

EMS

EMISSIONS SYSTEMS, INC.

Portable Exhaust Gas Analyzer Operators Manual Rev.5

Model # 5001 (4 & 5 Gas)

Model # 8000 (Wireless)



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General Information

Congratulations on your purchase of an EMS Exhaust Gas Analyzer. This product is designed to assist you in the process of diagnosing driveability issues. With proper care and maintenance this product will provide accurate information for many years to come.

Figure 1 highlights the features and buttons available on the Model 5001 front display area. If you purchased a 4-Gas analyzer the “O2/NOX” button is inactive. The “Z”, “P” and “C” buttons will be described in detail later in this manual.

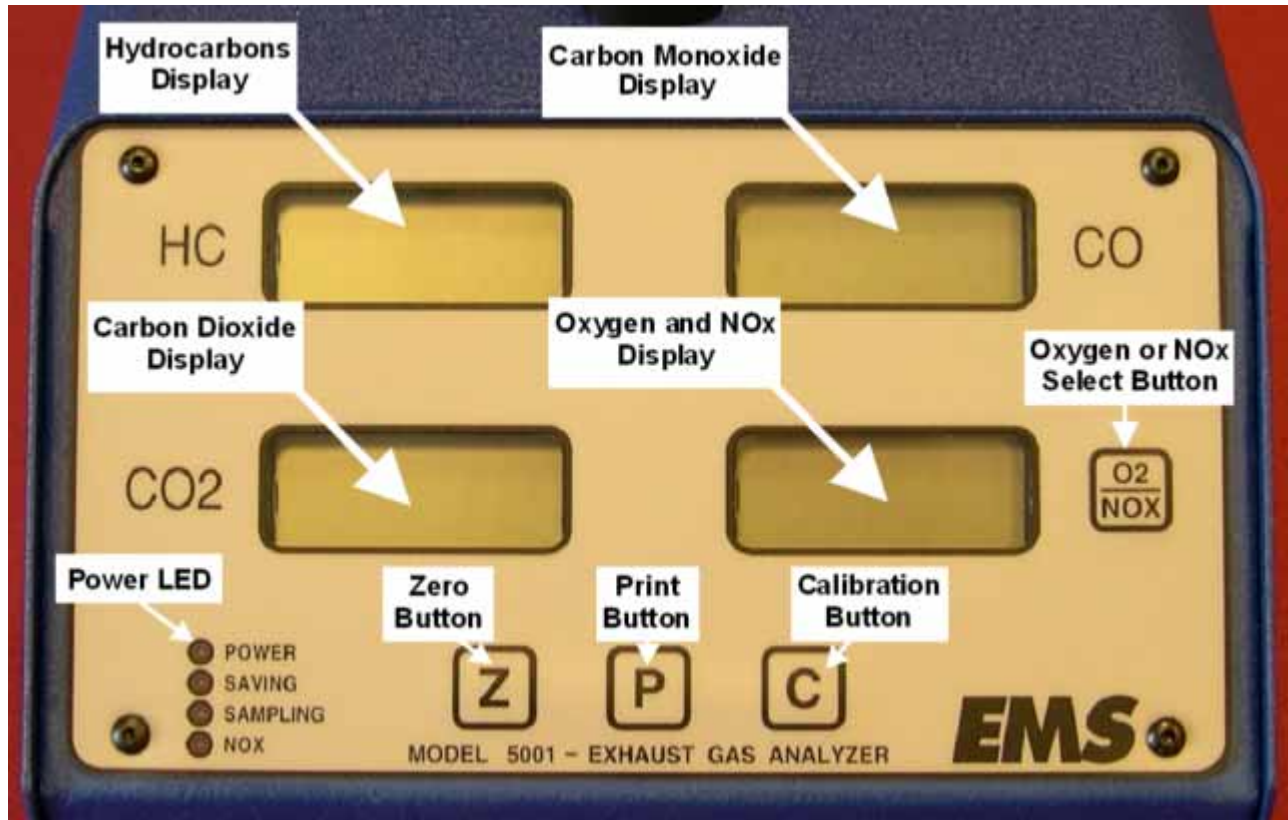


Figure 1

LED and Button Operation Model 5001



Figure 2

Figure 2 shows the LED display from the lower left corner of the gas analyzer:

1. Power LED: This LED will illuminate when power is applied to the analyzer.
2. Saving LED: This LED is not currently used.
3. Sampling LED: This LED is illuminated when the pump is operating.
4. NOx LED: This LED indicates a NOx cell is present (**5-Gas Analyzer only**).

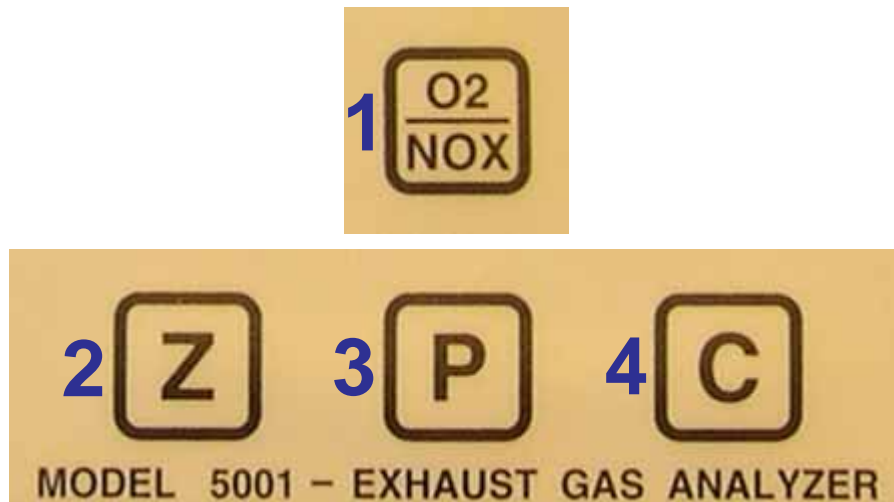


Figure 3

Figure 3 shows the control buttons on the front of the gas analyzer:

1. The “**O2/NOx**” button is used on 5-Gas analyzers only. The O2/NOx button switches the display from reading Oxygen to reading NOx. The default following warm-up or restart is O2. Switching from O2 to NOx, press the O2/NOx button, hold down until the decimal point disappears and then release the button. The analyzer will now display NOx.
2. The “**Z**” button has several functions.
 - a. Zeroing the gas analyzer as needed during use.
 - b. Restarting the pump following automatic shutdown.
 - c. Used along with the “**C**” button to begin calibration and changing values.
3. The “**P**” button is used to print a snapshot of gas reading information. A parallel printer will need to be connected to the 25 pin connector on the back of the analyzer.
4. The “**C**” button is used to calibrate the gas analyzer. The calibration procedure will be explained in detail later in this manual.

Rear Panel Description

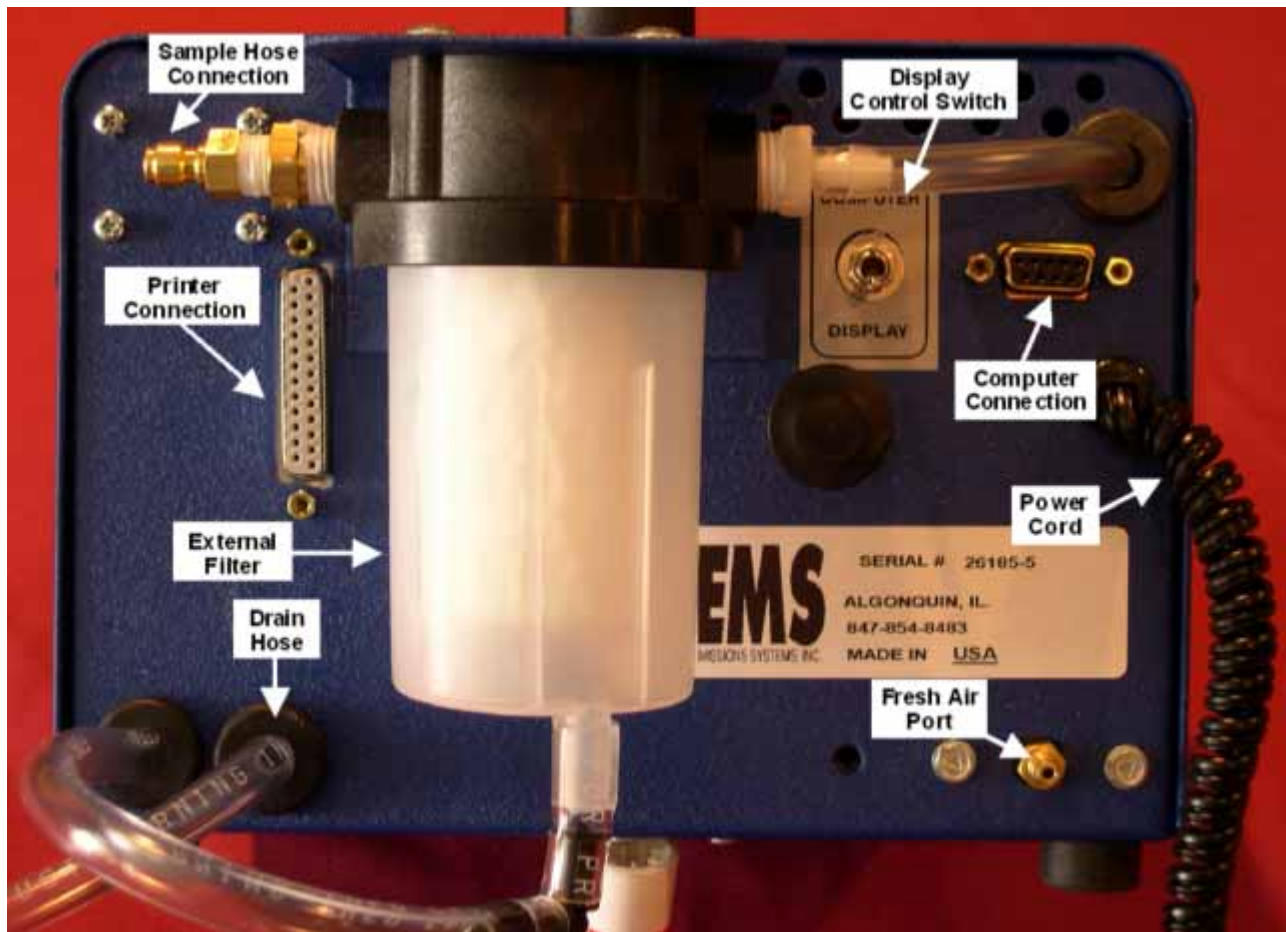


Figure 4

Figure 4 shows the view from the back of the analyzer. The specific details of each item are described below, starting from the upper left corner of the analyzer and working clockwise.

Sample Hose Connection: The sample hose connection uses a quick disconnect coupler. This is helpful for storage of the analyzer and maintenance of the sample hose.

Display Control Switch: The display switch has two basic positions, Computer and Display. The switch should normally be in the lower position "Display". If you are using PC software for display or recording, the switch should be in the up position. **Note: If the analyzer is not displaying gas values after warm-up, the display switch may be in the computer position.**

Computer Connection: This is used to connect the analyzer to the PC.

Power Cord: Connect to the appropriate voltage supply source.

Fresh Air Port: The analyzer uses this for fresh air sampling. **Do not plug.**

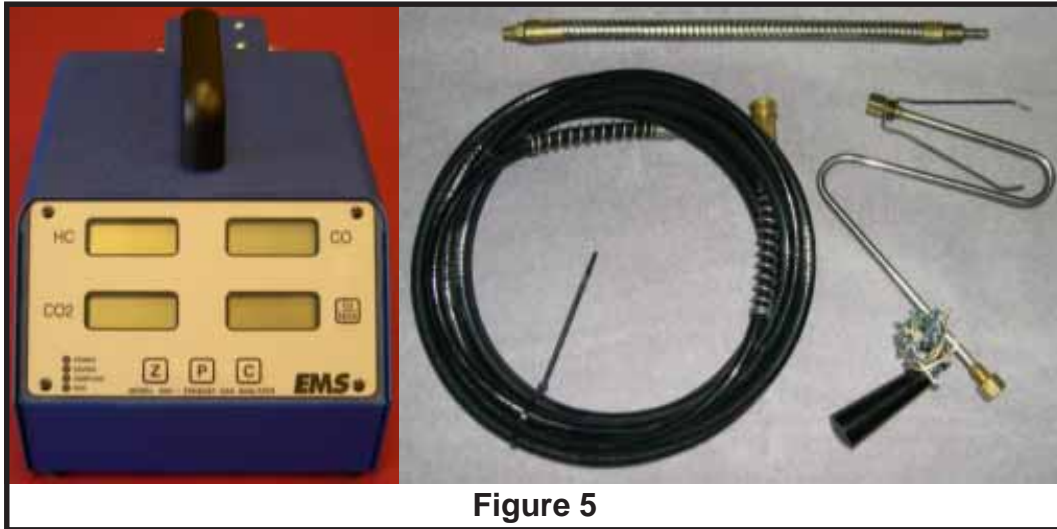
Drain Hose: This hose will drain moisture collected during the sample process.

External Filter: This is the primary sample filter. Filter maintenance will be discussed in the Maintenance section of this manual.

Printer Connection: Connect to an approved parallel printer.

Gas Analyzer Preparation

Getting started is simple. Figure 5 shows the items you should have received in the shipping container. **Note: This description applies to the Model 5001 analyzer with a display, see Page 13 for instructions on setting up a Model 8000 bluetooth wireless analyzer.** The first step is assembling the sample hose. Once the sample hose is assembled, connect the hose to the sample hose fitting on the back of the analyzer.



The next step is providing power to the analyzer. The analyzer should be connected to a 12v DC power source. You have several options:

1. Cigarette Lighter Connection - Figure 6
2. Cigarette lighter to battery connection with adapter - Figure 7
3. AC to DC Power Supply - Figure 8 (Radio Shack Model #22-504)



Figure 6



Figure 7



Figure 8

The Power LED in the lower left corner of the display will light once voltage is applied.

Gas Analyzer Operation

Immediately after applying power, the analyzer will display 8's (Figure 9) for a few seconds and then flash dashes (Figure 10). This starts the analyzer warm-up mode and will continue for approximately 5 to 10 minutes, depending on ambient temperature. Once the warm-up mode is complete, the analyzer will go into the gas sample mode (Figure 11) and the Sample LED will turn ON. **Note: If the display only shows decimal points (Figure 12), check the "Display/Computer" switch on the back of the analyzer. The switch should be in the display position. Disconnect power before changing the switch position.**



Figure 9



Figure 10



Figure 11



Figure 12

Once the analyzer has completed the warm-up process the sample hose can now be connected and the probe placed in the tailpipe.

Caution: Exhaust gases pass through the gas analyzer and vent through its exhaust tubing. Use the analyzer in a well vented area.

Note: Gas analyzers are designed for diagnostics and verification of repairs. The sample probe should be removed from the tailpipe after taking readings to prolong analyzer life and save on maintenance costs.

The pump will continue to operate as long as the CO₂ level is above 3%. The pump will automatically shut-off after the CO₂ level has been below 3% for approximately 15 minutes. The pump can be turned back on by depressing the "Z" button.

Caution: Monitor the clear hose between the filter assembly and the cabinet. If moisture appears in the tubing, remove the probe from the tailpipe and disconnect the sample hose from the analyzer immediately. Use compressed air to remove moisture from the sample hose. Operate the analyzer without the exhaust hose connected, until the moisture is removed. It may be necessary to replace the filters. Once the lines are dry, normal operation can continue.

Gas Analyzer Operation

Manual Zero: Any time after warm-up, you can zero the gas readings and calibrate O₂ by pressing the “Z” button. If the pump is off, it will automatically start. **Note: The sample probe should be removed from the tailpipe, when the unit is being zeroed.**

Automatic Zero: The analyzer will automatically zero as needed. If the analyzer does not sense exhaust gases, the automatic zero procedure will begin. The Sample LED will flash during this process. If exhaust gases are present, the analyzer will wait until the gases are clear.

Low Flow Warning: If gas flow into the bench becomes restricted due to clogged filters or restricted sample hose, the “HC” display will show “LO” (Figure 13). The other gas displays will be blank. Check the sample hose for restrictions or kinks. If no problems are found, check the filters. Begin with the External filter and then check the Internal filter. Keep in mind the gas flows through the inside to the outside of the filter. The filter may look clean on the outside, but be clogged on the inside.



Figure 13

Printing: Connect a parallel printer to the 25 pin connector on the back of the analyzer. Press the “P” button to begin the printing process. **Note: To avoid print communication problems, connect and power on the printer first, then provide power to the analyzer.**

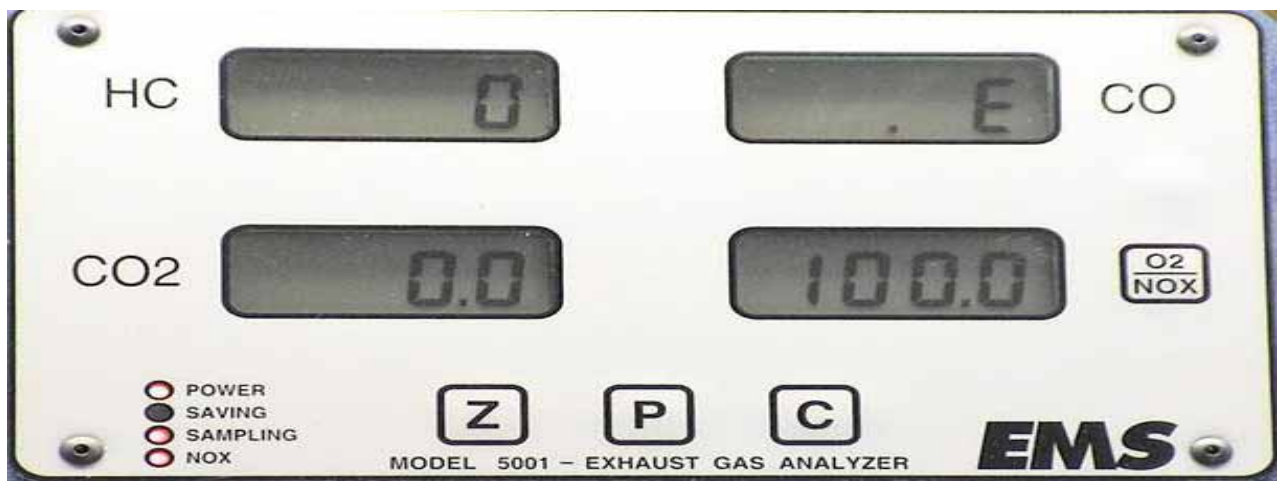
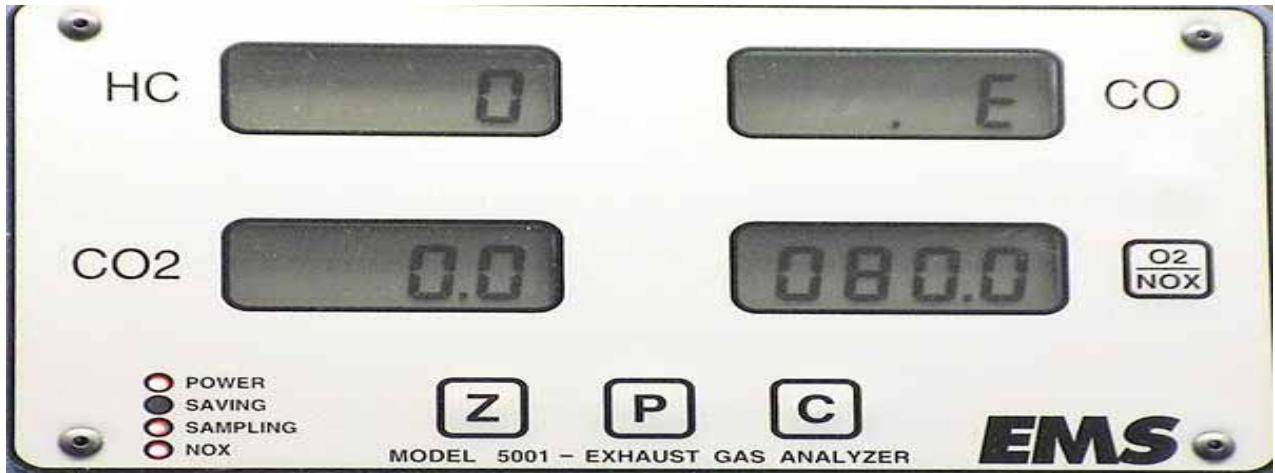
Computer Connection: PC software can enhance the diagnostic benefits of the analyzer. The analyzer can be connected to a PC using a 9 pin serial communications cable. EMS offers software that will display the sample gases, graph data and record information. Using the portable gas analyzer with a laptop will help diagnose problems that only occur when driving. The EMS software will be discussed later in this manual.

ERROR CODES

O2 Sensor Error Code: Any time after warm-up, you can get a O2 sensor error code that will be shown with an “E” in the CO window, and a number “800” in the O2/NOX window. When this error message is displayed, a new O2 sensor needs to be installed. See maintenance for the O2 sensor replacement.

NOX Sensor Error Code: Any time after warm-up, you can get a NOX sensor error code that will be shown with an “E” in the CO window, and a number “1000” in the O2/NOX window. When this error message is displayed, a new NOX sensor needs to be installed. See maintenance for the O2 sensor replacement.

Optical Bench Error Codes (HC,CO,CO2): Any time after warm-up, you can get an error code that will be shown with an “E” in the CO window, and a number “100” in the O2/NOX window indicates HC out of range, “200” in the O2/NOX window indicates CO out of range, “400” in the O2/NOX window indicates “CO2” out of range. When this error message is displayed, the analyzer MUST be sent to EMS for a bench diagnosis. Please send the unit to 801 N. Harrison St., Algonquin IL. 60102, and indicate in writing what the error code is that occurred.



Calibration

The gas analyzer should be checked periodically for accuracy. The analyzer can be calibrated in the field. In order to perform the calibration procedure you will need a bottle of calibration gas and a calibration kit assembly (Figure 14). The calibration assembly can be purchased from EMS or your local distributor. The recommended calibration gas is Bar 97 Low and can be purchased from Scott Speciality Gases 1-909-887-2571, Part No. 02-04-C506645--3.

Calibration Procedure:

1. To begin the calibration procedure depress the “Z” and “C” buttons together. **Note: If the “C” button is pushed too late the analyzer will begin the zeroing procedure. If this occurs, wait until the the zero procedure is complete and try again.** The analyzer display will go blank if the buttons are depressed properly. Release the buttons and the display will show the stored calibration gas values. Compare these numbers to the calibration gas bottle. If the numbers do not match, they can be changed using the “Z” and “C” buttons. The “C” button will change the number that is flashing. Once the flashing number is adjusted to the correct value, the “Z” button is be used to cycle to the next digit. This process is continued until all the calibration gas values are correct.

Note: The NOx gas concentration value is displayed in the 02 window.

2. Once the calibration gas values have been verified or adjusted, the calibration procedure can continue. Depress the “Z” and “C” buttons together. The analyzer display will go blank. Release the buttons and the analyzer will begin the calibration sample mode. The display will show current sample values and then display dashes.

3. Connect the hose from the regulator assembly to the sample hose inlet. Open the valve on the gas bottle. **(Note: Do not adjust the regulator, this was preset to the appropriate flow value.)** Once the calibration gas values stabilize, depress the “C” button. The analyzer will capture the gas concentrations and perform the final calibration procedure. The calibration process is now complete.

4. If the calibration procedure was unsuccessful, error numbers will flash along with the sample numbers. If this occurs, perform the calibration procedure again. If the problem continues, contact EMS or your local distributor



Figure 14

Maintenance

Maintenance of the analyzer is essential for accuracy and optimal performance. The filters, hoses and connections should be checked on a regular basis. Maintenance of the gas analyzer is simple and only requires a few minutes, but the time you spend will pay off, with accuracy during the diagnostic process. Specific maintenance procedures are described below:

External Analyzer Maintenance:

1. The exhaust sample hose should be cleaned once a week (Figure 15). Disconnect the hose from the filter assembly and blow shop air through the hose. This will remove carbon, dirt and moisture that collects inside the hose. The exhaust probe tip should be checked for leakage around the flex tube. Exhaust gas should only enter through the holes in the exhaust tip end. If the flex tube is worn and loose, oxygen may enter around the worn flex tube. A simple way to check the flex tube is blowing shop air through the hose and spraying soapy water around the flex tube. If bubbles are seen the exhaust probe tip should be replaced. The sample hose and plumbing should be checked for leaks. Checking for leaks is simple, with the analyzer in sample mode, place a rubber cap over the probe tip holes. Within a few seconds the analyzer display should read low flow. If this does not occur a leak is present in the system. Check the sample hose for leaks first, check the external filter next and finally the internal hoses. Contact EMS or your local distributor for assistance if required.

2. The External Filter should be checked often (Figure 16). This filter catches most of the particles and impurities. The life-cycle of this filter depends on usage, but the average shop replacement is 6 months. To determine the correct replacement interval for your shop, check the filter once a month. Keep in mind the exhaust gas flows from the inside of the filter to the outside, so the filter may look good on the outside, but be plugged on the inside. To check the condition of the filter, view it from the bottom of the bowl or remove the filter and look inside. Another way to keep track of replacement intervals is to write the replacement date on the filter with a marker.

Filter Replacement:

- a. Disconnect the hose from the bottom of the filter.
- b. Rotate the filter counter-clockwise to remove.
- c. The new filter o-ring should be lubricated prior to installation.
- d. Re-install the filter assembly clockwise hand tight.

Figure 15



Sample Hose Assembly

Figure 16



External Filter

Maintenance

Internal Analyzer Maintenance:

The maintenance items discussed below are located inside the analyzer. The outside cover will need to be removed to gain access. The cover is held in place with 11 screws, 5 on each side panel and one at the top behind the handle.

3. The Internal Filter is located inside the analyzer (Figure 17). This filter is designed to catch particles missed by the External Filter. The replacement interval varies, but a good starting point, is replacing the filter every other time you replace the External Filter. Note: This filter is directional, check the arrow on the filter.

4. Oxygen Sensor should be replaced as required (Figure 18). Replacement intervals will vary, but the average life-cycle is 9 to 12 months. A fault code will flash when the sensor needs to be replaced, the analyzer cannot be used until the sensor is replaced. To avoid unexpected down time, the O₂ sensor display can be monitored, if the reading drops below 17.0% the O₂ sensor should be replaced. The oxygen sensor is located inside the analyzer.

a. Remove the analyzer cover. Note: The power should be disconnected prior to cover removal. The sensor is located at the left rear of the analyzer (Figure 18).

b. Disconnect the two wire connector from the sensor. Rotate the sensor counter-clockwise.

c. Install the new sensor, rotate clockwise until the o-ring seats. Re-connect the two wire connector. Replace the cover and power the analyzer. No additional steps are required.

5. NO_x Sensor should be replaced as required (Figure 19). Replacement intervals will vary. A fault code will flash when the sensor needs to be replaced.

a. Remove the analyzer cover. Note: The power should be disconnected prior to cover removal. The sensor is located at the left rear of the analyzer (Figure 19).

b. Disconnect the four wire connector from the sensor. Rotate the sensor counter-clockwise.

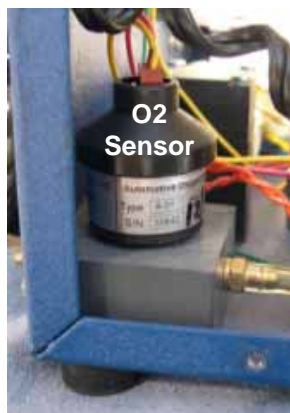
c. Install the new sensor, rotate clockwise until the o-ring seats. Re-connect the four wire connector. Replace cover and power the analyzer. No additional steps are required.

Figure 17



Internal Filter

Figure 18



Oxygen Sensor

Figure 19



NOx Sensor

Maintenance

Spare Parts and Accessories

Part No: Description

EMS-5060	Oxygen Sensor
EMS-5065	NOx Sensor
EMS-5093	Internal Filter
EMS-5095	External Filter
EMS-5096	Exhaust Hose
EMS-5097	Exhaust Handle
EMS-5098	Exhaust Tip
EMS-5210	Power Cord
EMS-5500	Gas Calibration Kit
EMS-5020	12V Sample/Water Pump
EMS-5030	12V Solenoid
EMS-5040	Optical Bench
EMS-5050	Flow Switch
EMS-5070	External Filter Head
EMS-5250	Display PC Board
EMS-5200	Front Membrane Switch

Wireless Gas Analyzer



The latest innovation from EMS is the Bluetooth wireless gas analyzer. The gas analyzer may be equipped with or without a display. The function of the gas analyzer is exactly the same. The only difference is the PDA software. The next few pages will describe the PDA software. **Note: Download the Palm Software first and then install the EMS Software.**

1. The first step is to power-up the gas analyzer and PDA.
2. Figure 1 shows the home screen for most PDA's. In the center of the screen you will find the **Emissions** icon. Tap the **Emissions** icon to launch the software.
3. Figure 2 shows the data display screen. During the warm-up process a note above the Record button shows "Warming up" and just the right you will see a counter. In this example, the warm-up process has 98 seconds remaining. **Note: The display control switch at the back of the analyzer must be in the display position.**

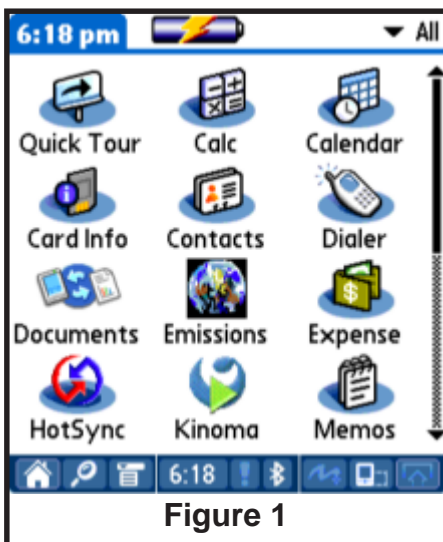


Figure 1

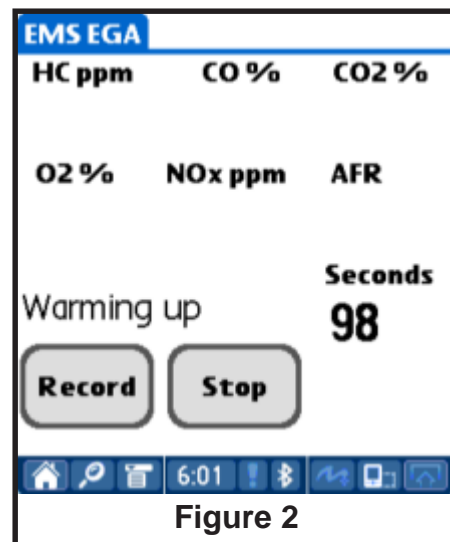


Figure 2

Wireless Gas Analyzer

4. Figure 3 shows the gas analyzer in sample mode. Tapping the **Emissions** icon in the upper left hand corner, opens two new menu options. **Gas Analyzer** (Figure 4) and **Options** (Figure 5).

5. The drop down box in (Figure 4) controls the gas analyzer:

- Restart:** Tapping this button restarts the gas analyzer.
- Set Zero:** Tapping this button zeros the gas analyzer (Figure 6).
- Calibrate:** Tapping this button begins the calibration procedure.
- Pumps Off:** Tapping this button turns the gas analyzer pumps off.

6. The drop down box in (Figure 5):

- Preferences:** Tapping this button brings up the display preference screen (Figure 7). This screen allows you to change Test Time, O2 Value, NO Display, AFR/Lambda Display and Transmit/Receive (Tx-Rx) Display. The Tx-Rx shows the communication from the Palm to Analyzer Antenna. Fast switching indicates strong signal and slow indicates a weak signal.

- About wGas:** Tapping this button provides information about the software version (Figure 8).

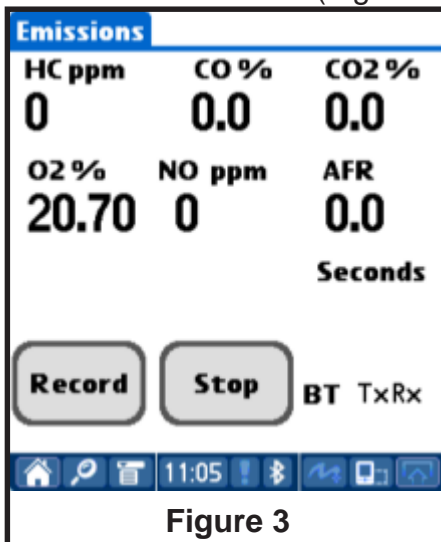


Figure 3

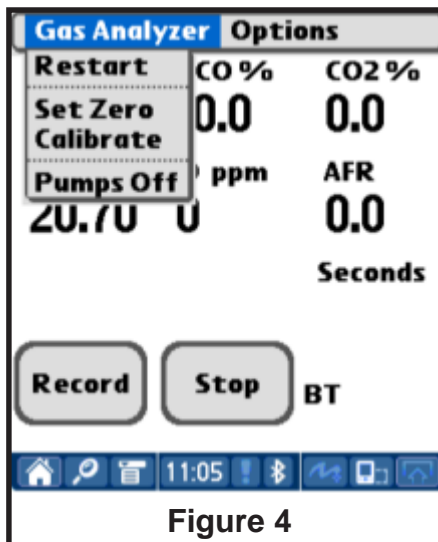


Figure 4

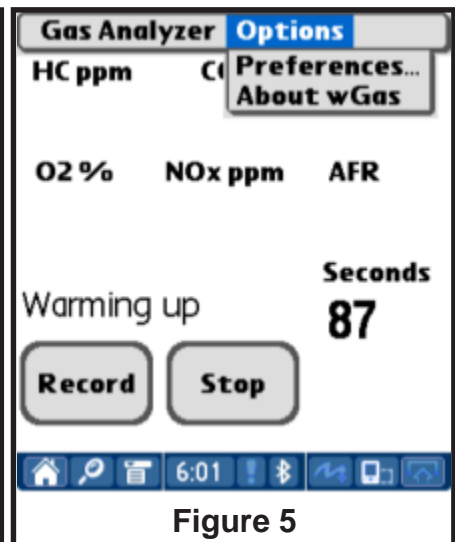


Figure 5

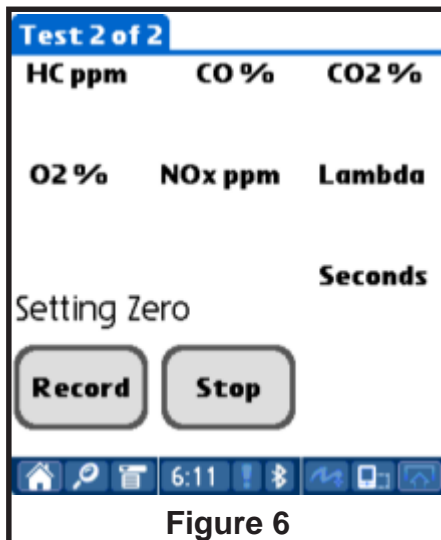


Figure 6



Figure 7



Figure 8

Wireless Gas Analyzer

7. Figure 9 shows the **Preferences** screen. Figures 10-13 demonstrate changes made to the display **Preferences**:

- O2 as XX.XX and O2 as XX.X**: Figure 10 shows O2% displayed with two decimal point resolution for maximum accuracy. Figure 13 shows O2% displayed with one decimal point resolution.
- Show NO**: Figure 10 shows NOx displayed in ppm. In Figure 12 NOx is not displayed.
- Test Time**: The recording time can be adjusted in this box. Figure 9 shows the current time set to 30 seconds.
- AFR, Lambda and Neither**: This changes the desired air/fuel calculations. Figure 10 displays AFR (Air/Fuel Ratio), Figure 11 displays Lambda and Figure 13 shows Neither.
- Show Tx-Rx**: This shows the communication strength between the Palm and Analyzer Antenna.



Figure 9

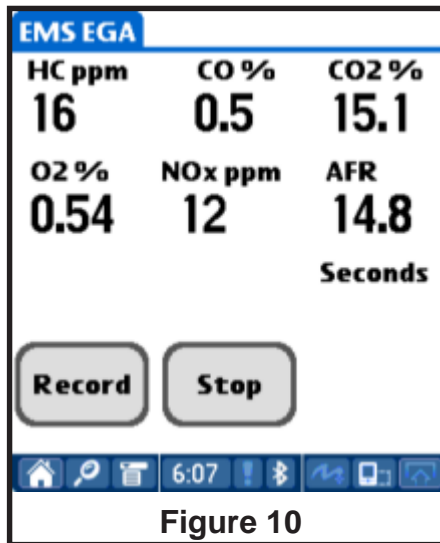


Figure 10

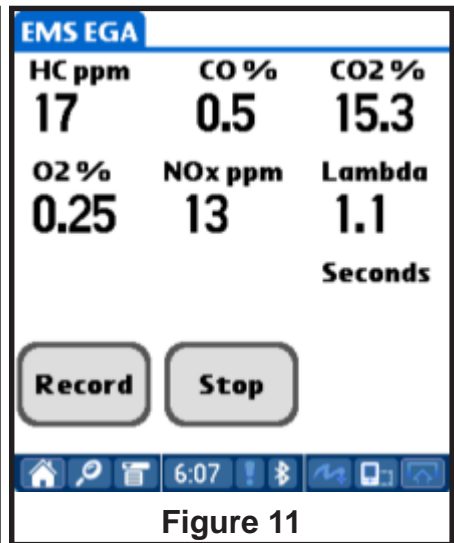


Figure 11

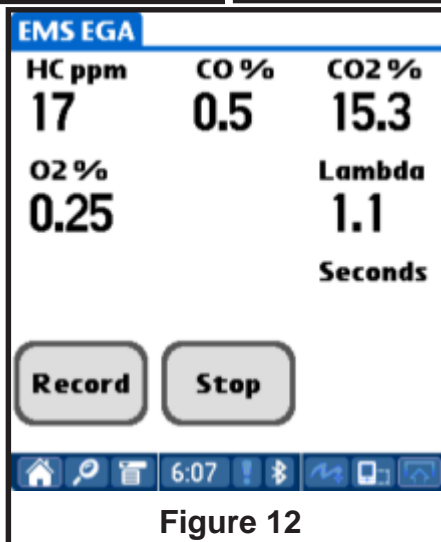


Figure 12

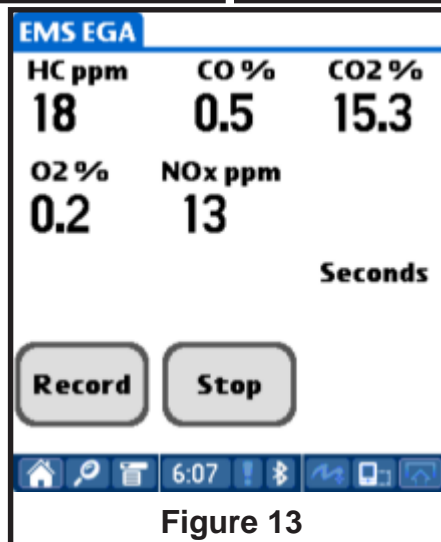


Figure 13

Wireless Gas Analyzer

8. This section will explain recording a test and transferring the data to the PC. Figure 14 shows a sample Test recording.

- a. To record a test, set the Test Time in the Preferences screen to the desired recording length in seconds.
- b. Insert the sample hose into the tailpipe. Once the gases begin to display, tap the record button on the sample display screen lower left. The top of the sample screen will show Test 1 of 1 and a Seconds counter will begin. The recording will stop once the Test Time has expired or when the Stop button is tapped. Additional tests may be captured by tapping the Record button. The title at the top of the screen will change from Test 1 of 1 to Test 2 of 2.
- c. To transfer the tests, insert the Palm into the Palm cradle and HotSync to the PC. After the HotSync is complete, open the EMS Database Software. Select Find Owner/Vehicle button. The next screen will display all the available Tests that have been saved into the database. The most recent tests can be identified by looking at the date. **Note: the test date will be the date the HotSync was performed.** Once this is opened it will show the total number of tests made with a test number. At this point the tests can be opened or saved to the database as a particular Name, Vehicle, File, etc.

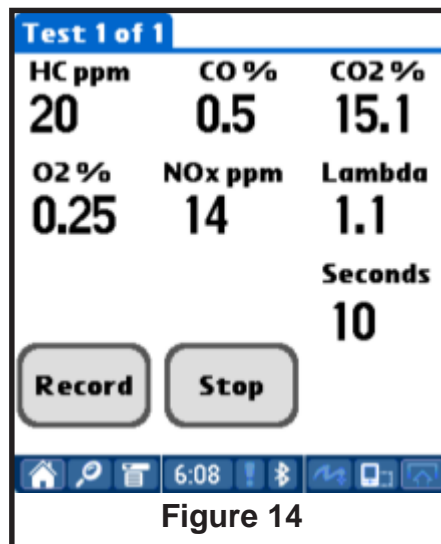


Figure 14

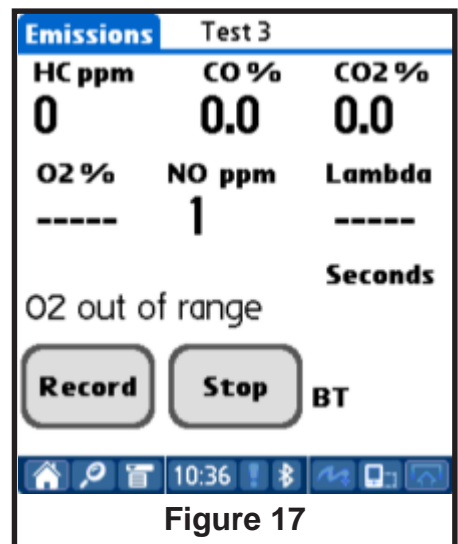
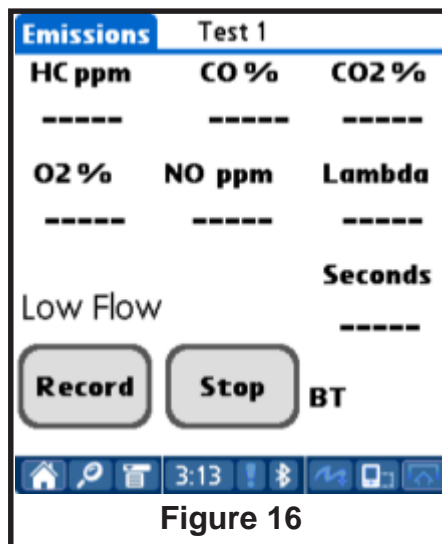
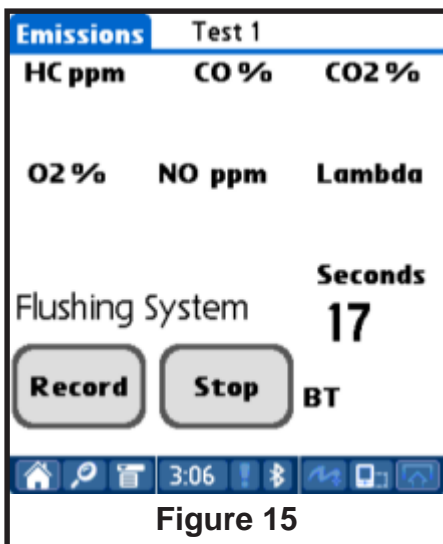
Wireless Analyzer Messages

9. The gas analyzer displays various messages through the Palm screen. The messages may indicate normal system operation, faults or analyzer maintenance.

a. Figure 15 - Flushing System Message: The Flushing System message displays under two conditions. 1) If the pump is operating and the CO₂% reading drops below 3.0% for a set period of time, the gas analyzer will begin a system flushing procedure. 2) The Flushing System message will appear as part of a Zeroing procedure.

b. Figure 16 - Low Flow: The Low Flow message appears when the volume of air flow through the gas analyzer is low. This message will appear if the sample hose is kinked/restricted or if the filters are clogged.

c. Figure 17 - O₂ out of range: The O₂ out of range message will appear when the O₂ sensor reading is out of specification. Normal O₂ sensor readings should be approximately 21%, with the pump running, sampling ambient air. To avoid unexpected down time, the O₂ sensor display can be monitored, if the reading drops below 17.0% the O₂ sensor should be replaced.



Gas Analyzer Usage

Exhaust gas analyzers can be used to diagnose driveability concerns, ignition system problems, fuel management issues, engine mechanical problems, excessive emissions problems and many other vehicle systems. Vehicle inspection and preparation are the keys to getting the most out of your gas analyzer.

1. A visual inspection should include; vacuum hoses, air filter, exhaust system, air management system, emission related components, etc. If the malfunction indicator light (MIL) is illuminated, check the diagnostic trouble codes (DTC's) prior to testing.
2. Vehicle preparation:
 - a. The engine should be at operating temperature prior to testing.
 - b. Start the engine and run until the cooling fan cycles on and off. Another option is using a scan tool to check the engine coolant temperature (ECT). The temperature should exceed 190 degree F.
 - c. After the engine is warm, increase the engine speed to 2500 RPM for approximately 60 seconds.
 - d. Return the engine speed to idle.
 - e. Insert the sample probe and begin your diagnostics.

Understanding the relationship of exhaust gases will enhance your ability to diagnose driveability issues. The Exhaust Gas Relationship Chart will provide a few suggestions:

Exhaust Gas Relationships	
Potential Problems	Hydrocarbon
	HC (PPM)
Normal combustion efficiency	Low
Engine Mechanical Issues	High
Cooling System Issue-Cold Engine	High
Ignition misfire, false air, lean condition	High
Rich mixture	Slightly High
Rich mixture with ignition misfire condition	High
Exhaust leak and air injection issues	Low
Lean mixture	High

Exhaust gas analyzers can be used to diagnose other vehicle systems. Here are a few suggestions:

1. Evaporative emission system operation.
2. Evaporative emission system leaks.
3. Fuel odors in and around the vehicle.
4. No-Start conditions.
5. Engine combustion gases in the cooling system.
6. Air injection emission systems.
7. Exhaust system leaks.
8. More...

Warranty

- Emission Systems products are guaranteed to be free of defects in material and workmanship to the original purchaser, for a period of one year from the date of purchase. Probes and electrical leads are warranted for ninety days. The optical bench is warranted for three years.

- This warranty does not apply to products which have been:

- 1) Altered
- 2) Improperly installed, maintained or repaired.
- 3) Damaged by accident, negligence or misuse.

- **THIS WARRANTY EXCLUDES ALL INCIDENTAL OR CONSEQUENTIAL DAMAGES**

- If you suspect there is a problem with your unit, the operating manual should be reviewed first. Your particular problem may be covered in the operating instructions. If the issue cannot be resolved, contact EMS or your authorized distributor for additional information. If the unit requires repair, contact EMS to obtain a Return Authorization Number. The unit should be properly packaged and should include all accessories. The unit will be returned in the shortest possible timeframe.

- In the USA and Canada call: 847-854-8483 for assistance.

- Outside USA call your authorized distributor for assistance.

Warranty Information:

- Date of Purchase: _____

- Serial Number: _____