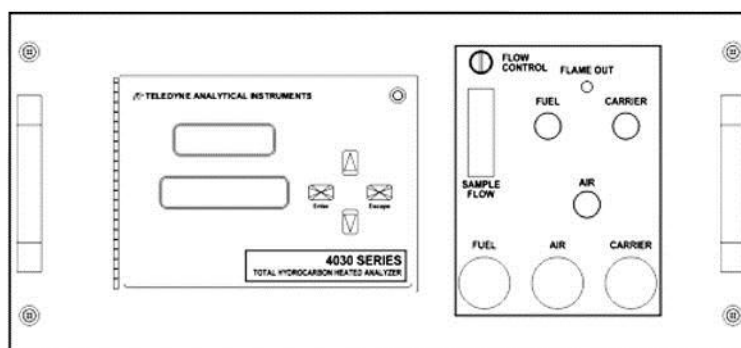


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# INSTRUCTION, OPERATING AND MAINTENANCE MANUAL FOR SERIES 4030 HEATED THC



P/N M77216  
DATE 5/18/15



**DANGER**



Toxic and/or flammable gases or 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.

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**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.

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**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 be properly trained in the process being measured, 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 Teledyne at the time the order is placed.

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## Safety Messages

Your safety and the safety of others are 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.



**STAND-BY:** This symbol indicates that the instrument is on Stand-by but circuits are active.

**CAUTION: THE ANALYZER SHOULD ONLY BE USED FOR THE PURPOSE AND IN THE MANNER DESCRIBED IN THIS MANUAL.**



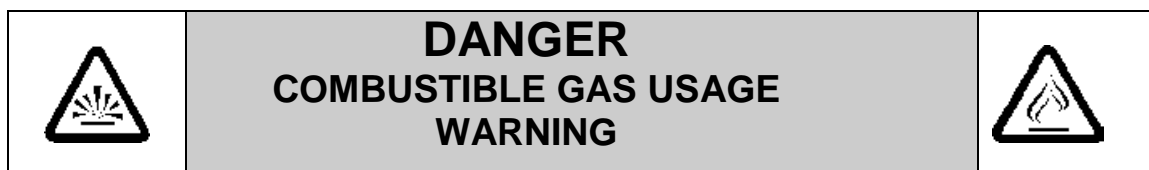
**IF YOU USE THE ANALYZER IN A MANNER OTHER THAN THAT FOR WHICH IT WAS INTENDED, UNPREDICTABLE BEHAVIOR COULD RESULT POSSIBLY ACCOMPANIED WITH HAZARDOUS CONSEQUENCES.**

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 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 specific to your instrument.

Manuals do get misplaced. Additional manuals can be obtained from Teledyne 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](http://www.teledyne-ai.com).

## Additional Safety Information



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

The customer should ensure that the principles of operating of this equipment are well understood by the user. 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 Teledyne, no responsibility by Teledyne, its affiliates, and agents for damage or injury from misuse or neglect of this equipment is implied or assumed.

**WARNING:** *HYDROGEN GAS IS USED IN THIS INSTRUMENT AS A FUEL. HYDROGEN IS EXTREMELY FLAMMABLE. EXTREME CARE MUST BE USED WHEN WORKING AROUND GAS MIXTURES CONTAINING FLAMMABLE GASES.*



*A Successful leak check was performed at TI/AI on the sample system of this instrument prior to calibration, testing and shipping. Ensure that there are no leaks in the fuel supply lines before applying power to the system.*

*Always purge the entire system before performing any maintenance and always leak check the system after removing any tubing or fittings on the sample*

system. See the procedures for purging and leak checking this instrument on the following pages.

If toxic gases or other hazardous materials are introduced into the sample system, the same precautions regarding leak checking and purging apply to the sample lines and sample supply or delivery lines.

**WARNING:**

**ELECTRICAL SHOCK HAZARD. WITH THE EXCEPTION OF OPENING THE DOOR AND ADJUSTING THE PRESSURE REGULATORS, FLOW CONTROLLER, OR OBSERVING THE PRESSURE GAUGES AND THE FLOWMETER, ONLY AUTHORIZED AND SUITABLY TRAINED PERSONNEL SHOULD PERFORM WORK INSIDE OF THE INSTRUMENT. COMPONENTS WITHIN THE COVER ON THE INSIDE OF THE DOOR, INSIDE THE ISOTHERMAL CHAMBER (SAMPLE SYSTEM), AND ON THE ELECTROMETER-AMPLIFIER PC BOARD CONTAIN DANGEROUSLY HIGH VOLTAGE SUFFICIENT TO CAUSE SERIOUS INJURY OR DEATH.**

There are the following three types of inaccessible shock hazards within the Analyzer:

1. Line voltages and line related voltages such as 115 VAC which exists within the 230 VAC versions as well. These voltages stop when the Analyzer is turned off and the mains (line) cord is removed from the instrument.
2. The sensor anode supply voltage (approximately 250 VDC). This voltage exists on the Flame Guard, anode power supply, PCB, the motherboard, and the anode/igniter terminals on the sensor. **THIS VOLTAGE WILL REMAIN HAZARDOUS FOR MANY MINUTES AFTER THE ANALYZER HAS BEEN TURNED OFF!**
3. External hazardous voltages which may be connected to the Analyzer alarm relay connections.



## Procedure for Removal of Internal Inaccessible Shock Hazards



**CAUTION:** SERVICING OR MAINTENANCE OF THE ANALYZER SHOULD ONLY BE DONE BY SUITABLE TRAINED PERSONNEL. TO AVOID THESE INACCESSIBLE HAZARDOUS VOLTAGES WHEN SERVICING THE SERIES 4060, PERFORM EACH OF THE FOLLOWING STEPS, IN THE ORDER GIVEN, BEFORE SERVICING BEGINS:

1. Switch off the power to the Analyzer and remove the main (line) power cord from the Analyzer.
2. Remove all external voltages from the connections to the alarm contacts.
3. Wait one minute.
4. Discharge the anode supply voltage.
  - a. Connect one end of an insulated (to 1000 VDC or more) clip lead to Analyzer chassis ground (the standoff for the upper right corner of the mother PCB).
  - b. Put one end of a 500V rated 1000 ohm resistor in the other end of the clip lead.
  - c. Check the voltage between chassis ground (the standoff for the upper right corner of the mother PCB) and the top side of R2 at PCB number B74671. It should be between -5VDC and +5VDC. If is in that range, the inaccessible hazardous voltage removal procedure is completed, if not repeat steps 4.a and 4.b.

If it is absolutely necessary to work inside the instrument with power on, use the ONE HAND RULE:

Work with one hand only.

Keep the other hand free without contacting any other object. This reduces the possibility of a ground path through the body in case of accidental contact with hazardous voltages.

**WARNING:** *THIS INSTRUMENT IS DESIGNED TO BE OPERATED IN A NONHAZARDOUS AREA. THE ANALYZER USES HYDROGEN GAS AND/OR OTHER COMBUSTIBLE GASES IN ITS OPERATION. THIS EQUIPMENT, IF NOT USED AND MAINTAINED PROPERLY CAN BE*



***AN EXPLOSION HAZARD. THE ANALYZER, DEPENDING ON THE APPLICATION, MAY ALSO USE TOXIC GASES. IT IS THEREFORE, THE CUSTOMER'S RESPONSIBILITY TO ENSURE THAT PROPER TRAINING AND UNDERSTANDING OF THE PRINCIPLES OF OPERATION OF THIS EQUIPMENT ARE UNDERSTOOD BY THE USER. SINCE THE USE OF THIS INSTRUMENT IS BEYOND THE CONTROL OF TELEDYNE, NO RESPONSIBILITY BY TELEDYNE, ITS AFFILIATES AND AGENTS FOR DAMAGE OR INJURY RESULTING FROM MISUSE OR NEGLIGENCE OF THIS INSTRUMENT IS IMPLIED OR ASSUMED. 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.***

**CAUTION:**



**WHEN OPERATING THIS INSTRUMENT, THE DOORS MUST BE CLOSED AND ALL COVERS SECURELY FASTENED. THE GAUGES MUST BE IN PROPER WORKING ORDER. DO NOT OVERPRESSURIZE THE SYSTEM.**

**READ THIS MANUAL BEFORE OPERATING THE INSTRUMENT AND ADHERE TO ALL WARNINGS INCLUDED IN THIS MANUAL.**





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## Introduction

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Teledyne Analytical Instruments Series 4030 Total Hydrocarbon (THC) Analyzer is designed to measure the quantity of hydrocarbons present in a heated sample gas, such as gaseous mixtures or ambient air in various industrial applications. The Analyzer is a microprocessor controlled digital instrument based on Teledyne's highly successful Model 402R series Total Hydrocarbon Analyzer, coupled with carrier gas, a switching valve and a sample draw pump (optional). This allows for the sample into the Sample Loop kept inside a heated Sample Chamber and maintained at a constant temperature in the range of 50 to 120°C as per application. With a 2-position, 10 port switching valve and carrier gas, the sample collected inside the sample loop is pushed inside the Flame Ionization Detector (FID) and analyzed for THC.

The sample integrity, as it enters the Analyzer, is maintained by ensuring that condensation does not take place inside the Sample Chamber. Using a dedicated PID temperature controller a sufficiently high temperature (50 - 80°C typical) is maintained within the Sample Chamber. Also, the sample is diluted with the carrier gas to ensure that once the mixed sample reaches the FID, no further condensation takes place.

A separate Sample Selector Module unit (optional) may be provided for use in conjunction with the Model 4030. This allows the user to bring the heated sample gas (max: 120 C) and the span gas to the sample selector unit and manually select either sample or span for entry into the Model 4030. The user is responsible for making all gas connections from the sample point to the sample selector unit and also between sample selector unit and Model 4030. The user must also ensure that gases are heated above the dew point (max: temp. allowed 120°C) and are clean with no particles larger than 2 microns.

### 1.1 Main Features of the Analyzer

The Analyzer is sophisticated yet simple to use. A dual display on the front panel prompts and informs the operator during all phases of operation. The main features of the analyzer include:

- Easy-to-use front panel interface that includes a red 5-digit LED display and a vacuum fluorescent display (VFD), driven by microprocessor electronics.
- High resolution, accurate readings of concentration.
- Versatile analysis with three user-definable analysis ranges.
- Microprocessor based electronics: 8-bit CMOS microprocessor with 32 KB RAM and 128 KB ROM.
- Auto ranging allows analyzer to automatically select the proper preset range for a given measurement. 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.
- RS-232 serial digital port for use with a computer or other digital communication device.
- Analog outputs for selectable concentration, analog input waveform and range identification (0-1 VDC standard and isolated 4-20 mA dc).
- Superior Accuracy

## 1.2 Principle of Operation

The sample is brought to a heated Sample Chamber (50 - 120°C per application) and into a sample loop and a 10-port, 2 position (Position A & B) switching valve. The carrier gas, typically nitrogen, pushes the sample alternatively from each sample loop into the FID to detect the hydrocarbons.

## 1.3 Analyzer Description

The standard analyzer is housed in a sheet steel equipment case flush-mounted in a 19" rack. The front interface panel is mounted on a door which, when opened, allows convenient access to the Analyzer electronics. The entire front panel can slide out of the chassis to provide greater access to the electronics and to the sample system. Gas pressure and flow controls are mounted on the front panel adjacent to the LED and VFD displays and user interface.





At the rear of the instrument are ports for the introduction of air, carrier, fuel, span, and sample gas. A single 50-pin user-interface cable connector contains input/output and alarm signals available to the user. An RS-232 port is also available at the rear panel for connection to a remote computer or other digital communication device. The Analyzer is set up for either 120 VAC 60 Hz or 230 50/60Hz operations depending on the customer's requirements. The appropriate power cord for your unit has been shipped with this instrument.

### **1.4 Applications**

- Monitoring the ambient air for Total Hydrocarbons in chemical and petrochemical plants.
- Fugitive emission monitoring.
- Process emission gases in the chemical industry.



## Theory of Operation

---

### 2.1 Introduction

Using a built-in pump, the heated sample from the Sample Selector Unit is brought to the heated Sample Chamber of Model 4030, housing filter cartridge, switching valve and sample loops. Using nitrogen carrier gas and the microprocessor actuated switching valve, a fixed volume of sample, which is collected in the Sample Loop, is pushed into the FID detector.

Series 4030 uses a Flame Ionization Detector to sense hydrocarbons. The FID was selected based on the positive performance and extensive experience in the use of this detector in other Teledyne analyzers namely Model 402R and Model 4020. The FID has proven itself to be a rugged, stable, long life sensor giving years of trouble free operation in various applications.

Typically, Model 4030 is calibrated using a known mixture of methane in air, and thus the THC is shown as equivalent ppm methane concentration.

A separate Sample Selector Module Unit (optional) may be provided with a heated chamber (120°C typical) and a manual 3- way valve. This allows the user to connect sample gas and the span gas to the back of the Sample Selector Unit and manually select the gas to Model 4030 for analysis. The user must ensure that the sample gas is kept above the dew point to avoid condensation from the sample point to its entry into Model 4030.

The Series 4030 Analyzer is composed of three subsystems:

1. Sample System
2. Detector Cell
3. Electronic Signal Processing, Display and Control

### 2.2 Sample System

The Analyzer contains two separate isothermal chambers controlled by individual PID temperature controllers, viewed just behind the front panel. The chambers, 'SAMPLE' and 'FID' are described below.

The Analyzer consists of a Sample Chamber containing the 10-port switching valve and 2 sample loops. A sample filter with replaceable filter cartridge is also included inside the Sample Chamber. The Analyzer also consists of an 'FID' chamber containing the Flame, pressure regulators, pressure gauges and flow restrictors.

### ***2.2.1 Input Porting***

The Analyzer is equipped with ports for the introduction of air, fuel, carrier gas and sample gas. It is imperative that these gases are supplied at constant pressures using two stage stainless steel diaphragm gas regulators. The recommended pressure range is 30 to 60 psig.

### ***2.2.2 Gas Flow Control System***

The Piping Diagram is in the rear of this manual. A 10 port-switching valve is used to control and direct gas flows to the FID detector. The fixed volume sample loop ensures the same volume of sample injection in the Analyzer every cycle.

### ***2.2.3 Fuel and Blanket Air Systems***

Stable flow is achieved by maintaining a constant pressure across restrictors upstream from the cell. Each system incorporates an adjustable pressure regulator, pressure gauge, and restrictor. A flame out light is included to indicate when the flame fails. A fuel shut-off solenoid valve, mounted on the line that supplies fuel, stops the fuel flow in case of flame failure. This valve is located in line with the fuel port.

### ***2.2.4 Flame Ionization Detection Cell***

The carrier gas containing sample and fuel are combined within a tee fitting located in the isothermal chamber. The mixed gas is emitted from a burner within the sensor assembly. Blanket air is introduced into the sensor (or cell) by means of a separate fitting that is located in the base section of the assembly. The upper half of the assembly houses the anode-igniter, collector, and flame guard thermistor.

## **2.3 Detection Cell**

The upper section of the stainless steel flame ionization cell houses the cylindrical collector electrode, the high voltage (+260 VDC) anode-igniter coil, and the sensing thermistor of the flame guard circuit (see cell cross-section Figure 2-1).



**WARNING:** *DANGEROUS HIGH VOLTAGE EXISTS AT THE ANODE IGNITER COIL (+260 VDC). DO NOT ATTEMPT TO DISCONNECT THE IGNITER COIL CABLE OR DISASSEMBLE ANY OF THE FLAME IONIZATION CELL COMPONENTS WITHOUT TURNING OFF THE POWER AND DISCONNECTING THE POWER CORD.*



The collector is interconnected with the electrometer-amplifier PC board by a coaxial cable. Although the cable and fittings are intended for coaxial service, the cable is actually being used as a shielded single-conductor connection.

The anode-igniter, as its name implies, serves two functions. When relay K2 at PCB part number B74671 is energized, the coil becomes an electrical heating element that glows red-hot and ignites the hydrogen fuel. When relay K2 at B74671 is de-energized, the coil is connected to the +260 volt DC terminal of the anode-flame guard power supply PC board. In this configuration, the necessary potential difference is established between the coil (anode) and collector to promote ionization of the burned hydrocarbons. The coil functions as the high voltage anode in all three-range positions of the selector switch.

The thermistor acts as the sensor in the flame guard circuit. Its ambient temperature resistance is in the 100 K ohms region. When the flame is ignited, its resistance is reduced by a factor of 100. The thermistor is coupled to a semiconductor control circuit on the anode-flame guard power supply PC board, which will be described in a following section.

The cell electrodes of both the anode-igniter and flame guard thermistor are connected to the electronics chassis by means of a plug-in cable.

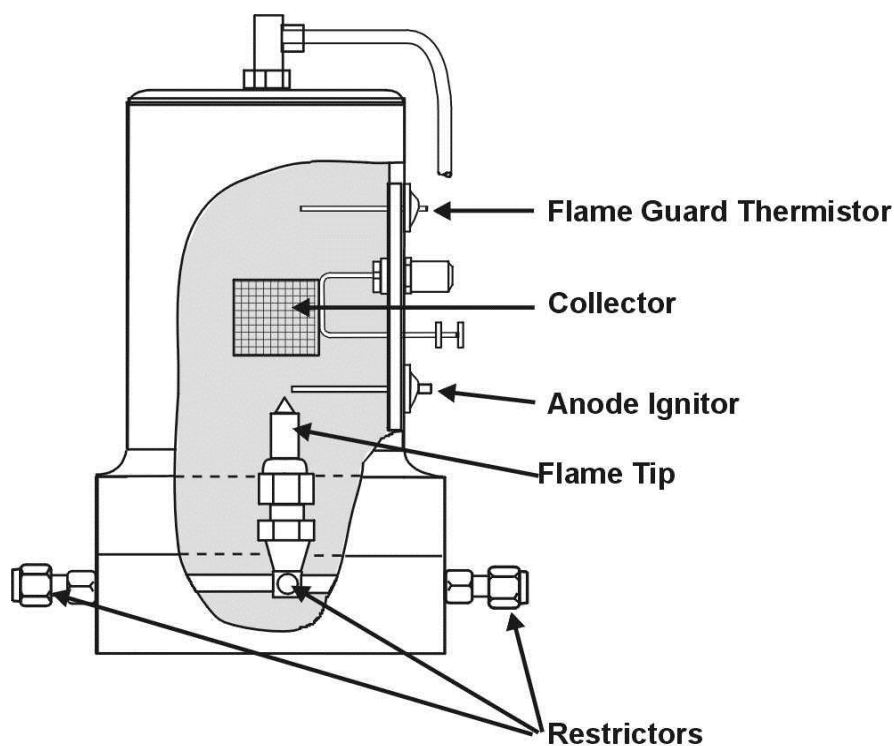


Figure 2-1: Flame Ionization Cell

The electrode section of the cell may be removed for inspection by turning off the power, disconnecting the electrode lead plug, and removing the screws, which retain the electrode assembly in the sensor body.

### 2.3.1 Electrometer-Amplifier

The collector cable is coupled directly to a coaxial fitting located on the electrometer-amplifier PC board. The PC board is located on the side panel next to but outside of the isothermal chamber. See Figure 2-1 and consists of an electrometer amplifier and an operational amplifier. This circuit is a very high-gain, current-to-voltage converter circuit, having an input impedance measuring in the billions of ohms. It is static sensitive and highly susceptible to contamination. Special care must be taken in handling this PC board.

### ***2.3.2 Anode Power Supply***

The high voltage anode power supply components are mounted on the anode power supply printed circuit board. High voltage regulation is achieved through the use of series-connected zener diodes. The simplicity of this circuit's design can be attributed to the extremely low current demand of the anode circuit. The positive output voltage is nominally 125 volts. Output tolerance is  $\pm 10$  volts from the specified 125 volts.

### ***2.3.3 Flame Guard Circuit***

A thermistor-controlled, transistorized switching circuit is employed to operate a relay in the event of a flameout condition. A panel indicator light and fuel shut-off solenoid valve are operated by the relay to alarm personnel that a flameout condition has occurred. The fuel shut-off solenoid valve stops the hydrogen flow.

### ***2.3.4 Flame Ignition Circuit***

The flame ignition circuit includes the anode-igniter electrode (in the detector cell), a transformer, and processor-controlled relay. The circuit is automatically energized when the FID cools due to lack of flame.

If automatic ignition fails five times, there will be a message that reports this, and the flame can be manually ignited by pressing simultaneously the Up and Down key.





## Installation

---

Installation of the Series 4030 Analyzer includes:

1. Unpacking
2. Mounting
3. Gas connections
4. Electrical connections
5. Testing the system.

### 3.1 Unpacking the Analyzer

Although the Analyzer is shipped with all the materials you need to install and prepare the system for operation. 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 Series 4030 and the Sample Selector Unit are general-purpose units and as such are designed with (non-sealed) enclosures. They must be installed in an area where the ambient temperature is not permitted to drop below 40°F nor rise above 100°F. In areas outside these temperatures, auxiliary heating/cooling must be supplied. The 4030 enclosure is oil and dust resistant and although it is designed to resist moisture, it should NOT be considered completely watertight. Mounting to walls or racks must be made securely. Avoid locations that are subject to extreme vibration and sway.

Sufficient space must be provided around the analyzers to accommodate the necessary electrical conduit and plumbing connections. The front panel must be allowed to be pulled out for possible service access to all components of the enclosure. Refer to the system/analyzer outline drawings for dimensions.

**Note:** To completely slide the Model 4030 Analyzer out of the enclosure, pull Analyzer out until it stops, and then push down on the release levers found almost at the end of the sliders, both sides at the same time.

Regardless of configuration, the analyzer/system must be installed on a level surface with sufficient space allocated on either side for personnel and test equipment access. Subject to the foregoing, the Analyzer/system should be placed as close to the sample point as is possible.

All pertinent dimensions, connecting points, and piping details can be found in the drawings section as part of the outline, input-output, and piping diagrams. These drawings are specific to the instrument or system to which the manual applies.

### 3.3 User Connections

All user connections are made on the rear panel. Consult the input-output and outline diagrams in the drawing section of the manual. Not all the features displayed may be present in your system. Refer to any Addenda for additional information that may apply to your instrument.

#### 3.3.1 Electrical Power Connections

The standard analyzer requires a supply of 100-125VAC, single-phase power. Power connections are made at the rear panel of the unit. Refer to the input-output diagram for more information. The electrical power service must include a high-quality ground wire. A high-quality ground wire is a wire that has zero potential difference when measured to the power line neutral. If you have the 220 VAC option, you will require 220 or 240 VAC, 50/60 Hz power. Check the analyzer input-output diagram, power schematic, outline, and wiring diagrams for incoming power specifications and connecting points.

**CAUTION: PRIMARY POWER TO THE SYSTEM SHOULD NOT BE SUPPLIED UNTIL ALL CUSTOMERS WIRING IS INSPECTED PROPERLY BY START-UP PERSONNEL.**



#### 3.3.2 Gas Connections

The analyzer gas connection diagram identifies the various gas connection points as to function and location. Figure 3-1 shows the gas connection points for Model 4030 with the optional Sample Selector Module (top) and without the module (bottom).

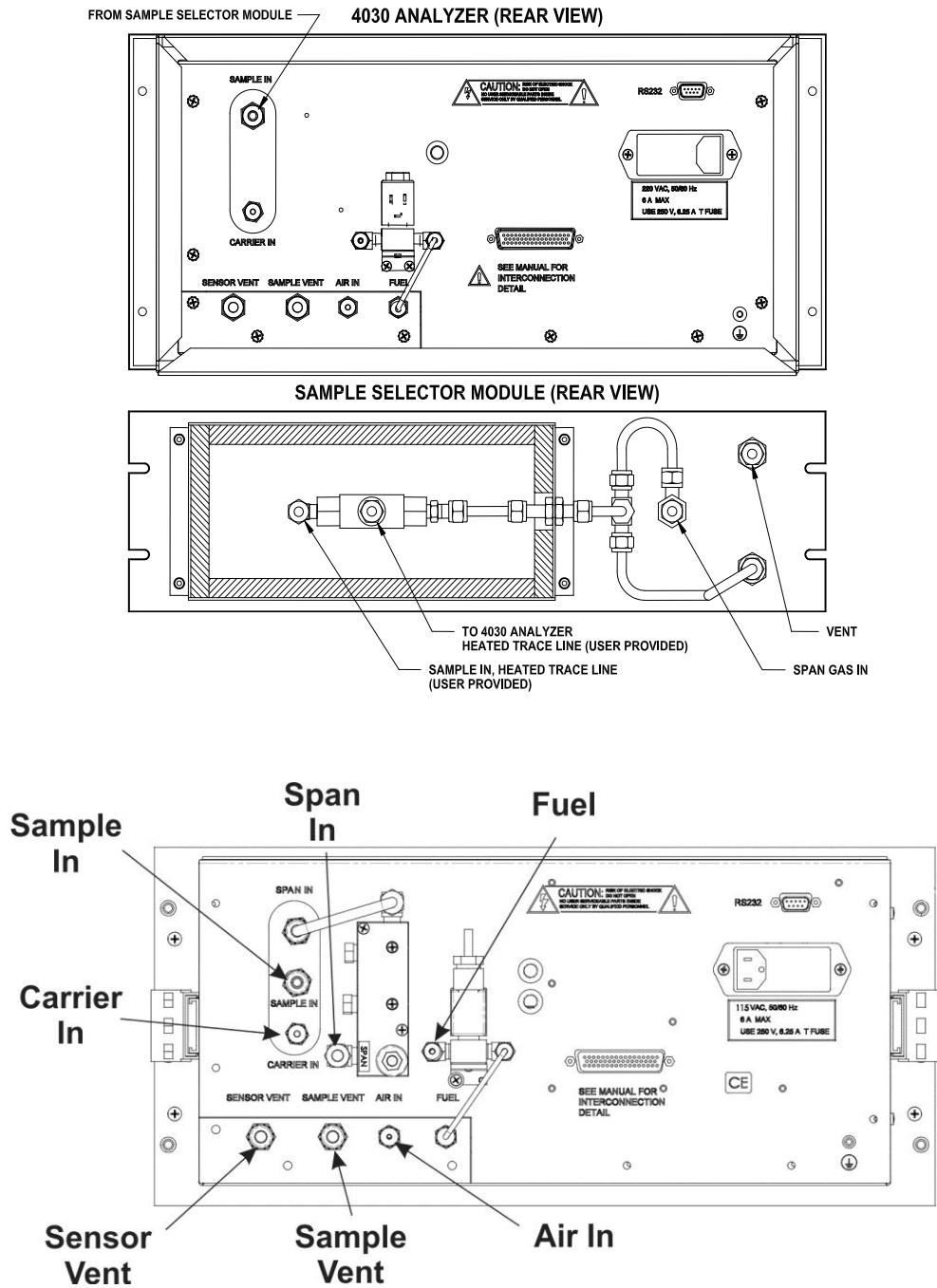


Figure 3-1: Gas Connections

Gas connections to the instrument are made at the 1/8" or 1/4" stainless steel tube fittings provided on the rear panel. Note that the carrier, fuel and air fittings are 1/8" while all other gas connections are 1/4".

If the sample line is heat traced to avoid condensation, the User must ensure that a clean (2 micron or better filter) and heated sample, maintained at a constant temperature not exceeding 120 C, is delivered to the Sample Selector Module and the connection between the Sample Selector Module and the Model 4030 is similarly heat traced. The Sample Selector Unit contains provisions to accept tubing diameter in the range of 1.25 to 1.50 inches, typically the O.D. of the heat-traced lines.

It is recommended that all gas tubing leading to the connections on the back of the analyzer be of the coiled type. This will facilitate sliding the unit out of the case without disconnecting the gas supply to the analyzer.

Before tubing is connected to the system, it must be decontaminated to rid it of hydrocarbon deposits. Using a small torch, heat each length of tubing, while passing nitrogen through it, until it glows red. Begin at the nitrogen source end and proceed down the length of the tube, "chasing" the red glow (and hydrocarbon deposits) down to the open end of the tube. Cap tubing while not in use with suitable non-contaminating caps.

All sample, calibration, and supporting gas lines, which deliver gas to the analyzer, must be decontaminated before connection; vent lines do not.

When connecting the various gas lines to the system, be absolutely certain that no "dead ends" are left; that is, no unused branch lines should be left capped off, where pockets might form of material that is not representative of the current contents of the line, or which might keep contaminants from being purged out of the system.

**CAUTION:** **THE GASES USED MUST BE OF THE HIGHEST QUALITY, ULTRA ZERO GRADES, AS SHOWN BELOW. FAILURE TO DO SO WILL RESULT IN CONTAMINATION AND FAILURE TO DETECT LOW CONCENTRATIONS OF HYDROCARBONS.**



- AIR:** CONNECT ULTRA ZERO GRADE, WATER PUMPED, AIR WITH THC LESS THAN 0.1 PPM TO THE AIR INPUT.
- FUEL:** CONNECT ULTRA HIGH PURITY (UHP) GRADE HYDROGEN GAS, 100%, WITH THC LESS THAN 0.5 PPM TO THE FUEL INPUT
- CARRIER GAS:** CONNECT ULTRA HIGH PURITY GRADE NITROGEN GAS, WITH THC LESS THAN 0.1 PPM TO THE CARRIER GAS INPUT.

### 3.3.3 Electrical Connections

Figure 3-1 shows the Series 4030 rear panel. There are connections for power, digital communications, and both digital and analog concentration output.

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.



#### 3.3.3.1 PRIMARY INPUT POWER

The power cord receptacle and fuse block are located in the same assembly. Insert the power cord into the power cord receptacle.

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



The standard power supply requires 110 VAC, 50/60 Hz or 220 VAC, 50/60 Hz (optional) power.

#### 3.3.3.2 FUSE INSTALLATION

The fuse block, at the right of the power cord receptacle, accepts US or European size fuses. A jumper replaces the fuse in whichever fuse receptacle is not used.

### 3.3.3.3 50-PIN EQUIPMENT INTERFACE CONNECTOR

Figure 3-2 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.

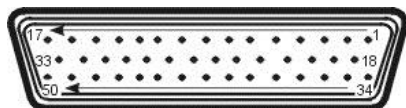


Figure 3-2: Equipment Interface Connector Pin Arrangement

### 3.3.3.4 ANALOG OUTPUT

There are four DC output signal pins—two pins per output. For polarity, see Table 3-1. The outputs are 0-1 VDC, 0-1 VDC, 4-20mA DC, and 4-20mA DC.

The 1<sup>st</sup> and 3<sup>rd</sup> outputs (0-1 VDC, and 4-20mA DC) operate analogously as do the 2<sup>nd</sup> and 4<sup>th</sup> outputs (0-1 VDC, and 4-20mA DC).

Both the first and third set of outputs as well as the second and fourth set of outputs may be set to any of the following functions:

- THC -- Total hydrocarbon as measured in the first phase of detection. The output is the percentage of the selected range.
- SMP -- An alternate measurement that occurs during the second phase of detection. The output represents the percentage of the selected range.
- WAVE – Analogous to the continuous output of the FID.
- RID – Indicates the selected range. Low Range is at 1/5 of maximum output. Mid Range is at 1/2 of maximum output. High Range is 4/5 of maximum output.

Table 3-1: Analog Output Connections

Pin	Function
3	Channel 2, + 4-20 mA, floating
4	Channel 2, – 4-20 mA, floating
5	Channel 1, + 4-20 mA, floating



6	Channel 1, – 4-20 mA, floating
8	Channel 2, 0-1 VDC
23	Channel 2, 0-1 VDC
24	Channel 1, 0-1 VDC
7	Channel 1, negative ground

### 3.3.3.5 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 3-4. They are capable of switching up to 3 amperes at 250 VAC 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

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).

#### System Alarm:

Actuates when power is removed from analyzer.

It is triggered if 4030 fails to ignite after five times.

The System Alarm may be reset by selecting the STANDBY function in the menu to send to sleep mode, then press the ENTER or ESCAPE key to restart the analyzer. However, if the condition that caused the 4030 to fail ignition is not remedied, the 4030 will likely fail to ignite again, and the System Alarm will be re-triggered.

Further detail on flame ignition failure can be found in Chapter 4, Section 4.3.1.

*Table 3-2: Alarm Relay Contact Pins*

<b>Pin</b>	<b>Contact</b>
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

### **3.3.3.6 RANGE ID RELAYS**

There are three dedicated Range ID relay contacts. They 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. Table 3-6 lists the pin connections. Contacts are normally open, and they close when 4040 switches to that particular range.

*Table 3-3: Range ID Relay Connections*

<b>Pin</b>	<b>Function</b>
21	Range 1 ID Contact
38	Range 1 ID Contact
22	Range 2 ID Contact
39	Range 2 ID Contact
19	Range 3 ID Contact
18	Range 3 ID Contact
34	Not Used
35	Not Used



**3.3.3.7 NETWORK I/O**

A serial digital input/output for local network protocol. At this printing, this port is not yet functional. It is to be used in future options to the instrument. Pins 13 (+) and 29 (-).

**3.3.3.8 Pin Out Table**

The following table summarizes all the outputs/inputs available in the 50-pin D-Sub connector on the back panel of the Analyzer.

*Table 3-4: Pin out of 50 pins D-Sub Connector*

Pin #	Description
1	
2	
3	+ Output 4-20 ma, Channel 2, ID
4	- Output 4-20 ma, “, Range ID
5	+ Output 4-20 ma, Channel 1, %
6	- Output 4-20 ma, “, % Output
7	- Output 0-1 v (Channel 1)
8	+ Output 0-1 v (Channel 2)
9	
10	
11	
12	
13	
14	
15	
16	Span Solenoid Return
17	Span Solenoid Hot
18	Range 3 Contact
19	Range 3 Contact
20	Alarm 3 C Contact
21	Range 1 Contact
22	Range 2 Contact
23	- Output 0-1 v (Channel 2)
24	+ Output 0-1 v (Channel 1)
25	
26	
27	
28	Alarm 1 C Contact
29	
30	
31	

Pin #	Description
32	Exhaust Solenoid Hot
33	Sample Solenoid Hot
34	Range 4 Contact/ not used
35	Range 4 Contact/not used
36	Alarm 3 NC Contact
37	Alarm 3 NO Contact
38	Range 1 Contact
39	Range 2 Contact
40	
41	
42	Alarm 2 NC Contact
43	Alarm 2 NO Contact
44	Alarm 2 C Contact
45	Alarm 1 NC Contact
46	Alarm 1 NO Contact
47	
48	Exhaust Solenoid Return
49	
50	Sample Solenoid Return

### 3.3.4 RS-232 Port

The digital signal output is a standard 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.

**Input:** The input functions using RS-232 that have been implemented to date are described in Table 3-5.

*Table 3-5: Commands via RS-232 Input*

Command	Description
<b>AS</b> <enter>	immediately starts an auto span.
<b>AL</b> <enter>	immediately revert to Analyze (THC Phase)
<b>RL</b> <enter>	Change to Manual Range LOW
<b>RM</b> <enter>	Change to Manual Range MEDIUM
<b>RH</b> <enter>	Change to Manual Range HIGH
<b>RA</b> <enter>	Change to Manual Range AUTO

**Implementation:** The RS-232 protocol allows some flexibility in its implementation. Table 3-6 lists certain RS-232 values that are required by the Model 4030 implementation.

*Table 3-6: Required RS-232 Options*

Parameter	Setting
Baud	2400
Byte	8 bits
Parity	none
Stop Bits	1
Message Interval	Sent at the end of each cycle.

### 3.3.5 Supporting Gases

Normally, four supporting gases of different composition (see Section 4.1: *Equipment*) will be required to operate the analyzer. The recommended composition of these gases is specified in the Application Data section of the Appendix. The gases should be supplied from cylinders that are equipped with the type of regulator specified in the aforementioned sections.

**CAUTION:** **UNDER NO CIRCUMSTANCES SHOULD YOU EMPLOY A REGULATOR THAT IS NOT EQUIPPED WITH A METALLIC DIAPHRAGM ANYWHERE IN THE SYSTEM.**



The regulators should be inspected prior to installation to be sure that they are oil-free. Failure to comply with these directives will result in a constant drift in analyzer output, as organic compounds will outgas into the plumbing system at a rate that is related to the ambient temperature. Use 316 stainless steel, dual-stage stainless steel diaphragm regulators only in fuel, sample, and blanket air lines; shutoff valves should be used downstream from each regulator.

Place the supply cylinders as close to the analyzer as possible, and interconnect them to the analyzer with new tubing. Be sure that all plumbing connections are free of leaks.

*Note: Use only stainless steel tubing throughout the system. Consult the assembly, piping, outline drawings, and any Addenda included with this manual to determine if special conditions apply.*

**CAUTION:** THE GASES USED MUST BE OF THE HIGHEST QUALITY, ULTRA ZERO GRADES, AS SHOWN BELOW. FAILURE TO DO SO WILL RESULT IN CONTAMINATION AND FAILURE TO DETECT LOW CONCENTRATIONS OF HYDROCARBONS.



**AIR:** USE ULTRA ZERO GRADE AIR WITH THC LESS THAN 0.1 PPM. DO NOT USE OIL PUMPED AIR UNDER ANY CIRCUMSTANCES.

**FUEL:** USE ULTRA HIGH PURITY (UHP) GRADE HYDROGEN WITH THC LESS THAN 0.5 PPM.

**CARRIER GAS:** USE ULTRA HIGH PURITY GRADE NITROGEN GAS, WITH THC LESS THAN 0.1 PPM.

**SPAN GAS:** CONNECT A PREPARED MIXTURE OF 70-90% OF THE HYDROCARBON OF INTEREST IN AN INERT GAS ON THE RANGE OF INTEREST. FOR EXAMPLE PREPARE 70 PPM METHANE IN NITROGEN (OR OTHER HYDROCARBON-FREE BACKGROUND) FOR ANALYZING METHANE ON THE 0-100 PPM RANGE. CONNECTION IS MADE TO THE SPAN INPUT ON THE SAMPLE SELECTOR MODULE.

*Note: If the Sample Selector Module is not present, the user must install a means of switching between sample and span gas or, alternatively, replace the sample line with span gas when a calibration is required. The latter is not a recommended practice as it bears the risk of contamination and generating sample system leaks.*

*Note: A zero calibration using a zero gas is not required for this analyzer. The instrument zero is handled electronically.*

#### **3.3.5.2 EFFLUENT**

All the gases introduced into the detection cell vent from one fitting at the rear of the analyzer. TAI recommends that the cell be permitted to vent directly to the atmosphere wherever possible.

If a vent line is required, the installation must include a drop-out pot to collect the water that is formed by the burning of the hydrogen fuel. The vent line must be constructed so that water and dirt cannot collect in it.



**3.3.5.3 SAMPLE BYPASS VENT**

The sample bypassed by the back-pressure regulation system vents from a separate port at the rear of the analyzer. If a vent line is required, it must be installed so that water and dirt cannot accumulate in it.

**3.3.5.4 FUEL AND AIR CONNECTIONS**

The fuel used to provide combustion should be hydrogen gas, zero quality with certified THC of less than 0.5 ppm and a pressure of 30 psig. The compressed air, ultra zero gas quality with THC less than 0.1 ppm should be used at a controlled pressure of 30 psig. Connect the fuel and air sources to the instrument according to the gas connection diagram included at the back of this manual.



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## Operation

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### 4.1 Placing the System in Operation

1. Plug the power in the AC power inlet in the back of the Analyzer and the Sample Selector Unit.
2. Allow at least 2 hours warm-up (heat up sensor & sample system) after making the air adjustment described below. Warm up time is set by the software at the factory but may be overridden by pressing the <ENTER> key.

**DO NOT attempt to ignite the flame during warm up countdown.** Condensation will occur.

### 4.2 Activating the Support Gases

#### 4.2.1 Air

1. Set the air tank regulator to 30 psig.
2. Adjust the Analyzer Air regulator until the air pressure gauge reads the recommended air pressure of 9 psig.

After the air is flowing through the sensor and warm-up time has been completed, activate the following gases:

#### 4.2.2 Carrier Gas

Set the Carrier gas tank regulator to 50 psig and adjust the Analyzer Sample regulator until its (sample) pressure gauge reads the recommended sample pressure of 9.5 psig.

#### 4.2.3 Span Gas

The Span gas containing certified mixture of methane in air, recommended range 6 to 8 ppm methane in zero grade air, may be connected to the Span Manifold or the ¼ inch connection on the back of the Sample Selector Module.

#### 4.2.4 Fuel

1. Open the main valve on the tank and set the fuel tank pressure regulator to 30 psig.
2. Adjust the Fuel regulator until its pressure gauge reads the recommended pressure of 3.5 psig.

*Note: Adjust fuel settings only when the red LED (flame failure light) is off.*

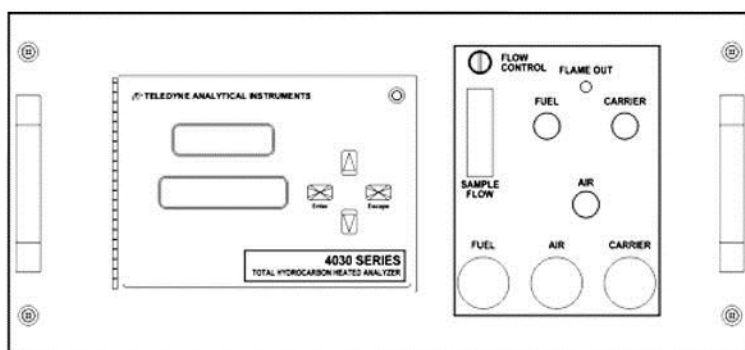


Figure 4-1: Front Panel View of Regulator and Gages

### 4.3 Flame Ignition

Observe that after warm up count down timer reaches zero (timer to preheat the sensor), the amber heater lamp is blinking (indicating that the temperature controller is maintaining the temperature set point) and the red flame failure lamp is on. See Figure 4-1.

The Series 4030 will automatically attempt a flame ignition sequence following the warm up period, which has been preset at the factory. If the ignition process fails, the instrument will attempt to ignite the flame 4 more times. If it continues to fail after the fifth attempt, a flame failure message will appear on the display. If this occurs refer to Section 4.3.1.



### **4.3.1 Verification of the Flame Guard Circuit**

The operation of the flame guard circuit has been checked at the factory, but should be re-verified during start-up. Use the following procedure after ignition of the flame has been achieved:

1. Turn off the fuel at the supply cylinder.
2. Observe the fuel pressure gauge on the analyzer control panel. The gauge indication will decay as the fuel in the line is exhausted. When the gauge reading reaches the vicinity zero, the flame will be extinguish as the fuel solenoid shuts off the fuel supply. The analyzer will automatically try to re-ignite. After 5 attempts, it will display: flame failure, check air, fuel and the flame failure LED will be on.
3. Open the cylinder supply valve and re-ignite the flame by pushing the UP and DOWN buttons simultaneously.

### **4.3.2 Ignition and/or Flame Guard Circuit Failure**

If the flame ignition or guard circuits do not operate as described in the above two sections, set the instrument fuel regulator to the recommended pressure. If still fails to ignite, proceed as directed in Chapter 5: *Maintenance & Troubleshooting*.

### **4.3.3 Sample Pump**

A built-in Sample Pump is provided to draw Sample Gas from the Sample line. The gas flow rate should be maintained at about 1000 to 1200 cc/minute using the Front Panel FLOW CONTROL valve (clockwise increases flow).

## **4.4 Analyzer Operation**

Although the Model 4030 has been programmed for your application at the factory, it can be further configured at the operator level. Depending on the specifics of the application, this might include all or a set of the following procedures:

1. Setting system parameters
  - Establish a security password, if desired, requiring operator to log in
  - Establish and start an automatic calibration cycle (not available)
  - Choose auto ranging or select a fixed range of analysis

- Set alarm set points and modes of alarm operation
  - Calibrate analog output, select analog output source.
2. Routine operation
    - Calibrate the instrument

Procedures for accessing and/or changing parameters as well as analyzer operation are detailed in the sections to follow. In general, the sequence of menus available on screen follows a logical course for setup and operation. It is not required, however to follow this sequential path. The user could, for instance, go directly to set an analysis range and then program an offset to the current output for matching a range on the user's recording device. The only exception to this is when the instrument is powered up. It will go through a warm-up period, followed by a diagnostic self-test routine.

#### **4.4.1 Default Parameters**

The versatility of this analyzer usually results in significant changes being made to parameters over the course of time to better suit a particular application. Occasionally processes change requiring alteration to alarms, ranges etc. At some time, it may be beneficial to reset the analyzer to the default conditions as it was when shipped from the factory. Below is a listing of the default parameters used in configuring your instrument:

**Range/Application:** Refer to the data sheet on the first page of this manual

**Range:** Auto

**Alarms:** Enabled, AL1=20ppm, AL2=50ppm, HI, NON-FAILSAFE, NON-LATCHING, THC levels

**Auto Span Timing:** Not available.

**THC Span:** 8 ppm methane in air.

**Password:** TAI

**Analog Outputs:** Ch1=THC levels  
Ch2=Range ID

#### **4.4.2 Style Conventions**

The following typeface conventions are used when referring to screen names, key presses and screen readout:



Screens:	Arial 12 pt. type in capital letters. Example: ANALYZE or MAIN screen or menu.
Key presses:	<key> The particular keystroke to enter is placed between < and >. Example: <enter> or <escape> or <▲> (UP key) or <▼> (DOWN key.  Only when the keystroke is to be entered will it be placed between the brackets. If discussing a particular key it will be typed as text using all caps. Example: this is the ENTER key.
Screen Modes:	Times New Roman 12 pt. italic. Example: <i>Analysis Mode</i> or <i>Setup Mode</i> .
Screen Readout:	Arial Narrow, 12 pt bold. Example: <b>AUTOCAL</b> or <b>Span in 12 days</b> .

#### 4.4.3 Navigation and Data Entry

*Note: All menus time out after 15 (fifteen) seconds elapse with no button presses, the analyzer returns to the ANALYSIS SCREEN, if parameters have been altered but not saved (with the ENTER key), the alterations are lost.*

Navigation and Data Entry is possible using 2 ARROW KEYS, the ENTER key, and the ESCAPE key. It is important to read and understand the MENU STRUCTURE section to fully understand navigation and data entry.

##### 4.4.3.1 ARROW KEYS

Pressing the ARROW KEYS select menus and modifies values.

1. In the ANALYSIS SCREEN, the ARROW KEYS cause entry into the MAIN MENU.
2. When the selected option is a function on the MAIN MENU or any SUB MENU screen, the ARROW KEYS move to the next lower or upper menu.

3. If the selected option is a **MODIFIABLE ITEM** (value is flashing), The **ARROW KEYS** increment or decrement numeric values or toggle **ON/OFF**, **YES/NO**, or **ENABLE/DISABLE** type values.

#### **4.4.3.2 ENTER**

The **ENTER** key is used in several context-sensitive ways.

1. When showing the **THC** analysis mode, the **ENTER** key toggles the **LINE 2** display.

**LINE 2** display mode 1 data:

- Current analysis mode
- Dynamic (real time) **FID** input level
- Time spent in mode
- Range
- Activity indicator

**LINE 2** display mode 2 data:

- Current analysis mode
- Analysis **TOTAL AREA** from most recent pass of current mode.
- Time spent in mode
- Range
- Activity Indicator

2. When the selected option is a function on the **Main Menu** or any sub menu screen, the function name appears with an arrow next to it. In some cases, the item in the menu is the parent of another **SUB MENU**; in other cases, the item in the menu is the parent of a **MODIFIABLE ITEM**.
3. If the selected option is a modifiable item, the **ARROW KEYS** are used to modify the value of the item. A modifiable item is flashing. The **ENTER** key is then used to accept the value and move you to the next field to continue programming.

#### **4.4.3.3 ESCAPE**

The **ESCAPE** key is used in several context-sensitive ways.



1. When showing the THC analysis mode, the ESCAPE key temporarily clears any present alarms. However, if the alarm condition is still present, the alarm will re-occur when re-detected. Also, pressing the ESCAPE key clears the messages generated by incorrect gain settings (i.e. bad span, gain too high).
2. When the selected option is a function on the MAIN MENU or any SUB MENU screen (the menu name appears with a flashing arrow next to it), the ESCAPE key is used to return to the parent menu finally returning to the ANALYSIS SCREEN the function.
3. If the selected option is a modifiable item (value is flashing), The ESCAPE key is used to escape to the parent menu **without saving the value**. The value will revert to the original before modification (if any).

#### 4.4.4 Menu Structure

The 4030 screen setup consists of several classes of screens and items. No item occupies more than 1 line. It is important to read and understand the NAVIGATION AND DATA ENTRY section to fully understand the menu structure.

1. The ANALYSIS SCREEN displays the following:

##### LINE 1:

- Analysis value of THC
- Alarms, if present, dashes if not ("AL -2" means alarm 2 has been triggered, "AL 1-" means alarm 1 has been triggered, "AL 12" means both alarms have been triggered). If in Span calibration, Alarm display is replaced with the message "SPAN".

##### LINE 2 (display mode 1):

- Current analysis mode
- Dynamic (real time) FID input level
- Time spent in mode
- Range
- Activity indicator

**LINE 2** (display mode 2):

- Current analysis mode
  - Analysis TOTAL AREA from most recent pass of current mode, identified by the units 'vS' – volt Seconds (the alternate mode TOTAL AREA is shown while the ESCAPE key is held down).
  - Time spent in mode
  - Range
  - Activity Indicator
2. The Main Menu and sub menu screens have a flashing arrow on the left side indicating which item is being pointed to modifiable item screens have a flashing value somewhere in the line.

**4.4.4.1 MAIN MENUS**

The MAIN MENU consists of 13 functions you can use to customize and check the operation of the analyzer. They are listed here with brief descriptions:

1. AUTO-CAL: Used to define and/or start an automatic calibration sequence. *AUTOCAL is not available for standard configurations of the 4030.*
2. GAIN: Used to change the amplification of the incoming signal. This is factory set, and should not change.
3. PASSWORD: Used to establish password protection or change the existing password.
4. LOGOUT: Logging out prevents unauthorized tampering with the analyzer settings.
5. MODEL: Displays Manufacturer, Model, and Software version of the instrument.
6. SELF-TEST: The instrument performs a self-diagnostic routine to check the integrity of the power supply, and output boards.
7. SPAN: Set up and/or start a span calibration
8. ALARMS: Used to set the alarm set points and determine whether each alarm will be active or defeated, HI or LO acting, and failsafe or not.
9. RANGE: Used to set up three analysis ranges that can be switched automatically. With auto-ranging or used as individual fixed ranges.



10. ANALOG-OUT ADJUST: Adjust the analog output with offset and scaling for Channel 1 only.
11. CHANGE STREAM: Not available.
12. TIMING: Low-level application specific timing parameters. Factory set. Do not change these.
13. STANDBY: Removes power to outputs and displays, but maintains power to internal circuitry.

Any function can be selected at anytime. Just scroll through the MAIN MENU with the DOWN/UP keys to the appropriate function, and ENTER it. The analyzer will immediately start that function, unless password restrictions have been assigned. (Password assignment is explained in Section 4.4.10).

#### **4.4.4.2 EXPANDED MENUS**

An exhaustive list of menu messages is provided as follows.

```
AUTOCAL
-----
          AUTO SPAN NOT AVAILABLE
-----
```

***AUTOCAL is not available for standard configurations of the 4030.***

```
PASSWORD
-----
          Enter Password
          'T' 'A' 'I'
-----
GAIN ADJUST
-----
          GAIN 0
-----
-----
          Password Incorrect
          Change Password
-----
```

-----  
Enter New Password  
'T' 'A' 'I'  
-----

-----  
Reenter New Password  
'A' 'A' 'A'  
-----

-----  
Password Mismatch  
-----  
Password Changed!  
-----

LOGOUT

-----  
Restrict Access?  
ENTER=YES ESCAPE=NO  
-----

MODEL

-----  
4030 THC Monitor  
V1.0  
-----

SELF TEST

-----  
Begin Self-Test?  
ENTER=YES ESCAPE=NO  
-----



```
-----  
Running Diagnostic  
5V    - Test  
15V   - Test  
DAC A - Test  
DAC B - Test  
-----
```

```
-----  
Diagnostic Result  
5V    - GOOD  
15V   - GOOD  
DAC A - GOOD  
DAC B - GOOD  
-----
```

## SPAN

```
-----  
THC Span ?: Yes  
SMP Span ?: No  
THC Sp:    8.00 ppm  
SMP Sp:    0.00 ppm  
Span Begin  
-----
```

```
-----  
Begin Span?  
ENTER-YES  ESCAPE-NO  
-----
```

## ALARMS

```
-----  
AL-1 DEFEATED  
AL-1 HIGH  
AL-1 NON-FAILSAFE  
AL-1 NON-LATCHING  
-----
```

AL-1 20.00 ppm  
AL-1 SOURCE THC  
AL-2 DEFEATED  
AL-2 HIGH  
AL-2 NON-FAILSAFE  
AL-2 NON-LATCHING  
AL-2 50.00 ppm  
AL-2 SOURCE THC

-----  
RANGE

-----  
Range Select: Auto  
AutoRange Src: THC  
Man Rng: R1  
R1: 0-10.00ppm  
R2: 0-100.00ppm  
R3: 0-1000.00ppm

-----  
ANALOG-OUT ADJUST

-----  
CH1 mA Offset: 0  
CH1 mA Gain: 0  
CH1 Select: THC  
CH2 Select: WAVE

-----  
CHANGE STREAM

-----  
CHANGE STREAM NOT AVAILABLE  
-----

## TIMING

```
-----  
THC I/P:      100%/00%  
THC TIME:     05m00s  
THC I Begin:  00m05s  
THC I End:    00m05s  
AIR I Begin:  00m05s  
AIR I End:    00m05s  
THC Base 1:  00m03s  
THC Base 2:  00m03s  
SMP I/P:     100%/00%  
SMP TIME:     05m00s  
SMP I Begin:  00m05s  
SMP I End:    00m30s  
SMP Base 1:  00m03s  
SMP Base 2:  00m03s  
-----
```

## STANDBY

```
Switch to Sleep Mode  
ENTER=YES  ESCAPE=NO
```

notification if logged out

```
-----  
Access Restricted  
Re-enter Password  
-----
```

#### **4.4.5 Setting up an AUTO-CAL**

*AUTO-CAL is not available for standard configurations of the 4030.*

#### **4.4.6 Adjusting the GAIN**

The output of the FID is conditioned by an amplification circuit with 3 user-adjustable settings:

- 0) x1
- 1) x10
- 2) x100

The resulting signal is converted to a number. Numbers outside the range  $-262144$  to  $262143$  are unreliable and lead to inaccurate measurements. If the number is outside this range during analysis, the message '**GAIN TOO HIGH**' is shown on the 2<sup>nd</sup> line of the display, and the analyzer is not updated to a new, calculated value. The Gain Too High message may be removed by pressing the ESCAPE key.

The gain has been set at the factory such that the analyzer will work reliably within the prescribed range of operation. The user may change the gain when a different level of sample is to be analyzed.

To setup the GAIN:

- 1) From the Analysis Screen, press an arrow key to enter the *Setup Mode*. The VFD will display the first 2 lines of functions available.

---

-> GAIN ADJUST  
PASSWORD

- 
- <▲ ▼> If the arrow is not adjacent to the GAIN ADJUST menu item, use the ▲ ▼ keys to move the arrow to the proper position.
- <Enter> Press <Enter> to activate the function and move you to the next screen.

---

-> GAIN 1

---

*Note: For instruction on how to, please refer to the section 4.4.3 Navigation and Data Entry.*

In the example, the number to the right of the word 'GAIN' is 1, this reflects a gain of x10.

#### 4.4.6 Password Protection

Before a unique password is assigned, the system assigns TAI by default. If the password is the default, it will be displayed automatically. The operator just presses <Enter> from the any of the MAIN MENU items to be allowed access to that item's sub menu. If the password has previously been changed from the default then the initial display will be 'A' 'A' 'A', and the correct letters must be input.

If user has LOGGED OUT, then only the following SUB MENU procedures may be executed:

1. PASSWORD
2. LOGOUT (which only repeats the logout)
3. MODEL

Note however, that the instrument can still be used for analysis without entering the password. To defeat security the password must be entered.

*Note: If you use password security, it is strongly advised to keep a copy of the password in a separate, safe location. If the password is lost and security is enabled, the analyzer must be cold-booted. Cold booting invalidates parameters necessary for correct operation so they must be re-entered.*

##### 4.4.6.1 ENTERING A PASSWORD

To install a new password or change a previously installed password, you must key in and ENTER the old password first. If the default password is in effect it will be displayed as the default gausses for each letter, pressing <Enter> for each letter of the password will enter the default password for you.

To enter a password:

- <any key> From the ANALYSIS SCREEN Enter MAIN MENU setup by pressing an ARROW KEY.
- <▲ ▼> Use the UP or DOWN key to scroll to **PASSWORD**.

---

AUTOCAL  
-> PASSWORD

---

- <Enter>** Press <Enter> to activate the password function. Either the default TAI password or AAA place holders for an existing password will appear on screen.

#### 4.4.6.2 ENTER PASSWORD SCREEN

---

Enter a Password

'T' 'A' 'I'

---

- <▲ ▼>** Use the ▲ ▼ keys to change the letters to the proper password.
- <Enter>** Press <Enter> to advance to the next letter
- <Enter>** The last <Enter> enters the password.
- <Escape>** Steps back to the previously entered letter or, if on the first letter, returns to the MAIN MENU.

If the correct password has been entered the 4040 now allows access to all the SUBMENU items.

The 4040 next presents the CHANGE PASSWORD screen.

#### 4.4.6.3 CHANGE PASSWORD SCREEN

---

-> Change Password

---

- <Escape>** Press <Escape> to return to the MAIN MENU, you are now logged in and have access to ALL SUBMENU items.
- <Enter >** Press <Enter> to change the password.

---

#### 4.4.6.4 ENTER NEW PASSWORD SCREEN

---

Enter a new Password

'T' 'A' 'I'

---

- <▲ ▼> Use the ▲ ▼ keys to change the letters to the new password.
- <Enter> Press <Enter> to advance to the next letter
- <Enter> The last <Enter> moves to the REPEAT PASSWORD ENTRY screen.
- <Escape> Steps back to the previously entered letter or, if on the first letter, returns to the CHANGE PASSWORD menu.

---

#### 4.4.6.5 REPEAT PASSWORD ENTRY SCREEN

---

Reenter a new Password

'A' 'A' 'A'

---

Note that the new password has been replaced by 'A' as placeholder characters. This is to ensure that the wrong password is not mistakenly entered.

- <▲ ▼> Use the ▲ ▼ keys to reenter the letters of the new password.
- <Enter> Press <Enter> to advance to the next letter
- <Enter> If the repeated password matches the previously entered new password, the new password is set, the 4060 resumes the ANALYSIS SCREEN after displaying a brief message 'Password Changed'.
- <Escape> Steps back to the previously entered letter or, if on the first letter, returns to the CHANGE PASSWORD menu.

*Note: If you log off the system using the LOGOUT function in the MAIN MENU, you will now be required to reenter the password to gain access to most menus.*

#### 4.4.7 Logging Out

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 parameters protected until the password is reentered. The system will continue analysis, however.

To log out:

- <▲ ▼> From the MAIN MENU scroll to field of LOGOUT function.
- <Enter> Press <Enter> to logout .  
The screen will display the message:

---

```
Restrict Access?  
ENTER=Yes ESCAPE=NO
```

---

Pressing <Enter> will logout the current user and protect the system from unauthorized changes to parameters.

If user has LOGGED OUT, then only the following SUB MENU procedures may be executed:

1. PASSWORD
2. LOGOUT (which only repeats the logout)
3. MODEL

Note however, that the instrument can still be used for analysis without entering the password. To defeat security the password must be entered.

#### 4.4.8 The Model Screen

The MODEL screen displays the model, and software version information. It is accessed via the MAIN MENU by scrolling (▲ ▼> to MODEL and pressing <Enter>.

#### 4.4.9 System Self-Diagnostic Test

The Model 4030 has a built-in self-diagnostic testing routine. Preprogramming signals are sent through the power supply, output board, preamp 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 BAD. If any of the functions fail, the System Alarm is tripped.

*Note: The self diagnostics are run automatically by the analyzer whenever the instrument is turned on, but the test can also be run by the operator at will.*

*Note: The self diagnostics will interrupt analysis temporarily.*

To initiate a self-test:

- <▲ ▼> From the MAIN MENU scroll to the SELF-TEST function.
- <Enter> Activate the SELF-TEST function by pressing <Enter>. This brings up the SELF-TEST initialization screen.

---

```
BeginSelf-Test?
ENTER=Yes ESCAPE=NO
```

---

<Enter or Escape> Start the diagnostic testing routine by pressing <Enter> or cancel out by pressing <Escape>.

If you pressed <Enter> the self-test routine will begin and after a few moments the results will appear onscreen. The module is functioning properly if it is followed by OK otherwise it is followed by BAD. In this case, please contact TAI Customer Service for an explanation of the problem.

To return the analyzer to the MAIN MENU, press <Enter> after the results screen.

If you pressed <Escape> you will be returned to the *Analyze Mode*.

#### 4.4.10 Span

The SPAN function is used to calibrate the analyzer.

The analyzer is calibrated using span gas as described in Section 4.1. This section assumes that this gas has been properly connected and the line checked for leaks.

To initiate a pan calibration:

- <▲ ▼> From the MAIN MENU, scroll down to the SPAN function.
- <Enter> Press <Enter> to activate the SPAN function.

---

```
-> THC Span?      YES
    SMP Span?      NO
    THC Sp: 8.00 ppm
    SMP Sp: 0.00 ppm
    Span Begin
```

---

The first line determines whether a span calculation will be performed for THC. The second line determines whether a span calculation will be performed for SMP. The third line allows the user to modify the span target value for THC calibration. The fourth line allows the user to modify the span target value for SMP.

The last line commences the span (after the following query:

---

```
Begin Span:
ENTER=YES  ESCAPE=NO
```

---

Pressing <Enter> enters the SPAN mode in the SMP phase first. The first pass in the SMP phase only purges the sample gas from the column (no span calculation is performed this time around). Then the THC is span calibrated followed by the second pass of the SMP mode, where the span calculation is performed. The 4030 goes through all of these phases, but span values are only adjusted if the user selected YES in the initial menu for the respective phase.

#### **4.4.11 The Alarms Function**

The Model 4030 is equipped with two alarms and a system failure alarm relay. Each alarm relay has a set of form "C" contacts rated for 3 amperes 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 terminal connections. The alarm relay contacts are accessible to the user from the 50-pin Equipment Interface connector.

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

The concentration alarms can be configured from the ALARM function screen as follows:

---

```
-> AL-1 DEFEATED
    AL-1 HIGH
    AL-1 NON-FAILSAFE
    AL-1 NON-LATCHING
    AL-1 20.00 ppb
    AL-1 SOURCE THC
    AL-2 ACTIVE
    AL-2 LOW
    AL-2 FAILSAFE
    AL-2 LATCHING
    AL-2 50.00 ppb
    AL-2 SOURCE SMP
```

---

*Note: For the purpose of example, Alarm 2 has been set differently than Alarm 1.*

*Note: An alarm in 'alarm condition' is signaling that action must be taken such as correcting the alarm or the analysis concentration. If an active (not defeated) alarm has been set to HIGH at 20.0 ppb, and the analysis concentration is above that level, then the 'alarm condition' is occurring.*

**DEFEATED:** If an alarm is defeated, its relay is de-energized, regardless of failsafe condition. A defeated alarm does not react to a transition over its trip point in either direction.

**HIGH:** If an alarm is set as HIGH, it will not create a new alarm condition (see latching) if the analysis concentration is below the trip

point, if the analysis concentration is above the trip point, then an alarm condition will be created or maintained.

**FAILSAFE:** A non-defeated alarm that is in FAILSAFE mode *energizes* an alarm relay in a non-alarm condition and *de-energizes* an alarm relay in an alarm condition.

*Note: Failsafe condition of an alarm is in software. This is not related to relays that have both normally-open and normally-closed terminals.*

**LATCHING:** The latching property configures the alarm such that the user must manually relieve the alarm condition even though the concentration no longer violates the trip point of the alarm. So, if an alarm is NON-LATCHING, and the analysis concentration temporarily drifts above the trip point of a HIGH alarm, the alarm condition occurs only during the time the concentration is above the trip point. If that alarm were LATCHING, the alarm condition would persist (even though the concentration is no longer above the trip point), until the user released it.

**RELEASING A LATCHED ALARM:** When alarm conditions are present, the main analysis screen will have one of the following messages: 'AL1-', 'AL-2', 'AL12'. Pressing ESCAPE (in the main/analysis screen) will release a latched alarm and defeat the alarm until the pertinent phase is re-completed.

**TRIGGER POINT:** This is the threshold at which an active alarm can enter into alarm condition. If an alarm is HIGH, ACTIVE, and set at 20.00 ppb, then when the analysis concentration is at or above 20.00 ppb an alarm condition is initiated or maintained.

**SOURCE:** The alarm can react to measurement levels of THC, SMP, or AVG (the average of the previous 2).

**CAUTION:**



**IT IS NOT GOOD PRACTICE TO SILENCE AN EXISTING ALARM BY SETTING THE ALARM ATTRIBUTE TO 'DEFEAT'. THE ALARM WILL NOT AUTOMATICALLY RETURN TO "ACTIVE" STATUS. IT MUST BE RESET BY THE OPERATOR BY PRESSING THE *ESCAPE* BUTTON. IF IT IS NOT RESET, YOUR PROCESS WILL BE RUNNING WITHOUT SAFEGUARDS THIS INSTRUMENT IS DESIGNED TO PROVIDE.**



---

#### 4.4.12 The Range Function

---

```
-> Range Select: Man
    Autorange Src:  THC
    Man Rng:      R1
    R1: 0-10.0 ppm
    R2: 0-100.0 ppm
    R3: 0-1000.0 ppm
```

---

The value of the upper limit of the currently selected range (AUTO or MANUAL) affects the voltage and current of the analog outputs on the rear of the analyzer as well as contact closures indicating which range is current. The Analog outputs on the rear of the analyzer represent the proportion of the analysis concentration to the currently selected range limit.

**MANUAL/AUTO RANGE SELECT:** In Manual Range select, the Range indicated on the second line 'Man Rng:' is maintained as the current range of operation. In Auto Range select, the software determines the smallest range whose limit is larger than the analysis concentration.

**AUTO RANGE SOURCE:** The automatic selection of range can be set to select according to the THC, SMP, or AVG concentration.

**RANGE LIMITS:** Ranges may be set as low as 2.0 ppb and as high as 9999.99 ppm. Range 3 can only be set at a value greater than Range 2. Range 2 can only be set at a value greater than Range 1.

#### 4.4.13 Changing Stream

*CHANGE STREAM is not available for standard configurations of the 4030.*

Affects the relay on the rear panel that controls which gas is allowed to flow to the column and detector.

When the instrument has electronically controlled calibration valves, the gas stream can be switched here. You can set the incoming gas source to span, sample (or zero gas, which is nothing more than a 3<sup>rd</sup> source of gas) without entering the calibration mode in order to check instrument response. During a span calibration, the span stream is activated. After a span calibration, the stream reverts to whatever was set before the span. This value is not remembered if the power is cycled on the unit, the analyzer will default to the analyze stream.

#### 4.4.14 Analog output Adjustment

The software in this instrument provides a way to enter to manage the analog output of the analyzer **FOR ANALOG CHANNEL 1 ONLY**. To access the offset function:

- <▲ ▼> From the MAIN MENU, scroll to the ANALOG ADJUST function using the UP/DOWN keys.
- <Enter> Pressing <Enter> activates the function and takes you to the next screen.

```
ANALOG-OUT ADJUST
-----
CH1 Offset:  0
CH1 Gain:    0
CH1 Select:  THC
CH2 Select:  R-ID
-----
```

- <Enter> Use the <Enter> key to move over to the **Offset** field.
- <▲ ▼> Use the UP/DOWN keys to change each digit's value.
- <Enter> Use the <Enter> key to save the value.
- <Escape> Use the <Escape> key to revert to the original value.

Use the same procedure to set the gain of the instrument. After the last digit is entered, the final <Enter> press will accept the gain value.

The values entered do not have explicit units of current or voltage. Adjustment should be gauged using a voltmeter or current meter attached to the analog output. When the ANALOG ADJUST menu is entered the following is displayed:



---

```
-> CH1 mA Offset:  0
    CH1 mA Gain:   0
```

---

When the arrow is on the Offset, or when the user presses <Enter> to modify the offset, the analog output is 4mA plus a value that is proportionate to the number indicated to the right of 'Offset:' That number may be modified –500 to 500.

When the arrow is on the Gain, or when the user presses <Enter> to modify the gain, the output is 20mA scaled by the value to the right of 'Gain:' plus the Offset value **plus a value that is proportionate to the number indicated to the right of 'GAIN:'**.

If these 2 values are modified and entered and accepted, then the analog output will be affected in like manner in ANALYSIS MODE. That is, it will be scaled by the gain value, then summed with the offset value.

The analog output for each channel may be set to source THC, SMP, AVG, WAVE, or R-ID. In the case of THC/SMP/AVG, the output will reflect the percent of range for the respective selection. In the case of WAVE, the output will track the FID output. In the case of R-ID, the output will reflect the selected range: LOW: 1/5 of full scale, MID: 1/2 of full scale, HIGH: 4/5 of full scale.

#### 4.4.15 Standby

This function allows you to place the instrument in STANDBY.

**CAUTION: STANDBY SHUTS DOWN POWER TO THE DISPLAYS ONLY. INTERNAL CIRCUITS ARE STILL ENERGIZED AND ELECTRICAL SHOCK HAZARD STILL EXISTS.**



To place the instrument in STANDBY status:

- <▲ ▼> From the MAIN MENU, scroll to the STANDBY function using the UP/DOWN keys.
- <Enter> Pressing <Enter> places the instrument in STANDBY. To exit STANDBY, scroll again to the STANDBY function and press <Enter> again.

## 4.5 Advanced User Functions

The Model 4030 provides additional functions for tailoring the instrument to your specific application. These functions include:

1. Timing

### ***4.5.1 Timing***

Timing controls the parameters of the valve and data acquisition. It is specific to the setup of the instrument and must be determined at the factory or TAI trained personnel.



## Maintenance & Troubleshooting

---

**WARNING:** *DANGEROUS HIGH VOLTAGES EXIST INSIDE THIS INSTRUMENT.*



*THERE ARE NO USER SERVICEABLE PARTS WITHIN THE COVER ON THE INSIDE OF THE DOOR, INSIDE THE ISOTHERMAL CHAMBER, (SAMPLE SYSTEM), AND ON THE ELECTROMETER-AMPLIFIER PC BOARD. WORK IN THESE AREAS MUST BE PERFORMED BY AUTHORIZED AND TRAINED PERSONNEL ONLY.*

*BEFORE STARTING ANY OF THESE MAINTENANCE AND TROUBLESHOOTING PROCEDURES, READ THE CAUTIONS AND WARNINGS INCLUDED IN THE SECTION TITLED "ADDITIONAL SAFETY WARNINGS". PAY SPECIFIC ATTENTION TO THE PROCEDURES FOR REMOVAL OF INTERNAL INACCESSIBLE SHOCK HAZARDS. IF THE INSTRUMENT MUST BE TURNED ON DURING ANY OF THESE MAINTENANCE AND TROUBLESHOOTING PROCEDURES, BE CAREFUL AND WORK WITH THE ONE HAND RULE:*

*Work with one hand only.*

*Keep the other hand free without contacting any other object. This reduces the possibility of a ground path through the body in case of accidental contact with hazardous voltages.*

**CAUTION:** *MANY OF THE ELECTRICAL PARTS WITHIN THE ANALYZER ARE SUSCEPTIBLE TO DAMAGE FROM ELECTROSTATIC DISCHARGE (ESD). USE ESD SAFE PROCEDURES WHEN HANDLING OR WORKING WITH ELECTRONIC COMPONENTS.*



If the analyzer is suspected of incorrect operation, always evaluate performance with zero or span gas flowing in the sample path. Never attempt to evaluate performance on sample gas. If analyzer sensitivity is questionable, use the span gas. For all other evaluations, use the zero gas

and low range for maximum sensitivity. The important consideration is to control as many variables as possible. Using cylinder-supplied gases of known hydrocarbon content eliminates the possibility of introducing an unknown variable.

Do not overlook the seemingly obvious. Check to see that power is available for the instrument (and of the proper voltage, etc.), and that connections are correct. Also verify that support/calibration gases are not depleted.

## 5.1 Measuring Circuit Electrical Checks

If the analyzer performs erratically on span gas, the trouble can be related to either the integral gas control systems, or the electronics. To isolate the problem, the two systems must be separated. To isolate the electronics, employ the following procedure:

- Open the door to the analyzer, remove and disconnect the collector cable from the sensor leaving it attached to the electrometer board. (Consult schematic and assembly drawings for circuitry and location). With this cable disconnected, the electronic circuitry is completely isolated from the gas control system and cell.

### 5.1.1 Anode Voltage Check

If the output can be adjusted by the zero control (the above section, step 2), the cell anode voltage should be verified as follows:

**WARNING:** *THESE PROCEDURES SHOULD BE CARRIED OUT ONLY BY PERSONNEL FAMILIAR WITH HIGH VOLTAGE CIRCUIT BOARDS. THE ANODE-IGNITER UNIT AND ASSOCIATE CIRCUITRY INVOLVE DANGEROUSLY HIGH VOLTAGES.*



Refer to the cell wiring diagram. Using a voltmeter set to measure 125 VDC, check the voltage on either of the anode-igniter electrodes, as follows:

1. Connect the **negative** voltmeter lead to ground and the **positive** lead to either electrode. Be careful not to short the circuit by touching both an electrode and the cell body simultaneously. The reading obtained should be  $125 \pm 10$  VDC.
2. If no reading is obtained, disconnect the anode-igniter cable and check for the voltage on pin "J4-1" of the connector located at PC board part number B74671. If the proper voltage is still not

present, replace the flame guard and anode power supply PC board. If it is, check the wiring in the anode-igniter cable plug. If necessary, the circuit board can be replaced by first turning off the power, then removing 4 screws holding the board.

**WARNING: DO NOT TOUCH CAPACITOR C1 OR C2 OR THEIR RELATED CIRCUIT FOILS. A SHOCK HAZARD MAY EXIST.**



3. Carefully remove the circuit board without touching any connections which might lead to C1 or C2. After removal, discharge the two capacitors by placing a jumper wire across each.
4. The anode voltage may also disappear or be greatly diminished when condensation inside the sensor has occurred, shorting the igniter to the sensor body across the wet insulator. This usually occurs when the flame is turned on, if the sensor has not been preheated for at least 1 hour.

### 5.1.2 Electronic Stability

If the checks outlined above indicate that conditions are normal, allow the analyzer to run electronically with the collector cable disconnected for several hours in the lowest range, and with the zero offset value adjusted so that the recorder is reading midscale. If all is normal electronically, a noise-free (pen width) recording, showing absolutely no instability, should be obtained for as long as the analyzer is allowed to run in this configuration. If the recording obtained is noisy or erratic, replace the electrometer-amplifier PC board.

### 5.1.3 Printed Circuit Board Replacement

If performance is not adequate, then the analyzer must be recalibrated as described in Section 4.4.10: *Span* before being placed back in service.

Whenever the flame guard and anode power supply printed circuit board have been replaced the analyzer must be recalibrated.

If the instrument performs as outlined in this section, the problem is not related to the measuring circuit electronics.

### 5.1.4 Collector Cable

Before reconnecting the collector cable, check the continuity of the center wire of the cable with an ohmmeter by measuring between the center pins at each plug on the lowest resistance scale of the meter. Flex the cable while making this measurement to be sure that there is not an intermittent open circuit. If there is, replace the cable. Do not attempt to repair the cable, as special tooling is required to disassemble and reassemble the cable plugs.

## 5.2 Temperature Control Electronic Check

If the heating circuit fails, the output of the analyzer will tend to drift with changes in ambient temperature. Such a failure will be more evident in the low range. If the temperature environment surrounding the analyzer is closely regulated, failure in this circuit might go unnoticed after the initial failure. If the environment follows day and night temperature changes, the analyzer will show a diurnal, bi-directional drift when operated on zero gas. The magnitude of the drift will be a function of the temperature differential experienced by the analyzer.

The Model 4030 uses PID temperature controllers (P/N CP2408) for controlling the thermal environment in the sample compartment and FID. The temperature controllers use a thermocouple (typically, type K) for providing feedback to the temperature controller.

The setpoints and control parameters have been set at the factory for your application.

Refer to the PID Temperature Controller Manual for maintenance and troubleshooting information the temperature control units.

*Note: If any of the components located inside the isothermal chamber have failed, the instrument must be removed for service.*

## 5.3 Ignition and/or Flame Guard Circuit Checks

If the flame guard circuit will not hold the flame-out lamp off when the ignition procedure is employed (see section 4.3 *Flame Ignition*), perform the following procedure to isolate the problem (consult the system schematic for details of the circuit):

1. Disconnect the anode-igniter/flame guard thermistor cable from the socket.



2. Check the flame guard sensing thermistor by measuring the resistance between pins J4-3&4 of PCB part number B74671, disconnect the cable plug. The reading should be about 100 K $\Omega$  at room temperature. The actual resistance is not important, since the thermistor experiences radical changes in resistance as the temperature changes. No indication in a sufficiently high range on the ohmmeter indicates an open thermistor. (If the thermistor is hot, the resistance will be much lower.)
3. Check the anode-igniter coil for continuity by measuring between pins J4-1&2 of the disconnected cable plug. The ohmmeter should indicate a short circuit.
4. If either step 2 or 3 does not check as indicated, remove the electrode assembly of the detection cell and replace it. If the quartz flame tip is damaged, the top section of the cell may be removed by disconnecting the vent line, and removing the screws around its flange. Return the unit complete with attached electrode cable. If steps 2 and 3 both check out properly, reconnect the anode-igniter cable.
5. Check K1 and K2 relays operation as the analyzer is RE-IGNITING. If the relays do not energize, remove the flame guard power supply board and check the forward and backward resistance of its transient suppression diode by measuring pins 13 and 14 of the relay socket. The ohmmeter should indicate a short circuit resistance in one direction, and some resistance value when the leads are reversed. If the indication is a short circuit, then the diode must be replaced.

*Note: If, after replacing a defective diode, the circuit still does not work properly, the flame guard circuit components have been damaged, and the PC board must be replaced.*

6. If the preceding steps check out correctly, the flame guard portion of the circuitry on the flame guard/anode power supply PC board is defective.

**IMPORTANT: If the circuit proves defective, the analyzer will have to be recalibrated after the board is replaced.**

## 5.4 Sampling System

If the procedures outlined above do not correct the problem, the fault must be related to the gas control systems. Plugged or faulty regulators,

plugged restrictors, or leaks within the system can cause erratic performance. TAI recommends that the factory or an authorized representative be contacted before attempting any repairs to the sample or supporting gas systems within the analyzer.

## 5.5 Printed Circuit Board Descriptions

The electronics circuitry of the analyzer is designed with the latest integrated circuit technology. The individual circuits which are required to process the incoming signal and condition it to provide the various outputs, alarms, indicators, etc.,

### 5.5.1 Flame Guard and Anode Power Supply PCB

Schematic No. B-74672

Assembly Dwg. No. B-74671

**Anode Power Supply:** The high voltage anode power supply components are mounted on the flame guard and anode power supply printed circuit board. High voltage regulation is achieved through the use of zener diodes. The simplicity of this circuit's design can be attributed to the extremely low current demand of the anode circuit. The positive output voltage is nominally 125 volts. Output tolerance is  $\pm 10$  volts from the specified 250 volts, due to variation in components from unit to unit.

**Flame Guard Circuit:** A thermistor-controlled, comparator circuit is employed to operate relays in the event of a flame-out condition. A panel indicator light is turned on by the relay to alarm personnel that a flame-out condition has occurred.

The controlling thermistor is located within the upper section of the cell assembly. The electronic circuit components and relays are mounted on the same printed circuit board as the anode power supply. the indicator light on the control panel.

The thermistor is located in the circuit so that it controls the input of comparator. The circuit is factory set so that with the flame burning, the output of comparator is low. The microprocessor senses the low input and in turn sends 5VDC to turn on Q1, this holds the relay energized. When energized, the relay extinguishes the Flame Out indicator light. Conversely, if the flame goes out, bias to the switching transistor is lost, the relay drops out, and the Flame Out light receives power through normally closed contacts.



During ignition, the flame heats the thermistor, holding the relay in the energized condition and the indicator light off. If the Flame Out light comes on as the analyzer returns analyzing mode, then the flame is not burning, and the ignition procedure must be repeated.

### **5.5.2 Electrometer-Amplifier PCB**

Schematic No. B79159

Assembly Dwg. No. B79153A

The ions formed in the process of burning hydrogen in the presence of hydrocarbon components of the sample gas cause an electrical conduction between two electrodes in the combustion chamber (or detector cell) that is amplified by a high sensitivity and high input impedance electrometer-amplifier circuit. The electrical output of the electrometer-amplifier is directly proportional to the quantity of flame ionizable hydrocarbons present.

The electrometer amplifier PC board is located on the side of sample module, interconnected to the electronic circuitry by means of a single 8-pin cable, so that the ease of replacement of a board is maintained. The high input impedance requires a shield, or cover, which is removable for access, as well as a shielded input conductor. Interconnection with the collector is made by a coaxial cable.

Although the cable and fittings are intended for coaxial service, the cable is actually being used as a shielded single-conductor connection. The collector cable plugs into a coaxial connector on the electrometer amplifier PC board, which is located at the side of the sample module.

The circuit consists of an electrometer amplifier and an operational amplifier. It is a very high-gain, current-to-voltage converter circuit, having an input impedance measuring in the billions of ohms. It is static sensitive and highly susceptible to contamination, and special handling precautions must be taken.

Because of its high impedance, the input circuitry to the electrometer has had careful design consideration. The resistors (R2 and R3) in the input gain circuit (see schematic) are installed on Teflon-insulated standoffs, instead of directly to the printed circuit, to eliminate the possibility of leakage currents.

To eliminate any possibility of contamination of the insulating materials employed, the completed PC board is ultrasonically cleaned in laboratory grade alcohol. **Under no circumstances should the parts**

**described be handled with bare fingers.** A freshly-scrubbed finger, stroked along one of the glass resistors, would deposit enough skin oil to completely upset the range division of the attenuator circuit.

Resistor R3 is a 1000 M $\Omega$  resistor used in the feedback circuit of the amplifier. R2 has a resistance of 10,000 M $\Omega$  and is used in series with the zero potentiometer slider. This circuit is used to nullify any offset signal introduced by the signal electrode. Trimmer P1 is used to nullify the offset signal generated by the electrometer amplifier.

The output of the circuit is standardized against gases with known hydrocarbon concentrations by zero and span calibration, so that the meter and/or recorder indicate the hydrocarbon concentration of the gas being used.

The positive and negative operating voltage required by the electrometer amplifier is furnished by a switching power supply circuit, mounting at the back panel of the Analyzer

The stability of the electrometer circuit can be tested as follows:

1. Disconnect the collector cable.
2. Place the analyzer in the auto range.
3. Adjust zero offset value so that the recorder reads at some point upscale, and record a 24 hour chart.



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## Appendix

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### Specifications

**Fuel:** Per application:

- Mixture of 40% hydrogen, 60% nitrogen
- Hydrogen

**Accuracy:** 1% of full scale

**Electronic response time:** 90% within one minute

**Noise:** Less than  $\pm 0.5\%$  of full scale

**Drift:** Less than 1% of full scale per day

**Ranges:** 3 ranges user defined from 0 ppm to 6% (methane equivalent)

**Sensitivity:** As low as 0-1 PPM methane equivalent full scale

**Output:** Linear signal; meter readout  
0-1 VDC plus 4-20 mA analog output

**Ambient temperature:** 40 °F to 110 °F (5 °C to 43 °C)

**Flow rate:** 100-400 ml per minute of sample  
100-200 ml per minute of fuel (200 cu. ft. cylinder lasts about 1 month)

**Power requirement:** 115 VAC, 60 Hz, single phase

**Power consumption:** 140 W maximum

**Pressure rating:** Up to 50 psi

**Dimensions:** 8.75 " x 19 " x 15.5 " (H x W x D)  
222 mm x 483 mm x 394 mm

**Weight:** 55 lbs.

### Application Data

Model Number:

Serial Number:

Ranges Of Analysis:

Output Signal:

Start-Up Span Setting:

Control Panel Pressure Settings:

Comments:

Blanket Air:

Fuel:

Sample:

Bypass Flowrate: A minimum of **0.25 SCFH** is indicated on the integral flowmeter

Recommended Support Gases: The accessory gases should **all** be laboratory analyzed and certified as to their hydrocarbon content.

Blanket Air: Water pumped, hydrocarbon free, compressed air.

Zero Gas: Water pumped, hydrocarbon free (certified)

Span Gas: ppm methane in (certified)

The span gas contains a known amount of methane impurity. The span gas **must** be certified as to its methane equivalent impurity.

***IMPORTANT: For the best possible results, zero and span gases that are representative of the parent (or background) gas should always be used.***

This is particularly true in applications where the analyzer is being used to analyze a number of different samples with varying concentrations of oxygen. The geometry and temperature of the flame will be somewhat dependent on the oxygen content of the sample. Alterations in the flame configuration will lead to differences in output readings. For the best possible results, TAI recommends that zero and span gases representative of each of these samples be used to standardize the analyzer.

### Recommended Spare Parts List

Qty.	P/N	Description
1	B74671	PC board, Flame guard & anode power supply
1	C75825A	Micro-processor PC board
1	CP2540	Coaxial cable
1	B79154	Sensor Assy.
1	C62371A	Display PCB Assy.
1	B74674A	Interface to Motherboard PCB Assy.
1	C65507A	Backpanel/Power Supply PCB Assy.
1	B79153A	Electrometer PCB Assy.
1	F77	Fuse, 6.25A (3 AG)
1	L156	Lens, red
1	L154	LED, red
1	A33748	Thermistor assembly
1	V825	Ten-way valve
1	CP2408	PID temperature controller

**IMPORTANT:** Orders for replacement parts should include the part number and the model and serial number of the system for which the parts are intended.

Send orders to:

#### **TELEDYNE INSTRUMENTS**

##### ***Analytical Instruments***

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Web: [www.teledyne-ai.com](http://www.teledyne-ai.com)  
or your local representative.

Email: [ask\\_tai@teledyne.com](mailto:ask_tai@teledyne.com)

## Drawing List

D77214	Model 4030 Outline diagram
D77215	Wiring diagram (Rev. 2)
D79158	FID Sensor Assembly