

Introduction to GEMS - 1

- GEMS is an advanced digital closed-loop Sequential Fuel Injection (SFI) system with Direct Ignition (DI), controlled by an Intel digital processor in the Engine Control Module (ECM), which together with the sensors and IACV actuator forms the Engine Management System (EMS). It uses the ISO 9141-2 interface standard (which in the US is referred to as Chrysler/Import), and is in full conformance with NAS OBD-II standards.
- It can adapt to minor changes in engine characteristics, and can control the ignition advance of each cylinder independently if knock is detected. There are no external user adjustments except for the idle air bleed bypass, which is under a blanking plug on the throttle body. It is fitted to the Plus 8 in the North American Specification (NAS) standard, with four O2 (Lambda) sensors, one in front and behind each catalytic converter.
- GEMS stores all the operational parameters including fuel and ignition maps in two PROMS, which can be removed or changed when the ECM is opened. It also stores adaptive and setup data (such as Manual/Auto transmission, Engine capacity and VIN) in Erasable PROMS so that the main settings are not lost if the power to the ECM is interrupted.

Introduction to GEMS - 2

- It uses a high pressure fuel rail maintained at a constant pressure differential (35 psi) with respect to the inlet manifold, and the injectors are timed to fire on each intake stroke. The mixture is controlled by measuring the mass air flow into the engine, applying corrections for temperature and variations in engine intake efficiency with RPM, and then calculating the correct injector pulse width needed to achieve the desired fuel/air ratio. The oxygen content of the resultant exhaust gas is measured and corrections made to the injector pulse width – these take the form of long and short term fuel trims. The short term fuel trim varies in real time as the engine changes operating conditions, but the long term fuel trim is calculated as an average of the short term fuel trim value and changes very slowly. The long term fuel trim is one of the adaptive parameters and is stored when the engine is shut down.
- The idle speed is controlled by the Idle Air Control Valve (IACV), which uses a stepper motor to open and close the idle air bleed. There is also an air bleed bypass which must be set to ensure that the IACV operates in the correct part of its range – a dirty IACV or incorrect setting of this bypass are the most common problems when idle faults are encountered. GEMS determines that the throttle is closed by comparing the voltage from the throttle position sensor with a stored value of the closed position, so if the stored value is incorrect GEMS will not be able to detect closed throttle or idle correctly.

Operational Modes

- GEMS normally operates in a closed loop mode, using the data from the heated O2S to optimize the fuel/air mixture
- Under some conditions GEMS will default to open loop control; the full list of operating modes is shown below. These can only be read by a Rovacom or similar diagnostic unit.
 - **OPEN NOT YET SATISFIED CONDITIONS**
 - The engine is not running or is still too cold to use the feedback from the sensors so when there is nothing wrong, the system is open loop
 - **CLOSED USING O2 SENSORS NORMALLY**
 - This is the usual operating mode; the engine is operating normally with no faults detected
 - **OPEN DUE TO DRIVING CONDITIONS**
 - The system has been using the sensors and there are no problems, but it has decided not to use them at the moment, as the feedback is not required for correction
 - **OPEN DUE TO A DETECTED FAULT**
 - There is a fault with the sensor and the system has reverted to using the pure map without the aid of closed loop correction
 - **CLOSED BUT AN O2 SENSOR IS FAULTY**
 - This can only happen in vehicles fitted with two sensors per bank, or the NAS standard. This applies to all Plus 8 manufactured with the Advanced Evaps system. Although the system knows one of the sensors is faulty it can switch to using the other one to give closed loop fuel correction

Adaptive Parameters - 1

- The adaptive parameters use a Z-transformed statistical technique to calculate the average difference between the mapped settings in the ECM EPROMS and the actual settings required due to minor difference in the engine build standard. Since they compute an average over time the car will have to be driven for some distance before they converge to the correct values.
- The main adaptive parameters are:
 - Adaptive Fuel Mass Flow Rate
 - The Adaptive Fuel Mass Flow Rate (FMFR) is learnt by the system over a period of time and is added to the normal fuel rate to compensate for manufacturing tolerances between fuelling components
 - The limits are + 0.625 to -0.625, after which it will log a fault in its memory
 - Adaptive Air Mass Flow Rate
 - The Adaptive Air Mass Flow Rate (AMFR) is learnt by the system over a period of time and is added to the normal air rate to compensate for manufacturing tolerances between airflow components
 - The limits are + 5.5 Kg/hr to -5.5 Kg/hr after which it will log a fault in memory
 - Short Term Idle
 - This is the value that the GEMS uses to regulate the current idle speed to take into account current engine load, temperature, etc
 - Long Term Idle
 - This is the value that the GEMS learns over a period of time to take into account manufacturers tolerances on component which affect overall idle speed

Adaptive Parameters - 2

- Closed Throttle Value
 - This Adaptive value is stored by the GEMS so it knows when the engine is at idle
 - If any adjustments are made which result in the stored value being lower than the current throttle position with the throttle properly closed poor idle characteristics may occur
 - Gems can re-learn its new value by re-setting all ECM Adaptations when it will be set to 0.85 volts – the first time the engine is started the ECM will then store the new closed throttle value. It can also be set manually, but this is not advised.
- There are number of other parameters that will be affected by the reset function, including the Long Term Fuel Trim, but these are of lesser importance and rapidly adapt after a reset operation.