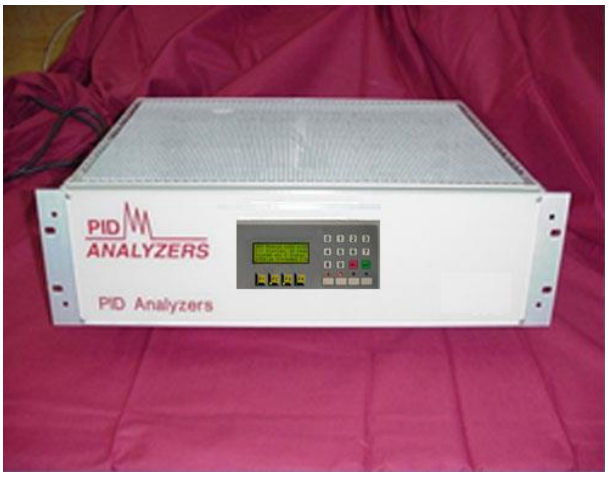
Model 201-C
CONTINUOUS GAS MONITOR
PID or FID Models
December 2013

201 C Wall Mount



201 C 19" Rack Mount

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PART #: 81 -MN2010513

PID ANALYZERS

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OPERATIONAL WARNINGS

WARNINGS

Turn power OFF and allow equipment to cool before any disassembly or servicing. When inspecting the equipment with the power "ON", use extreme care. High voltage levels up to 1200 V DC can be present and the temperature of the detector can be up to 80°C.

Do not observe the lamp without proper eye protection. If the lamp Is removed from the Ion chamber and operated separately, do not observe the lamp window closer than 6 Inches. When necessary, observe only briefly. Continued exposure to ultraviolet energy may be harmful to the eyesight.

Exercise great care during disassembly and reassembly of the detector. Accidental dropping can cause serious damage to the lamp or ion chamber. Protect the assembly at all times to prevent an inadvertent fall.

Safely vent all exhaust outlets. The instrument is non-destructive and toxic or hazardous gases are unchanged by the instrument.

Do not pressurize vent lines. This can lead to measurement errors. All vents should be separate and open directly to atmosphere or connected separately to a 3 inch ID venting conduit, spaced at least 1 to 1 1/2 feet apart.

Be careful when working with flammable gas samples to stay below the Lower Explosive Limit (LEL). For hazardous or toxic gases, stay below the Threshold Limit Value (TLV) if the gases are not vented outside or adsorbed on a charcoal tube or absorber.

SECTION I: GENERAL

1.1 INTRODUCTION

This manual describes the Installation, operation, maintenance and parts list for the Model 201-B Continuous Gas Monitor. This Manual contains the instructions for both the photoionization detector (PID) and flame ionization detector (FID) versions. These instruments, the Model 201-B PID & FID comply with the Year 2000 Conformity Requirements as defined in document DISC PD 2000-1 of the British Standards Institution. All the components in the 201 operate on 12 VDC from by the power supply.

1.2 GENERAL INFORMATION

The Continuous Gas Monitor measures the concentration of a wide variety of gases in ambient air, process streams, industrial environments and related atmospheres. Typical examples are measurements of:

a. Aliphatic and aromatic hydrocarbons at the exhaust of carbon beds, stacks, processes

b. CS_2 plus H_2S, NH_3, PH_3, I_2 and other inorganic compounds can be **detected by the PID only**

- Benzene, ketones and chlorinated hydrocarbons in industrial atmospheres.
- Solvent vapors (chlorinated hydrocarbons) from degreasers, paint spraying operation and various paper and metal coating processes.
- Hydrocarbons in Kraft paper mill stacks gases, oil drilling rigs and ambient field studies.
- Amine leaks in ambient or process

1.4 New Features in the Model 201C

- 4 line x 20 character backlit LCD display
- 4 Analog to digital converters- up to 4 sensors can be added instead of two
- Inputs from other sensors (like flow) can be added to produce a total emissions analyzer
- Up to three ranges now 0-100, 0-1,000, 0-5,000 ppm all of which are linear
- 12 character keyboard
- 4 function keys for programming
- RS232 & RS485 are standard items
- Direct internet connection
- Digital inputs/outputs increased to 16Alarms
- LEDs for indicating modes
- Summary on the 4 LED indicators when they are ON:
- F4-LED indicates that the automatic saving the data is active;
- LED1 shows Cooler pump ON;
- LED2 shows that autozero is in progress;
- LED3 shows the sample pump ON;
- LED4 indicates the gain position
- *Optional* internal storage of Data for more than 1 year of continuous operation-data stored in ASCII format for direct importing into EXCEL

- Optional Peltier cooler can be added to remove moisture
- 19" Rack Mount or optional NEMA 4 enclosure
- Optional Z purge to meet Class 1 Div. II standards
- Optional Temperature control: heating/cooling for outdoor installations

The Model 201-C PID monitor employs the principle of photoionization for detection. Photons from an ultraviolet lamp are absorbed by molecules which then become ions if the energy of the photon is greater than the ionization potential of the molecule. The positively charged ions formed are driven by a positive accelerating voltage, to the collection electrode where the current is measured. The current is directly proportional to concentration and is displayed on the digital meter.

The Model 201-C FID monitor employs the principle of flame ionization for detection. The sample is burned in a hydrogen-air flame that produces ions from carbon containing compounds only. The positively charged carbon ions are driven by a positive accelerating voltage to the collection electrode (located just above the flame jet) where the current is measured. The current is directly proportional to concentration and is displayed on the digital meter.

The monitor consists of two portions: the fluidics and the electronics. The function of, the fluidics is to convey the gas sample through the monitor to the detector and to exhaust the gas. The function of the electronics system is to control the detector, determine and display the concentration present in the sample, and to make it available for a data acquisition system, PLC or process computer.

The 201-C will measure a single sample gas Input. It has an optional two point sample system or an 8, 12, 16, 24 or 32 sample system.

The monitor is available In two configurations: an enclosed rack Model (201-001) and a wall mount unit. The components and functions are similar in all 201 Models. Specification data is given in Table 1-1.

In this manual, the fluidics system along with its parts list is described in Section 2, the electronics system and its operating instructions are given In Section 4, maintenance instructions in Section 5, calibration procedure is described in Section 6, and troubleshooting information in Section 7.

TABLE 1-1

Model 201-C Specifications

Species measured: VOC's

Detector: **PID or FID**

Performance: Isobutylene referred (PID or FID)

Electrical classification: General purpose

Display: The output is a backlit 16 character by 4 line LCD display with an attached keyboard

Response time: 3 sec. to 90% response PID; 5 sec. To 90% for FID or TCD

Sample flow rate: >1 LPM

Zero drift: <1% over 24 hours

Span drift: <1% over 24 hours; 24 Hour autocal; Remote cal

Range: 0.1 to 5,000 ppm/1 to 50,000-PID or FID; Readout: Digital- 5 digits

Power requirements: 100V, 115V, 220V, 240V; 50/60 Hz

Dimensions:

Enclosed rack: 19" W x 11"H x 23"D

Weight: 15/18 pounds (PID/FID

Wall- 23"W x 21"H x 10"D

Weight: 40 pounds

Power consumption: 200 watts maximum

Instrument operating conditions: 5-40 ^{o}C, 0-95% RH (non-condensing)

Outputs: 0-1V RS232, RS485 output/ internet connection

Options

- Two Models: 19" Enclosed rack unit; NEMA 4 Wall mounted unit
- Multiple sensors or channels
- Z purged unit meets class I division II NEC requirements- wall mount only
- Isolated 4-20 ma output
- Alarms
- Datalogger- stores> one year of information (time & date stamped) on a memory stick in comma delimited format for easy import into Excel.

Multipoint sequencer- sequential sampling systems are available for area monitoring for 2 & 4+ or up to 20 channels-additional information available on request. For additional information, contact your local PID Analyzers LLC Office.

Features:

- Lamp out/ FID out; Autocal/24 Hour cal
- Four setpoints; Autodial on alarm

SECTION 2: FLUIDICS SYSTEM

2.1 SYSTEM DESCRIPTION

The sample from the inlet flows first through an instrument filter that removes particulate matter from the stream. A diaphragm pump draws the sample from the filter. The output from the pump is divided. A small amount flows through a restrictor to the detector. There the sample is exposed to photons from an ultraviolet lamp causing the gas to be ionized (see section 3.1). After passing through the detector (**PID or FID**), the gas is vented through an outlet. The remainder of the sample output from the pump is exhausted through a bypass to a separate outlet (see Figures 2-1, 2- or 2-2).

2.2 COMPONENTS

The components of the fluidics system are listed below. All components are made of stainless steel or coated with inert materials.

a. Filter:	A filter containing a disposable fluorocarbon coated microfiber filter tube cartridge to remove fine particulate, 0.6 microns or greater, from the sample. This is an instrument filter and it should be preceded by coarse (10-20 microns) prefilter in the sample line inlet where the particulate loading in the sample may be moderate to high.
b. Pump	A diaphragm pump with a capacity of up to 3-4 liters/minute to pump the sample through the system. Typical system flow is about 3 liters/minute.
c. PID Detector	PID Analyzers Photolonization detector to measure the amount of trace gas contained in the sample. The detector consists of a heated base, an ultraviolet lamp, and. An inert coated ion chamber. Flow rate through the detector is about 100 cc/min.
d. FID Detector	PID Analyzers FID Detector responds to the concentration of hydrocarbons in the sample. The detector consists of a heated base and an FID. Flow rate through the detector is about 300 cc/min air & 80-100 cc/min of hydrogen.
d. Restrictor	Limits the flow of sample through the detector to about 150cc/min.
e. By-pass	Exhausts excess sample from the system
f. Multipoint	1. The sequencer can operate on a timing basis or 2. For carbon beds, it can use an alarm level to switch to a second bed 10 seconds after an alarm level is exceeded (see Appendix for a more complete description

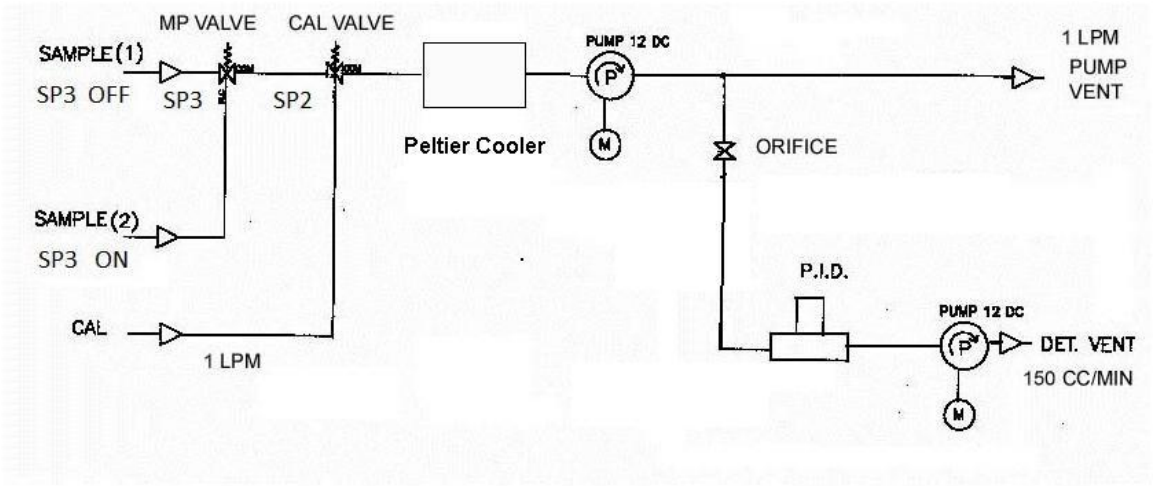


Fig. 2-1 Model 201C PID with Peltier Cooler Flow Schematics

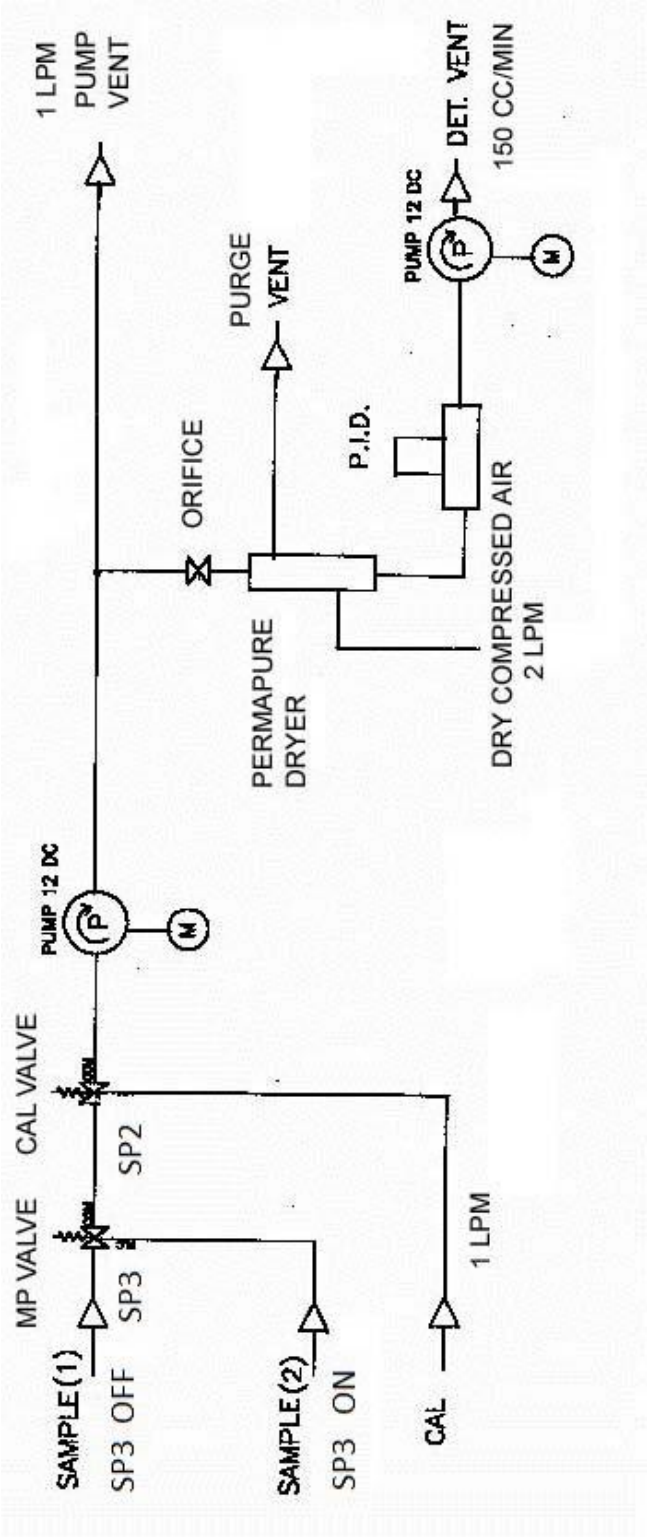


Fig. 2-2 Model 201C PID with Permapure Drier Flow Schematics

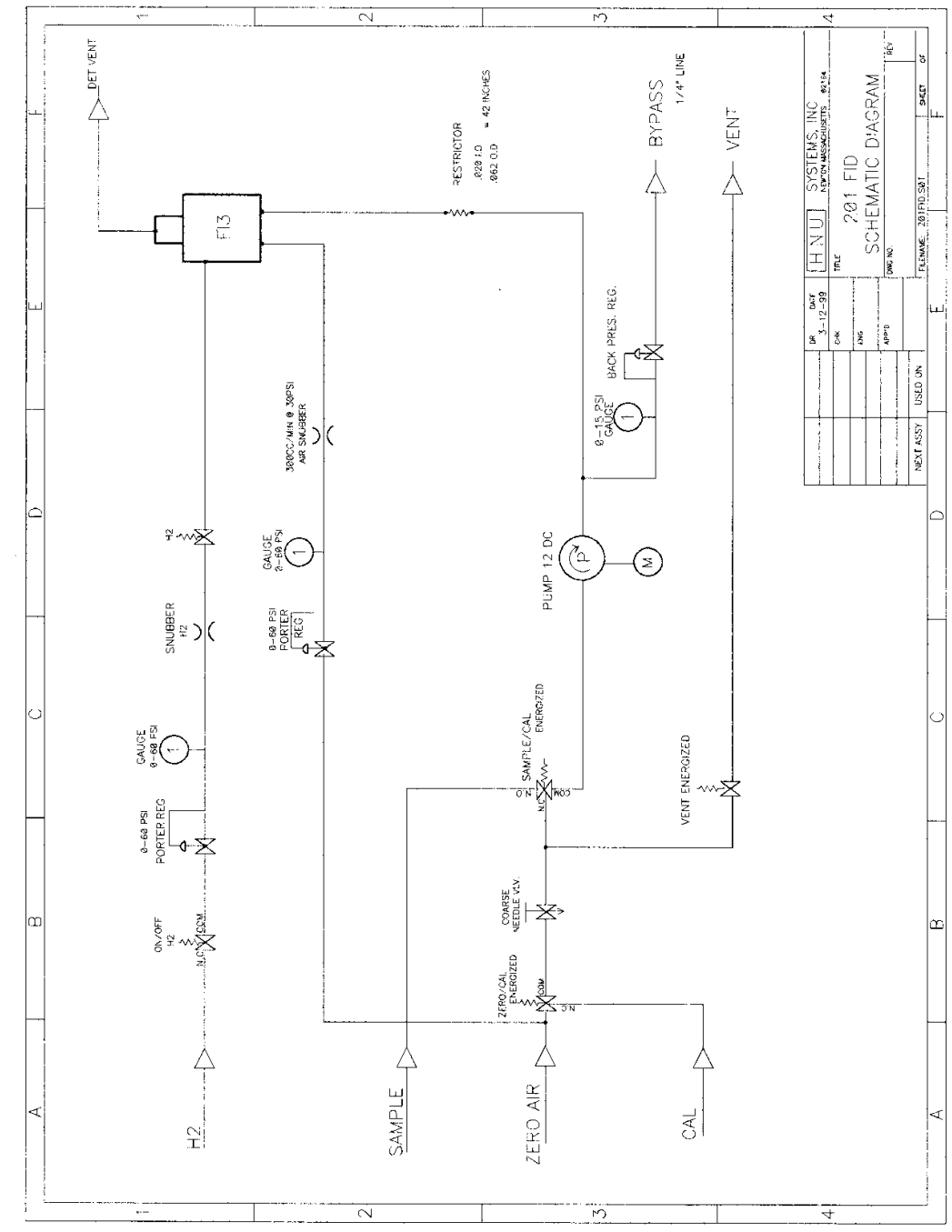


Fig. 2-3 Model 201 C FID Flow Schematic

SECTION 3: THEORY & ELECTRONICS

3.1 THEORY OF OPERATION

a. PID

PID Theory

The concentration of gases present in a sample is measured using the principle of photoionization. This process occurs when a molecule absorbs light of sufficient energy to ionize a molecule as shown in the formula below:

$$RH + h\nu \Rightarrow RH^{+} + e^{-}$$

in which

RH is a molecule of gas

hν photon with an energy greater than or equal to the ionization potential of the molecule RH.

A schematic of the detection process is shown in Figure 3-1. The ultraviolet lamp generates photons that ionize the molecule RH (above) and generates positive ions. An accelerator electrode (positively biased) pushes the ions, to the collector electrode where the current generated (proportional to concentration) is amplified and displayed on the digital meter.

Ionization Potential

The ionization potential of a molecule is that energy in electron volts (eV) required to move an electron an infinite distance from the nucleus, thereby creating a positive ion plus an electron.

The standard lamp in the PI-201 has an energy level of 10.6 eV. An optional lamp has a level of 9.5 eV. As can be seen from the tables, the major components of air i.e., nitrogen, oxygen, carbon dioxide, etc., have ionization potentials ranging from 12.0 to 15.6 and thus will not be ionized. Molecules of gases having potentials less than that of the lamp will be ionized and thus detected in the atmosphere. In some cases, gases having potentials slightly higher than that of the lamp will be ionized. For example, the 10.6 eV lamp will ionize compounds with IP's up to 10.6 eV. Use of the 9.5 eV lamp permits detection of compounds with IP's less than about 9.7 eV in the presence of compounds with ionization potentials greater than 10 eV.

Photolonization Sensitivity

The amount of current that is generated by the ion chamber depends upon the amount of ionizing gas present and upon the sensitivity of that gas to the ionization process. Each gas or compound has its particular sensitivity to ionization and thus the system requires calibration for the compound to be measured. This is accomplished by the adjustment of a control referred to as *a span* setting while measuring a reference sample of the compound.

A list of the photoionization sensitivities of various groups of compounds is given in Table 3-1. For additional PID sensitivities, go to:

http://www.hnu.com/secure/pdf/ips.pdf

TABLE 3-1

RELATIVE PHOTOIONIZATION SENSITIVITIES FOR GASES

Chemical Grouping	Relative Sensitivity
Aromatic-benzene, toluene, styrene	10
Aliphatic Amine- diethylamine	10
Chlorinated Unsaturates- vinyl chloride, vinylidene chloride, trichloroethylene	5-9
Ketones- MEK,MIBK, Acetone	7 - 9
Unsaturated- acrolein, propylene, cyclohexene	3 - 5
Paraffin (C5-C7)- pentane, hexane	1 - 3
Ammonia	0.3
Paraffin (CI-C4) -methane, ethane	0

NOTE: Sensitivity expressed in ppm, Detector equipped with 10.6 eV lamp; system calibrated for benzene.

b. **FID**

Flame ionization is the process of ionization that occurs in organic compounds when the carbon- carbon bond is broken via a thermal process in the flame that results in the formation of carbon ions. These ions are collected in the flame by applying a positive potential to the FID jet and the ions are pushed to the collection electrode where the current is measured. The response (current) is proportional to the concentration and is measured with an electrometer/amplifier. An FID consists of a combustion/ion chamber, a flame, a voltage source for the accelerating electrode (usually applied to the jet) and an amplifier.

The FID is a mass sensitive detector, the output of which is directly proportional to the ratio of the compound's carbon mass to the total compound mass. Thus, the sample is destroyed in the flame. Some characteristics of the FID are as listed in Table 3-2.

Table 3-2
FID Characteristics

Sensitivity increases as the carbon number increases (carbon counter)
Sensitivity to substituted species depends on the mass of carbon present and the ability to break the carbon bonds
The FID is most sensitive to hydrocarbons
Detector is destructive since sample is burned
Requires the use of zero grade (high purity) hydrogen and air to produce the flame

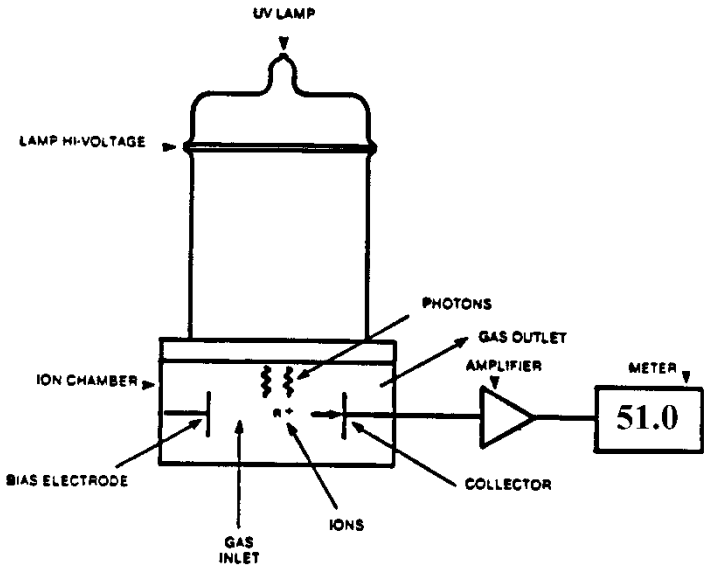
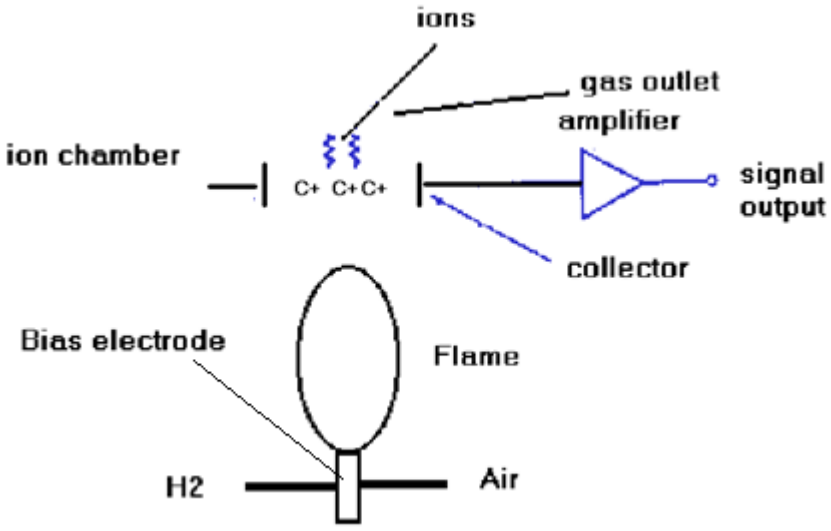


Fig. 3-1 Photoionization Detection Process



Fig, 3-2 Flame ionization Process

As an optional Application Engineering Service (AE-201), the instrument can be calibrated at the factory using a gas mixture that closely matched the sample stream. Prior to ordering this service, customers must submit a Detailed Applications Worksheet and allow additional time for delivery. If this service is ordered, the instrument will be set by PID Analyzers to adjust the output to report directly in concentration units referenced to the custom calibration gas. Unless this option is specified, PID Analyzers will use its best judgment in selecting a calibration gas. Response factors are used primarily to adjust the instrument to read directly on a particular gas.

c. Background Level

A background level will always be measured as a result of trace VOC's in the air or matrix gases or sample lines. Clean air background can vary from 0.2- 2 ppm for the PID and the levels may be higher 1-5 ppm for the FID as a result of ambient methane background.

e. Flow Rate

The instrument is unaffected by variation in the sample flow rate from 0.5 to 6 liters per minute. Only about 100 cc per minute of the sample (bypass) goes through the detector. The rapid flow rate provides a very fast response of 1 second (to 90%) value.

3.2 CONTROLS AND INDICATORS

The controls and indicators for the PID are described below in Table 3-3. Those additional controls for the FID are in Table 3-4.

TABLE 3-3

CONTROLS AND INDICATORS (PID)

COMMAND	Function	Comments
Function Key (**F1**)	SETUP	To set the parameters of the data collection and processing;
Function Key (**F2**)	Next & manual operations	Proceed (Next step) during setup; it is also used to manually switch the cooler into the flush out mode, to manually start autozero, to turn the pump ON/OFF, lamp ON/OFF, and to switch gain.
Function Key (**F3**)	CALIBRATE	Note that **each range requires a separate calibration and has a different calibration factor**
Function Key (**F4**)	DATA	Controls saving data (automatically or manually)
F4-LED		Indicates that the automatic saving the data is active;
LED 1		Indicates that the cooler pump is ON;
LED 2		Indicates that autozero is in progress;
LED 3		Indicates that the sample pump ON
LED 4		Indicates the gain switch is ON.
F2_LED		Indicates the lamp ON/OFF
Hold **0** key and press **F2**	Autozero	Initiate autozeroing sequence. LED2 indicates that the autozeroing in process is active
Hold **2** key and press **F2**	Pump On	Start the Pump.
Hold **3** key and press **F2**	Pump Off	Stop the Pump
Hold **8** key and press **F2**	Max Gain	Switch to high gain (maximum sensitivity (0-1.000 ppm)
Hold **4** key and press **F2**	Min Gain	Switch to low gain (0-5000 ppm)
Hold **6** key and press **F2** key	Lamp on	Turns lamp on
Hold **7** key and press **F2** key	Lamp off	Turns lamp off
Hold **5** key and press **F2** key	Empty cooler reservoir	Turn on the cooler valve to empty the reservoir
Hold **Backspace** key and press **F2** key	Close cooler valve	Return to the normal operation (the cooler valve OFF)
Hold **0** key and press **Enter** key	Set date/time	4 - UP, 8 - DOWN, F2 -NEXT
Hold **0** key and press **Enter** key again	Exit from setting date/time	

TABLE 3-4
CONTROLS AND INDICATORS (FID)

Name	Description
Ignite/ Start flame switch	Use to provide power to the ignition coil, press when starting the FID Turn on flame prior to calibration.
Flame out indicator	The display indicates that the Flame is out. A temperature sensor in the FID is used to determine whether the flame is on. If the FID goes out, the temperature goes down and the hydrogen valve is shut off automatically.
Hydrogen gauge	Pressure of hydrogen feed
Air gauge	Pressure of air feed

3.3 ELECTRONIC SYSTEM DESCRIPTION

The electronic system (Block Diagram, Figure 3-3 below) consists of the following:

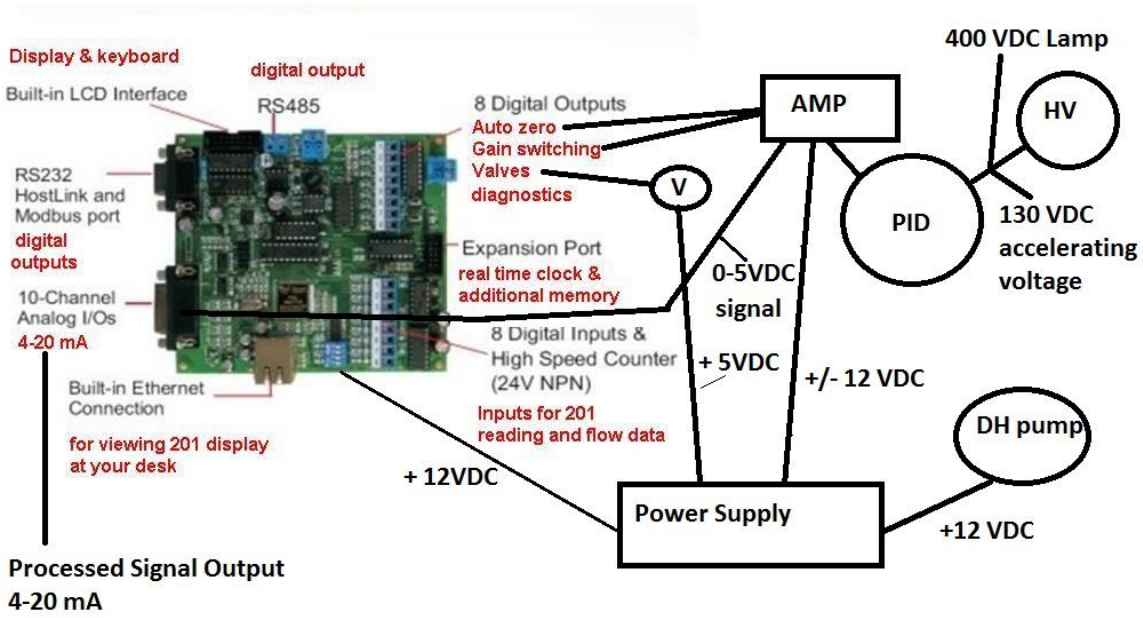


Fig. 3-2 Electronic System Block diagram

Electronic System Description

a. Detector Assembly

For the FID, this consists of an assembly that contains the following: FID base & jet, an igniter coil, a collection electrode, a thermocouple, the chamber block and the heater.

For the PID, this consists of the ultraviolet lamp, the ion chamber, the chamber block and a heater. The lamp in the standard instrument is a 10.6 eV unit. An optional lamp available for specific applications is the 9.5 lamp. The lamp Input voltage is:

Operating -330 to -420 V DC (Nominal -350 VDC)

Start Up -1080 to -1220 V DC (Nominal -1200 VDC)

The ion chamber bias voltage Is +130 V DC. . A collection electrode in the ion chamber prov0ides the output signal from the detector. The detector assembly is the same for both the 10.6 and 9.5 eV lamps.

b. Amplifier

This is a printed circuit board that is shielded from noise in a metal enclosure. The input to the amplifier is from the collection electrode of the ion chamber. The amplifier provides the output signal for the meter, displaying the value as measured in the ion chamber. It provides a 0-1 V output for the digital meter. The software in the meter adjusts the response to direct reading of the gas being measured. There is a low and high sensitivity mode.

c. Programmable Logic Controller-

The PLC in Fig. 3-_ controls all the functions of the Model 201-C . It is mounted on the front panel below the display/keyboard. The meter is also used to generate the automatic calibration, valves, optional 4-20 mA, RS485 and RS232 outputs. The digital outputs are used to control the calibration and sample valves. The PLC contains a Real time Clock.

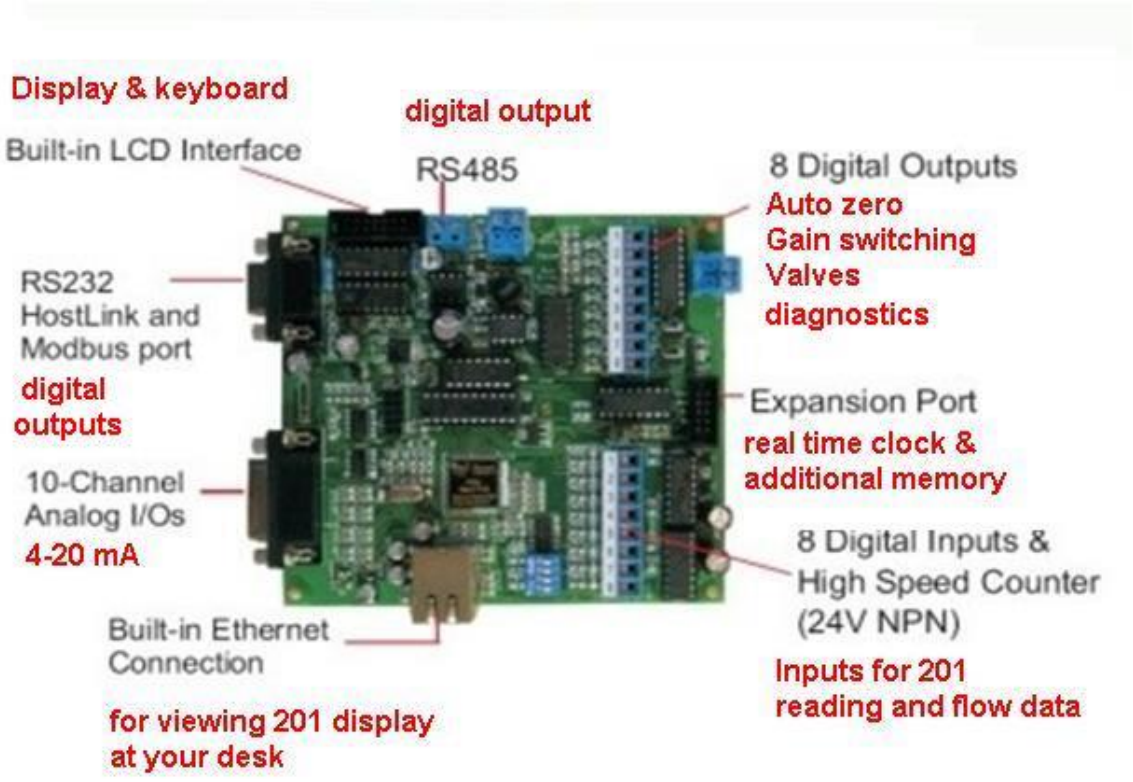


Fig 3-4 PLC for the Model 201-C

d. Display and keyboard- The output is a backlit 16 character by 4 line display with an attached keyboard (shown in Fig. _ below:

Fig. 3-5 201C display/Keyboard

e. Function controls

f. Power Supply (DC voltages)-

F1-
F2-
F3-
F4-
-backspace
-enter

A power supply supplies multiple DC voltages +/- 12 VDC to power the pump (+12VDC), valves (+12VDC), amplifier (+/- 12VDC) and the meter (+12VDC).

g. Flame out circuit thermocouple/chip & meter software (**FID only**)

h. Data acquisition module (Optional) operates off the RS232 output to collect & store up to 1 year of data. The data is stored on an 8 GByte memory stick as daily comma delimited ASCII files. These can be imported directly into Excel on ant PC.

The location of various components is shown in the photo in Fig. 3-7 below.

Fig. 3-6 PID System Wiring Diagram

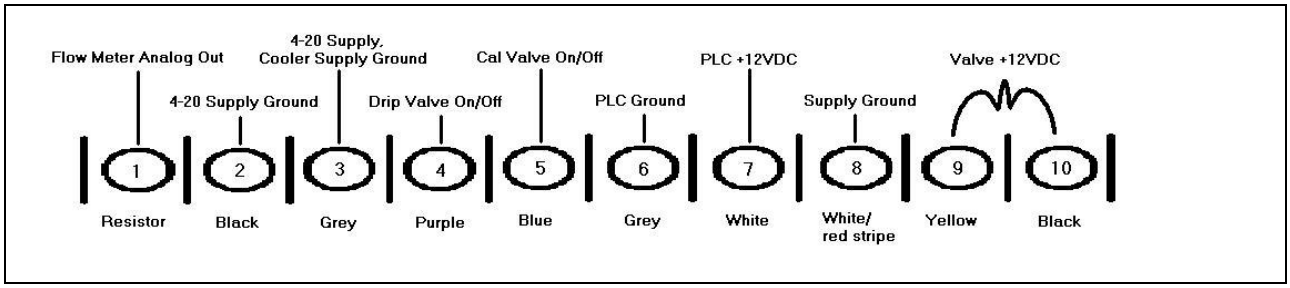
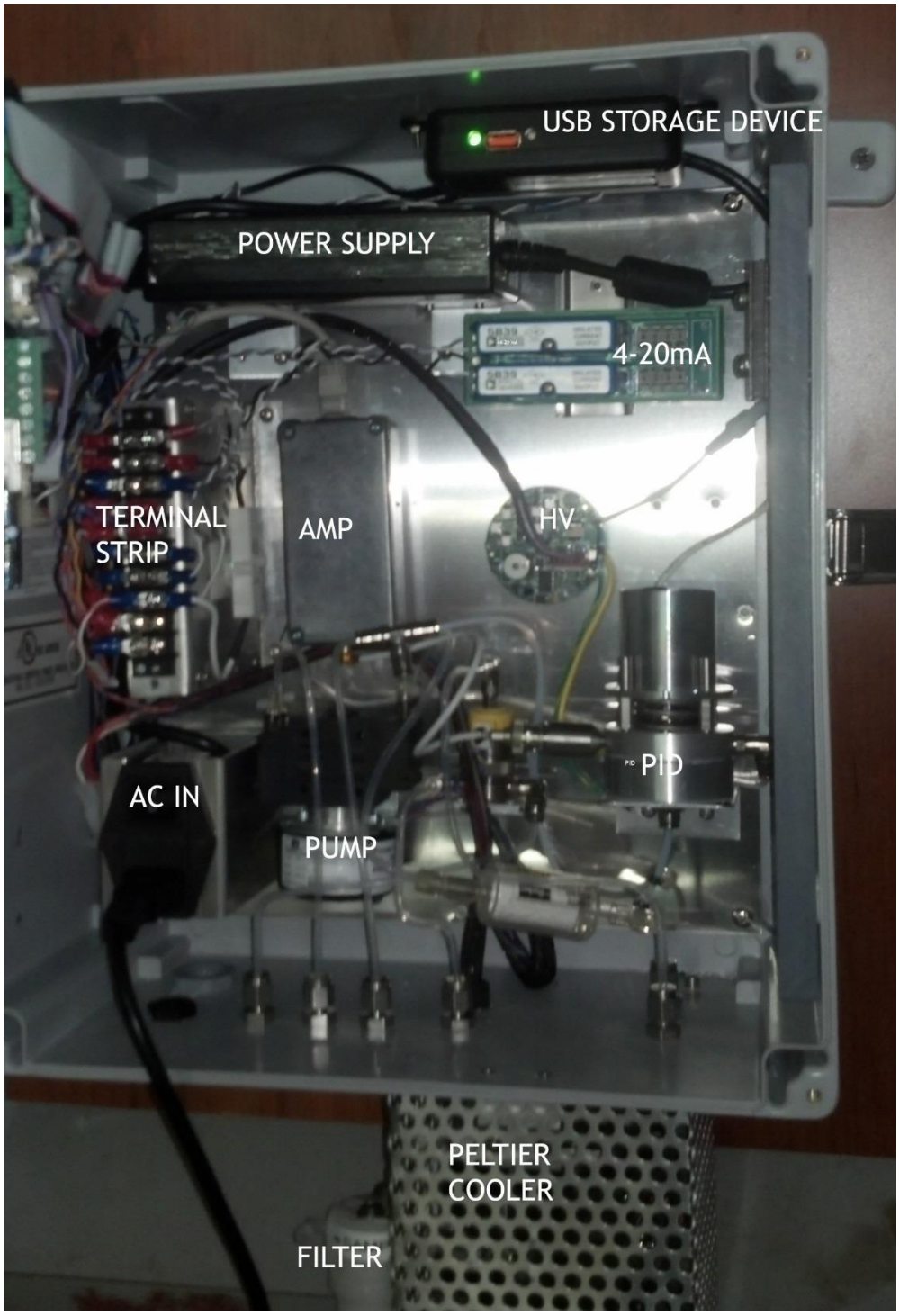


Fig. 3-7 Photo of Wall Mount (Inside) with delineation



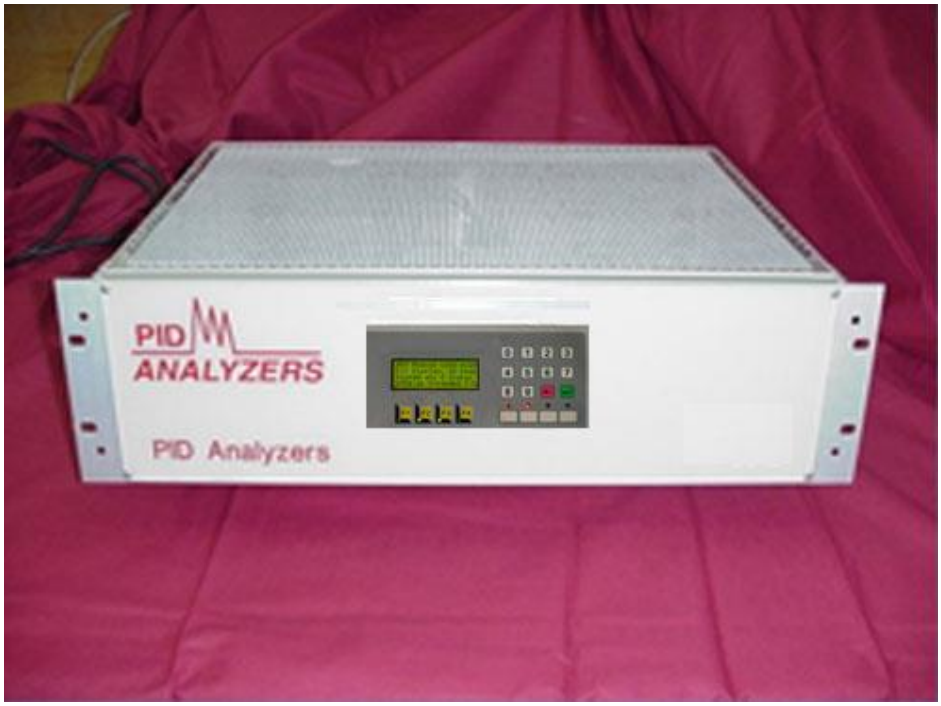


Fig. 3-8 FID 19” Rack Photo

A wiring schematic diagram for the 201 C is show in **Figure 3-6** above.

SECTION FOUR: INSTALLATION AND OPERATION

4.1 INSTALLATION

Unpack the instrument carefully from the shipping carton. Instruments are shipped with the lamp and instrument filters installed. Any damage to the equipment must be reported immediately. Note any damage to the outside of the container and, if possible, save the container. Note that the FID requires zero grade air and zero grade hydrogen to operate. Each of these gases require a special regulator. Place the instrument in the operating location and install as described below:

4.2 ALL MODELS

a The sample lines installed between the source and the instrument must be a material that will not alter or react with the gas being measured (for example- Teflon or polyethylene or polypropylene or stainless steel.

b. The sample lines must be of an adequate size to permit an acceptable transmission time of the sample from source to instrument. The instrument comes with 1/8" bulkhead fittings. Choose either ¼" or 1/8" for the O. D. of the sampling lines. These diameters provide a high linear velocity and will ensure a minimum lag time in the lines especially for the multipoint systems.

c. Be sure the inlet and outlet connections are of adequate size so no restriction of flow occurs.

d. Safely vent the detector and bypass outlets and the relief valve outlet. This is especially important if monitoring toxic or hazardous gases since the PID is non-destructive, however, no back pressure on the instrument from the exhausts must occur. Such back pressure would cause errors in system calibration by back pressuring the detector. The detector and by-pass vents must be separate and open directly to the atmosphere or be connected separately to a 3' ID conduit, spaced at least 1 to 1 1/2 feet apart.

e. Before connecting the sample input line, clean it thoroughly of all moisture or foreign matter to prevent its being drawn into the instrument. This can be accomplished by back flushing the line with compressed air or by allowing the free flow of clean gas through the line until it is clean.

f. Line filters (20 micron particulate filter) should be installed at the inlet of the sample line tubing. It is necessary that the input stream be adequately filtered to allow successful operation. For assistance in this the user is advised to consult the local PID Analyzers representative.

g. Be sure there is adequate ventilation around the 201-B so an ambient temperature of 40°C (upper operating temperature) is not exceeded.

- Make and test connections for 4-20 mA, 0-1V, RS232 use as required (see Fig. 4-1).

h. **For the FID**, connect the hydrogen and air lines from the cylinders from the instrument and leak test to ensure that there are no leaks.

When installation is complete, the response time of the system (include the lag time in the lines) should be measured. This can be accomplished by using a broad felt-tip marker (such as a Magic Marker) at the sample source and measuring the time it takes for the instrument to respond.

4.3 19" RACK MODELS

a. Place in operating position on bench or table. Ensure that power is off and line cord is not connected.

b. Remove the top cover by removing all screws.

c. Check wiring for any loose connections.

d. Check co-ax cable from the amplifier to the ion chamber.

a. Ensure that the amplifier and high voltage circuit boards are properly seated and nothing is loose in the module.

f. Ensure all tubing connections are secure. Be sure the tubing is clear of the pump assembly to avoid any abrasive wear.

g. Plug power cord into proper AC outlet. Turn unit ON.

h. Allow system to warm up for 45 to 60 minutes.

i. Perform start-up procedures (Section 4.5).

4.4 NEMA 4: WALL MOUNT MODEL

a. Mount the instrument upright on a bench using four 2"x4" pieces of wood or other supports to keep the unit upright

b. Open front door

c. Check all cable connections & meter to be sure they are secure.

d. Ensure all circuit boards are properly seated and nothing is loose in the module.

e. Ensure that all tubing connections are secure. Be sure the tubing is clear of the pump assembly to avoid any abrasive wear.

f. Connect AC power cord to terminal strip located inside case (refer to installation diagram provided with the instrument).

f. Plug power cord into proper AC outlet. Turn power switch ON.

g. Allow system to warm up for about 1 hour & perform start-up procedures (Section 4.5).

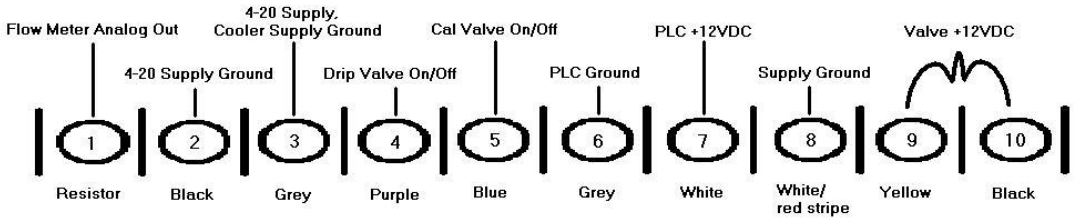


Figure 4-1 TB1 Drawing of Customer Interface

4.5 START-UP

Main (working) mode

On power on, the device is in its **Main (working) mode**. The display shows the measured concentration of NOVEC in ppm, the air flow in m^3/h, and the product (NEVAC) output in mg/h, from the channels as they were previously calibrated. Blinking H or L in the top right corner indicates the gain switch status. In this main mode, the following actions are available:

- Press **F4** key to start the timer and enable saving the data at the time interval set during the Setup. The data is saved to the DM32 registers, and also to the USB drive(file CAPTURE.TXT, the data written as coma separated values). F4-LED will turn ON to indicate that the automatic saving is enabled.
- Hold the **Backspace** key and press **F4** key to stop automatic saving data (on timer).
- Hold **5** key and press **F4** key to immediately save the data point (independently on the timer).
- Hold **Enter** key and press **F4** key to upload all the content of 2000 DM32 registers to the USB drive.
- Hold **0** key and press **F2** to initiate autozeroing sequence (lamp goes OFF, autozero digital output is ON which supplies LOW for autozero coil); this takes about 10 s, but you can terminate the process earlier by holding **1** key and pressing **F2**.
-
- Hold **2** key and press **F2** to turn the pump ON.
-
- Hold **3** key and press **F2** to turn the pump OFF.
-
- Hold **4** key and press **F2** to activate the gain switch. LED4 will go ON.
-
- Hold **5** key and press **F2** key to turn the cooler valve ON (flush out water).
-
- Hold **6** key and press **F2** to turn the lamp ON. F2_LED will go ON.
-
- Hold **7** key and press **F2** to turn the lamp OFF. F2_LED will go OFF
-
- Hold **8** key and press **F2** to switch the gain back. LED4 will go OFF.
-
-

- .
-
-
- Hold **Backspace** key and press **F2** key to return to the normal operation (the cooler valve OFF).

Hold **0** key and press **Enter** key to enter the date and time set mode. Use keys **4 (UP), 8(DOWN)** and **F2 (proceed**) to set the desired date and time. Use **0 + Enter** combination again to exit from this mode any time.

4.5.1 PID startup-

a. Turn instrument power switch ON. The display should be on. The on/off switch is at the rear of the instrument on the 19" rack models and is inside the wall mount unit below the front panel.

WARNING: Be sure the instrument has warmed up for 45 to 60 Minutes before operation. This ensures that the instrument has come to a stable operating condition.

No moist samples are to be introduced into the instrument. A membrane dryer (optional) is included in the PID version (*only*) to condition moist samples.

b. Turn the lamp switch ON. An upscale deflection should occur.

c. Make sure that the calibration gas is connected and that the flow rate is set to 1 liter/min. when calibration is activated

d . Connect sample input(s) to the inlets at the bottom (wall mount) or rear of the 201-B (rack mount).

e . In the case of a wall model, close and secure front panel. Close and lock the door with the special key.

i. Observe and record the meter reading when a sample without the gas is being measured by the system. This is the background level.

1. The system is now ready for operation.

m. After the instrument has been ON for about 2 hours:

1 . Check flow rate at detector outlet and sample by-pass.
2. Check zero by turning lamp OFF.
3 . Check the filter for traces of moisture.
4. Manually activate the High and Low alarms (if this option is included) to verify proper connections and operation.

n. Recheck the calibration.

4.5.2 FID Startup

Connect the following to the proper connections at the rear of the 201-FID:

Hydrogen- zero grade; supply pressure 40 PSIG
Air- zero grade; supply pressure 30 PSIG; also zero gas
Methane in zero air- standard span gas

a. Turn instrument power switch ON. The display should be on. The on/off switch is at the rear of the instrument on the bench/rack models and is inside the wall mount unit below the front panel.

WARNING: Be sure the instrument has warmed up for 45 to 60 minutes before operation. This ensures that the instrument has come to a stable operating condition.

No moist samples are to be introduced into the instrument until stable operating conditions have been reached.

b. Turn power off. Open the top of the instrument by removing the screws. Unscrew the FID detector head and place it to one side.

c. Measure the air flow at the jet tip (the values should be about 300 cc/min.). Turn the power on. Turn hydrogen switch (front panel) on and hold down start flame switch (This overrides the flame out circuit and opens the hydrogen valve). Wait about 5 minutes and measure the hydrogen flow (should be 80-100 cc/min.). Remove the jet with the tool included and measure the air to the FID at the base.

d. Put the jet back on the base and return and tighten the FID head.

e. Hold down the hydrogen start switch. Wait two minutes and press down on the ignite switch. Check the vent for formation of water vapor indicating that the flame is lit. When the flame out LED goes out, release the hydrogen switch. The flame out light should stay off and the flame should stay lit. If the flame goes out, it will automatically shut off the hydrogen.

f. Allow another 30 minutes for the FID to stabilize before calibrating.

g. Check calibration by putting cal gas into the sample port using a gas sampling bag or flowrate set to app. 1 LPM. If the reading is more than 10% off the Cal value, recalibrate the 201. For further details see Section 6.

h . Connect sample input(s) to the inlets at the bottom (wall mount) or rear of the 201-B (19" rack mount).

i . In the case of a wall model, close and secure front panel.

j. Observe and record the meter reading when a sample without the gas is being measured by the system. This is the background level.

k. The system is now ready for operation.

l. After the instrument has been ON for 2-3 hours:

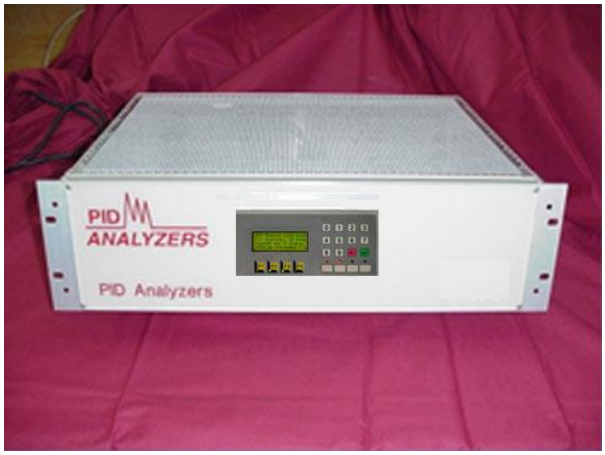
1 . Check flow rate at detector outlet and sample by-pass.
2 . Check the filter for traces of moisture.
3. Manually activate the High and Low alarms (if this option is included) to verify proper connections and operation.

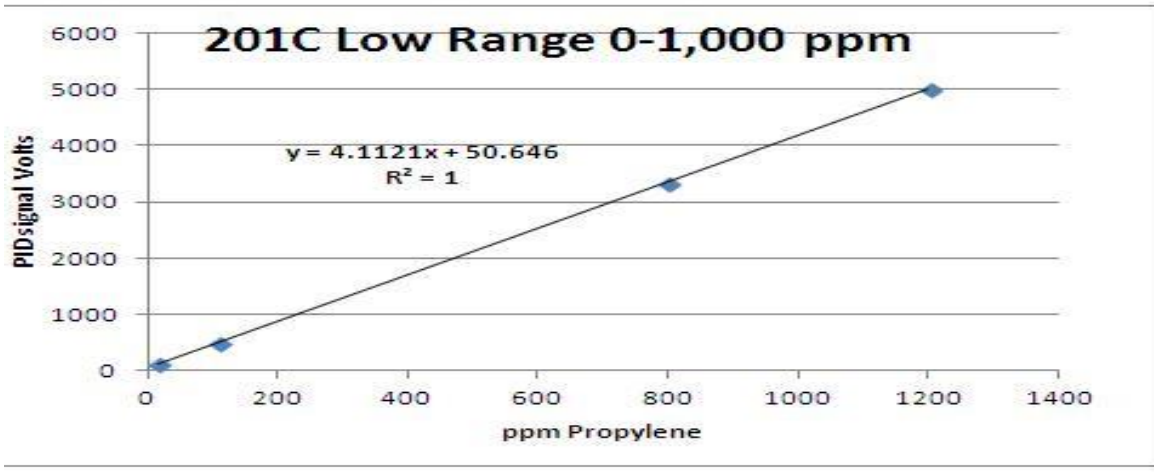
4.6 **OPERATION**

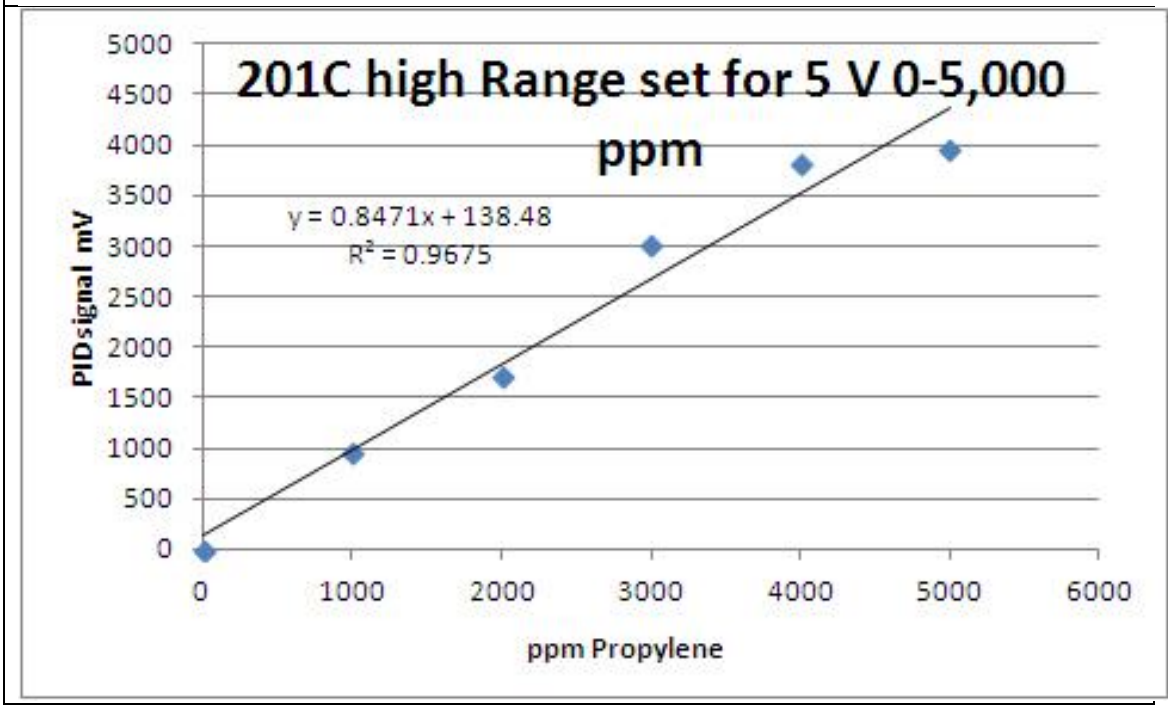
If the system has been calibrated as described in Section 6, the instrument will provide a direct reading of the presence of the gas. If a calibration gas is not available, we would recommend a factory calibration (Special Application) to determine a response factor for the gas which can be supplied.

4.7 Photographs of the Wall and Rack Mount 201-B instruments are shown below in Fig. 4-2.

Fig. 4-2 Photos of Model 201-B Wall and 19" Rack Mount units

	
201-C Wall Mount	**19" Rack Mount- 201-C**





The linearity curves for polypropylene at 0-1,000 ppm and 0-5,000 ppm are shown above in Fig. ___

SECTION FIVE: MAINTENANCE

5.1 GENERAL

Routine maintenance procedures required include checking and replacing the filter, checking and cleaning the lamp window and ion chamber. For the FID, the hydrogen and air supply should be checked regularly until a maintenance schedule can be setup. Routine maintenance should be performed at monthly intervals or more frequently, if necessary. Once the instrument has been running for three months, the intervals can be modified by experience. 0perating conditions at each installation usually determine the most desirable frequency. Access to components for maintenance is as follows:

WARNING: Disconnect power line and allow instrument to cool before any disassembly. This instrument contains high voltage circuits, up to 1200 VDC and high temperature components, up to 80°C. Exercise extreme caution when working on the instrument to avoid shock and/or burns.

a. Enclosed Rack Model

Remove the top panel for access to the electronics & fluidics components.

b. Wall Mount Model

Unlock the front door and open the door. Remove the two screws on the front panel and swing the panel outward for access to the electronics.

5.2 FILTER REPLACEMENT

Particulate matter or moisture can cause clogging of the instrument filter. Remove the filter housing from the instrument inlet. Inspect for clogging.

Check for "tracking' or streaking which can indicate leaking. If necessary, replace with new filter of same grade as previous filter. Replace the filter at the instrument inlet.

5.3 PID DETECTOR ASSEMBLY

a. Lamp Operation- To check lamp operation, turn the instrument power and lamp power ON.

WARNING: This instrument contains high voltage circuits, up to 1200 V DC, and high temperature components, up to 80° C. Exercise extreme caution when servicing the instrument to avoid shock and/or burns.

Observe the lamp operation thorough a port in the top of the lamp housing. A glow from the lamp should be noted. The lamp may be safely observed in this fashion.

WARNING: If the lamp is removed from the ion chamber and operated, separately do not observe the window closer than 6 inches. If

necessary, observe only briefly. Continued exposure to ultraviolet energy generated by the light source may be harmful to eyesight.

If the lamp is operating properly, turn the instrument and lamp power OFF and allow to cool for about thirty minutes to one hour. If insulated gloves are used, the lamp can be removed within a few minutes. If the lamp is not operating, follow the troubleshooting procedures in Section 7 to locate the fault.

b. Lamp Cleaning

Loosen the four spring loaded lamp housing screws, twist the lamp cover and lift upward to remove it. The lamp and spring will remain on the detector base.

WARNING: Exercise great care in disassembly and reassembly of the detector. Accidental dropping of the detector components can break the lamp or damage the ion chamber. The lamp may adhere to the ion chamber on disassembly. Protect the assembly at all times to prevent an inadvertent fall or damage.

Carefully remove the lamp (and spring) from the detector. Check the lamp window for deposits or fouling by looking at a reflected image on it. Any deposits, films or discoloration may reduce the UV intensity and therefore the sensitivity of the PID. Clean the window as follows:

1. First clean by rubbing with lens tissue dipped in a detergent solution.

2. If this does not remove the deposit, apply a small amount of PID Analyzers cleaning compound directly onto the lens of the lamp and spread evenly over the surface with a non-abrasive tissue or a lens tissue.

3. Wipe off compound with a new tissue.

4. Rinse with **hot** water (80 °C) to remove all traces of the cleaning compound. Dry with new tissue.

5. If the lamp is now clean, it is ready to be reinstalled in the detector. If the cleaning is not successful, replace the lamp. It may take several hours for the lamp to stabilize after cleaning with the cleaning compound.

6. The lamp o-ring should be replaced after cleaning because it may be deformed and leak.

c. Ion Chamber Cleaning

1 . Disconnect signal cable at ion chamber end.

2. Disconnect the bias voltage connector. The other side goes to the high boltage board (J4). Loosen screw and disconnect. Chamber should be free at this point.

3. Remove the ion chamber and examine for fouling or corrosion. Clean chamber with a cotton swab and an organic solvent such as methanol or chloroform to remove all contaminants.

CAUTION: Avoid using any blades or abrasive materials in his area when attempting to remove apparent stains or discoloration in chamber area. This could cause permanent damage to chamber.

4. With a new dry swab re-wipe chamber area. inspect chamber for any cotton hairs or dust. If chamber appears to be damaged when checking it while cleaning, contact an PID Analyzers representative for assistance.

5. Check lamp contacts in upper housing for corrosion. Clean contacts with a pencil eraser.

6. Place chamber in oven preheated to 50°C. Leave for approximately 15-20 minutes. If oven is not available, run instrument for additional 30 minutes after reinstallation and before operation or calibration.

d. Reassembly- When all parts are cleaned and ready to install, reassemble as follows:

1. If required, place a new seal in the detector base.

2. Position the ion chamber so that:

   a. The cavity faces toward the base, and the collector faces toward the lamp when installed.
   b. The accelerating voltage lead (24 gage wire) is directed upward toward the top of the panel.
   c. The signal cable is directed downward toward the bottom of the panel.

3. If required, place a new seal (PN 91-DA-10187) on the ion chamber.

4. Place the lamp in the housing.

5 . Place the housing with lamp on the base over the ion chamber and align with the four screws. Push down and twist the lamp cover. The assembly should be firmly in place. Tighten the four screws.

6. Connect the accelerating voltage lead to the high voltage board via J4 and the signal lead to the amplifier.

7. Check and replace, if necessary, all filters on sample lines and dilution lines (if applicable), before running.

9. Run the instrument I hour, then recalibrate.

SECTION 6: CALIBRATION

6.1 Setup:

Because the calibration process can be done with two standards, for the gain switch OFF and ON, set the switch to the desired state (**4 key + F2** to activate the switch, **8 key +F2** to deactivate it, as described above.)This must be done in the **Main state** (not during the setup or calibration). After that,
Press **F1** to enter the **Setup mode.** You will go through a sequence of steps to set different parameters; the current value of each parameter is displayed. You can agree with it (press **F2** to proceed to the next parameter) or you can key in its new value using keypad and pressing **Enter** to accept the new value. Press **F2** to proceed to the next parameter. The parameters to be set are:

- Calibration standards St1 and St2, in ppm., for the case of gain switch OFF and the switch ON. The program will store that or the other standard based on the gain switch status,
- Max value of the concentration, in ppm, for the analog output 1 to be 20 mA.
- Vapor density of NOVEC, in g/m^3. For NOVEC 72DE, it is some number between 5888 and 6267 (depending on the particular composition of DE72).
- Max value of the process output (NOVEC), in mg/h, for the analog output 2 to be 20 mA.
- Response factor, in % relative to the cal gas.
- Min flow value as set in CTV310
- Max flow value as set in CTV310.

Minute in the hour at which Cooler valve goes ON and pump goes OFF (for 30 s during hours 2, 10, and 18, and for 1 s for all the other hours)

6.2 GENERAL

The system is calibrated at the PID Analyzers factory prior to delivery. Calibration data is provided in the Application Data Sheet. The system is calibrated for isobutylene unless (1) prior to placing an order, an Application Worksheet for another gas has been completed by the Customer and approved by PID Analyzers Staff and (2) Applications Engineering (PN AE201) is specified as a line item on the Purchase Order.

The 201-C does not increase or decrease the gain of the amplifier during calibration. Any gain adjustment results from a software change to the calibration factor. It also provides a contact closure to let an external computer know that the instrument is in the calibration mode. The data from the 201-C should be logged or recorded to ensure that any change in sensitivity can be compensated for. The variation of the meter reading at calibration should be less than 5% of the reading. If a larger change is observed, check the trouble shooting section.

6.3 CALIBRATION GAS

a. General

The calibration gas is connected to the inlet. In the initial installation, a flow meter should be connected to the detector outlet. This flow meter is not required for subsequent calibration but may be used if desired. Flowrate through the detector outlet should be about 100 cc/minute. The total flow will be 1-2 liters/min.

The gas used to calibrate the instrument should contain the same gas as the sample at a

level of about 100 ppm. This will provide linearity to > 3000 ppm.

The calibration gas should also be in the same matrix as the sample being measured. It Is especially Important In the case of oxygen content. Oxygen In a mix quenches (neutralizes) some of the ions present and reduces the signal generated. If the sample matrix is a normal atmosphere containing about 21% oxygen, the calibration gas matrix must have between 12 and 21% oxygen. The quenching effect is somewhat constant within this range. When the sample contains a level of oxygen, less than 12% or greater that 21 %, the calibration gas should be adjusted to match the sample.

The size of the calibration gas should be standard laboratory size bottles (Type 1A or 3A). This should last between 6 months and one year. For shelf life, contact PID Analyzers or your local gas supplier.

If difficulties are encountered in calibration the user should consult their local PID Analyzers representative.

WARNING: Be sure the detector, bypass outlets and the relief valve outlet are safely vented. This is important during calibration and normal operation.

6.4 PID CALIBRATION PROCEDURE

a. Allow system to run for 45 to 60 minutes.

b. Set up the calibration gas cylinder so that the calibration gas line is connected to the ***calibration input***.

c. Push the Calibration button, the display will read “Zeroing”- the lamp is turned off and zero value is stored in memory.

d. Next, the meter will display “Set Calibration Value”. Use the up or down arrow on the meter to increase or decrease the value. When the correct value is set, press the program key (P) on the meter.

f. Open the main valve on the gas cylinder, set the cylinder pressure so that the calibration gas flow rate is about 2 liters/minute. Push the calibration switch on the front panel. Allow the gas to flow until the meter reading reached the maximum value and is stable (about 1 minute).

g. Once the reading is stable push the program (P) key on the meter. The meter should display calibration okay. The calibration is completed.

6.5 FID CALIBRATION PROCEDURE

a. Allow system to run for 45 to 60 minutes.

b. Set up the calibration gas cylinder so that the calibration gas line is connected to the ***calibration input***.

c. Push the switch to Calibrate. The instrument will read “Zeroing”. Zero gas is applied and a three way valve is energized to feed zero gas to the FID. After the reading is

stabilized, the zero value is stored in memory by pressing the program key (P) on the meter.

d. Next, the meter will display “Set Calibration Value”. Use the up or down arrow on the meter to increase or decrease the value. When the correct value is set, press the program key (P) on the meter.

f. Open the main value on the gas cylinder, set the cylinder pressure so that the calibration gas flow rate is about 2 liters/minute. Push the calibration switch on the front panel. Allow the gas to flow until the meter reading reached the maximum value and stable (about 1 minute).

g. Once the reading is stable push the program (P) key on the meter. The meter should display “Calibration okay”. The calibration is completed.

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7.0 : TROUBLESHOOTING

TABLE 7-1

TROUBLESHOOTING TABLES

FID or LAMP NOT OPERATIONAL

Possible Cause	***Corrective Action***
Faulty power supply	Check HV power supply board (Sections 7-2.1 and replace if required.
Faulty lamp (**PID only**)	Replace If required (Section 5-3).
No H2 or Air (**FID only**) potential on the HV board	Check flows and/or gas cylinders, Check the accelerating

METER ERRATIC OR UNSTABLE

Possible Cause	***Corrective Action***
Loose cable connection	Check cable connection at amplifier and observe the meter; tighten or replace the cable as necessary.
Dirty or loose meter connections	Check meter connections; tighten as required.
Contamination in ion chamber (**PID**)	Clean ion chamber (Section 5-3).
High voltage power supply board	Check HV board outputs (Table 7-2); if the voltage is not correct, replace the faulty board
Unstable or noisy lamp (**PID**)	Disconnect the amplifier lead from the ion chamber. Observe the lamp through the top of the detector to see if output is steady. If not, check for loose connections and if none are found, replace lamp & ensure that output is steady.
Unstable flow rate	Check the flow rate at the detector outlet (should be 125 cc/min.): Check the pump operation- should be ~3 LPM
Pump flow rate too low	Check and clean sample tubing in unit, pump inlet & outlet, filter inlet & outlet, check pump flapper valves & diaphragm clean or replace if necessary

METER ERRATIC OR UNSTABLE (Continued)

Possible Cause	***Corrective Action***
Water in ion chamber (**PID**)	Disassemble the detector, then Inspect, clean, and dry the Ion chamber.
Water in detector (**FID**)	Check FID by removing vent; keep running & problem will clear
Bypass orifice plugged	Check the flow out of the bypass vent. Clean the orifice if plugged.
Amplifier board malfunction	Check the connectors on the amplifier board. Reseat if Necessary.

NO METER RESPONSE

Possible Cause	***Corrective Action***
Electrical connection to the meter open	Check all wires leading to meter; clean connection & contacts.
Power supply defective	Check the power supply voltages (+/- 12 VDC- see 7-2.1 a 2.2). If the voltages are not correct, replace the power supply
No sample flow	Check the flow at the detector outlet. Check the filter & pump.
Light source not ON (**PID**)	Check the high voltage supply (see 7-2.2). Remove the lamp from Its housing and check the high voltage on th contact ring. If high voltage is present at all above points, replace lamp. **Warning high voltage!**
Input signal connection broken	Check to ensure that the input connector on the amplifier in detector or at amplifier board is firmly pressed down. Check the cable from the ion chamber to the amplifier for an open circuit. Check the components on the back side of the amplifier boa of the connections should be solid and no wires should touch any other object.

METER RESPONSE HIGHER OR LOWER THAN EXPECTED

Possible Cause	*Corrective Action*
Lamp dirty	Clean the lamp
Filter dirty	Check the filter and replace as necessary
Dirty or loose connections.	Clean or tighten all connections at the amplifier board, Ion chamber, and meter
Contamination in Ion chamber	Clean the ion chamber
Faulty pump	Check the pump operation Check the flow coming from the by-pass Outlet & detector vent (see Fig. 2-1) Check the diaphragms
Ion chamber power supply output faulty	Check the 130 V supply (Section 7-2.2)
Incorrect gas standard	Check the gas standard
Invalid calibration	Re calibrate (Section 6)
Water in Ion chamber	Disassemble the detector then Inspect, clean, and dry the ion chamber

SLOW RESPONSE

Possible Cause	*Corrective Action*
Pump not operating properly	Check the pump flow rate with a flow meter. The acceptable range is 0.9 to 1.2 liters per minute.
Dirty filter	Check the filter and replace as necessary.

DRIFTING METER RESPONSE

Possible Cause	*Corrective Action*
Ion chamber contaminated	Clean the ion chamber (see Section 5-3).

NO OUTPUT OR LOW OUTPUT **(FID Only)**

Probable Cause	*Corrective Action*
Flame out	Check for flame with watch glass or shiny spoon. flame is on, condensation will form. Operate ignit switch. Check thermocouple temperature (press arrow for CH2 –should be > 200C.
Gas leaks	Check gas connections, tighten, if necessary
Detector fouled	Clean detector
Amplified board faulty	Replace board
Bad connections	Check connections at FID head and at rear of module.
Faulty high voltage board	Check voltage at pin, should be 130 VDC. Repla board, if necessary
Incorrect flame operation	Measure gas flows. Check for optimum signal position

PID ANALYZERS

Appendix I

Spare Parts for Model 201

Quantity	Part Name	Part #
1	Power Supply	81-201-512
1	Pump- Dual head	81-201-DH
4	3 way Valve	81-201-ETO3
1	HV Board	81-201-HV
1	Amp Board	81-201-Amp
1	Eurostyle Terminal Block	81-201-HV
2 or 3	LED- Red	81-201-RLED
2 or 3	On/Off Rocker Switch	81-201-SWR
1	Momentary Off Switch	81-201-SWM
1	Processor board	81-201-PLC-602
1	Display/keypad	81-201-DK
1 pkg	Particulate filter (3)	81-201-filter
1 pkg	Lamp o-ring (3)	19-DA-101361-1
1	Lamp cleaning compound	81-101-500

Appendix II

Warranty

PID Analyzers, LLC warrants that all Items delivered under this order will be free from defects in material and workmanship when used under normal operating conditions. PID Analyzers liability hereunder shall be limited to the repair or replacement of the articles ascertained to be defective within one (1) year after date of shipment (except that the light source warranty Is limited to three (3) months and does not Include breakage, provided, however that the Buyer shall give notice to PID Analyzers within thirty (30) days after the discovery of such defective material and provided further that all defective material be shipped prepaid to the PID Analyzers plant within a reasonable time from the date of discovery of the defect and during such warranty period. After the repair or replacement, PID Analyzers will ship the said item to the Buyer, transportation charges prepaid, to any point in the United States that Buyer may designate.

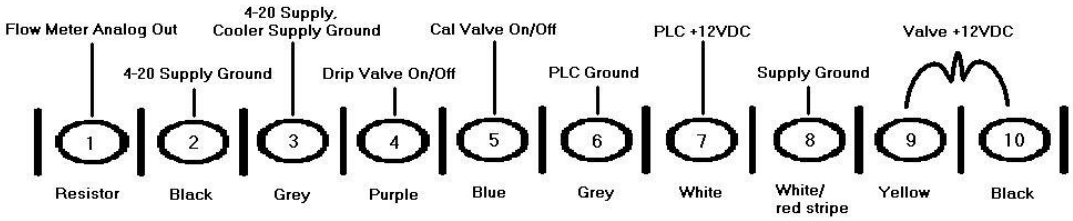
THE FOREGOING IS THE SOLE EXTENT OF PID Analyzers 'S WARRANTY AND NO OTHER STATEMENTS OR WARRANTIES, EXPRESSED OR IMPLIED, SHALL BE HONORED. UNDER NO CIRCUMSTANCES SHALL PID Analyzers BE SUBJECT TO ANY LIABILITY FOR SPECIAL INCIDENTAL OR CONSEQUENCIAL DAMAGES.

PID ANALYZERS

Appendix III

Photo of 201C Wall mount with Terminal board Identified

Appendix IV
Customer Interface for 201 PID (TB1)



Wire Position/Color	Description
1/Resistor Attached	Flow Meter Analog Output
2/Black	4-20 Output Board Signal Ground
3/Grey	Ground for 4-20 power, Cooler
4/Purple	Drip Valve Activate
5/Blue	Calibration Valve Activate
6/Grey	PLC Power Supply Ground
7/White	PLC Power Supply +12VDC
8/White with Red Stripe	General Power Supply Ground
9/Yellow	+12VDC for Valves
10/Black	+12VDC for Valves

Gas	Gauge	Flow (cc/min)	
Total sample		1,000	
Cal gas flow		1,000	
Permapure dryer flow		2,000	
PID sample flow	NA	>150	
Temp.	NA		
Resistor	50 GB		
Sensitivity	0-5.00 ppm benzene FS		
Full Scale setting	50 mV		

Indicator LEDs:

F2:	Lamp On/Off
F4:	Autosaving, LED On=On
LED 1:	Cooler Valve
LED 2:	Autozero
LED 3:	Sample Pump
LED 4:	Gain State (On=Low Gain)

Appendix V
Peltier Cooler

A Peltier Cooler is an option to remove water from the sample stream. It will automatically empty the water from the cooler reservoir. A photo of the system is shown below:

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PID ANALYZERS

Appendix VI
Short Form Instructions for the 201C

COMMAND	Function	Comments
Function Key (**F1**)	SETUP	To set the parameters of the data collection and processing;
Function Key (**F2**)	Next & manual operations	Proceed (Next step) during setup; it is also used to manually switch the cooler into the flush out mode, to manually start autozero, to turn the pump ON/OFF, lamp ON/OFF, and to switch gain.
Function Key (**F3**)	CALIBRATE	Note that **each range requires a separate calibration and has a different calibration factor**
Function Key (**F4**)	DATA	Controls saving data (automatically or manually)
F4-LED		Indicates that the automatic saving the data is active;
LED 1		Indicates that the cooler pump is ON;
LED 2		Indicates that autozero is in progress;
LED 3		Indicates that the sample pump ON
LED 4		Indicates the gain swich is ON.
F2_LED		Indicates the lamp ON/OFF
Hold **0** key and press **F2**	Autozero	Initiate autozeroing sequence. LED2 indicates that the autozeroing iprocess is active
Hold **2** key and press **F2**	Pump On	Start the Pump.
Hold **3** key and press **F2**	Pump Off	Stop the Pump
Hold **8** key and press **F2**	Max Gain	Switch to high gain (maximum sensitivity (0-1.000 ppm)
Hold **4** key and press **F2**	Min Gain	Switch to low gain (0-5000 ppm)
Hold **6** key and press **F2** key	Lamp on	Turns lamp on
Hold **7** key and press **F2** key	Lamp off	Turns lamp off
Hold **5** key and press **F2** key	Empty cooler reservoir	Turn on the cooler valve to empty the reservoir
Hold **Backspace** key and press **F2** key	Close cooler valve	Return to the normal operation (the cooler valve OFF)
Hold **0** key and press **Enter** key	Set date/time	4 - UP, 8 - DOWN, F2 -NEXT
Hold **0** key and press **Enter** key again	Exit from setting date/time	