Operations Manual

PGA 3500

Portable 3-Gas IR Analyzer

Table of Contents

WARNINGS

RETAIN ORIGINAL PACKAGING.

PROPER PACKAGING IS REQUIRED WHEN RETURNING PGA FOR CALIBRATION OR REPAIR.

DAMAGE CAUSED BY IMPROPER PACKAGING IS NOT COVERED UNDER THE WARRANTY.

Shipping the instrument back to Super Systems

When returning the PGA3500 to SSI for calibration or any other service, it must be properly protected during shipment. The best method of packaging the instrument is in its original packaging which includes custom-fit foam. For this reason, **the original packaging should be retained**. If the original packaging is not available, the instrument should be shipped in a suitably sized cardboard box with at least 4" of solid padding on each side of the instrument (not packing peanuts).

In the event that the PGA3500 is returned to Super Systems with improper packaging, **we reserve the right to charge for replacement custom foam and a new box instead of risking damage to the instrument during reshipment.**

Super Systems will not be responsible for damage caused by improper packaging.

IT IS THE RESPONSIBILITY OF THE OPERATOR TO ENSURE THAT THE GAS BEING SAMPLED DOES NOT PRODUCE ANY CONDENSATION.

SENSOR DAMAGE DUE TO MOISTURE WILL VOID THE WARRANTY

Moisture and Condensation

Depending on the composition of the gas being sampled, it is possible that condensation could occur in the sample tubing. This is not likely in a properly operating endothermic atmosphere, however condensation can occur in either a poorly operating endothermic or any exothermic atmosphere. Do not leave the PGA3500 unattended for long periods of time unless you are confident that the gas being sampled will not condense in the sample lines. If moisture gets inside the instrument it will result in permanent damage the sensors, which is not covered under the warranty.

Typical Diagnostic Uses of the PGA3500

The PGA3500 Analyzer measures CO, CO_2, and CH_4. Carbon potential can be calculated using furnace temperature and the relationship of these 3-gases. Oxygen probe real-time measurement of the furnace atmosphere can be verified by 3-Gas analysis. In addition to being an excellent diagnostic device, the PGA3500 will provide the necessary data to fine-tune your atmosphere control.

Endothermic Generator Diagnostics

The effectiveness of the catalyst is measured by the CH_4 content. Less than 0.5% is an indication of properly functioning catalyst. Higher concentrations indicate the necessity for either conditioning or replacement.
Measuring the level of CO in the carrier gas allows correction of the % carbon reading at the furnace.

Heat Treat Furnaces – Conventional Endo Gas

Furnace atmosphere carbon potential (% C) can be verified with the PGA3500.
Measuring carbon monoxide (CO) and carbon dioxide (CO_2) can show possible problems (i.e. water leaks, air leaks, and radiant tube leaks).
The PGA3500 measures the free methane (CH_4) in the furnace atmosphere.

Heat Treat Furnaces – Nitrogen/Methanol Endo Gas

The carbon monoxide (CO) level in the furnace atmosphere indicates the effectiveness of the cracking of the methanol. Equilibrium of the methanol cracking reaction ($CH_3OH \rightarrow CO + 2H_2$) is temperature dependent.

Heat Treat – Oxygen Sensor Control

Periodic verification of the performance of oxygen probes.
COF and PFC adjustments can be made (based on the calculations of the 3 gases) to provide more precise control of the carbon in the furnace atmosphere.

Combustion – Burner Balancing

Measures excess O_2 in the flue gas to allow burner adjustments.

PGA 3500 Operating Instructions

Introduction

The Model PGA3500 is a portable 3-Gas IR analyzer with an Oxygen (O_2) cell on-board. It measures Carbon Monoxide (CO), Carbon Dioxide (CO_2) and Natural Gas (CH_4) typically found in an endothermic atmosphere.

Specifications

The unit is designed and manufactured for the atmosphere heat-treating industry.

CO range:	**0.00 to 30.00 % ***
CO_2 range:	**0.000 to 2.000 %**
CH_4 range:	**0.00 to 15.00 % ***
O_2 range:	**0.1 to 25.0%**

* Note: The CO and CH4 sensors have been calibrated to be most accurate within the ranges as shown above, however both sensors are capable of measuring gas concentrations of up to 100.00%.

Sampling method:	Extraction by internal pump (when necessary)
Accuracy and repeatability:	± 1% of full scale
Flow Meter:	Inside case lid and also on-screen
Pump Operation:	On/Off/Automatic
AC Power:	90 to 230 VAC, 50 to 60 Hz, 60 Watts
DC Power: (Charger integrated inside instrument)	12VDC rechargeable NiCd battery
Communications:	RS232, Ethernet, RS485 (Future Use)
Data Storage:	Continuous automatic data logging
Data Retrieval:	Visible in graphical and tabular format using XGA Viewer software (included)
Operating Temperature:	32° to 122° F (0° to 50° C)
Dimensions:	Approx. 16”H X 20”L X 8”D
Weight:	Approx. 30 lbs.

Basic Operating Description

The Model PGA 3500 has been designed for the simultaneous analysis of CO, CO2 and CH4 in heat-treat furnace atmosphere gases. It has a 16 line by 40-character LCD display and a 4 x 4 keypad for the operator interface. Information is presented to the operator on various screens. The operator selects the appropriate page and enters the number using the keypad.

Keypad Assignments

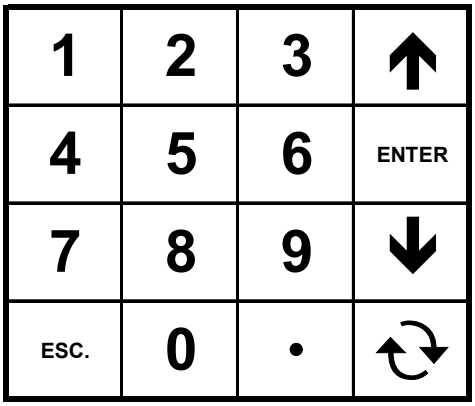
All of the functions of the PGA3500 are controlled from the keypad. The functions of each button are as follows:

0 – **9** are used to enter numeric data that can vary with each page.

"**.**" is used to enter a decimal point where necessary for data entry.

Enter is used when entering numeric data from the keypad or initiating automatic functions.

↑ and ↓ are used to navigate through the menu options or scroll through data on a specific page.



Esc is the escape key. This clears any entered text, and if continuously pressed toggles between the main page and the menu list.

On most pages, this key can be used to turn the pump on and off (without using Screen 4). On some screens it is used to change a selection or view additional data.

Analyzer Start-Up Procedure

Turn the power switch ON and allow the instrument to warm up until numbers appear on the default screen instead of ********. This process should take approximately three minutes. During this time, the user will be prevented from accessing the calibration screens since the sensors have not had enough time to provide accurate data. It is recommended that the instrument is powered on for four or five minutes prior to use, although measurements can be taken within only three.

Sampling Criteria

Accurate readings are only possible if the sample is taken from a clean (free of excess carbon buildup) sample port. The current state-of-the-art technology associated with infrared gas detection requires that a clean, soot free sample be available for analysis. This will also increase the life of the filter elements, and reduce the possibility that soot will enter the unit and contaminate the sensors.

On a furnace, the ideal port would be found on SSi's Sample Port (Part Number 20263). If this were not available, the burnout port of a freshly burned-out Gold Probe™ would be an alternative, although this would still contain a trace amount of soot.
On a generator, a dedicated sample port should be available. This sample port should be blown out before it is used, which will remove any soot that has accumulated in the line. This is accomplished by opening the valve without connecting the analyzer. Wait until the gas stream is clean before proceeding, and connect the sample line on the PGA3500 to the sample port.
The ideal flow rate for sampling should be between 1.0 and 1.5 Standard Cubic Feet per Hour (SCFH). A visual indication of flow rate can be obtained through the mini flow meter located on the inside of the lid of the case, or by the digital flow meter on the left side of the display. The flow meter on the inside of the case also contains a dial that allows the user to restrict the flow, if necessary, to maintain an appropriate flow rate. If the sample gas is not under pressure, the internal pump can be used to extract it. The internal pump can be operated manually by pressing the circular arrow key, or it can be turned on or off automatically when it detects low sample flow.

Filters

There are two filters that are intended to prevent soot or other contaminants from entering the unit. The first is a light-blue colored in-line filter that is located at the end of the sample tubing assembly. The second is a bowl filter located on the inside of the lid. Periodic inspection of these filters will ensure smooth operation. When new, the elements in both of these filters are a yellow/white color. Both are oriented in the sample stream in a manner that causes any contaminants to collect on the outside of the filter media, which allows for a visual inspection of filter status. If the primary filter is properly maintained, the secondary filter will rarely require changing.

Condensation / Moisture

When a hot gas is cooled rapidly, moisture in the gas can condense and form water. This water can collect in the sample tubing assembly, and eventually enter the bowl filter. Care must be taken to ensure that no water enters the unit, as this will cause permanent damage to the sensors. The unit should be closely monitored during operation to determine if moisture is collecting in the bowl filter. If this is the case, the bowl filter basin can be removed and emptied by unscrewing it. Although water in the bowl filter will not cause damage to the unit, this filter is not intended to be used as a condensation receptacle. If moisture has collected in the bowl filter, sampling should be stopped, and steps should be taken to prevent this from continuing before operation is resumed.

Battery

The battery in the PGA3500 is intended to provide more than enough power to operate the unit continuously for an eight-hour shift. When *Battery Low* is displayed on the LCD screen, the unit is in need of a charge. To charge the PGA3500, plug it into a 110 or 220VAC power source using the supplied power cord. The LED above the power cord input will appear red while the unit is being charged, and it will turn to green when charging is complete.
For maximum battery life, do not recharge the battery after each use unless the *Battery Low* message appears on the screen. Reducing the number of times that the unit is charged will maintain the battery's original storage capacity for a longer period of time.

It is possible to view the condition of the battery by accessing Menu page #9 - *Battery Status*.

Menu List

The menu list shows the available pages displayed six at a time. To access the list, press the **Esc** key. Depending upon where you are starting from, it may require pressing this button more than once. The up (↑) and down (↓) arrows are used to scroll through the selections, which are repeated below. To go to a specific page, either type in the page number and press **Enter**, or use the arrow keys to highlight your selection and then press **Enter**.

Operator Level – No Pass Code Required

1. IR STATUS DISPLAY
2. IR OVERALL STATUS DISPLAY
3. O2 DISPLAY
4. PUMP CONTROL
5. SET DISPLAY VALUES
6. HELP
7. CALIBRATION DATES
8. LANGUAGE / LENGUA
9. BATTERY STATUS
10. ABOUT / SIGN-ON
11. REVISION DISPLAY
12. LOGGED DATA START DATE
13. LOGGED DATA DISPLAY
14. SESSION
15. SAMPLING PARAMETERS

Supervisor Level – Level 1 Pass Code Required

16. SET THE DATE AND TIME
17. PORT SETUP
18. ZERO CALIBRATION
19. O2 CELL CALIBRATION
20. COMMUNICATIONS SETUP

Configuration Level – Level 2 Pass Code Required

22. CALIBRATE FLOW METER
23. CALCULATION FACTORS
24. SPAN CALIBRATION
25. SET PASS CODES
26. SET IP ADDRESS
27. OPTIONAL CELL CALIBRATE
28. GENERAL INFORMATION

Page 21 is reserved for future use and does not exist at this time. To minimize the possibility of unintended modifications to the instrument, certain menu pages will require the entry of a pass code to access them. Pages 1 through 15 are Operator level screens that do not require any security codes. Pages 16 - 20 are Supervisor screens requiring a level 1 pass code

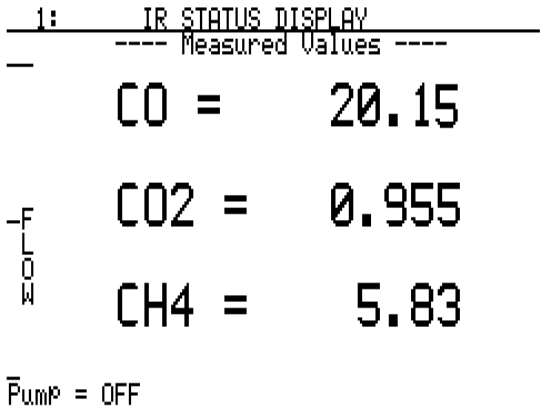
(default = **1**). Pages 22 – 26 are Configuration screens requiring a Level 2 pass code (default = **2**).
At the bottom of the Menu Screen is a status bar. This tells the current date and time, and also displays the internal temperature (IT) of the instrument. This internal temperature should never exceed 50

Note about Menu Numbers

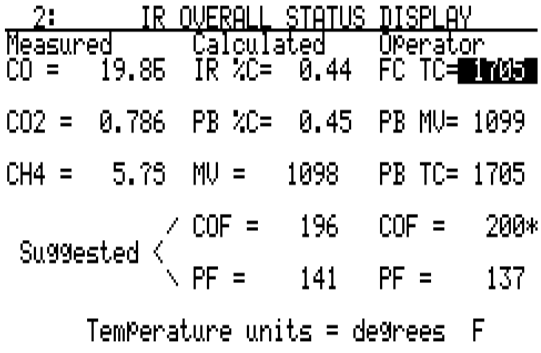
Each menu screen has a unique number that will be displayed in the upper left-hand corner of the screen. This number is shown for reference. If you know the menu number of the screen that you would like to go to, this number can be typed in to access it directly from the IR Status Display or the Menu List.

IR Status Display – Menu Page 1

The IR status display shows the current readings of CO, CO2 and CH4. Also shown is the relative flow rate of the sample by a fuel gauge on the left-hand side of the screen. The sample pump may be turned on or off by pressing the circular arrow key at the lower right-hand side of the keypad.



IR Overall Status Display – Menu Page 2



The IR Overall Status Display provides the user with the calculated carbon percentage (%C) from two different sources (probe and infrared). It provides information to allow the atmosphere controller to be "tuned" to match the information from the 3-gas analyzer.

To obtain the most information from this screen, some data must be manually entered. This is done at the right hand side of the screen under the heading *Operator*. Using the keypad to enter numbers, and the arrow keys to move the highlighted area up and down, the following data should be entered:

FC TC= This is the furnace thermocouple value, or the furnace temperature.
PB MV= This is the millivoltage from the carbon probe.
PB TC= This is the probe thermocouple value, or the probe temperature.
COF= This is the CO Factor value read from the SSi, Honeywell, Barber Colman, Yokogawa, or other atmosphere controller.
PF= This is the Process Factor value read from the Marathon Sensors atmosphere controller.
Temperature Units = This determines the measurement units for temperature. Enter **0** for Fahrenheit or **1** for Celsius.

<u>Measurement of Infrared % Carbon (IR %C)</u>
To accurately measure the % carbon in a furnace atmosphere, the instrument will need to know the values of each of the three gases and the temperature of the gas being measured. At the left side of the screen, under the heading *Measured*, are the real-time values of CO, CO2, and CH4. The values of these three gases, plus the furnace temperature (FC TC) value, will result in the calculation of the IR % Carbon (IR %C). This is displayed in the center of the screen, under the heading *Calculated*. Please note that if the furnace temperature

information has not been entered correctly the resulting carbon calculation will NOT be accurate.

Measurement of Probe % Carbon (PB %C)

The measurement of the probe % carbon requires three pieces of information to be entered. These are the probe millivolts, probe temperature, and either the COF or the PF (depending on the type of atmosphere controller you are using). The probe millivolts and probe temperatures are entered on the right side of the page. Before entering either a COF or a PF, you will need to determine the manufacturer of the atmosphere control instrument you are using. If SSi, Honeywell, Barber Colman, Yokogawa, or anyone other than Marathon manufactures the instrument, then it will contain a CO Factor Adjustment variable. If you are using a Marathon Sensors instrument, then this variable is called a Process Factor Adjustment. Only one of these (COF or PF) will be used at any one time, and the other will not be relevant. If your instrument has a CO Factor Adjustment variable, then use the arrow keys to go to the appropriate location and type in the value that is stored in your atmosphere control instrument. After the value is entered, you will see an ***** appear next to the number. This lets you know that the CO Factor is being used for the calculations, not the Process Factor. If your instrument has a Process Factor Adjustment variable, then this value should be entered in the **PF=** slot, which will result in the ***** appearing by the number that you entered.

The calculation of probe % carbon is no different from the % carbon as displayed on the atmosphere controller. The algorithm used by both instruments in their calculations is identical. The reason the information is entered into the PGA is not to calculate the probe % carbon, but to enable the PGA to compute the suggested COF / PF. Without knowing the current instrument values, it cannot compute the suggested values.

What is a CO Factor or a Process Factor?

The carbon probe is measuring the amount of oxygen in the atmosphere. Knowing the amount of oxygen, the atmosphere controller can determine the percentage of carbon. The calculation that the instrument uses to translate oxygen concentration into % carbon is based on a theoretically pure atmosphere being present in the furnace. The composition of this theoretically pure atmosphere is 40% hydrogen (H2), 40% nitrogen (N2), and 20% carbon monoxide (CO). In many situations, the measured amount of CO is less than the theoretically exact 20%. This can be due to a variety of factors including seasonal changes in natural gas composition and incomplete gas cracking in an endothermic generator. The CO Factor and Process Factor adjustments are intended to make adjustments to the calculation to accommodate differences between theoretical and actual gas compositions.

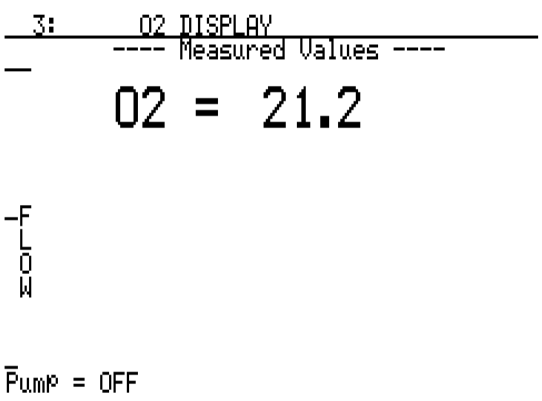
Suggested COF / PF

Between the two methods of determining % carbon (probe and infrared), the infrared is considered to be more accurate. This is because the infrared analyzer evaluates the levels of three gases (CO, CO2, and CH4) to make its calculation, instead of just using % oxygen like the probe does. At the bottom of the middle display column, you will see suggested COF and PF values. These values are determined by making a comparison between where the probe is actually reading and where it should be reading. The suggested COF and PF values can be entered into your atmosphere controller to make it display the same % carbon reading as the PGA3500. By performing periodic evaluations with the PGA3500 and making the suggested modifications to the adjustment factor in the atmosphere controller, you can be assured that your continuous source of process data (the probe) is as accurate as possible. Of course,

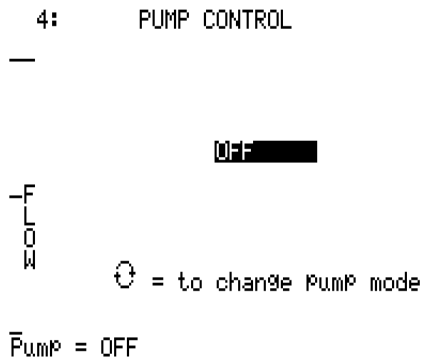
large changes in CO Factor or Process Factor should be verified by shim stock analysis or other means to confirm the significance of the change.

Combustion Display – Menu Page 3

The combustion display shows the current reading in % excess oxygen. Also shown is the relative flow rate of the sample by a fuel gauge on the left-hand side of the screen. The sample pump may be turned on or off by pressing the circular arrow key.
This screen is not intended to measure oxygen as accurately as a probe. It is intended only to serve as a method of checking to see if there is oxygen contamination in the sample. This sensor measures oxygen to a tenth of a percent, where a probe will provide accuracy in the parts per million.



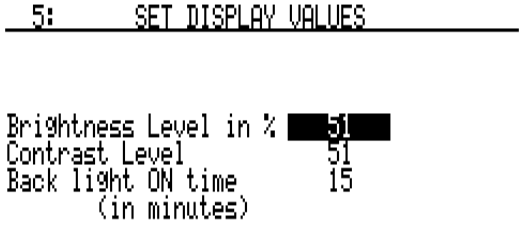
Pump Control - Menu Page 4



The pump control page is used to set the pump mode. The sample pump mode can be changed from OFF to ON to AUTO by pressing the circular arrow key. Auto mode will turn the pump on when the flow is below approximately 1.5 SCFH and off when it is above approximately 1.5 SCFH. Also shown is the relative flow rate of the sample by a fuel gauge on the left-hand side of the screen. There is also a traditional flow meter located in the lid of the PGA. Although the flow indicator on the screen has been calibrated at the factory, the most accurate flow measurements should be taken with the flow meter inside the lid.

Set Display Values – Menu Page 5

This page is used to adjust the display values. The backlight brightness and contrast are factory set to 51%, which should be appropriate for most viewing conditions. Their values can range from 0 to 100% if desired. Also shown on this page is the Backlight ON Time. This is a power saving feature that will enhance battery life by turning the backlight off if no buttons are pressed within a pre-determined number of minutes. When it turns



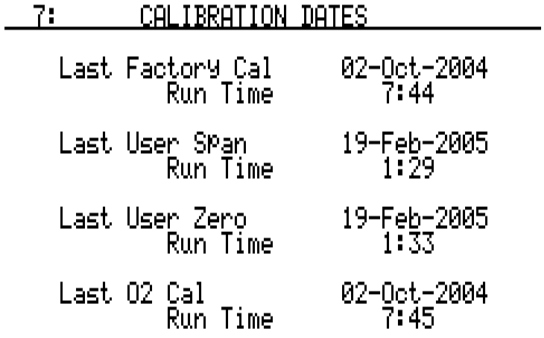
off, the instrument still operates fully, but the display is more difficult to read. To restore the backlight, press any key. To disable this function, enter **0** and the backlight will be always on.

Help Page - Menu Page 6

This page can be used as a reference to briefly describe the functions of the various buttons on the keypad. This manual is a better resource, however if it is not available this screen will be able to offer information that will help in navigating through the screens on the PGA3500. Below is the text for the Help page:

Use the up and down arrows to see all. To view the list of menu pages, go to the menu screen by pressing the 'Esc' button. This button will toggle between the IR Status Display (Screen 1) and the Menu List. To access a specific menu, use the arrow keys to scroll up or down to the desired selection and press 'Enter'. Or, if you already know the number of the screen, simply type it and press 'Enter'. The circular arrow button on the bottom right side of the keypad will either show additional data for that screen or it will change the pump status. To enter data on a specific screen, highlight the desired location by using the up and down arrow keys. Then enter the number using the numeric keypad and pressing 'Enter'. Pressing the 'ESC' button once will clear any typed data that is on the screen. Pressing it again will return you to the menu list, and pressing it one more time will return you back to Screen #1, the main page.

Calibration Dates and Run Times - Menu Page 7



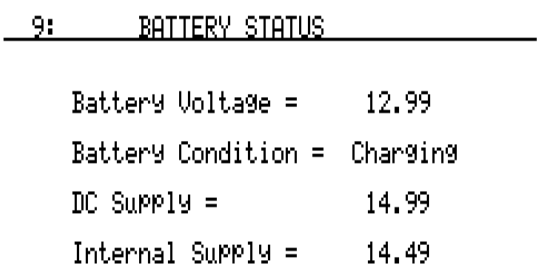
This page shows the most recent calibration dates, as well as the amount of time that has elapsed since each calibration. Time is shown in hours and minutes. These dates do not need to be set after calibration since they will be set automatically whenever a calibration is performed. *Note: For accurate calibration dates to be entered, the internal clock must be set correctly (see menu page 16 – Set The Date and Time)*.

Language / Lengua – Menu Page 8

This menu page will allow the user to select a different language for most of the displayed words. These language files are stored on the PGA drive and should not be modified by the user unless directed to by a Super Systems Inc employee. *Warning: Modification of the language files can produce unwanted or undesirable results*. Use the up or down arrow keys to select the

desired language and then press the **Enter** key. The selected language will be displayed above the list of languages.

Battery Status – Menu Page 9

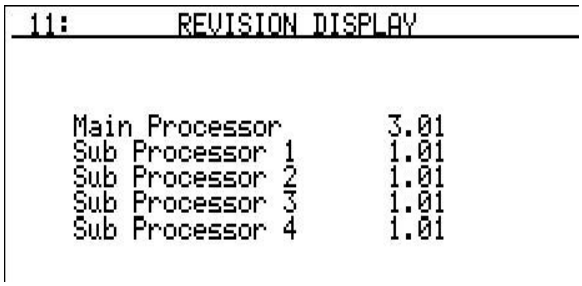


This page displays information regarding the instrument power supply.
The Battery Voltage shows the DC voltage from the battery. It will read higher when the instrument is plugged in, so a true measurement should be taken when it is not connected to AC power.
The Battery Condition will show the battery status as **Very Low**, **Low**, or **OK** depending on the battery voltage. When the unit is plugged in, it will show **Charging**.
The DC Supply is the amount of power that is being generated by the internal power supply. This will be **0** when it is not plugged in.
The Internal Supply is the amount of voltage that the instrument is seeing. It is the greater of the battery voltage and the DC supply.
If the instrument has been left unattended in the on position, the battery may be completely dead. It may be possible to recharge the battery but it will take a few days to accomplish this. By leaving the instrument plugged in and periodically checking the battery voltage to see if it is increasing, you will be able to determine if the battery is taking a charge. Keep in mind that it could take three or four days if the battery is completely dead.
It is recommended that the instrument not be plugged in after every use. The battery will last longer if it is fully or mostly discharged before it is charged, so it is good practice to only charge it after it has been used for three or four hours or more. If the battery gets low, a warning message will appear on the screen, followed by an estimate of the amount of time until it runs out of power. You will always have at least an hour of run time when you first see this message.
When it is plugged in to recharge, the instrument can still be used. The unit will recharge and operate at the same time.

About/Sign-On – Menu Page 10

This page is the sign-on screen that shows the SSi logo and phone number. Also shown is the unit serial number, the date of the last factory calibration, and the number of hours and minutes that the instrument has been in use since the last factory calibration.

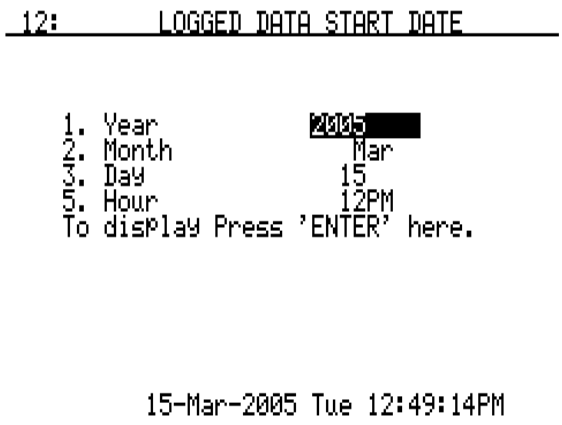
Revision Display – Menu Page 11



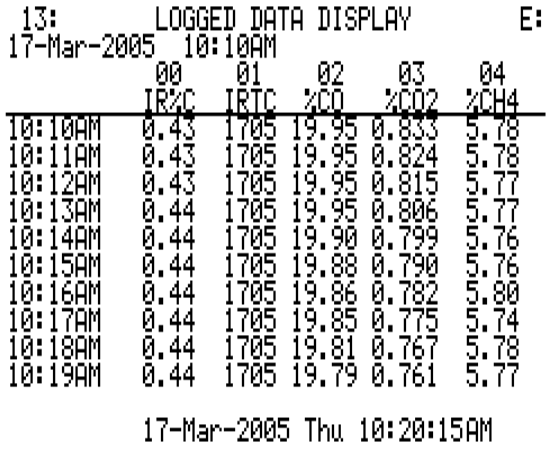
This page shows the firmware revision levels for the instrument. Although the user cannot modify this information, it may be helpful to report when contacting Super Systems for support.

Logged Data Start Date – Menu Page 12

Data is continuously logged in the PGA3500, so there is no need to turn it on or off. It is always on. This page can be used to view data from a specific date, with the default setting being the current hour of the current date.



Logged Data File – Menu Page 13

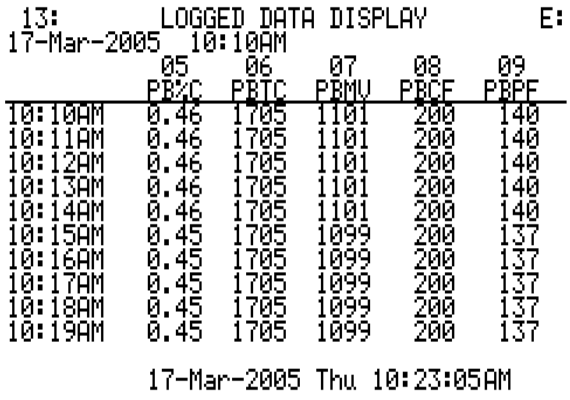


Each minute, there are 15 points of data collected. The time of each data point is shown along the left-hand side of the screen. The arrow buttons will scroll backwards and forwards in time, however it will not allow you to view data beyond the current time. Although 15 data points are stored, only 5 are visible at one time. The others can be accessed by pressing the circular arrow key at the bottom right of the keypad. When the screen is first accessed, the following five variables are shown:

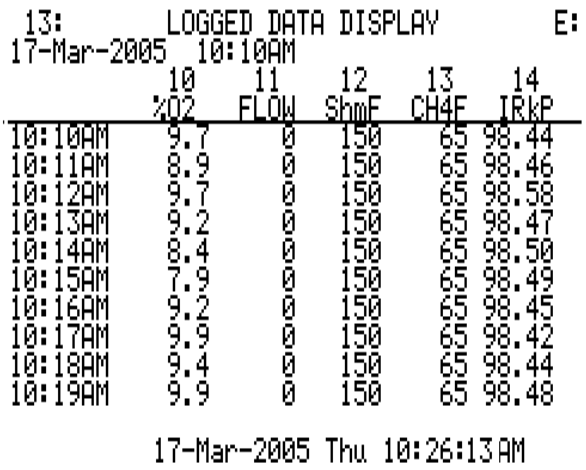
(00) IR%C – Percent Carbon as computed by the PGA3500
(01) IRTC – Temperature used by the PGA3500 to compute the Percent Carbon
(02) %CO – Percent Carbon Monoxide
(03) %CO2 – Percent Carbon Dioxide
(04) %CH4 – Percent Methane / Natural Gas

Pressing the circular arrow button will display the following five variables:
PB%C – Percent Carbon as computed by the probe
PBTC – Probe Thermocouple (Temperature)
PBMV – Probe Millivolts
PBCF – Probe CO Factor
PBPF – Probe Process Factor

By pressing the circular arrow button again, the following screen is shown:



```
 13:       LOGGED DATA DISPLAY          E:
17-Mar-2005  10:10AM
            05     06     07     08     09
          PB%C   PBTC   PBMV   PBCF   PBPF
10:10AM   0.46   1705   1101    200    140
10:11AM   0.46   1705   1101    200    140
10:12AM   0.46   1705   1101    200    140
10:13AM   0.46   1705   1101    200    140
10:14AM   0.46   1705   1101    200    140
10:15AM   0.45   1705   1099    200    137
10:16AM   0.45   1705   1099    200    137
10:17AM   0.45   1705   1099    200    137
10:18AM   0.45   1705   1099    200    137
10:19AM   0.45   1705   1099    200    137

          17-Mar-2005 Thu 10:23:05AM
```

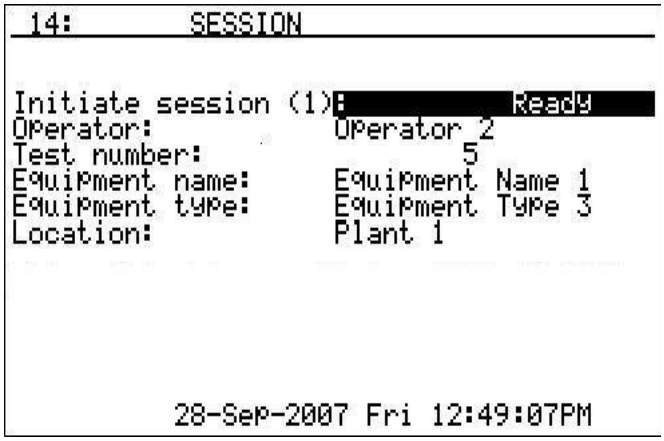


```
 13:       LOGGED DATA DISPLAY          E:
17-Mar-2005  10:10AM
            10     11     12     13     14
          %O2   FLOW   ShmF   CH4F   IRkP
10:10AM    9.7      0    150     65  98.44
10:11AM    8.9      0    150     65  98.46
10:12AM    9.7      0    150     65  98.58
10:13AM    9.2      0    150     65  98.47
10:14AM    8.4      0    150     65  98.50
10:15AM    7.9      0    150     65  98.49
10:16AM    9.2      0    150     65  98.45
10:17AM    9.9      0    150     65  98.42
10:18AM    9.4      0    150     65  98.44
10:19AM    9.9      0    150     65  98.48

          17-Mar-2005 Thu 10:26:13AM
```

The abbreviated headings for the columns represent:
%O2 – Percent Oxygen
FLOW – Flow Rate (0 to 100 represents 0.0 to 2.0 SCFH)
ShmF – Infrared Shim Factor Adjustment Setting
CH4F – Infrared CH4 Factor Adjustment Setting
IRkP – Sample Pressure in KiloPascals

Pressing the circular arrow button again will return you to the first set of variables.

Session - Menu Page 14



```
 14:          SESSION

Initiate session (1):          Ready
Operator:              Operator 2
Test number:                    5
Equipment name:        Equipment Name 1
Equipment type:        Equipment Type 3
Location:              Plant 1

          28-Sep-2007 Fri 12:49:07PM
```

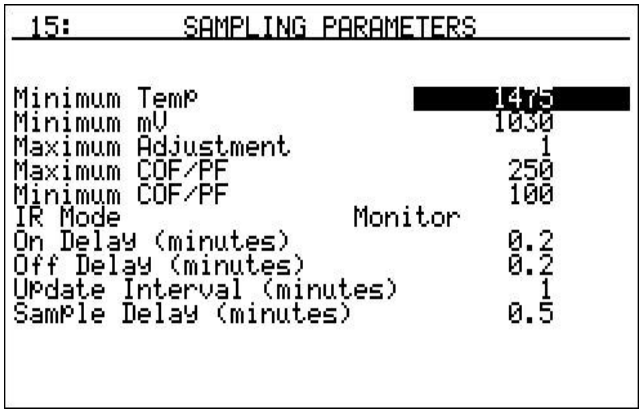
Session page will allow the user to start a session on the PGA. A session will allow the user to identify the operation of the PGA and break all of the logged data into manageable sections. Sessions can be viewed on a computer with the XGA Viewer software. For instance, when testing a generator, the user can start a session that will indicate that the generator is being tested, when it was tested, where it was tested, how long it was tested, and who did the testing. The first line, "Initiate session (1):" will allow the user to start a session on the PGA. *Note: Even though this is the first line on the screen, it will be the last line used, since all of the data entry lines are below*. The next line, "Operator:" will allow the user to scroll through the list of operators in the PGA. The user can either enter a number corresponding to the location of the operator in the list, or the user can cycle through the operators by pressing the circular arrow key. For example, if the list of operators was: J. Doe, B. Smith, and C.

Jones, then to select B. Smith, the user can enter a **2** while the "Operator" line is highlighted, or the user can press the circular arrow key until B. Smith is shown. The next line, "Test number:" will allow the user to enter a test number, which will be used for identification purposes. The test number can be between **1** and **999**. The next line, "Equipment name:" will allow the user to select the equipment name being used, i.e., Furnace 1, Furnace 2, Generator, etc. The process for selecting an equipment name is the same as selecting an operator. The next line, "Equipment type:" will allow the user to select the equipment type being used, i.e., Furnace, Generator, etc. The process for selecting an equipment type is the same as selecting an operator. The next line, "Location:" will allow the user to select the location where the PGA is being used, i.e., Main Plant, Zone 1, etc. The location can be as broad or as specific as desired. The locations can be cities, plants, or even sections of the same plant. The process for selecting a location is the same as selecting an operator. Once all of the information has been entered, the user can scroll back up to the top line, enter a **1**, and then press the **Enter** to begin the session. The list of operators, equipment names, equipment types, and locations can all be modified and added through the XGA Viewer software.

Once a session has started, the second page of the session menu will be displayed. From this page, the user can add a note to the session, or end the session. Once again, the first line will be one of the last lines to be accessed since there can be some data entry involved with adding a note. To add a note, scroll down to the second line, "Desired note". The process for selecting a note is the same as selecting an operator from the first page. The notes are kept in a list that can be managed by the XGA Viewer software. Once the note has been selected, scroll back up to the first line, press a **1**, and then press the **Enter** key to add the note. To end the session, scroll to the first line, press a **2**, and then press the **Enter** key. The "Session started:" line will let the user know when the session was started.

Sampling Parameters - Menu Page 15

This menu page will allow the user to set up the parameters that will affect when the pump will be turned on or off (only when pump is in automatic mode) and it will determine the parameters for the automatic adjustment of the COF/PF. The Minimum Temp is the lowest temperature that the instrument will sample from. When the temperature drops below this value, the COF/PF adjustment will stop and the sample pump will turn off only if the pump is set to automatic mode. See the section *Pump Control – Menu Page 4* for information on how to change the mode of the pump. To use this feature, the instrument should be communicating



with an instrument that can provide real-time temperature data. The purpose of this function is to prevent the instrument from pulling a bad sample, which could potentially damage the sensors. The minimum temperature should always be slightly higher than the lowest possible process temperature. The range of values for the Minimum Temp is **0** to **2000**.
The Minimum mV is the millivolt set point that will stop the COF/PF adjustment. This will prevent adjustments from being made when the proper conditions are not met. The minimum millivolts set point should be slightly higher than the minimum millivoltage that is expected. The range of values for the Minimum mV is **0** to **2000**.
The Maximum Adjustment is the largest increment of change that will be applied to automatic COF/PF adjustments. This will dictate the size of the steps the instrument takes when it adjusts the COF or PF of the control instrument. A higher value will result in more speed in achieving the desired set point, but a lower value will result in a smoother approach. The Maximum Adjustment feature should be coordinated with the Update Interval time to achieve the desired responsiveness. The range of values for the Maximum Adjustment is **0** to **20**.
The Maximum COF/PF establishes the upper allowable limit for the COF/PF. For example, if this is set to **300**, then the instrument will make changes to the COF/PF until it is at 300, but it will not go any higher. The value will range from **0** to **999**.
The Minimum COF/PF establishes the lower allowable limit for the COF/PF. For example, if this is set to **100**, then the instrument will make changes to the COF/PF until it is at 100, but it will not go any lower. The value will range from **0** to **999**.
The IR Mode is a selection to determine if the instrument is running in Automatic or Manual mode. When in **Monitor** mode, no changes will be made to the COF/PF of the control instrument. There are two Automatic modes to select from. **COF/PF Adj. %C** will make adjustments to the COF/PF in the atmosphere controller based on the calculated percent carbon. This is the preferred method of adjustment. The other Automatic mode, **COF/PF adj. CO**, will make adjustments based only on the measured level of CO and not on the carbon calculation. The three options are:

Monitor
COF/PF Adj. %C
COF/PF adj. CO

To cycle between each selection, press the circular arrow key or enter the number that corresponds to the option's position in the list and press **Enter**, where Monitor is at position **0** and COF/PF adj. CO is at position **2**.
The On Delay determines the amount of time it takes for the pump to turn on after both of the operating parameters (temperature and millivolts) have been met. The value will range from **0** to **60** minutes.
The Off Delay determines the amount of time it takes for the pump to turn off after either of the operating parameters (temperature and millivolts) falls outside of the pre-defined boundaries. The value will range from **0** to **60** minutes.
The Update Interval determines the amount of time between automatic updates of the COF/PF on the control instrument. This is adjustable in one-minute increments. It is recommended that the Update Interval be set to one (1) minute, and the Maximum Adjustment set to one (1) point. This will allow the COF/PF to be adjusted frequently, but only a small amount at a time, which will result in smooth operation. The value will range from **0** to **20**.
The Sample Delay determines the amount of time the PGA will wait to continue to adjustment of the COF or the PF once the pump has turned on. The range of values is **0** to **30**.
Example – The following will show how to set up the sampling parameters of:
Minimum Temp – 1500

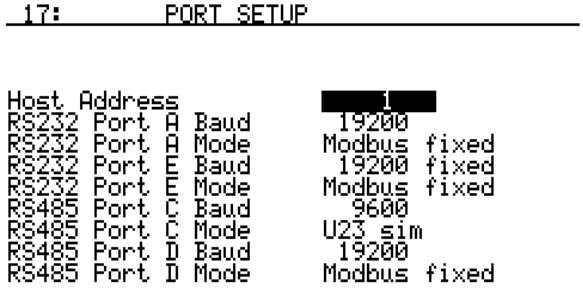
Minimum mV – 1200
Maximum Adjustment – 1
Maximum COF/PF – 250
Minimum COF/PF – 75
IR mode – COF/PF Adj. %C
On Delay – 10.5 minutes
Off Delay – 5 minutes
Update Interval – 1 minute
Sample Delay – 30 seconds
*When the menu screen first displays, the Minimum Temp field is already highlighted. Enter a **1500** and press **Enter**. Press the down arrow key once to highlight the Minimum mV field. Enter a **1200** and press **Enter**. Press the down arrow key once to highlight the Maximum Adjustment field. Enter a **1** and press **Enter**. Press the down arrow key once to highlight the Maximum COF/PF field. Enter a **250** and press **Enter**. Press the down arrow key once to highlight the Minimum COF/PF field. Enter a **75** and press **Enter**. Press the down arrow key once to highlight the IR Mode field. Enter a **1** and press **Enter** (Note – the screen will display **COF/PF Adj. %C**). Press the down arrow key once to highlight the On Delay field. Enter a **10.5** and press **Enter**. Press the down arrow key once to highlight the Off Delay field. Enter a **5** and press **Enter**. Press the down arrow key once to highlight the Update Interval field. Enter a **1** and press **Enter**. Press the down arrow key once to highlight the Sample Delay field. Enter a **0.5** and press **Enter**.*

Set The Date and Time - Menu Page 16

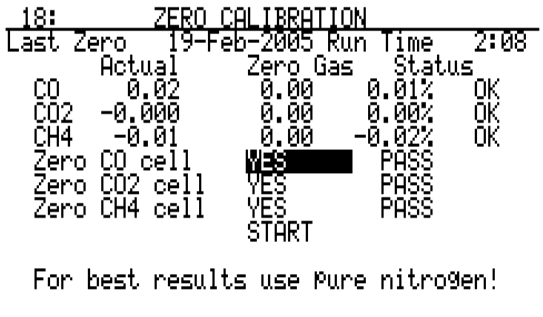
This page is used to set the internal clock and calendar. Select a number that you would like to change by using the up and down arrow buttons. Then type in the number and press **Enter**. No changes will take place until the seconds are set, which starts the clock under the new settings. Numbers 1 through 12 changes the month. The days of the week are entered using **0** for Sunday through **6** for Saturday. Hours are entered in 24-hour format, i.e. **8** for 8AM and **14** for 2PM.

Port Setup - Menu Page 17

Port Setup is used to set the parameters for the communications ports. The factory default settings are shown, and they should not need to be changed by the operator.



Zero Calibration – Menu Page 18

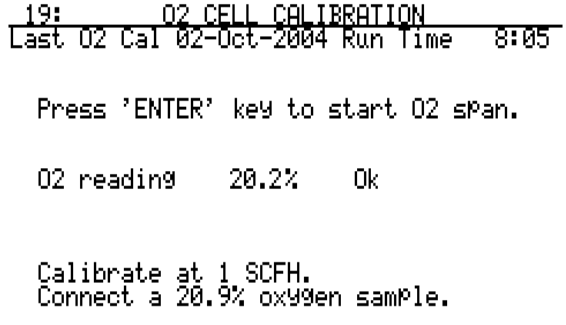


This page is used to zero the IR cells. It is very important to be sure that the sample gas is a good zero especially for CO2. Ambient air has nominal percentage of CO2, which should not be present when performing a zero calibration. It is recommended that 99.9% pure nitrogen be used for zeroing the PGA3500. If there is no nitrogen present, the CO2 Scrubber (P/N 13112) can be used to remove the CO2 from ambient air. The sample gas flow rate should be between 1 and 1.5 SCFH.
When viewing this screen, the current measured values are shown at the left under the heading *Actual*, while the desired values will be in the center column, *Zero Gas*. The final column is *Status*, and this shows the percentage difference between the actual and desired values, followed by a comment. This comment can either be **OK**, **?OK**, or **BAD**, depending on how far apart the values are. If the difference is between 0 and 10% of the span value, then it will be **OK** and the calibration will proceed without interruption. If the difference is between 10% and 20%, it will be **?OK**, and a warning message will be displayed. Pressing **Enter** will allow the calibration to continue. If the value is more than 20% out, it will be **BAD** and the calibration will not be allowed to proceed. If this occurs, check to make sure that you are using the correct gas and that there is adequate flow. If it is still not operating properly contact SSi for additional support.
It is possible to calibrate one, two, or all three sensors. The default setting is to calibrate all three, however if you do not want to calibrate one of the sensors you can use the up and down arrows to access the sensor that you do not want to calibrate, and press **Enter** over the existing Yes. This will change it to No, and that sensor will not be calibrated.
To proceed with the calibration of one or more sensors, use the arrow key to move to the **Start** button and press **Enter**. Timers will count down approximately two minutes and at the conclusion the sensors will be calibrated.

WARNING: Do not pressurize PGA3500 with compressed gas. Always start the flow of Nitrogen and regulate prior to connecting to PGA3500 inlet.

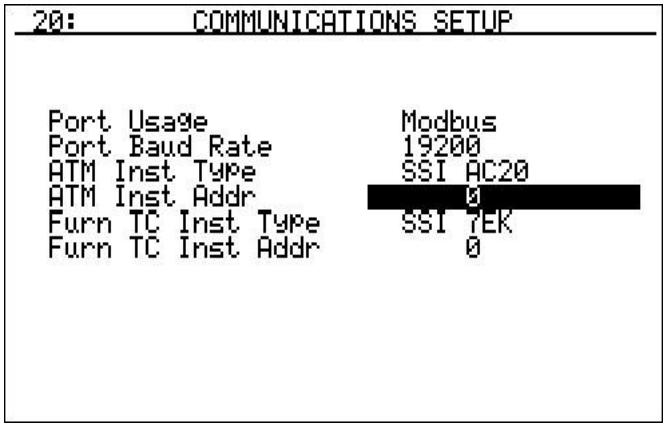
O2 Cell Calibration – Menu Page 19

O2 Cell Calibration is used to calibrate the oxygen sensor. The oxygen sensor is calibrated using air (20.9% O_2) as the reference. If the oxygen cell output is outside of a 30% band then the message REPLACE O_2 CELL! will appear near the bottom of the screen. When calibrating the O_2 sensor, no special gas is required, only fresh ambient air. It is better to perform this calibration in an office or



outside to be sure that the process gas does not influence the ambient air. After the pump has been on for long enough for the readings to stabilize (approximately one minute), press the **Enter** key to begin the calibration process. A calibration complete message will appear when the calibration is finished.

Communications Setup – Menu Page 20



The menu page will allow the user to set up the communications settings for the PGA.

The Port Usage determines how the PGA will communicate. The options are either **RS485 Host Port** or **Modbus**. These can be changed either by pressing the circular arrow key to cycle through the options, or by entering a number which corresponds to the option's position in the list, where **RS485 Host Port** is at position **0**, and **Modbus** is at position **1**.

The Port Baud Rate determines how fast the PGA will communicate. The options with the position number are:

Position	Rate	Position	Rate
0	1200	9	76800
1	2400	10	115200
2	4800	11	230400
3	9600	12	460800
4	14400	13	921600
5	19200		
6	28800		
7	38400		
8	57600		

To change the baud rate, press the circular arrow key until the desired option is reached, or enter in the position number from the list above and press **Enter** to select the desired option.

The ATM Inst Type is the make and model of the instrument that will be supplying the PGA with information on: probe temperature, probe millivolts, and COF/PF. The options with the position number are:

Position	Type	Description
0	SSI AC20	Super Systems AC20
1	Yoko 750	Yokogawa 750
2	UDC 3300	Honeywell UDC 3300
3	DP 1 Mod	Marathon Sensors DualPro – Modbus Protocol Loop 1
4	DP 2 Mod	Marathon Sensors DualPro – Modbus Protocol Loop 2
5	9200 lp	Super Systems Model 9200 Loop 1

To change the instrument type, press the circular arrow key to cycle through the options, or press the option's position number and press **Enter**.

The ATM Inst Addr is the address of the ATM Inst. To change the address, enter the new value and press **Enter**. The values can range from 0 to 250.

The Furn TC Inst Type is the make and model of the instrument that will be supplying the PGA with information on furnace temperature. If there is no instrument associated with this input, the PGA will use the value from the probe temperature (ATM Inst Type) as the furnace temperature. The options with the position number are:

Position	Type	Description
0	SSI 7EK	Super Systems 7EK
1	Yoko 750	Yokogawa 750
2	UDC 3300	Honeywell UDC 3300
3	DP 1 Mod	Marathon Sensors DualPro – Modbus Protocol Loop 1
4	DP 2 Mod	Marathon Sensors DualPro – Modbus Protocol Loop 2
5	9200 lp1	Super Systems Model 9200 Loop 1
6	9200 lp2	Super Systems Model 9200 Loop 2
7	9200 lp3	Super Systems Model 9200 Loop 3
8	9100 lp2	Super Systems Model 9100 Loop 2
9	SSI_DO0	Super Systems DAC Output Board Channel 0
10	SSI_DO1	Super Systems DAC Output Board Channel 1
11	SSI_DO2	Super Systems DAC Output Board Channel 2
12	SSI_DO3	Super Systems DAC Output Board Channel 3

To change the instrument type, press the circular arrow key to cycle through the options, or press the option's position number and press **Enter**.
The Furn TC Inst Addr is the address of the Furn TC Inst. To change the address, enter the new value and press **Enter**. The values can range from 0 to 250.

Calibrate Flow Meter – Menu Page 22

This page is used to calibrate the internal digital flow meter. This will already be performed at the factory, however adjustments are simple if necessary. First, with the pump off, press the up arrow key to set the Zero Factor. Next, turn the pump on by pressing the circular arrow button at the bottom right of the keypad. The actual flow amount can be viewed on the flow meter inside the lid of the case. Adjust the valve on the flow meter to set the flow at 1.5 SCFH. Then type in **75** followed by **Enter**. This will set the flow meter to equate 1.5 SCFH to 75% of the maximum of the digital flow meter.

```
22:        CALIBRATE FLOW METER
—

    Flow Value      0
    Zero Factor    32
    SPan Factor  0.0383

-F
 L  Enter flow value in % and
 O  Press 'ENTER' for span calibration.
 W  Press 'UP ARR' for zero calibration


-
```

Calculation Factors - Menu Page 23

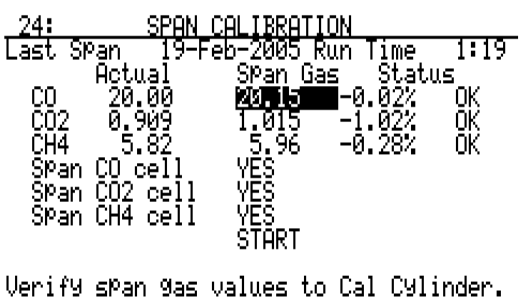
```
23:        CALCULATION FACTORS

    IR Shim Factor  150
        CH4 Factor   65
  Pressure Factor   OFF
```

Calculation Factors allows for the entry of data that the operator should not normally access. The first two items are the IR shim factor and the CH4 Factor, both of which are used in the calculation of % carbon. The third item is a Pressure Factor, which should contain a value of 0, which is "Off". These values should only be

changed after determining that additional adjustments are required based on the specific conditions and equipment at your facility. Please contact Super Systems for help with adjusting these pre-set values.

Span Calibration – Menu Page 24

This page is used to span calibrate the IR cells. It is very important to be sure that a Certified Primary Standard sample gas within the noted specifications is used. The nominal composition of this gas should be:
20% CO (Carbon Monoxide)
1% CO2 (Carbon Dioxide)
6% CH4 (Methane or Natural Gas)
40% H2 (Hydrogen)
Balance N2 (Nitrogen)

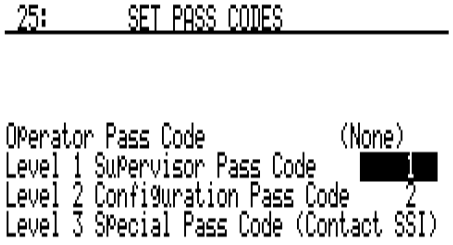


When viewing this screen, the current measured values are shown at the left under the heading *Actual*, while the desired values will be in the center column, *Span Gas*. The final column is *Status*, and this shows the percentage difference between the actual and desired values, followed by a comment. This comment can either be **OK**, **?OK**, or **BAD**, depending on how far apart the values are. If the difference is between 0 and 10% of the span value, then it will be **OK** and the calibration will proceed without interruption. If the difference is between 10% and 20%, it will be **?OK**, and a warning message will be displayed. Pressing **Enter** will allow the calibration to continue. If the value is more than 20% out, it will be **BAD** and the calibration will not be allowed to proceed. If this occurs, check to make sure that you are using the correct gas and that there is adequate flow. If it is still not operating properly contact SSi for additional support.
To proceed with the calibration of one or more sensors, use the up and down arrows and the numeric keypad to enter the specific values of each gas. These will be listed on the calibration cylinder. It is possible to calibrate one, two, or all three sensors. The default setting is to calibrate all three, however if you do not want to calibrate one of the sensors you can use the up and down arrows to access the sensor that you do not want to calibrate, and press **Enter** over the existing Yes. This will change it to No, and that sensor will not be calibrated.
When this data has been entered, use the arrow key to move to the **Start** button and press **Enter**. Timers will count down approximately two minutes and at the conclusion the sensors will be calibrated.

WARNING: Do not pressurize PGA3500 with compressed gas. Always start the flow of Nitrogen and regulate prior to connecting to PGA3500 inlet.

Set Pass Codes - Menu Page 25

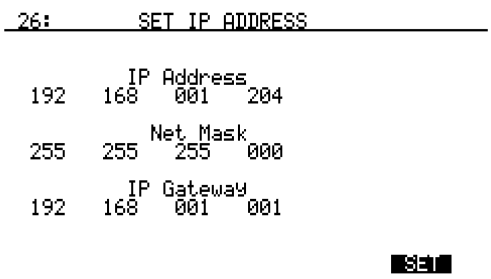
This page is used to change the pass code for menu screens 16 and higher. For screens 1 through 15, no pass code is required to access the screen. Menu screens 16 through 21 are considered Supervisor Level, and they require the Level 1 pass code. Menu screens 22 through 29 are considered Configuration Level, and they require the Level 2 pass code. The



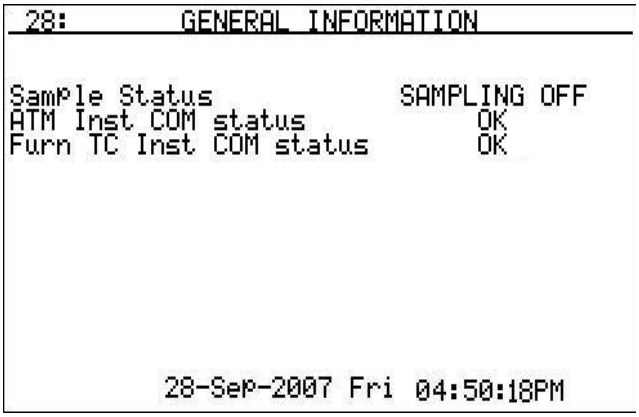
default setting for Level 1 is **1**, and the default setting for Level 2 is **2**. Either of these can be changed to any number between 0 and 512. Please note that the Level 2 (Configuration) pass code will also work on all Level 1 menus, so in the default settings entering a **2** will give you access to all available menus.
The Level 3 menus are not visible, and SSi uses them when the instrument is being set up prior to shipment.

Set IP Address- Menu Page 26

This page is used to setup the Ethernet communications address. The instrument does not have DHCP, therefore a fixed IP address must be assigned.



General Information - Menu Page 28



This menu page will display some general information about the PGA. This screen is for display purposes only, so no information can be entered on the screen.
The Sample Status will display the status of the pump. If the pump is not running, the text will display **SAMPLING OFF**. If the pump is running, then the text will display **SAMPLING ON**.
The ATM Inst COM status will display the status of the atmosphere instrument's communications. The status of the communications can be either **OK** or **BAD**.
The Furn TC Inst COM status will display the status of the furnace TC instrument's communications. The status of the communications can be either **OK** or **BAD**.

PGA3500 Spare Parts

• Factory Calibration	Part Number 13113
• Cylinder of Zero Calibration Gas	Part Number 30054
• Cylinder of Span Calibration Gas	Part Number 13084
• Bowl Filter Assembly (Including Element)	Part Number 37048
• Bowl Filter Element Media Replacement (10/Pack)	Part Number 31027
• Flexible Sample Tubing Assembly with Filter	Part Number 20315
• Replacement In-Line Filter	Part Number 31033
• Flow Meter	Part Number 36033
• CO_2 Scrubber	Part Number 13112
• Sampling Wand Assembly	Part Number 20263
• PGA3500 Battery	Part Number 32012
• Replacement box and custom-fit foam	Part Number 23075

Revision History

Rev.	Description	Date	MCO #
-	Initial Release	03-15-2005	N/A
A	SSi Address and General Update	05-18-2005	2035
B	Added/Revised "Spare Parts List"	01-04-2007	2041
C	Added "MCO #" section in Revision History; Updated logo on title page; Updated parts list; Changed picture sizes; Added functionality for menus: 8, 14, 15, 20, 28; Updated menu 6 to include help text; Updated screen shot for menu 11; Moved the "Typical Diagnostic Uses for the PGA3500" section to the beginning of the manual	10-04-2007	2050
D	Changed part number 20104 to 20315 in "PGA3500 Spare Parts" section	08-13-2008	2066