

## OZONE ANALYZER

### Model UV-100

#### Overview

The model UV-100 is a UV absorption analyzer designed specifically for ozone. It uses a mercury lamp filtered for absorption at 254 nm. The Eco Sensors design is compact and uses the latest digital microprocessor technology. The standard calibrated range of the UV-100 is 0-999 PPM. Its outputs are an LCD digital display, 0-2.5 VDC, 4-20 mA, and a time and date stamped digital data stream for external readout and data logging. The data output are via serial port and USB. There is also an internal data logger which can store and forward approximately 90 hours of data. The theory of operation is described in Appendix D.

Panel LEDs indicate: power, low Lamp output, low pump flow rate, and ozone concentration at the sampling point exceeds 0.1 PPM.

The instrument is conditionally warranted for one year. Read the warranty statement at the end of this manual.

#### Operation

Plug the AC adapter into AC power and plug the adapter's output plug into the power jack on the instrument. Find the power switch on the rear panel and turn the instrument on. The green LED "Power" indicator and the LCD display backlighting should illuminate. **Allow at least 30 minutes warm-up.** More than 1 hour is preferred if time permits. Initial PPM readings may start out high and possibly drop to zero for a few minutes. Then the readings will tend towards the actual value as the systems settles into equilibrium.

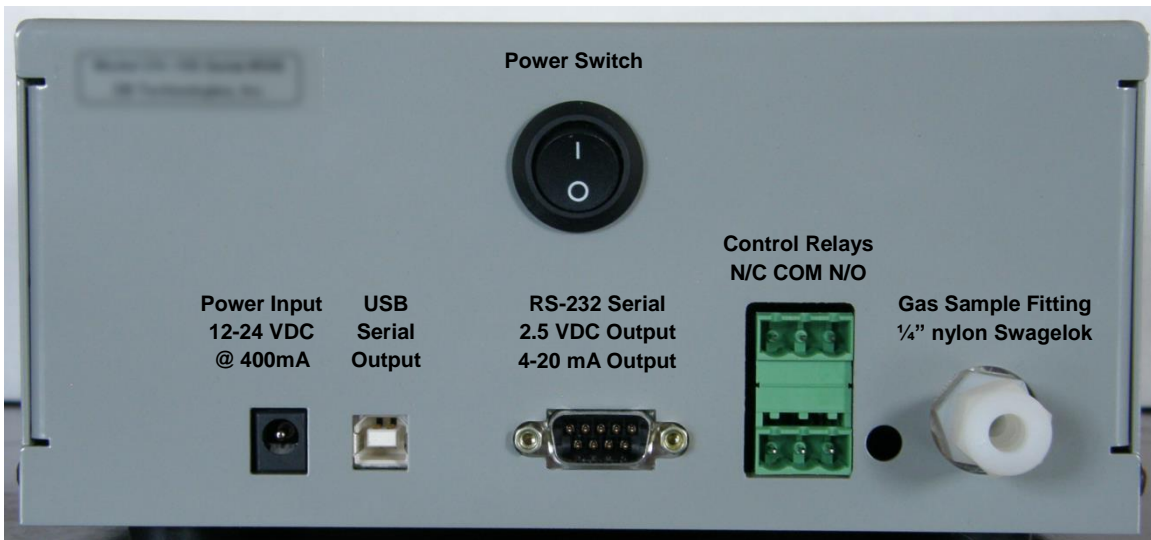
**The compact, high-speed sample pump in the instrument makes a buzzing sound. This is normal.**

Connect your sample feed tubing to the instrument's 1/4" input compression fitting. The inlet tubing should be made of PTFE (Teflon), PFA, FEP, PVDF or some other inert material that does not destroy ozone and that does not desorb plasticizers and other organics that can contaminate the flow path. The length of tubing should be kept as short as possible (preferably not more than a few feet) to minimize ozone destruction within the inlet tubing. Tygon, polypropylene (which may look like Teflon) and metal tubing should not be used. FEP-lined Tygon tubing, which is used inside the instrument provides the flexibility of Tygon with the inertness of FEP. A Teflon or PVDF inlet filter is highly recommended to prevent internal contamination of the tubing and absorption cell by particulate matter. Filters and filter holders are available through Eco Sensors.

## Front Panel



## Back Panel



## Front Panel

### LCD Display

The data displayed on the LCD depends on a variety of settings that are available via the **Instrument Menu** and **Function** Knob.

By default, when the instrument starts, the front panel LCD will display the software version number and the date & time, followed by ozone measurements, temperature & pressure measurements and the date & time. Also available are average & instantaneous ozone measurements, log sample number and flow rate.

### LED Indicators

> **0.1 PPM:** Measurement is above the OSHA Limit for 8-hour exposure to ozone

**Low Flow:** Input sample draw is less than the average of 1 LPM. Check the inlet tubing and filter for obstruction.

**Low Lamp:** UV Lamp output is below normal levels. This can be caused by internal contamination or a fault in the lamp or lamp circuitry. Contact our Technical Support if this light turns on.

**Power:** UV-100 is powered and operating.

### Function Knob

The **Function** Knob is used to navigate the instrument menu. The knob rotates clockwise or counterclockwise to move the selection cursor around the menu. The knob depresses like a pushbutton to enter the menu and activate a cursor selection.

## Instrument Menu

To access the instrument menu, push and hold the **Function** Knob on the front panel until:

**Menu**

is displayed, then release the knob. After a few seconds, the menu selections will appear:

**Menu**

**Dat Avg Cfg Lmp ←**

**Dat** (Data Logging), **Avg** (Averaging), **Cfg** (Configuration), and **Lmp** (Lamp) are submenus that may be selected. The blinking cursor at the bottom of the display indicates which submenu item is selected. Rotating the **Function** Knob in either direction will move the cursor between items. Pushing the **Function** Knob will enter the submenu of the selected item. To exit the menu or submenu, select the back arrow (←) and press the knob.

### **Averaging (Avg) Submenu:**

From the instrument menu, select **Avg** and push the **Function** Knob. The averaging submenu will appear:

**Avg Menu**

**10s 1m 5m 1h ←**

The options are represented in terms of averaging times. The minimum measurement cycle of the UV-100 is 10 s, therefore the default selection of 10 s represents no additional averaging. A 1 m average time will average 6 discrete measurements. A 5 m averaging time will average 30 discrete measurements. A 1 h averaging time will average 360 discrete measurements. While in averaging mode, the front panel display will alternate between the instantaneous 10 s measurement and the averaged value at 5 s intervals.

### **Data (Dat) Logging Submenu:**

From the instrument menu, select **Dat** and push the **Function** Knob. The data submenu will appear:

**Dat Menu**

**Xmt Log End ←**

*Start Log:*

To start logging to the internal memory, select **Log**. You will be prompted to overwrite any data that is stored in the instrument:

**Overwrite Data?**

**No Yes ←**

If there is data stored in the instrument that you need to keep, select **No** and follow the instructions below to download the data to a computer. Otherwise, to erase all previous data and start a new log, select **Yes**. This will start the log and return to the **Dat** menu. The UV-100 will now store all readings until the internal memory is filled.

*Power Loss:*

The log data is retained when the UV-100 loses power or when it is turned off with the power switch. In these circumstances, when power is returned to the UV-100, the note: "Data Interruption" is written to the log file and then logging is resumed. This allows the UV-100 to be used remotely in one or multiple locations and then returned to a computer for download.

*Logging with Averaging Enabled:*

The UV-100 can store up to 32,736 lines of data. When averaging is enabled, data is logged at the same rate as the averaging. The approximate log duration is indicated below for each setting.

<b>Averaging</b>	<b>Approximate Log Duration</b>
10 s	3.8 days
1 m	22.7 days
5 m	113 days
1 h	3.7 years

*Stop Log:*

To stop logging to the internal memory, select **End** from the **Dat** menu.

*Transmit Log:*

To transmit the contents of the log to a computer, setup the USB connection as described in the section: "Digital Data Output" and then select **Xmt** from the **Dat** menu.

If you select **Xmt** prior to stopping the log with **End**, then the UV-100 will automatically execute the **End** command prior to transmitting the log.

### **Configuration (Cfg) Submenu:**

From the instrument menu, select **Cfg** and push the **Function** Knob. The configuration submenu will appear:

#### **Cfg Menu**

**D/T Cal I/O Unt ←**

#### *Date and Time (D/T):*

From the **Cfg** submenu, select **D/T** and push the **Function** Knob. The **D/T** submenu will appear:

**D/T: 14:32:21 ←**

**17/10/2016**

The time format is 24-hour, military time (HH:MM:SS). The date format is European standard (DD/MM/YYYY). To change a value, rotate the knob to move the cursor to the value you want to change, push the knob to activate the value, rotate the knob to change the value, and then push the knob again to store the value. You may then rotate the knob to select a different value and repeat the process.

#### *Calibration (Cal):*

The instrument is calibrated at the factory where slope and offset parameters are entered into the instrument's memory. These preset calibration parameters are given in the instrument's Birth Certificate and recorded on the calibration sticker on the back of the instrument. However, the calibration parameters may be changed by the user.

The instrument zero may drift by a few ppb over time. For this reason, frequent zeroing of the instrument using an external ozone scrubber, to determine the offset, may be desirable. Any change in the slope (gain) of the instrument is likely due to a serious problem such as contamination, an air leak, obstruction of air flow, or loss of catalytic activity by the internal ozone scrubber. The slope can be adjusted by the user but in most cases, it is recommended that the instrument is returned for service and recalibration.

From the **Cfg** submenu, select **Cal** and push the **Function** Knob. The **Cal** submenu will appear:

#### **Cal Menu**

**Fm O3 ←**

To change the calibration factor for the flow meter, select **Fm** from the Cal Menu and push the **Function** Knob. The submenu will appear:

**Fm Cal Menu**

**Fm= 0.92 ←**

This is a multiplicative factor that will increase the flow rate if you increase the value. Adjust this value to correct the flow value when comparing it to a calibrated volumetric flow meter connected to the inlet of the instrument.

To change the calibration factors for the ozone measurement, select **O3** from the Cal Menu and push the **Function** Knob. The submenu will appear:

**Cal Menu**

**Z= -3 S= 1.01**

**Z** is the offset applied (in this case -3 ppb) and **S** is the slope applied (in this case 1.01). The value of **Z** is added to the measured ozone value, and the value of **S** is then multiplied by the measured ozone value. During calibration, **Z** is set to 0 and **S** is set to 1.00. If the instrument reads an average of 3 ppb with the external scrubber in place, the value of **Z** should be set to -3. If after correction for the zero, the instrument consistently reads 2% low (in the presence of a precisely known ozone concentration), the value of **S** should be set to 1.02.

To change a value, rotate the knob to move the cursor to the value you want to change, push the knob to activate the value, rotate the knob to change the value, and then push the knob again to store the value. You may then rotate the knob to select a different value and repeat the process.

*Inputs & Outputs (I/O):*

From the **Cfg** submenu, select **I/O** and push the **Function** Knob. The **I/O** submenu will appear:

**I/O Menu**

**Bdr Ext Hrs ←**

*Baud (Bdr):*

The baud rate is not adjustable at this time.

*External Outputs (Ext):*

The UV-100 includes analog voltage & current outputs as well as a relay that may be used to interface with other devices. Select **Ext** from the I/O submenu and push the **Function** Knob. The submenu will appear:

**Ext Menu**  
**REL1 REL2 V\_OUT ←**

*Relays (REL1 & REL2):*

To set the ON/OFF limits of the relays, select **REL1** or **REL2** from the I/O submenu and push the **Function** Knob. The settings will appear:

**On= 0009.90 ppmv**  
**Off= 0010.10 ←**

To change a value, rotate the knob to move the cursor to the value you want to change, push the knob to activate the value, rotate the knob to change the value, and then push the knob again to store the value. You may then rotate the knob to select a different value and repeat the process.

With the settings in the example, the relay will close (pass current) until the ozone concentration exceeds 10.10 ppm. Above this concentration the switch relay will open. The relay will not close again until the ozone concentration drops below 9.90 ppm. In this way, for example, ozone concentration from an ozone generation could be controlled in the range 9.90 to 10.10 ppm.

Physical connections to the relays are made via the supplied screw connectors. When viewing the connectors from the rear of the instrument, REL1 is on the bottom and REL2 is on the top. The right terminal is normally open (N/O), the center terminal is common (COM), and the left terminal is normally closed (N/C).

*Analog Voltage and Current Outputs (V\_OUT):*

To change the scaling of the analog voltage and current outputs, select **V\_OUT** from the I/O submenu and push the **Function** Knob. The settings will appear:

**2.5V=0001.00 ppm**  
**20mA=0001.00 ppm ←**

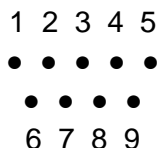
To change a value, rotate the knob to move the cursor to the value you want to change, push the knob to activate the value, rotate the knob to change the value, and then push the knob again to store the value. You may then rotate the knob to select a different value and repeat the process.



While any scaling factor may be defined, the analog voltage and current scaling factors are tied together and cannot be adjusted independently.

With the settings in this example, the output scaling factor is set as 2.5 V (full scale) = 1.00 ppm; that is, 1 V = 0.40 ppm. Also, the current output will be scaled such that the full scale of 20 mA corresponds to 1.00 ppm. A reading of zero ozone concentration will be output as 0 V and as 4 mA.

The analog output are available as part of the DB9 connector on the back of the UV-100. When viewing the connector from the rear of the instrument, the pin numbers are:



The analog voltage signal is measured across pins 1 (+) and 5 (GND). The analog current signal is measured across pins 9 (+) and 5 (GND).

#### *Hours of Operation (Hrs):*

The UV-100 logs the total number of hours that it has been in use. This is helpful for determining when the instrument should be serviced. Select **Hrs** and push the **Function** Knob. The total number of hours will be displayed.

#### *Units (Unt):*

From the **Cfg** submenu, select **Unt** and push the **Function** Knob. The **Unt** submenu will appear:

**Unt Menu**

**T/P O3 ←**

Changing units for ozone is not available at this time. To change the units for temperature and pressure, select **T/P** and push the **Function** Knob. The submenu will appear:

**T/P Units Menu**

**T:K P:torr ←**

For temperature, the units of °C or K may be selected. For pressure, the units of mbar or torr may be selected. To change a value, rotate the knob to move the cursor to the value you want to change, push the knob to activate the value, rotate the knob to change the value, and then push the knob again to store the value. You may then rotate the knob to select a different value and repeat the process.

### **Lamp (Lmp) Submenu:**

If the instrument measurements are excessively noisy (with a standard deviation above 2 ppb) or are always near zero in the presence of ozone, it is useful to perform a UV lamp check. Before performing the test, allow the instrument to warm up for 30 minutes.

From the instrument menu, select **Lmp** and push the **Function** Knob. The display will momentarily read:

#### **Lamp Test**

The diagnostic results will then be displayed after a short delay, for example:

**PDV= 0.89801 V**

**1.2 +/- 4.85 ←**

The PDV value should be in the range: 0.6 to 2.2 V and the +/- value should be less than 2.5. If either of these values are out of range, please contact our Technical Support.

### **Digital Data Output**

The UV-100 may be connected to a computer (via USB or serial cable) to transmit real-time data or internally logged data. 3<sup>rd</sup>-party terminal programs such as TeraTerm or puTTY are available online for interfacing with the UV-100. These programs should be setup for serial communication with the UV-100 on the correct COM port with the following settings:

Baud rate: 9600

Data Bits: 8

Parity: None

Stop Bits: 1

When the UV-100 is connected to a computer with these settings, the instrument will output a line of data at the rate defined by the averaging setting (**Menu > Avg**).

When the instrument is not in logging mode, the data output will be in the following form:

```
0.00, 304.7, 739.6, 731, 1.057, 07/03/16, 15:14:39
0.00, 304.7, 739.6, 745, 1.059, 07/03/16, 15:14:49
0.00, 304.7, 739.6, 742, 1.060, 07/03/16, 15:14:59
0.00, 304.7, 739.6, 746, 1.060, 07/03/16, 15:15:09
0.01, 304.7, 739.6, 748, 1.061, 07/03/16, 15:15:19
0.01, 304.7, 739.5, 761, 1.061, 07/03/16, 15:15:29
0.01, 304.7, 739.5, 764, 1.061, 07/03/16, 15:15:39
```

where the columns of data are:

PPM, Cell Temperature (K), Cell Pressure (torr), Flow Rate, Photodiode Voltage, Date, Time

When the instrument is logging, the data output will be in the following form:

```
1,0.00,304.7,739.6,750,1.060,07/03/16,15:16:59
2,0.00,304.7,739.6,738,1.059,07/03/16,15:17:09
3,0.00,304.7,739.6,743,1.059,07/03/16,15:17:19
4,0.00,304.6,739.6,736,1.058,07/03/16,15:17:29
5,0.00,304.6,739.6,743,1.058,07/03/16,15:17:39
6,0.00,304.6,739.5,737,1.057,07/03/16,15:17:49
7,0.01,304.6,739.5,739,1.057,07/03/16,15:17:59
8,0.01,304.6,739.6,727,1.056,07/03/16,15:18:09
Logging Ended
```

where the columns of data are:

Sample Number, PPM, Cell Temperature (K), Cell Pressure (torr), Flow Rate, Photodiode Voltage, Date, Time

To download internally logged data, navigate to **Menu > Dat > Xmt**. This will print all the stored data lines to the terminal program.

```
Logged Data
1,0.00,304.6,739.5,749,1.059,07/03/16,15:16:59
2,0.00,304.6,739.5,737,1.059,07/03/16,15:17:09
3,0.00,304.6,739.5,743,1.058,07/03/16,15:17:19
4,0.00,304.6,739.5,735,1.058,07/03/16,15:17:29
5,0.00,304.6,739.5,742,1.057,07/03/16,15:17:39
6,0.00,304.6,739.5,737,1.057,07/03/16,15:17:49
7,0.01,304.6,739.5,738,1.056,07/03/16,15:17:59
8,0.01,304.6,739.5,727,1.056,07/03/16,15:18:09
End of Log
```

where the columns of data are:

Sample Number, PPM, Cell Temperature (K), Cell Pressure (torr), Flow Rate, Photodiode Voltage, Date, Time

Different programs have different methods for saving or logging this data to a file. Please refer to the user manual of the terminal program you are using for more details.

## Accessing the Serial Menu

When the UV-100 is connected to a computer (via USB or serial cable), as described above, commands can be sent to adjust instrument parameters and initiate logging tasks. Listed below are the lower case command letters for performing operations while the instrument continues to measure.

- l** Start logging and delete previously logged data
- t** Transmit logged data
- e** End logging
- h** Output serial data line header
- m** Serial menu

If the letter **m** is sent as a command, **menu>** will be displayed in the terminal emulator window. When the serial menu is accessed, the instrument is no longer making measurements; it is waiting for the next command to be entered. The following is the list of menu items accessible from this point:

- x** Exit menu and return to measuring
- l** Start logging and delete previously logged data
- t** Transmit logged data
- e** End logging
- h** Output serial data line header
- a** Displays list of possible averaging times and the number that must be entered to change to the desired averaging time
- z** Displays current zero calibration setting and waits for new setting followed by a carriage return
- s** Displays current slope calibration setting and waits for new setting followed by a carriage return
- c** Clock menu, displays current date and time and waits for **d** or **t** to be entered
  - From clock menu,
    - d** Asks to enter date in DDMMYY format
    - t** Asks to enter time in HHMMSS format

REL2 can operate as an ON/OFF limit switch, as described in the **Configuration** section, above. Alternatively, REL2 can be set to operate when certain diagnostic tests have failed (cell temperature, cell pressure, flow rate, photodiode voltage). The following are related commands that can be set from the serial menu:

- o** Change relay 2 operation for temperature, pressure, flow, and photodiode voltage
- q** Change relay 2 operation for ozone
- 1** Enable temperature inclusion for relay 2
- !** Disable temperature inclusion for relay 2
- 2** Enable pressure inclusion for relay 2
- @** Disable pressure inclusion for relay 2
- 3** Enable flow inclusion for relay 2
- #** Disable flow inclusion for relay 2
- 4** Enable pdv inclusion for relay 2
- \$** Disable pdv inclusion for relay 2
- ?** Indicates the enable/disable status of the diagnostic tests

The limits for each of the diagnostic tests are listed below:

Temperature	LOW: 5	HIGH: 50
Pressure	LOW: 500	HIGH: 1100
Flow	LOW: 400	HIGH: 2000
Photodiode Voltage	LOW: 0.6	HIGH: 2.45

## Calibration

The Eco Sensors, Inc., UV-100 is calibrated to a reference instrument whose calibration is traceable to the US government standards agency, NIST. The UV-100 has internal sensors and programming to correct its calibration for temperature and pressure. Calibration data and date for your UV-100 are included in the document package included with the instrument.

Recalibration can be done simply and quickly at Eco Sensors, Inc.

## Service and Maintenance

The Ozone Monitor is designed to be nearly maintenance-free. There are no user serviceable parts inside the UV-100. **Opening the enclosure will void the warranty.**

**Input Filter:** The input sample tubing filter is recommended for any operational environment. A length of Tygon TE-200 Teflon coated tubing and a disposable micromesh disk filter is provided. It is recommended that the input filter is replaced at 6 month intervals or more frequently in dusty or harsh environments.

In severe condensing humidity environments a small moisture trap may be needed on the input to protect the UV-100's internal tubing from condensing moisture internally. Contact Technical support for more information.

Components with a limited lifetime are the air pump (~5,000 hours), lamp (~20,000 hours) and solenoid valve (rarely fails). It is recommended that the instrument be returned to Eco Sensors if any of these components fail.

*The following are indications of various instrument malfunctions.*

**Air Pump Failure:** The instrument will not make a humming sound. Also, the circuit breaker may prevent the instrument from powering up if the motor in the air pump develops a short.

**Lamp Failure:** The ozone measurements will be erratic and the Lamp Test will show 0.0 volts for the photodiode voltage.

**Solenoid Valve Failure:** The ozone readings will be low and average to close to zero if the solenoid valve is not switching. Partial switching of the solenoid valve will cause the instrument to read low but not zero.

**Contaminated Flow Path:** The instrument will typically have a large positive or negative offset and the ozone readings will be low once corrected for the measured offset.

## AC Adapter

The Eco Sensors P-20-15 adapter is included with every UV-100. This adapter is suitable for Type A power outlets (North America). Adapters for other locations may be available for special order from Eco Sensors. Otherwise, adapters should be purchased locally that fit local wall sockets and conform to local codes. The output should be 12 VDC at 1250 mA. The DC plug is 5.5/2.1 mm x 10 mm, center positive (+). For more details, see our Tech Note P-101.

## Precautions

- Allow at least 30 minutes warm-up.
- Read all instructions in this manual.
- Keep the instrument dry. Never let water or other liquids into the sensor.
- Do not drop the instrument or subject it to continuous vibration.
- Do not store in high levels of dust.
- Do not clean the instrument with cleaning chemicals or solvents. Clean it with a damp cloth.
- Do not operate near heavy aerosols (spray) usage or where oxygen is being administered.
- Call a qualified electrician if you have any doubts about voltages, currents, electrical practice, etc.
- While not necessary for typical uses, for highest precision results in electrically noisy locations, the instrument should be grounded to earth to achieve maximum stability.

## UV-100 Options

- |  |                     |
|--|---------------------|
| • Pelican case                                     | PN: 20-0598         |
| • Hi Efficiency Sample Line Filter and Housing     | PN: FLTRS(LARGE)    |
| • Hi Efficiency Sample Line Filter Elements, 10pcs | PN: FILTERPAK(LARG) |
| • Heavy Duty External Pump(replaces internal pump) | PN: EXT PUMP(HD)    |

## Specifications

<b>Sensor Technology:</b>	UV Absorption
<b>Measurement Range:</b>	0-999 ppm
<b>Resolution:</b>	0.01 ppm
<b>Precision:</b>	± 2% of reading or ± 0.01 ppm, whichever is greater
<b>Accuracy:</b>	± 2% of reading or ± 0.01 ppm, whichever is greater
<b>Response Time:</b>	< 60 s
<b>Measurement Rate:</b>	10 s
<b>Temperature Compensation:</b>	Yes
<b>Recommended Temperature Range:</b>	10-40 °C
<b>Recommended Humidity Range:</b>	0-80% RH
<b>Power Requirements:</b>	11-28 VDC, nominally 500 mA at 12 V, 6.0 watt
<b>Enclosure Size:</b>	3.75 x 8.5 x 8.5 in (9.5 x 21.6 x 21.6 cm)
<b>Weight:</b>	4.0 lb (1.8 kg)

## Warranty

This product is warranted against defects in materials and workmanship for one year following the date of purchase by the original owner. This warranty does not include damage to the product that results from misuse, accident, dropping, modifications or alterations, and it does not apply if the instructions in this manual are not followed, or if the unit is otherwise used outside its intended specifications.

If a defect develops during the warranty period, Eco Sensors, in its sole discretion, will repair the instrument or replace it with a new or reconditioned model of equivalent quality. In the event of replacement with a new or reconditioned instrument, the replacement unit will continue the warranty of the original unit.

If the product should become defective during the warranty period, please return it through your distributor, or call Eco Sensors at (800) 472-6626 or e-mail at [sales@ecosensors.com](mailto:sales@ecosensors.com) to receive return instructions and a Return Materials Authorization (RMA) number.

Except as provided herein, Eco Sensors makes no warranties, expressed or implied, including warranties of merchantability and fitness for a particular purpose. Eco Sensors shall not be liable for loss of use of this instrument or other incidental or consequential damages, expenses or economic loss, or claims for such damage or economic loss.

RECORD YOUR SERIAL NUMBER HERE

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KEEP THIS MANUAL AND WARRANTY FOR YOUR RECORDS.

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For brochures, application and tech notes, and other useful information, visit our extensive website at [www.ecosensors.com](http://www.ecosensors.com). E-mail us at [sales@ecosensors.com](mailto:sales@ecosensors.com).



## APPENDIX A

### USB Driver Installation

#### Items Required

- UV-100 Ozone Monitor
- USB Cable
- PC Computer
- USB to UART Driver Disk  
(or download drivers from the Firmware and Software Section on our support webpage:  
[www.ecosensors.com/support/](http://www.ecosensors.com/support/))

#### Driver Installation

- With the UV-100 off, attach USB cable from the instrument to a USB port on the computer.
- Turn the UV-100 on. The computer will fail to locate drivers on its own.
- On a Windows computer, locate the Device Manager.
- Within the list on the device manager, locate the device that is not correctly installed
- Right-click on the device and choose “Update Driver Software”
- In the window that opens, choose “Browse my computer for driver software”
- In the next window, click the “Browse” button and then navigate to the driver file (unzip this file first)
- Select the unzipped file: cdc\_NTXPVista7.zip and click “Ok”
- Follow any other remaining on-screen instructions.

## APPENDIX B

### Using the USB Connection

#### Determining the COM Port

With the instrument connected, turned on, and the drivers installed, determine which COM port the connection is using:

- If using Windows, locate the “Device Manager”
- Press the “+” sign next to “Ports”.
- The COM port number is indicated in parenthesis, next to the “USB to UART” listing. This number will be used for the settings for the terminal program.

#### Using the Connection

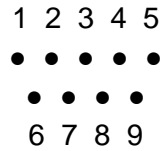
The UV-100 may be connected to a computer (via USB or serial cable) to transmit real-time data or internally logged data. 3<sup>rd</sup>-party terminal programs such as TeraTerm or puTTY are available online for interfacing with the UV-100. These programs should be setup for serial communication with the UV-100 on the correct COM port with the following settings:

Baud rate: 9600  
Data Bits: 8  
Parity: None  
Stop Bits: 1

## APPENDIX C

### Pinout of the DB-9 Connector

Rear view of the UV-100 DB-9 Connector (Male)



#### Pin Description:

1	0-2 V Analog Signal Out
2	TXD RS-232 Transmit
3	RXD RS-232 Receive
4	No Connection
5	Ground
6	No Connection
7	No Connection
8	No Connection
9	4-20 mA Analog Signal Out

## APPENDIX D

### Application Examples

Two examples of common applications for the UV-100 are described below. These are shown **for reference only**. For more details contact Eco Sensors Tech Support.

#### Remediation Example

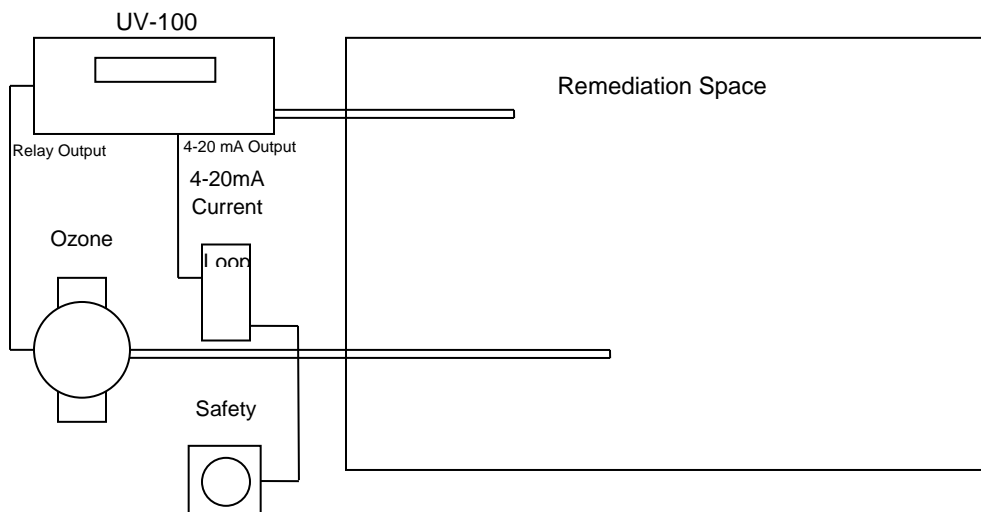
Ozone's cleaning and disinfecting properties are well known. Its ability to break down bacteria and a wide range of contaminants with almost no residue is just beginning to be used in real-world applications. The following is an example of one of Eco Sensor's Customer setup to remove mold from rooms and combined spaces in flooded homes:

Items:

- UV-100
- Ozone generator(s) (UV 550 Pro or similar)
- Power relay (s) for generator and fan (optional)
- Indicator light for OSHA limit
- 4-20 mA current loop

To destroy mold the space is held at a very high Ozone level for a predetermined amount of time. The generator is controlled using the set point relay on the back of the UV-100 to hold Ozone.

After the Ozone "dwell" interval is complete, generator power is shut off or UV-100 generator ON level is set to zero. Over the course of a few hours the Ozone will decay to zero. In this particular installation an indicator light was tied to the 4-20 mA output to give an "all clear" indication when the space was reading under the OSHA immediate limit of 0.3 PPM. 4-20 mA scale is set to 4 mA = 0 PPM, 20 mA = 1 PPM.



## Cold Condensing Example

### Items:

- UV-100
- Tygon SE-200 Teflon lined tubing, length variable
- Small moisture trap
- Ozone generator (if Ozone control is required)

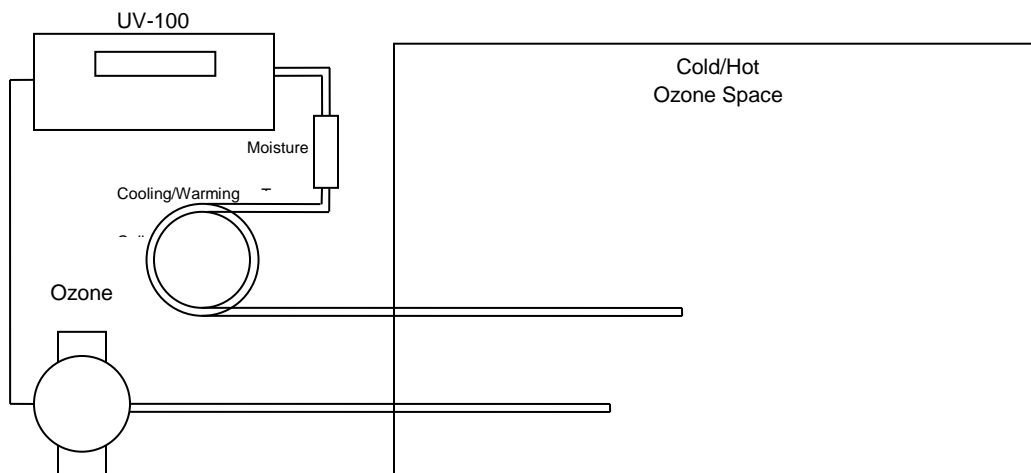
In some applications the environment under measurement is outside the temperature and/or humidity range of the UV-100. Several methods can be used to shield the UV-100 from these extremes.

The UV-100 is kept isolated by being outside the cold space and by using a long length of inlet tubing, the majority of which coiled outside the cold space. This allows for the inlet sample to be warmed to an acceptable level before measurement.

Condensation from the temperature change is eliminated using a small moisture trap spliced into the inlet line.

Due to the extra length of inlet tube and moisture trap, offsets will need to be made for measurements. The reading will be delayed depending on the length of tube, as much as an extra minute or more. Testing with high Ozone pulses can determine this delay.

The reading will also be attenuated as much as 5% due to the inlet length and loss from the moisture trap.



## APPENDIX E

### Theory of Operation

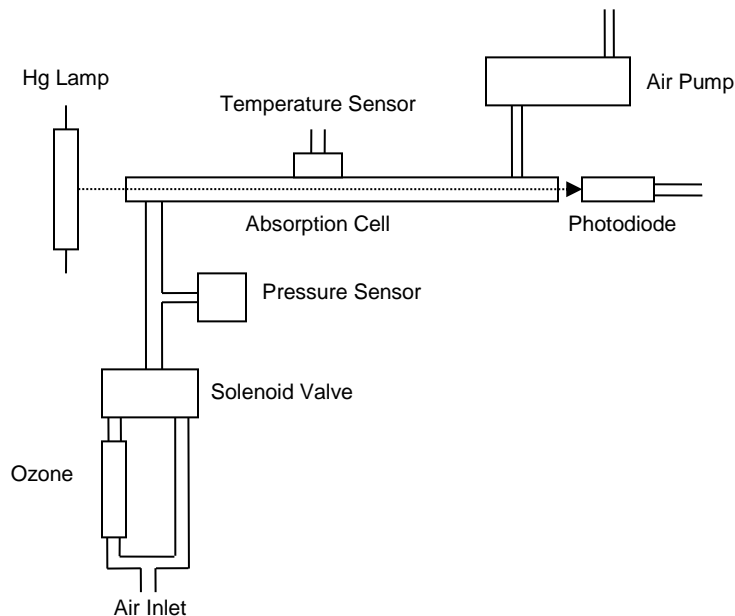
The Eco Sensors Ozone Monitor is designed to enable accurate measurements of indoor ozone over a wide dynamic range extending from a limit of detection of .01 ppm by volume (ppmv) to an upper limit of about 1,000 ppm based on the well-established technique of absorption of ultraviolet light at 254 nm. The Ozone Monitor is light weight (4.7 lb., 2.1 kg.) and has low power consumption ( $\approx 5$  watt) relative to conventional instruments and is therefore well suited for applications such as:

- Industrial hygiene monitoring where ozone may be present in the workplace.
- Control of ozone generators and systems.
- Research and quality checking of ozone emitting equipment.
- Monitoring high ozone concentrations such as process off-gassing.

### Theory of Operation

Absorption of UV light has long been used for measurements of atmospheric ozone with high precision and accuracy. The ozone molecule has an absorption maximum at 254 nm, coincident with the principal emission wavelength of a low-pressure mercury lamp. Fortunately, few molecules found at significant concentrations in the atmosphere absorb at this wavelength. However, interferences, such as organic compounds containing aromatic rings, can occur in highly polluted air.

#### Schematic Diagram of UV-100



Ozone is measured based on the attenuation of light passing through a 6.2 cm long absorption cell fitted with quartz windows. A low-pressure mercury lamp is located on one side of the absorption cell, and a photodiode is located on the opposite side of the absorption cell. The photodiode has a built-in interference filter centered on 254 nm, the principal wavelength of light emitted by the mercury lamp. An air pump draws sample air into the instrument at a flow rate of approximately 1 L/min. A solenoid valve switches so as to alternately send this air directly into the absorption cell or through an Ozone scrubber and then into the absorption cell. The intensity of light at the photodiode is measured in air that has passed through the Ozone scrubber ( $I_o$ ) and air that has not passed through the scrubber ( $I$ ). Ozone concentration is calculated from the measurements of  $I_o$  and  $I$  according to the Beer-Lambert Law:

$$C_{O_3} = \frac{1}{\sigma l} \ln\left(\frac{I_o}{I}\right)$$

Where  $l$  is the path length (6.2 cm) and  $\sigma$  is the absorption cross section for ozone at 254 nm ( $1.15 \times 10^{-17}$  cm<sup>2</sup> molecule<sup>-1</sup> or 308 atm<sup>-1</sup> cm<sup>-1</sup>), which is known with an accuracy of approximately 1%. The Eco Sensors instrument uses the same absorption cross section (extinction coefficient) as used in other commercial instruments.

The logarithm of equation 1 is approximated in the microprocessor of the instrument with sufficient accuracy to provide five orders of dynamic range; ozone mixing ratios are measured up to 1,000 ppmv, as compared to 1 ppmv for most commercial ozone instruments.

The pressure and temperature within the absorption cell are measured so that the ozone concentration can be expressed as a mixing ratio in parts-per-million by volume (ppmv).

In principle, the measurement of ozone by UV absorption requires no external calibration; it is an absolute method. However, non-linearity of the photodiode response and electronics can result in a small measurement error. Therefore, each instrument is compared with a NIST-traceable standard ozone spectrophotometer in the laboratory over a wide range of ozone mixing ratios. These results are used to calibrate the Ozone Monitor with respect to an offset and slope (gain or sensitivity). Calibration data is supplied with the instrument. It is recommended that the instrument be recalibrated at least once every year and preferably more frequently. The offset may drift due to temperature change or chemical contamination of the absorption cell. An accurate offset correction can be measured from time to time using the ozone scrubber ("zero ozone filter") available for use with the instrument.

**IMPORTANT NOTE:** The calibration of the UV-100 is pressure (P) and temperature (T) compensated. Many other UV analyzers on the market are not P and T compensated even though their calibration is certified as traceable to an international standard. The major difference that will be observed from the lack of P and T compensation is at high altitudes the UV-100 will read a higher ozone concentration inversely proportional to the barometric pressure at the higher altitude versus the barometric pressure at sea level. A convenient formula for approximating the correction for Ozone analyzers other than the UV-100 is: For every 1,000 meters of altitude, add 14% to the uncorrected reading or for every 1,000 feet of altitude, add 5% to the uncorrected reading.