



Sustainability is exciting

It is becoming harder and harder to find credible dissent from two rapidly emerging themes; that as population and expected living standards in previously poorer countries rise, the sustainability of our world in the form we are used to is genuinely under imminent threat; that as our awareness of health problems associated with pollutants in population-dense areas rises, our willingness to accept this is reducing. These themes are already producing political effects (e.g. banning of new petrol and diesel car sales in UK from 2035) and they are probably also changing our views as to what we aspire to; what is 'cool'; what is acceptable. Consider how many people would now think of somebody who decided to fly to New York to go Christmas shopping? Was this even an issue 10 years ago? As we live our lives in real time it can be difficult to notice the latter effect, but when we look back with the benefit of hindsight, we may find this effect to have been surprisingly powerful.

The view is often expressed that whatever we do in the UK will be immaterial compared to the effects of billions of people increasing their consumption to the same level as ours. On the face of it this appears objectively reasonable (if ethically problematic) but is that really the case? My view is that the positive impact we can have goes far beyond reducing our own footprint if we can show how a sustainable future can be not just possible but exciting and motivating. Our role in Integral e-drive is to be an enabler in an important area; by setting new standards of performance, efficiency and controllability for electrical motive power, we are enabling our clients to make the amazing products that show the world that sustainable motive power hugely extends what we can achieve rather than limiting it.

Outstanding e-drives enable outstanding new machines

The world of electric drives is underpinned by combinations of mechanical, electrical, electronic and software technologies that are themselves advancing rapidly. Simultaneously the demand for power dense, efficient e-drives is just beginning, inspired as it is by the electrification of transport. This makes it a very exciting and fertile area to be working in.

State of the art e-drives differ fundamentally from IC engines in some important ways. They are fully reversible both in direction of rotation and also that of energy flow. They are capable for example of decelerating a vehicle and returning energy to the battery. Driven by semiconductor switches and software executing thousands of times per second, e-drives also offer a whole new world of controllability. Outstanding power density and efficiency completes the picture giving the product architect the scope to produce amazing new machines.

Performance leadership through innovation

At Integral e-drive we are pushing to maximise all these advantages and to make them available to clients in quality assured products. The attribute of extreme power density is a key enabler for many of our clients, enabling them to achieve vehicle level goals that would not otherwise be possible. Power density is inextricably linked with the identification and minimization of any losses as the operational frequency is increased whilst meeting often conflicting mechanical, thermal and insulation system requirements. This is an area that responds extremely well to innovation and one way to really fast-track innovation is to go racing.



*Penske Autosport EV4 Formula E race car
(Image courtesy of Space-Suit Media)*

The message that ‘racing improves the breed’ makes companies pay to be associated with premium motorsport but the resemblance of a Formula 1 racing car and its IC engine to any road application is fairly tenuous. For electric drives though, the linkage is very real and premium motorsport is building huge expertise in e-drive systems and encouraging us to push the limits in a way that only racing can.

Much of our work is confidential but, on rare occasions, some clients will allow us to publish our involvement and one such instance was our role in providing the integrated motor inverter systems for VW’s IDR 2018 Pike’s Peak car. This was the first time that an electric vehicle beat an open class field of IC engines in a premium motorsport event and it smashed the course record in the process.



Volkswagen Motorsport's 2018 Pikes Peak ID. R race car

2 years later, motors derived directly from the machines in the IDR are about to go into production in no fewer than 5 hypercars. Making this happen has been a ‘whole company’ achievement. Capturing the features that enable ultra-high performance in a production environment targeted at up to 10,000 units per annum has required innovation in production processes and much work with the supplier base and all of this has been captured and assured in our quality system.

Making outstanding e-drives available to the world

A key question now must be how do we maximise the number of applications we can support? The specific requirements from clients are extremely diverse and to a large degree unpredictable, but Integral e-drive is itself designed to prosper in this world based on two concepts. The first of these we call 'Core Technology Bespoke'. The basis of this is to define our core technologies throughout the product lifecycle at rule level so that they can be faithfully re-produced in any required form factor. In some cases, more than one core technology is supported (e.g. for ultimate power density we use expensive cobalt steel for our stators but, where cost / benefit constraints dictate is significant, a silicon steel grade is used). These core technologies are evolved in the light of experience and R&D and taking account of new offerings from the supply base. In a very tangible way this ethos embeds continuous improvement leveraging previous projects to reduce the time and risk associated with offering a fully optimized product to clients.



Same core technology is used across multiple motor platforms

Of course, as we develop more and more e-drives, the chance to find a good match with an existing product perhaps with changes to stack length or winding configuration increases and this can also be attractive to further minimize time to market or NRE. We call such products 'Current Platform Derivatives'.



Integral e-Drive SPM 242 Platform Family

There is so much still to do

Core technology is a firm basis but is not a static thing. New processes in the supply base can offer performance or economic advantages and we are continually seeking to improve the attractiveness of our products in the market through innovation. For example, in R&D we have an advanced scalable integrated motor inverter (SIMI) project that is now in hardware. Meanwhile on our core controls platform we are engineering an MCU safety system due for launch in a road vehicle later this year.

And whilst the automotive bow wave is currently underway, it is clear that developments in battery and fuel cell technology and availability are encouraging other sectors. In many cases the rules of engagement for application of e-drives have not yet been written and it is exciting to explore the art of the possible, to achieve the best possible match to client wishes and demonstrate this in running hardware. We are currently operating a number of pilot projects in aerospace, marine and test equipment and we hope to see these and other sectors going substantially electric during this decade.

At Integral e-drive we are excited by the challenges and the possibilities driven by the need for sustainability. We are confident that the electric drive is a 'game-changer', a combination of 21st century technologies that makes amazing new machines possible. Our footprint may be small on a global scale but if we can help make sustainability exciting then that feels like a worthwhile contribution.

To learn more take a tour of our [website](#) or call 01908 278600 to discuss your requirements with one of our emissions' specialists.

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