Operations Manual

PGA 3000

Portable 3-Gas IR Analyzer

Table of Contents

PGA 3000 Operating Instructions

Introduction

The Model PGA3000 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:	**0.01 to 25.00%.**
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**
Power:	**115/230 VAC - 50/60 Hz – 60 Watts (Rechargeable Battery Power)**
Data Retrieval:	**Up to 4 gases - 10 Furnaces/Generators 500 minutes/furnace Data collection review on PGA3000 screen or Upload to Microsoft EXCEL**
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 Theory

The Model PGA 3000 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.

Numeric keypad key assignments.

0 – 9 are used to enter numeric data.
***** is the escape key and clears all numbers previously entered.
will display a specific menu, to select a specific page, press a numeric key (or two numeric keys) and then the **#** key.
A is used as the ENTER key.
B moves the cursor up.
C moves the cursor down.
D adds a decimal point to the data being entered on a screen, also toggles from one furnace to the next on the data collection page.

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 two minutes.
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 IR sampling requires that a clean, soot free sample be available for analysis. A clean sample port 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 is 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 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, 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 an 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 white. 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.

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 occurring before operation is resumed.

Battery

The battery in the PGA3000 in 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 PGA3000, plug it into a 110 or 220VAC power source using the supplied power cord. The LED above the power cord input is 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.

Menu List

The menu list shows the available pages displayed six at a time. The cursor up (**B**) and the cursor down (**C**) keys are used to scroll the list.

OPERATOR MENU
1. IR STATUS DISPLAY
2. IR OVERALL STATUS DISPLAY
3. COMBUSTION DISPLAY
4. PUMP CONTROL
5. SET LCD DISPLAY (CONTRAST/BRIGHTNESS) VALUES
6. HELP
7. CALIBRATION DATES

11. ABOUT/SIGN-ON
12. START LOGGER
13. LOGGED DATA FILE
14. ZERO CALIBRATION
15. O2 CELL CALIBRATION

CONFIGURATION MENU – Pass code required
21. PORT SETUP
22. SET THE DATE AND TIME
23. DATA SET PAGE
24. SPAN CALIBRATION
25. SET PASS CODES
26. CLEAR LOGGED FILE

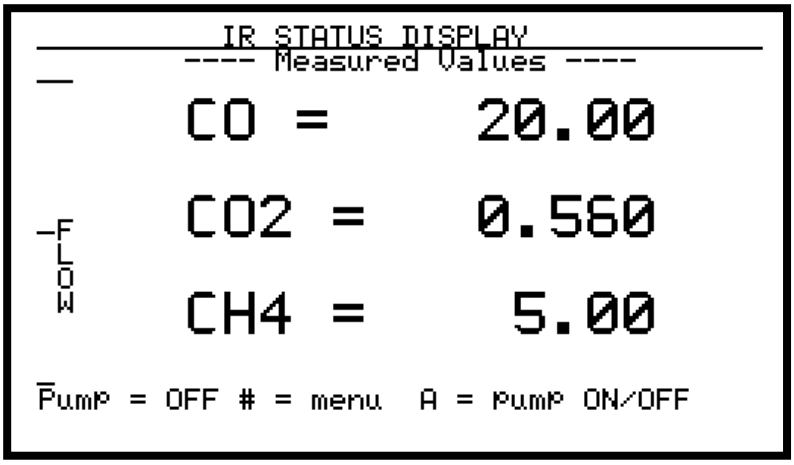
Pages number 8, 9, 10, 16, 17, 18, 19, 20 do not exist. The Configuration Menu pages require the entry of a pass code to access them. The menu list page shows the date and time at the bottom of the screen.

Pressing the **#** key allows the user to review the menus at anytime.

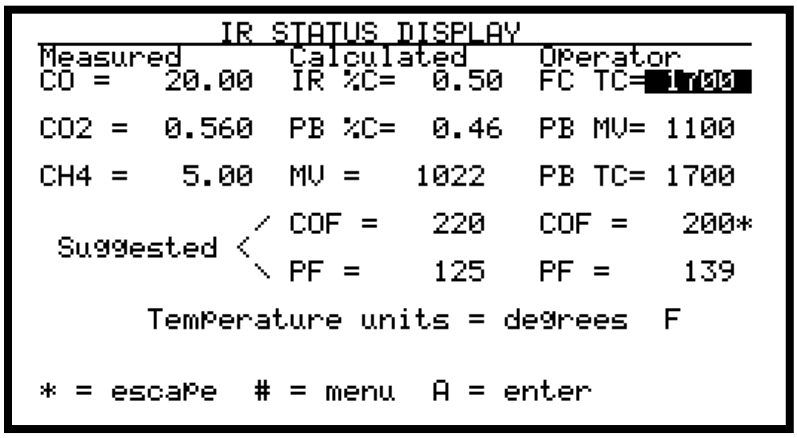
Screens 1 through 20 do not require any security codes. Screens 21 and higher are configuration screens, and a pass code is required. The default pass code is **1**, however this can be changed to any number between 0 and 512 by accessing Menu Page 25.

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 **A** key.



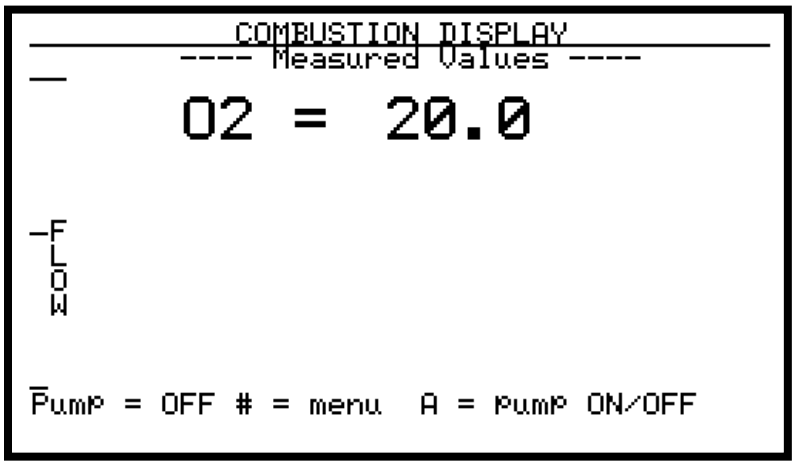
IR Overall Status Display – Menu Page 2



The IR Overall Status Display shows measured values and calculated values, and allows entry of data for the calculations. The operator can enter the furnace temperature, probe millivolts, probe temperature, and either the CO Factor or the Process Factor. The probe calculations will be based on which value was entered last (i.e. COF or PF). An ***** after the data values indicates which value is used in the calculations. The equivalent value of the other value is computed and displayed. For example if the probe millivolts is 1100, the probe temperature 1650 and the COF is 200, then the probe %C is calculated as 0.51% and the equivalent PF is calculated as 143. From the three gases and the furnace temperature the IR %C and equivalent millivolts is computed. The IR %C and the probe %C are used to compute suggested COF and PF values. Data values are changed by using the cursor keys (**B** and **C**) to highlight the value and then entering the new value followed by the **A** key. Suggested COF or PF can be entered in your control instrumentation so that the %C calculated from the carbon probe readings will be the same as the %C calculated by the IR 3-Gas readings.

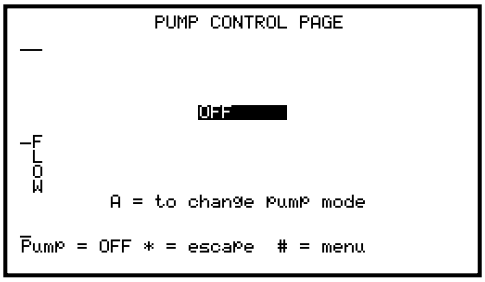
WARNING – Large changes should be verified by shim stock analysis.

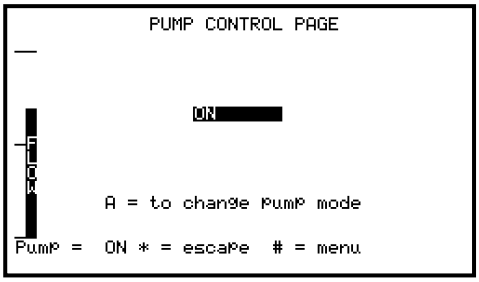
Combustion Display – Menu Page 3



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 **A** key.

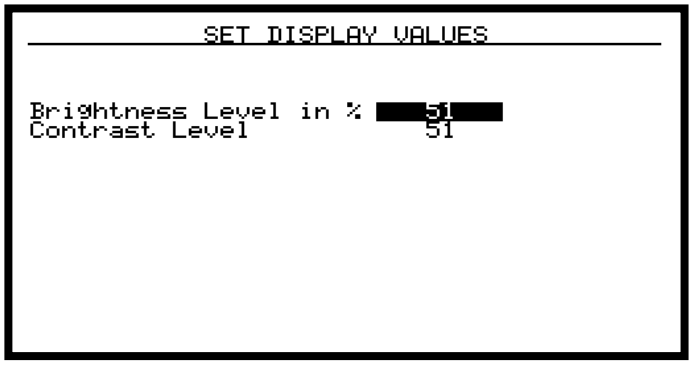
Pump Control - Menu Page 4





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 **A** 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

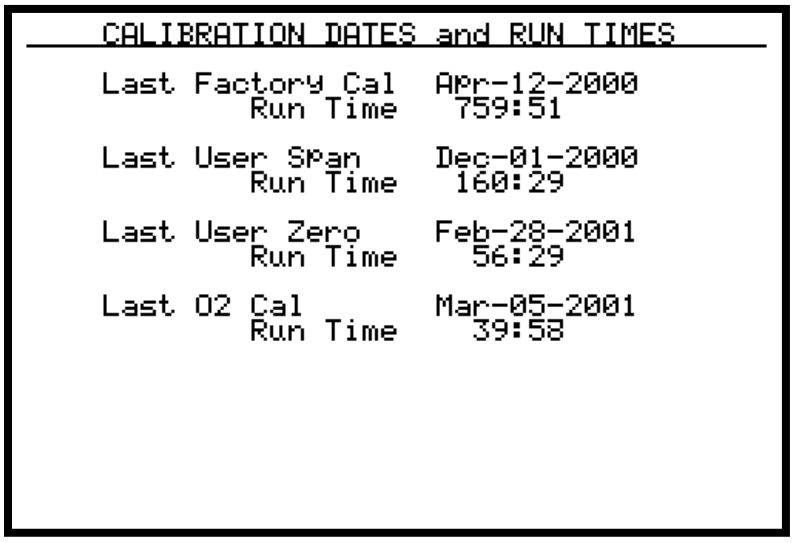


This page is used to adjust the display backlight brightness and the contrast. The values entered range from 0 to 100.

Help Page - Menu Page 6

This page can be used as a reference to show the functions of the various buttons on the keypad.
The same information has also been included on the laminated reference sheet that has been attached inside the lid of the PGA.

Calibration Dates and Run Times - Menu Page 7

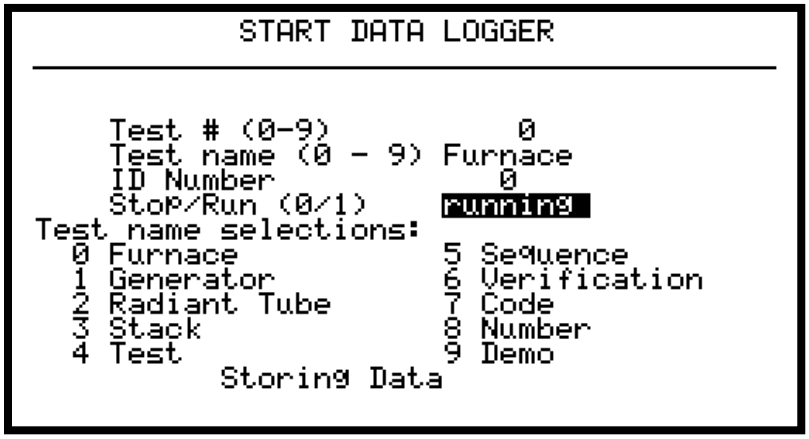


This page shows the most recent calibration dates, as well as the amount of time that has elapsed since each calibration. Time is shown in hours and minutes.
These dates do not need to be set after calibration since they will be set automatically whenever a calibration is performed. NOTE: For the correct calibration dates to be entered, the internal clock must be set correctly (see page 22).

About/Sign-On – Menu Page 11

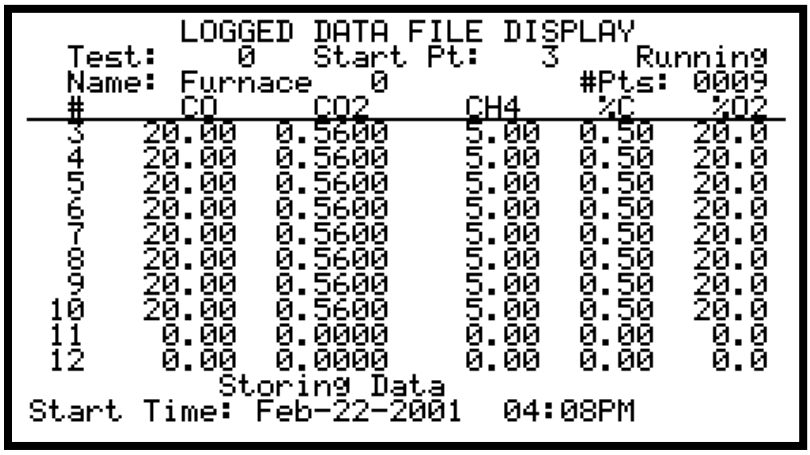
This page is the sign on screen that shows the SSi logo, address, and phone number. Also shown are the firmware version number, the unit serial number, and the date of the last factory calibration. Some units will also show the internal temperature of the unit.

Start logger – Menu Page 12



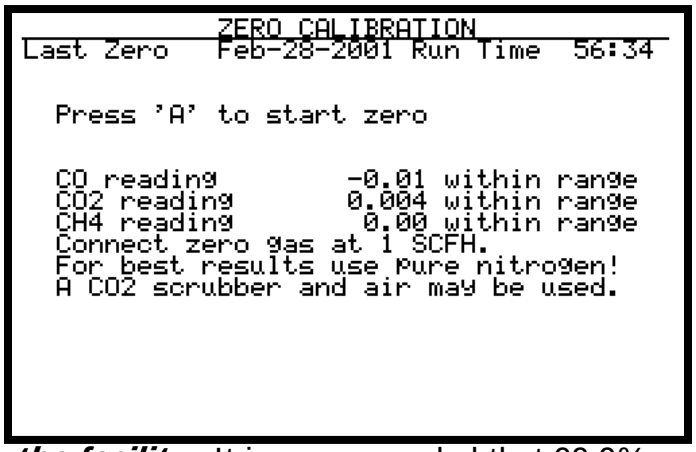
This page is used to name and store a data log file. The PGA3000 is capable of storing 10 tests (files) of 500 minutes each. To start storing data, first select a test number, 0 – 9. This specifies the storage location (file) of the data. Then input a name and then an ID number. The name selected from the list at the bottom of the page by number (0 – 9). The ID number is any value from 0 to 999. Then cursor down to the Stop/Run then select and press the **A** key to start or stop storing data. STORING DATA will appear near the bottom of the screen whenever the data logging is active. Only one test number can be active at a time. If the test number is changed and started, then the previous one is stopped. When a test is started, all previous data in that test is cleared. See Basic Operating Theory (page 4 of 15) for keypad key assignments.

Logged Data File – Menu Page 13



This page displays the logged data ten points at a time. When the page is first entered, it displays the most recent test number and the data point. The starting number of the data points displayed can be changed either by the cursor keys **(B = up. C = down)** or entering a point number and pressing the **A** key. Entering a number and pressing the D key or simply pressing the D key to sequence through the tests can change the test number displayed.

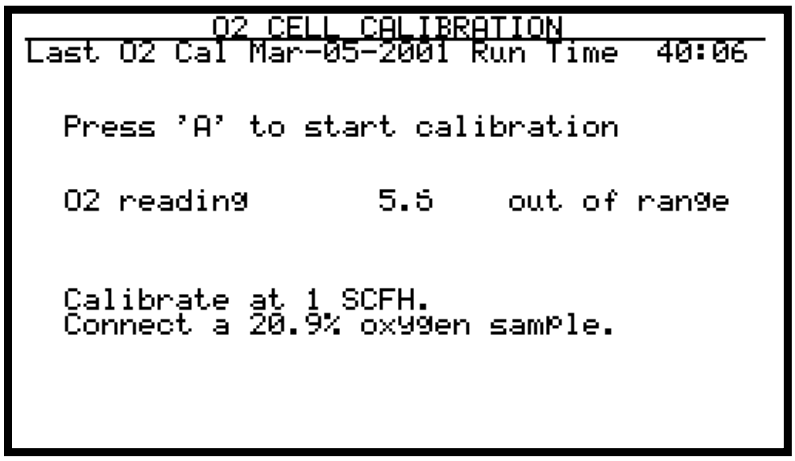
Zero Calibration – Menu Page 14



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. Air has approximately 0.08% CO2 and required a CO2 scrubber (See Spare Parts List). ***WARNING: If using the CO2 scrubber, the source of air should be from outside the facility, not air from within the facility.*** It is recommended that 99.9% pure nitrogen be used for zeroing the PGA3000. The sample gas flow rate should be between 1 and 1.5 SCFH. Pressing the **A** key will start the zeroing process, which could take up to 4 minutes. If the flow rate is too low then an error page will appear and the cells will not be zeroed. If any of the readings of the cells are greater than 10% of nominal range, then a range error page will appear. This is a WARNING and it is recommended that the zero gas be checked before proceeding. Pressing the **A** key will bypass the range error and begin the zeroing process. If any of the readings of the cells is greater than 20% of nominal range, then a FACTORY CALIBRATION REQUIRED message will appear near the bottom of the screen and the calibration is inhibited. A zero complete page will appear when zero calibration is finished. ***WARNING: Do not pressurize PGA3000 with***

compressed gas. Always start the flow of Nitrogen and regulate prior to connecting to PGA3000 inlet.

O2 Cell Calibration – Menu Page 15



This page 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, turn on the pump and calibrate using air span only. Pressing the **A** key will begin the calibration process. A calibration complete page will appear when calibration is finished.

Port Setup - Menu Page 21

This page is used to set the parameters for the RS 232 port on the DB-9 connector. The baud rates are set by entering a number from 0 to 7 baud rates of 1200 to 38400 (1200, 2400, 4800, 9600, 14400, 19200, 28800, and 38400). Entering a number 0 to 2 can change the RS 232 mode. 0 is the dump/minute mode, 1 is Modbus, and 2 is terminal mode.

The default setup is: 19200 Baud rate, MODBUS

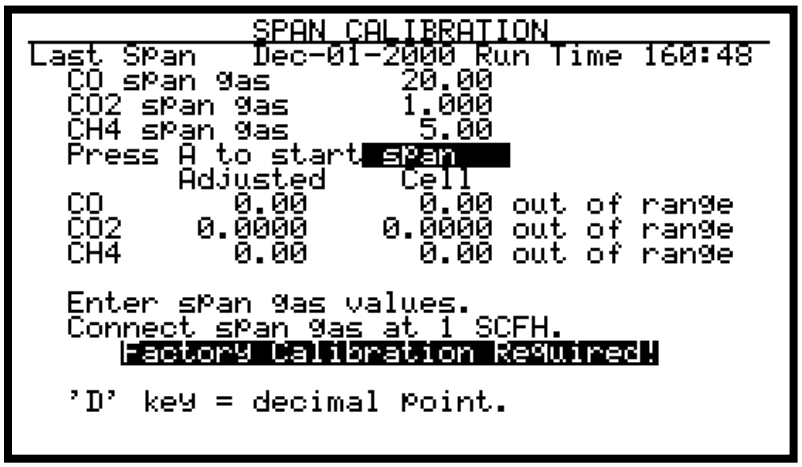
Set The Date and Time - Menu Page 22

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

Data Set Page - Menu Page 23

This page allows for the entry of data that the operator should not normally access. At this time the only data value is the IR shim factor used in calculation the % carbon. Normally this value should be 150. However furnace conditions, measured by shim stock tests, may require changing this value.

Span Calibration – Menu Page 24



This page is used to span the IR cells. It is very important to be sure that the sample gas is certified and within the noted specifications. Using the **B** key, cursor up to the value of each gas and enter the value displayed on the certified tank. The sample gas flow rate should be between 1.0 and 1.5 SCFH. Pressing the **A** key will start the spanning process. Note that the spanning process could take up to 3 or 4 minutes. If the flow rate is too low, then an error page will appear and the cells will not be calibrated. If any of the cell readings is greater than 10% of nominal range, then a range error page will appear. This is a WARNING and it is recommended that the span gas and entered values be checked before proceeding. Pressing the **A** key will bypass the range error and begin the calibrating process. If any of the readings of the cells is greater than 20% of nominal range then a FACTORY CALIBRATION REQUIRED message will appear near the bottom of the screen and the calibration is inhibited. A Span Complete page will appear when calibration is finished.
For maximum accuracy, the values of the span gas should be approximately 20%CO, 1%CO2, and 5%CH4. The farther the gas value is from these nominal values, the less accurate the calibration will be.

Set Pass Codes - Menu Page 25

This page is used to change the pass code for Menu Screens 21 and higher. The default setting is **1**, however this can be changed to any number between 0 and 512.

Clear Logged File - Menu Page 26

This page is used to clear the data-logged data. Select the test number to clear. Then cursor down and press the **A** key to clear the data. Since the data log file is cleared whenever a test is started, it is usually not necessary to use this page. The new data will over-write the existing data.

Typical diagnostic uses:

Why a 3-Gas IR Analyzer for atmosphere diagnostics?

The **PGA3000** 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 PGA3000 will provide the necessary data to fine-tune your atmosphere control.

Data retrieval: RS232, 9-Pin connector (included), Export to MS Excel via Upload Utility Software (included)

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 PGA3000.
- Measuring carbon monoxide (CO) and carbon dioxide (CO_2) can show possible problems (i.e. water leaks, air leaks, and radiant tube leaks).
- The PGA3000 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 this 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.

Spare Parts

Bowl Filter	Part Number 37048
Bowl Filter Media Replacement (10/Package)	Part Number 31027
Sample Tubing	Part Number 20104
In-Line Filter	Part Number 31033
Flow Meter	Part Number 36033
O_2 Sensor	Part Number 31409
CO_2 Scrubber	Part Number 13112

Revision History

Rev.	Description	Date
-	Initial Release	04-27-2001
A	Added Revision History Page	07-09-2001
B	Modified per updated manufacturing procedure	08-10-2001
C	Updated Spare Parts List	01-29-2002
D	Added Additional Operation Instructions	06-19-2002
E	SSi Address Update, General Update	04-12-2005