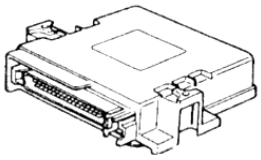
May 2012

Technical Newsletter

Automotive Electronic Control Systems



AECS

Training, Equipment and Data for Automotive Diagnostic Specialists

Wizard Wise

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

Vehicle

2002 Isuzu Wizard 3.2 V6 petrol (drive by wire)

Problem presented to the Helpdesk

This Wizard is sometimes cutting out or at least misfires badly while driving over bumps, it also sometimes made the 'check trans' light flash. There were no fault codes.

The customer has bought the ATIS scope recently and is in need of some assistance.

The customer of AECS also purchased technical support as part of the scope package, this assistance works in two ways:

1) to assist with the diagnosis on the car so that a chargeable job gets churned out and

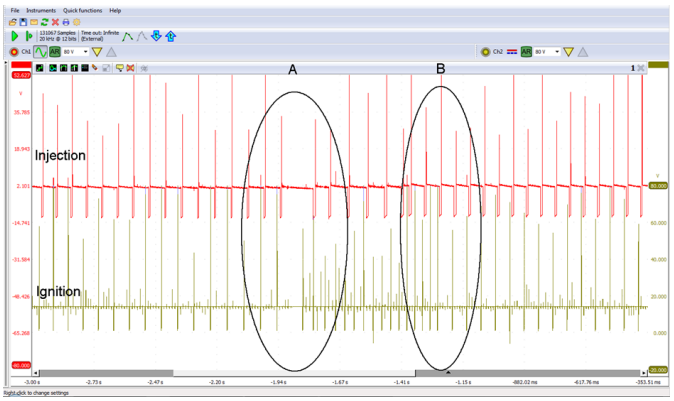
2) to teach the diagnostician **how to use the scope effectively** in a real life and relevant situation.

AECS has this service also available for our scan tools, emission testers, and air conditioning service equipment.

So where do we start?

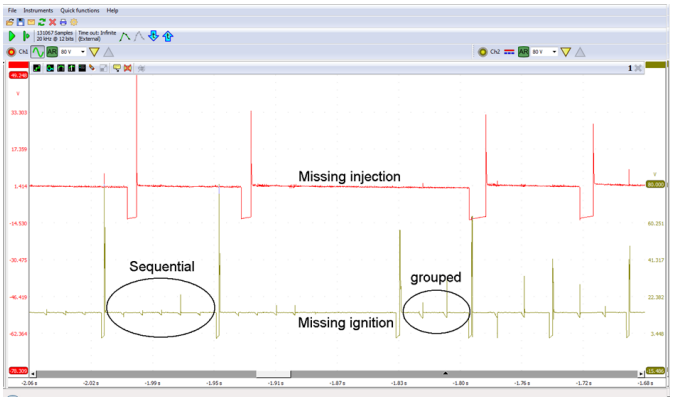
As explained in the AECS training seminars, we need to start with a long time recording of Ignition over Injection, capturing the moment when the engine misfires or stalls.

This diagnostician had attended a number of the AECS training seminars so had added to the technical request this very first scope recording.



ATS 5000 scope recording of ignition vs. injection.

Two spots in the pattern show irregularities, they need further investigation. Please find below the same pattern zoomed in.



Zoomed in pattern of Ignition vs injection

Firstly, there is an irregularity in the injection pattern; there is a pulse missing, and just after the missing pulse are broader injection pulses.

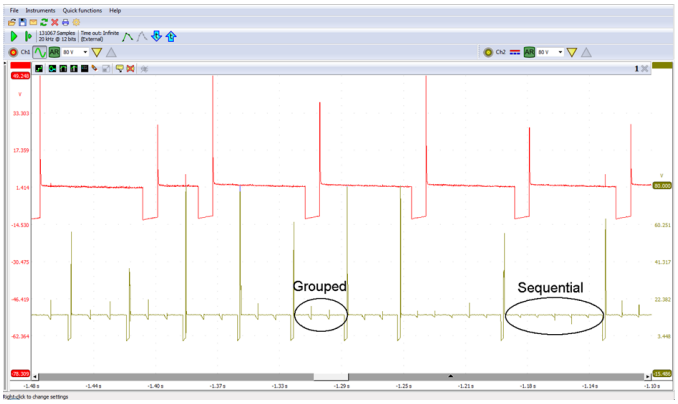
Secondly the ignition pattern; I have circled the area between the ignition pulses, where 5 dips are visible between the two ignition patterns. These dips are the result of a shared bad power supply by all coils. The bad power supply is not the problem. It does indicate that there are 6 separate coils firing sequentially, each coil firing every 720 crankshaft degrees.

Did you know that when you purchase equipment from AECS you have the option take up our offer of technical support. Talk to us if you would like to know more information.

Ph: 06 8749 077

After the missing ignition, there are only 2 dips between the ignition patterns. This indicates that the ECU switches to semi sequential (grouped) ignition, each coil firing every 360-crankshaft degrees. The dips are deeper in this section, indicating that the current draw on the bad power supply is higher, so it is safe to assume that two coils fire at the same time (grouped).

The missing pulses in both patterns will make the car stumble, as for about two revolutions there is no ignition and no injection. This is the moment when the car was driven over the bump in the road.



Zoomed in on section B, the ignition and injection return to sequential again

In the previous pattern, both the ignition and injection return seamlessly back to sequential again, this will not be noticed during driving.

Why?

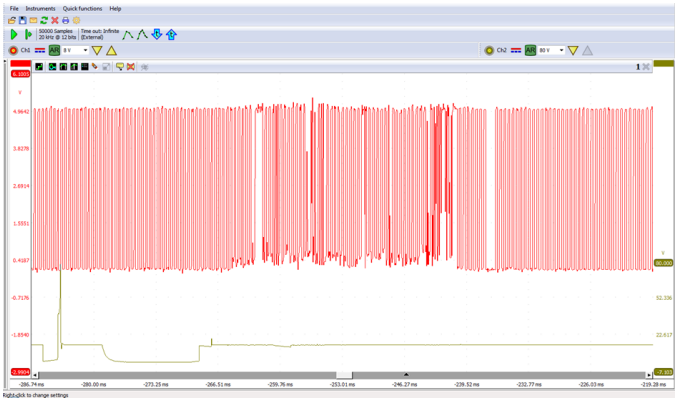
Why does a system turn from sequential to semi sequential? Simple, this can only be if the crankshaft and/or camshaft sensor signal relation gets interrupted (input), or if the ECU power supply is interrupted, or if the ECU itself is faulty.

Crank

Next measurement had to be the crankshaft sensor signal vs. ignition, and find the spot where the ignition changed to grouped.

In the above pattern, recorded while driving over a bump, the crankshaft sensor signal (CH1) is clearly interrupted at the moment when the ignition (CH2) changes from sequential to semi sequential.

Please note: *there are big dips in the ignition pattern, which I blame on the connection between the scope probe, and signal wire, being interrupted while the driving over the bump*.



Zoomed in on crankshaft disruption.

The above zoomed pattern shows the crankshaft sensor signal going all wrong. This eliminates the ECU and the ECU power supply as possible faults, as mentioned before.

We now have four further options.

The sensor is a Hall sensor, these sensors need:
1) a proper power supply,
2) an earth and
3) a signal wire properly connected to the ECU and
4) a working sensor.

Jumper wires
The technician decided to put 3 jumper wires between the ECU and the Hall sensor in one go, effectively replacing the earth, power supply and signal wire.

This had no effect on the signal…….

New sensor
A logic conclusion was to replace the sensor. This left us with exactly the same signal!

What next?
Way too soon to look at replacing the ECU! The ECU has four earth wires, all connected to the intake manifold. One of the earth wires is usually for low current sensor earth. The others are for high current actuator current like throttle control motor, ignition coils, and injectors.
The Hall sensor earth could be connected to any of those earth wires.

The diagnostician decided to draw an extra heavy earth wire to the connection point on the intake manifold. This had hardly an effect, but an effect all the same!
After consultation with the AECS help desk, he decided to split the high current wire for the throttle control motor circuit of the three and leave it connected to the manifold due to its high speed current changes putting interference on every earth point. The throttle motor earth was found while measuring with a current clamp on that wire.
The other ECU earth wires where all directly connected to the new earth cable without being connected to the manifold.

Did it!
The diagnostician took a recording of the crankshaft sensor signal vs. earth on the ECU while driving over the same bump, which used to cause all the problems.

Zoomed in recording of ECU earth vs Crankshaft.

The ECU earth still shows signs of the throttle control motor loading up the earths while the throttle position changes (correction) while driving over the bump, however the crank shaft signal voltage does not lift up nearly as much as what it did in the previous recording. It easily passed the 'arm' and 'fire' points in the ECU.
The original wires were connected to the ECU and hall sensor again, with no effect on the signal.

We were not happy with the signal, it is not clean, but short of redesigning the car, economically we could not do much more to rectify this problem.
The car ran okay, but no doubt, it will be back in time when other bad connection, (because of corroding wiring and electrolysis) gets the better of the system again.

Conclusion
Please reader, realise that this is a common car on our roads. In addition, AECS has seen many problems like these already across almost all brands.
I cannot see how you can fix a problem like this without a serious scope (the ATS) and without decent training.
I can also not see how through for example a simple re-flash of the computer (=upgrading ECU software as covered in the EMS 2-2) you will have any effect on an error like this.
The ECU needs a decent core input like the crankshaft sensor. Anything wrong with that signal will upset the main systems in the car, like in this case the ignition and injection. You can simply not measure the quality of a crankshaft sensor without a scope, even though the sensor's signal is regarded as slow in diagnostics.

Herbert

For **AECS Ltd**:
H.P. Leijen
(trainer/research)
E-Mail: hpleijen@aecs.net