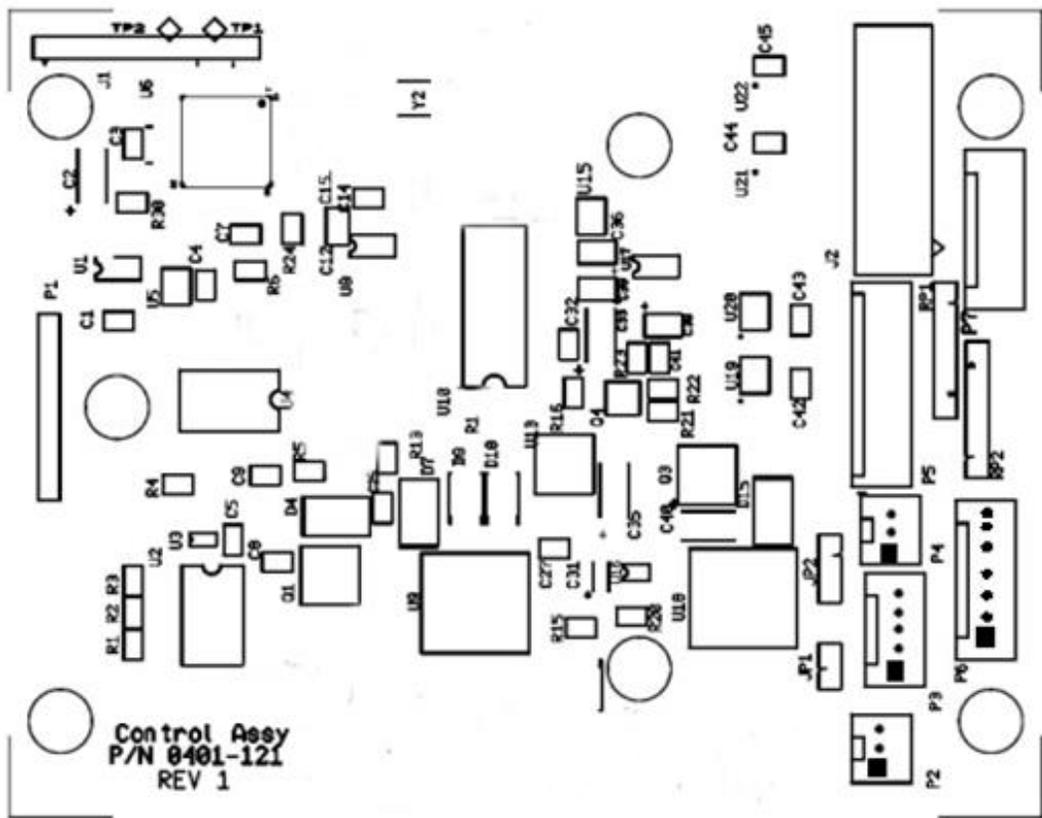
TO 401-422  
OPTO ALARM  
DRIVER

Control PCB 401-121	
Connector	Function
P2-1	+12VDC
P2-3	Common
P4-1	Motor +12 VDC
P4-3	Motor Return
P6-4	Detector +5V
P6-7	Detector Return
P6-1	LED +5.5VDC
P6-2	LED Return
P5-3	Loop+ (optional)
P5-4	Loop Return
P5-1 to P5-8	Contact Switch In
P5-9	Contact Common
P1-1 to P1-8	Loop Expansion (optional)
P7-1	2.5 VDC
P7-2	Flowmeter Signal
P7-3 to P7-4	A/D Aux
P7-5	Flowmeter +5VDC
P7-7	Common
J2-1	Contact Out +5.5VDC
J2-2 to J2-16	Contact Out Drive



401-121 Control PCB Wiring Diagram

DATE	02/25/2010	REVISION	1	SHEET	1 of 2
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Control Assy  
 P/N 0401-121  
 REV 1

■ DENOTES PIN 1

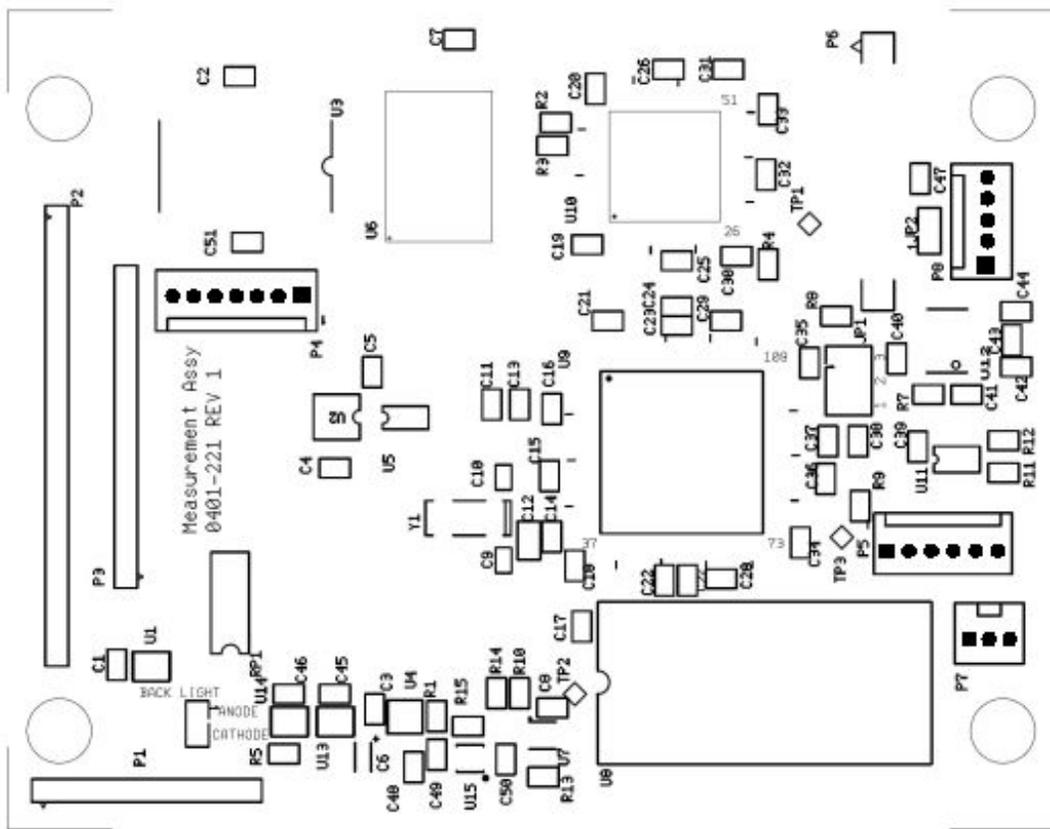


TITLE 401-121 Control PCB Wiring Diagram

DATE 02/25/2010	REVISION 1	SHEET 2 of 2
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Optional

LCD



■ DENOTES PIN 1

401-221 Measurement Assy	
DATE 03/25/2010	1 of 2

DATE 06/27/2011	REVISION 1
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# Suggested Spare Parts

For one year's operation for 1600-II Series **Analytical Systems Int'l**  
Analyzers

Description	Part Number	Note
<b>Spare Parts</b>		
LED Pressure Block Assembly	1200-011	
Detector Block Assembly	1200-021	Analyzer Serial Number Required for Part Number
Detector Block Assembly	1200-500	
Detector Block Assembly (PPB)	1200-700	
Humidifier Assembly	1202-003	
Motor Assembly	1203-011	
Pinch Roller Assembly	1206-001	
Drive Belt	0234-100	
Flow Meter	0387-110	
Keypad	0435-001	
Electronics Assembly	1460-100	Analyzer Serial Number Required for Part Number
Display Module	1412-011	
Power Supply	Serial Number Required for Part Number	
Temperature Controller (Programed)	T.S. 0453-001	
Furnace Assy for Total Sulfur 1600 & 1700	1208-001	1
<b>Supplies</b>		
<b>ASI</b> Tape	000098	6 Rolls Recommended
<b>ASI</b> Humidifier Solution	1501-100	4 Quarts Recommended
Ferrule Graphite 3/8" For Total Sulfur Furnace	0358-160	6 Recommended

Ceramic Tube for 1600 + 1700 Total Sulfur Furnace	0370-888	3 Recommended
--	----------	---------------

# Options

The following page(s) provide descriptions and/or operating instructions for particular options that you have purchased on your **Analytical Systems Int'l** analyzer. If, at any time in the future, you choose to have additional options added to your analyzer by the **Analytical Systems Int'l** factory, the appropriate information/instruction pages for this option will be provided and included in this section.

The following options are available for **Analytical Systems Int'l** analyzers:

- 4-20mA Output Loop Calibration
- Diagnostic Alarm
- Concentration Alarms
- Low Tape Alarm
- Electronic Flow meter with Alarm
- Data Communication
- Auto Calibration
- Chart Recorder
- Bottle Regulator
- Liquids Removal Filter
- Cabinet Heater
- Range Change
- On Screen Graphics
- Low Range

## 4-20 mA CURRENT LOOP

The loop is normally supplied in a "Self Powered" configuration. Applying external power to the loop will produce unpredictable results. If you wish to convert to an "external power" or isolated loop, contact Analytical Systems Int'l.

### Connection:

- The connection for the current loop is located in the 4-20 mA Alarm housing. The positive terminal is marked with a + and usually is connected to a blue or white wire. Polarity can be verified with a voltmeter when the Analyzer is powered on.
- The Loop Load Resistance can be from 0 ohms to 500 ohms in standard configurations. For higher Load Resistance requirements, contact Analytical Systems Int'l.
- If the Loop is not connected or the load resistance is too high, **OPEN LOOP** may be displayed on the main screen.

### Calibration:

The current loop was calibrated at the factory to be within 0.01 mA DC of the desired current using a 0 to 250 ohm resistive load. If the load will have non-resistive factors or to verify the loop calibration:

1. Connect a current meter set to Milliamp DC range or suitable Loop Calibration tool in line with the Loop + connection (See Figure 2).

Note: The configuration in Figure 2 will calibrate the analyzer to the complete loop.

The configuration in Figure 3 will calibrate only the Analyzer.

2. Go to the LOOP CAL menu.

If the Analyzer has more than one loop, the cursor will stop to allow the Loop number to be set. If the Loop is an open circuit (high load resistance) when the LOOP CAL menu is entered, OPEN will be displayed by the LOOP #x. OPEN will not be cleared until the circuit is closed and a key is pressed.

3. Use  and  arrows to move the cursor to 04.00 under **CHECK**. Press .
4. The current meter should read 4.00 +/-0.01 mA.

LOOP CAL

LOOP # #1	CHECK	SET	CAL
	04.00	04.00	03.95
	20.00		* 20.00

MENU = ESCAPE  
ENTER = SELECT

Figure 1

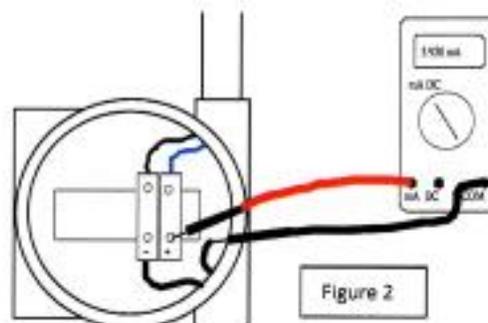


Figure 2

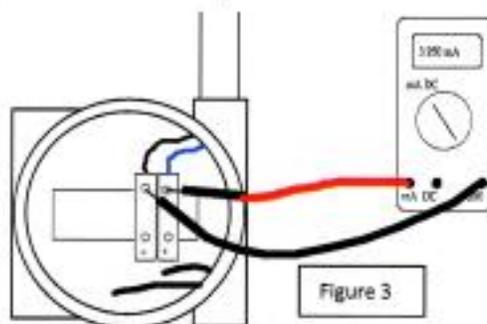


Figure 3

5. If the meter does not read correctly, use the ← and → keys to move the cursor under the **CAL** value.
6. Use the ↑ and ↓ arrows to set the **CAL** value to match the current meter reading and press .
7. The current meter should read 4.00 +/-0.01 mA. If it does not, go back to step 6.
8. Use the ← and → arrows to put the cursor beside 20.00 under CHECK. Press .
9. The current meter should read 20.00 +/- 0.01 mA.
10. If the meter does not read correctly, move the cursor under the CAL value for 20.00 mA.
11. Set the Cal value to match the current meter reading and press .
12. The current meter should read 20.00 +/- 0.01 mA. If it does not, go back to step 10.

LOOP CAL

LOOP #1		
CHECK	SET	CAL
04.00	04.00	03.95
		*
20.00		20.00
MENU = ESCAPE		
ENTER = SELECT		

The loop may be set to any value by using the SET value.

# ALARMS (Optional)

## DIAGNOSTIC ALARMS

---

Diagnostic Alarms are created to indicate a problem with the functional state of the Analyzer.

A list of alarms is shown below.

These alarms can also be connected to any combination of up to 14 contact relays.

Normally the relays are energized when the alarm is off (Fail Safe) so that an alarm is generated during power failure.

Only the CAL FAIL alarm is latched. When the condition that created any other alarm is removed, the alarm is cleared. Diagnostic alarms shown below with a \* indicate latched alarms.

ALARM	SCREEN DISPLAY	Optional Contact Output
TAPE OUT	Always	
TAPE DARK	Always	
OVER RANGE	Always	
LOW LED	Always	
AUTO CAL SPAN	Optional	
AUTO CAL ZERO	Optional	
CAL FAIL	Optional with Auto Cal	
LED CAL FAIL	Always	
CAL ON	Always, displays MAN CAL	
LOOP OPEN #x	Optional	
SYS ERROR	Always	
FLOW ERROR	Optional	
TEMPERATURE	Always	
LOW TAPE	Optional	

## CONCENTRATION ALARMS (Optional)

---

Concentration Alarms are Alarm set points for the H<sub>2</sub>S concentration. When the concentration exceeds the set point, ALARM x is indicated on the screen and a contact output is activated.

- Two alarms are available. Each can have a user set point between 0.001 and 9999.
- Each alarm can be user enabled or disabled independently.
- Normally Alarm 1 is latched and requires RESET function to clear the alarm. Alarm 2 is not latched and the alarm will clear when the concentration drops below the alarm set point. Alarm latches are defined at the time of manufacture. User control of alarm latches is optional.
- Alarms are normally Fail Safe. The alarm relay is powered until an alarm set point is exceeded. This produces an alarm when power to the analyzer is lost. If lower power consumption is required, Alarms can be made not Fail Safe at time of manufacture.

Setup:

### 1. Enable / Disable Alarms

- Use the  and  keys to place the cursor under the Y or N for the Alarm to Enabled / Disabled.
- Use the  and  keys to set the desired state.
- Press ENT to set the new state.
- To verify that the correct state was saved, use the  and  keys to move the cursor from the Y or N and verify that the correct state remains.

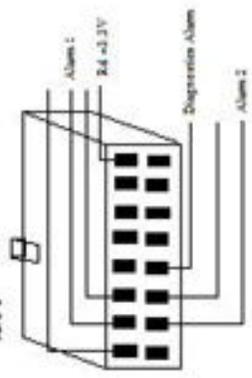
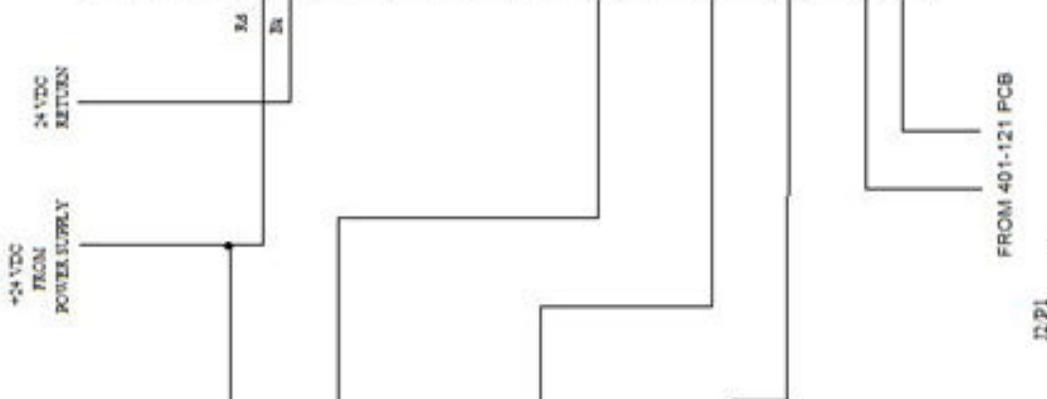
ALARMS			
ALARM #	IN USE	UPDATE	
N	1	1.000	1.000
*			
N	2	1.000	1.000

MENU = ESCAPE  
ENTER = SELECT

### 2. Change set point

- Use the  and  keys to place the \* under the UPDATE value of the alarm to be set.
- Use the , ,  and  arrows to set the Set Point Value.
- Press .
- The IN USE column should now show the new desired value.

401-422 OPTO IF ALARM DRIVER	
CONNECTOR	FUNCTION
TB1-1	+24VDC
TB1-2	+24VDC Return
TB4-1	+24VDC
TB4-2	24VDC Return
TB2-1	OPTIONAL
TB2-2	OPTIONAL
TB2-3	OPTIONAL
TB2-4	OPTIONAL
TB2-5	OPTIONAL
TB2-6	OPTIONAL
TB2-7	OPTIONAL
TB3-1	DIAGNOSTIC ALARM
TB3-2	OPTIONAL
TB3-3	OPTIONAL
TB3-4	CONCENTRATION ALARM 1
TB3-5	CONCENTRATION ALARM 2
TB3-6	OPTIONAL
TB3-7	OPTIONAL
P1-1	+3.3VDC FROM 401-121 PCB
P1-2 TO P1-16	CONTROL SIGNAL FROM 401-121 PCB



- NOTES**
- TB2-1 to TB2-7 MAX 36VDC 0.2A SINK EACH SOURCE 0.0 A
  - TB3-1 TO TB3-7 MAX 36VDC 0.2A SINK EACH SOURCE 0.0 A
  - TB4-1 AND TB4-2 ALTERNATE CONNECTORS FOR +12 VDC AND 12 V RETURN (COMMON)
  - P1-2 TO P1-16 MAX 5VDC, SINK 0.005 A EACH



TITLE  
401-422 ALARM PCB Wiring Diagram DIV 1

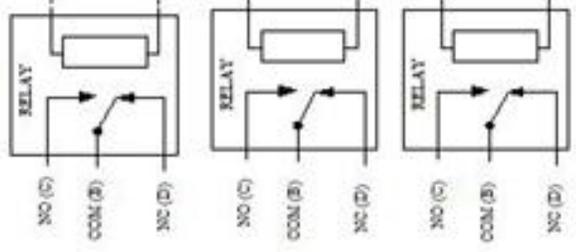
DATE  
05/04/2011

REVISION  
1

Optional

+24 VDC FROM POWER SUPPLY

24 VDC RETURN



401-422 OPTO IF ALARM DRIVER		
CONNECTOR		FUNCTION
TB2-1		+24VDC
TB2-2		+24VDC Return
TB4-1		+24VDC
TB4-2		+24VDC Return
TB2-1	OR	DIAGNOSTIC ALARM
TB2-2		OPTIONAL
TB2-3		OPTIONAL
TB2-4		CONCENTRATION ALARM 1
TB2-5		CONCENTRATION ALARM 2
TB2-6		OPTIONAL
TB2-7		OPTIONAL
TB3-1		OPTIONAL
TB3-2		OPTIONAL
TB3-3		OPTIONAL
TB3-4		OPTIONAL
TB3-5		OPTIONAL
TB3-6		OPTIONAL
TB3-7		OPTIONAL
P1-1		+3.3 VDC FROM 401-121 PCB
P1-2 TO P1-16		CONTROL SIGNAL FROM 401-121 PCB

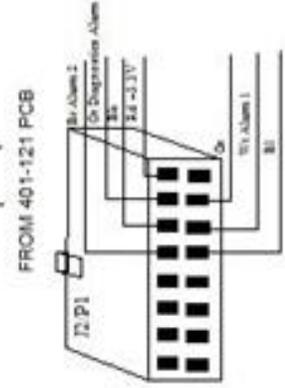
**NOTES**

TB2-1 to TB2-7 MAX 36VDC 0.2A SINK EACH SOURCE 0.0 A

TB3-1 TO TB3-7 MAX 36VDC 0.2A SINK EACH SOURCE 0.0 A

TB4-1 AND TB4-2 ALTERNATE CONNECTORS FOR +12 VDC AND 12 V RETURN (COMMON)

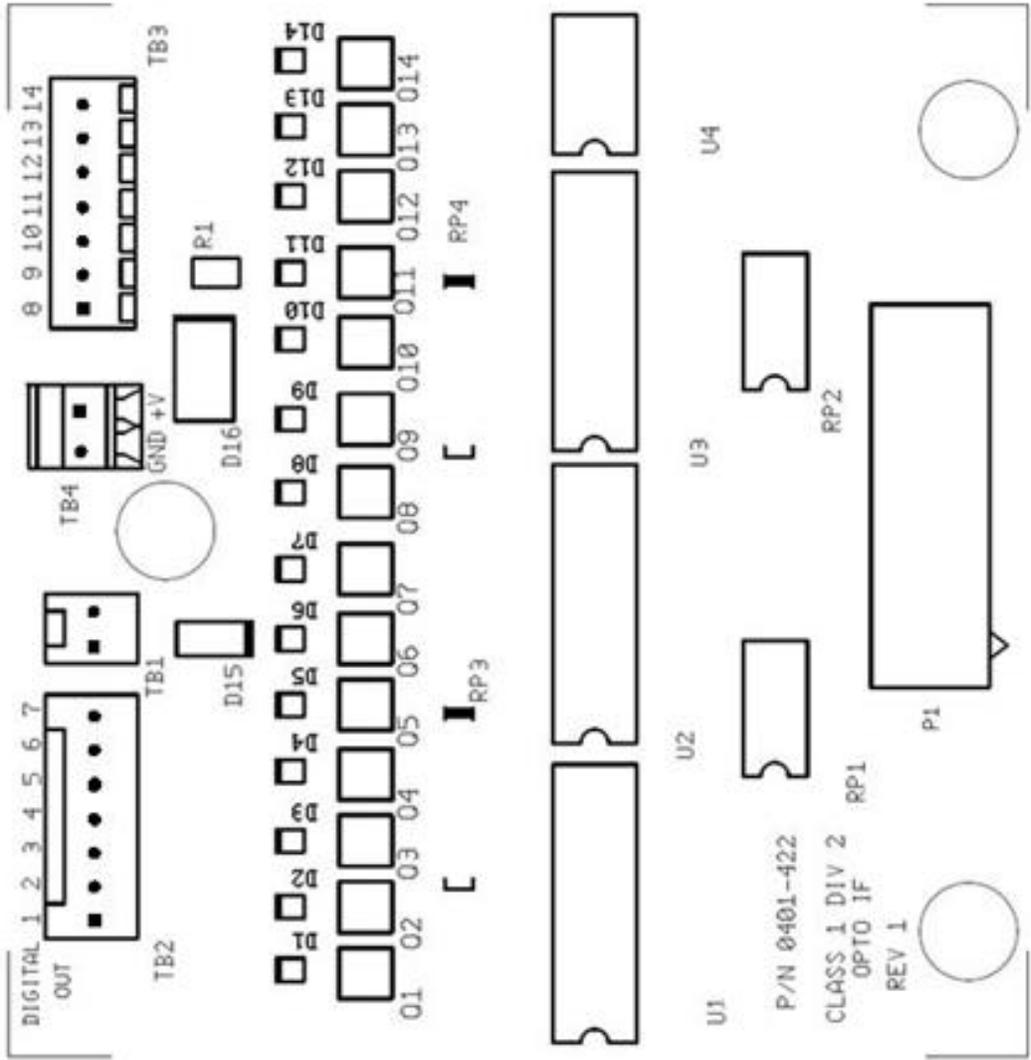
P1-2 TO P1-16 MAX 5VDC, SINK 0.005 A EACH



FILE 401-422 ALARM PCB Wiring Diagram

DATE 05/04/2011 REVISION 1

**General Purpose Option**



■ DENOTES PIN 1

# Low Range Option

## Overview

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For readings from 0.005 to 1.000 PPM, the Low Range Option must be installed. The Low Range Option is a combination of hardware and software.

The Low Range option requires 30 to 45 minutes warm-up with gas flowing after the power has been turned on to allow the readings to stabilize. This is true even if the analyzer was only powered off for a few seconds.

When the enclosure door is opened, allow 15 minutes after the door is closed for readings to stabilize.

Any out of sequence tape advances caused by the RESET Function will require 15 minutes wait for the readings to stabilize.

After the analyzer has been through the warm-up period the response will be normal.

## Tips for ppb Level

### Readings

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Note that H<sub>2</sub>S is chemically active and will “stick” to surfaces of all kinds. At ppb levels there are no molecules of H<sub>2</sub>S to waste. At ppb levels, unpassivated tubing will “scrub” the H<sub>2</sub>S from the sample.

A method to passivate the sample tubing before a reading or series of readings is to sweep a small amount of calibration gas through the measurement tubing. This allows the chemically sticky spots in the sample tubing to be deactivated by the H<sub>2</sub>S from the calibration gas.

Readings at ppb levels require that sample or air needs to be flowing during a warm up period of operation for 30 to 45 minutes.

The analyzer must be left on after warm-up to maintain sample or air flow and proper on-time tape advances. Any out of time sequence tape advance (from a RESET function) will require further warm-up time of at least 15 minutes. A power off/on cycle will require 30 to 45 minutes warm-up.

It is further recommended that the door be closed during readings to avoid reading disruptions from external events.

The basic thought process is that ppb amounts of H<sub>2</sub>S can be lost if careful procedures are not followed.

# TEMPERATURE CONTROLLER

The reducing furnace temperature is controlled with a full-featured temperature controller. The proper operating parameters for the furnace have been selected and stored in the controller.

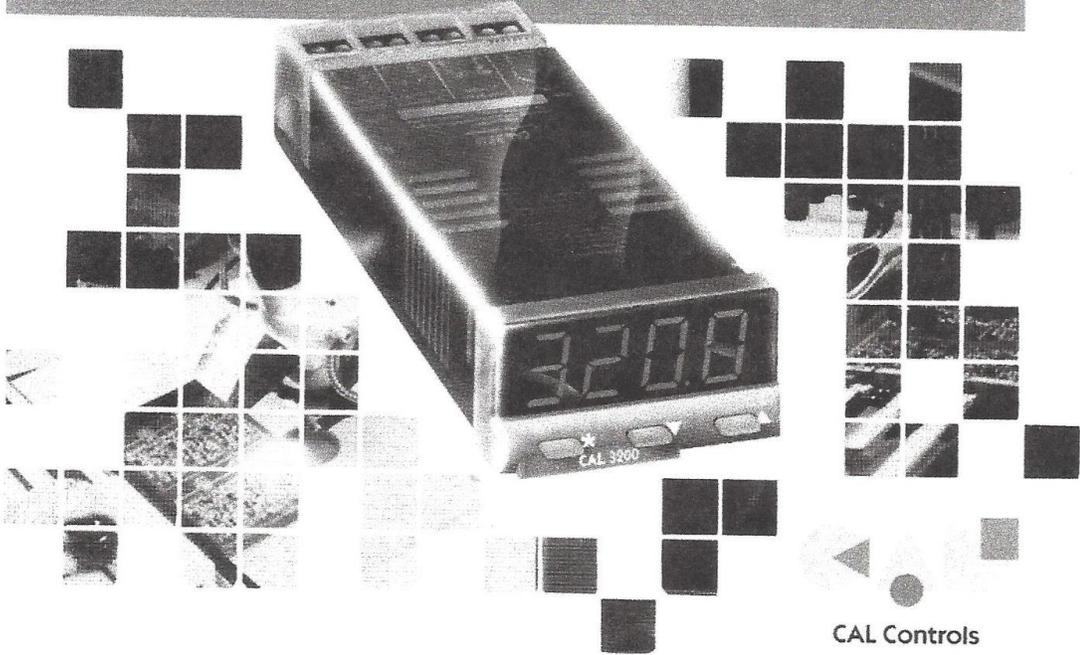
**WARNING: DO NOT CHANGE or adjust the controller operating parameters. Any changes can permanently damage the reducing furnace!**

The required parameters are listed below, with respect to a completely reset controller position.

The entire operating instructions for the controller are provided. These instructions detail how to enter the required parameters.

<p><b>LEVEL 1</b></p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td>tunE</td> <td></td> <td>DV (DO NOT USE)</td> </tr> <tr> <td>bAnd</td> <td>33</td> <td></td> </tr> <tr> <td>int.t</td> <td>1.6</td> <td></td> </tr> <tr> <td>dEr.t</td> <td>6</td> <td></td> </tr> <tr> <td>dAC</td> <td>5</td> <td></td> </tr> <tr> <td>CYC.t</td> <td>5</td> <td></td> </tr> <tr> <td>oFSt</td> <td></td> <td>DV</td> </tr> <tr> <td>SP.LK</td> <td></td> <td>DV</td> </tr> <tr> <td>SEt.2</td> <td></td> <td>DV</td> </tr> <tr> <td>bnd.2</td> <td></td> <td>DV</td> </tr> <tr> <td>CYC.2</td> <td></td> <td>DV</td> </tr> </table>	tunE		DV (DO NOT USE)	bAnd	33		int.t	1.6		dEr.t	6		dAC	5		CYC.t	5		oFSt		DV	SP.LK		DV	SEt.2		DV	bnd.2		DV	CYC.2		DV	<p><b>LEVEL 3</b></p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td>SP1.d</td> <td>SSd</td> <td></td> </tr> <tr> <td>SP2.d</td> <td></td> <td>DV</td> </tr> <tr> <td>burn</td> <td></td> <td>DV</td> </tr> <tr> <td>rEU.d</td> <td></td> <td>DV</td> </tr> <tr> <td>rEU.L</td> <td></td> <td>DV</td> </tr> <tr> <td>SPAn</td> <td></td> <td>DV</td> </tr> <tr> <td>2Ero</td> <td></td> <td>DV</td> </tr> <tr> <td>ChEK</td> <td></td> <td>DV</td> </tr> <tr> <td>rEAd</td> <td></td> <td>DV</td> </tr> <tr> <td>dAtA</td> <td></td> <td>DV</td> </tr> <tr> <td>UEr</td> <td></td> <td>DV</td> </tr> <tr> <td>rSEt</td> <td colspan="2">(Used to reset everything prior to entry of required parameters)</td> </tr> </table>	SP1.d	SSd		SP2.d		DV	burn		DV	rEU.d		DV	rEU.L		DV	SPAn		DV	2Ero		DV	ChEK		DV	rEAd		DV	dAtA		DV	UEr		DV	rSEt	(Used to reset everything prior to entry of required parameters)	
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<p><b>LEVEL 2</b></p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td>SP1.P</td> <td></td> <td>DV</td> </tr> <tr> <td>hAnd</td> <td></td> <td>DV</td> </tr> <tr> <td>PL.1</td> <td>25</td> <td></td> </tr> <tr> <td>PL.2</td> <td></td> <td>DV</td> </tr> <tr> <td>SP2.A</td> <td></td> <td>DV</td> </tr> <tr> <td>SP2.6</td> <td></td> <td>DV</td> </tr> <tr> <td>diSP</td> <td></td> <td>DV</td> </tr> <tr> <td>h s.SC</td> <td>1000</td> <td></td> </tr> <tr> <td>Lo.SC</td> <td></td> <td>DV</td> </tr> <tr> <td>inPE</td> <td>tc S</td> <td></td> </tr> <tr> <td>unit</td> <td>°C</td> <td></td> </tr> </table>	SP1.P		DV	hAnd		DV	PL.1	25		PL.2		DV	SP2.A		DV	SP2.6		DV	diSP		DV	h s.SC	1000		Lo.SC		DV	inPE	tc S		unit	°C		<p>DV = Default Value</p> <p>SET POINT 900°C</p>																																				
SP1.P		DV																																																																				
hAnd		DV																																																																				
PL.1	25																																																																					
PL.2		DV																																																																				
SP2.A		DV																																																																				
SP2.6		DV																																																																				
diSP		DV																																																																				
h s.SC	1000																																																																					
Lo.SC		DV																																																																				
inPE	tc S																																																																					
unit	°C																																																																					

# CAL 3200 AUTOTUNE TEMPERATURE CONTROLLER OPERATING MANUAL



CAL Controls

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# 1 IMPORTANT SAFETY INFORMATION ... PLEASE REVIEW

## 1.1 INSTALLATION

Designed for use:

UL873 – only in products where the acceptability is determined by Underwriters Laboratories Inc. EN61010-1 – within Installation Categories II and III environment and pollution degree 2.

To avoid possible hazards accessible conductive parts of final installation should be protectively earthed in accordance with EN61010 for Class 1 equipment. Output wiring should be within a grounded cabinet. Sensor sheaths should be bonded to ground or not be accessible.

Live parts should not be accessible without use of a tool. It is the responsibility of the installation engineer to ensure that this equipment's compliance to EN61010 is not impaired when fitted to the final installation and to use this equipment as specified in this manual, failure to do so may impair the protection provided. Ensure the installation is in compliance with appropriate wiring regulations

## 1.2 CONFIGURATION

All functions are front key selectable, it is the responsibility of the installing engineer to ensure that the configuration is safe. Use the program lock to protect critical functions from tampering

## 1.3 ULTIMATE SAFETY ALARMS

Normal safety advice: Do not use SP2 as the sole alarm where personal injury or damage may be caused by equipment failure

## WARRANTY

CAL Controls warrant this product free of defects in workmanship and materials for three (3) years from date of purchase

1. Should the unit malfunction, return it to the factory. If defective it will be repaired or replaced at no charge.
2. There are no user-serviceable parts in this unit. This warranty is void if the unit shows evidence of being tampered with or subjected to excessive heat, moisture, corrosion or other misuse.
3. Components which wear, or damage with misuse, are excluded e.g. Relays
4. CAL Controls shall not be responsible for any damage or losses however caused, which may be experienced as a result of the installation or use of this product. CAL Controls liability for any breach of this agreement shall not exceed the purchase price paid E. & O.E.

## IN BRIEF ...



## Routine adjustments

- \* View setpoint
- \* ▲ Increase setpoint
- \* ▼ Decrease setpoint

## To reset alarm or fault message

- ▼ ▲ Momentarily press together

## SYMBOLS USED IN THE MANUAL

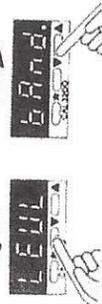
* ▼ ▲ Keys	Indicator: flashing

## 2 FUNCTIONS MENU AND PROGRAM MODE GUIDE

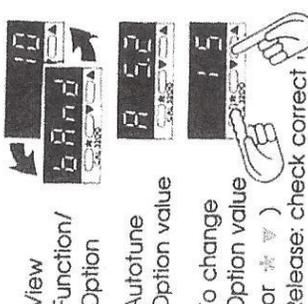
### Brief Guide:

- 1. Enter/exit program mode**  
Press and hold  $\nabla$  3 sec

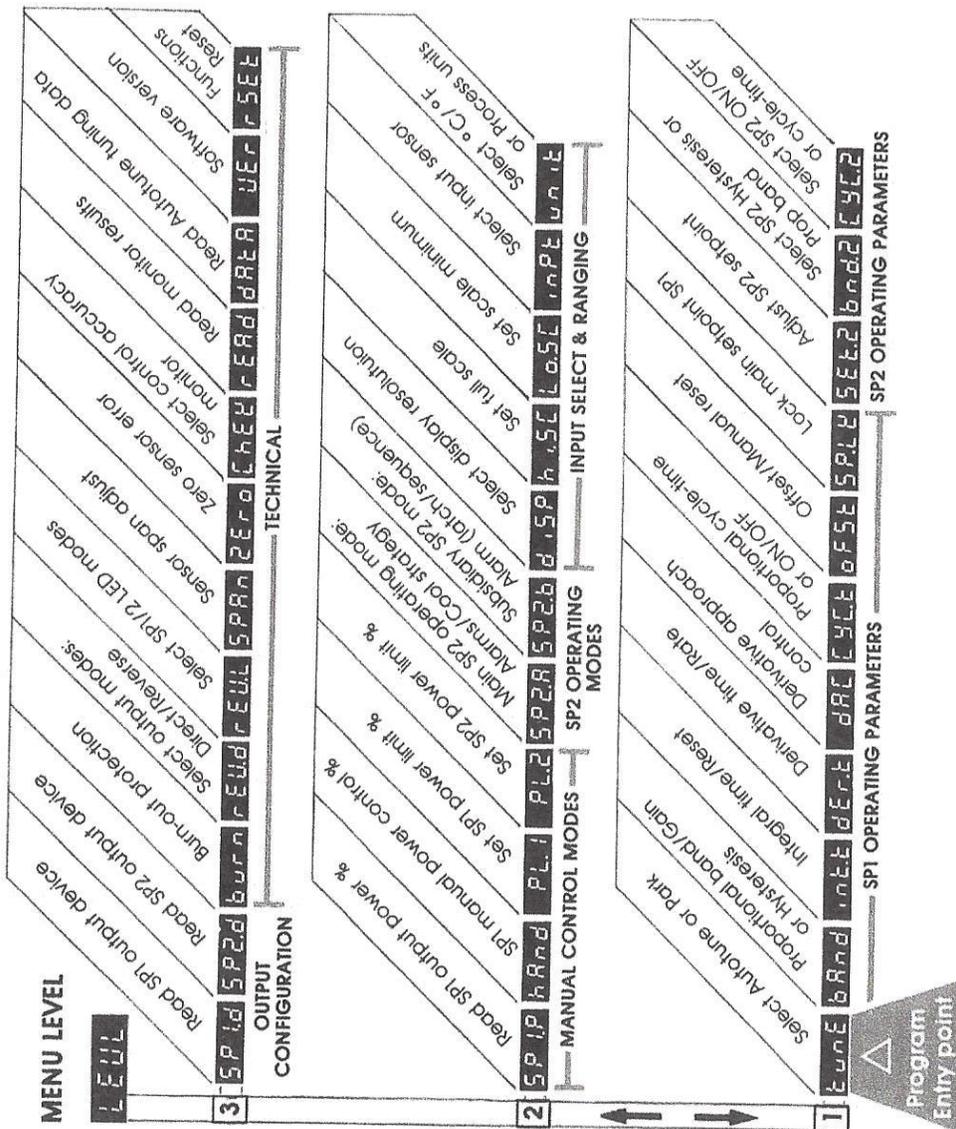
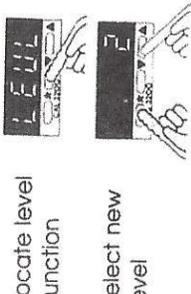
### 2. Single level navigation



### 3. View/Change Option



### 4. Changing menu levels



# Flow Controller

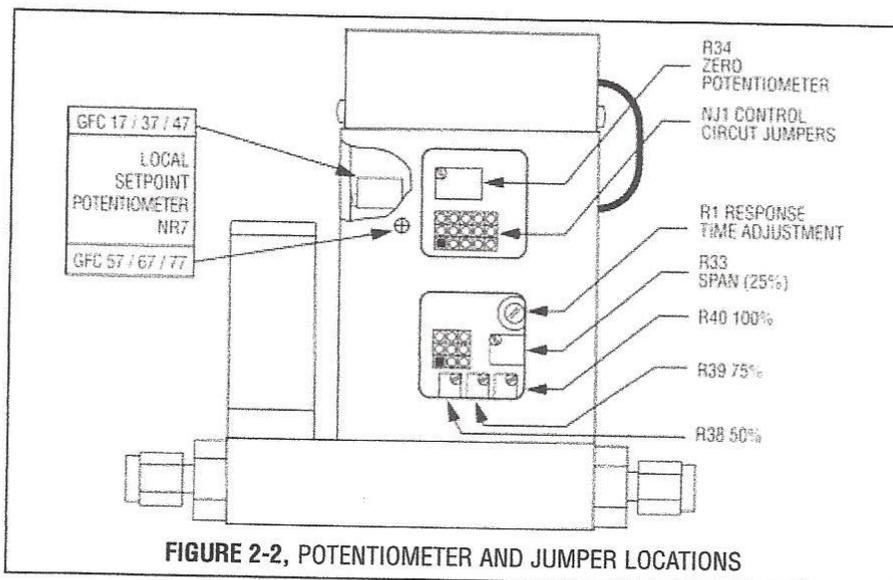


FIGURE 2-2, POTENTIOMETER AND JUMPER LOCATIONS

## 2.2.1 Valve Control Configuration

There are three basic valve control options.

- (a) LOCAL or REMOTE control.
- (b) 0 to 5 VDC or 4 to 20 mA setpoint signal -  
 \*Note: this only applies for the REMOTE control configuration;
- (c) 2% cutoff active or not active. Note: 2% cutoff not available for GFC 57/67/77.

When active, the 2% cutoff will shut off the power to the valve when a setpoint of less than 2% of the full scale flow range is set. Figure 2-2 shows the jumper configurations for the three basic valve control options.

The factory default jumper settings are: LOCAL control, 2% cutoff off, and 0 to 5 VDC.

FUNCTION	NJ1A	NJ1B	NJ1C	NJ1D	NJ1E
0 to 5 VDC	2 - 3	5 - 6	8 - 9		
4 to 20 mA	1 - 2	4 - 5	7 - 8		
local				11 - 12	
remote				10 - 11	
2% cutoff on					13 - 14
2% cutoff off					14 - 15

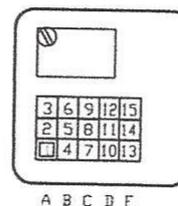


FIGURE 2-3, VALVE CONTROL CONFIGURATION JUMPERS

## 2.2.2 Remote LCD Readouts

GFC Mass Flow Controllers are available with optional remote reading LCD displays supplied with a three foot long wire to accommodate most applications. This configuration includes the upper block element which serves as the LCD readout mounting. Special lengths of remote extension wiring (up to 9.5 feet [3 meters]) are available on request.

### 2.2.3 Panel Mounting Readouts

Another option for the GFC Mass Flow Controller is the Panel Mounting Remote Readout.

In this configuration the LCD readout is supplied with a three foot long extension wire, and no aluminum housing around the LCD. The LCD readout for panel mounting includes a bezel with two plastic screws which conveniently fit into a rectangular cut-out for panel mounting (see Figure 2-3).

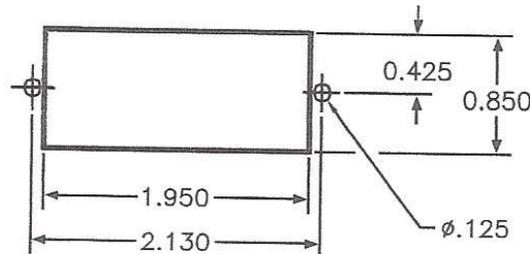


FIGURE 2-3 CUTOUT DIMENSIONS FOR LCD PANEL MOUNTING

## 3. PRINCIPLE OF OPERATION

The stream of gas entering the Mass Flow transducer is split by shunting a small portion of the flow through a capillary stainless steel sensor tube. The remainder of the gas flows through the primary flow conduit. The geometry of the primary conduit and the sensor tube are designed to ensure laminar flow in each branch. According to principles of fluid dynamics flow rates of gas in two properly sized laminar flow conduits are related to one another. Therefore, the flow rates measured in the sensor tube are directly proportional to the total flow through the transducer.

In order to sense the flow in the sensor tube, heat flux is introduced at two sections of the sensor tube by means of precision wound heater-sensor coils. Heat is transferred through the thin wall of the sensor tube to the gas flowing inside. As gas flow takes place heat is carried by the gas stream from the upstream coil to the downstream coil windings. The resultant temperature dependent resistance differential is detected electronically. The measured gradient at the sensor windings is linearly proportional to the instantaneous rate of flow taking place.

An output signal is generated that is a function of the amount of heat carried by the gases to indicate mass-molecular based flow rates.

GFC Mass Flow Controller models GFC17/37/47 also incorporate a proportionating solenoid valve and models GFC57/67/77 a motorized valve. The closed loop control circuit of the GFC continuously compares the mass flow output with the selected flow rate. Deviations from the setpoint are corrected by compensating valve adjustments, thus maintaining the desired flow parameters.

#### 4. SPECIFICATIONS

**FLOW MEDIUM:** Please note that GFC Mass Flow Controllers are designed to work with clean gases only. Never try to meter or control flow rates of liquids.

**CALIBRATIONS:** Supplied at Standard Conditions (14.7 psia and 70° F), or Normal Conditions (0 °C and 1.01 bar abs) unless otherwise requested or stated.

**ENVIRONMENTAL (per IEC 664):** Installation Level II; Pollution Degree II.

**ACCURACY:**

ACCURACY % FS				OPTIONAL ENHANCED ACCURACY % FS			
MODEL	GFC 17, 37	GFC 47, 57, 67, 77		MODEL	GFC 17	GFC 37, 47, 57, 67, 77	
FLOW RANGE	2.5-100%	20-100%	0-20%	FLOW RANGE	2.5-100%	20-100%	0-20%
ACCURACY	±1.5%	±1.5%	±3%	ACCURACY	±1%	±1%	REF DATA with ±1%

**REPEATABILITY:** ±0.5% of full scale.

**TEMPERATURE COEFFICIENT:** 0.15% of full scale/ °C.

**PRESSURE COEFFICIENT:** 0.01% of full scale/psi (0.07 bar).

**RESPONSE TIME:** **GFC17:** 300ms time constant; approximately 1 second to within ±2% of set flow rate for 25% to 100% of full scale flow.

**GFC 37/47:** 600ms time constant; approximately 2 seconds to within ±2% of set flow rate for 25% to 100% of full scale flow.

**GFC 57/67/77:** 1800ms time constant; approximately 5 seconds to within ± 2% of set flow rate for 25% to 100% of full scale flow.

**MAX GAS PRESSURE:** 1000 psig (69 bars) GFC 17, 37 and 47; 500 psig (34.5 bars) GFC 57, 67 and 77. Optimum pressure is 20 psig (1.4 bars).

**TURNDOWN RATIO:** 40:1.

**MAX DIFFERENTIAL PRESSURE:** 50 psid (345 kPa).

**GAS TEMPERATURE:** 32 °F to 122 °F (0 °C to 50 °C).

**AMBIENT TEMPERATURE:** 14 °F to 122 °F (-10 °C to 50 °C).

**GAS RELATIVE HUMIDITY:** Up to 70%.

**MAXIMUM INTERNAL LEAK:** 0.5% FS.