

Back to basics

Diagnostics equipment has a critical part to play in fault-finding with today's trucks, vans, buses and coaches. However, we're not looking at a magic wand, says Brian Tinham

How many technicians, if they were honest, would concede that they joined the transport trade because they were interested in trucks, engines and gearboxes – not in response to a latent love affair with the electrical or electronic sides of vehicles? We all know the answer: the vast majority.

So it is little surprise that, when it comes to troubleshooting the array of electrical and electronic systems on modern commercial vehicles, there is generally now an over-dependence on diagnostic equipment. Too few engineers seem comfortable getting stuck in with a DMM (digital multimeter). Even fewer are happy to wield an oscilloscope. And even if they can, it's only those rare superheroes who are able to move logically around vehicle harnesses, determining the root causes of electrical problems and making informed decisions about repair work – particularly where additional subsystems have been installed on, for example, specialist vehicles.

The problem with all of this is not that trucks, vans or buses are left in a dangerous or unroadworthy state: that is seldom the case. No, it is primarily that repairs may be costing considerably more than they should – at a time when we're all supposed to be tightening our belts. Also, there is a risk that associated emerging problems – such as short circuits caused, for instance, by multi-core cables bending over a bodywork edge or rubbing against moving parts – will go undiagnosed, leading to vehicles in and out of the workshops, or breaking down in service and costing operators even more money, in terms of further repairs and downtime.

Simple electrics

Yet Colin Lock, head of vehicle electrical training at S&B Automotive Academy in Bristol, says it need not be like this. "It's not just apprentices; when qualified technicians come to us, there is always a fair percentage that see the electrical side as too complicated. Their knowledge of wiring and basic tools, such as meters, is poor. And it's the same with the electrical side of vehicle sensors and actuators."

They're worried about setting fire to something or blowing up a £500 ECU, so they tend to leave the electrics to 'somebody else', he says. "That's a big mistake, given that virtually everything today has

wires hanging off it – even mirrors and wheel hubs."

For him, learning electrics is a simple matter of going back to basics, and explaining that these can, and should, be applied to any sensor or system, no matter how apparently complex. "I always start by running through the fundamentals of electricity, because technicians need to understand that amps equate to current flow, voltage to pressure and ohms to resistance." Armed with that knowledge, technicians will, at the very least, know that ammeters must be connected in series with a circuit, while voltmeters are set up in parallel.

Why does this matter so much? Lock explains that when, for example, the diagnostic system tells a technician that it can't see a camshaft sensor – or a crankshaft sensor, wheel speed sensor, whatever – if he can't use a DMM, that individual is left guessing which part to swap out.

"Those that know what they're doing will find out what needs replacing, because they'll follow up what the diagnostic kit says by wandering around the relevant sensor and circuit, quickly performing appropriate simple meter tests."

In the case of a passive wheel sensor, for example – essentially a small coil – technicians should expect to find the resistance of that coil by performing a quick test across the sensor. If the resistance is correct, the problem is with the wiring or the computer, and the next step should be to go



Correct processes are the key

The problem with diagnostics is that some technicians think they can just plug it in and start throwing parts at a problem. “They think of diagnostics as a magic wand that will just fix a problem, but it won’t. It’s another tool to help them.” So says Stephen Ball, technical trainer with diagnostics equipment manufacturer Texa.



“I always say that you need to speak to the person who acknowledged the fault first, whether that’s the driver, the vehicle owner, whoever. Ask questions such as: was it raining, were you braking, were you going downhill? Get the context for the fault. Then check the basics: look for split pipes, loose battery terminals, all the obvious stuff. Only then should you plug in the diagnostics.”

Ball gives the example of an ABS warning light on a truck instrument panel. Having carried out the basic checks, he says, the correct process starts with plugging in the diagnostic, communicating with the ECU and looking for errors or fault codes.

“That will point to a circuit with a problem. It may be an ABS sensor circuit fault, so you need to look at wheel speeds and voltages by spinning the wheel. From there, you can determine if there a problem, but then you need to revert back to normal testing – checking the sensor resistance and looking for mechanical faults, such as wheel bearing problems or corroded sensor rings.”

For Ball, diagnostics are part of the mix of troubleshooting. It’s about blending good, old-fashioned technician practice with modern equipment.



back to the ECU, unplug it and perform the same test on the loom wires, with the DMM in resistance mode. If that’s open circuit, it’s the wiring.

His point: although the fault might be with the sensor, the diagnostic kit is only saying it can’t communicate with the device. “Technicians who don’t know any better tend to blindly fit what the kit indicates as a potential problem. Often they will be right – wheel speed sensors’ wiring, for instance, tends to go across the suspension. By fitting a new sensor, which comes with its own length of wire, they may overcome the problem – even without realising that it could, in fact, have been due to faulty wiring or just a connector left unplugged.”

Scoping the problem

But it’s not just about using a DMM properly. Most modern diagnostic equipment also includes oscilloscope screens, capable of revealing vehicle sensor and actuator waveforms. As Lock explains, if the diagnostics are pointing to our wheel speed sensor, but it’s not open circuit, then you can identify exactly what’s going on by spinning the wheel in question and then spinning another known good wheel at the same speed, and comparing signals.

“If it turns out to be a weak signal, the problem might not be the sensor itself. It could be a large air gap between the sensor and rotor, or just debris interfering with the magnetic field. Clearly, technicians do need to understand the basics of sensors as well, but at least the equipment will help them get to the real cause,” he advises.

However, scopes really come into their own – whether as part of the diagnostic kit or, even more, as standalone instruments – when the problems detected concern motorised actuators, which are generally computer-controlled, using PWM (pulse width modulation) signals.

“You can’t see what’s going on with a voltmeter, because the signals move too fast,” explains Lock. “But a scope will draw you a picture of exactly what’s happening. With the test leads clipped to the wiring, it will show you what the computer is trying to do, with its power switching signals. And you can compare that with the actuator response around its duty cycle. If it’s the throttle, for example, revving the engine should show the pulse width signal changing, as the computer attempts to move the actuator. But, if the device stays put, then the fault is at the actuator end. It might be seized or there could be a fault with the actuator electrics.”

And it’s much the same with, for example, crank shaft speed and position sensors. Here the value of using a scope is that it enables a technician to compare signal shape with that of the OEM’s reference on the website – always ensuring that the measurement conditions are the same. Clearly, with properly administered electrical testing, there are opportunities to save time and money. 