OPERATING INSTRUCTIONS FOR

MODEL 2000RS

Thermal Conductivity Analyzer

P/N M95586
11/14/23

DANGER

Toxic gases and or flammable liquids may be present in this monitoring system.

Personal protective equipment may be required when servicing this instrument.

Hazardous voltages exist on certain components internally which may persist for a time even after the power is turned off and disconnected.

Only authorized personnel should conduct maintenance and/or servicing. Before conducting any maintenance or servicing, consult with authorized supervisor/manager.

Warranty

This equipment is sold subject to the mutual agreement that it is warranted by us free from defects of material and of construction, and that our liability shall be limited to replacing or repairing at our factory (without charge, except for transportation), or at customer plant at our option, any material or construction in which defects become apparent within one year from the date of shipment, except in cases where quotations or acknowledgements provide for a shorter period. Components manufactured by others bear the warranty of their manufacturer. This warranty does not cover defects caused by wear, accident, misuse, neglect, or repairs other than those performed by Teledyne or an authorized service center. We assume no liability for direct or indirect damages of any kind, and the purchaser – by the acceptance of the equipment – will assume all liability for any damage which may result from its use or misuse.

We reserve the right to employ any suitable material in the manufacture of our apparatus, and to make any alterations in the dimensions, shape, or weight of any parts, in so far as such alterations do not adversely affect our warranty.

Important Notice

This instrument provides measurement readings to its user and serves as a tool by which valuable data can be gathered. The information provided by the instrument may assist the user in eliminating potential hazards caused by his process; however, it is essential that all personnel involved in the use of the instrument or its interface, with the process being measured, be properly trained in the process itself as well as all instrumentation related to it.

The safety of personnel is ultimately the responsibility of those who control process conditions. While this instrument may be able to provide early warning of imminent danger, it has no control over process conditions, and it can be misused. In particular, any alarm or control systems installed must be tested and understood, both as to how they operate and as to how they can be defeated. Any safeguards required, such as locks, labels, or redundancy, must be provided by the user or specifically requested of The Company at the time the order is placed.

Therefore, the purchaser must be aware of the hazardous process conditions. The purchaser is responsible for the training of personnel, for providing hazard warning methods and instrumentation per the appropriate standards, and for ensuring that hazard warning devices and instrumentation are maintained and operated properly.

The Company, the manufacturer of this instrument, cannot accept responsibility for conditions beyond its knowledge and control. No statement expressed or implied by this document, or any information disseminated by the manufacturer or its agents, is to be construed as a warranty of adequate safety control under the user's process conditions.

Specific Model Information

The instrument for which this manual was supplied may incorporate one or more options not supplied in the standard instrument. Commonly available options are listed below with check boxes. Any that are incorporated in the instrument for which this manual is supplied are indicated by a check mark in the box.

Instrument Serial Number: _____

Options Included in the Instrument with the Above Serial Number:

- ❑ **19" Rack Mount:** The 19" Relay Rack Mount units are available with up to four 2000RS series analyzers installed in a custom 19" chassis and ready to mount in a standard instrument rack.

- ❑ **Auto Cal:** This analyzer includes optional internal Sample, Span, and Zero solenoid valves. This option allows the selection of Sample, Zero, or Span gases which are attached to the rear of the analyzer.

- ❑ **Sealed-Air** This analyzer includes an optional sealed gas TCD sensor. Analyzers with this option do not require a flowing reference gas.

Important Notice

Model 2000RS complies with all the requirements of the Commonwealth of Europe (CE) for Radio Frequency Interference, Electromagnetic Interference (RFI/EMI), and Low Voltage Directive (LVD).

The following International Symbols are used throughout the Instruction Manual. These symbols are visual indicators of important and immediate warnings of when you must exercise CAUTION while operating the instrument. See also the Safety Information on the next page.

STAND-BY: Instrument is on Stand-by, but circuit is active.

GROUND: Protective Earth

CAUTION: The operator needs to refer to the manual for further information. Failure to do so may compromise the safe operation of the equipment.

CAUTION: Risk of Electrical Shock

Safety Messages

Your safety and the safety of others is very important. We have provided many important safety messages in this manual. Please read these messages carefully.

A safety message alerts you to potential hazards that could hurt you or others. Each safety message is associated with a safety alert symbol. These symbols are found in the manual and inside the instrument. The definition of these symbols is described below:

GENERAL WARNING/CAUTION: Refer to the instructions for details on the specific danger. These cautions warn of specific procedures which if not followed could cause bodily Injury and/or damage the instrument.

CAUTION: HOT SURFACE WARNING: This warning is specific to heated components within the instrument. Failure to heed the warning could result in serious burns to skin and underlying tissue.

WARNING: ELECTRICAL SHOCK HAZARD: Dangerous voltages appear within this instrument. This warning is specific to an electrical hazard existing at or nearby the component or procedure under discussion. Failure to heed this warning could result in injury and/or death from electrocution.

Technician Symbol: All operations marked with this symbol are to be performed by qualified maintenance personnel only.

No Symbol

NOTE: Additional information and comments regarding a specific component or procedure are highlighted in the form of a note.

CAUTION: **THIS PRODUCT SHOULD ONLY BE INSTALLED, COMMISSIONED, AND USED FOR THE PURPOSE AND IN THE MANNER DESCRIBED IN THIS MANUAL.**

IF YOU IMPROPERLY INSTALL, COMMISSION, OR USE THIS INSTRUMENT IN ANY MANNER OTHER THAN INSTRUCTED IN THIS MANUAL OR BY OUR TECHNICAL SUPPORT TEAM, UNPREDICTABLE BEHAVIOR COULD RESULT WITH POSSIBLE HAZARDOUS CONSEQUENCES.
SUCH RISKS, WHETHER DURING INSTALLATION AND COMMISSION OR CAUSED BY IMPROPER INSTALLATION/COMMISSIONING/USE, AND THEIR POSSIBLE HAZARDOUS OUTCOMES INCLUDE BUT ARE NOT LIMITED TO:

RISK	HAZARD
Liquid or dust/debris ingress	Electrical shock hazard
Improper or worn power cable	Electrical shock or fire hazard
Excessive pressure from improper gas bottle connections	Explosion and projectile hazard
Sampling combustible gas(es)	Explosion and fire hazard
Improper lift & carry techniques	Personal injury

NOTE THAT THE SAFETY OF A SYSTEM THAT MAY INCORPORATE THIS PRODUCT IS THE END USER'S RESPONSIBILITY.

This manual provides information designed to guide you through the installation, calibration, and operation of your new analyzer. Please read this manual and keep it available.

Occasionally, some instruments are customized for a particular application, or features and/or options are added per customer requests. Please check the front of this manual for any additional information in the form of an Addendum, which discusses specific information, procedures, cautions and warnings that may be peculiar to your instrument.

Manuals do get lost. Additional manuals can be obtained from The Company at the address given in the Appendix. Some of our manuals are available in electronic form via the internet. Please visit our website at: www.teledyne-ai.com.

This is a general-purpose instrument designed for use in a nonhazardous area. It is the customer's responsibility to ensure safety, especially when combustible gases are being analyzed, since the potential of gas leaks always exists.

Customers should ensure that the principles of operation of this equipment are well understood by the users. Misuse of this product in any manner, tampering with its components, or unauthorized substitution of any component may adversely affect the safety of this instrument.

Since the use of this instrument is beyond the control of The Company, no responsibility by The Company, its affiliates, and/or agents for damage or injury from misuse or neglect of this equipment is implied or assumed.

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Introduction

1.1 Overview

The Model 2000RS (also referred to as the Analyzer) is a redesigned compact version of model 2000A Thermal Conductivity Analyzer. It is a versatile microprocessor-based instrument for measuring a component gas in a background gas. It compares the thermal conductivity of a sample stream with that of a reference gas of known composition. The 2000RS can:

- measure the concentration of one gas in a mixture of two gases.
- measure the concentration of a gas in a specific mixture of background gases.
- measure the purity of a sample stream containing a single impurity or a mixture of impurities.

The standard 2000RS is preprogrammed with automatic linearization algorithms for a large number of gases and gas mixtures. The factory can add to this data base for custom applications, or sophisticated users can add their own unique application.

This manual covers the Model 2000RS, a General Purpose Analyzer. **These units are for indoor use in a nonhazardous environment**.

1.2 Typical Applications

The Analyzer can measure the concentration of one gas in a mixture of two gases. A few typical applications of the Analyzer are:

- Power Generation
- Air separation and liquefaction
- Chemical reaction monitoring
- Steel manufacturing and heat treating

- Petrochemical process control
- Quality assurance
- Refrigeration and storage
- Gas proportioning control.

1.3 Main Features of the Analyzer

The Analyzer is sophisticated, yet simple to use. The main features of the Analyzer include:

- A compact 320x240 touch sensitive LCD screen, driven by microprocessor electronics, that continuously prompts and informs the operator.
- Three independent, user-definable, analysis ranges allow up to three different gas applications with one concentration range each, or up to three concentration ranges for a single gas application, or any combination.
- Microprocessor-based electronics.
- Three user-definable output ranges (from ppm through percent ranges) allow for purity inverted ranges.
- Digital temperature sensor allows convenient on-screen detector temperature monitoring from the interface panel.
- Auto Ranging allows the Analyzer to automatically select the proper preset range for a given measurement (for same gas application). Manual override allows the user to lock onto a specific range of interest.
- Two adjustable concentration alarms and a system failure alarm.
- Extensive self-diagnostic testing – at startup and on demand – with continuous power-supply monitoring.
- CE and UKCA Compliance.
- RS-232 serial digital port for use with a computer or other digital communication device.
- Profibus port.
- LAN port (future)
- Two analog outputs:

- one for percent of range output for measurement, which can be selected by software to be either 0-1 vdc or 4-20 ma.
- one for range identification.

(Only percent of range output in 4-20 ma mode can be calibrated.)

- Compact design: can fit up to four instruments in a 19-inch rack.

1.4 Model Designations

2000RS:	Standard model.
2000RS-C	Auto Cal option included.

1.5 Front Panel (Operator Interface)

The standard 2000RS is housed in a rugged case with a front panel mounted touch screen display that handles all gas controls and displays. See Figure 1-1. The touch screen panel has a touch sensitive button to access various menus and sub menus for setting up and operating the analyzer. It has a digital flowmeter display showing both the current flow and any fluctuation in flow via a simulated onscreen flowmeter. The analyzer panel has a large display area for data, process variables, and other operational details depending on the function selected or current alarm status.

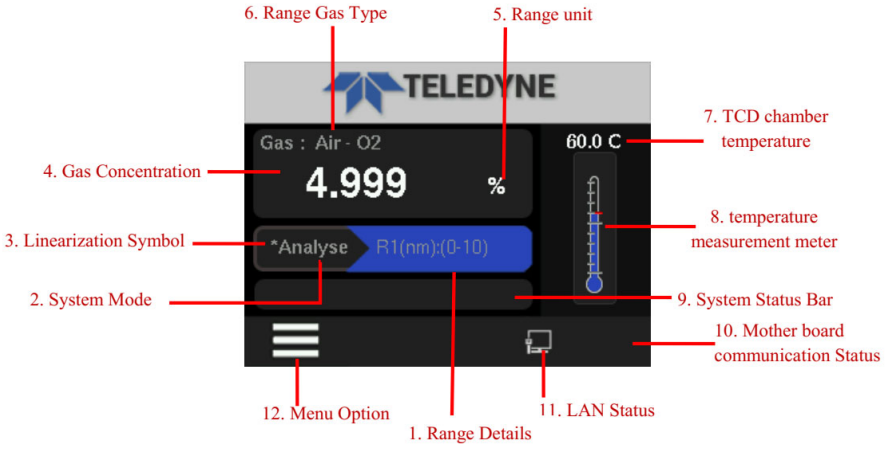
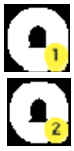


Figure 1-1: Model 2000RS Front Panel

- **Concentration Display:**
  When in Analysis mode, the display region indicates a continuous readout in ppm or % depending on range programmed in the instrument. The display screen, depending on the function selected, will also display values, options, and messages that give the operator immediate feedback.
- **Instrument Mode:**
  Identifies the current mode of the analyzer: Analyze Mode or System Mode.
- **Temperature of sensor:**
  Reports the current temperature of TCD box in degrees centigrade.
- **Alarm Indicator:**
  Indicates whether an alarm is triggered
  Alarm 1

  Alarm 2



- **Communication Status:**
  LAN status icon displays when the LAN connection established.

1.6 Front Access Door

The 2000RS includes a front panel door which is hinged and swings down after pressing the top latch.

Figure 1-2:19" relay rack chassis with two RS analyzers installed.

1.7 Rear Panel (Equipment Interface)

The rear panel, shown in Figure 1-2, contains the gas and electrical connectors for external inlets and outlets. The connectors are described briefly here and in detail in the *Installation* chapter of this manual.

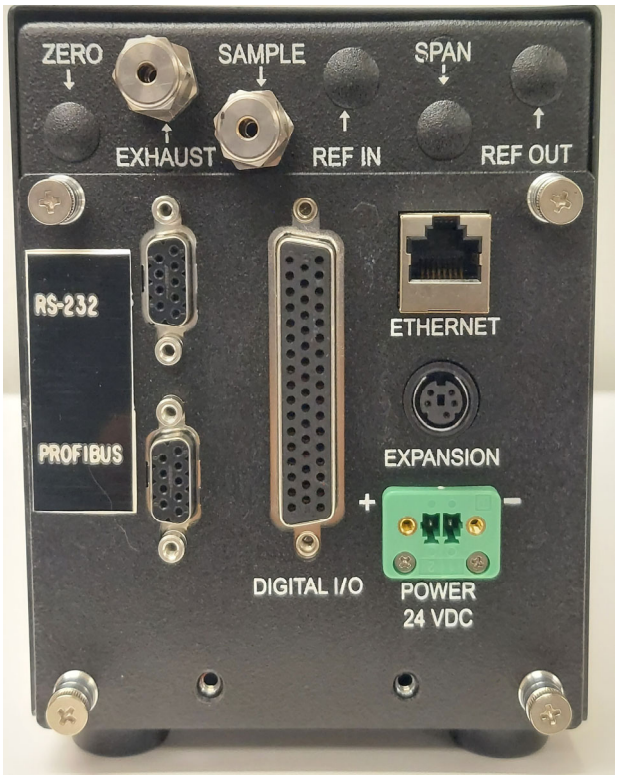


Figure 1-3: Model 2000RS Rear Panel (sealed air option)

Power Connection: 24VDC power source.

Gas Connections: Sample in and Sample out, and Reference in and Reference out.

RS-232: Serial digital concentration signal output and control input.

Profibus: Connection for Profibus communication.

LAN: Serial digital communications for local network access (not implemented)

50-Pin Equipment Interface Port:

- Analog Outputs: user selectable 0–1 VDC concentration plus 0-1 VDC range ID, or isolated 4–20 mA DC plus 4-20 mA DC range ID (there cannot be both 0-1 vdc and 4-20 ma dc at the same time).
- Alarm Connections: 2 concentration alarms and 1 system alarm.
- Remote Span/Zero Digital inputs allow external control of analyzer calibration.
- Calibration Contact: To notify external equipment that instrument is being calibrated and readings are not monitoring sample.
- Range ID Contacts: Four separate, dedicated, range relay contacts. Low, Medium, High, Cal.
- Network I/O: Serial digital communications for local network access. For future expansion. Not implemented at this printing.

Optional:

Calibration Gas Ports (Auto Cal Option) Separate fittings for zero, span and sample gas input, and internal valves for automatically switching the gases.

Note: If you require highly accurate Auto-Cal timing, use external Auto-Cal control where possible. The internal clock in the Model 2000RS is accurate to 2-3 %. Accordingly, internally scheduled calibrations can vary 2-3 % per day.

Operational Theory

2.1 Introduction

The analyzer is composed of two subsystems:

1. Thermal Conductivity Sensor

2. Electronic Signal Processing, Display and Control.

The sensor is a thermal conductivity comparator that continuously compares the thermal conductivity of the sample gas with that of a reference gas having a known conductivity.

The electronic signal processing, display and control subsystem simplifies operation of the analyzer and accurately processes the sampled data. A microprocessor controls all signal processing, input/output, and display functions for the analyzer.

2.2 Sensor Theory

For greater clarity, Figure 2-1 presents two different illustrations, (a) and (b), of the operating principle of the thermal conductivity cell.

2.2.1 Principles of Operation

The thermal conductivity sensor contains two chambers, one for the reference gas of known conductivity and one for the sample gas. Each chamber contains a pair of heated filaments. Depending on its thermal conductivity, each of the gases conducts a quantity of heat away from the filaments in its chamber. See Figure 2-1(a).

The resistance of the filaments depends on their temperature. These filaments are parts of the two legs of a Wheatstone bridge circuit that unbalances if the resistances of its two legs do not match. See Figure 2-1(b).

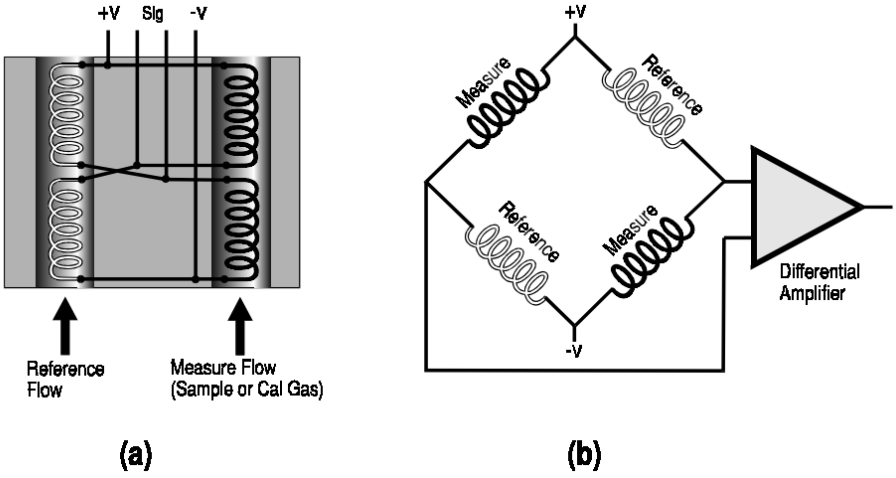


Figure 2-1: Thermal Conductivity Cell Operating Principle

If the thermal conductivities of the gases in the two chambers are different, the Wheatstone bridge circuit unbalances, causing a current to flow in its detector circuit. The amount of this current can be an indication of the amount of impurity in the sample gas, or even an indication of the type of gas, depending on the known properties of the reference and sample gases.

The temperature of the measuring cell is regulated to 60 °C within 1 °C by a sophisticated control circuit. Temperature control is precise enough to compensate for diurnal effects in the output over the operating ranges of the analyzer. Temperature is displayed on the front panel display.

2.2.2 Calibration

Because analysis by thermal conductivity is not an absolute measurement, calibration gases of **known composition** are required to fix the upper and lower parameters ("zero" and "span") of the range, or ranges, of analysis. These gases must be used periodically, to check the **accuracy of the analyzer.**

During calibration, the bridge circuit is balanced with zero gas against the reference gas at one end of the measurement range, and it is sensitized with span gas against the reference gas at the other end of the measurement range. The resulting electrical signals are processed by the Analyzer's electronics to produce a standard 0-1V, or an isolated 4–20 mA dc, output signal, as described in the next section.

2.2.3 Effects of Flowrate and Gas Density

Because the flowrate of the gases in the chambers affects their cooling of the heated filaments, the flowrate in the chambers must be kept as equal, constant, and low as possible.

When setting the sample and reference flowrate, note that gases lighter than air will have an actual flowrate higher than indicated on a flowmeter, while gases heavier than air will have an actual flowrate lower than indicated. Due to the wide range of gases that are measured with the Thermal Conductivity Analyzer, the densities of the gases being handled may vary considerably.

Then, there are limited applications where the reference gas is in a sealed chamber and does not flow at all. These effects must be taken in consideration by the user when setting up an analysis.

2.2.4 Measurement Results

Thermal conductivity measurements are nonspecific by nature. This fact imposes certain limitations and requirements. If the user intends to employ the analyzer to detect a specific component in a sample stream, the sample must be composed of the component of interest and one other gas (or specific, and constant, mixture of gases) for the measured heat-transfer differences to be non-ambiguous.

If, on the other hand, the user is primarily interested in the purity of a process stream and does not require specific identification of the impurity, the Analyzer can be used on more complex mixtures.

2.3 Electronics and Signal Processing

The Analyzer uses a microcontroller to control all signal processing, input/output, and Communication to a display PCB interface functions for the Analyzer. System power is external with requirements of 24 vdc and at least 30 watts rating. External fuse recommendation is 2 A 250 V Type T, slow blow.

The temperature control circuit, the signal processing electronics – including the microprocessor, analog-to-digital, and digital-to-analog converters – are located on the Main board at the bottom of the case.

The amplifier section is part of the main board. The main board is accessible after removing the back panel. Figure 2-2 is a block diagram of the Analyzer electronics.

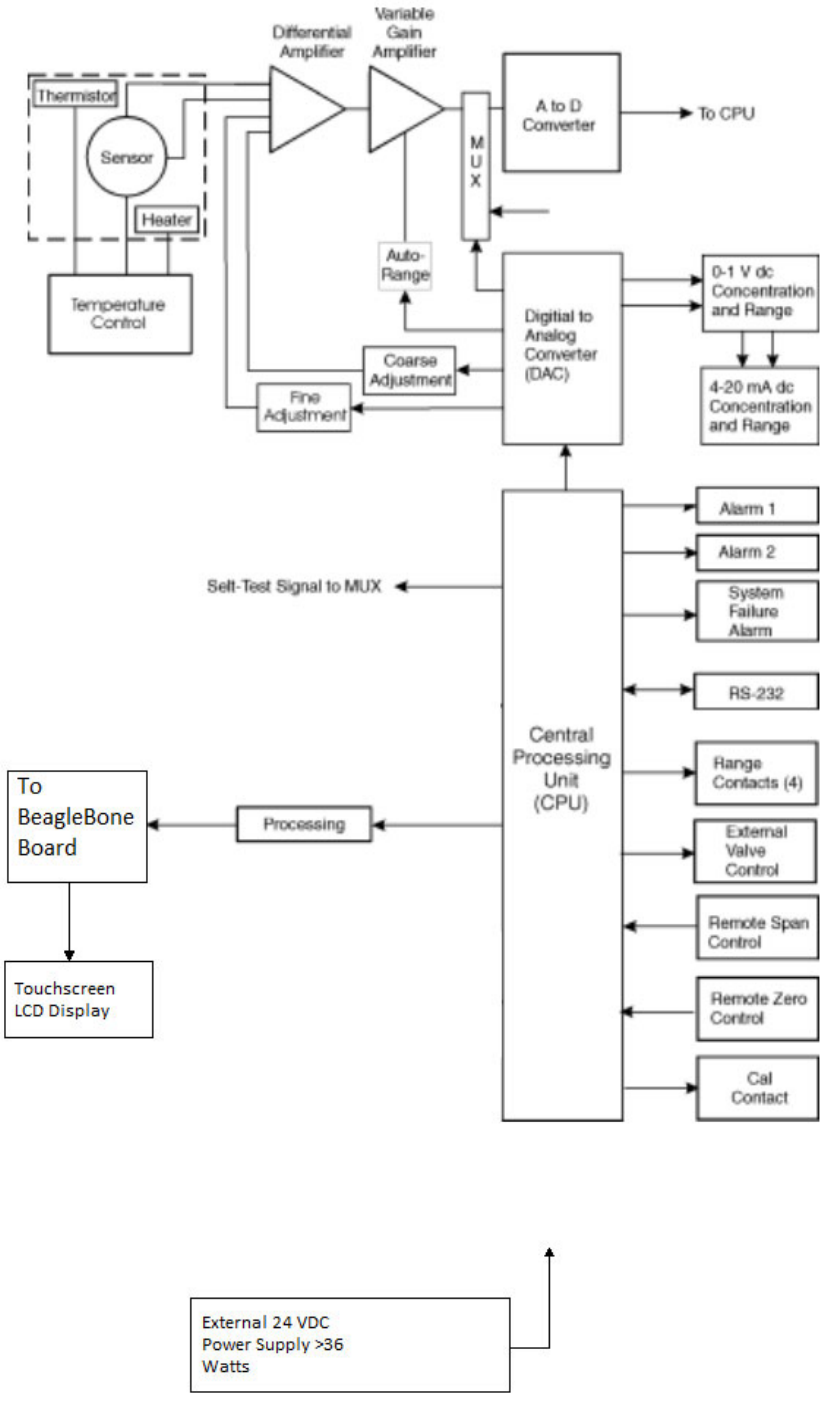


Figure 2-2: Block Diagram of the model 2000RS

The Temperature Control Board keeps the temperature of the measuring cell regulated to within 1° C at 60° C. A thermistor is used to measure the temperature located under the TC detector, the main board regulates the power in a cartridge-type heater. The result is a sensor output signal that is temperature independent.

In the presence of dissimilar gases, the sensor generates a differential voltage across its output terminals. A differential amplifier converts this signal to a unipolar signal, which is amplified in a variable gain amplifier, providing automatic range switching under control of the CPU. The output from the variable gain amplifier is sent to an 18-bit analog-to-digital converter.

The digital concentration signal, along with input from the control panel, is processed by the CPU and passed on to the 12-bit DAC, which outputs 0-1 V dc Concentration and Range ID signals. By user selection, the converter can also provide 4-20 mA dc concentration signal and range ID outputs.

The CPU also provides appropriate control signals to a Beagle Bone PCB to update a touchscreen LCD Display, Alarms, and External Valve Controls, and it accepts digital inputs for external Remote Zero and Remote Span commands.

The RS-232 port provides two-way serial digital communications to and from the CPU. A Profibus port is also available in version DP-V0. A GSD file is needed by the Profibus master to connect to the 2000RS. Request the GSD file from the factory. These and all of the above electrical interface signals are described in detail in chapter 3 *Installation*.

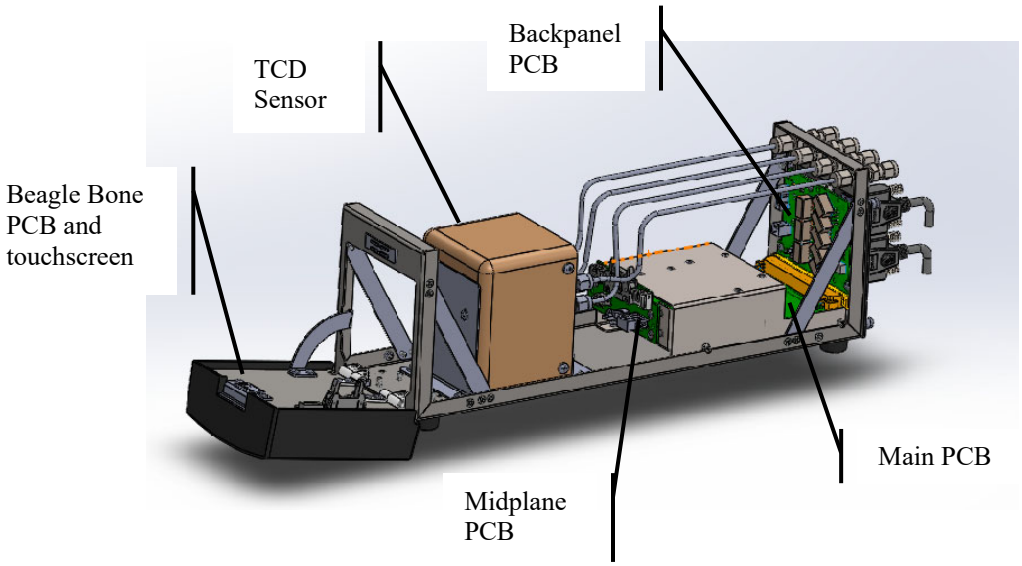


Figure 2-3: 2000RS Internal Electronic Component Location

Installation

CAUTION: PLEASE REVIEW THE RISKS/HAZARDS SAFETY MESSAGES IN THE FRONT MATTER OF THIS MANUAL BEFORE INSTALLING, COMMISSIONING, OR OPERATING THIS INSTRUMENT.

Installing the Analyzer includes:

1. Unpacking
2. Mounting
3. Making gas connections
4. Making electrical connections
5. Testing the system.

3.1 Unpacking the Analyzer

Although the analyzer is shipped complete, certain parts – such as fuses and sensors – are wrapped separately to be installed on site as part of the installation. Carefully unpack the analyzer and inspect it for damage. Immediately report any damage or shortages to the shipping agent.

3.2 Mounting the Analyzer

The Analyzer is designed for indoor use in a general-purpose area. It is NOT for hazardous environments of any type.

The RS series analyzers are designed to mount in a 3U size 19" relay chassis. A standard RS analyzer is supplied without chassis or cover. The optional 19" chassis can be supplied configured for one to four RS analyzers. There is also a single cover option that includes the cover and feet for bench top use of a single RS analyzer.

The touch screen operator control buttons are mounted on the front panel, which is hinged at the bottom to provide access to the TCD sensor and front panel PCB, if needed. The front door has a magnetic latch on the top which, when pulled on, allows the front door to open downwards exposing the TCD compartment. See Figure 3-1.

Figure 3-1: 2000RS (optional single cover with feet for bench top use)

3.3 Rear Panel Connections

Figure 3-2 shows the Model 2000RS rear panel. There are ports for gas, power, and equipment interface.

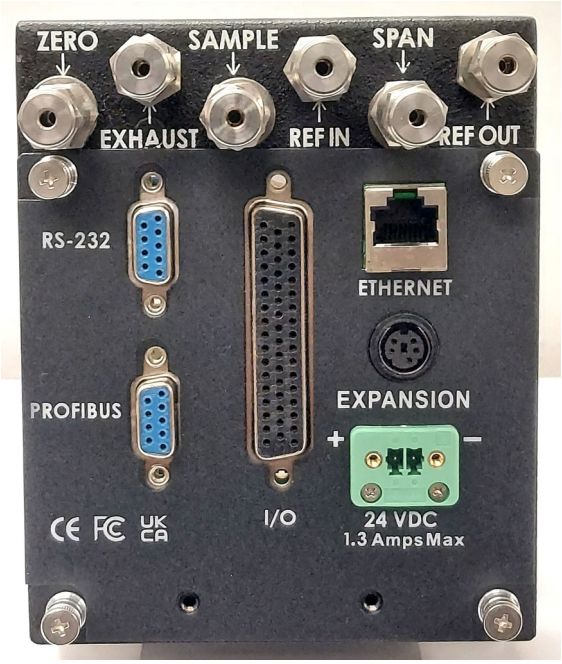


Figure 3-2: Rear Panel of the Model 2000RS (Auto-Cal option)

3.4 Gas Connections

The gas fittings are accessed through the port on the back side of the analyzer chassis, as shown in Figure 3-2. These connectors use 1/8" tubing. The standard analyzer includes no gas control valves inside the main chassis. A sample system must be provided for introduction of zero and span gas, as well as sample gas, into the sample path, and for controlling the flowrates through the sample and reference paths of the analyzer. Internal Auto Cal vales are available as an option.

3.4.1 SAMPLE SYSTEM DESIGN

The unit is manufactured with 1/8" inch tubing fittings as ports. The customer must provide matching fittings.
For best results, use the recommended piping system. Select a flowmeter that can resolve 40-50 cc/min (0.08 scfh) for the reference path of the analyzer and select a flowmeter that can resolve 150 cc/min (0.3 scfh) for the sample path of the analyzer.

Note: The sample-line pressure regulator should be installed as close to the sample point as possible to minimize sample-line lag time.

3.4.2 PRESSURE AND FLOWRATE REGULATION

Appropriate pressure reducing regulators must be installed at all gas supply sources. To minimize flowrate adjustments the pressure regulators on the supporting gas supply cylinders should be adjusted to provide the same output pressure as the sample line regulator.

The gas pressure input should be reasonably well regulated. Pressures between .35 and 3.5 bar (5 - 51 psig) are acceptable- .7 bar (10 psig) is normal if the pressure, once established, will **keep the flow constant** during analysis, and within 50-200 cc/min (between 0.1 and 0.4 scfh). A needled valve or restrictor is needed before the analyzer inlets to set the flow to required range.

Note: Gases lighter than air have a flowrate higher than indicated on the flowmeter, while gases heavier than air have a flowrate lower than indicated. Values can range from one half to twice the indicated flowrate.

For example: For hydrogen or helium, set the flowrate to

50 cc/min (0.1 scfh). For carbon dioxide or argon, set the flowrate to 200 cc/min (0.4 scfh).

When installing pressure regulators on supply cylinders, crack the cylinder valves so that gas is flowing during installation. This will eliminate the most common cause of standardization-gas contamination: air trapped during assembly diffusing back into the cylinder. This procedure is particularly important in applications where impurity content of 1 to 2 % is the range of interest.

3.4.3 VENT EXHAUST

There are two separate VENT fittings—one for the sample gas and one for the reference gas. Connect both sample and reference vents to tubing that minimized back pressure from restricted flow.

Exhaust connections must be consistent with the hazard level of the constituent gases. Check local, state, and federal laws, and ensure that the exhaust stream vents to an appropriately controlled area if required. If not vented to the same area, both VENT lines must vent to areas with equal ambient pressures, and pressures must vary no more than the normal barometric changes.

Install VENT lines such that water and dirt cannot accumulate in them.

3.4.4 SAMPLE GAS

In the standard model, sample and calibration gases are introduced through the SAMPLE fitting. The gases must be teed into the Sample inlet with appropriate valves.

The gas pressure in should be well regulated. The sample line pressure regulator should be installed as close to the sample line as possible to minimize sample line lag time. If greater flow is required for improved response time, install a bypass in the sampling system upstream of the analyzer input.

3.4.5 REFERENCE GAS

A gas of fixed composition is needed as a reference to which the sample gas will be compared. The reference gas is normally selected to represent the main background gas of the analysis.

For most applications, a constant supply of reference gas flowing at the same rate as the sample is required for best results. However, in

many cases, the flow of reference gas can be slowed to about 0.08 scfh (40 cc/min) with good results.

For some applications, an optional sealed air reference is installed. In sealed-reference sensors, the reference side of the detector cell is filled with air and sealed. This eliminates the need to have reference gas constantly passing through the cell.

NOTE: For instruments equipped with the optional sealed air reference, there is no REFERENCE inlet or reference VENT port.

It is highly recommended that the same cylinder of gas be used for both the REFERENCE gas and the ZERO gas. Pressure, flow, and safety considerations are the same as prescribed for the SAMPLE gas, above.

3.4.6 ZERO GAS

For the ZERO gas, a supply of the background gas, usually containing none of the impurity, is required to zero the analyzer during calibration.

For suppressed zero ranges, the zero gas must contain the low-end concentration of the impurity.

NOTE: Because most cylinder gases are between 99.95 and 99.98% pure, it is highly recommended that the same cylinder of gas be used for both REFERENCE and ZERO gas.

NOTE: It is essential to the accuracy of the analyzer that the purity of the zero gas be known. Otherwise, when the zero control is adjusted during zero standardization, the reading will indicate the impurity content of the zero gas, rather than zero.

3.4.7 SPAN GAS

For the SPAN gas, a supply of the background gas containing 80-100 % of the component of interest is required as a minimum. If linearization is required, intermediate concentrations of the target gas in the background gas may be necessary. From one to nine separate span gases may be used, depending on the desired precision of the linearization. See chapter 4, *Operation*.

3.5 Testing the System

Before plugging the instrument into the power source:

- Check the integrity and accuracy of the gas connections. Make sure there are no leaks.
- Check the integrity and accuracy of the electrical connections. Make sure there are no exposed conductors.
- Check that the pressure and flow of all gases are within the recommended levels, and appropriate for your application.

Power up the system, and test it by performing the following operations:

1. Repeat the Self-Diagnostic Test as described in chapter 4, section 4.3.5.

3.6 Warm Up at Power Up

Every time the unit is turned on, the instrument stays with the introduction screen for thirty minutes. This is to allow the cell to come up to temperature (60° C). The only way to bypass this warm up period is by pressing skip button on the touchscreen.

The instrument warms up for half an hour so that it will not receive a remote calibration signal, send false readings to a monitor system, or be calibrated by an untrained operator while the cell is cold.

NOTE: There is temperature readout on the display while on warm up mode and normal operation mode to monitor if TCD is at correct temperature.

3.7 Electrical Connections

For safe connections, no uninsulated wiring should be able to come in contact with fingers, tools or clothing during normal operation.

CAUTION: **USE SHIELDED CABLES. ALSO, USE PLUGS THAT PROVIDE EXCELLENT EMI/RFI PROTECTION. THE PLUG CASE MUST BE CONNECTED TO THE CABLE SHIELD, AND IT MUST BE TIGHTLY FASTENED TO THE ANALYZER WITH ITS FASTENING SCREWS. ULTIMATELY, IT IS THE INSTALLER WHO ENSURES THAT THE CONNECTIONS PROVIDE ADEQUATE EMI/RFI SHIELDING.**

3.7.1 24VDC INPUT POWER

The analyzer is powered using a 24 VDC source. Insert the power supply connector into the receptacle shown in Figure 3-2. Use external fuses for each 2000RS series instrument as 24 vdc power is distributed. External fuse recommendation is 2 A 250 V Type T, slow blow.

CAUTION: **POWER IS APPLIED TO THE INSTRUMENT'S CIRCUITRY AS LONG AS THE INSTRUMENT IS CONNECTED TO THE POWER SOURCE.**

3.7.2 50-PIN EQUIPMENT INTERFACE CONNECTOR

Figure 3-3 shows the pin layout of the Equipment Interface connector. The arrangement is shown as seen when the viewer faces the rear panel of the analyzer. The pin numbers for each input/output function are given where each function is described in the paragraphs below.

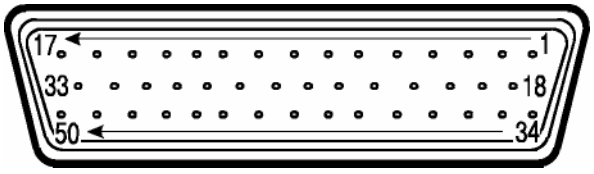


Figure 3-3: Equipment Interface Connector Pin Arrangement

Analog Outputs: There are four DC output signal pins—two pins per output. For polarity, see Table 3-1. The outputs are user selectable (either 0-1 vdc or 4-20 ma) but must be selected from the system menu:

- 0–1 VDC % of Range: Voltage rises linearly with increasing concentration, from 0 V at 0 ppm to 1 V at full scale ppm. (Full scale = 100% of programmable range.)
- 0–1 VDC Range ID: 0.25 V = Low Range, 0.5 V = Medium Range, 0.75 V = High Range, 1 V = Air Cal Range.
- 4–20 mA DC % Range: Current increases linearly with increasing concentration, from 4 mA at 0 ppm to 20 mA at full scale ppm. (Full scale = 100% of programmable range.)
- 4–20 mA DC Range ID: 8 mA = Low Range, 12 mA = Medium Range, 16 mA = High Range, 20 mA = Air Cal Range.

Table 3-1: Analog Output Connections Pin Function

Pin	Function
3	+ Range ID, 4-20 mA, floating
4	– Range ID, 4-20 mA, floating
5	+ % Range, 4-20 mA, floating
6	– % Range, 4-20 mA, floating
8	+ Range ID, 0-1 VDC
23	– Range ID, 0-1 VDC, negative ground
24	+ % Range, 0-1 VDC
7	– % Range, 0-1 VDC, negative ground

Alarm Relays: The nine alarm-circuit connector pins connect to the internal alarm relay contacts. Each set of three pins provides one set of Form C relay contacts. Each relay has both normally open and normally closed contact connections. The contact connections are shown in Table 3-2. The contacts are capable of switching up to 1 amp at 250 V ac into a resistive load. The connectors are:

Threshold Alarm 1:

- Can be configured as high (actuates when concentration is above threshold), or low (actuates when concentration is below threshold).
- Can be configured as failsafe or non-failsafe.
- Can be configured as latching or non-latching.
- Can be configured out (defeated).

Threshold Alarm 2:

- Can be configured as high (actuates when concentration is above threshold), or low (actuates when concentration is below threshold).
- Can be configured as failsafe or non-failsafe.
- Can be configured as latching or non-latching.
- Can be configured out (defeated).

System Alarm:

- Actuates when DC power supplied to circuits is unacceptable in one or more parameters. Permanently configured as failsafe and latching. Cannot be defeated. Actuates if self-test fails.
- Alarm 1 and Alarm 2 are configured from the Alarm configuration screen.

Further detail can be found in Chapter 4 Section 4-7.

Table 3-2: Alarm Relay Contact Pins

Pin	Contact
45	Threshold Alarm 1, normally closed contact
28	Threshold Alarm 1, moving contact
46	Threshold Alarm 1, normally open contact
42	Threshold Alarm 2, normally closed contact
44	Threshold Alarm 2, moving contact
43	Threshold Alarm 2, normally open contact
36	System Alarm, normally closed contact
20	System Alarm, moving contact
37	System Alarm, normally open contact

Digital Remote Cal Inputs: Accept 0 V (off) or 5-24 VDC (on) inputs for remote control of calibration. (See *Remote Calibration Protocol* below.) See Table 3-3 for pin connections.

Zero: Floating input. 5 to 24 V input across the + and – pins put the analyzer into the *Zero* mode. Either side may be grounded at the source of the signal. 0 to 1 volt across the terminals allows *Zero* mode to terminate when done. A synchronous signal must open and close the external zero valve appropriately. See *Remote Probe Connector*. (The –C option internal valves operate automatically.)

Span: Floating input. 5 to 24 V input across the + and – pins put the analyzer into the Span mode. Either side may be grounded at the source of the signal. 0 to 1 volt across the terminals allows Span mode to terminate when done. A synchronous signal must open and close external span valve appropriately. See Figure 3-4 Remote Probe Connector. (The –C option internal valves operate automatically.)

Cal Contact: This relay contact is closed while analyzer is spanning and/or zeroing. (See *Remote Calibration Protocol* below.)

Table 3-3: Remote Calibration Connections

Pin	Function
9	+ Remote Zero
11	– Remote Zero
10	+ Remote Span
12	– Remote Span
40	Cal Contact
41	Cal Contact

Remote Calibration Protocol: To properly time the Digital Remote Cal Inputs to the Model 2000RS Analyzer, the customer's controller must monitor the Cal Relay Contact.

When the contact is OPEN, the analyzer is analyzing, the Remote Cal Inputs are being polled, and a zero or span command can be sent.

When the contact is CLOSED, the analyzer is already calibrating. It will ignore your request to calibrate, and it will not remember that request.

Once a zero or span command is sent, and acknowledged (contact closes), release it. If the command is continued until after the zero or

span is complete, the calibration will repeat and the Cal Relay Contact (CRC) will close again.

For example:

1. Test the CRC. When the CRC is open, Send a zero command until the CRC closes (The CRC will quickly close.)
2. When the CRC closes, remove the zero command.
3. When CRC opens again, send a span command until the CRC closes. (The CRC will quickly close.)
4. When the CRC closes, remove the span command.

When CRC opens again, zero and span are one, and the sample is being analyzed.

Note: The Remote Valve connections (described below) provides signals to ensure that the zero and span gas valves will be controlled synchronously. If you have the –C Internal valve option—which includes additional zero and span gas inputs— the 2000RS automatically regulates the zero, span and sample gas flow.

Range ID Relays: Four dedicated Range ID relay contacts. The first three ranges are assigned to relays in ascending order—Low range is assigned to Range 1 ID, Medium range is assigned to Range 2 ID, and High range is assigned to Range 3 ID. The fourth range is reserved for the Air Cal Range (25%). Table 3-4 lists the pin connections.

Table 3-4: Range ID Relay Connections

Pin	Function
21	Range 1 ID Contact
38	Range 1 ID Contact
22	Range 2 ID Contact
29	Range 2 ID Contact
19	Range 3 ID Contact
18	Range 3 ID Contact
34	Range 4 ID Contact (Air Cal)
35	Range 4 ID Contact (Air Cal)

Remote Valve Connections: The standard analyzer is a single chassis instrument with no internal control valves. Instead, the Remote Valve connections are used as a method for directly controlling external sample/zero/span gas valves. See Figure 3-4.

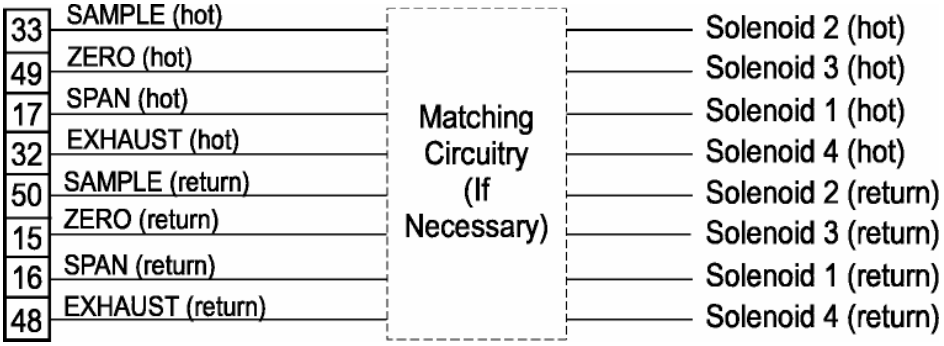


Figure 3-4: Remote Probe Connections

The voltage from these outputs is nominally 0 V for the OFF and 24 VDC for the ON conditions. The maximum combined current that can be pulled from these output lines is 100 mA. (If two lines are ON at the same time, each must be limited to 50 mA, etc.) If more current and/or a different voltage is required, use a relay, power amplifier, or other matching circuitry to provide the actual driving current.

In addition, each individual line has a series FET with a nominal ON resistance of 5 ohms (9 ohms worst case). This can limit the obtainable voltage, depending on the load impedance applied. See Figure 3-5.

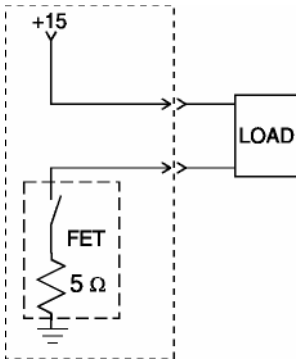


Figure 3-5: FET Series Resistance

3.7.3 RS-232 PORT

The digital signal output is a standard, full duplex RS-232 serial communications port used to connect the analyzer to a computer, terminal, or other digital device. It requires a standard 9-pin D connector.

The output data is status information, in digital form, updated every two seconds for Standard mode of serial communication (see section 4.3.11). Status is reported in the following order for Standard mode:

- The concentration in ppm or percent
- The range in use (HI, MED, LO)
- The span of the range (0-100 ppm, etc.)
- Which alarms—if any—are disabled (AL–x DISABLED)
- Which alarms—if any—are tripped (AL–x ON).

Each status output is followed by a carriage return and line feed.

Three input functions using RS-232 have been implemented to date. They are described in Table 3-5.

Table 3-5: Commands via RS-232 Input

Command	Description
as<enter>	Immediately starts an Auto-span.
az<enter>	Immediately starts an Auto-zero.
st<enter>	Toggling input. Stops/Starts any status message output from the RS-232, until **st**<enter> is sent again.
rmx<enter>	switch to range x, where x is 1,2, or 3

The RS-232 protocol allows some flexibility in its implementation. Table 3-6 lists certain RS-232 values that are required by the 2000RS implementation.

Table 3-6: Required RS-232 Options

Parameter	Setting
Baud	9600
Byte	8 bits
Parity	None
Stop Bits	1
Message Interval	2 seconds. When CRC opens again, zero and span are done

3.7.4 PROFIBUS

There is a port for Profibus communication. The address is set in the in the System menu through the front panel touchscreen. The master Profibus PLC needs a GSD file to connect to the 2000RS. Request the GSD file from customer service at TAI.

Use only commercially available Profibus connectors. Do not build your own. It is recommended to use a straight out Profibus connector such as Siemens 6GK15000FC10 due to size and accessibility restrictions.

Operation

4.1 Introduction

Although the Analyzer is usually programmed to your application at the factory, it can be further configured at the operator level, or even, **cautiously**, reprogrammed. Depending on the specifics of the application, this might include all or a subset of the following procedures:

- Setting system parameters:
  - Establish a security password, if desired, requiring Operator to log in.
  - Establish and start an automatic calibration cycle, if desired.
- Routine Operation:
  - Calibrate the instrument.
  - Choose auto ranging or select a fixed range of analysis.
  - Set alarm setpoints, and modes of alarm operation (latching, failsafe, etc).
- Program/Reprogram the analyzer:
  - Define new applications.
  - Linearize your ranges.

If you choose not to use password protection, the default password is TETAI, and you simply can access to all functions of the analyzer except for Application and Logarithm.

4.2 Start Up Screens

The Analyzer has a built-in self-diagnostic testing routine. Pre-programmed signals are sent through the power supply, output board and sensor circuit. The return signal is analyzed, and – at the end of the test the status of each function – is displayed on the screen, either as OK or as a number between 1 and 3. (See *System Self Diagnostic Test* in Chapter 5, Section 5.4 for number code).

The self-diagnostics are run by demand by the operator whenever the instrument is turned on. It is also run during analyze mode through the system menu.

The first screen identifies the make and model of Analyzer and has three touch sensitive buttons along the bottom.

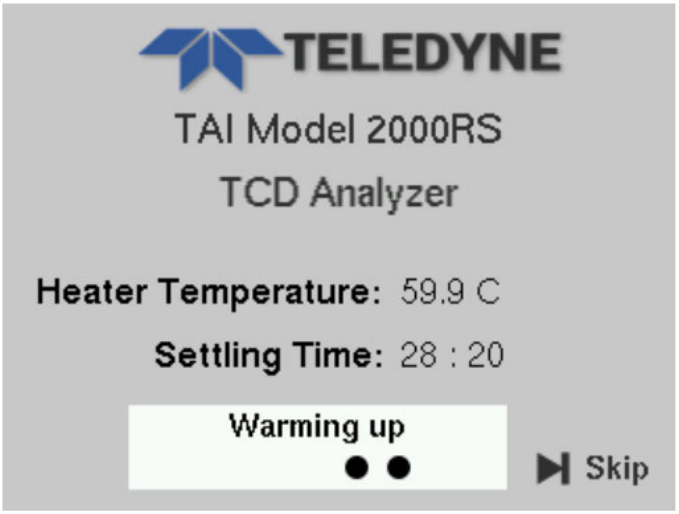


Figure 4-1: Start Up Screen

This screen updates the TCD Chamber temperature, and a settling time runs down from 30 minutes. When the settling time reaches 0, system will update the settling time as “completed.” After 10 seconds, the front panel moves to next screen.

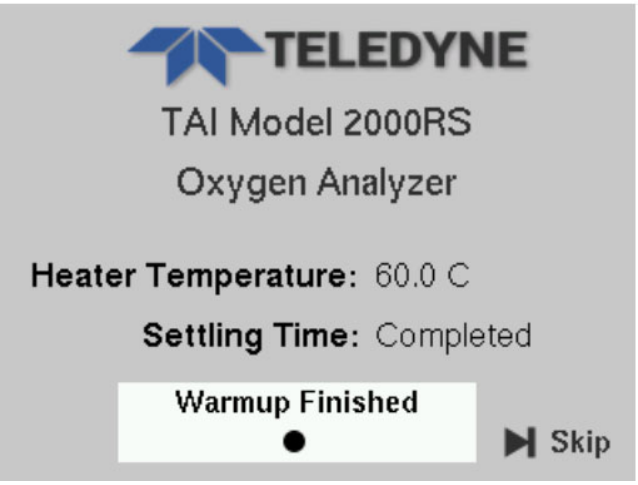


Figure 4-2: Warmup Finished

If user wants to move to the next screen during the warmup time, click the 'skip' option. If no key is pressed for 10 seconds, the system will automatically invoke the self-test and present the Diagnostics screen.

4.2.1 Diagnostic Screen

Clicking on Self-Test (or not pressing any other button for 10 seconds) will start the internal diagnostic self-test routine. It will update the status [PASS/FAIL] on this screen as it proceeds. The Self-Test routine includes the following processes.

- Power supply section testing
- Analog output section testing
- Pre-amp testing

As testing completes and results are reported, the list will extend beyond the bottom screen limit and a scroll bar will appear on the right. Use the scroll bar to view the additional test results.

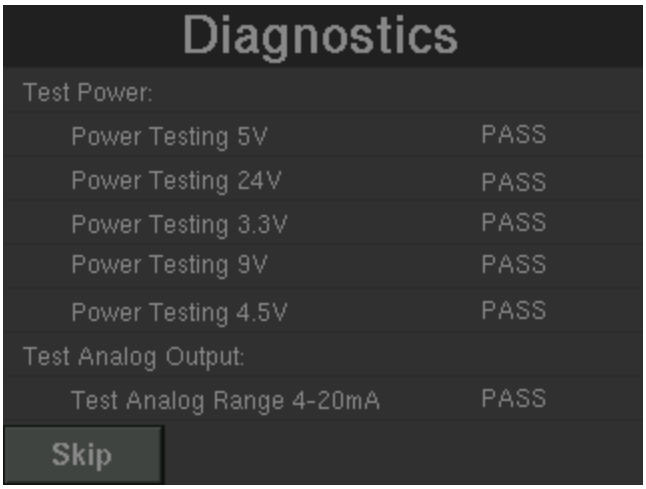


Figure 4-3: Screen 1

Using the scroll bar, you can view all the test results.

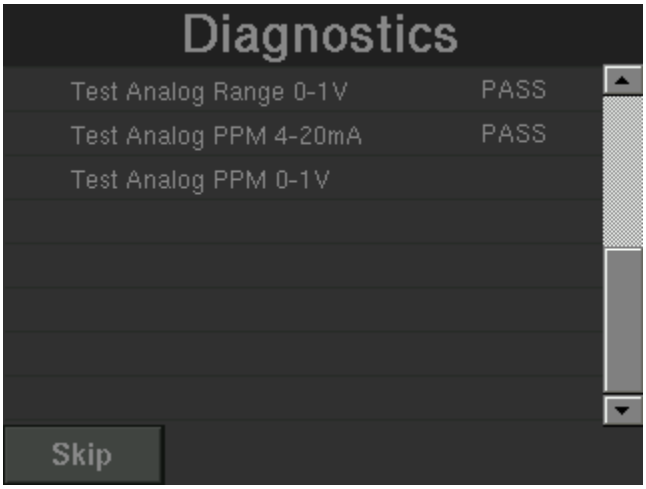


Figure 4-4: Screen 2

It is possible to skip the self-test at any time by pressing Skip button.

1. SKIP - Skip the test and move to the Main Screen.
2. Once self-test has completed, the display remains on the last screen awaiting any additional user input. If no button is pressed for 30 seconds, the system will automatically display the Main screen.

4.3 Main Screen

The screen display and available buttons depend on the particular function or screen selected for display. Figure 4-5 shows the default (Analyze mode) Main screen from which all other screens and menus can be summoned.

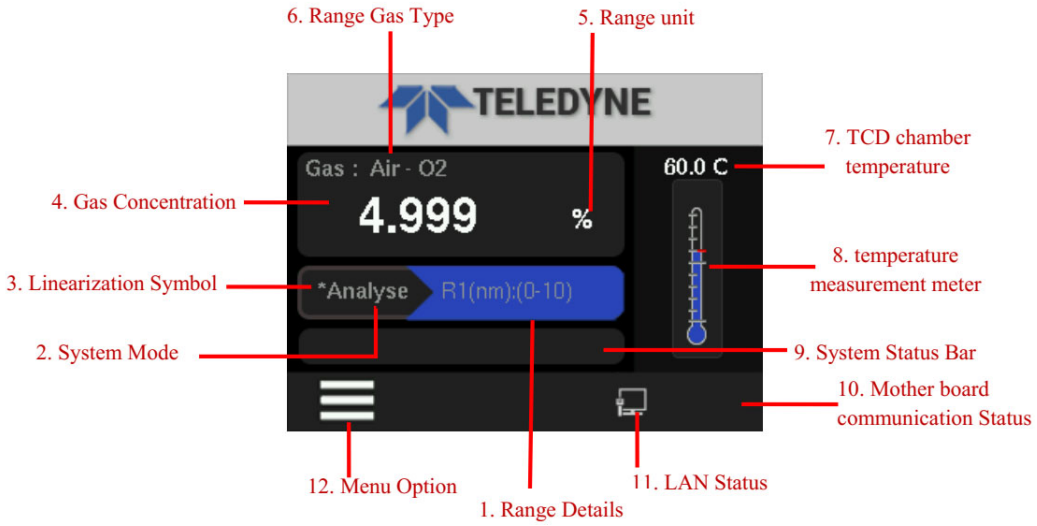


Figure 4-5: Analyze Screen Display

Main screen displays the following status:

1. Current Range details
   a. Current Range number

υ	R1 - Range 1
υ	R2 - Range 2
υ	R3 - Range 3
υ	CAL - Cal Range

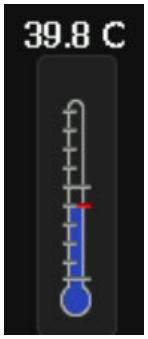
2. System Mode
   a. Range Type and Mode

υ	n - noninverting type (superest deactive)
υ	i - inverting type (superest active)
υ	m - manual mode
υ	a - auto mode

b. Range Limits

υ	Low limit
υ	High limit

3. System Mode
   a. Analyze - When the motherboard is in analyze mode front panel displays “analyze” string in the system mode.
   b. Zero - When the motherboard is in zero calibration mode front panel displays “zero” string in the system mode.
   c. Span - When the motherboard is in span calibration mode front panel displays “span” string in the system mode.
   d. Self-test - When the motherboard is in self-test mode front panel displays “S-TEST” string in the system mode.
4. Linearization Symbol
   a. When the system gas concentration output is linearized, then in the system mode “*” will appear.
   b. If the output concentration is not linearized, then there will no symbol in the system mode.
5. Gas Concentration: Current gas concentration output.
6. Range Unit: Current range unit (% or PPM).
7. Range Gas Type: Current range gas type (Impurity - Background).
8. TCD Chamber Temperature:
   a. System shows current TCD chamber temperature.
9. Temperature measurement meter:
   a. System shows current TCD chamber temperature value progress.



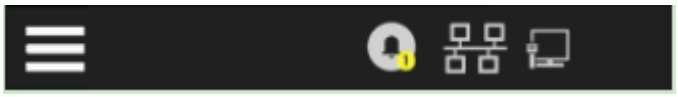
10. System status: “Cell Fail /Zero High” -> If there is an error, System updates the current system on this status bar.
11. Mother Board Communication Status:
    a. System shows “Green” symbol, when the communication between front panel and mother board is proper.
    b. System shows “Red” symbol, when the communication between front panel and mother board is not proper. Notification Bar at the bottom: This notification bar is common for all the screens except Diagnostics and factory reset.
12. After the zero, span or algorithm screen exists, if the motherboard remains in the functions then system will display the system mode as ZERO, SPAN or ALGO. In main screen after 5 seconds system will change to the ANALYZE mode.

The Notification details is given below:

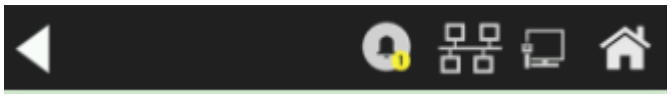
The bar at the bottom of the screen includes a menu select button, an alarm indicator, and an icon indicating current communication status. This bar will change in appearance depending on the selected function or system notification.

Two types of notification bars are used in 2000RS user interface (UI) screens:

1. **Main Menu:** This is the notification bar with the menu select button displayed:



2. **All other screens:** All other screens except Diagnostic and Factory reset screens have the Back button available to revert back to the previous screen.



The notification bar has 2 navigate buttons and 3 status icons.

Navigation Buttons:

1. Home Icon: This touch sensitive icon is used to move to the Main screen from any other screen. The Home button will not appear in the Main screen and Menu screen.

2. Menu Icon: click on to navigate to the Menu Screen from the main screen.

Status icons:

1. LAN status Icon: displays when the LAN connection established.

3. Profibus Status Icon: Displays when the Profibus is connected.

4. Alarm:
   a. No alarms: No Icon.
   b. Alarm 1 active:

   c. Alarm 2 active:

4.4 Menu Screen

Pressing the Menu icon from the Main screen produces the Menu Select Screen (Menu Select).

This screen has the “Back” arrow icon to navigate back to the Main screen.

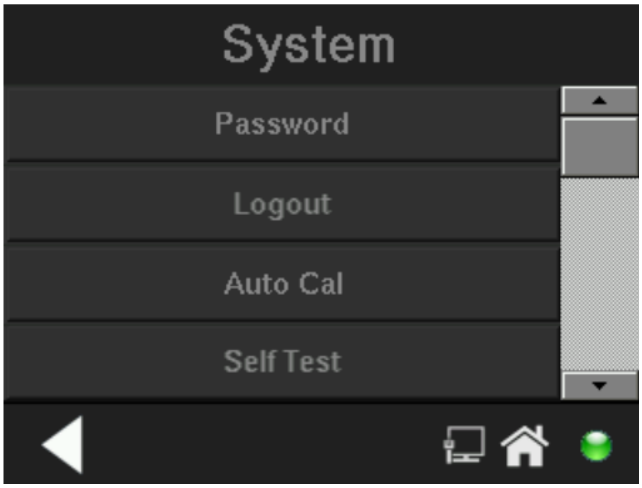
The Menu screen has 6 selection buttons which are:

1. Analyze - Change system to Analyze mode.
2. Span - Start Span calibration.
3. Alarms - Move to Alarm configuration.
4. System - Move to System configuration.
5. Zero - Start Zero calibration.
6. Range - Range configuration

Three text boxes are used to display the gas concentration, TCD chamber temperature and number of errors. These are synchronized with the main screen.

4.5 System Screen

Clicking on the System button on the Menu screen will cause the System screen to display.



The System screen contains 16 functions with 4 options displayed per screen. Use the scroll bar on the right to view the various system functions.

The System screen provides the following functions:

1. Screen 1: Password, Logout, Auto cal, Self-Test
2. Screen 2: Application, Algorithm, Cal Independent, Range Polarity
3. Screen 3: VB Baud rate, Profibus, Analog Output, More
4. Screen 4: Version, System Status, Firmware Upgrade, Factory Reset

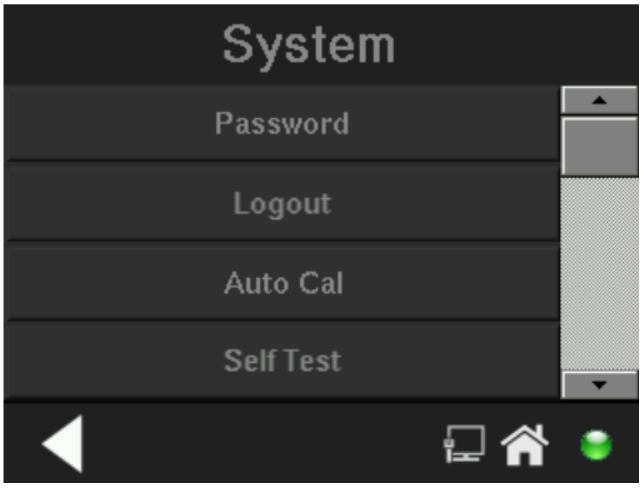
Dragging the Scroll bar shows next 4 options. Click on any one of the options to navigate to that function screen.

Any function can be selected at any time by navigating to the proper System screen and pressing the appropriate onscreen button (unless password restrictions apply). The order as presented in this manual is appropriate for an initial setup.

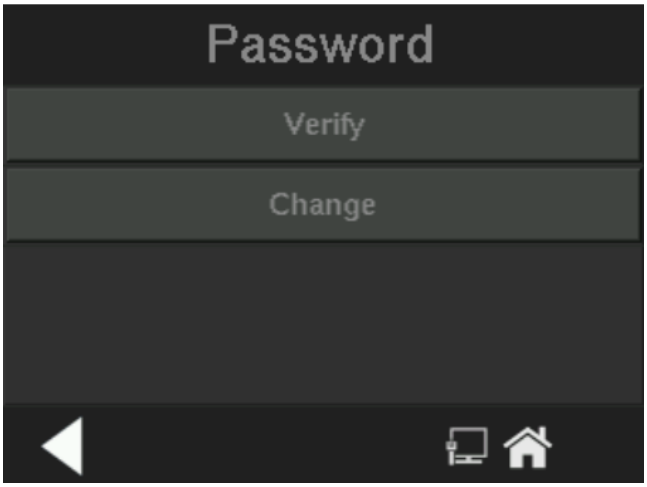
Each of these functions is described in greater detail in the following procedures. The display screen text that accompanies each operation is reproduced, at the appropriate point in the procedure.

4.5.1 Password

The Password setup function is available from the first System screen.



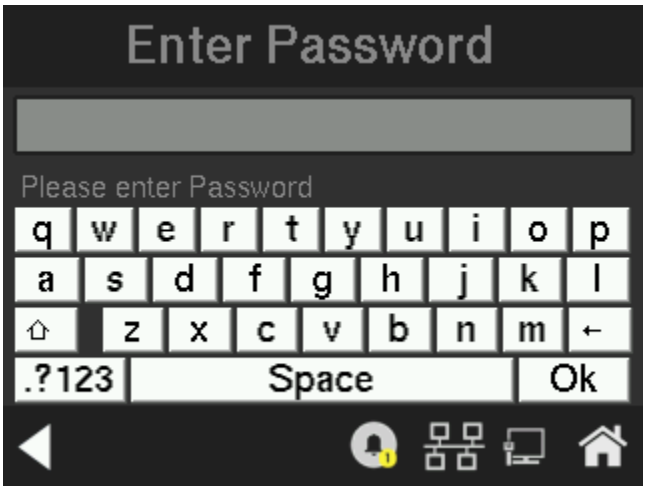
Selecting the password option from the first System screen produces the following display:



From this screen the user can select either to verify the existing password to gain access to the features of the instrument or to change the existing password. **By default, the factory password - "TETAI" - will be used and all features will be available to the user.**

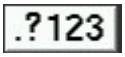
Verify: It prompts the user to enter the password to remove the password restrictions imposed on the different features in the instrument.

Change: This option can be used to change the existing password of the instrument. When the user presses the change option, the screen will change to Enter Password screen. Here the user must verify the existing password to get access to change the password.



The following buttons are used to change the keypad mode.

: special character button (only displays when needed)



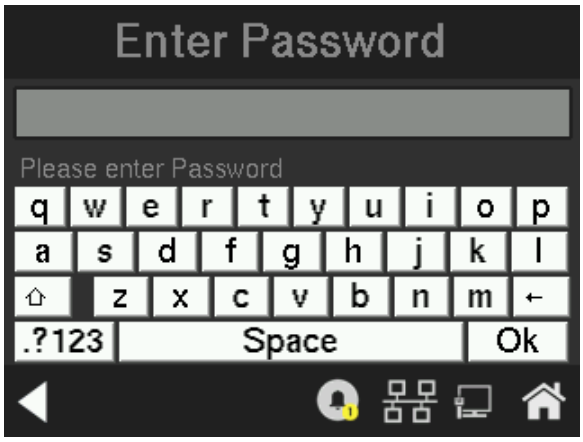
: Number display setting button.


: upper case letters display button.

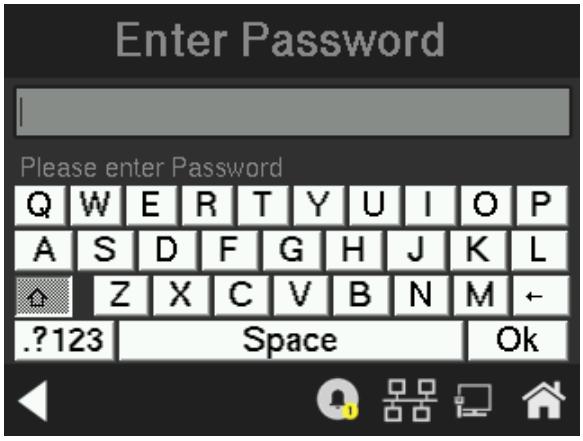

: lower case letters display button.

Pressing any of the above icons will display the type and format of the characters available:

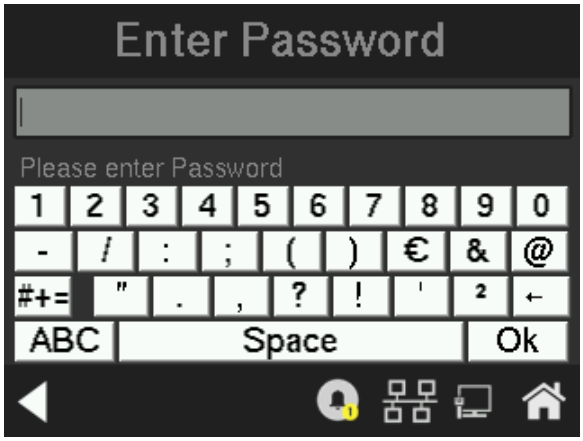
Qwerty pad: Lower case letters (select  if another format button is currently enacted):



Qwerty pad: Upper case letters: (Select ⇧ if another format button is currently enacted):



Number pad: (select .?123)

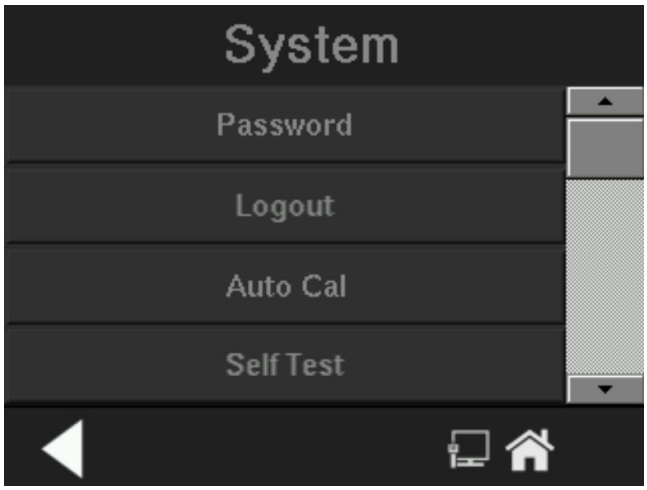


Special character pad: (select #+=)

4.5.2 Logout

The Logout function is available from the first System screen.

The Logout function provides a convenient means of leaving the analyzer in a password protected mode without having to shut the instrument off. By entering Logout, you effectively log off the instrument leaving the system protected against use until the password is reentered. To log out, press the *System* button from the Menu screen and then press Logout.

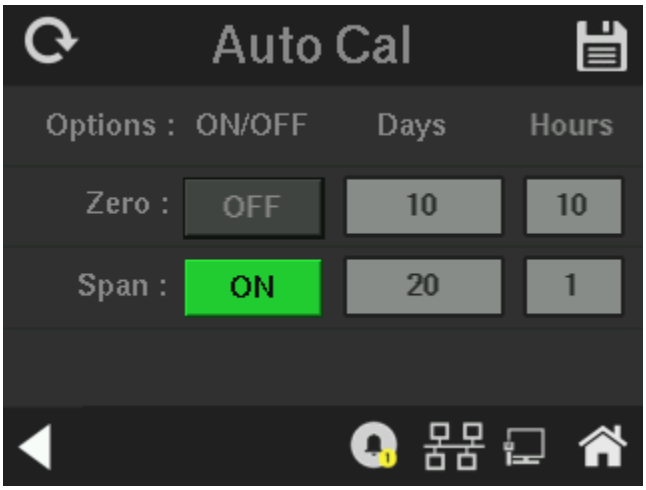


4.5.3 Auto Cal Screen

When proper automatic valving is connected, the analyzer can cycle itself through a sequence of steps that automatically zero and span the instrument. The Auto-Cal screens that follow can be used to define an automatic calibration sequence and/or start an Auto-Cal event.

The Auto Cal function is available from the first System screen.

To enter the Auto Cal function press System and then Auto Cal. A series of screens will appear beginning with the following screen:



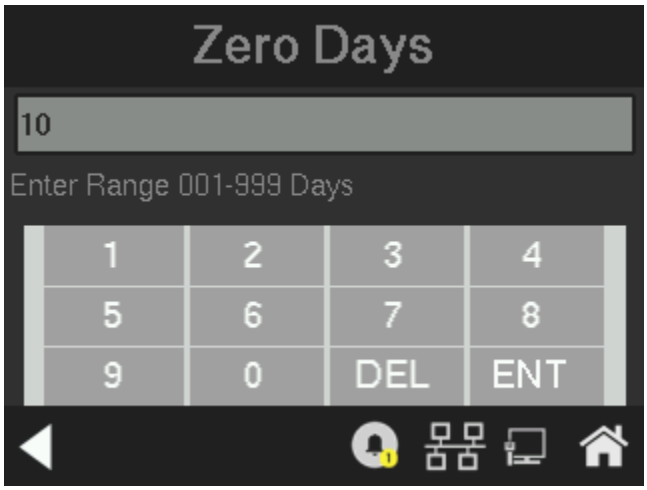
Auto Cal screen has the following options,

1. Auto Cal Zero ON or OFF
2. Auto Cal Span ON or OFF

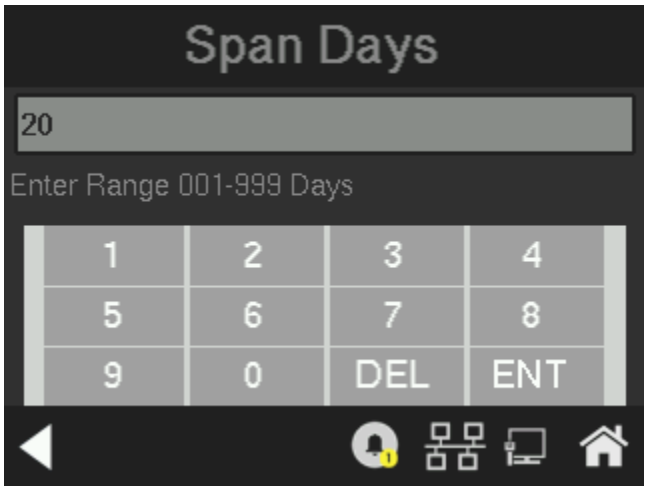
The Zero/Span schedule can be set to xxx days and xx hours before the next auto calibration cycle will automatically occur. The Zero and Span rows have Days and Hours Edit boxes. Clicking on the edit box will bring up individual number pads for entering or editing the Days and Hours setting.

The Zero Days / Span Days range from 1 to 999.

Zero Days:



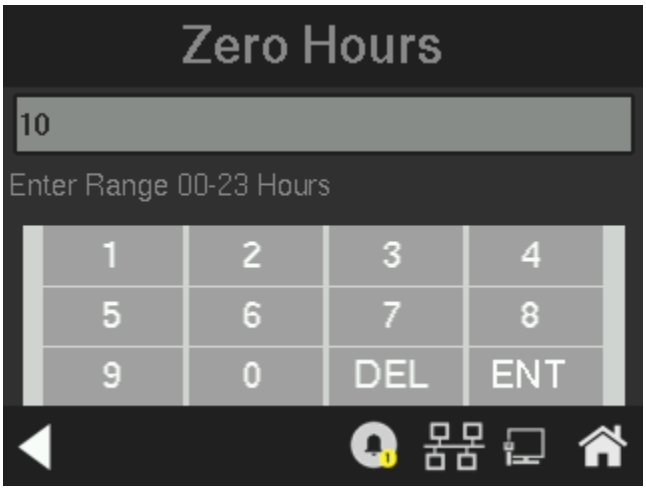
Span Days:



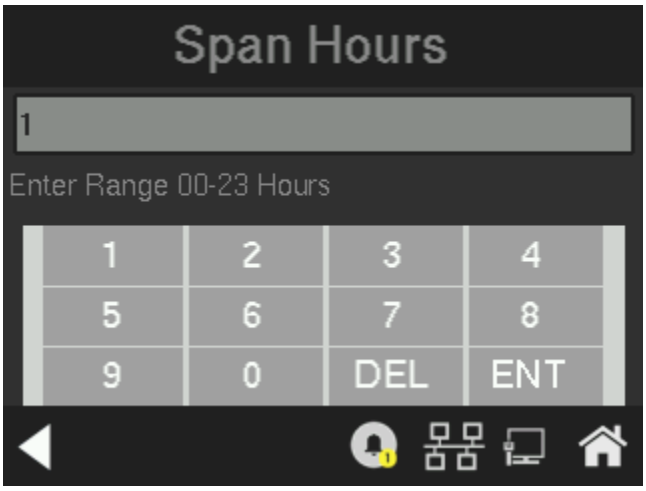
Clicking on the DEL button will delete one character with each click from the Edit box. Clicking on the ENT button will store the entered values and move back to the parent (Auto Cal) screen. Clicking on the back arrow will move to the Auto Cal screen as well but without saving the edited values.

Zero Hours

The range of Zero/Span Hours is from 0 to 23.



Span Hours



Clicking on the DEL button will delete one character with each click from the Edit box. Clicking on the ENT button will store the entered values and move back to the parent (Auto Cal) screen. Clicking on the back arrow will move to the Auto Cal screen as well but without saving the edited values.

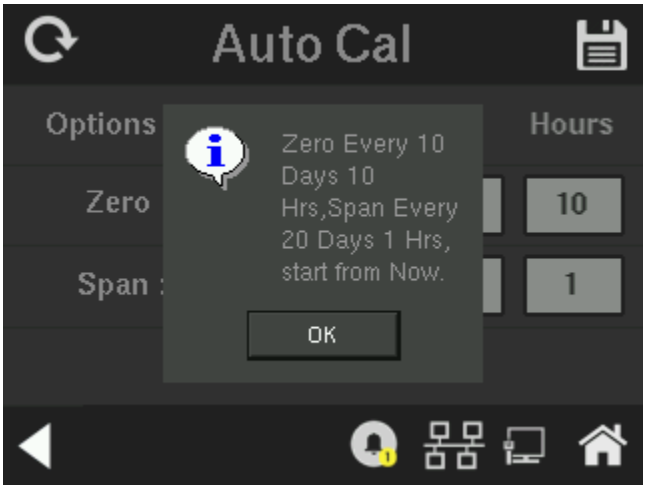
Auto Cal screen has Reset, Save and Back buttons.

Clicking on the Reset button will revert back to the previous values and any changes that have been made will not be saved.

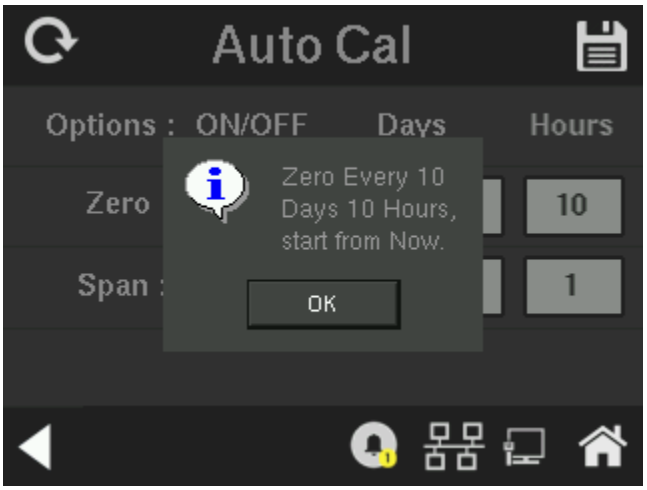
Clicking on home button will move to main screen without saving the edited values.

Clicking on the Save button will save the newly entered values.

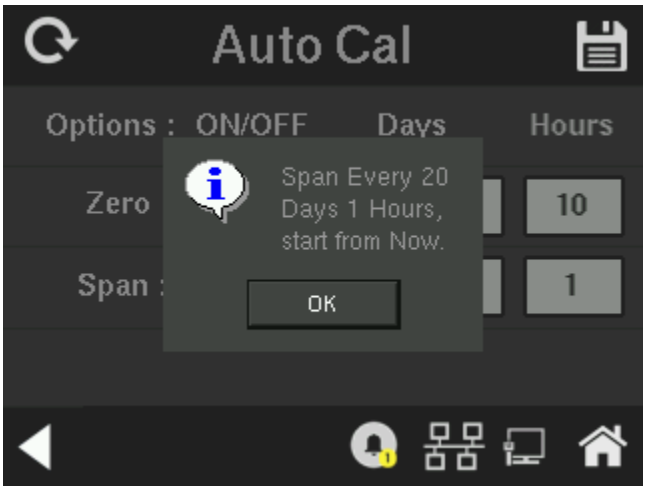
1. If both Zero and Span calibration have been set "ON" and SAVE is pressed, the following pop-up message will appear:



2. If only the Zero calibration has been set to "ON" and the SAVE button is pressed, then the following pop-up message will appear:

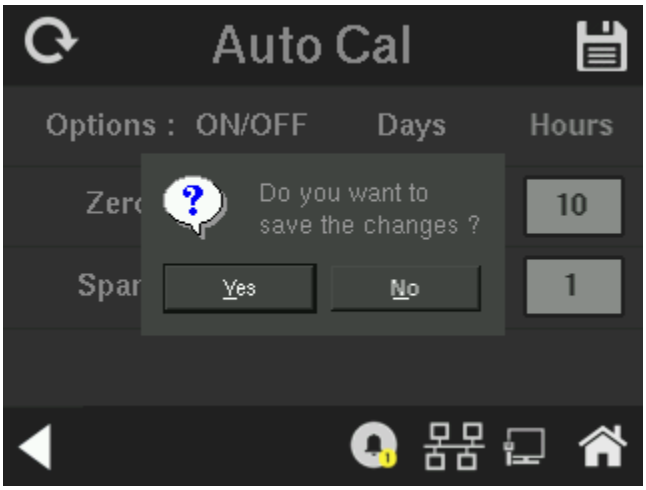


3. If only the span calibration is set to “ON” and the SAVE button is pressed, the following pop-up message will appear:



4. If both zero and span calibration are set to “OFF” then no pop-up messages will be displayed.

5. Clicking on the back button  will move the display back to the System screen. If any changes have been made, then a message box will be shown asking: “Do you want to Save the changes”. Use the Yes or No buttons to answer and dismiss the screen.

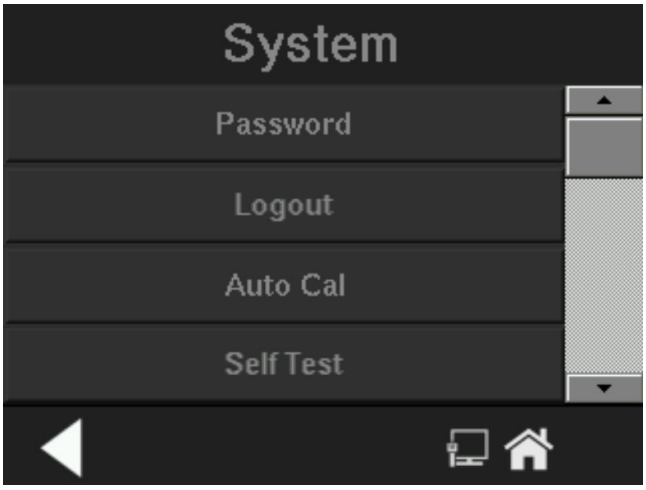


a. Clicking on “Yes” will save user entered values and move to the System screen.
b. Clicking on “No” will discard the changes and move to System screen.

4.5.4 Self-Test

The analyzer undergoes a diagnostic self-testing routine whenever it is powered on. In addition, this routine can be summoned at any time using the Self-Test function. This function is found on the first System screen.

System screen 1:



Pressing Self-Test will initiate the self-test routine.

4.5.5 Application

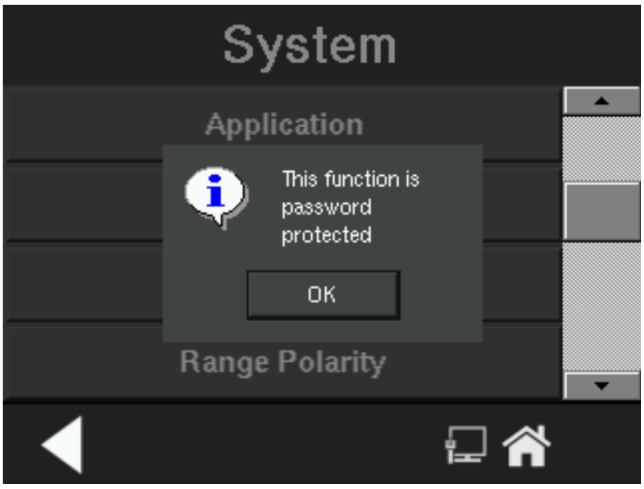
Protection for Application and Algorithm Screen

The Application and Algorithm setup option has two layers of password protection.

When the system is in restricted mode, user can’t access the application screen and algorithm setup option.

If user clicks on the options, then system will display the following error message. When user clicks the “OK” option, system will go

to system screen 2.



➢ To access the screen, user must remove the system restrictions using the 'password -> verify' option (first layer protection).

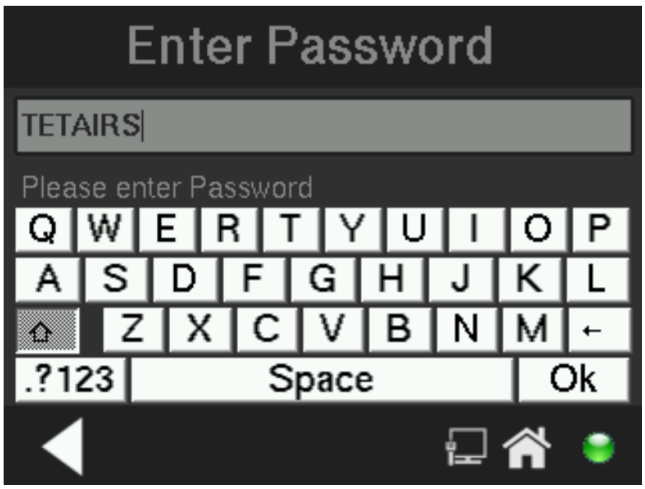
➢ By default second layer protection is disabled. User can enable the protection by sending "st" command through RS232.

➢ To the second layer protection can be disabled by using the UI or RS232 command.

1. After the system restriction is removed, when user access the application or algorithm setup option system will provide the password edit option for user.

2. when user sends the remote programming (“rp”) command from the valve box, the system will disable the second layer protection for application and algorithm setup option.

➢ In UI, when user access the application or algorithm setup option the following screen appears.

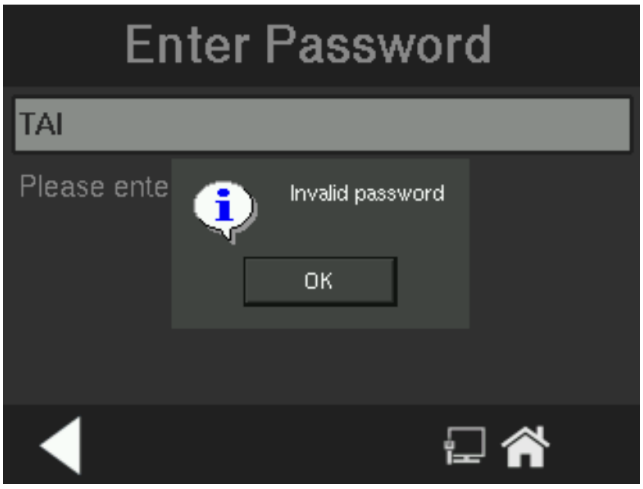


➢ Here user must enter the password as “**TETAIRS**”. It is factory password. User can’t change it.

➢ Once user entered the correct password system will remove the second layer protection.

➢ When both the password protections are disabled, system won’t restrict the access for application and algorithm screen until the power off or system log out or RS232 status message is disabled and then enabled.

➢ If user enters the wrong password, then system will display the “invalid password” error message. When user clicks the “OK” button, system will go to system screen 2.

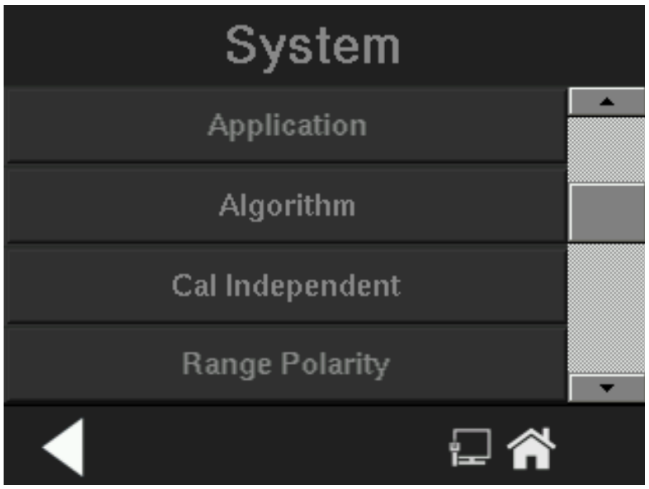


When user clicks on the Application button in the System Screen 2, System shows the Application screen.

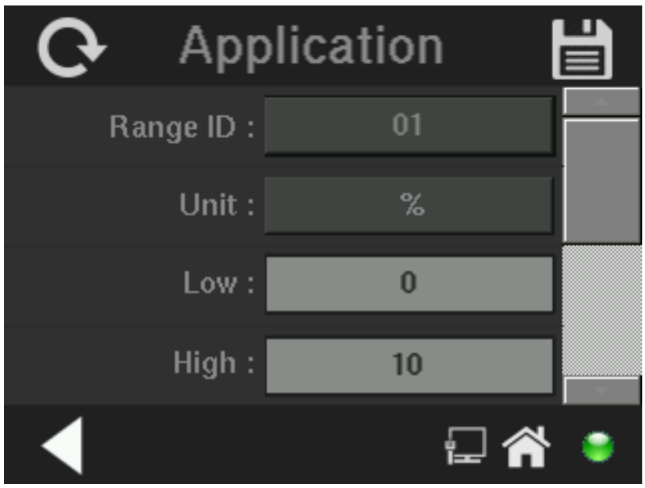
➢ Application screen has two screens. User can use the scroll bars to program the range details.

➢ Application screens are shown in below.

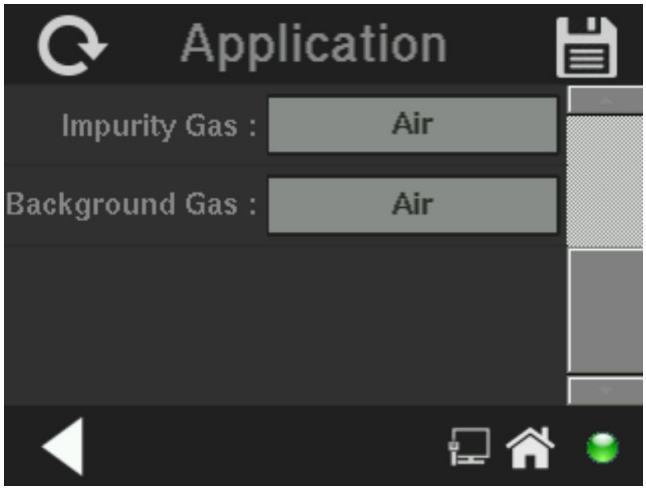
System Screen 2:



Application Screen 1:



Application Screen 2:



Application has the following options,

A. Range ID
    1. Range Id has 01, 02, 03, CAL options
    2. When user clicks on the range id option, it toggles.
B. Unit
    I. Unit has two types.

a. Percentage (%)

b. PPM

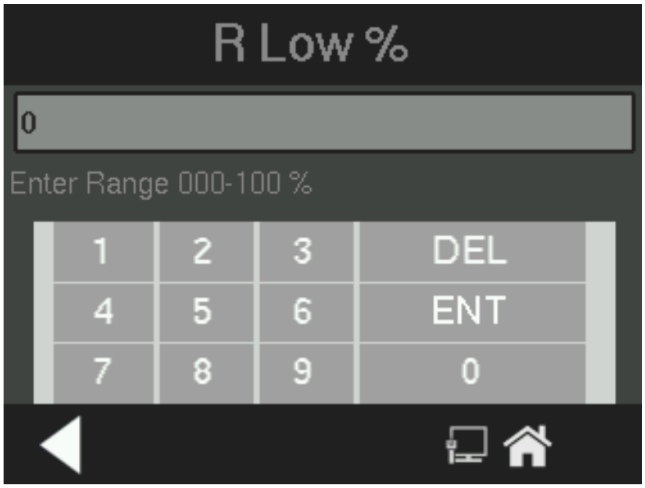
II. When user clicks on the unit option, it toggles.

C. Low Limit

I. Based on the selected unit, low limit option will be enabled. When the unit is PPM, user can't edit the range low value.

II. When user clicks on the low option, keypad will appear in the screen. Using the keypad user can enter the values. The maximum limit is specified in the keypad.

III. The keypad screen is shown below:



a. Click on "DEL" button to delete the one character from the Edit box.

b. Click on "ENT" Button to store the values and move back to the parent (Application) screen.

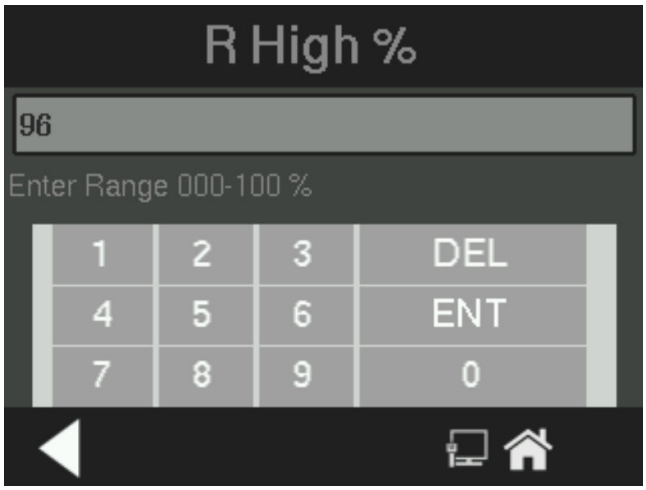
c. Click on "Back arrow" on this screen, will move to Application screen without saving edited values.

D. High Limit

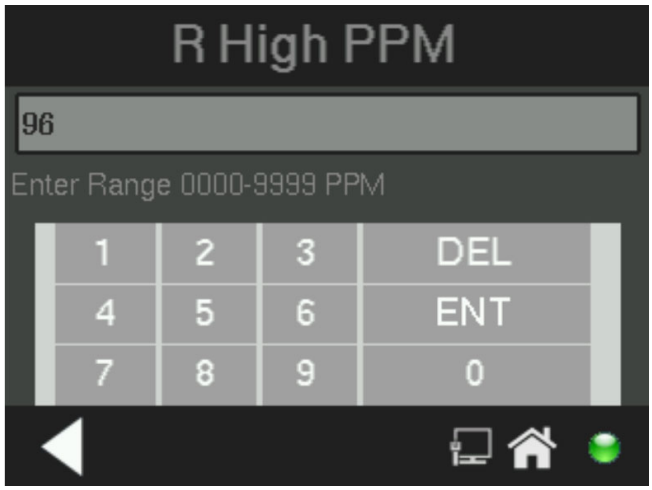
I. When user clicks on the high limit option, keypad will appear in the screen. Using the keypad user can enter the values. The maximum limit is specified in the keypad.

II. Based on the unit, maximum limit will appear in the keypad.

III. The Range high limit edit option keypad is shown below:



a. When the unit is Percentage (%)
b. Click on “DEL” button to delete the one character from the Edit box.
c. Click on “ENT” Button to store the values and move back to the parent (Application) screen.
d. Click on “Back arrow” on this screen, will move to Application screen without saving edited values.
e. When the unit is PPM,



E). Impurity Gas

1. When user clicks on the impurity gas option, gas selector keypad will appear.
2. In the gas selector keypad, user can select the gas type.

F. Background Gas

I. When user clicks on the background gas option, gas selector keypad will appear.

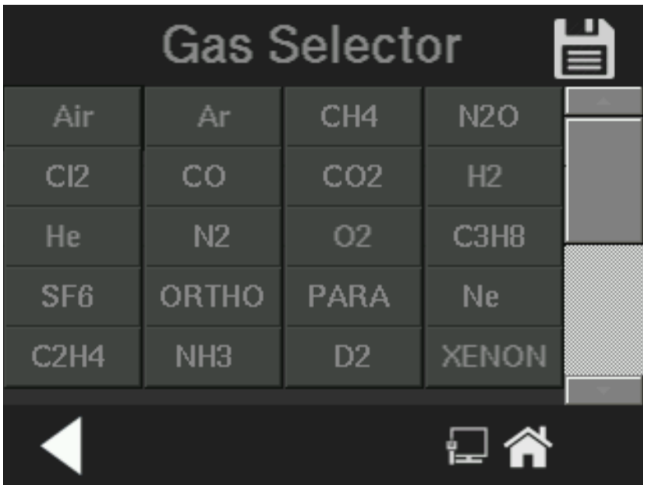
II. In the gas selector keypad, user can select the gas type.

III. Gas selector keypad is shown below,

a. When user selects the gas in the keypad, system will automatically go back to the application screen.

b. If the user clicks the back button, will move system to the application screen.

c. Save button doesn't have any usage. System will remain gas selector keypad.



G. Application screen has SAVE, RESET and BACK buttons.

I. Clicking on the Reset button  will revert to the old values, if in case any changes done.

II. Clicking on home button  will move to main screen without saving edited values.

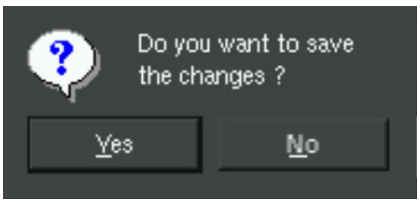
III. Clicking on the Save button  will save newly entered values.

IV. Click on the back button  will move back to the System screen. In case if any changes done then a message

box will be shown “Do you want to Save the changes” with Yes or No buttons.

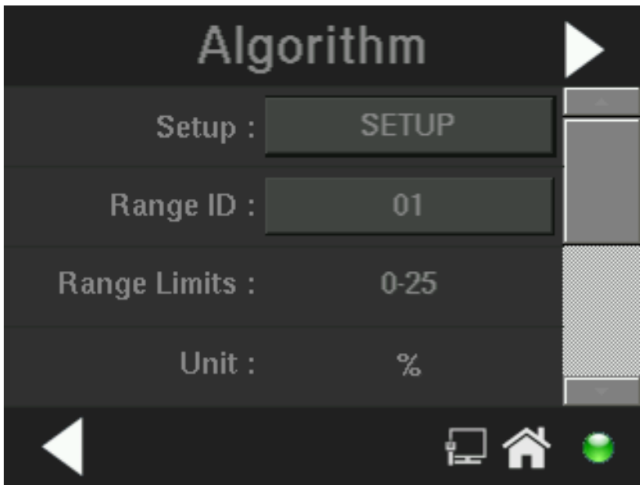
a. Clicking on “Yes” will save user entered values and move to the System screen.

b. Clicking on “No” will discard the changes and move to System screen.



4.5.6 Algorithm

When user clicks on the Algorithm button in the System Screen 2, System shows the Algorithm.



Algorithm screen has the following options,

A. It displays the range limit, unit, impurity, and background gas types. User can’t edit these options.

B. Range ID.

   I. It has the 01, 02, 03 options.

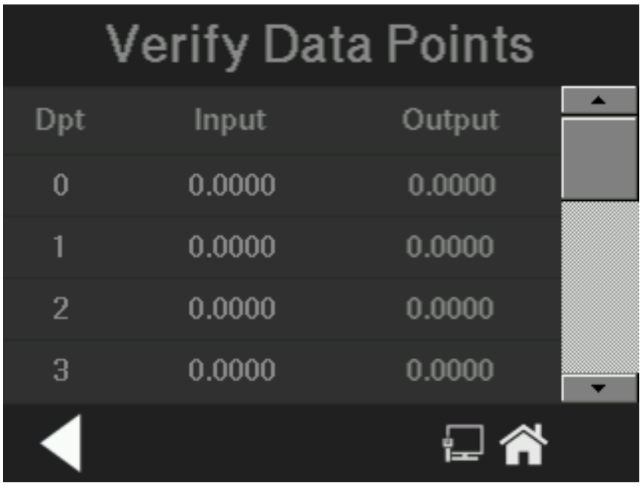
   II. When user clicks the option, it toggles.

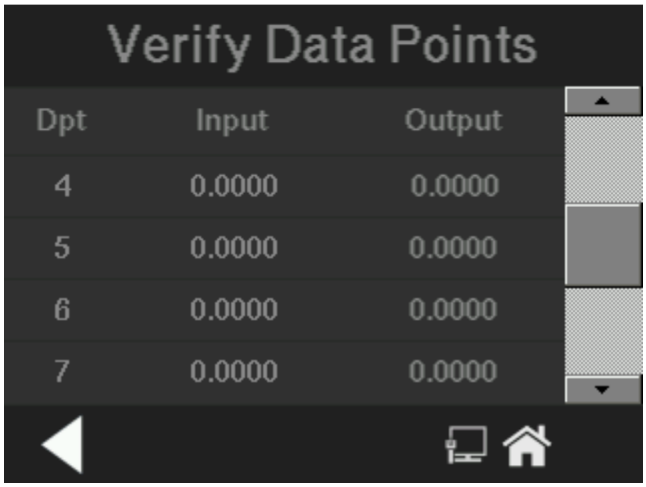
C. Setup

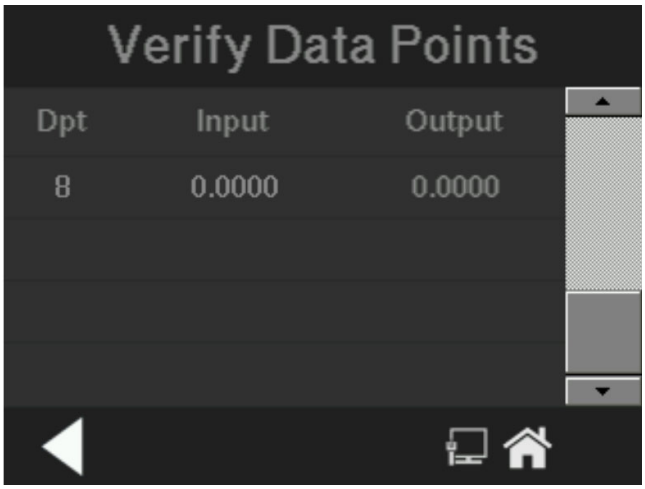
   I. It has SETUP and VERIFY options.

   II. When user clicks on the option, it toggles.

a. VERIFY:
   i. When the setup option is VERIFY and user clicks the  (next) button will display the linearization data table screen
   ii. In the linearization table user can view the data points using the scroll bar.







iii. When user clicks the  button, system will go to algorithm screen.

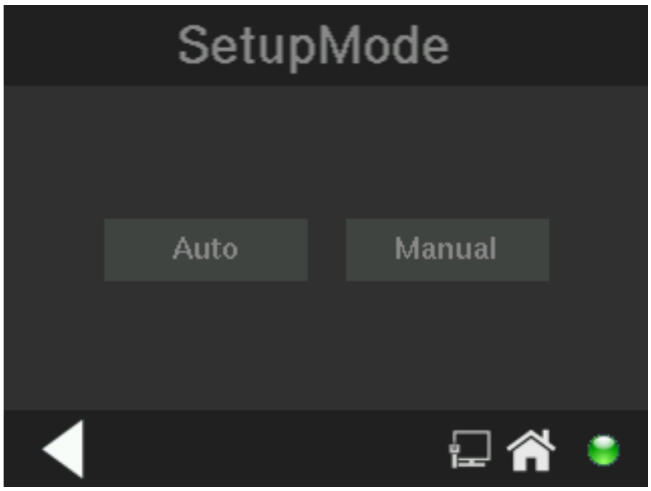
b. SETUP:

i. When the setup option is SETUP and user clicks the next button, system will go to setup mode screen.

ii. The setup mode screen has two options:

1. AUTO
2. MANUAL

iii. User can touch or click the auto or manual option.

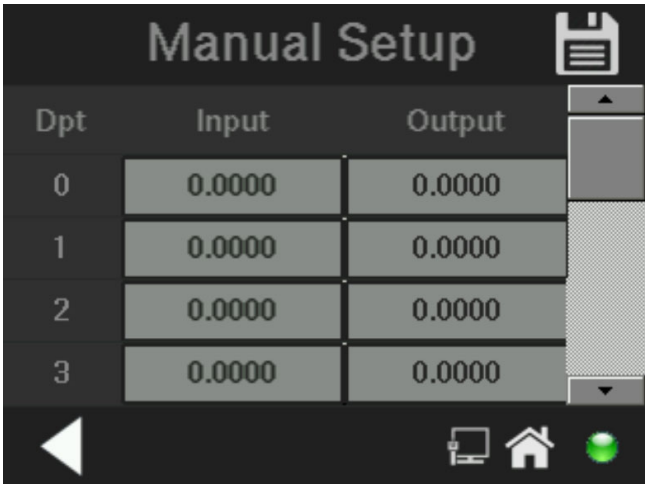


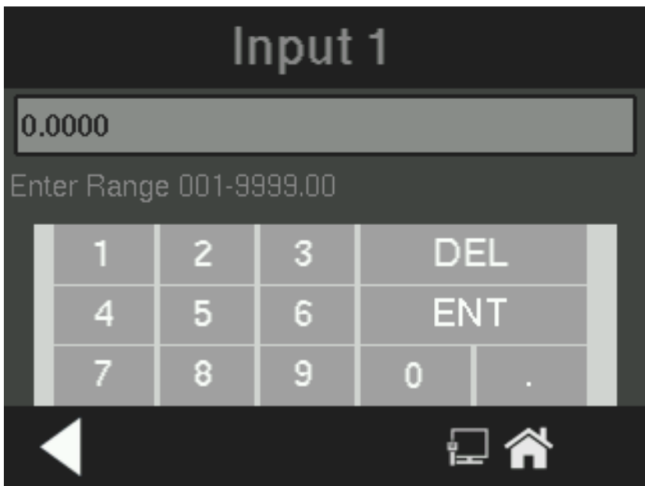
iv. When user clicks the ‘auto’ option, system will go to AUTO SETUP screen. If the user clicks the ‘manual’ option, system will go to MANUAL SETUP screen.

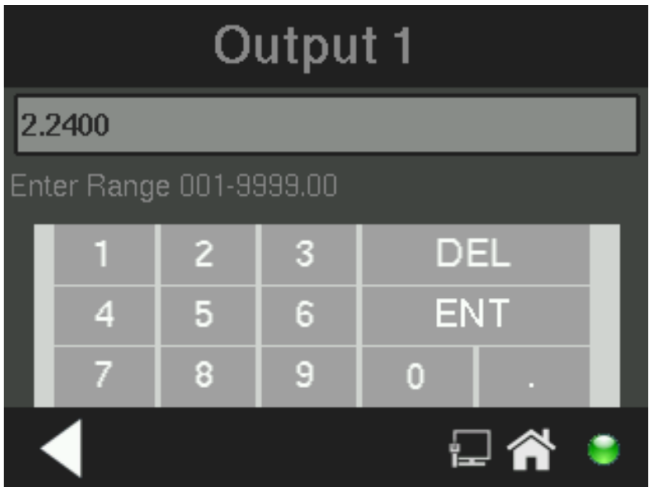
1. Manual Setup.

a) The manual screen will appear as below.

b) User can edit the 9 data input and output points. In this screen user can edit the input and output points by clicking on the field.

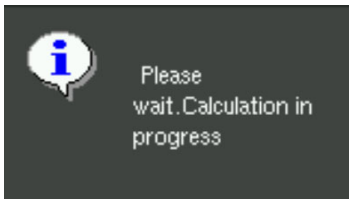




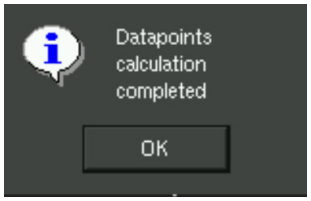


c) Touch/click on edit box, then system displays number pad screen to edit the data point value. Press “ENT” to save the values. Press “DEL” to delete the values. Press “Back arrow” to discard the changes.

d) When user press the save button in the manual setup screen, "Please wait. Calculation in progress will appear” message will appear for 5 seconds.

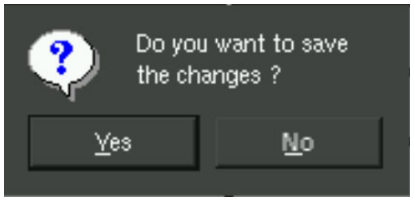


e) Then system will display, a dialog box with “Datapoints calculation completed” message and “Ok” Button.



f) Click or touch on the 'OK' button will move to the algorithm screen.

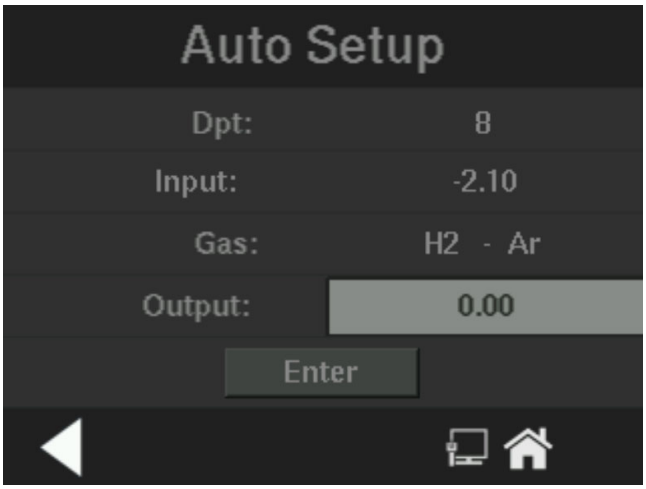
g) Click on the back  button will move back to the System screen. In case if any changes done then a message box will be shown "Do you want to Save the changes" with Yes or No buttons.



- Clicking on "Yes" will save user entered values and displays the "Please wait. Calculation in progress will appear" and the "Datapoints calculation completed" message. Then system will move to the Algorithm screen.
- Clicking on "No" will discard the changes and displays the "Please wait. Calculation in progress will appear" and the "Datapoints calculation completed" message. Then system will move to the Algorithm screen.

2. Auto Setup

a) When user clicks the 'auto' option, system will go to the auto setup screen.



b) In this screen user can edit only the 'Input' value. The output value
will be in '%'.
c) Clicking the ENTER button, will move to the next data point.

c) When user clicks the ENTER button, "Please wait. Calculation in progress will appear" message will appear for 5 seconds.

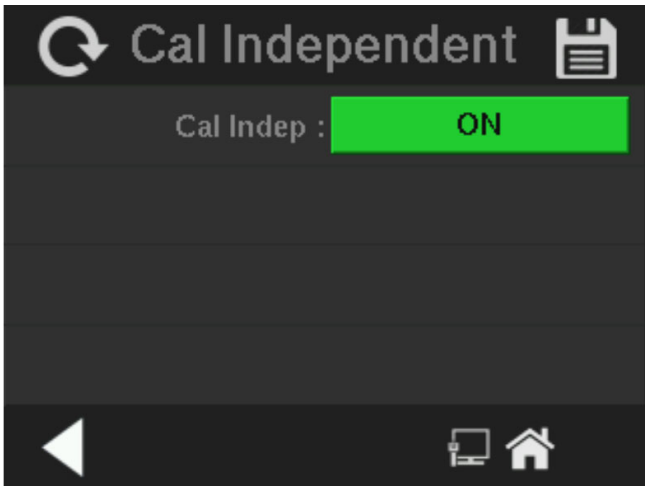
d) If the dpt is reached 8 and clicking the ENTER button, will display a dialog box with "Datapoints calculation completed" message and "Ok" Button

e) Click or touch on the 'OK' button will move to the algorithm screen.

f) Click on "Back arrow" on this screen, will move to Algorithm screen. But it will display the "Please wait. Calculation in progress will appear" and the "Datapoints calculation completed" messages.

4.5.7 Cal Independent

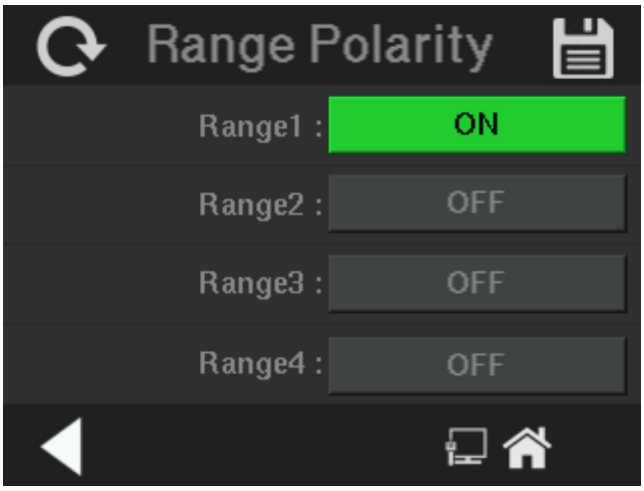
When user clicks on the Cal Independent button in the system screen 2, System shows the Cal Independent screen. Cal Independent means the analyzer will calibrate only the range it is on. It will not calibrate the other ranges.



A. In Cal Independent screen, user can toggle Cal independent option between ON and OFF.
   I. ON - When the option is ON and the system is single gas application model, the user must calibrate each range independently. This is needed when each range is not linear.
   II. OFF - When the option is OFF and the system is in single gas application model, the user doesn't need to do independent calibrations. The analyzer will calibrate all ranges. This is suitable when the application is of a single s gas and linear on all the ranges that the analyzer is programmed to have.

4.5.8 Range Polarity

When user clicks on the Range Polarity button in the system screen 2, System shows the Range Polarity screen.

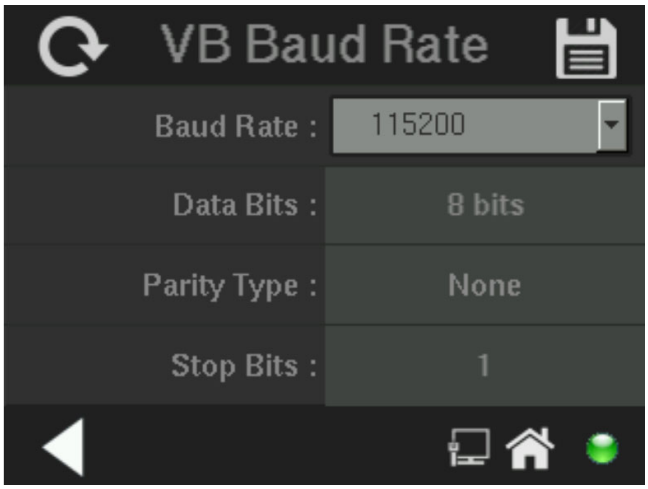


A. The Range Polarity screen displays range number and the polarity status of the range. When user clicks on the polarity status, it toggles between ON and OFF.

B. If the polarity status of the range number is ON, system will change the sign of the application gas result. Use, if readings go negative on span gas for example.

4.5.9 VB Baud Rate Screen

The VB Baud Rate screen allows the user to set or edit the Baud rate. The VB Baud Rate function is available from the second System screen. To enter this function, press System and scroll to the second screen.

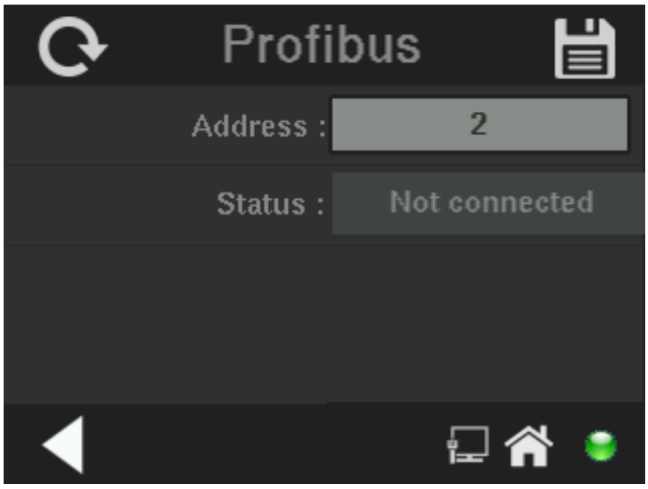


VB Baud rate setup screen will provide option to edit Baud rate with drop down option. Selections are 2400, 4800, 9600, 19200, 38400, 115200.

The remaining three fields, data bits, parity bits and stop bits are read only.

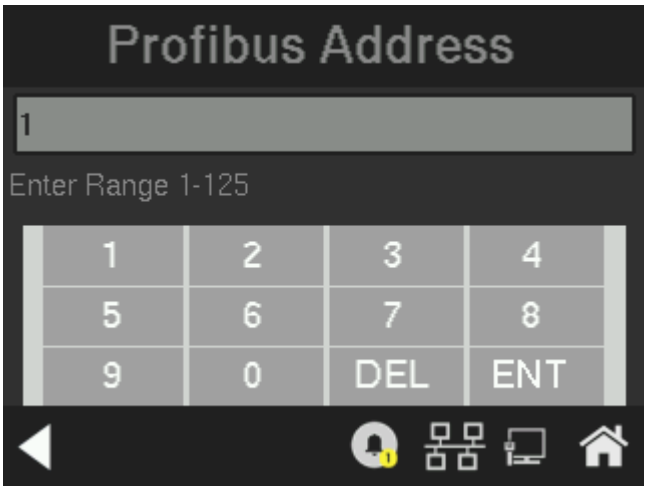
4.5.10 Profibus Screen

When using Profibus communication, the Profibus function available from System screen 2 displays the Profibus configuration.



From this screen, the user can view and edit the Profibus slave address as well as see the current status (connected or disconnected).

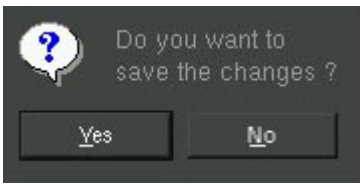
Selecting Address by pressing on the edit box brings up a numerical pad for entering or editing the slave address.



1. The Profibus address can range from 1 to 125.
2. Click on the "DEL" button to delete the one character at a time from the Edit box.
3. Click on "ENT" Button to store the values and move back to the parent (Profibus) screen.
4. Click on "back arrow" button on this screen, to move back to the Profibus screen without saving the edited value.

Clicking on home button  will move the display to the Main screen without saving the edited values.

Clicking on the back button  will move the display back to the System screen. If any changes have been entered, a message box will appear requesting: "Do you want to Save the changes?" Use the Yes or No buttons to reply.



- "Yes" will save user entered values and move to the System screen.
- "No" will discard the changes and move to System screen.

The status of the Profibus connection can be viewed from this screen. The Status box will indicate:

- "Connected" if the 2000RS board is connected to the external Profibus master PLC.
- "No Connection" if the 2000RS board Profibus communication has failed to communicate with the external with Profibus Master PLC.

4.5.10.1 PROFIBUS TASK

The Profibus task will receive remote commands from a master PLC. These are the System module input registers:

Address	Byte Location	Variable	Variable description
0x00	0x00	Analyzer Command	0x01 - Analyze 0x08 - Span 0x10 - Zero 0x20 - ESC

The System output module registers are organized like this:

Group	Address	Bit Number	Variable	Variable description
Gas Concentration Value (0x00 - 0x03)	0x00		Gas concentration (LSB)	Current gas concentration values updated.
	0x01			
	0x02			
	0x03		Gas concentration (MSB)	
Reserved (0x04 - 0x07)	0x04		Reserved	Reserved
	0x05			
	0x06			
	0x07			

Group	Address	Bit Number	Variable	Variable description
Model Number (0x08-0x0F)	0x08		Model No (LSB)	System model no will be updated
	0x09			
	0x0A			
	0x0B			
	0x0C			
	0x0D			
	0x0E			
	0x0F		Model No (MSB)	
Serial Number (0x10 - 0x17)	0x10		Serial No (LSB)	System serial no will be updated
	0x11			
	0x12			
	0x13			
	0x14			
	0x15			
	0x16			
	0x17		Serial No (MSB)	
Software Version (0x18)	0x18		Software Version	Software version will be updated (multiply by 10) update first two digits of software version. Example: 1.2.0, will be 1.2*10 = 12

Group	Address	Bit Number	Variable	Variable description
Diagnostic status - Power on test results (0x19)	0x19	0	5V	Based on the diagnostic result, system will set the diagnostic variable bit as 1 or 0. 0 - PASS 1 - FAIL
		1	3.3 V	
		2	9V	
		3	24V	
		4	4..5V	
		5	Range 4 - 20 mA	
		6	Range 0 - 1 V	
		7	PPM 4 - 20 mA	
Diagnostic status -Power on test results (0x1A)	0x1A	0	PPM 0 - 1 V	
		1-7	Reserved	
Diagnostic status - Reserved (0x1B)	0x1B		Reserved	Reserved
System Mode (0x1C)	0x1C	0	Analyzer Mode, Zero Mode	Current system mode will be updated in the 0th and 1st bit. The mode values will be 00 - Init (0) 01 - Analyzer mode (1) 10- Span mode (2) 11- Zero mode (3)
		1	Span Mode, Zero Mode	
		2	Reserved	
		3	Reserved	
		4	Reserved	
		5	Reserved	
		6	Reserved	
		7	Reserved	

Group	Address	Bit Number	Variable	Variable description
System Status - Negative Sign, Heart beat (0x1D)	0x1D	0	Negative sign bit	when the negativesign bit is enabled,system will set this bit as high. otherwise, it be zero.
		1	Heart bit	System will toggle the bit at constant intervals
		2	Reserved	Reserved
		3	Alarm1	Based on alarm1 status 0 - OFF, 1 - ON
		4	Alarm2	Based on alarm2 status 0 - OFF, 1 - ON
		5	Reserved	Reserved
		6	Reserved	
		7	Reserved	
System Status - Communication and Calibration (0x1E)	0x1E		Reserved	Reserved
System Status - Reserved (0x1F)	0x1F		Reserved	Reserved
Reserved (0x20 - 0x21)	0x20		Reserved	Reserved
	0x21		Reserved	
Reserved (0x022 - 0x23)	0x22		Reserved	Reserved
	0x23		Reserved	Reserved

Group	Address	Bit Number	Variable	Variable description
Range Status (0x24)	0x24	0	Range type	RType : NON-0 INV-1
		1	Range mode	RMode : AUTO-0 MAN-1
		2	Range Linear	RLiner : NON-0 LIN-1
		3	Edit Allowance	EditAllowed : NO-0 YES-1
		4	Range Unit	RUnit : %-0 PPM-1
		5	Reserved	
		6	Reserved	
		7	Reserved	
Current Heater Temperature (0x25-0x28)	0x25		Heater Temp (LSB)	Current Heater Temperature value updated
	0x26			
	0x27			
	0x28		Heater Temp (MSB)	

The gas value is given in four bytes, those four bytes are combined into a 32-bit word to be converted into a float value. The float value is O2 concentration in ppm.

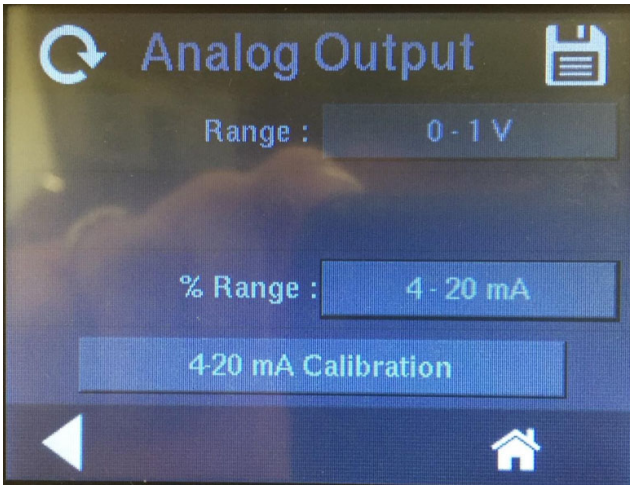
4.5.11 Analog Output

The analog output signal from the Model 2000RS is a voltage (0-1 VDC) or current (4-20 mA) signal which depends on the concentration AND the currently activated analysis range. To relate the signal output to the actual concentration, it is necessary to know what range the instrument is currently on, especially when the analyzer is in the auto ranging mode.

The Analog Output screen allows the user to choose the output configuration for the range ID and the concentration. The available choices are 0-1 VDC or 4-20 mA. Both outputs are not available at the same time.

The Analog Output function is available from the third System screen. To enter this function, press System and scroll to the third System screen.

Analog Output screen:



4.5.11.1 RANGE IDENTIFICATION

Click on the edit box for Range to toggle between "0-1V" and "4-20mA".

Selecting 0-1V or 4-20 mA for Range ID will scale the range identification as follows:

Range	Voltage (V)	Current (mA)
01	0.25	8
02	0.50	12
03	0.75	16
CAL	1.00	20

4.5.11.2 CONCENTRATION

The signal output for concentration is linear over the currently selected analysis range. For example, if the analyzer is set on range that was defined as 0–100 %, then the output would be:

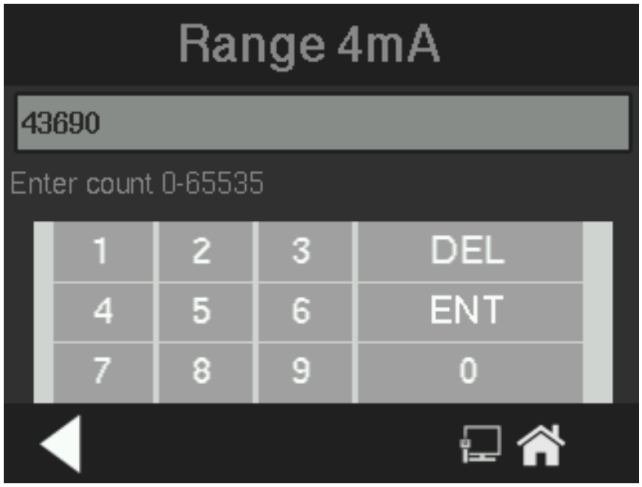
Range 0-100%	Voltage Signal Output (VDC)	Current Signal Output (mA dc)
0	0.0	4.0
10	0.1	5.6
20	0.2	7.2
30	0.3	8.8
40	0.4	10.4
50	0.5	12.0
60	0.6	13.6
70	0.7	15.2
80	0.8	16.8
90	0.9	18.4
100	1.0	20.0

4.5.11.3 4-20 MA CALIBRATION

The 4-20 ma outputs for % Range or range ID can be calibrated. A button named “4-20 mA Calibration” will appear for % range and range ID outputs.

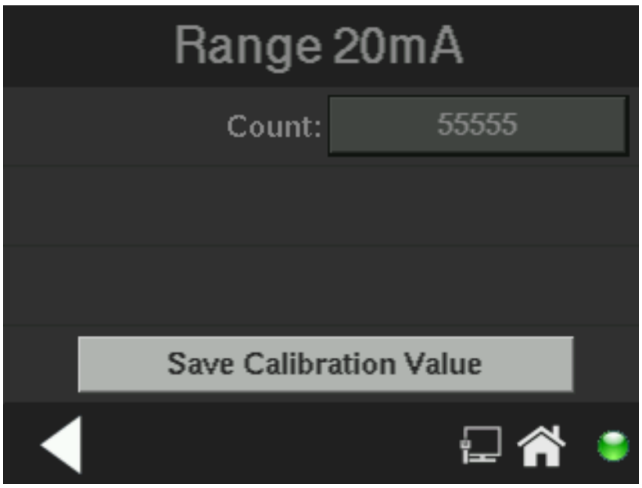
When the user presses the “4-20 mA Calibration” button and new screen will appear with the option to calibrate the low limit, 4.00 mA. A DVM needs to be connected on the output of the analyzer to monitor the output while adjustment is being through the front screen.

The user can tune the DAC that drives the 4-20 ma output by pressing the count option on the screen. When the user presses the count option, the screen changes to the edit screen as follows. Here the user can enter the value and press ENT. This will tune the DAC with the new value and can be measured using a multimeter.



The user can continue tuning the DAC until precise output is obtained by changing the count value and pressing ENT. Once the calibration is done press the "save calibration value" option to write this value into the memory.

Once the low limit value is saved the screen will move to tuning of Range 20mA output. This screen provides similar functionality like the previous screen but this time the adjustment is for the high limit, 20 mA.

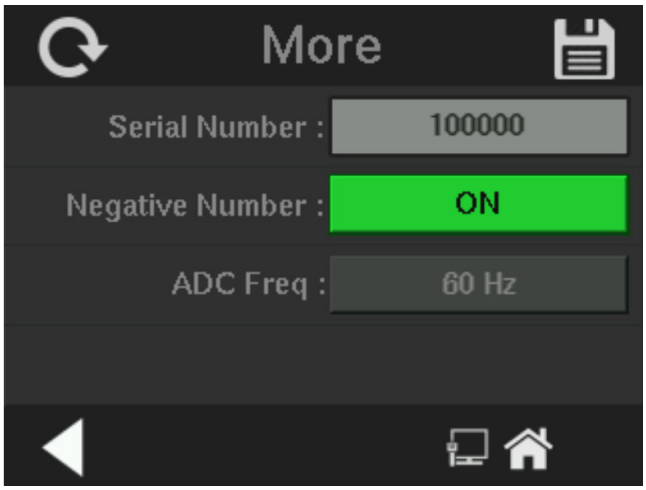


Press the count option to tune the DAC like in 4mA case. In the edit screen you can change the value and press ENT to write the DAC with the new value. User can verify this by measuring the output of the DAC using a multimeter.

Note: The limits of the counts for the DAC are from 0 to 65535. The counts for 4.0 ma by default are set at 10922. The counts for 20.0 ma by default are set at 54613.

4.5.12 More Screen

The More button contains a group of 3 additional system functions: Serial Number, Negative Number, AC Main power frequency.



Serial number is not set at the factory but can be input here so that it is easy to find.

Negative number sets to ON means the unit can display negative concentration.

ADC Freq sets the AC power frequency to either 50 or 60 Hz so that it can be filtered in Analog to Digital Converter, ADC.

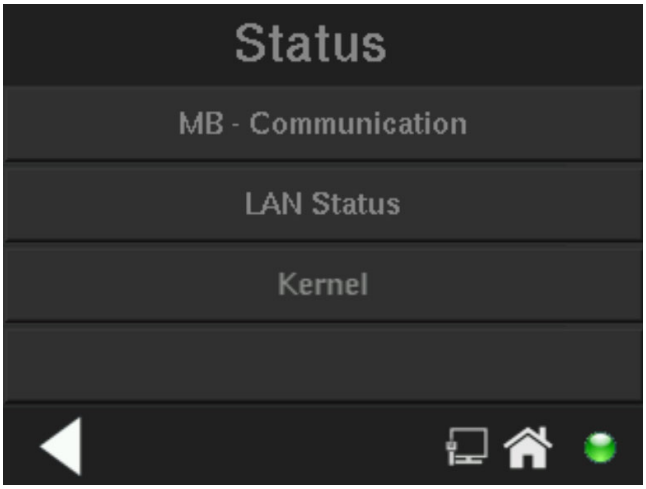
4.5.13 Version

The Version screen is a read-only screen that displays the manufacturer, model, and software version information. It is accessible from the fourth System screen.

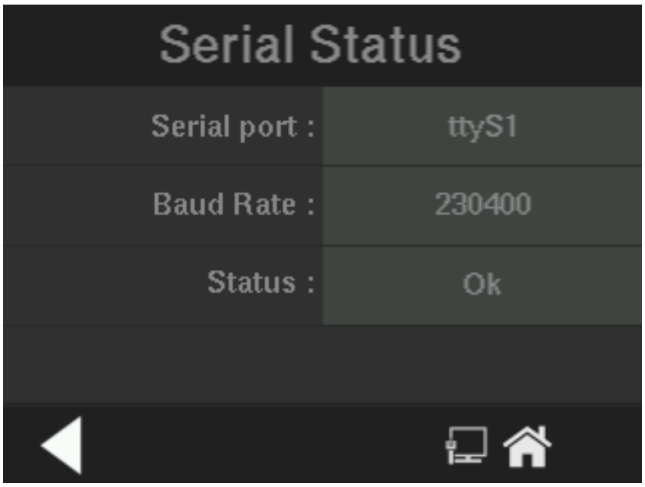
Version screen:

4.5.14 System Status

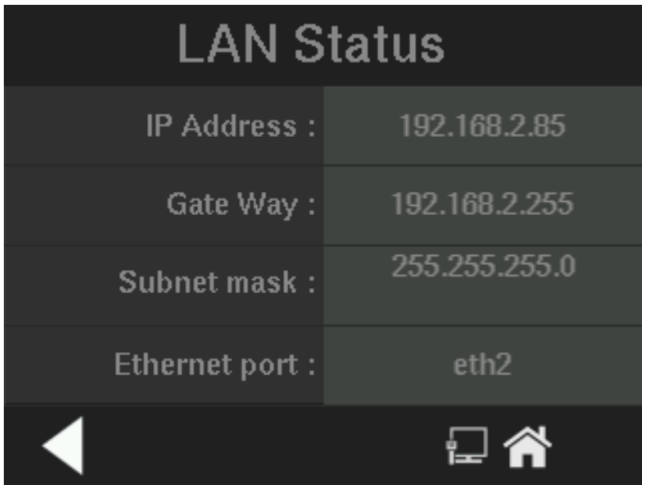
The System Status screen is available from the third System screen. It displays the current system status for the following features:



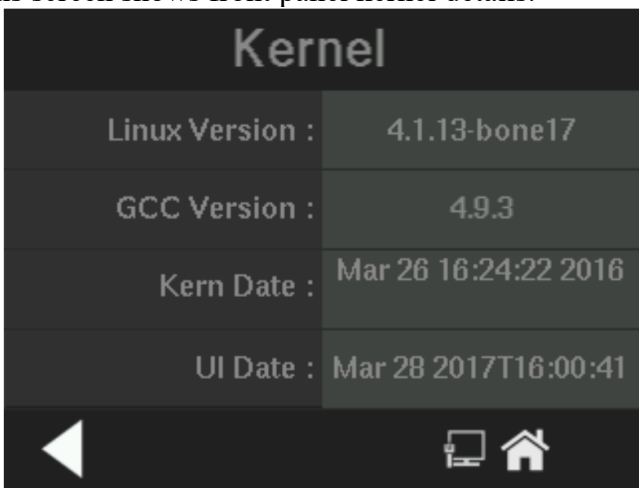
MB Communication: This screen shows baud rate between front panel and motherboard as well as MODBUS communication status.



LAN Status: This screen shows details about front panel LAN connection. It will display the power on time Ethernet port status. LAN icon in the notification status bar is used to indicate the LAN status.



Kernel: This screen shows front panel kernel details.

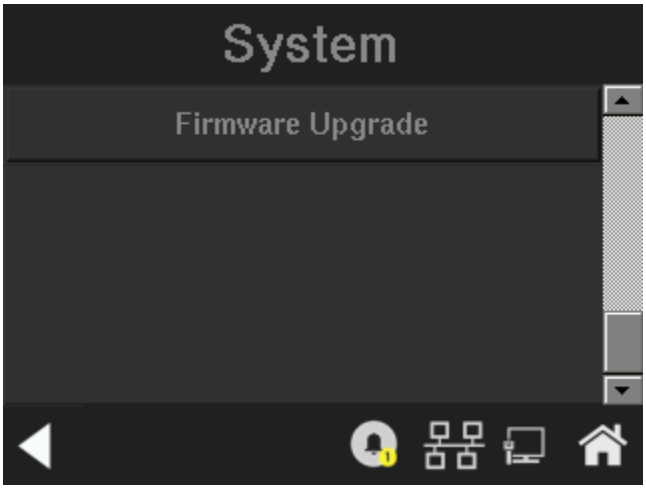


Note: The System Status function is not implemented in this version.

4.5.15 Firmware Upgrade

The Firmware Upgrade function provides an option to upgrade the firmware on the motherboard. It is available from the fourth System screen.

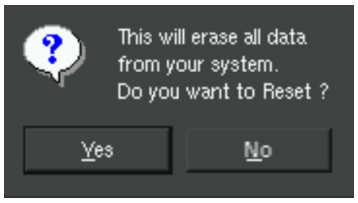
Note: The Firmware Upgrade function is not implemented currently.



4.5.16. Factory Reset

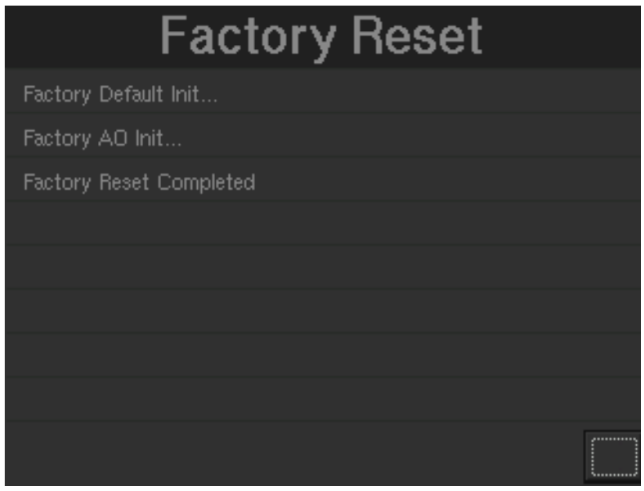
This screen provides option to reset the system settings. When the system is in restricted mode, user can't access the option.

A. When the user clicks on the Factory Reset option on the screen, before starting the factory reset system displays a popup window for confirmation.



B. System starts with calculating electronic offset. All the configuration parameters will be set to factory default values.

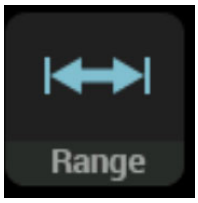
C. Resets all the settings values to default value. Then system will move to self-test.



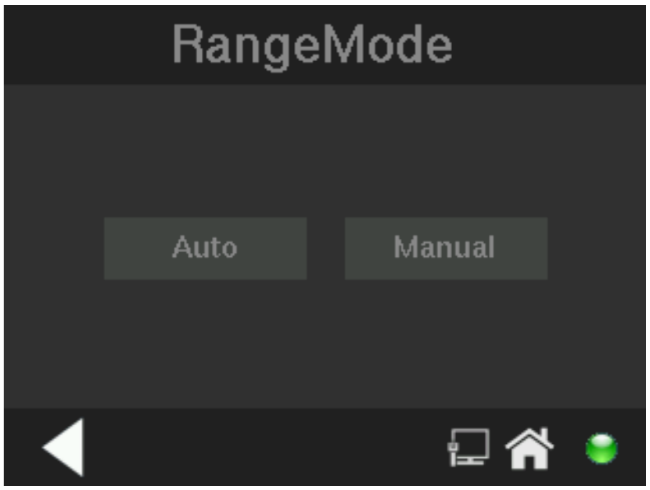
4.6 The Range Function

The Range function allows the operator to program up to three concentration ranges to correlate with the DC analog outputs. If no ranges are defined by the user, the instrument cannot access them other than range 01.

Press the range button:

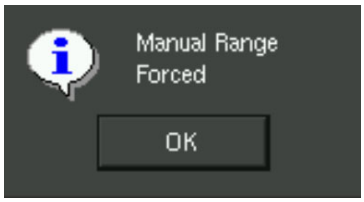


The Range Mode screen will appear:



In the range mode screen user can select the range mode as AUTO or MANUAL. After clicking on the option, wait for 5 seconds.

When user selects the AUTO mode, system checks the auto range mode is allowed or not. If the auto range is not allowed, system will display following popup message. Pressing the “OK” will go to the range screen and the range mode will be MANUAL.

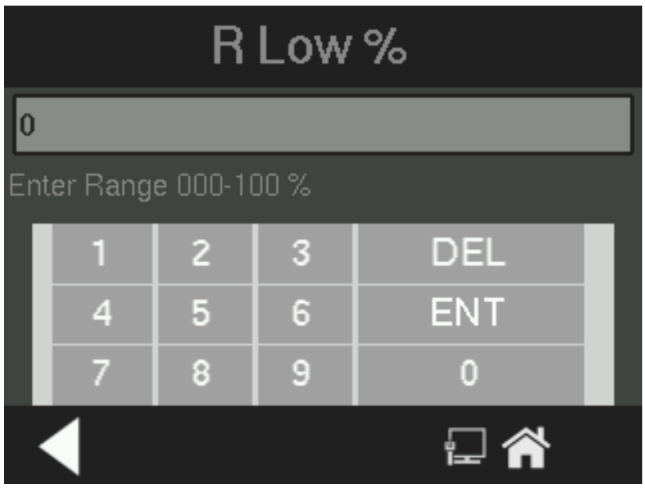


If the auto range is allowed, system will go to the range screen and system mode will be AUTO.

This screen provides an option to edit LOW and HIGH range limits, and Type and mode. In range screen user can't change the unit, impurity and background gas. User can't set the range type for CAL RANGE.

Low: Range low edit box, click on this edit box to enter low Range PPM or % values.

RANGE LOW edit screen:

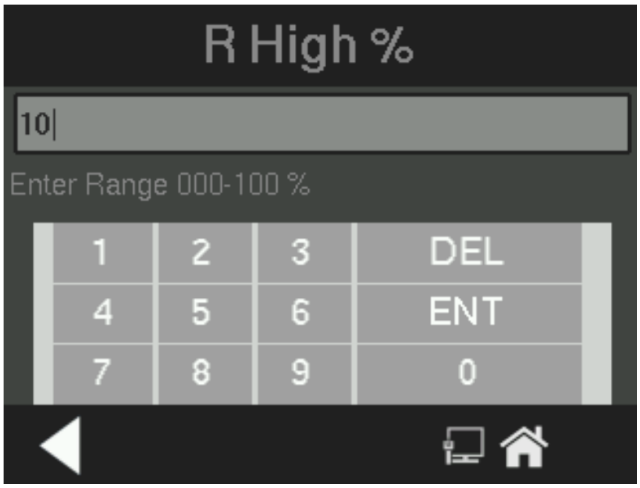


User can enter the range low values from 0 to 9999 PPM or (0-100 %). Click on "DEL" button to delete the one character from the Edit box. Click on "ENT" Button to store the values and move back to the

parent (range) screen. Click on “Back arrow” on this screen, will move to range screen without saving edited values.

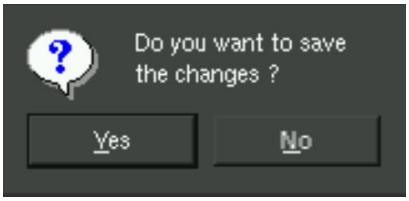
High: Range high edit box, click on edit box to enter high Range PPM values.

RANGE HIGH edit screen:



Suppressed range: push button to toggle **ACTIVE/DEACTIVE (type invert/non invert).**

The Save button will save newly entered values.



4.7 Alarm Function

The Model 2000RS is equipped with 2 fully adjustable concentration alarms and a system failure alarm. Each alarm has a relay with a set of form “C" contacts rated for 1amp resistive load at 250 VAC. See Figure in Chapter 3, Installation and/or the Interconnection Diagram included at the back of this manual for relay connections.

The system failure alarm has a fixed configuration described in Chapter 3 Installation.

The concentration alarms can be configured from the display as either high or low alarms by the operator. The alarm modes can be set as latching or non-latching, and either failsafe or non-failsafe, or, they can be defeated altogether. The setpoints for the alarms are also established using this function.

Decide how your alarms should be configured. The choice will depend upon your process. Consider the following four points:

A. Which if any of the alarms are to be high alarms and which if any are to be low alarms?

   Setting an alarm as HIGH triggers the alarm when the concentration rises above the setpoint. Setting an alarm as LOW triggers the alarm when the concentration falls below the setpoint.

   Decide whether you want the alarms to be set as:

   - Both high (high and high-high) alarms, or
   - One high and one low alarm, or
   - Both low (low and low-low) alarms.

B Are either or both of the alarms to be configured as failsafe?
   In failsafe mode, the alarm relay de-energizes in an alarm condition. For non-failsafe operation, the relay is energized in an alarm condition. You can set either or both concentration alarms to operate in failsafe or non-failsafe mode.

C Are either of the alarms to be latching?
   In latching mode, once the alarm or alarms trigger, they will remain in the alarm mode even if process conditions revert to non-alarm conditions. This mode requires an alarm to be recognized before it can be reset. In the non-latching mode, the alarm status will terminate when process conditions revert to non- alarm conditions.

D Are either of the alarms to be defeated?
   The defeat alarm mode is incorporated into the alarm circuit so that maintenance can be performed under conditions which would normally activate the alarms.
   The defeat function can also be used to reset a latched alarm. (See procedures, below.)

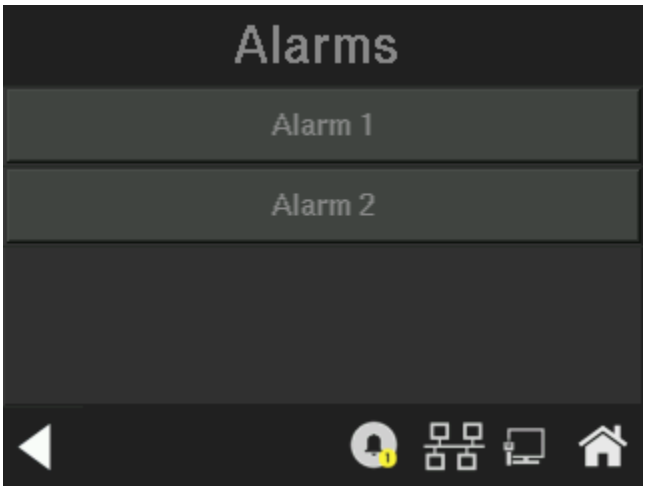
If you are using password protection, you will need to enter your password to access the alarm functions. Follow the instructions in

section 4.5.1 to enter your password. Once you have clearance to proceed, enter the Alarm function.

Press the Alarm button on the Menu screen to enter the Alarm function.

Menu screen:

Alarms screen:



To define the alarm parameters, touch the ALARM 1 or ALARM 2 edit box to bring up the alarm configuration screen for that alarm.

Five parameters can be changed on this and the second alarm configuration screen plus an alarm status:

- Value of the alarm setpoint or threshold #### ppm or %
- Select Range of interest for alarm: 01,02, or 03

- Out-of-range direction, **HI** or **LO**
- Defeated? Dft–**Y/N** (Yes/No)
- Failsafe? Fs–**Y/N** (Yes/No)
- Latching? Ltch–**Y/N** (Yes/No).

Use the scroll bar to view the last two items.

Alarm 1 configuration screen 1:

4.7.1 Alarm Setpoint

To define the alarm setpoint, touch the ALARM 1 or ALARM 2 Threshold edit box to bring up a numerical keypad.

Alarm 1 Threshold set:

Note: Alarm 1 is shown, Alarm 2 is identical.

Enter the alarm setpoint using the keypad.

1. Click the "DEL" button to delete the one character at a time from the Edit box.
2. Click the "ENT" Button to store the values and move back to the parent (Range) screen.
3. Click the "back arrow" to move to the Alarm screen without saving any edited values.

Use the same procedure for setting Alarm 1 or Alarm 2 setpoint. (Remember, the setpoint units are ppm O_2.) To set the other alarm parameters touch the edit box for the parameter.

4.7.2 HI/LOW Alarm

To set whether the alarm is a HIGH or LOW alarm, touch the HIGH/LOW edit box and toggle the value to the desired configuration.

4.7.3 Alarm Defeat

The user can defeat either or both the alarms by toggling the Defeat edit box between OFF (defeat) or ON (active).

4.7.4 Failsafe/Non-Failsafe Mode

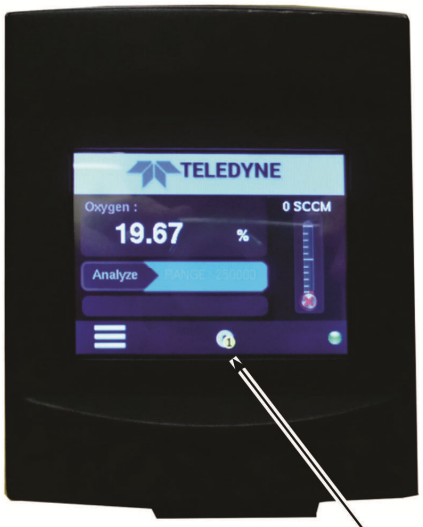
The user can set either or both the alarms to operate in failsafe or non-failsafe mode by toggling the value in the edit box.

4.7.5 Latching/Non-Latching Alarm

The user can set whether the alarms will be latching or non-latching by toggling the value (ON = Latching/OFF = non-latching) in the edit box.

1. ON- Once the alarm or alarms trigger, it will remain in the alarm mode even if process conditions revert to non-alarm conditions. This mode requires an alarm to be recognized before it can be reset.
2. OFF - The alarm status will terminate when process conditions revert to non-alarm conditions.

An alarm is recognized by touching the Alarm icon  on the Main screen.



4.7.6 Alarm Status

The Alarm Status is non editable option. It is used to view the status of whether a concentration alarm is active or not.

1. When alarm is active (alarm triggered), it will show "Reset Alarm 1" or "Reset Alarm 2". If the alarm is inactive, it will not show the Reset Alarm touch button.
2. Reset: Touch the Alarm Indicator icon on the Main screen to reset the active alarm.

4.8 The Zero and Span Functions

Note: Zeroing is not required to achieve the published accuracy specification of this unit.

Zeroing will eliminate offset error contributed by sensor, electronics, and internal and external sampling system and improve performance beyond published specification limits.

The analyzer is calibrated using zero and span gases.

Suitable gases for zero and span depend on the application programmed in the 2000RS. Consult the sales order or separate sheet describing factory calibration. If it is not clear, contact factory and supply the serial number of the analyzer.

1. The Model 2000RS can have as many as three analysis ranges plus a special calibration range (Cal Range); and the analysis ranges, if more than one, may be programmed for separate or identical gas applications.
2. If all ranges are for the same application, then you will not need the Cal Range. Calibrating any one of the ranges will automatically calibrate the others if all ranges are linear. If non-linear, zero calibration is the same for all ranges, but span gas must be done independently for each range.
3. If: a) each range is programmed for a different gas application, b) your sensor calibration has drifted less than 10 %, and c) your Cal Range was calibrated along with your other ranges when last calibrated, then you can use the Cal Range to calibrate all applications ranges at once.

If your Model 2000RS analyzer fits the paragraph (3) description, above,

use the Cal Range. If your analyzer has drifted more than 10 %, calibrate each range individually.

Connect the calibration gases according to the instructions given in Section 3.4, Gas Connections, observing all the prescribed precautions.

CAUTION: **ALWAYS ALLOW 4-5 HOURS WARM-UP TIME BEFORE CALIBRATING, IF YOUR ANALYZER HAS BEEN DISCONNECTED FROM ITS POWER SOURCE. THIS DOES NOT APPLY IF THE ANALYZER WAS PLUGGED IN BUT WAS IN STANDBY.**

Note: Shut off the gas pressure before connecting it to the analyzer and be sure to limit pressure to 40 psig or less when turning it back on.

Readjust the gas pressure into the analyzer until the flowrate through the sensor settles between 50 to 200 cc/min (approximately 0.1 to 0.4 scfh).

If you are using password protection, you will need to enter your password to gain access to either of these functions. Follow the instructions in Sections 4.5.1 to enter your password. Once you have gained clearance to proceed, you can enter the *Zero* or *Span* function.

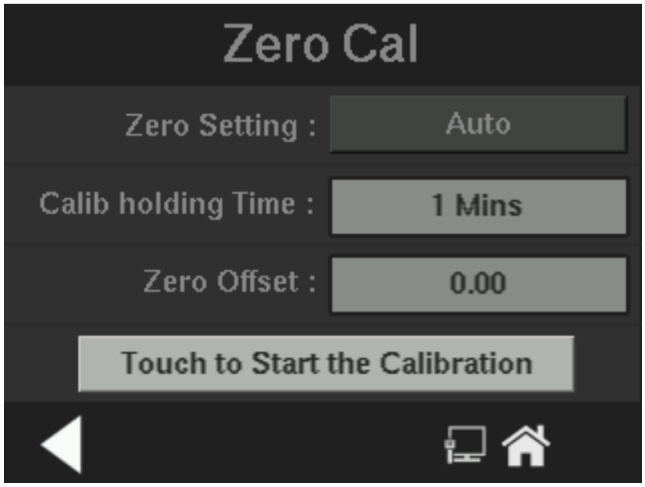
4.8.1 Zero Cal

The *Zero* button on the Menu screen is used to enter the Zero calibration function. Zero calibration can be performed in either the automatic or manual mode.

CAUTION: **IF YOU ARE ZEROING THE CAL RANGE BY ITSELF (MULTIPLE APPLICATION ANALYZERS ONLY), USE MANUAL MODE ZEROING. IF YOU WANT TO CALIBRATE ALL OF THE RANGES AT ONCE (MULTIPLE APPLICATION ANALYZERS ONLY), USE AUTO MODE ZEROING IN THE CAL RANGE.**

Make sure the Zero calibration gas source is connected to the instrument (see Section 3.3.1). Press the Zero button on the Menu screen to enter the Zero Calibration function.

Menu screen:



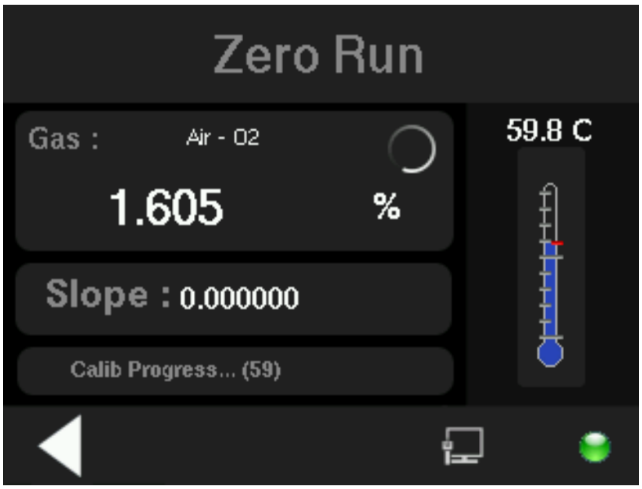
Click /touch on “Zero Setting” edit box to toggle between “AUTO “or “MANUAL”.

- AUTO: When user select auto mode, calibration will set to auto mode and will calculate calibration offset automatically.
- MANUAL: When user select manual mode, the user has to press “ENTER” to manually indicate that slope got settled, if accepted calibration offset will be calculated and saved into memory.

Click/touch on “Touch to Start the Calibration” to start the calibration process. Details about calibration run screens are as follows,

4.8.1.1 AUTO MODE ZEROING

When the Zero calibration mode is set to Auto and the “Touch to Start the Calibration” button is pressed, the Zero Auto Run screen is displayed.



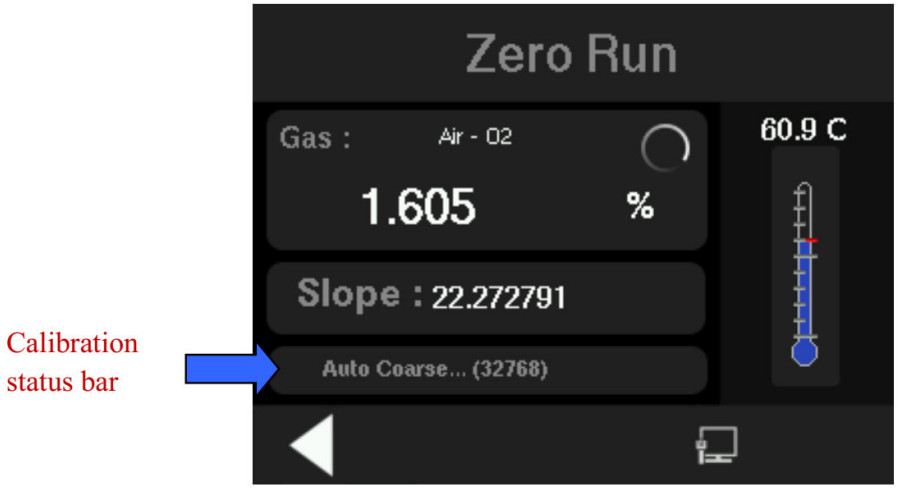
Calibration status bar will display a message of “Calib is starting...” and then system will wait till the hold time completes. During the time “Calib progress. (48)” message will appear in the status bar.

Zero calibration auto mode run screen contains the following options (Refer above image):

1. Calibration is in progress icon . It only appears in AUTO calibration mode. Calibration is finished or an error occurs when progress icon stops refreshing,
2. Gas % or ppm values
3. Slope values
4. Calibration status bar
5. Temperature status

The calibration status bar, below “Slope” is counting down the timer set in “Calib holding time”. Once the slope value is settled and user set “Calib holding time” duration is completed (timer counter is down to zero) then system will start the coarse setting process. The icons on the screen switches to the Coarse setting value as software tries to adjust reading down to zero.

Zero Calibration Run screen:



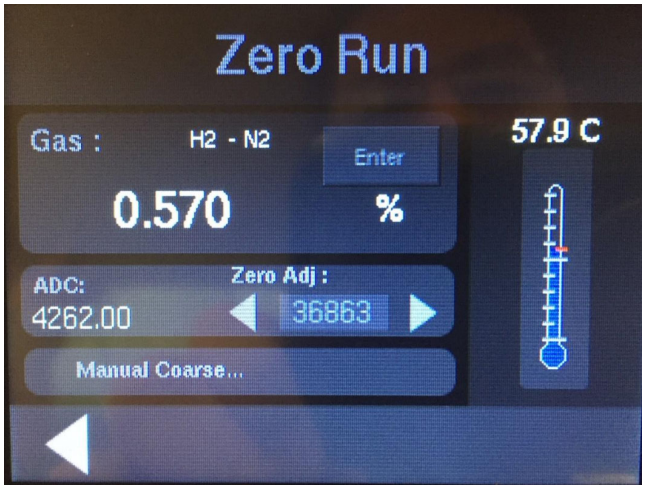
After the offset calculation of coarse setting, the analyzer will switch to fine adjustment. When that is complete the analyzer proceeds with the calculation of offset of each gain in the amplifier. Then system will display the calibration done/fail message.

Once the calibration is completed, if user didn't press back arrow within **30 second** firmware will automatically move to the main screen.

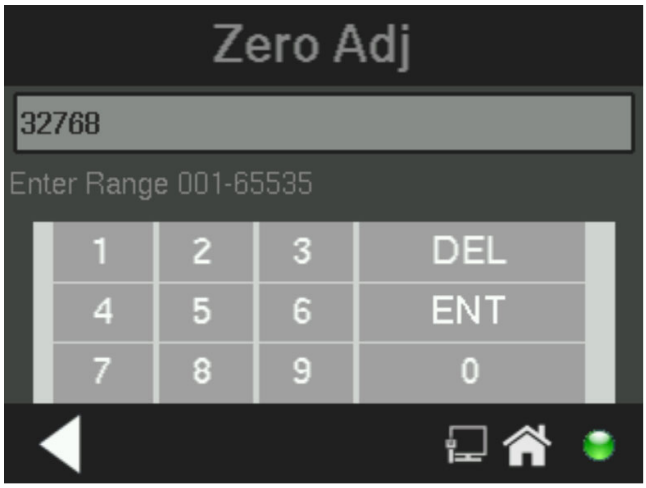
4.8.1.2 MANUAL MODE ZEROING

When user set Zero calibration mode as Manual and clicks on the "Touch to Start the Calibration" button, System displays Zero Manual Run screen.

Zero Cal screen 1:



The screen in manual mode is similar but since this time the Coarse and the Fine adjustment are done manually by the operator, there is a zero adjustment field that can be adjusting by inputting the value in a numeric keypad or quickly advance with small left and right arrow ◄►. The coarse adjustment is first. Tapping on the numeric field of the Zero Adj value will bring up the numeric keypad for adjusting.



The range of either the coarse or the fine adjustment are from 1 to 65535 as shown on screen above.

Alternatively, repeatedly pressing one of the arrow heads at either side of the Zero Adj. value makes the numeric value quickly jump from single digit to x10, x100 until the zero adjustment reaches one of the range limits.

In coarse adjustment, Press Enter when ADC value is as close to 0 as coarse adjustment will allow. Then screen will switch to Fine adjustment. Repeat adjustment till the ADC value is near zero within 1000 counts (the window around zero value of acceptability for ADC counts in fine adjustment is wider than coarse adjustment). Press Enter and let the unit read the offsets for each gain.

Once the calibration is completed, if user didn't press back arrow within **30 second** firmware will automatically move to the main screen.

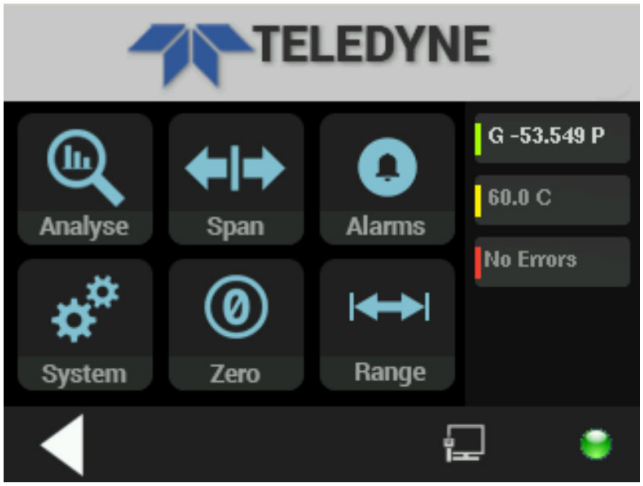
4.8.2 Span Cal

The *Span* button on the Menu screen is used to span calibrate the analyzer. Span calibration can be performed using the **automatic** mode, where an internal algorithm compares consecutive readings from the sensor to determine when the output matches the span gas concentration. Span calibration can also be performed in **manual** mode, where the operator determines when the span concentration reading is acceptable and manually exits the function. Make sure the appropriate span gas source is connected to the analyzer. See Section 3.4.

4.8.2.1 AUTO MODE SPANNING

Press *Span* to enter the span function.

Menu screen:

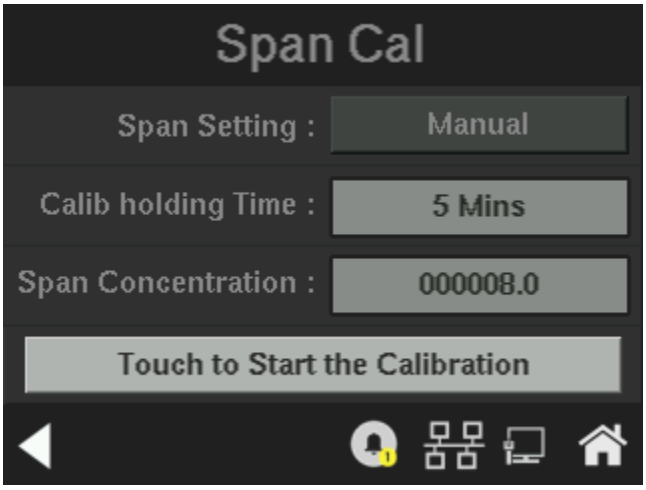


The screen that appears allows you to select whether the span calibration is to be performed automatically or manually.

This screen also allows the operator to set the time the analyzer should be held in the span mode after the readings of the analyzer settle. Five minutes is the default, but it could be adjusted anywhere from 1 to 60 minutes by user.

This screen is also used to enter the span concentration of the calibration gas.

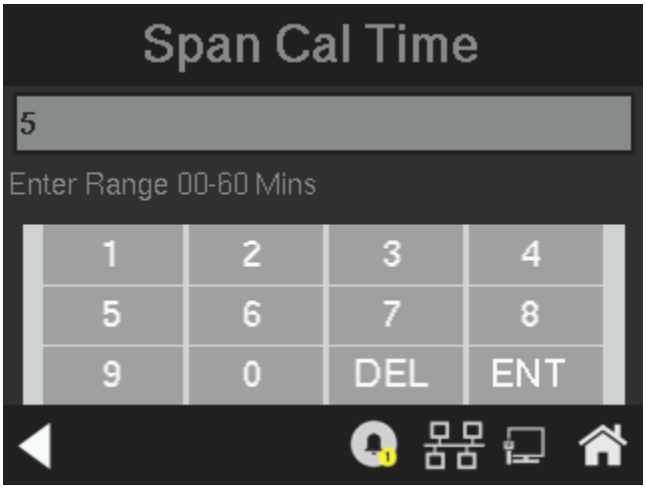
Span Cal configuration screen:



In addition to setting the manual or automatic span mode and the calibration hold time, this menu.

Calibration Hold Time:

To set the calibration hold time, touch the corresponding edit box to bring up the numerical pad.

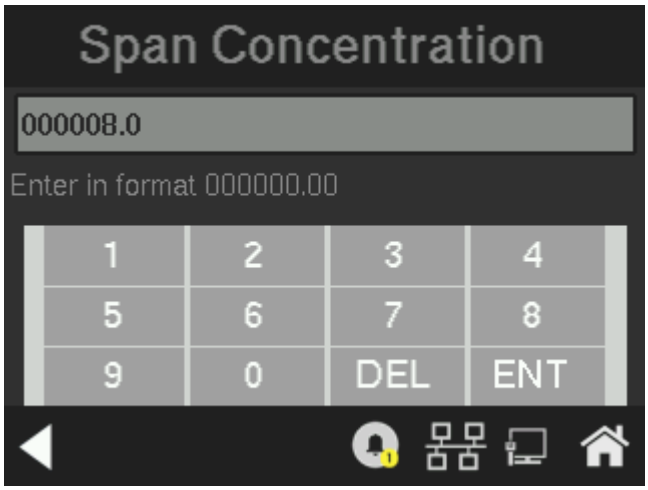


Enter the hold time using the keypad.

1. Click the “DEL” button to delete the one character at a time from the Edit box.
2. Click the “ENT” Button to store the values and move back to the parent Span Cal screen.
3. Click the “back arrow” to move to the Span Cal screen without saving any edited values.

Span concentration:

To enter or check the Span Concentration of the calibration gas touch the corresponding edit box to bring up the numerical pad.

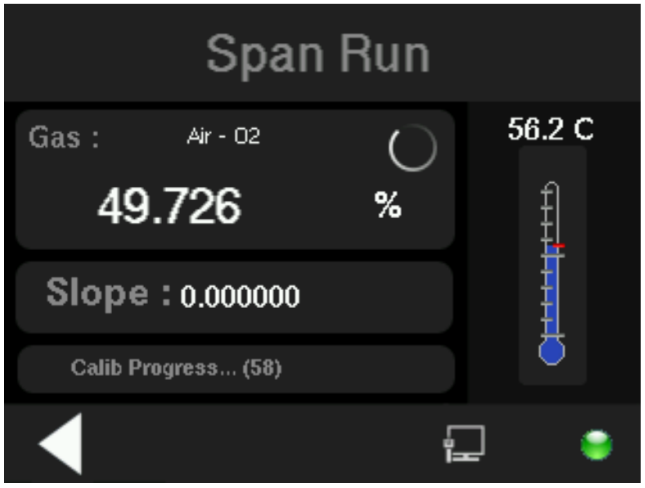


Enter the span concentration using the same procedure as for the cal holding time described above. When you have finished typing in the concentration of the span gas you are using, press ENT to save the value or the back arrow to discard the entry and dismiss the numerical pad.

Start the Calibration:

To begin the Span calibration, touch the corresponding box on the Span Cal screen.

Span Cal Run screen:



The beginning span value is shown in the Gas display box along with a span in progress icon that constantly updates as the calibration proceeds.

The temperature of the TC detector is displayed to the right along with a simulated thermometer. As the span reading settles, the screen displays and updates information on Slope. Spanning automatically ends when the span output corresponds, within tolerance, to the value of the span gas concentration. Then the instrument automatically returns to the Main screen.

The following items are contained within the Span calibration auto mode run screen:

1. Calibration is in progress icon.
2. Gas concentration ppm or % values.
3. Slope values
4. Calibration status bar
5. Temperature reading status.

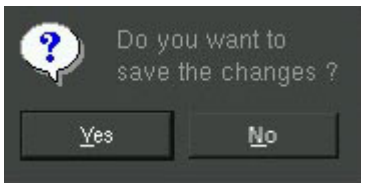
The Calibration in Progress icon will appear only in the Auto calibration mode. It means that a calibration is in progress. When the calibration is finished or if an error occurs, the icon will stop refreshing.

The current concentration (in percent or ppm) will be updated in the Gas field as will the slope as calibration proceeds.

The Span Calibration Run screen has a Back arrow button that when pressed DURING A CALIBRATION will bring up a display which will allow the abort the calibration without saving. Use the Yes or No buttons to reply.

- "Yes" will ABORT the calibration and move back to the Menu screen.
- "No" will continue the calibration.

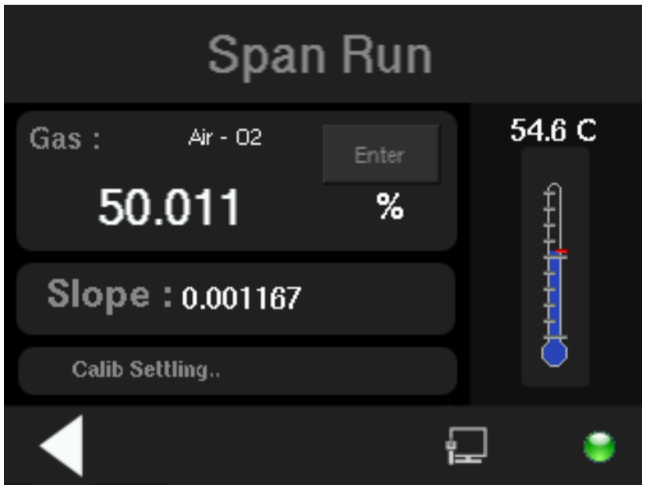
After the calibration has FINISHED, pressing the Back arrow will bring up a similar requester.



4.8.2.2 SPAN MANUAL MODE RUN SCREEN

When the Span calibration mode is set to MAN and the "Touch to Start the Calibration" button is pressed, the Span Run screen is displayed.

Span Cal Manual Mode Run screen:



The Manual Calibration ENTER button is used to save the calibration factor value and will only appear in the Manual calibration mode. Everything else operates the same way.

Maintenance

5.1 Routine Maintenance

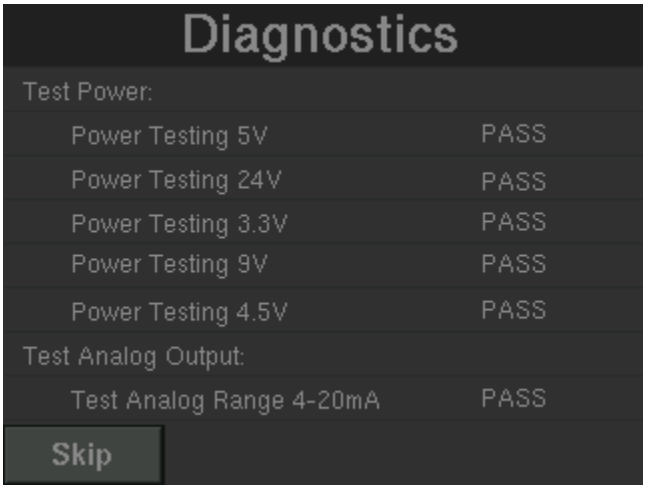
Aside from normal cleaning and checking for leaks at the gas connections, routine maintenance is limited to recalibration. For recalibration, see chapter 4.

WARNING: SEE WARNINGS ON THE TITLE PAGE OF THIS MANUAL.

5.2 System Self Diagnostic Test

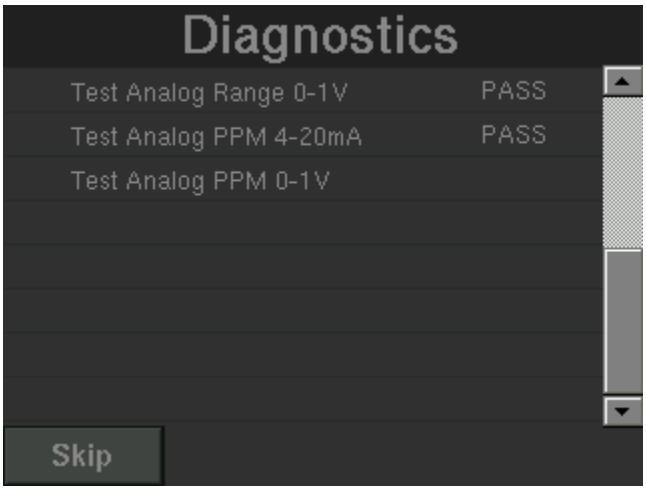
Refer to Section 4.5.4 to initiate a Self-Diagnostic Test. The analyzer will run through multiple test to check the health of the instrument.

Screen 1:



Using the scroll bar you can view all the test results.

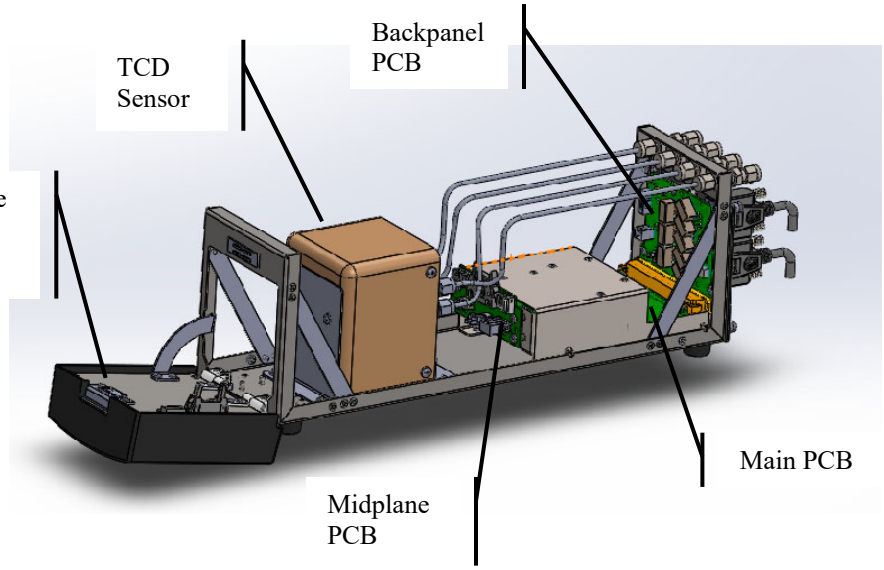
Screen 2:



5.3 Major Internal Components

The front PCBs can be accessed by pulling down the front panel door. Other internal components are accessed by removing the four rear panel screws and sliding out the back panel chassis. See Figure 5-1, below.

WARNING: SEE WARNINGS ON THE TITLE PAGE OF THIS MANUAL.



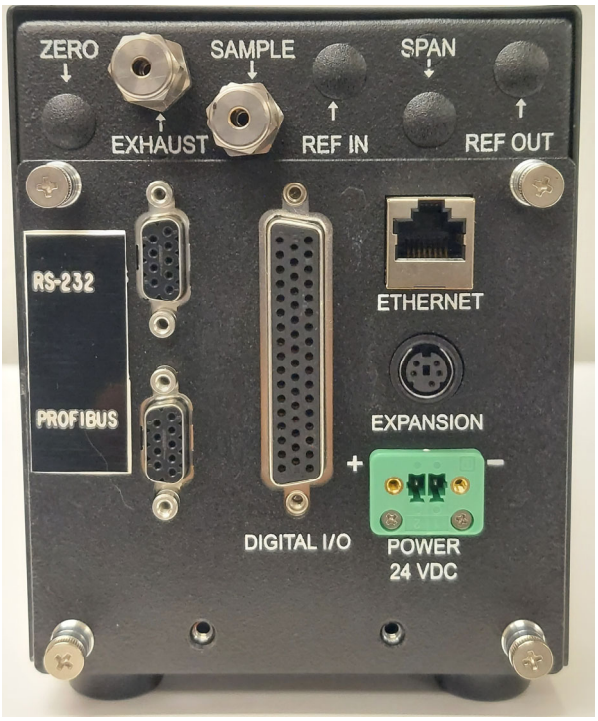


Figure 5-1:

Component location and Rear Panel Removal

The 2000RS contains the following major components:

- Analysis Section
  - Thermo Conductivity Detector (TCD)
  - Calibration valves
- Main Microprocessor board
- Touch Screen Display and Display PCB
- RS-232, Profibus Communications Ports and Network.

See the drawings in the Drawings section in rear of this manual for details.

5.6 Cleaning

If instrument is unmounted at time of cleaning, disconnect the instrument from the power source. Close and latch the front-panel access door. Clean outside surfaces with a soft cloth dampened slightly with plain clean water. DO NOT use any harsh solvents such as paint thinner or benzene.

For panel-mounted instruments, clean the front panel as prescribed in the above paragraph. DO NOT wipe front panel while the instrument is controlling your process.

5.7 Troubleshooting

Problem	Possible Cause	Solution
Erratic readings of the concentration as reported by the analyzer.	No flow or flow too high to sample and or reference inlets	Check flows and make sure they are adjusted properly: 50-200 ccm for sample, 50 ccm for reference.
	The analyzer may have been calibrated in an inaccurate fashion.	Recalibrate analyzer in Manual mode for both zero and span.
	No temperature control at TCD.	Identify if thermistor is OK by checking if temperature reading is sensible. If thermistor is OK, measure resistance of heater in TCD with a DVM. The value should be in the range of 45 Ohms. If thermistor and heater are OK, then main is to be replaced.

Problem	Possible Cause	Solution
Analyzer fails to zero	No flow or flow too high to sample and or reference inlets	Check flows and make sure they are adjusted properly: 50-200 ccm for zero calibration gas, 50 ccm for reference.
	Wrong gas used for zero calibration or wrong reference gas	Verify what gases are needed for calibration and reference with factory.
	No temperature control at TCD	Identify if thermistor is OK by checking if temperature reading is sensible. If thermistor is OK, measure resistance of heater in TCD with a DVM. The value should be in the range of 45 Ohms. If thermistor and heater are OK, then main is to be replaced.
	Failure of TCD bridge power or failure in a TCD filament	To properly diagnose this will require opening the analyzer and removing the TCD cover. Power across TCD detector should be measured between black and red wires of TCD cable and should measure about 4.3 vdc. If power is OK, then measure from black to green wires, it should measure about 2.15 vdc. The same measurement from black to white wires. Consult factory.

Appendix

A-1 Model 2000RS Specifications

Packaging: General Purpose

- Relay rack mount. Contains up to four instruments in one 19" relay rack chassis (optional).
- Single bench top (optional).

Sensor Thermal Conductivity detector.

Tubing and fittings: 316 stainless steel.

Ranges: Three ranges plus a Cal range, field selectable within limits (application dependent) and Auto Ranging

Alarms: One system-failure alarm contact to detect power failure or sensor-zero failure.

Two adjustable concentration threshold alarm contacts with fully programmable setpoints.

Contact rating 1A 150 vac resistive.

Display: User interactive touch screen display.

Digital Interface: Full duplex RS-232 communications port

Profibus Port

LAN port.

Power: 24+/-1 VDC, 25 Watts

Operating Temperature: 0-50 °C (32-113 °F)

Accuracy: ±1% of full scale for most binary mixtures at constant temperature
±5% of full scale over operating temperature range once temperature equilibrium has been reached

Gas Flow: Sample (Reference, optional) 50 – 200 SCCM

Analog Outputs: 0-1 VDC percent-of-range,
0-1 VDC range ID
Or (user selectable)
4-20 mA DC—isolated—percent-of-range, 1000 ohms max load
4-20 mA DC—isolated—range ID , 1000 ohms max load

Dimensions:

A-2 Recommended 2-Year Spare Parts List

Part Number	Description	Qty.
A68314	BACK PANEL CONNECTOR	1
B95941B	RS SERIES POWER ADAPTER	1
C94750A	3000RS/2000RS PCB ASSEMBLY BACK PANEL PCB	1
CP02487	CONNECTOR PLUT T-BLOCK 2 PIN	1
D61549-XX	DETACHABLE POWER CORD (COUNTRY SPECIFIC, SPECIFY AT TIME OF ORDER)	1
F02172	CONNECTOR REDUCING UNION	1
U00211	CONNECTOR STRAIGHT UNION	2
V00948*	SOLENOID VALVE, 24 VDC 0.65W, S.S., N.C., W/ BLADE SOLENOID*	2

* For auto-calibration valve replacement
** Does not iclude AC power cord

Note: Orders for replacement parts should include the part number (if available) and the model and serial number of the instrument for which the parts are intended.

Orders should be sent to:

TELEDYNE Analytical Instruments

16830 Chestnut Street
City of Industry, CA 91748

Phone (626) 934-1500, Fax (626) 961-2538

Web: www.teledyne-ai.com
or your local representative.

A-3 Drawing List

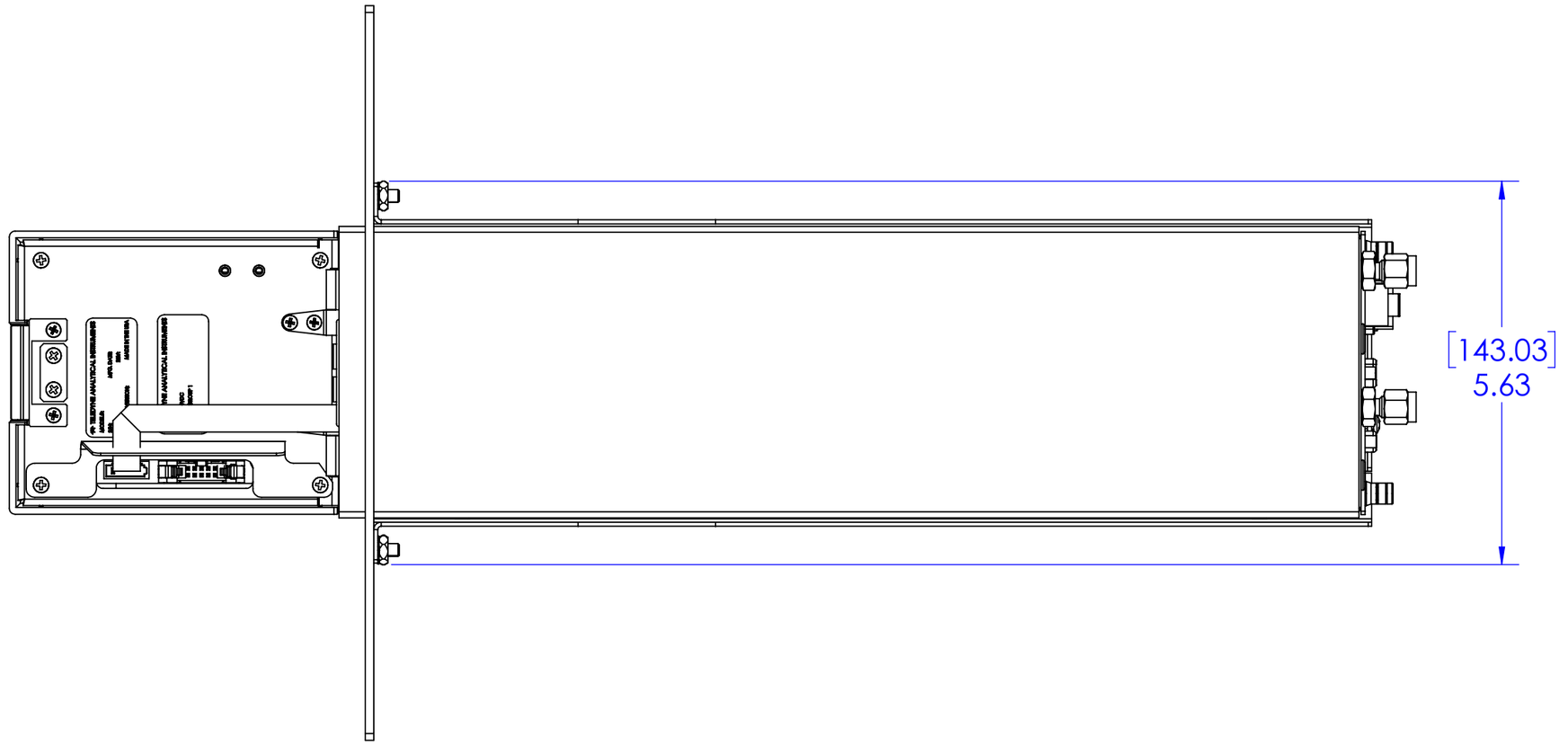
C96143	3000RS/2000RS Adapter Outline
C96118	3000RS single module outline

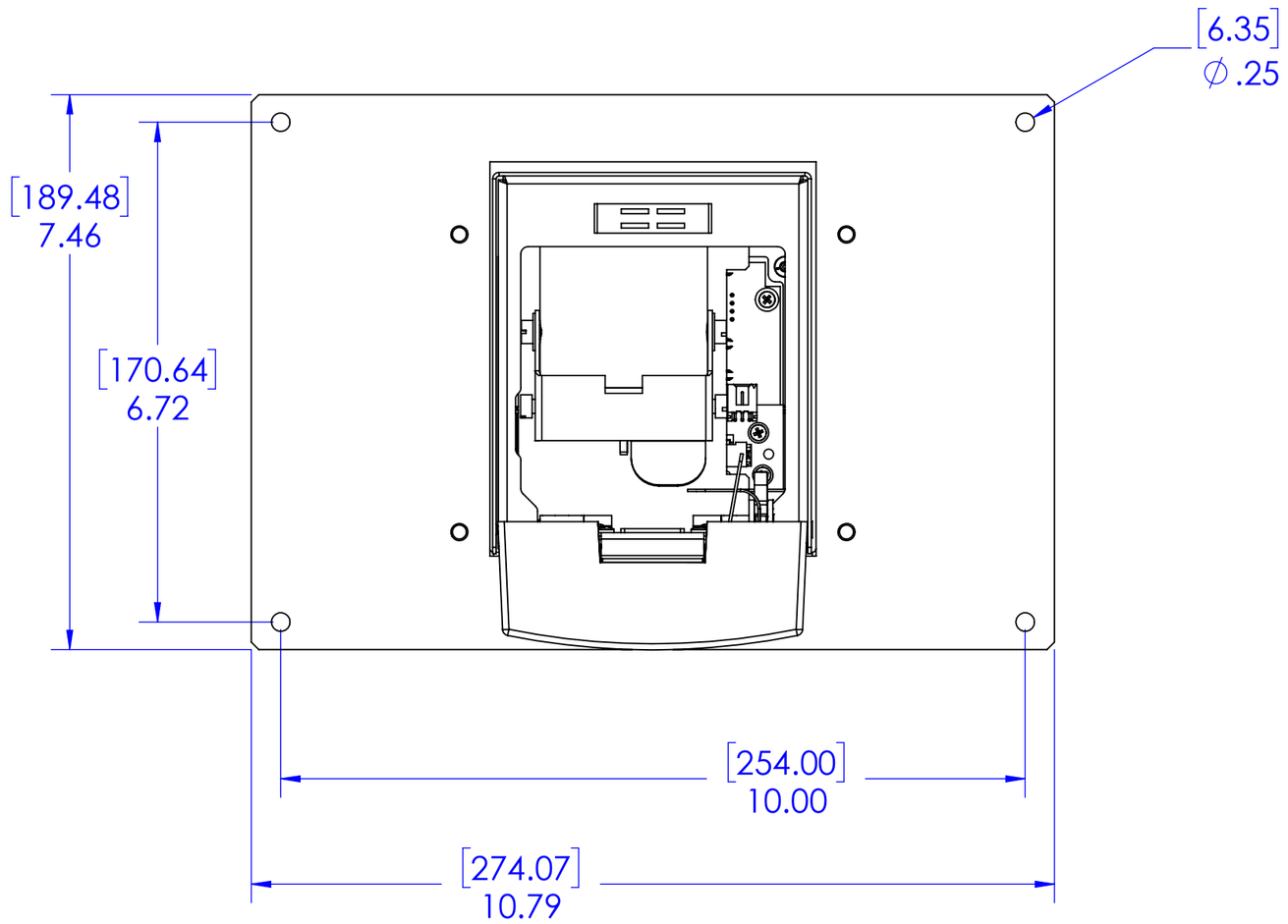
A.4 Application notes

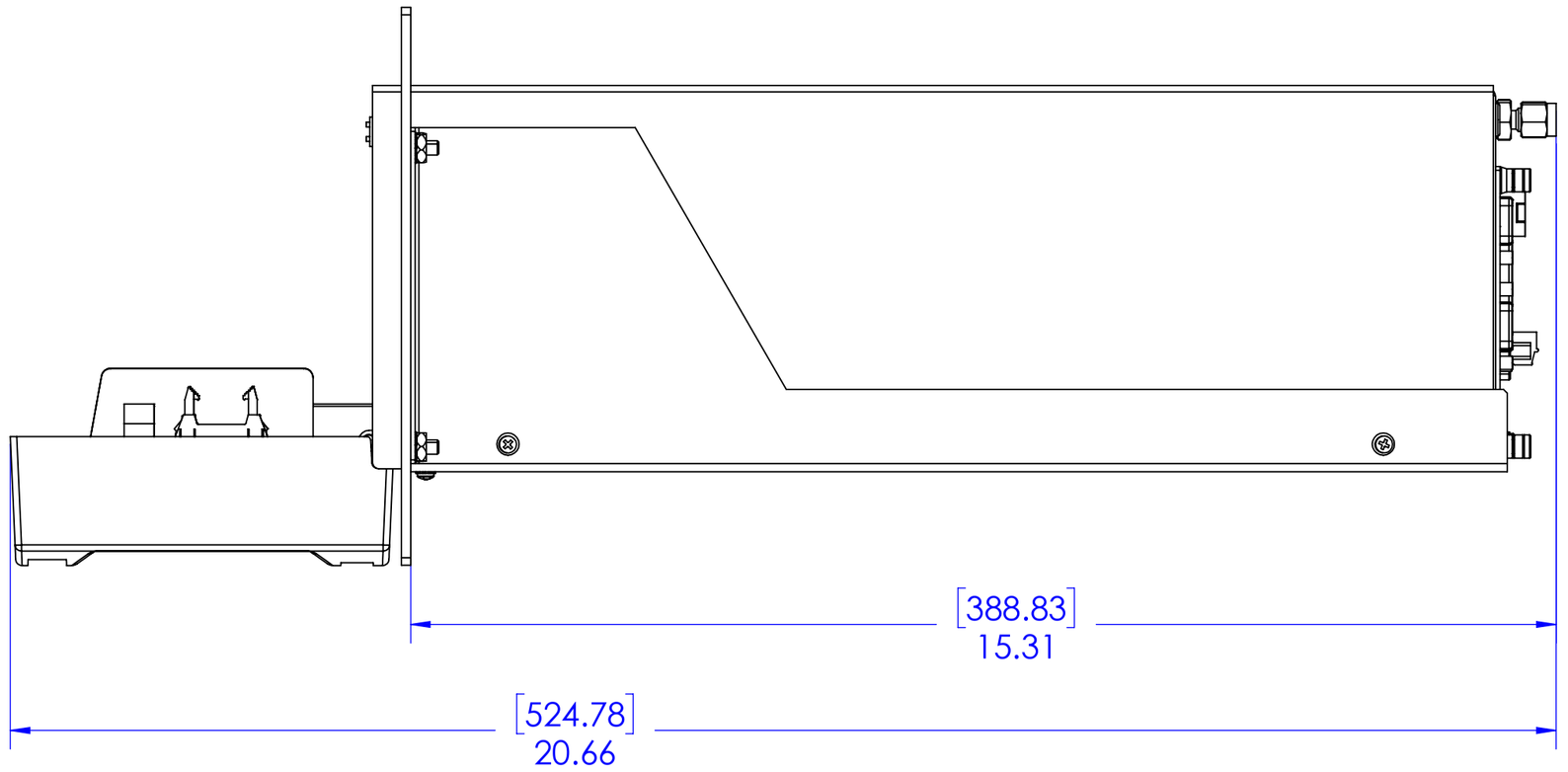
NOTES: UNLESS OTHERWISE SPECIFIED.

DEMENTIONS, MM [ ], INCHES

REV.	DESCRIPTION	DATE	APP.	REV BY
0	INITIAL RELEASE	3/8/24	KFP	







A SERIES PROFILE DETIAL

BILL OF MATERIALS

DO NOT SCALE DRAWING

TOLERANCE UNLESS OTHERWISE SPECIFIED: ANGULAR ±1/2°
LINEAR .X = ±0.1, .XX = ±0.02, .XXX = ±0.010

Teledyne Analytical Instruments
A Teledyne Technologies Company
CITY OF INDUSTRY, CALIFORNIA 91748, USA

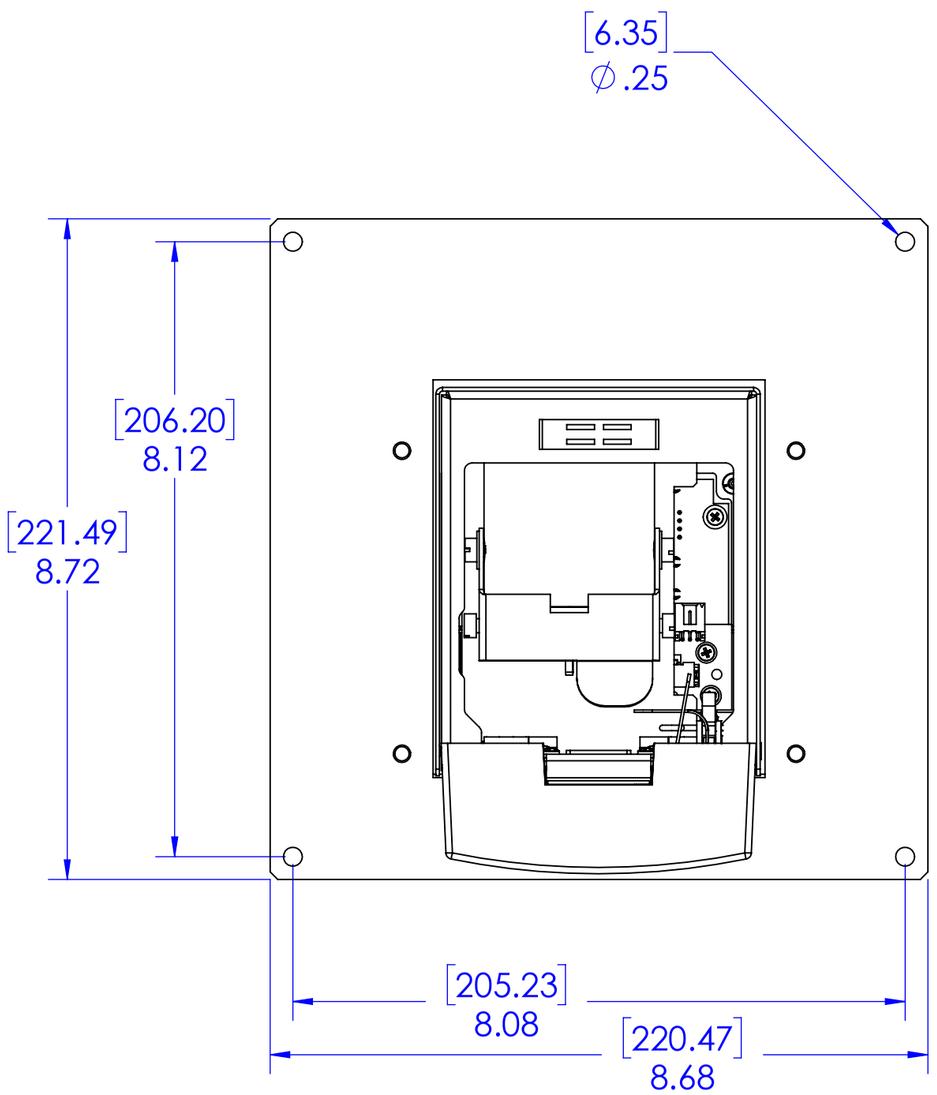
	SIGNATURES	DATE
S/	DRFT: KFP	3/8/24
N/	CHK:	
P/	APPR:	
O/	ENGR: KFP	
F/	S.O.	
REFERENCE	CAD ID C96143-0	

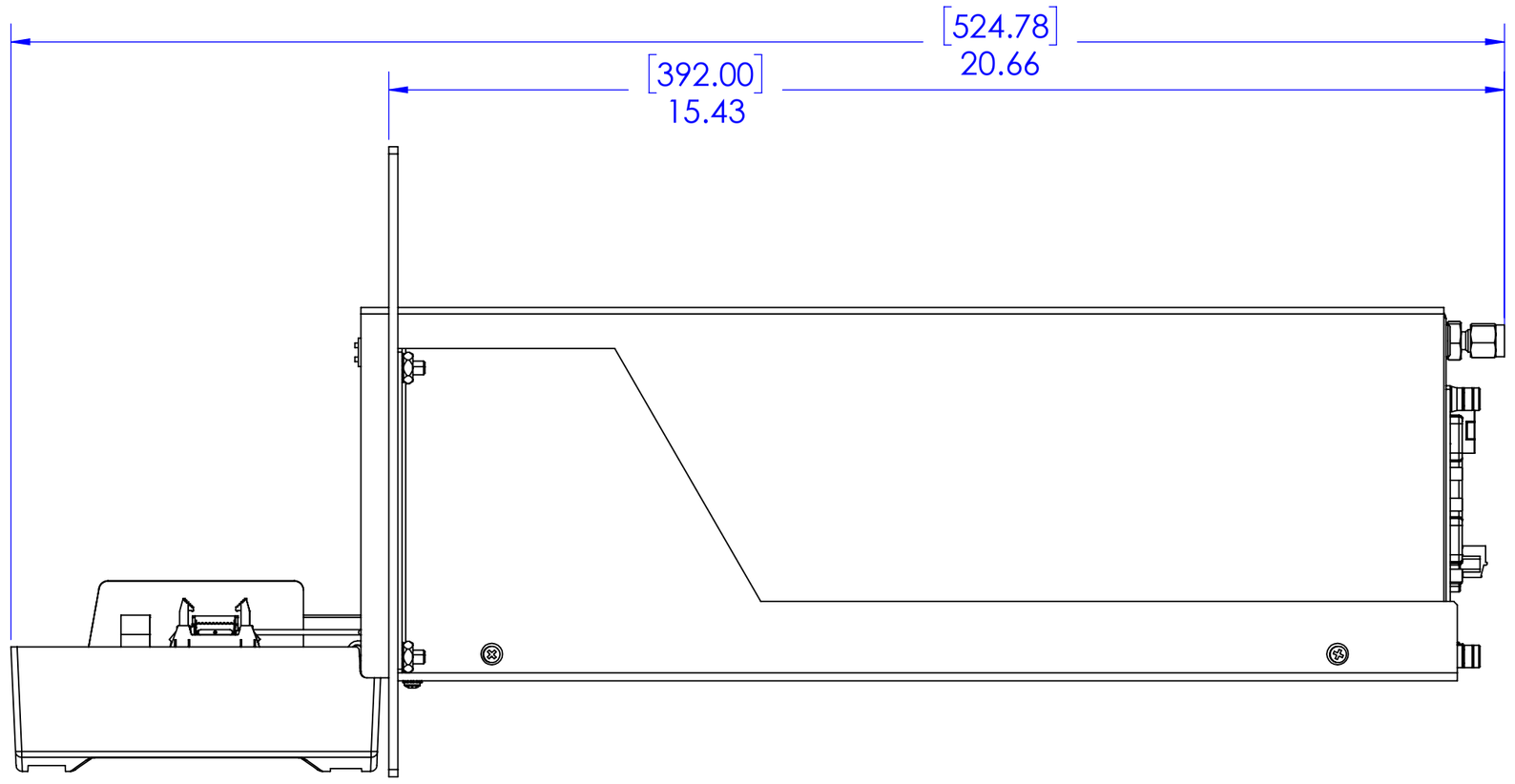
TITLE: RS SERIES PANEL MOUNT ADAPTER OUTLINE WITH ANALYZER

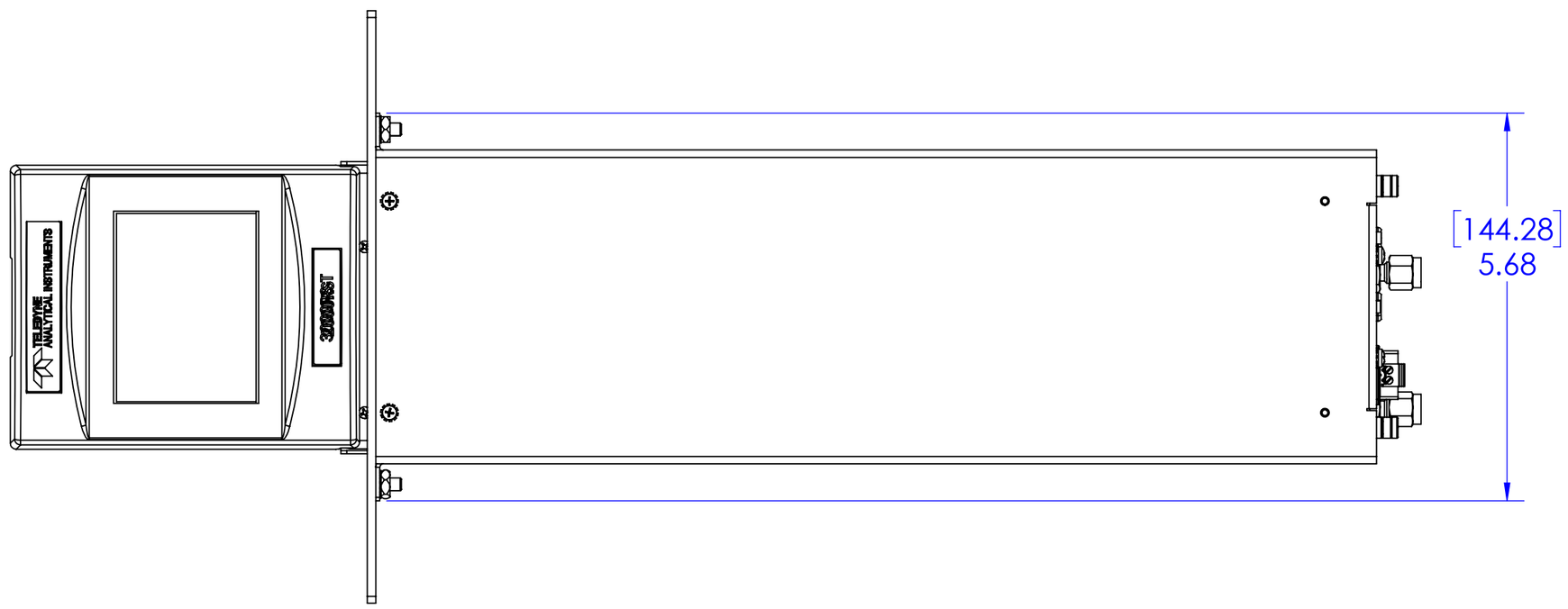
SCALE 1:5
SIM C96118
SHEET 1 OF 2

MATL. NOTED
DWG NO. C96143
REV 0

REVISIONS
SEE SHEET 1







VB PROFILE ADAPTER DETAIL

SHEET	DWG NO.	REV
2 OF 2	C-96143	0

NOTES: UNLESS OTHERWISE SPECIFIED.

DEMENTIONS, MM [ ], INCHES

REV	DESCRIPTION	DATE	APP.	REV BY
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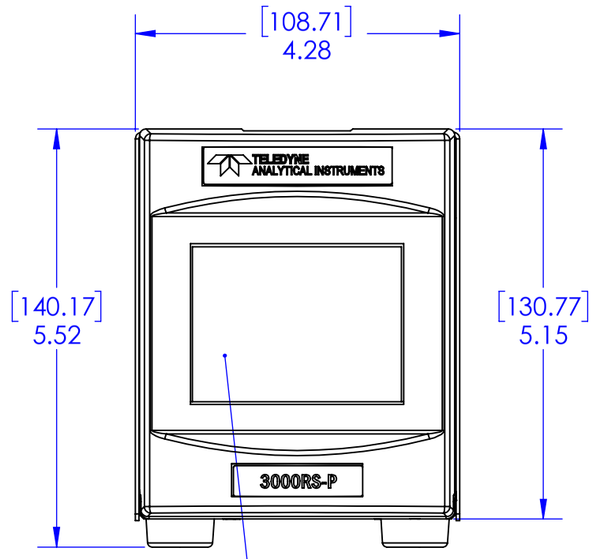
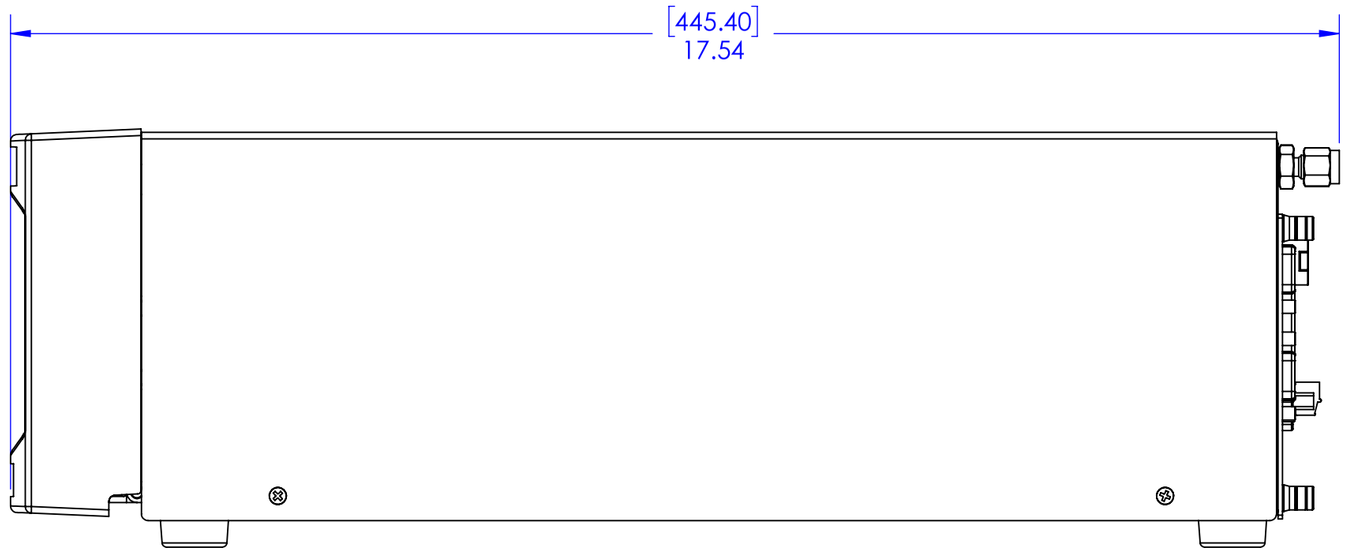
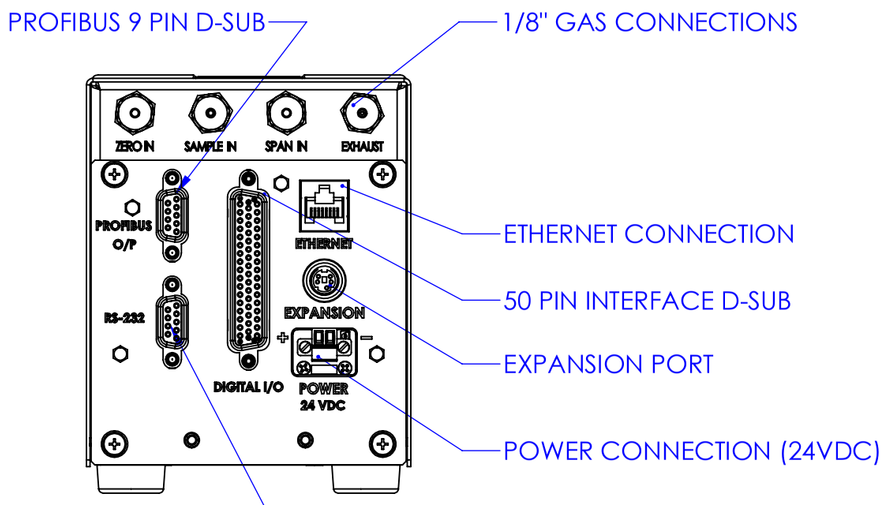
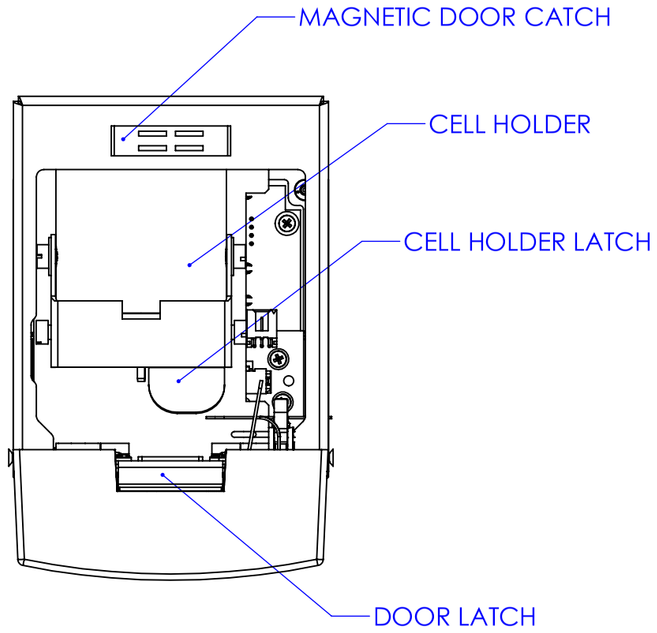


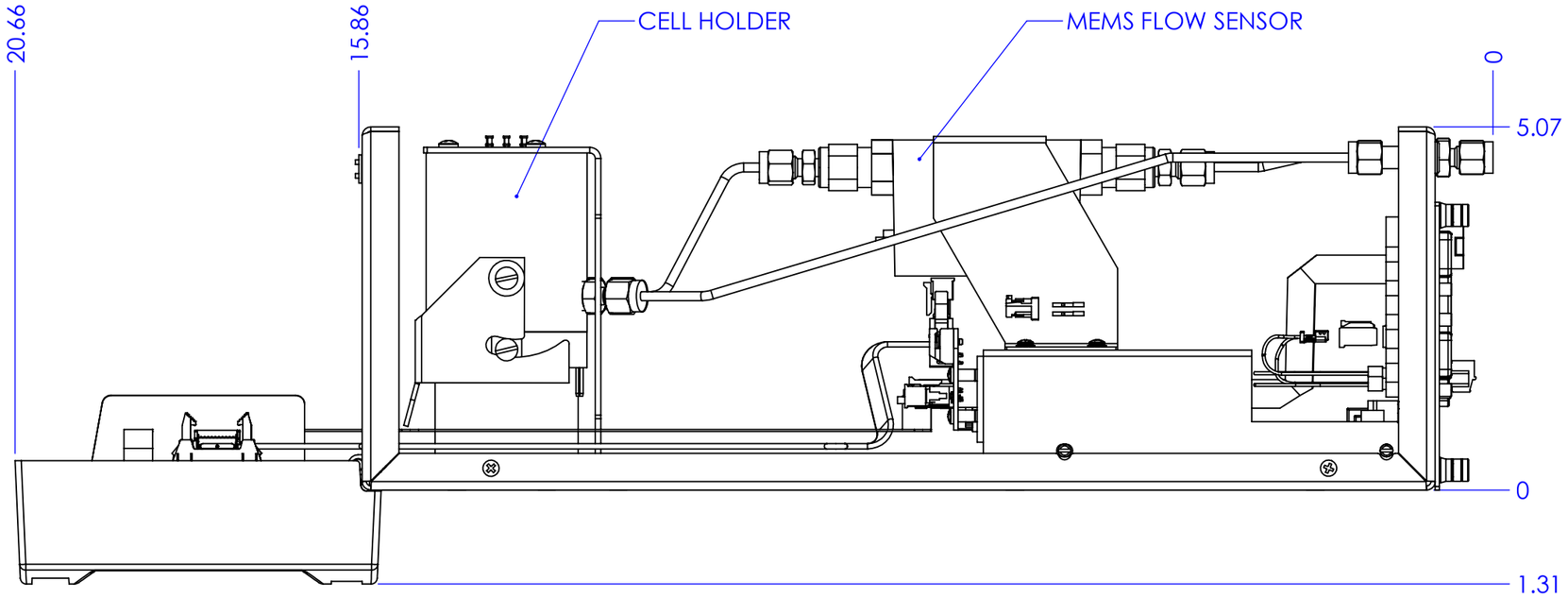
TOUCH SCREEN USER INTERFACE DISPLAY



OPTIONAL SINGLE COVER WITH FEET, AND OPTIONAL AUTO-CAL VAVLES







3000RS-T WITH OPEN DOOR

BILL OF MATERIALS

DO NOT SCALE DRAWING

TOLERANCE UNLESS OTHERWISE SPECIFIED: ANGULAR ±1/2°
LINEAR .X = ±0.1, .XX = ±0.02, .XXX = ±0.010

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	SIGNATURES	DATE
S/	DRFT: KFP	10/12/23
N/	CHK:	
P/	APPR:	
O/	ENGR: KFP	
F/	S.O.	
REFERENCE	CAD ID C96118-0	

TITLE: RS SERIES SINGLE MODULE OUTLINE

SCALE 1:5 | SIM | SHEET 1 OF 1

MATL. NOTED | DWG NO. C96118 | REV 0