

Getting to the heart of the problem

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As a diagnostic specialist business, we are often asked to look at vehicles which have had previous repair attempts made. Sometimes the customers find us by themselves, as they may be frustrated with the performance of the previous repairer, or, the other repairer may choose to engage our services directly when they have run out of steam with a job.

Non-referred jobs can often present their own set of issues. The frustrated customer usually requires some form of booking-in 'therapy'. The customer, understandably, is very keen to find out exactly how much we will charge them and, very early in their conversation, they tell us how much they've spent at the 'other' place trying to get the fault sorted, and how they have not got much money left to spend fixing the problem. I'm sure many reading this experience similar things.

I try to lend a sympathetic ear to their tales of repair woe, but respectfully inform them that money spent elsewhere doesn't affect what's wrong with their vehicle, nor will it alter what it will take to make it right. If they have an issue with another repairer over the cost, quality or performance of the repair attempt,



and remote key fob matching which most aftermarket scan tools will do). I was wondering about their capability to make a correct diagnosis in light of this. As the convenience ECU is a pattern failure part (typically due to water ingress), usually resulting in a distinct set of symptoms, I considered that they may have used the 'prior knowledge' diagnostic route (a.k.a. chancing it and taking a punt based on probability).

Anyway, the result of their diagnosis was that the customer bought and paid for a new unit and took it to be coded by another repairer. Unfortunately though, the unit struggled to pair the remote control and the original symptoms still prevailed. The vehicle suffered from the alarm going off randomly,

Whilst looking through the diagrams (figure 2) it was confirmed that the body CAN connected several of the functions on the vehicle which were affected. Function chain analysis (understanding the way the car system should function, and what hardware elements are involved) is a key skill which we cover on our CAN Bus and in vehicle networking training course. By 'researching' the job before we attempt any testing (or stripping covers or components in order to test them) allows us to form a plan of attack; what, how, where and when to measure. Another guiding principle of fault finding (which we cover in electrical fault finding training) is that if you have made 5 measurements and haven't found the root cause – STOP! Technicians



figure 1

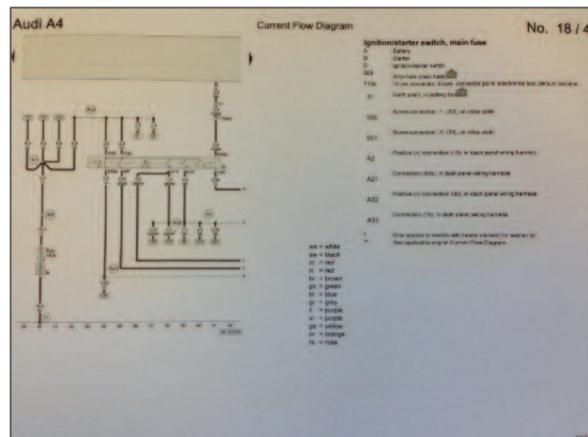


figure 2

we always advise that they enter a dialogue directly with the other repairer.

The focus of this article is on an Audi A4 (figure 1) which appeared at my workshop having had a new convenience ECU fitted. The garage that fitted and coded the convenience ECU wasn't the garage that diagnosed it. Worryingly, and this probably should have set the alarm bells ringing, the garage that diagnosed the ECU as being faulty, didn't have the capability to code the new ECU to the car (a simple variant coding procedure

none of the stalk function (wipers, washers, indicators) worked, the dash illumination didn't, and central locking was flaky, along with some other minor faults. We agreed a budget with the customer to enable us to begin our investigation of the root cause. There were several clues in the batch of symptoms, as some of the functions were hosted by the convenience unit, but others were hosted by the central electronics unit. A review of the wiring diagrams was necessary to see what was connected, where and how.

who have been shown this method of testing, known as the 'rule of halves' will hopefully be nodding sagely as they read this. Having a plan and executing that plan with ruthless logic is the only way to quick and accurate diagnostics.

It became apparent that either several ECUs had failed (very unlikely), a common supply or ground has failed (the wiring diagram and the vehicle functions showed this was not possible), that there was a local wiring fault (possible) or an inter ECU com-

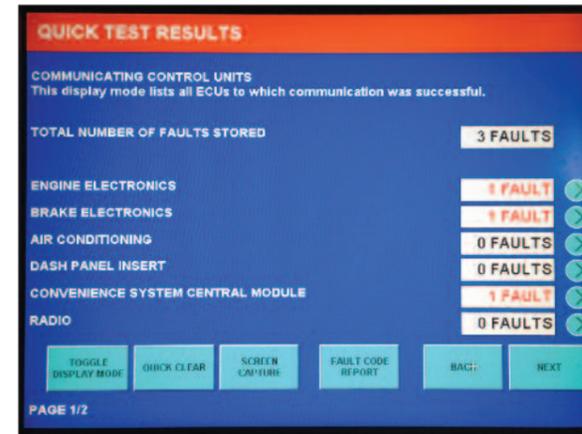


figure 3

munication fault (possible). The wiring diagram shows that the vehicle functions (which weren't working) are shared as data over the body CAN (network). Why did I choose network rather than power and grounds? Well, if the unit was turned off completely (through a bad power or ground), several of the things that did work (e.g. headlights) wouldn't have. So my function analysis and testing had ruled

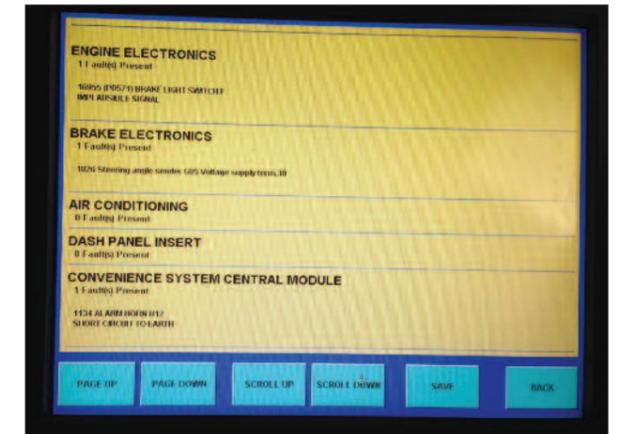


figure 4

circuit was the central electronics ECU. This component was also relatively straightforward to access by dropping the under dash panel (a few screws). Figure 5 shows the central electronics ECU exposed to the world.

The next step was to look at the network signals on the body CAN which has two wires (or channels) known as CAN high and CAN low. The best tool to analyse these

function chain analysis (what worked and what didn't) and the structure of the wiring (what was connected where and in which order) and the data taken by the oscilloscope (one side of the bus affected), it was certainly not right and had to be corrected. Was it definitely the root cause of the problem? Probably. However, it's not always possible to declare that replacing a unit will absolutely fix



figure 5

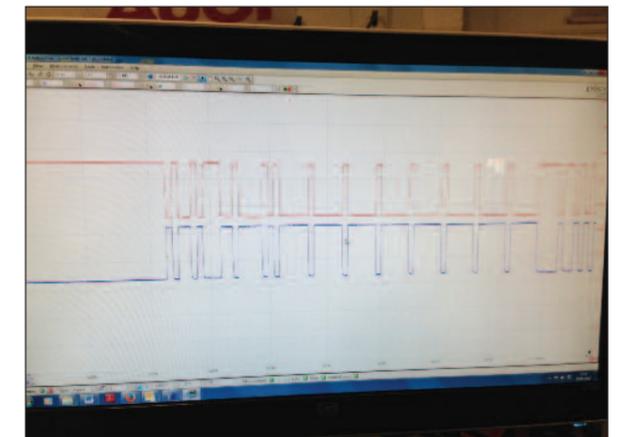


figure 6

certain failures out by virtue of what was still working. A global vehicle fault code scan showed 11 faults and some units with no communication (figure 3 & 4). The wiring diagram research showed that 'middle' of the

signals was the oscilloscope. Connecting involved removing the plug cover and back probing the relevant wires. A quick check with the central electronics unit unplugged showed a perfect CAN signal (figure 6). Testing the wiring in this state, according to the layout of the CAN shown in the wiring diagrams, and getting a good signal, ruled out problems with the convenience unit and wiring, otherwise the signal would be affected regardless of the connection status of the central electronics ECU.

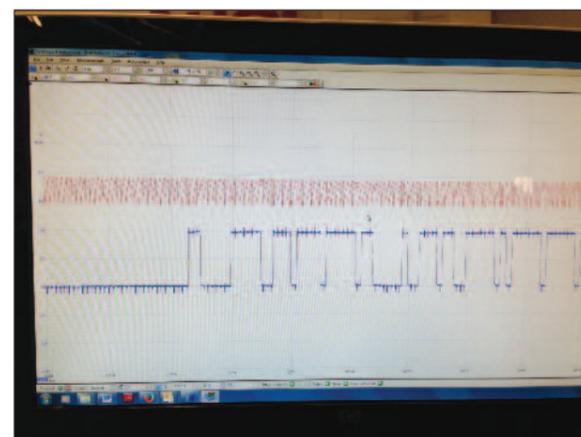


figure 7

I plugged the central electronics ECU back in and saw the waveform in figure 7. One side of the network was being drastically affected by being connected to the ECU. Was this enough to condemn the ECU? Based on the combination data of

the problem, because it's impossible to tell if the symptom will be corrected until the replacement is made.

I discussed my findings with the customer and they authorised the purchase of a new central electronics ECU. It arrived the next morning, and once fitted the symptoms were fixed. A quick check of the CAN signals showed all was well electrically. The failed ECU was indeed the root cause of the problem. The customer was delighted to have the vehicle back in full working order.

I thought that I'd support this case study with a video, so I chose to record my diagnostic journey with this vehicle. It is unscripted, off the cuff and sort of unfolds as I do the repair, therefore, it's not cinematographically perfect, however, it does provide an insight into the diagnostics processes of this case study.

The video can be found on the YouTube Channel 'dillondiagnostics' and at the following URL <https://www.youtube.com/watch?v=sbxDCORYJO4>