



Y S I Life Sciences



**Operations
Manual
YSI BIOVISION
8500
CO₂ Monitor**

**Data
for Life.™**

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1. Introduction

The YSI BIOVISION 8500 is a microprocessor based, menu-driven system designed to perform real time *in situ* monitoring of dissolved CO₂ in fermentation and cell culture processes.

The sensor capsule and probe are autoclavable. In addition, the sensor capsule is designed for single use (one fermentation/culture run) and is disposable.

Internal memory for storing up to 7500 readings and RS232 and RS485 ports allow you to upload or log data from the Model 8500 directly to a computer.

1.1 Description

The complete CO₂ monitoring system consists of the YSI 8500 CO₂ Monitor, YSI 8500 Series Cable, YSI 8500 Series Probe and YSI 8550 Sensor Capsule as shown in Figure 1.1. Side or top mount probes are available for 12, 19 or 25mm diameter bioreactor ports. See *10 Accessories and Replacement Parts* for a list of available probes and cables.

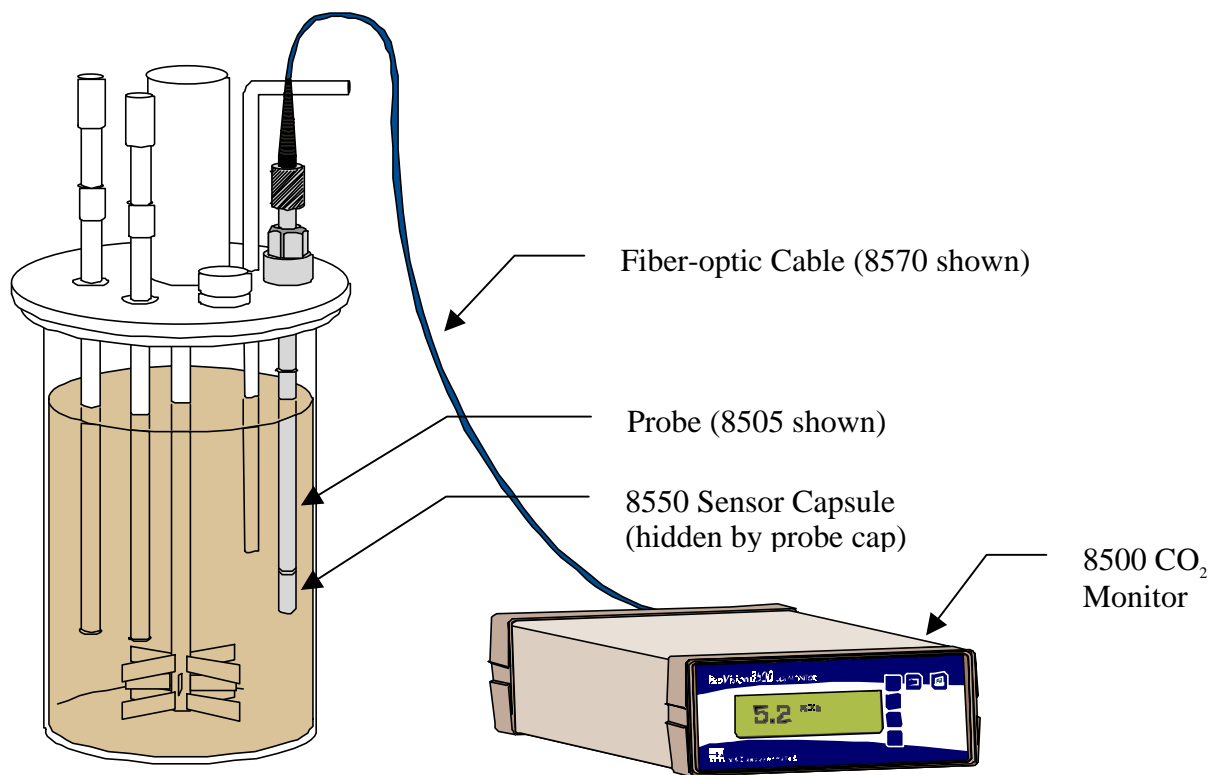


Figure 1.1

1.2 Capabilities

- Real time in situ dissolved CO₂ measurement
Sensor installs directly in bioreactor
- 7500 data point memory
Stores date, time and CO₂ concentration
- RS232 and RS485 serial ports
Output suitable for import to any spreadsheet
- Field software updates
Via RS232 serial port
- AC line power
100–250 VAC, 50–60 Hz

1.3 User Features

- Autoclavable sensor and probe assembly
- Disposable sensor
- Stainless steel probe body
- Detachable fiber-optic probe cable
- Backlit graphic LCD
- Audio feedback
- Soft-key/menu system
- Real time clock
- Y2K compliant: 4-digit year
- Alarm

1.4 Controls

1.4.1 Front Panel

The front panel of the instrument contains the display and keypad as shown in Figure 1.2.

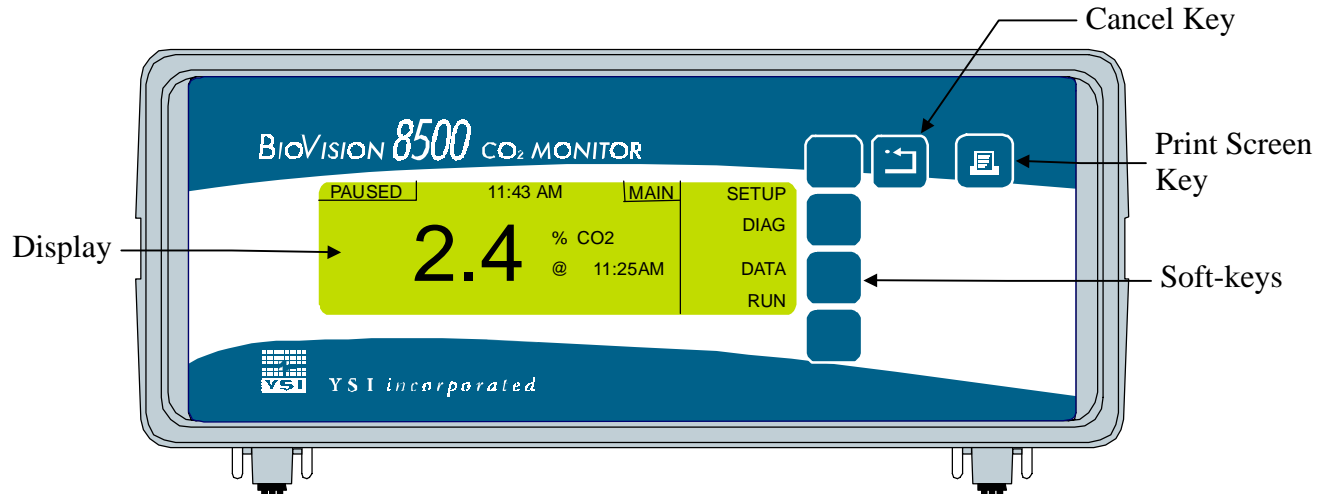


Figure 1.2

Display

The Main menu of the BIOVISION 8500 shows the four main operating modes, Setup, Diagnostics, Data and Run. The name of the current menu is shown at the top of the display just to the right of the time. The top left corner shows the current operation (paused, running c, running s, etc.). Figure 1.3 shows the typical display at the Main menu.

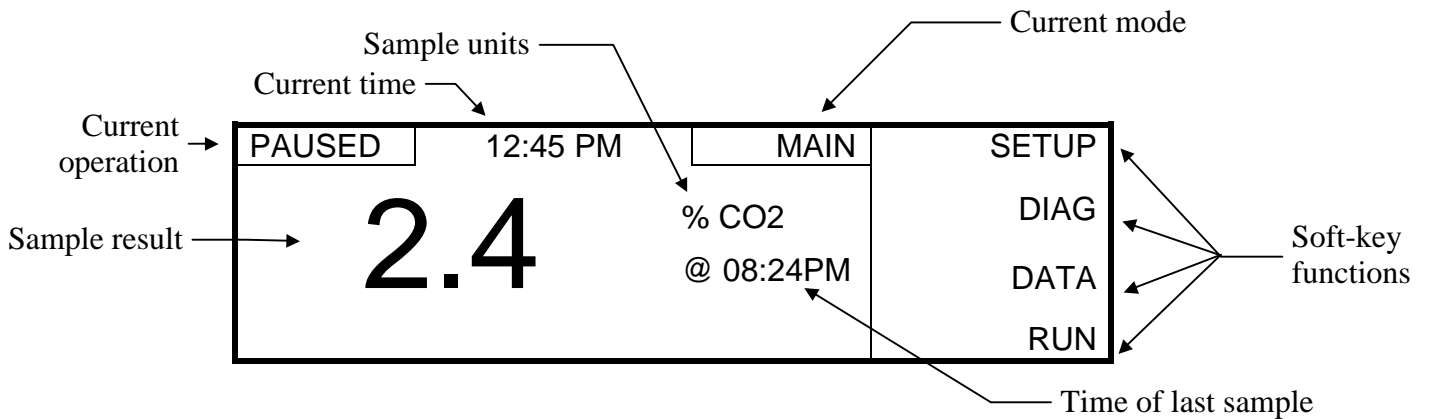


Figure 1.3

Keypad

The right column of the display identifies the functions of the four soft-keys which are located on the keypad to the right of the display. The function of each of these keys changes with each menu.

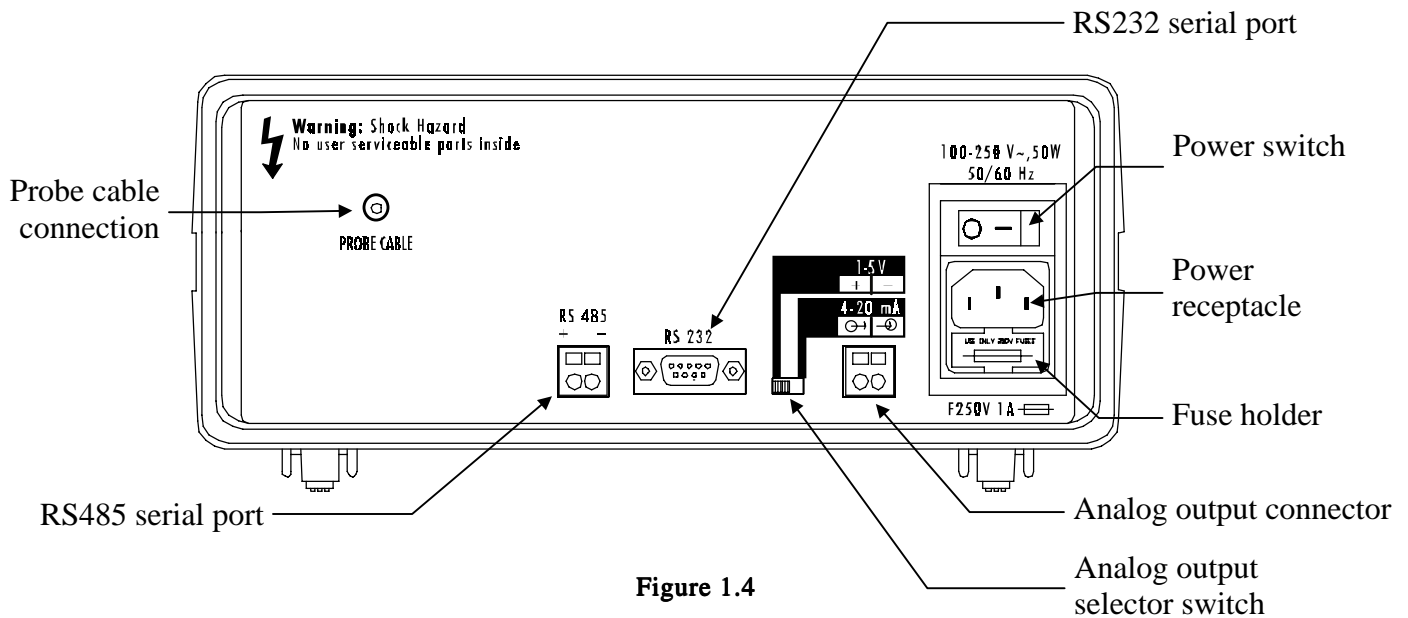
The soft-keys and [CANCEL] key are used to navigate through the menus. Pressing a soft-key will bring up a new set of soft-key functions (menu). The [CANCEL] key is used to backup through the menus to the top level.

The [PRINT SCREEN] key is used to send the information currently displayed on the screen to a computer or serial printer via the RS232/RS485 port.

The bottom row of the display is used to display error messages, See *8.1 Error Messages* for details.

1.4.2 Rear Panel

The rear panel contains the power switch and connections for the power cord, probe cable, analog output (1–5 VDC or 4–20 mA), RS232 and RS485 serial ports and fuse holder as shown below.



Power Switch

The power switch is an on/off toggle switch (0-off and I-on) located on the back of the instrument.

Power Receptacle

One end of the power cord (supplied) plugs into this receptacle, while the other end plugs into a properly grounded 100–250VAC, 50–60Hz electrical outlet. The instrument will automatically adjust the voltage as needed.

Probe Cable Connection

The SMA connector end of the fiber-optic cable (YSI 8500 Series) plugs into this connector, while the ST connector end attaches to the probe assembly. See *10 Accessories and Replacement Parts* for a list of available cables.

Analog Output Selector Switch

This switch is used to set the analog output to either 4–20 mA or 1–5 VDC.

Analog Output Connection

The analog output can be set to 4–20 mA or 1–5 VDC using the slide switch to the left of the connector (see Figure 1.4). See *5 Output* for wiring.

RS232 Connection

The RS232 connection is a standard DB9F connector. This connector allows the YSI 8500 to be connected directly to the serial port of a computer or serial printer. A standard straight (NOT a null modem) cable is required for connecting to a computer (see *10 Accessories and Replacement Parts*). To connect to a serial printer, use a 9 pin male to 25 pin female cable. See *5.1 RS232 Serial Output* for wiring and *4.1.3 Outputs, Setup Communications* for parameter setup.

RS485 Connection

The RS485 connection is a standard two-conductor connection. See *5.2 RS485 Serial Output* for wiring and *4.1.3 Outputs, Setup Communications* for parameter setup.

Fuse Holder

The fuse holder houses the power line fuse and slides out for fuse replacement. See *7.2 Fuse Replacement* for more details.

2. Menu Flowchart

The software flow chart for the BIOVISION 8500 is shown below in Figure 2.1. The four operating modes are shown at the top with the soft-key functions that are accessed in each menu below them.

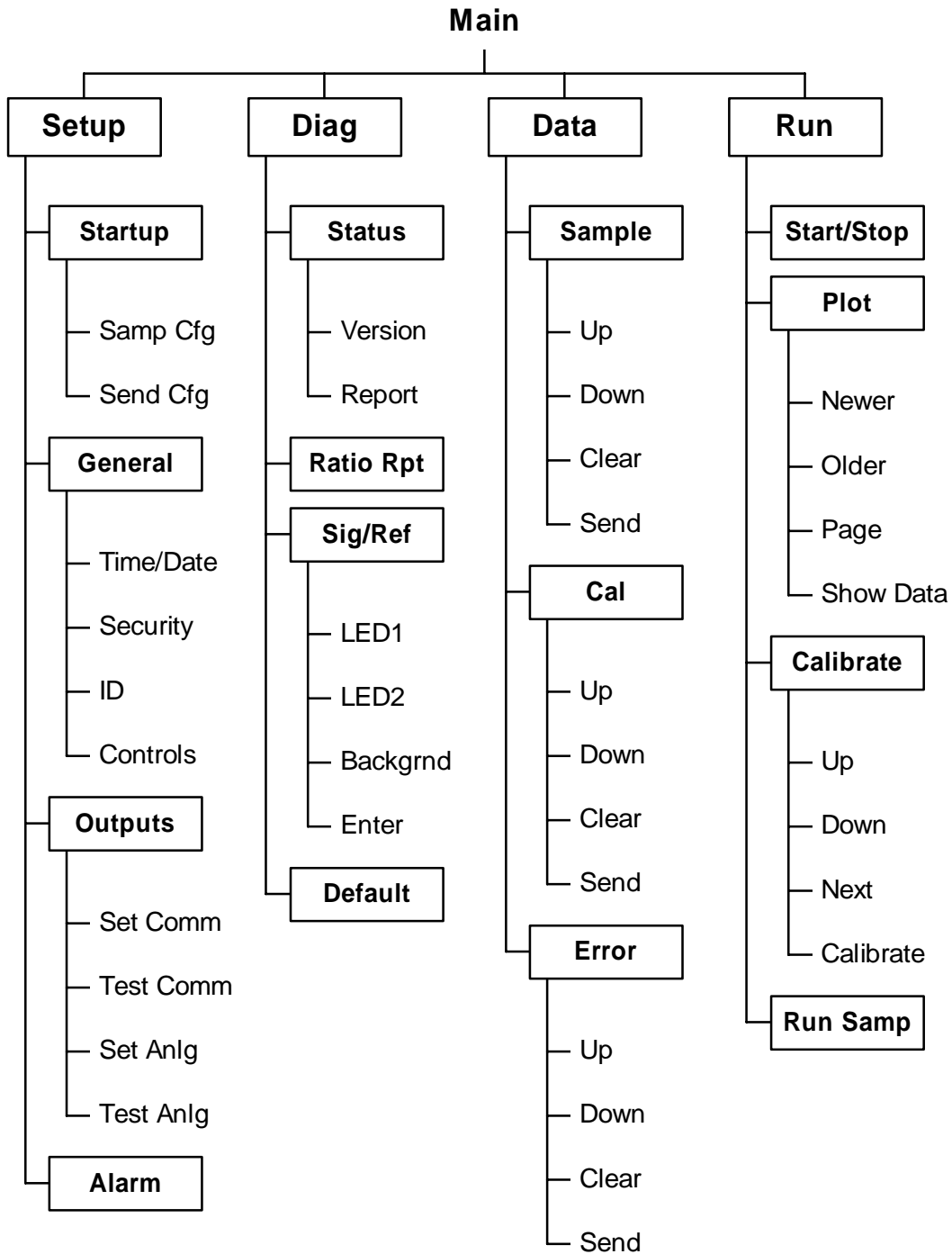


Figure 2.1
Software Flow Chart

3. Getting Started

3.1 Unpacking

When you unpack your new YSI BIOVISION 8500 for the first time, check the packing list to make sure you have received everything you should have. The probe, cable and sensor capsules are packaged in the same carton as the instrument. If there is anything missing or damaged, call the dealer from whom you purchased the YSI 8500. If you do not know which of our authorized dealers sold the system to you, call YSI Life Sciences Customer Service at 800 659-8895 or 937 767-7241, and we'll be happy to help you.

3.2 Notes on Safety

DO NOT PLUG THE INSTRUMENT IN AT THIS TIME. You should apply power only when directed to do so in the setup instructions.

NOTES ON SAFETY (Electrical precautions)

1. Use **ONLY** the line power cord supplied with the instrument. When directed to, connect the plug to a matching three-pronged wall receptacle.
2. Use **ONLY** fuses of the type supplied (see *7.2 Fuse Replacement*). Replacement power cords and fuses can be obtained from YSI, or your Dealer Representative (see *Appendix C - Warranty and Repair* and *Appendix F - Line Power Cord and Plug Wiring*).
3. Do **NOT** use an extension cord without protective grounding.
4. Do **NOT** remove front or rear cover. There are no user serviceable parts inside.
5. Repairs are to be performed only by trained and approved personnel.
6. This instrument must be connected to a protectively grounded (earthed) outlet.
7. The following notice is provided in compliance with IEC1010 Part 1 1990. See *Appendix F - Line Power Cord and Plug Wiring* for mains plug wiring and fusing instructions.
8. If the equipment is used in a manner not specified by YSI, the protection provided by the equipment may be impaired.

WARNING: For analog output connection, refer to section *5.3 Analog Output*.

WARNING: For RS232 or RS485 connection, refer to sections *5.1 RS232 Serial Output* and *5.2 RS485 Serial Output*. Equipment should be EN 61010 or EN 60950 approved only.

9. The mains (power) switch is for functional purposes **ONLY**. To disconnect the instrument from the mains supply, unplug the mains power cord from the back of the instrument.

3.3 Warranty Card

Please complete the Warranty Card and return it to YSI. This will record your purchase of this instrument in our computer system. Once your purchase is recorded, you will receive prompt, efficient service in the event any part of your YSI 8500 should ever need repair.

3.4 What You Need

Several things are needed in order to monitor CO₂ using the YSI 8500. The following list shows the basic items required.

- YSI 8500 Instrument (with AC Power Cord)
- YSI 8500 Series Fiber-Optic Cable
- YSI 8500 Series Probe
- YSI 8550 Sensor Capsule
- Bioreactor with 12, 19 or 25mm port (Adapter required for 19mm ports)

NOTE: See *10 Accessories and Replacement Parts* for available probes and cables.

3.5 Basic Setup

The following list describes the basic steps necessary for monitoring. See the following sections for details of each step.

1. Install Sensor Capsule
2. Install Probe in Bioreactor
3. Sterilize Bioreactor/Probe
4. Attach Cable to Probe
5. Attach Cable to Instrument
6. Connect AC Power
7. Setup Instrument Parameters
8. Calibrate System
9. Start Monitoring

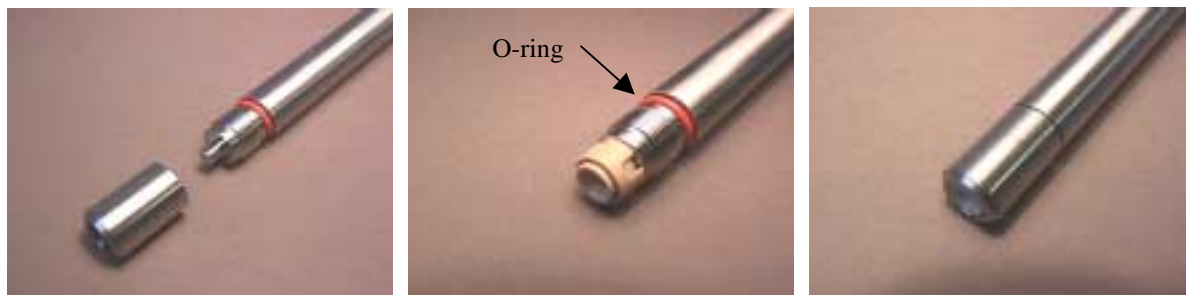
For example purposes, we will demonstrate how to set up the YSI 8500 to monitor the dissolved CO₂ level (in %) in a bioreactor at 5 minute intervals.

3.5.1 Install Sensor Capsule

The YSI 8550 Sensor Capsule is packaged in a container of bicarbonate buffer solution and should always be stored in this solution (see *6.2 Sensor Capsule Storage*). Remove the sensor capsule from its package and install it on the end of the probe as described below. For 12mm probes, see Figure 3.1. For 25mm probes, see Figure 3.2. Several probes are available. See *10 Accessories and Replacement Parts* for details.

12mm Probes

1. Unscrew the probe end cap and remove it from the probe.
2. Remove the old sensor capsule (if present) from the probe or end cap. **Do not touch the polished tip of the probe.**
3. Examine the probe tip for oxidation and clean if necessary (see *7.1 Probe Cleaning*).
4. Remove the new YSI 8550 Sensor Capsule from its package.
5. Shake excess buffer from the sensor capsule.
6. Verify that the o-ring is in place around the end of the probe.
7. Slide the new sensor capsule over the tip of the probe.
8. Install the probe end cap over the sensor capsule and screw it onto the probe.
9. **Store the probe in bicarbonate buffer until use** (see *6.2 Sensor Capsule Storage*).



Unscrew the probe end cap and remove it from the probe.

Slide the new sensor capsule over the tip of the probe.

Install the probe end cap.

Figure 3.1

25mm Probes

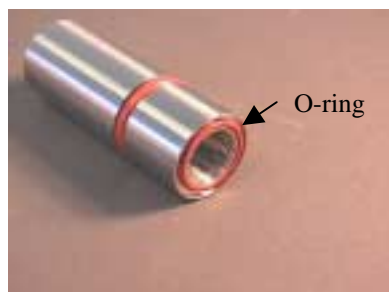
1. Unscrew the probe end cap and remove it from the probe.
2. Remove the old sensor capsule (if present) from the probe or end cap. **Do not touch the polished tip of the probe.**
3. Examine the probe tip for oxidation and clean if necessary (see *7.1 Probe Cleaning*).
4. Remove the new YSI 8550 Sensor Capsule from its package.
5. Shake excess buffer from the sensor capsule.
6. Slide the new sensor capsule over the tip of the probe.
7. Verify that the o-ring is in place in the base of the probe end cap.
8. Install the probe end cap over the sensor capsule and screw it onto the probe.
9. **Store the probe in bicarbonate buffer until use** (see *6.2 Sensor Capsule Storage*).



Unscrew the probe end cap and remove it from the probe.



Slide the new sensor capsule over the tip of the probe.



Verify the o-ring is in place.



Install the probe end cap.

Figure 3.2

3.5.2 Install Probe Assembly in Bioreactor

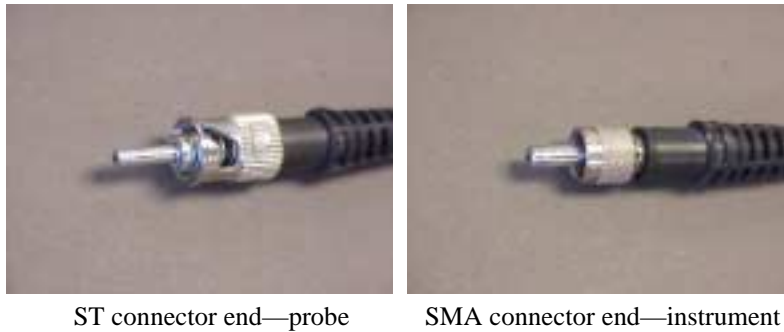
Install the probe assembly (with sensor capsule installed) in the bioreactor according to the bioreactor manufacturer's instructions. **Do NOT attach the YSI 8500 Series cable to the probe at this time.**

3.5.3 Sterilize Bioreactor/Probe

If possible, sterilize the bioreactor and probe as a unit. The probe may be subjected to temperatures up to 132°C and pressures up to 30 psi for 20 minutes. **Do NOT sterilize the YSI 8500 Series Cable.** If the probe is placed inside an autoclave, install an autoclave cap (see *10 Accessories and Replacement Parts*) on the ST connector.

3.5.4 Attach Cable to Probe

YSI 8500 Series Cables contain a glass fiber. **Do not kink or bend the cable in a curve with less than a 10 inch diameter.** One end of the cable has an ST connector that attaches to the probe, the other has an SMA connector that attaches to the back of the 8500 instrument. The ST connector is larger and has a slot in the side (see Figure 3.3).



ST connector end—probe SMA connector end—instrument

Figure 3.3

Attach the ST connector end of the cable to the probe as shown in Figure 3.4 and Figure 3.5.



Figure 3.4

Remove the dust cap (or autoclave cap, if installed) from the ST connector on the probe. Pull the protective cap off the ST connector end of the YSI 8500 Series Cable. **Do not touch the polished tip of the cable.**

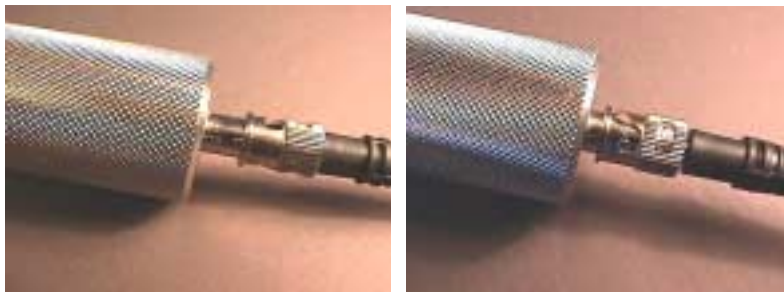


Figure 3.5

Carefully insert the tip of the cable into the connector at the end of the probe. Rotate the cable connector, while gently pushing toward the probe, until it slides into place. Twist the cable connector clockwise to lock it in position.

3.5.5 Attach Cable to Instrument

Pull the protective cap off the SMA connector end of the YSI 8500 Series Cable. **Do not touch the polished tip of the cable.** Carefully insert the tip of the cable into the probe connector on the back panel of the 8500 instrument. Screw the SMA connector onto the instrument connector by turning clockwise (see Figure 3.6).



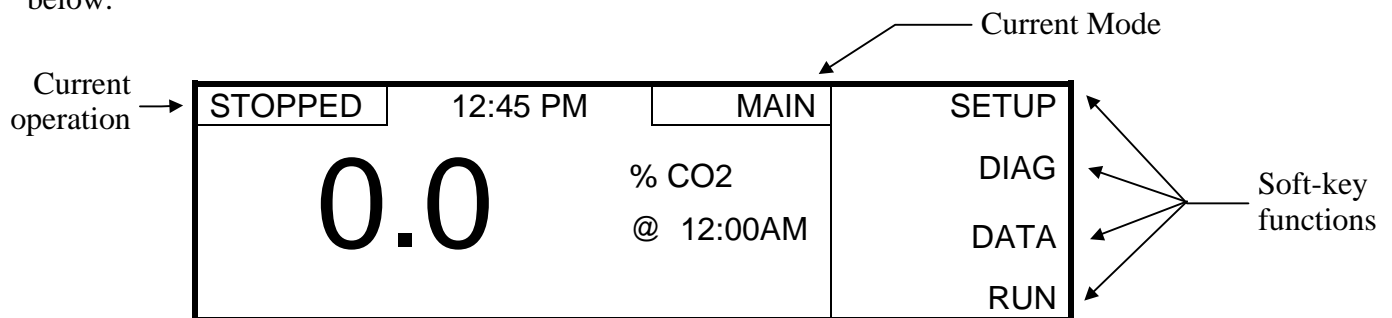
Figure 3.6

3.5.6 Connect AC Power

Plug the power cord (included with the BIOVISION 8500) into the power receptacle on the back of the instrument, then into a properly grounded 100–250VAC, 50–60Hz electrical outlet. The instrument will automatically adjust the voltage as needed. If you are located outside the United States, see *Appendix F - Line Power Cord and Plug Wiring*.

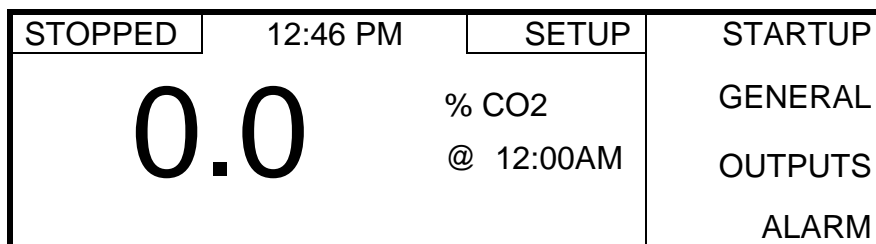
3.5.7 Setup Instrument Parameters


Turn the instrument on with the power switch on the rear panel (see Figure 1.4). The display should light up and, after a few seconds, the Main menu screen should appear similar to the one below.



The name of the current menu, is shown at the top of the display just to the right of the time. The right column of the display identifies the functions of the four soft-keys which are located on the keypad to the right the display.

Press the [SETUP] soft-key (top key) to enter the Setup menu as shown below.



You can return to the previous menu at any time by pressing the  [CANCEL] key. See Figure 1.2 on page 1-3 for the location of the [CANCEL] key. The right column of the display now shows the setup selections that are used to change the instrument setup as described below.

Press the [GENERAL] soft-key to display the General menu.

STOPPED	12:50 PM	GENERAL	TIME/DATE
0.0		% CO2	SECURITY
		@ 12:00AM	ID
			CONTROLS

Then, press the [TIME/DATE] soft-key to display the following screen.

	STOPPED	TIME/DATE	UP
Time format →	12 Hr	01:26 PM	DOWN
Date format →	MM/DD	04/14/2000	NEXT
			ENTER

Follow the steps below to set the current time and date.

1. Notice that the cursor (dark box) is on the time format. Press the [UP] or [DOWN] soft-key to change the format to 12 Hr.
2. Press the [NEXT] soft-key to move the cursor to the hour field, then use the [UP] or [DOWN] soft-key to change the hour to the current hour.
3. Press the [NEXT] soft-key to move the cursor to the minutes field, then use the [UP] or [DOWN] soft-key to change the minutes to the current minute.
4. Press the [NEXT] soft-key to move the cursor to the AM/PM field, then use the [UP] or [DOWN] soft-key to select AM or PM.
5. Press the [NEXT] soft-key to move the cursor to the date format, then use the [UP] or [DOWN] soft-key to change the date format to MM/DD. The date format can be set to Month/Day/Year (MM/DD) or Day/Month/Year (DD/MM).
6. Press the [NEXT] soft-key to move the cursor to the month field, then use the [UP] or [DOWN] soft-key to change the month to the current month.
7. Press the [NEXT] soft-key to move the cursor to the day field, then use the [UP] or [DOWN] soft-key to change the day to the current day.
8. Press the [NEXT] soft-key to move the cursor to the year field, then use the [UP] or [DOWN] soft-key to change the year to the current year.
9. Press the [ENTER] soft-key to save the changes and return to the General menu.

STOPPED	12:50 PM	GENERAL	TIME/DATE
0.0		% CO2 @ 12:00AM	SECURITY ID CONTROLS

Press the [CANCEL] key to return to the Setup menu.

STOPPED	12:51 PM	SETUP	STARTUP
0.0		% CO2 @ 12:00AM	GENERAL OUTPUTS ALARM

3.5.8 Calibrate System

The YSI 8500 system should be calibrated before each fermentation/cell culture run. Calibration should be performed under the same conditions (temperature and pressure) as expected during the run. For improved accuracy during long runs, recalibrate every 7 to 14 days during the run. See the *Application Notes* section.

The initial calibration value depends on the desired measurement range and accuracy. The allowed range is 3–100%, but 5% or 10% is normally used. For highest accuracy, the calibration point should be at the high end of your required measurement range.

Set Sample Interval and CO₂ Units for Calibration

For calibration, the CO₂ units should be set to %CO₂ and the sample interval should be set between 1 and 10 minutes to allow the user to determine when the readings are stable.

From the Setup menu, press the [STARTUP] soft-key to display the Startup menu.

STOPPED	12:01 PM	STARTUP	SAMP CFG
0.0		% CO2 @ 12:00AM	SEND CFG

Then press the [SAMP CFG] soft-key to display the SAMP CFG menu.

STOPPED		SAMP CFG	UP
Sample Interval:	10 Minutes		DOWN
Temperature:	37.0 Deg C		NEXT
Report CO2 in:	% CO2		ENTER

Press the [UP] or [DOWN] soft-key to set the sample interval between 1 and 10 minutes. Press the [NEXT] soft-key to move the cursor to the sample interval units. If necessary, use the [UP] or [DOWN] soft-key to change the units to minutes.

Press the [NEXT] soft-key to move the cursor to the temperature field, then use the [UP] or [DOWN] soft-key to set the value to the bioreactor temperature.

NOTE: For accurate measurements, the correct bioreactor temperature must be entered. If the temperature changes during a run, enter the Samp Cfg menu and enter the new bioreactor temperature.

Press the [NEXT] soft-key to move the cursor to the CO₂ units, then use the [UP] or [DOWN] soft-key to change the units to % CO₂.

Press the [ENTER] soft-key to save the changes and return to the Startup menu.

Press the [CANCEL] key two times to return to the Main menu.

Calibrate

Expose the probe to a known CO₂ level by sparging the bioreactor (containing the appropriate liquid) with CO₂ (normally 5% or 10%) from a compressed CO₂ cylinder.

From the Main menu, press the [RUN] soft-key to display the Run menu.

STOPPED	02:26 PM	RUN	START
0.0	% CO2	@ 02:23PM	PLOT
			CALIBRATE
			RUN SAMP

Press the [START] soft-key to display the following screen.

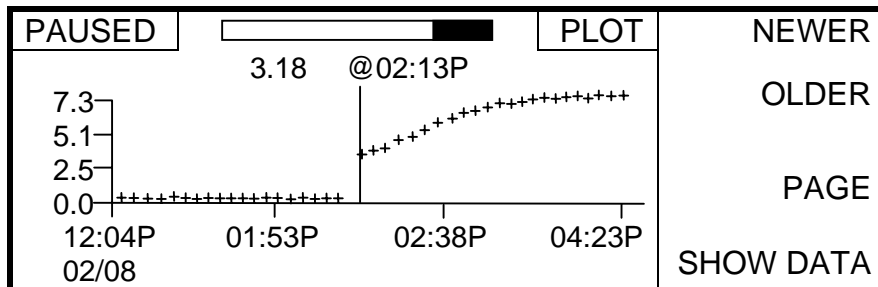
STOPPED		START	
Start Monitoring			
Push START to begin			
			START

Then, press the [START] soft-key again to start monitoring.

RUNNING S	02:26 PM	RUN	STOP
1.3		% CO2	PLOT
		@ 02:23PM	CALIBRATE
			RUN SAMP

Allow the reading to stabilize. Stabilization time varies from 40 minutes to 8 hours depending on the sparging rate, agitation, size, temperature and contents of the bioreactor. For $\pm 5\%$ accuracy, 2 hours are usually required.

To visually check for a stable reading, press the [PLOT] soft-key.



NOTE: The plot display does NOT update after each sample. To update the plot, press the [CANCEL] key, then the [PLOT] soft-key.

After visually checking for a stable reading, press the [CANCEL] key to exit to the Run menu.

When the reading is stable, press the [STOP] soft-key to display the following screen.

PAUSED	STOP
Stop Monitoring Push STOP to stop	
STOP	

Press the [STOP] soft-key again to confirm. The 8500 will stop monitoring and return to the Run menu.

STOPPED	02:26 PM	RUN	STOP
4.3		% CO2	PLOT
		@ 02:23PM	CALIBRATE
			RUN SAMP

Press the [CALIBRATE] soft-key to display the Calibrate menu.

STOPPED		CALIBRATE	UP
Enter % CO ₂ :		5.0	DOWN
Push CALIBRATE to calibrate			CALIBRATE

Use the [UP] or [DOWN] soft-key to enter the percent CO₂ level (usually 5% or 10%), then press the [CALIBRATE] soft-key. The 8500 will calibrate and return to the Run menu. Press the [CANCEL] key to return to the Main menu.

Set Sample Interval and CO₂ Units for Monitoring

After calibration, the sample interval (which was changed during the calibration procedure) must be set to the desired sample interval for monitoring. The CO₂ units may also be changed.

From the Main Menu, press the [SETUP] soft-key to enter the Setup menu.

STOPPED	02:41 PM	SETUP	STARTUP
0.0	% CO ₂	@ 12:00AM	GENERAL
			OUTPUTS
			ALARM

Then, press the [STARTUP] soft-key to display the Startup menu.

STOPPED	02:41 PM	STARTUP	SAMP CFG
0.0	% CO ₂	@ 12:00AM	SEND CFG

Then press the [SAMP CFG] soft-key to display the SAMP CFG menu.

STOPPED		SAMP CFG	UP
Sample Interval:	30	Minutes	DOWN
Temperature:	37.0	Deg C	NEXT
Report CO ₂ in:	%	CO ₂	ENTER

Press the [UP] or [DOWN] soft-key to set the desired sample interval for monitoring. Press the [NEXT] soft-key to move the cursor to the sample interval units. If necessary, use the [UP] or [DOWN] soft-key to change the units.

Press the [NEXT] soft-key to move the cursor to the temperature field, then use the [UP] or [DOWN] soft-key to set the value to the bioreactor run temperature.

NOTE: For accurate measurements, the correct bioreactor temperature must be entered. If the temperature changes during a run, enter the Samp Cfg menu and enter the new bioreactor temperature.

To change the CO₂ Units, press the [NEXT] soft-key to move the cursor to the CO₂ Units field, then use the [UP] or [DOWN] soft-key to select the desired units.

Press the [ENTER] soft-key to save the changes and return to the Startup menu.

NOTE: If the units (Report CO₂ in) are set to mBar or mmHg, you will be prompted to enter the atmospheric¹ and gauge pressures as shown below.

STOPPED		PRESSURE	UP
Enter Pressure:			DOWN
Atmospheric:	29.92	inHg	NEXT
Gauge:	1.47	psi	ENTER
Vessel Pressure	16.17	psi	

Verify that the Atmospheric and Gauge pressures are correct, then press the [ENTER] soft-key to store the values and return to the Startup menu. Press the [CANCEL] key two times to return to the Main menu.

The 8500 is now setup, calibrated and ready to start monitoring as shown below.

3.5.9 Start Monitoring

From the Main Menu, press the [RUN] soft-key to display the Run menu.

PAUSED	02:46 PM	RUN	START
0.0		% CO ₂	PLOT
		@ 12:00AM	CALIBRATE
			RUN SAMP

Then, press the [START] soft-key to display the following screen.

¹ Enter the true local barometric pressure. This corresponds to a reading from a mercury barometer. Do **NOT** use the pressure reported by the weather bureau. Weather bureaus correct pressures to sea level.

STOPPED		START	
Start Monitoring Push START to begin			START

Press the [START] soft-key to confirm. The 8500 will start monitoring and the display will return to the Run menu. Notice that the [START] soft-key changes to a [STOP] soft-key. The status window displays the current operation; PAUSED between samples and RUNNING S during each sample.

Current operation →	PAUSED	02:47 PM	RUN	STOP
Sample result →	2.3		% CO2 @ 02:47PM	PLOT
				CALIBRATE
				RUN SAMP

Time of last sample

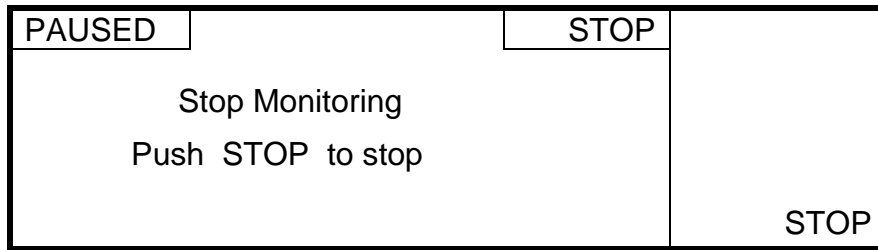
RUNNING S	02:48 PM	RUN	STOP
2.8		% CO2 @ 02:48PM	PLOT
			CALIBRATE
			RUN SAMP

Results are displayed on the screen and stored in memory. The 8500 will continue to monitor at the sample interval set in the SAMP CFG Menu.

3.5.10 Stop Monitoring

PAUSED	03:49 PM	RUN	STOP
2.6		% CO2 @ 03:45PM	PLOT
			CALIBRATE
			RUN SAMP

From the Run menu, press the [STOP] soft-key to display the following screen.



Press the [STOP] soft-key to confirm. The 8500 will stop monitoring and return to the Run menu. Notice that the [STOP] soft-key at the Run menu changes back to a [START] soft-key.

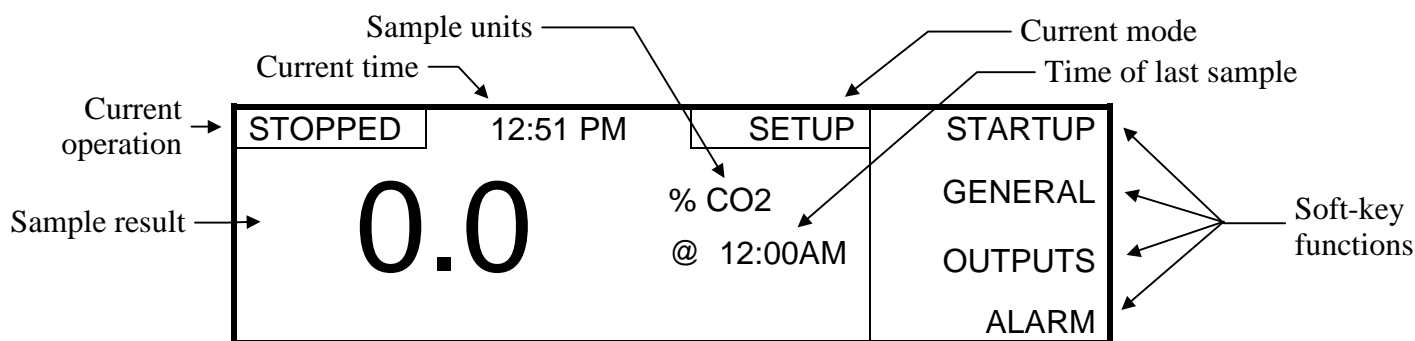
4. System Configuration and Operation

4.1 Setup Menu

Before operating the YSI 8500, you must set the instrument parameters. Once set, these parameters are maintained in memory. These parameters are discussed below.

STOPPED	12:52 PM	MAIN	SETUP
0.0	% CO2	@ 12:00AM	DIAG
			DATA
			RUN

From the Main Menu, press the [SETUP] soft-key to enter the Setup menu.



Notice that the name of the current menu is shown at the top of the display just to the right of the time. You can return to the previous menu at any time by pressing the [CANCEL] key. See Figure 1.2 on page 1-3 for the location of the [CANCEL] key.

The right column of the display shows the soft-key setup selections. These four selections are used to change the instrument setup as described below.

4.1.1 Startup

From the Setup menu, press the [STARTUP] soft-key to display the Startup menu.

STOPPED	12:51 PM	STARTUP	SAMP CFG
0.0	% CO2	@ 12:00AM	SEND CFG

The Startup menu is used to enter sample parameters and send the current configuration to a computer or serial printer via the RS232 or RS485 serial port.

SAMP CFG

From the Startup menu, press the [SAMP CFG] soft-key to display the following menu.

STOPPED	SAMP CFG	UP
Sample Interval:	15 Minutes	DOWN
Temperature:	37.0 Deg C	NEXT
Report CO2 in:	% CO2	ENTER

The SAMP CFG menu is used to set monitoring parameters. These consist of the sample interval, bioreactor temperature and the sample measurement units. In the example above, the 8500 will monitor the %CO₂ every 15 minutes in a bioreactor with a temperature of 37°C. Allowable ranges for the parameters are as follows:

Parameter	Default Setting	Range
Sample Interval Value ²	15	1 to 100 Minutes or Hours 15 to 100 Seconds
Sample Interval Units	Minutes	Hours, Minutes or Seconds
Temperature	37.0	15 to 60°C
Sample Units	% CO2	% CO2, mBar or mmHg

To change any of these parameters, press the [NEXT] soft-key repeatedly until the cursor (dark box) is on the parameter, then use the [UP] or [DOWN] soft-key to change the value. When the correct value has been selected, press the [NEXT] soft-key to move the cursor to the next parameter. When you have finished changing the necessary parameters, press the [ENTER] soft-key to save the changes and return to the Startup menu. If you wish to exit without saving any changes, press the [CANCEL] key.

If the sample units are set to mBar or mmHg, the Pressure screen will be displayed after pressing [ENTER].

STOPPED	PRESSURE	UP
Enter Pressure:		DOWN
Atmospheric:	29.92 inHg	NEXT
Gauge:	1.47 psi	ENTER
Vessel Pressure	16.17 psi	

² Note that the sample interval is the time interval between samples (from the end of the last sample to the start of the next sample) and not the sample to sample time. The sample to sample time is slightly longer (approximately 0.4 seconds), since it takes a small amount of time to run each sample.

Select the desired units for Atmospheric pressure using the [UP] or [DOWN] soft-key. Press the [NEXT] soft-key to move the cursor to the atmospheric pressure field, then enter the current atmospheric³ pressure using the [UP] or [DOWN] soft-key. Press the [NEXT] soft-key to move the cursor to the Gauge units field, then use the [UP] or [DOWN] soft-key to select the desired units. Press the [NEXT] soft-key to move the cursor to the Gauge pressure field, then use the [UP] or [DOWN] soft-key enter the gauge pressure (difference between bioreactor pressure and atmospheric pressure).

Allowable parameters and ranges are as follows:

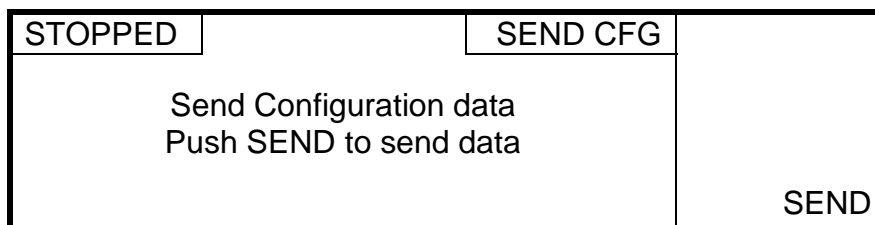
Parameter	Range	Units
Atmospheric Pressure	4.07 to 40.72	inHg
	103.43 to 1034.30	mmHg
	138 to 1379	mBar
	2.00 to 20.00	psi
	13.79 to 137.90	kPa
Gauge Pressure	0.01 to 10.00	psi
	0.07 to 68.95	kPa

Notice that the total vessel pressure (atmospheric + gauge) is displayed at the bottom of the screen. Press the [ENTER] soft-key to save the changes and return to the Startup menu. If you wish to exit without saving any changes, press the [CANCEL] key to return to the SAMP CFG menu.

Note that the 8500 does **not** compensate for pressure while the CO₂ units are set to % CO₂. Therefore, if pressure changes are expected during a run, set the CO₂ units to mmHg or mBar and enter the current atmospheric and gauge pressures in the Samp Cfg menu. When the pressure changes during the run, the mmHg or mBar reading will change correspondingly. **Do not change the pressure settings during a run unless you recalibrate.**

Send Configuration

From the Startup menu, press the [SEND CFG] soft-key to display the following screen.



Press the [SEND] soft-key to send the current system setup to a computer or serial printer via the RS232 or RS485 serial port. The format is as follows:

³ Enter the true local barometric pressure. This corresponds to a reading from a mercury barometer. Do **NOT** use the pressure reported by the weather bureau. Weather bureaus correct pressures to sea level.

```

Config. Lock is      DISABLED
Probe ID:           _____
Sensor ID:           _____
Bioreactor ID:      _____
Sample Interval:    15           Minutes
Temperature:        37.0        Deg C
Report CO2 in:      % CO2
Atmospheric:        29.92       inHg
Gauge:              1.47        psi
BG with LED 1 on:   137
BG with LED 2 on:   296
  Min.              0.0         % CO2
  Max.              10.0        % CO2
Alarm Status        DISABLED    AUDIBLE
  High:             10.0        % CO2
  Low:              0.0         % CO2
Time/Date Format     12Hr        MM/DD/YYYY
  Contrast:         92
  Beeper:           DISABLED
  Language:         ENGLISH
  Radix:            00.00
  Baud              9600
  Mode              RS232
  Handshaking       XON/XOFF
  Data Bits         8
  Parity            NONE
  Data to Send:     SAMPLE
  Send data to      COMPUTER

```

See *5 Output* for instructions on connecting to the serial port and *4.1.3 Outputs, Setup Communications* for communications parameter setup.

4.1.2 General

From the Setup menu, press the [GENERAL] soft-key to display the General menu.

STOPPED	12:52 PM	GENERAL	TIME/DATE
0.0		% CO2	SECURITY
		@ 12:00AM	ID
			CONTROLS

The General menu is used to set the time and date, enable security, enter ID numbers for the operator, sensor capsule and bioreactor, set the display contrast and choose a language.

Time/Date

From the General menu, press the [TIME/DATE] soft-key to display the following screen.

	STOPPED	TIME/DATE	UP
Time format →	12 Hr	01:26 PM	DOWN
Date format →	MM/DD	03/08/2000	NEXT
			ENTER

Use the [NEXT] soft-key to select the parameter you wish to change, then use the [UP] or [DOWN] soft-key to change the value. The time format can be set to 12 or 24 hours and the date format can be Month/Day/Year (MM/DD) or Day/Month/Year (DD/MM). Press the [ENTER] soft-key to save the changes or [CANCEL] to abort and return to the General menu.

Security

From the General menu, press the [SECURITY] soft-key to display the following screen.

PAUSED	SECURITY	UP
Configuration Lock		DOWN
DISABLED		ENTER

Use the [UP] or [DOWN] soft-key to enable or disable the configuration lock, then press the [ENTER] soft-key to save the change or [CANCEL] to abort and return to the General menu. With the lock enabled, the instrument parameters cannot be changed. If an attempt is made to change a parameter while the lock is enabled, a message is displayed at the bottom of the screen.

STOPPED	SET ANLG	UP
Min.	0.0 % CO2	DOWN
Max.	10.0 % CO2	NEXT
CFG lock is ENABLED		ENTER

ID

From the General menu, press the [ID] soft-key to display the following screen.

PAUSED	ID	UP
Probe ID:	█ -----	DOWN
Sensor ID:	-----	NEXT
Bioreactor ID:	-----	ENTER

Use the [NEXT] soft-key to select each character (starting with Probe ID), then use the [UP] or [DOWN] soft-key to change the character. To change the Sensor ID or Bioreactor ID, continue pressing [NEXT] until the cursor selects a Sensor or Bioreactor character, then use the [UP] or [DOWN] soft-key to change the character. Press the [ENTER] soft-key to save the changes or [CANCEL] to abort and return to the General menu.

Controls

From the General menu, press the [CONTROLS] soft-key to display the following screen.

PAUSED		CONTROLS	UP
	Contrast:	92	DOWN
	Beeper:	DISABLED	
	Language:	ENGLISH	NEXT
	Radix:	00.00	ENTER

The Controls menu has selections for changing the display contrast, turning the beeper on or off and selecting your language and radix. To change any of these parameters, press the [NEXT] soft-key repeatedly until the cursor (dark box) is on the parameter, then use the [UP] or [DOWN] soft-key to change the value. When the correct value has been selected, press the [NEXT] soft-key to move the cursor to the next parameter.

Available values are as follows:

Contrast:	0 to 255.	Language:	ENGLISH FRANCAIS ESPAÑOL ITALIANO DEUTSCH
Beeper:	ENABLED DISABLED		
Radix:	00.00 00,00		

When you have finished changing the necessary parameters, press the [ENTER] soft-key to save the changes and return to the General menu. If you wish to exit without saving any changes, press the [CANCEL] key.

4.1.3 Outputs

From the Setup menu, press the [OUTPUTS] soft-key to display the following menu.

STOPPED	12:53 PM	OUTPUTS	SET COMM
0.0	% CO2		TEST COMM
	@ 12:00AM		SET ANLG
			TEST ANLG

The Outputs menu is used to setup and test the outputs as shown below.

Setup Communications

From the Outputs menu, press the [SET COMM] soft-key to display the following screen.

STOPPED		SET COMM	UP
Baud	9600	Data Bits 8	DOWN
Mode	RS232	Stop Bits 1	
Parity	NONE		NEXT
Handshaking	XON/XOFF		
Send	SAMPLE to COMPUTER		ENTER

Use the [UP], [DOWN] and [NEXT] soft-keys to change the communications parameters to match the computer or printer that is connected to the RS232 or RS485 serial port. The available values for each parameter are as follows:

Baud Rate:	9600 4800 2400 1200	Handshaking:	XON/XOFF None
Data Bits:	7 8	Send:	Sample Calibration (CAL) Error (ERR) All None
Mode:	RS232 RS485	Send To:	Computer Printer
Stop Bits:	1		
Parity:	None Odd Even		

NOTE: Although there are separate connections for RS232 and RS485 outputs, only one output can be used at a time.

When you have finished changing the necessary parameters, press the [ENTER] soft-key to save the changes and return to the Outputs menu. If you wish to exit without saving any changes, press the [CANCEL] key.

Test Communications

From the Outputs menu, press the [TEST COMM] soft-key to display the following screen.

STOPPED		TEST COMM	UP
Data to Send:	BIOVISION 8500		DOWN
Data Received:			NEXT
			SEND

Press the [SEND] soft-key to send a test string of data. The default is “BIOVISION 8500”. The [UP], [DOWN] and [NEXT] soft-keys may be used to enter different characters. When you have finished, press the [CANCEL] key to return to the Outputs menu.

Setup Analog Output

From the Outputs menu, press the [SET ANLG] soft-key to display the following screen.

STOPPED	SET ANLG	UP
Min. 0.0 % CO2		DOWN
Max. 10.0 % CO2		NEXT
		ENTER

The Set Analog menu is used to match the CO₂ values with their corresponding analog output levels. Use the [UP], [DOWN] and [NEXT] soft-keys to change the minimum and maximum settings to match the CO₂ range you will be monitoring. After the values have been changed, press the [ENTER] soft-key to save the values and return to the Outputs menu.

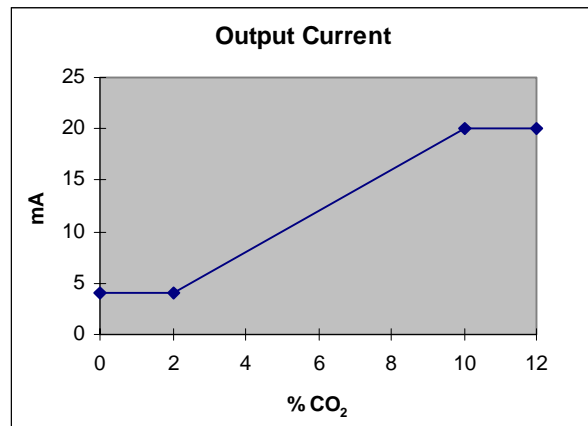
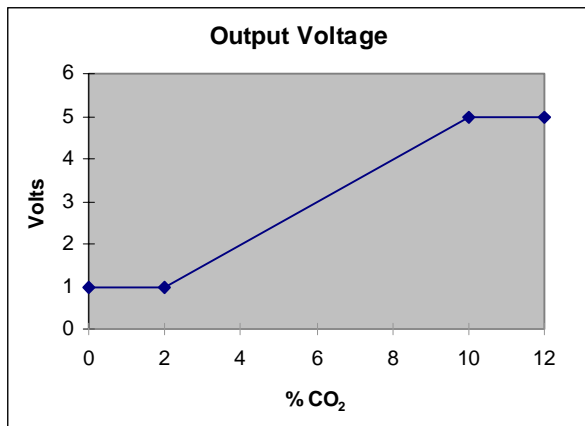


Figure 4.1

The analog output varies proportionally with the CO₂ level. Two examples are shown. Figure 4.1 shows this relationship when the minimum value is set to 2% and the maximum is set to 10%.

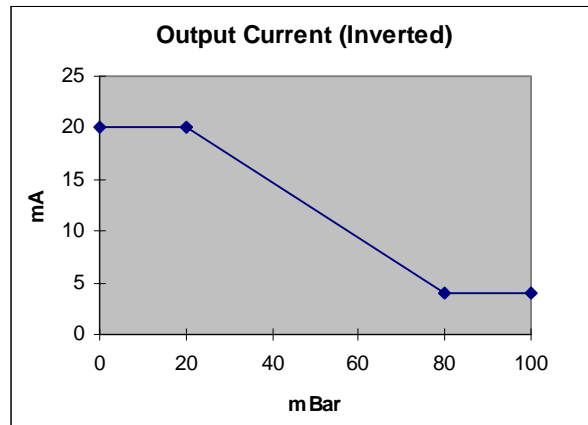
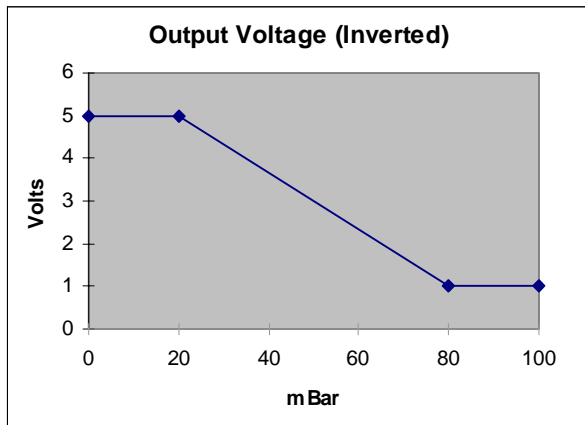


Figure 4.2

Figure 4.2 shows an inverted output where the minimum value is set to 80 mBar and the maximum is set to 20 mBar.

Test Analog Output

From the Outputs menu, press the [TEST ANLG] soft-key to display the following screen.

STOPPED	TEST ANLG	UP
Analog Output:	NORMAL	DOWN
Output Current:	8.03 mA	
Output Voltage:	2.50 V	

The Test Analog menu allows the analog output to be temporarily set to MAX (full scale), MIN (minimum) or NORMAL (the value that corresponds to the current CO₂ reading). This function allows external devices that are connected to the analog output to be tested.

Use the [UP] or [DOWN] soft-key to select the output level. After you have finished testing the analog output, press the [CANCEL] key to return the output to NORMAL and return to the Outputs menu.

Press the [CANCEL] key to return to the Setup menu.

4.1.4 Alarm

From the Setup menu, press the [ALARM] soft-key to display the following screen.

STOPPED	ALARM	UP
High: 10.0 % CO ₂		DOWN
Low: 0.0 % CO ₂		
DISABLED	AUDIBLE	NEXT
		ENTER

The Alarm menu is used to enable the alarm and set the high and low alarm points. If the alarm is enabled and the CO₂ level reaches one of the set alarm points, an alarm message will be sent via the RS232/RS485 serial port and, if the alarm is set to Audible, the alarm beeper will also sound.

Use the [UP], [DOWN] and [NEXT] soft-keys to enable the alarm and change the high and low settings as required for your application. After the alarm settings have been changed, press the [ENTER] soft-key to save the values and return to the Setup menu, or press [CANCEL] to abort.

Press the [CANCEL] key to return to the Main menu.

4.2 Diagnostics Menu

From the Main Menu, press the [DIAG] soft-key to display the Diagnostics menu.

PAUSED	12:45 PM	DIAG	STATUS
0.0			RATIO RPT
% CO2			SIG/REF
@ 12:00AM			DEFAULT

The Diagnostics menu is used to report instrument status, set the background values for the probe and cable and set all parameters to the factory default values as shown below.

4.2.1 Status

From the Diagnostics menu, press the [STATUS] soft-key to display the status menu.

PAUSED	12:45 PM	STATUS	VERSION
0.0			REPORT
% CO2			
@ 12:00AM			

The Status menu is used to display the software version or print a diagnostic report.

Software Version

From the Status menu, press the [VERSION] soft-key to display the software version number.

PAUSED	VERSION
VERSION: 2.00	

Press the [CANCEL] key to return to the Diagnostics menu.

Report

From the Status menu, press the [REPORT] soft-key to display the following screen.

STOPPED	REPORT
Print Diagnostic Report Push PRINT to print report	
PRINT	

Press the [PRINT] soft-key to send a diagnostic report to a computer or printer. The format is as follows:

```

Atmospheric:      29.92   inHg
Gauge:           1.47    psi
Temperature:     37.0    Deg C
Slope:           0.1050
Y Intercept:     0.500
BG with LED 1 on: 137
BG with LED 2 on: 296
BG Signal:       200.640
BG Reference:    201.340
Signal 1:        6269.800
Signal 2:        6548.359
Reference 1:     4902.540
Reference 2:     8024.319
F1:              6069.16
F2:              6347.72
R1:              4701.20
R2:              7822.98
Ratio:           1.05016
% CO2            10.0
  
```

Press the [CANCEL] key to return to the Diagnostics menu.

4.2.2 Ratio Report

From the Diagnostics menu, press the [RATIO RPT] soft-key to display the following screen.

STOPPED	RATIO RPT	
F1: 5274.92	F2: 5421.44	
R1: 3841.60	R2: 8639.82	
BG1: 73	BG2: 140	
Ratio: 1.2991	% CO2: 7.2	

The Ratio Report displays the signal, reference and ratio data for the last sample/calibration. This information is used for diagnostics. See 4.2.3 *Signal/Reference* below for details.

Press the [CANCEL] key to return to the Diagnostics menu.

4.2.3 Signal/Reference

From the Diagnostics menu, press the [SIG/REF] soft-key to display the following screen.

STOPPED	SIG/REF	LED1
LED1: OFF	LED2: OFF	LED2
Signal: 204		BACKGRND
Reference: 201		
BG1: 72	BG2: 140	ENTER

The Signal/Reference menu is used to set the probe and cable background values and for diagnostics.

Background

Background values for the probe and cable are set at the factory and remain constant, therefore, they do not need to be changed as long as the original probe and cable are used. Sensor capsules do NOT affect the background values.

For highest accuracy after replacing the original probe or cable, the background values should be set as follows:

1. Install a YSI Background Sensor Capsule (see *10 Accessories and Replacement Parts*) in the probe. See *3.5.1 Install Sensor Capsule* for instructions.
2. Press the [BACKGRND] soft-key to measure the background values and display them at the bottom of the screen.
3. Press the [ENTER] key to save the new background values and return to the Diagnostics menu.

The Signal/Reference menu is also used to verify that the LEDs, photo-detectors and sensor capsule are functioning. The reference and signal values should be approximately 200 with both LEDs off. As each LED is turned on or off (by pressing the [LED1] or [LED2] soft-key), a corresponding increase or decrease in signal and reference levels should occur. With either LED 1 or LED 2 on, the reference value should be 4,000 to 16,000.

Test the currently installed sensor capsule by turning on LED 1 (with LED 2 off). The signal value should be greater than 4000. Sensor capsules with values less than 4000 may be erratic and have a slow response. Note that oxidation on the probe tip also causes a low signal value. Clean the probe tip if necessary. See *7.1 Probe Cleaning*.

Press the [CANCEL] key to return to the Diagnostics menu.

4.2.4 Reset to Default

From the Diagnostics menu, press the [DEFAULT] soft-key to display the following screen.

STOPPED	DEFAULT	
Reset to Default Config Push DEFAULT to Reset		DEFAULT

Press the [DEFAULT] soft-key to reset all parameters to factory default configuration values or press [CANCEL] to abort and return to the Diagnostics menu. Note that default is disabled if the configuration lock is ON or the 8500 is monitoring.

STOPPED	DEFAULT	
Reset to Default Config Restoring Cfg Default Values		DEFAULT


Press the [CANCEL] key to return to the Main menu.

4.3 Data Menu

From the Main menu, press the [DATA] soft-key to display the Data menu as shown below.

PAUSED	12:45 PM	DATA	SAMPLE
0.0	% CO2		CAL
	@ 12:00AM		ERROR

The Data menu is used to review and delete sample results, calibration data, and errors stored in the 8500's memory. Stored data can also be sent to a computer or serial printer via the RS232/RS485 serial port.


NOTE: The  [PRINT SCREEN] key can be used at any time to send the displayed data to a computer or serial printer via the RS232/RS485 serial port.

4.3.1 Sample Data

From the Data menu, press the [SAMPLE] soft-key. The following screen will be displayed.

PAUSED			SAMPLE	UP
03/08/2000	11:55A	3.9	% CO2	DOWN
03/08/2000	11:45A	2.8	% CO2	CLEAR
03/08/2000	11:35A	2.7	% CO2	SEND
03/08/2000	11:25A	2.7	% CO2	
03/08/2000	11:15A	2.6	% CO2	

Last sample result



Reviewing Sample Data

Stored sample results are displayed using the current units and pressure settings. **The current settings must match the settings that were present at the time the readings were stored.**

The last 5 sample results are shown along with the dates and times they were taken. To review previous results, press the [DOWN] soft-key to scroll through the data a screen at a time. To scroll back up, press the [UP] soft-key. If you scroll [UP] past the beginning or [DOWN] past the end of the stored data, a message will be displayed.

PAUSED				SAMPLE	UP
At End					DOWN
03/08/2000	11:15A	3.6	% CO2		Error Indication
03/08/2000	11:05A	3.5	% CO2*		
03/08/2000	10:55A	3.4	% CO2		
03/08/2000	10:45A	3.2	% CO2		
					SEND

Note that an asterisk indicates an error has occurred. Review the Error Log for details.

Clearing Sample Results

To delete ALL sample results from the Sample menu, press the [CLEAR] soft-key to bring up the following display.

PAUSED				SAMPLE	
Clear Sample Data					
Push CLEAR to clear data					
					CLEAR

Press the [CLEAR] soft-key to clear ALL samples from the Model 8500's memory (or press [CANCEL] to abort and return to the Sample menu). After deleting all sample results, the display will return to the Sample menu.

PAUSED				SAMPLE	UP
Deleted					DOWN
					CLEAR
					SEND

NOTE: There is NO way to restore sample results once they have been deleted.

Press the [CANCEL] key two times to return to the Main Menu.

Sending Sample Results

Send is used to send all stored sample results to a computer or serial printer via the RS232/RS485 serial port. See *5 Output* for instructions on connecting to the serial port and *4.1.3 Outputs, Setup Communications* for communications parameter setup.

NOTE: To send a single screen of sample data, use the [PRINT SCREEN] key while in the Sample menu.

Stored sample results are sent via the RS232/RS485 serial port using the current units and pressure settings. **The current settings must match the settings that were present at the time the readings were stored.**

To send all sample results via the RS232/RS485 serial port from the Sample menu, press the [SEND] soft-key to bring up the following display.

PAUSED	SAMPLE
Send Sample Data	
Push SEND to send data	
	SEND

Press the [SEND] soft-key to send all stored sample results from the Model 8500's memory (or press [CANCEL] to abort and return to the Sample menu). After sending all sample results, the display will return to the Sample menu. Press the [CANCEL] key to return to the Data menu.

4.3.2 Calibration Data

From the Data menu, press the [CAL] soft-key. The following screen will be displayed.

PAUSED		CAL	UP
03/23/2000	11:07A	5.0 % CO2	DOWN
03/18/2000	11:22A	5.0 % CO2	
03/13/2000	10:30A	5.0 % CO2	
03/08/2000	11:24A	5.0 % CO2	CLEAR
03/08/2000	09:32A	0.0 % CO2	SEND

Reviewing Calibration Data

The last 5 calibrations are shown along with their date and time. To review previous calibrations, press the [DOWN] soft-key to scroll through the calibration data a screen at a time. To scroll back up, press the [UP] soft-key. If you scroll [UP] past the beginning or [DOWN] past the end of the stored calibration data, a message will be displayed. After you have finished reviewing calibration data, press the [CANCEL] key to return to the Data menu.

Clearing Calibration Data

To delete all calibration data from the Cal menu, press the [CLEAR] soft-key to bring up the following display.

PAUSED	CAL	
Clear Calibration Data		
Push CLEAR to clear data		CLEAR

Press the [CLEAR] soft-key to confirm and clear ALL calibration data from the 8500's memory (or press [CANCEL] to abort and return to the Cal menu). After deleting the calibration data, the display will return to the Cal menu. Press the [CANCEL] key two times to return to the Main Menu.

NOTE: There is NO way to restore calibration data once it has been deleted.

Sending Calibration Data

Send is used to send all stored calibration data to a computer or serial printer via the RS232/RS485 serial port. See *5 Output* for instructions on connecting to the serial port and *4.1.3 Outputs, Setup Communications* for communications parameter setup.

NOTE: To send a single screen of data, use the [PRINT SCREEN] key while in the Cal menu.

To send all stored calibration data from the Cal menu, press the [SEND] soft-key to bring up the following display.

PAUSED	CAL	
Send Cal Data		
Push SEND to send data		SEND

Press the [SEND] soft-key to confirm and send all calibration data from the Model 8500's memory (or press [CANCEL] to abort and return to the Cal menu). After sending the calibration data, the display will return to the Cal menu. Press the [CANCEL] key two times to return to the Main Menu.

4.3.3 Error Log

From the Data menu, press the [ERROR] soft-key. The following screen will be displayed.

PAUSED	ERROR	UP
07/29/2000 10:47P	1793	DOWN
		CLEAR
		SEND

Reviewing the Error Log

The last 5 errors are shown along with their dates and times. To review previous error screens, press the [DOWN] soft-key to scroll through the errors a screen at a time. To scroll back up, press the [UP] soft-key. If you scroll [UP] past the beginning or [DOWN] past the end of the error log, a message will be displayed. See *8.1 Error Messages* for a description of possible errors. After you have finished reviewing the error log, press the [CANCEL] key to return to the Data menu.

Clearing the Error Log

To clear the error log from the Error menu, press the [CLEAR] soft-key to bring up the following display.

PAUSED	ERROR
Clear Error Data	
Push CLEAR to clear data	
CLEAR	

Press the [CLEAR] soft-key to clear the error log (or press [CANCEL] to abort and return to the Error menu). After deleting the error log, the display will return to the Error menu. Press the [CANCEL] key two times to return to the Main Menu.

NOTE: There is NO way to restore the error log once it has been deleted.

Sending the Error Log

Send is used to send the entire error log to a computer or serial printer via the RS232/RS485 serial port. See *5 Output* for instructions on connecting to the serial port and *4.1.3 Outputs, Setup Communications* for communications parameter setup.

NOTE: To send a single screen of errors, use the [PRINT SCREEN] key while in the Error menu.

To send the entire error log from the Error menu, press the [SEND] soft-key to bring up the following display.

PAUSED	ERROR
Send Error Data	
Push SEND to send data	
SEND	

Press the [SEND] soft-key to send the entire error log (or press [CANCEL] to abort and return to the Error menu). After sending the error log, the display will return to the Error menu. Press the [CANCEL] key two times to return to the Main Menu.

4.4 Run Menu

Calibration and sample measurement are accessed from the Model 8500 Run menu. The 8500 is usually setup to automatically monitor at set intervals, however, a single sample measurement can be performed.

Before taking a measurement, the 8500 must be setup (see 4.1.1 Startup), the Probe and Sensor Capsule must be installed (see 3.5 Basic Setup), and the system must be calibrated (see 4.4.1 Calibrate).

4.4.1 Calibrate

The YSI 8500 system should be calibrated before each fermentation/cell culture run. Calibration should be performed under the same conditions (temperature and pressure) as expected during the run. For improved accuracy during long runs, recalibrate every 7 to 14 days during the run. See the *Application Notes* section.

Initial Calibration

The initial calibration value depends on the desired measurement range and accuracy. The allowed range is 3–100%, but 5% or 10% is normally used. For highest accuracy, the calibration point should be at the high end of your required measurement range.

For calibration, the CO₂ units should be set to %CO₂ and the sample interval should be set between 1 and 10 minutes to allow the user to determine when the readings are stable. See 4.1.1 *Startup*, *SAMP CFG* for instructions.

Expose the probe to a known CO₂ level by sparging the bioreactor with CO₂ (normally 5% or 10%) from a compressed CO₂ cylinder.

Start monitoring in order to observe the reading for stability. See 4.4.2 *Monitoring*, *Start Monitoring* for instructions.

Allow the reading to stabilize. Stabilization time varies from 40 minutes to 8 hours depending on the sparging rate, agitation, size, temperature and contents of the bioreactor. For ±5% accuracy, 2 hours are usually required. Press the [PLOT] soft-key to visually check for a stable reading. See 4.4.3 *Plot* for instructions.

When the reading is stable, stop monitoring. See 4.4.2 *Monitoring*, *Stop Monitoring* for instructions.

From the Run menu, press the [CALIBRATE] soft-key to display the Calibrate menu.

STOPPED	CALIBRATE	UP
Enter % CO ₂ : 3.0		DOWN
Push CALIBRATE to calibrate		CALIBRATE

Use the [UP] or [DOWN] soft-key to enter the percent CO₂ level (usually 5% or 10%), then press the [CALIBRATE] soft-key. The 8500 will calibrate and return to the Run menu. Press the [CANCEL] key to return to the Main menu.

After calibration, the sample interval (which was changed during the calibration procedure) must be set to the desired sample interval for monitoring. See 4.1.1 *Startup, SAMP CFG* for instructions.

Recalibration

For improved accuracy during long runs, recalibrate every 7 to 14 days during the run. For recalibration, measure the CO₂ level inside the bioreactor by another method, such as a blood gas analyzer.

To recalibrate while in the Run menu, press the [CALIBRATE] soft-key. The following screen will be displayed if measurement units are set to %CO₂.

PAUSED		CALIBRATE	UP
Enter %CO ₂ : 3.0			DOWN
Push CALIBRATE to calibrate			CALIBRATE

If the measurement units are set to mBar or mmHg, the screen will also display values for atmospheric and gauge pressures as shown below.

PAUSED		CALIBRATE	UP
Enter Pressure:			DOWN
CO ₂ :	101.3	mmHg	
Atmospheric:	1241	mBar	
Gauge:	10.13	kPa	NEXT
Push CALIBRATE to calibrate			CALIBRATE

Use the [UP] or [DOWN] soft-key to enter the percent CO₂ level obtained by another method (such as a blood gas analyzer). If the measurement units are set to mBar or mmHg, enter the current atmospheric⁴ and gauge pressures.

Press the [CALIBRATE] soft-key to calibrate the 8500 system and return to the Run menu. The 8500 will calibrate, store the calibration data, then return to its previous state (stopped or monitoring).

⁴ Enter the true local barometric pressure. This corresponds to a reading from a mercury barometer. Do **NOT** use the pressure reported by the weather bureau. Weather bureaus correct pressures to sea level.

4.4.2 Monitoring

From the Main Menu, press the [RUN] soft-key to display the Run menu.

STOPPED	12:45 PM	RUN	START
0.0		% CO2 @ 12:00AM	PLOT CALIBRATE RUN SAMP

Start Monitoring

To start monitoring, press the [START] soft-key to display the following screen.

STOPPED	START
Start Monitoring Push START to begin	
START	

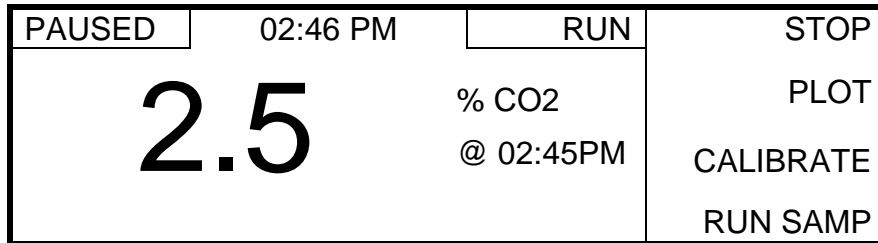
Press the [START] soft-key to confirm. The 8500 will start monitoring and the display will return to the Run menu. Notice that the [START] soft-key changes to a [STOP] soft-key. The status window displays the current operation; PAUSED between samples and RUNNING S during each sample.

Current operation →	PAUSED	12:45 PM	RUN	STOP
Sample result →	2.3		% CO2 @ 12:45PM	PLOT CALIBRATE RUN SAMP
				Time of last sample

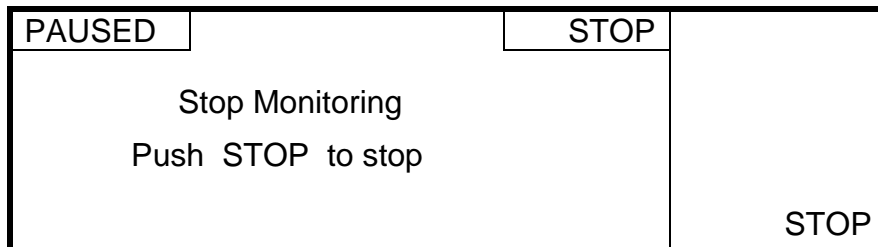
RUNNING S	01:15 PM	RUN	STOP
2.4		% CO2 @ 01:15PM	PLOT CALIBRATE RUN SAMP

Results are displayed on the screen and stored in memory. The 8500 will continue to monitor at the sample interval set in the SAMP CFG Menu. Results may also be sent to a computer or serial printer, see *Setup Communications* on page 4-7.

Stop Monitoring



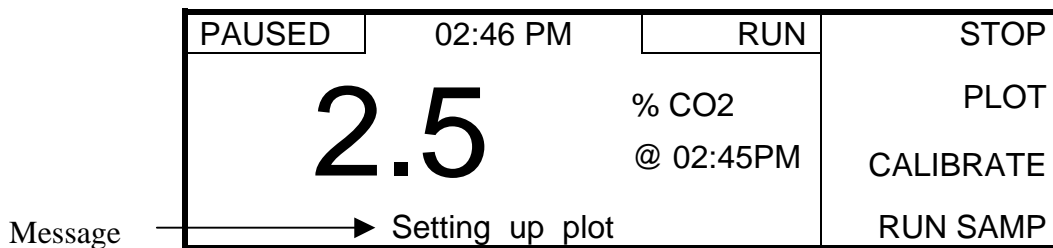
From the Run menu, press the [STOP] soft-key to display the following screen.



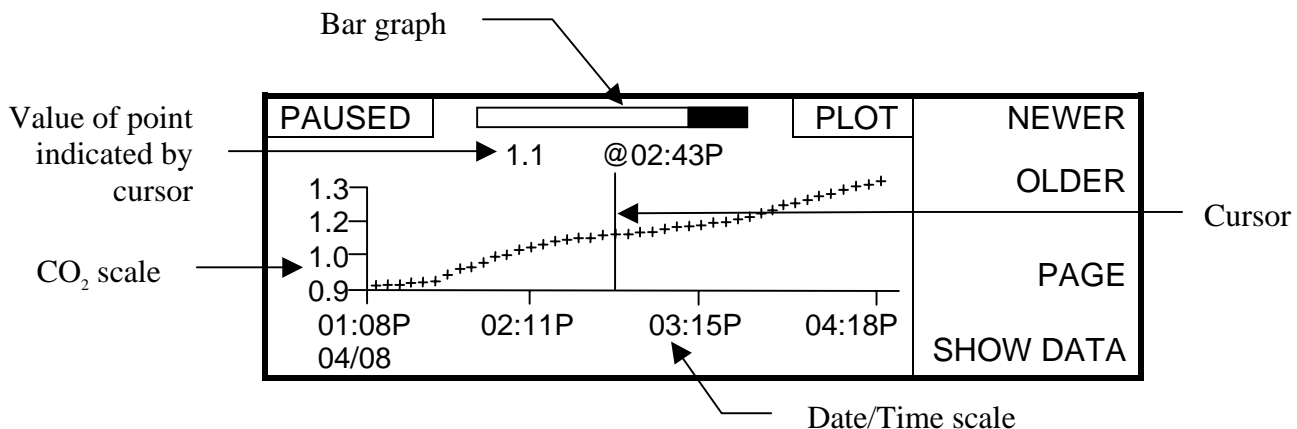
Press the [STOP] soft-key to confirm. The 8500 will stop monitoring and return to the Run menu. Notice that the [STOP] soft-key at the Run menu changes back to a [START] soft-key.

4.4.3 Plot

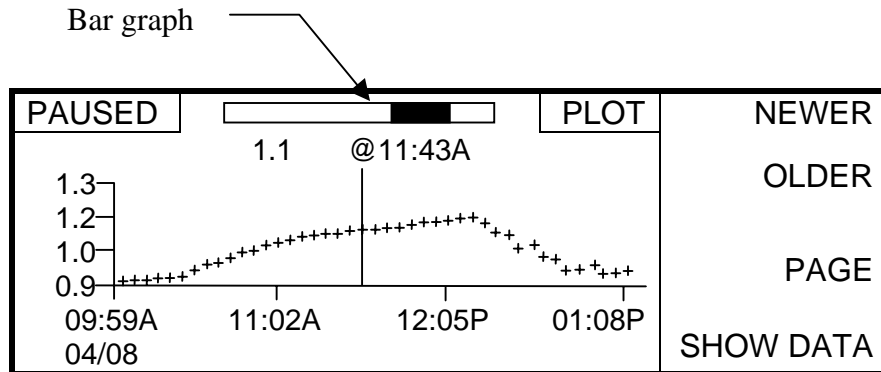
From the Run menu, press the [PLOT] soft-key.



The message “Setting up plot” is displayed for a few seconds, then a graph of the 40 most recent CO₂ readings stored in memory is displayed.



The vertical line, marking the data towards the center of the plot, is the cursor. The value at the cursor position is displayed above the plot. To display the value of a different point, move the cursor to the point by pressing the [OLDER] soft-key to move to the left or the [NEWER] soft-key to move to the right. The black bar in the bar graph at the top indicates the amount of stored data that is currently displayed (the width of the black bar compared to the total width of the bar graph) and its relative position, in memory. Older data is to the left. To view an older screen of data, hold down the [OLDER] soft-key and press the [PAGE] soft-key at the same time. The message “Paging to older data” is displayed for a few seconds, then the older data is displayed.

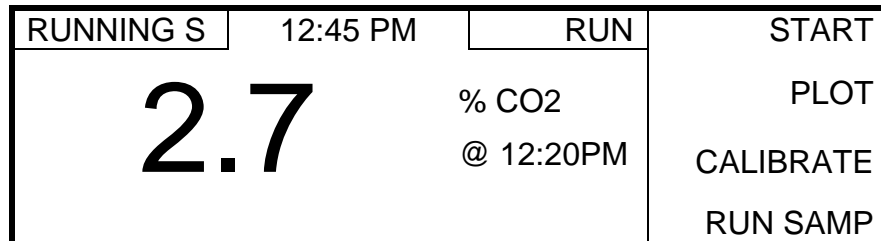


Notice that the black bar in the bar graph at the top of the screen moves to the left. To view a newer screen of data, hold down the [NEWER] soft-key and press the [PAGE] soft-key at the same time.

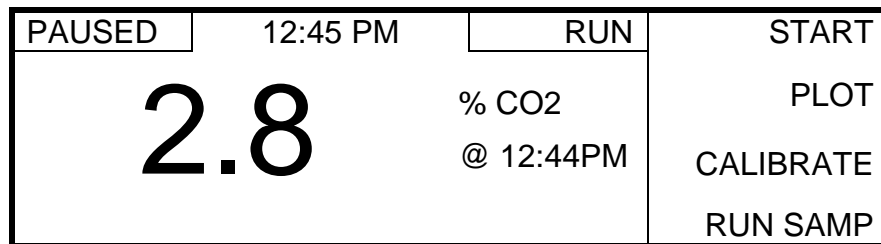
NOTE: The plot display does NOT update after each sample. To update the plot, press the [CANCEL] key, then the [PLOT] soft-key.

4.4.4 Run Sample

A single sample result can be obtained while the Model 8500 is stopped or paused between monitor samples. From the Run menu, press the [RUN SAMP] soft-key.



The 8500 will make one sample measurement and store and display the sample result.



After the sample is finished, the 8500 will return to its previous state (stopped or monitoring).

5. Output

Both the RS485 serial and the analog outputs of the 8500 use quick release connectors that accept 14 to 28 AWG (0.08 to 2.5 mm²) solid, stranded or fine stranded wire. Connect the wires as follows:

1. Strip 1/3" (8–9 mm) of insulation off the end of each wire.
2. Insert a small flat-bladed screwdriver into the square upper hole. Push firmly until it stops. See Figure 5.1.
3. Insert the stripped wire into the round lower hole until it stops.
4. Remove the screwdriver to clamp the wire in place.
5. Repeat for second wire.

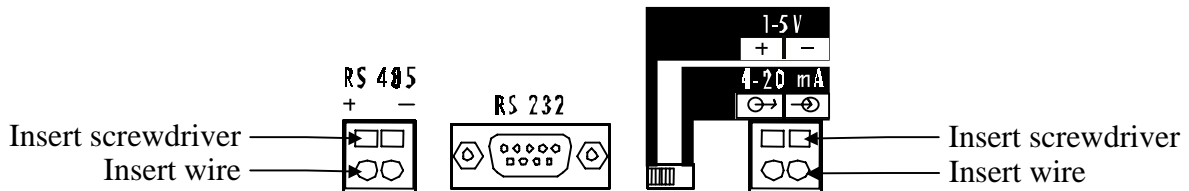


Figure 5.1

To remove the wires from the connector, proceed as follows:

1. Insert a small flat-bladed screwdriver into the square upper hole above the wire. Push firmly until it stops.
2. Remove the wire from the lower hole.
3. Remove the screwdriver.
4. Repeat for second wire.

5.1 RS232 Serial Output

The Model 8500 has both RS232 and RS485 serial outputs, but only one type can be used at a time. See 4.1.3 *Outputs* for details.

The RS232 serial output allows the Model 8500 to be connected to a computer or serial printer as shown below. Use the RS232 output for distances up to about 100 feet. For longer distances, see 5.2 *RS485 Serial Output* below.

RS232 Serial Printer Connection

To connect to a serial printer, use a 9 pin male (DB9) to 25 pin male (DB25) cable.

8500: 9 pin d-sub (male)	Printer: 25 pin d-sub (male)
pin 2	pin 2
pin 5	pin 7

RS232 Serial Computer Connection

A standard straight (NOT a null modem) cable is required for connecting to a computer RS232 serial port. The 8500 requires a male DB9 connector.

8500: 9 pin d-sub (male)	Computer: 9 pin d-sub	Computer: 25 pin d-sub
pin 2	pin 2	pin 3
pin 3	pin 3	pin 2
pin 5	pin 5	pin 7

NOTE: Only three connections are required for RS232 connection to a computer.

5.2 RS485 Serial Output

The RS485 serial output allows the Model 8500 to be connected to a computer or serial printer at greater distances than RS232. Use the RS485 output for distances up to about 4000 feet.

RS485 Serial Computer Connection

The RS485 serial output requires a standard twisted pair cable. Be sure to observe the polarity when connecting to the RS485 serial output.

5.3 Analog Output

The analog output section of the Model 8500 creates a current or voltage signal which is proportional to the concentration of CO₂. The user has the ability to adjust the minimum and maximum CO₂ values. The analog output can be set to either 1–5 Volts or 4–20 mA using the selector switch on the back of the Model 8500. See 4.1.3 *Outputs, Setup Analog Output* for details.

The 4–20 mA analog output may be powered by the Model 8500 or an external voltage supply. See Figure 5.2 for details.

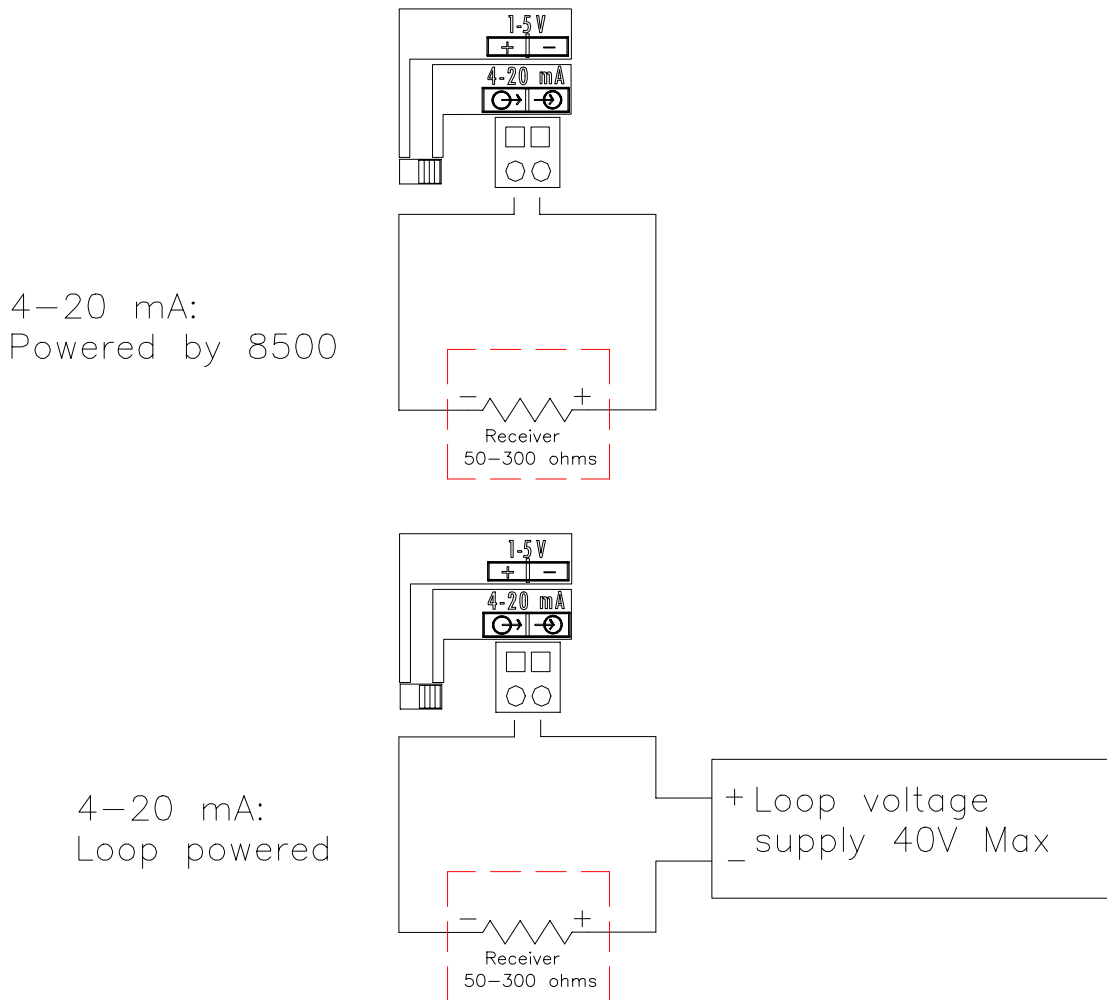


Figure 5.2

6. Storage

6.1 Probe Storage

Always store the probe with the end cap in place to prevent scratching the optical fiber. If the probe is to be stored with a sensor capsule installed, store it in bicarbonate buffer. See *10 Accessories and Replacement Parts* for probe storage bottles and bicarbonate buffer.

6.2 Sensor Capsule Storage

The sensor capsule should always be stored in the supplied bicarbonate buffer. Unused sensor capsules should be refrigerated until use (do NOT freeze). If the sensor capsule is installed in a probe, either store the probe in bicarbonate buffer, or remove the sensor and store it in bicarbonate buffer. See *10 Accessories and Replacement Parts* for probe storage bottles and bicarbonate buffer.

7. Maintenance

7.1 Probe Cleaning

After prolonged operation, the probe tip may become oxidized. Remove the oxidation using micro-fine polishing compound (such as toothpaste) and a lint free tissue. After cleaning, rinse the probe well with deionized or distilled water before installing a new sensor capsule.

7.2 Fuse Replacement

It may be necessary to replace the fuse in the back of the Model 8500. New fuses may be purchased from YSI or obtained from many local electrical component suppliers. Be sure to obtain the correct fuse rating as indicated below.

UNPLUG THE INSTRUMENT FROM THE MAINS SUPPLY, then unplug the other end of the power cord from the back of the instrument.

Using your fingers, grasp the top and bottom edges of the fuse holder and slide it out until it stops (see Figure 7.1). Only the inner compartment of the fuse holder (closest to the instrument case) is used. Carefully pry up on the fuse, then pull it out.

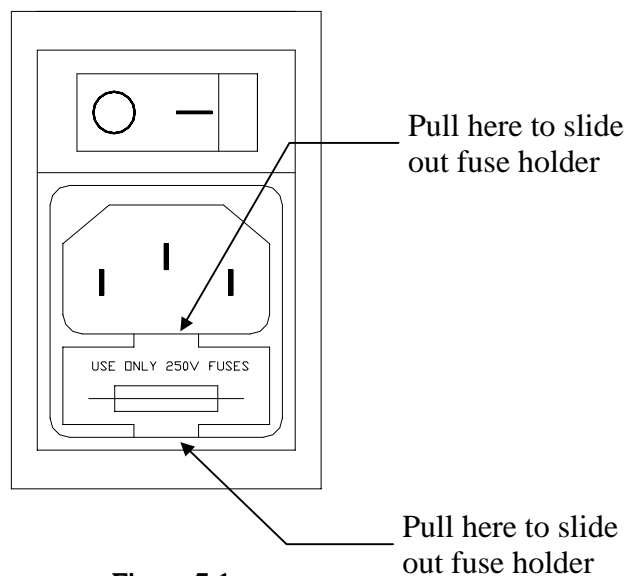


Figure 7.1

Fuse Requirements

Fuse Type: 100–250 VAC Operation — 1.0 Amp (YSI #085166UL)
Slow-blow (S Type), 250 volt, 5mm x 20mm

Install a new fuse in the inner compartment of the fuse holder and press it down to snap it in place. Push the fuseholder back into the instrument.

With the power switch in the off (O) position, plug the power cord into the instrument and then into the power mains. Refer to Section 3.5 *Basic Setup* to confirm correct power up response.

8. Troubleshooting

This section provides a systematic approach to establishing the cause of an instrument, probe/cable or sensor malfunction. Before taking any corrective action, be certain you have collected as much pertinent information as possible.

To establish probable cause, you should:

- Review the database for trends in data and errors.
- Check sensor capsule installation date. Compare the elapsed time to the recommended time.
- Review Section 4.2 *Diagnostics* to learn more about how you can test individual components of the 8500.
- Use the troubleshooting chart in this section to assist you in identifying the problem, then use the chart to guide you to a corrective action.

If the problem cannot be resolved, contact YSI Customer Service (address and phone information in *Appendix C - Warranty and Repair*). When communicating with service personnel, please indicate the serial number of the instrument. If writing or transmitting a FAX for assistance, please include a thorough description of the problem.

8.1 Error Messages

The following is a list of error messages that are displayed on the bottom line of the Model 8500 screen. Errors are also logged to memory along with the date and time that they occurred. See *4.3.3 Error Log*.

Error	Description
3	Instrument lost power while saving sample data. Missing last sample data.
4	Instrument lost power while updating sample data pointers. Last sample data recovered.
5	Instrument lost power while saving calibration data. Missing last calibration data.
6	Instrument lost power while updating calibration data pointers. Last calibration data recovered.
11	Instrument lost power while saving error data. Missing last error data.
12	Instrument lost power while saving configuration data. Missing last configuration data.
501	Real-time clock battery has failed.
502	Real-time clock chip has failed.
1792	CO ₂ reading has triggered the Low alarm.
1793	CO ₂ reading has triggered the High alarm.
CFG lock is ENABLED	An attempt to change the instrument setup was made while the configuration lock was enabled. See <i>4.1.2 General, Security</i> .

8.2 Troubleshooting Chart

Symptom: **Blank Display, Display Backlight Off**

Possible Cause: Power off
Action: Verify that the power switch is on.
Section: *1.4.2 Rear Panel, Power Switch*

Possible Cause: Blown fuse
Action: Replace fuse
Section: *7.2 Fuse Replacement*

Symptom: **Blank Display, Display Backlight On**

Possible Cause: LCD contrast too high or low
Action: Adjust contrast
Section: *4.1.2 General, Controls*

Symptom: **Unstable Readings**

Possible Cause: Bad sensor capsule
Action: Check sensor capsule. Replace if necessary.
Section: *4.2.3 Signal/Reference*
3.5.1 Install Sensor Capsule

Possible Cause: Probe tip oxidized
Action: Check probe tip. Clean if necessary.
Section: *7.1 Probe Cleaning*

Possible Cause: Loose/disconnected probe cable connection
Action: Check probe cable connections.
Section: *3.5.4 Attach Cable to Probe*
3.5.5 Attach Cable to Instrument

Possible Cause: Broken probe cable
Action: Check probe cable for breaks.
Section: —

Symptom: **Slow Response**

Possible Cause: Bad sensor capsule
Action: Check sensor capsule. Replace if necessary.
Section: *4.2.3 Signal/Reference*
3.5.1 Install Sensor Capsule

Possible Cause: Probe tip oxidized
Action: Check probe tip. Clean if necessary.
Section: *7.1 Probe Cleaning*

Symptom:	No Response to Changing CO₂ Levels
Possible Cause:	Bad sensor capsule
Action:	Check sensor capsule. Replace if necessary.
Section:	<i>4.2.3 Signal/Reference</i> <i>3.5.1 Install Sensor Capsule</i>
Possible Cause:	Probe tip oxidized
Action:	Check probe tip. Clean if necessary.
Section:	<i>7.1 Probe Cleaning</i>
Possible Cause:	Loose/disconnected probe cable connection
Action:	Check probe cable connections.
Section:	<i>3.5.4 Attach Cable to Probe</i> <i>3.5.5 Attach Cable to Instrument</i>
Possible Cause:	Broken probe cable
Action:	Check probe cable for breaks.
Section:	—

Symptom:	CO₂ Always Reads Zero
Possible Cause:	Loose/disconnected probe cable connection
Action:	Check probe cable connections.
Section:	<i>3.5.4 Attach Cable to Probe</i> <i>3.5.5 Attach Cable to Instrument</i>
Possible Cause:	Broken probe cable
Action:	Check probe cable for breaks.
Section:	—

Symptom:	CO₂ Always Reads 100% (full scale)
Possible Cause:	Loose/disconnected probe cable connection
Action:	Check probe cable connections.
Section:	<i>3.5.4 Attach Cable to Probe</i> <i>3.5.5 Attach Cable to Instrument</i>
Possible Cause:	Broken probe cable
Action:	Check probe cable for breaks.
Section:	—

Symptom:	No Signal Present at Analog Output
Possible Cause:	Incorrect Analog Output settings
Action:	Set Analog Output range
Section:	<i>4.1.3 Outputs, Setup Analog Output</i> <i>4.1.3 Outputs, Test Analog Output</i>

Symptom:	Incorrect Signal Level at Analog Output
Possible Cause:	Incorrect Analog Output settings
Action:	Set Analog Output range
Section:	<i>4.1.3 Outputs, Setup Analog Output</i> <i>4.1.3 Outputs, Test Analog Output</i>
Possible Cause:	Analog Output Selector Switch set incorrectly
Action:	Set Analog Output Selector Switch to required position
Section:	<i>1.4.2 Rear Panel, Analog Output Selector Switch</i>

Symptom:	No Data Transmitted via RS232/485 Serial Port
Possible Cause:	Incorrect RS232 cable
Action:	Do NOT use a null modem cable
Section:	<i>5.1 RS232 Serial Output</i>
Possible Cause:	Incorrect communications mode
Action:	Set mode to required value (RS232 or RS485)
Section:	<i>4.1.3 Outputs, Setup Communications</i>
Possible Cause:	SEND field set to NONE
Action:	Set SEND field to required value (SAMPLE, ALL, etc.)
Section:	<i>4.1.3 Outputs, Setup Communications</i>

9. Principles of Operation

9.1 Sensor Technology

The YSI 8550 CO₂ sensor capsule consists of a small reservoir of bicarbonate buffer covered by a gas permeable silicone membrane. The buffer contains HPTS (Hydroxypyrene trisulfonic acid), a pH-sensitive fluorescent dye. Figure 9.1 shows an exploded view of the sensor capsule.

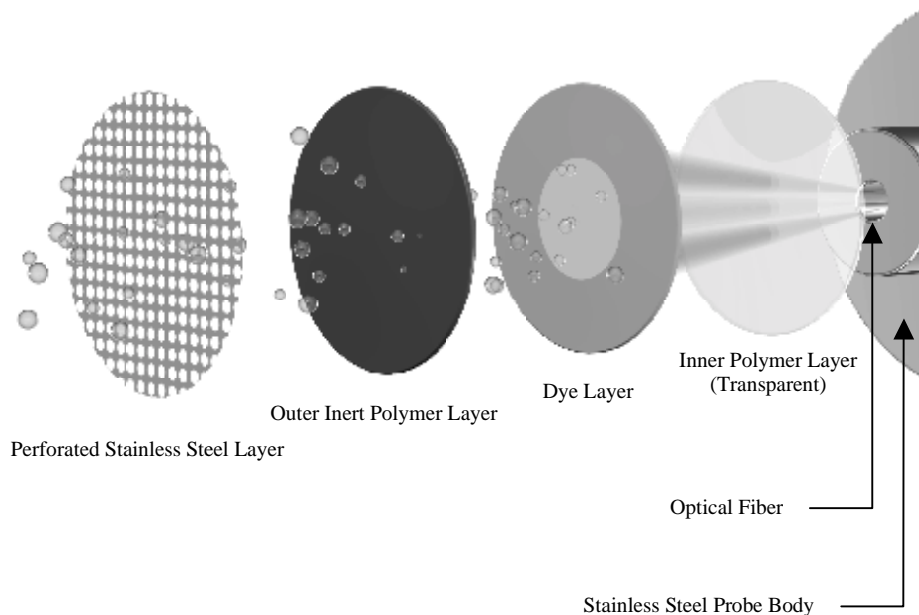
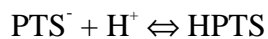


Figure 9.1

CO₂ diffuses through the membrane into the buffer, changing its pH. As the pH changes, the fluorescence of the dye changes.



The 8500 compares the fluorescence of the dye at two different wavelengths to determine the CO₂ concentration of the sample medium.

9.2 Background Values

All probes and cables have background fluorescence levels. For accurate measurements, these background values must be stored in the 8500. See 4.2.3 *Signal/Reference, Background* for details.

9.3 Calibration

Before an accurate measurement can be made, the system must be calibrated. Calibrating establishes the sensors' response to a known concentration of CO₂.

Calibrate the YSI 8500 system before each fermentation/cell culture run. Calibration should be performed under the same conditions (temperature and pressure) as expected during the run. For improved accuracy during long runs, recalibrate every 7 to 14 days during the run (see the *Application Notes* section). From the Run menu, recalibration can be initiated by pressing the [CALIBRATE] soft-key. See 4.4.1 *Calibrate* for details.

9.4 Temperature Compensation

The sensitivity of the YSI 8550 Sensor Capsule varies with temperature (approximately 0.05%/°C). The run temperature of the bioreactor must be entered in the setup for accurate calibration and readings. See 4.1.1 *Startup, SAMP CFG*.

9.5 Pressure Compensation

When vessel pressure (atmospheric pressure + gauge pressure) changes, the partial pressure of CO₂ changes. Since the sensor measures the partial pressure of CO₂, this causes a proportional change in the displayed % CO₂ value. The instrument software does **not** correct for this, therefore, if pressure changes are expected during a run, set the CO₂ units to mmHg or mBar and enter the current atmospheric⁵ and gauge pressures in the Samp Cfg menu. When the pressure changes during the run, the mmHg or mBar reading will change correspondingly. **Do not change the pressure settings during a run unless you recalibrate.**

⁵ Enter the true local barometric pressure. This corresponds to a reading from a mercury barometer. Do **NOT** use the pressure reported by the weather bureau. Weather bureaus correct pressures to sea level.

10. Accessories and Replacement Parts

YSI Number	Description	Comments
8504	Probe, 25mm x 70mm	Fits Safety or INGOLD® port.
8505	Probe, 12mm x 320mm	PG13.5 fitting
8506	Probe, 12mm x 320mm	Compression fitting
8507	Probe, 12mm x 120mm	PG13.5 fitting
8520	Manual, Instruction, French	
8521	Manual, Instruction, German	
8550	Sensor Capsule	Fits all probes.
8551	Six Pack of Sensor Capsules	6 each of 8550.
8556	Background Sensor Capsule	Used to set background values.
8560	19mm Probe Adapter	Adapts 12mm PG13.5 probe to 19mm port.
8570	Cable, Probe, 1 meter (3 feet)	Fiber-optic
8571	Cable, Probe, 3 meters (10 feet)	Fiber-optic
8576	Cable, Probe, Reinforced, 1 meter	Fiber-optic with steel sheath.
8577	Cable, Probe, Reinforced, 3 meters	Fiber-optic with steel sheath.
8580	Autoclave Cap	Covers probe ST connector.
8581	5 Pack of Autoclave Caps	5 each of 8580.
8591	Bicarbonate Buffer	250 mL when reconstituted
8592	Probe Storage Bottle Kit, 12mm	Contains 5 bottles
8593	Probe Storage Bottle Kit, 25mm	Contains 5 bottles
8594	O-ring Kit, 25mm Probe	Fits 8504 probe. 25 each of 085040, 085043 and 085041.
8595	O-ring Kit, 12mm Probe, PG13.5	Fits 8505 and 8507 probes. 25 each of 085037 and 085030. 5 each of 085035.
8596	O-ring Kit, 12mm Probe, Compression	Fits 8506 probe. 25 each of 085030.
8597	O-ring Kit, 19mm Adapter	Fits 8560 19mm Adapter. 25 each of 085174 and 062777.
085250	O-ring, Sensor Capsule End	Included with sensor capsule.
085251	O-ring, Probe Cap End, 12mm	Seals probe cap to probe.
085252	O-ring, Probe Cap End, 8504	Seals probe cap to probe.
085254	O-ring, Probe Cap, 8504, INGOLD®	Seals probe in reactor port.

YSI Number	Description	Comments
085253	O-ring, Probe Cap, 8504, Safety	Seals probe in reactor port.
085037	O-ring, PG13.5	Seals probe in reactor port.
085035	Ring, Teflon, PG13.5	Seals probe in reactor port.
085033	Cap, Probe, 8504, INGOLD®	Retains sensor capsule.
085032	Cap, Probe, 8504, Safety	Retains sensor capsule.
085030	Cap, Probe, 12mm (8505, 8506 & 8507)	Retains sensor capsule.
085256	O-ring, 19mm Adapter, Outer	Seals adapter in reactor port.
085255	O-ring, 19mm Adapter, Inner	Seals probe to adapter.
052021	RS232 Cable	DB9M-DB9F
028110UL	Power Cord, AC	
085166UL	Fuse, 1A, Slow-blow (S type)	AC Power, Rear of instrument

11. Appendix A - Specifications

System:

Measurement:	pCO ₂
Measurement range:	1–25% at atmospheric pressure (760 mmHg)
Measurement Accuracy:	±5% of reading or 0.2% absolute, whichever is greater
Calibration Procedure:	Single Point calibration performed with reference gas before start of process.
Calibration Drift:	2% of actual reading per 7 days
Response Time:	T ₉₀ < 7 minutes
Output signals:	
Serial:	RS232 or RS485
Analog:	4–20 mA, offset = ±0.25mA, differential = ±0.05mA or 1–5VDC, offset = ±0.1V, differential = ±50mV
Instrument operating environment:	10–40°C, 5–90% RH non-condensing For indoor use only For use at an altitude of up to 2000m
Case size:	10.1" (25.7cm) L x 4" (11.5cm) W x 10.5" (26.5cm) D
Display:	LCD, 40 characters x 8 lines
Data storage:	7500 samples, calibration information, error messages
Regulatory compliance:	CUL, UL, CE
UL3101-1 compliance:	Pollution degree 2 Installation category 2

Sensor Capsule:

Material:	All wetted polymers in contact with the media are FDA 21 CFR 177 compliant
Working life:	45 days continuous use
Break-in Period:	30 minutes
Shelf life:	12 months
Size:	0.357" (9.1mm) diameter x 0.258" (6.6mm) length
Storage Temperature:	Refrigerate (do NOT freeze)

Probe:

Material:	316L Stainless steel
Insertion Length:	8504 – 70mm 8505 – 320mm 8506 – 320mm 8507 – 120mm
Insertion Diameter:	8504 – 25mm 8505 – 12mm 8506 – 12mm 8507 – 12mm
Sterilizing conditions:	132°C, 20 minutes 2 bar (30 psig) maximum
Operating conditions:	20–40°C, 0–10 psig maximum

Cable:

Material:	8570 – Fiber-optic 8571 – Fiber-optic 8576 – Fiber-optic with steel sheath 8577 – Fiber-optic with steel sheath
Connectors:	ST – Probe end SMA – Instrument end
Length:	8570 – 1 meter (3 feet) 8571 – 3 meters (10 feet) 8576 – 1 meter (3 feet) 8577 – 3 meters (10 feet)

12. Appendix B – Pressures and Altitudes

Conversion Factors for Common Units of Pressure

	kilo Pascals	mm Hg	Millibars	Inches H ₂ O	PSI	Inches Hg
1 atm	101.325	760.000	1013.25	406.795	14.6960	29.921
1 kiloPascal	1.00000	7.50062	10.0000	4.01475	0.145038	0.2953
1 mmHg	0.133322	1.00000	1.33322	0.535257	0.0193368	0.03937
1 millibar	0.100000	0.750062	1.00000	0.401475	0.0145038	0.02953
1 inch H₂O	0.249081	1.86826	2.49081	1.00000	.0361	0.07355
1 PSI	6.89473	51.7148	68.9473	27.6807	1.00000	2.0360
1 inch Hg	3.38642	25.4002	33.8642	13.5956	0.49116	1.00000
1 hectoPascal	0.100000	0.75006	1.00000	0.401475	0.0145038	0.02953
1 cm H₂O	0.09806	0.7355	9.8 x 10 ⁻⁷	0.3937	0.014223	0.02896

Atmospheric Pressures and Altitudes

inHg	Pressure		Altitude		Factor
	mmHg	millibars	Feet	meters	
30.23	768	1023	-276	-84	1.01
29.92	760	1013	0	0	1.00
29.61	752	1003	278	85	0.99
29.33	745	993	558	170	0.98
29.02	737	983	841	256	0.97
28.74	730	973	1126	343	0.96
28.43	722	963	1413	431	0.95
28.11	714	952	1703	519	0.94
27.83	707	942	1995	608	0.93
27.52	699	932	2290	698	0.92
27.24	692	922	2587	789	0.91
26.93	684	912	2887	880	0.90
26.61	676	902	3190	972	0.89
26.34	669	892	3496	1066	0.88
26.02	661	882	3804	1160	0.87
25.75	654	871	4115	1254	0.86
25.43	646	861	4430	1350	0.85
25.12	638	851	4747	1447	0.84
24.84	631	841	5067	1544	0.83
24.53	623	831	5391	1643	0.82
24.25	616	821	5717	1743	0.81
23.94	608	811	6047	1843	0.80
23.62	600	800	6381	1945	0.79
23.35	593	790	6717	2047	0.78
23.03	585	780	7058	2151	0.77
22.76	578	770	7401	2256	0.76
22.44	570	760	7749	2362	0.75
22.13	562	750	8100	2469	0.74
21.85	555	740	8455	2577	0.73
21.54	547	730	8815	2687	0.72
21.26	540	719	9178	2797	0.71
20.94	532	709	9545	2909	0.70
20.63	524	699	9917	3023	0.69
20.35	517	689	10293	3137	0.68
20.04	509	679	10673	3253	0.67
19.76	502	669	11058	3371	0.66

13. Appendix C - Warranty and Repair

The YSI 8500 CO₂ Monitor, 8500 Series Probes and 8500 Series Cables are warranted for one year from date of purchase by the end user against defects in materials and workmanship, exclusive of batteries. Breakage of fiber-optic cables is NOT covered under warranty. Within the warranty period, YSI will repair or replace, at its sole discretion, free of charge, any product that YSI determines to be covered by this warranty.

To exercise this warranty, write or call your local YSI representative, or contact YSI Customer Service in Yellow Springs, Ohio. Send the product and proof of purchase, transportation prepaid, to the Authorized Service Center selected by YSI. Repair or replacement will be made and the product returned, transportation prepaid. Repaired or replaced products are warranted for the balance of the original warranty period, or at least 90 days from date of repair or replacement.

Limitation of Warranty

This Warranty does not apply to any YSI product damage or failure caused by (i) failure to install, operate or use the product in accordance with YSI's written instructions, (ii) abuse or misuse of the product, (iii) failure to maintain the product in accordance with YSI's written instructions or standard industry procedure, (iv) any improper repairs to the product, (v) use by you of defective or improper components or parts in servicing or repairing the product, or (vi) modification of the product in any way not expressly authorized by YSI.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. YSI's LIABILITY UNDER THIS WARRANTY IS LIMITED TO REPAIR OR REPLACEMENT OF THE PRODUCT, AND THIS SHALL BE YOUR SOLE AND EXCLUSIVE REMEDY FOR ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY. IN NO EVENT SHALL YSI BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES RESULTING FROM ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY.

YSI Factory Service Centers

United States

YSI Incorporated • Repair Center • 1725 Brannum Lane • Yellow Springs, OH • 45387 • Phone: 937 767-7241 • Fax: 937 767-9353

Europe

YSI (UK) Ltd • Lynchford House • Lynchford Lane • Farnborough, Hampshire • GU14 GLT • Phone: 441 252 514711 • Fax: 441 252 511855

Japan

YSI (Japan) Ltd • 3Fl., Sakura – Building 5-6-13 • Shinjuku • Shinjuku-ku • Tokyo 160 • Phone: 81-3 5360-3561 • Fax: 81-3 5360-3565

Cleaning Instructions

NOTE: Before they can be serviced, equipment exposed to biological, radioactive, or toxic materials must be cleaned and disinfected. Biological contamination is presumed for any instrument, probe, or other device that has been used with body fluids or tissues, microorganisms or with wastewater. Radioactive contamination is presumed for any instrument, probe or other device that has been used near any radioactive source.

If an instrument, probe, or other part is returned or presented for service without a Cleaning Certificate, and if in our opinion it represents a potential biological or radioactive hazard, our service personnel reserve the right to withhold service until appropriate cleaning, decontamination, and certification have been completed. We will contact the sender for instructions as to the disposition of the equipment. Disposition costs will be the responsibility of the sender.

When service is required, either at the user's facility or at YSI, the following steps must be taken to insure the safety of our service personnel.

1. In a manner appropriate to each device, decontaminate all exposed surfaces, including any containers. 70% isopropyl alcohol or a solution of 1/4 cup bleach to 1 gallon tap water are suitable for most disinfecting. Instruments used with wastewater may be disinfected with 0.5% Lysol if this is more convenient to the user. Autoclavable products may be autoclaved.
2. The user shall take normal precautions to prevent radioactive contamination and must use appropriate decontamination procedures should exposure occur.
3. If exposure has occurred, the customer must certify that decontamination has been accomplished and that no radioactivity is detectable by survey equipment.
4. Any product being returned to the YSI Repair Center should be packed securely to prevent damage.
5. Cleaning must be completed and certified on any product before returning it to YSI.

Packing Instructions

1. Clean and decontaminate items to insure the safety of the handler.
2. Complete and include the Cleaning Certificate.
3. Place the product in a plastic bag to keep out dirt and packing material.
4. Use a large carton, preferably the original, and surround the product completely with packing material.
5. Insure for the replacement value of the product.

<p>Cleaning Certificate</p> <p>Organization _____</p> <p>Department _____</p> <p>Address _____</p> <p>City _____ State _____ Zip _____</p> <p>Country _____ Phone _____</p> <p>Model No. of Device _____ Lot Number _____</p> <p>Contaminant (if known) _____</p> <p>Cleaning Agent(s) used _____</p> <p>Radioactive Decontamination Certified?</p> <p>(Answer only if there has been radioactive exposure)</p> <p>___ Yes ___ No</p> <p>Cleaning Certified By _____</p> <p style="text-align: right;">Name Date</p>
--

14. Appendix D - Cleaning, Disinfecting and Decontamination

Proper precautionary lab practices should be followed when handling biological hazards.

Suggested cleaning and disinfecting solutions/procedures include:

- Isopropanol 70%
- Sodium hypochlorite, 5000 ppm free available chlorine (1:10 solution of household bleach)
- Autoclave (132°C for 20 minutes minimum)

Decontamination Procedures

Wipe the instrument case, probe and fiber-optic cable with mild soap and water, **do not immerse**. If necessary, isopropanol may be used. A non-abrasive cloth or paper towel must be used when cleaning the probe tip or cable ends to prevent damage to the optical fiber.

The disposable sensor capsule is designed to be used only once, however, it may be cleaned if necessary using the disinfecting agents above. Clean the capsule while it is attached to the probe.

Disposal of the sensor capsule should follow procedures consistent with disposal of materials that may have been in contact with it. In fermentation and cell culture applications, processes for disposal of biological hazards should be followed.

The probe and sensor capsule should be sterilized in place prior to use.

15. Appendix E - Required Notice

This equipment generates and uses radio frequency energy and if not installed and used properly, may cause interference to radio and television reception. There is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

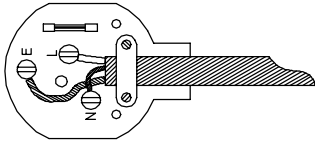
- Reorient the receiving antenna
- Relocate the computer with respect to the receiver
- Move the computer away from the receiver
- Plug the computer into a different outlet so that the computer and receiver are on different branch circuits.

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet, prepared by the Federal Communications Commission, helpful: "How to Identify and Resolve Radio-TV Interference Problems." This booklet is available from the U.S. Government Printing Office, Washington, DC 20402, Stock No. 0004-000-00345-4.

16. Appendix F - Line Power Cord and Plug Wiring

Make sure that the cord and plug are appropriate for the power output you intend to use.

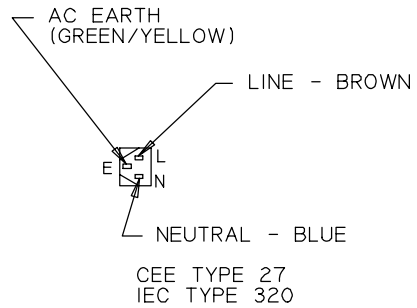
Make sure you use a plug to BS1363 and ASTA approval
Use Fuse 3A to BS1362 and ASTA approval



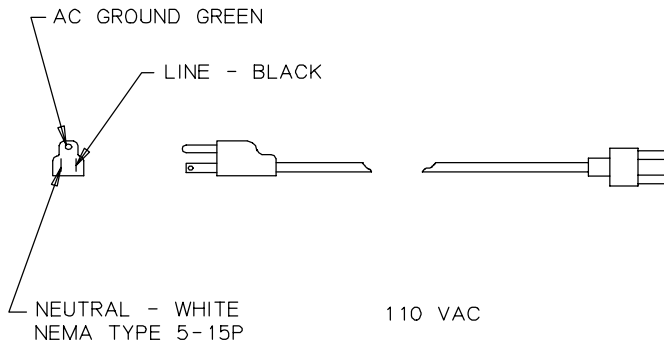
Green and yellow wire to E (Earth)

BROWN wire to BROWN or L (live)
BLUE wire to BLUE or N (neutral)

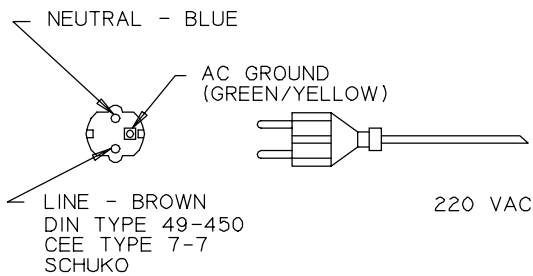
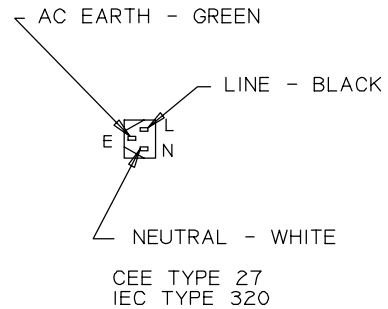
Before refitting the top cover of the plug or socket, make sure that the cable clamp is securely holding the outer sheath of the cable.



240 VAC



110 VAC



220 VAC

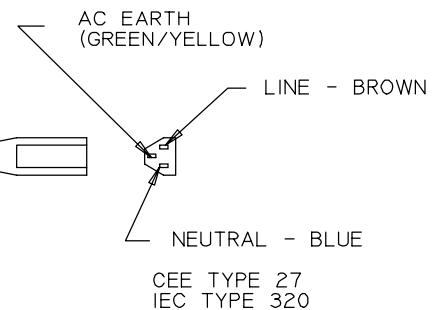


Figure 16.1

17. Appendix G - CE Compliance

Important Notice regarding CE standards compliance:

1. Users should note that RS232/485 communications may be susceptible to ESD. Data corruption or serial communications failure may occur. If malfunction occurs, users may restore proper operation by resetting communications parameters under the “Setup, Outputs, Set Comm” menu.

Application Notes

Application notes for the YSI BIOVISION 8500 CO₂ Monitor are currently under development. For a current listing, please contact YSI Life Sciences Customer Service (800 659-8895 or 937 767-7241 extension 2) or visit the YSI web site at www.YSI.com.

Ordering Information

To place an order, contact YSI Life Sciences Customer Service or the US Manufacturer's Representative in your area. YSI business hours are Monday through Friday, 8AM to 5PM ET.

- Phone: 800 659-8895 or
937 767-7241 extension 2
- Fax: 937 767-9353
- email: lifesciences@ysi.com
- Mailing Address:

YSI Incorporated
Life Sciences Customer Service
PO Box 279
Yellow Springs, Ohio 45387

YSI Number	Description	Comments
8500	Instrument	Instrument only
8500-04	System	Instrument, 8504, 8571, 2 each of 8550
8500-05	System	Instrument, 8505, 8571, 2 each of 8550
8500-06	System	Instrument, 8506, 8571, 2 each of 8550
8500-07	System	Instrument, 8507, 8571, 2 each of 8550
8504	Probe, 25mm x 70mm	Fits Safety or INGOLD® port.
8505	Probe, 12mm x 320mm	PG13.5 fitting
8506	Probe, 12mm x 320mm	Compression fitting
8507	Probe, 12mm x 120mm	PG13.5 fitting
8520	Manual, Instruction, French	
8521	Manual, Instruction, German	
8550	Sensor Capsule	Fits all probes.
8551	Six Pack of Sensor Capsules	6 each of 8550.
8556	Background Sensor Capsule	Used to set background values.
8560	19mm Probe Adapter	Adapts 12mm PG13.5 probe to 19mm port.
8570	Cable, Probe, 1 meter (3 feet)	Fiber-optic
8571	Cable, Probe, 3 meters (10 feet)	Fiber-optic

8576	Cable, Probe, Reinforced, 1 meter	Fiber-optic with steel sheath
8577	Cable, Probe, Reinforced, 3 meters	Fiber-optic with steel sheath
8580	Autoclave Cap	Covers probe ST connector.
8581	5 Pack of Autoclave Caps	5 each of 8580.
8591	Bicarbonate Buffer	250 mL when reconstituted
8592	Probe Storage Bottle Kit, 12mm	Contains 5 bottles
8593	Probe Storage Bottle Kit, 25mm	Contains 5 bottles
8594	O-ring Kit, 25mm Probe	Fits 8504 probe. 25 each of 085040, 085043 and 085041.
8595	O-ring Kit, 12mm Probe, PG13.5	Fits 8505 and 8507 probes. 25 each of 085037 and 085030. 5 each of 085035.
8596	O-ring Kit, 12mm Probe, Compression	Fits 8506 probe. 25 each of 085030.
8597	O-ring Kit, 19mm Adapter	Fits 8560 19mm Adapter. 25 each of 085174 and 062777.



Y S I incorporated

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