TEXT: STUART GALLACHER

PHOTOS: ASM

MANAGEMENT BASICS

WITH THE INBOX SECTION RUNNING TOO FULL TO ANSWER TECH QUERIES, OUR TECHNICALITIES SECTION WAS BORN. IF YOU HAVE A QUESTION THAT REQUIRES A MECHANICALLY FLAVOURED ANSWER, SEND US AN EMAIL TO INBOX@AUTOSALON.ORG, WITH 'TECHNICALITIES' AS THE SUBJECT.

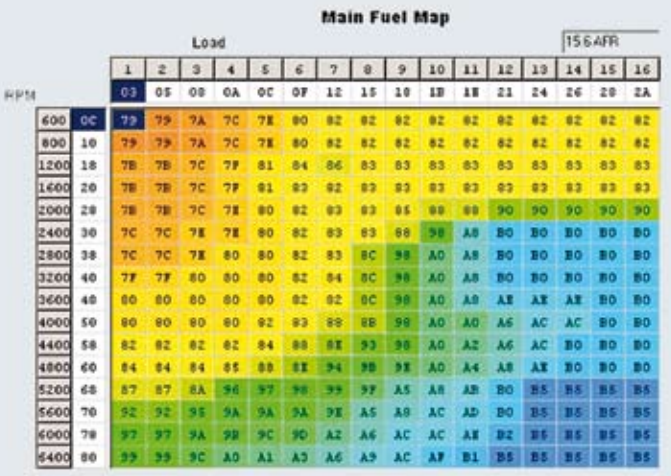
QUESTION

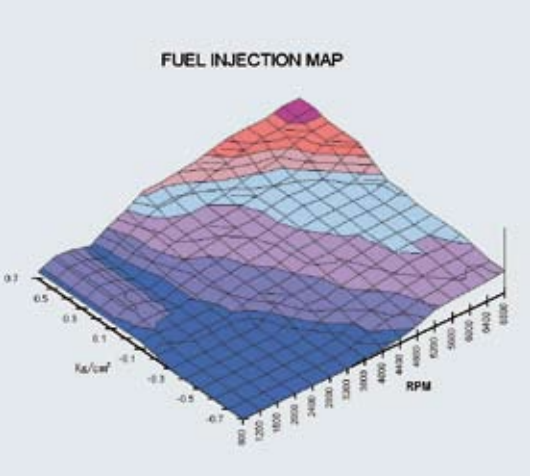
I recently bought a car with a programmable ECU (it is an IS200 with the Japanese-spec 3SGE engine that has been moderately modified) and not being massively doshed-up, was thinking of trying some of my own ghetto-style tuning. I'm pretty sure the engine is running rich because it has a strong petrol smell and blackish smoke on acceleration. However, I need your advice - is it easy to tune?

Peter

Email

"THE RPM VS LOAD FUEL MAPS WILL PROVIDE THE BASIS OF THE FUEL DELIVERY INSTRUCTIONS.





IF YOUR KNOWLEDGE IN THIS AREA IS LIMITED it would definitely be best not to attempt anything yourself, but rather visit a workshop that specialises in tuning cars and tell them what you have noticed when driving the car. For now, if you just wanted to know some of the basics of ECU function then we can help you out a little. Below is a brief overview of what an ECU has to do in order to keep your engine running.

At its most basic and primitive level, and assuming ignition timing is independently set, the only things your ECU needs to know in order to supply the right amount of fuel is what speed the engine is running at, and what load it is being placed under (a high load being typically produced by something such as an incline in the road and a low load being produced by something such as a downhill run). Stored within the ECU is a map of values for how long the fuel injectors should be open to meet the fuel requirements of the two above parameters. For instance, if the motor is running at 2000RPM with a minimal load, the fuel injectors will be opened only very briefly each four-stroke cycle - as listed in the stored 'RPM vs Load' fuel map. If the engine is running at 2000RPM with a slightly increased load, the amount of time the injectors are opened per-cycle will increase (in order to supply more fuel) - also as listed in the RPM vs Load map.

So, if the ECU detects 5000 revolutions per minute and knows the engine load level is moderate (load level being provided by something such as a Manifold Absolute Pressure sensor and/or Throttle Position Sensor) it refers to its fuel map with these two parameters and knows exactly how much time the injectors need to be open for in order to provide enough fuel. However, because there are many other situations that a typical engine will see, rather than just one single engine speed and load, the amount of fuel that needs to be fed into an engine cannot be provided by the two simple engine-speed and load reference points alone. Considering an engine needs an increased amount of fuel per-cycle to accelerate, less fuel per-cycle when cruising, a higher idle and more fuel when cold, and a higher idle when the car's voltage drops, the ECU has to have a means of calculating what to do in order to keep the engine running as desired.

In the most simple of terms, the RPM vs Load fuel maps will always provide the basis of the fuel delivery instructions. The other factors that are encountered during normal operation (as listed in above paragraph), simply augment this basic fuel map in order to increase or decrease fuel delivery - or air intake at idle via the ECU-controlled Idle Air Control. An example of a sensor input affecting the amount of fuel supplied by the ECU can be seen when the throttle is opened rapidly. The TPS, or Throttle Position Sensor, measures how much the throttle is open and feeds this information to the ECU. When the ECU sees that the throttle has been fully opened, the base RPM vs Load fuel delivery settings are bumped up, and so a greater amount of fuel is delivered in order to allow acceleration.

Another example of the RPM vs Load map being augmented is when the car is 'cruising' at only light throttle and with little load. When this 'cruising' load level has been detected, the ECU can withdraw some fuel from the main fuel map by refering to an exhaust O2 sensor to reach the optimum ratio. This is referred to as 'closed loop' operation and ensures that the engine runs the most efficient air: fuel ratio when cruising.

An aftermarket ECU allows customised RPM vs Load maps, and additional parameters, to be programmed into the unit. When using a wide band O2 sensor in the exhaust (to measure the air: fuel ratio in real time), custom tuning is a matter of building a base fuel map and then adding the additional values for which the sensor information can affect this base map. Using a process of trial and error, these values can be fine tuned at various regular RPM increments until the desired air: fuel ratio is reached through all operations. asm