



Series 6103

OZONE TRANSFER STANDARD MULTI-GAS CALIBRATOR

User's Guide

Revision 7
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Software Rev 6103-1.39-XX

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WARNING

**READ THIS MANUAL CAREFULLY BEFORE USING THIS INSTRUMENT.
FAILURE TO DO SO MAY VOID THE WARRANTY,
DAMAGE THE INSTRUMENT OR CAUSE SERIOUS INJURY.**

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6103 USER'S MANUAL CHANGES

Manual Rev. #	Software Rev. #	Manual Release Date	Changes
2	1.31-03	12OCT2002	Initial release
3	1.33-01	08APR2003	<ul style="list-style-type: none"> • Added manual change log page, added UL listing requirements to preface, • Adjusted index, Pages 6 and 13 • Changed PORTS Mode to GASES Mode (system now supports multi-component cylinders) • Page 22 – Added saving and recalling gas blend routines. • Pages 20, 21 – Added new view modes. • Pages 6, 34-37 added REMOTE mode. Page 17 – added power-up mode.
4	1.35-02	12SEP2003	<ul style="list-style-type: none"> • Pages 37, 38 - Added remote mode commands for flow mode, photo mode, ozone control and diagnostic information • Page 17, 33 - Added functionality for 2nd analog output channel and adjustable range for both analog output channels. • Page 40 - Added automatic pump control for PHOTO mode, CONC mode, FLOW mode and REMOTE mode.
5	1.37-01	28MAR2007	<ul style="list-style-type: none"> • Added automatic Table of Contents/Figures • Added Program Mode • Updated Status Input/Output • Removed Series 101 emulation section • Added warmup note • Added section on automatic ozone control/GPT • Updated PREFS mode section
6	1.38-01	23MAR2011	<ul style="list-style-type: none"> • Corrected typo in CONNECTING TO OTHER DEVICES section • Added Remote Mode GAS commands • Added Serial Data Output to PREFS and REMOTE sections
7	1.39-01	05MAR2012	<ul style="list-style-type: none"> • Added P&ID for 6103 with Third MFC Option • Updated various to include optional MFC3 • Updated Forward • Updated Status Output - LEADS mode • Updated Remote commands

SERIES 6103
MULTI-GAS CALIBRATOR

ENVIRONICS, INC
69 INDUSTRIAL PARK ROAD EAST
TOLLAND, CT 06084

EQUIPMENT SUMMARY – TYPE:

(X) Measurement; () Control; () Laboratory

Marked electrical rating:

115 VAC, 50/60 Hz, T2.0A
230 VAC, 50/60 Hz, T1.0A

Connection to Supply: Standard IEC Inlet Coupler/Cord Connected

Environmental rating: Standard
Temperature: 15-30 deg C
Humidity: <95% RH @ 15-30 deg C
Altitude: up to 2000 Meters

Installation Category (Annex J): Installation Category (Over voltage Category) II
Pollution Degree:2

Equipment Class (Annex H): Class II Equipment

Equipment function/feature/description:

S6003 was designed for precision Multi-Gas Calibrations with Ozone.

Mode of operation:

Concentration Mode, Flow Mode, Program Mode, Calibrate Mode.

Degree of mobility:

() Permanently Connected; (X) Other Cord Connected.

Overall size: 17"x7"x15" Weight: 27 lbs.

Ventilation requirements:

Do not cover or block the ventilation holes in the top cover or fan filter on the rear panel.

WARNING

Operating the instrument at an incorrect line voltage will damage the instrument and void the manufacturer's warranty. Check the line voltage before you plug the instrument into any power source.

For 230 volt input power, only qualified personnel shall determine the correct input power connections needed to be supplied to the system.

The standard supplied 115 volt power cord should be plugged into the rear panel power entry module of the instrument, the other end should then be plugged into a properly grounded outlet.

DISCONNECT POWER CORD FROM REAR OF UNIT BEFORE SERVICING

IMPORTANT

Before connecting or disconnecting any cables, wiring harnesses or other sources of potential electrical impulse, be sure the unit is powered OFF.

The main power disconnect for the unit shall be the power cord that is plugged into the rear of the unit. The instrument is totally enclosed at all times with a top and bottom cover for safety.

Position the equipment so that it is not difficult to operate the disconnecting device.

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LIST OF ABBREVIATIONS / ACRONYMS

AC	Alternating Current
ADC	Analog to Digital Converter
CCM	Cubic Centimeters per Minute
CGC	Cylinder Gas Concentration
DAC	Digital to Analog Converter
EMI	Electromagnetic Interference
EPA	Environmental Protection Agency
Hz	Hertz
lbs	Pounds
LCD	Liquid Crystal Display
LPM	Liters Per Minute
MFC	Mass Flow Controller
NIST	National Institute of Standards and Technology
OGC	Output Gas Concentration
P&ID	Piping and Instrument Diagram
PPM	Parts Per Million
PSIA	Pounds Per Square Inch Absolute
PSIG	Pounds Per Square Inch Gauge
RFI	Radio frequency Interference
SCCM	Standard Cubic Centimeters per Minute
SLPM	Standard Liters Per Minute
UHP	Ultra High Purity
VAC	Volts, Alternating Current
VDC	Volts, Direct Current

FORWARD

The Environics Series 6103 Computerized Ozone Transfer Standard/ Multi-Gas Calibrator was designed to be the finest instrument available for producing highly precise mixtures of ozone and other gases. The system meets or exceeds all U.S. Environmental Protection Agency requirements.



The Series 6103 consists of a single chassis supporting 2 thermal mass flow controllers (with an option for a third), an ozone generation module, photometer, glass output manifold, mixing chamber, a reaction chamber for gas phase titration, and control electronics. Commands are entered from the front panel and displayed on a backlit 4 line by 20 character liquid crystal display. The instrument may also be remotely operated using contact closures or the RS-232 serial data interface, both are standard in the Series 6103.

The mass flow controllers are calibrated to a NIST (National Institute of Standards and Technology) traceable primary standard. Calibration data is stored in non-volatile memory and may be updated by the user with a suitable standard.

The internal ultra-violet (UV) based ozone generator is temperature controlled and includes a precision photo-optical feedback circuit to compensate for lamp aging effects providing stable ozone generation. The ozone generator is factory calibrated using a NIST traceable photometer standard.

Although the Series 6103 is very easy to operate, we strongly suggest you read this User's Guide portion of this document completely prior to operating the system. It describes all the functions and operations of the system.

Environics is pleased to provide this quality instrument that utilizes state-of-the-art electronic technology. Our knowledgeable service team is ready to assist you in the use of this instrument should the need arise.

Troubleshooting, servicing and calibration information can be found in the separate 6103 service manual.

Note: The Series 6103 is intended for use with ambient gases, which don't interact (NO, NO₂, SO₂, CO, CO₂ and O₃). If you intend to connect other gases to the system, consult with Environics prior to doing so.

UNPACKING AND INSPECTING THE SYSTEM

The Series 6103 is shipped completely assembled and ready for use. You only need to properly unpack and inspect the system prior to connecting the power and gas sources.

The Series 6103 should be removed from its shipping container and inspected for damage. Any damage to the shipping case should be noted and immediately reported to the freight carrier.

Report any damage to your new system to the Environics home office or your local Environics distributor.

Place the unit at the desired operating location where there is easy access to both the front and rear panels of the unit.

Important

Please allow the system to be powered up for 30 minutes before running the system. This will allow the MFCs to warm up and the ozone block temperature to reach 50° C. Insufficient warm up will cause unstable ozone and flow readings. During this warm up period, ozone should be commanded in the FLOW or CONC mode for conditioning and a better response time when running the system during normal operation.

SYSTEM LAYOUT

FRONT PANEL LAYOUT

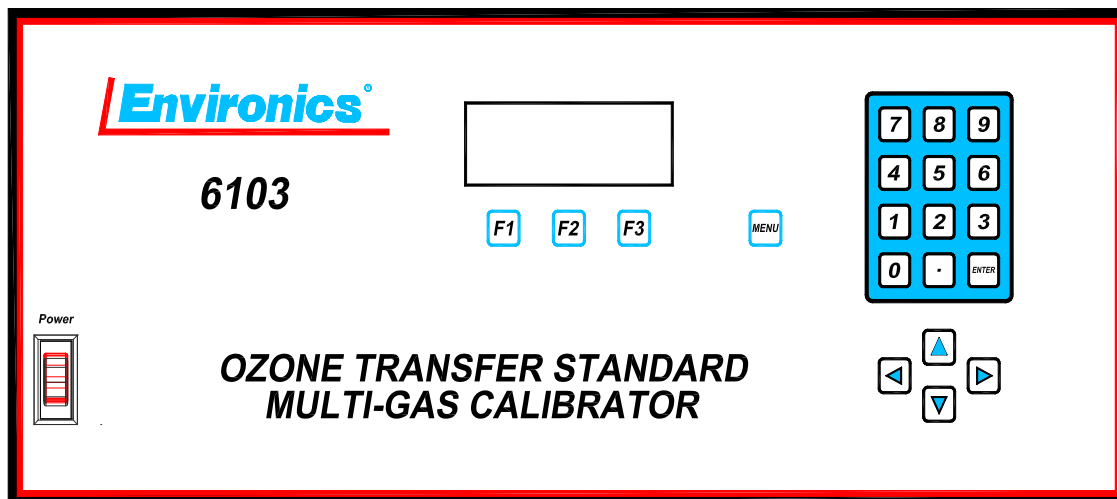


Figure 1 - Front Panel Layout

Power Switch

To turn the system on, press the top of the rocker-type power switch. The switch and display will illuminate and the READY message will appear on the display.

LCD Display

The backlit liquid crystal display (LCD) is a four line, 20 characters display, protected by a clear lens. The display is illuminated when the system is in operation.

Function Keys

Three function keys (F1, F2 and F3) are located below the display and are used to make various selections from the menu displayed on the bottom line of the screen. The current function of each key is displayed above each function key on the bottom line of the display. While the system is in operation, the function of each key will change, depending on the current operating mode.

Numeric Keypad

The numeric keypad is used for data entry of numbers 0 through 9 and a decimal point. Pressing the ENTER key completes the entry of the numeric data selected.

Arrow Keys

The arrow keys are used to move the cursor on the display screen to different fields located on the different entry screens or to scroll information up or down. Pressing and holding the arrow keys will cause them to repeat.

Menu Key

The menu key will change the function menu currently being displayed. The functions are displayed on the bottom line of the screen above the three function keys. Each time the menu key is pressed, the menu will advance to the next menu (if applicable).

REAR PANEL LAYOUT

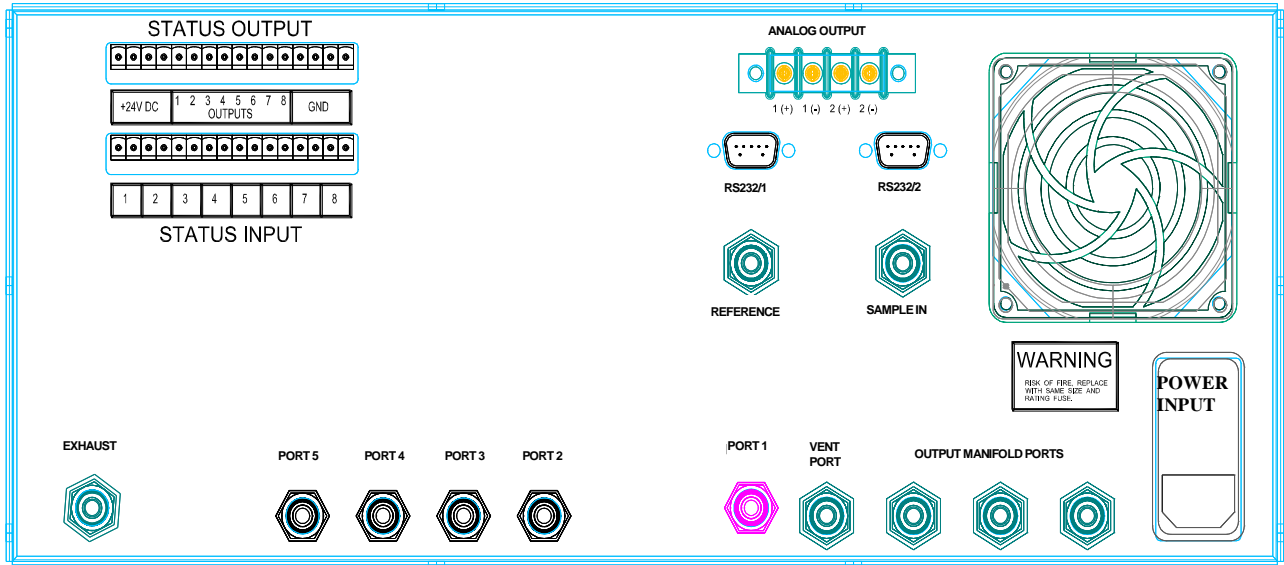


Figure 2 - Rear Panel Layout

Power Input

This EMI/RFI filtered AC input power module supplies power to the internal power supply.

Gas Input ports

These ports supply source gas to the system. Port 1 is for the zero air connection for MFC1. Ports 2 through 5 are for span gas connections for MFC2 and MFC3 (optional).

Output manifold ports

The three output ports supply gas to external instrumentation.

Vent port (if equipped)

The vent port prevents the internal glass supply manifold from being over-pressurized. If not equipped with the vent port, use one of the three manifold output ports as a vent.

Reference Port

The reference port supplies the photometer with a constant source of zero air.

Sample In Port

The Sample in port allows the photometer to analyze an externally generated source of ozone.

Exhaust Port

The exhaust port vents the ozone-containing sample once it has been analyzed by the photometer system

RS-232 Ports

Two RS-232 serial ports are supplied for remote control operation and for serial data output.

Status Input/Output

The Status Inputs allow external devices to initiate various system functions.

The Status Outputs allow the system to signal external devices when certain operating events occur.

Analog Output

Two analog voltage output signals are supplied, which represent different photometer parameters.

POWER AND GAS CONNECTIONS

WARNING

Operating the instrument at an incorrect line voltage will damage the instrument and void the manufacturer's warranty. Check the line voltage before you plug the instrument into any power source.

For 230 volt input power, only qualified personnel shall determine the correct input power connections needed to be supplied to the system.

The standard supplied 115 volt power cord should be plugged into the rear panel power entry module of the instrument, the other end should then be plugged into a properly grounded outlet.




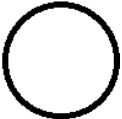
IMPORTANT

Before connecting or disconnecting any cables, wiring harnesses or other sources of potential electrical impulse, be sure the unit is powered OFF.

The main power disconnect for the unit shall be the power cord that is plugged into the rear of the unit. The instrument is totally enclosed at all times with a top and bottom cover for safety.

Position the equipment so that it is not difficult to operate the disconnecting device.

After the Series 6103 is unpacked and inspected, the system should be connected to power and the appropriate gas sources should be connected to the gas inlet ports on the rear panel. We recommends the use of a UPS (uninterruptible power supply), as is typically used for computers, to eliminate power problems from affecting system operation.

SYMBOLS USED	PUBLICATION	MEANING
	ISO 3864, No. B.3.1	CAUTION (Refer to accompanying documents). Refer to specific WARNINGS and CAUTIONS in Operating Manual.
	IEC 417, No. 5019	PROTECTIVE CONDUCTOR TERMINAL
	IEC 417, No. 5007	ON (SUPPLY)
	IEC 417, No. 5008	OFF (SUPPLY)

POWER CONNECTION

- (1) Insert the standard power cord supplied with the system into the power connector on the rear panel and insert the plug into a properly grounded outlet. The standard unit allows for 100 – 250 VAC (50/60 Hz).
- (2) Turn the front panel switch to the ON position. The screen will indicate that a self-test is being performed and then READY will appear. When READY appears on the screen, turn the power switch to the OFF position and proceed to the section on Gas Connection.

GAS CONNECTIONS

Gas connections are standard ¼-inch (optional 1/8-inch) compression fittings.

Overview of gas ports

PORT 1 serves as a diluent or balance port for use with zero air.

PORTS 2 through 5 are for span gases. These ports feed a solenoid valve manifold, whose outputs are in common and feed the input of MFC2 and MFC3 (optional). We recommends connecting span gases sequentially, beginning with PORT 2 and proceeding to PORT 5.

The REFERENCE port supplies the photometer with a vented source of zero air. The photometer needs a constant source of reference gas (ozone-free zero air) in order to make reference measurements against the sample gas containing ozone.

An internal fixed orifice sets the flow to 3 to 3.5 SLPM with a REFERENCE port input pressure of 20 to 25 PSIG. All venting is done internally and the supply line to this port should not be vented. The internal diaphragm pump draws an average of 2 SLPM. Instantaneously, it will draw more as the diaphragm strokes; hence the need to supply excess gas, as to not “starve” the pump. The same principle applies to the sample in port below.

The SAMPLE IN port is for connecting an external source of ozone (not ambient). When supplying this port with an externally generated source of ozone, it is important to make sure that the ozone source is externally vented. Ideally, the vent should be as close to the input of the SAMPLE IN port as possible. Also, it is important to supply the sample port with at least 3 SLPM of a sample containing ozone. The 6103 internal photometer will draw 2 SLPM from this sample and 1 SLPM will exhaust through the external vent.

The OUTPUT MANIFOLD PORTS are supplied for connecting up to three gas analyzers.

The VENT PORT prevents the internal glass output manifold from being over-pressurized; I.E when connecting multiple analyzers to the output manifold. The Vent port is internally connected to the output manifold. This port may or may not need to be capped for different plumbing schemes and total flow rates. If there are problems with the supply of gas to analyzers, incorrect or unstable values, consult the factory. If not equipped with the vent port, use one of the three manifold outputs as a vent.

Connecting the gas ports

Turn the compression fittings with a wrench following the fitting manufacturer's procedure for compression tube connections.

1. On the rear of the Series 6103, connect a source of zero air, at a pressure of 20 to 25 PSIG (30 PSIG MAX.), to PORT 1 (dilution gas port). Connect all span gases to PORTS 2 through 5 (span gas ports) at a pressure between 15 and 25 PSIG. When using the photometer, supply zero air at a pressure of 20 to 25 PSIG to the REFERENCE port.

- IMPORTANT -

It is important that the gas pressures stay within the ranges specified for each gas port. Otherwise the system may produce gas blends that fall outside the accuracy specifications of the system.

Call your Environics representative or the Environics home office with any questions regarding input pressure.

2. Open cylinder valves and pressurize lines to between 15 and 25 PSIG. (These pressures may vary depending on system configuration. For example, if flow rates exceed 10 SLPM, input pressures may need to be higher.)
3. Make the output gas connections as required using the OUTPUT MANIFOLD PORTS. The VENT PORT should not be used as an output port.

- IMPORTANT -

Do not pressurize the output of the Series 6103.

When supplying an external manifold from the 6103 output manifold, tube size and technique for gas venting is critical to system ozone stability and accuracy. If problems arise in supplying an external manifold, contact Environics technical services.

The Series 6103 is now ready for set up and operation.

SYSTEM OVERVIEW AND SETUP

OPERATING MODE SUMMARY

The system software provides a number of different operating modes, which are selected with the MENU and F1/F2/F3 function keys.

These operating modes are described briefly below, and in more detail in other sections of the manual. The text shown in parentheses is the name of the mode as it is shown on the LCD display.

Concentration Mode (CONC)

The Concentration Mode allows the user to create a gas mixture by specifying the desired output span gas concentration (OGC); which pre-mixes with the diluent gas (MFC1).

The user defines the required OGC from a single or multi-component gas cylinder and the total flow rate required. If ozone is required in this mix, the ozone concentration is also entered in this mode. The Series 6103 software then translates these output concentrations into gas flow rates and, using the dilution flow controller (MFC1), proceeds to dilute the span gas to the defined OGC, with or without ozone.

Flow Mode (FLOW)

In the Flow Mode, you specify the amount of flow for the diluent (MFC1) and the span gas. The difference between the Flow Mode and the Concentration Mode is that in Flow Mode, you decide what flow rate is used by the MFCs, instead of having the system software compute the flows as it does in Concentration Mode.

Photometer Mode (PHOTO)

The Photometer mode allows the user to analyze an externally generated source of ozone. Within this mode, all photometer diagnostic information is displayed.

Gases Setup Mode (GASES)

The gas setup mode is used to specify the gases (gas name and concentration) connected to the ports on the rear panel of the system. This information is used internally for error checking and all concentration and flow calculations.

Up to 20 gases can be identified in this mode allowing for multi-gas (multi-component) cylinders.

Program Mode (PROG)

The Program Mode allows you to build sequences of Concentration Mode settings, and to schedule these sequences to run on a repeating schedule.

Preferences (PREFS)

This Preferences Mode is used to change various user settings, including Ozone Generator control features, Status Input and Output setup, Powerup/Idle Timer options, and to adjust the Time/Date and LCD display.

System Mode (SYSTEM)

The System mode consolidates all system calibration data. The system mode is used to enter, view or edit calibration information for various system devices such as MFCs, ozone module, photometer, analog to digital converters (ADC) and digital to analog converters (DAC). Calibration data compares measured versus desired performance of the various devices, so that corrections can be made to improve their operation.

NOTE: *It is important that a hard copy of the calibration data be kept in a safe place. The calibration data will be required to restore the system in the unusual event of data loss.*

Leak Test (LEAK)

Using a pressure decay test, this mode allows all of the system plumbing to be automatically checked for leaks.

ENTERING DATA

At various times during system operation, the user is required to enter data into the system.

Numeric Data Entry

Where numeric data is required, data is entered by using the numeric keypad. Press the number key(s) representing the desired data values and press `ENTER` to record the data in the appropriate field. If the numbers entered completely fill the field, the value is automatically accepted and the `ENTER` key is not required. Pressing an arrow key will also complete the entry and move the cursor to another field. The system automatically adds a decimal point followed by zeros to fill the rest of the field, if required.

Alphanumeric Data Entry

For fields requiring alphanumeric data to be entered, the arrow keys may also be used to input data. The following listing shows the order of the alphanumeric and punctuation symbols that can be accessed by pressing the up and down arrow keys:

ABCDEFGHIJKLMNOPQRSTUVWXYZ0123456789.+-/()%#

Note that the digits **0 – 9** and **.** can also be entered directly by pressing the corresponding key on the numeric keypad.

To enter alphanumeric data, press the up/down arrow until the desired character is displayed. Then press the `ENTER` key, or use the left/right arrow keys to position the cursor in the desired location.

The `SPACE` function key is used to enter a blank space.

The `CLEAR` function key will clear all data entered.

The `ENTER` function key will complete the entry of data.

MAIN SCREEN (READY)

The Series 6103 was designed with emphasis on simplicity and ease of operation. The system's menu-driven software guides the User through all operating routines.

After the system has powered up, the user will see the `READY` screen:

Select one of the three currently displayed functions using the function keys, or press the menu key to change the functions.

```
(day) (date) (time)
  ENVIRONICS 6103
      READY
CONC  FLOW  PHOTO
```

The next set of functions to appear on the bottom line of the display is:

```
GASES  Prefs
```

Press the menu key again and the third set of functions will appear:

```
SYSTEM LEAK  INFO
```

The first step in any `FLOW` mode or `CONC` mode operation should be entering or verifying the information in the `GASES` mode. See *GAS SETUP MODE*.

GASES SETUP MODE (GASES)

IMPORTANT: Proper entry of gas information is critical to the proper operation of the system. Be sure that gas concentrations and port assignments are correct. Incorrect entry of information will result in inaccurate gas blends.

Before operating the system for the first time, you must identify which gases you intend to use. Press the **MENU** button until the bottom line of the display screen shows:

GASES	PREFS ▾
-------	---------

and select **GASES** by pressing the function key below it.

This will bring up the main **GASES** screen:

GAS	CONC	PORT
GAS1	100%	1
GAS2	100%	2
EDIT		EXIT

On the top line, **GAS** refers to the gas name (user defined), **CONC** refers to the concentration of that gas in the cylinder (**CGC**), and **PORT** identifies the physical port that gas is connected to. Note that more than one gas can be assigned to the same port, in the case of a multicomponent cylinder.

Use the up/down arrow keys to scroll through the list of gases. Up to 20 gases can be defined. Even though there are only 5 physical gas ports (standard), a multi-component cylinder can be used with more than one component gas.

To change the settings for a particular gas, use the up/down arrow keys to position the cursor on the gas to be changed and press **EDIT**. The cursor appears as a line under the first letter/number in the **GAS** column.

The gas editing screen looks like this:

GAS:	(name)
CONC:	(XXXXX ppm)
PORT:	(X)
SPACE	CLEAR

Changing the Gas Name

Use the left/right arrow keys to position the cursor on the alphanumeric character you want to change. Then use the up/down arrow keys to change the character at the cursor location.

Use the `SPACE` key to enter a space in the gas name, or the `CLEAR` key to clear all characters. Number characters can be entered directly but pressing the keys on the number keypad.

For applications where Gas Phase Titration (GPT) is being used to generate NO₂ from NO and Ozone, the system recognizes any gas name starting with "NO" as containing Nitric Oxide. If the first 2 letters of the gas name are "NO", the system will automatically switch control of the ozone generator when performing GPT. Refer to the section "Automatic Ozone Control" for more details on how this works.

Once the desired gas name has been entered, press the `ENTER` key to move onto the `CONC` field.

NOTE: The gas in the first row (default GAS1) is reserved for use with the gas connected to port 1. This gas should always be 100% UHP zero grade air (or 100% N₂ for applications not requiring ozone). Only the gas name can be changed. The concentration is fixed at 100%, and the port is fixed at 1.

Changing the Gas Concentration

To enter the concentration of gas in the cylinder, use the numeric keypad. The concentration can either be entered as a PPM or percent concentration. Enter the desired concentration value and press `ENTER` to move the cursor to the PPM/% field. To leave the concentration value unchanged, just press the `ENTER` key without entering any values.

NOTE: The concentration for the first gas is fixed at 100% and cannot be changed.

To change the PPM or % designator, press the corresponding PPM or % function key as shown on the bottom line on the display. For units of %, the value must be between 0 and 100%. For units of ppm, the value must be between 0 and 1,000,000 ppm. If the value entered is outside the range for the PPM/% units selected, the system will move the cursor back to the concentration field so the value can be corrected.

When the concentration value is correct, press `ENTER` to move the cursor to the `PORT` field.

Changing the Port

The port number indicates which gas port a gas is connected to. To enter the port number, enter a numerical value between 2 and 5 (standard) for the gas port to which the gas is connected.

Port 1 is reserved for Gas #1 and cannot be used for other gases.

A port number of zero should be entered for any gases that are not being used. This will prevent them from showing up in the available list of gases in other modes and prevent erroneous mixes.

To create a multi-component gas cylinder, simply create gas entries for each of the gas components, and assign all of these gases to the same gas port.

When all the gases have been entered correctly, press the EXIT function key to return to the main menu.

RUNNING THE SYSTEM

SYSTEM WARMUP

IMPORTANT

Please allow the system to be powered up for 1 hour before running the system. This will allow the MFCs to warm up and the ozone block temperature to reach 50° C. Insufficient warm up will cause unstable ozone and flow readings. During this warm up period, ozone should be commanded in the FLOW or CONC mode, for conditioning and a better response time when running the system during normal operation.

CONCENTRATION MODE (CONC)

One of the most powerful features of the Series 6103 is the Concentration Mode. This mode allows you to easily create a gas mixture by specifying the desired span gas concentration, amount of ozone and total flow rate. The system software automatically calculates the correct Mass Flow Controller flow rates needed to generate the desired gas mixture. Concentration Mode is designed to work single and multicomponent cylinders, as well as perform Gas Phase Titration (GPT).

The photometer operates the ozone generator in a closed-loop mode, ensuring that the ozone concentration is accurate. The ozone control loop is turned off automatically by the system when performing GPT, or manually under user control.

To start using Concentration Mode, from the Main Menu (READY mode), press the CONC function key. The main CONC MODE edit screen looks like this:

```
CO2=1.00000 ppm
O3=0.5000 ppm
FLOW=1000.0 ccm
START GAS FILE
```

The top line indicates the concentration of the active SPAN gas (CO2).

The 2nd line indicates the concentration of ozone

The 3rd line indicates the total flow rate

Setting up CONC mode

- (1) Select the desired span gas by pressing the GAS function key
- (2) Use the up and down arrows keys to move the arrow cursor (>) to the desired span gas. Press SELECT to select the gas, or press CANCEL to leave the gas at its original setting.
- (3) Using the up/down arrow keys, move the cursor to the span gas row (first row) and enter the desired concentration for the span gas. The ppm or % units displayed will be the same as what was entered in the GASES mode setup screen for that span gas.
- (4) Move the cursor to the second line and enter the concentration of ozone (O3) to be included in the gas mixture or enter zero if none is required. The amount of ozone will always be in ppm.
- (5) Move the cursor to the third line of the display, and specify the total flow rate of the gas mixture, in cubic centimeters per minute (ccm).

Running CONC mode

After the desired CONC mode values have been entered, press the START key to start the flow of gas.

The system will display the actual gas concentration, ozone concentration and total flow rate on the screen. A blinking asterisk in the upper right corner indicates that the system is running.

While running, the bottom line of the display appears like this:

EDIT	VIEW	STOP
------	------	------

To change any values while the system is running, press the EDIT function key. The display will switch to the Edit screen, showing the previously entered values, and the EDIT key will change to UPDATE. Change the values as desired and press the UPDATE key to run using the new values.

To stop the flow of gas, press the STOP function key. The screen will return to the original data entry screen for the Concentration Mode.

When done using the Concentration Mode, press the MENU key and then the EXIT function key to return to the main menu.

Viewing Output Gas Concentration data

While the system is running, move the cursor to the top row (gas concentration) and press the `VIEW` function key. This will bring up a list of all the output gas concentrations for the gases connected to the port that is currently running. This is particularly useful if a multi-component cylinder is being used.

GAS 3 =	XXXXXXXXX	ppm
GAS 4 =	XXXXXXXXX	ppm
GAS 5 =	XXXXXXXXX	ppm
PREV	NEXT	EXIT

If a cylinder has more than 3 calibration gases, press the `NEXT` key to show the next 3 gases, or press the `PREV` key to show the previous 3 gases.

Press the `EXIT` key to return to the normal `CONC` mode screen

Viewing Ozone/Photometer data

To view detailed diagnostic information on the performance of the photometer and ozone generator, place the cursor on the second line (`O3` concentration) and press the `VIEW` button.

This will bring up the Photometer Diagnostic Screen, shown below

PHOTO	sample/ref	
O3=0.501	P=14.345	
LT=48.6	T=32.4	F=1.8
EDIT	VIEW	STOP

sample/ref = sample and reference intensity of the photometer lamp
O3 = measured ozone concentration (user units)
P = photometer gas pressure (user units)
LT = photometer lamp temperature (°C)
T = photometer gas temperature (°C)
F = photometer flow rate (LPM)

Figure 3 - Photometer Diagnostic Screen

Pressing the VIEW key again will switch the display to the Ozone Generator Diagnostic Screen, shown here:

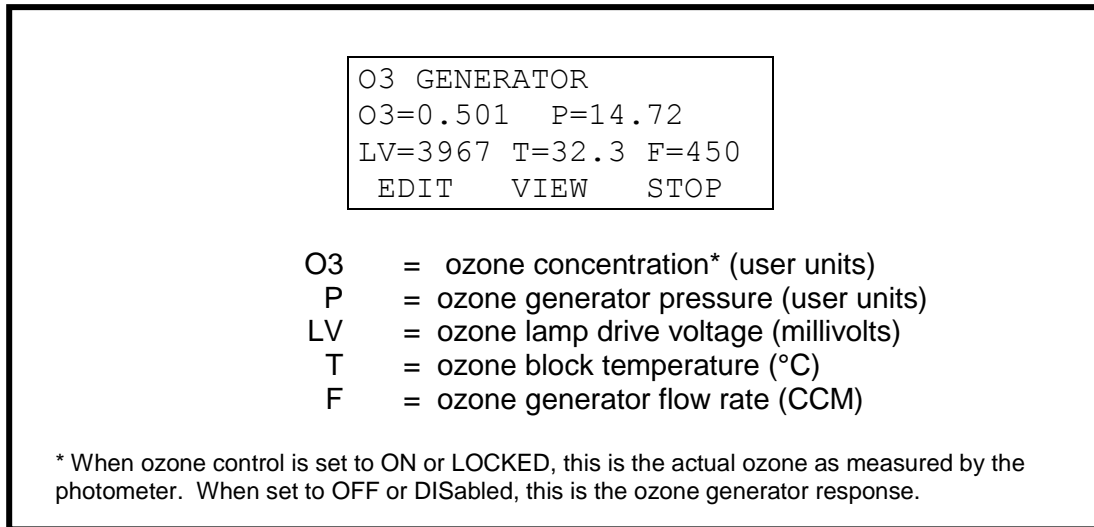


Figure 4 - Ozone Generator Diagnostic Screen

Pressing the VIEW key once more will switch the display back to the normal Concentration Mode display

Viewing Flow details

Pressing the VIEW function key, while the cursor is on the third line (FLOW), will bring up the screen of actual flow controller flow rate values. Pressing the View key a second time, returns the screen to normal view.

Automatic Ozone/Photometer Control

In Concentration Mode, the system will automatically change the operation of the ozone generator when performing Gas Phase Titration (GPT). When performing GPT, the ozone generator cannot operate under photometer control, since the GPT process uses up all available ozone. When the system detects that GPT is being performed, the control loop is automatically disabled, and re-enabled when GPT is complete. For more details on how the Automatic Control works, refer to the section AUTOMATIC OZONE CONTROL.

Changing the Ozone/Photometer operation

Although the system has automatic ozone/photometer control capabilities, it is possible to override the automatic settings if desired. While the system is running, pressing the MENU button will access the Ozone Control Menu. This menu allows you to change the operation of the ozone generator control loop, photometer gas

source and photometer pump. Pressing MENU a second time will return to the previous display.

O3 CTRL = ON
PHO SOURCE = INTERNAL
PHO PUMP = AUTO
O3CTRL PHOSRC PUMP

Ozone Control Menu

Ozone Control (O3 CTRL)

O3 CTRL indicates the current ozone control loop setting. This setting determines how the photometer control loop makes adjustments to the ozone generator in order to generate accurate ozone concentration. Press the O3CTRL key to toggle the O3 CTRL setting between these three values:

ON --- The photometer is allowed to control the ozone level to maintain the desired level of ozone.

LOCKED --- The photometer control of ozone is temporarily disabled, and the ozone generator control voltage is locked at its current setting. The ozone generator will continue to operate, but will no longer be controlled by the photometer. The main purpose of the LOCKED setting is to hold the ozone constant after reaching a stable ozone reading, prior to performing Gas Phase Titration of NO and Ozone. Refer to the Gas Phase Titration section for more information.

OFF --- ,The ozone generator operates by using the built in ozone calibration data. Although not as accurate as the when set to ON, this mode of operation will generate faster response time for ozone.

If the O3 CTRL setting shows DISABLED, this indicates that the ozone control loop has been disabled in the Preferences – Ozone Setup menu. In that case, no changes to the O3 CTRL can be made without first setting O3 PHO FEEDBK = ENB in the Preferences – Ozone Setup menu.

Photometer Source (PHO SOURCE)

The photometer source selects whether the photometer measures ozone internally, or from an external source. Press the PHOSRC key to toggle this setting between INT (internal) and EXT (external)

When set to INTernal, the photometer measures the level of ozone produced by the ozone generator, as sampled via the internal glass output manifold.

When set to EXTERNAL, the photometer measures the level of ozone from the external SAMPLE IN port. This setting allows the system to dilute gas and generate ozone, while simultaneously measuring an external source of ozone. In most cases, the O3 CTRL setting should be set to OFF or LOCKED, otherwise the system will try to adjust the amount of ozone being generated in response to the amount of ozone measured from the SAMPLE IN port.

Photometer Pump (PHO PUMP)

The Photometer Pump setting determines whether the photometer pump turns on automatically as needed, or remains off. Press to PUMP key to toggle this setting between AUTO and OFF

When set to AUTO, the photometer pump turns on automatically as needed. Refer to the Automatic Photometer Pump Control section for details about when the AUTO setting activates the pump.

When set to OFF, the photometer pump remains off. Care should be used when setting the pump to OFF, since the photometer will not be able to measure ozone correctly.

Saving and Recalling concentration mode settings

The current CONC mode settings (Gas Concentration, Ozone Concentration, Total Flow) can be saved to a file for later use. These saved settings can be recalled later, or used as part of a PROGRAM MODE or STATUS INPUT action. Concentration Mode must be stopped first to save or recall a file.

To save a file:

- (1) Enter the desired Concentration Mode settings as described in “Setting up CONC mode”.
- (2) Press the FILE key followed by the SAVE key.
- (3) At the SAVE REGISTER> prompt, enter a file # from 1-99 and press ENTER (Enter is not necessary if entering a 2 digit number)

To recall a file:

- (1) Press the FILE key followed by the LOAD key.
- (2) At the LOAD REGISTER> prompt, enter the file # from 1-99 and press ENTER
- (3) The previously stored data will be loaded into the CONC mode screen. Press START to run Concentration Mode with these settings

FLOW MODE (FLOW)

The Flow Mode allows you to create a gas mixture by specifying the flow rate of each gas and the desired concentration of ozone.

In this mode you must specify the amount of flow for the diluent and the span gas. The difference between the Flow Mode and the Concentration Mode is that the user decides what flow rates to use for each MFC, instead of having the system software compute the flows automatically.

NOTE: The Automatic Ozone/Photometer Control described in CONC MODE, does not function in FLOW MODE. Changes to the Ozone/Photometer control must be done manually if desired.

To start FLOW MODE from the main READY screen, select the FLOW function key. The following screen appears:

GAS 1	=	10001.	lpm
NO	=	10.002	ccm
O3	=	0.000	ppm
START		GAS	EXIT

The first line indicates the flow rate for gas on port 1 through MFC1.
The second line indicates the currently selected span port and its flow rate.
The third line indicates the concentration of ozone.

Setting up FLOW mode

- (1) Move the cursor to line one of the display (GAS 1) and enter the flow rate for the diluent gas in LPM.
- (2) Select the desired span gas (if not currently selected) by pressing the GAS function key. Use the up and down arrows keys to move the arrow cursor (>) to the desired span gas. Press SELECT to select the gas, or press CANCEL to leave the gas at its original setting.
- (3) Move the cursor to line two of the display (NO). Enter the flow rate for the span gas.
- (4) Move the cursor to line three of the display (O3) and enter the concentration of ozone in PPM to be generated, if any.

Running FLOW mode

After the desired FLOW mode values have been entered, press the START key to start the flow of gas. The photometer pump will turn on whenever gas is flowing. The system will display the actual gas flow rates and ozone concentration on the screen. A blinking asterisk in the upper right corner indicates that the system is running.

While running, the bottom line of the display appears like this:

EDIT	VIEW	STOP
------	------	------

To change any values while the system is running, press the EDIT function key. The display will switch to the Edit screen, showing the previously entered values, and the EDIT key will change to UPDATE. Change the values as desired and press the UPDATE key to run using the new values.

To stop the flow of gas, press the STOP function key. The screen will return to the original data entry screen for the Flow Mode.

When done using the Flow Mode, press the EXIT function key to return to the main menu.

Viewing Ozone/Photometer data

While the system is running, press the VIEW key to view detailed information on the photometer. Press the VIEW key again to see ozone generator information. Press the VIEW key once more to return to the normal FLOW mode display. (see the CONC MODE section for an explanation of the data displayed in these views)

Changing the Ozone/Photometer operation

Pressing the MENU key while running in the FLOW MODE allows you to change the ozone/photometer operation. This is explained in detail in the CONC MODE section above.

Verifying MFC flow rate

The Flow Mode can be used to verify MFC flow rates, as part of the MFC calibration process. To verify flow rates from each MFC individually, the photometer pump must be off. This is done by pressing the MENU key while the system is flowing, and then pressing the PUMP key to set the photometer pump to OFF. This will isolate any leaking that may occur back out through the photometer.

More detailed information on the MFC calibration process can be found in 6103 Service Manual.

OZONE GENERATOR/PHOTOMETER OPERATION

The software operates the ozone generator in a closed-loop mode, using the photometer to measure the actual amount of ozone generated, and correct for errors. This is the default mode of operation for the ozone generator, and will achieve the greatest accuracy of ozone.

When performing GPT (gas phase titration), the closed-loop operation must be temporarily disabled (LOCKED). The GPT process results in no net ozone reaching the photometer, so the photometer is not able to properly adjust the ozone generator. When LOCKED, the command voltage to the ozone generator is held constant.

Closed-loop operation can also be temporarily turned OFF. In this case, the system falls back to using its internal ozone calibration table.

GAS PHASE TITRATION

GPT is the process of combining Nitric Oxide (NO) with Ozone to produce Nitrogen Dioxide (NO₂). Because the GPT process uses up all the available ozone before it reaches the photometer, the photometer cannot be used to control the ozone generator in closed-loop mode during GPT. To generate the required ozone for GPT, the ozone closed-loop control must be temporarily disabled or turned off completely before adding NO to the mix.

Before performing GPT however, the ozone concentration must be allowed to stabilize while under closed-loop photometer control.

The system software will automatically change the control loop settings when GPT is being performed, so long as the NO gas is correctly identified. Simply use the letters "NO" as the first 2 letters of the gas name for your Nitric Oxide gas source. Refer to the GASES SETUP section for more information.

To perform GPT:

1. Make sure that the system is plumbed to the gas analyzer for calibration, as it will be during NO_x calibration.
2. Be sure ozone closed-loop control is enabled (it is by default - Refer to the PREFERENCES section for details on how to change it)
3. From the READY mode, select CONC mode, and specify the flow rate and ozone level to be used during GPT. FLOW mode can also be used, but the automatic ozone control feature will not work, and you must manually change the control loop setting. Therefore, CONC mode is the preferred method.
 - Enter the total flow in the third row.
 - Enter the desired ozone value, and press START
4. The Photometer pump will turn on automatically
5. The Ozone Control loop will automatically turn on. Press the MENU button and verify O₃ CTRL is set to ON. If it is not set to ON, press the O₃ CTRL

key until it is. This will activate the photometer control loop. This step can also be done with O3 CTRL set to off; however, the ozone will not be as accurate, as it is not being controlled by the photometer. However, the response time with the O3 CTRL set to OFF will be slightly faster.

6. Press the MENU key to return to the active FLOW or CONC screen.
7. Allow the ozone level to stabilize. Monitor the ozone level with the analog output channel on the rear panel with a chart recorder or data acquisition system if available, or watch the displayed ozone level for a stable reading.
8. When the O3 level is stable, GPT may be performed.
9. If operating in FLOW MODE, press the MENU button to bring up the CHANGE O3 CONTROL menu. Press O3CTRL so that "O3 CTRL = LOCKED" is displayed. This step is not necessary if O3 CTRL was set to OFF in step 5. Press MENU again, to return to the previous screen.
10. Press EDIT, and enter the desired Flow/Conc value for NO
 - If using the FLOW mode, enter the NO flow rate in the second row.
 - If using the CONC mode, enter the NO concentration in the first row
11. Press UPDATE. NO will begin to flow and mix with O3 to produce NO2.
12. In CONC mode, the ozone control loop will automatically switch to LOCKED. You can verify this by pressing the MENU key

When O3 CTRL = LOCKED, the photometer will not be actively controlling the ozone generator. The ozone generator will operate at the same command value.

AUTOMATIC OZONE/PHOTOMETER OPERATION

The software automatically controls the photometer pump and ozone control loop based on specific operating conditions of the system.

Automatic control of photometer pump

The software automatically switches on/off the photometer pump as needed. The photometer pump will normally be off, but will automatically turn on under the following conditions:

In CONC mode:

- Pump will be on anytime ozone is generated (so the photometer can display measured ozone)
- Pump will be on when flowing diluent gas only (so an ozone "zero reference" value can be established)

In FLOW mode:

- Pump will be on whenever gas is flowing

In PHOTO mode:

- Pump will be on whenever the system is in PHOTO mode

In order for the automatic pump control to work, it must be set to AUTO. The Pump Control setting is changed by pressing MENU while running in the FLOW or CONC mode. Refer to "Changing the Ozone/Photometer operation" in the CONC mode section

NOTE

When setting pump control to OFF, the pump turns off immediately, and will no longer be controlled by software. When setting pump control to AUTO, it will remain off until the user presses EDIT/UPDATE, or until the next conc. step

Automatic Ozone Control

When running the system in Concentration Mode, the control loop automatically switches to OFF/ON/LOCKED depending on whether or not you are performing Gas Phase Titration (GPT). This applies any CONC mode operation, regardless of whether it is run manually from the front panel, from a program, remotely, or by status input.

In order to detect a GPT condition, the first 2 characters of the gas name must be set to "NO" in the GASES mode. When running in CONC mode, if the NO gas is selected, has a concentration value set to greater than 0.0, and ozone is generated at the same time, the software will detect this as GPT.

The following rules are used for switching the o3 control loop:

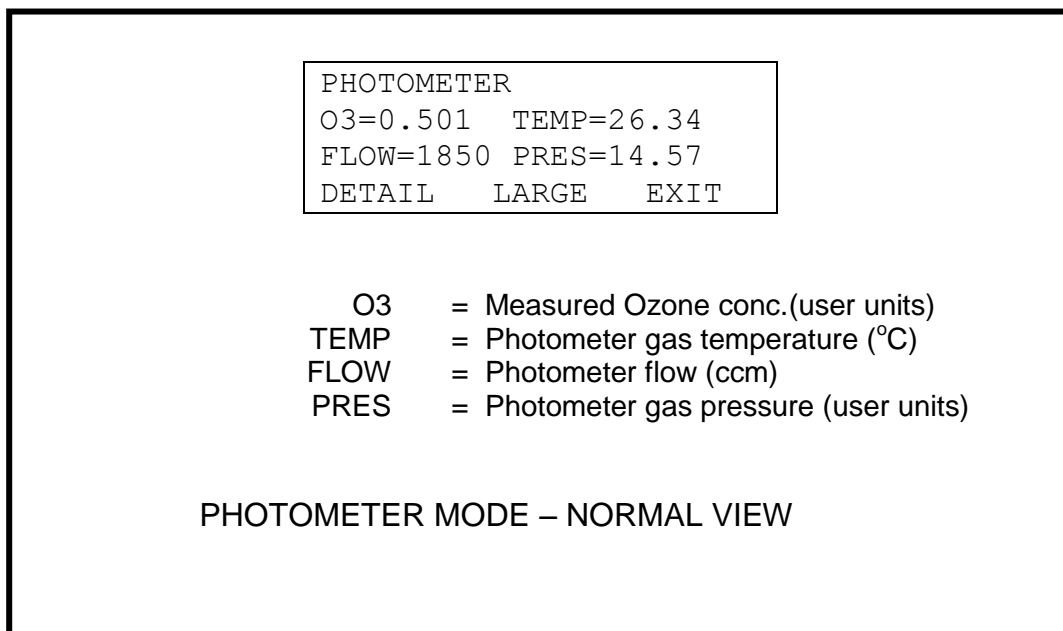
- a) When generating ozone (without NO), the control loop is ON
- b) When first starting CONC mode, the control loop is ON
- c) When generating ozone + NO (GPT), but *without* generating ozone in the preceding step, the control loop is OFF. This would be the case if the first step in a program was to perform GPT. The control loop is turned off in this case since there is no previous ozone level established, so the LOCK function will not work.
- d) Once the control loop has been turned OFF, it can be turned back ON by flowing dilution gas only (ozone and NO conc = 0.0)
- e) When transitioning from ozone only to ozone + NO (GPT), the control loop is LOCKED
- f) When transitioning from ozone + NO (GPT) to ozone only, the control loop is LOCKED
- g) When performing a 2nd consecutive ozone only step, the control loop is turned back ON

PHOTOMETER MODE (PHOTO)

The Photometer Mode allows an external source of ozone (not ambient) to be analyzed and displayed on the screen.

To use Photometer Mode, connect the gas (vented) to be analyzed to the SAMPLE IN port. From the Main Menu, press PHOTO to enter Photometer Mode. The photometer pump will automatically turn on, and the internal SAMPLE IN solenoid valve V1 is turned on (see P&ID at the end of the manual), allowing sample gas to flow through the photometer. When exiting PHOTO mode, the SAMPLE IN solenoid valve and pump are turned off, blocking the flow of the sample gas.

The Photometer Mode has three different modes of displaying data: NORMAL, DETAIL and LARGE. The default display mode is NORMAL and has the following appearance:



The DETAIL view adds additional diagnostic information to the display, including photometer lamp intensity readings, and photometer lamp temperature. To see the DETAIL view, press the DETAIL function key

```
PHOTO    sample/ref
O3=0.501  P=14.345
LT=48.6  T=32.4  F=1.8
EDIT     VIEW    STOP
```

sample/ref = sample and reference intensity of the photometer lamp
O3 = measured ozone concentration (user units)
P = photometer gas pressure (user units)
LT = photometer lamp temperature (°C)
T = photometer gas temperature (°C)
F = photometer flow rate (LPM)

PHOTOMETER MODE – DETAIL VIEW

To switch back to the NORMAL view, press the `NORMAL` function key

To see the measured ozone concentration in a LARGE format, press the `LARGE` function key. The LARGE display shows ozone concentration in PPM or PPB (user selectable) as shown:

```
0.056
```

To switch back to the NORMAL view, press any of the function keys (F1/F2/F3)

Other settings

The **Photometer Pump** and sample/reference solenoid valve automatically activate when entering the PHOTO mode. For troubleshooting purposes, they can be deactivated by pressing the `ENTER` key. Pressing the `ENTER` key again will turn them back on.

The **Photometer Prefs** menu is used to adjust the photometer filter/averaging settings. These settings are useful for reducing noise or to adjust the averaging of photometer readings. To get to the Photometer Prefs screen, press the `MENU` key. For more information about the photometer prefs, refer to the `PREFERENCES – PHOTOMETER PREFS` section of the manual.

PROGRAM MODE

The Program Mode allows you to create a group of Concentration Mode items to be run in sequence (a program). This program can be run manually, by status input control, or can be run automatically on a repeating schedule.

To start Program Mode from the Main Menu, press the MENU button until PROG is shown on the menu, then press the PROG function key.

The main Program Mode menu is shown below. Select PROG to create or run a program, or SCHED to create or run a schedule.

```
PROGRAM MODE
PROG   SCHED   EXIT
```

Program Menu

The Program Menu allows you to create up to 20 programs. Each program can consist of up to 20 Concentration Mode steps.

Enter the program you wish to edit or run, by entering in the program number (1-20) at the PROGRAM: prompt

```
PROGRAM MENU
PROGRAM: 1
EDIT   RUN   EXIT
```

Press EDIT to edit the program, or RUN to run the program. Press EXIT to return to the PROGRAM MODE screen

Editing Programs

The Program Editing screen is where you will enter the Concentration Mode items to be run in sequence. A program is built from Concentration Mode files, so you will need to know which concentration mode files you wish to use in the program. If you have not already set up Concentration Mode files, you can create a program first, and then update the Concentration Mode files with the settings you want later.

The left side of the screen displays the STEP # (1-20) of the program. The ITEM column indicates the CONC mode file to be run. The RUNTIME column shows the run time for that item (in minutes).

#	ITEM		RUNTIME
1	CONC	1	10
2	CONC	2	15
	INSERT	DELETE	EXIT

Press the UP/DOWN arrows to select which step you want to edit.

To enter a new step, or edit an existing step, press the RIGHT arrow key. This moves the cursor to the CONC field. Enter the CONC mode file (1-99) you want to be run in this step.

Press the RIGHT arrow or ENTER to move to the runtime field. Enter the number of minutes for the step to be run (1-999).

Repeat the above steps until all program steps have been entered.

You can run the program at any time by pressing the MENU key until RUN appears, then press RUN.

When you are finished editing the program, press EXIT to return to the Program Menu. Any changes made to the program will automatically be saved.

Inserting or Deleting Steps

To insert a blank space into an existing program, place the cursor at the desired step and pressing INSERT. This will insert a blank step and shift all remaining steps down. You can now add a step into the program as described above. To prevent you from accidentally erasing steps, the software will not allow you to insert a step if there is an existing step at line 20.

You can delete a step by placing the cursor at the desired step and pressing DELETE. This will delete the step and shift all remaining steps up.

Note that when running a program, if any blank steps are encountered, the program will terminate and any steps after the blank steps are ignored.

Running a Program

When a program is running, the Concentration Mode values will be displayed on the screen, similar to the way they are displayed when running directly in Concentration Mode. No changes to the CONC mode settings are allowed.

```
GAS2=1.0000 %
O3=0.0000 ppm
FLOW=2000.0 ccm
SKIP VIEW ABORT
```

You can view details about the current Program step by pressing the VIEW button. This displays the current Program, Step # and Conc Mode file #, as well as the time remaining for the current step.

```
PROGRAM 1
STEP 1 CONC 1
TIME LEFT 8:48
SKIP VIEW ABORT
```

To skip the current step and advance to the next step, press the SKIP key. If the last step is currently running, the program will end.

To abort the current program, press the ABORT key. This will stop the current step and abort the program. No additional program steps will be run.

Note that when running a program, if a blank step is encountered in the program, the program will end and no further steps will be run.

Schedule Menu

The Schedule Menu allows you to create and run up to 20 different schedules. Each schedule can consist of up to 20 Program steps.

Enter the schedule you wish to edit or run, by entering in the schedule number (1-20) at the SCHEDULE: prompt

```
SCHEDULE MENU

SCHEDULE: 1
EDIT      RUN      EXIT
```

Press **EDIT** to edit the schedule, or **RUN** to run the schedule. Press **EXIT** to return to the PROGRAM MODE screen

Editing Schedules

The schedule editing screen is where you will enter the Program items into the schedule. A schedule is built from Programs, so you must know which Program files you wish to use in the schedule. You can also create a schedule first, and then update the Program files with the settings you want later.

```
# DAY TIME      ITEM
1 MO 10:00 PROG 1
2 TU 11:45 PROG 5
INSERT DELETE  EXIT,
```

The left side of the screen displays the STEP # (1-20) of the schedule. The DAY and TIME columns indicate the day of the week and time the Program item is to be run. The ITEM column indicates which PROGRAM file is to be run.

Press the UP/DOWN arrows to select which step you want to edit.

To enter a new step, or edit an existing step, press the RIGHT arrow key. This moves the cursor to the DAY field. Press the UP or DOWN arrow key to change the day.

Press the RIGHT arrow or ENTER to move to the TIME field. Enter the HOUR, then the MINUTES. Time must be specified in 24 hour format

Press the RIGHT arrow or ENTER to move to the ITEM field. Enter the program # (1-20) to be run. Press RIGHT arrow or ENTER again to complete the entry.

When entering schedule steps, note that steps are executed in the order they are listed. For example, if step 1 is WED 10:00 and step 2 is TUE 10:00, then step 1 will execute on the first WED, but step 2 will not run until the following TUE. This allows you to build multi-week schedules by specifying the days of the week out of order. However, if you want only a 1 week repeating schedule, be sure to enter the steps in day of the week order.

When finished editing the schedule, press `EXIT` to return to the Schedule Menu. Any changes made to the schedule will automatically be saved.

You can also run the current schedule, by pressing the `MENU` key until `RUN` appears, then press `RUN`.

Inserting or Deleting Steps

You can insert a blank space into an existing schedule by placing the cursor at the desired step and pressing `INSERT`. This will insert a blank step and shift all remaining steps down. To prevent you from accidentally erasing steps, the software will not allow you to insert a step if there is an existing step at line 20.

You can delete a step by placing the cursor at the desired step and pressing `DELETE`. This will delete the step and shift all remaining steps up.

Note that when running a schedule, any blank steps are ignored. However, the first step in a schedule must not be blank, otherwise the schedule will not run.

Running a Schedule

When running a schedule, the scheduler automatically selects the step in the schedule that is nearest to the current time, and waits for the current time/date to match the time/date of the scheduled step. The display shows the step to be run on the first line, and the current time/date below it.

```
RUN SCHEDULE
 1 MO 10:00 PROG 1
TUE 13APR04 10:39:23
SKIP RUNNOW CANCEL
```

While the scheduler is waiting for the current step to run, several actions can be selected by pressing the appropriate button.

<code>SKIP</code>	Skip the current step and advance to the next step.
<code>RUNNOW</code>	Run the current step immediately (don't wait for its scheduled start time)
<code>CANCEL</code>	Stop the current schedule

When the schedule time matches the current time, the specified program will run. While the program is running, no changes to the CONC mode settings are allowed.

After the specified program has finished running, the scheduler selects the next step in the schedule and waits until it is time for it to run. After all steps in the schedule have completed, the schedule starts again at step 1.

Press the CANCEL key to cancel the current schedule.

SYSTEM MODE

The system mode consolidates all calibration modes and calibration tables for the system devices. This includes MFCs, ozone generator, photometer, photometer ADCs (pressure, temperature and flow devices), ozone generator ADCs (temperature, pressure and flow devices)

Detailed System Mode functions and calibration procedures are contained in the 6103 Service Manual. The system mode may be password protected.

LEAK TEST

The 6103 has an automated Leak Test function, to determine if the system has any inboard/outboard leaks.

To run the Leak Test:

1. Be sure there is a source of gas connected to Port 1.
2. Select the LEAK function from the Main Menu, and then press START. The software will acquire Atmospheric Pressure, and then prompt for the outputs to be capped.
3. Cap the Output Manifold, Vent and Exhaust ports.
4. Press OK. The Leak Test will fill the volume of the system plumbing with gas from Port 1 to 5 PSI above atmospheric pressure, and use pressure decay to calculate the leak rate. Any leak in excess of the maximum leak specification for the system (3 SCCM) will be displayed.

PREFERENCES MODE (PREFS)

The Preferences Mode allows you to set various operating preferences, such as ozone and photometer control settings, status input/output settings, powerup and idle timer functions, time/date, and screen contrast.

To access the PREFS mode, from the READY mode, press the MENU button until **PREFS** on the system menu, and then press the PREFS function key.

When the PREFS mode is selected, the following screen appears:

```
> OZONE SETUP
  PHOTOMETER PREFS
  STATUS IN SETUP
                        EXIT
```

A pointer cursor (>) appears on the left side of the display, indicating which Preference item is to be changed. Move the pointer cursor to select the desired item using the up and down arrow keys, and press **ENTER** to select it.

OZONE SETUP

The OZONE SETUP menu is used to adjust the control of the ozone generator.

Ozone Pressure Correction

If the pressure in the ozone generator were to fluctuate, this can have an effect on the amount of ozone generated. To compensate for this, ozone pressure correction can adjust the ozone lamp intensity as the pressure in the ozone generator rises or falls.

To change the ozone pressure correction setting, use the up/down arrow keys to move the pointer cursor to the 03 PRESS CORR line. Then press the **ENTER** key to change the setting. .

Setting 03 PRESS CORR = ENB will enable pressure correction

Setting 03 PRESS CORR = DIS will disable pressure correction

Note: Regardless of the setting, ozone pressure correction is never active when the photometer control loop is enabled (see below). Ozone pressure correction only occurs when the photometer control loop is set to **DISABLED**.

Ozone-Photometer Control Loop

When generating ozone, the photometer control loop measures the amount of ozone being generated and makes adjustments to the ozone generator in order to accurately generate the requested level of ozone.

If this feature is disabled, the ozone generator uses the data in the ozone calibration table (see SYSTEM mode) to generate the requested level of ozone. Since the photometer is historically more accurate and less influenced by operating variables, it is the most accurate way to control ozone. For normal operation, 03 PHO FEEDBK is enabled.

While the photometer control loop generates more accurate ozone, it can take longer for the ozone concentration to reach the desired target value. For applications where it is not critical to reach an exact target ozone value, disabling the control loop may be beneficial.

To change the ozone photometer control setting, use the up/down arrow keys to move the pointer cursor to the 03 PHO FEEDBK line, and press the ENTER key.

Setting 03 PHO FEEDBK = ENB will enable the control loop

Setting 03 PHO FEEDBK = DIS will disable the control loop

Note: Even with the control loop ENABLED, it is possible for the user to temporarily turn OFF the control loop, from the CONC or FLOW mode. However, if the control loop is set to DISABLED, it cannot be temporarily turned back on.

After changing the ozone settings to the desired values, press the ACCEPT key to save settings, or the CANCEL key to leave them unchanged.

PHOTOMETER PREFS

The photometer preferences screen sets the amount of averaging and noise filtering applied to the photometer readings before being displayed on the screen.

PHOTOMETER PREFS
AVERAGING = 8
NOISE FILT = 0
ACCEPT CANCEL

These settings can be changed from the PREFS – PHOTOMETER PREFS menu, but can also be changed at any time, even while the system is generating or measuring ozone.

To access the photometer preferences screen while flowing gas in the CONC or FLOW mode, move the cursor to the O3 (ozone) row and press VIEW to bring up the photometer diagnostic data screen, then press MENU

To access the photometer preferences screen while running PHOTO mode, press the MENU key

Photometer Averaging setting

The AVERAGING setting determines how many photometer readings are averaged together to determine the average photometer reading. The average reading is the value that is displayed on the LCD display, as well as output on the serial port and analog output.

Move the cursor to the AVERAGING row and enter the desired averaging value.

The averaging can be set between 1 (no averaging) and 32 (maximum).

Photometer Noise Filter setting

The NOISE FILT setting determines how the system handles noisy photometer readings. Normally the Noise Filter is set to 0. However, in the event that the photometer readings are unusually noisy, turning on noise filtering will help reduce noise. The noise filter is used to eliminate a minimum and maximum reading before averaging the values

Setting the noise filter to 1 or 2 will eliminate 1 or 2 sets of minimum/maximum readings from the average.

Setting the noise filter to 0 will leave all readings unchanged

Since the noise filter removes either 2 or 4 photometer readings from the average, the averaging setting must be at least 1 more than the number of readings to be filtered out.

For a Noise Filter setting of 1, Averaging must be at least 3.

For a Noise Filter setting of 2, Averaging must be at least 5.

When finished changing the AVERAGING and NOISE FILT settings, press the ACCEPT key to save the changes, or press CANCEL to leave them unchanged.

Status Input/Output settings

The **STATUS IN SETUP**, **STATUS IN MODE**, and **STATUS OUT SETUP** menus are for setting up the operation of the Status Input and Status Output controls. These menus are discussed in detail in the **CONNECTING TO OTHER DEVICES – STATUS INPUT and STATUS OUTPUT** section of the manual starting on page 53

ANALOG OUT SETUP

The system has two analog output channels whose voltages represents different photometer parameters.

The outputs are pins 1(+), 1(-), 2(+) and 2(-) on the 4-pin connector labeled "ANALOG OUTPUTS" on the real panel

ANALOG OUTPUT RANGE
#1: O3 (1PPM) = 1 V
#2: 20 PSI = 2 V
ACCEPT CANCEL

Channel #1 represents the concentration of ozone measured by the photometer. The scale of the output is adjustable for 1, 2, 5 or 10 VDC for 0 to 1 PPM of ozone.

Channel #2 represents the photometer pressure. The scale of the output is adjustable for 1, 2, 5 or 10 VDC for 0 to 20 PSI pressure.

- (1) Use the up and down arrow key to select the analog channel to set.
- (2) Use the right and left arrow keys to select the range (1, 2, 5 and 10 VDC).

When finished changing the settings, press the **ACCEPT** key to save the changes, or press **CANCEL** to leave them unchanged.

SERIAL OUT SETUP

The system has the capability to output concentration or photometer data to serial port #2 on a periodic basis. The rate at which the concentration data is generated can be adjusted.

To setup the SERIAL OUTPUT operation:

- (1) From the PREFS menu, move the cursor to SERIAL OUT SETUP and press ENTER
- (2) With the cursor in the MODE row, press Enter to toggle the output data between CONC and PHOTO
- (3) Press the Down Arrow key to move the cursor to the RATE row
- (4) Enter the desired rate, in seconds (0-9999). A value of 0 will prevent any data from being output. In PHOTO mode, N/A is displayed as the rate is fixed by the photometer cycle (normally 8 seconds) and cannot be changed.
- (5) Press EXIT to save the setting and return to the previous menu.

Refer to the section SERIAL DATA OUTPUT for details on the format of the serial data.

UNITS OF MEASURE

The user has the option to change the units of measure for certain values in the system. The units selected affects how data is entered and displayed on the screen, as well as data logged to the serial port #2.

To change the UNITS OF MEASURE:

- (1) From the PREFS menu, move the cursor to UNITS OF MEASURE and press ENTER
- (2) Move the cursor to the desired row(s), press ENTER to toggle the units
- (3) Press EXIT to save the setting and return to the previous menu.

Note that units of measure do not affect REMOTE COMMANDS. The units used by these commands are specified in the Remote Command List and cannot be changed.

POWERUP MODE

The system has the capability to power up into a user selectable mode. In the event of a power failure, the system will automatically enter the selected mode when power is restored. This feature is useful for systems that operate unattended, from the Program Mode.

The available powerup modes are:

- READY The system will power up in the normal READY mode. This allows the user to interact normally with the system through the keyboard/LCD display. This is the default setting.

- SCHED 1 The system will start running Schedule #1. The step in the schedule closest to the current time/date will automatically be selected.

```
SET POWERUP MODE
POWERUP = READY

EXIT
```

To change the Powerup Mode:

- (1) At the SET POWERUP MODE screen, press the LEFT/RIGHT arrow keys or the ENTER key to cycle among the available settings.
- (2) Press EXIT to save the setting and return to the previous menu.

After powering up into SCHED 1 mode, if desired the user can cancel this action by pressing the appropriate EXIT or CANCEL key shown on the LCD display. The system will return to the Ready mode, and the system can be operated normally from the front panel

IDLE TIMER

The system has the capability to automatically switch to a different operating mode after a period of inactivity. This is useful where the system generally operates unattended (from a schedule) but occasionally must be operated by the user from the front panel.

If the user forgets to switch the system back to unattended mode, the system will do it automatically after the system has been idle for the specified IDLE TIME period

The available IDLE TIMER actions are:

- NONE This is the default setting. If set to NONE, nothing happens. This is the same as setting the IDLE TIME value to 0
- SCHEDED 1 The system will start running Schedule #1. The step in the schedule closest to the current time/date will automatically be selected.

```
SET IDLE TIMER
  ACTION = SCHED 1
  IDLE TIME = 60 MIN
  EXIT
```

To set the IDLE TIMER:

- (1) Use the up/down arrow keys to move the cursor to the ACTION row.
- (2) Press the left/right arrow keys to toggle the ACTION setting
- (3) Use the up/down arrow keys to move the cursor to the IDLE TIME row.
- (4) Enter the desired idle time value (from 0 to 999 minutes)
- (5) Press EXIT to save the setting and return to the previous menu.

Idle Timer Operation

When a value other than 0 is entered for IDLE TIME, the Main Menu (Ready Mode) will display:

```
READY IDLE = xxx
```

where xxx is the IDLE time specified.

The IDLE value will decrease with each minute that the system is idle (no keys have been pressed). When this value reaches 0, the specified ACTION will be taken.

Pressing any key will cause the IDLE value shown to reset to the IDLE TIME value specified in the SET IDLE TIMER screen

The IDLE TIMER will only operate while the system is in the READY mode (at the main menu).

SET TIME/DATE

To set the time and date:

- (1) With the left/right arrow keys, move the cursor to the desired date or time field
- (2) Press the up and down arrow keys to set the desired time/date value.

Note: the day of the week is calculated by the system automatically.

When the correct time and date are entered, press the `EXIT` key.

ADJUST CONTRAST

The contrast of the LCD display is affected somewhat by the angle at which the display is viewed as well as the ambient temperature. To adjust the contrast for optimum results:

```
ADJUST CONTRAST
CONTRAST = 100
↑/↓ TO CHANGE
DONE
```

- (1) Press the up arrow to increase the contrast on the screen, or the down arrow to decrease the contrast. The contrast value can be changed from 100 (max) to 0 (min). The contrast value will change in increments of 5.
- (2) After reaching the desired contrast setting, press the `DONE` function key to return to the main Preferences menu.

SYSTEM INFO

This `SYSTEM INFO` function displays the system model number, software revision and serial number.

```
ENVIRONICS 6103
REV: 6103-1.39-01
SERIAL#: 1234
EXIT
```

When done viewing the `SYSTEM INFO`, press `EXIT`

CONNECTING TO OTHER DEVICES

The 6103 is capable of interfacing to other devices for remote control and monitoring purposes. There are 8 status inputs (digital), 8 status outputs (digital), 2 analog outputs, and 2 RS-232 serial ports available.

STATUS INPUT

The Status Input feature allows the system to perform various functions in response to one or more of the 8 status input control signals available on the rear panel of the instrument. To use the Status Input feature, the 2 control pins for the desired status input must be connected together. The status input signal must be present for at least 500 milliseconds to ensure that the signal is properly detected by the software.

Caution: *The status inputs respond only to a connection between adjacent pins of the desired input, usually using a switch or a relay. Do not apply any voltage to the status input pins, as this will result in damage to the instrument*

Contact Duration setting (STATUS IN MODE)

The Status Input feature allows for two different input modes, according to the duration of signals to be supplied to the system. This setting determines the type of input signal required to start a function and keep it running.

- When this is set to **MOMENTARY**, a momentary input signal (500 msec minimum) will activate the assigned function for that input. The function will continue to operate even after the input signal is removed. To stop the function, a separate **STOP** signal is required (explained below)
- When this is set to **ACTIVE**, the assigned function for an input will remain active only while that input is active. When the status input signal is removed, the function will stop running.

To change the Status Input Mode, from the Main Menu select **PREFS**. Move the cursor to **STATUS IN MODE** and press **ENTER**.

Press **ENTER** to toggle the input type between Momentary and Active. When done, press **ACCEPT**.

Status Input Setup

The Status Input Setup screen allows you to assign different functions to each status input or groups of inputs.

To change the Status Input Setup, from the Main Menu select `PREFS`. Move the cursor to `STATUS IN SETUP` and press `ENTER`.

The Status Input Setup screen is shown below. The left side of the screen shows the status input # (1-8), while the right side shows the function currently assigned to that input.

#	ACTION
1	CONC 1
2	PROG 1
	GROUP EXIT

Use the `UP/DOWN` arrow keys to select the status input line you want to change, then press the `RIGHT` arrow key or `ENTER`.

Next, press the `UP` arrow key to select the desired Action. The following actions are available:

NONE	No action – input signal is ignored.
STOP	Stop whatever action is currently running.
CONC	Run the specified CONCENTRATION MODE file.
PROG	Run the specified PROGRAM file.

For the `NONE` and `STOP` actions, press `ENTER` to complete the entry.

For the `CONC` and `PROG` actions, press `ENTER` to advance to the `ITEM #` field. Then, enter the `CONC` or `PROG` item you want to run (1-99 for `CONC`, 1-20 for `PROG`). Or, press the `GROUP` button to make this input part of a `GROUP` (explained below) of inputs.

Using the GROUP capability

Two or more Status Input lines can be grouped together and used to select among a larger number of `CONC` or `PROG` items than could normally be selected individually.

For example, creating a `CONC GROUP` with 4 inputs would allow running 15 different `CONC` mode settings. This is done by activating 1 or more of the grouped inputs simultaneously.

Both the CONC and PROG actions can each have their own set of GROUPED inputs. For example, Inputs #1, 2, 3, and 4 could be CONC GROUP inputs, while inputs # 6, 7, and 8 could be PROG GROUP inputs.

Note that grouped inputs for each type of action (CONC or PROG) must be assigned sequentially, with no gaps in between. For example, assigning inputs #4, 5, 6, and 8 as CONC GROUP inputs is not a valid configuration (because #7 is skipped). In this case, inputs #4, 5, 6 will still function as a group since they are sequential, but input #8 will be ignored.

The table below shows the total number of CONC or PROG items that can be selected using a given number of grouped inputs.

# OF GROUPED INPUTS	ITEMS THAT CAN BE SELECTED
2	3
3	7
4	15
5	31
6	63
7	99

How the software evaluates GROUPED inputs

When a group of inputs are configured for GROUPED operation, 1 or more inputs can be activated simultaneously. The combination of active inputs is used to compute a value, which identifies which CONC or PROG mode file is to be run.

To determine this value, the software computes the binary value of all grouped inputs. To understand how this works, examine the table below. Each grouped input has a value assigned to it. The total grouped value is determined by adding all of the input values for status inputs that are active within the group.

GROUPED INPUT	Value
1	1
2	2
3	4
4	8
5	16
6	32
7	64

For example, suppose inputs # 3, 4, 5 and 6 are configured as CONC GRP inputs. Since input #3 is the first input in the group, its value is 1. Likewise input #4 has a value of 2, #5 has a value of 4, and #6 has a value of 8.

Now, suppose that inputs # 3, and #5 are active. Since input #3 is the 1st input in the group, and input #5 is the 3rd input in the group, the chart shows these inputs have a value of 1 and 4 respectively. Therefore, the group value = 1 + 4 = 5, so CONC mode #5 will be run.

Since status input groups can be assigned to any status input line, keep in mind that the value determined from the table is not based on the actual status input line # that is active, but rather its relative position within the group.

It is important to note that if the group value for an action is out of range, no action will be taken. The range for CONC group items is 1-99, while the range for PROG group items is (1-20)

Status Input Priority

Status Inputs have priority, with input #1 having the highest priority, and input #8 having the lowest priority. If 2 or more signals (or groups) are active at the same time, the inputs with the higher priority will take precedence over inputs of lower priority

STATUS OUTPUT

The Status Output feature allows the system to indicate its current operating conditions to external devices. This is useful for directly or indirectly (using a relay) activating a device such as a data logger or zero-air source.

There are 8 status output signals available on the rear panel of the instrument, as well as 4 connections for Ground and 4 connections for +24 VDC.

To use a Status Output to provide a "contact" output, connect the inputs for the device being controlled to the desired STATUS OUTPUT pin, and to GROUND.

To use a Status Output to provide a "powered" 24 VDC output (to drive a relay for example), connect the inputs for the device being controlled to the desired STATUS OUTPUT pin, and to +24 VDC.

Caution: Each status output can sink a maximum of 100 mA. Do not connect anything to the outputs (such as a solenoid) that will draw more than 100 mA, as this will result in damage to the instrument

Status Output Setup

The software supports 2 different modes for programming the status outputs: STANDARD and LEADS. The STANDARD mode allows each individual status output signal to be programmed to activate under specific conditions. The LEADS mode allows the state of all status output signals to be controlled when a specific condition is met. The LEADS mode must be selected when integrating with the LEADS Environmental Monitoring Software from IPS MeteoStar, but can also be used by anyone desiring this type of operation.

To program the status outputs, select PREFS from the menu, scroll down to STATUS OUT SETUP and press ENTER

Press the MODE button to toggle between STANDARD and LEADS mode.

```
STATUS OUTPUT SETUP
MODE = STANDARD

EDIT   MODE   DONE
```

Press the EDIT button to modify the status output programming.

Status Output – Standard Mode

Each of the 8 Status Output lines can be programmed to activate whenever a particular Concentration Mode file is running, or whenever a particular Mass Flow Controller is running. Whenever the operating conditions of the system matches one or more specified Status Output condition, it corresponding status output line(s) will activate.

#	TYPE	CONDITIONS			
1	CONC	03	10	45	72
2	MFC	01	02	00	00
	TYPE				EXIT

Use the up/down arrow keys to select the desired Status Output line (1-8).

Press the TYPE key to select the type of condition to monitor (CONC or MFC). Each press of the TYPE key will cycle through the available condition types. Then press the right arrow key to enter the desired condition values. Up to 4 values may be entered for each status line. Enter 0 to ignore that condition.

For Concentration Mode conditions, values from 01 to 99 indicate that whenever the system is running that Concentration mode file, then the corresponding Status output will be activated. A Concentration Mode file can be activated either manually (by pressing LOAD, #, START) or using the Status Input lines.

For MFC conditions, values 01 to 03 indicate that whenever any of the specified Mass Flow controllers are operating, then the corresponding Status Output will be activated.

When done entering Status conditions, press EXIT to return to the PReFerences menu.

Status Output Operation - Standard Mode

Once the Status Output conditions have been programmed, the status output lines will now operate whenever the specified conditions match the operating state of the instrument.

For Concentration Mode conditions, the status output will activate in response to the concentration mode file that is currently running. The concentration mode file can be selected manually by entering Concentration Mode, and pressing FILE – LOAD – file # - START (refer to the Concentration Mode section of the manual). It can also be selected automatically using the instrument's Status Input lines, or by Program Mode control.

After a Concentration Mode file is selected, it will continue to remain "active" whenever Concentration Mode is running (by pressing START or by Status Input). Any Status Output lines programmed with the corresponding file # will activate at that time. Pressing STOP or stopping the system by Status Input will deactivate the corresponding Status Output lines.

When operating the system manually, the most recently loaded file # will remain as the current file #, regardless of any changes the user makes to flow, concentration or gas values. To make a different file active, press FILE – LOAD – file #. To make the current file inactive (so that status output lines do not get activated) simply exit and re-enter Concentration Mode.

For MFC conditions, the status output will activate whenever the specified MFC is flowing gas, and will deactivate whenever it stops flowing gas.

Status Output – LEADS Mode

When operating in LEADS mode, the 8 status output lines are controlled as a group, based on what modes are currently running, and the corresponding user specified Status Block values assigned to those modes.

Status Block values are assigned to both Concentration Mode registers (LEVELS) and Program Mode registers (SEQuences).

Status Blocks are divided into 2 sections, STATBLK1 and STATBLK2. The Status Block values (BLK1 and BLK2) each consist of 8 bits, where each bit can be set to 0 (off) or 1 (on).

The 8 bits of STATBLK1 correspond directly to the 8 Status Output signals, with the leftmost bit corresponding to Status Output #8, and the rightmost bit corresponding to Status Output #1.

The 8 bits of STATBLK2 are used internally by the LEADS software only, and have no effect of the Status Output signals.

LEVEL 10		
STATBLK1	STATBLK2	
10000011	11000000	
LEVEL	SEQ	EXIT

Press the LEVEL button to set the Status Block values for Concentration Mode (LEVELS). Press the SEQ button to set the Status Block values for Program Mode (SEQuences)

Press the UP/DOWN arrow keys to cycle through and select the desired LEVEL or SEQ. As the LEVEL or SEQ # changes, the corresponding STATBLK values will be displayed. This allows you to quickly review the STATBLK values.

Press the LEFT/RIGHT arrow keys to move the cursor between STATBLK1 and STATBLK2

To change the STATBLK value, simply enter the number '0' or '1' with the keypad. Once you begin changing a STATBLK value, you must enter all 8 bits.

Status Output Operation - LEADS mode

Once the Status Output conditions have been programmed, the status output lines will now operate whenever the specified conditions match the operating state of the instrument.

For Concentration Mode (LEVEL), whenever the specified Conc Mode register is active, the status output will be set to the corresponding LEVEL STATBLK1 setting.

For Program Mode (SEQ), whenever the specified Program Mode register is active, the status output will be set to the corresponding SEQ STATBLK1 setting. Keep in mind that a Program consists of one or more Conc Mode steps. Therefore, both the SEQ and LEVEL STATBLK1 values are used to determine the setting of the Status Output lines.

ANALOG OUTPUT

The system has two analog output channels whose voltages represents different photometer parameters.

The outputs are pins 1(+), 1(-), 2(+) and 2(-) on the 4-pin connector labeled "ANALOG OUTPUTS".

Channel #1 represents the concentration of ozone measured by the photometer. The scale of the output is adjustable for 1, 2, 5 or 10 VDC for 0 to 1 PPM of ozone.

Channel #2 represents the photometer pressure. The scale of the output is adjustable for 1, 2, 5 or 10 VDC for 0 to 20 PSI pressure.

REMOTE CONTROL

The system has the ability to be controlled remotely using Serial Port #1. Refer to the REMOTE COMMUNICATIONS section of the manual for full details.

SERIAL DATA OUTPUT

The system has the ability to output concentration or photometer data to Serial Port #2. This data can be logged using an external data logger or PC.

The type and frequency of data output are controlled by the SERIAL OUT SETUP item in the PREFS mode.

The data is output is fixed at 9600 baud, 8 bits, 1 stop bit, no parity.

Concentration Mode

When the serial data output mode is set to CONC, the frequency of data output is adjustable to anywhere from 1-9999 seconds. This setting is changed under SERIAL OUT SETUP in the PREFS mode.

This is a sample of the data output:

TIME	GAS	CONC	OZONE	FLOW
11:42:30	CO2	0.000000	0.000	0.0000
11:42:40	CO2	10.00100	0.501	1000.02
11:42:50	CO2	10.00104	0.500	1000.01

GAS = span gas currently in use
CONC = actual span gas concentration (ccm)
OZONE = average photometer ozone reading (ppm)
FLOW = actual total gas flow rate (ccm)

Photometer Mode

When the serial data output mode is set to PHOTO, the frequency of data output is controlled by the photometer sample/reference cycle (typically 8 seconds) and cannot be changed.

This is a sample of the data output:

TIME	PHOTEMP	PHOPRESS	I	I0	O3AVG
10:53:30	24.87	15.25	835752	835749	0.0000
10:53:38	24.86	15.25	835759	835755	0.0000
10:53:46	24.86	15.25	835748	835745	0.0000

PHOTEMP = photometer gas temperature (°C)
PHOPRESS = photometer pressure (user units)
I = photometer intensity, while measuring ozone
I0 = photometer intensity, while measuring reference gas
O3AVG = average photometer ozone reading (user units)

REMOTE COMMUNICATIONS

The REMOTE COMMUNICATIONS mode allows the instrument to be controlled remotely by a host computer, by sending specific commands to the instrument. The instrument will respond to commands issued by the host computer, but will not issue any unsolicited messages to the host, except to acknowledge a command or to return an error code.

The host computer communicates with the instrument through one of the RS232 ports using the commands described in the "REMOTE COMMAND LIST" section of this manual. If an error occurs, the instrument will return an error code, indicating the problem. These error codes are described in the "REMOTE ERROR CODES" section.

In order to establish communication with a host computer, RS232 port #1 on the system must be used. The instrument will accept remote commands any time the system is powered up.

INTERFACE SPECIFICATION

The communication interface is a standard RS-232C serial interface, connected via a Male DB-9 connector. The instrument operates as a DTE (Data Terminal Equipment) device, requiring a null modem cable to connect to a PC

Communication port parameters are: 1 Start bit, 8 data bits (LSB first), 1 Stop bit (always high), No parity bit. The speed of communications port is fixed at 9600 baud.

Data Format

All remote communications use standard ASCII characters. Commands are terminated with either of the following single byte ASCII codes:

<CR> Carriage Return	(ASCII Code 0x0D)
<LF> Linefeed	(ASCII Code 0x0A)

Command Format

Commands sent to the instrument must be formatted a follows:

COMMAND FORMAT:	COMMAND <CR><LF>
-or-	COMMAND <CR>
-or-	COMMAND <LF>

Since some systems send a <CR> character with a <LF> character, either format is acceptable. Commands are not case sensitive.

Reply Format

All replies from the instrument to the host computer will be formatted in one of three possible methods, depending on the type of response required.

COMMAND ACCEPTED: If the command received requires no data to be returned, the instrument will acknowledge that it successfully received and performed the command. This will be indicated by:

RESPONSE: **OK<CR><LF>**

DATA RETURNED For commands that require data to be returned, the data will be formatted as follows. If the data consists of a list of values, each value will be separated with a comma.

RESPONSE: data<CR><LF>

EXAMPLE: 5000.0<CR><LF>

ERROR RETURNED If the command received contains errors, or cannot be performed by the instrument, an error code will be returned. The error message is formatted as:

RESPONSE: **ERR(error code)<CR><LF>**

EXAMPLE: ERR12<CR><LF>

Format Of Numeric Data

All numeric data for physical parameters such as Flow, Concentration, Voltage, etc. must be specified as a real number, with decimal point and fractional value required. Exponential notation is not permitted.

These values are indicated by the format "**x.xxx**"

All other numeric data must be specified as INTEGER values, with no decimal point. These values are indicated by the format "**n**"

All flow values are specified in "cubic centimeter per minute" (CCM).

All concentration values are specified in "parts per million" (PPM).

REMOTE COMMAND LIST

CONCENTRATION MODE COMMANDS

CONC TOT TARGET x.xxx	Set the target total flow rate for CONC mode.
CONC TOT ACTUAL ?	Read the actual total flow for CONC mode.
CONC OZONE TARGET x.xxx	Set the target ozone concentration.
CONC OZONE ACTUAL ?	Read the actual ozone concentration.
CONC GAS n	Select gas "n" to be used as the span gas by CONC mode. (2 <= n <= 20)
CONC GAS TARGET x.xxx	Set the target output gas concentration (OGC) for the current span gas.
CONC GAS ACTUAL ?	Read the actual OGC for the current span gas.
CONC UPDATE	Start/update CONC mode with the current settings.
CONC STOP	Stop running CONC mode.

CONC x GAS y nnn.n OZONE mmm.m FLOW fff.f
Assign Conc Mode paramters to a Conc File (Level)

x = File # (1-99)

y = Gas # (2-20) {y=1 is dilution gas, and is not permitted}

nnn.n = Output Gas Conc (ppm)

mmm.m = Ozone conc (ppm)

fff.f = Total Flow rate (ccm)

Example: CONC 10 GAS 3 23.0 OZONE 0.0 FLOW 5000.0

CONC x STATBLK bbbbbbbb bbbbbbbb
Assigns status block bits to a CONC file (Level)

x = File # (1-99)

bbbbbbbb = Status Block 1 and Status Block 2 values

Example: CONC 10 STATBLK 10000000 00000100

FLOW MODE COMMANDS

FLOW DIL TARGET x.xxx	Set Dilution (MFC1) Flow rate
FLOW DIL ACTUAL ?	Get actual dilution flow rate
FLOW OZONE TARGET x.xxx	Set ozone concentration
FLOW OZONE ACTUAL ?	Get actual ozone concentration
FLOW GAS n	Select gas "n" as span gas. (2 <= n <= 20)
FLOW GAS TARGET x.xxx	Set target flow rate for span gas (MFC2)
FLOW GAS ACTUAL ?	Get actual flow rate for span gas
FLOW UPDATE	Start/update flow mode with current settings
FLOW STOP	Stop flow mode

PHOTOMETER COMMANDS

PHOTO START	Put system into PHOTO mode. This switches the SAMPLE IN solenoid on, allowing an external source of ozone to be analyzed. This operates the same as the PHOTO mode available from the main menu.
PHOTO STOP	Take system out of PHOTO mode
PHOTO PRESS	Get photometer pressure
PHOTO LAMPTEMP	Get photometer lamp temperature
PHOTO GASTEMP	Get photometer gas temperature
PHOTO FLOW	Get photometer flow
PHOTO OZONE	Get photometer ozone reading

PHOTO SOURCE x Changes the photometer sample input source between INTERNAL (x=INT) and EXTERNAL (x=EXT)

This command should be used only in CONC and FLOW mode. The change does not take effect until a CONC UPDATE or FLOW UPDATE command is received. This setting stays in effect until changed again with this command or by the user from the Photometer Preferences menu.

OZONE COMMANDS

OZONE PRESS Get ozone pressure

OZONE BLOCKTEMP Get ozone block temperature

OZONE LAMPVOLTS Get ozone lamp voltage

OZONE FLOW Get ozone flow

GAS COMMANDS

GAS PORTS Returns number of gas ports available

GAS n CONC x.xxx Set the concentration for gas #n to x.xxx, in ppm. Gas concentration cannot be changed while the system is flowing gas.

GAS n CONC ? Returns the concentration for gas #n, in ppm

GAS n NAME mmmmmmm Set the name for gas #n to "mmmmmm" (max 7 characters)

GAS n NAME ? Returns the name for gas #n

GAS n PORT x Set the port for gas #n to x. Note Gas #1 is fixed to Port #1 and cannot be changed. To unassign a gas, set the port to 0.

GAS n PORT ? Returns the port for gas #n,

GAS LIST

Display a list of gases in the following format: gas #, port #, conc, name

Example:

```
1, 1, 1000000.0, GAS1
2, 2, 50.000000, CO2
3, 2, 120.00000, CO
4, 3, 800,00000, NO
```

PROG COMMANDS

PROG x CLEAR

Clear all steps from a Program (sequence).
This should be done prior to programming individual steps, to ensure there are no undesired steps in the program

x = Program # (1-20)

Example: PROG 1 CLEAR

PROG x STEP y CONC z TIME t

Assign Program Mode steps to a Program (sequence)

x = Program # (1-20)

y = Step # (1-20)

z = Conc file # (1-99)

t = run time (minutes) (1-999)

Example: PROG 1 STEP 5 CONC 10 TIME 5

PROG x STATBLK bbbbbbbb bbbbbbbb

Assigns status block bits to a Program

x = Program # (1-20)

bbbbbbbb = Status Block 1 and Status Block 2 values

Example: PROG 1 STATBLK 10000000 00000100

MISCELLANEOUS COMMANDS

GET INFO	Returns the system model #, serial # and software revision.
GET MFC n	n = 1-3 : Gets the MFC flow rate for the specified MFC in ccm.
GET ADC n	n = 0-15 : Gets the voltage for the specified ADC.
SET O3CTRL xxxx	Sets the ozone control mode. This determines whether or not the photometer is used to control the level of ozone being generated.
xxxx = ON	Normal operation. The photometer monitors the level of ozone and adjusts the ozone lamp voltage to keep the ozone level stable.
xxxx = LOCKED	Use this when performing GPT. The photometer does not control the ozone lamp voltage. The voltage remains locked at its current level.
xxxx = OFF	The ozone generator is not controlled by the photometer and relies solely on its calibration data.

REMOTE ERROR CODES

<u>ERROR#</u>	<u>MEANING</u>
4	COMMAND OVERFLOW The input command is too long (120 characters max)
12	UNKNOWN COMMAND An unknown or improperly formatted command was received.
18	COMMAND ERROR Command is recognized but improperly formatted.
19	TOO MANY ITEMS IN COMMAND STRING Command string contained too many separate data elements.
24	INVALID PORT Gas specified is not assigned to a port.
25	FLOW OUT OF RANGE In CONC or FLOW mode, flow value is out of range.
34	CONC OUT OF RANGE CONC mode only, concentration is out of range.
40	CONC FILE OUT OF RANGE Conc mode file # out of range
45	PROG MODE OUT OF RANGE Program Mode register out of range
46	PROG MODE STEP OUT OF RANGE Program Mode step # is out of range.
47	PROG MODE TIME OUT OF RANGE Program Mode step time is out of range.
53	VALUE OUT OF RANGE Specified value is out of range.
72	GAS # OUT OF RANGE Specified gas number must be between 1 and 20
74	CYLINDER GAS CONC OUT OF RANGE Specified concentration must be <= 1,000,000 ppm
76	GAS PORT OUT OF RANGE Specified gas port must be <= max number of ports
78	GAS NAME TOO LONG Gas name must be no more than 7 characters
99	ILLEGAL OPERATION Command not valid while system is running.

UPLOADING CONFIGURATION DATA

You can easily upload configuration files to the system using the Windows Hyperterminal software. This is useful when deploying multiple systems with identical configurations.

The types of configuration data that can be uploaded include

- Gases (name/concentration/port assignment)
- Concentration Mode settings (gas/ozone/flow)
- Program Mode settings (program steps and run times)

Start by creating a text file containing the Remote Commands you want to use. See the example at the end of this section

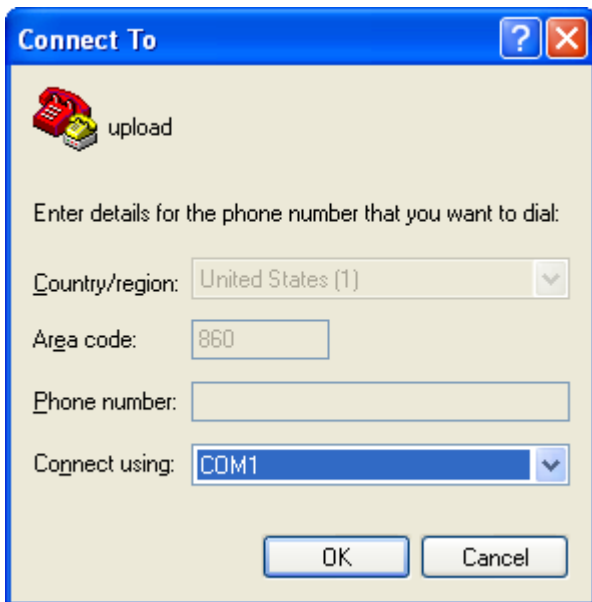
Configuring Hyperterminal

Start the Hyperterminal software. At the New Connection prompt, enter “upload” for the name, or use any name you choose.

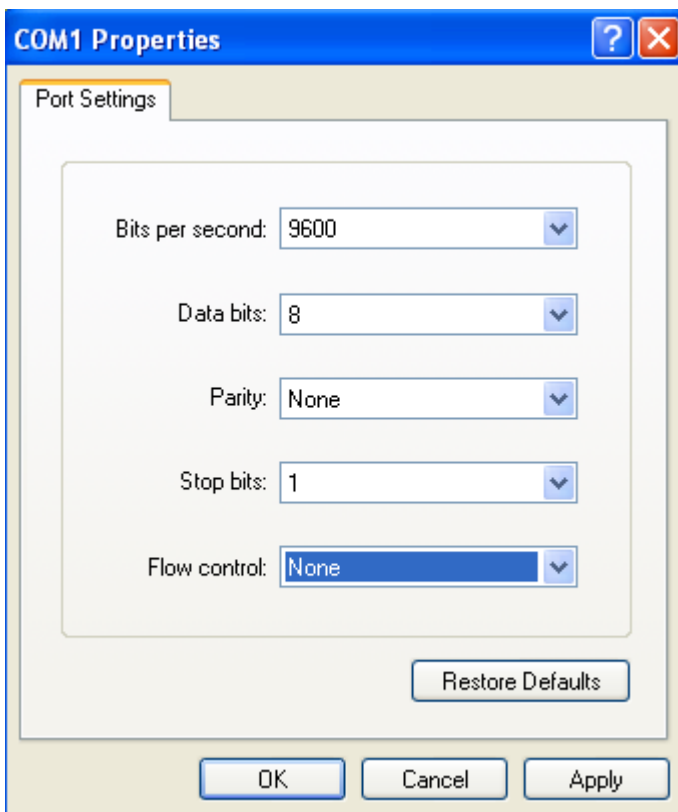
(Note, if you’ve already saved these connection settings, click Cancel, then click File - Open to open the previously saved settings)



At the Connect To prompt, select the serial port you want to use.

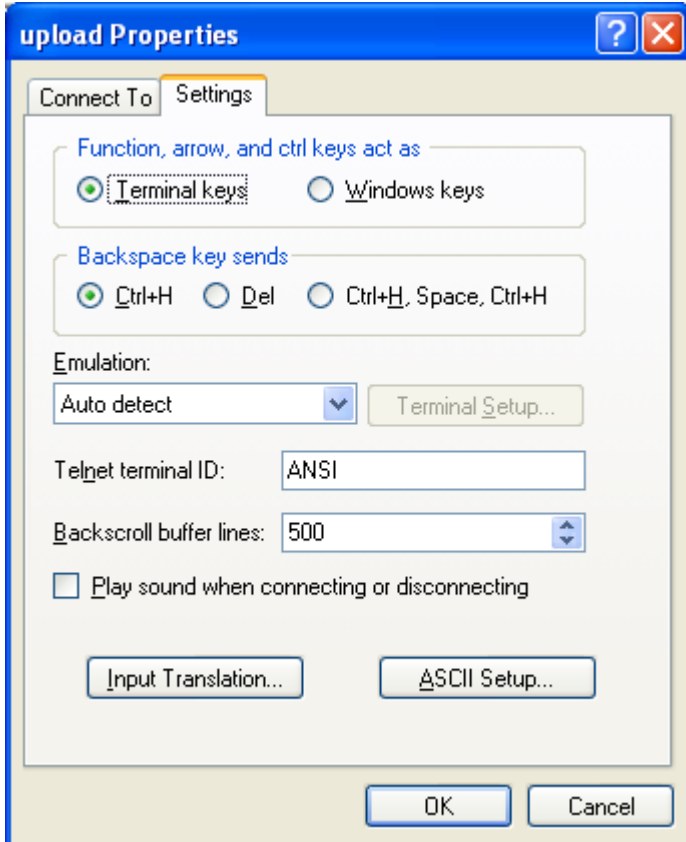


At the Port Settings prompt, set up as shown below.



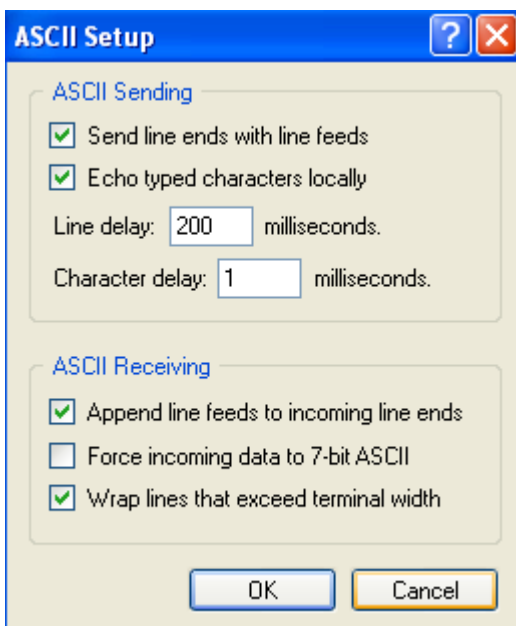
Click OK

Next, click File – Properties, then click the Settings tab



Click ASCII Setup

Set the ASCII setup screen as follows, then click OK



Uploading a Configuration File

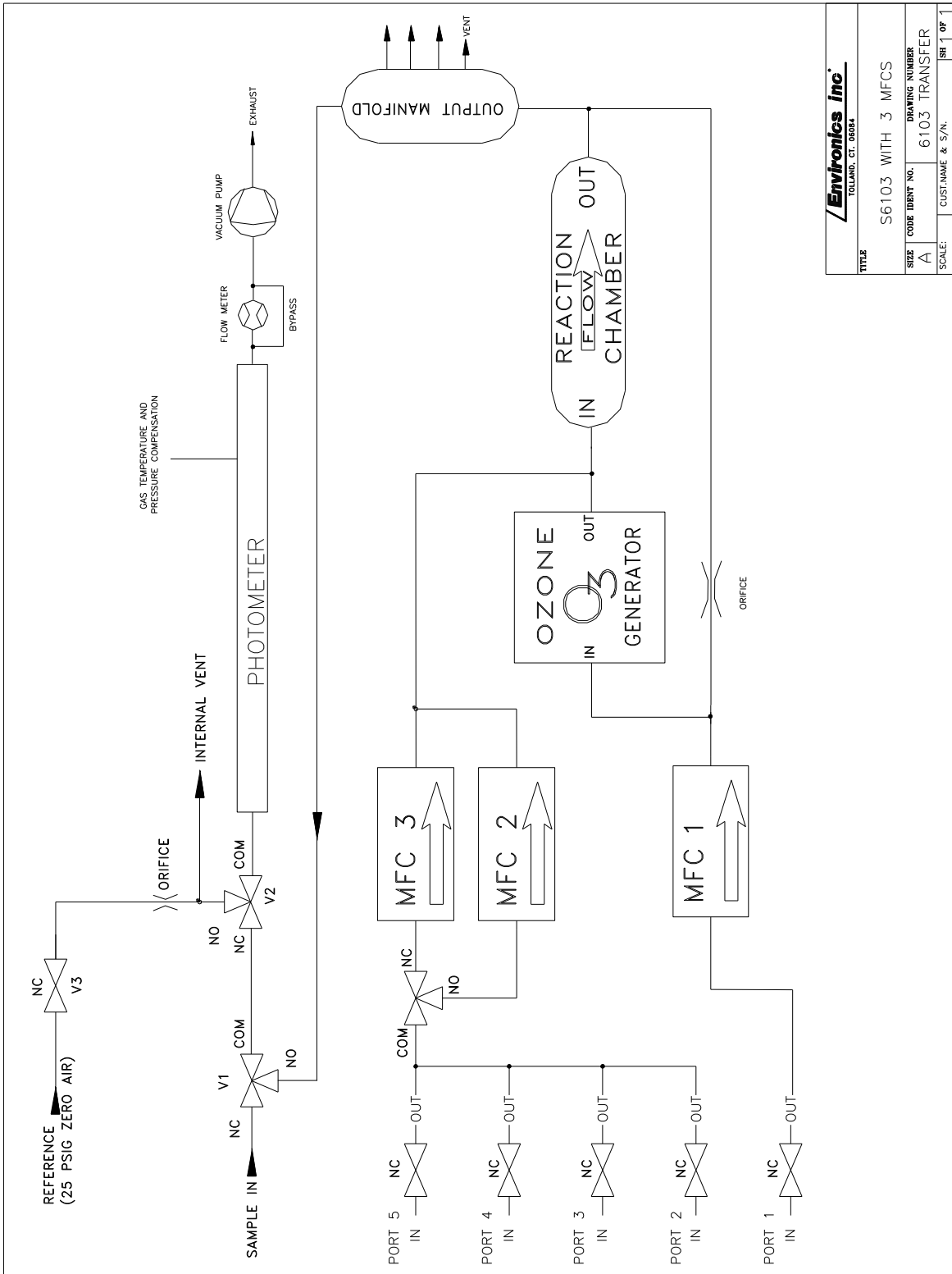
To upload a configuration file, click Transfer – Send Text File, and select the configuration file to send.

The commands being sent will be echoed on the Hyperterminal screen, along with the system's response to each command. While sending, verify that OK is displayed for each entry.

Below is a sample configuration file for uploading configuration data.

CONFIG.TXT:

```
GAS 1 NAME AIR
GAS 2 CONC 200.0
GAS 2 NAME CO
GAS 2 PORT 2
GAS 3 CONC 50.0
GAS 3 NAME NO
GAS 3 PORT 3
GAS 4 CONC 250.0
GAS 4 NAME CH4
GAS 4 PORT 4
GAS 5 CONC 50.0
GAS 5 NAME H2S
GAS 5 PORT 4
CONC 10 GAS 2 0.0 OZONE 0.0 FLOW 4000.0
CONC 12 GAS 2 0.160 OZONE 0.0 FLOW 3000.0
CONC 14 GAS 2 0.270 OZONE 0.0 FLOW 3000.0
CONC 15 GAS 2 0.370 OZONE 0.0 FLOW 3000.0
CONC 16 GAS 2 0.470 OZONE 0.0 FLOW 3000.0
CONC 19 GAS 2 0.470 OZONE 0.0 FLOW 3000.0
CONC 10 STATBLK 10000000 00000001
CONC 12 STATBLK 10000000 00000011
CONC 14 STATBLK 10000000 00000101
CONC 15 STATBLK 10000000 00000110
CONC 16 STATBLK 10000000 00000111
CONC 19 STATBLK 00000000 00000000
PROG 1 CLEAR
PROG 1 STATBLK 11000000 00000011
PROG 1 STEP 1 CONC 19 TIME 10
PROG 1 STEP 2 CONC 16 TIME 15
PROG 1 STEP 3 CONC 10 TIME 10
PROG 1 STEP 4 CONC 14 TIME 10
PROG 1 STEP 5 CONC 12 TIME 10
```

Envtronics inc. TOLLAND, CT. 06084	
TITLE: S6103 WITH 3 MFCs	
SIZE: A	DRAWING NUMBER: 6103 TRANSFER
SCALE:	CUST. NAME & S/N: SH 1 OF 1

Figure 6 - S6103 Piping and Instrument Diagram - 3 MFC