MAINTENANCE MANUAL

Model 100A

digitalPID
Fast-Response Photo-Ionization Detector

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Aurora Scientific Inc.
360 Industrial Pkwy. S., Unit 4
Aurora, Ontario, Canada L4G 3V7

Tel:	1-905-727-5161
Toll Free:	1-877-878-4784
Fax:	1-905-713-6882
Email:	questions@AuroraScientific.com
Web Site:	www.AuroraScientific.com

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1.0 Introduction

The digitalPID (Digital Photo-Ionization Detector) combines fast response, high sensitivity and microprocessor control in an easy-to-use package. The sensor has a frequency response of 50 Hz and a detection limit of 50 ppb (parts per billion) propylene gas in air. It is self-contained and only requires a 12-volt battery for power. A built-in microprocessor allows all functions of the sensor (on/off, gain, zero, and data transmission) to be remotely controlled through either a RS-232 or a RS-485 communications interface. A 20-bit charge-digitizing analog-to-digital converter provides precision conversion of the sensor output.

Easy-to-use control software provides the functions required for control, data retrieval, and calibration of up to 16 sensors. Data from up to 16 sensors can be simultaneously displayed on the computer screen in real-time while data logging is underway. The software operates under RTLinux and comes complete with a PC.

The digitalPID model: 100A includes the sensor, mounting bracket, RS-485 communications/power cable and an RS-232 to RS-485 converter. The DPID software and PC are purchased separately.

For a typical outdoor trial the user must supply a fixed or mobile mast or tripod for mounting the sensor, a 12 VDC battery for power, a DPID PC computer for sensor control and data acquisition, a tracer gas supply (normally propylene but many other substances can be detected), and a tracer gas dissemination system. The sensors are used to record concentration fluctuations of the dispersing gas as it passes by the sensor location.

2.0 digitalPID Fast-Response Sensor Overview

2.1 Operating Principle

In the digitalPID photo-ionization detector (PID) a gas or vapour sample is exposed to high intensity ultraviolet light that ionizes the molecules of chemical substances. Ions are collected on positive and negative electrodes within the detector cell, creating a current proportional to the contaminant concentration. Ionization depends on the minimum energy needed by a molecule to produce ions and this energy (ionization potential) is different for each chemical substance. The molecules of most permanent gases (including the constituents of air: nitrogen, oxygen, carbon dioxide, argon, etc.) are not ionized, as they require a photon energy level higher than that generated by the lamp. Molecules having ionization energy levels below the lamp energy (10.6 eV) are the ones that are ionized.

Since the PID is sensitive to any gas with an ionization potential below 10.6 eV, the output of the device should be viewed as an expression of the total ionizables present (TIP). Because of this, the accuracy of the PID is dependent on whether interference gases are present.

2.2 Sensor Sub-Assemblies

The digitalPID sensor consists of the following 5 main sub-assemblies, detector, microprocessor, power supply, RF lamp drive and air handling. A brief overview of each sub-assembly is provided below. Schematics for all circuits are included in appendix A.

2.2.1 Detector

The detector consists of a Teflon printed circuit board that contains the anode and cathode of the detector as well as a 20-bit A/D converter, precision reference, 18-bit D/A converter and a temperature sensor. The A/D converter provides direct digitization of the detection cell output current. The D/A converter is used to zero and offset the signal into the A/d converter.

The detector is capable of measuring very small currents, as small as 100 Pico amps ($100x10^{-12}$ amps). Because of this precautions must be taken when handling the detector circuit. Cleanliness is critical; a fingerprint on the circuit board can allow leakage currents to flow across the board surface that are greater than the current being measured. These leakage currents increase sensor noise. To avoid contamination, handle the board by the edges only. If the board is contaminated then clean it with lab grade methanol. Ensure that precautions are taken to prevent static discharge into the circuit.

2.2.2 Microprocessor

The microprocessor controls all functions of the sensor including the A/D and D/A converters, switching power on and off, communications with the host computer and measuring status information such as voltage and temperature. The microprocessor board is the largest circuit board in the sensor and includes the power and communications connectors and connectors to the detector board and the power supply board.

2.2.3 Power Supply

The sensor uses a +12 volt DC power source, typically a battery. Other voltages are required within the sensor for example, +/-5 VDC, +10 VDC, +300 VDC and -15 VDC. The +300 and -15 VDC power supplies are two switching power supply modules mounted on the power supply board. This board plugs onto the microprocessor board. Caution must be observed when handling an open sensor. The +300 VDC supply has sufficient current capacity to provide a shock.

2.2.4 RF Lamp Drive

The sensor uses an RF excited lamp. The RF drive consists of an RF Interface board located on the outside of the lamp housing and a RF drive board located within the lamp housing. The RF circuit is tuned electronically by the microprocessor but there is a trim potentiometer located on the RF Interface board that set an offset voltage for the tuning circuit.

2.2.5 Air Handling

The air handling system consists of a rotary vane pump and associated air tubing. The pump is controlled by the microprocessor through a relay located on the microprocessor board. In most cases a 12-volt battery will power the sensor. The voltage of a battery varies with the amount of charge and can range from 14 volts down to about 11 volts. To ensure that the pump runs at a constant speed a separate regulator is provided to power the pump. This regulator has an output voltage of about 10 volts.

3.0 Maintenance

3.1 Opening the Sensor

HIGH VOLTAGE is present inside the sensor when it is turned on.
Ensure that the power connector is removed BEFORE opening the sensor case.

The following procedure should be followed to open the sensor.

1) Remove the power and communications connector from the back of the sensor.
2) Place the sensor on a table.
3) Using a 0.050" Allen key remove the four flat head screws that connect the detector end cap (the end cap with the inlet needle attached to it) to the main sensor case.
4) Using a 1/16" Allen key remove the four button head screws on the bottom of the main case.
5) Do not remove the 4 socket head cap screws, located on the detector end cap next to the inlet needle.
6) Grasp the detector end cap and gently pull the sensor electronics out of the main case. **Take precautions to prevent static discharge damage to the sensor electronics.** Note: the connector end cap does not need to be removed.

3.2 Checking the Pump

A rotary vane sample pump is mounted inside the digitalPID sensor. Because the pump flowrate affects the sensor calibration, the flowrate should be checked periodically. A rotameter with a 0 to 2 SLPM (standard litres per minute) range can be attached to the digitalPID inlet needle using a short length of 1/16" ID vinyl tubing and some 1/16" OD Teflon tubing. Ensure a gas tight connection between the rotameter and the digitalPID inlet needle. Also ensure that any valves attached to the rotameter are wide open. Turn on the digitalPID sensor and observe the flow rate indicated on the rotameter. If there is no flow or the measured flow rate is significantly less than 800 SCCM then perform the following checks.

1) The pump **will not run** unless the UV lamp is lit. Therefore if there is no suction from the pump check that the UV lamp is on.
2) Check that the "Lamp" reading under the Status section of the main menu of the TIPSJ3 program shows a number less than about 25. Also check that you can hear the pump running.
3) If you can hear the pump running but there is no flow indicated on the rotameter then remove the digitalPID inlet needle (using a 1/4" open-end wrench) and check it for obstructions. It can be cleaned out with a fine wire and compressed air.
   Visually check that the needle is clear and re-attach it to the sensor. Recheck the flow rate through the sensor to confirm correct operation. The inlet needle diameter is smaller than any of the internal passages in the sensor and therefore a blockage is most likely to occur in the needle.
4) If during step (3) it is found that the inlet needle is not blocked then the sensor must be opened and the internal tubing checked for blockages and kinks. Use the procedure

outlined in section 3.1 to open the sensor.
HIGH VOLTAGE is present inside the sensor when it is turned on.
Ensure that the power connector is removed BEFORE opening the sensor case.
Once the sensor is open check the internal tubing to ensure that there are no sharp bends or kinks in the tubing. Also check the exhaust tubing for blockages. Check that the suction tubing is attached to the lamp housing and also to the suction port of the pump (port is marked "V").

5) If step (4) shows that the sample line is okay then the problem may be with the pump power supply. Unplug JP3 (the pump connector) and check the voltage across the two pins. The voltage should be greater than 10 volts. If not then the voltage regulator (U11) or the relay (K1) could be faulty. In this case return the sensor to Aurora Scientific Inc. for repair.

The sensor should be re-calibrated if the sample flow rate changes.

3.3 UV Lamp Cleaning and Replacement

Removal and Cleaning

The following procedure can be used to remove the lamp.

1) Open the sensor, see section 3.1.
2) Position the sensor so that the solder side of the main circuit board is on the table.
3) Remove the two Philips head screws that attach the power supply circuit board to the main circuit board.
4) Unplug the cables that run from the lamp housing to the main circuit board.
5) Remove the suction tube from the pump (the longer tube that runs to the lamp housing).
6) Grasp the power supply board and the main circuit board and unplug the power supply board from the main board.
7) The lamp can be removed by unscrewing the large screw cap found on the digitalPID lamp housing. Grasp the **lamp housing** firmly before unscrewing the cap, **DO NOT torque on the screw cap while holding the main circuit board this can result in permanent damage to the main circuit board.** When the screw cap is removed slide the lamp out of the housing, ensure that you do not drop the lamp when removing it. This can result in lamp failure. Also make certain that the lamp compression spring is not lost.

If successive calibrations show a decrease in signal output for a given calibration concentration, then it is most likely that the lamp is dirty. To clean the lamp, remove the lamp and inspect the flat face for dirt. This face can be cleaned with a soft cloth. If the dirt will not easily wipe off then dampen the cloth with methanol and wipe the surface again. Do not use other solvents since they can be detected by the sensor and will result in a very large signal offset. Ensure that the lamp face is free of dirt and fingerprints before replacing it in the sensor head. The sensor **must** be re-calibrated after lamp removal or cleaning.

Lamp Replacement

If repeated attempts to light the UV lamp fail, or the lamp glows with an orange colour, then the lamp requires replacement. Replacement lamps are available from Aurora Scientific Inc.

Follow the lamp removal procedure listed above and then install a new lamp. The sensor **must** be re-calibrated after lamp replacement.

3.4 Detection Cell Cleaning

CAUTION
HIGH VOLTAGE PRESENT WITHIN THE DETECTOR CELL.
Ensure the sensor is switched OFF and UNPLUGGED
prior to detection cell cleaning.

Under normal operation the detection cell in the digitalPID sensor will require cleaning about once every 200 hours of operation, more often if the sensor is used in dusty environments. There is no inlet filter on the digitalPID and therefore dirt can accumulate within the detection cell. An easy method for monitoring the dirt accumulation in the detection cell and on the lamp face is to use the results of successive calibrations. If the calibration values get progressively lower for a given calibration gas concentration then this is a good indication that the detection cell and lamp require cleaning.

Shut off the sensor and remove the power cable. Following the procedure of section 3.3 to remove the lamp. Obtain a can of compressed air that has a small diameter plastic delivery tube on it. A recommended product is "Aero Duster" (available from Miller-Stephenson Chemical Company, product number MS-222N) or a similar product such as "Dust Off" (available at most camera stores). Look into the end of the lamp cavity and note the stainless steel plate at the far end that has three 1mm wide slots cut in it. Insert the delivery tube of the Aero Duster into the lamp cavity and position it near the slots. Actuate the nozzle on the Aero Duster and blow off the dust accumulated within the slots. **CAUTION: Wear adequate eye protection while cleaning the detection cell.** Remove the inlet needle from the sensor and use the Aero Duster to blow out any accumulated dust in the needle. After cleaning replace the lamp and re-calibrate the sensor.

3.5 RF Circuit Tuning

The RF circuit is tuned automatically by the microprocessor each time that the sensor is turned on. In addition the user can issue a Lamp command (F5) that will cause the microprocessor to retune the RF circuit. However if the lamp has been replaced or the lamp holder/antenna former has been re-positioned the offset adjustment on the RF Interface circuit may need adjustment.

1) Using a test harness, connect an ammeter in line with the RF power wires. Turn on the sensor and allow it to warm up. Once the sensor has completed its auto tuning note the duty cycle shown on the DPID program main screen. Ideally the duty cycle should be about 72% +/-5%. If the duty cycle is outside of this range then the RF Interface potentiometer should be adjusted.
2) If the duty cycle is less than 72% then turn the potentiometer in a clockwise direction one or two turns. If the duty cycle is greater than 72% turn the pot counter clockwise.
3) Issue a Lamp command (F5) and wait until it completes (this can take up to 1 minute). Check the duty cycle on the main menu screen and readjust the pot if necessary.

3.6 digitalPID Test Procedure

The following procedure is followed when checking and cleaning a sensor. Under normal operating conditions this procedure should be performed about once a year.

1) Remove sensor from case (section 3.1).
2) Remove and clean the lamp (section 3.3).
3) Clean the detection cell (section 3.4).
4) Connect the sensor to the test computer and a battery. When testing older models (those with grooves along their sides), remember to place a jumper wire between the RF module and the communications connector at the back of the sensor.
5) Place a current meter on the RF line. Use the RF test harness.
6) Connect the ground lead of a voltmeter to the communications connector. The other lead will be used to measure voltages.
7) Start the DPID program and set the sensor serial number. Set the gain to 0 then issue an Init (F1) command. Turn the sensor on (F2). If the sensor doesn't start within 2 minutes try to start it again (F2). If after several attempts the sensor still doesn't start then proceed to section 3.8.
8) Turn on the supply of zero air and set the flow to about 1100 SCCM. Place the hose over the inlet needle, ensure that the tube does not seal on the inlet needle.
9) Measure and record the output voltage of the 300 volt power supply. If the output of the power supply is less than 285 V change it.
10) Go to the Record Menu (F8), enable (F2), zero (F6), record zero level (wait until output reasonably level, should be about 5K).
11) Turn air off, turn calibration gas on (use 100-ppm concentration). Record level. If level is greater than 40K then continue with step (12). If level is between 30K and 40K, then clean the lamp and try re-tuning the RF circuit (section 3.6) to maximize the output. If level is less than 30K, then change the lamp. Check the RF current, if the current is less than 0.070 amps and the sensor output is less than 30K, change the lamp. Record the RF current.
12) Turn the gas off, turn the zero air on. Disable (F3), exit (F11), set gain to 3 (set to 3, then F3). Go to the Record Menu (F8), enable (F2), set record filename (Rxx.dat, where xx is s/n). Set record time to 00:00:30. Zero the sensor (F6) and wait until the output is reasonably flat. Record the zero level. Press Record Data (F4) key. Wait until the recording finishes.
13) Turn off air, turn gas on (1 ppm). Record output level. If output > 10K, make notes and finished. If less than 10K, then try to re-zero with air and repeat (12), if still low then make note and set aside for further evaluation.
14) Use FAN program to check recorded data for noise level. Noise should be less than 500 A/D levels on high gain.

3.7 Sensor Fails to Start

The following procedure should be followed when evaluating a sensor that fails to start. It is assumed that the sensor is connected to a power supply (battery) and the test computer. It is further assumed that there is a known good lamp in the sensor.

1) Check for 12-volt power at the sensor. Connect the ground lead of a voltmeter to the communications connector. Measure the voltage on both sides of fuse F1. If 12 volts not present on both sides then replace fuse and check voltage again. If fuse is blown again then check for shorts on the circuit board and check diode D9.
2) Check for the +5 volt microprocessor power (pin 3 of U14, pin 26 of U5, pin 32 of U1, pin 16 of U9). If not present, replace voltage regulator U14.
3) Try issuing Init command to sensor, if there is no response then check connection to computer. Also unplug the sensor for about 1 minute and then plug it in again, issue an Init command. If still no response run ProComm or a similar communications program on the PC and press the reset button on the communications connector. The digitalPID copyright banner should be seen on the computer screen (communications parameters should be set to 19200 baud, no parity, 8 data bits, 1 stop bit). If the banner is not seen then unplug the sensor and wait 1 minute, then plug it in again. Press the reset button. If the banner is still not seen then there is a communications failure. Check PC set-up and the communications cable. If these are okay then replace the RS-232 driver IC U9.
4) It is now assumed that the sensor has power and is communicating with the PC but the sensor won't light when switched on. Measure the voltage at pin 3 of relay K3. Switch the sensor on, if the supply voltage is not seen after switching on then replace K3.
5) Measure the -15 volt power supply after switching the sensor on (pin 5 and 6 of connector S2. If -15 volt is not present then replace the -15 volt power supply module.
6) Measure the voltage at the filter feed-throughs on the RF module (J1 on RF Interface board) it should be -15 volts. Measure the voltage on J2 (RF control voltage) it is normally about –5 volts. If not then check the connections to the RF Interface.
7) Monitor the current to the RF module and try to re-tune the RF circuit (section 3.5). If during the attempt to light the lamp the RF current is less than about 0.040 amps then replace the lamp.
8) If the lamp will still not light then remove the lamp holder/antenna former and check the tightness of the antenna on the former. Tighten the antenna if the coils are loose and then try to start the sensor again.
9) There is a light sensor on the RF circuit board. If this sensor is not working then the lamp may light but the lamp status (on the DPID computer program) will never show numbers less than about 200, in addition the lamp will light but the pump won't start and after about 2 minutes the lamp will go out again. If this is the case then replace the light sensor.

3.8 Troubleshooting

Table 3.1 Troubleshooting Table

Problem	Recommended Action
digitalPID sensor does not respond when "INIT" command sent.	1. Ensure that the power/communications connector is plugged securely into the sensor. 2. Ensure that the 12-volt DC battery has sufficient voltage and is connected correctly. 3. Ensure the communications wires are connected correctly. 4. Ensure the PC is operating correctly and the correct serial #, port #, and slot # are shown on the DPID program main menu. 5. If none of the above solves the problem then try removing power from the sensor for about 1 minute and then re-apply the power. This will cause the microprocessor in the sensor to reset. 6. Check the sensor's internal fuse located near the connector end of the main circuit board and replace if it necessary. (Littelfuse part number 25101.5, 1.5 Amp)
UV lamp does not switch on, "Lamp" status number is high (>150).	1. Ensure that the "Mode" setting on the main menu of the DPID program is set to "ON". 2. Issue the "Mode" command (F2), check the "Status" section of the main menu to see if the sensor has received the command, this will be indicated by an "ON" under the "Mode" column. 3. The UV lamp can take up to 2 minutes to light especially if the unit has not been turned on for a while. 4. If the UV lamp has not lit after about 2 minutes, the sensor will automatically switch itself "OFF". Issue a "Query" command (F6) and check the Status section to see if the sensor is "ON" or "OFF". If the sensor has powered itself OFF, then wait about 1 minute, and then issue another "Mode" command (F2). 5. Ensure that the 12-volt battery is fully charged and that the sensor is connected to the battery correctly. 6. Ensure that a UV lamp is present in the sensor and the lamp screw cap is on. 7. If repeated attempts to turn on the UV lamp fail then replace the lamp. If the new lamp does not light then return the digitalPID sensor to the factory for repair.
Pump does not run, "Lamp" status indicates that the lamp is lit.	1. Ensure that the "Mode" setting is set to "ON" not to "IDLE". Idle turns on all power supplies in the sensor but leaves the pump off. 2. Ensure the "Lamp" status shows a number less than about 20. If the lamp is not bright enough (a number less than 20) the pump will not run. The pump will not run if the UV lamp is not on. 3. Ensure that the pump connector inside the sensor is properly attached and that the power wires are not broken.

Table 6.1 Troubleshooting Table (continued)

Problem	Recommended Action
Pump runs but no air is sucked into inlet needle.	1. Check the inlet needle for blockages (see section 6.1 for procedure). 2. Check the sample line between the detection cell and the pump for a pinched or crimped hose. 3. Check the exhaust line between the pump and the outlet for a pinched, blocked, or crimped hose.
UV lamp is on and pump is on but the sensor does not respond to gas concentrations.	1. Check that the pump is drawing air into the sensor head inlet needle (see previous troubleshooting information on pump). 2. Switch the sensor to a higher gain setting. 3. Change the "Range" setting under the "Display Options" section of the "Record" menu to a more sensitive range. This will allow small signals to be seen on the graph. 4. Ensure that the tracer in use has an ionization potential of 10.6 eV or less (see Appendix D for ionization potentials of common compounds). 5. Ensure that the concentration of the tracer gas delivered to the sensor is greater than 100 ppb propylene equivalent. 6. If using calibration gas standards ensure that the flow rate of the calibration gas to the sensor is about 1.1 times the sensor inlet flow rate.
Sensor operates correctly but the signal output has a positive offset.	1. Ensure the sensor is operating in a clean environment with no background ionizable material present. 2. Issue the "Zero" command (F4) from the main menu or (F6) from the record menu. 3. If after zeroing the offset is still greater than desired then reduce the "Zero" setting in the main menu to a smaller number and re-issue the "Zero" command.
Sensor operates correctly but a red line is seen at the bottom of the record menu graph.	1. This indicates that the sensor is "under flowing". This usually occurs when the sensor is zeroed with some background level of ionizable material present and then this background level decreases. 2. Issue a "Zero" command and check that the "Zero" setting on the main menu is greater than about 50. Only zero when clean background is present. 3. Ensure the pump is operating correctly and that there is the correct flow into the inlet needle.
Sensor operates correctly but a red line is seen at the top of the record menu graph.	1. This indicates that the sensor is "over flowing". This usually occurs when the concentration of ionizable material present is greater than the maximum for the gain range setting. 2. Change to a lower gain setting. Issue a "Gain" command (F3) after setting the "Gain" setting to the desired level. Note: gain 0 is the lowest gain and gain 3 is the highest. 3. Issue a "Zero" command when the background concentration is zero. When initially switching to the highest gain settings the sensor may indicate an overflow. Always re-zero when changing gain settings for the first time. Only zero when clean background is present. 4. Ensure the pump is operating correctly and that there is the correct flow into the inlet needle.

Table 3.1 Troubleshooting Table (continued)

Problem	Recommended Action
Sensor operates correctly but a red line is seen in the middle of the record menu graph.	1. This indicates that the sensor is not transmitting data. This usually occurs when there is a communications or power problem. 2. Exit the "Record" menu and issue a "Query" command (F6) from the main menu. Check that the sensor responds to the Query and that it is turned on and the lamp is lit. 3. If there is no response to the Query command then check communications lines and power cables to the sensor. Also check the battery voltage. 4. Try unplugging the sensor for 1 minute and then re-applying power. This will perform a microprocessor reset. Note: if power is re-applied too quickly a reset will not take place. 5. If power has been lost then the sensor must be re-initialized ("Init" command (F1)) prior to turning it on. 6. If the sensor responds correctly to a "Query" command, check that the "Slot #" for the sensor is unique for the "Port #" that it is attached to. Note if two or more sensors have the same slot # then they will try to transmit data at the same time and this will result in data transmission errors and it will appear as if the sensor is not transmitting data.
Output signal from the sensor is noisy.	1. Because the sensor has very fast response it is able to track concentration fluctuations in the atmosphere which may appear to be "noise". Evaluate sensor noise with a steady flow of calibration gas. 2. If the background sensor noise is above the typical noise level (10 A/D levels on gain 0, 40 A/D levels on gain 1, 160 A/D levels on gain 2, and 320 A/D levels on gain 3) then clean the lamp and detection cell.

3.10 Technical Assistance

Technical assistance is available by regular mail, email, phone, or fax. Use the information below to contact Aurora Scientific Inc.

Address:	Aurora Scientific Inc. digitalPID Technical Assistance P.O. Box 2724 Richmond Hill, Ontario, CANADA L4E 1A7
Phone:	1 905 727-5161
Toll Free:	1 877 878-4784
Fax:	1 905 713-6882
Email:	questions@AuroraScientific.com
Web site:	www.AuroraScientific.com

Appendix A Schematics and Assembly Drawings of the digitalPID Sensor

Drawing #	Title
DDC101	digitalPID Detector Schematic
Micro	digitalPID Micro-processor Schematic
Power Supply	digitalPID Power Supply Schematic
RF Lamp Drive	digitalPID RF Lamp Drive Schematic
RF Interface	digitalPID RF Interface Schematic
DP-ASM1	digitalPID Assembly - Sensor Internal View
DP-ASM2	digitalPID Assembly - Overall Dimensions
DP-ASM3	digitalPID Assembly - Mounting Configuration
326-E934	General Assembly - Cable, Sensor-Modem (RS-232)
326-E935	General Assembly - Cable, Sensor-Power (RS-485)
326-E938	General Assembly - PC-RS-485

Appendix B Sensor Specifications

General

Detector Type: Photo-ionization, with 10.6 eV, RF-excited, electrodeless discharge tube.

Frequency Response: 50 Hz.

Detection Limit: 50 ppb (propylene).

Gain Ranges:

Gain Setting	Gain Factor	Full Scale Conc. (ppm)	Integration Time (msec)	Number of Integrations/sample
0	x1	1000	0.25	64
1	x4	250	1.00	16
2	x16	62	4.00	4
3	x32	31	8.00	2

Gas Sampling Rate: 1.0 litre/minute.

Microprocessor Controller: Motorola 68HC11

A/D Converter: 20-bit precision, wide dynamic range, charge digitizing A/D converter.

Data Rate: 50 samples/second.

Output Data Format: 18-bit output formatted as 3 printable ASCII characters in range from 0 to lower case o (Hexadecimal 30 to Hexadecimal 6F).

Communications: RS-232 and RS-485 (only one communication mode allowed at a time, configuration of mating connector determines the communications mode).

Connector: Power and Communications: 2-row male DB-15.

Environmental

Operating Humidity Range: 0 to 90% RH (non-condensing).

Operating Temperature Range: 32F to 105F (0C to 40C).

Physical

Enclosure:	Anodized aluminum.
Dimensions:	2.0" (5.1 cm) high, 3.0" (7.6 cm) wide, 8.75" (22.2 cm) long.
Weight:	2.25 lbs (1.0 kg).
Power:	0.5A @ 12VDC.