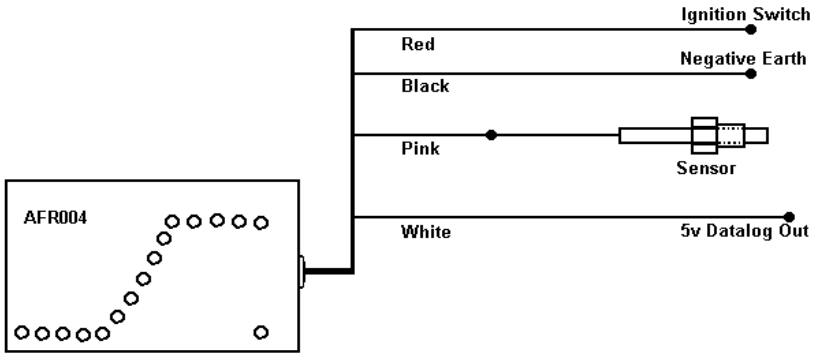
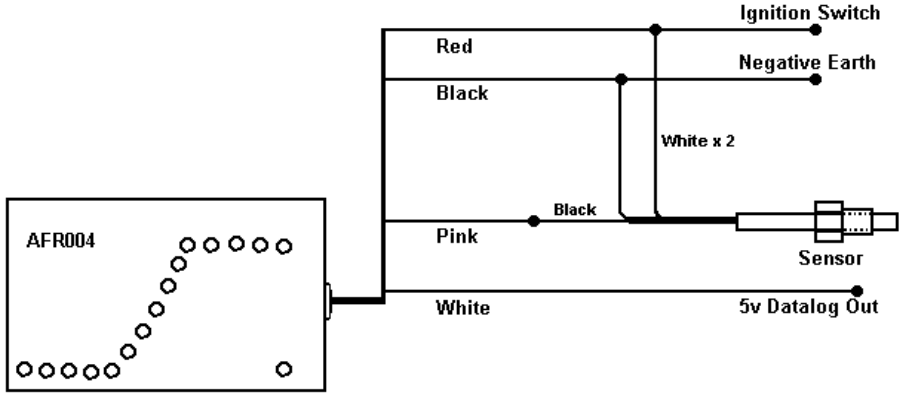
Wiring Instructions for AFR004

Connection for Single Wire Lambda Sensor



Connection for Three Wire Lambda Sensor



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Lumenition®

AFR004: 19 LED Air/Fuel Ratio Monitor

Introduction:

For decades measuring exhaust gases as a means of analysing the air/fuel ratio of the internal combustion engine has caused problems for the serious engine builder or tuner. Until recently the only reliable method was to use an infrared CO gas analyser. The slow reaction time of this type of equipment creates difficulties when interpreting the readings when the engine is at full speed. This can lead to engine damage especially when trying leaner mixtures for fuel efficiency.

With the introduction of emission controls into vehicle requirements and the use of catalytic converters, the lambda sensor has become an economic tool. The lambda sensor measures the exhaust gas oxygen content which under most engine running conditions is directly proportional to the air/fuel ratio. The sensor voltage output can be displayed using the AFR004 and the rich or lean condition of the fuel mix into the engine determined.

The AFR004 has nineteen LEDs indicating mixtures from lean to rich. Seven red LEDs for lean, five orange in the centre range and seven green LEDs for rich conditions. The centre orange LED shows the value lambda = 1 which is the stoichiometric point for air/fuel ratio (the normal ideal mixture). The ideal air to fuel ratio for a petrol engine is 14.7:1. Richer mixtures will reduce the ratio and lean mixtures will increase the ratio value. For tuning purposes it is generally accepted that engine give the most power when running with a rich mixture. Most modern vehicles will run at or above lambda =1 for reduced emissions and higher fuel economy.

The AFR004 relies on the use of a 1v Zirconia type EGO or lambda sensor mounted into the exhaust of the vehicle. If the vehicle is already fitted with a sensor for ECU operation then you should check the sensor type for compatibility before wiring up the AFR004. Lumenition can supply a heated 3-wire sensor and also a weld –in mounting boss for those vehicles not fitted with a sensor. A heated sensor will give accurate readings more quickly from startup and maintain the sensor at close to its optimum performance regardless of exhaust gas temperature.

Installation:

The AFR004 can be connected to most original equipment lambda sensors without affecting the operation of the engine management system. It is important to identify the correct sensor output wire for connection to the Pink sensor input of the AFR004. This information should be found in the wiring diagrams or workshop manual for the vehicle. Incorrect connection of the input can result in damage to the AFR004.
If using a Lumenition sensor this should be mounted into the exhaust system as close as possible to the engine where it will sense the gases from all cylinders. Generally this will be in the collector pipe and must be before the catalytic converter if fitted. If the engine is turbo charged the sensor should be mounted at least 1.5m from the engine to avoid the excessive temperatures that can be generated.
The AFR004 unit can be mounted onto any flat surface using sticky pads or velcro.

Wiring:

The AFR004 has four wire connections. Red is a positive 12v ignition switched supply. Black is an earth connection (negative earth only). Pink is connected to the sensor signal output. White is a zero to 5v output from the AFR004 for data log use.

If using a Lumenition sensor with three wires. The two white wires are for the heater and should be taken, one to earth and the other to a switched 12v supply capable of at least 1 amp. The heater is not polarity sensitive and either wire can be used.

The sensor signal output (black wire) is connected to the pink wire of the AFR004.

The sensor voltage output is referenced to the body of the sensor and you must ensure that the connection between the mounting point and the battery earth is good. Some exhaust systems have mounts or connections that are electrical insulators and do not provide an earth path. It may be necessary to add an earth strap to the exhaust to maintain an accurate reading.

Note: Some sensors have four wires in which the fourth wire (usually grey) is the sensor reference connection. When using this type of sensor the can be connected to the same earth that is being used for the black wire of the AFR004.

For data acquisition the AFR004 provides a 0-5 volt replication of the 0-1v input signal from the lambda sensor. This appears on the white wire that can be connected to the data logging system of your choice.

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Using the AFR004:

The AFR004 can be used to help you achieve the best performance from your engine both in power and economy or to monitor the performance of original or chipped ecus and fuelling components. The AFR004 can be used as a tuning aid when setting up carburettors or fuel injection systems.

The green led to the bottom right will indicate that there is power to the unit. When the engine is first started the AFR004 will show full lean and gradually increase as the sensor is heated. It may take several minutes for the sensor to show correct readings. This may be longer if an unheated single wire sensor is used.

Tuned engines:

It is generally accepted that tuned engines give best power at a lambda reading of between 0.8 and 0.9 depending upon the engine type and condition. This point is indicated between the first and third green light on the display. Under full load it is this indication that should be achieved. During acceleration the higher green LEDs should show for adequate enrichment. On deceleration and overrun the indicator will drop into the red region. Part throttle fuelling can be anywhere between the last red and the third green. Constant running in the lean region can lead to engine damage.

Standard Engines:

If the vehicle is fitted with an engine control ecu that runs ‘closed loop’ it means that the readings from the factory fitted lambda sensor will be used by the ecu to control the amount of fuel delivered. How the fuelling is controlled will affect the way that the AFR004 behaves when fitted to the vehicle. When operating closed loop the lambda reading will swing regularly between lean and rich, usually once every 1 to 2 seconds. Acceleration and deceleration characteristics are likely to be similar to that of the tuned engine described above. At full throttle or at higher engine speeds the fuel may be maintained just in the green region as the ecu goes open loop. Be aware that prolonged operation of a vehicle fitted with a catalytic converter at rich mixtures can damage or shorten the life of the ‘cat’.

Alternative Fuels:

The AFR004 will operate with most fuels used such as methanol, alcohol, lpg, nitrous and 2 stroke. The numerical air/fuel ratio will differ for each fuel but the stochiometric lambda =1 will remain the same. The use of fuel additives can reduce the accuracy of the sensor unless approved for use on catalytic fitted vehicles. In particular lead, octane booster and oil will shorten the working life of the sensors. Working life under these conditions is very dependent upon various parameters such as operating temperature, type of additive and level of contaminant and therefore is not predictable.