INSTRUCTION, OPERATING AND MAINTENANCE MANUAL FOR

MODEL 4060TCD

P/N M82787
Date 09/16/09
Rev 3

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.

Warranty

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

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

Important Notice

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

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

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

Safety Messages

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

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

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

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

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

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

No Symbol

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

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.

Additional Safety Information

	DANGER GAS USAGE WARNING	

This is a general purpose instrument designed for use 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.

A successful leak check was performed at TAI on the sample system of this instrument prior to calibration, testing and shipping. Ensure that there are no leaks in the supply lines, especially if using combustible gases, before applying power to the system.

If toxic gases or other hazardous materials are introduced into the sample 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.

WARNING: ***ELECTRICAL SHOCK HAZARD.***
WITH THE EXCEPTION OF OPENING THE DOOR AND ADJUSTING THE TEMPERATURE CONTROLLERS, ONLY AUTHORIZED AND SUITABLY TRAINED PERSONNEL SHOULD PERFORM WORK INSIDE OF THE INSTRUMENT. COMPONENTS WITHIN THE COVER ON THE INSIDE OF THE DOOR AND INSIDE THE ISOTHERMAL CHAMBER (SAMPLE SYSTEM) CONTAIN HIGH VOLTAGE SUFFICIENT TO CAUSE SERIOUS INJURY OR DEATH.

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

Teledyne Analytical Instruments 4060TCD, Thermal Conductivity Detector Analyzer, is a GC (Gas Chromatograph) type and a versatile instrument designed to measure the quantity of a sample gas stream. Using a thermal conductivity detector after gas separation through a column, this enhancement to Teledyne's 4000 series of instruments extends the range of analysis to include additional phase separable inert, or other difficult to analyze gas phase components like N_2, H_2. etc. that are present in a positive pressure sample gas. The analyzer is a microprocessor controlled digital instrument based on Teledyne's highly successful Model 4000 series of gas chromatograph Aromatic Hydrocarbon Analyzers. The 4060TCD Analyzer couples a gas separation column plus sampling valve with a sensitive thermal conductivity detector to extend the range of compounds for analysis. Depending on the application and setup, this analyzer allows for the measurement of various compounds of interest.

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.
- Gas chromatographic separation column.
- Precise sampling valve for sample metering and delivery
- Thermal Conductivity Detector
- Three dedicated temperature controllers for maintaining precise temperature for the sample, detector and separation column.
- Pressure control for carrier and reference gas.

- Versatile analysis with three user-definable analysis ranges.
- Microprocessor based electronics: 8-bit CMOS microprocessor with 32 kB RAM and 128 kB ROM.
- Manual ranging allows the user to lock onto a specific range of interest.
- Two adjustable concentration alarms and a system failure alarm.
- Extensive self-diagnostic testing at startup and on demand with continuous power supply monitoring.
- RS-232 serial digital port for use with a computer or other digital communication device.
- Analog outputs for concentration and range identification (0-1 VDC standard and isolated 4-20 mA dc).
- Superior Accuracy
- Software package for interfacing a PC to the instrument for data collection, visual and statistical analyses and graphic manipulation of data images.

1.2 Principle of Operation

The analyzer uses a sample valve which is a specialized electronic-controlled valve responsible for extracting a precise volume of sample and delivering it to the separation column. This valve uses four micro cavities and rotates between two positions in a timed fashion controlled by the timing function in the control section.

The gas separation column separates the component of interest in the sample gas based on its retention time in the packed column. Using a carrier gas and a microprocessor actuated switching valve, the eluted gas is analyzed using a Thermal Conductivity Detector (TCD). After each injection cycle the column is back flushed to accept the fresh sample in the next cycle. The result is a series of peaks over time corresponding to the detector output for each sample cycle. The integrated area under the peak is directly related to concentration and after signal processing, this result is displayed in the appropriate units on the top LED display screen. The screen is updated after each cycle.

The effectiveness of gas separation depends on several critical parameters, one of which is the relative interaction of the materials in the packed GC column. Different species will have different retention times and therefore create an extremely reproducible temporal difference in arrival time at the detector. By controlling the carrier gas pressure as well as the temperature of the column and sample, the retention time is characteristic of the analyte in the sample gas.

The Model 4060TCD uses the difference in thermal conductivity between a compound of interest and a reference gas and relates the thermal conductivity changes to the concentration of the analyte in the sample. The actual concentration can be determined since the sampling valve injects a fixed, known volume of gas each cycle as long as the temperature and pressure remain fixed.

1.3 Analyzer Description

The standard analyzer as shown in Figure 1-1 is a rack mountable instrument designed to fit into a standard 19” instrument rack. The front interface panel is mounted on a door which, when opened, allows convenient access to the three temperature controllers that control the temperature of the TCD sensor, the GC column, and the sample (housing sample loop, TCD and GC boxes). The right side of the instrument contains the gas controls and pressure gauges for the process. It includes a pressure adjustment knob for the carrier gas and a flow control valve and flowmeter for sample control. Pressure gauges are installed to monitor the carrier and reference gas pressures. Both carrier and reference gas pressures are controlled by the same regulator, however, it is the carrier gas pressure that needs to be adjusted to the specific value as requested in the Appendix B.

The top cover of the instrument can be removed to provide greater access to the electronics, the sampling valve and the TCD thermal chamber which includes the sample system.

At the rear of the instrument are ports for the introduction of carrier, zero, span, and sample gases as well as a purge gas for the instrument housing. A single 50-pin user-interface cable connector contains input/output and alarm signals available to the user. An RS-232 port is 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 50/60 Hz operation depending on the customer's requirements. The appropriate power cord for your unit is included with this instrument.

Figure 1-1 shows the Model 4060TCD front interface and Figure 1-2 shows the instrument with the front door opened revealing the three temperature controllers. Figure 1-3 shows the rear panel including the user connections.

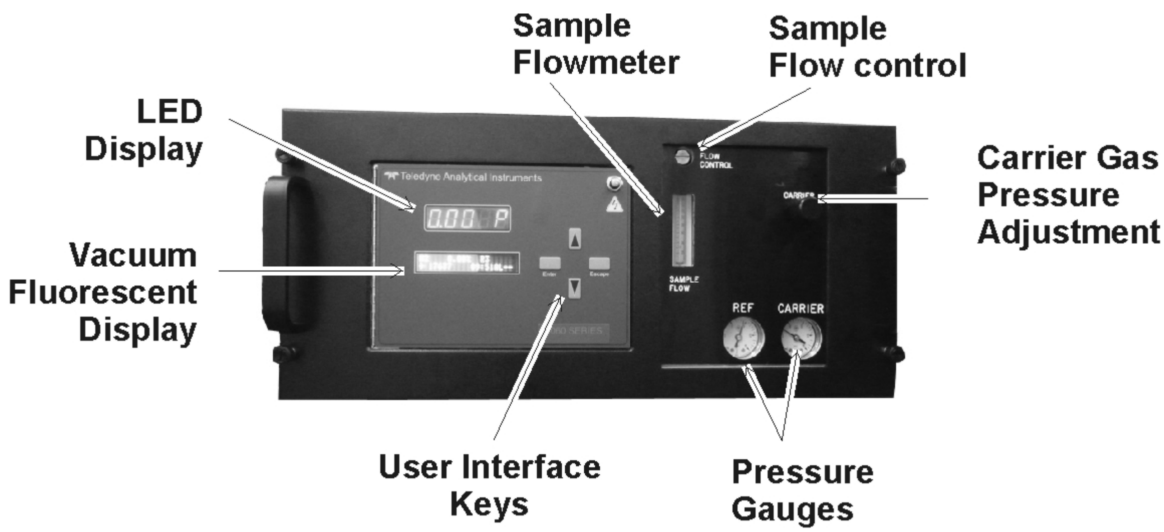


Figure 1-1: Model 4060TCD Front Panel Interface

Figure 1-2: Model 4060TCD Temperature Controllers

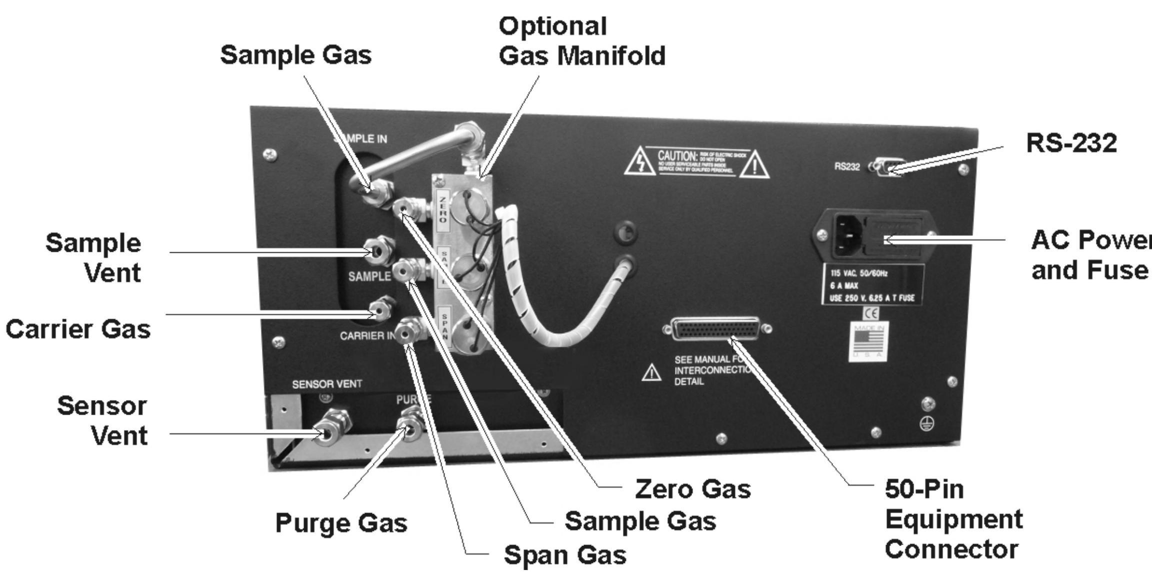


Figure 1-3: Model 4060TCD Rear Panel

1.4 Applications

- Monitoring the purity of unreactive or other stable gases.
- Monitoring contamination in air liquefaction and other gas production processes.
- Gas purity certification.
- Detecting trace pollutants in ambient air.

Operational Theory

2.1 Introduction

The Model 4060TCD Analyzer combines an automatic sampling valve, a Gas Chromatograph (GC) Column, and a Thermal Conductivity Detector for measuring a variety of components in a sample gas. Using a carrier gas and a microprocessor actuated switching valve, a fixed volume of sample is pushed into the column maintained at a constant temperature. The eluted gas is analyzed for the component of interest using a thermal conductivity detector and is based on critical separation timing of gases within the GC column and matched to the timing set up for the sampling valve. After injection, the column is back flushed to accept the fresh sample for the next cycle. Actual separating and detecting sequence of the sample is stable and highly repeatable but will vary for different gaseous components. Each instrument is configured at the factory for analyzing the component of interest for a specific application as specified by the customer at the time of purchase.

The Model 4060TCD Analyzer uses a thermal conductivity detector to sense a variety of components that are separated through a column and eluted to the sensor in a time sequence determined by their respective retention time. It compares the difference in conductivity between a known volume of injected sample driven by carrier gas at a fixed temperature to a constant flowing reference gas. Thermal conductivity is a fast, accurate and reproducible tool for detection and measurement under certain conditions. In general, thermal conductivity measurements are binary and non-specific in nature, that is, they respond to the total difference in thermal conductivity between two samples. If the sample contains more than two components, the thermal conductivity measurement is ill defined and cannot be used to determine the concentration of the mixture without extensive calibration. Similarly, if the thermal conductivity difference between components of a binary mixture is low, sensitivity is negatively impacted.

The Model 4060TCD avoids these issues by coupling the TC detector with a gas separation capability in the GC column. Therefore, even if the sample stream contains more than one compound, at any time during analysis, only a binary mixture which includes the component of interest based on its separation properties, plus carrier gas is delivered to the detector. A suitable carrier gas can be selected that among other properties, maximizes the thermal conductivity difference for enhanced sensitivity. And since the sampling valve is designed to inject a precise and known volume of sample at a fixed temperature, the actual concentration of the compound of interest can be determined.

A stainless steel packed column containing Chromosorb Diatomite or other material depending on the application, is held at a constant temperature. The temperature as well as the carrier gas and its pressure are critical and depend on the application. The actual temperature setpoint and compound separation for your instrument have been determined at the factory. They are listed in the *Addendum and Testing Results* section of Appendix B.

Using a specific carrier gas to inject the sample gas into a known in volume, the specific component of interest elutes from the column within a few minutes. The exact timing is characteristic of the material and has been determined at the factory during testing. Additionally, a clear separation is observed from other components in the sample gas however each has a characteristic timing so the instrument can select only the peak associated with the compound of interest for processing. All necessary information regarding carrier gas type, sample loop volume, temperature and pressure settings, and internal timing settings are given in the *Addendum and Testing Results* section of Appendix B.

2.2 Modes of Operation

The analyzer has two modes of operation depending on the position of the GC sampling valve (See Piping Diagram in Figure 2-1). They are: Sample Mode (position A) and Analysis Mode (position B).

1. Valve Position A—**Sampling Mode**
   In this mode the analyzer configures the operational valve to back flush the column and charge the sample loop. The Sample Mode is programmed to continue for a specific timing interval for your system which is listed in the *Addendum and Testing Results* section of Appendix B. It is possible to set the Sample Mode duration up to 25 minutes.

2. Valve Position B—**Analysis Mode**
   In this mode the analyzer configures the sampling valve to feed

> the gas in the sample loop through the column and to the detector. The eluted sample from the column is fed to the TC detector for the analysis of the compound of interest in the stream. This mode is usually programmed to continue until the compound of interest is fully eluted from the column. It is possible to set it up to 25 minutes.

During the Analysis Mode, a 'Peak Detect' period is programmed at which time the analyzer reads the detector output. The analyzer integrates the peak area during this time in conjunction with the baseline settings to calculate the concentration of the compound of interest. The calculation is performed at the end of the 'Peak Detector' period and the result is displayed at the end of Analysis Mode. Timing settings are determined at factory for each specific application and individual analyzer. These parameters are listed for review in the *Addendum and Testing Results* section of Appendix B. It is important that the user does not alter or change these critical settings unless authorized from Teledyne.

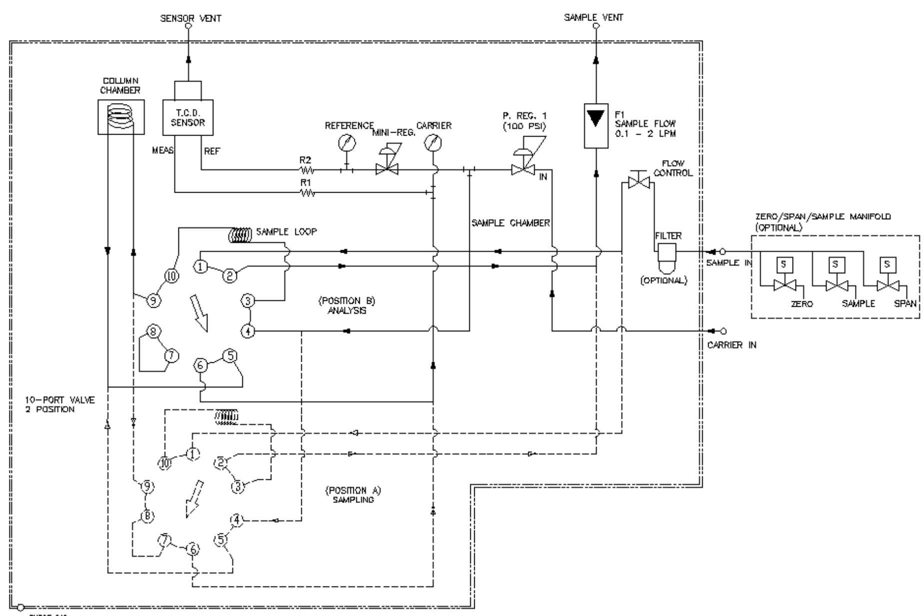


Figure 2-1: Typical Piping Diagram for Model 4060TCD

2.3 Analyzer Subsystems

The Model 4060TCD is composed of four subsystems:

1. Sample System
2. Gas Separation
3. TC Detector
4. Electronic Signal Processing, Display and Control System

2.3.1 Sample System

All components used to control the sample and supporting gases are located inside the analyzer chassis. They are accessible by removing the top cover of the analyzer.

Adjustments are made using the appropriate control on the front panel.

The analyzer contains three separate isothermal chambers 'SAMPLE', 'SENSOR', and 'COLUMN' that are controlled by individual PID temperature controllers. These controllers with integral readout display are visible just behind the front panel as shown in Figure 2-2.

Figure 2-2: Internal Temperature Controllers

The sample chamber contains the 10-port GC switching valve and the sample loop, and the sensor and column housings. The 'SENSOR' chamber contains the TC module. The 'COLUMN' is housed in a separate 'COLUMN' housing. These are identified in Figure 2-3. The actual temperature setpoints for your instrument are listed in the *Addendum and Testing Results* section of Appendix B.

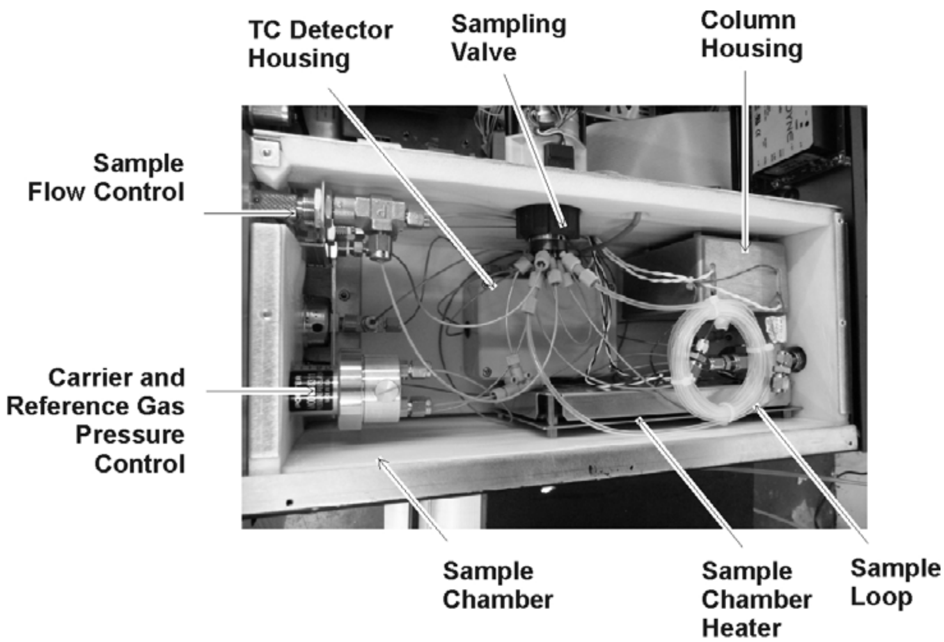


Figure 2-3: Internal Components Within Sample Chamber

2.3.2 Gas Flow Control System

The analyzer is equipped with ports for the introduction of carrier gas, span, zero, and sample gas. There is also a port for connecting a purge gas to purge the housing if this is necessary.

The Model 4060TCD is equipped with a pressure regulator for the carrier gas however the sample and calibration gases must have their own regulators. The sample and calibration gas pressure should be set to 20 psig.

A typical Piping Diagram for the standard instrument is shown in Figure 2-1. A 10-port 2-position GC sampling valve is used to control and direct gas flows including sampling, back flush, and carrier gas. The fixed volume sample loop ensures the same volume of sample injection in the column every cycle.

If your instrument is fitted with the optional auto calibration module, a separate compartment containing three solenoid valves is installed for controlling the introduction of sample or calibration (zero and span) gas to the detector circuit. With the auto calibration module, calibration can be performed automatically on a programmed schedule or manually using the front panel interface.

2.3.3 Gas Separation System

The carrier gas pressure and column temperature are the critical parameters in the separation process. A heater is used in column housing and the temperature controlled by a dedicated PID controller. A constant carrier gas flow is provided by a pressure regulator on the front panel set to a specific pressure with an inlet carrier gas supply of 80 psig at the rear panel. Thus, a stable flow is achieved by maintaining a constant pressure across restrictors upstream from the cell. Actual carrier gas flow rate through the column, which is crucial for separation retention time, will depend on the carrier gas pressure and the type of column used for each application. It is important that all temperature and pressure settings are set to the values listed in the *Addendum and Testing Results* section of Appendix B.

2.3.4 TC Detector

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

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

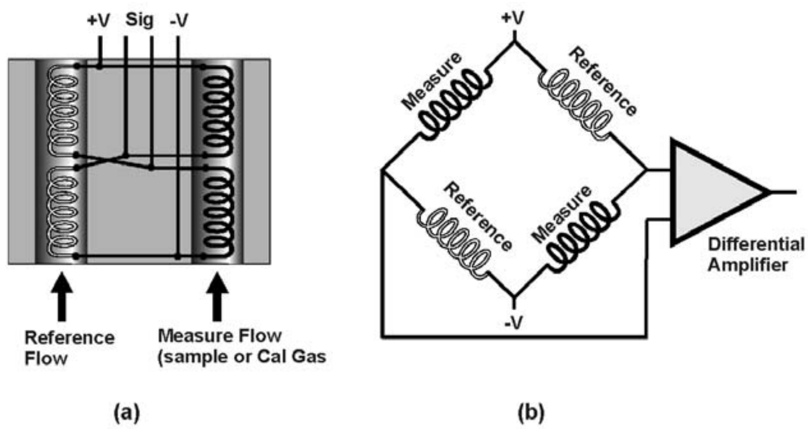


Figure 2-4: Thermal Conductivity Cell Operating Principle

If the thermal conductivities of the gases in the two chambers are different, the Wheatstone bridge circuit unbalances, causing a current to flow in its detector circuit. There will be a constant current flowing as a result of the different flow rates between the reference and carrier gases, though both are the same gas. However, when a compound of interest is eluted from the column and reaches the detector, it will create a peak above the baseline value if the compound has a thermal conductivity that is different from the carrier gas. The magnitude of this current pulse is an indication of the amount of the compound in the sample gas, and the timing of the peak can be an indication of the type of compound, depending on the known properties of the reference and sample gases.

The temperature of the measuring cell is regulated to within 0.1 °C by a sophisticated control circuit. Temperature control is precise enough to compensate for diurnal effects in the output over the operating ranges of the analyzer.

2.3.5 Calibration

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

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

2.3.6 Effects of Flowrate and Gas Density

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

Gases lighter than air will have an actual flowrate higher than indicated on the flowmeter, while gases heavier than air will have an actual flowrate lower than indicated. These effects have been considered when testing and setting up this instrument at the factory. The flowrate as listed in the *Addendum and Testing Results* section of Appendix B are the corrected values to use for your application.

2.3.7 Measurement Results

Thermal conductivity measurements are nonspecific by nature. This fact imposes certain limitations and requirements. In the Model 4060TCD, the thermal conductivity sensor will respond to a specific component in a sample stream as it separates and is mixed with the carrier gas. The TC sees the separated component and the carrier gas (which is also the reference gas) by the heat-transfer differences, and for this to be non-ambiguous, the gas mixture reaching TCD must be binary during the elusion peak area calculation, i.e., the separated compound plus carrier gas. Since the column elutes other components in the sample gas as well, albeit at different times, the timing of the sampling valve and retention peak calculation window are critical. If the timing settings deviate from factory default values, mismatching between actual retention peaks and internal timing settings will result. If this occurs, the thermal conductivity difference between the sample and reference can no longer be associated with the concentration of the species of interest. For this reason, it is important that the user does not alter the default timing values as entered in the timing function during setup. The timing function is detailed in Section 4.4.15.

2.4 Electronics and Signal Processing

The thermal conductivity detector module incorporated in the Model 4060TCD uses an 8031 micro controller (Central Processing Unit—

CPU) with 32 kB of RAM and 128 kB of ROM to control all signal processing, input/output.

The signal processing electronics including the microprocessor, analog to digital, and digital to analog converters are located on the motherboard at the bottom of the TCD case.

The preamplifier board is mounted on top of the motherboard. Figure 2-5 is a block diagram of the TCD electronics.

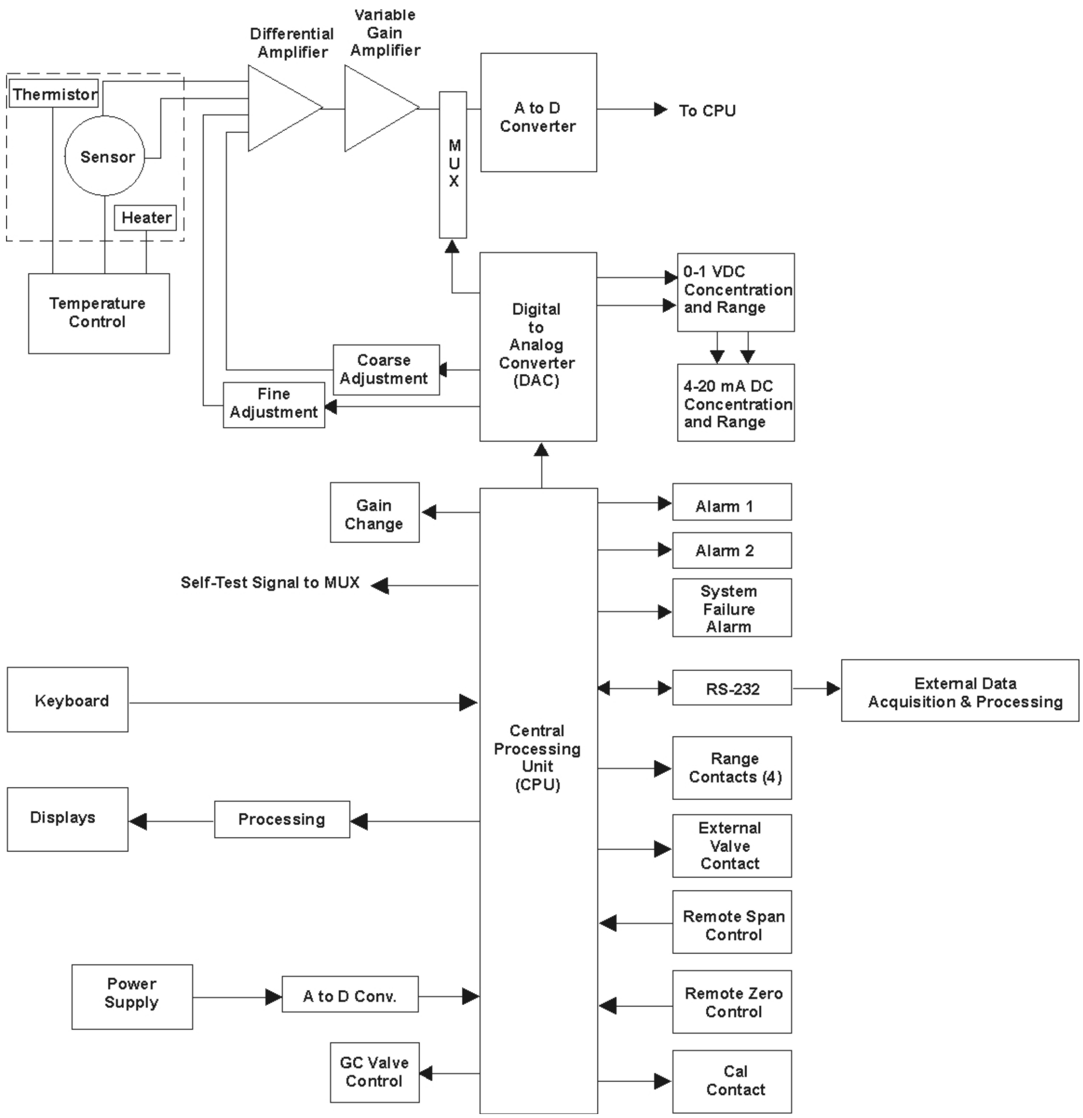


Figure 2-5: Block Diagram for TCD Electronics

The temperature control board keeps the temperature of the measuring cell regulated to within 0.1°C. A thermistor is used to measure the temperature, and a zero-crossing switch regulates the power in a cartridge-type heater. The result is a sensor output signal that is temperature independent.

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

The digital concentration signal along with input from the control panel is processed by the CPU and passed on to the 12-bit DAC, which outputs 0-1 VDC Concentration and Range ID signals. A voltage-to-current converter provides 4-20 mA DC concentration signal.

The CPU also provides appropriate control signals to the displays, alarms, and external valve controls, and accepts digital inputs for external Remote Zero and Remote Span commands. It monitors the power supply through an analog to digital converter as part of the data for the system failure alarm.

The RS-232 port provides two-way serial digital communications to and from the CPU. These, and all of the above electrical interface signals are described in detail in chapter 3 *Installation*.

2.4.1 Temperature Control

For accurate analysis the sensor used in the standard instrument is temperature controlled to 60°C. The actual temperature is application dependant and, if different, will be listed in Appendix B: *Addendum and Testing Results.*

Installation

Installation of the Model 4060TCD 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 Model 4060TCD is a general-purpose analyzer and as such is designed with (non-sealed) enclosures. It must be installed in an area where the ambient temperature is not permitted to drop below 32ºF nor rise above 100ºF. In areas outside these temperatures, auxiliary heating/cooling must be supplied. The 4060TCD 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 analyzer to accommodate the necessary electrical conduit and plumbing connections. The top cover must be allowed to removed for possible service access to all internal components. Refer to the system/analyzer outline drawings for dimensions.

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 Electronic Connections

Figure 3-1 shows the Model 4060TCD 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 SIELDING.

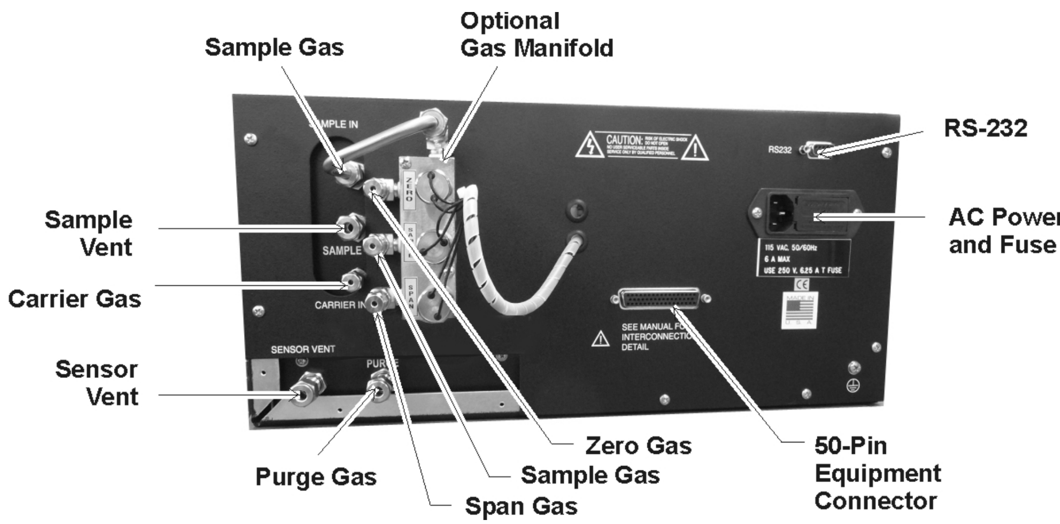


Figure 3-1: Model 4060TCD Rear Panel

3.3.2.1 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.

3.3.2.2 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.

3.3.2.3 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.

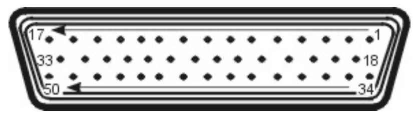


Figure 3-2: Equipment Interface Connector Pin Arrangement

3.3.2.4 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 % of Range:	Voltage rises linearly with increasing concentration, from 0 V at 0 concentration to 1 V at full scale. (Full scale = 100% of programmable range.)
0–1 VDC Range ID:	0.20 V = Low Range 0.5 V = Medium Range 0.80 V = High Range
4–20 mA DC % Range:	Current increases linearly with concentration, from 4 mA at 0 concentration to 20 mA at full scale. (Full scale = 100% of programmable range.)
4–20 mA dc Range ID:	6.8 mA = Range 1 12.0 mA = Range 2 16.8 mA = Range 3

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, negative ground
24	Channel 1, 0-1 VDC
7	Channel 1, negative ground

Examples:

The analog output signal has a voltage which depends on gas concentration relative to the full scale of the range. To relate the signal output to the actual concentration, it is necessary to know what range the instrument is currently on, especially when the analyzer is in the auto ranging mode.

The signal output for concentration is linear over the currently selected analysis range. For example, if the analyzer is set on a range that was defined as 90-100 % nitrogen then the output would be as shown in Table 3-2.

To provide an indication of the range, the Range ID analog outputs are used. They generate a steady preset voltage (or current when using the current outputs) to represent a particular range. Table 3-3 gives the range ID output for each analysis range.

Table 3-2: Analog Concentration Output—Example

% Nitrogen	Voltage Signal Output (VDC)	Current Signal Output (mA DC)
0	0.0	4.0
10	0.1	5.6
20	0.2	7.2

30	0.3	8.8
40	0.4	10.4
50	0.5	12.0
60	0.6	13.6
70	0.7	15.2
80	0.8	16.8
90	0.9	18.4
100	1.0	20.0

Table 3-3: Analog Range ID Output—Example

Range	Voltage Signal Output (VDC)	Current Signal Output (mA DC)	Application
Range 1	0.20	6.8	95–100 % Nitrogen
Range 2	0.50	12	90–100 % Nitrogen
Range 3	0.80	16.8	85–100 % Nitrogen

3.3.2.5 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
- Can be configured as non-latching
- Can be configured out (defeated).

Threshold Alarm 2:

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

System Alarm:

- Actuates when DC power supplied to circuits is unacceptable in one or more parameters. Permanently configured as failsafe and latching. Cannot be defeated.

Note: Reset by pressing the STANDBY button to remove power. Then press STANDBY again and any other button except SYSTEM to resume. Further detail can be found in Chapter 4, Section 4.4.19.

Table 3-4: Alarm Relay Contact Pins

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

3.3.2.6 Digital Remote Cal Inputs

The digital remote calibration input accepts 0 V (off) or 24 VDC (on) for remote control of calibration. (See *Remote Calibration Protocol* below.) See Table 3-5 for pin connections.

Span: Floating input. A 5–24 V input across the + and – pins puts the analyzer into the *Span* mode. Either side may be grounded at the source of the signal. A 0–1 volt across the terminals allows *Span* mode to terminate when done. A synchronous signal must open and close external span valve appropriately.

Cal Contact: This relay contact is closed while analyzer is spanning. (See Remote Calibration Protocol below.)

Table 3-5: Remote Calibration Connections

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

Remote Calibration Protocol: To properly time the Digital Remote Cal Inputs to the Model 4060TCD Analyzer, the customer's controller must monitor the Cal Relay Contact.

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

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

Once a span command is sent, and acknowledged (contact closes), release it. If the command is continued until after the span is complete, the calibration will repeat and the Cal Relay Contact (CRC) will close again.

For example:

1. Test the CRC. When the CRC is open, send a span command until the CRC closes (The CRC will quickly close.)

2. When the CRC closes, remove the span command.

When CRC opens again, the span calibration is done, and the sample is being analyzed.

3.3.2.7 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 4060 switches to that particular range.

Table 3-6: Range ID Relay Connections

Pin	Function
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

3.3.2.8 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 (–).

3.3.2.9 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 3-7: Pin out of 50 pin D-Sub Connector

pin #	Description		pin #	Description
1			26	
2			27	
3	+ Output 4-20 ma - Channel 2		28	Alarm 1 C Contact
4	- Output 4-20 ma - Channel 2		29	
5	+ Output 4-20 ma – Channel 1		30	
6	- Output 4-20 ma – Channel 1		31	
7	- Output 0-1 v (Channel 1)		32	Exhaust Solenoid Hot
8	+ Output 0-1 v (Channel 2)		33	Sample Solenoid Hot
9			34	Range 4 Contact/ not used
10	Remote Span +		35	Range 4 Contact/not used
11			36	Alarm 3 NC Contact
12	Remote Span -		37	Alarm 3 NO Contact
13			38	Range 1 Contact
14			39	Range 2 Contact
15			40	Calibration Contact
16	Span Solenoid Return		41	Calibration Contact
17	Span Solenoid Hot		42	Alarm 2 NC Contact
18	Range 3 Contact		43	Alarm 2 NO Contact
19	Range 3 Contact		44	Alarm 2 C Contact
20	Alarm 3 C Contact		45	Alarm 1 NC Contact
21	Range 1 Contact		46	Alarm 1 NO Contact
22	Range 2 Contact		47	
23	- Output 0-1 v (Channel 2)		48	Exhaust Solenoid Return
24	+ Output 0-1 v (Channel 1)		49	
25			50	Sample Solenoid Return

3.3.2.10 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 3-8.

Table 3-8: Commands via RS-232 Input

Command	Description
AS<enter>	Immediately starts an autospan.
AL<enter>	Immediately revert to Analyze (CH4 Mode)
RL<enter>	Change to Manual Range LOW
RM<enter>	Change to Manual Range MEDIUM
RH<enter>	Change to Manual Range HIGH
RA<enter>	Change to Manual Range AUTO

Implementation: The RS-232 protocol allows some flexibility in its implementation. Table 3-9 lists certain RS-232 values that are required by the Model 4060 implementation.

Table 3-9: 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.

3.3.3 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 instruments fitted with the optional autocal module.

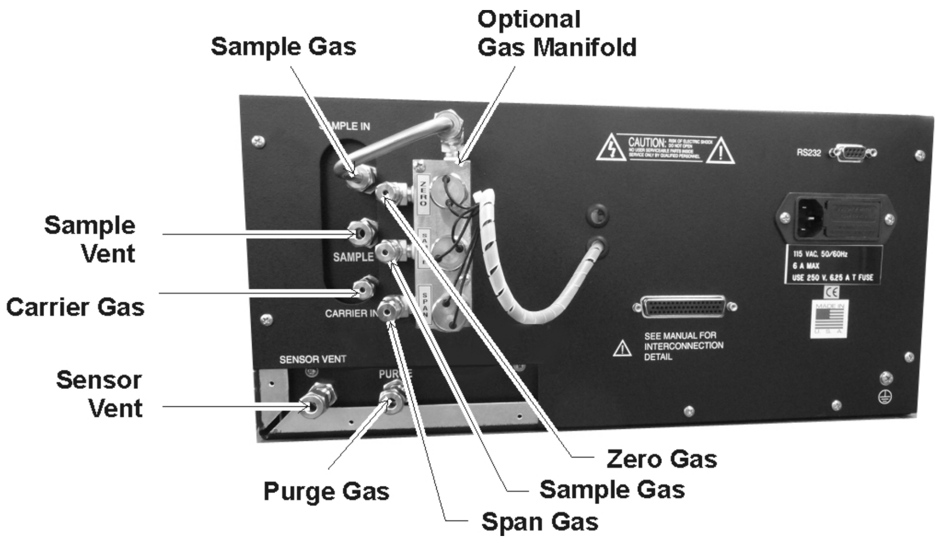


Figure 3-3: Gas Connections

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 Purge and Sensor Vent fittings are 1/4” while all other gas connections are 1/8”.

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 eliminate any impurity 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 impurity deposits) down to the open end of the tube. Cap the 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 AT THE REQUIRED ACCURACY.

Normally, four supporting gases of different composition (see Section 4.1: *Equipment*) will be required to operate the analyzer. The recommended composition is specified Appendix B: *Addendum and Testing Results.* 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 regulator in the sample line; shutoff valves should be used downstream from each regulator.

Place the supply cylinders as close to the analyzer as possible, and connect 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.

3.3.3.1 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 atmospheric pressure 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 heated TC sensor The vent line must be constructed so that water and dirt cannot collect in it.

3.3.3.2 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.

3.3.3.3 Carrier Gas Connection

The carrier gas supply is also used as the reference gas for the TC sensor. The specific gas used is application dependant and is listed in the *Addendum and Testing Results* section of Appendix B.

The carrier gas should be supplied at 80 psig. Make the carrier/reference gas connection according to the gas connection diagram included at the back of this manual.

3.3.3.4 Sample, Span, and Zero Gas Connections

The sample, span, and zero gas connections are made at the rear panel. If the optional autocal module is installed, the sample and calibration gases will connect to this module. If no autocal module is present, these gases connect to the labeled fittings on the rear panel.

Set the supply pressure for sample, span, and zero gas to 20 psig.

3.4 Placing the System in Operation

See Section 4 for information on starting the analyzer for the first time. Makes sure that all electrical connections have been made correctly and all connectors are fully seated. Make sure all gas connections are correct and leak–free.

Operation

This section of the manual describes how to setup and operate the Model 4060TCD Analyzer. Sections 4.1 through 4.3 describe preliminary steps and equipment needed to operate the analyzer. Beginning with Section 4.4, the actual operation of the analyzer is described along with descriptions of the display prompts, messages and options available to the user within a menu or sub menu. You should read this chapter in its entirety and become familiar with the operating characteristics of this system before starting the analyzer for the first time. The *Addendum and Testing Results* section of Appendix B lists the software revision and default settings for your specific system.

4.1 Equipment

The following supporting gases and hardware will be required to operate the (standard) analyzer:

1. **Carrier Gas**: A cylinder of carrier gas (application dependant, see *Addendum and Testing Results* section of Appendix B), with zero gas quality, equipped with dual stage metallic diaphragm regulator is required.
2. **Span Gas**: A cylinder or a permeation device system, capable of generating known concentration of the species of interest. TAI recommends using a known concentration of 70-90% of the range of interest.
3. **Zero Gas**: A high purity source containing less than 0.05 ppm of the analyte.
4. **Sample Pressure Regulation**: An oil-free, metallic diaphragm regulator must be installed at the sample point when possible; see Section 3.3.3 *Gas Connections*.

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 AT THE REQUIRED ACCURACY.

CARRIER GAS: ULTRA ZERO GRADE WITH LESS THAN 0.1 PPM ANALYTE.

4.2 Preliminary Power-Off Check List

Make the following checks of the installation before proceeding further into the start-up procedure:

1. Check to see that the sample and supporting gas installation is in accordance with the specifications called for in the installation and application sections of the manual (Chapter 3). Be sure that the supporting gases are of the proper composition and are connected to the correct fittings at the rear of the analyzer.
2. Check to see that the electrical installation conforms to the instructions contained in the installation section (Chapter 3) and on the input-output diagram.
3. Open the door and check to see that the printed circuit boards and cables are firmly seated in their respective sockets.
4. Confirm that recorder and alarm connections are properly made.

4.3 Activating the Support Gases

All gas controls are located on the front panel as shown in Figure 1-1. Turn the analyzer on and allow the instrument to warm-up for 2 hours. After the warm up period, activate the following gases:

4.3.1 Carrier Gas

Set the carrier gas source regulator to 80 psig and adjust the analyzer sample regulator until the sample pressure gauge reads the recommended sample pressure of 7.0 psig.

4.3.2 Span and Zero Gas

1. Feed span gas to the analyzer (see Section 4.4.5). Gas switching can also be handled through the autocal valves (if the option is added), which can also be manually activated as described in Section 4.4.5.

2. Observe that the analyzer sample flow meter reads from 0.3 to 1.0 SCFH.
3. Turn off span gas and repeat the above for zero gas.

4.4 Analyzer Operation

Although the Model 4060TCD 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 (if equipped with the optional autocal module).
2. Routine operation.
    - Calibrate the instrument.
    - Set alarm setpoints and modes of alarm operation.
3. Special functions setup.
    - Calibrate analog output, select analog output source.

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.

CAUTION: **ALARM SUPPRESSION:**
WHEN AN ALARM CONDITION OCCURS (SEE ALARMS), ONE OR BOTH OF THE MESSAGES, 'AL-1', AND/OR 'AL-2' WILL BE DISPLAYED ON THE VFD WHILE IN THE ANALYSIS SCREEN. AT THIS TIME, THE ENTER BUTTON MAY BE PRESSED TO

ACKNOWLEDGE THE ALARM(S) IN WHICH CASE THE ALARMS WILL BE SUPPRESSED UNTIL THE ANALYSIS VALUE IS NEXT UPDATED. THIS CAN RESULT IN A CONDITION WHERE THE SCREEN MAY BE REPORTING A VALUE THAT SHOULD CAUSE AN ALARM, BUT UNTIL THE ANALYZER AGAIN ENTERS SAMPLE MODE, NO ALARM CONDITION WILL REOCCUR.

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, filter settings 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 the typical Model 4060TCD instrument. Your specific application may require different settings. Refer to the *Addendum and Testing Results* section of Appendix B for any specific changes or recommendations that apply to your application.

Range/Application:	Refer to the *Addendum and Testing Results* section of Appendix B
Range:	Manual
Alarms:	Defeated, 20%, 50%, HI, NON-FAILSAFE, NON-LATCHING
Auto Span Timing:	Defeated, every 7 days, at 12 hours
Span:	Factory default; Need to change to actual value
Password:	TAI

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: *Analysis Mode* or *Setup Mode.*
Screen Readout:	Arial Narrow, 12 pt bold. Example: AUTOCAL.

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. The arrow keys, when pressed simultaneously, are used to manually ignite the flame after a flame-out condition.

4.4.3.2 ENTER

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

1. 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.

Note: An exception to this is found in the TIMING *screen where a forward or backward arrow indicates the sampling valve DIRECTION. See section 4.4.15.*

2. 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 displaying the 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 4060TCD 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 analysis value, the range, the alarms (if any) and some information about what phase of analysis is occurring.
2. The MAIN MENU and SUB MENU screens have a flashing arrow on the left side indicating which item is being pointed to.
3. MODIFIABLE ITEM screens have a flashing value somewhere in the line.

4.4.4.1 Main Menus

The MAIN MENU consists of 15 functions you can use to customize and check the operation of the analyzer. They are listed here with brief descriptions:

- SPAN: Set up and/or start a span calibration
- ALT-SPAN: Set up and/or start an alternate span calibration. ALT-SPAN is not used in this 4060TCD implementation.
- MODEL: Displays Manufacturer, Model, and Software version of the instrument.
- SELF-TEST: The instrument performs a self-diagnostic routine to check the integrity of the power supply, output boards, cell and amplifiers.
- ALARMS: Used to set the alarm setpoints and determine whether each alarm will be active or defeated, HI or LO acting, and failsafe or not.

- RANGE: Used to set up three analysis ranges that can be switched manually.
- ANALOG-OUT ADJUST: Adjust the analog output with offset and scaling.
- LINEARIZATION: Linearization option. (Not applicable to the 4060TCD instrument).
- CHANGE STREAM: (optional feature) Controls a relay switch for using alternate gases. Has no effect during span mode (span gas relay setting used at that time).
- AUTO-CAL: Used to define and/or start an automatic calibration sequence. ***AUTOCAL is an optional feature not included in the standard configurations of the 4060TCD.***
- TIMING: Low level application specific timing parameters. Factory set. **Do not change these values.**
- GROUP SETUP: Determines compound names, associated timing and measurement ranges. **Do not change these.**
- DETECTOR: Selects type of detector in use. Enter "TCD".
- PSWD: Used to establish password protection or change the existing password.
- LOGOUT: Logging out prevents unauthorized tampering with the analyzer settings.
- 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 4.4.17).

4.4.5 Span

The SPAN function is used to calibrate the analyzer. The known concentration of the span gas is entered in this screen. Span calibration can be performed either manually or automatically with the autocal function if equipped.

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 span calibration:

<**UP/DOWN** >From the MAIN MENU, scroll down to the SPAN function.

<**Enter**> Press <Enter> to activate the SPAN function.

-> Span 100 %

Span Begin

The first line allows the user to modify the span target value.

The second line commences the span after the following query:

Begin Span:

ENTER-YES ESCAPE-NO

Pressing <Enter> enters the SPAN mode in the *Sampling Phase*. This is similar to the *Analysis Mode* both in the Sampling Phase and Analysis Phase. The difference is that, at the end, the analyzer calculates the calibration constants rather than the standard concentration calculation. After both Sampling Phase and Analysis Phase are complete, the calculation is performed and the 4060TCD re-enters *Analysis Mode*.

4.4.6 ALT-SPAN

If a particular compound of interest is not contained in the span gas, another compound existing in the span gas can be used for the alternate calibration. In this implementation of the 4060TCD, ALT-SPAN is non-functioning.

4.4.7 The Model Screen

The MODEL screen displays the model, and software version information. It is accessed via the MAIN MENU by using the <UP/DOWN > keys to scroll to MODEL and pressing <Enter>.

4.4.8 System Self-Diagnostic Test

The Model 4060TCD 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 GOOD 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:

<**UP/DOWN** >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.

Begin Self-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 GOOD 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*.

4.4.9 The Alarms Function

The Model 4060TCD 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 the Interconnection Diagram included at the back of this manual for relay terminal connections. The alarm relay contacts are accessible to the user from 50-pin Equipment Connector. See Section 3.3.2.5 and Table 3-2.

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 %

AL-2 ACTIVE

AL-2 LOW

AL-2 FAILSAFE

AL-2 LATCHING

AL-2 50.00 %

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 %, 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 or both of the following messages: 'AL-1', 'AL-2' followed by the instruction 'ENT/ACK' . Pressing ENTER will release a latched alarm. That is, if there will not be an alarm condition until the analysis concentration is again violating the trip point. Furthermore, the alarms will be suppressed until the analysis value is updated, so even though the screen may be reporting a value that should cause an alarm, until the analyzer again enters SAMPLE MODE, no alarm condition will reoccur.

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 %, then when the analysis concentration is at or above 20.00 % an alarm condition is initiated or maintained.

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. IF IT IS NOT RESET, YOUR PROCESS WILL BE RUNNING WITHOUT THE SAFEGUARDS THIS INSTRUMENT IS DESIGNED TO PROVIDE.

4.4.10 The Range Function

CAUTION: THE RANGES HAVE BEEN SET AT THE FACTORY FOR YOUR APPLICATION. THEY ARE CRITICALLY INTERRELATED WITH SPECIFIC TIMING VALUES USED IN THE GC SEPARATION PROCESS. THE TIMINGS ARE BASED ON EXTENSIVE TESTING AT THE FACTORY. FOR THIS REASON, TAI STRONGLY SUGGESTS THAT THE RANGES ARE NOT REPROGRAMMED FROM THE DEFAULT VALUES. IF A RANGE CHANGE IS REQUIRED FROM THE THREE RANGES INCLUDED WITH YOUR INSTRUMENT, CONTACT TAI CUSTOMER SERVICE.

-> Range Select: Man

Man Rng: R1

R1: 95-100.00%

R2: 90-100.00%

R3: 85-100.00%

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 from the 50 –pin Equipment connector (see Section 3.3.2.4 and Table 3-1) 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. Automatic Range selection in Auto Range is governed by hysteresis such that the concentration must fall below 90% of the limit of the next smaller range before the current range will be set to the lower range.

RANGE LIMITS: Ranges may be set as low as 100.0 % and as high as 100.0 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.

4.4.11 Analog Output Adjustment

The software in this instrument provides a way to manage the analog output of the analyzer. To access the offset function:

<UP/DOWN >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.

-> CH1 Offset

CH1 Gain

CH1 (Wave, Id for Ch2, or Group Output)

CH1 (Select Groups)

CH2 (Wave, Id for Ch2, or Group Output)

CH2 (Select Groups)

For the initial setup of the 4-20 analog output use the following parameters:

- Set CH1 Offset: 0
- Set CH1 Gain: 0

- Set CH1: Group Output
- CH1: Select Groups
- Set CH1: TS Y 100%
- Set CH1:ID-> 100%
- Set all others to N

To adjust the analog output:

- Attach an ammeter meter to the 4-20 mA output on the Control Unit.
- Select CH1 OFFSET:
- Adjust up or down to set the meter to 4.00 mA
- Select CH1 Gain:
- Adjust up or down to set the meter to 20.0 mA.

Disconnect the meter. The 4-20 mA analog output is now calibrated.

4.4.12 Linearization

Not applicable to the 4060TCD configuration.

4.4.13 Changing Stream

This function 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 auto calibration valves (option), the gas stream can be switched here. You can flow span, sample (or zero 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 sample stream is activated regardless of what was set before the span.

CAUTION: **MAKE SURE THAT YOU CHANGE THE STREAM BACK TO ANALYZE, OTHERWISE, WHEN THE INSTRUMENT RETURNS TO ANALYZE MODE, SPAN (OR ZERO) GAS WILL BE FLOWING TO THE DETECTOR AND YOU WILL NOT BE ANALYZING THE PROCESS STREAM.**

4.4.14 Setting up an AUTO-CAL

The Model 4060TCD Analyzer can be fitted with an external auto calibration module as an option. This feature provides automatic switching of sample and calibration gases and allows the operator to program calibration events to occur automatically

Note: *If your instrument is not fitted with an autocal module, the autocal screens will still appear on the display but will be non-functional.*

Note: *Before setting up an AUTOCAL, be sure you understand the Span functions as described in Section 4.4.5, and follow the precautions given there. Auto Span performs a span calibration using the target span value set in the Span feature menu.*

Note: *If you require highly accurate AUTOCAL timing, use external AUTOCAL control where possible. The internal clock in the Model 4060TCD is accurate to 2-3 %. Accordingly, internally scheduled calibrations can vary 2-3 % per day.*

To setup an autocal cycle for a span event to occur in a certain number of days/hours:

From the Analysis Screen, press the UP or DOWN key to enter the *Setup Mode*. The VFD will display the first 2 lines of functions available.

-> AUTOCAL

PASSWORD

<**UP/DOWN**> If the arrow is not adjacent to the AUTOCAL menu item, use the UP/DOWN keys to move the arrow to the proper position.

<**Enter**> Press <Enter> to activate the function and move you to the next screen.

Here are the autocal parameters (with an example of data). The underlined items are modifiable (but not underlined in the actual display):

```
-> AS:3d 20h
 AUTO SPAN Enabled
 Span in 11 days
 Span in 6 hours
```

Note: For instruction on how to set the parameters, please refer to the Data Entry section.

The first line tells how soon the next automatic span will occur. Pressing <Enter> on this line has no effect.

The second line Enables/Disables the Auto Span. When the Auto Span is enabled, the values in the first line count down to zero, at which time Analysis is aborted and a Span Cycle is started in the Sample Phase (See Theory of Operation).

When the Auto Span is disabled, the countdown is halted, but the Days and Hours remain and will commence countdown if the Auto Span is re-enabled.

The 3rd and 4th lines modify the days and hours until the next Auto Span occurs. When these are changed and <Enter> is pressed, the Auto Span is re-set to occur according to the number of Days/Hours set. The first line will reflect the new count down.

4.4.15 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. Refer to the *Addendum and Testing Results* section of Appendix B for the specific timing settings used for your system and application. These values are based on extensive testing at the factory for your application, **do not change these values** unless directed by Customer Service at TAI. For further information please contact TAI Customer Service.

4.4.16 Group Setup

Group Setup assigns to each compound a name, a range given in Range settings and an associated peak window that is determined in Timing settings. These values should not be modified unless directed by TAI customer Service.

4.4.17 Detector

The factory default setting should be on “TCD”. If, for any reason, the analyzer keeps asking for “Flame Ignition” during a fresh start, one needs to press the left arrow key on front panel and select “TCD” in the Detector option.

4.4.18 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.

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 UP/DOWN KEY.

<**UP/DOWN** >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.

ENTER PASSWORD SCREEN

Enter a Password

'T' 'A' 'I'

<**UP/DOWN** >Use the UP/DOWN 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 4060TCD now allows access to all the SUBMENU items.

The 4060TCD next presents the CHANGE PASSWORD screen.

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.

ENTER NEW PASSWORD SCREEN

Enter a new Password

'T' 'A' 'I'

<**UP/DOWN** >Use the UP/DOWN 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.

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.

<**UP/DOWN** >Use the UP/DOWN 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 4060TCD 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.*

4.4.19 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:

<**UP/DOWN** >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 .

4.4.20 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:

<**UP/DOWN** >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.

Appendix

A.1 Specifications and Initial Settings:

Range(s):	Refer to Addendum and Testing Results in Appendix B.
Power Requirements:	Refer to Addendum and Testing Results in Appendix B.
Signal Output:	Two analog channels: Channel 1: 0-1 VDC and isolated 4-20 mADC Channel 2: 0-1 VDC and isolated 4-20 mADC User configurable as: Purity or concentration measurement of permanent gas or other gases.
Alarms:	Two Concentration Alarm ‘C’ Type relay contacts. User configurable. One System Alarm for AC power failure, fail safe, ‘C’ type relay contacts.
Calibration Contact:	Calibration Contact, ‘A’ Type Relay contact for span mode indication.
RS-232 Output:	Provided
Ambient Temp:	0 – 40º C. Install in a well ventilated area

A.2 Recommended Spare Parts List

Qty.	P/N	Description
1	C82893	PC board, Electrometer-amplifier
1	C75825A	Micro-processor PC board
1	B82773	TCD Sensor assembly
1	C62371A	Display PCB Assy.
1	B74674A	Interface to Motherboard PCB Assy.
1	C65507A	Back panel/Power Supply PCB Assy.
5	F10	Fuse, 2A (220V uses F9)
1	V1078	10 Port Switching Valve
1	P1604	Power Supply for the 10 port switching valve
1	CP2408	PID Temperature controller

A minimum charge of US $150.00 is applicable to spare parts orders.

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

16830 Chestnut Street
City of Industry, CA 91749-1580

Telephone: (626) 934-1500
Fax: (626) 961-2538

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

Email: ask_tai@teledyne.com

A.3 Drawing List

(Refer to the *Addendum and Testing Results* section of Appendix B for actual drawing list for your application.)

D-82770	Outline Diagram
D-83119	Wiring Diagram
C-82772	Piping Diagram
B-74678	Schematic, Electrometer PCB
D-65506	Schematic, Back Panel/Power Supply PCB
B82773	Assembly, TCD Sensor

PC Board Assemblies

C-82893	PCB Assy, Electrometer
C-75825A	PCB Microprocessor
C-65507A	PCB Power Supply

Appendix B

B1 Addendum and Testing Results

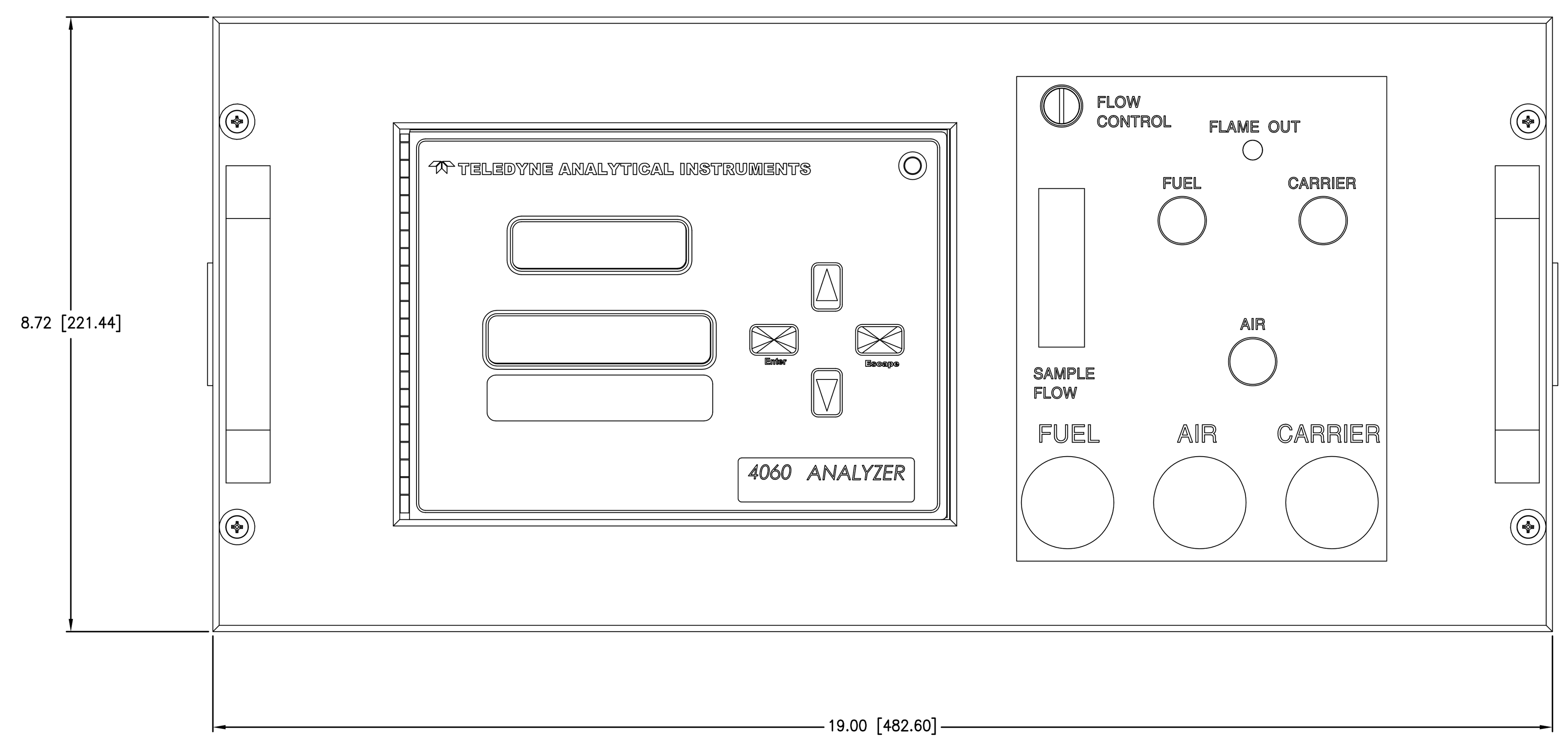
NOTES: UNLESS OTHERWISE SPECIFIED.

1. ELECTRICAL CONNECTION:
   STANDARD: 110 VAC, 50/60 Hz, 6 AMP. MAX
   FUSE USED: 250 V, 1 A, TYPE T
   OPTIONAL: 220 VAC, 50/60 Hz, 6 AMP MAX
   FUSE USED: 250 V, 1 A, TYPE T
2. GAS CONNECTIONS:
   1/8" TUBE FITTINGS: AIR INLET, FUEL, CARRIER IN.
   1/4" TUBE FITTING: SENSOR VENT, SAMPLE IN, SAMPLE VENT
3. INPUT/OUTPUT DATA CONNECTIONS:
   RS 232: 9 PIN DSUB CONNECTOR
   CONTROL DATA: 50 PIN DSUB CONNECTOR
4. ALL DIMENSIONS ARE IN INCHES [MILLIMETER]

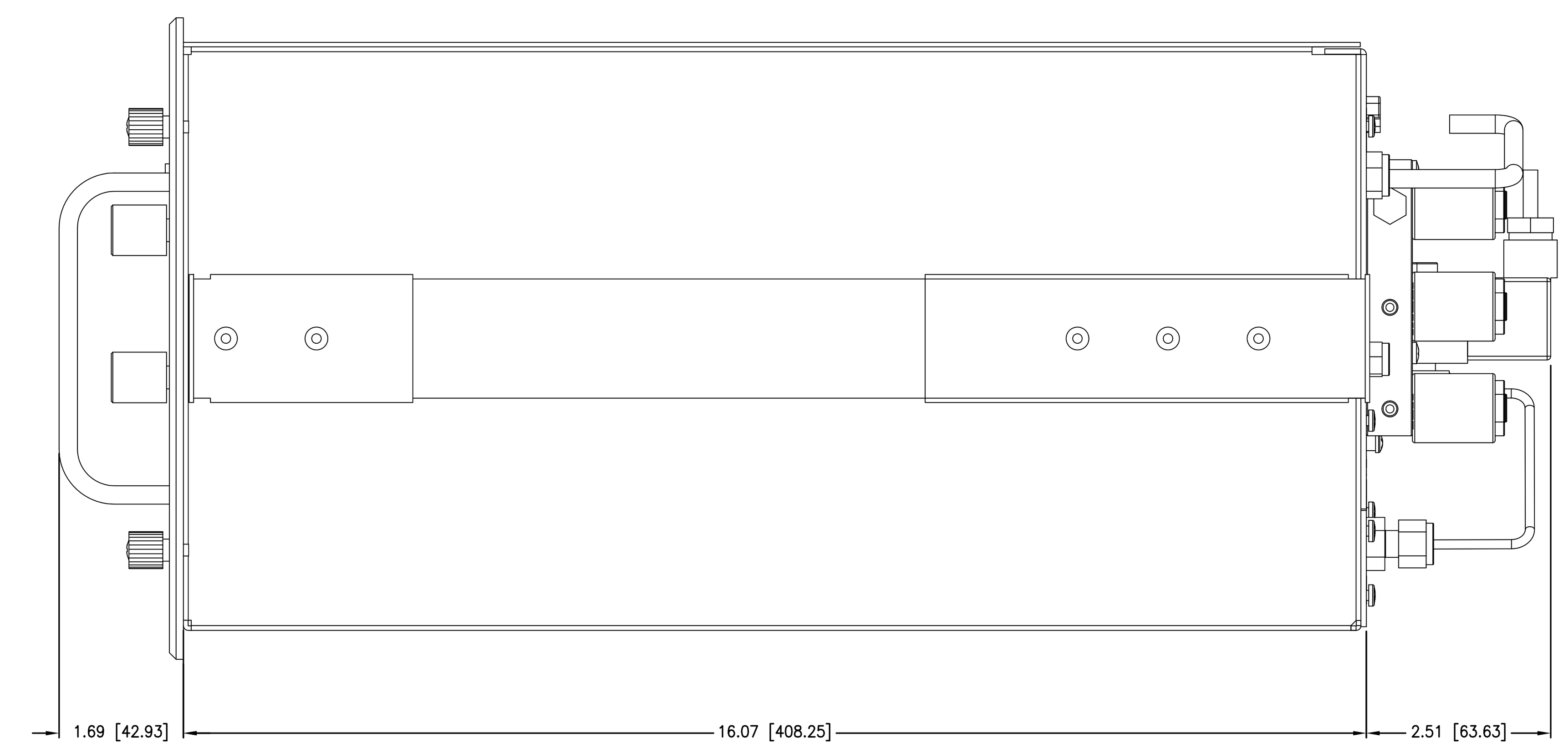
5. AUTO CAL MANIFOLD: OPTIONAL FEATURE

REVISIONS

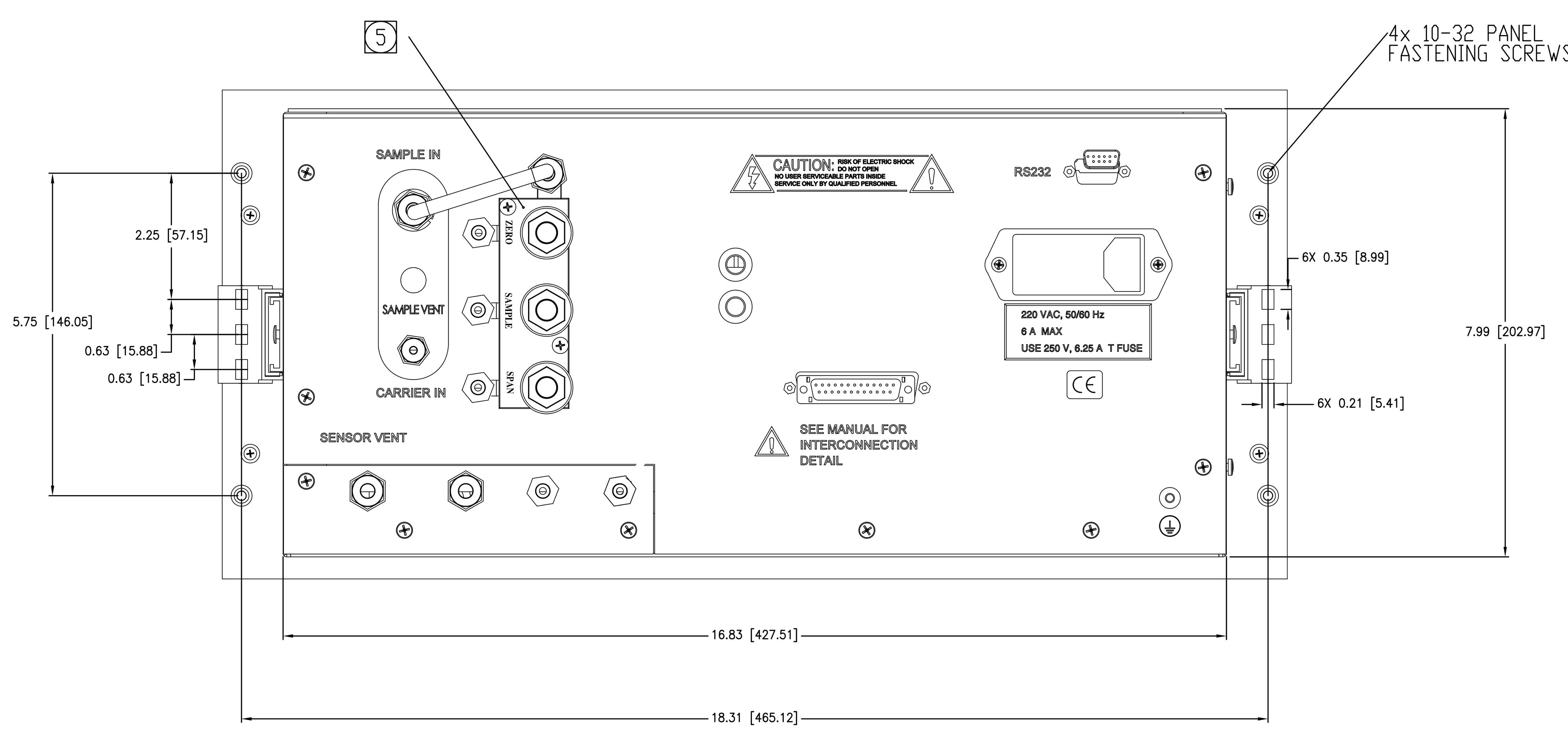
REV	DESCRIPTION	DATE	APP.	REV. BY
0	INITIAL RELEASE	05/04/09	KN	--
1	REVISE TAG WAS 4040 IS 4060	09/23/09	E.Y	J.A



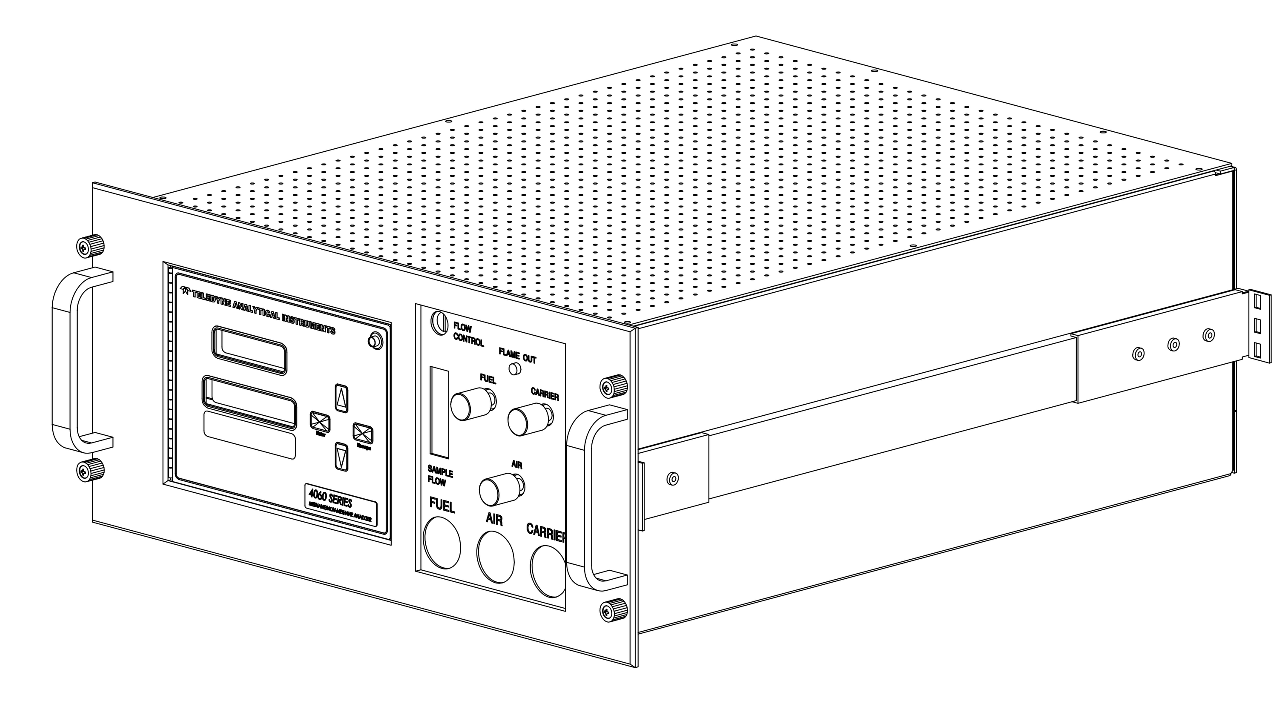
FRONT VIEW



SIDE VIEW



REAR VIEW

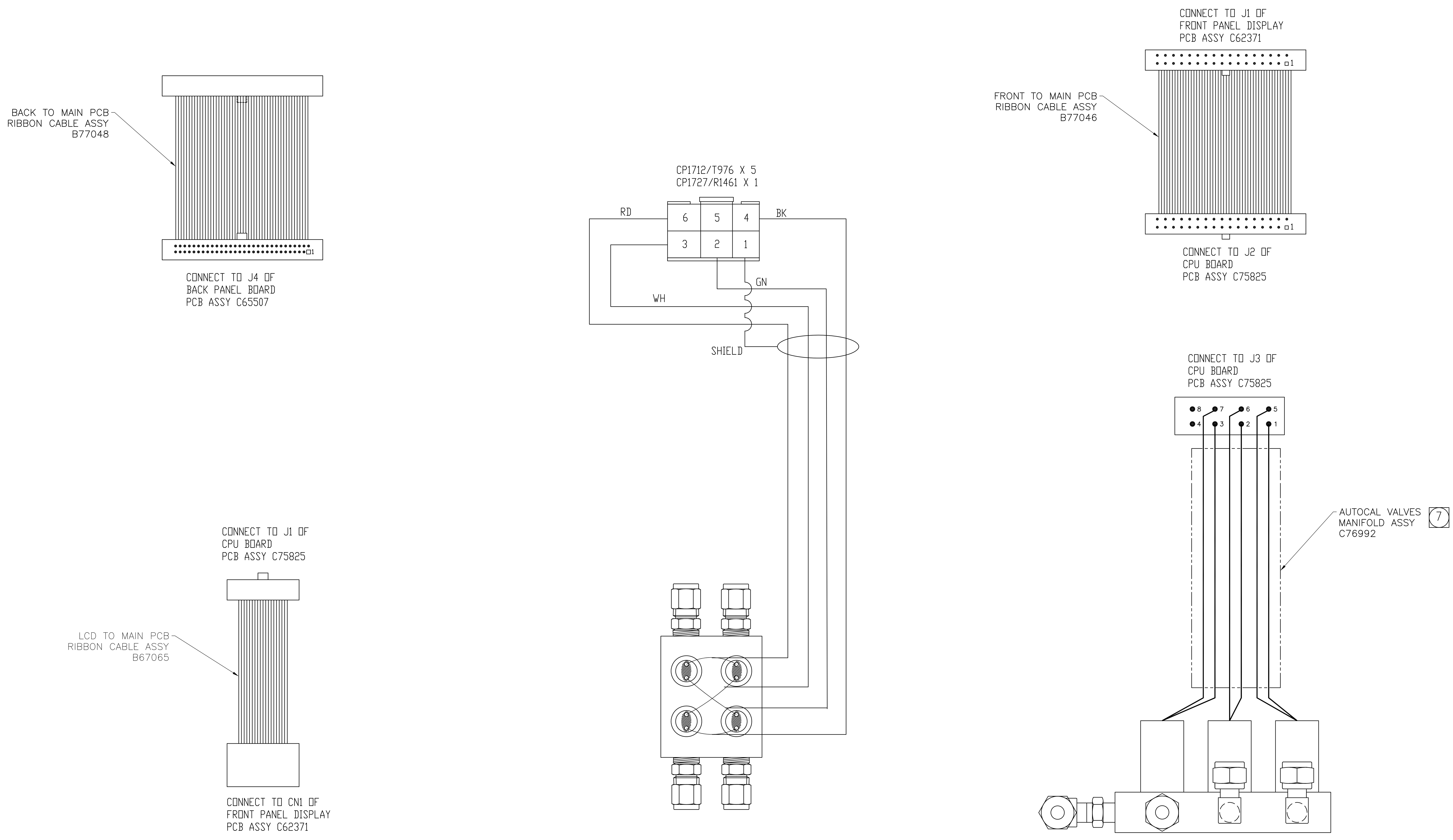


DO NOT SCALE DWG	THIS DRAWING IS THE PROPERTY OF TELEDYNE ANALYTICAL INSTRUMENTS AND CONTAINS CONFIDENTIAL INFORMATION. IT IS NOT TO BE COPIED, REPRODUCED OR USED WITHOUT WRITTEN PERMISSION.
TOLERANCE UNLESS OTHERWISE SPECIFIED: ANGULAR ±1/2° LINEAR .X = ± .XX = ± .XXX = ±	TELEDYNE INSTRUMENTS Analytical Instruments A Teledyne Technologies Company City of Industry, California, 91748, USA

	SIGNATURES	DATE	TITLE	
N/	DRFT: KIET NGO	05/04/09	OUTLINE DIAGRAM MODEL 4060TCD/GC	SCALE 1:2
I/	CHK:			SIM D77394
O/	APPR:			SHEET 1 OF 1
P/ C82772	ENGR: KIET NGO			
F/ D82787	C.O.: 119741		MATL. DWG NO. D-82770	REV 1
REFERENCE	CAD ID D82770-1			

NOTES: UNLESS OTHERWISE SPECIFIED.

REVISIONS				
REV	DESCRIPTION	DATE	APP.	REV. BY
0	INITIAL RELEASE	08/24/09	KN	--
1	REVISED PER REDLINE	04/22/10	KN	JA
2	REVISED TO ADD T1662 (3) FEATURE	01/19/11	RF	RF
3	ADDED CP1727/CP1712 FOR DIFF. OPTION	03/17/11	KN	KN
4	UPDATE WIRING FOR PID FROM SD TO PM	11/06/12	RF	RF



(7.) AUTOCAL MANIFOLD SUBASSY C76992 IS AN OPTIONAL FEATURE.

ITEM	QTY	PART NO.	DESCRIPTION

BILL OF MATERIAL

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TOLERANCE UNLESS OTHERWISE SPECIFIED: ANGULAR ±1/2°
LINEAR .X = ±.1, .XX = ±.02, .XXX = ±.010

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	SIGNATURES	DATE
N/	DRFT: KIET NGO	08/24/09
I/	CHK:	
O/	APPR:	
P/	ENGR: KIET NGO	
F/	C.O. 119741	
REFERENCE	CAD ID D83119-4	

TITLE: MODEL 4060TCD ANALYZER, WIRING DIAGRAM

SCALE: NONE
SIM: D82542
SHEET: 1 OF 2
MATL.: -- --
DWG NO.: D-83119
REV: 4

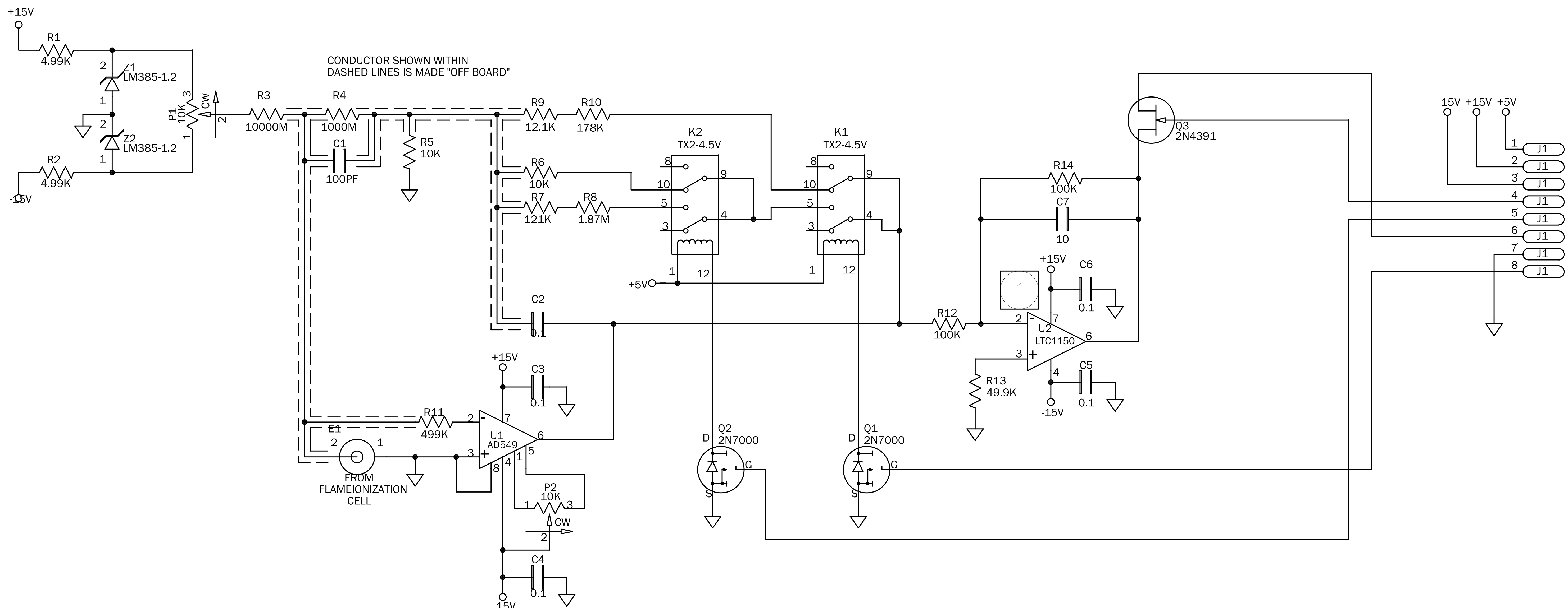

REVISIONS
SEE SHEET 1
CONNECTOR CABLE ASSY
A82667
24 VOLT
POWER SUPPLY
P1478
P1604
V1078
RD
BK
ACTUATOR
J10
CPU BOARD PCB ASSY
C75825
E1
E2
BL
BN
*BK
*BK
*BL
*BN
CP 1332
3X CP 1334
GN/YL
BOTTOM
VIEW
(P540)
C76997
TERM BLK
TB-1
(3X T1413)
TOP
BOTTOM
TERM BLK
TB-2
(3X T1413)
POWER INLET MODULE
C 76997
WIRE NUTS
74B
PID 1
(CP 2408)
TOP
PID 2
(CP 2408)
MIDDLE
PID 3
(CP 2408)
BOTTOM
YEL
(+)
RED
(-)
OUTPUT 2
R1
S1
L2
K2
98
99
WH
R1459
T976-4X
110 V
220 V
REAR VIEW OF CONNECTOR
P625
T977-2X
R1462
T976-2X
RELAY 2
(R 2839)
SSR
T/C 1
(T 1403)
T/C 2
(T 1403)
T/C 3
(T 1403)
(T1662)
P622
T977-4X
H-3
(H 722)
H-4
(H 722)
TCD SENSOR BOX
H-1
(H 2)
H-2
(H 2)
SAMPLE CHAMBER BOX
H-3
(H 598)
H-4
(H 598)
COLUMN BOX
WIRE HEATER ASSY
A77587
OLD SD SERIES
PID 1 - PID 3
CONNECTIONS
DETAIL "A"
7. REF. FOR OLD SD TYPE PID CONTROLLER.
SEE DETAIL 'A' FOR CONNECTIONS
6. TOP AND BOTTOM TERMINALS INSTALL SHORTING BRIDGE T1414
3-POSITION EACH.
5. ALL WIRES #22 AWG, EXCEPT THOSE WITH * USE #18 AWG.
4. CONNECT TO J2 OF C65507 (BACK PANEL BOARD PCB ASSY)
3. CONNECT TO J1 OF B74671 (IGNITION/PSI COMP BOARD PCB ASSY)
2. REF. DETAIL 'A;' FOR OLD SD TYPE PID CONTROLLER (SD TYPE) CONNECTIONS.
1. WITH A BLACK PERMANENT MARKER, DRAW A LINE ON TOP OF CONNECTOR
NOTES: UNLESS OTHERWISE SPECIFIED:
SHEET 2 OF 2
DWG NO. D-83119
REV 4

NOTES: UNLESS OTHERWISE SPECIFIED.

(1) U2 CAN BE SUB FOR 430MAX

REVISIONS

REV	DESCRIPTION	DATE	APP.	REV. BY
0	INC ECO 04-0050	1/26/06	RLM	--
1	INC ECO 12-0087	5/31/12	AA	VF



ITEM	QTY	PART No.	DESCRIPTION

BILL OF MATERIAL

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCE:
ANGULAR ±1/2° LINEAR .X = ±.1, .XX = ±.02, .XXX = ±.010

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City of Industry, California 91748, USA

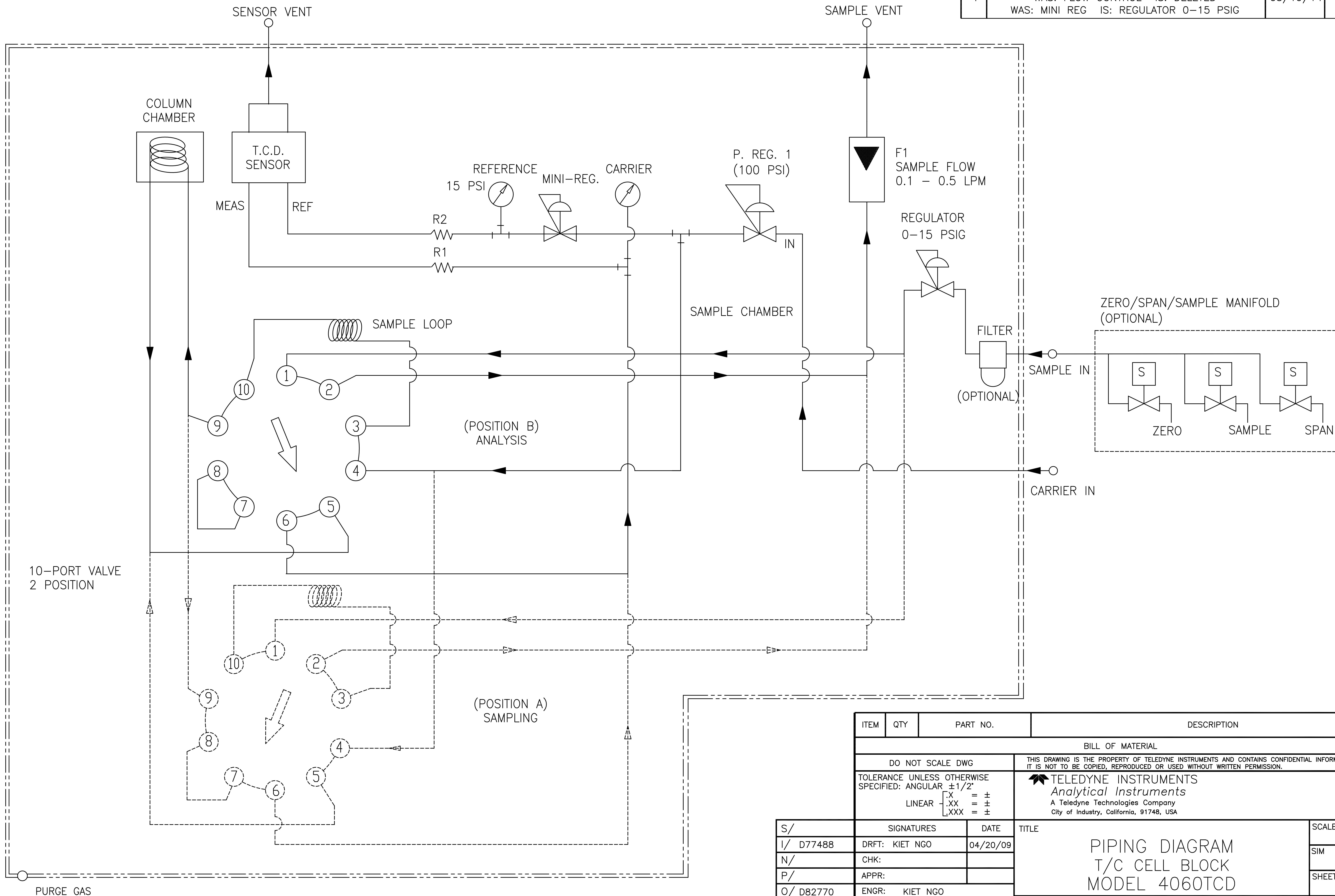
REFERENCE	SIGNATURES	DATE
S/		
N/	DRFT: R. MILVERSTED	7/22/03
I/	CHK:	
P/	APPR:	
O/	ENGR: QUYEN DANG	
F/	C.O.:	
REFERENCE	CAD I.D. B74678-0	

TITLE: SCHEMATIC DIAGRAM ELECTROMETER BOARD MODEL 4020

SCALE N/A
SIM NONE
SHEET 1 OF 1
MATL. N/A
DWG NO. B- 74678
REV 1

NOTES: UNLESS OTHERWISE SPECIFIED.

REVISIONS				
REV	DESCRIPTION	DATE	APP.	REV. BY
0	INITIAL RELEASE	04/20/09	KN	--
1	MOVED MINI-REGULATOR	09/03/09	EY	QD
2	ADDED MINI-REGULATOR BEFORE FLOW CONTROLLER	09/17/09	EY	QD
3	REVISE PIPING	07/03/12	KN	KN
4	WAS: FLOW CONTROL IS: DELETED WAS: MINI REG IS: REGULATOR 0-15 PSIG	05/19/14	PH	VM



ITEM	QTY	PART NO.	DESCRIPTION
BILL OF MATERIAL			

DO NOT SCALE DWG

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

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Analytical Instruments
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REFERENCE	SIGNATURES		DATE
S/			
I/ D77488	DRFT:	KIET NGO	04/20/09
N/	CHK:		
P/	APPR:		
O/ D82770	ENGR:	KIET NGO	
F/ D82771	C.O.	119741	
	CAD ID	C82772-4	

TITLE: PIPING DIAGRAM
T/C CELL BLOCK
MODEL 4060TCD

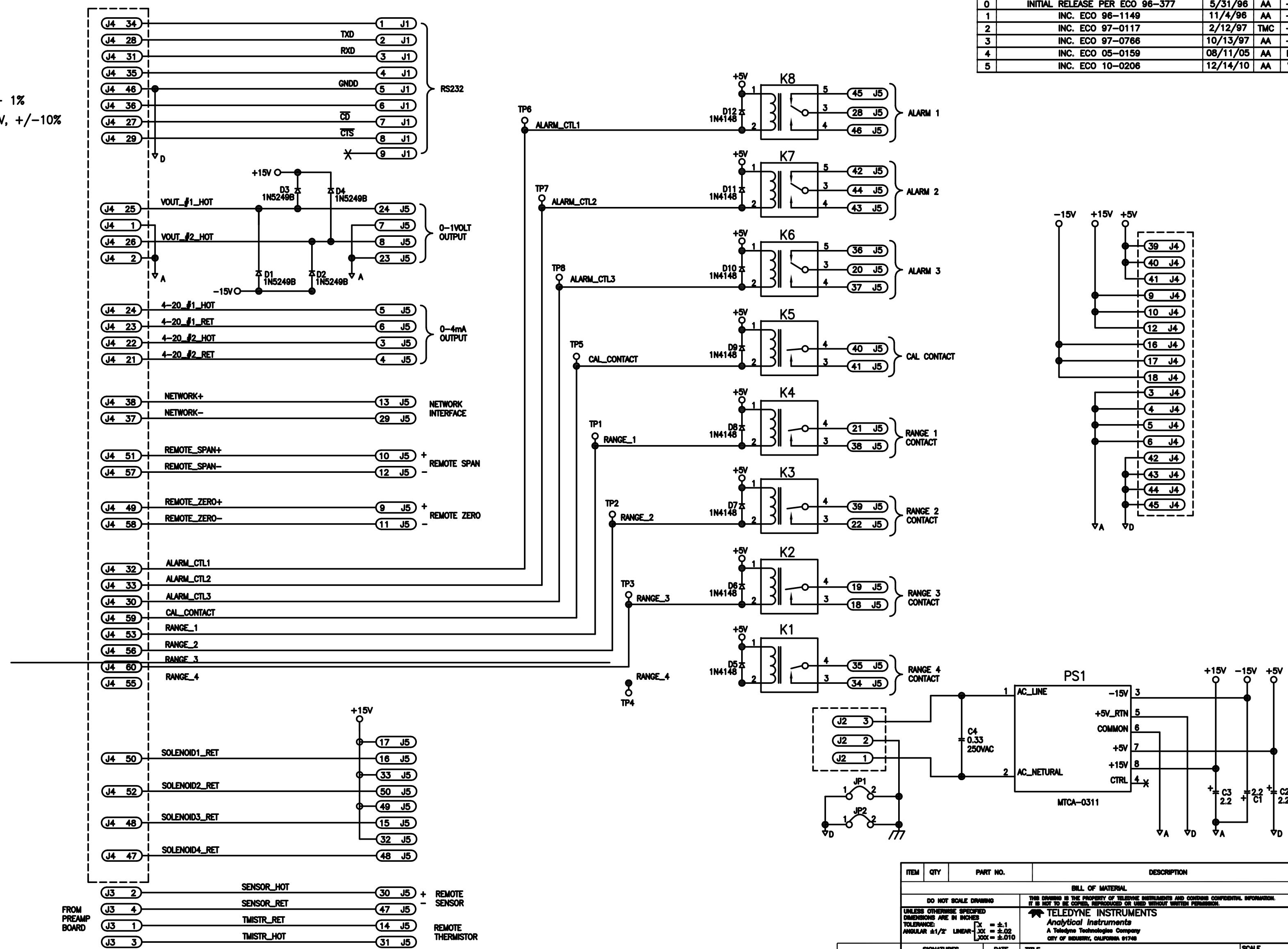
SCALE: NONE
SIM: C76068
SHEET: 1 OF 1
MATL.: NONE
DWG NO.: C- 82772
REV: 4

NOTES: UNLESS OTHERWISE SPECIFIED.

1. PREPARED IAW DOCUMENTS LISTED:
   GRAPHIC SYMBOLS: ANSI Y32.2
   REFERENCE DESIGNATORS: ANSI Y32.16
   DEFINITIONS OF ENGR DWGS: ANSI Y14.15
2. FOR ASSEMBLY SEE C65507
3. RESISTANCE VALUES ARE IN OHMS, 1/8W, +/- 1%
4. CAPACITANCE VALUES ARE IN MICROFARADS, 50V, +/-10%

REVISIONS

REV	DESCRIPTION	DATE	APP.	REV. BY
0	INITIAL RELEASE PER ECO 96-377	5/31/96	AA	---
1	INC. ECO 96-1149	11/4/96	AA	---
2	INC. ECO 97-0117	2/12/97	TMC	---
3	INC. ECO 97-0766	10/13/97	AA	---
4	INC. ECO 05-0159	08/11/05	AA	MN
5	INC. ECO 10-0206	12/14/10	AA	VF



ITEM	QTY	PART NO.	DESCRIPTION

BILL OF MATERIAL

DO NOT SCALE DRAWING

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UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCE: ANGULAR ±1/2° LINEAR .X = ±.1, .XX = ±.02, .XXX = ±.010

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

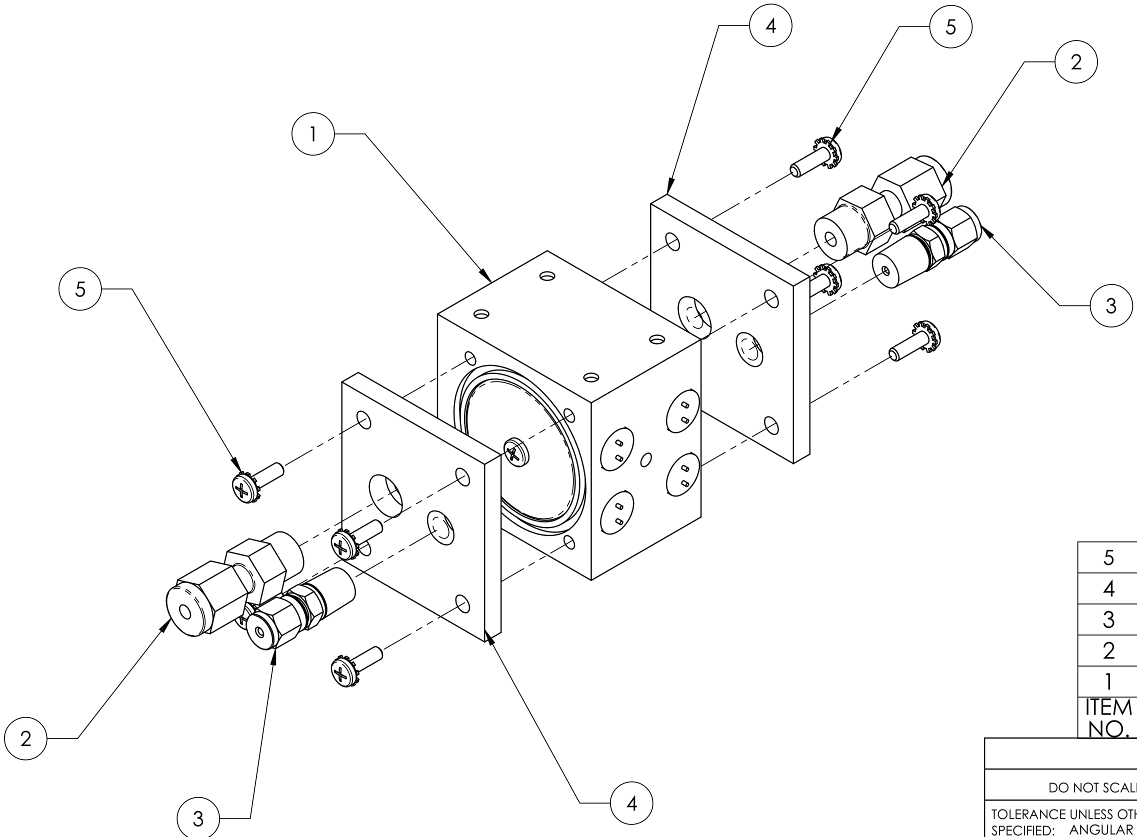
	SIGNATURES	DATE
N/	DRFT: T.MCINTYRE	5/13/96
I/	CHK:	
O/	APPR:	
P/	ENGR:	
F/	C.O.	
REFERENCE	CAD ID D65506-5	

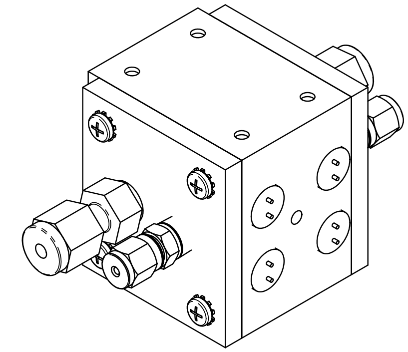
TITLE: SCHEMATIC DIAGRAM MODEL 3000 BACK PANEL BOARD (EURO VERSION)

SCALE: NONE
SIM
SHEET: 1 OF 1
MATL.
DWG NO. D-65506
REV 5

NOTES: UNLESS OTHERWISE SPECIFIED.

REVISIONS				
REV.	DESCRIPTION	DATE	APP.	REV. BY
0	INITIAL RELEASE	04/20/09	KN	--
1	CHANGE ITEM 1 AND 2. ADDED ITEM 4	10/16/2009	KN	JA





ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
5	8	---	SCREW, 4-40 x 0.375LG. BINDER HEAD
4	2	A83290	T/C ANALYZER CELL ASS'Y BLOCK CONNECTOR PLATE DET
3	2	CP2866	CONNECTOR, 1/16T X 1/16NPT
2	2	R598	RESTRICTOR, 30CCM
1	1	A31157	CELL BLOCK SUBASSY T/C ANALYZER MODEL 235, 275

BILL OF MATERIALS

DO NOT SCALE DRAWING

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

Teledyne Analytical Instruments
A business unit of Teledyne Electronic Technologies
CITY OF INDUSTRY, CALIFORNIA 91748

	SIGNATURES	DATE
S/	DRFT: KIET NGO	4/20/2009
I/	CHK:	
P/	APPR:	
O/	ENGR: KIET NGO	
F/	S.O.:	
REFERENCE	CAD I.D. B82773-1	

TITLE: CELL BLOCK ASSEMBLY T/C CELL MODEL 4060TCD

SCALE 1 : 1
SIM
SHEET 1 OF 1

MATL. AS NOTED

DWG NO. B82773

REV 1