Petrol engine EGR Feedback

Exhaust Gas Recirculation (EGR) has been around for many years, but just like any system, it has evolved and variations have been designed by various manufacturers. This Institute of the Motor Industry (IMI) guide to the basic variations of EGR feedback systems, will help you understand how each works and how to diagnose and repair faults.

There are four methods of EGR feedback:

Variations in manifold pressure and/or airflow

When the EGR is commanded, the exhaust gases replace some of the induction air. This will show as a reduction in air flow in the induction tract and an increase in any manifold pressure (petrol). The weakness in this strategy is that any fault in the MAP, MAF or IAT sensor will confuse the feedback loop.

EGR poppet valve position sensor

The valves can be motorised or have a controlled solenoid, and will include a sensor which provides a feedback voltage to the PCM. This reports the position of the poppet valve. It does not report actual flow, but armed with information from MAF/MAP, it can create a much more accurate picture of EGR operation.

Delta pressure feedback (EGR DPFE)

This system uses a differential pressure sensor which monitors the pressure drop created when exhaust gases flow through a restriction or orifice. This means that the actual flow is monitored, not just the command. This gives a much clearer picture of EGR operation and can produce some accurate and descriptive digital trouble codes when it goes wrong.

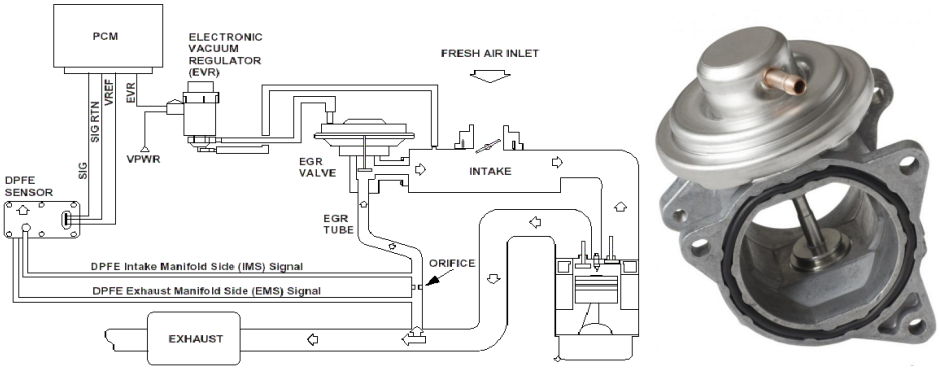
Wide band oxygen sensor

Some newer vehicles are fitted with a wide band oxygen sensor which truly closes the EGR loop. The careful balance between airflow, EGR flow and throttle butterfly position can be accurately controlled by monitoring the air/fuel ratio from the exhaust gases.

Symptoms of problems

Petrol and diesel engines use EGR differently, so symptoms and diagnostic procedures can differ. We will deal with only spark ignition (SI), or petrol engines, in this issue.

SI engines use EGR to improve fuel efficiency by reducing pumping losses and knock control, as well as the control of NOx. It is only used when certain conditions apply. The EGR system has a number of overrides that prevent or reduce the computer EGR commands. Some of them are well known, but others may be overlooked at times by technicians. As with any system on a vehicle, remember the basics and check them first.



An example DPFE EGR system diagram and a typical vacuum operated EGR valve

EGR is disabled under the following conditions:

- Idle
- Wide open throttle
- Warm up of engine
- High inlet air temperature
- Low barometric pressures or (high altitudes)
- Overrun and/or braking

To do this it needs information from these sensors

- Throttle position sensor (TPS)
- Inlet air temp (IAT)
- Atmospheric pressure sensor
- Manifold absolute pressure (MAP)
- Mass air flow (MAF)
- Vehicle speed sensor (VSS)
- Park/neutral switch (PNP)

At all other times, the quantity of recirculation is modulated by the computer to a value determined by the software in the PCM. It is continually monitored to ensure that the EGR command values give the correct EGR feedback values within certain tolerances. It is only when these tolerances are exceeded on a number of occasions and for a specific length of time that the PCM will flag up trouble codes relating to EGR.

Unfortunately, because the information from the sensors is used to control other parts of the engine management systems, the codes flagged up may not directly identify an EGR fault, or an EGR fault may be identified when a fault lies with a common sensor.

Take, for instance, a faulty mass airflow meter. Oxygen sensor Lambda control allows the system to operate with a slightly out of calibration MAF sensor without putting the MIL on. The EGR system is not always so tolerant of a faulty EGR and can cause driveability problems. Take a look at short and long term fuel trim, to see how accurate the engine load parameter is. Too much EGR flow will dilute the air/fuel mixture and make the engine run rough or stall. Excess EGR flow weakens combustion and may result in the following conditions:

- Engine stops after cold start
- Engine stops at idle after deceleration
- Vehicle surges during cruise
- Rough idle

A blocked exhaust will cause sufficient back-pressure under load to lift the EGR valve and fill the manifold with exhaust gases. This causes low power and an EGR feedback fault DTC. On MAP/speed sensed engines, it may produce O2 sensor fault.

Excessive EGR will cause a rise in MAP. Use a vacuum gauge or scan tool to monitor manifold pressure. It should be steady at between 300-400mb (30-40kPa) at idle. Higher than this and suspect a faulty
EGR or an air leak. Too little or no EGR flow can allow combustion temperatures to get too high during acceleration and load conditions. This could cause:

- Pinging (pre-detonation of the air/fuel mixture)
- Engine overheating
- Emission test failure

Look at EGR command and feedback on the scan tool; check fuel trims and operation of the sensors listed above.

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