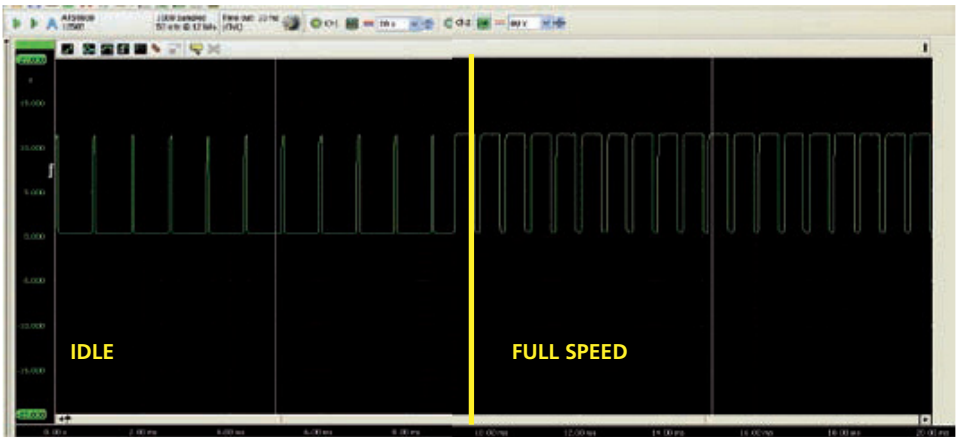
# Diesel engine EGR Feedback

Diesel Exhaust Gas Recirculation (EGR) is different in some respects to petrol engines, but it still works in the same basic way. This Institute of the Motor Industry (IMI) guide to CI, or diesel EGR feedback systems, will help you understand how it works and how to diagnose and repair faults.

Compression ignition (CI or diesel engines) use EGR to control NOx. Unlike the spark ignition (SI or petrol engines), EGR can be up to 60% of the intake air. Too much EGR will show itself under acceleration as excessive black smoke. Diesel engines rely on an accurate MAF value to monitor EGR. In many systems, EGR feedback is determined as the difference between calculated gas flow (EGR + air)) and measured airflow. The gas flow is calculated based on engine capacity, speed, air pressure and temperature. This shows how important the airflow value is. If the airflow meter gives an air flow value greater than actual airflow, EGR would be commanded to increase, and the engine would be starved of air and black smoke will come out of the exhaust.




**A typical PWM (pulse width modulated) signal from an EGR Controller at idle, on left, and at full speed, on right**

## Actuators

When diagnosing EGR systems, most people are more comfortable checking the mechanical bits first. Fortunately, that's where most problems are. For this you are going to need a vacuum gauge and vacuum pump, or in the case of motorised actuators, a scan tool. Apply a vacuum to the actuator diaphragm. There should be a "clunk" sound when the vacuum is released. For peace of mind, remove the EGR valve for a bench test. It will give you an opportunity to inspect the insides, especially the valve seat and passages. Inspect all of the vacuum lines of the EGR system to make certain there are no leaks, kinks or other obstructions. For EGR systems with electrical sensors or controls, make certain that all of the wiring is connected properly and firmly.

Another problem that can occur with an EGR valve is an internal vacuum leak. With the engine turned off, apply approximately 500 mbar to the EGR valve. The EGR valve should hold this vacuum for 5 minutes. Repeat this test with the engine running and fully warmed up. If the car is equipped with an EGR Valve with two diaphragms, the test must be conducted at each port separately. When applying the vacuum load to the EGR valve, watch for movement of the valve rod, when possible. It should move along with increasing vacuum, and then return smoothly when the vacuum is released.

**Some EGR systems control vacuum supplied to the valve based on various sensor inputs**

The most common problem is clogging of the EGR valve. This can happen naturally over time, without any faulty condition in the EGR, or very quickly when a fault does occur. Think about the problem with the fault airflow meter, too much EGR produces high levels of particulates, which then re-enter the engine through the EGR system. The particulates act as seeds for bigger particulates to grow on. This process goes into a vicious cycle of black smoke making even more black smoke. The valve eventually clogs with carbon, which can cause it to stick, open or closed, or simply becomes slow to react. EGR valves respond well to a good de-coking, but look further into the conditions that caused it to clog in the first place.

When all the passages are clear, and the valve opens and closes properly, then the task is to determine if the valve is operating as commanded, and if the commands are based on good sensor data. Understanding the operating strategy will help. Check the electro-pneumatic valve for operation, resistance and proper insulation. Use a vacuum gauge to check the vacuum supplied from the vacuum pump (on a diesel engine) or manifold (on a petrol engine).

**An EGR Valve this heavily fouled will not be capable of working correctly, but after cleaning it may be fine**

Here is a quick check that can be made with a scan tool: With the engine running at idle and fully warmed-up, look at the live data to see what the mass air flow value is. When you disconnect the EGR vacuum pipe, you should see a sharp rise in inlet air flow. When you reconnect the pipe to the EGR valve, you should see a sharp fall.

## Check the PWM signal

If all these tests check out, then the EGR strategy comes under the microscope. Any unstable signal output of the sensor values, especially mass air flow, can cause the EGR to operate out of parameter and trigger a DTC, or cause a driveability problem. It is worth mentioning at this point, that some head scratching faults in the EGR and fuelling area can only be resolved by a re-flash of the ECU. As always, it is worth checking for technical service bulletins specific to the vehicle you working on.

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