

# INSTALLATION INSTRUCTIONS PRO PLUS WIDE BAND AIR/FUEL RATIO MONITOR



## Installation

1. Disconnect the negative (-) battery cable.
2. Gauge can be mounted in a 2 1/8" dia. hole with brackets supplied. Gauge can also be mounted in Auto Meter Mounting Cup, or in Auto Meter Gauge Works Pods.
3. Wire gauge as shown.

### WARNING

Sender Will Get Very Hot During Operation.

### CAUTION!

As a safety precaution, the red wire of this product should be fused before connecting to the 12V ignition switch. We recommend using a 3 AMP automotive type fuse.

Connect Data Acquisition Unit and Air/Fuel Ratio Monitor to a common grounding point

### Red Wire(Power):

Connect to a fused and switched 12V positive source that is turned on and off with the ignition switch. Place a 3 amp automotive fuse (available commercially) in line with this connection to protect your gauge. It is recommended that vehicles without alternators connect this wire to a separate switch or direct to the vehicle's master cutoff switch. (See Sensor Heating Element Section)

### Black Wire(Ground):

Connect to good engine ground.

### Brown Wire(Optional Peak/Recall & Warning WOT Switch):

Connect to Wide Open Throttle Switch. Required for Peak Recall and Alarm/Warning Functionality.

### Blue Wire (Optional Data Logger Signal Output):

Connect to signal input(+) or Engine Management System or Data Acquisition unit.

### Blue/Black Wire (Optional Data Logger Signal Ground):

Connect to signal input(-) on Engine Management system or Data Acquisition Unit.

### Orange (Pro Control Output):

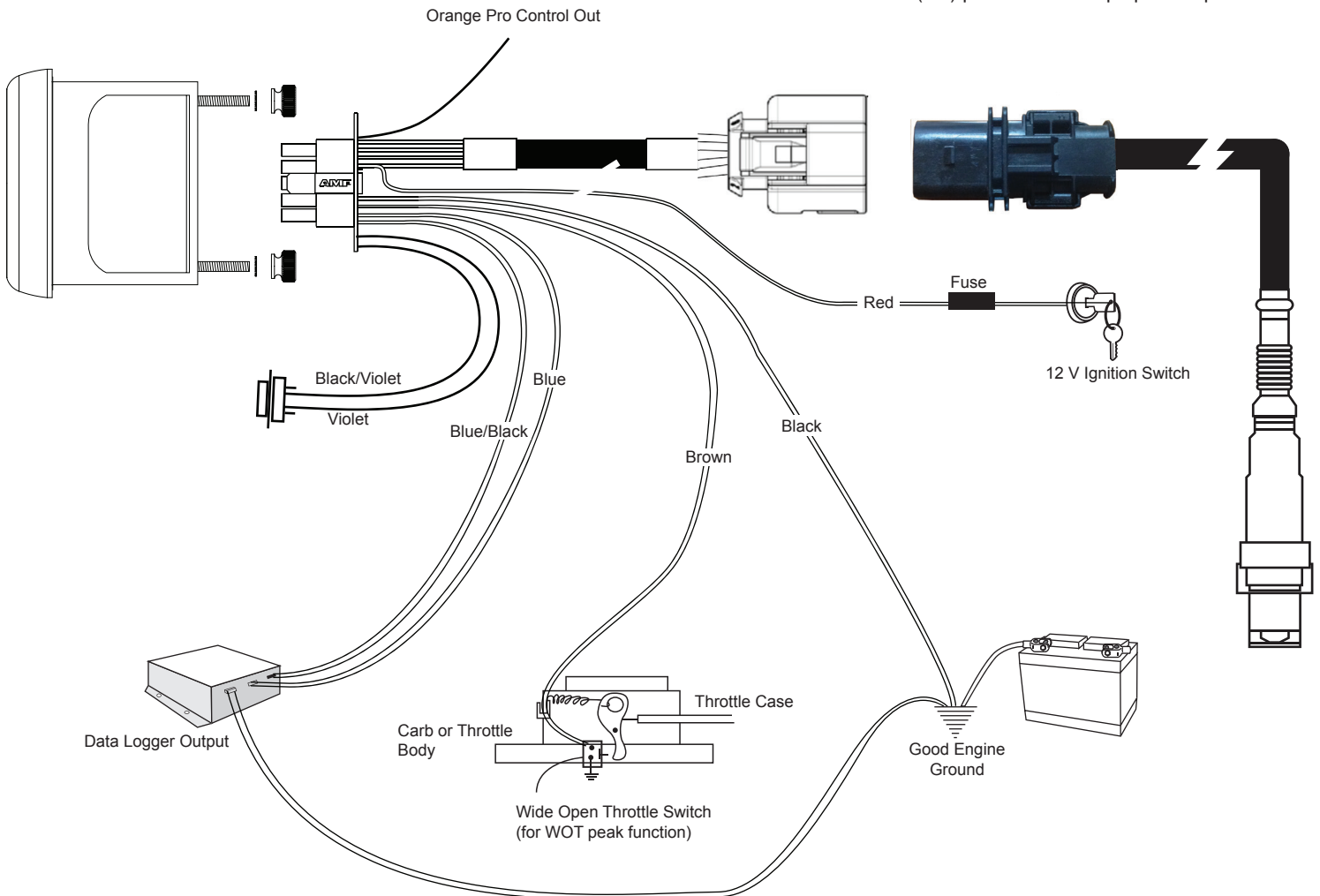
Connect to the coil of a relay

### Violet/Black (Serial Ground):

Connect to the ground pin of a PC or laptop serial port.

### Violet (Serial Out):

Connect to the receive (RX) pin of a PC or laptop serial port.



# Mounting Sensor

The heated oxygen sensor comes with a stainless steel weld-in bung, plug, and wiring harness with a weather pack connector. The oxygen sensor should be installed as close to the cylinder head as is reasonably possible so that the sensor reaches operating temperature quickly. If long tube headers are used, the oxygen sensor should be installed in the collector. If cast iron manifold(s) or shorty headers are used, install the sensor in the pipe just below the manifold. In multi-bank applications mounting in the left or right side is acceptable. Turbocharged applications should have sensor installed 4-5" after turbo on the down pipe. Open header applications may require minimum length of 18" of EXH pipe after sensor for proper reading at idle and part throttle.

## **Auto Meter recommends welding supplied stainless steel bung with a TIG welder.**

1. The exhaust pipe in front of the sensor should not contain any pockets, projections, protrusions, edges, flex-tubes etc. to avoid accumulation of condensation. A downwards slope of the pipe is recommended. If the exhaust pipe is parallel to the ground, the sensor must be installed in the top half of the pipe to avoid damage due to condensation
2. Tightening torque: 30-44 ft lbs.
3. Avoid excessive heating of the sensor cable. Route sensor cable away from exhaust pipe.
4. The maximum temperature of the sensor on the outside of the exhaust fitting should not exceed 900° F.

The Air / Fuel Ratio Monitor can be used with the following fuels.

<b>Fuels</b>	<b>Stoichiometric Air / Fuel Ratio</b>
Unleaded Gasoline	14.7:1
Methanol	6.4:1
Ethanol	9.0:1
LPG (Propane)	15.5:1
CNG	17.2:1
E85	9.8

**NOTE:** OK for use with Nitrous Oxide.

**NOTE:** Stoichiometric Air / Fuel Ratio is the chemically correct ratio where theoretically all of the oxygen and all of the fuel are consumed. The mixture is neither rich or lean.

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# Operation Guide

This product has many features that can be adjusted for your specific application. Use the **MODE (-)** and **SELECT (+)** buttons to navigate menu options, confirm selections, and fine tune options to your needs.

## **Acronyms:**

A list of acronyms and abbreviations are defined below in order to help you more clearly understand the menu operations, functions, and components available on your Auto Meter Wideband Air/Fuel gauge:

**BGD** – Bar Graph Display. This is the curved, multi-color, LED radial display used to indicate how “Rich” or “Lean” the current Air Fuel or Lambda reading is relative to your Stoichiometric point with respect to your upper and lower range tolerances.

**SSD** – Seven Segment Display. This is the digital numeric display that indicates your current Air Fuel or Lambda reading. This display is also used to help you navigate and make changes to your settings.

**AFR** – Air / Fuel Ratio. This is shown as a numeric value on the SSD, characterized by only having a single decimal place (i.e. 14.7). This value is also visually represented on the BGD, indicating whether the value is “Rich” or “Lean” of the selected Stoichiometric value and relative to the upper and lower range tolerances. AFR, as the name implies, represents the ratio of Air to Fuel being mixed and consumed, in real time, by the engine / vehicle upon which this instrument has been installed.

**Lambda**, is an alternate way of expressing AFR, assuming that the stoichiometric point selected equals one and readings “rich” or “lean” will be expressed as values above or below one, characterized by a value displayed with two decimal places, (i.e. 1.00). The gauge can display data in either AFR or Lambda as needed by the user.

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# Real-Time Mode:

Real-Time mode is the default mode of operation for this product. When Real-Time mode is active, the instrument will display the current air/fuel ratio in either **AFR** or Lambda.

To toggle between **AFR** and Lambda display types, press the **SELECT(+)** button. Remember that **AFR** values have a single decimal place (i.e. 14.7), and that Lambda values have two decimal places (i.e. 1.00).

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## Menu Options:

There are several other features provided by your Auto Meter Wideband Air/Fuel Ratio gauge. Use the **MODE (-)** button to navigate through the following options in order:

- Peak/Recall - SSD will display "P"
- Alarm/Warning - SSD will display "ALr"
- Pro Control - SSD will display "PrC"
- Stoichiometric - AFR Setting - SSD will display "AFr"
- BGD Range - SSD will display "dSP"
- Auto-Dim - SSD will display "br"
- Heater - SSD will display "Htr"
- Response - SSD will display "rsP"
- Firmware - SSD will display the firmware revision.

Once the desired option is displayed on the gauge, press the **SELECT(+)** button to confirm your selection. Specific Menu options are outlined in the following section.

If no selection is desired, you may continue to press **MODE (-)** until you return to Real-Time Mode or press neither button for 10 seconds and the gauge will return to Real-Time Mode on its own.

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## Wide Open Throttle Peak/Recall Mode:

WOT Peak/Recall mode provides you with a quick and easy way to find out exactly how "Lean" your engine / vehicle got during the last pull, run, or race. This value is recorded when the Brown Wire in the instrument harness is connected to a good engine ground via a normally open, momentary closed wide open throttle switch (not included, see wiring diagram) such as may be used with a Nitrous Oxide application. This allows peak readings to be sampled only during wide open throttle conditions. If the Air / Fuel Monitor gauge will not be used with a Wide Open Throttle switch, you may connect the brown wire permanently to a good engine ground to continuously monitor for peak conditions, or leave disconnected if peak lean is not needed.

### To View:

- From Real-Time Mode, press **MODE (-)** to scroll until the display indicates "P", then press **SELECT (+)** to display your Peak.

### To Clear:

- When the Peak value is displayed, press **SELECT (+)** to clear your Peak value and return to Real-Time Mode. The SSD will display "---" once the peak has been cleared and until a new peak value has been recorded.

If neither button is pressed for 3 seconds after the Peak Value is displayed, the gauge will return to Real-Time Mode.

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## Wide Open Throttle Alarm/Warning Mode:

Alarm/Warning mode enables you to program a visual alert point into the gauge in order to warn you of when air/fuel mixtures are running dangerously lean in your vehicle's engine. The visual alarm or warning activates when the AFR or Lambda reading reaches or exceeds your programmed alarm point. When the alarm activates the BGD will blink rapidly to warn the driver of the Alarm condition. Similar to Peak/Recall Mode, this function only operates when the Brown wire is grounded via a normally open, momentary closed, wide open throttle switch (not included, see wiring diagram) such as may be wired with a Nitrous Oxide application.

### To View your current Alarm Point Setting:

- From Real-Time Mode, press **MODE (-)** to scroll until the display indicates "ALr", then press **SELECT (+)** to display your current Alarm set point.

### To Change your Alarm Point Setting:

- When the current Alarm set point is displayed, press **SELECT (+)** to increase your alarm point setting, and **MODE (-)** to decrease your alarm point setting.
  - After you have selected your new alarm set point, the gauge will flash your new set point 8 times on the display and then the SSD will display "S C" for Save/Cancel.
  - To confirm your new alarm point setting, press **MODE (-)**. This will save your Alarm set point changes and return the gauge to Real-Time mode.
  - To cancel the changes and return to your previous set point, press **SELECT (+)**. This will cancel the Alarm set point changes and the gauge will return to real time mode.
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# Stoichiometric AFR Setting Mode:

The Stoichiometric AFR setting allows you to adjust the gauge scale for alternate fuel types such as Ethanol. As a default this product is set up for gasoline, with a stoichiometric AFR point of 14.7:1. If you would like to adjust this product for use on an alternate fuel type or would merely like to adjust the “center” point of your BGD, please follow the instructions below.

To view your current Stoichiometric AFR setting:

- From Real-Time Mode, press **MODE (-)** to scroll until the display indicates “AFr”, then press **SELECT (+)** to display your current Stoichiometric set point.

To Change your Stoichiometric AFR setting:

- When the current Stoichiometric set point is displayed, press **SELECT (+)** to increase your Stoichiometric AFR setting, and **MODE (-)** to decrease your Stoichiometric AFR setting.
- After you have selected your new Stoichiometric set point, the gauge will flash your new set point 8 times on the display and then the SSD will display “S C” for Save/Cancel.
- To confirm your new Stoichiometric setting, press **MODE (-)**. This will save your Stoichiometric set point changes and return the gauge to Real-Time mode.
- To cancel the changes and return to your previous set point, press **SELECT (+)**. This will cancel the Stoichiometric set point changes and return the gauge to Real-Time mode.

# Pro Control Setting Mode:

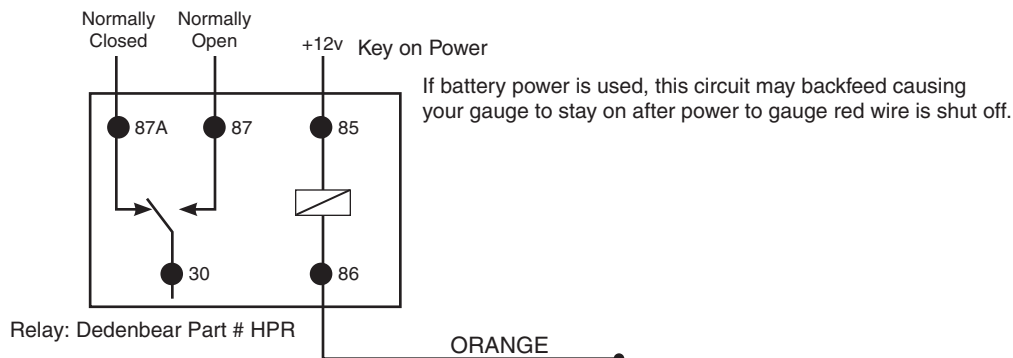
The Pro Control setting allows you to adjust the AFR or lambda value that causes the Pro Control output to turn on. The Pro Control wire supplies ground when activated. It is recommended to use a relay switch such as the Dedenbear HPR or equivalent. If you would like to adjust this value, please follow the instructions below.

To view your current Pro Control AFR setting:

- From Real-Time Mode, press **MODE (-)** to scroll until the display indicates “PrC”, then press **SELECT (+)** to display your current Pro Control set point.

To Change your Pro Control setting:

- When the current Pro Control set point is displayed, press **SELECT (+)** to increase your Pro Control setting, and **MODE (-)** to decrease your Pro Control setting.
- After you have selected your new Pro Control set point, the gauge will flash your new set point 8 times on the display and then the SSD will display “S C” for Save/Cancel.
- To confirm your new setting, press **MODE (-)**. This will save your Pro Control set point changes and return the gauge to Real-Time mode.
- To cancel the changes and return to your previous set point, press **SELECT (+)**. This will cancel the Pro Control set point changes and return the gauge to Real-Time mode.



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## BGD Range Setting Mode:

The Bar Graph Display (BGD) Range Setting Mode allows you to fine tune the resolution of this instrument for your specific application. With upper and lower set point adjustability, you can set the BGD to utilize the exact range that the engine / vehicle operates within and see exactly how rich or lean you are running in relation to your current set up and tune. Adjusting your BGD limits also adjusts the scaling of the 0-5v data logger output supplied from the gauge. The selected low set point of the BGD Range becomes the 0v value of the data logger output. The selected high set point of the BGD Range becomes the 5v value of the data logger output. Whenever you change these points, the instrument adjusts the data logger output so that the 0-5v signal is always linear between your chosen set points.

To view your current BGD Range HI / Lean setting or LO / Rich setting:

- From Real-Time Mode, press **MODE (-)** to scroll until the display indicates “dSP”, then press **SELECT (+)** to display your current BGD Range set point.
- The SSD of your display will show “HI” in the display to indicate that you will be viewing the “above Stoichiometric” or “Lean” upper range boundary.
- If you would like to view the LO / Rich setting, press **MODE (-)** when “HI” is shown on the SSD. The SSD should now indicate “LO”.

When the desired setting, “HI” or “LO”, is displayed, confirm this selection by pressing **SELECT (+)**. The upper or lower BGD range value will then be displayed in the SSD of your gauge corresponding to your selection.

**Note:** When your selection is made and the numeric range value is shown, LEDs in the BGD will light to indicate which set point you are viewing. If the LEDs to the left of center or Stoichiometric are lit, you are viewing the “LO” or Rich set point. If the LEDs to the right of center or Stoichiometric are lit, you are viewing the “HI” or Lean set point.

If neither button is pressed for 3 seconds after the BGD Range “HI” Setting is displayed, the gauge will return to Real-Time Mode.

To Change your BGD Range setting:

When the current BGD Range “HI” or “LO” set point is displayed, press **SELECT (+)** to increase your chosen BGD Range setting, and **MODE (-)** to decrease your BGD Range setting.

- After you have selected your new BGD Range set point, the gauge will flash your new set point 8 times on the display and then the SSD will display “S C” for Save/Cancel.
- To confirm your new BGD Range setting, press **MODE (-)**. This will save your BGD Range set point changes and return the gauge to Real-Time mode.

To cancel the changes and return to your previous set point, press **SELECT (+)**. This will cancel the BGD Range set point changes

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## Data Logger Output Range:

The Auto Meter Wideband Air / Fuel gauge has a signal output for supplying information to a Data Logger or engine management system. The signal provided is a linear 0-5v output. See the BGD Range Setting Mode for information about how to define the air/fuel mixture values for low (0v) and high (5v) ranges of the output in order to scale this linear signal output for best operation with your Data Logger or engine management.

The formula to determine the AFR output from the voltage provided by the gauge is derived from  $y=mx+b$  (algebraic equation for a straight line), where in our needs the following applies:

$$y = \text{AFR}$$

$$m = \text{slope of the plotted line (BGD AFR High - BGD AFR Low) / (5v - 0v)}$$

x = output voltage from the gauge

b = offset or AFR value at 0v

Using the default values of 10:1 AFR for 0v and 18:1 AFR at 5v the formula looks like this:

$$y = ((8/5) * v) + 10$$

or can be simplified as:

$$y = 1.6 * v + 10$$

If we plug in 1.25v into that equation then we get: 12:0 AFR =  $(1.6 * 1.25) + 10$  which falls right along the plot chart. If you were to adjust the BGD endpoints to say 11:1 and 15:1 then the formula would be modified to look as follows:

$$y = ((4/5) * v) + 11 \text{ simplified to } y = 0.8 * v + 11$$

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## Auto-Dim Mode:

This product incorporates an Auto-Dimming feature that allows it to adjust automatically for varying lighting conditions. This is accomplished with a sensor light embedded in the dial. You may enable or disable this feature depending upon your viewing preference. When Auto-Dim mode is disabled, the product and LED's operate at maximum brightness regardless of atmospheric lighting conditions. The auto-dim mode is set to "off" from the factory.

To view your current Auto-Dim setting:

- From Real-Time Mode, press **MODE (-)** to scroll until the display indicates "br" for brightness, then press **SELECT (+)** to display your current Auto-Dim setting which will be indicated as either "ON" or "OFF" in the SSD.

If neither button is pressed for 3 seconds after the Auto-Dim Setting is displayed, the gauge will return to Real-Time Mode.

To Change your Auto-Dim setting:

- When the current Auto-Dim setting is displayed, press **MODE (-)** to toggle between "On" and "OFF".
- When your new Auto -Dim setting is displayed, press **SELECT (+)**
- The gauge will flash your new setting 8 times on the display and then the SSD will display "S C" for Save/Cancel.
- To confirm your new auto dim settings, press **MODE (-)**. This will save your Auto-Dim setting changes and return.
- To cancel the changes and return to your previous set point, press **SELECT (+)**. This will cancel the Auto-Dim setting changes and return the gauge to Real-Time mode.

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## Heater Control Mode:

All O2 sensors must be heated before an accurate signal is produced. Potential sensor damage can occur if the gauge begins to heat the sensor before the engine is running due to condensation that forms on the sensor tip and in the exhaust. To accommodate this, an internal trigger within the gauge will automatically begin heating the sensor when 13.5 volts or higher is seen on the Red wire ("Normal" operating mode). While the gauge does not require 13.5 volts to operate (12 volts will suffice), this voltage is used to indicate to the gauge that the engine is running, as most regulated charging systems will maintain 14 volts or higher. Once the gauge sees 13.5 volts the SSD will display "htg". When the sensor is heated, the SSD will flash "rdy" and the gauge will begin reading air/fuel ratio in real-time.

In applications where a standard charging system is not used (vehicles without a regulated alternator, for example) there is an override available that will allow sensor heating to occur without the gauge reading a 13.5 volt trigger. This can be accomplished while the seven-segment display shows (---) (thereby overriding "Normal" operating mode) or set to trigger when 12 volts is applied on the Red wire ("On" operating mode).

To Override "Normal" Operating Mode:

- While displaying (---), press any button to begin the heater process.

To View your current Heater Operating Mode:

- From Real-Time Mode, press **MODE (-)** to scroll until the display indicates "Htr", then press **SELECT (+)** to display your current Heater Operating Mode.
- If neither button is pressed for 3 seconds after the Heater Operating Mode is displayed, the gauge will return to Real-Time Mode.

To Switch Between Heater Operating Modes:

- When the current heater operating mode is displayed (either "Nor" or "On"), press **SELECT (+)** to choose the current setting or **MODE (-)** to switch to the alternate setting. "nor" = 13.5V trigger is active, "on" = 13.5v trigger is turned off.
- After you have selected your new Heater Operating Mode, the SSD will display "S C" for Save/Cancel.
- To confirm your new Heater Operating Mode, press **MODE (-)**. This will save your current Heater Operating Mode and return the gauge to Real-Time mode.
- To cancel the changes and return to your previous Heater Operating Mode, press **SELECT (+)**. This will cancel the Heater Operating Mode change and return the gauge to Real-Time mode.

**NOTE:** Even with 13.5v trigger deactivated gauge will still show "htg" after every power up while the sensor is heating.

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## Response Setting Mode:

The response setting allows you to choose how quickly the SSD and BGD will change with varying AFR. FAST response is a high speed display update rate that allows you to see AFR changes as fast as they are happening, but this may make it difficult to read. SLOW response is a display update rate that is easier to read, and still fast enough to get useful information.

To view your current Response setting:

- From Real-Time Mode, press **MODE (-)** to scroll until the display indicates "rsp" for response, then press **SELECT (+)** to display your current Response setting which will be indicated as either FSt" or "Slo" in the SSD.

If neither button is pressed for 3 seconds after the Response Setting is displayed, the gauge will return to Real-Time Mode.

To Change your Response setting:

- When the current Response setting is displayed, press **MODE (-)** to toggle between "FSt" or "Slo".
  - When your new Auto -Dim setting is displayed, press **SELECT (+)**
  - The gauge will flash your new setting 8 times on the display and then the SSD will display "S C" for Save/Cancel.
  - To confirm your new auto dim settings, press **MODE (-)**. This will save your Response setting changes and return.
  - To cancel the changes and return to your previous set point, press **SELECT (+)**. This will cancel the Response setting changes and return the gauge to Real-Time mode.
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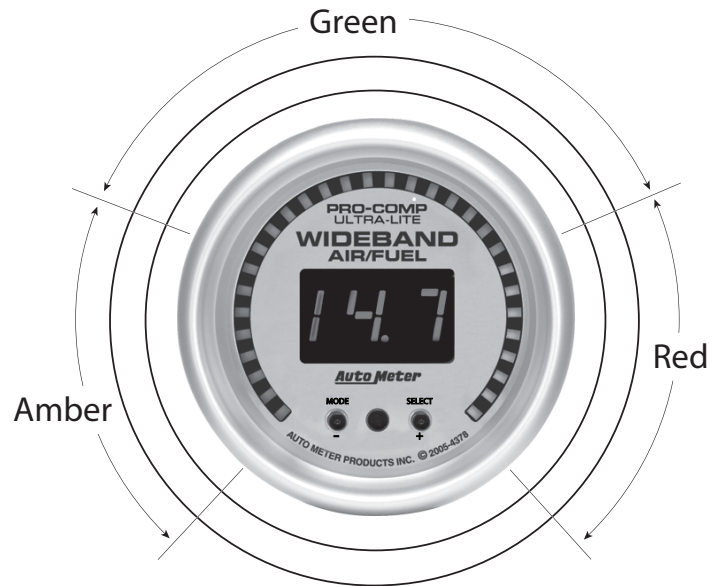


# Warning

Fouling and/or permanent damage to the oxygen sensor over time will result if used with any of the following:

- **Leaded gasoline and fuel additives containing lead**
- **2 cycle gasoline (gas/oil mix)**
- **Diesel Fuel**
- **Nitromethane**
- **Excessively rich mixtures**

If the Air/Fuel Ratio Monitor responds sluggish, the oxygen sensor is probably partially fouled and should be replaced.

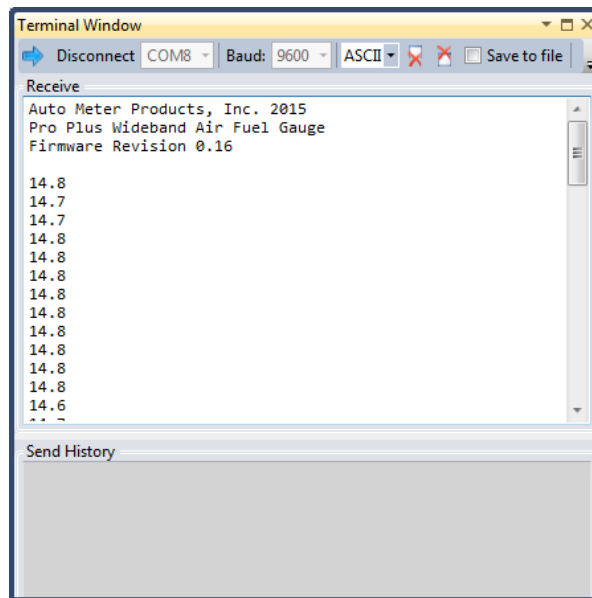


## LED Chart

<b>Lean Range</b>	Eight red LED's
<b>Stoichiometric Range</b>	Fourteen green LED's
<b>Rich Range</b>	Eight amber LED's

# Serial Output

The Auto Meter Pro Plus wideband has a serial output for supplying AFR or lambda to a PC, laptop, or other digital device. The device serial connection must be set to 9600 baud, 8 bits data, no parity, 1 stop bit, flow control -none. A terminal program will display the data as shown below.



## SERVICE

For service send your product to Auto Meter in a well packed shipping carton. Please include a note explaining what the problem is along with your phone number. If you are sending product back for warranty adjustment, you must include a copy (or original) of your sales receipt from the place of purchase.

## 12 MONTH LIMITED WARRANTY

AutoMeter Products, Inc. warrants to the consumer that all AutoMeter High Performance products purchased from an Authorized AutoMeter Reseller will be free from defects in material and workmanship for a period of twelve (12) months from date of the original purchase. Products that fail within this 12 month warranty period will be repaired or replaced at AutoMeter's option, when determined by AutoMeter that the product failed due to defects in material or workmanship. This warranty is limited to the repair or replacement of parts in the AutoMeter High Performance product and the necessary labor done by AutoMeter to effect the repair or replacement of the AutoMeter High Performance product. In no event shall AutoMeter's cost to repair or replace an AutoMeter High Performance Product under this warranty exceed the original purchase price of the AutoMeter High Performance Product. Nor shall AutoMeter Products, Inc. be responsible for special, incidental or consequential damages or costs incurred due to the failure of an AutoMeter High Performance Product. This warranty applies only to the original purchaser of the AutoMeter High Performance Product and is non-transferable. This warranty also applies only to AutoMeter High Performance Products purchased from an Authorized AutoMeter Reseller. All implied warranties shall be limited in duration to the said 12 month warranty period. Breaking the instrument seal, improper use or installation, accident, water damage, abuse, unauthorized repairs or alterations voids this warranty. AutoMeter disclaims any liability for consequential damages due to the breach of any written or implied warranty on all products manufactured by AutoMeter Products, Inc. For a comprehensive listing of Un-Authorized AutoMeter Resellers please visit [www.autometer.com/autometerlocator/index/unauthorized](http://www.autometer.com/autometerlocator/index/unauthorized).

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