Operations Manual

Gas Analyzer

MODEL MGA6000

Continuous Multi-Gas NDIR Analyzer

Please read, understand, and follow these instructions before operating this equipment.
Super Systems, Inc. is not responsible for damages incurred due to a failure to comply with these instructions. If at any time there are questions regarding the proper use of this analyzer, please contact us at (800) 666-4330 for assistance.

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WARNING

MOISTURE

WHEN A HOT GAS CONDENSES MOISTURE HAS THE POTENTIAL TO FORM. WHEN USING THIS INSTRUMENT YOU MUST GUARD AGAINST MOISTURE FORMING IN THE SAMPLE LINES AND THE BOWL FILTER. THIS CAN BE ACCOMPLISHED THROUGH SETTING THE PUMP OPERATION TO "AUTO" AND ENTERING APPROPRIATE SAMPLING PARAMETERS ON SCREEN #17.

THE WARRANTY WILL BE VOIDED IF PROPER SAMPLING TECHNIQUES ARE NOT

MGA6000 Operating Instructions

Introduction

The Model MGA6000 is a continuous Multi-Gas Analyzer using NDIR (Non-Dispersive Infra-Red) technology. It is capable of measuring between one and four gases, depending on how it is configured at the factory prior to shipment. The unit is designed and manufactured for the atmosphere heat treating industry.

Possible Configurations

CO range:	**0.00 to 30.00 % ***
CO_2 range:	**0.000 to 2.000 %**
CO_2 High range:	**0.0 to 20.00 %**
CH_4 range:	**0.00 to 15.00 % ***
O_2 range:	**0.1 to 25.0 %**
Hydrogen:	**0.0 to 100.0 %**
Dew point	**0 to 80 F**

**** 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% .***

Specifications

Sampling method: **Extraction by internal pump (when necessary)**

Accuracy and repeatability: **± 1% of full scale**

Flow Meter: **0 to 2 SCFH, mounted on enclosure front and also displayed on-screen**

Pump Operation: **On/Off/Auto Sample**

AC Power: **90 to 230 VAC, 50 to 60 Hz, 60 Watts**

Communications: **Ethernet, RS485**

4-20 mA Outputs: **Four (4) user-defined**

Digital Inputs: **Two (2) for stopping pump and inhibiting COF/PF adjustment**

Relays: **One (1) for alarm or control**

Operating Temperature: **32° to 122° F (0° to 50° C)**

Dimensions: **Approx. 16” x 14” x 8”**

Weight: **Approx. 20 lbs.**

Part Number Designations

The following table references the gases available in the MGA6000s with their applicable part numbers.

Part Number:	13404	13391	13392	13393	13394	13395	13396	13397	13398	13399	13402	13403
CO		X			X	X	X	X		X	X	X
CO2			X		X		X		X		X	X
CH4				X		X				X	X	X
H2	X						X	X	X	X		X

Oxygen cell option: Part number 13400 will add Oxygen (O2) to the MGA.

<u>Example:</u> Part Number 13399 would contain: Carbon Monoxide (CO), Methane or Natural Gas (CH4), and Hydrogen (H2).

Electrical Connections

1001	+	90-265 VAC
1002	-	
1003	GND	
1101	+	RS 485 COMMS (MASTER)
1102	-	
1103	GND	
1211	+	4-20mA #1
1212	-	
1221	+	4-20mA #2
1222	-	
1231	+	4-20mA #3
1232	-	
1241	+	4-20mA #4
1242	-	
1301	+	Alarm/Control
1302	-	
1411	+	Digital Input #1 (Pump Stop)
1412	-	
1421	+	Digital Input #2 (Inhibit Adjustment)
1422	-	
1501	+	RS 485 COMMS (AUTO-CAL BOX)
1502	-	

Basic Operating Description

The Model MGA6000 has been designed for the simultaneous analysis of selected gases 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

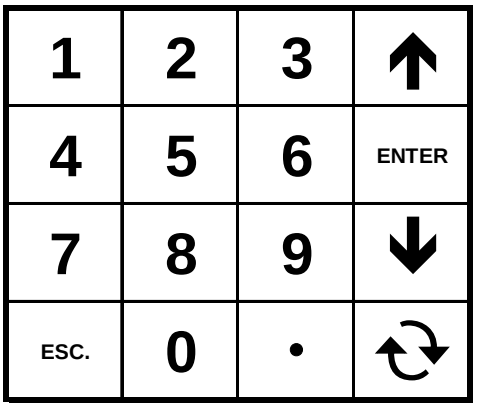
All of the functions of the MGA6000 are controlled from the keypad. The functions of each button are as follows:

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 some screens, This button 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 for at least three minutes. During this time, the gas values on the screen will show "********". While the instrument is warming up, 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 at least 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 20264). This sample port contains a high-temperature filter that contains the same element that is in the filter on the side of the analyzer. This filter will not only prevent contaminants from entering the analyzer, but since the filter is at the furnace it will also protect the sample lines from the furnace to the analyzer.

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.

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 flow meter located on the face of the enclosure, or by the digital representation of flow on the left side of the display screen. The flow meter on the outside of the enclosure 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. For additional information on the operation of the pump, please refer to the section *Pump Control* (menu option 4).

Filters

The side of the enclosure contains a large bowl filter that is intended to prevent soot and other contaminants from entering the instrument. Periodic inspection of this filter will ensure reliable operation of the MGA6000. When this element is new, it is a white/eggshell color. As this filter becomes dirty it will turn black and the flow rate of the analyzer will begin to diminish. Replacing the filter element is as simple as unscrewing the clear bowl from the filter housing, and unscrewing the retaining plug at the base of the element. Information on replacement filters can be found in the section of this manual entitled “Spare Parts”.

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 and eventually enter the bowl filter. Care must be taken to ensure that no water enters the unit, as this will cause permanent, irreversible 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 should not 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.

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 the user is 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 the selection and then press **Enter**.

Operator Level – No Pass Code Required

1. MAIN PAGE
2. IR STATUS (Availability depends on configuration)
3. GENERAL INFORMATION
4. PUMP CONTROL
5. SET DISPLAY VALUES
6. *[NOT CURRENTLY USED]*
7. **CALIBRATION DATES**
8. *[NOT CURRENTLY USED]*
9. *[NOT CURRENTLY USED]*
10. ABOUT / SIGN-ON
11. REVISION DISPLAY
12. *[NOT CURRENTLY USED]*
13. *[NOT CURRENTLY USED]*
14. *[NOT CURRENTLY USED]*
15. *[NOT CURRENTLY USED]*

Supervisor Level – Level 1 Pass Code Required

16. SET THE DATE AND TIME
17. SAMPLING PARAMETERS
18. IR CELL ZERO CALIBRATION
19. 4 – 20 mA OUTPUT ASSIGNMENT
20. AUTO CALIBRATION SETUP
21. MAIN DISPLAY SETUP

Configuration Level – Level 2 Pass Code Required

22. COMMUNICATIONS SETUP
23. CALCULATION FACTORS
24. IR CELL SPAN CALIBRATION
25. SET PASS CODES
26. SET IP ADDRESS
27. H2 CELL CALIBRATION (Availability depends on configuration)
28. AUTO SEQUENCE SETUP
29. GAS or CV CONFIGURATION

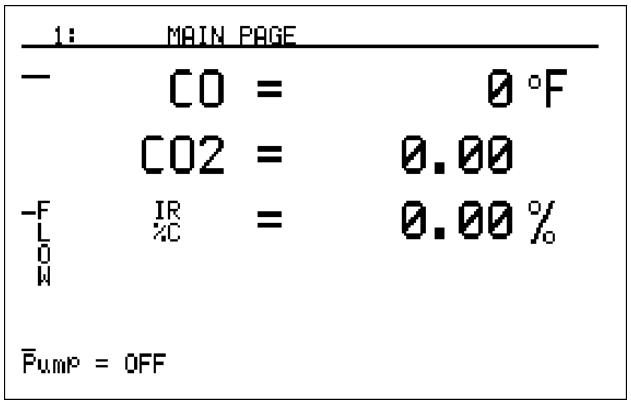
Menu options 6, 8, 9, 12, 13, 14, and 15 are reserved for future use and are not currently used. To minimize the possibility of unintended modifications to the instrument, certain menu pages will require the entry of a pass code to access them. Pages 1 through 15 are Operator level screens that do not require any security codes. Pages 16 - 21 are Supervisor screens requiring a level 1 pass code (default = **1**). Pages 22 – 28 are Configuration screens requiring a

Level 2 pass code (default = **2**). Page 29 requires the Super Systems Inc special passcode to access. The default pass codes can be changed by accessing the *Set Pass Codes* (menu option 25) menu.
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 122°F (50°C).

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 *Main Page* (Menu option 1) or the Menu List.

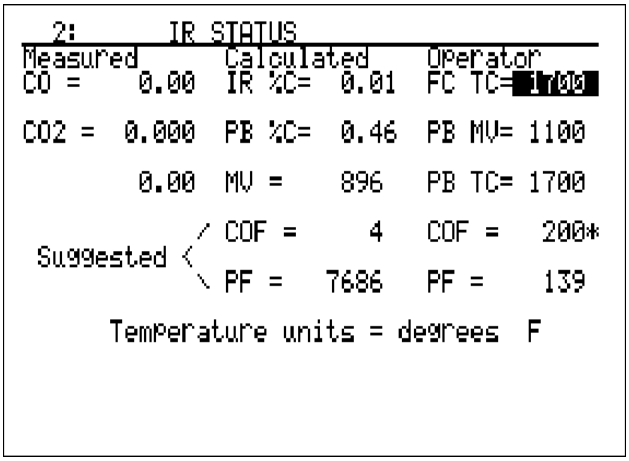
Main Page – Menu Page 1



The IR status display shows the current readings of the gases being sampled. Depending on the configuration of your instrument, this screen will show the values from one to four gases or calculations. To change how the gases are displayed, use the menu option *Main Display Setup* (menu option 21). Also shown is the relative flow rate of the sample by a fuel gauge in the left-hand side of the screen. The "Pump = OFF" message in the lower left-hand side shows the status of the pump. When the pump is in auto mode, this message will read "Pump = AUTO".

IR Status – Menu Page 2

Depending on the configuration of the instrument, this screen may not contain all of the information shown in the example. For one- and two-gas configurations, the "Calculated" values will not be shown, since there is not enough information available for the instrument to compute the percent carbon. When the instrument is configured with three gases (CO, CO2, and CH4), carbon percentage can be calculated by the instrument, The IR 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, data from the carbon probe must be entered. This can either be done manually or automatically via RS485 communications. This information is displayed 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=** The furnace thermocouple value, or the furnace temperature.
- **PB MV=** The millivoltage from the carbon probe.
- **PB TC=** The probe thermocouple value, or the probe temperature.
- **COF=** The CO Factor value read from the SSi, Honeywell, Barber Colman, Yokogawa, or other atmosphere controller.
- **PF=** The Process Factor value read from the Marathon Sensors atmosphere controller.

- **Temperature Units =** This determines the measurement units for temperature. Enter **0** for Fahrenheit (degrees F) or **1** for Celsius (degrees C).

Although it is possible to enter the data manually using the keypad, the atmosphere controller should be utilized to provide the data automatically if possible. When the data is entered automatically, it will change as the composition of the atmosphere changes. This will allow for a more reasonable correlation between the values from the MGA and the values from the probe.
The probe information can also be used to ensure that the pump operates only when the conditions are right for sampling. This can be used to prevent damage to the instrument if the pump is left running as the furnace cools or when the conditions deviate from pre-determined parameters. For additional information on operating the pump in "Auto Sample" mode, please refer to the section titled *Sampling Parameters* (menu option 17).

Measurement of Infrared % Carbon (IR %C)
To accurately measure the % carbon in a furnace atmosphere, the instrument will need to know the values of CO, CO2, and CH4 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. For best results, it is recommended that the temperature information be entered automatically from either the atmosphere controller or the temperature controller.

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 (PB MV), probe temperature (PB TC), 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, under the heading *Operator*. 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 Sensors manufactures the instrument, then it will contain a CO Factor (COF) adjustment variable. If the user is using a Marathon Sensors instrument, then this variable is called a Process Factor (PF) adjustment. Only one of these (COF or PF) will be used at any one time, and the other will not be relevant. If the instrument has a CO Factor adjustment variable, then use the up or down arrow keys to go to the appropriate field and type in the value that is stored in your atmosphere control instrument. After the value is entered, an asterisk **(*)** will appear next to the number. This lets the user know that the CO Factor is being used for the calculations, not the Process Factor. If the instrument has a Process Factor adjustment variable, then this value should be entered in the "PF **=**" slot, which will result in the asterisk appearing by that number 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 MGA is not to calculate the probe % carbon, but to enable the MGA 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 percent 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%

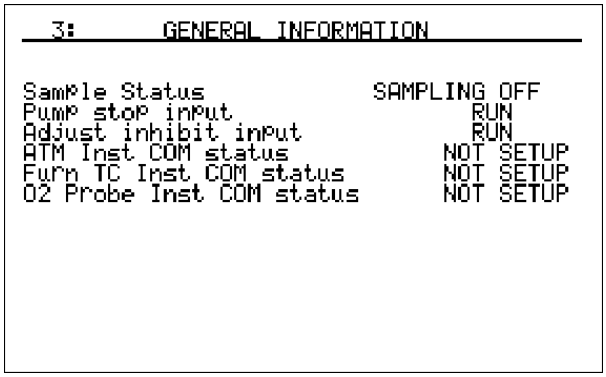
nitrogen (N2), and 20% carbon monoxide (CO). In many situations, the measured amount of CO is less than the theoretically exact 20%. This can be due to a variety of factors including seasonal changes in natural gas composition and incomplete gas cracking in an endothermic generator. The CO Factor and 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, *Calculated*, 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 MGA6000. By performing periodic evaluations with the MGA6000 and making the suggested modifications to the adjustment factor in the atmosphere controller, the user can be assured that the 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.

Example – The following will show how to set the Operator variables for: furnace temperature of 1500 degrees, probe millivolts of 1000, probe temperature of 1500 degrees, a CO factor of 250, and the temperature units are Fahrenheit. When the menu screen first displays, the furnace temperature field is already highlighted. Enter a ***1500*** *and press* ***Enter****. Press the down arrow once to highlight the probe millivolts field. Enter a* ***1000*** *and press* ***Enter****. Press the down arrow key once to highlight the probe temperature field. Enter a* ***1500*** *and press* ***Enter****. Press the down arrow key once to highlight the CO Factor field. Enter a* ***250*** *and press* ***Enter*** *(Note – there will be an asterisk* ******* *next to the value entered). Press the down arrow key twice to highlight the temperature units field. Enter a* ***0*** *and press* ***Enter*** *(Note – the screen will display* ***degrees F****).*

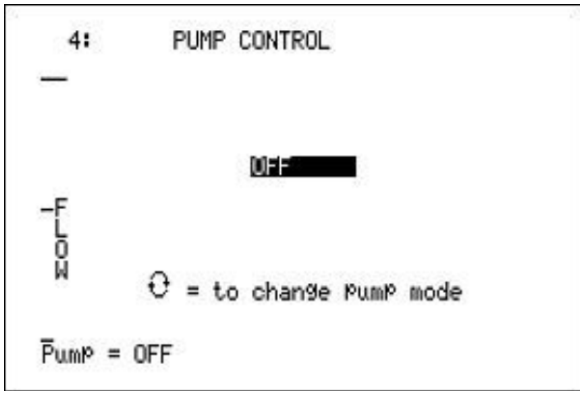
General Information – Menu Page 3



The General Information screen displays some general information. This screen is for display purposes only, so no information can be entered on this screen.

There are two digital inputs that can be energized to either stop the pump or to temporarily inhibit the adjustment of COF/PF. These can be useful for making sure that the instrument does not operate normally when unusual temporary conditions exist (i.e. probe burnoff, door opening, etc.). Connections for these inputs can be made at the terminal block (See *Electrical Connections* section). Digital Input #1 is for stopping the pump. Pump operation will be stopped if the contact between Terminal 1411 and 1412 is closed. Digital Input #2 is for inhibiting the adjustment of COF/PF. The adjustment will be stopped if the contact between Terminal 1421 and 1422 is closed.

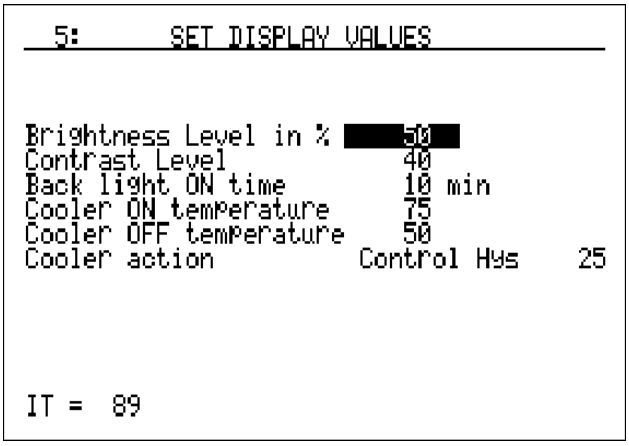
Pump Control - Menu Page 4



The pump control page is used to set the pump mode. The sample pump mode can be changed from **OFF** to **AUTO SAMPLE** by pressing the circular arrow key. **AUTO SAMPLE** mode will automatically turn the pump on and off based on the conditions described in the *Sampling Parameters* menu (menu option 17). *Note: This menu screen is the only location to change the mode of the pump*. Also shown is the relative flow rate of the sample by a fuel gauge in the left-hand side of the screen. There is also a traditional flow meter located in the door of the MGA. 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 on the front of the analyzer.

Example – the following will show how to change the pump status to Auto Sample. When the screen first displays, the pump status field is already highlighted, displaying the word "OFF". Press the circular arrow key to change the pump status to Auto Sample.

Set Display Values – Menu Page 5

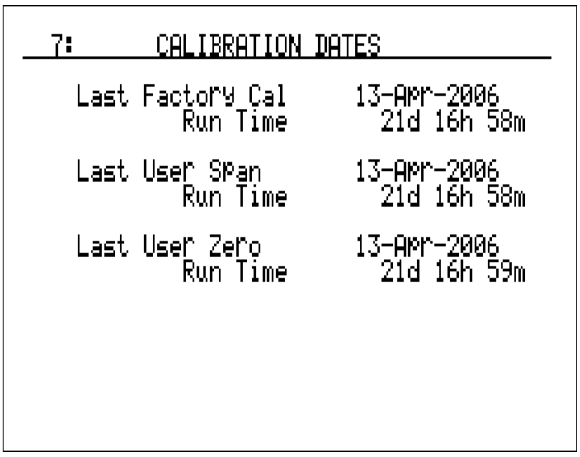


The Set Display Values screen is used to adjust the display values. The brightness and contrast values are factory set to 51%, which should be appropriate for most viewing conditions. The values can range from 0 to 100(%) if desired. Also shown on this page is the Back light ON Time. This is a power 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 fully operates, but the display is more difficult to read. To restore the backlight, press any key. The backlight is factory set to 15 minutes. To disable this function, enter a value of **0** in this field and the backlight will always be on. The maximum number of minutes allowed is 240. *Note – the brightness and contrast levels are displayed and entered as a percentage, while the back light ON time is displayed and entered in number of minutes*.

The MGA 6000 comes equipped with an internal cooler that can control the internal temperature of the instrument. The Cooler ON temperature and the Cooler OFF temperature can contain values ranging from 0 to 122 degrees when degrees Fahrenheit is selected, or 0 to 52 degrees, when degrees Celsius is selected. The Cooler ON and Cooler OFF temperatures are not updated if the temperature mode is switched from Fahrenheit to Celsius or vice-versa. Therefore, the user will have to manually change the temperatures to reflect the new temperature mode. The Cooler action line will display one of three messages: *Cooler Always ON*, *Cooler Always OFF*, or *Control Hys xx* where *xx* is the difference between the Cooler ON temperature and the Cooler OFF temperature. "Hys" is an abbreviation for hysteresis, which is the difference between the on and off temperatures. If the ON temperature is less than or equal to the OFF temperature, then the cooler will always be on and the Cooler action label will read *Cooler Always ON*. If the ON temperature is greater than the OFF temperature, then the cooler will turn on when the internal temperature rises above the Cooler ON temperature, and the cooler will turn off when the internal temperature falls below the Cooler OFF temperature. If the ON temperature is set above 120 degrees Fahrenheit, or 50 degrees Celsius, then the cooler will always be off and the Cooler action line will read *Cooler Always Off*. *Note – If the OFF*

temperature is higher than the ON temperature (Cooler Always ON), but the ON temperature is above 120 (or 50) degrees (Cooler Always OFF), then the cooler will always be off. Whenever there is a conflict between settings, the cooler will always be off. To reduce the frequency of heating and cooling cycles, it is recommended that at least a 10° difference is maintained between the On and Off temperature set points. *Example – The following will show how to set the brightness to 60%, contrast to 40%, the back light ON time to 20 minutes, the Cooler ON temperature to 75 degrees (assume °F), and the Cooler OFF temperature to 50 degrees (assume °F). When the menu screen first displays, the brightness level field is already highlighted. Enter a* ***60*** *and press* ***Enter****. Press the down arrow key once to highlight the contrast field. Enter a* ***40*** *and press* ***Enter****. Press the down arrow key once to highlight the back light ON time field. Enter a* ***20*** *(for the back light ON time) and press* ***Enter****. Press the down arrow key once to highlight the Cooler ON temperature field. Enter a* ***75*** *and press* ***Enter****. Press the down arrow key once to highlight the Cooler OFF temperature field. Enter a* ***50*** *and press* ***Enter****. The Cooler action field should read "Control Hys 25".*
Note – Any changes made to the brightness or contrast level will take effect immediately.

Calibration Dates and Run Times - Menu Page 7

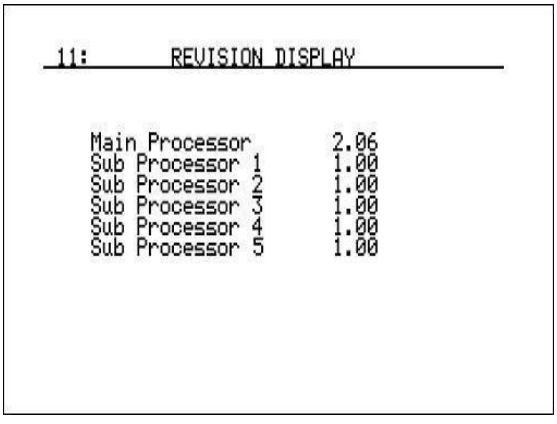


This page shows the most recent calibration dates, as well as the amount of time that has elapsed since each calibration. Time is shown in days (d), hours (h), and minutes (m).
These dates do not need to be set after calibration since they will be set automatically whenever a calibration is performed.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

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 days, hours, and minutes that the instrument has been in use since the last factory calibration.

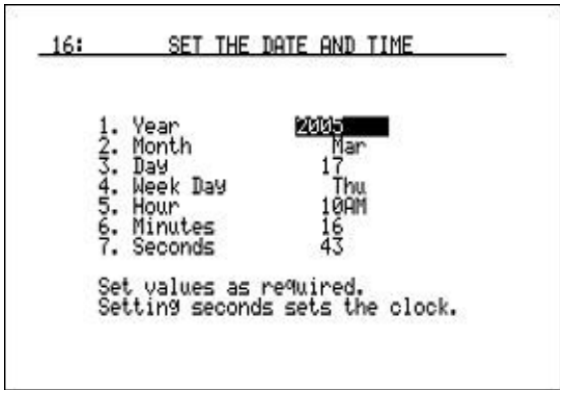
Revision Display – Menu Page 11



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.

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. Consult the following chart for the numerical values that correspond to the Months, Days of the week, and the Hours.



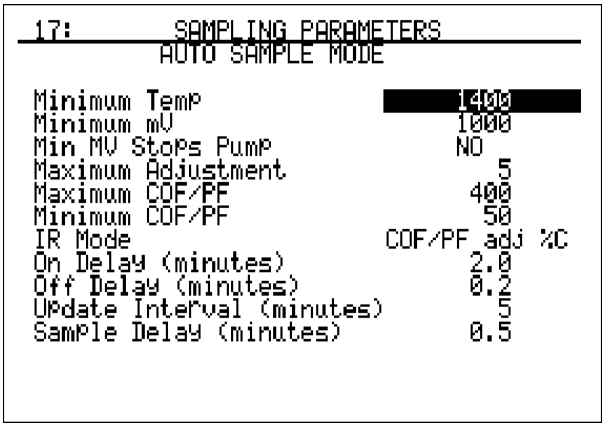
Example – The following will show how to set the internal clock to May 25, 2006 1:30:00 pm. When the menu screen first displays, the year field is already highlighted. If year is not 2006, enter **2006** and press **Enter**. Press the down arrow key once to highlight the month field. Enter a **5** (for May) and press **Enter**. Press the down arrow key once to highlight the day field. Enter a **25** and press **Enter**. Press the down arrow key once to highlight the week day field. May 25, 2006 is a Thursday. Enter a **4** (for the week day) and press **Enter**. Press the down arrow key once to highlight the hour field. Enter a **13** (for the hour) and press **Enter**. Press the down arrow key once to highlight the minutes field. Enter a **30** and press **Enter**. Press the down arrow key once to highlight the seconds field. Enter a **0** and press **Enter**. Once the seconds have been entered, the internal clock will be updated with the new date and time. Note – Not all of the fields need to be entered for a change to take effect, but only by entering a new value in the seconds field will any changes be made.

Month	Value
January	1
February	2
March	3
April	4
May	5
June	6
July	7
August	8
September	9
October	10
November	11
December	12

Day	Value
Sunday	0
Monday	1
Tuesday	2
Wednesday	3
Thursday	4
Friday	5
Saturday	6

Hour	Value	Hour	Value
12:00 AM	0	12:00 PM	12
1:00 AM	1	1:00 PM	13
2:00 AM	2	2:00 PM	14
3:00 AM	3	3:00 PM	15
4:00 AM	4	4:00 PM	16
5:00 AM	5	5:00 PM	17
6:00 AM	6	6:00 PM	18
7:00 AM	7	7:00 PM	19
8:00 AM	8	8:00 PM	20
9:00 AM	9	9:00 PM	21
10:00 AM	10	10:00 PM	22
11:00 AM	11	11:00 PM	23

Sampling Parameters - Menu Page 17



The Sampling Parameters screen is used to select the sampling parameters. It determines when the pump will be turned on and off (only when in Auto Sample mode) and it determines the parameters for the automatic adjustment of the COF/PF.

Minimum temp

This value 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 "Auto Sample" mode*. To change the pump status, go to *Pump Control* (menu option 4). 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 value will range from 0 to 2000.

Minimum mV

This value 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 value will range from 0 to 2000.

Min MV Stops pump

This value is a switch that will determine if the instrument will turn off the pump when the minimum millivolts value is reached. This will occur *only if the pump is set to "Auto Sample" mode*. To change the pump status, go to *Pump Control* (menu option 4). To use this feature, the instrument should be communicating with an instrument that can provide real-time probe millivolt data. This is another feature that is intended to prevent the analyzer from pulling a bad sample and potentially damaging the sensors. The value will be either **Yes** (**1**) or **No** (**0**).

Maximum Adjustment

This 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 value will range from 0 to 20.

Maximum COF/PF

This value 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.

Minimum COF/PF

This value 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.

IR Mode

This is a selection to determine if the instrument is running in Automatic or Manual mode. When in **Manual** 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.

To cycle between each selection, press the circular arrow key to change the IR Mode.

On delay (in minutes)

This 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, adjustable in tenths of a minute.

Off delay (in minutes)

This determines the amount of time it takes for the pump to turn off after either of the operating parameters (temperature and millivolts) fall outside of the pre-defined boundaries. The value will range from 0 to 60 minutes, adjustable in tenths of a minute.

Update interval (in minutes)

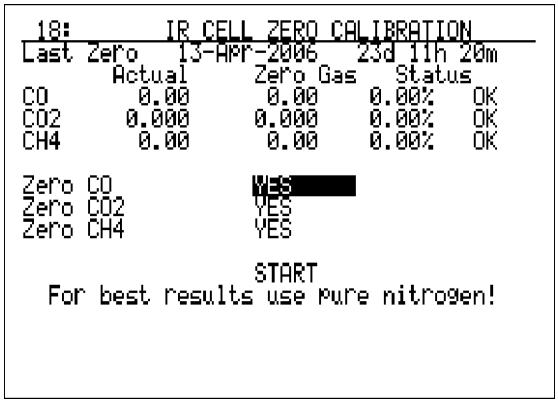
This determines the amount of time between automatic updates of the COF/PF on the control instrument. This is adjustable in one-minute increments. It is recommended that the Update Interval be set to one (1) minute, and the Maximum Adjustment set to one (1) point. This will allow the COF/PF to be adjusted frequently, but only a small amount at a time, which will result in smooth operation. The value will range from 0 to 20.

Sample delay (in minutes)

The value will range from 0 to 300 tenths of a minute.

Note about delays: The delays are entered in tenths of a minute, i.e. twenty tenths equals two minutes and five tenths equals thirty seconds. If the user enters a **2**, this will be displayed as 0.2. If the user enters a **20**, this will be displayed as 2.0. If the user enters a **200**, this will be displayed as 20.0.
Example – The following will show how to set up the sampling parameters of: minimum temp – 1500, minimum millivolts – 1200, minimum millivolts stops the pump – yes, maximum adjustment – 1, maximum COF/PF – 250, minimum COF/PF – 75, IR mode – Monitor, on delay – 10.5 seconds, off delay – 5 seconds, update interval – 1 minute, sample delay – 5 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 millivolts field. Enter a* ***1200*** *and press* ***Enter****. Press the down arrow key once to highlight the minimum millivolts stops the pump field. Enter a* ***1*** *and press* ***Enter*** *(Note – the screen will display* ***YES****). 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* ***0*** *and press* ***Enter*** *(Note – the screen will display* ***Monitor****). Press the down arrow key once to highlight the on delay field. Enter a* ***105*** *(delays are entered as tenths of a minute) and press* ***Enter*** *(Note – the screen will display* ***10.5****). Press the down arrow key once to highlight the off delay field. Enter a* ***50*** *and press* ***Enter*** *(Note – the screen will display* ***5.0****). 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* ***50*** *and press* ***Enter*** *(Note - the screen will display* ***5.0****).*

IR Cell Zero Calibration – Menu Page 18

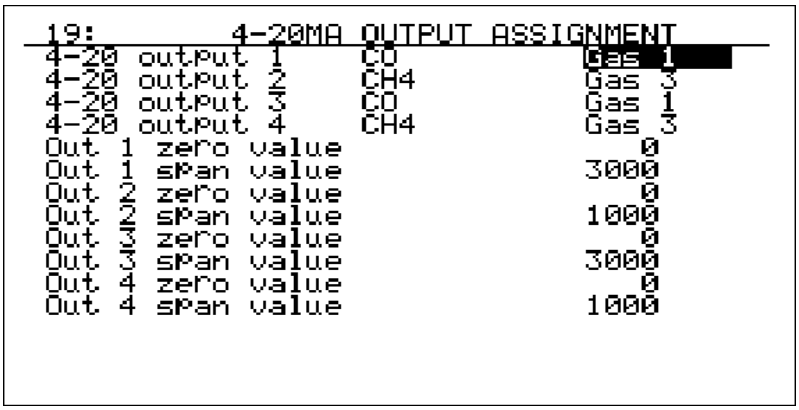


This page is used to perform a zero calibration on the IR cells. It is very important to be sure that the sample gas is a good zero especially for CO2, when CO2 is one of the gases that is being monitored. Ambient air has nominal percentage of CO2, which should not be present when performing a zero calibration. It is recommended that 99.9% pure nitrogen be used for zeroing the MGA6000. 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 the correct gas is being used 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. To set a sensor to not be calibrated, use the up or down arrow keys to highlight the **YES** next to the specific sensor and press **Enter**. This will change the display to **NO**, and that sensor will not be calibrated.
To proceed with the calibration of one or more sensors, use the arrow key to highlight the **Start** and press **Enter**. Timers will count down approximately two minutes and at the conclusion the sensors will be calibrated.

*Example – the following example will show how to calibrate the first and third sensor, but not the second sensor. When the screen first displays, the **YES** for the first sensor will be highlighted. Since this sensor will be calibrated, press the down arrow key to highlight the **YES** for the second sensor. Press the **Enter** key (Note – this will display a **NO** on the second sensor's line). Since the third sensor will be calibrated, press the down arrow key three times to highlight the **START** display. Press the **ENTER** key.*

WARNING: Do not pressurize MGA6000 with compressed gas. Always start the flow of Nitrogen and regulate prior to connecting to MGA6000 inlet.

4-20mA Output Assignment – Menu Page 19

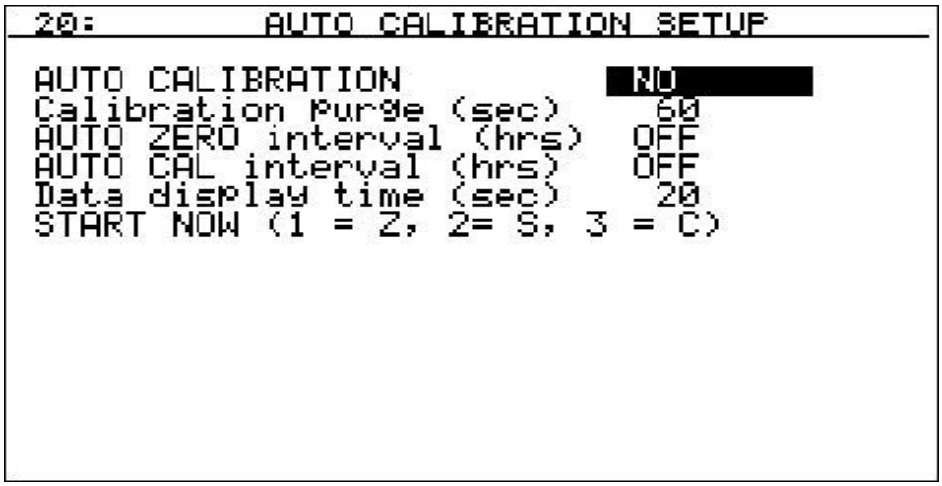


This page assigns the gases to be re-transmitted and the zero and span value of those gases. There are four 4-20mA outputs which will re-transmit the value of the process variable measured by the analyzer. The 4-20 Output 1, Output 2, Output 3, and Output 4 *Assignment* has an option of one out of nine choices – Gas 1 through Gas 6 and Calculated Value 1 through Calculated Value 3. The *Output* column contains the gas that is assigned to each gas assignment. The user can select a new assignment as well as change the zero and span values. To change the assignment, choose a gas or CV value (gas 1 – 0, gas 6 – 5, CV 1 – 6, CV 3 – 8) for each output that is to be changed. The new assignment and output will be displayed. To change the zero or span value, enter the new value and press **Enter**. The zero and span values have a range of 0 to 9999.

Note about Gases and Calculated values: The choices for possible gasses are CO, CO2, CH4, O2, H2, and Dew point. Dew point can be brought into the MGA through 4-20 mA. The calculated values can include, but are not limited to, %C, CO/CO2 Ratio, etc. The calculations are user-defined and are based upon available inputs.

*Example – The following will show how to set output 1 and output 3 to Gas 1 (CO) with a zero value of 0 and a span value of 3000, and set output 2 and output 4 to Gas 3 (CH4) with a zero value of 0 and a span value of 1000. When the screen first displays the assignment for output 1 is already highlighted. Enter a **0** to select Gas 1 (Note – the screen will display "Gas 1" under the assignment column and the output column will display **CO**). Press the down arrow key once to highlight the assignment for output 2. Enter a **2** for Gas 3 and press **Enter** (Note – the screen will display "Gas 3" under the assignment column and the output column will display **CH4**). Press the down arrow key once to highlight the assignment for output 3. Enter a **0** to select Gas 1 (Note – the screen will display "Gas 1" under the assignment column and the output column will display **CO**). Press the down arrow key once to highlight the assignment for output 4. Enter a **2** for Gas 3 and press **Enter** (Note – the screen will display "Gas 3" under the assignment column and the output column will display **CH4**). Press the down arrow key once to highlight the zero value for output 1. Enter a **0** and press enter. Press the down arrow key once to highlight the span value for output 1. Enter a **3000** and press **Enter**. Press the down arrow key once to highlight the zero value for output 2. Enter a **0** and press enter. Press the down arrow key once to highlight the span value for output 2. Enter a **1000** and press **Enter**. Press the down arrow key once to highlight the zero value for output 3. Enter a **0** and press enter. Press the down arrow key once to highlight the span value for output 3. Enter a **3000** and press **Enter**. Press the down arrow key once to highlight the zero value for output 4. Enter a **0** and press enter. Press the down arrow key once to highlight the span value for output 4. Enter a **1000** and press **Enter**.*

Auto Calibration Setup – Menu Page 20



Note: This screen only applies when the Auto Calibration System (SSi Part Number 13446) is used in conjunction with the MGA. For information on how to make the wiring connections between the MGA and the Auto Calibration System, please consult the drawings that were sent with the instruments.

Auto Calibration

This field will turn the auto calibration feature on or off. To turn the feature on or off, press the circular arrow on the keypad or enter the corresponding numeric value. The value will either be **Yes** (1) or **No** (0).

Calibration Purge (sec)

This field will set the time, in seconds, that the calibration gas is flowing to the MGA before the calibration begins. It is recommended that this time be at least 60 seconds to allow for the sensors to come to equilibrium in the calibration gas.

Auto Zero Interval (hrs)

This is the desired amount of time between zero calibrations. This will only perform zero calibrations and not span calibrations. This field may not need to be set if the Auto Cal Interval is being used, since the zero calibration will automatically be performed. The range will be **0** to **533.3** hours. A value of **0** will turn this field **OFF**.

Auto Cal Interval (hrs)

This is the desired amount of time between zero and span calibrations. The calibration will be much more accurate if a zero calibration is performed before a span calibration, so it is not an option to conduct a span calibration alone. This feature will perform both calibrations at the specified interval. The range will be **0** to **533.3** hours. A value of **0** will turn this field **OFF**.

Data Display Time (sec)

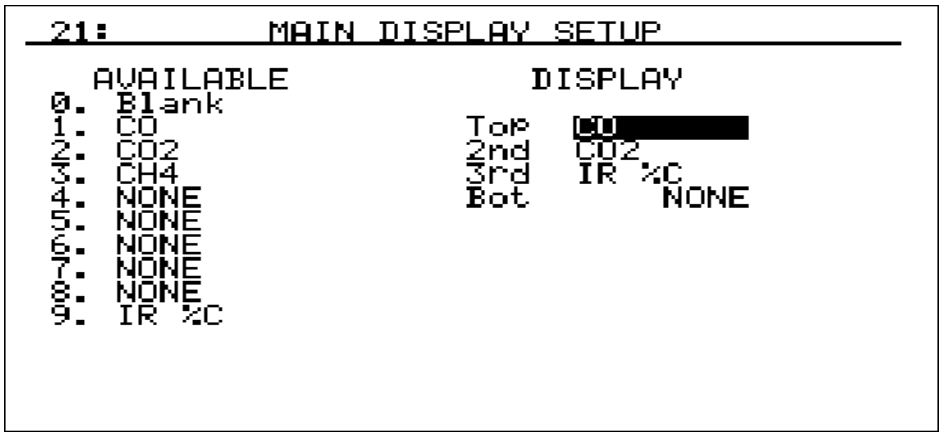
This is the amount of time that the post-calibration information is shown on the display before reverting aback to the normal operating screen. The range will be **0** to **120** seconds.

Start Now (1 = Z, 2 = S, 3 = C)

This field allows the operator to perform a zero, span or both types of calibrations immediately, without waiting for the specified interval. Pressing a **1** will perform a zero calibration only. Pressing a **2** will perform a span calibration only. Pressing a **3** will perform a zero calibration, followed by a span calibration.

*Note: Even if values are entered for the Auto Zero or Auto Cal Intervals, the instrument will only initiate them if the Auto Calibration state is **Yes**.*

Main Display Set – Menu Page 21

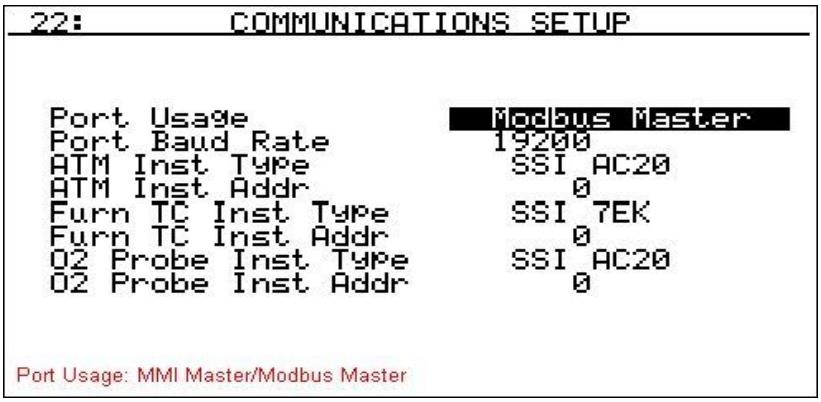


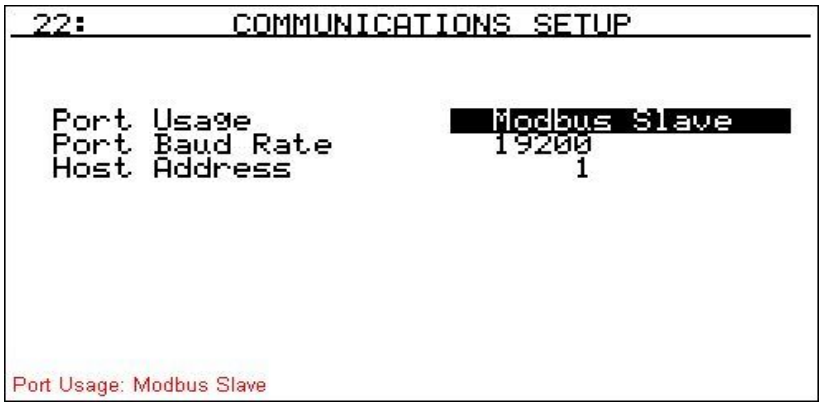
This page assigns the order in which the gases are displayed on the menu *Main Page*, menu option 1. The list *Available* on the left side of the screen is the list of available gases to choose. The "Top", "2nd", "3rd" and "Bot" is in which position the gas will be displayed. Up to four gases can be displayed. To change a gas' position, highlight the position of the display, and enter the number next to the gas on the left side (i.e. "1"), and press the **Enter** key.

*Example – The following will show how to set up the display to match the screen shot above (Top – CO, 2nd – CO2, 3rd – IR % C, Bot – None), assuming the MGA is configured with the matching gas availabilities. When the menu screen first displays, the top field is already highlighted. Enter a **1** and press **Enter**. The gas listed will be **CO**. Press the down arrow once to highlight the 2nd field. Enter a **2** and press **Enter**. The gas listed will be **CO2**. Press the down arrow key once to highlight the 3rd field. Enter a **3** and press **Enter**. The gas listed will be **IR % C**. Press the down arrow key once to highlight the bot field. Enter a **0** and press **Enter**. The gas listed will be **None**. Note – the user can select options 4 through 8, but if these gases ever get assigned a gas value, that gas will then be displayed on the main display page. Assigning a value of **0** (blank) will ensure that the display line does remain blank.*

Communications Setup – Menu Page 22

The Communications Setup screen displays the communications setup for the MGA 6000. The menu option *IR Status* (menu option 2) allows the user to enter in furnace temperature, probe millivolts, and probe temperature. However, this information can be entered and updated automatically. This is where the communications setup comes in. *Note – the item O2 Probe Inst Addr is not normally used at this time, but may be used in the future*. This would be used for input from an HP2000 or Lambda probe. *Note: The display will change based on the port usage used*.





Port Usage

The communication method used to supply information to the MGA. To change the port usage, enter a number between 0 and 2. The possible values are:

0 – MMI Master
1 – Modbus Master
2 – Modbus Slave

Port Baud Rate

This is the speed of the communication. To

change the baud rate, press the circular arrow key to cycle through the options or enter a number between 0 and 15. To enter the baud rate directly, the possible values are:

0 – 1200	8 - 57600
1 – 2400	9 - 76800
2 – 4800	10 - 115200
3 – 9600	11 - 230400
4 – 14400	12 - 460800
5 – 19200	13 - 921600
6 – 28800	14 - 128000
7 – 38400	15 – 256000

ATM Inst Type

This is the make and model of the instrument that will be supplying the MGA with information on: probe temperature, probe millivolts, and COF/PF. To change the type, enter a number between 0 and 11 and press **Enter**. The possible values are:

0 – SSi AC20 (Super Systems AC20)
1 – UDC 3300 (Honeywell UDC 3300)
2 – DP1 Mod (Marathon Sensors DualPro – Modbus Protocol Loop 1
3 – DP 2 Mod (Marathon Sensors DualPro – Modbus Protocol Loop 2
4 – DP 1 MMI (Marathon Sensors DualPro – MMI Protocol Loop 1
5 – DP 2 MMI (Marathon Sensors DualPro – MMI Protocol Loop 2
6 – Eur 2404 (Eurotherm 2404)
7 – Eur 2500 (Eurotherm 2500)
8 – CP V3.5 (Marathon Sensors CarbPro Version 3.5)
9 – CP V3.0 (Marathon Sensors CarbPro Version 3.0)
10 – CarbPC (Marathon Sensors CarbPC)
11 – 9200 LP 1 (Super Systems Model 9200 Loop 1)

ATM Inst Addr

This 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.

Furn TC Inst Type

This is the make and model of the instrument that will be supplying the MGA with information on furnace temperature. If there is no instrument associated with this input, the MGA will use the value from the probe temperature (ATM Inst Type) as the furnace temperature. To change the type, enter a number between 0 and 18 and press **Enter**. The possible values are:

0 – SSi 7EK (Super Systems 7EK)
1 – UDC 3300 (Honeywell UDC 3300)
2 – DP1 Mod (Marathon Sensors DualPro – Modbus Protocol
3 – DP 2 Mod (Marathon Sensors DualPro – Modbus Protocol
4 – DP 1 MMI (Marathon Sensors DualPro – MMI Protocol
5 – DP 2 MMI (Marathon Sensors DualPro – MMI Protocol
6 – Eur 2404 (Eurotherm 2404)
7 – Eur 2500 (Eurotherm 2500)
8 – UP V3.5 (Marathon Sensors UniPro Version 3.5)
9 – UP V3.0 (Marathon Sensors UniPro Version 3.0)
10 – CP3.5 SL (Slave Instrument connected to a Marathon Sensors CarbPro Version 3.5)
11 – CP3.0 SL (Slave Instrument connected to a Marathon Sensors CarbPro Version 3.0)
12 – 10Pro (Marathon Sensors 10Pro)

13 – DP In C (Marathon Sensors DualPro Loop on Input C)
14 – 9200 LP 1 (Super Systems Model 9200 Loop 1)
15 – 9200 LP 2 (Super Systems Model 9200 Loop 2)
16 – 9200 LP 3 (Super Systems Model 9200 Loop 3)
17 – 9100 LP 1 (Super Systems Model 9100 Loop 1)
18 – 9100 LP 2 (Super Systems Model 9100 Loop 2)

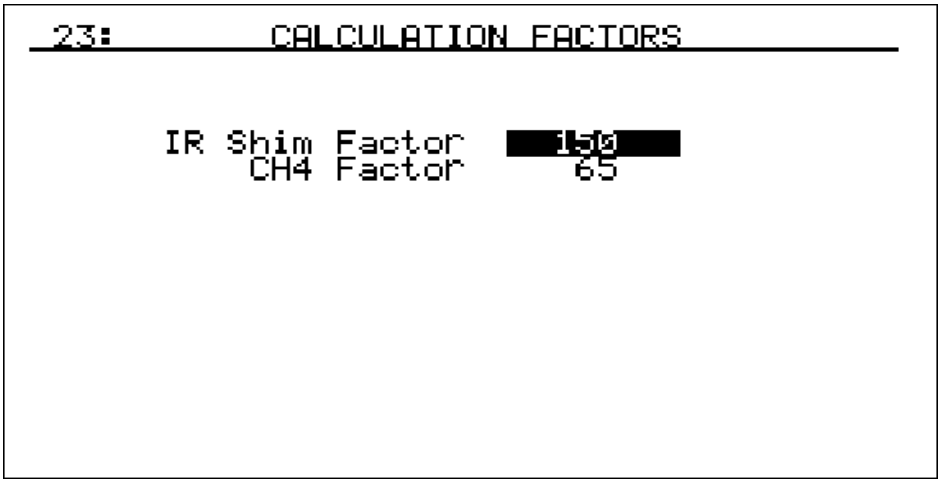
Furn TC Inst Addr
This is the address of the Furn TC Inst. To change the address, enter the new value and press **Enter**. The values can range from 0 to 250.

O2 Probe Inst Type
This is the make and model of the instrument that will be supplying the MGA with information on Oxygen. To change the O2 probe inst type, enter a number between 0 and 11 and press **Enter**. The possible values are:

0 – SSi AC20 (Super Systems AC20)
1 – UDC 3300 (Honeywell UDC 3300)
2 – DP1 Mod (Marathon Sensors DualPro – Modbus Protocol
3 – DP 2 Mod (Marathon Sensors DualPro – Modbus Protocol
4 – DP 1 MMI (Marathon Sensors DualPro – MMI Protocol
5 – DP 2 MMI (Marathon Sensors DualPro – MMI Protocol
6 – Eur 2404 (Eurotherm 2404)
7 – Eur 2500 (Eurotherm 2500)
8 – CP V3.5 (Marathon Sensors CarbPro Version 3.5)
9 – CP V3.0 (Marathon Sensors CarbPro Version 3.0)
10 – CarbPC (Marathon Sensors CarbPC)
11 – 9200 LP 1 (Super Systems Model 9200)

02 Probe Inst Addr
This is the address for the O2 probe. To change the address, enter the new value and press **Enter**. The values can range from 0 to 250.
*Example – The following will show how to set up the following communications factors: Port Usage – Modbus Master, Port Baud Rate – 19200, ATM Instrument – SSi AC20, ATM Instrument address – 1, Furnace TC Instrument – DP 1 MMI, Furnace TC instrument address – 2, O2 probe instrument – SSi AC20, O2 probe instrument address – 3. When the screen first displays, the port usage field is already highlighted. Enter a **1** and press **Enter** (Note – the screen will display **Modbus Master**). Press the down arrow key once to highlight the port baud rate field. Enter a **5** and press **Enter** (Note – the screen will display **19200**). Press the down arrow key once to highlight the ATM instrument type field. Enter a **0** and press **Enter** (Note – the screen will display **SSi AC20**). Press the down arrow key once to highlight the ATM instrument address. Enter a **1** and press **Enter**. Press the down arrow key once to highlight the furnace TC instrument field. Enter a **4** and press **Enter** (Note – the screen will display **DP 1 MMI**). Press the down arrow key once to highlight the furnace TC instrument address field. Enter a **2** and press **Enter**. Press the down arrow key once to highlight the O2 probe instrument type field. Enter a **0** and press **Enter** (Note – the screen will display **SSi AC20**). Press the down arrow key once to highlight the O2 probe instrument address field. Enter a **3** and press **Enter**.*

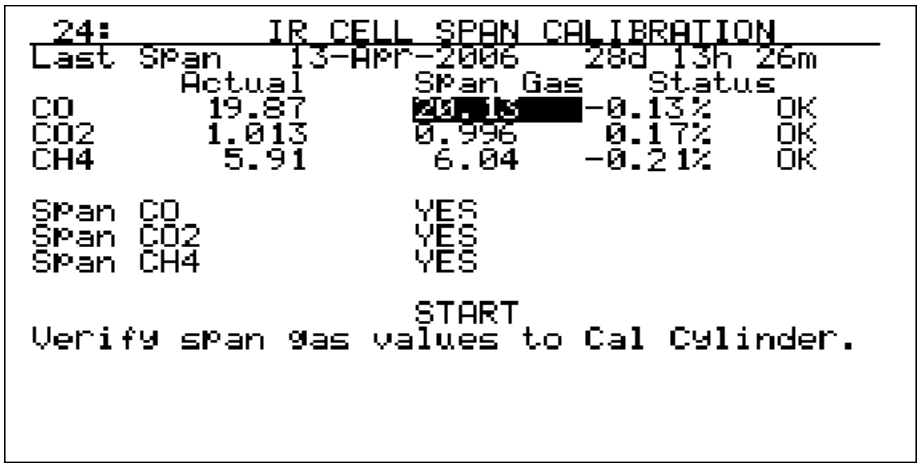
Calculation Factors - Menu Page 23



The calculation factors screen allows for the entry of calculation factors when dealing with the calculation of % carbon. The IR shim factor is factory set to **150** and the CH4 Factor is factory set to **65**. 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 at 800-666-4330 for help with adjusting these pre-set values.

Example – the following will show how to set the IR Shim factor to 170 and the CH4 factor to 50. When the screen first displays, the IR Shim factor field is already highlighted. Enter a **170** and press **Enter**. Press the down arrow key once to highlight the CH4 factor field. Enter a **50** and press **Enter**.

IR Cell Span Calibration – Menu Page 24

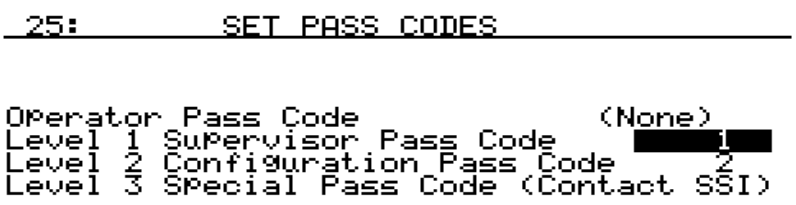


The IR Cell Span Calibration page is used to span calibrate the IR cells. It is very important to be sure that a Certified Primary Standard sample gas within the noted specifications is used. The nominal composition of this gas should be:
20% CO (Carbon Monoxide)
0.5% CO2 (Carbon Dioxide)
5% CH4 (Methane 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. 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 to enter the specific values of each gas. These values 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, to keep from calibrating one of the sensors, use the up and down arrows to highlight the sensor that will not be calibrated, and press **Enter**. This will change the **YES** to **NO**, and that sensor will not be calibrated.

When the data has been entered, use the down arrow key to move to the **Start** display and press **Enter**. Timers will count down approximately two minutes and at the conclusion the sensors will be calibrated.
*Example – the following will show how to set the CO level to 0.50, the CO2 level to 0.50, and calibrate the first two sensors (CO, CO2), but not the third sensor (CH4). When the screen first displays, the span gas field for CO is already highlighted. Enter a **0.5** and press **Enter** (Note – the screen will display **0.500**). Press the down arrow key once to highlight the CO2 span gas field. Enter a **0.5** and press **Enter** (Note – the screen will display **0.500**). Press the down arrow key three times to highlight the span CO sensor field. If this field displays **NO**, then press **Enter** (Note – the field should now display **YES**). If the span CO sensor field displays **YES**, then press the down arrow key once to highlight the span CO2 sensor field. If this field displays **NO**, then press **Enter** (Note – the field should now display **YES**). If the span CO2 sensor field displays **YES**, then press the down arrow key once to highlight the span CH4 sensor field. If this field displays **YES**, then press **Enter** (Note – the field should now display **No**). If the span CH4 sensor field displays **NO**, then press the down arrow key twice to highlight the **Start** display. Press **Enter** to start the calibration.*

WARNING: Do not pressurize MGA6000 with compressed gas. Always start the flow of Nitrogen and regulate prior to connecting to MGA6000 inlet.

Set Pass Codes - Menu Page 25



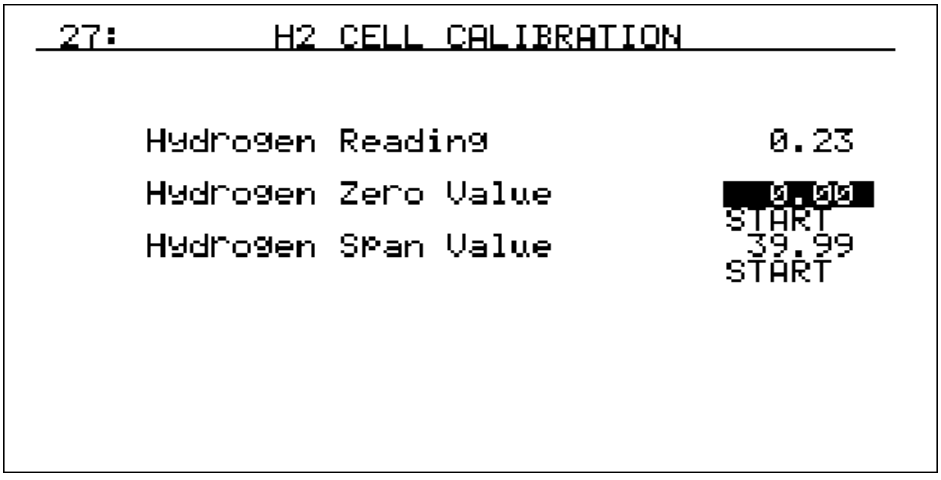
This page is used to change the pass code for menu screens 16 and higher. Menu Screens 1 through 15 are considered operator level and do not require a pass code to access the screen. Menu screens 16 through 21 are considered Supervisor Level, and they require the Level 1 pass code. Menu screens 22 through 28 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**. These pass codes can be changed to any number between 0 and 512.
Note – The Level 2 (Configuration) pass code will also work on all Level 1 menus. The Level 3 menus are not visible, and SSi uses them when the instrument is being set up prior to shipment.
*Example – The following will show how to change the Level 1 pass code to **10** and the Level 2 pass code to **20**. When the screen first displays, the Level 1 pass code field is already highlighted. Enter a **10** and press **Enter**. Press the down arrow key once to highlight the Level 2 pass code field. Enter a **20** and press **Enter**.*

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. To change the IP Address, Net Mask, or IP Gateway, use the up or down arrow keys to highlight the proper section of the address, enter the new value, and press **Enter**. Use the up or down arrow keys to highlight the **SET** display and press **Enter**. *Note – The addresses will not be set until the user performs the previous step*.

*Example – The following will show how to change the IP address to "192.168.1.220". Note – It is important to make sure that no other computer, device, printer, etc is located at the IP address prior to changing the address. When the screen first displays, the **SET** display is highlighted. Press the down arrow key four times, or the up arrow key nine times to highlight the last section of the IP address. Enter a **220** and press **Enter**. The User can either press the down arrow key nine times to highlight the **SET** display, or press the up arrow key four times to highlight the **SET** display. Once the **SET** display is highlighted, press **Enter** to lock in the displayed values.*

H2 Cell Calibration – Menu Page 27



The H2 Cell Calibration screen is used to perform both zero and span calibrations for the Hydrogen sensor, assuming that the instrument contains an H2 cell. This screen will not be accessible if there is not a Hydrogen sensor in the instrument.

This screen allows the user to calibrate the zero value of the H2 cell and the span value of the H2 cell. Displayed is the hydrogen reading, which is the current reading of the H2 cell, the hydrogen zero value target value, a **Start**, which will start the zero calibration, the hydrogen span value target value, and another **Start**, which will start the span calibration.

To calibrate the zero value, turn the pump off and begin the flow of zero gas at a rate of 1.5 to 2.0 SCFH. An appropriate zero gas would be Nitrogen, Argon, or any other inert gas. Allow the gas to flow until the values stabilize, which should be within one to two minutes. Enter the target value (which should be zero), press the down arrow key once to highlight the **Start** display, and press **Enter**. At the completion of the zero calibration, the Hydrogen Reading should be equal to the Zero Value.

To calibrate the span value, turn the pump off and begin the flow of span gas at a rate of 1.5 to 2.0 SCFH. An appropriate span gas would be a Certified Primary Standard containing 40 to 50% H2. Allow the gas to

flow until the values stabilize, which should be within one to two minutes. Enter the exact quantity of Hydrogen in the calibration gas in the Hydrogen Span Value area, press the down arrow key once to highlight the **Start** display, and press **Enter**. At the completion of the span calibration, the Hydrogen Reading should be equal to the Span Value.

Example – The following will show how to calibrate the zero value with a target value of 0, and to calibrate the span value with a target value of 39.99. When the screen first displays, the hydrogen zero value field is already displayed. Enter a ***0*** *and press* ***Enter*** *(Note – the screen will display* ***0.00****). After the zero gas has come to equilibrium, press the down arrow key once to highlight the* ***Start*** *display and press* ***Enter****. The MGA will now zero calibrate the H2 cell. When the calibration begins, a message will be displayed below the "Hydrogen Span Value" line that says "Processing". If the zero calibration was successful, this message will change to "Z1 Pass". If the zero calibration was not successful, the message will change to "Z1 Fail". Next, switch the flow of gas from zero to span and allow the values to come to equilibrium. Press the down arrow key once to highlight the hydrogen span value field. Enter a* ***39.99*** *and press* ***Enter****. Press the down arrow key once to highlight the* ***Start*** *display and press* ***Enter****. The MGA will now span calibrate the H2 cell. When the calibration begins, a message will be displayed below the "Hydrogen Span Value" line that says "Processing". If the span calibration was successful, this message will change to "S1 Pass". If the span calibration was not successful, the message will change to "S1 Fail".*

Auto Sequence Setup – Menu Page 28

This option is not yet implemented.

Gas or CV Configuration – Menu Page 29

This menu option requires the Super Systems Inc special passcode to view. The menu option is used in setting up the individual gasses for the MGA and it should not be modified without contacting Super Systems Inc at 800-666-4330. These gasses are preset at the factory and should not require any modifications.

MGA6000 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 37050
- Bowl Filter Element Media Replacement — Part Number 37051
- Flow Meter — Part Number 36013
- Sampling Wand Assembly without filter — Part Number 20263
- Sampling Wand Assembly with filter — Part Number 20264

Appendix 1 – MGA Side Vents

A. Sample Inlet – The sample inlet is where the gas that is being measured goes into the MGA.
B. Sample Vent – The sample vent is where the gas that is being measured goes out of the MGA after measurement.
C. Nitrogen Purge Inlet – The nitrogen purge inlet is where the flow of nitrogen will go into the MGA during a nitrogen purge. A nitrogen purge will allow the operator to fill the casing with nitrogen in the event there is a leak in the gas line.
D. Nitrogen Purge Vent – The nitrogen purge vent is where the flow of nitrogen will go out of the MGA when the nitrogen purge is complete.
E. Ethernet Connection – The Ethernet connection is where the Ethernet wire will be plugged into the MGA for Ethernet/network communications.
F. Communications Connection – The communications connection is where the communication wires will go into the MGA enclosure. Communications could be: Modbus RS485 communications to an atmosphere/temperature controller, 4-20 mA outputs for up to four process variables, digital inputs to remotely turn the pump off or suspend the COF/PF adjustment, or communications with the auto calibration box (if available).
G. Power Connection – The power connection is where the A/C power wires will go into the MGA enclosure. The power and communications wires are kept separate to reduce the possibility of the A/C wires causing interference with the communications wires.
H. Nitrogen Purge Flow – The nitrogen purge flow meter will display the flow of nitrogen into the MGA enclosure during a nitrogen purge.

Appendix 2 – MGA Modbus Registers

This appendix is meant to be used as a reference only. Please contact Super Systems Inc at 800-666-4330 before directly modifying any register's values.

Register Number	Description
0	Release number (Displayed * 100)
1	RS485 Host port Baud (0 to 13 for 1200 to 921600)
2	RS485 Host/slave port; 0 = MMI master, 1 = Modbus master, 2 = Modbus slave (host port)
3	RS485 Slave port Baud fixed 5 = 19.2k
4	RS485 Slave port; fixed 1 = modbus
5	RS232 H2 port 3 for 9600 baud 8N1
6	RS232 H2 port forced Hydrogen cell = 6
7	coms to PICs forced to 19200
8	coms to PICs forced to Modbus
9	RS232 Aux port Baud (0 to 13 for 1200 to 921600)
10	RS232 Aux port; forced Modbus = 1
11	Not used in the MGA
12	Number of bases (Out dated; forced to a value = 0)
13	Selected language (Future use; not used at this time)
14	Modbus address of the instrument
15	Temperature degrees (0 = degree F; 1 = degree C)
16	IR control 0 = manual, 1 = auto
17	IR control proportional band
18	IR control reset
19	IR control rate
20	Item to display 1st on main display
21	Item to display 2nd on main display
22	Item to display 3rd on main display
23	Item to display 4th on main display
* Registers 24 to 42 not used	
43	Number of free sectors
44	Number times kill has been called
45	Elevation from sea level in feet (Blue Ash airport 856 ft./4250 Creek Rd 802 ft./7205 Edington 887 ft.)
46	pressure trim value
47	Local pressure entered for calibration
48	O2 calibration factor (2489 = .2489)
49	O2 zero offset
50 to 53	Pressure reading at last calibration in kPa * 100
54	Adjust minimum temperature
55	Adjust minimum millivolts
56	Minimum MV action; 0 = only inhibits adjust and control, 1 = also stops pump.
57	max adjust amount
58	maximum COF/PF
59	minimum COF/PF
60	mode: 0 = monitor, 1 = COF/PF adjust base on %C, 2 = COF/PF adjust based on CO
61	RS232 Host port baud
62	RS232 Host port mode: Modbus
63	IR control setpoint
* flow calibration	
64	flow zero offset

65 flow span value

* Register 66 not used

67 Dualpro process factor register

68 LED D2 ON time in millisecs

69 LED D2 OFF time in millisecs

70 Display polarity

71 Display contrast

72 Backlight brightness

73 Backlight on time; 0 = always ON

74 Web change enable; 0 = disable, 1 = enable

75 Calibration stage

76 Pump ON delay

77 Sample OFF delay

78 Adjust/control update interval

79 sample ON delay time

80 H2 zero gas % times 100 (xx.xx)

81 H2 span gas % times 100 (xx.xx)

82 hydrogen cell calibration request; 1 = zero, 2 = span

83 H2 cell in % times 100 (xx.xx)

84 Help pointer

85 Sum of Active Cell start up timers

86 Backlight brightness output

87 to 95 slave communications status

96 PIC processor communications status (96 - 99)

100 local cooler ON set point

101 local cooler OFF set point

102 auto calibration and/or sequencing

- bit 0 = auto cal; 0 = OFF, 1 = ON
- bit 1 = sequencing; 0 = OFF, 1 = ON
- bit 2 = seq mode; 0 = normal; 1 = specific
- bits 4 - 7 Not Used
- bits 8 - 13 CH active bit map
- bits 14 - 15 Not Used

103 Auto cal interval in minutes 0 = OFF

104 Auto Zero interval in minutes 0 = OFF

105 Auto data display time at end of seq

106 purge time before cal or zero

* Registers 107 to 109 not used

* Selected gas types:
  - 0 = none
  - 1 to 4 = PIC 0 to 3 SPI IR cells respectively
  - 5 = H2 cell via RS232
  - 6 = Lambda probe via RS-485
  - 7 = PIC 2 A/D1 Oxygen cell
  - 8 = PIC 2 A/D3 Ext thermister
  - 9 = PIC 1 A/D3 Ext 0 to 5 volt
  - 10 = PIC 3 A/D0 Ext 0 to 1 volt
  - 11 = PIC 3 A/D1 Ext 0 to 1 volt
  - 12 = PIC 3 A/D3 Ext 0 to 5 volt

Selected Calculation types:
  - 0 = none
  - 1 = IR % carbon (needs CO and CO2 and optionally CH4)
  - 2 = Gas ratio (Gas_1_val/Gas_2_val)

3 = Dew point (need to define how calculated)

Message selections:
0 = use name (Gas_x_name),
1 = CO,
2 = CO2,
3 = CH4,
4 = H2,
5 = O2,
6 = CO/CO2 Ratio,
7 = Probe MV,
8 = Probe TC,
9 = Probe %C,
10 = IR %C,
11 = NH3,
12 = DP,
>= 20 is blank

* Gas 1
110 Selected gas type; 0 = none
111 Reading for gas 1
112 Full scale range for gas 1
113 Decimal place location; low byte = display, hi = source
114 Span gas value for gas 1
115 Message Selection
116 Calcuation Type; 0 = blank, 1 = %, 2 = deg F, 3 = deg C,
* Registers 117 to 119 not used
* Gas 2
120 Selected gas type; 0 = none
121 Reading for gas 2
122 Full scale range for gas 2
123 Decimal place location; low byte = display, hi = source
124 Span gas value for gas 2
125 Message Selection
126 Calcuation Type; 0 = blank, 1 = %, 2 = deg F, 3 = deg C,
* Registers 127 to 129 not used
* Gas 3
130 Selected gas type; 0 = none
131 Reading for gas 3
132 Full scale range for gas 3
133 Decimal place location; low byte = display, hi = source
134 Span gas value for gas 3
135 Message Selection
136 Calcuation Type; 0 = blank, 1 = %, 2 = deg F, 3 = deg C,
* Registers 137 to 139 not used
* Gas 4
140 Selected gas type; 0 = none
141 Reading for gas 4
142 Full scale range for gas 4
143 Decimal place location; low byte = display, hi = source
144 Span gas value for gas 4
145 Message Selection
146 Calculation Type; 0 = blank, 1 = %, 2 = deg F, 3 = deg C,
* Registers 147 to 149 not used
* Gas 5

150 Selected gas type; 0 = none
151 Reading for gas 5
152 Full scale range for gas 5
153 Decimal place location; low byte = display, hi = source
154 Span gas value for gas 5
155 Message Selection
156 Calculation Type; 0 = blank, 1 = %, 2 = deg F, 3 = deg C,
* Registers 157 to 159 not used
* Gas 6
160 Selected gas type; 0 = none
161 Reading for gas 6
162 Full scale range for gas 6
163 Decimal place location; low byte = display, hi = source
164 Span gas value for gas 6
165 Message Selection
166 Calculation Type; 0 = blank, 1 = %, 2 = deg F, 3 = deg C,
* Registers 167 to 169 not used
* CV 1
170 Calulated value type type; 0 = none
171 Reading for CV 1
172 Full scale range for CV 1
173 Decimal place location; low byte = display, hi = source
174 Zero Scale value for CV 1
175 Message Selection
176 Calculation Type; 0 = blank, 1 = %, 2 = deg F, 3 = deg C,
* Registers 177 to 179 not used
* CV 2
180 Calulated value type type; 0 = none
181 Reading for CV 2
182 Full scale range for CV 2
183 Decimal place location; low byte = display, hi = source
184 Zero Scale value for CV 2
185 Message Selection
186 Calculation Type; 0 = blank, 1 = %, 2 = deg F, 3 = deg C,
* Registers 187 to 189 not used
* CV 3
190 Calulated value type type; 0 = none
191 Reading for CV 3
192 Full scale range for CV 3
193 Decimal place location; low byte = display, hi = source
194 Zero Scale value for CV 3
195 Message Selection
196 Calcuation Type; 0 = blank, 1 = %, 2 = deg F, 3 = deg C,
* Registers 197 to 199 not used
200 CO Reading
201 CO2 Reading
202 O2 Reading
203 CH4 Reading
204 Turn off bench, pump, and sample
205 IR %C
206 IR suggested COF
207 IR suggested PF
208 IR equivalent millivolts
209 probe MV

210	probe COF
211	probe temperature
212	probe process factor
213	probe %C
214	Total Pump run time (minutes)
215	Total Pump run time (weeks)
216	pump status; 0 = off, 1 = On
217	Pump run timer
218	Pump run maximum
219	calibration status
220	IR temperature
221	control output in percent
222	sample flow
223	sample valve state
224	sample valve control
225	flow timer
226	Status of base; 0 = OFF, 1 = pump delay ON 2 = sample delay, 3 = measure delay 4 = delay OFF, 5 = ON
227	alarm bit map bit 0 = low flow; bit 1 = base communications bit 2 = max factor; bit 3 = min factor; bit 4 = ; bit 5 = bit 6 = programmer alarm; bit 7 = high byte is acknowledge
228	D/C Voltage
229	Internal voltage
230	Battery voltage
231	local temperature x 10 in deg F or C based on degree
232	menu level for display
233	security level for menu
234	list limit for menu either menu_max or menu_over
235	current displayed page
236	Cell number to display
237	number of entries in Que
238	pressure reading in kPa * 100
239	pressure difference due to elevation in kPa * 100
240	sea level (barometric) pressure
241	pressure in atmospheres * 1000
242	pressure in inHG * 100
243	external temperature x 10 in deg F or C based on degree
244	external oxygen data from O2 instrument
* Register 245 not used	
246	H2 cell communications status
247	UB check result
248	check user block versus actual
249	check user block pointer
* Registers 700 to 709 not used	
710	indicates that co_data is valid
711	indicates that co2_data is valid
712	indicates that ch4_data is valid
* Registers 713 to 719 not used	
720	PIC 1 IR cell link to gas n
721	PIC 2 IR cell link to gas n

722 PIC 3 IR cell link to gas n
723 PIC 4 IR cell link to gas n
* Register 724 not used
725 PIC 1 span gas value
726 PIC 2 span gas value
727 PIC 3 span gas value
728 PIC 4 span gas value
* Registers 729 to 730 not used
731 IR shim factor
732 Pressure compensation factor; 0 = off, 10 = 1.0, max 2.0
733 CH4 factor
734 IR CO compensation factor
735 Control output assignment 1
736 Control output assignment 1
737 Control output assignment 1
738 Control output assignment 1
739 Calculation flag 0 = COF, 1 = MMI PF
740 pump ON delay timer
741 sample OFF delay timer
742 sample ON delay timer
743 Interval timer for COF/PF adjust
744 pump mode; 0 = off, 1 = on, 2 = auto
* Registers 745 to 749 not used
750 Dac 1 assignment
751 Dac 2 assignment
752 Dac 3 assignment
753 Dac 4 assignment
754 Dac 1 zero
755 Dac 1 span
756 Dac 2 zero
757 Dac 2 span
758 Dac 3 zero
759 Dac 3 span
760 Dac 4 zero
761 Dac 4 span
762 selected sequence storage (762 - 777)
4 sequence numbers per integer
* Registers 778 to 799 not used
800 Gas1/Gas2 ratio
* Registers 801 to 819 not used
820 HiTech CO compensation ratio * 1000
821 HiTech CO2 compensation ratio * 1000
822 HiTech CH4 compensation ratio * 1000
* Registers 823 to 824 not used
825 Calculated new factor for COF/PF adjust
826 pump control; 0 = off, 1 = on
* Registers 827 to 837 not used
838 calculate p trim value (need 92)
839 calibration timer
840 calibration inhibit (IN/OUT of range)
bits 0,8 = PIC 1 gas, bits 1,9 = PIC 2 gas, bits 4,12 = PIC 3 gas
bits 5,13 = PIC 4 gas
841 calibration function
* Registers 842 to 878 not used

879 If none, zero inhibits datalogging
880 Auto mount return code
881 Number of FAT devices available
882 MAX number of possible partitions
883 Partitions mounted (883 - 890)
891 File open return code
892 Number of log partition, 1 = A:, 5 = E:
893 return code of UDPDL_init()
* Registers 894 to 899 not used
900 product ID code
901 reset logging
902 Dynamic C compiler version in hex
903 long date/time stamp in secs from
904 midnight Jan 1, 1980.
905 Hack attempts counter
906 Web access code, level 1
907 Web access code, level 2
908 session ID passed to Java Applet
909 Set factory defaults control, 23205 (0x5aa5) to set
910 Force user block write; 0xa5 (165) = write w/o conf,
0xa9 (169) = write with config, 222 = write user setups, 444 = read user setups
* Registers 911 to 913 not used
914 4 locations for IP address (914 - 917)
918 4 locations for netmask (918 - 921)
922 4 locations for gateway (922 - 925)
* Registers 926 to 929 not used
930 10 locations for port states (930 - 939)
940 auto calibration interval timer
941 auto zero interval timer
942 auto cal/zero request; bit 0 = zero, bit 1 = span
943 auto cal/zero sequence
944 sequence timer
945 auto cal/zero status
946 Flag to initiate log of Auto cal
947 Number of entries in Auto cal log file
* Registers 948 to 949 not used
950 Auto sequence pointer
951 Auto sequence stage
952 Auto sequence timer
* Registers 953 to 995 not used
996 web page writes here as update indicator (996 - 999)

* Events IN/Output file_1[EVT_base][] offsets
1603 event output setpoint
1605 event output actual
1606 event output new setpoint

1698 events setpoint write reg

* Analog output file_1[DACbase][] offsets
1700 copy of com_stat + DACbase -1
1701 board address (lo Byte)
1701 baud rate; 0 = 9600, 1 = 19200 (hi Byte)

1702 DAC 0 zero calibration
1703 DAC 0 span calibration
1704 DAC 1 zero calibration
1705 DAC 1 span calibration
1706 DAC 2 zero calibration
1707 DAC 2 span calibration
1708 DAC 3 zero calibration
1709 DAC 3 span calibration
1710 DAC 0 Value
1711 DAC 1 Value
1712 DAC 2 Value
1713 DAC 3 Value
1714 DAC version

* computed values to send to DAC
1750 DAC 0 Output
1751 DAC 1 Output
1752 DAC 2 Output
1753 DAC 3 Output

* CPU file_1[PICbase][] offsets (100 per PIC)
* Actual signals

* register name	PIC 0	PIC 1	PIC 2	PIC 3
* AD0_reading	Pwr Supply	Abs Press	Int Thermister	Ext 0-1v (J8;5,6)
* AD1_reading	Int Supply	Diff Press	O2 signal	Ext 0-1v (J8;7,8)
* AD3_reading	Bat Voltage	Ext 0-5v	(J8;1,2) Ext Thermister	Ext 0-5v (J5;3,4)
* Dig Out 1	Sample cont	Pump control	N.U.	N.U.

1800 copy of PIC_com_stat
1801 A/D Input 0 reading
1802 A/D Input 1 reading
1803 A/D Input 3 reading
1804 sensor reading
1805 PIC address
1806 bit 0 = Digital input 1 (PIC 0 only)
bit 1 = nu
bit 2 = Digital input 2 (PIC 0 only)
bit 3 = nu
bit 4 = PIC addr bit 0
bit 5 = PIC addr bit 1
bit 6 = Digital output; 0 = OFF (low), 1 = ON (high)
bit 7 = nu
bits 8 - 15 = version number x100
1807 Digital output control
1808 PIC A/D control
1809 read control
1810 zero read data from EErom
1811 span read data from EErom
1812 write control
1813 zero write data to EErom
1814 span write data to EErom
1815 read working register
1816 write working register
1817 Cell star value to send (1817 - 1818)

1819 Command to send to cell
1820 sensor start up timer (500ms increments)
1821 read SPI
1822 SPI data counter, high byte
1823 SPI store state 0 = normal operation (store)
1 = receiving data from boss, 2 = OK to send to Cell, 4 = sending to cell
1824 timer on SPI response, 10ms inc
1825 indicates SPI responded
1826 Last command used
1827 Result of the last command
* Registers 1828 to 1829 not used
* Data sent by IR cell in master mode
1830 decimal place //debug
1831 gas reading
* calc structure
1832 deg C (1832 - 1833)
1834 volts (1834 - 1835)
1836 atten (1836 - 1837)
1838 zero_volts_tc (1838 - 1839)
1840 span_volts_tc (1840 - 1841)
1842 atten_tc (1842 - 1843)
1844 curve_in (1844 - 1845)

* cal structure
1846 degCZ (1846 - 1847)
1848 degCS (1848 - 1849)
1850 Zero_volts (1850 - 1851)
1852 Span_Volts (1852 - 1853)
1854 ztc (1854 - 1855)
1856 stc (1856 - 1857)
1858 zero_offset (1858 - 1859)
1860 span_target (1860 - 1861)
1862 Command
1863 Command result

* curve structure
1864 c_dummy (1864 - 1865)
1866 coeff_0 (1866 - 1867)
1868 coeff_1 (1868 - 1869)
1870 coeff_2 (1870 - 1871)
1872 coeff_3 (1872 - 1873)
1874 coeff_4 (1874 - 1875)
1876 coeff_5 (1876 - 1877)
1878 coeff_6 (1878 - 1879)
1880 coeff_7 (1880 - 1881)

* EEROM structure
1882 software revision (1882 - 1890)
* Define date_of_cal
1891 Filter
1892 span_offset (1892 - 1893)
* Registers 1894 to 1898 not used
* calculated values
1899 gas_value_adj

1900 copy of PIC_com_stat
1801 A/D Input 0 reading
1902 A/D Input 1 reading
1903 A/D Input 3 reading
1904 sensor reading
1905 PIC address
1906 bit 0 = Digital input 1 (PIC 0 only)
bit 1 = nu
bit 2 = Digital input 2 (PIC 0 only)
bit 3 = nu
bit 4 = PIC addr bit 0
bit 5 = PIC addr bit 1
bit 6 = Digital output; 0 = OFF (low), 1 = ON (high)
bit 7 = nu
bits 8 - 15 = version number x100
1907 Digital output control
1908 PIC A/D control
1909 read control
1910 zero read data from EErom
1911 span read data from EErom
1912 write control
1913 zero write data to EErom
1914 span write data to EErom
1915 read working register
1916 write working register
1917 Cell star value to send (1917 - 1918)
1919 Command to send to cell
1920 sensor start up timer (500ms increments)
1921 read SPI
1922 SPI data counter, high byte
1923 SPI store state 0 = normal operation (store)
1 = receiving data from boss, 2 = OK to send to Cell, 4 = sending to cell
1924 timer on SPI response, 10ms inc
1925 indicates SPI responded
1926 Last command used
1927 Result of the last command
* Registers 1928 to 1929 not used
* Data sent by IR cell in master mode
1930 decimal place //debug
1931 gas reading
* calc structure
1932 deg C (1932 - 1933)
1934 volts (1934 - 1935)
1936 atten (1936 - 1937)
1938 zero_volts_tc (1938 - 1939)
1940 span_volts_tc (1940 - 1941)
1942 atten_tc (1942 - 1943)
1944 curve_in (1944 - 1945)

* cal structure
1946 degCZ (1946 - 1947)
1948 degCS (1948 - 1949)
1950 Zero_volts (1950 - 1951)
1952 Span_Volts (1952 - 1953)

1954	ztc (1954 - 1955)
1956	stc (1956 - 1957)
1958	zero_offset (1958 - 1959)
1960	span_target (1960 - 1961)
1962	Command
1963	Command result

* curve structure

1964	c_dummy (1964 - 1965)
1966	coeff_0 (1966 - 1967)
1968	coeff_1 (1968 - 1969)
1970	coeff_2 (1970 - 1971)
1972	coeff_3 (1972 - 1973)
1974	coeff_4 (1974 - 1975)
1976	coeff_5 (1976 - 1977)
1978	coeff_6 (1978 - 1979)
1980	coeff_7 (1980 - 1981)

* EEROM structure

1982	software revision (1982 - 1990)

* Define date_of_cal

1991	Filter
1992	span_offset (1992 - 1993)

* Registers 1994 to 1998 not used
* calculated values

1999	gas_value_adj
2000	copy of PIC_com_stat
2001	A/D Input 0 reading
2002	A/D Input 1 reading
2003	A/D Input 3 reading
2004	sensor reading
2005	PIC address
2006	bit 0 = Digital input 1 (PIC 0 only) bit 1 = nu bit 2 = Digital input 2 (PIC 0 only) bit 3 = nu bit 4 = PIC addr bit 0 bit 5 = PIC addr bit 1 bit 6 = Digital output; 0 = OFF (low), 1 = ON (high) bit 7 = nu bits 8 - 15 = version number x100
2007	Digital output control
2008	PIC A/D control
2009	read control
2010	zero read data from EErom
2011	span read data from EErom
2012	write control
2013	zero write data to EErom
2014	span write data to EErom
2015	read working register
2016	write working register
2017	Cell star value to send (2017 - 2018)
2019	Command to send to cell
2020	sensor start up timer (500ms increments)

2021 read SPI
2022 SPI data counter, high byte
2023 SPI store state 0 = normal operation (store)
1 = receiving data from boss, 2 = OK to send to Cell, 4 = sending to cell
2024 timer on SPI response, 10ms inc
2025 indicates SPI responded
2026 Last command used
2027 Result of the last command
* Registers 2028 to 2029 not used
* Data sent by IR cell in master mode
2030 decimal place //debug
2031 gas reading
* calc structure
2032 deg C (2032 - 2033)
2034 volts (2034 - 2035)
2036 atten (2036 - 2037)
2038 zero_volts_tc (2038 - 2039)
2040 span_volts_tc (2040 - 2041)
2042 atten_tc (2042 - 2043)
2044 curve_in (2044 - 2045)

* cal structure
2046 degCZ (2046 - 2047)
2048 degCS (2048 - 2049)
2050 Zero_volts (2050 - 2051)
2052 Span_Volts (2052 - 2053)
2054 ztc (2054 - 2055)
2056 stc (2056 - 2057)
2058 zero_offset (2058 - 2059)
2060 span_target (2060 - 2061)
2062 Command
2063 Command result

* curve structure
2064 c_dummy (2064 - 2065)
2066 coeff_0 (2066 - 2067)
2068 coeff_1 (2068 - 2069)
2070 coeff_2 (2070 - 2071)
2072 coeff_3 (2072 - 2073)
2074 coeff_4 (2074 - 2075)
2076 coeff_5 (2076 - 2077)
2078 coeff_6 (2078 - 2079)
2080 coeff_7 (2080 - 2081)

* EEROM structure
2082 software revision (2082 - 2090)
* Define date_of_cal
2091 Filter
2092 span_offset (2092 - 2093)
* Registers 2094 to 2098 not used
* calculated values
2099 gas_value_adj
2100 copy of PIC_com_stat
2101 A/D Input 0 reading

2102 A/D Input 1 reading
2103 A/D Input 3 reading
2104 sensor reading
2105 PIC address
2106 bit 0 = Digital input 1 (PIC 0 only)
bit 1 = nu
bit 2 = Digital input 2 (PIC 0 only)
bit 3 = nu
bit 4 = PIC addr bit 0
bit 5 = PIC addr bit 1
bit 6 = Digital output; 0 = OFF (low), 1 = ON (high)
bit 7 = nu
bits 8 - 15 = version number x100
2107 Digital output control
2108 PIC A/D control
2109 read control
2110 zero read data from EErom
2111 span read data from EErom
2112 write control
2113 zero write data to EErom
2114 span write data to EErom
2115 read working register
2116 write working register
2117 Cell star value to send (2117 - 2118)
2119 Command to send to cell
2120 sensor start up timer (500ms increments)
2121 read SPI
2122 SPI data counter, high byte
2123 SPI store state 0 = normal operation (store)
1 = receiving data from boss, 2 = OK to send to Cell, 4 = sending to cell
2124 timer on SPI response, 10ms inc
2125 indicates SPI responded
2126 Last command used
2127 Result of the last command
* Registers 2128 to 2129 not used
* Data sent by IR cell in master mode
2130 decimal place //debug
2131 gas reading
* calc structure
2132 deg C (2132 - 2133)
2134 volts (2134 - 2135)
2136 atten (2136 - 2137)
2138 zero_volts_tc (2138 - 2139)
2140 span_volts_tc (2140 - 2141)
2142 atten_tc (2142 - 2143)
2144 curve_in (2144 - 2145)

* cal structure
2146 degCZ (2146 - 2147)
2148 degCS (2148 - 2149)
2150 Zero_volts (2150 - 2151)
2152 Span_Volts (2152 - 2153)
2154 ztc (2154 - 2155)
2156 stc (2156 - 2157)

2158	zero_offset (2158 - 2159)
2160	span_target (2160 - 2161)
2162	Command
2163	Command result

* curve structure

2164	c_dummy (2164 - 2165)
2166	coeff_0 (2166 - 2167)
2168	coeff_1 (2168 - 2169)
2170	coeff_2 (2170 - 2171)
2172	coeff_3 (2172 - 2173)
2174	coeff_4 (2174 - 2175)
2176	coeff_5 (2176 - 2177)
2178	coeff_6 (2178 - 2179)
2180	coeff_7 (2180 - 2181)

* EEROM structure

2182	software revision (2182 - 2190)

* Define date_of_cal

2191	Filter
2192	span_offset (2192 - 2193)

* Registers 2194 to 2198 not used
* calculated values

2199	gas_value_adj
8600	1 to 4 char label for gas 1 (8600 - 8609)
8610	1 to 4 char label for gas 2 (8610 - 8619)
8620	1 to 4 char label for gas 3 (8620 - 8629)
8630	1 to 4 char label for gas 4 (8630 - 8639)
8640	1 to 4 char label for gas 5 (8640 - 8649)
8650	1 to 4 char label for gas 6 (8650 - 8659)
8660	1 to 4 char label for CV 1 (8660 - 8669)
8670	1 to 4 char label for CV 2 (8670 - 8679)
8680	1 to 4 char label for CV 3 (8680 - 8689)

* Registers 8690 to 8694 not used

8695	Que_0 status
8696	Que_1 status
8697	generic que inst number
8698	generic que register
8699	generic que data

Revision History

Rev.	Description	Date	MCO #
-	**Initial Release**	**06/08/06**	**N/A**
A	**Clarification of manual (Specifications, Part # Designations, Electrical Connections, Sample Delay,4-20 mA Output Assignment menu option)**	**06/28/06**	**2036**
B	**Added Cooler On/Cooler Off to Menu Option 5** *Set Display Values*	**08/08/06**	**2037**
C	**Added "WARNING" and Digital Input operation**	**4/18/2007**	**2043**
D	**Updated "Revision History" section – Added "MCO #" column; Updated logo on title page; Changed format of footer; Pump control is from screen 4 only; Adjusted "Communications Setup" menu option to include 2 screen shots; Adjusted screen shot formats to allow text around picture; Added "Appendix 1- MGA Side Vents"; Added "Appendix 2 – MGA Modbus Registers"**	**2/26/2008**	**2052**
E	**Adjusted Calibration Gas ratios**	1/24/2018	2226