AVNET ABACUS

focus

Edition 31

Powering your designs

focus

Focus is the quarterly magazine from Avnet Abacus, featuring in-depth trend and technology reviews, new product spotlights, Avnet community news and interviews with market leaders.

If you have any comments or questions on the technologies featured in this edition, or wish to speak to one of our technical specialists on power, you can get in touch at avnet-abacus.eu/ask-an-expert

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Keep up to date with the latest news, product information and technical insights via our social media channels.

We are delighted to introduce Avnet Abacus' new President, Rudy Van Parijs, as Nigel Ward announces his retirement. With an excellent technical and commercial background, and eight years at the helm of EBV's South Europe region, Rudy is highly qualified to step into Nigel's role at Avnet Abacus. We'd like to thank Nigel for his contribution to Avnet Abacus' ongoing success and offer our support to Rudy as he takes on this new opportunity.

Rudy Van Parijs, President Avnet Abacus

This latest edition of Focus offers an in-depth insight into power system design. Every product designed by our customers is powered by electricity, and delivering power safely, reliably, accurately and efficiently is a test many engineers face. In this publication our power specialists discuss some of the challenges and solutions our customers are facing.

The first of our feature articles reviews when an engineer should consider using a configurable power supply. Hector Garcia demonstrates the key criteria that encourage engineers to consider configurable solutions as a viable and attractive proposition early in the design process.

Andrew Hutton gives a guided tour of the latest design techniques in transportation. Covering a range of applications from entertainment to sensor and lighting systems, this is a fast growing market segment which can present unique design challenges.

Philip Lechner considers the solutions available for engineers to tackle demanding LED lighting applications. Clearly the optimum choice for most lighting requirements today, designers must build a power solution that meets legislative requirements and ensures the safe, reliable operation of their lighting fixtures over the complete lifetime of the system.

In the last of our feature articles we discuss how lithium-ion batteries face unprecedented demand. Driven chiefly by the automotive market's move to electrically powered vehicles, Avnet Abacus' battery specialist Tim Parker details the market situation and outlook, what it means for engineers and what steps they can take to mitigate the risks of a surge in demand for lithium-ion cells.

And in an exclusive interview, industry veteran Eddie Gallacher tells us about power specialist Artesyn. He reviews the current state of the power supply industry and the future trends that are driving decision-making at Artesyn.

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When configurable power supplies are the best solution

Traditionally, system designers try to use 'off-the-shelf' standard components, expecting the lowest cost as a result. With power supplies, this is not necessarily the case when a holistic view is taken. A compelling case can be made for cost effectiveness of factory- or field-configurable supplies when elements such as time to market and flexibility are taken into account. Author Hector Garcia, Power Specialist, weighs up the pros and cons.

Hector Garcia

Technical Specialist,
Power, Avnet Abacus

Standard, custom or modular?

It is often assumed that in any product design, if you can use a standard 'off-the-shelf' power supply it will be the lowest cost option compared with a full custom or configurable part. It's true that with today's fast-paced product launches and upgrades, if a custom part is commissioned, the Non-Recurring Engineering (NRE) costs may not be recoverable, risks are high and the time for development could be way too long. Even in military development programs, which can be measured in decades, Commercial off-the-shelf (COTS) parts are often preferred. Configurable parts should not be dismissed though.

'You can have any colour as long as it's black'

The statement attributed to Henry Ford wasn't quite what he said but the edict would certainly make manufacturers' lives easier if translated to power supply product specifications. Of course, power supply manufacturers do concentrate their marketing on particular standard models and try to specify them to capture the largest share of applications. When a manufacturer can sell most of its product as a single configurable style though, the cost on the market can be surprisingly close to a 'standard'.

An argument often put forward is that a 'standard' part is shipped to many customers and therefore manufacturers benefit from economy of scale. If you believe that the savings are always passed on to customers then this is surely a good thing. But there's a fallacy here: each power supply manufacturer needs to have hundreds if not thousands of 'standards' to meet market demands. Just look at the power product listings boasting a multitude of variants available from typical suppliers. For them, this means huge approved vendor lists and mountains of documentation. If they could sell fewer types that fit more applications, real savings could be made and passed on to the end user. This is where 'configurable' products can score for both manufacturers and their customers.

Does the power supply have to fit in the 'space that's left' anymore?

With energy and cost saving constraints, system designers are now acutely aware that their power system cannot be an 'afterthought' as in the bad old days. This has the unfortunate effect though that the power supply specification must be set early on in development with guesses at power rating, size, voltage rails and even safety compliance levels.

When configurable power supplies are the best solution

Then there's the monitoring and control features to anticipate. The result can be that product designers have to work around the pre-determined power specification, chosen from standard offerings, severely limiting the scope of their designs.

No responsible designer would compromise too far, so there is the very real risk that the power supply and its specification would need to change mid-program with consequential disruption to mechanical arrangements. Even if the designer works around his power specification constraints, could marketing change their requirements during development? Surely not. Have circuit designers never been asked to 'just add an extra interface' or 'just add in a medical version'? That decision to fix the power supply as a standard gets thrown out of the window and the search starts again with all the costs and uncertainties involved.

The alternative solution is to specify a configurable or programmable power supply from the outset. These typically are a base unit with mains filtering and a power factor correction stage followed by plug-in modules for individual output isolation and regulation. Now, any specification changes can be accommodated with, at worst, a module swap and sometimes no more than an adjustment of a potentiometer to a different voltage. Many configurable supplies for example can adjust a single output from 5V to 3.3V with no effect on other outputs.

Module power ratings can be chosen up to a maximum for the base unit and outputs can be put in parallel or series to increase current and voltage levels respectively. Usually effort is made by the manufacturer to make the configurable supply meet worst case specifications. As such you can expect them to meet the most stringent EMC performance and medical safety specifications, even patient-connect type (2 x MOPP).

You might say that the argument for specifying a configurable supply at some extra unit cost relies on the assumption that a standard power supply choice will always change during program development with its associated disruption, necessitating choice of another standard part. No one wants to anticipate failure so the argument would not be a popular one, especially with the financial guys. However, that's not the whole story.

Liberating designers

There are positive advantages to going the route of a configurable supply from the start. As long as the right footprint is allocated in the end product, power supply selection can be left to the later stages of product development when actual voltages, power levels and signalling requirements are known. The product designer is then freed up to optimise their part of the design without power constraints. And more, the inherent flexibility can be used to tailor the end product for its application. Those marketing guys might also want a bare-bones version – just remove or downsize power modules. They might want a fully featured option – just add or upgrade power modules. Time to market for variants is minimised by having that configurability.

Configurable power supply designers know that for their product to be attractive, flexibility is the key so they will often feature all-isolated outputs, for example.

"Have circuit designers never been asked to 'just add an extra interface' or 'just add in a medical version'?"

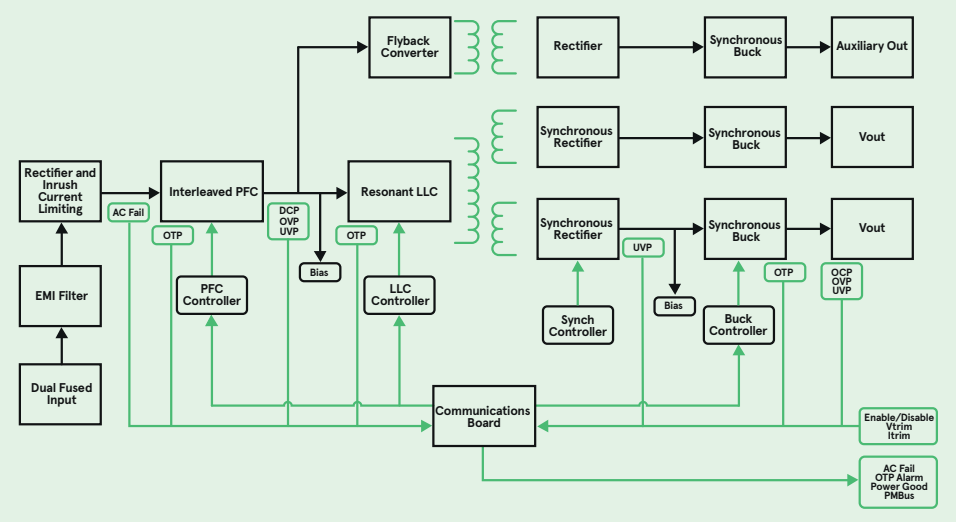


Figure 1: Typical configurable power supply architecture

Typical standard power supplies will have a common ground for multiple outputs constraining grounding systems from being optimum for EMC and functionality. Standard multi-output supplies will also often require a minimum load on a specified 'main' output, below which other outputs fall out of specification. Configurable supplies, with their individually regulated outputs don't suffer from this restriction. The typical way individual outputs are controlled is shown in Figure 1, an example from the Excelsys CoolX range.

Programmability gives flexibility and 'future proofing'

Perhaps the biggest potential advantage of configurable and programmable supplies is that because of their modular nature with individual output regulation, they will often incorporate comprehensive signalling and control. Recent programmable power supply products incorporate multiple microcontrollers for full digital loop control. Opening up the internal control bus to users via a Graphic User Interface (GUI) gives the possibility of adding factory and field programmability and extra functionality to the end product. Figure 2 shows an example of the monitoring features of the free software supplied for the Artesyn iHP configurable product.

Now, power supplies can be set in the factory to a particular configuration for an end-product variant, field service is facilitated by hooking up to portable diagnostics and end users can fine-tune power supply performance to match their load characteristics.

Using the manufacturer-supplied GUI, some programmable power supplies can even be dynamically and automatically adjusted – for example in battery charging where voltage might need to change depending on cell temperature and mode change from constant current to constant voltage might be required.

Figure 2: Artesyn iHP series monitoring software GUI

When configurable power supplies are the best solution

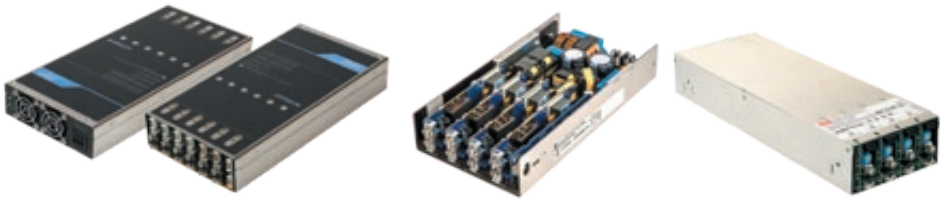


Figure 3: Example configurable power supplies from Artesyn, Excelsys and MEAN WELL

Your choice of configuration and suppliers

So, what are the choices on the market today? Leaders in configurable supplies are Artesyn, Excelsys and MEAN WELL, all well represented by distribution. Artesyn has two ranges, µMP configurable and iMP/iVS, fully configurable and programmable. All are compliant to EN60601-1 medical specifications, the µMP can have up to 12 outputs while the iMP can have 21 and the high-power iVS 24. A free downloadable GUI is available for the µMP and iMP and the iVS can be controlled by standard PMBus commands over an i2C interface. The high power iHP series can be expanded with modules up to 24kW in 3kW increments with up to eight outputs. The system holds industrial safety approvals with additional compliance to SEMI F47 for semiconductor processing equipment.

Excelsys has gone down the route of convection cooling, with leading efficiency designs that still give high power in small form factors at high temperatures. Its CX06M, for example, provides up to eight outputs at 600W combined up to 40ºC with derating to 85ºC. The package size is 1U x 4.5 x 8 inches (1U x 114.3mm x 203.2mm).

The parts are particularly suitable for medical applications where the lack of fan noise is often appreciated.

MEAN WELL has recently introduced its NMP series of configurable 2 x MOPP medical grade supplies at 650 and 1200W. The fan cooled NMP650 is just 1U x 6.3 x 3.5 inches (1U x 160mm x 88.9mm) and the NMP1K2 1U x 6.3 x 5 inches (1U x 160mm x 127mm). Like the Excelsys offering they include a 5-year warranty.

All the products offer monitoring and programmability to some degree, typically able to report on voltage levels, output currents and temperature by PMBus signals. Fault threshold monitoring can be set and protection is comprehensive. Even mode of operation can be set in some models, changing from constant voltage to constant current with foldback as required. Figure 3 shows some examples.

Flexibility from stock

With the extreme flexibility of configurable supplies available at keen prices, they can realistically compete with the rigidly specified 'standard' parts and enable system designers to pass on that flexibility to end users. Specifications can be tailored for their exact application along with 'future-proofing'. There is also the possibility of easy upgrades and output specification changes through exchangeable modules and remote programming through friendly GUIs.

Programmable power supplies from Artesyn, Excelsys and MEAN WELL are available through Avnet Abacus from stock.

Further resources

avnet-abacus.eu/power
avnet-abacus.eu/meanwell
avnet-abacus.eu/excelsys

To download the white paper from Artesyn on configurable power supplies visit avnet-abacus.eu/artesyn

World Leader in Configurable Power Supplies

MEDICAL AND INDUSTRIAL APPROVALS	UNRIVALLED TECHNICAL SUPPORT	UP TO 24 OUTPUTS	400W to 24kW	DIGITAL CONTROL

LATEST PRODUCTS

MicroMP (µMP10/µMP16) Series

Intelligent High Power (iHP) Series

MicroMP (µMP04/µMP09) Series

Artesyn configurable power supplies give you the ultimate flexibility and control and may eliminate the need for an expensive custom unit.

Many have medical safety approvals and some are cost comparable with standard units.

For more information visit: avnet-abacus.eu/artesyn

ARTESYN™
EMBEDDED TECHNOLOGIES

Excelsys CoolX1800 modular power supplies

Excelsys

The new CoolX1800 modular power supply platform represents another AE innovation in highly engineered precision power conversion. Measuring just 267mm x 127mm x 41mm it leads the market with conversion efficiencies of up to 93 percent. It can be populated with up to six CoolMods, providing up to 12 isolated DC outputs ranging from 2.5V to 58.0V. A 24W, medically isolated, auxiliary supply is available as standard, offering another output for system intelligence, control and displays. Outputs can be adjusted to the required set point voltages and configured in parallel or series for higher current and/or higher voltages.

excelsys
An Advanced Energy Company

FEATURES

- All outputs isolated (1850vac)
- Variable fan speed control
- Field configurable
- 24W auxiliary bias (5V or 12V option)
- MTBF >200000 hrs
- Level 4 input surge protection
- Reverse energy protection
- Safety approved to 5000m altitude
- 5 year warranty
- PMBus™ Digital Control and Communications

APPLICATIONS

- Medical
- Industrial
- Hi-rel COTS

For more information visit avnet-abacus.eu/excelsys

Bourns CSS series shunt resistor

Bourns

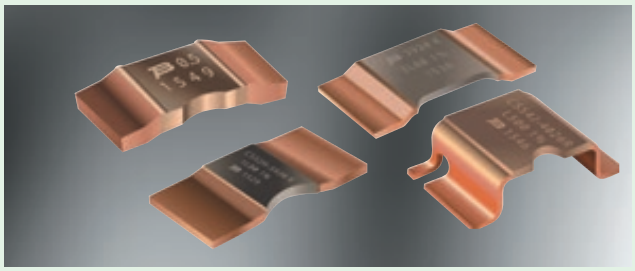
Bourns developed its CSS series high power current sense resistors to satisfy the accurate measurement requirements of a wide range of applications. Because of their very low resistance, low thermal Electromagnetic Field (EMF), low TCR, very high power and excellent long term stability, Bourns CSS series products are optimal high accuracy current measurement solutions.

FEATURES

- Excellent long term stability
- Low inductance
- Low thermal EMF
- AEC-Q200 compliant
- Custom capability

APPLICATIONS

- Current sensing
- Battery management systems
- Power modules/motor controllers
- Frequency converters



L-R: CSS2H-2512, CSS2H-5930, CSS2H-3920, CSS4J-4026

	CSS
Construction	EB welded Mn/Cu alloy
Low resistance	0.1 to 5 mOhms
High power rating	1 to 15 W
Low TCR	±75 to 150 pp,/°C

BOURNS®

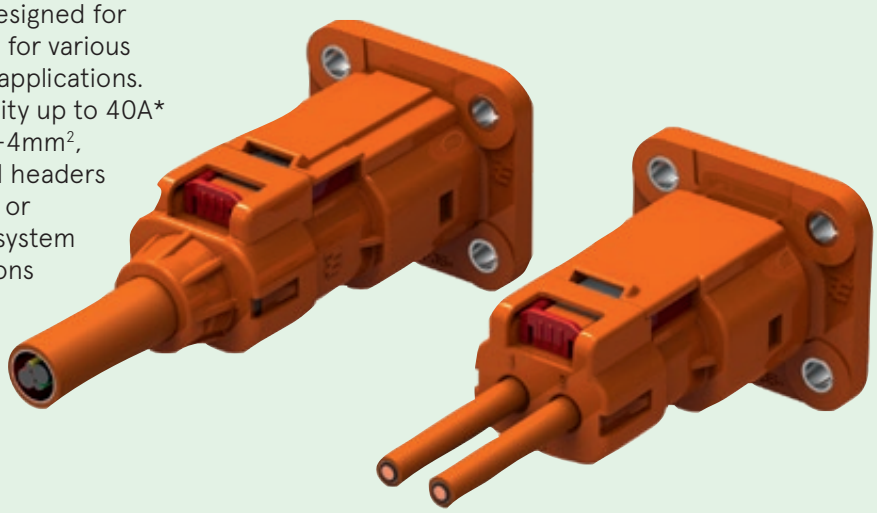
For more information visit avnet-abacus.eu/bourns

TE Connectivity AMP+ HVA 280 low-medium current connectors and headers

TE Connectivity

Options to match your vehicle architecture

TE Connectivity's AMP+ HVA 280 finger-proof, touch safe 2 or 3 position low-medium current connectors and headers are designed for flexibility with options available for various hybrid/electric vehicle device applications. With a current carrying capability up to 40A* at 85°C and a cable range of 2-4mm^2, AMP+ HVA 280 connectors and headers can be utilised with multi-core or individually shielded wire. The system provides multiple latching options and an integrated internal HVIL allowing for package size optimisation and routing flexibility.



HVA 280 KEY FEATURES

- Safety: Touch proof (finger safe)
- Safety: 2 stage unlatching for effective HVIL functionality
- Common package size for 2 and 3 position connections
- Common header footprint for multi-core and individual shielded wires
- Common plug that will mate to header and/or in-line system
- Plastic header or die cast aluminium header
- Shunted or pass-thru HVIL feature provides flexibility in system design
- Unmate using tool or finger

APPLICATIONS

- Battery packs
- DC-DC converters
- On-board chargers
- Electric heaters
- Electric air conditioning
- Electric power steering
- High voltage power distribution

MECHANICAL

- Terminal: 2.8mm MCP, 064 MQS
- Wire range: 2-4mm² multi-core or individual shielded wire
- Latching style: Two-stage, tool or finger actuated
- HVIL: Integrated, internal
- CPA available
- Inline cap with HVIL ELECTRICAL
- Voltage rating: Up to 600V individually shielded wire: Up to 750V multi-core wire
- Current rating: Up to 40A* @ 85°C
- Temperature range: -40°C to 140°C*
- Shielding: 360° from wire to device
- IP rating: Mated: IP67, IP6k9k Unmated: IP2xb

STANDARDS AND SPECIFICATIONS

- USCAR
- RoHS compliant
- LV 215-1
- IEC 60529

*Depends on cable size and cable construction

AUTHORIZED DISTRIBUTOR

For more information visit avnet-abacus.eu/te-connectivity

Trends and solutions in power supply with Artesyn Embedded Technologies

For this edition of Focus magazine, we met with Eddie Gallacher from Artesyn. Eddie has been with Astec/Artesyn for 27 years, more than half that time working in Asia, in roles of increasing responsibility in engineering and programme management. He returned to the UK in early 2009 as Sales Director for Northern Europe and assumed the role of Vice President of Distribution Sales in March 2014. He holds a BSc (Hons) in Electronics & Electrical Engineering from the University of Glasgow and lives with his family in East Ayrshire in the west of Scotland.

Interview: Eddie Gallacher, Vice President of Distribution Sales, Artesyn

Tell us about Artesyn and the role it plays in the power supply market

Artesyn is a major player in the computing, storage, telecom, medical, industrial and consumer markets. As one of the world's largest power supply manufacturers, we have multiple engineering centres of excellence, four wholly owned factories and more than two million square feet of manufacturing space. Our capability is unrivalled in the power supply market.

As a company, our approach goes beyond the product itself. Artesyn has immense experience and long relationships with OEMs of all sizes who require technologically advanced solutions to power their systems. We understand how our customers use our power supplies and how our power supplies interact with the rest of their system requirements. This is why our clients view us as a trusted advisor on all aspects of embedded power.

Artesyn has the capability to deal with customers with widely differing demands, from those servicing high-volume markets to those that need to ensure their power needs are tuned for specific projects. The manufacturing and support capability Artesyn possesses allows us to scale our operations from one-off sample requests and small unit numbers up to production runs in the many thousands. Our distribution partnerships are vital in helping us serve this wide range of customers.

The requirements of many of our customers necessitate stringent controls to ensure consistency and full traceability within our engineering and manufacturing processes. As processes are common across all business segments, all customers benefit from this. In addition, Avnet Abacus has highly trained experts in Artesyn products that can offer clients access to the highest levels of support.

What are the key trends you see in the power supply market?

The first key trend is that of increasing power density. In the data-centre sector for example, we are now seeing individual server blades that demand more than a kilowatt to provide power to multicore processors and accelerator hardware. Integration has made it possible to deploy huge amounts of computer processing in a small space. But this is not just a trend in data centres. In many markets, customers want more power in the same physical volume or the same power in a smaller volume. These advances make it possible to build complex products ranging from smart robots to high-powered lasers.

A second trend is that of increased control and monitoring capability. Many systems now have complex power needs with processors and SoCs that adapt their voltage and current requirements in real time. Power supplies need to react quickly to these changing conditions, which demands careful design. Customers also want more information from their power supplies to watch for potential problems such as over-temperature faults and current consumption thresholds. Digital management buses integrated into the power supplies provide the features they want.

Customers are also looking for greater design-in flexibility. They want the convenience of being able to use standard products but often their projects have non-standard requirements. All of the power supply models that we have released in the past few years are digitally controlled and make extensive use of software. There are numerous advantages to the application of digital control but one of the most important is the ability to modify and tune products to meet the individual needs of customers. We have also agreed to some hardware modifications if the customer volume warrants it.

Trends and solutions in power supply with Artesyn Embedded Technologies

What advances do you think you will see in the next five years?

We will see innovation on a number of fronts. We are already capitalising on the introduction of digital control and we see the use of this expanding into the future to deliver greater efficiency and configurability. In parallel we see improvements in components and magnetics. For example, we have implemented GaN technology on some of our higher end products. GaN provides similar benefits to SiC but has a greater potential to be manufactured more cost effectively so we see the use of GaN growing in the future. Artesyn's experience in electromechanical packaging and power control will be crucial to delivering on what these technologies promise.

The barriers to entry in both of these areas can be high. But Artesyn took an early leadership position in understanding the importance of both digital control and electromechanical packaging, and then implementing these in a high volume production environment. Our continued levels of investment maintain our leadership position and ensure we will be able to incorporate new technological advances as they emerge from the labs.

What are the key growth markets for your units?

Artesyn sees strong growth in a number of markets that include industrial control, medicine, horticultural lighting and robotics. The improving cost-performance ratio of LEDs will revolutionise the design of greenhouses, and efficient power is key to unlocking the potential of that market. Robotic systems will demand increasingly compact power supplies that are able to deliver the high levels of peak power needed for their actuators. Medical systems are also becoming more compact, while needing increased power, as imaging techniques become more sophisticated.

There are other common factors for these markets. Reliability is key. Artesyn's processes ensure the power supplies provided to each of these sectors provide the highest levels of reliability and resilience. Comprehensive test regimes are built into all stages of our development processes, our production processes and even post-production. During development, testing is performed against detailed and strenuous performance specifications, including stress testing, rigorous environmental testing, as well as safety and compliance testing. Products are tested at multiple points in the production process and post-production testing includes Ongoing Reliability Testing (ORT) in order to ensure reliability is maintained throughout the production lifetime of our products. Mechanical and electrical testing is not the only important factor in maintaining reliability. As the control of power supplies relies increasingly on digital control, we have ensured we have put in place comprehensive software and firmware testing. Investment in capital equipment, state-of-the-art labs and employee training means that all of this capability resides in-house.

What is the most common challenge you encounter from engineers?

The biggest challenge that engineers face is time. There is immense pressure to reduce product development times. It is important to ensure that integration of the power supply into the product is smooth and that any issues are resolved quickly. The ability to configure and tune our digitally controlled products is clearly important in this context. But this is backed-up with an industry-leading technical support capability that ensures the smooth integration of the power supply to the end product by rapidly resolving any issue that may arise. We win deals because of the technical support we provide our customers, as well as our ability to deliver efficient and cost-effective power supplies.

To learn more visit avnet-abacus.eu/artesyn

"Artesyn sees strong growth in a number of markets that include industrial control, medicine, horticultural lighting and robotics."

DC-DC power conversion challenges in transportation applications

Transportation vehicles pose a challenging environment for the power supply designer. DC-DC converters are used to power on-board sensors, communication radios, positioning and location sensing, lighting and information systems. Huge voltage variations and disturbances occur from load dumps, jumpstarts, conducted and radiated switching noise, and spikes from other equipment.

Andrew Hutton discusses techniques and solutions to meet these engineering challenges.

Today, vehicles are like mobile data centres; the computing, communication and sensing power in a typical car is astonishing. With upcoming autonomous, driverless features, even human participation in vehicle control is disappearing with the driver now cocooned in an environment where he or she expects to be entertained and internet-connected in climate-controlled comfort. It's not just cars of course; trains, buses, planes and even forklifts can have all these features as well.

The transportation environment can be a headache to product designers though, with high temperatures, shock, vibration and extreme electrical disturbances to cope with. The cabin of a car parked in the sun can easily rise to temperatures lethal to electronics, as well as to your pet dog. Leave your smartphone in there and it will refuse to operate until cooled off. When it powers up, you really have to believe that your USB charging outlet is an effective protection barrier to electrical transients. It's a pretty hostile environment.

Andrew Hutton

Product Manager, Power, Avnet Abacus

The automotive electrical environment

Cars have particular electrical supply characteristics with their typical 12V nominal DC bus swinging over a wide range from as low as 3.2V with cold cranking to 42V with load dumps. The automotive standard LV124 is often applied, established by the German car manufacturers in 2013. Part 1 is for electrical requirements and tests and is quite severe. Figure 1 for example, shows the test voltages under cold cranking conditions for a 12V system: the black limit being for a start with a degraded battery. LV124 defines different allowable outcomes depending on the tested equipment; ranging from functional status A, where there should be no effect, to functional status E requiring repair work.

At the other end of the voltage spectrum, ISO 7637-2 specifies various high voltage transients at different severity levels. Different car manufacturers have their own particular interpretations and requirements but transients are applied up to -220V for 5ns along with higher energy pulses at lower voltages, for example +101V for 400ms. Negative pulses are specified, as this is what results from parallel inductive loads being de-powered. Series inductance, such as in cabling, causes positive-going spikes on switch-off, generally of lower energy.

Reverse connection and load dumps need to be withstood as well, with high-energy surges up to 27V for 300ms being typical. Because the source impedance set during these load dump tests is very low, it is often impractical to absorb the energy and DC-DC converters on the rail are expected to include the peak voltage in their normal operating input range. A summary of the static voltages that a 12V nominal converter should typically withstand is shown in Figure 2 overleaf.

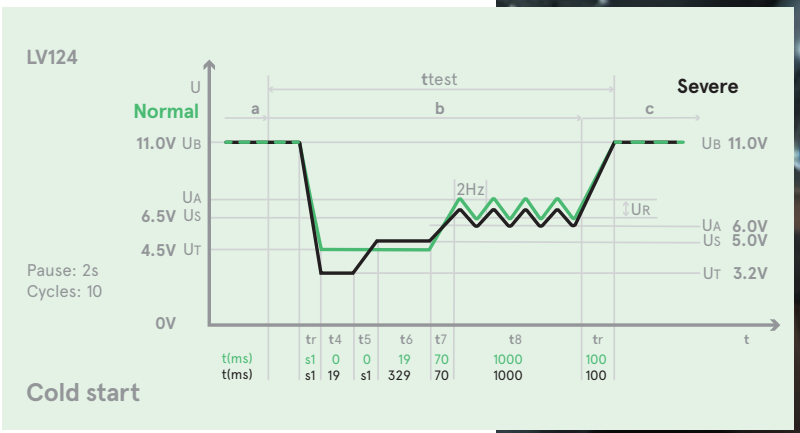


Figure 1: LV124 cold cranking conditions

DC-DC power conversion challenges in transportation applications

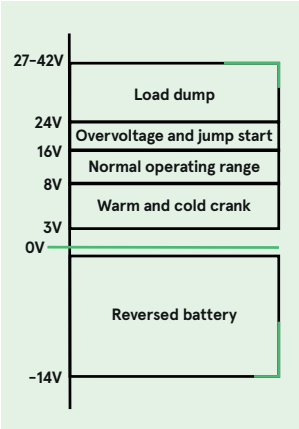


Figure 2: Summary of 12V DC-DC converter input range requirements

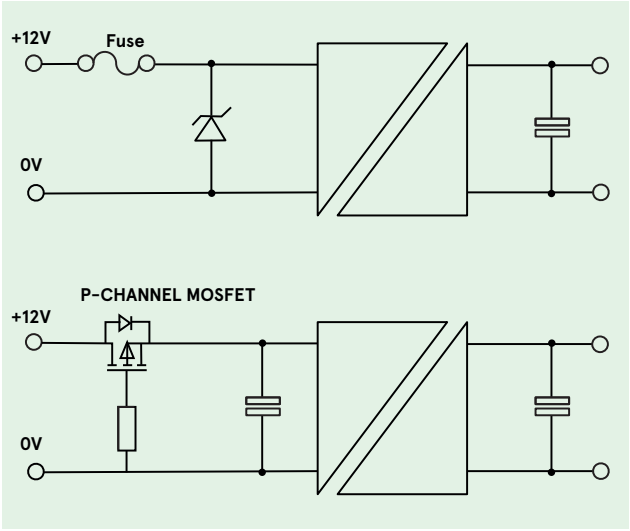


Figure 4: Reverse polarity protection options

A feature of these specifications for automotive applications is that there really is no universal standard. Car manufacturers often set their own limits, often at a more severe level than the generic standards. A saving grace though is that there will usually be some centralised transient suppression, starting with Transient Voltage Suppressor (TVS) diodes or similar embedded in the alternator.

Automotive DC-DC input filtering

For an isolated or non-isolated DC-DC converter to operate effectively on an automotive voltage rail, it should have an input range as wide as possible to withstand the surges and ride through the lowest dips. It will need either internal or external filtering for the higher voltage spikes and some sort of reverse polarity protection as shown in Figure 3 below.

Here the series diode provides reverse polarity protection, the Metal Oxide Varistor (MOV) provides an initial 'soft' voltage clamp then the TVS, after an Electromagnetic Interference (EMI) suppression inductor, forms a harder clamp at a lower voltage, acting like a zener diode. A disadvantage of the series diode though is that it drops some voltage and dissipates power.

A parallel diode is a lossless option, which conducts with reverse polarity and blows the fuse, but a neater self-resetting solution is to use a series P-channel MOSFET that only conducts when the input is positive. The other options are shown in Figure 4 above without the EMI filtering components.

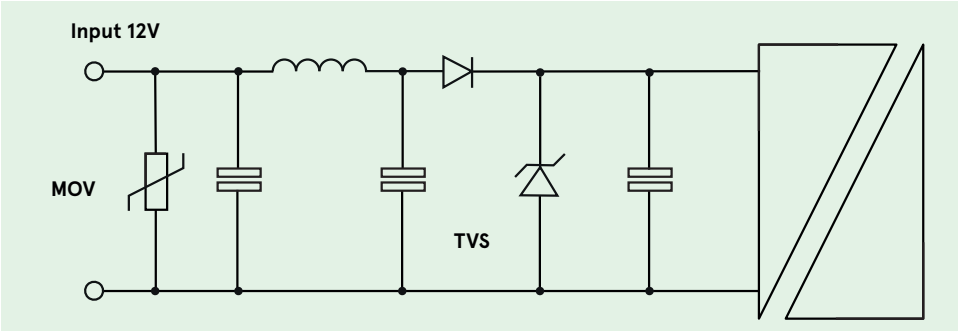


Figure 3: Automotive DC-DC input filter

Railway power specifications

Unlike in automotive, there is no guaranteed centralised transient and surge limiting in rail applications, so electronics at the system level often have to withstand extremely severe stress. The standard generally applied is EN 50155, although British standards RIA12 and RIA13 are still sometimes seen. An extra requirement over automotive is for the equipment to withstand regular input dropouts that can last for up to 20ms in 'Class S3' applications. Equipment for rail applications tends to be larger in scale than automotive, so DC-DCs in DIN rail and chassis mount configurations are often seen. There are different categories of installation, though, ranging from axle- to body-mounted with different shock, vibration and bump requirements. The category effectively defines the degree of environmental sealing required, up to full encapsulation. An added complication is that the nominal DC system voltage can be anything from 24V to 110VDC.

The surges at worst can be 3.5 x the nominal input or 385V from a 110V nominal lasting for 20ms. Transients for some microseconds are up to several kV defined by the EN 61000-4 series called up in the European 'EMC directive'. Dips can be down to 70% of nominal supply for no loss of function or 60% with some loss.

A summary of the possible voltage surges and dips applied to electronic equipment in the rail environment is given in Figure 5 for US, European and the French national standard NF-F-01-510.

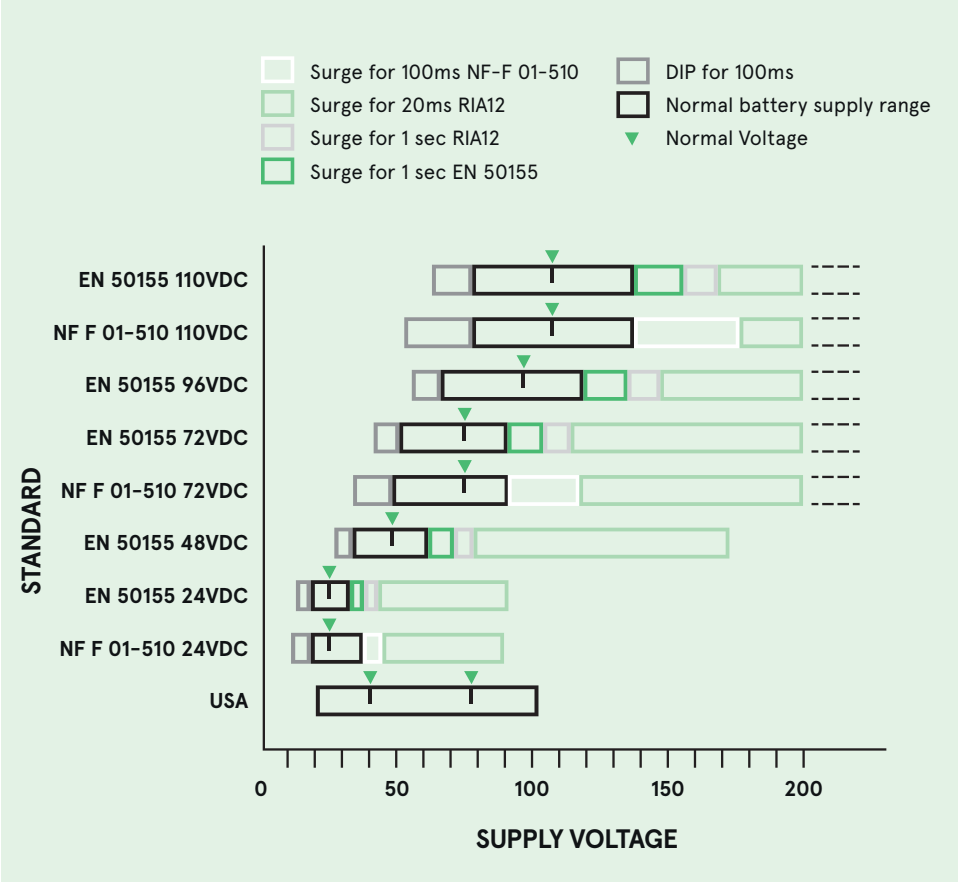


Figure 5: Input voltage ranges for rail applications

DC-DC power conversion challenges in transportation applications

Dips and dropouts

As in automotive, the high energy surges are even less practical to clamp or absorb, so DC-DCs are either designed to include the highest voltage in their normal input range or to rely on a pre-conditioning circuit elsewhere that provides a stabilised input. In any case, to include the dips the DC-DC should have the widest possible operating range, with 10:1 input ranges not uncommon. DC-DCs with auto-ranging switched inputs are possible but have to operate consistently and safely with the input voltage surging and dipping across input ranges. Often a practical solution is to precede the DC-DC with a linear regulator that drops the excess voltage during a surge. Its peak dissipation is high but averages to be low, as the surges are relatively infrequent.

Because of the energy levels involved, coping with dropouts is particularly problematic. A large capacitor on the converter input is a simple solution but is impractical for lower nominal input voltages. Imagine trying to hold up a DC-DC input at 200W for 20ms with a nominal 24V and dropout of 16V. The capacitance needed would be 25,000µF. Worse still, the capacitor voltage rating would need to be 75V to cope with the surges on a 24V line. As of today, that is a component about 2.5" (50mm) diameter and 6" (150mm) long, comparable with the size of a 200W DC-DC!

Schemes have been devised to boost the input to a higher voltage level and store energy on a capacitor which is then 'switched' onto the input when it is detected to have dropped. Although this does add complexity and cost, it can be traded against the high cost of a large capacitor, and if an electrolytic type can be consequently avoided there is a reliability and life gain.

Input filters similar to automotive as in Figure 3 will commonly be used in rail applications as well for transient susceptibility and reverse polarity protection. However, automotive and rail specifications also put limits on emissions generated by a DC-DC converter, which must also be dealt with. Sometimes, in both application areas, a degree of common-mode noise emission suppression is needed, particularly if the DC-DC produces isolated outputs. This type of noise is attenuated by a common-mode, or 'current compensated' choke inserted in the DC-DC input lines. The windings are arranged such that normal running current magnetic flux cancels, so high winding inductances can be used without fear of saturation.
The choke presents, instead, a high inductance and hence high impedance to noise currents, which are common to both lines circulating to ground. Figure 6 shows the typical arrangement. L1 and L2 give some differential mode noise attenuation.

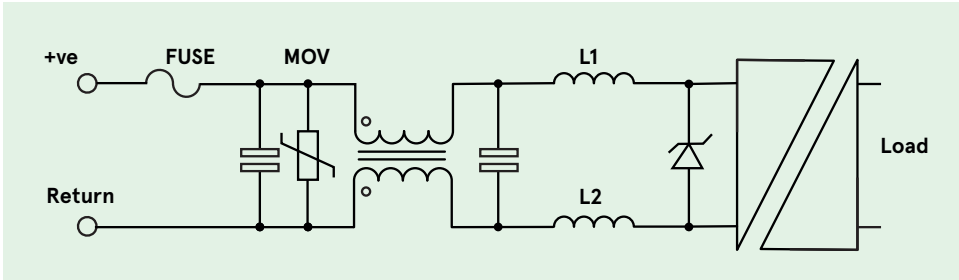


Figure 6: Common mode noise filtering

Ready-to-go solutions

Of course, the ideal solution is to specify a DC-DC converter that already has input filtering and maybe reverse polarity protection built in. Parts are available from several suppliers that have these features and even approvals to EN 50155 for rail. Delta and Bel Power Solutions, for example, hold EN 50155 approvals for their wide input DIN-rail DC-DCs, while MEAN WELL has the approval for its open-frame RSD30/60 series. Delta additionally has a chassis mount range suitable for harsh environments in transport, the B40SR12424 series, with IP67 optional sealing. All have high levels of transient suppression and ESD immunity built in.

For a discrete filter, MOVs are available from suppliers such as KEMET, Bourns or AVX, and TVS diodes from Bourns. Common- and differential-mode inductors can be obtained from suppliers such as Schaffner, TE Connectivity and Premier Magnetics.

To find out more about how Avnet Abacus can help meet your power requirements or to talk to a technical specialist in your own language visit **avnet-abacus.eu/ask-an-expert**

DC-DC power design in transportation with Murata

Murata

Transportation markets are set to drive significant growth in the electronics sector over the next five years. Applications for this industry will require efficient and highly reliable power conversion.

Murata's IRH and IRQ series deliver the latest technology in fixed frequency power conversion available for the transportation industry. The advanced electrical and mechanical design provides high reliability power conversion in the most demanding transportation applications. The industry-standard quarter brick and/or half brick offer packaging and pin configuration options that allow the system designer to choose the most effective solution for cooling and power delivery.

FEATURES

- 3:1 Vin range of 57.6 VDC to 160 VDC
- Delivers 5V, 12V or 24Vout with 3,000Vrms input to output isolation
- Designed and tested to meet the requirements of EN 50155
- Available with standard and flanged baseplate options, and with DOSA or alternate industry standard pinout options
- Standard features include on/off logic control and protection against short circuits, overvoltage and overtemperature
- Efficiency ratings of 91% at 5 Vout, 89.5% at 12 Vout and 89% at 24 Vout

IRH series: Encapsulated half-brick 150-Watt

IRQ series: Encapsulated quarter-brick 100-Watt

muRata
INNOVATOR IN ELECTRONICS

For more information visit avnet-abacus.eu/murata

Don't Miss the Ride: Aimtec Railway Power Converters

aimtec
Your Power Partner

When it comes to designing power converters for railway applications, reliability and rugged construction are key due to the elevated levels of vibrations and harsh environments. Aimtec's DC-DC railway converters are designed to be reliable, cost effective and technically compliant. Aimtec's converters are extensively tested and undergo 100% burn-in tests to ensure maximum reliability. The power range is from 6W to 150W and can be PCB or DIN-rail mounted.

As an additional benefit, Aimtec railway series can effectively function as a filter, offering galvanic isolation when used as a power source for non EN 50155 compliant equipment. This allows the railway operator to use Commercial Off The Shelf (COTS) products for such applications.

Aimtec's railway converters can be used all throughout electric or diesel locomotives, trackside controls and during the cabin refurbishing process.

Our products can also convert power from weight saving 110VDC batteries used in modern trains, to the 12 or 24VDC required by the onboard equipment.

Product Series with Target Applications:

- Train Systems: AM50/75/100QB-NZ, AM150HB-NZ
- Passenger Comfort Systems: AM6CW-NZ, AM8TW-SH30Z, AM10EW-NZ
- Railway Operating Systems: AM10/15/20EW-NZ

Features:

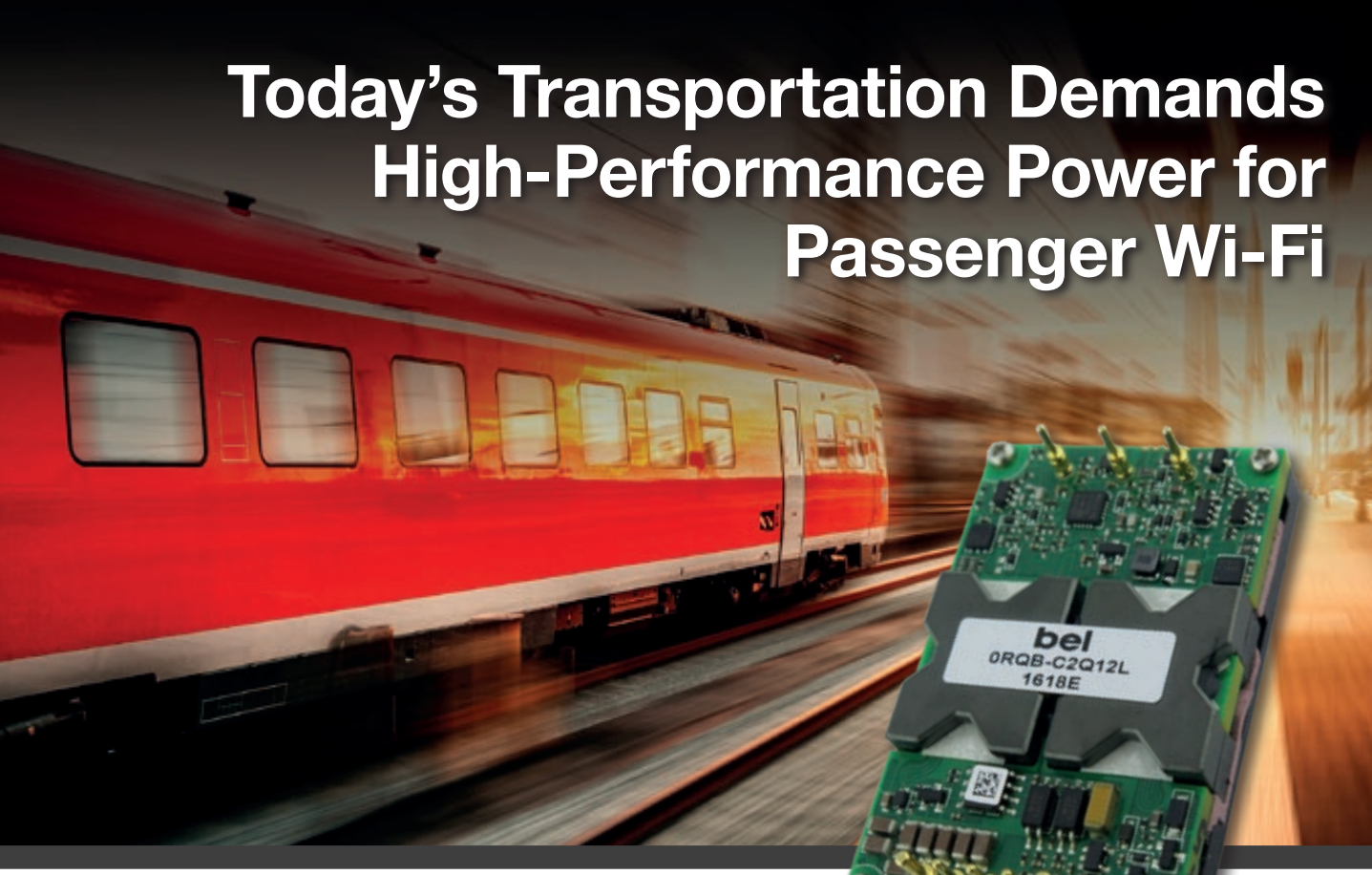
- Max operating temperature range: -40°C to +105°C
- EMC: EN 55022 class B & EN 55024
- Shock and vibration: IEC/EN 61373
- Many package types for all railway applications
- Input voltage: 9VDC to 176VDC

For more information visit avnet-abacus.eu/aimtec

Applications

Cameras | Sound & Communication | Infotainment | Trackside Controls | Lighting

Today's Transportation Demands High-Performance Power for Passenger Wi-Fi



Power supplies designed for the next generation of railway and bus travel need to be robust and reliable. Today's transportation operators increasingly need to offer passengers an infotainment experience via a high-performance Wi-Fi connection, including real time information, email, social media, film and games.

The **Bel Power Solutions** **0RQB-C2Q12 Series** is a 156 W compact isolated quarter brick power supply designed to provide high-performance passenger Wi-Fi connections for railway and bus at 9-36 Vdc input, 12 Vdc output and 13 A. Both highly efficient and affordable, additional features include remote on/off, overcurrent protection and overvoltage protection.

bel POWER SOLUTIONS & PROTECTION
a bel group

For more information visit avnet-abacus.eu/bel-power-solutions

Designing safe, certified and efficient power solutions for LED lighting systems

ENEC (European Norms Electrical Certification) is the European hallmark for luminaires and related products and is used to demonstrate compliance with European safety standards. This certification system also includes LED drivers – the electronics that supply power and control for LEDs in lighting systems.

These drivers are crucial for safety and effective operation; Philip Lechner details what to look for in certified devices.

LED lighting has become the product of choice now in all types of environments from domestic to industrial through to specialist areas such as stage lighting.

Philip Lechner

Technical Specialist, Power, Avnet Abacus

LED lighting has become the product of choice now in all types of environments from domestic to industrial through to specialist areas such as stage lighting. The combination of efficiency in terms of lumens per watt, long life and controllability of LEDs make them better than incandescents in just about every way. There are major differences though in how to provide power to them; specific electronic LED drivers are needed which have their own characteristics and specifications and it's easy to get it wrong. A cheap light bulb will just fail early but a low-cost LED driver from a dubious source can be at best unreliable and at worst a shock and fire hazard. It may even actively generate electrical noise risking interference with other equipment.

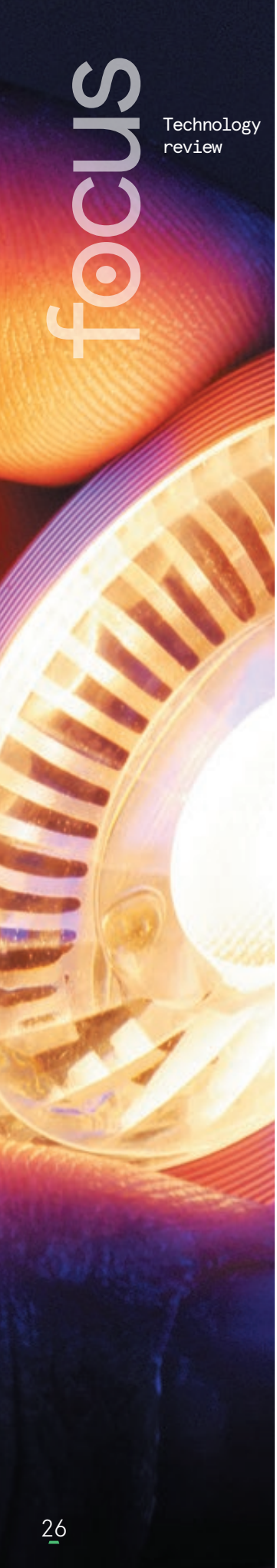
Look for the certification mark

A vital starting point when selecting an LED driver is to find one with the 'ENEC' mark (Figure 1).

Figure 1: The ENEC certification mark

This signifies that the product meets the relevant safety standard, EN 61347-1 in Europe, broadly equivalent to UL 8750 in the US. The ENEC mark also shows compliance with EN 62384, a standard for LED driver performance. In fact, in Europe it is mandatory for luminaires to show the ENEC mark, as well as for LED drivers if they are not inside fixtures. Even if an LED driver module is fitted inside a luminaire, in practice it needs the mark otherwise the builder or importer would need to have the driver certified separately, which would be at prohibitive cost and impractical without the close support of the original manufacturer. Certification must be done by an accredited test facility and the manufacturer must have a quality system based on ISO-9000 standards. The mark also confirms that the manufacturer's facilities are inspected annually and the product and its production process are monitored going forward. It is sometimes thought that a 'CE' mark is sufficient to guarantee safety of products but this is not the case; the CE mark is placed by the manufacturer to signify that they think the part meets relevant European directives, and they might think only the Machinery Directive applies for example. The ENEC mark gives specific guarantees of safety standards applied to the design and manufacture of the driver.

While the ENEC mark can be applied to any electrical appliance against the relevant standards, an interesting development for LED lighting is the formation of the ENEC+ mark, which is a tie between ENEC certification and LightingEurope, the voice of the European lighting industry. The ENEC+ mark is a flexible scheme that is intended to evolve as technology advances, providing independently verified confirmation of a manufacturer's claims for safety and performance of lighting systems including the most complex LED types.



Designing safe, certified and efficient power solutions for LED lighting systems

Look also for compliance with the EU Eco-Design Directive (2009/125/EC) for ecological requirements. From 2016 it has been mandatory for LED fixtures and lamps to comply with stage 3 of the Directive.

What the certification tells you

We all believe that the right mark on a product makes it 'safe' but the certification is more than a simple guarantee against electric shock. EN 61347-1, for example, covers marking, insulation, moisture resistance, electric strength, thermal endurance, performance under fault conditions, resistance to heat, fire, tracking, corrosion and much more. Internal construction is specified to ensure correct creepage and clearance distances across safety barriers as well as appropriate protection against accidental contact with live parts. The result is a product that does not just happen to protect against high voltages and temperatures but is shown to be designed and built to do so reliably over many years in service in all reasonably expected environmental and fault conditions. The standards evolve over time and the latest version of IEC 61347-1:2015 A1:2017, for example, has additional requirements for marking, creepage and clearance, and includes consideration of systems that must have high availability in harsh conditions, both electrical and environmental.

We mentioned that ENEC marking also includes a guarantee of functional performance according to EN 62384; this standard covers LED drivers operating on supplies up to 250VDC or 1000VAC supplying constant current or voltage. The tests applied are for marking to correspond with actual performance, for power rating, power factor, output voltage and current. Start-up into capacitive load is checked along with temperature, endurance and input voltage cycling. Fault conditions are simulated such as LED disconnection, LED reduced resistance and output short circuits. In all cases, the driver should be undamaged after replacement of any 'protecting device' such as a fuse. A particular requirement of some LED 'control gear' or drivers is that they should present an inductive load to the supply at audio frequencies between 250Hz and 2kHz. A specialised network is used for the test, which generates an audio signal on the supply line at 3.5% of the voltage input. When the driver complies, it is marked with a special 'Z' symbol.

It's reassuring that EN 62384 gives guidance on quoting product life and failure rate in product specifications. This is often confused by manufacturers of dubious origin who sometimes even wrongly define MTBF (mean time between failures) as lifetime. The standard specifies that life and failure rate are identified separately in hours and FITs (failures in time) respectively.

Driver classification

The standards cover different types of LED drivers, referred to as 'lamp control gear' with corresponding constructional requirements. The drivers can be Class I, Class II or Class III, respectively, with a protection earth, earth-free and devices with no voltages higher than SELV (Safety Extra Low Voltage) present. The system designer should be aware of what the installation requires and use an appropriate part. A Class I rated driver used in an earth-free Class II installation would function, for example, but would be potentially dangerous as driver single-fault protection would be lost, and if the casing is metallic an operator or installer might experience a high 'touch' current.

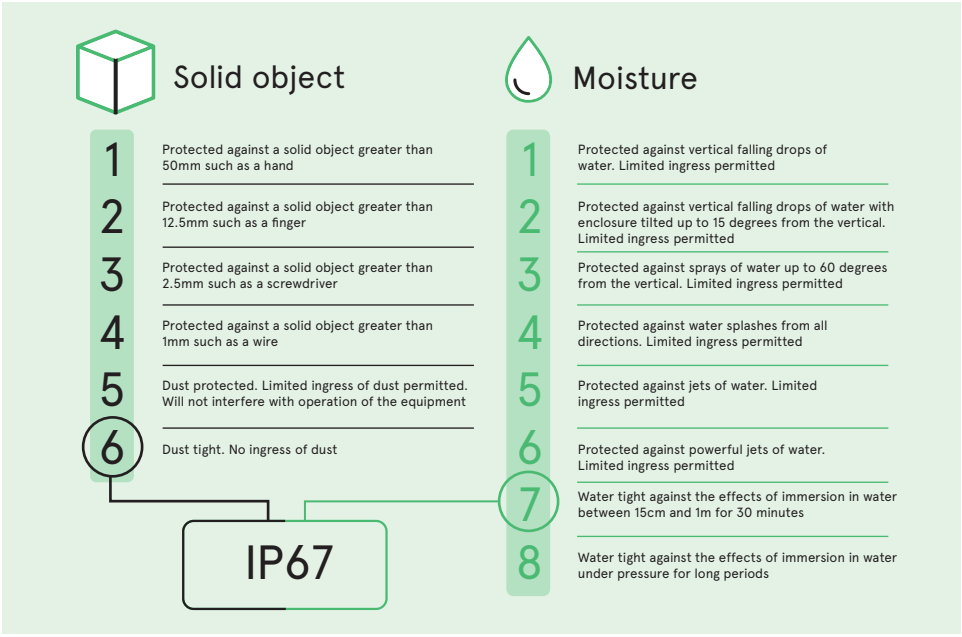


Figure 2: Ingress Protection (IP) ratings

IP rating

According to EN 61347-1 'lamp control gear' must be moisture resistant as a minimum with 90% humidity tests performed for 48 hours after which insulation resistance is checked. Parts available on the market have differing IP or 'Ingress Protection' ratings (Figure 2) and generally range from IP20 for indoor use to IP67 or IP68 for an outdoor installation where complete sealing is required.

Dimming

Being able to dim an LED through its driver is a key feature that can give significant energy savings, prolonged life and user comfort benefits. In little-used areas, deep dimming when no traffic is sensed can have surprisingly little effect on perceived illumination with just 10% of LED power being perceived as 32% of maximum illumination (see Figure 3 overleaf). In fact, a 15-20% reduction has been shown to be imperceptible by a majority of users[1]. Dimming can be achieved in a 'linear' way with the LED current varied smoothly or in a PWM (Pulse Width Modulated) way. In either case, at deep dimming levels, there is a risk of 'flicker' with poorly designed drivers. The standards test for acceptable levels of flicker as well as residual AC supply ripple, typically at 100 or 120Hz which is highly visible and uncomfortable for the observer.

DALI and DMX

Many LED drivers will have a Digital Addressable Lighting Interface (DALI). This enables remote control and monitoring of the attached LED through a two-wire communications link. A central controller is used which can connect to a maximum of 64 devices, which can be addressed individually or in groups. The DALI standard, defined in IEC 62386 and IEC 60929, allows for some intelligent features such as 254 levels of brightness control translated to a logarithmic curve that matches the steps in LED power with consistent steps in perceived brightness by the human eye.

DMX512 is a standard for a more general unidirectional control and communication system that is extensively used in stage and theatre environments, where lighting and other equipment such as fog machines can be controlled. The electrical interface is the familiar RS485 arrangement.

Designing safe, certified and efficient power solutions for LED lighting systems

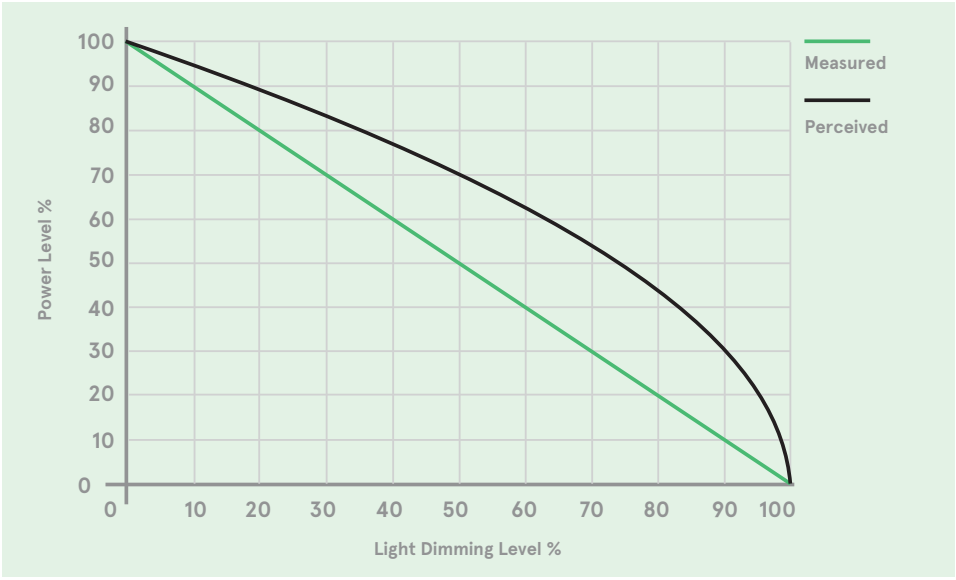


Figure 3: Perception v. Power (acknowledgement to Lighting Control Association) DALI and DMX

Figure 4: Typical commercial LED driver modules

Products available

There are some major players in the market for the supply of LED drivers (Figure 4) such as Fulham. Its range includes DC and low inrush current AC inputs with power levels up to 165W. Constant current and constant voltage types are available in cases rated from IP20 to IP68. Its LUMO and Workhorse series with ENEC marking are particularly popular with power ratings up to 200W and currents from 200mA to 4A, some with a DALI interface. The parts are suitable for stand-alone or built-in applications and feature strain relief on their slide-in terminal connectors.

Delta, the largest power supply manufacturer worldwide, has recently introduced its new LNP series, which is targeted at the cost sensitive, non-dimmable downlight LED market. Rated 15W up to 50W and an IP20 case with strain reliefs, they are Class II, earth-free. MEAN WELL has a large range of LED driver modules suitable for all applications, some with DALI interfaces and casing styles varying from leaded and board-mount to slide-in terminal types. IP ratings include open frame boards up to rectangular and circular IP67 and electrical ratings are up to 320W/5A.

Avnet Abacus is an LED driver distributor for Aimtec, Delta, Fulham, MEAN WELL Moons, and Murata, with products available from stock.

[1] Kryszgzuk and Boyce, 2001 and 2002, Shikakura et al, 2001, and Akashi and Neches, 2004

Hirose DF63 series, 3.96mm pitch, 15A high current, wire-to-board connectors

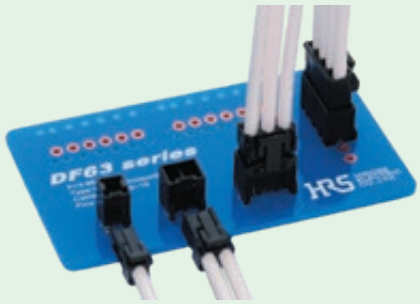
Hirose

HIROSE has introduced the DF63 series to meet the increased requirement for small, high powered wire-to-board connectors offering advanced reliability for industrial equipment.

The main connector range consists of cable mount, female crimp sockets and board mount vertical and right angle male headers that can handle up to 15A (amps) max current rating. Waterproof and non-waterproof in-line versions have been added to the range (DF63W waterproof). The overall size has been designed with space saving in mind. The three position header for example, only occupies 88mm² approximate board space due to the small pitch.

Secure locking is guaranteed by the robust lock that gives a clear tactile click when mated. This confirms the connector is fully engaged guaranteeing complete electrical and mechanical connection. The lock is on the centre of the housing to avoid uneven locking and cable entanglement which is common with side locks. Furthermore, multiple connectors can be mounted close together, side by side. The DF63 series is part of the EnerBee product family. The EnerBee family features wire-to-board and wire-to-wire power connectors to provide technically advanced connectivity solutions for industrial power sources.

Ideal applications are robots, medical devices, industrial machinery, smart meters, gaming equipment and home appliances.



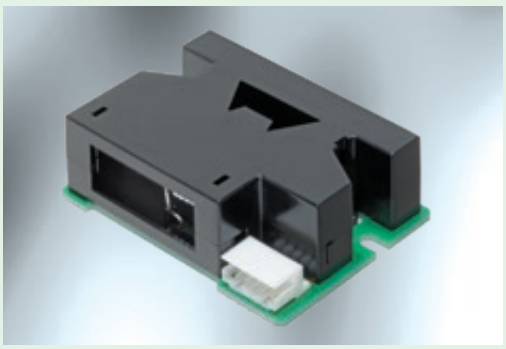
HRS HIROSE ELECTRIC EUROPE B.V.

For more information visit avnet-abacus.eu/hirose

Omron B5W-lD0101 air quality sensors

Omron

The highly sensitive B5W-LD0101 sensor from Omron is capable of detecting particles down to 0.5µm in diameter by using an LED light source. It features a unique flow path structure that allows high suction performance and increased air flow leading to more accurate results.



FEATURES

- High measurement accuracy
- Capable of detecting particles from 0.5µm
- Small size allows greater design flexibility
- High performance suction
- 52.3mm x 39.3mm x 17.6mm (L x W x H)

APPLICATIONS

- Air purification
- HVAC systems
- Air conditioning
- Ventilation
- Temperature control

For more information visit avnet-abacus.eu/omron

OMRON

Strategies to combat volatility in the lithium-ion battery market

Rapidly increasing market demand and the rationalisation of product offerings from Li-ion cell manufacturers are impacting the choices available to design engineers. Here Tim Parker discusses the background to these dynamics and how engineers can successfully navigate this challenging market.

Tim Parker

Product Manager, Batteries and Energy Storage Devices, Avnet Abacus

We've all heard of the considerable increase in demand for lithium-ion batteries driven by their increasing inclusion in portable devices and electric vehicles. Since the the first Li-ion batteries were commercialised by Sony in 1991 their use initially steadily increased and then levelled, but recently Tesla has led a surge in demand (Figure 1) with 18650 size cylindrical cells in its existing electric vehicles and now the larger 21700 size in the new model 3, all manufactured in partnership with Panasonic. Tesla's target for 2018 is to reach a production of 35GWh, but may ultimately be dwarfed by the VW automobile group with its plans to install 150GWh-worth of batteries each year from 2025 in 80 new electric models.

Portable devices and other applications such as mobility, grid storage and stationary equipment are not being left behind though, with their share of the Li-ion pack market actually predicted to be about twice that of all EVs in 2025 at about $24B[1].

Other reports are more bullish and put the total Li-ion market even bigger at $93.1B by 2025.[2]

Currently raw material supply is not meeting projected demand and extra capacity is planned for lithium extraction with major expansion in China, Canada, Australia, South America and elsewhere. Other exotic materials are required as well; cobalt is used as a cathode material with China controlling 80% of that market. From data compiled by Deutsche Bank Markets Research[3], global lithium demand is set to increase three times between 2015 and 2025, cobalt eleven times and overall battery consumption five times.

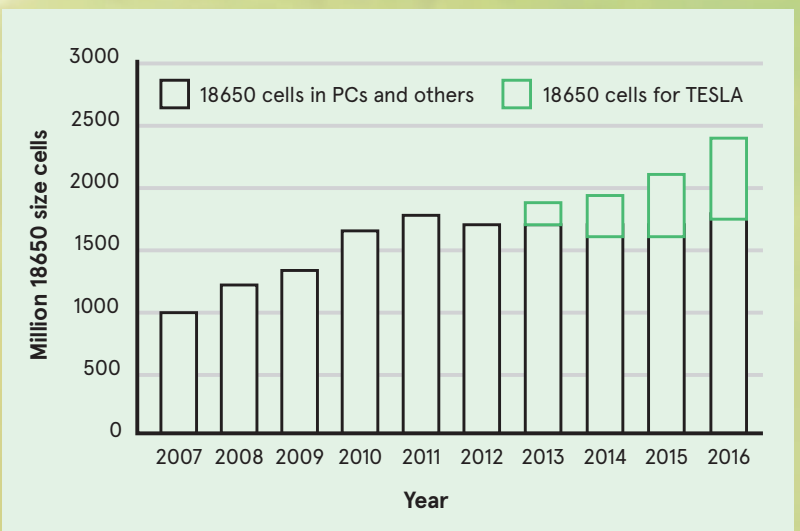


Figure 1: Lithium battery usage. Source - Avnet Abacus, estimated

Strategies to combat volatility in the lithium-ion battery market

The major manufacturers of Li-ion cells are juggling the competing forces of demand and raw material supply aswell as standardising on cell size and construction to get economies of scale. Many existing designs of the 'prismatic' style in welded aluminium or steel housings are being discontinued in favour of 'pouch' cells, often in lithium-polymer technology that allows a laminated construction, which is lighter and gives mechanical flexibility and slightly higher specific energy. Pouch cells do suffer from swelling with charge/discharge cycling though, with smaller sizes growing as much as 10% in volume over 500 cycles. The standard 18mm x 65mm 18650 cylindrical cells and larger variants will certainly still be supported for some time to come, as the format suits applications like Tesla's 100kWhr module where 8256 cells are stacked in staggered rows with pipes for liquid cooling. The cylindrical wound format is good for mechanical stress resilience and the small remaining gaps between cells allow for some air-cooling. The volume of cylindrical cells produced over the years has also brought their cost down considerably.

So, as a design engineer, you've decided on a Li-ion battery for your new device and need a few prototypes. The prospective production volume is, you hope, high but getting one of the 'big four' manufacturers to consider supporting a new custom design is a mountain to climb. A solution is to pick from the extensive range of standard parts from Avnet Abacus[4], which includes the 18650 size cylindrical cells from major suppliers Dubilier, Panasonic, RRC, Samsung and Varta, available in single 3.7V cells from 2250mAh to 3300mAh, to packs of up to 70 cells at 25.2V/29000mAh. A range of 'prismatic' types are supported in single and 3-cell formats along with a more extensive range of 'pouch' lithium polymer cells in varying mechanical sizes and ratings from 130mAh to 3000mAhr. Many of the prismatic 'hard pack' variants are supported by relevant chargers. The standard range also features the Coin Power Li-ion button cells from Varta.

Figure 2: Selection of Li-ion batteries from Avnet Abacus

A suitable Li-ion battery type for most applications is available from the Avnet Abacus range[4] with a variety of construction styles, dimensions and capacities. 'Soft' packs suit embedded applications and 'hard' packs are ideal for ease of removal, recharging and replacement with some types even including SMBUS SMART functionality. The parts are available on very short lead-times with low MOQs giving fast time to market. As you would expect from the world-class suppliers represented, all battery packs meet the minimum approvals for shipping of lithium-ion and polymer products. All lithium batteries meet the UN regulation (UN38.3) for worldwide transportation by air, road and sea freight. Many of the parts also meet IEC62133/CB scheme and UL2054 safety standards for regional and US markets. Continuity of supply is offered in many of the products with a guaranteed product availability of 10-15 years.

For more information and to download the Avnet Abacus standard lithium-ion battery brochure visit **avnet-abacus.eu/batteries**

References

[1] AVICIENNE ENERGY analysis 2016. [2] https://www.grandviewresearch.com/press-release/global-lithium-ion-battery-market. [3] https://www.prnewswire.com/news-releases/emergence-of-electric-vehicles-to-push-demand-for-lithium-and-cobalt-674165683.html [4] Avnet Abacus Lithium-ion Battery Brochure

A frequent application for electromechanical relays is the switching of 230V alternating voltage. For example, many homes have stair lighting buttons which are switched on and off centrally via a relay. State-of-the-art LED lights with integrated voltage converters and all conventional power supply units have input capacitors. During charging, high inrush currents of up to several hundred amperes flow from microseconds to a few milliseconds on the sine wave depending on the capacitance and switching time. This significantly reduces service life of the relay contacts.

The most elegant solution for switching the high inrush currents of state-of-the-art lights is to prevent such currents from occurring in the first place, by always switching the load at the voltage zero cross.

Switching electromechanical relays at the zero cross (see Figure 1) can extend service lives by as much as 10 times as there is much less wear on the contact material.

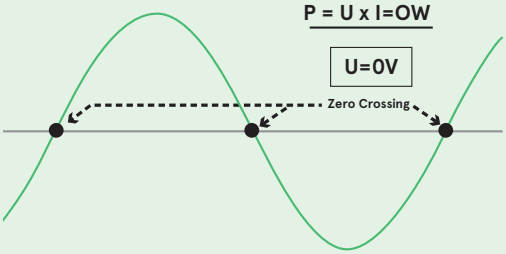


Figure 1: Switching the relay at the zero cross

Zero cross switching does not require a great deal of hardware (see Figure 2).

To make sure switching always takes place at the zero cross, the controller continuously monitors the power voltage via an optocoupler which provides the controller with a pulse on every zero cross.

The microcontroller must also be capable of changing (correcting) the exact switching time of the relay. This control loop can be safely and reliably implemented by software in the controller in conjunction with high-quality relays.

In addition to the information on the timing of the voltage zero cross, electromechanical relays have a pick-up and release time in the single-digit millisecond range owing to mechanical inertia. These actual switching times can be documented by measurements at the relay manufacturer's lab and provided to the users as reference values. The average value should be stored in the microcontroller's memory (e.g. in the EPROM).

A current measuring coil at the controller's analogue input continuously monitors the actual current flowing. If the inrush current is above the specification defined at the development stage, the software automatically adjusts the switching time (i.e, corrects it forward or back). This creates a control loop which regulates the inrush current to the minimum possible value, and so increases the service life of the switching contacts by as much as 10 times. For direct actuation of the relay coil(s) of the controller's digital output, a driver is normally also inserted.

The rest is handled by the controller software. A zero cross circuit enables the use of small, low-cost power relays. For building automation applications especially, size, cost-effectiveness and durability are the key selling arguments.

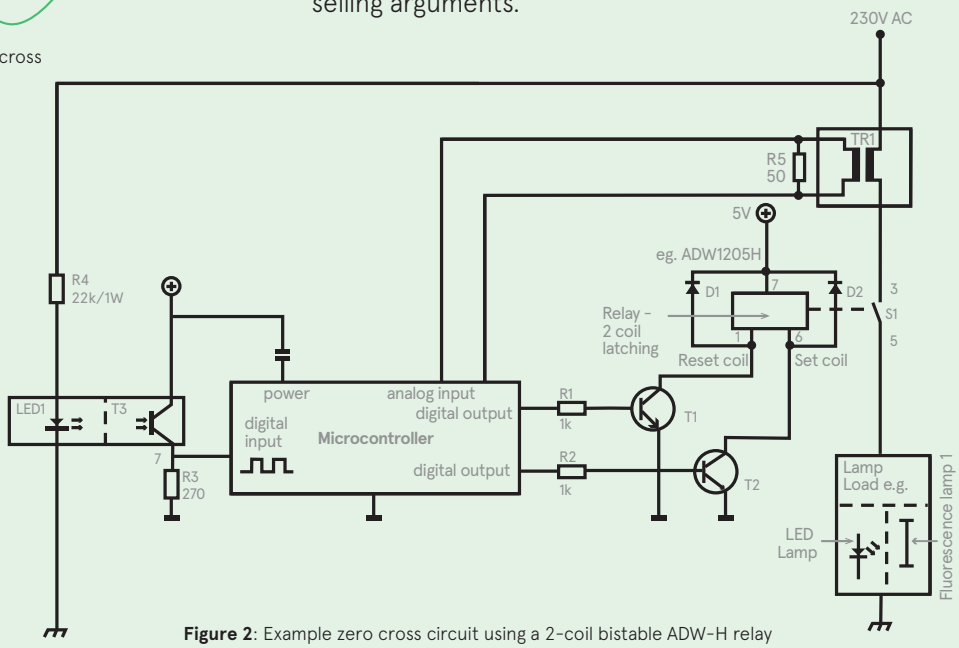


Figure 2: Example zero cross circuit using a 2-coil bistable ADW-H relay

Panasonic

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Avnet Abacus wins Distributor of the Year from Molex

Company achievement exemplifies the substantial contribution to sales growth across the region

For the second consecutive year, Molex has named Avnet Abacus EMEA Distributor of the Year. This year's award, recognising 2017 achievements, also saw Avnet Abacus succeed in two additional categories: Northern Europe Distributor of the Year, with credit to the UK team; and France, Benelux and South Africa Distributor of the Year, highlighting the successes of the Benelux team.

Avnet Abacus was selected as the outstanding channel collaborator for their excellent work in areas such as market engagement, year-over-year growth and project conversion rate.

Henry Fürniss, Vice President Sales and Marketing EMEA, Molex, commented:

"Avnet Abacus continues to deliver top-class sales performance across our technology range – a testament to the excellent leadership and technical know-how of the team, which continues to inspire confidence in our customers. This is a significant factor in our company's sustained growth in Europe. These awards are thoroughly deserved."

"Once again, our close working relationship with Molex has resulted in benefits across the supply chain, spanning many markets," said Alan Jermyn, Vice President Marketing, Avnet Abacus.

"These awards represent a shared success and we are particularly thrilled that the contributions of our teams in the UK and in Benelux were individually recognised this year and combined with EMEA Distributor of the Year."

molex

Engineers' Insight: the Avnet Abacus blog

Solving design challenges

Avnet Abacus' technical blog, Engineers' Insight, is designed to help you solve key challenges across the breadth of markets and technologies we serve.

From electronics phenomena such as equivalent series resistance in electrolytic capacitors and discussions on the best approaches to new wireless technologies, to in-depth design guides for power solutions, this is a blog written for engineers, by engineers.

Where to read?

avnet-abacus.eu/engineers-insight

AVNET ABACUS

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