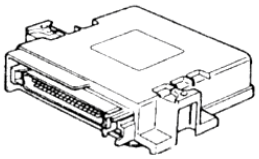
October
2008
Technical Newsletter

Automotive Electronic Control Systems



AECS
Training, Equipment and Data for Automotive Diagnostic Specialists

Rusting in Raro

This article is a true description of an AECS technical help desk problem and how it was solved.

Vehicle: Daihatsu Hi-jet 1999 Engine EF-SE 659cc, Japanese import

Problem presented to the help desk

The car presented to this YES Diagnostic network member in Rarotonga is one of those "highly fuel efficient and environmental friendly" cars. A three cylinder really small flat deck truck. One where you are the crumple zone.

The problem with this fresh Jap. import was that the engine was hunting badly at idle and was unsaleable. The idle control valve had been replaced by another garage and the throttle position was adjusted back. The hunting had reduced but now the engine would badly stumble on takeoff (not cynical... and yes, it is meant to run on three cylinders!).

Under hard acceleration it felt like it was not getting any fuel, with the odd backfire, but eventually it would catch up and the revs would slowly climb.

The check engine light was not on and the scan tool present in that workshop would not communicate with the vehicle.

Where would you start?

I personally would start with a measurement of the ignition over injection, dual channel, as it is very likely that something is wrong with either the ignition quality or the injection duration.

The vehicle has 3 COP coils with internal ignitors. This eliminates the possibility to measure primary vs injection. The next best thing is to measure secondary vs injection. The secondary pattern will at least show us the spark duration, not the spark quality. Instead of using secondary pickups, we measured the change in magnetic field around the coils, which is similar to a secondary measurement.

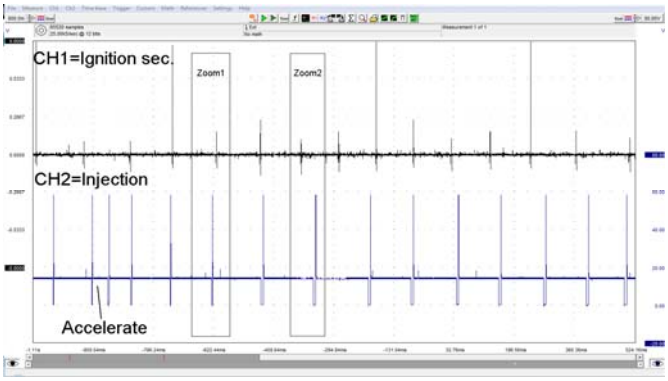


Figure 1: ATS 801 dual channel scope recording of ignition over injection. Highlighted are the two areas where the next 2 pictures/measurements are taken.

In the above scope measurement is clear to see that acceleration takes place (one extra injection pulse). It is also clear to see that not immediately the injection pulse width increases (bogging down). Less obvious is that the injection and ignition timing are running out of phase (just after the box “zoom2”), creating a further lack of fuel.

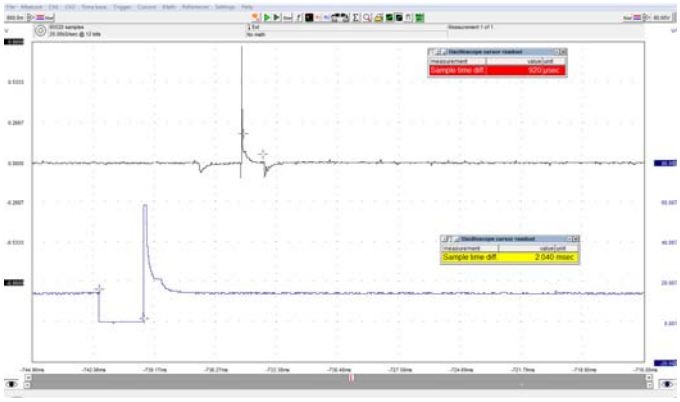


Figure 2: Zoomed in on box “zoom1”.

In the zoomed picture, it is clear to see that the ignition (0.92msec) during acceleration is not great but certainly not the cause of the misfiring. The injection however at just over 2 msec is absolutely not enough, these are idle values.

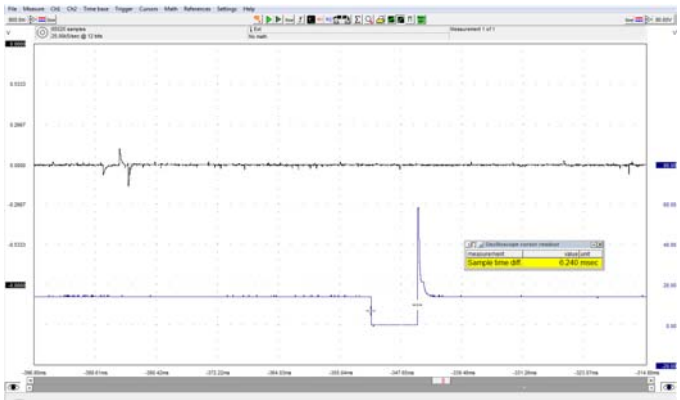


Figure 3: Zoomed in on box “zoom2”.

Too late! The injection has suddenly increased to a steady 6.24 msec some time after acceleration.

Look at type of injection system

It almost looks like the ECU does not receive the “accelerate!” instruction, but judging by the double injection pulse it *does* get that instruction. In general, the injection pulse width is predominantly affected by three main ECU inputs, torque sensor, TPS and ECT sensor. Let’s look at the type of injection system to see what we have.

This vehicle does not have a MAP or Airmass sensor, meaning it calculates the pulse width with Alpha/N control; throttle angle over RPM. This makes the throttle position sensor a very important sensor.

Measure TPS

Next plan is to measure the TPS vs the injection and see the movement of the accelerator and the response of the ECU..

In the figure 4, it is again visible where acceleration takes place (double injection pulses where the TPS voltage increases). It is also clear, even without zooming in, that the injection pulse width does not increase after the acceleration. The frequency of injecting shows clearly that the engine actually slows down. Than all of a sudden, the

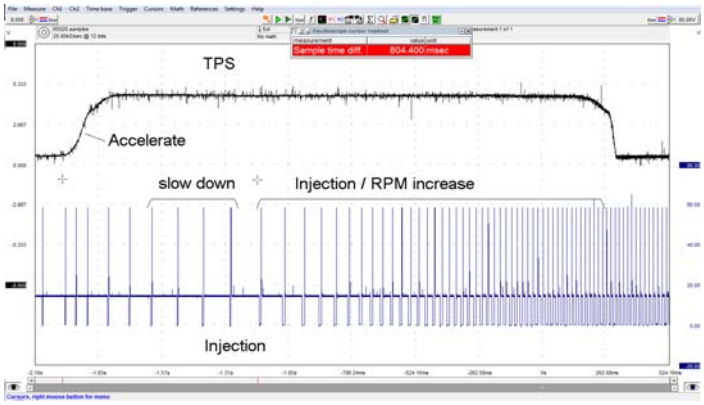


Figure 4: ATS scope recording of the TPS vs the injection

injection pulse width increases and the RPM picks up. At the end of the pattern when the accelerator is released the injection pulse width does not back down, until the rev's fall to a low level.
It almost seems as if the ECU does not receive the hashy but other than that reasonable okay TPS signal.

Broke wire?

We now had to establish if the signal produced in the TPS made it into the ECU for processing.
The best method is to measure the signal voltage at the TPS and at the ECU on the same wire.

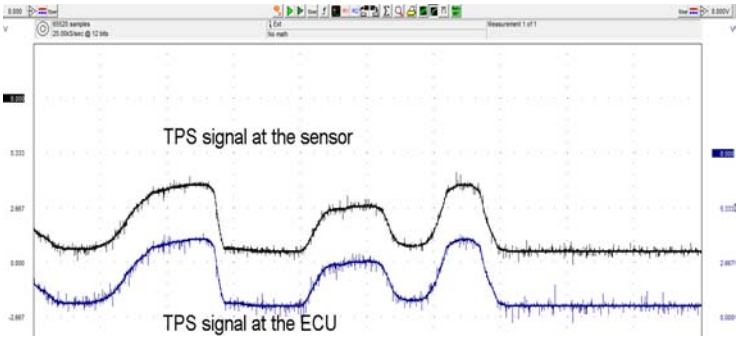


Figure 5: ATS scope recording of the TPS vs the injection.

The measurement revealed virtually no difference between the signal voltage at the sensor and at the ECU. The "Math" function of the scope (Ch1-Ch2) confirmed this.

Crook ECU?

ECU's virtually never fail, but this is starting to look like one! Just to be sure, the fuel pressure was checked, as our feeling told us that there was a lack of fuel pressure despite the fact of what we saw on the scope!
The return less fuel supply pressure remained at a nice constant level during acceleration and when the revs did pick up. Trust the scope!
Okay let's have a look inside the ECU to check for any obvious damage.

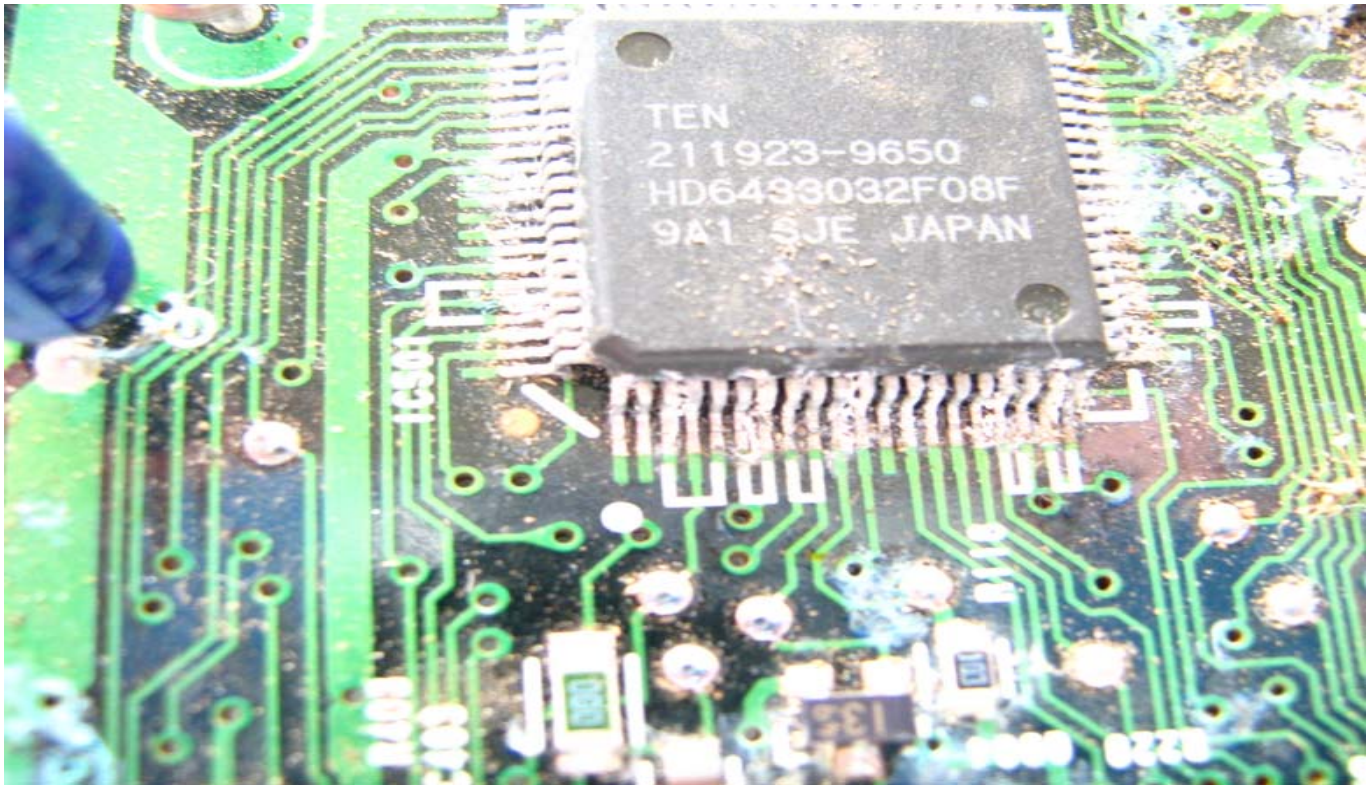


Figure 6: Daihatsu's ECU internal.

WOW!

The ECU's printed circuit board (figure 6) looked like a veggie garden at a Rarotonga beach! Sand, corrosion and bits stuck between the CPU's pins shorting inputs and outputs together. Only the ocean waves where missing!

Problem found!

Time for a new ECU, not a chance that this one can be repaired. A new one was ordered and fitted, the vehicle runs fine now, although only on three cylinders….

Conclusion

How would you have solved this without a fast dual channel (or 4 channel) large buffer recording ATS scope? BTW Not a chance with a scan tool.

For *AECS*

H.P. Leijen

(Trainer/Research)

Ph:+64 (6) 8749 077

E-mail: info@aecs.net