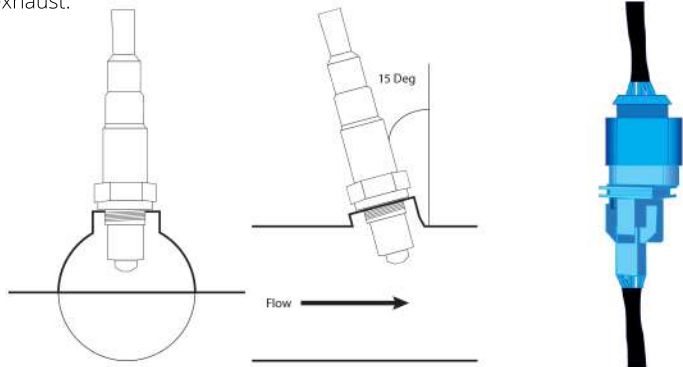


# Setting up the SM-AFR

## Step 1: Install the Oxygen Sensor

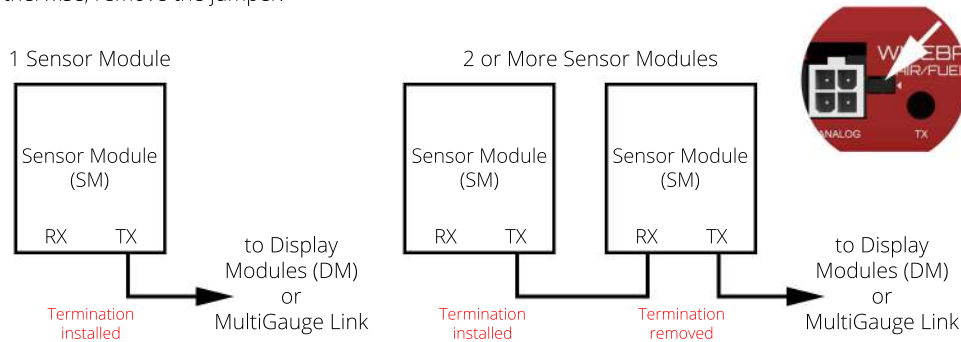
Install the Wideband O2 Sensor into a pre existing M18 x 1.5mm bung or weld a separate bung. Tighten to 30 ft-lb (40Nm). Then connect the oxygen sensor to the wire harness. Use ONLY PLX Devices P/N 897346002733 Bosch LSU4.9 sensor to ensure accuracy and proper calibration.

Mount the O2 Sensor before the catalytic converter and at least 24" downstream from your engine block for naturally aspired engines or 36" downstream from your turbo for optimal performance. The sensor should be mounted in the top side of the exhaust pipe at a 15 degree angle away from the flow of the exhaust.



## Step 2: Connect Serial Ports

Serial ports are used to send digital sensor data to your gauges or smartphone. If the SM-AFR is the only sensor module or last sensor module in the daisy-chain, be sure to have the termination jumper installed. Otherwise, remove the jumper.



## Step 3: Connect Wire Harness

Connect the harness to the SM-AFR unit. If routing O2 Harness through a firewall, use a grommet. Avoid having the harness come in direct contact with exhaust components. This will prevent damage to the O2 Sensor Harness.



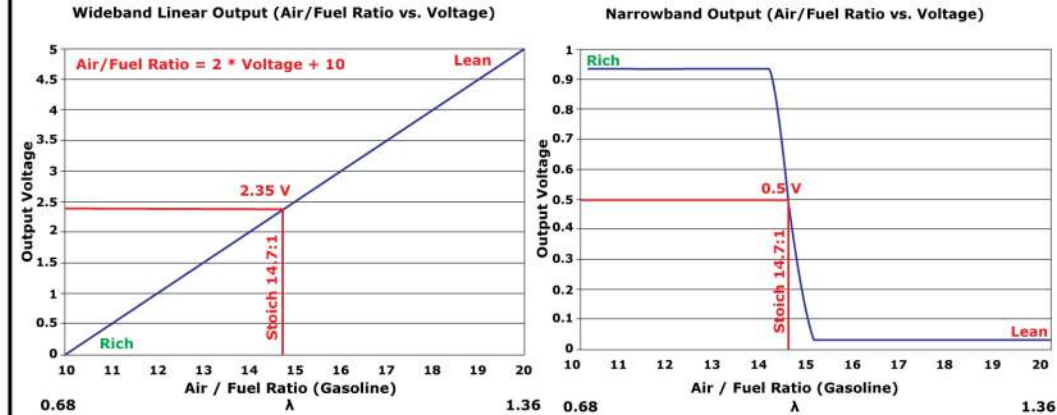
## Step 4: Analog Outputs

The SM-AFR has one 0-5V analog wideband output designed to be interfaced with a number of aftermarket products such as engine management systems, data loggers, and tuning electronics.

It also has one 0-1V analog narrowband output for you to simulate the behavior of your stock narrowband sensor so that you may replace your narrowband sensor with a wideband sensor to avoid having to install a separate O2 bung. Please see PLXApp004 for details.



1. 3.3VDC
2. 0-1V Narrowband
3. 0-5V Wideband
4. 8.0V



## Step 5: Connect Power

**Warning:** Connecting the SM-AFR in reverse polarity will damage the unit and void your warranty. Double check connections before powering on.

The SM-AFR accepts 9-25V DC for power. Connect the negative wire (black) to your vehicle's ground. This is usually the negative terminal of your automobile's battery. Connect the positive wire (red) to your vehicle's ignition power. This power is only supplied when your key is turned passed a specific position and is off when your key is removed. Your power connection must be capable of supplying at least 3 Amps of current. A 5 Amp fuse is recommended for safety. If you plan to integrate the SM-AFR with other aftermarket devices by utilizing the analog output signal wire. Make sure that the negative wire (black) is connected as close as possible to your device's ground. This guarantees that both devices "see" the same reference ground and a more accurate interpretation of the output voltages will be achieved.



# Compatibility with Other Fuels

The graphs on the reverse side assume that the device will be used with gasoline (14.7). The SM-AFR is also compatible with the following fuels: Diesel (14.6), Methanol (6.4), Ethanol (9.0), LPG (15.5), CNG (17.2), E85 (9.7). To find the new relationship of AFR to output voltage, simply multiply the lambda value by the specific fuel's stoichiometric air/fuel ratio.

Example: If your engine uses methanol instead of gasoline, the conversion will be as follows.

- 1) Divide the AFR value by 14.7 (gasoline) to obtain a lambda value
- 2) Multiply the lambda value by 6.4 (methanol)

Lambda	0.68	0.80	0.90	1.00	1.10	1.20	1.30	1.36
Gasoline	10.00	11.76	13.23	14.70	16.17	17.64	19.11	19.99
Diesel	9.93	11.68	13.14	14.60	16.06	17.52	18.98	19.86
Methanol	4.35	5.12	5.76	6.4	7.04	7.68	8.32	8.70
Ethanol	6.12	7.20	8.10	9.00	9.90	10.80	11.70	12.24
E85	6.60	7.76	8.73	9.70	10.67	11.64	12.61	13.19
LPG	10.54	12.40	13.95	15.50	17.05	18.60	20.15	21.08
CNG	11.70	13.76	15.48	17.20	18.92	20.64	22.36	23.39

## Enhanced Features

The SM-AFR 4th Generation and later Wideband Oxygen Air/Fuel Ratio Controller offers 3 additional sensors: Battery Voltage, O2 sensor health, and O2 Sensor Reaction Time. The Battery Voltage is simply the voltage across the red and black wire that is being used to power the SM-AFR controller. The O2 Sensor Health uses PLX proprietary algorithms to learn the health of the oxygen sensor. The O2 Reaction Time also uses PLX proprietary algorithms to learn the speed or reaction time of the oxygen sensor. The additional 3 parameters are automatically reported through the serial TX port of the digital data stream. Note: The SM-AFR Gen4 is currently only compatible with the DM-6 Version 2.0 or higher. All DM-6 Version 1.0 gauge is not compatible with Gen4 and later SM-AFR modules.

**Sensor Condition:** An oxygen sensor's health depends on 2 key factors: the sensor's ability to accurately measure the exposed exhaust gas; and the sensor's ability to move or respond to the changes of O2 content in the exhaust. A healthy sensor will read O2 content of the exhaust gas accurately and quickly. Over time with wear and tear, the sensor will slow down, and become less accurate. The PLX Devices Intelligent Health Monitoring System gives you the ability to see these parameters clearly on our MultiGauge.

**Sensor Health:** To obtain the O2 Sensor Health, simply expose the oxygen sensor to free air for 5 or more seconds. The SM-AFR Gen4 automatically learns the condition of your oxygen sensor and reports the reading from 0-100% in increments of 10% to your MultiGauge. In the event that the oxygen sensor can't be removed from the exhaust pipe it is advisable to locate a safe road where you can drop the vehicle into a low gear (2nd or 3rd) and rev it up to about 80% of redline. Then release the gas pedal completely, letting the vehicle engine brake for 5 or more seconds. During this time, your engine must not inject any fuel and your MultiGauge should be reading "Air" for at least 5 seconds. This allows the SM-AFR Gen4 to learn the oxygen sensor's health. Once the SM-AFR Gen4 has successfully learned your oxygen sensor's health, the percent reading is reported onto your DM-6 gauge. It is advisable to replace your O2 sensor if your health is below 50%.

**Sensor Reaction Time:** To obtain the O2 Sensor Reaction Time, bring the vehicle to a rich condition then to a lean condition as quickly as possible. Give the vehicle 4-5 quick pulses with the gas pedal. This may require some practice. The SM-AFR Gen4 will learn and measure how quickly your oxygen sensor can react to the changes of O2 content from your exhaust gas. Please keep in mind that, the SM-AFR Gen4 is ONLY capable of measuring the reaction time of the gas depending on the actual performance that the engine is outputting. It is advised for most vehicles to find a safe road and travel ~40MPH. At this time, quickly press and depress the gas pedal to bring the vehicle from rich to lean condition as fast as you can. The SM-AFR Gen4 will report how quickly your O2 sensor can measure the exhaust gas giving you a clue as to how healthy your O2 sensor is after it has successfully learned. A reaction time of less than 150mS is excellent, 151-250mS is good, and greater than 251mS is poor. It is advisable to replace your oxygen sensor if your sensor reaction time is slower than 250mS.

Excellent  
0ms - 150ms

Good  
151ms - 250ms

Poor  
251ms or Greater

## Troubleshooting

Upon power up, the WB analog output should read 2.30V-2.40V with the O2 sensor disconnected. With the O2 sensor connected and exposed to free air, the WB analog output should read starting from 2.3V climbing up to 5.0V within 30 seconds. If both conditions are met, your SM-AFR is properly working. If the sensor does not reach Lean/Air within 45-60 seconds, please replace your O2 sensor. Replacement sensors are available from [plxdevices.com](http://plxdevices.com)

1. The output is not showing the correct AFR readings:
    - A. With the O2 sensor harness disconnected, at initial power-up it should display between 14.6 and 14.7 (wideband analog voltage: 2.30V - 2.40V).
      - i. If it is reading below 14.5, please verify that the unit is receiving at least 12V and you have at least a 5 amp fuse. If it is still reading below 14.5 even with the correct voltage, contact [rma@plxdevices.com](mailto:rma@plxdevices.com) and request a RMA number. Your unit is faulty and needs to be repaired.
      - ii. If it is reading above 14.8, contact [rma@plxdevices.com](mailto:rma@plxdevices.com) and request a RMA number. Your unit is faulty and needs to be repaired.
    - B. Reconnect the O2 sensor with the sensor harness, with the O2 sensor exposed to free air. During the 30 second warm up phase, the voltage should increase from 2.35V to 5.0V.
      - i. Voltage does not read 5.0V even after 60 seconds:
        - a. Try another power source for your SM-AFR.
        - b. Verify that a fuse is installed rated no less than 5A.
        - c. Check connectivity of harness and O2 sensor.
        - d. Your O2 sensor needs to be replaced.
    - C. When the unit says AIR\*, blow on the O2 sensor. The display should show LEAN\*.
      - i. Display does not go to LEAN\*:
        - a. Your O2 sensor needs to be replaced.
- \* Will only show "LEAN" or "AIR" on DM-6 Gauge



PATENTED

# Setting up the DM-6 Multi Gauge to the SM-AFR

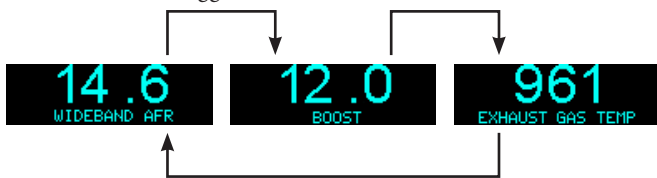


## Navigating the DM-6

There are a total of 3 capacitive touch buttons on the DM-6. They are highlighted in the image below.

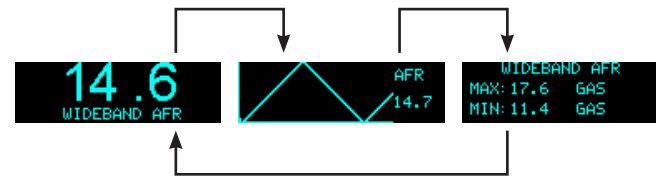


Use the left button to toggle between sensors.\*



\* - Sensors available are based on Sensor Modules in daisy chain. Display order is based on location of the Sensor Module in the daisy chain

Use the right button to toggle between Numeric, Graph, and Peak/Hold screen views.



Hold the logo button to display unit label and range. Left and right values refer to entire LED sweep range.

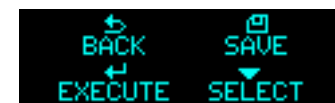


In the Peak/Hold view, holding the right button will open a menu option to save or reset current/all peak/hold values.



## The Menu

Pressing and holding both left and right buttons together will take you into the menu system. Once inside the menu system, use the left button to save changes, the logo button to select which menu item is currently selected, and the right button to access the current selection option. Please note the icons used.



## Setup Unit

To setup the unit for a particular sensor, follow the procedures listed below:

1. Hold both left and right button to get into the "SETUP MENU".
2. Press the right button to get into "SETUP UNIT" screen.
3. To change the sensor, press the right button.
4. To change the unit for that particular sensor, press the logo button to move down the arrow.
5. Press the right button to change the unit.
6. Press the left button to save and go back to the "SETUP MENU" screen.



## Warnings:

The DM-6 can be operated to trigger the warning by setting the limit of the parameters (Parameter 1(P1) and Parameter 2(P2)). Sensors that are daisy-chained with the DM-6 can be selected to associate with the parameter setting. The DM-6 is capable of monitoring up to 2 parameters for warnings. To trigger the warning, the reading of the DM-6 must go above or below the parameter setting as determined by the user. The table below shows the 4 schemes that are supported by DM-6.

Mode	Description
P1 and P2	Warning triggers only when the reading falls within the range set by both Parameter 1 <b>and</b> Parameter 2
P1 or P2	Warning triggers only when the reading falls within the range set by Parameter 1 <b>or</b> Parameter 2
P1 Only	Warning triggers when the reading falls within the range set by <b>Parameter 1 only</b>
P2 Only	Warning triggers when the reading falls within the range set by <b>Parameter 2 only</b>

Example:

Trigger point settings (SET P1 or SET P2)	DM-6 Reading	Result
Parameter 1: AFR > + 15.0	AFR = 14.0	FALSE
Parameter 2: EGT > + 800	EGT = 900	TRUE

If the DM-6 measures the above values and the "SCHEME" is set to "P1 OR P2", this means that if Parameter 1 is TRUE OR Parameter 2 is TRUE, the warning will trigger. Since EGT is set in Parameter 2 and the measured value exceeds the trigger point set for this particular sensor, the warning will trigger as soon as the measured value exceeds 800.

The LEDs will be flashing, indicating that the warning has been triggered. DM-6 will also display the particular sensor that triggers the warning in the numerical mode.

If mode P1 AND P2 is selected, as the warning triggers, you can press the left button to view the two sensors that trigger the warning.

To trigger the warning, first set the "SCHEME":

1. In the "SETUP MENU", choose "WARNING" by pressing the logo button.
2. Press the right button to get into the "WARNING" screen.
3. To change the "SCHEME", press the right button. Refer to the above table for the description for each "SCHEME".
4. Press the left button to save and return to the "SETUP MENU" screen.



## SET P1/SET P2:

1. In the "SETUP MENU", choose "SET P1 or SET P2" by pressing the logo button.
2. Press the right button to get into the "SET P1 or SET P2" screen.
3. To select the sensor as the warning sensor, press the right button.
4. To set the trigger value, press the logo button to move down the arrow.
5. Press the right button to change the highlighted character.
6. To highlight the next character, hold on to the right button for 3 seconds.
7. Press the left button to save and return to the "SETUP MENU" screen.
8. If the limit is invalid, the "LIMIT EXCEED RANGE" screen will show to indicate the proper range of values to be set.
9. Press the right button to re-enter the parameter or press the left button to go back to the "SETUP MENU" screen.



## Included Items:

1. DM-6 2 1/16" (52 mm) Gauge
2. 4 Pin connector for SM-AFR connectivity
3. 2 Terminals for 4 pin Connector
4. 3.5 mm Y Splitter
5. 6" M/F Extension Serial Cable
6. User guide

## Specifications:

Physical Dimensions:	Standard 2 1/16 x 0.7" (52 X 18 mm)
Display Technology:	1.10" OLED Screen (124 x 36 pixels), LED (16 Green, Yellow, Red)
Viewing Angle:	180 Degrees
Polarization:	None
Supply Voltage:	3.3 V and 8 V from SM Module
Power Consumption:	< 1 Watt
Cable Length:	6' Power, 6" Serial
Operating Temp:	0 - 85 Degrees Celsius
Human Interface:	3 Button Capacitive Touch
Number of Sensors:	16 Maximum Daisy Chain
Supported Units:	US Standard, Metric

## TERMS OF USE

PLX Devices Inc. does not guarantee product functionality with any ECU, data logger or other devices that uses the output signals. Implementation and integration of the PLX products with any other device(s) must be done at your own risk. Improper installation and usage may lead to engine damage. Mount and install PLX products in a location where it does not obstruct the driver's view and/or ability or safely control the vehicle.

PLX Devices Inc. does not guarantee product functionality with ALL vehicles. Implementation and integration of the PLX products with any other device(s) must be done at your own risk. Improper installation and usage may lead to engine damage. Mount and install PLX products in a location where it does not obstruct the driver's view and/or ability or safely control the vehicle