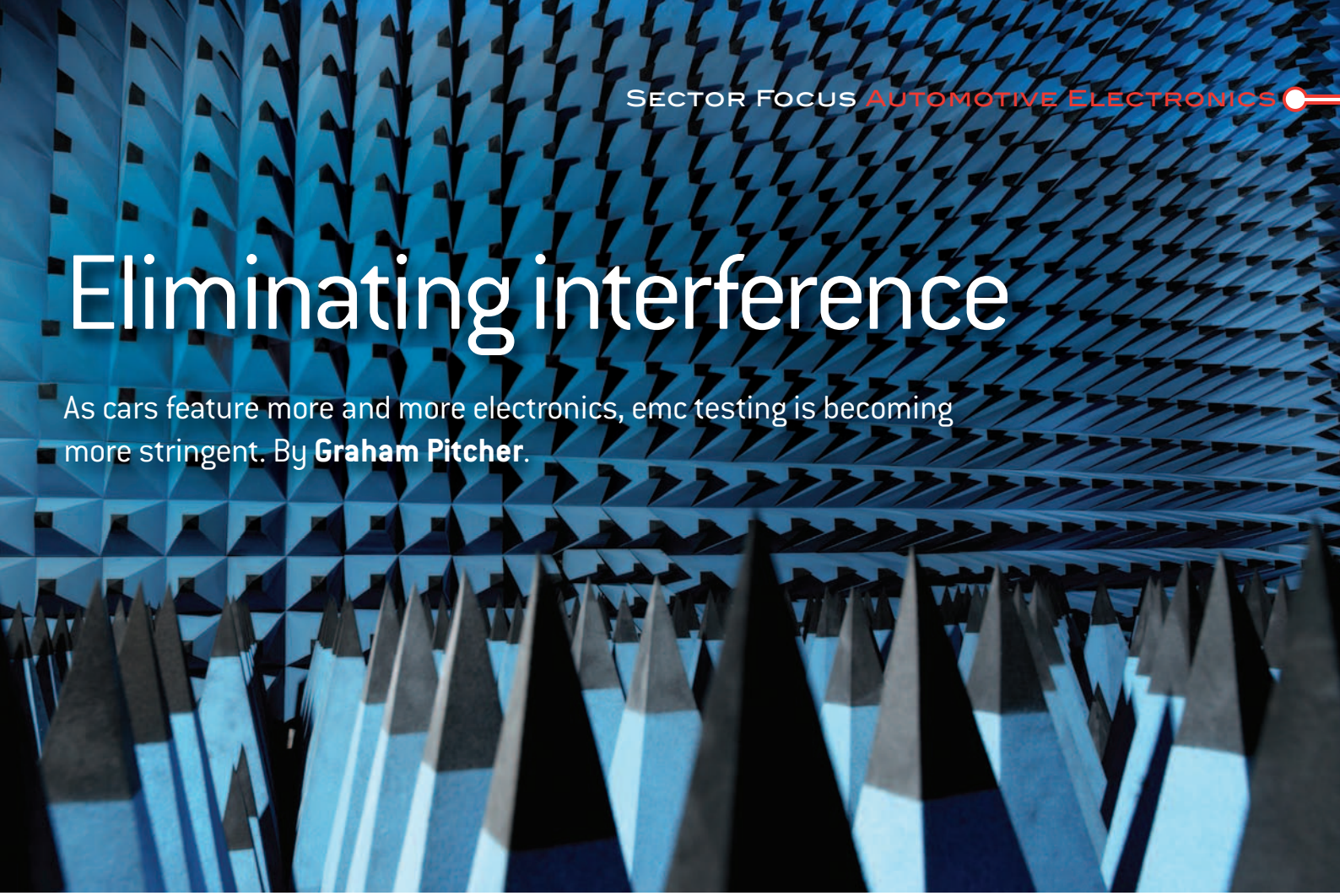

Eliminating interference

As cars feature more and more electronics, emc testing is becoming more stringent. By **Graham Pitcher**.

Since its introduction into UK law at the beginning of 1996, the EMC Directive has blended into the background of electronic design. While a few companies may still be ignoring its requirements, the vast majority of engineers now adopt designing with emc in mind as best practice.

And emc requirements pertain as much in the automotive sector as they do elsewhere. James Gordon-Colebrooke, managing director of 3C Test, said that while emc regulations, as they apply to cars, are changing 'painfully slowly', car manufacturers themselves are designing and testing to far more stringent specifications.

"There are two guiding principles," he claimed. "Vehicles shouldn't interfere with passers by or upset tv and radio reception, and they should not cause interference with equipment inside them."

Tests are made of radiated emissions – how much interference a car generates – and of radiated immunity – how resistant a car is to external interference.

When testing radiated emissions, investigations are carried out over the fm band and most of DAB, plus the analogue tv bands and mobile communications from 30MHz to 1GHz. "For radiated immunity," he continued, "we test from 30MHz to 2GHz, taking in the GSM bands. This is a significantly greater span than tests made in the commercial world."

Tests for a CE mark require a field strength of between 3 and 10V/m to be applied. "For vehicles," he said, "it's a minimum of 30V/m. We also do in car tests to make sure that if someone puts an antenna on the vehicle, it won't be upset by the installation: for example, with a taxi."

For passenger vehicles and for motorbikes, emc aspects are handled by the Vehicle Certification Agency (VCA), which issues type approvals. But other vehicles need to be tested. "For example," Gordon-Colebrooke continued, "there are agricultural vehicles and earthmovers. But they receive CE marking against different standards. Nevertheless, the technical requirements are basically the same; it doesn't matter what vehicle it is, the same tests apply."

While the final test may be on the vehicle itself, that will be the culmination of a series of time consuming tests on its components. "If it's supplied with the vehicle – original fit – a component doesn't need to be approved in its own right," he pointed out. "But something fitted as an after market part will require CE marking."

According to the VCA, all passenger vehicles need full type approval to Directive 72/245/EEC. For aftermarket electronic sub assemblies, two routes are available. Those components defined as being 'immunity related' need automotive type approval, while those said to be 'non immunity related' need to conform with the EMC Directive and to meet the Automotive Directive 2004/104/EC.

Immunity related products are those which:

- affect the direct control of the vehicle
- affect the protection of the driver, passengers and other road users
- may cause confusion to the driver and

other road users by optical and audible disturbances
- affect vehicle data bus functionality
- affect vehicle statutory data.

However, the Automotive Directive is being phased out, Gordon-Colebrooke noted. "In the future, everything will need to be certified to ECE Regulation 10." This is a United Nations requirement for 'E' marking road vehicles that has similar demands to EMC Directive.

The rise of the electric vehicle (EV) is also bringing changes to the testing regime; for example, encompassing charging stations. "EVs also generate conducted emissions," he added, "so companies like 3C will also have to test for dips, drop outs, harmonics and flicker, alongside the normal immunity tests."

Gordon-Colebrooke said OEMs are becoming more aware of emc related issues and are requiring tougher tests. "Ford, for example, requires components to be tested to field strengths of 100V/m, while Peugeot Citroen is even more rigorous, requiring tests at 200V/m."

In terms of bulk current injection – where current is injected directly into the wiring loom – OEMs are working beyond the general requirement of 60mA. "Chrysler, for example, requires a 375mA bulk current injection."

Automotive companies are changing their requirements on a regular basis because the technology they are using is moving rapidly. "So quickly that standards can't keep up with the changes," Gordon-Colebrook commented.

And it's not just radiated fields which companies like 3C are testing, there are a large number of electrical tests, such as dips and drop outs. "We'll test over anything from 10μs to 10s," said Gordon-Colebrooke, "to see what happens to the equipment. For example, a drop out of 800μs might see the equipment lock up and be unable to recover. So tests are getting more sophisticated and we're trying to locate every single area that might upset a piece of electronics."

Gordon-Colebrook: "Electric vehicles also generate conducted emissions, so companies like 3C will also have to test for dips, drop outs, harmonics and flicker, alongside the normal immunity tests."

With cars featuring more and more electronic systems, the interference potential – from outside the car and from within – is large. "It can be a real problem," said Gordon-Colebrook, "and there's a lot of work being done to protect these frequency bands in the vehicle."

Tougher tests

In his opinion, the test requirements for automotive products are as tough as for any military standard – 'probably tougher'. "Some of the toughest emc regulations in the world apply to vehicles," he noted, "and all this is being driven by car manufacturers, who are, in turn, being driven by customer expectation."

While requirements get more stringent, testing is also getting harder. The reason? "There's just so much radio communications today that measuring emc on an open site – as we used to do in the past – is almost impossible," said Gordon-Colebrook. "To overcome this, 3C has invested in anechoic chambers. Testing the whole vehicle is an essential part of the process; when you put components together, they often behave differently."

A further benefit of using a chamber, rather than an open site, is that various road conditions can be simulated. The chamber is equipped with features that allow such systems as braking, skid control to be tested. "This is particularly important for EVs," Gordon-Colebrook claimed. "We have to make sure that drive units don't interfere with radio and tv reception. Their inverters are running at 400 to 600V and generate enormous amounts of noise, which varies with vehicle speed."

3C has four chambers at its Silverstone site; two of which are equipped with turntables. Tests are conducted using approximately £1million worth of equipment. "It's a big investment," Gordon-Colebrook admitted.

"One of the issues we have is that the specs to which we're testing are becoming more complicated in terms of how they're applied; there's a combination of levels, bandwidth and scan times. Conventional test receivers can't do tests at an effective rate, so we're moving to time domain analysers. Using Fast Fourier Transform techniques speeds testing times enormously."

One thing is certain: that changes in regulations will continue. "EV technology is relatively unknown," said Gordon-Colebrook, "and changes to the Directive will come as more knowledge is gained. And there will be changes to standards as systems such as adaptive cruise control and collision avoidance come in."

But while there is an understandable focus on the electronics which control the car, spare a thought for the humble key fob. "It's going to be an area where there will be much more testing," he concluded. "There's so much going on in the 433MHz band that people may not be able to get into their cars because of all the interference."