Electrical problems require proper tools

As electronics electrical circuits get more advanced, the tools required to diagnose and fix them have also evolved. Brendan Ryan, from A.D.S, explains how to use a few of these tools, that are considered by many, to be as essential as a spanner when working on diagnosing electrical faults.

2003 Navara - Intermittent No Start

A 2003 Nissan Navara 2.5 D22 pick-up came in with an intermittent starting problem. The customer also said that the engine management light was flashing when trying to start the vehicle, but once the vehicle was running, it ran fine. The Autoland Vedis II diagnostics scanner showed a single fault, from the crankshaft position sensor.

While looking at the live data stream, it could be seen that when the problem occurred on cranking, the engine speed was jumping up to an unrealistic 2000-3000 rpm. We all know that a cranking engine will be turning at about 250 rpm.

The next step was an inspection of the crankshaft sensor and its wiring. The crankshaft sensor on this model is a 2 wire inductive type sensor. The crank sensor looked to be new, so a quick call to the customer confirmed that a new sensor had been fitted to no avail. We then connected a GMTO oscilloscope to the crankshaft sensor wires and cranked over the engine . The waveform from the crankshaft sensor is shown on the left of figure 1. The waveform was not smooth, and has a lot of noise/interference. As there was a new crank sensor fitted, the next step was to look at the toothed ring on the flywheel and sensor wiring.

The wiring diagram showed the crank sensors were routed to the engine ECU and then onto the instrument cluster. A continuity test, short to earth and short to positive test was done on the wiring and all tests came up OK. The instrument cluster was disconnected and the crank sensor signal was examined on the scope. The signal was still bad, eliminating the instrument cluster as the cause of the interference.

Ideas were becoming scarce at this stage, so after some deliberation, it was decided that it was possible that the starter was causing the interference, as the starter motor is positioned close to the crankshaft sensor on this engine. Checking the crank signal in conjunction with the amps drawn by the starter while cranking with a current clamp was the best way to prove this, and it showed that when the amps drawn increased, it matched the interference pattern in the crank signal.

This proved that a fault to the windings in the starter was causing magnetic field fluctuations, which were creating the interference in the crank sensor signal. The starter motor was replaced and the crank sensor signal pattern was back to normal, as shown on the right side of figure 1.

2000 Alhambra - Communications Problem

In what was initially thought to be a straightforward airbag fault, on plugging in the diagnostic scanner there was no communications with the airbag. There was also no communication possible with the engine ECU or ABS. A very useful diagnostic tool in this situation is a Data Link Connector (DLC) Breakout Box. With the box plugged into the diagnostic socket the diagnostic tool is plugged into the other side of the breakout box, allowing the scanner to function and allowing a direct connection to each of the signal pins if needed.

When the unit is connected, it displays the vehicle battery voltage and then automatically tests all of the pins in the diagnostic socket. If any pin has a fault , the box will light up the faulty pin number and buzz to warn you of the fault. In this case, as you can see in figure 2, there was a fault on pin 7.

On this vehicle, this is the K-Line, used for diagnostics on all control units. A quick look at the radio told us that a aftermarket radio had been fitted to the vehicle. We decided that this was the first thing to check, as the K-Line is routed to the OE radio. On removing the radio, the K-Line was found to be joined into the live wire, the obvious cause of the problem. Once disconnected, communication with the airbags and all other control units was restored, allowing the work to be completed on the airbag fault.

Another feature of a breakout box is that it provides a way to connect a scope to see any of the signals at each pin. This can be indispensable when diagnosing a communication problem without damaging the pins at the back of the connector.

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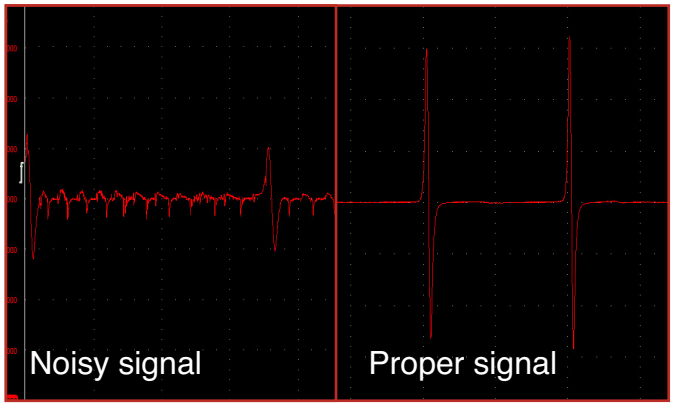

Fig. 1 The noisy crank sensor signal on the left, and a proper, clean crank sensor signal on the right.

Fig. 2 The light at pin 7 on the DLC Breakout Box indicated a fault in the K-Line. A scope could also be used to see the signal at any pin.