ENGLISH

CODICO®

impulse

1/2024

ISABELLENHÜTTE: FMK

GaN Solutions From INNOSCIENCE

HIROSE's Home Electrification

CONTENTS

24 | ISABELLENHÜTTE: Safe on the slope!

A few years ago, ISABELLENHÜTTE introduced the FMx series as shunts to close a gap in the portfolio for low-ohmic resistance values in smaller sizes. The FMx series covers values from 2 to 6mΩ in size 1206. One application example is the electric parking brake (EPB), which has already become established in new vehicles up to the compact class.

ACTIVE COMPONENTS

CODICO IN-HOUSE

PASSIVE COMPONENTS

CONNECTORS

IMPRINT: Issued by CODICO GmbH Zwingenstraße 6-8, A-2380 Perchtoldsdorf
Responsible for the content: Sven Krumpel | Editorship: Birgit Punzet
Design: www.rittbergerknapp.com | date of issue: 01-010524
Print: Gutenberg Druck – Kooperationspartner der Print Alliance HAV Produktions GmbH, Druckhausstrasse 1, 2540 Bad Vöslau

Editorial

Sven Krumpel
CEO CODICO

Let's meet CODICO!

Dear readers,
We are on the road! You could and can meet CODICO at a total of eight trade fairs in the first half of 2024.

At a time when digitalisation has transformed many aspects of our business, but cannot replace the human factor, trade fairs are an indispensable tool for CODICO. They are not only a place where we present solutions and innovations from our manufacturers, but also a platform to get in direct personal contact with you. Especially now, when innovation is becoming increasingly important, we want to exchange ideas, support you with our technical expertise and accompany your product developments right from the start.

We started in France: On February 8th 2024, we met CODICO at the evertiq event in Sophia Antipolis. This was followed by TEK Wroclaw and then it was time for Las Vegas – being part of a trade fair in the USA was a new experience for us.

According to a PwC analysis, the number of electric vehicles registered in the USA will increase almost tenfold by 2030 from the current figure of around 3 million and grow to over 90 million by 2040. The charging infrastructure required for this will experience growth from the current economic market volume of $8 billion to over $100 billion in the same period. This means a new installation of up to 30 million charging stations by 2030 and a further expansion of a total of over 100 million charging points in the USA by 2040.

The EV Charging Summit & EXPO 2024 in Las Vegas was therefore the ideal opportunity to present ourselves with our own stand and talk to industry-specific experts and customers about collaborations and new product developments. Our focus here was clearly on the QUALCOMM HomePlug GreenPHY-based BEET communication modules in combination with the SW ISO15118 stack from our partner SEVENSTAX.

Back from Las Vegas, the focus was on the world of embedded systems at embedded world in Nuremberg from April 9th to 11th. Here we were able to demonstrate our expertise in the areas of EV charging, motion control, communication, IoT connectivity and AI.

Fortronic in Bologna from May 7th to 8th also focused on the area of EV charging. Other highlights in May were our participation in Hardware Pioneer in London and Eliaden 2024 in Norway.

Meet CODICO again in Nuremberg from June 11th to 13th ! PCIM – the event for power electronics – is just around the corner and we would be delighted to welcome you in person at our stand 7-511! Will we see each other? We would be thrilled!

Sven Krumpel

Wi-Fi x4

FN-LINK Continues to Rely on QUALCOMM

FN-LINK continues to rely on the technology leader QUALCOMM for the new Wi-Fi PCIe radio modules. No less than 4 additional modules join the existing solutions. These include one Wi-Fi5, two Wi-Fi6 and one Wi-Fi7 module.

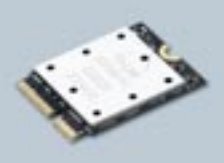
With the new 8274N-PR (based on QCA-6574A-1), the temperature range has been extended from -40°C to 85°C when compared to its slightly older »twin brother« 8274B-PR (based on QCA-6174A-1). Therefore, the 8274N-PR can be used in all industrial Wi-Fi5 applications. Both modules support MIMO 2x2, dual band, HT80 and additionally Bluetooth V5.0, BLE.

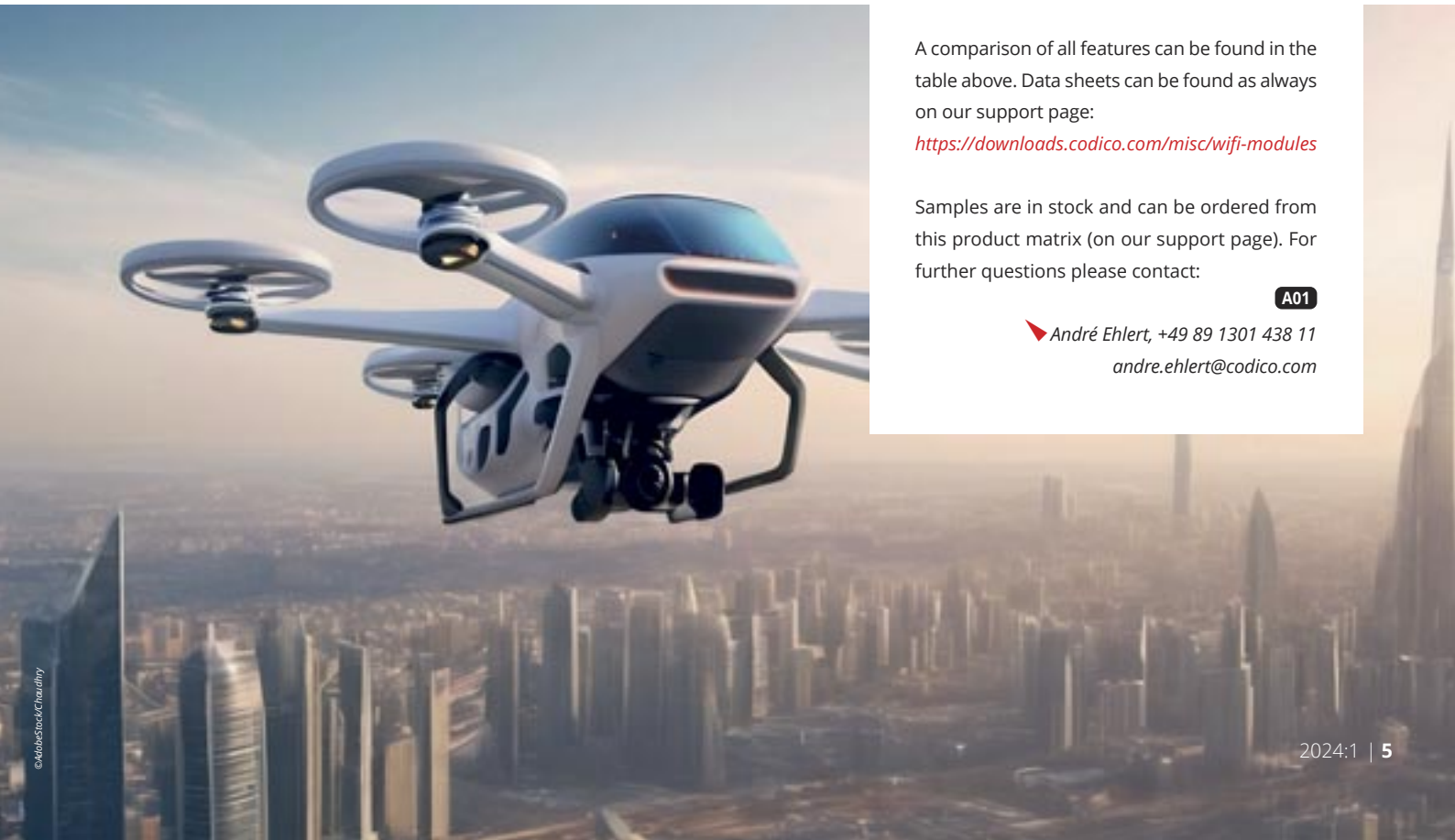
8124N-P relies on the new Wi-Fi6 device QCN-9024 and offers connectivity to 256 clients in its MU-MIMO4x4 antenna configuration. The module operates exclusively on the 5GHz band (HT160) with a maximum antenna data rate of 4804Mbps. The module has full access point functionality and is therefore designed for AP, routers and IoT gateways.

8296N-PR is based on the QCA-6696 and operates on both bands (2.4GHz + 5GHz) in DBS (Dual Band Simultaneous) mode. In its MU-MIMO2x2 antenna configuration with HT80, this Wi-Fi6 radio module achieves an antenna data rate of 1774 Mbps. It also supports Bluetooth V5.2, BLE. A special feature is the automotive qualification AEC-Q100 and thus 8296N-PR covers the full industrial temperature range of -40°C to 85°C. But certainly FN-LINK's first Wi-Fi7 PCIe radio module 8276M-PU, which is offered in the M.2 form factor (2230 Key E), deserves special pride. A new feature of this module is its ability to support three bands (2.4GHz, 5GHz and 6GHz) in DBS mode. This means that the following bands can be operated alternatively at the same time:

- 2.4GHz and 5GHz
- 2.4GHz and 6GHz
- 5GHz and 6GHz

With a MU-MIMO2x2 and HT160 configuration, the 8276M-PU achieves a maximum antenna data rate of 5.3Gbps in DBS mode (5GHz & 6GHz). Thus, this module is a future-proof investment for applications in the area of robotics, drones, sensor technology and smart city. In addition, it already masters the new Bluetooth standard V5.3/BLE.

MODEL NAME		8274N-PR	8124N-P	8296N-PR	8276M-PU
					
ORDERING PART NUMBER		FG8274NPRX-01	PA8124NPXX-00	FG8296NPRX-00	FG8276MPUX-00
PLATFORM	Chipset	QCA-6574A-1	QCN-9024	QCA-6696	QCA-2076
	Interface Wi-Fi	PCIe	PCIe M.2	Low Power PCIe one lane	Low Power PCIe one lane
	Interface Bluetooth	UART, PCM	no	UART, PCM	USB
	Linux & Android / Mainline Driver	yes / yes	yes / from 5.4 upward	yes / no	yes / no
	Windows	Win CE, XP,Win7, Win10	no	WIN7/WIN10/XP	WIN7/WIN10/XP
WIRELESS	Bluetooth Standard	V5.0, BLE	no	V5.2, BLE	V5.3, BLE
	Wi-Fi Standard	Wi-Fi 5	Wi-Fi 6	Wi-Fi 6	Wi-Fi 7
	MIMO	2x2	MU 4x4	MU 2x2	MU 2x2
	Frequency	2.4GHz & 5GHz	5GHz	2.4GHz, 5GHz, DBS	2.4GHz, 5GHz, 6GHz, DBS
	Bandwidth	HT20/HT40/HT80	HT20/HT40/HT80/HT160	HT20/HT40/HT80	HT20/HT40/HT80/HT160
	Antenna Data Rate	866Mbps	4804Mbps	1774Mbps	5.3Gbps
	Monitor Mode	yes	yes	yes	yes
	Antenna Configuration	[BT,2G,5G] + [2G,5G]	[5G] + [5G] + [5G] + [5G]	[2G,5G] + [2G,5G] + [BT]	[2G,5G,6G,BT] + [2G,5G,6G,BT]
	Antenna Type	2× Pins	4× IPEX	3× Pins	2× IPEX
MODULE SPEC	Power Supply	3.3V	3.3V & 5V	3.3V	3.3V
	Dimension (mm)	23.4×19.4	62.4×57	23×23	22×30
	Package	LGA	M.2 Key E Module	LGA	M.2 2230 Key E Module
	Temperature Range	-40°C to 85°C	-20°C to 70°C	-40°C to 85°C, AEC-Q100	-30°C to 85°C
	Mounting	Single Side	Dual Side	Sinlge Side	Dual Side
	Carrier / QTY	Tape & Reel / 1000	Tray	Tape & Reel / 500	Tray / 30
	MOQ	1000	1260	1500	1500
	Weight	2.1g	15.2g	3.56g	TBD
	Certificate	CE	CE	CE	CE
DVK		yes	no	yes	no



A comparison of all features can be found in the table above. Data sheets can be found as always on our support page:
https://downloads.codico.com/misc/wifi-modules

Samples are in stock and can be ordered from this product matrix (on our support page). For further questions please contact:

A01

André Ehlert, +49 89 1301 438 11
andre.ehlert@codico.com

NEW STANDARDS

The World's Smallest 6.0V 600mA DC/DC Solution

TOREX has released a new low quiescent current synchronous DC/DC converter which is not only low power but also the world's smallest in its respective category. The XC9290/91 features TOREX's HiSAT-COT technology and is the world's smallest 6.0V 600mA synchronous buck DC/DC making it an ideal solution for modules and other space sensitive applications.

XC9290/91 Series (6.0V, 600mA Synchronous Step-Down DC/DC Converter)

The XC9290/91 is a 600mA synchronous step-down DC/DC that can operate from 2.5V~6.0V. Output voltage is selectable between 0.7V~3.6V and the quiescent current is only 11µA (XC9291) in operation. The XC9290/91 has an enable pin which allows the DC/DC to be placed in stand-by mode with a stand-by current of just 0.6µA (max.) With a switching frequency of either 4MHz or 6MHz, a small 0.47uH inductor can be selected to reduce total board space without sacrificing on efficiency. Whilst the XC9290 is fixed PWM control, the XC9291 is automatic PFM/PWM control and is designed for high efficiencies at low output loads. The series can be used with small low ESR ceramic capacitors (Figure 1).

Ultra-fast load transient response

The XC9290/91 supports fast load transient response performance thanks to HiSAT-COT control. This ensures that the output voltage remains stable as the load current changes (see Figure 2).

Low EMI performance

The PCB area and subsequently the length of copper tracks is minimised due to the use of ultra-small flip-chip packaging which reduces the parasitic inductance of noise normally associated with wiring inside the package. This, together with the use of smaller external components, results in extremely low radiated noise and excellent EMI performance as illustrated in the graph (Figure 3). The XC9290/91 passes EN55032 (CISPR 32) CLASS B with good margin.

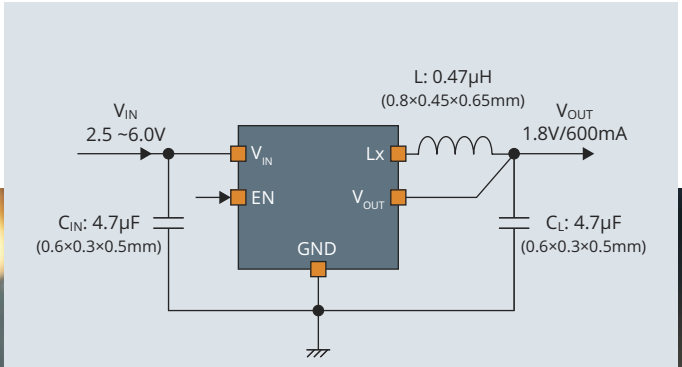


Figure 1: Typical Application Circuit

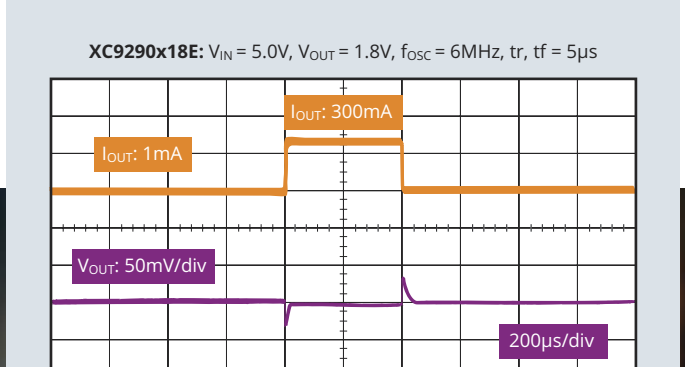


Figure 2: Load Transient Response

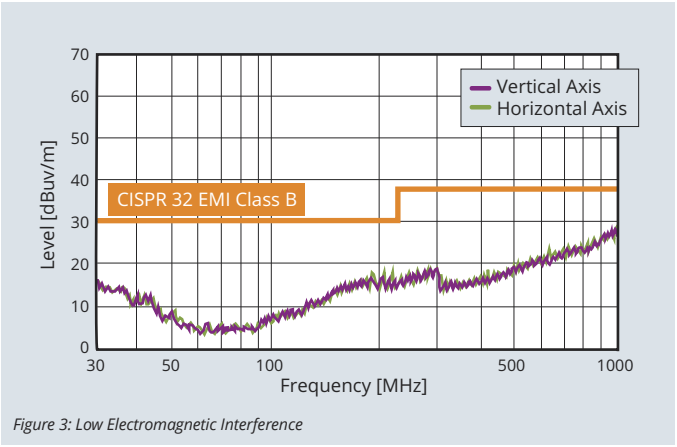


Figure 3: Low Electromagnetic Interference

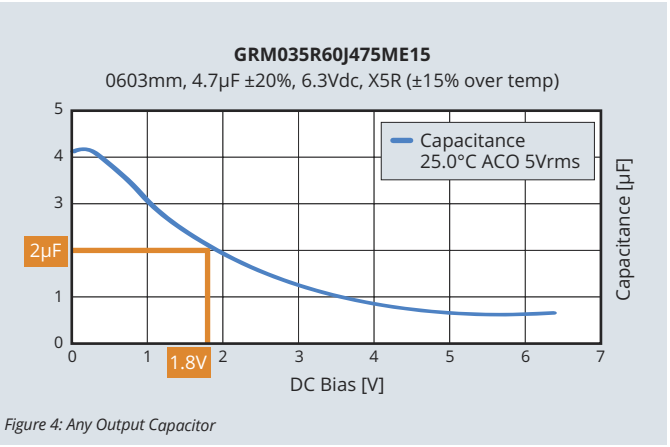


Figure 4: Any Output Capacitor

Any output capacitor

As shown in the graph (Figure 4), the CL capacitance value will reduce to 2µF at 1.8V and this will further decrease at higher temperatures. The XC9290/91 is designed to operate with lower capacitance values which will occur under DC bias conditions. As a result, designers can safely use smaller, lower cost, 0603 sized (0.6×0.3×0.5mm) multilayer capacitors without sacrificing performance.

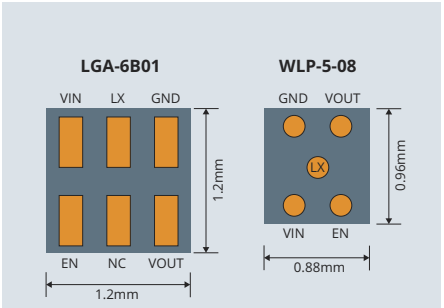


Figure 5: XC9290/91 Packages

The XC9290/91 is available in either a LGA-6B01 package (1.2×1.2×0.3mm) or an ultra-small WLP-5-08 package measuring only 0.96x0.88x0.3mm (Figure 5). The total solution size of the XC9290/91 with the WLP-5-08 package is only 3.15mm² (Figure 6).

HiSAT-COT (Constant on Time)

The XC9290/91 is one of a number of new DC/DCs from TOREX that features the latest generation of HiSAT-COT technology. These products provide not only ultra-fast load transient response performance, as shown in Figure 2, but in comparison to the previous generation of HiSAT-COT products, have improved output voltage accuracy and a more stable switching frequency over load current and input voltage, something which is an inherent issue with traditional COT (Constant On-Time) architectures.

Samples and/or evaluation boards for the XC9290/91 can be requested via CODICO.

If your application requires more output current, then TOREX also has HiSAT-COT step-down DC/DC solutions for supporting 1A (XC9285 and XC9286 series) and 1.5A (XC9287, XC9288 and XC9289 series) – samples and evaluation boards available from CODICO.

A02

Johannes Kornfehl, +43 1 86305 149
johannes.kornfehl@codico.com

Figure 6: XC9290/91 Solution Size

OVERVIEW LV DC/DC CONVERTERS				
	XC9290/91	XC9285/86	XC9287/88	XC9289
VIN	2.5V to 6.0V	2.5V to 5.5V	2.5V to 5.5V	2.5V to 5.5V
VOUT	0.7V to 3.6V	0.8V to 3.6V	0.8V to 3.6V	0.8V to 3.6V
IOUT	0.6A	1.0A	1.5A	1.5A
fosc	4.0MHz, 6.0MHz	1.2MHz	1.2MHz, 3.0MHz	1.2MHz, 3.0MHz
Iq	XC9291: 11µA	XC9286: 15µA	XC9288: 15µA	XC9289: 15µA
Control Methods	HiSAT-COT Control	HiSAT-COT Control	HiSAT-COT Control	HiSAT-COT Control
	100% Duty Cycle	100% Duty Cycle	100% Duty Cycle	100% Duty Cycle
	PWM Control (XC9290)	PWM Control (XC9285)	PWM Control (XC9287)	PWM Control (MODE: High)
	PWM/PFM Auto (XC9291)	PWM/PFM Auto (XC9286)	PWM/PFM Auto (XC9288)	PWM/PFM Auto (MODE: Low)
Protection Circuits	Current Limit	Thermal Shutdown	Thermal Shutdown	Thermal Shutdown
		Current Limit	Current Limit	Current Limit
		Short Circuit Protection (Type B)	Short Circuit Protection (Type B)	Short Circuit Protection (Type B)
Functions	Soft-Start	Soft-Start	Soft-Start	Soft-Start
	UVLO	UVLO	UVLO	UVLO
	CL Discharge (Type B)	CL Discharge (Type B)	CL Discharge (Type B)	CL Discharge (Type B)
Ta	-40°C to 105°C	-40°C to 105°C	-40°C to 105°C	-40°C to 105°C
Packages	LGA-6B01, WLP-5-08	SOT-25, USP-6C	SOT-89-5, USP-6C	LGA-8B01 (1.2×1.4×0.3mm)

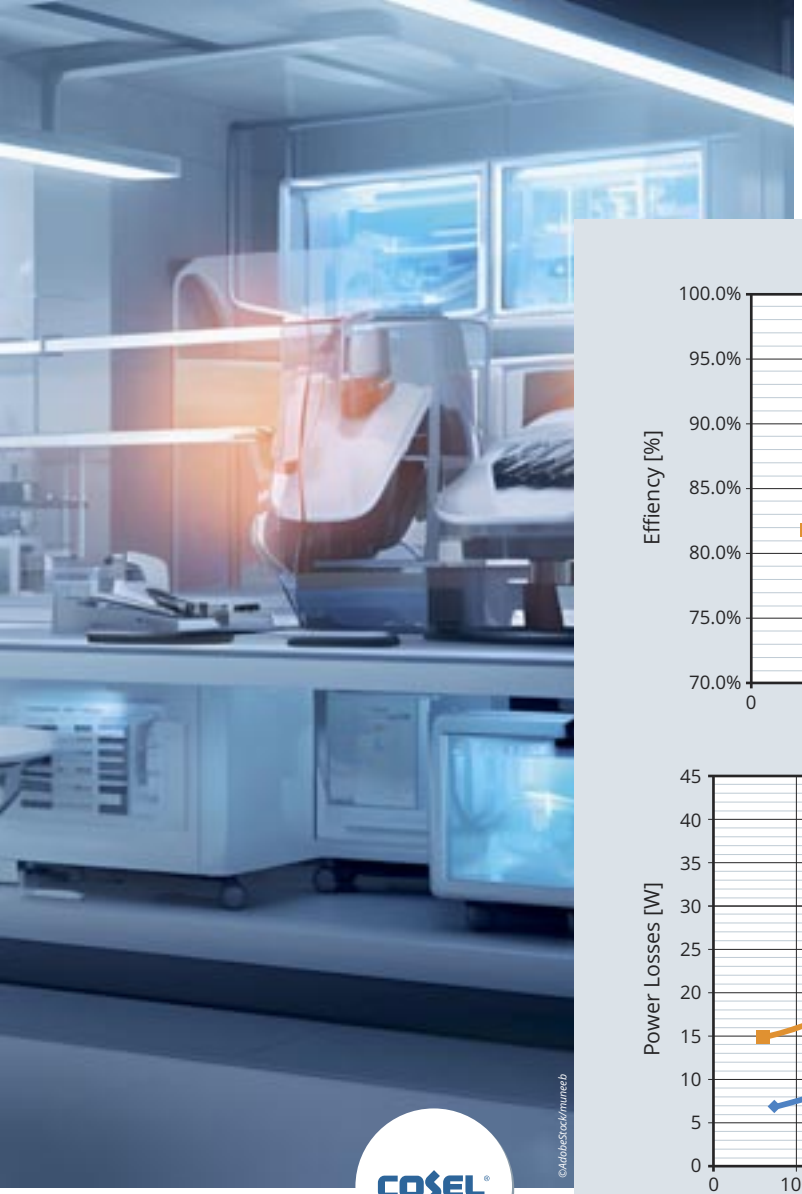
THE BIG DIFFERENCE

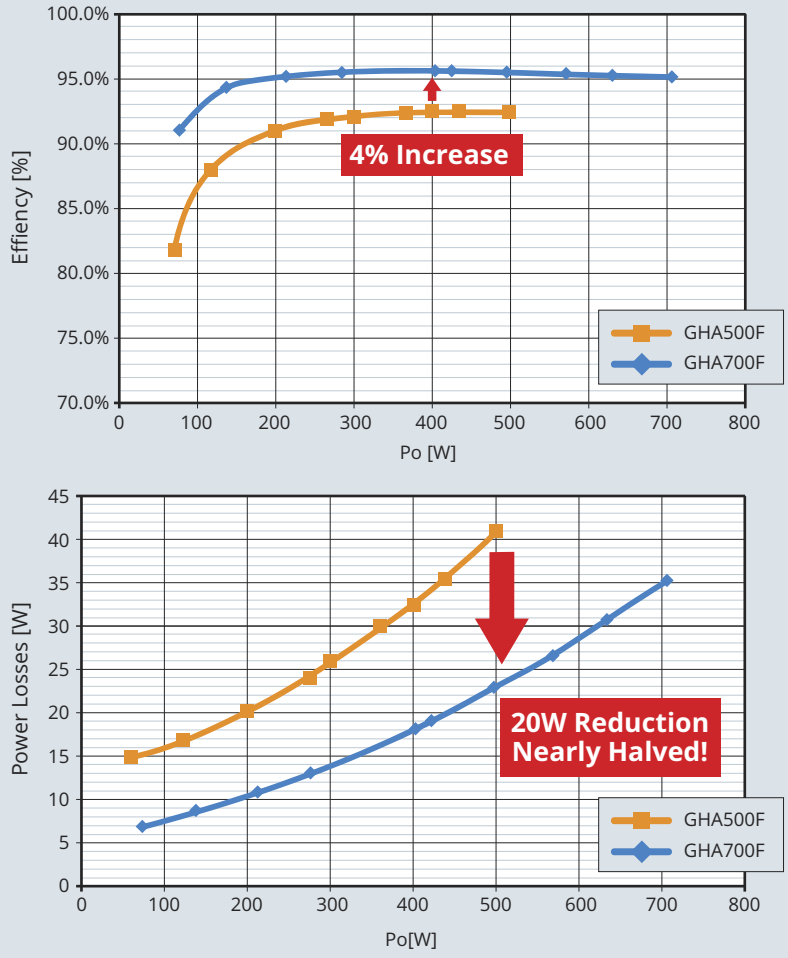
COSEL Dual Board AC/DC on 3×5” with Increased Power Rating Up to 700W & Medical Approvals

COSEL extends their GHA product range with a 700W contestant.

The GHA700 presents itself as a brushed-up version of the GHA500, in essence it is a whole new product. The footprint still measures 3”×5”×1.5” (76.2×127×38.1mm) only, but on this very same footprint the power supply now achieves up to 700W rated power. Such a high-power density usually requires a combination of cooling methodologies.

The GHA family was introduced as a hybrid, combining convection, conduction and forced air cooling. Stating the obvious, the root cause of cooling is the efficiency of any product. This is where COSEL’s GHA700 wants to be distinguished. Not only, have COSEL’s engineers managed to improve the efficiency at 230VAC supply voltage to 96%, which means an uplift of 4% and a net heat loss reduction of 20W, which equals 50% heat loss reduction. The product is now a true conduction cooled power supply. The GHA500, its predecessor, started its derating at zero degrees measured at the centre point of the base-





Derating

plate ending at 100W available power at 80°C. With the new GHA700, the whole thermal behaviour got shifted to a nominal 400W at 60°C. The derating ends at 150W at 80°C baseplate temperature. In real-life applications conducted head dissipation is always supported by either convection or forced air cooling making the 150W the lowest threshold possible.

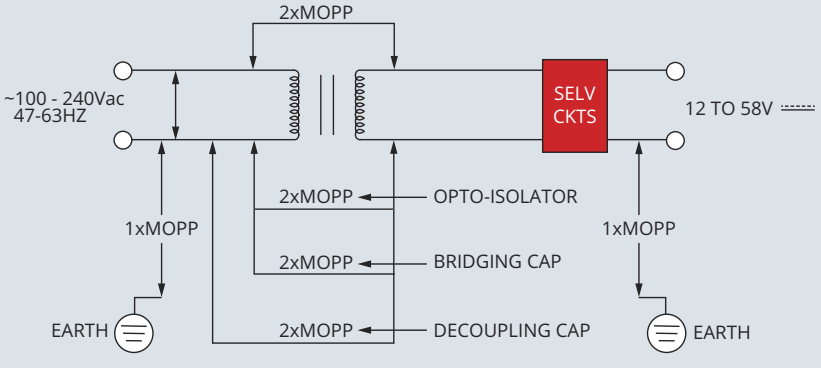
The GHA700 is currently available with output voltages covering 24V, 30V, 48V and 56V. (12V to follow 2HY, 2024). It is designed to meet the household standard (EN60335) and complies, thanks to its IEC61558-2-16 (Safety transformers). The product comes with medical approvals and optional protection class II. Whenever the GHA700 is used in a medical appliance that actually is equipped with an applied part, this touchable part needs to be isolated by reinforced or double insulation. This is not only applicable for isolation between primary and secondary side directly but also for an – hypothetical – earth loop.

Possible by using plastic screws and stand-offs, the optional protection class II allows seamless integration in portable and homecare equipment for direct patient contact. (2xMOPP, BF acc. to EN60601)

Contact CODICO for information on pricing, lead times and samples.

A03

Andreas Hanausek, +43 1 86305 131
andreas.hanausek@codico.com



Isolation diagram for the representation of 2xMOPP

GLOBAL

LC29H Dual-Band Multi-Constellation GNSS Modules with Optional RTK & DR

The QUECTEL LC29H is a series of dual-band, multi-constellation GNSS modules that support the concurrent reception of all four global GNSS constellations: GPS, BDS, Galileo and GLONASS.

Compared to GNSS modules that track only L1 signals, the LC29H series can receive and track a higher number of visible satellites in multi bands, thereby significantly mitigating the multi-path effect in deep urban canyons and improving positioning accuracy. By having an internal LNA and SAW filter, the module achieves better sensitivity and anti-interference capability. Featuring dual frequency support, the module delivers CEP accuracy values of 1m in autonomous mode and centimetre levels in the real-time kinetic (RTK) positioning capable variants.

The optional dead reckoning (DR) function, which is available in variants to address two-wheeled or four-wheeled vehicles, ensures the module's superior positioning performance even in weak signal areas or when GNSS signals are not available.

High-precision positioning

The LC29H offers high performance, power-efficient solutions to meet market needs of high-precision positioning at the centimetre and decimetre levels. These modules are perfectly suited to address the expanding market for autonomous lawn mowers, precision agriculture, micro-mobility scooters and delivery robots as well as other industrial and autonomous applications. In addition, some versions contain 6-axis IMU inertial sensors (3-axis accelerometer & 3-axis gyroscope), and integrate RTK and DR positioning algorithms, allowing for continuous lane-level accurate positioning in scenarios where the satellite signal is partially or completely blocked, such as underground parking lots, tunnels, urban-canyons or forests. When the satellite signal is re-acquired, the LC29H combines inertial sensor data with GNSS signals.

Low-power with compact footprint

The LC29H features a dual-frequency receiver chip and advanced low-power management, thereby enabling low-power GNSS sensing and position fixing. This makes the module an ideal solution for power-sensitive and battery-powered devices including handheld devices, asset trackers, and shared vehicles. With an LCC form factor and an industry standard footprint size of 12.2×16.0×2.5mm, the LC29H series design allows for easy system integration and smooth migration of legacy designs to the latest high-precision GNSS technologies.

In addition, the LC29H can be bundled with QUECTEL's wide range of off-the-shelf and customised GNSS antennas. Both passive and active antennas are available, along with customised connector types and cable lengths. QUECTEL also provides comprehensive antenna design support including simulation and testing services. The manufacturing of customised antenna solutions is also available to fast-track customer product development.

A04

Joachim Strohschenk, +49 89 130143817
joachim.strohschenk@codico.com

HIGHLIGHTS

- LC29H (AA) - Dual-band, meter-accurate, PVT only
- LC29H (BA) - 2-wheel or 4-wheel dead reckoning + RTK, cm-accurate
- LC29H (CA) - 2-wheel or 4-wheel dead reckoning, meter-accurate
- LC29H (DA) - 1Hz update rate, RTK only, cm-accurate
- LC29H (EA) - 10Hz update rate, RTK only, cm-accurate
- LC29H (BS) - Base station to provide cm-accurate correction data

POE++ POWER AS IN POE IEEE802.3BT

Since its ratification in early 2019, the adoption of IEEE802.3bt has been relatively slow to take off, mainly due to the limited number of compliant Midspan and Endspan switches and injectors available on the market.

However, manufacturers are now making their versions of these high-power networking products more readily available and are being deployed into a wide variety of applications. Traditionally, powered devices (PDs) capable of power delivery beyond PoE+ (IEEE802.3at) and as a precursor to the .bt standard, were physically too large to be used in most applications... until now!

SILVERTEL announcing their latest PD modules specifically designed for 4-pair powering. The Ag59612-LPB and Ag59624-LPB are PD modules capable of delivering IEEE802.3bt Class 6 power (50W) at either 12V or 24V respectively to a peripheral device. They are especially useful where a designer requires higher than PoE+ but doesn't necessarily require the highest power (85-90W) that PoE++ has to offer. Products operating at the maximum power levels defined by IEEE802.3bt, require large form factor components in order to deliver the power. Operating at just below these power levels (and with a little design wizardry) allows to shrink the form factor tremendously.

Intended for embedded integration, both modules are available in a surface mount format using gold block terminals to connect to the host PCB. SILVERTEL has not only managed to reduce the amount of wasted energy (efficiency of 92-93% for the 12V variant), but also reduced the module footprint, smaller than any other module solution in its class.

Measuring a mere, 45×25mm (L×W), the modules provide the necessary identification, classification, isolation and DC/DC conversion features required of an IEEE compliant PD. Output voltage adjustment is also possible with an external resistor. The use of gold block terminations promotes good thermal transfer to the host PCB, essential in any power design.

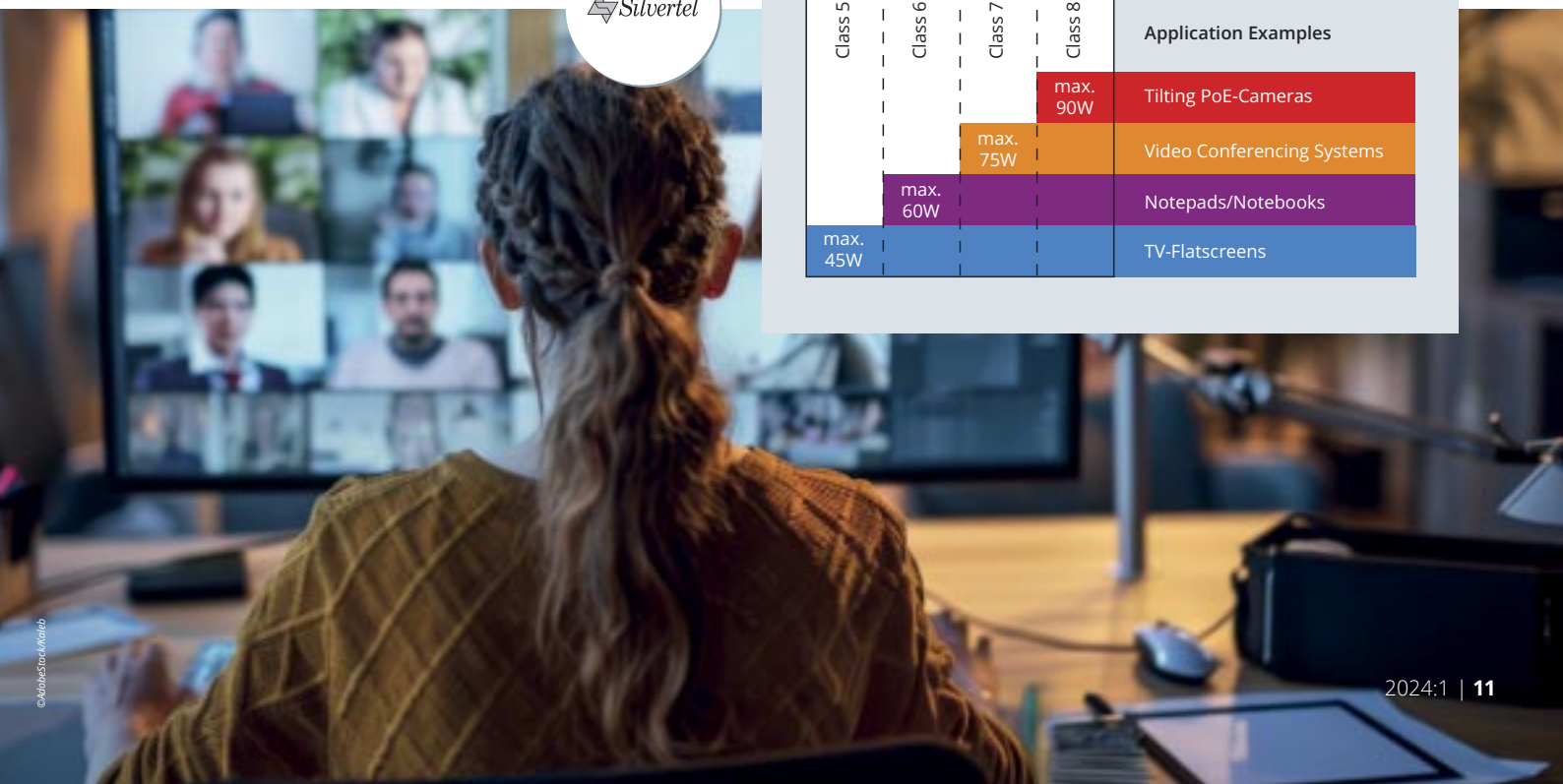
The modules can deliver the full 50W of useable power, peaking at 60W maximum, over the entire industrial temperature range of -40°C to +85°C and also incorporate over-voltage, over-current and thermal protection to provide a robust PoE solution.

Simplicity of integration and ease of use is synonymous with SILVERTEL's products, and these modules are not different requiring very few, low-cost, external components.

Datasheets, samples and eval boards are now available via CODICO.

A05

Andreas Hanausek, +43 1 86305 131
andreas.hanausek@codico.com



NEW PATHS

Revolutionising Power Supplies: The Advantages of Integrated Power Modules

In the fast-paced world of electronics, the demand for efficient and compact power solutions is ever-growing. As technology advances, engineers are constantly seeking ways to simplify design, reduce board space, and expedite the development process.

MPS meets these demands by offering the widest portfolio of power modules on the market. These devices integrate the power stage, control loop, and inductor in a single SMD package (see Figure 1). This article explores the numerous advantages of using integrated power modules over traditional discrete DC/DC power supplies.

Simplified design and reduced board space

By integrating the power stage, control loop, and inductor, MPS power modules offer unrivaled power density. The converter, inductor, and other passive components are directly placed on the lead frame using MPS's patented MeshConnect™ technology, achieving increased thermal dissipation, higher reliability, and lower parasitic inductance. This leads to significantly simplified design, effectively reducing the design time and iteration cycles.

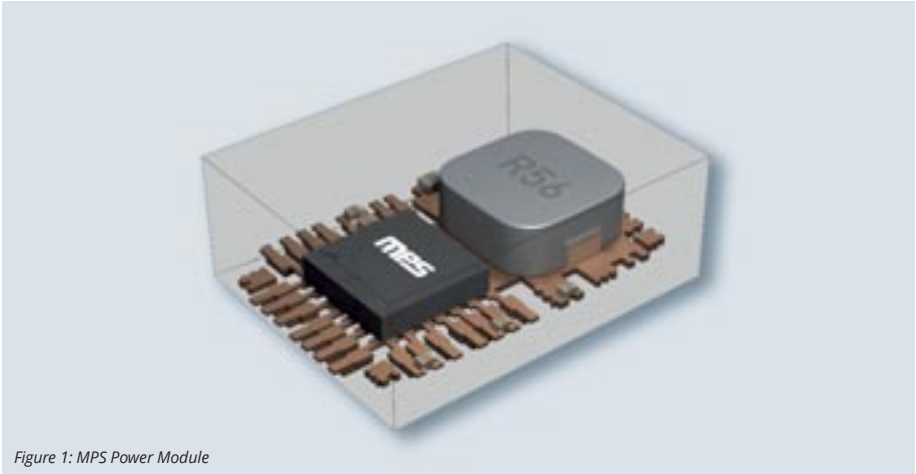


Figure 1: MPS Power Module

MPS power modules integrate passive components such as the bootstrap (BST) capacitor, VCC decoupling capacitor, input decoupling capacitor, and feedback resistive divider. This allows engineers to focus on higher-level aspects of the system, rather than spending time on discrete component selection and optimisation. The integrated passive components simplify design by streamlining the process and reducing the BOM, which addresses challenges with component compatibility issues and the component sourcing process. Furthermore, MPS power modules are pre-validated, eliminating the need for extensive testing and verification of individual components. This accelerates the time-to-market for electronic products.

Multiple-output power modules such as the MPM38111 can be used to increase power density. By delivering two or more separately controlled outputs (e.g. two MP2152 devices), the required number of input capacitors and overall board size are reduced (see Figure 2).

Figure 2: Size Comparison between a Dual-Output Power Module and Two Single-Channel Discrete Systems

In addition to simplifying the design process, MPS power modules offer a compact solution with reduced footprint compared to discrete alternatives. For applications where space is at a premium, designers can create smaller and more portable devices. In addition, the integrated components optimise board layout to reduce parasitic elements and enhance overall system performance.

With MeshConnect™ technology, MPS power modules can deliver high currents in very compact packages. Consider the MPM3864, a 6A power supply in an ECLGA-19 (3×3×1.85mm) package,

Figure 3: Example of the MPM3864 on an Optical Module

Figure 4: Use MPS' Virtual Bench Pro to Easily Configure Digital Devices

making it ideal for space-constrained applications such as optical power modules or handheld computing devices (Figure 3).

Increased design flexibility

As systems become more complex, power tree design is becoming an increasingly time-consuming effort due to the increased number of rails, strict voltage regulation requirements, and sharp load current transients, all of which require very precise fine-tuning. MPS modules help engineers quickly complete fine-tuning with the digital communication interfaces incorporated into the modules. Using MPS's Virtual Bench Pro software, designers can easily change aspects such as the output voltage (V_{OUT}), switching frequency (f_{SW}), and protection thresholds. Advanced parameters can also be adjusted to fine-tune operation, such as the blanking time, compensation loop gain, and slope compensation ramping voltage (see Figure 4).

The MPM3698 is a dual-output power module that delivers up to 120A of total current in a BGA (15×30×5.18mm) package. This device is designed to power the core rails of high-end FPGAs and ASICs, and is fitted with an advanced control loop that allows designers to tune many aspects of the control loop through its digital interface. Nonlinear control methods such as active voltage positioning (AVP) can be tuned to optimise transient response. Advanced communication protocols including SVID and AVSBus can also be configured, in addition to providing precise telemetry of the input voltage (V_{IN}), V_{OUT}, input current (I_{IN}), output current (I_{OUT}), and device temperature.

Advanced control methods: Constant-On-Time (COT) control

MPS power modules typically provide constant-on-time (COT) control, making them ideal for powering digital loads between the microcontroller unit (MCU) and the high-power system-on-chip (SoC). COT control improves power conversion and transient response by fixing the switching period's on time, allowing for changes in f_{SW} according to the load requirements. Transient response significantly improves due to the following two factors:

1. The control loop's operation is independent of the clock signal.
2. The converter can increase its f_{SW} to deliver energy faster to the output.

As a result, V_{OUT} is impacted less during sudden load current transients compared to conventional control methods. Figure 5 shows a comparison of current-mode control and COT control.

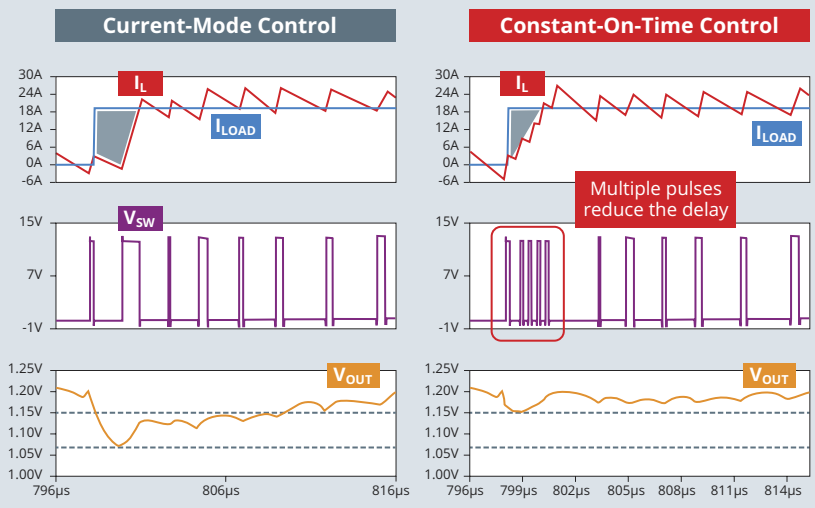
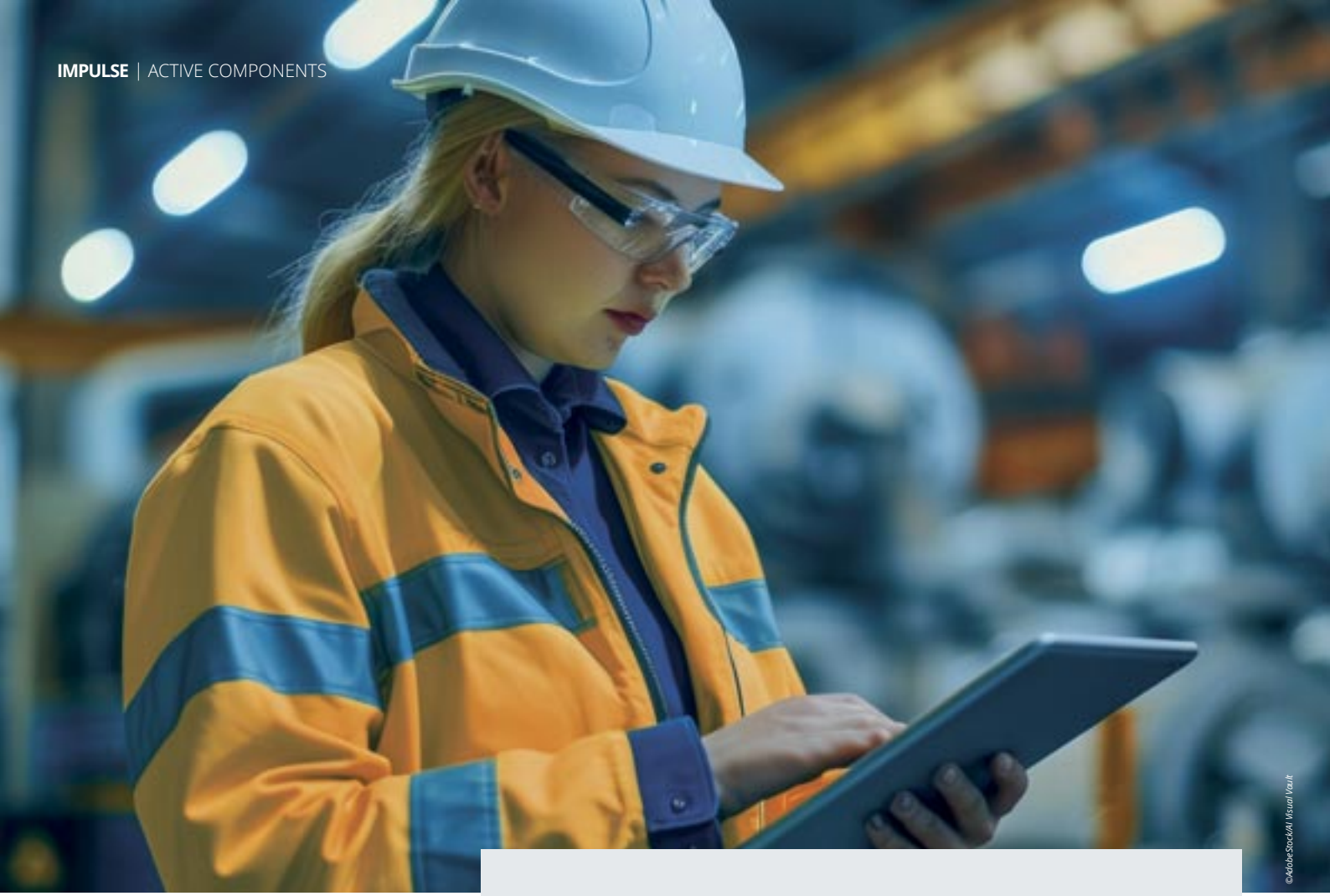


Figure 5: Current-Mode Control vs. COT Control



Another benefit of COT control is the converter's greatly reduced f_{SW} during periods where the load is significantly diminished (e.g. when the MCU enters sleep mode). COT control enables much higher efficiency at light loads without being forced to switch via a clock signal or being required to implement pulse-skip mode (PSM).

EMI reduction for power modules in industrial applications

Integrating the entire converter into a single package inherently leads to smaller switch nodes, reducing electromagnetic interference (EMI). This is crucial to meet electromagnetic compatibility (EMC) standards. Furthermore, the compact nature of integrated power modules contributes to smaller hot loops, which minimises the loop area and mitigates EMI concerns. A more robust design against EMI ensures reliable operation in various environments (see Figure 6).

MPS also offers modules with EMC pre-compliance for standards such as CISPR25.

A06

Thomas Berner, +49 89 130143815
thomas.berner@codico.com

Author: Tomas Hudson, Applikationsingenieur MPS

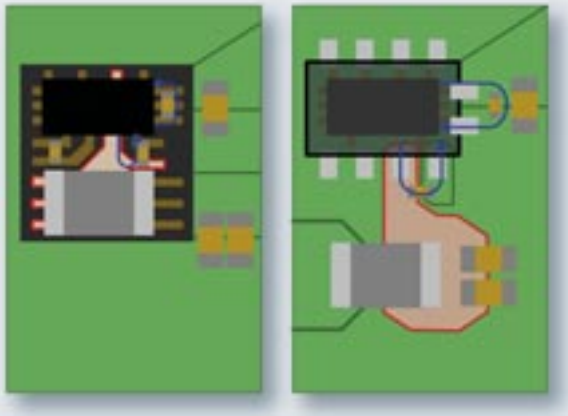


Figure 6: Reducing the Switch Node and Hot Loop Size with MPS Power Modules

CONCLUSION

Power modules with integrated inductors offer numerous advantages, including simplified design, reduced board space, faster development times, and EMI reduction. As the electronics industry continues to evolve, embracing innovative solutions like integrated power modules are paramount to stay ahead in the competitive landscape. The integration of essential power components marks an important development for achieving more efficient and compact power supply designs.

MPS is leading the market shift toward integrated power components by offering a wide range of compact, easy-to-use power modules. With output currents ranging from below 1A to above 100A, and input voltages ranging from below 6V to above 72V, speed up and simplify power supply design using MPS' robust portfolio of multiple-output power modules.

©AdobeStock/Creative-Touch

FULL SIGNAL

TELIT CINTERION introduces an advanced positioning receiver module for precise navigation and diverse applications.

The SE868K5-RTK was recently launched as a state-of-the-art positioning receiver module renowned for its multifrequency and multi-constellation capabilities, tailored specifically for precise navigation. Its compact design and refined positioning engine make it an ideal choice for applications requiring high precision, such as precision agriculture and drone operations. By leveraging real-time kinematic (RTK) technology, the SE868K5-RTK achieves outstanding performances.

Employing dual frequencies, L1/E1 and L5/E5, the SE868K5-RTK enhances location accuracy while mitigating multipath effects, especially in dense urban environments. Through the integration of differential corrections, it can achieve centimeter-level accuracy seamlessly. The support of Assisted GNSS (A-GNSS) with self- and server-generated orbit predictions enables fast-fix acquisition and reduces power consumption post-module wake-ups.

This module offers flexibility in receiving RTK corrections from user-owned base stations or recommended service providers, ensuring centimetre-level precision. Furthermore, it can operate autonomously, maintaining performance standards comparable to its predecessor, the SE868K5-D.

The SE868K5-RTK's relevance spans various markets and use cases due to its advanced positioning capabilities. In precision agriculture, it optimizes crop yields and resource utilisation through precise guidance systems. Similarly, in drone technology, it enables precise navigation and mapping crucial for aerial surveys and surveillance. In the construction industry, accurate site mapping and equipment tracking enhance efficiency and safety during building projects. Geospatial applications benefit from surveying, mapping, and urban planning capabilities, facilitating accurate data collection and analysis. For transportation and logistics, precise vehicle trakking and navigation improve route optimization and delivery accuracy. In marine and offshore industries, the module supports precise positioning for vessel navigation, offshore exploration, and even underwater mapping (maritime robots, mini-submarines). Emergency response, mission critical and public safety agencies could utilise the SE868K5-RTK for accurate location tracking during search and rescue operations, disaster management, and law enforcement activities. Furthermore, its compatibility with SBAS ranging systems such as WAAS, EGNOS, MSAS, and GAGAN ensures enhanced accuracy and integrity of satellite signals. The integration of RTC (Real-Time Clock) functionality enables precise timekeeping, essential for syncronisation and time-sensitive applications. A-GNSS capability, which includes self- and server-generated orbit predictions, enhances positioning accuracy and acquisition performance, especially in urban canyons and obstructed environments.

The SE868K5-RTK's compact design and high precision extend its applicability to wearable technology and telecommunications sectors, supporting network infrastructure optimisation and precise location services for mobile devices. Across asset tracking/fleet management, e-mobility, precision agriculture, drones, and robotic applications, the SE868K5-RTK emerges as a versatile solution, driving innovation and efficiency in various industries. With its ability to deliver centimetre-level accuracy and reliable positioning, it enhances operational performances and drives value for CODICO's customers in robotics, machines monitoring, logistics and electrical transportation.

For further questions, please contact:

A07

Rudy Alix, +33647875532
Rudy.alix@codico.com

QCC711: REDEFINING THE LIMITS OF LOW-ENERGY COMMUNICATION

Tri-core Ultra-Low Power Bluetooth® Low Energy (BLE) SoC, a unique architecture leveraging a license free, powerful, open software development environment.

QUALCOMM® QCC711 is an industry leading tri-core ultra-low power Bluetooth® Low Energy SoC, optimised for IoT applications like beacons for asset positioning and tracking, smart health/fitness devices, remote control, computer peripherals or for Bluetooth on-boarding for Wi-Fi devices in smart switches and sensors, building automation and control and much more. QCC711 is a Bluetooth 5.4 qualified device, and supports single-mode Bluetooth Low Energy.

Unlike other BLE devices on the market, QCC711 is the first publicly announced Bluetooth Low Energy device integrating three separate micro-controller-based subsystems with on-chip 128KB SRAM and 512KB RRAM (which can be extended with external flash if required).

Advanced hardware-based security subsystem

A dedicated RISC-V Root of Trust (RoT) CPU for a Trusted Execution Environment (TEE) with dedicated and lock-in SRAM and ROM as well as crypto acceleration engine stands out against competition for security-sensitive applications. Security feature support includes Secure Boot, QUALCOMM® Trusted Execution Environment (TEE), Cryptographic Accelerator and Secure debug.

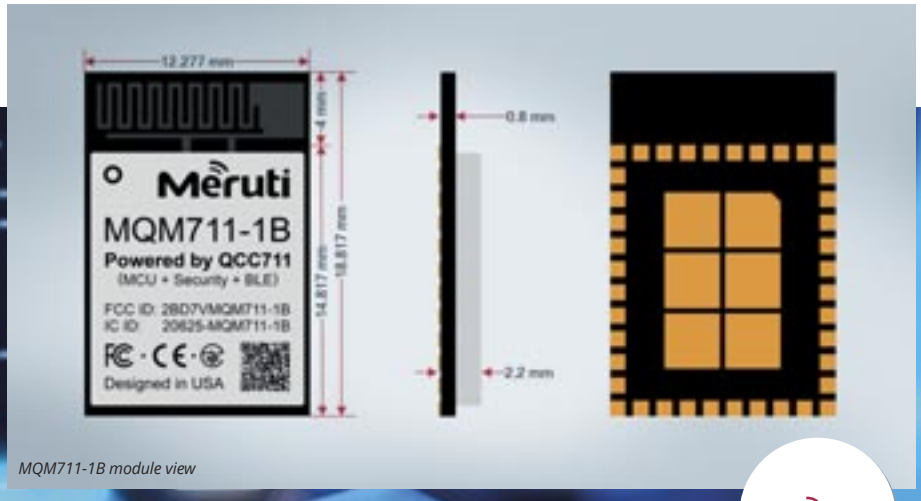
Dedicated application microcontroller

A dedicated Arm® Cortex®-M3 processor to run customer application on embedded RRAM without need of additional external NOR flash. Application can run with or without an RTOS providing product designers with product customisation flexibility.

Dedicated Bluetooth® microcontroller

A dedicated Arm® Cortex®-M0 processor to run the Bluetooth Low Energy stack in ROM, designed to support consistent execution without taking computing resource from Cortex-M3 processor. QCC711 supports Bluetooth 5.4 and single-mode Bluetooth Low Energy.

Each of the subsystems above has its own memory to ensure software integrity and logical separation. This makes the QCC-711 particularly suited for applications that require a high degree of security for example smart locks and secure access systems.



MQM711-1B module view

QCC711 development kit

Additional capabilities offered by the QCC-711 include:

Coded PHY: Coded PHY is a new physical layer modulation scheme that is introduced in Bluetooth 5.3 specification. It doubles the range of BLE devices and improves their reliability in noisy environments.

Advanced hardware-based security: The QCC-711 features a dedicated Root of Trust (RoT) CPU and associated memory for trusted execution environment (TEE). This provides a secure environment for running critical tasks, such as key provisioning and secure boot.

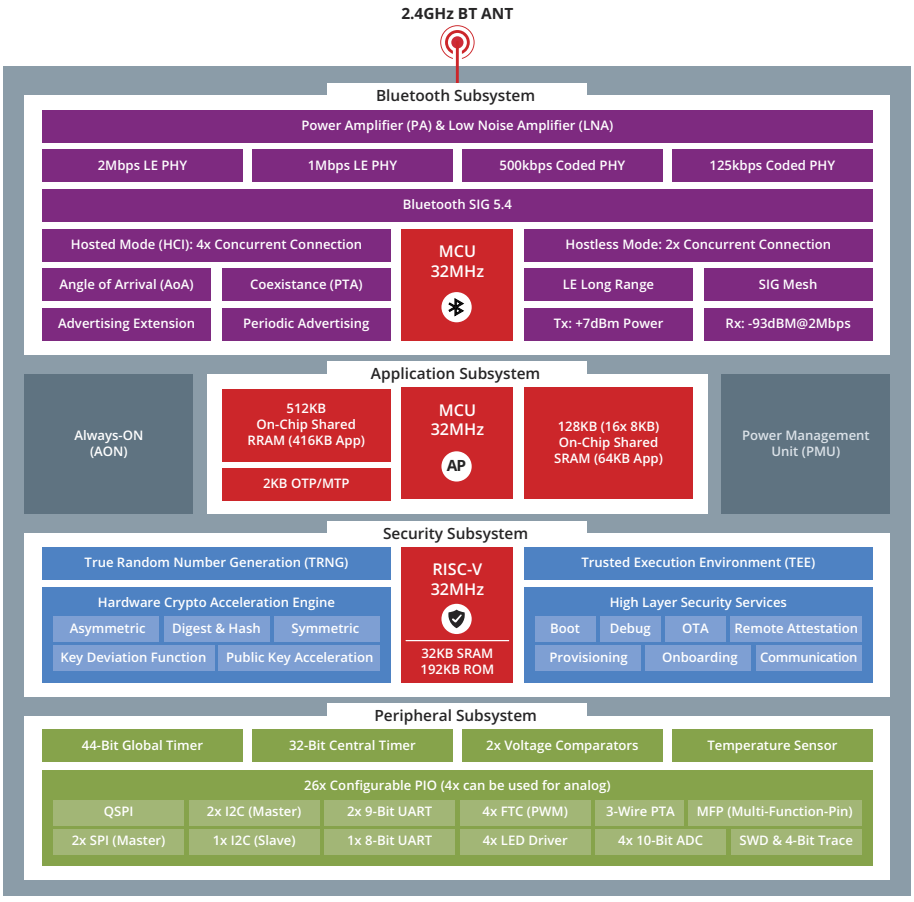
Comprehensive set of peripherals & interfaces: The QCC-711 includes a wide range of peripherals and interfaces, such as QSPI, SPI, UART, I2C, FTC (PWM), ADC, MFP, and PTA.

Dual operating modes: The QCC-711 can operate in either host-less or hosted mode.

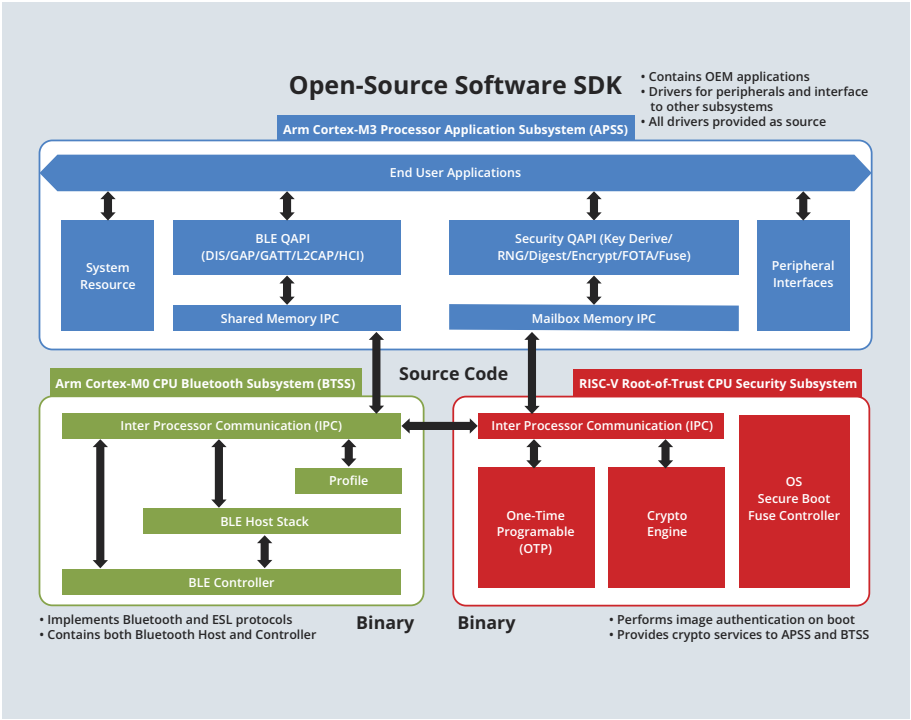
Integrated power management unit: The QCC-711 includes an integrated power management unit (PMU) with direct battery connection.

Flexible, license free and open development environment with SDK provided as source code

-40°C to 85°C operating temperature range.



QCC711 is driven by an open-source software SDK which is available on GitHub here, this SDK is currently prepared for Microsoft Visual Studio and IAR workbench IDEs. The software SDK contains the complete framework for all 3 sub-systems (Application, Bluetooth Low Energy, Root of Trust) and includes ARM Cortex standard libraries (CMSIS) as well as example applications to allow you to get started quickly. QCC711 is equipped with QUALCOMM® Connectivity Integrated Development Environment (QCCIDE) based upon Microsoft Visual Studio Code (VSCode). The QCC711 specific VScode extension plug-in is available as open-source software to allow customised VSCode specifically for QCC711. mTo access the QCC-711 technical collateral please register for an account on *QUALCOMM.com* and download the datasheet, programming guide and other technical information for the device from here.



Size and cost optimised modules and associated development kits are available from CODICO's partner MERUTI:

DEVICE	PART NUMBER	PACKAGING
QCC-711-1	QCC-711-1-MQFN48C-MT-03-1	Bulk
	QCC-711-1-MQFN48C-TR-03-1	Reel

QCC-711 based MERUTi modules and development kits deliverables:

QCC-711 Module P/N	MQM711-1B-4R
QCC-711 Module / Development Kit P/N	DVK-MQM711-1B-4R

A08

Thomas Carmody, +43 1 86305 362
thomas.carmody@codico.com

DO LC-DISPLAYS HAVE A FUTURE?

The headline of a digital signage consulting firm caused a stir: »LCD – a dying technology!« This assertion raises questions, as LC-displays continue to be produced and utilised in significant quantities. What comes instead? Here's the research.

The basis for this statement was a background discussion with the world market leader for liquid crystals, the German chemicals group Merck. According to the company, interest in new LC developments on the part of display manufacturers has waned significantly. There is simply no longer any motivation to deal with the further development of liquid crystals. The focus is now on other display technologies, such as OLED displays and micro-LED displays. But does this apply to all areas? Especially for the industry? Let's take a systematic approach and start by looking at the development of LCDs.

The history

Liquid crystal displays have been available for a relatively long time. Here is a brief look back at the development of LC-displays.

Before 1900

The Austrian botanist Friedrich Reinitzer (*25 February 1857 in Prague, † 16 February 1927 in Graz) discovered the two melting points of cholesterol and thus the liquid crystalline state in 1888 during experiments with ester derivatives of cholesterol. A third phase between the liquid and solid state, which has the ability to rotate the direction of polarised light – the birth of the liquid crystal. At that time, Otto Lehmann, a German researcher who continued Reinitzer's work, called them cholesteric liquid crystals because of the base material cholesterol.

It is remarkable that this discovery was made more than 10 years before the development of the cathode ray tube – Friedrich Braun invented the Braun tube in 1897. As is well known, the resulting picture tube was the main competitor to flat screens for several decades before the latter replaced its rival.

The 1960s

For a long time, the new material lay dormant and attracted little interest from researchers. In the 1960s, the fascinating material was rediscovered. In 1968, RCA presented the world with the first liquid crystal display. The only drawback was that a temperature of +80°C was required to operate it. Nevertheless, the idea of flat screens began to take shape. Research into nematic, i.e. rod-shaped, liquid crystals began.

The 1970s

The most important question now was: How can the operating temperature be lowered? Researchers in Germany succeeded in mixing nematic liquid crystals in such a way that they reached and retained their liquid crystalline state even at room temperature. A process that is still

used today to achieve a certain operating temperature range for a display.

The first pocket calculator with an LCD is presented at the ACHEMA (leading trade fair for the process industry) in 1970. Now it's all happening in quick succession – in 1971, an US-American and a Swiss physicist almost simultaneously develop a twisted nematic cell, in the so-called TN cell, which is still in use today. The breakthrough was achieved. Sharp uses a LCD in pocket calculators and BBC starts mass production of a wristwatch with TN-LCD in 1975.

Further materials with a stable nematic state at room temperature are developed. The optical properties are continuously improved and the switching times are reduced from several 100ms to 20ms and less.

The 1980s

Research continues to gather pace. In 1980, Merck develops a so-called VIP display (Viewing-Independent Panel), which forms the basis of all flat screens. Japanese companies in particular recognise the possibilities and drive the technology forward.

Seiko Epson presented the first LCD television to the public in 1982 and launched the first colour LCD television on the market in 1984. The first TFT LCD came from Citizen and was a small 2.7" pocket television. Sharp followed in 1988 with the first 14" full-colour TFT-LCD and Epson used the technology for projectors.

The 1990s

This decade is characterised by ever larger displays, which make flat monitors possible, but are also used in computers – notebooks and laptops are born. The first 21" LCD is introduced in 1984 and by the end of the 1990s, 40" displays are already available.

Further improvements to the technology are developed. Hitachi develops In-Plane Switching (IPS) in 1995, which enables a wide viewing angle from all directions. In 1996, Fujitsu follows with Multi-domain Vertical Alignment (MVA), a method that also increases the viewing angle and offers excellent contrast. At the same time, manufacturing costs fall, opening up further areas of application. The LCD industry expands from Japan to Taiwan and South Korea.

The 2000s

Sharp improves MVA technology in 2006 and uses Polymer-Stabilised Vertical Alignment (PS-VA) technology in its own LCDs. This increases the light transmission and thus reduces the energy consumption of the backlight. In the fourth quarter of 2007, the sales figures for LCD televisions were higher than those with cathode ray tubes for the first time and the switch to LCD is accelerating rapidly. The industry is also conquering China, which now accounts for the majority of LCD production.

The 2010s

The LCD has won, the last production facilities for cathode ray tubes were closed in 2011/12. Due to the increasing importance of mobile communication, more and more displays are required for end devices. This encourages further improvement of the technology. The aim is always to improve the display and reduce power consumption. In 2014, Ultra-Bright Fringe-Field Setting (UB-FFS) technology was developed, which enables brighter displays with less energy. Self-Aligned Vertical Alignment (SA-VA) technology followed in 2017, enabling simplified production processes and thus saving costs.

All in all, a long and very successful path. So why should liquid crystal displays die out?

LCD market

An important factor in assessing the overall situation is, of course, the market for displays. What does it currently look like and how will it develop?

Analysts largely agree on the market volume. It will be between US$ 150 and 160 billion in 2023. There is no longer as much consensus on the annual growth rate (CAGR). The forecast figures vary between 3.5% and 6.8%, with the majority expecting around 6%. However, even with this fluctuation range, the trend is clearly recognisable: the market is growing. In ten years, in 2032, a market volume of between US$ 214 billion and US$ 262 billion is expected. That is an increase of 50% to 70%, which is quite remarkable.

If you extract the liquid crystal displays from these figures, you realise that their share is growing in line with the market. Although the market share of competing OLED displays is steadily increasing – currently at around 30% – LCDs are holding their own and are still the largest group. Other technologies do not currently play a major role. An even clearer picture emerges when looking at the applications.

Traditionally, the drivers of the market are consumer applications, primarily dominated by te-

©AdobeStock/Supalim

levisions and smartphones. If you look at the ratio of LCD to OLED in these two areas, you realise that LCD and OLED are currently on a par, but OLED has higher growth rates. Looking at the industrial market gives a completely opposite impression. LCDs are far ahead here. They are well established; their possibilities are well known and they are cost-effective. OLED displays are only slightly represented in this market.

Finally, let's take a look at investments in production equipment. As with semiconductors, this is a good indicator for reading future trends. It is noticeable that manufacturers are investing around twice as much in the production of OLED displays than in that of LC-displays. At first glance, this looks as if production capacity is increasing massively and the number of units is skyrocketing. One could therefore assume that this is at the expense of market share for liquid crystal displays. But things are not quite as they seem.

Firstly, production facilities for OLED displays are much more expensive than for LCDs due to their complexity. More money has to be spent, but this does not necessarily result in greater output.

Secondly, in contrast to LCD factories, there are far fewer production facilities for OLED displays. Increasing demand therefore also requires more facilities. Thirdly, there is plenty of capacity for the production of LCDs, so it is not absolutely necessary to invest in new facilities in order to increase the number of LCD units.

From this point of view, too, there is no sign of LC technology disappearing.

The future of LCDs

As we saw at the beginning of this article, attempts are still being made to improve and further develop liquid crystal technology. The two main objectives are to improve the display and to reduce energy consumption. Increasingly efficient LEDs, which are used in backlights, increase the brightness and reduce the power consumption of the panels. Advances in technology also allow ever higher resolutions. The simultaneously improved response times, which minimise motion blur, contribute significantly to higher picture quality. A wide colour gamut and further improvements in contrast (deeper blacks, brighter whites) also help to display colours as faithfully as possible. These ongoing improvements are a continuous process.

But are there also really big technological steps independent of this? Yes, of course – let's pick out the two most important ones:

Quantum Dot

This buzzword is on everyone's lips – quantum dots. In 2023, the Nobel Prize in Chemistry was awarded for it, so it really is something groundbreaking. Abbreviated to QD, the technology is the magic word for televisions with a brilliant picture. It is used in both OLED displays and LC-displays. This is not the only area where it actually improves the picture and is now also beginning to gain a foothold in industrial applications.

Tiny nanocrystals that emit light in specific wavelengths significantly improve the image. Displays equipped with QD have a deep black background, the contrast is high and the displayed image has great colour accuracy. The manufacturing costs are lower than for comparable OLED displays, but higher than for pure LCDs. The main applications are definitely in the medical and professional video sectors, where true-to-life colour reproduction and a wide colour gamut are important.

MiniLED

MiniLEDs, i.e. very small light-emitting diodes, are an improvement on the backlight for LCDs. The common practice for backlighting LCDs is edge backlighting. LEDs are positioned on one side of the display and their light is distributed homogeneously across the entire display surface by a light guide. This requires expertise in the design of the light guide, but also offers advantages such as the simple integration of the LEDs.

The miniaturisation of LEDs opens up new possibilities. Thanks to their reduced size, the diodes can now be mounted directly behind the display. This method is also known as direct backlighting and is currently finding its way from large TV monitors into smaller displays for industrial environments. The advantage is obvious – if the LEDs are arranged in a matrix, sub-areas can be controlled individually. Ideally, this is done depending on the image content. This means that this field is dimmed or even switched off in dark image areas. The result is improved contrast, high peak brightness, a richer black and therefore a more appealing display overall. The areas of application for this are also the medical equipment market, the professional video sector, but also devices where excellent picture quality is important.

And what about the statement that LC-displays are dying? We at CODICO look forward to your new projects involving LCDs.

A09

Christian Forthuber, +43 1 86305 158
christian.forthuber@codico.com

©AdobeStock/Tatiana

CONCLUSION

LC-displays still have the largest market share. The flat-panel display market is still growing and the technology will be with us for a long time to come. It is undisputed that the share of other display technologies is increasing and that they are gradually gaining market share. This is particularly true of OLED displays, which are mainly found in the television, smartphone and digital signage markets. LCDs dominate in industrial applications and are still popular and almost exclusively used.

COMPACT DESIGNS

Comparing Discrete and Integrated GaN Solutions

Innoscience

The power electronics world has woken up to the benefits of gallium nitride (GaN), big time. Activity in the relevant press, at tradeshows and conferences has been dominated by discussions concerning the increases in efficiency and power that can be achieved by moving from silicon MOSFETs to GaN solutions.

Analysts vary in their growth expectations but nearly all expect at least a 24% CAGR from now until 2027, with some estimates much higher, especially in certain key market segments as diverse as industrial, consumer, telecom and automotive. This much we know. However, today, in addition to the widespread availability of discrete GaN HEMT devices, we are seeing the emergence of integrated GaN solutions from leading GaN manufacturers that build on the intrinsic benefits of GaN, and have the potential to deliver even better performance.

First, it is worth saying that the integrated solution is not a universal panacea. Depending on how the circuit design is partitioned, it may be preferrable to use a discrete high-efficiency GaN switch. This is especially the case if a specific driver is required, or if the driver is already included within the controller, or for higher power levels above, say 1kW, as some integrated solutions cannot yet be paralleled. For such applications and others that require the maximum design flexibility, manufacturers such as INNOSCIENCE offer a wide range of discrete parts ranging from 30V and up to 700V with various on-resistances.

But in many other cases, an integrated solution (e.g. driver & GaN HEMTs or Half-bridge & driver) can shrink design volume, offer increased power levels and reduce component count (smaller BOM). Let us take as an example, the ISG3201 is a 100V product in INNOSCIENCE's SolidGaN family that combines two 100V 2.3mΩ enhancement mode GaN devices with a 100V half-bridge gate driver. Presented in a 30-pin LGA package measuring just 5×6.5×1.12mm, the device targets high-frequency Buck converters, half bridge or full bridge converters, Class D audio amplifiers, LLC converters and power modules in applications including motor drivers, AI, servers, telecoms and super computers. Figure 1 shows a simplified schematic of the device.

A comparison of the half bridge circuit implemented using high-spec silicon MOSFETs, discrete GaN devices and the integrated ISG3201 shows that the discrete GaN solution is 66% smaller in area – as we might expect – but that the integra-

Innoscience SolidGaN™ (ISG3201), Half-bridge (3.2mΩ+3.2mΩ) & Driver

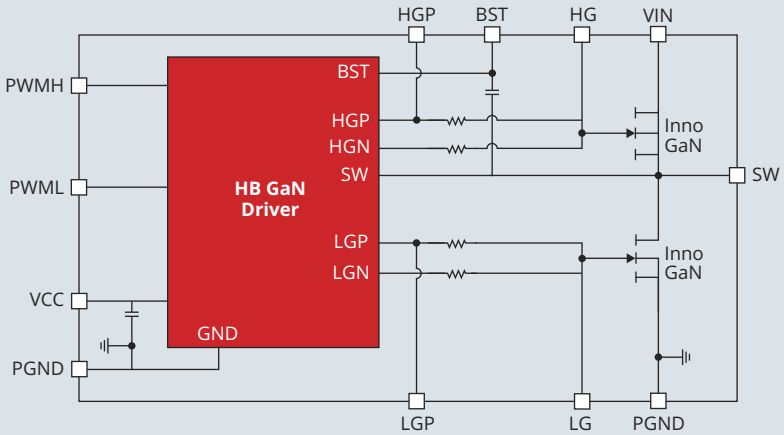


Figure 1

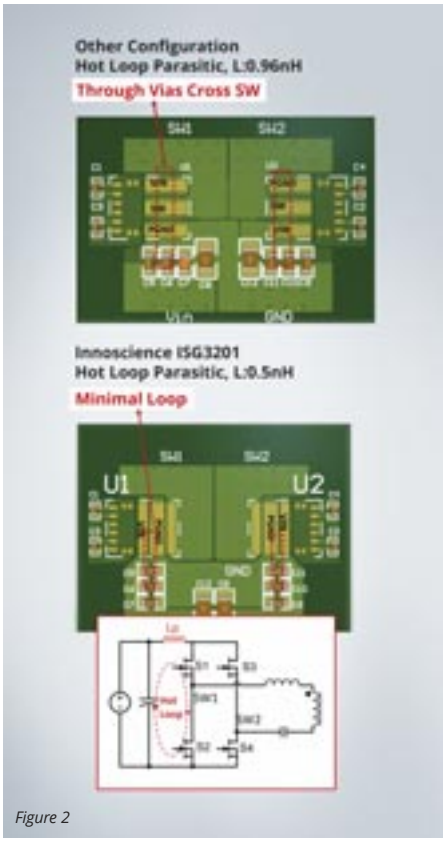


Figure 2

ted SolidGaN part is a further 19% smaller again, or 73% smaller than the silicon circuit. Figure 1 also explains how the ISG3201 also minimises the need for external components. The driving resistor, the Bootstrap and the VCC capacitor are all also included in the package, eliminating seven components (four resistors and three capacitors). A further benefit is that because all these functions are integrated, the gate loop inductance is reduced, as is the power loop inductance – typically by 40%. The reduction in parasitic leads to less ringing, for example, and reduced overshoot. This not only increases efficiency and simplifies design, but also improves reliability, since overshoot is minimised to 4V, 80% less than some competitors. Also, fewer clamping components are required.

The design also simplifies power stage layout. In some configurations the switch node is between Vin and PGND which simplifies device construction but requires extra external components. The INNOSCIENCE design in Figure 2 shows that the switch node is at the edge, so only a simple decupling capacitor is required between V_{IN} and P_{GND}, and the switch node connects to the external circuit. Depending on the power stage topology chosen this can save many components.

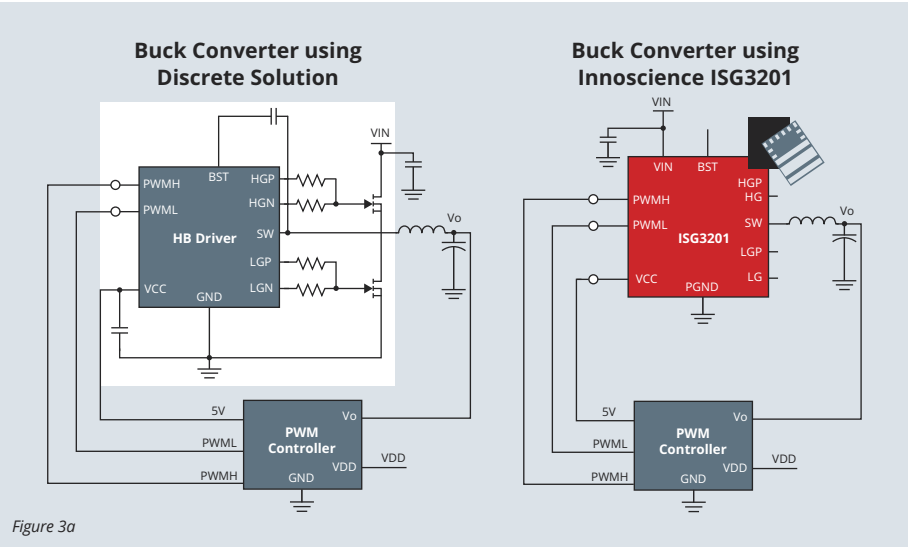


Figure 3a

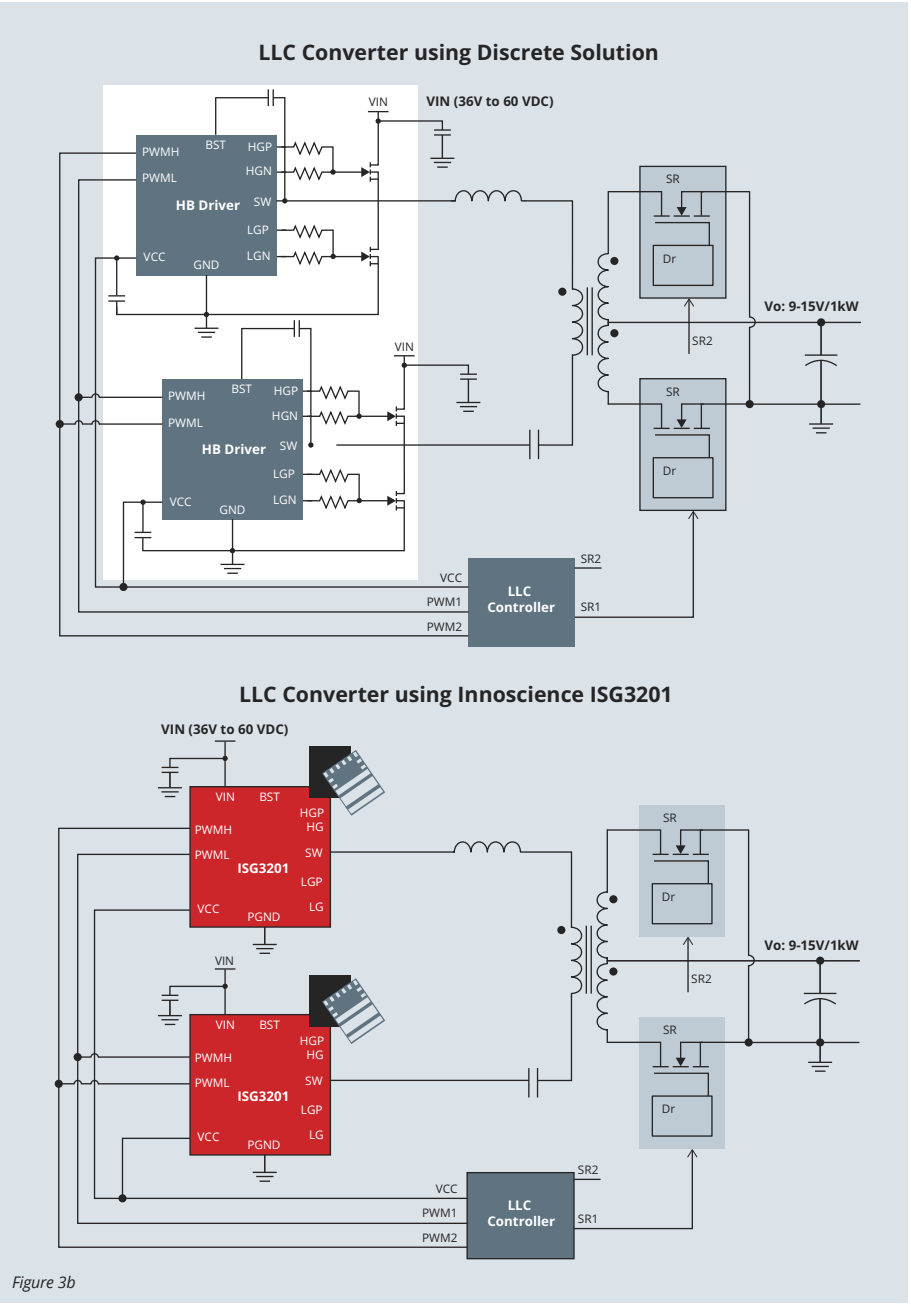


Figure 3b

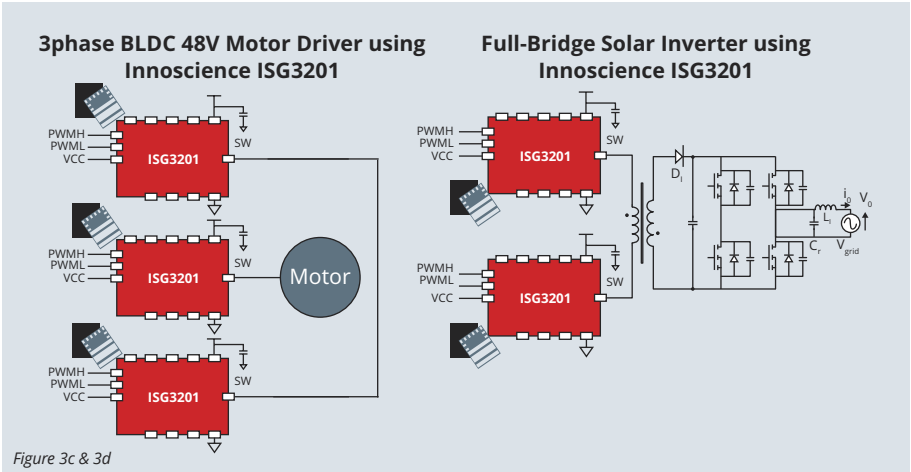


Figure 3c & 3d

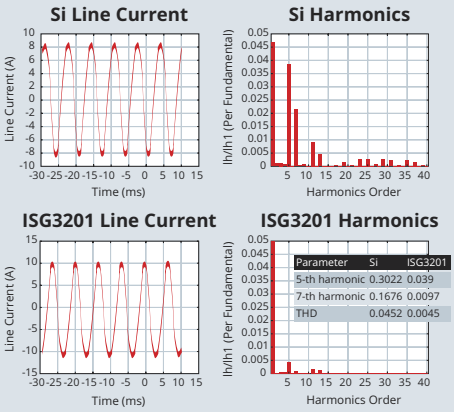


Figure 6

Figure 3 shows the simplicity of the circuits required for a Buck (Figure 3a), LLC (Figure 3b), 3-phase BLDC (Figure 3c) and full-bridge solar inverter (Figure 3d). Using a discrete approach would require more components as shown in Figure 3a (Buck) and Figure 3b (LLC).

The integrated design has manufacturing benefits too. Mounting discretes that come in a fine-pitch Wafer Level Chip Scale Package (WLCSP) is both difficult to control, and also limits the amount of copper that can be used on the PCB.

Although GaN typically runs cooler than silicon because it is more efficient, at high power levels, more copper to improve thermal performance is desirable, even essential. By using integrated packages with a larger pin pitch, two-ounce copper can be used rather than one-ounce which is the practical limit for fine-pitch discretes. This reduces power loss and increases efficiency, extending the practical useful power range of GaN technology. Tests have shown that the efficiency of half bridge designs using integrated parts such as the ISG3201 is 0.3% higher than implementations using discrete GaN devices due to the increase in PCB copper.

If we consider a 48/12V DC/DC converter module running at 1MHz, we see that these efficiency improvements start to make a significant difference. Figure 4 shows an overall improvement in efficiency of 0.7%. This can be achieved by implementing the design using the example ISG3201 integrated half bridge, rather than a discrete solution. The thermal plots prove that for the same temperature rise, this increase in efficiency means that 18% more power can be achieved using the integrated approach.

Motor driver application

Figure 5 presents the example of a 500W motor driver application (1000W peak power) which might be used in an e-mobility application. In this design, three compact SolidGaN ISG3201 half-bridge ICs can replace six TO-220-packaged 90V/4mΩ silicon MOSFETs and three half bridge driver ICs, plus a handful of external components, resulting in a space saving of nearly 90%. A reference design and evaluation board are available.

The use of GaN results in lower total harmonic distortion – by at least one order of magnitude. This results in less torque ripple, less over-current and fewer winding losses. The motor runs smoother with less audible noise, which has positive implications for reliability and motor life.

Conclusion

As we can see, integrated solutions offer many benefits, including size and efficiency, yet discrete GaN solutions still provide the ultimate in design flexibility and may be the only available choice at higher powers until further paralleling of integrated devices is achieved (this is in the roadmap). But whatever your preference, GaN – in some format – is probably the answer.

A10

Thomas Berner, +49 89 130143815
thomas.berner@codico.com

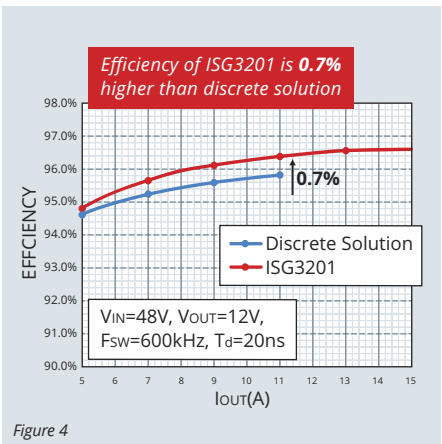


Figure 4

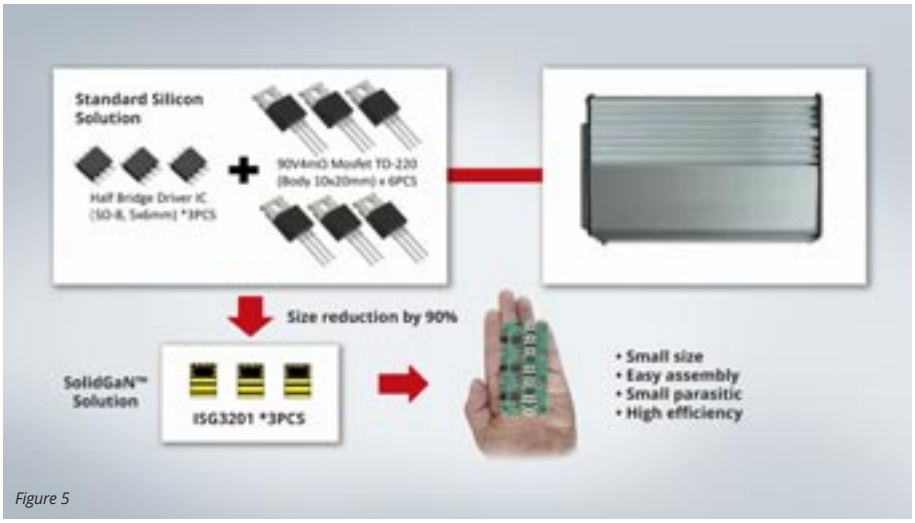


Figure 5

SAFE ON SLOPES

ISABELLENHÜTTE's »FMK« In Electric Parking Brake

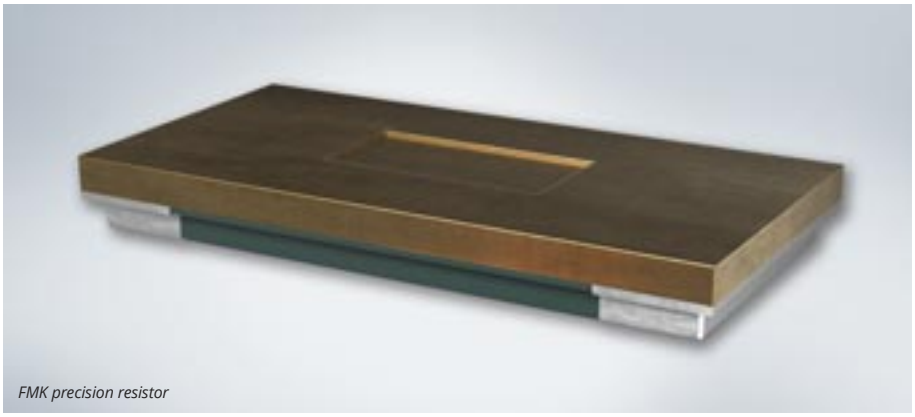
Downsizing remains the key trend in the automotive sector. Smaller and more compact components mean space savings, lower weight and ultimately a reduction in fuel consumption and CO2 emissions. However, the demands on the components remain just as high: miniaturisation with a comparably high performance is required.

Our partner ISABELLENHÜTTE, a specialist in active current measurement, introduced the FMx series of shunts a few years ago to meet this market requirement and close a gap in the portfolio for low-ohmic resistance values in smaller sizes. The FMx series covers the values from 2 to 6 mOhm in size 1206. The application possibilities offered by this shunt series can be seen in the example of the electric parking brake (EPB), which has become established in new vehicles right up to the compact class.

The conventional mechanical cable brake in the vehicle has always been susceptible to wear and failure. Cable pulls can corrode over the years due to the effects of salt and moisture and ultimately no longer function properly. This risk does not exist with the electric parking brake. In an EPB, the brake calipers are fitted with a drive unit on the side, which is located on the rear axle and consists of a DC motor and an actuator. This is activated via the switch in the interior and extends a mechanical spindle which presses the brake pads against the brake discs on both rear tires, thereby applying the brakes. If the on-board power supply fails (e.g. in winter due to low temperatures), the vehicle is still safely stationary as the EPB is locked thanks to the mechanical spindle.

Monitoring the current profile via shunt

The electric parking brake is therefore a safety-relevant system that must function absolutely reliably. The user needs to be able to rely on the bra-



FMK precision resistor

king system to stop the vehicle on slopes. To ensure reliable operation in the long term, the current profile must be monitored when the brake is applied. This is where the shunt comes in. It must monitor the current consumption of the actuator very precisely when the brake is applied and released, i.e. the voltage signals dropping across the resistor must be signaled back to the control unit. A fixed current profile for the contact pressure of the brake is stored in the control unit, which the motor must always achieve within certain limits. The shunt provides the corresponding feedback as to whether the limits are being adhered to. For example, if the engine were to lock for any reason, the control unit would assume that the brakes had been applied without any specific feedback. In reality, however, only the motor would have locked and the brake pads would not be on the brake discs. Precise feedback on the motor current is therefore required over the entire service life of the vehicle.

Low total deviation over temperature and life cycle

The main requirement for the current sensor is the lowest possible total deviation over its life cycle, i.e. it must always deliver the same signal over its entire operating life with identical current profiles. This is made more difficult by the operating temperatures, which are very high in the application described. Temperatures up to 135°C can occur at the contact point of the component. This is due to two factors: firstly, the self-heating of the component when the brake is actively applied and, secondly, passive heating caused by the braking process itself, as the entire unit is located directly on the brake caliper. The high temperatures can lead to stress on the materials used in the shunt and thus to a deviation in the electrical values. This behaviour is only very slight with the FMKx series – the shunt exhibits low drift and therefore high long-term stability.

High pulse load capacity

The second key requirement is a high pulse load capacity so that the shunt can dissipate the heat generated in the hotspot well and thus ensure only low self-heating. Activating the parking brake means high pulse currents. This happens firstly when the actuator starts up and secondly when the brake is applied. These pulses must be dissipated quickly to prevent the system from overheating.

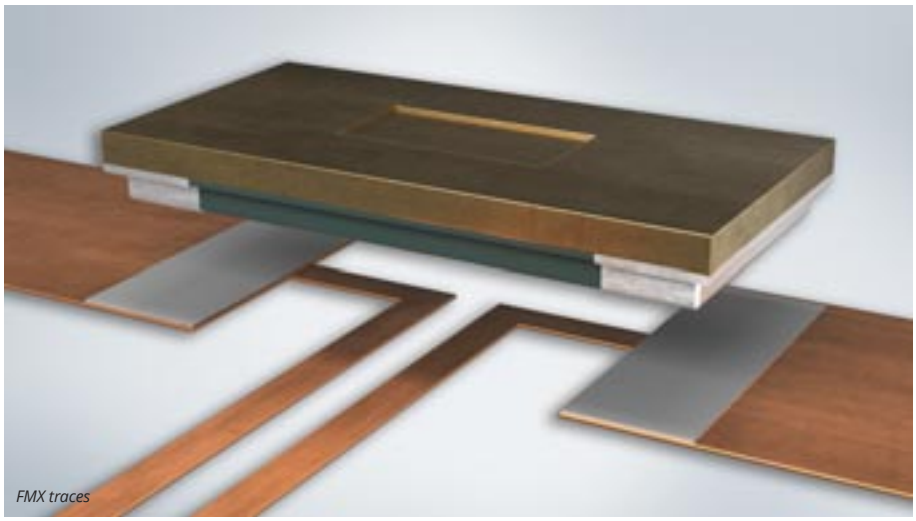
Shunts from the FMKx series consist of a full metal plate of the resistance alloy and, thanks to this solid structure, can absorb high pulse energies well and dissipate them to the outside. Thanks to the solid material plate and the low thermal resistance (Rthi), the FMK can withstand higher pulses and therefore short overloads very well. With the side connections, consisting of a layer of copper and tin as a finish, the components are soldered directly to the circuit board. This design achieves a particularly robust structure. This helps to absorb the energy during short pulses, store it temporarily in the material and then dissipate it in the form of heat via the contacts. The development of the NOVENTIN® resistance alloy, which makes it possible to achieve low resistance values in specific sizes, also represents a significant advance for FMx shunts. NOVENTIN® itself has particularly good temperature properties. It is extremely thermally stable and has a low temperature coefficient. Thanks to NOVENTIN®, the component has a long-term stability of only 0.3 per cent deviation at a maximum temperature of 135°C at the contact point.

Qualified according to AEC-Q200

For the qualification according to the automotive standard AEC-Q200, the long-term stability was tested at a temperature of 140°C at the contact point for a duration of over 2,000 hours, which corresponds approximately to the component life cycle. The drift here was less than ±0.5%. According to this qualification, current sensors from the FMx series are suitable for numerous other automotive applications such as lighting applications, DC/DC converters or assistance systems in addition the electric parking brake due to their high precision over the entire life cycle. The low-resistance shunts can also be used in industrial applications with BLDC motors in power tools or in the consumer sector for white goods and offer significant space savings compared to previous solutions.

P01

Selma Jakupovic, +43 1 86305 127
selma.jakupovic@codico.com



FMX traces

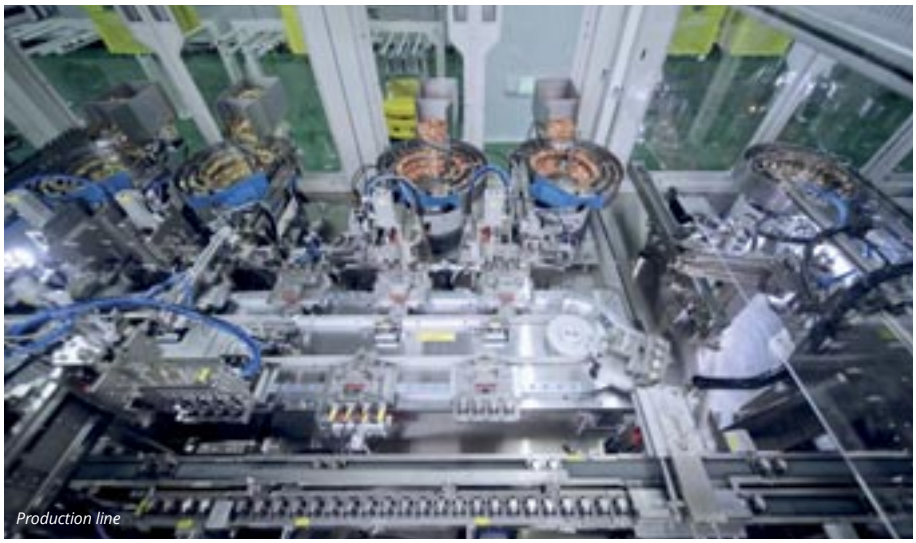
SMART FACTORY

Technology Revolution for PCB Relays

In the heart of China, SANYOU is entering a ground-breaking new era in relay manufacturing. The newly established Smart Factory by SANYOU in Ningbo aims to meet the demand for high-end printed circuit board (PCB) relays. It impressively demonstrates the company's commitment to full automation in accordance with the principles of Industry 4.0. The Smart Factory leverages state-of-the-art technologies, setting new standards for precision manufacturing and global connectivity.

In the era of globalization, SANYOU has set up a new Smart Factory in Ningbo, China. This initiative showcases the determination and future-oriented focus of the manufacturer. It harnesses the opportunities of Industry 4.0 to set new benchmarks in the production of modern relays. SANYOU has established its own engineering team exclusively dedicated to the planning, design, and construction of such facilities. The entire expertise, from relay development to the associated manufacturing facilities, is thus bundled. Intelligent operating systems such as warehousing, logistics and MES systems have been realised through SANYOU's investment in the »smart factory«. The Ningbo plant has introduced fully automated production lines, an intelligent warehouse system, 5G+ industrial internet platforms and a real-time digital tracking system to create an automated and digital »smart factory«. All of this ensures high precision, efficiency, productivity, and an entirely new level of quality. The

Robotically controlled


Production line

finished relays leave the production hall fully automated on narrow rails and are automatically packaged and then transported by robot to the dispatch area. The entire picking process takes place without any human intervention.

SANYOU's commitment to excellence is reflected in this new factory:

- All relay expertise in-house
- Complete expertise in high-end manufacturing technology, both hardware and software, in its own engineering team
- State-of-the-art production technology
- State-of-the-art quality level

SANYOU's Smartfab focuses on real-time traceablility, aiming for a quality level of Zero Defects. Currently achieving 1.5ppm, the next milestone is 1ppm through standardized improvement processes.

The 29,000m² operating area is a statement to the company's commitment to shaping the future of electromechanical solutions with 26 fully automated production lines. The current output of this factory is more than 600 million relays. Since its inception, the following four main series SRB, SRD, SJ, and SL(A) have been manufactured, covering a spectrum from 1 ampere to 40 amperes for power printed relays. SANYOU's CEO is confident that this range can cover 80% of applications in white goods, building management, heating industry, smart home, and green energy applications. Such a focus provides a outstanding price and quality level for the strategic buyer, following the motto »best value for your money.«

For technical inquiries or additional information, we are at your disposal. Our expert team at CODICO is ready to assist you in selecting the appropriate design-in solutions that meet your requirements.

Highlights of the four main series at a glance:

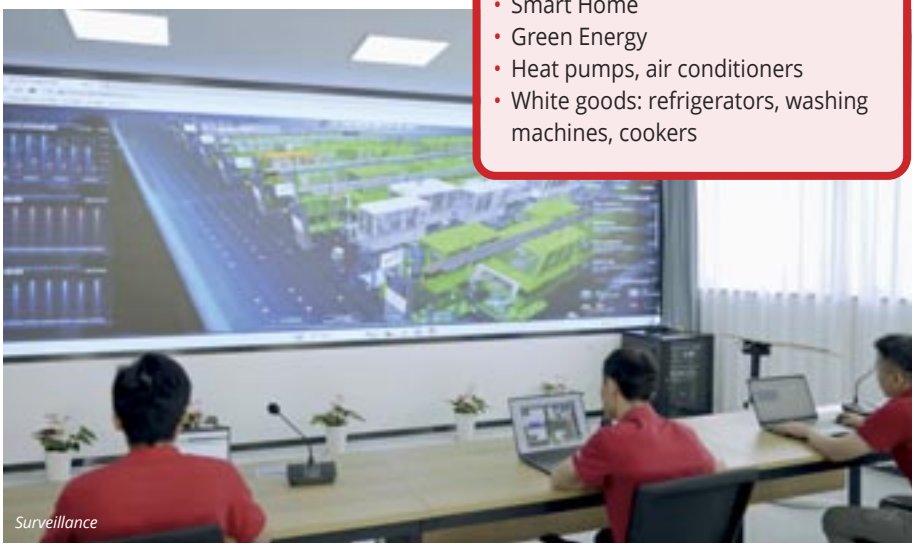
- 105°C ambient temperature solutions
- Meeting IEC 60335-1
- EX-Proof types for heat pumps and refrigerators

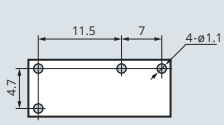
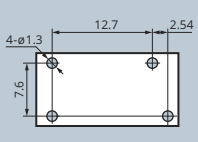
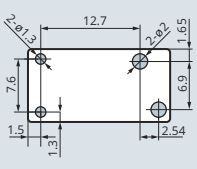
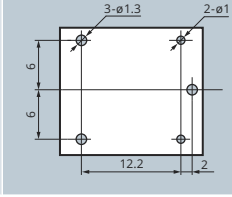
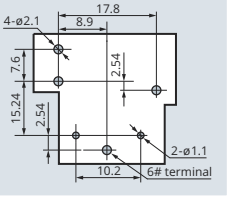
P02

Michael Blaha, +43 1 86305 105
michael.blaha@codico.com

APPLICATIONS

- Smart Home
- Green Energy
- Heat pumps, air conditioners
- White goods: refrigerators, washing machines, cookers


Surveillance

SERIES	SRB	SJ	SJ 16A	SRD/SRDI/SRD(I)-L	SLA/SLA-G
Amp.	5A	5A/10A	16A	10A/12A	30A/40A
Contact	NO	NO	NO	NO/CO	NO/CO
Temperature	105°C	85°C/105°C	85°C	up to 105°C	up to 105°C
Elec. Life	up to 100k	up to 100k	up to 50k	up to 100k	up to 100k
Ex-proof	Yes	Yes	Yes	Yes	Yes
Pinning					

LET'S START

No Standstill in the Development of Hybrid Capacitors

Panasonic INDUSTRY

The development of polymer hybrid aluminum electrolytic capacitors is moving forward rapidly. A technology, that is not only interesting for automotive applications, but also for several industrial applications with high ripple current requirements and possibly space constraints in addition. Brushless DC-motors are only one example. With hybrid capacitors you can realise a fully SMD equipped and miniaturized solution. No need for bigger THT e-caps.

The advantage of this technology is not only the low ESR and high ripple current capability in compact dimensions, combined with long life time, in comparison with conventional e-caps. A guaranteed open failure mode, compared to pure polymer capacitors, brings safety to your application and a higher CV ratio is reached as well.

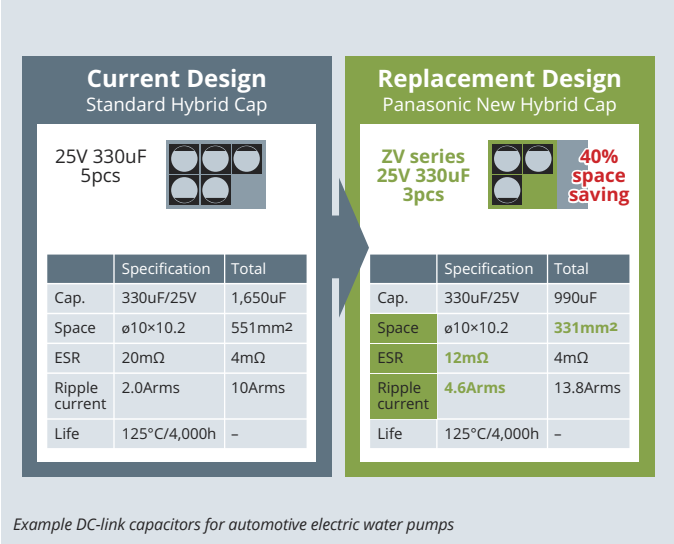
The latest series »ZUU« and »ZV«, that PANASONIC Industry recently added to their portfolio of conductive polymer hybrid aluminum electrolytic capacitors, are two of the best series in the marked, that set new standards in terms of ripple current capability and ESR per case size. They benefit from some of the best technical specifications currently available on the market for this type of capacitor. Both are rated at 125/135°C with a guaranteed life time of 4,000hrs. The available voltage ranges from 25 to 63V.

ZV is the smaller size version with dimensions of 8×10.2mm and 10×10.2mm. While comparable capacitors usually come up with an ESR of around 16 to 22mΩ at 25 to 35V, the ZV series has a significantly lower ESR of 12 to 16mΩ at this voltage level – and thus enhances efficiency and reliability in electronic systems.

Along with the lower ESR the ripple current capability is significantly improved as well, that ensures superior performance in demanding applications. The rating at 125°C is from 3,300mArms to 4,600mArms and from 2,300mArms to 3,400mArms at 135°C.

ZUU, with dimensions of 10×12.5mm and 10×16.5mm, does not only combine the lowest ESR and the highest ripple current capability per voltage and case size in one component, it has also one of the highest capacitances per volume. It features the highest rated ripple current capability of 6,100mArms at 125°C and 4,300mArms at 135°C, together with the lowest ESR value of 8mΩ and a large capacitance value of 1,000µF (25V) in dimensions 10×16.5mm.

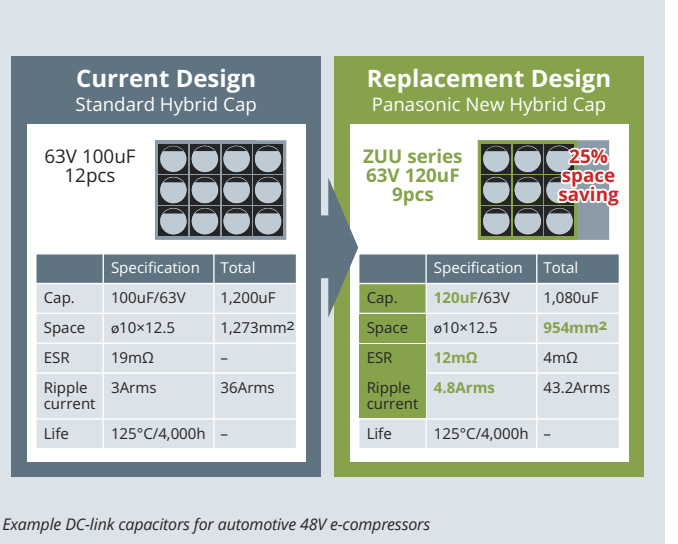
Both series are AEC-Q200 compliant, enforcing stringent quality control standards, particularly crucial for the automotive industry. Vibration-resistant versions are also available on request. Those can withstand shocks of as much as 30G, standard parts can withstand 10G maximum. All the features described in this article make those series the ideal choice in various »under the hood« applications like water and oil pumps, cooling fans, electric power steering, high current



	Specification	Total
Cap.	330uF/25V	1,650uF
Space	ø10×10.2	551mm²
ESR	20mΩ	4mΩ
Ripple current	2.0Arms	10Arms
Life	125°C/4,000h	–

	Specification	Total
Cap.	330uF/25V	990uF
Space	ø10×10.2	331mm²
ESR	12mΩ	4mΩ
Ripple current	4.6Arms	13.8Arms
Life	125°C/4,000h	–

Example DC-link capacitors for automotive electric water pumps



	Specification	Total
Cap.	100uF/63V	1,200uF
Space	ø10×12.5	1,273mm²
ESR	19mΩ	–
Ripple current	3Arms	36Arms
Life	125°C/4,000h	–

	Specification	Total
Cap.	120uF/63V	1,080uF
Space	ø10×12.5	954mm²
ESR	12mΩ	4mΩ
Ripple current	4.8Arms	43.2Arms
Life	125°C/4,000h	–

Example DC-link capacitors for automotive 48V e-compressors

DC/DC converter and ADAS. They are also suitable for use in industrial applications like inverter power supplies for robotics, cooling fans, solar power systems and more, covering the DC side of both inverter and rectifier circuits.

Briefly summarized: For various application purposes, PANASONIC's ZV and ZUU series are the ideal choice when it comes to achieving optimal performance and longevity. Specification summary per case size (reference value at 25V):

8x10.2mm: 16mΩ/3,900mArms @125°C/2,900mArms @135°C
10x10.2mm: 12mΩ/4,600mArms @125°C/3,400mArms @135°C
10x12,5mm: 10mΩ/5,300mArms @125°C/3,700mArms @135°C
10x16.5mm: 8mΩ/6,100mArms @125°C/4,300mArms @135°C

Not only in comparison with other technologies polymer hybrid aluminum electrolytic capacitors offer advantages. The latest high-performance series, with particularly low ESR and very high ripple current capability, enable a further miniaturisation by reducing the number of components required, compared to the use of conventional standard versions (see examples above).

For further information, samples or an offer, don't hesitate to contact us!

P03

Roland Trimmel, +43 1 86305 144
roland.trimmel@codico.com

ZV & ZUU series

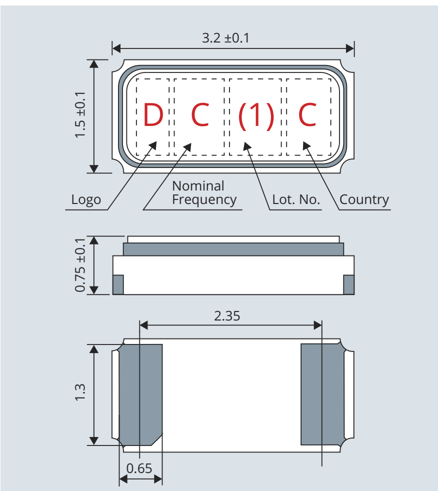
	Voltage (V)	Capacitance (µF)	ESR (mΩ)	Rated Ripple Current (mArms @125°C)	Rated Ripple Current (mArms @135°C)	Lifetime (h)	Dimensions (mm)
Specification ZV	25	220	16	3900	2900	4000	8x10.2
	25	330	12	4600	3400	4000	10x10.2
	35	150	16	3900	2900	4000	8x10.2
	35	270	12	4600	3400	4000	10x10.2
	50	68	19	3600	2500	4000	8x10.2
	50	100	14	4300	3200	4000	10x10.2
	50	120	14	4300	3200	4000	10x10.2
	63	33	22	3300	2300	4000	8x10.2
	63	47	22	3300	2300	4000	8x10.2
	63	56	16	4000	3000	4000	10x10.2
	63	68	16	4000	3000	4000	10x10.2
	63	82	16	4000	3000	4000	10x10.2
Specification ZUU	25	680	10	5300	3700	4000	10x12.5
	25	1000	8	6100	4300	4000	10x16.5
	35	470	11	5000	3500	4000	10x12.5
	35	680	9	5800	4100	4000	10x16.5
	50	180	12	4800	3400	4000	10x12.5
	50	270	10	5500	3800	4000	10x16.5
	63	120	12	4800	3400	4000	10x12.5
	63	180	10	5500	3800	4000	10x16.5

FOLLOWING THE TREND

The DST310SA

KDS announced the new DST310SA, a 3.2x1.5mm sized 32.768kHz crystal unit. This item will be one step ahead from your today's 3215size usage.

DST310SA is a new designed package 3.2×1.5mm (3215 size) of 32.8768kHz (tuning fork) crystal unit, which has the same crystal blank used inside as in DST1610A, 1.6×1.0mm (1610 size). The market share of 32.768kHz crystal in 1610 size is increasing now. More and more applications like wireless modules or smartphones are using this small size quartz product. The market share of this 1610 size will almost reach todays most commonly used 3215 size, and sooner or later will replace it. The only question is »when«. Despite the increase in the share of the 1610 size, the 3215 size is still used in many applications, especially when a smaller size is not needed.



Dimensions

The new DST310SA will be a good replacement for the existing projects that already use the 3215 size. By using 1610 size quartz blanks, the DST310SA has two advantages over the existing 3215 size products:

1. Costs

In a photolithographic process, the 32.768kHz crystal blank (called a »tuning fork« because of its shape) is cut from a quartz crystal wafer. The smaller the crystal blank, the more crystal blank chips can be produced. In fact, a 1610 chip blank today delivers around three times the performance of a 3215 chip with the same wafer size. With the next larger wafer size (4 inches), this ratio will be even 50% higher. This chip blank output quantity has a major impact on product costs.

2. Easier conversion to 1610size in the future

Although the 3215 package is large, the smaller crystal blank chip has different characteristics from the existing 3215 size products, especially the shunt capacitance (C0) and drive level (DL) values. These are related to the oscillation of DST310SA mounted on your existing circuit. Before using the DST310SA, we recommend that you perform an oscillation matching test or send your circuit board to KDS so that they can check the oscillation margin. This may seem like extra work. But once the DST310SA is tested and confirmed, it will be much easier to convert your PCB to 1610 size* in the future.

HIGHLIGHTS

- KDS offers the new DST310SA for 3.2×1.5mm for 32.768kHz requirements.
- One advantage is the price, as the DST310SA uses a smaller blank with a higher production quantity than the usual 3215 size.
- Another advantage is the easier conversion to the 1610 size in the future.
- We recommend carrying out an oscillation test on your PCB before using the DST310SA.

There are no other specification differences between DST310SA and existing 3215 size products. ESR can go down to low (max 50kΩ) and the tolerance can go tighter (±10ppm@+25°C max.). If you are still using 3215 size 32.768kHz crystal for your product, you should test the DST310SA. This will put you one step ahead of the new product trend.

In the CODICO Sample Shop, you can find patterns for testing purposes.

P04

Yasunobu Ikuno, +39 3476491038
yasunobu.ikuno@codico.com

**CODICO always recommends performing an oscillation matching test when using new products and suppliers in your applications. Even if the product specifications are the same, there are differences between products in terms of very small parasitic capacitances that can affect the oscillation of the crystal.*

LANxV

EATON Ensures Optimal Signal Integrity in High-Speed Remote Camera Monitoring

Today's remote camera monitoring systems require stable, high-speed data transmission and continuous power supply to operate optimally.

In a remote camera monitoring setup, multiple cameras are installed at various points and constantly stream video data to a central monitoring system using Ethernet cables. Power Over Ethernet (PoE) technology serves a dual purpose – allowing for the simultaneous transmission of data and DC power via a single Ethernet cable. This simplifies the installation process, reduces cost, and enhances system reliability.

10GBase-T PoE is a standard that provides 10 Gigabits per second data rates and up to 100W of power, making it an excellent choice for the latest IoT remote camera monitoring systems. With high-speed 10Gbps data rates, ensuring optimal signal integrity is crucial. Signal noise results in data loss and power noise could potentially damage the device.

LAN transformers and common mode chokes (CMC) are critical in Ethernet connectivity. The LAN transformer is used for signal decoupling and isolation in Ethernet applications and plays a crucial role in maintaining signal integrity during high-speed data transmission. With its power isolation capabilities, the PoE supply can be optimally utilised as it isolates the power delivery from data signals, preventing potential interference and improving the system's overall power efficiency. On the other hand, the CMC minimised common mode noise present in power lines and data lines, protecting the device from potential damage.

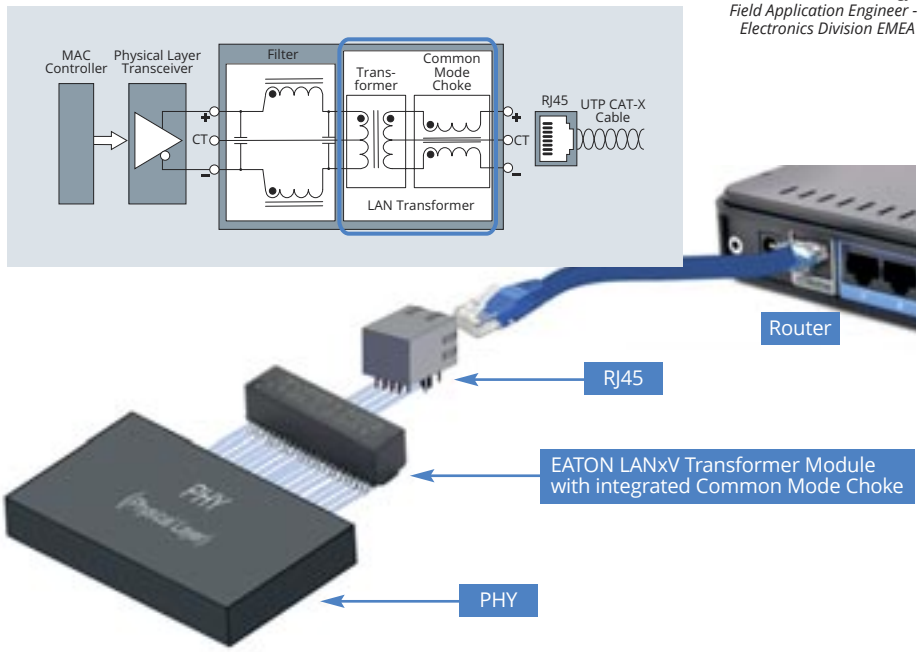
A LAN transformer and common mode choke module combines these two critical components into one package, thus simplifying the design and implementation of the Ethernet interface and reducing the PCB footprint and the overall system cost. This not only enables a more compact design for the camera itself, but also offers more room for other components or potential hardware upgrades. Fewer connections also reduce the potential points of failure and the time required for troubleshooting.

The EATON LANxV family is a comprehensive solution that combines a LAN transformer and a common mode choke into a single module. In remote camera monitoring systems, the LANxV series provides signal decupling from the power line and differential common mode filtering for unshielded transmit (Tx) and receive (Rx) lines. EATON offers a wide range of LAN transformers with IEEE802.3 compliance across protocols from 100BaseT to 10G for both non-PoE and PoE applications up to 100W. Packaged in SMT sizes from 13mm to 30mm, LANxV complies with IEEE802.3 (CSMA/CD bus), supporting 100/1000/2.5G/5G/10G BASE-T protocols. The LANxV family is rated for a wide operating temperature range from -40°C to +85°C.

P05

Sebastian Gebhart, +43 1 86305 205
sebastian.gebhart@codico.com

Author: Gabor Nagy, Field Application Engineer - Electronics Division EMEA



FACTS

Eight Arguments for High Voltage PMLCAPs

Over the last two years, CODICO has announced RUBYCON's new technology "High Voltage PMLCAP". This time we show you incredible »facts« that this high-voltage PMLCAP has advantages over film capacitors.

Today, PMLCAPs are available in MU and MS series for low-voltage applications ranging from 10V to 100V. These series enable you to reduce the size of your metalized film capacitor to just 1/10 while maintaining the same specifications. Although the size may be slightly larger compared to MLCCs, PMLCAPs do not exhibit undesirable characteristics commonly found in MLCCs (class 2), such as DC-bias or the piezoelectric effect.

Now, RUBYCON is pushing forward with the development of PMLCAPs for the high-voltage market, targeting voltages from 500V to 900V. Currently, two series are in development: the HPB series (box type, available in capacitances from 5µF to 25µF) and the HPM series (module type, customizable specifications). What sets these high-voltage PMLCAPs apart? Here's a concise summary of all facts:

Fact 1 - Smaller Size:

Miniaturisation by nearly 50% compared to other film capacitors.

In the future, high-voltage PMLCAPs could be nearly 50% smaller than today's film capacitors with equivalent specifications. This significant reduction in size is attributed to the difference in dielectric constants between film capacitors using PP (Polypropylene) with a range of 2.1-2.2K, and PMLCAPs utilising Acrylic with a higher value of 2.9K. Consequently, PMLCAPs exhibit greater capability to store electric charge compared to PP film capacitors.

With the current HPB series, RUBYCON has achieved a 30% reduction in size compared to film capacitors of equivalent specifications (see Figure 1). Moving forward, RUBYCON aims to increase the voltage gradient of PMLCAPs to 300V/µm, surpassing the current 250V/µm typical of film capacitors. Upon reaching this milestone, the size of the HPB series is projected to be nearly 50% smaller than today's film capacitors with identical specifications (see Figure 2).

Fact 2 – Downsizing:

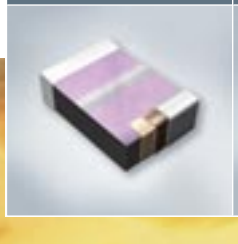
Miniaturisation by the next voltage gradient target 300V/µm.

The higher the voltage gradient is, the smaller the capacitor size will be. To increase the voltage gradient for film capacitors, the main improvement point is the fuse pattern which protects against short circuit and thermal runaway. If you can increase the fuse cell numbers in the same size of the film layer, you have stable capacitance even one fuse cell disappears. But to increase the fuse cell numbers in the same size of the layer, each fuse cell area will be smaller which makes the whole capacitance smaller. As it is already a matured technology another engineering innovation is necessary to increase the voltage gra-

BASIC INFORMATION

- PMLCAP stands for **P**olymer **M**ulti-**L**ayer **CAP**acitor
- No piezoelectric effect causing noise and sound
- No DC voltage bias characteristic
- Stable capacitance in wide temperature range
- No risk of short circuit, smoke or fire
- Today, it is mainly used in high-end audio to replace MLCC
- Already over 300million pieces were shipped in the market
- Widely used including automotive or NASA Mars lander »InSight«

FIGURE 1: PMLCAP PRODUCTS

MU Series (Low Voltage)	HPB Series (Box Type)	HPM Series (Module Type)	PP Film Cap
			

©AdobeStock/Aldas

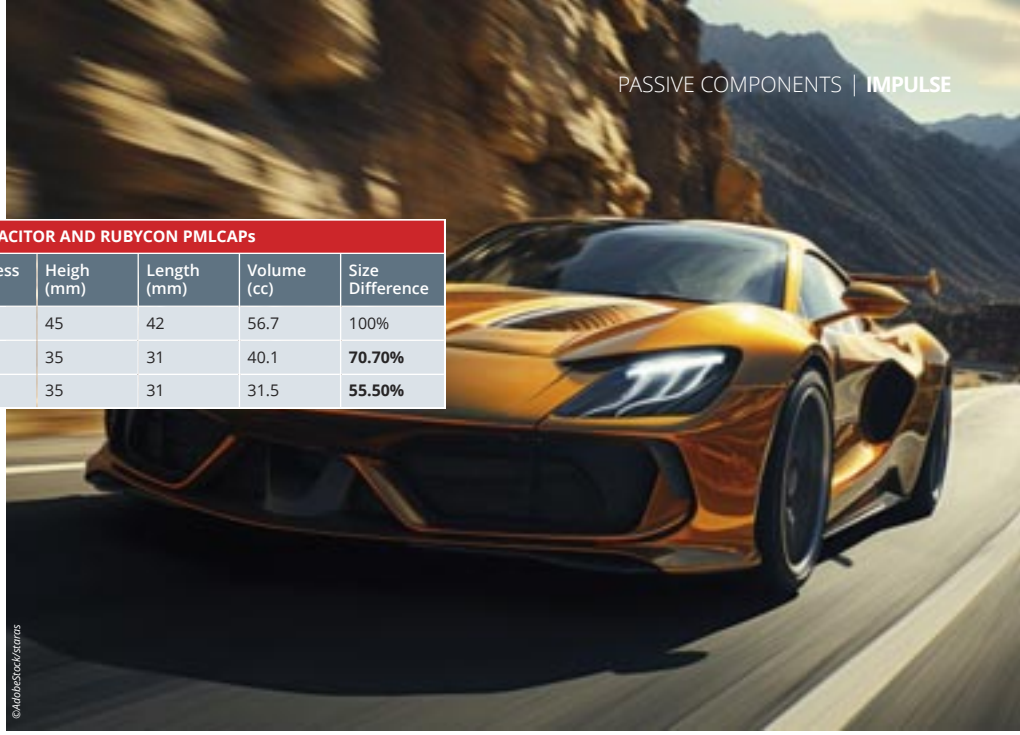


FIGURE 2: 900V 20µF IN COMPARISON BETWEEN FILM CAPACITOR AND RUBYCON PMLCAPs

	Voltage Gradient (V/µm)	Thickness (mm)	Heigh (mm)	Length (mm)	Volume (cc)	Size Difference
Competitor's Film Capacitor	250	30	45	42	56.7	100%
Rubycon PMLCAP (HPB series)	250	37	35	31	40.1	**70.70%**
Rubycon PMLCAP (HPB series)	300	29	35	31	31.5	**55.50%**

**1) The specification values are still under development*

dient of film capacitors (see Figure 3).

PMLCAP doesn't use such fuse pattern. To reach higher voltage gradient, PMLCAP still has more design flexibilities, such as material selection, structural change, etc. Indeed, RUBYCON already anticipates the possibility of reaching 300V/µm in the near future. Their current target already exceeds 300V/µm for further downsizing.

Fact 3 – Temperature Resistance:

No problem during operation at 125°C, with a future target set at 150°C.

The dielectric material of a film capacitor is typically thermoplastic, with PP film being commonly used due to its low dissipation factor (loss). However, the melting temperature of PP is only in the range of 160 to 170°C. Consequently, even when operating at 125°C, the risk of thermal runaways remains present. In contrast, the dielectric material of PMLCAP is Acrylic, which is a thermoset material. While it decomposes at 400°C, it lacks a melting temperature. Therefore, the PMLCAP element carries no risk when operating at 125°C.

Additionally, there is another advantage in terms of heat resistance. The capacitor itself can withstand higher temperature rises due to increased ripple current. Consequently, the higher the temperature and ripple current, the more advantageous PMLCAP becomes for miniaturisation.

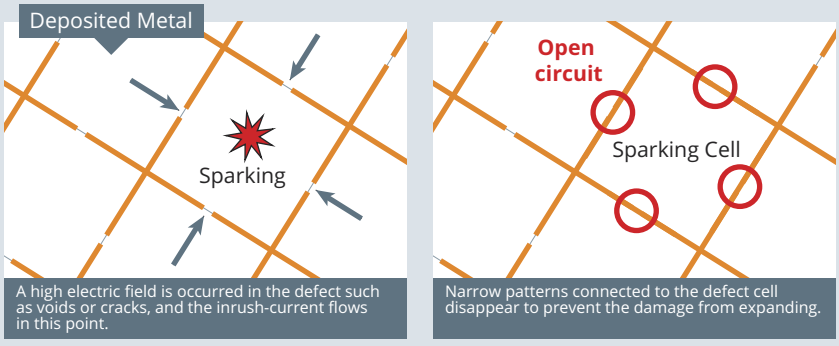


Figure 3: How film capacitor fuse pattern works

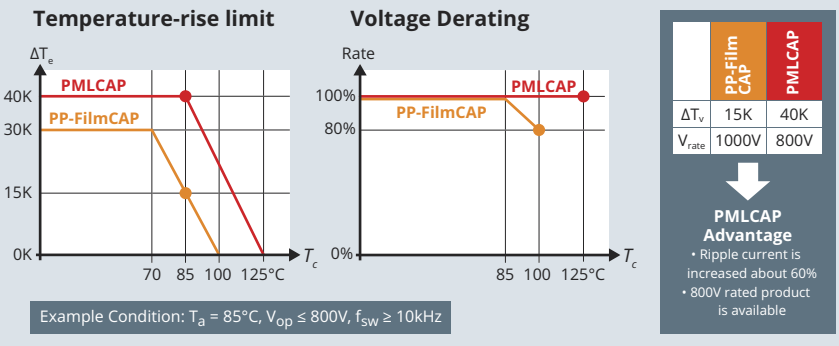


Figure 4: No voltage derating and heat resistance advantages can bring another miniaturisation

Fact 4 – SMD Possibility:

Withstand reflow soldering.

The exceptional heat resistance of PMLCAPs opens up another opportunity: the possibility of mounting them as surface-mount device (SMD) products using reflow soldering.

Already, the low-voltage series, MU and MS, are available as SMD products. The PMLCAP element can withstand standard reflow soldering processes, indicating that high-voltage PMLCAPs could also be SMD mounted and utilize reflow soldering methods in the future.

Fact 5 – Stable Voltage:

No voltage derating up to 125°C.

If you're considering using a film capacitor in conditions of both high temperature and voltage, voltage derating becomes a crucial factor to address. For instance, a film capacitor rated for 900V cannot be operated at its full 900V capacity within a high-temperature range like 125°C. Consequently, a higher-rated voltage film capacitor must be utilised in such scenarios.

One significant advantage of PMLCAP is the absence of voltage derating. The rated voltage for PMLCAP can be applied across all operating temperature ranges. Even at 125°C, both the HPB series and HPM series can operate at the same voltage as their rated voltage.

This presents another opportunity for capacitor miniaturisation. There's no necessity to use larger 1000V or higher film capacitors for a real demand of 900V. Instead, opting for smaller 900V PMLCAPs offers several advantages (refer to Figure 4).

FIGURE 5: CHARACTERISTIC COMPARISON BETWEEN PP FILM CAPACITOR AND PMLCAP		
Performance	Power Film Capacitor (PP Film)	PMLCAP
Plastic Type	Thermoplastic	Thermoset
Thin Film (µm)	currently 1.8µm min.	**less than 0.2µm**
Withstand Voltage (V/µm)	250V/µm	250V/µm
Dielectric Constant (K)	2.2K	**2.9K**
Dissipation Factor @1kHz (%)	0.02%	**0.50%**
Fuse Pattern	necessary	**unnecessary**
Melting Temperature (°C)	170°C	**none, decomposes @400°C**

Fact 6 – Ripple Current over 10kHz: Specifically for SiC and future power management technologies.

The dissipation factor of PMLCAP is 0.5% at 1kHz, which is higher than the value of PP film at 0.02%. This indicates that PMLCAP has a higher loss compared to PP film capacitors in terms of material properties (see Figure 5).

However, this drawback is only evident up to a switching frequency of 1kHz. If the switching frequency exceeds this, for example, over 10kHz, which is common in DC power supplies, PMLCAP will demonstrate an advantage in ripple current capability (see Figure 6).

The dissipation factor above 10kHz is more closely related to the capacitor's structure. To enable miniaturisation at higher voltages, the layers within the PMLCAP are connected in series, akin to capacitors in series. As depicted in Figure 7, the comparison between a film capacitor (no series) and PMLCAP (5 series) highlights the electrode resistance of PMLCAP being five times smaller, considering the difference in length. Furthermore, the series structure facilitates better heat dispersion. Thermal conductance in the length direction is approximately 2.3 times superior to that of a normal film capacitor. This construction is capable of accommodating higher ripple currents, which ultimately generate heat (refer to Figure 7).

Fact 7 – Production Reliability: RUBYCON is the only mass production leader today.

For over a decade, RUBYCON has been manufacturing and supplying PMLCAPs to the market. These capacitors are now widely utilised across various applications, ranging from consumer goods to automotive and even space exploration, such as the Mars lander »InSight«. However, it's essential to note that the PMLCAP technology was developed prior to RUBYCON's production involvement. RUBYCON was merely one of the contributors to this technology's development. Today, several other players have begun working on similar capacitors like PMLCAP.

Nevertheless, one fact remains evident: among the developers of »high voltage polymer-layered capacitors,« RUBYCON stands out as the only one with extensive production experience. This know-how accumulated over more than a decade is not easily replicated. RUBYCON's ability to maintain stable production with consistent quality levels is what sets it apart from newcomers.

Fact 8 – Application: Replacement for many other capacitors.

Due to these advantages, PMLCAPs are now being viewed as replacements for DC link film capacitors commonly employed in high-temperature applications such as automotive inverters and gearboxes. By opting for PMLCAPs, several benefits are apparent, including reduced size, decreased weight, absence of voltage derating, decreased risk in high-temperature environments, and increased availability of higher ripple currents.

If you are interested in PMLCAPs from RUBYCON, please contact:

P06

Yasunobu Ikuno, +43 1 86305 276
yasunobu.ikuno@codico.com

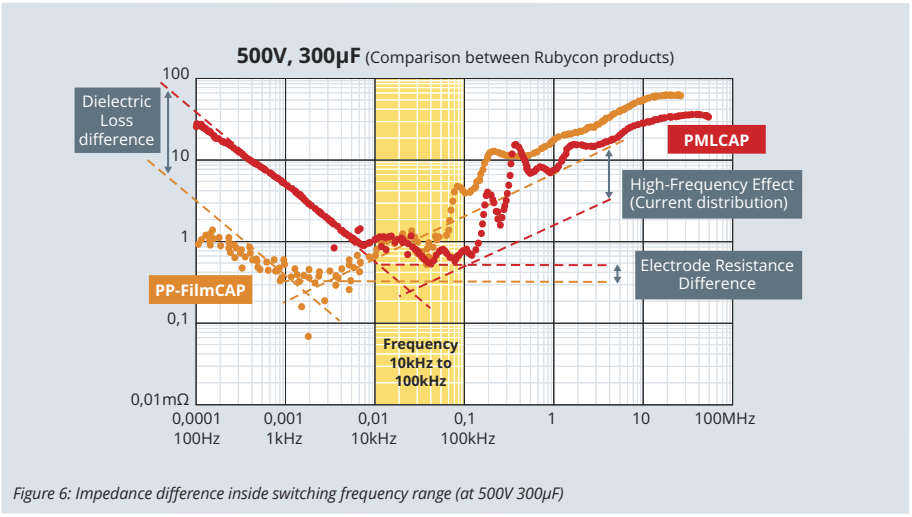


Figure 6: Impedance difference inside switching frequency range (at 500V 300µF)

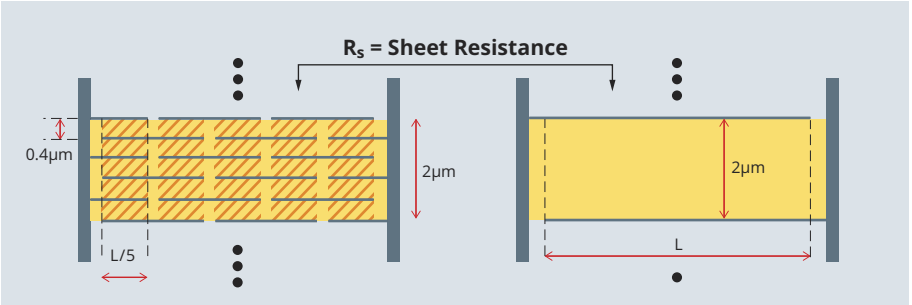


FIGURE 7: ADVANTAGE OF SERIAL CONNECTION WHICH PMLCAP USE			
Items	5 Serial	Normal	Ratio
Capacitance	Same value		1
R_{metal}: Electrode resistance	$\frac{4}{3} Rs \frac{L/5}{W}$	$\frac{4}{3} Rs \frac{L}{W}$	1/5
k_Z: Thermal conductance	0.2 (K/Wm)	0.2 (K/Wm)	1
k_L: Thermal conductance	0.683 (K/Wm)	0.297 (K/Wm)	2.316

W: Width of electrodes, R_{metal}: Electrodes electric resistance of the above aria highlighted in yellow, k_Z: Z direction (Stacking direction), k_L: length direction (Vertical for the stacking direction)

EFFICIENT

Rogowski-Coils & Current Transformers

Precise current measurement and monitoring is the basis for many electronic applications and devices. The focus is on high measurement accuracy and linearity over a wide current and temperature range.

SUMIDA has become a leader in the industry in the field of passive current measurement based on Rogowski-Coils and Current-Transformers with magnetic cores. By utilising optimised plastic core geometries and specially developed toroidal winding technology, SUMIDA can realise Rogowski-Coils with high linearity over a wide temperature range from -40°C to 180°C and optimal Rogowski-factors as well as a low external field-sensitivity. Round and oval coil geometries are available in 2cm to 35cm coil diameter.

Toroidal winding technology is an important prerequisite for cost-optimised components due to the extremely high number of turns (>10.000) and an orthocyclic winding structure. This has been continuously developed by SUMIDA in recent years so that high winding speeds and precise winding structures can be realized even in high-volume series production.

The Rogowski coil is used in various applications:

- Power electronics: Measuring currents in power converters and frequency inverters.
- Power distribution: Monitoring currents in power grids and distribution systems to ensure optimal power distribution.
- Industrial applications: Use in measurement and control technology to monitor process currents for efficient production.
- Renewable energy: Analysis and control of power flows in wind turbines and solar plants to ensure effective power generation.

For the Current-Transformers, SUMIDA uses magnetic cores made of Ferrite, Nanocrystalline, NiFe, as well as SiFe materials. In addition to the selection of the optimal core material, the winding technology also plays an important role in order to achieve high measurement accuracy and performance.

By combining Rogowski-Coils with Current-Transformers, Current-Transformer-Modules for single-phase as well as 3-phase applications (with 3 or 4 channels) can be achieved. The main applications for these modules are fuse switches (Residential-Molded-Case- & Air-Circuit-Breakers).

Based on global production network, it is possible to manufacture Rogowski-Coils and Current-Transformers (Modules) in Asia, Europe and North America in order to offer customers a high degree of flexibility and security of supply.

A »Center of Excellence« was set up at the SUMIDA location in Obernzell, Germany, for the development of customer-specific applications of these components.

Prototypes, samples and pre-series can be realised quickly to ensure optimum support for our customers and new projects.

P07

Selma Jakupovic, +43 1 86305 127
selma.jakupovic@codico.com

ROGOWSKI-COILS AND CURRENT TRANSFORMERS FROM SUMIDA

Rogowski-Coils	Current Transformers	Current Transformer Modules
		

CURRENT TRANSFORMER TYPES

Rogowski-Coil	Current Transformer	Push-trough Current Converter	Summation Current Converter
			

INSPECTION GLANCE

©AdobeStock/Oli Mein Stocker

No Reliance on Catalogues: Practical Tips From SAGAMI

Inductors are like the unsung heroes of electronics, quietly doing their job to keep everything running smoothly. But when the numbers in the catalogue don't match up with what happens in reality, it can throw a wrench in your plans. In this article, we'll explore the reasons behind these discrepancies and offer solutions to navigate them.

Specifically, we'll dissect two critical specifications – DC saturation allowable current (I_{sat}) and temperature rise allowable current (I_{rat}) – and give practical tips for dealing with the differences. The main focus this time is on the rated current (I_{rat}).

DC Saturation allowable current (I_{sat})

All suppliers specify the decline rate, and there are various options such as 10%, 20%, 30% and so on. Pay attention to the footnotes – they help to compare the specifications exactly.

Temperature rise allowable current (I_{rat})

All suppliers set the value of the I_{rat} relating to a temperature rise called ΔT (of e.g. 20, 30, or 40°C/°K), when the circuit board is supplied with current.

Additionally, the specifications can vary significantly based on the conditions in which the measurements are taken, particularly concerning the heat generated.

What We Found in Experiments

SAGAMI Elec did some tests comparing different inductor specs, and surprise, surprise—what we got didn't always match what the catalogues said. It all came down to how the tests were done and the conditions they were done in. In this example they tested their ferrite inductor CER1277C-2R2N (Figure 1) under different testing conditions, com-

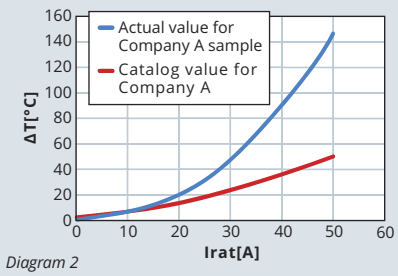


Diagram 2

FIGURE 1: TEST SAMPLE CER1277C-2R2N

Part Number	Inductance (uH)	DCR (2)±30%	DC Saturation Allowable Current (A)		Temperature Rise Allowable Current	
			Typical	Spec	Typical	Spec
CER1277C-2R2N	2,2 ±30%	0.007	17.7	11.6	9.6	6.85


Figure 2

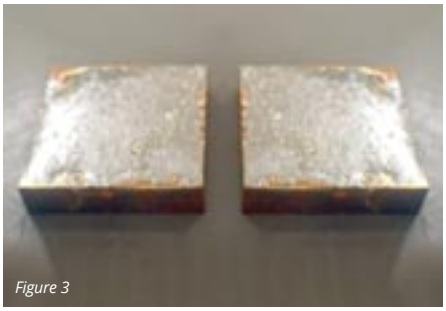


Figure 3


Figure 4

paring two setups used by other manufacturers and a customer's application.

- Setup 1: Copper foil (0.035mm) on a Copper plat (1.6mm) (see Figure 2)
- Setup 2: Copper plate (4.35mm) (see Figure 3)
- Setup 3: Customers PCB Board (unknown thickness) (see Figure 4)

There is an approx. 1.3-times difference between these 3 setups for the heating properties (see Diagram 1). SAGAMI Elec adheres to the JIS standard for testing their products. However, as users perceive catalogue information differently, each supplier establishes their preferred measurement conditions.

Even if the DC resistance values are similar, the specifications provided in the supplier catalogue may not align with the SAGAMI Elec specification. Simply testing those inductors will reveal the truth, as shown in Diagram 2. The tested sample of company A shows a deviation of 1.5 times between the measured results and their catalogue value.

Practical Tips

1. Check DCR values: Start by comparing the DC resistance – it's a good indicator of whether you're comparing apples and apples.
2. Pay attention to testing conditions: Even if the measurement conditions are not always stated, keep them in mind – it can change the values a lot.
3. Talk to the pros: When things get confusing, reach out to CODICO for advice.

When it comes to inductors, what you see in the catalogue isn't always what you get. But armed with a bit of know-how and some common sense, you can navigate the discrepancies and find the right fit for your electronics projects. Just remember, sometimes the numbers lie, so trust your instincts and double-check before you commit.

P08

Sebastian Gebhart, +43 1 86305 205
sebastian.gebhart@codico.com
Autor: SAGAMI Elec

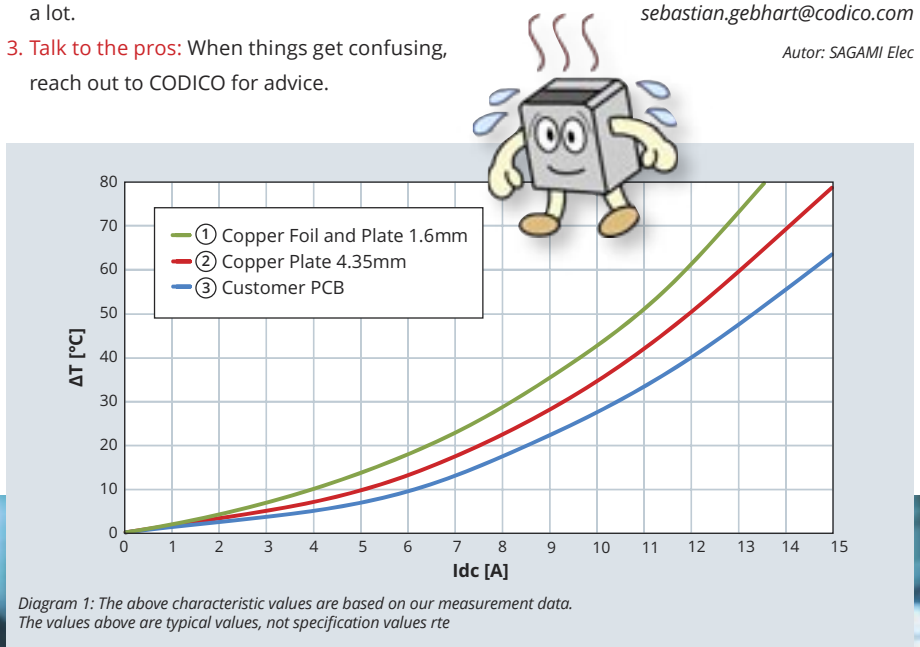


Diagram 1: The above characteristic values are based on our measurement data. The values above are typical values, not specification values rte

NEW HEROES

EMI Filtering Capacitors for Harsh Conditions

The market demand for X- and Y-capacitors with enhanced durability and THB grade is growing, particularly in challenging environments. There is also a need for capacitors offering a wider capacitance range and smaller sizes, enabling greater design adaptability across various applications.

MKP Y1 »R4Y« series

The R4Y series of KEMET is the first metallised polypropylene Y1 capacitor with the performance of THB grade IIB, max 125°C operation temperature, 100,000h lifetime at 85°C (2,000h at 125°C), that ensures R4Y working in a harsh and severe environment with a lower cost of maintenance in the whole lifetime. Capacitances of up to 33nF are offered.

R4Y is a great solution for line-to-ground common mode EMI filtering, where reinforced insulation is needed to secure a high safety level. It is rated at 500VAC (recommended DC voltage 1,500VDC) and can support up to 750VAC or 3,000VDC, which makes it a perfect fit for either AC (from grid) or DC (from HV battery) inputs. It can be widely used in automotive, EV charging stations and general industrial applications where Y1 class safety is needed in a harsh environment. Additionally, Y-capacitors are often used in AC/DC power supplies to bypass the safety isolating transformer for EMI reasons. As it is placed between secondary and primary side, which is a very critical position, high safety isolation is required. Usually, customers use 2 Y2 film capacitors in series to reach the requested dielectric strength or a ceramic Y1 (which is limited in capacitance). Metal paper Y1 capacitors are available as well, but very expensive.

The new metallised polypropylene Y1 film capacitor R4Y series provides following advantages:

- Stable capacitance compared to ceramic capacitors which have poor characteristics, especially when it is not class 1 ceramic. So, with R4Y EMI does not depend on temperature like it is the case with ceramic class 2 or 3.
- Higher capacitance values are available as well, which might be needed if we are talking about higher power applications like OBC or high-power industrial inverter. This is also another advantage compared to metal paper capacitors.
- Space and probably cost saving compared to 2 pcs. Y2 film capacitors in series.

Key Facts

- Harsh environment capability: THB IIB according to IEC 60384-14 (85°C/85% R.H., 500h at rated AC voltage)
- Long lifetime at high temperatures (85°C 100,000h/125°C 2,000h at rated VAC)
- Automotive (AEC-Q200) grade
- Miniaturised dimension and wide capacitance range (470pF to 33nF)
- Rated AC voltage: 500VAC/max. 750VAC 1,000h at 125°C
- Recommended DC voltage: 1,500VDC/max. 3,000VDC 1,000h at 85°C

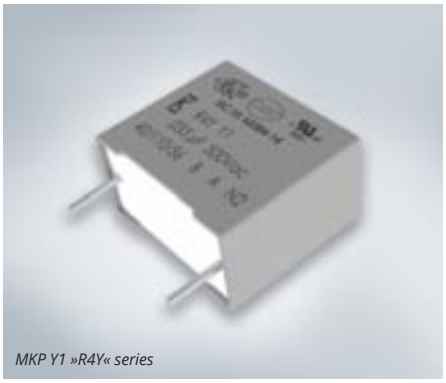
KEMET a YAGEO company

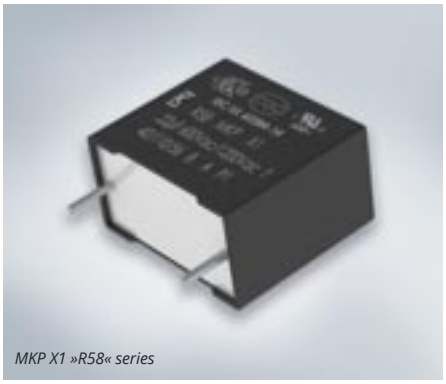
MKP X1 »R58« series

X-capacitors are widely used in all sorts of industrial equipment at the input stage for EMI filtering. For those who must work in harsh environments with high temperatures, high humidity and a high possibility of surge impulses (e.g., lightning strike, motor start/stop, switch on/off), the new R58 series from KEMET is a good choice. It provides THB grade IIIB, 110°C max. operation temperature and withstands 4kV pulses. The high reliability film technology also helps to reduce the costs of line down and maintenance.

R58 is an AEC-Q200 qualified capacitor with a rated voltage of 600VAC/1,200VDC under extremely high temperature and humidity conditions, and its hipot test qualifications are up to 3kV peak. These features perfectly fit demanding HV automotive battery systems and traction inverters for hybrid and electric vehicles.

Typical applications are the EMI filter stage (across the main) where X1 safety classification is needed. For example, energy storage systems, solar inverters, EV charging station platforms and general industrial applications where high reliability, current capability and high AC voltage are required (CANADA grid for example). R58 can also be used in automotive high voltage DC EMI filters where voltages exceed 800VDC.


MKP Y1 »R4Y« series


MKP X1 »R58« series

Key Facts

- High rated voltage 600VAC/1,200VDC
- High current (dv/dt)
- Harsh environment capability: THB IIIB according to IEC 60384-14 (85°C/85% R.H., 1,000h at both rated AC and DC voltages
- Automotive (AEC-Q200) grade
- Capacitance Range: 10nF to 8.2µF

P09

Roland Trimmel, +43 1 186305 144
roland.trimmel@codico.com

APPLICATIONS

AC and DC high voltage input/output EMI filtering in

- EV charging stations
- Solar inverter & energy storages
- OBC
- High voltage DC/DC converter
- E-compressors
- Heat pumps

NEW SSR GENERATION

Solid State Relays With Push-In Terminals, a Quick and Easy Wiring Solution

Solid State Relays with screw terminals are well known in the industry, but can be a little bit tricky in terms of tightening technique and wiring times. Using solid state relays with push-in terminals is therefore becoming more popular, as they just make everything easier.

What are push-in terminals?

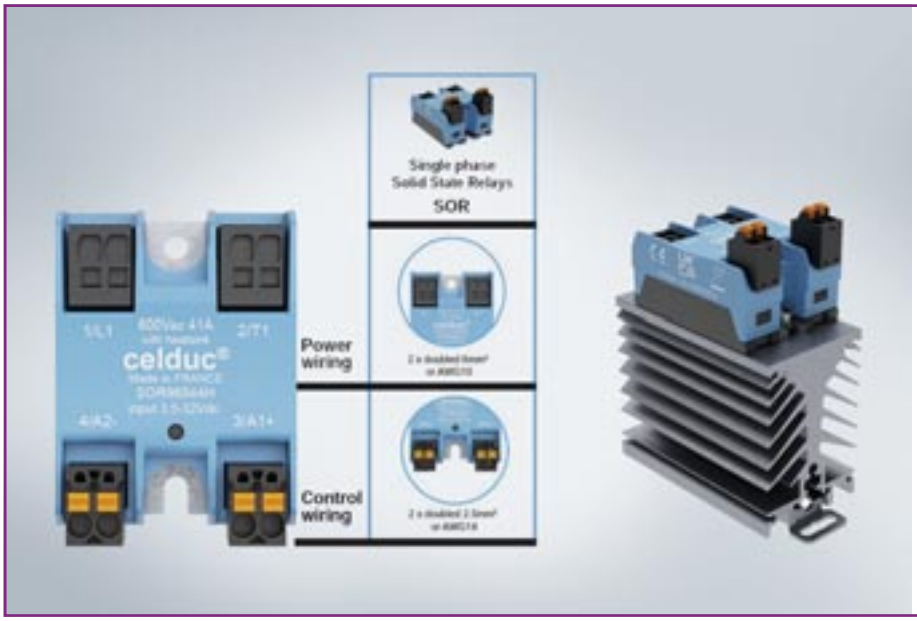
Push-in technology is based on plug-in terminals which make an electrical contact and use a spring to secure the conductor in place. The conductor itself can be rigid or have a ferrule and is pushed in to open the spring which allows, without the need of any tools, a direct and effortless connection.

CELDUC® relays' range

In order to provide the market with this fast and easy push-in technology, CELDUC® relais has launched a new range of solid-state relays with push-in terminals:

»ready to use« versions with integrated heatsink

©AdobeStock/tatgronz



1

The single-phase SOR series

The SOR Series is the single-phase Solid-State Relays with push-in terminals range in CELDUC® relais' offer, designed for resistive loads (AC-1) up to 41A at 40°C. The SOR range exists in both 12-280VAC and 24-600VAC, with a thyristor rating up to 90A-7200A²s and provides a large input range of 3-32VDC with regulated current. It is also equipped with TVS protection, a green LED input status, is compliant with CE and UKCA, and UL listed.

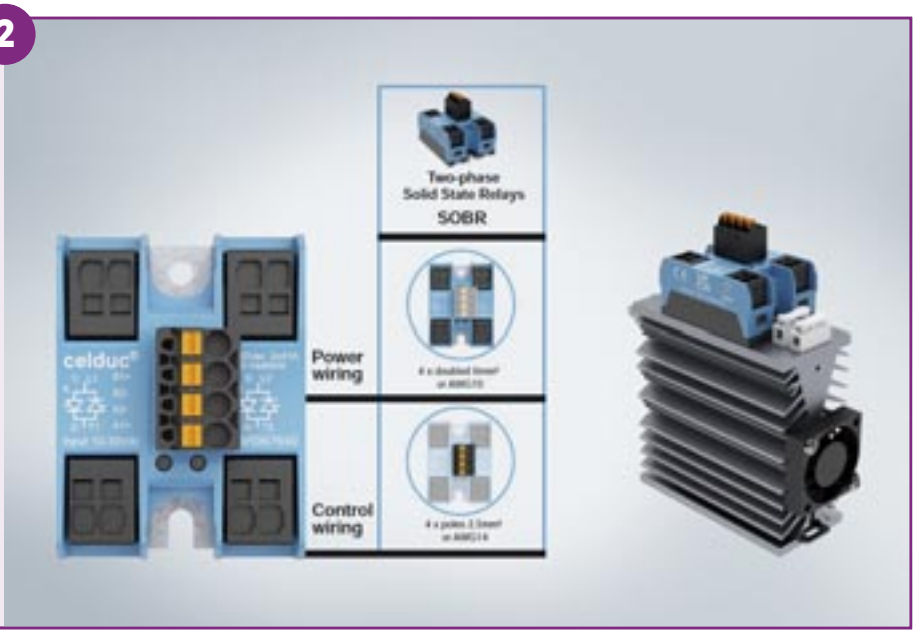
The SOR series also exists in »ready to use« versions with integrated heatsink.

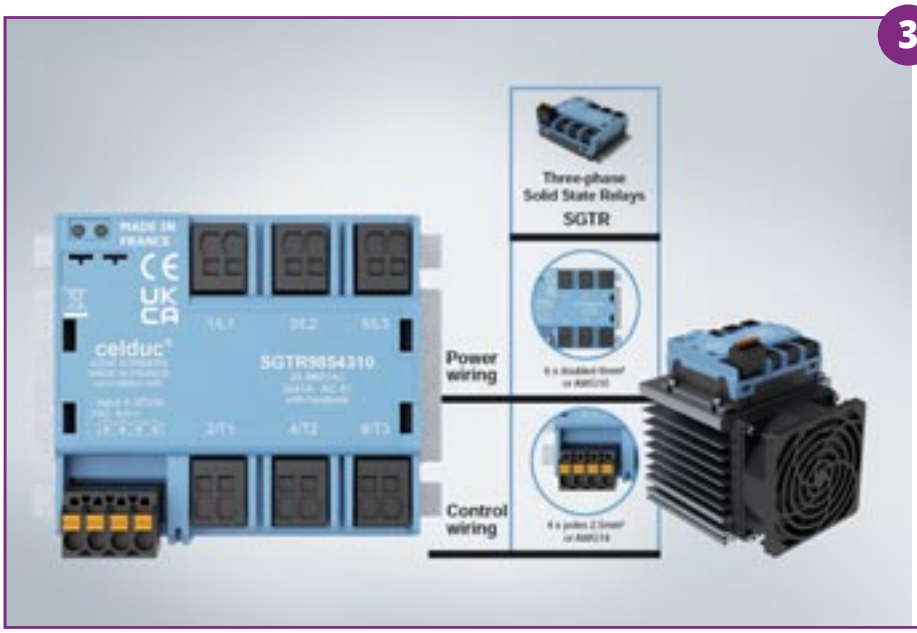
2

The two-phase SOBR series

CELDUC® relais also marketed the SOBR Series, two-phase Solid-State Relays with push-in terminals. The SOBR series is designed for resistive loads (AC-1) up to 2×41A at 40°C. It exists in both 12-280VAC and 24-600VAC, with a thyristor rating up to 75A-7200A²s and provides an input range of 10-30VDC. It is equipped with TVS protection, two green LED inputs status, is compliant with CE and UKCA, and UL listed.

The SOBR series also exists in »ready to use« versions with integrated heatsink.





3

The three-phase SGTR series

CELDUC® relais designed a three-phase SSR series with push-in terminals: the SGTR series. This series is designed to control resistive loads up to 3×41A at 40°C or 3×32A at 40°C. It is equipped with a thyristor rating up to 125A per line. Two versions have been marketed depending on your needs: The SGTR9 version for resistive loads AC-1 with TVS protection and the SGTR8 version for all types of loads with RC and VDR protection

The SGTR series also exists in »ready to use« versions with integrated heatsink.

©AdobeStock/AS Photo Family

WHAT ARE THE ADVANTAGES OF PUSH-IN TERMINALS?

STRONG Push-in connections are strong and reliable.	**FLEXIBLE** Push-in connections can be used for various conductors: solid, stranded, and fine-stranded with crimped-on ferrules conductors.	**SAFE** They allow to avoid downtime, maintenance, and they reduce costs. There is no heat risk, no breaking risk, it is no longer necessary to control and adjust the screw tightening (as there are no screws), and it is touchproof and vibration proof.	**FAST** Wiring is a lot faster (no more tools needed), even in tight spaces. SSRs with push-in terminal divides wiring time by 2.

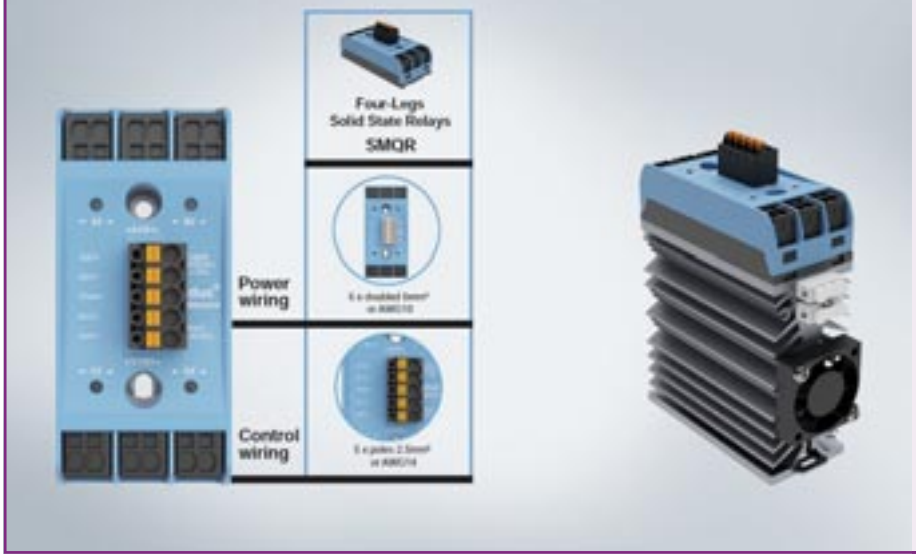
Conclusion

In comparison to screw terminals, push-in terminals are easier to handle, and offer significant time and cost advantages over the entire life cycle of a system thanks to faster commissioning and maintenance-free connections.

P10

Arnold Geitzenauer, +43 1 86 305 124
arnold.geitzenauer@codico.com

4



The four-legs SMQR

With its low profile (compact 45mm version), the SMQR series integrates four single-phase relays in one. It is the best option to reduce the size of control panels. The SMQR range is designed to control resistive loads up to 4× 41A at 40°C.

The SMQR series also exists in »ready to use« versions with integrated heatsink.

©AdobeStock/Roman

CLICK!

Coax Connector System Y-CMC for Camera Applications

Y-CMC (YAMAICHI Camera Module Connector) – a new connector series specially developed for the application of connecting cameras.

Cameras have become indispensable in today's world. In the automotive sector they are used as a reversing/rear-view mirror camera or as a front camera for traffic sign monitoring and distance control. But also in the industrial sector, cameras for monitoring and controlling productions are indispensable – to name just a few applications.

New development

The increasing data rates that have to be processed require new technologies in order to be able to transmit the data from the camera to the control systems without errors and at high speeds. YAMAICHI has developed a new connector system for this purpose, the Y-CMC series.

Miniaturised coaxial socket

The system consists of a coaxial socket that is soldered to the PCB. With a diameter of only 3.5mm and a height of 4.7mm, the socket meets the miniaturisation of camera systems.

Two cable-side solutions

For the cable side, YAMAICHI offers two possible solutions. The first solution is a connector side with a Fakra interface, i.e. the customer can contact the Y-CMC with a standard Fakra cable connector. An alternative option involves an overmolded cable side which can be paired with an additional plug in the required length or provided with free assembly on one end. The connector side is designed to allow for a screw connection to the camera housing.

Further special technical features

The design ensures, for example, a tolerance compensation of ±0.3mm in all directions. This ensures a reliable joining process even in locations with difficult access. The transmission rates are 4.3GHz and meet the requirements of modern camera systems.

Protection rating IP69K

When plugged in, the Y-CMC system is water-protected to IP69K and can therefore also be used in outdoor areas that are at risk from splashing water. A temperature range of -40°C to +105°C is covered. The system is tested and qualified for the automotive sector.

With the Y-CMC series, YAMAICHI complements its automotive and high-speed connectivity. In case customers have integrated the cable plug mating face in the housing, YAMAICHI naturally also offers Fakra standard interfaces as a coaxial socket.

S01

Christian Sichtar, +43 1 86305 134
christian.sichtar@codico.com

Y-CMC series

©AdobeStock/Valeriia

Revolutinising Smart Automation

FUSION OF ROBOTICS & CONNECTIVITY

The year 2023 saw remarkable advancements in various fields, particularly in the area of robotics. This was driven by the impetus of AI, robust software development, and transformative growth in the logistics sector. These key trends have shaped a dynamic landscape, emphasising the accelerated evolution of robots in response to the demands of an ever-changing technological era.

Advancements in software have focused on fostering streamlined collaboration and innovation. At the same time, the integration of Information Technology (IT) and Operational Technology (OT) has highlighted the critical importance of stable hardware connectivity for optimising operational efficiency. This foundational aspect of stable connectivity serves as the backbone, ensuring seamless and efficient communication within the intricate web of technological developments.

The projected Compound Annual Growth Rate (CAGR) of 46% for collaborative robots (cobots) in the logistics sector from 2023-2027 is noteworthy. This growth is driving the logistics industry to embrace increased automation. According to »The Robot Report«, a company has achieved a remarkable 500% surge in efficiency and order accuracy, thanks to the strategic utlilisatsion of robotics in its fulfillment center.

The increasing prevalence of AI, smart factories, and robotics underscores the growing importance of human-machine collaboration in machinery. As a prominent specialist in connectors, NEXTRON specializes in delivering advanced connectivity solutions designed for industrial applications and automation systems.

Mastery of industrial connectivity

Demonstrating exceptional manufacturing capabilities, NEXTRON offers tailored solutions adhering to PICMG (PCI Industrial Computer Manufacturers Group) specifications. This commitment extends to providing cost-effective automation solutions seamlessly integrating advanced technologies, incorporating waterproofing and heat dissipation features.

Addressing logistics and production challenges, NEXTRON's modular solutions cater to diverse industrial needs. The portfolio includes vibration-resistant components, an innovative dual-lock series, and a high-performance HD series. Effective wiring is emphasised for robust signal transmission over long distances, meeting varied industrial demands with precision.

In the context of Autonomous Mobile Robots (AMRs), the importance of Vision and Optical Sy-

stems is highlighted, ensuring optimal functionality and enhancing overall operational efficiency. This pragmatic approach positions NEXTRON as a reliable contributor to the evolving landscape of industrial connectivity.

The latter part delves into specific scenarios, showcasing our proficiency in various robots and machine automation applications within smart factory environments, focusing on the applications and solutions related to Industrial Robots and Autonomous Mobile Robots.

From Industrial Robots to AMRs

Industrial Robots

Robotic arms play a crucial role in modern manufacturing, demanding durable wiring and critical stability at every connection point for optimal machine automation. NEXTRON offers a comprehensive lineup, including industrial-grade SPE Connectors, the Chameleon Series, the Gecko HD Series, and Sensor Connections. These components ensure the seamless and efficient operation of intelligent manufacturing processes.

SPE Connectors

Single Pair Ethernet (SPE) transforms network technology, seamlessly merging data transmission and power delivery over a single pair of data lines (PoDL). Its primary advantage is a significant reduction in cable weight, simplifying installations while meeting the demands of modern industrial applications, including Industry 4.0 and AIoT technologies.

SPE's versatility is evident in its ability to cover distances up to 1,000 meters, support data rates up to 1Gbps, and deliver power up to 50W. These features make SPE an efficient solution for various applications, especially in Industry 4.0 and AIoT. Adhering to standard specifications (IEC 63171-6), SPE ensures reliability and compliance with industry norms (see figure 1).

Chameleon Series

Tailored for industrial use, the Chameleon Series features a patented Bidirectional Release System for seamless blind-mating, enhancing operator convenience by allowing easy connector release on both sides of robotic vests. The auto-coupling locking system ensures a secure connection with a simple click, making it ideal for devices like industrial exoskeletons.

With a rugged metal design, intuitive blind mating, and a user-friendly unlock system, the Chameleon Series gains widespread acceptance in Industrial IoT (IIoT) applications, optimising operations across a range of industrial scenarios (see figure 2).

Gecko HD Series

The Gecko HD Series, a standout in industrial applications, provides an advanced solution for compact and lightweight high-speed data transmission. Positioned as the premier choice for industrial connectivity, it seamlessly integrates durability, versatile data transmission, and user-friendly design to meet the evolving demands of

Figure 1

Figure 2

the Industrial Internet of Things (IIoT) landscape. With an impressive durability of 200 to 2500 cycles and a rated current of 2A per pin, the series ensures consistent and reliable performance, complemented by its IP67 compliance (mating) according to IEC60529 standards for robust operation in demanding environments.

Adding to its appeal, the Gecko HD Series offers versatile data transmission options, including USB 2.0, USB 3.1 Gen 2, and HDMI 2.0 configurations. The series features an aluminum alloy shell, emphasising lightweight construction without compromising structural integrity. This strategic design strikes a balance between performance and affordability, effectively addressing both weight and cost considerations. With user-friendly attributes such as keying and color codes, the series facilitates straightforward and error-free connections, solidifying its reputation as a dependable choice for precision and efficiency in industrial settings (see figure 3).

AMRs & Delivery Robots

AMRs and delivery products require connectors with enhanced features to withstand challenges such as vibrations, ensuring reliable connectivity in dynamic industrial environments.

NEXTRON's advanced connectors are designed to address these challenges, ensuring stable and uninterrupted connections as AMRs navigate their dynamic environments. This strategic development emphasizes the critical role of reliable

Figure 3

Figure 4

connectivity in supporting the seamless and efficient operation of AMRs in diverse industrial applications.

Power Charging Interface

The Power Charging Interface revolutionises AMR charging in industrial automation, supporting up to 260A with shared male-female ends for reliable performance across applications. Its patented unisex design, incorporation of Crown Spring and Signal Pins, and commitment to finger-proof safety (IPXXB compliant) exemplify adaptability.

Additionally, designed for electric motorcycle recharging, it ensures robust industrial performance with durability of up to 4,000 cycles. Compliant with IP67 standards (Mating) and resistant to vibrations (10 to 500Hz, per-axis acceleration of 10g), this connector excels in challenging environments, ensuring a dependable charging experience (see figure 4).

Rectangular Connector

The connector is designed for AMRs and offers compact, durable solutions with 44 anti-vibration contacts. It is ideal for high-density applications in Automated Storage and Retrieval Systems and ensures reliable communication in demanding industrial environments. It prioritizes operational efficiency, providing easy mating and un-mating, precise connections, and resilience in challenging conditions. With Cat.5E capabilities, it supports efficient data and power transmission. The user-friendly design ensures a seamless experience, while the latch-lock mechanism simplifies swapping processes. Resistant to vibrations (20-500Hz), it guarantees stable performance in dynamic industrial settings, enhancing overall AMR connectivity and efficiency (see figure 5).

LiDAR/ Radar Connector

The LiDAR/Radar Connector is a cutting-edge solution, featuring a 4-way SPE connector (1Gbp/s, 8A/pin, 60VDC) in a compact design. LiDAR technology, vital for Level 5 autonomous cars, plays a key role in supporting Advanced Driver Assistance Systems (ADAS) across diverse applications like heavy commercial trucks, indoor/outdoor mobile robots, and traffic control systems.

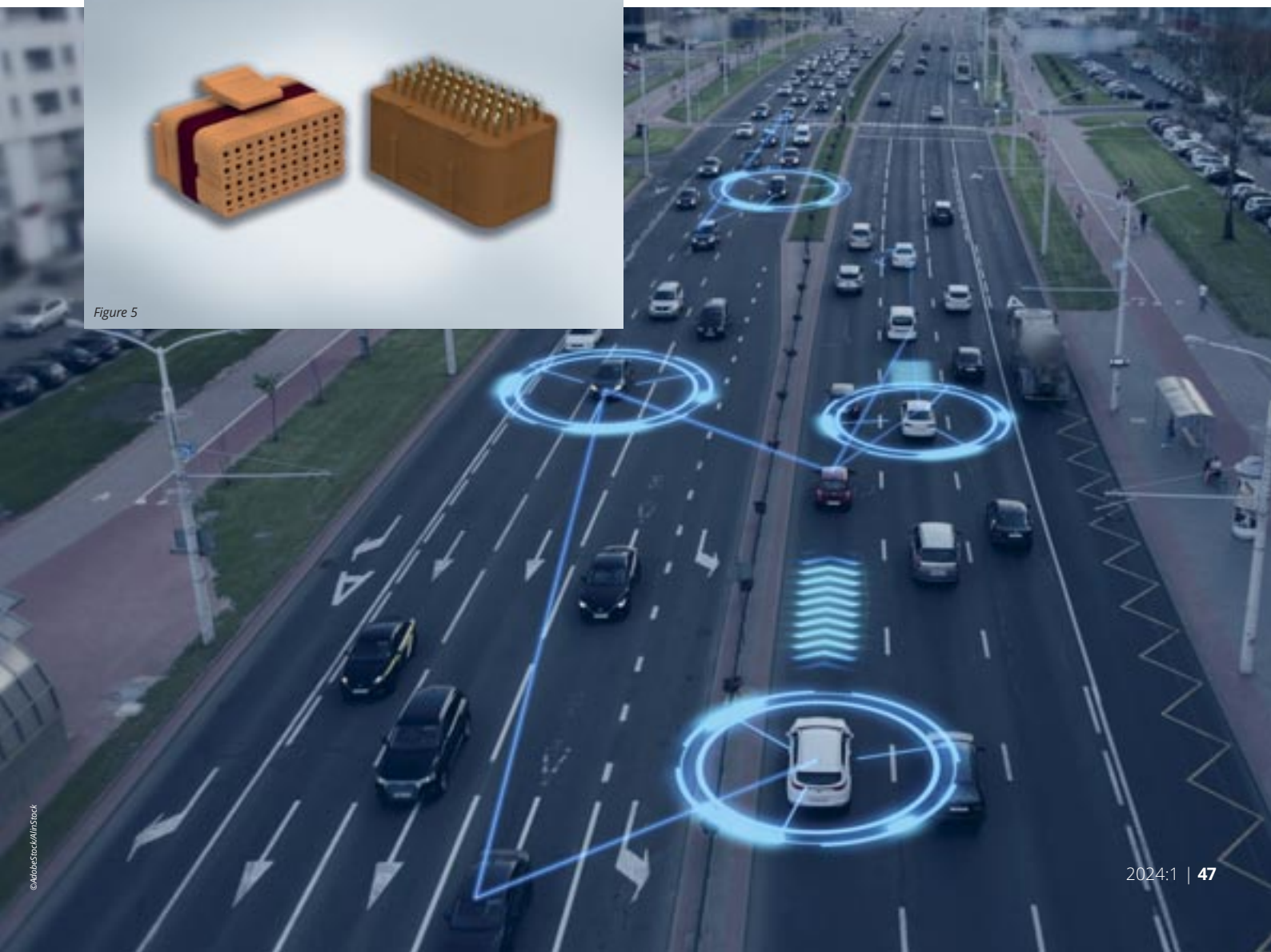
The LiDAR/Radar Connector ensures reliable and efficient connectivity, playing a key role in the seamless integration of LiDAR technology in Automated Mobile Robots (AMRs) (see figure 1).

NEXTRON has its unique technologies in high speed, press-fit, thermal, and locking mechanism with over 30 years of experience to provide interconnection solution for telecom, datacom, medical, industrial, and embedded system customers. Together with CODICO they support customers to find their perfect solution – no matter if it is a standard product or a customised solution.

S02

Barbara Schanda, +43 1 86305 152
barbara.schanda@codico.com

Figure 5



FORWARD-LOOKING ENERGY SUPPLY

Robotics: A Deep Dive Into Batteries & Chargers

Amphenol
COMMUNICATIONS SOLUTIONS

In the dynamic world of robotics, where precision and reliability are paramount, power supply stands at the core of these technological marvels. We shed light on the essential components that keep robots operational: batteries and chargers. Additionally, we take a closer look at the ground breaking products of AMPHENOL CS, the industry leader shaping the future of power supply solutions for robots.

Understanding the core: Batteries for robotics

Like the human heart, batteries are the life force of robots. They store and deliver the energy needed to run smoothly. When it comes to the diverse world of robotics, choosing the right battery is crucial, and factors such as weight, efficiency and longevity come into play.

Mobile robots require specialised performance

Autonomous vehicles, drones, and inspection robots present unique challenges. Unlike their stationary counterparts, they must be self-sufficient and carry their own power source. For drones, for example, there are ground-based charging stations where the drone can land and dock to recharge. This process can be repeated without human supervision, making the drone autonomous. In the case of Automated Guided Vehicles (AGVs), the robots return to a charging station on the factory wall for recharging. The batteries of these mobile systems are lightweight, compact, and durable.

Navigating the maze of battery chargers

To efficiently charge the batteries of mobile robots, specialsed battery chargers are required. These devices are designed to safely and powerfully supply the onboard batteries. AMPHENOL connectors for battery chargers stand out as they form a crucial part of the interface between the Battery Management System (BMS) and the battery.

BMS modules utilise intelligent algorithms to optimise charging speed while preserving battery health and preventing cell fractures.

Choosing the right battery for mobile robots: Key considerations

Selecting the ideal power supply or battery for your mobile robot requires careful consideration of several factors:

- Battery compatibility: Ensure that the charger is compatible with your robot's battery type, whether Li-ion, Ni-MH, or other.
- Energy efficiency: Choose a high efficiency charger to prolong battery life and reduce charging times.
- Size & weight: Choose a charger that fits within the size and weight constraints of your robot.
- Charging speed: Depending on the operating schedule, a fast charger may be essential to minimise downtime.
- Operating environment: Make sure the power supply can withstand the conditions your robot will be exposed to, whether indoors or outdoors, in high or low temperature environments.

Powering the silence: The unique needs of stationary robots

From the agile world of mobile robots, we move into the stationary realm of stationary robots. Ro-

bots commonly found in automated production lines and assembly plants have unique requirements for power supply, such as those needed for a robotic arm.

Continuous operation and high peak load: The challenges

Unlike mobile robots, stationary robots tend to operate continuously, performing tasks around the clock without interruption. This constant demand requires power supplies capable of delivering consistent performance under continuous load. Many industrial robots also face high peak load requirements, especially during heavy duty operations.

Key considerations for stationary robot power supplies

When selecting a power supply for stationary robots, key considerations include:

- Peak load capacity: Ensure that the power supply can handle peak power demands without sacrificing stability.
- Continuous power supply: Look for a power supply that provides consistent power under continuous load.
- Size: If space is an issue, consider a compact, high output power supply.
- Environmental conditions: The power supply should be able to withstand factory conditions such as dust, humidity or high temperatures.
- Reliability and Lifespan: For 24/7 operation, choose a power supply with proven reliability and long life to avoid costly downtime and premature replacement.

Solutions for robots

AMPHENOL offers a range of power supply connectors designed to meet the unique needs of stationary robots.

Figure 1: CoolPower®

High peak load power supplies: Powering industrial giants

Industrial robots often require power supplies capable of handling high peak loads without compromising stability. AMPHENOL's offerings, such as the PwrBlade® Mini, PwrBlade® ULTRA Connector System and CoolPower® SDM Connectors, ensure that robots get the power they need during peak operating times (Figure 1).

Compact high output power supplies: Efficiency in limited space

For applications where space is limited, compact power supplies with high performance are the solution. Connectors such as the Minitek® Pwr 4.2 Connector System, Clincher™ Flex Connectors, PwrBlade® Mini, PwrMAX® G2 Power Connector, or BarKlip® BK200 I/O deliver significant results in a smaller package, making them ideal for densely packed production lines or compact robotic systems (Figure 2).

AMPHENOL's latest product addition: DuraSWAP™

Connectors with cable assemblies offer outstanding durability with 10,000 mating cycles and a continuous current range of 15 to 70A. Ideal for e-mobility, swappable battery systems, industrial and instrumentation, warehousing, robotics, drones and more, these connectors feature a versatile 2 power & 6 signal configuration for application flexibility. With guide pins for blind mating, UL94V-0 rated body materials for safety and an operating temperature range of -20°C to +90°C, they are suitable for a wide range of environments. The connectors also incorporate a metal panel mounting socket, ensuring secure connections and effective panel IP sealing. With IP67 ratings, FMLB for power terminals and PokaYoke to prevent mismating, DuraSWAP™ connectors provide a robust and reliable solution for swappable docking requirements (Figure 3).

AMPHENOL's versatile range: Powering your unique needs

Whether your application involves mobile robots with high-performance requirements or stationary robots in continuous operation, AMPHENOL has the right solution for you. The diverse range of power connectors, covering a wide range of currents and voltages and their signal counterparts with value-added features such as thermal management, ensure you get quality without compromise.

S03

Julia Reiterer, +43 1 86 305 162
julia.reiterer@codico.com

Figure 2: Clincher & BarKlip®

Figure 3: DuraSWAP™

©AdobeStock/Natalia

PwrBlade®

Mini Connectors From AMPHENOL CS

In the ever-evolving technology and electronics landscape, it is essential to be one step ahead of time.

Enter the PwrBlade® Mini Cable-to-Board and Board-to-Board and mezzanine connectors, an innovative addition to AMPHENOL's renowned PwrBlade® product line. Designed to redefine power and signal transmission in low profile applications, these connectors offer a range of features to meet the demands of today's industries.

PwrBlade® Mini Cable-to-Board Connector: Power and efficiency redefined

High current density in a low profile

The PwrBlade® Mini Cable-to-Board Connector is designed to meet the increasing demand for higher current density in space-constrained applications. Capable of carrying up to 25A per contact (50A per column), this connector provides a robust power supply without compromising on space.

Flexible cable range

Power contacts can be terminated up to 12AWG, while signal contacts range from 26AWG to 22AWG. This versatility allows for a wide range of system designs to suit different power applications.

PwrBlade® Mini Cable-to-Board

Reliable connection and retention

The inclusion of squeeze-to-release latching and slide-latching CPA options ensures a secure and reliable connection in all applications. This feature not only strengthens the mated retention force, but also improves the overall durability of the connector.

Modular tooling for customisation

The modular tooling design allows for a variety of power and signal contact combinations, providing customisation options to meet specific application requirements. This adaptability sets the PwrBlade® Mini apart and makes it an ideal choice for a wide range of industries.

PwrBlade® Mini Board-to-Board Connector: Space-saving powerhouse

Unparalleled low-profile design

Standing just 8.10mm above the PCB, the PwrBlade® Mini Board-to-Board Connector is the epitome

PwrBlade® MiniMezz

PwrBlade® Mini Board-to-Board

of low-profile power and signal connectivity. With zero PCB overhang, it maximises space utilisation in even the most space-constrained designs.

Customisable contact configurations

Similar to its Cable-to-Board counterpart, the Board-to-Board connector features a modular tooling design that allows customisation of the power and signal contacts. This adaptability ensures that the connector can be seamlessly integrated into a variety of applications.

Efficient termination options

With both press-fit tails and solder tails, PCB termination options available, the PwrBlade® Mini Board-to-Board Connector offers flexibility in PCB layouts, making it compatible with a wide range of system configurations.

Low end-of-life contact resistance

The connector has a remarkably low end-of-life contact resistance of 2.0mΩ after rigorous testing. This ensures consistent performance and longevity even under demanding conditions.

PwrBlade® MiniMezz Connector Series

Compact and functional design

The PwrBlade® MiniMezz Connector Series introduces a breakthrough in mezzanine connector technology, seamlessly combining compactness with exceptional functionality. With stack heights ranging from 8-20mm and options for both power and signal contacts, this series offers a versatile solution for a wide range of applications.

Seamless blind mate connections

One of the outstanding features of this series is the innovative blind-mate guides, providing an impressive accuracy of ±0.80mm. This ensures that connections remain seamless even in challenging blind mating scenarios. This feature significantly increases the reliability and usability of the connector.

Termination flexibility

The series accommodates different PCB layouts and manufacturing processes by offering a choice of solder-tail or press-fit terminations. This flexibility guarantees a smooth integration process, meeting the specific requirements of the application effortlessly.

High current density and low contact resistance

Based on the proven PwrBlade® technology, this series is characterised by its ability to deliver higher current density in space-constrained environments. The power contacts feature patented GCS® plating, while the signal contacts use GXT®, resulting in low contact resistance. This ensures a reliable and efficient performance of the connector.

Applications across industries

The PwrBlade® Mini Connectors find their niche in various industries, including:

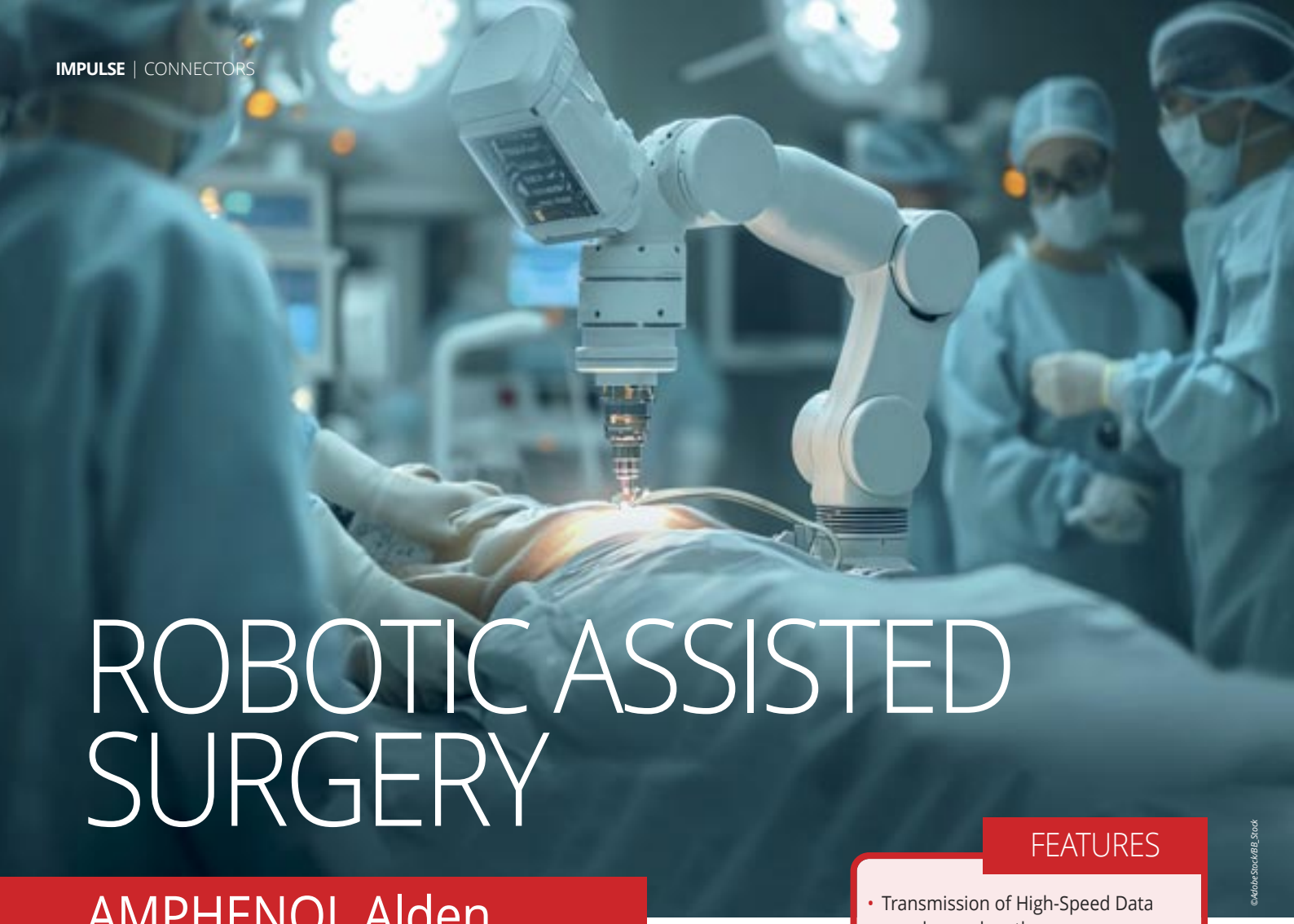
- Communications
- IT and Datacom-Server/Storage Applications
- Industrial Automation & Instrumentation
- ESS/UPS
- Automotive and EV Charging

S04

Julia Reiterer, +43 1 86 305 162
julia.reiterer@codico.com

SUMMARY

In summary, PwrBlade® Mini Cable-to-Board and Board-to-Board connectors are poised to revolutionise connectivity across industries with their low-profile design, customisation options and exceptional performance. Embrace the future of connectivity with Pwr Blade® Mini connectors.



ROBOTIC ASSISTED SURGERY

AMPHENOL Alden

Better interconnect solutions for better patient care.

Robotic Assisted Surgery

Robotic assisted surgery is a ground breaking advancement that combines the precision of robotics with the artistry and skill of human surgeons. It offers numerous benefits to patients and healthcare providers, transforming medical procedures while improving patient outcomes and reducing recovery times.

CODICO & the medical industry

If your organisation is sourcing cable assemblies or connectors for robotic assisted equipment, you've come to the right place! The cable assemblies from our supplier AMPHENOL Alden Products are designed for the unique environment in which medical robotics operate, ensuring superior mechanical and electrical performance throughout its service life. They have overcome challenges in high flex cycle durability, robust reprocessing endurance and multiple mating cycle longevity while maintaining excellent power and signal integrity.

FEATURES

- Transmission of High-Speed Data over longer lengths
- Characterisation & analysis of S-parameters using Vector Network Analysers & Time Domain Reflectometers
- Hybrid fiber optic and electrical cable assemblies and connectors

Products from AMPHENOL Alden

AMPHENOL Alden is laser-focused on the medical market. Their volume production manufacturing facilities are FDA-registered and the global quality system is ISO13485-certified. The production facilities are located in the United States, Mexico and China, and all have their own support staff for Engineering and Operations. Based on this setup, CODICO can offer local support with prompt responses whenever you have a request for medical connectors and customised cable assemblies.

S05

Christian Sichtar, +43 1 86305 134
christian.sichtar@codico.com

SurLok PLUS SERIES

Now Even More Dynamic at 1500VDC!

Amphenol Industrial

AMPHENOL Industrial Operations is constantly pushing the boundaries of innovation to provide you with cutting-edge solutions. In this article we are delighted to introduce an upgraded version of their SurLok Plus series, now boasting an impressive voltage capacity of 1500V DC.

SurLock Plus

What does this mean for you? It's simple – more power, less space! The SurLok Plus connector continues to revolutionise the industry by allowing you to carry higher voltages within the same compact envelope as its 1000VDC predecessor. But that's not all! The new SurLok Plus connector is ideal for a wide range of applications, including Energy Storage Market, Electric Vehicles, Battery Solutions, Fuel Cell Technology, Industrial Applications and many more. Why choose SurLok Plus? Well, it is not just about the voltage – it is about versatility, reliability and environmental responsibility. This field-installable connector offers a highly reliable alternative to common compression lugs, providing efficient power distribution in a small, compact form factor. With the capability to be used in DC to DC and AC to DC power transfers, SurLok Plus is your go-to solution for various power distribution needs. Whether you are looking to transfer power from a battery cluster to a control system or from a battery pack to the rest of your system, SurLok Plus has got you covered! Join us in embracing the future of interconnect systems and power distribution with SurLok Plus. Experience the difference that 1500VDC of power can make in your applications!

SurLock Plus Family

Ready to supercharge your projects? Contact us today to learn more about this groundbreaking connector and how it can elevate your products to new heights.

S06

Christian Sichtar, +43 1 86305 134
christian.sichtar@codico.com

INNOVATIVE PLATING FOR POGO PINS

Especially for Medical Applications!

CCP's upgraded AP plating family is an exclusively cutting-edge technology that complies to EU's safety regulations on hazard classification and labelling for medical and consumer electronics products.

Pogo-Pins are used in almost every kind of electronic device today. A typical pogo pin consists of a barrel, a plunger, and a spring (see figure 1). The high durability, tolerance and versatile application make them a preferred connector for intelligent electronic designs.

There are several factors that influence a pogo pin's performance, such as the spring force, the number of pins, the plunger design and so on. One of the most critical factors is the material of plating. Normally, pogo pins are coated with a layer of nickel and a layer of gold. However, if the application environment is with high humidity or the pins contact sweat or water from time to time, the impact of electrolysis might release toxic material from the basic metal inside.

ECHA (European Chemicals Agency) 's hazardous classification label ATP14 lists cobalt as harmful and carcinogenic to human body. On 23rd January 2024, it further released the new Candidate List of SVHCs with 5 new substances. With the current list of SVHCs containing 240 substances, it restricts suppliers to provide enough information for safe use of products that contain a substance of very high concern. In response to market changes and the EU's strict safety regulations,

Figure 1: Pogo-Pin structure

Figure 2

CCP has spent much time on plating technology development, adopting the precise process of in-house plating factory and actively customising pogo pin connectors with anti-electrolytic-corrosion plating. It successfully introduced the Super AP plating family to the market!

Unlike general consumer electronics, medical devices usually have a life cycle of 5 to 7 years. The requirements for plating and connectors are particularly stringent to ensure long-term product performance and durability. At the same time, in order to improve the safety of medical products, especially to ensure that the scheduled high-risk carcinogen metal cobalt will not contact human skin or be dissolved and released, this makes product upgrades more urgent.

European's major medical and healthcare device OEMs have exhibited its confidence in CCP technology by developing new connectors with CCP's Super AP plating. CCP is expected to become the exclusive supplier of some giant OEMs in this industry.

Illustration on anti-electrolysis results

While the metallic coating layer contacting human skin in daily use, electrolysis process might quietly start due to water and sweat. CCP's Super AP layer can resist electrolytic corrosion over 60min which is dozens of times better compared to normal gold plating (see Figure 3).

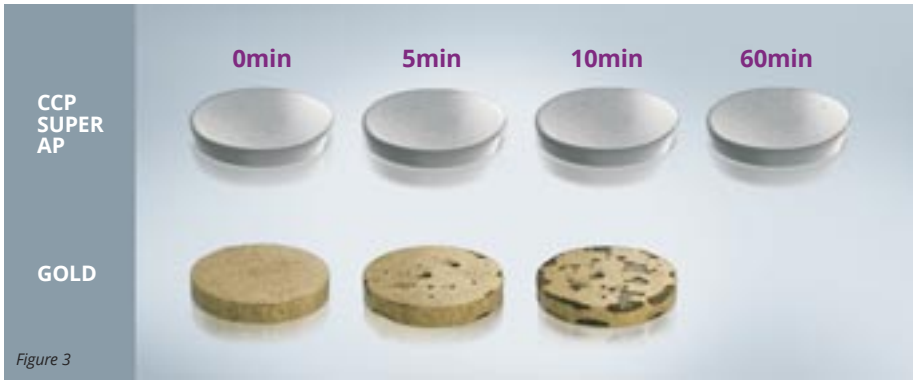


Figure 3

Applications examples

- Hearing aid products
- Medical detecting probes
- Smartwatches and wearables
- GPS healthcare wrist bands
- AR glasses
- Medical/healthcare devices chargers

Please contact CODICO for more details about pogo pins and Super AP plating.

S07

Barbara Schanda, +43 1 86305 152
barbara.schanda@codico.com

Features Comparison between gold plating and CCP AP plating family

Plating	Testing Standard	Au(50u")	AP	AP1-T30	APII	Super AP
Color	/	Gold	Silver	Silver	Silver	Silver
Nickel Release	EN 12472:2005+A1:2009	Nickel-containing process	Nickel-free process	Nickel-free process	Nickel-free process	Nickel-free process
Plating Thickness (micro inch)	XRF	100-170	110-170	130-190	270-400	210-400
Resistance (mΩ)	EIA-364-23	<50	<50	<50	<50	<50
Salt Spray Resistance (HR)	EIA-364-26	96	48	72	96	168
Artificial Sweat Resistance (HR)	ISO-3160	96	48	72	96	168
Surface Hardness (HV)	ISO 6507-1:2005	200	400	400	400	400
Electrolysis Resistance Time	1mA,5V, Pitch=0.60mm	< 1min	10min	15min	15min	60min

SWEET HOME

Empowering Home Electrification

Home electrification has become a cornerstone of modern living, with increasing reliance on electrical appliances, smart home technologies and renewable energy sources.

What is the role of connectors in home electrification? Connectors, often overlooked but essential components, play a critical role in ensuring the safe, efficient and reliable transmission of electricity within the home. The impact of rising energy costs has increased the demand for more energy efficient solutions. This has driven the market for heat pumps and solar-powered devices in home electrification. As these markets continue to grow, the importance of robust and well-designed connectors becomes even more critical, contributing to a sustainable and cost-effective approach to home electrification.

VERSATILITY, RELIABILITY, VARIATION

High Power, High Reliability

The Role of Connectors in Safety

Connectors are an integral part of ensuring the safety of home electrification systems. Properly designed and installed connectors prevent electrical faults, short circuits and overheating. They establish safe connections, minimise the risk of electrical fires and create a protected living environment.

Efficiency and Reliability

Efficiency is a key consideration in home electrification. Low resistance connectors ensure minimal energy loss during transmission, contributing to a more energy efficient home. In addition, reliable connectors reduce the likelihood of power interruptions and thus improve the overall reliability of the electrical system.

HIGH CURRENT, POSITIVE LOCK, SAFETY DESIGN

DF62W Series

The DF62W series impresses with its slim design and is suitable for cabling in confined spaces. An in-built cable and housing seal supports the watertightness of IP67 (reference value). A waterproof version (DF62WP) is also available.

DF62W

©AdobeStock/orrem

©AdobeStock/Patrick Hehnhdz

HRS HIROSE ELECTRIC EUROPE B.V.

Features DF62W Series

- Contact pitch [mm]: 2.2
- Rated Current [A]: 5 (max)
- Rated Voltage [V]: AC/DC 250
- Operating Temperature [°C]: -40 to +105
- Number of contacts: 2, 3, 4, 6 and 9
- Connection Type: Slim In-line Connector for Internal Wiring
- Termination AWG: 20-26
- Waterproof: IP67
- Glow Wire Compliant*

Features DF60 Series

- Contact pitch [mm]: 10.16
- Rated Current [A]: 65
- Rated Voltage [V]: AC/DC 1000
- Operating Temperature [°C]: -55 to +105
- Number of contacts: 1-6
- Connection Type: Wire-to-Board/Wire-to-Wire
- Termination AWG: 8-12
- Glow Wire Compliant*
- Finger protection (Electric shock prevention) type available

Features DF63 Series

- Contact Pitch [mm]: 3.96, 7.92
- Rated Current [A]: 15
- Rated Voltage [V]: AC/DC 630
- Operating Temperature [°C]: -55 to +105
- Number of contacts: 1-6
- Connection Type: Wire-to-Board
- Termination AWG: 16-22

DF60 Series

The DF60 series is HIROSE's most compact connector with high power and high current capability. It features a multi-point contact design and center-locking mechanism, ensuring enhanced operability and high reliability when connecting to main power sources. In addition, a finger protection type is available.

DF63 Series

The DF63 series is a wire-to-board connector for internal power supply. It has the capacity to handle a maximum of 15A when using 16 AWG wire. Various keying options are available to prevent reverse and mismating. The locking function secures the plug connection and ensures a clearly perceptible click.

More information available at:

S08

Julia Reiterer, +43 1 86 305 162
julia.reiterer@codico.com

**Glow Wire: HIROSE offers a range of products that have been glow-wire tested in accordance with IEC 60695-2-11, specifically the Glow-wire Flammability Test Method for End Products (GWEPT). Glow wire temperatures are maintained above 750°C or 850°C. GWEPT complies with IEC 60335-1 5th edition. It's important to note that "small component" connectors, as defined in IEC 60695-2-11 Section 4.4, are exempt from GWEPT because the end-product glow-wire flammability test is not suitable for testing such small components due to potential heat loss and inadequate support.*

DF60

DF63

BM54

Small Board-to-Board Connector With Floating in X-Y-Z Direction

HIROSE's BM54 series combines floating functionality and compact size to meet automotive specifications. With a width of 3.8mm, it is the world's smallest class of board-to-board connectors with a wide floating range of ±0.4mm in X, Y and Z directions.

Its 125°C heat resistance, required for in-vehicle equipment, makes it suitable for a wide range of applications, including consumer and industrial equipment, as well as front, rear and side cameras, millimeter wave radar and LiDAR, which are key components in automated driving.

Reliable connectivity and assembly efficiency for in-vehicle devices required as autonomous driving becomes more widespread

The number of in-vehicle cameras and LiDARs is increasing due to the mandatory installation of rear-view cameras and the development of autonomous driving. When utilising non-floating connectors for internal device connections, situations may arise where placing multiple connectors on a single board becomes challenging due to their inability to accommodate misalignment between boards. This limitation can pose difficulties in high-precision tasks such as optical axis adjustments during the assembly of cameras and high-power LiDAR.

Furthermore, miniaturisation poses a significant challenge, particularly as sensing devices positioned at the vehicle periphery impact overall vehicle design. To address these issues effectively, there is a demand for compact Board-to-Board connectors equipped with a floating function to absorb misalignments between boards.

Automotive quality connector with ±0.4mm large floating and small size

In response to this need, HIROSE has developed the »BM54« series, which absorbs board misalignment with a large floating amount of ±0.4mm in the XY direction, thereby improving contact reliability and contributing to more efficient application assembly. With a width of 3.8mm, this series is the world's smallest class of Board-to-Board connectors with floating function, contributing to the miniaturisation of applications. The two-point contact design and large effective mating length of ±0.4mm provide high contact reliability and heat resistance up to 125°C, making it suitable for use in automotive environments.

Large floating range ±0.4mm in X and Y directions (mated, 30pos.)

Features BM54 Series

- 0.4mm pitch, 3.8mm width, world's smallest class of floating Board-to-Board connectors
- Misalignment compensation
- X and Y direction: floating range ±0.4mm
- Z direction: effective mating length
  ±0.3mm (stack height = 3.0mm)
  ±0.4mm (stack height = 3.5 to 4.5mm)
- 125°C heat resistance for automotive specifications
- High contact reliability with two-point contact
- Supports PCI-ex Gen4 (16Gbps) and MIPI D-PHY Ver.2.1

The newly developed BM54 series will be expanded in the future with the following stacking heights and pin count variations:

- In mass production:
  30 pins, 3.0mm stack height
- Under development planning:
  Number of positions: 10, 20, 30,40
  Stack heights: 3.0, 3.5, 4.0, 4.5mm

S09

Julia Reiterer, +43 1 86 305 162
julia.reiterer@codico.com

PERFORMANCE FOR COMPACT MOTORS

HIROSEs MT Series

HIROSE ELECTRIC EUROPE B.V.

Waterproof, power and signal hybrid connector with lever for compact motors.

HIROSE is launching the »MT« series of interface connectors with lever locking, enhancing the wiring capabilities for motors throughout the entire channel. The MT series enables efficient wiring by simply pulling down the lever lock and contributes to saving space in the connection area by combining power signals. It is a space-saving hybrid power and signal connector with IP67 waterproof rating when mated.

Requires smaller sets and more efficient wiring

Due to the current shortage of skilled labor, the demand for industrial robots has significantly increased in the transition to smart factories. This trend is accompanied by a growing need for miniaturisation, especially in the case of collaborative robots. On the other hand, motors mounted on a robot's drive unit require separate wiring for power, signal and brake connections for each application, which takes up a lot of space in the interface area. In addition, many conventional connectors are bolted, which makes wiring time consuming and can cause sealing problems if the screws come loose.

Lever lock and power signal hybrid reduces wiring time and kit size

To solve these problems the »MT« series combines power, signal and brake connections. It saves space in the motor connection area and helps to reduce equipment size. In addition, locking is achieved by simply pulling down the lever, saving time during wiring. As no screws are used, there is no risk of loosening, and IP67 waterproofing is ensured when engaged. The high vibration resistance suitable for the operating environment of industrial equipment is also ensured, making it a product well suited for these applications.

S10

Julia Reiterer, +43 1 86 305 162
julia.reiterer@codico.com

MT series

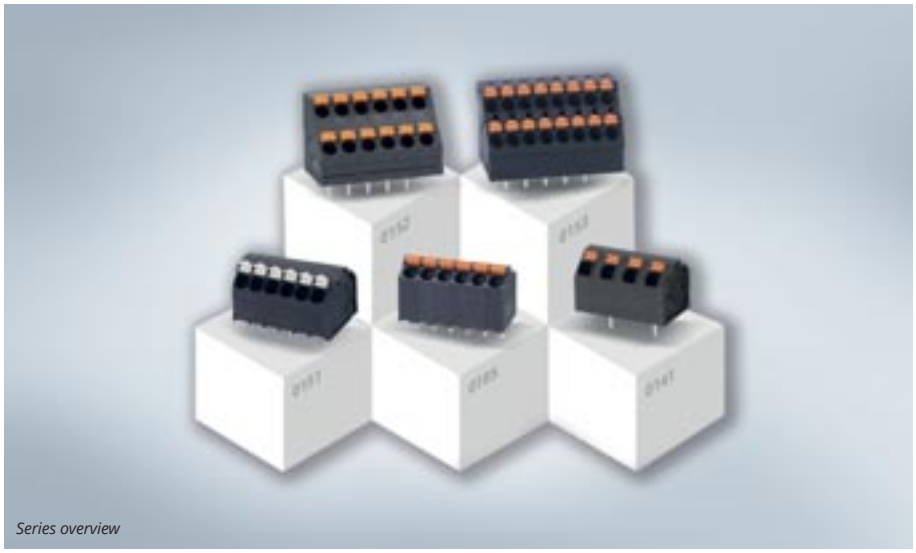
HIGHLIGHTS

- Lever lock provides easy operation
- Power/signal hybrid contributes to space saving in motors
- Provides vibration resistance required in motors
- IP67 waterproof (when mated)
- Wide variety to meet various application needs
- Conforms to safety standards (UL, CSA, TÜV)

PCB WIRING

DINKLE's 0151, 0185, & 0141 Series Stand Out!

As automation technology continues to spread and develop, the demands on core components such as PLCs and drives are increasing. The cabling of modern and highly dynamic production lines must also be able to keep pace with the ever-increasing requirements and data volumes.



Series overview

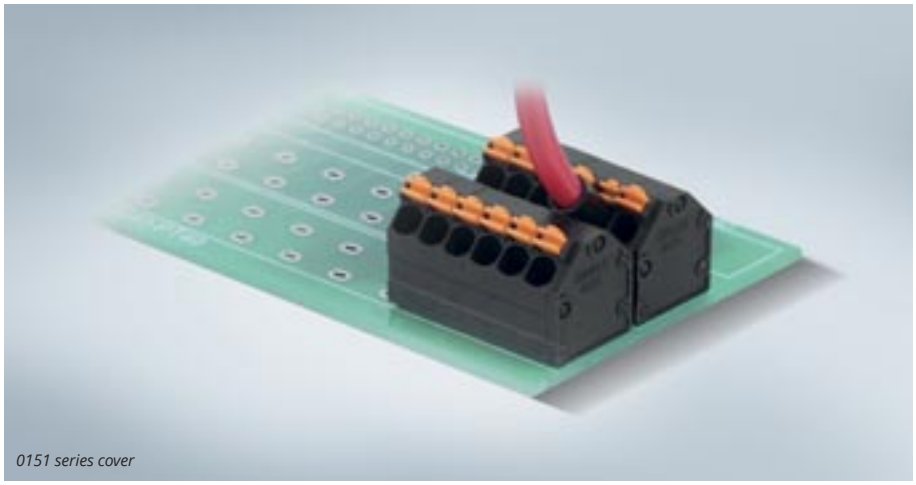
In addition to robust computing capabilities, seamless real-time data transmission, and effective data visualisation are essential for the smooth operation of such measurement systems. What can contribute to fulfilling these requirements? The answer lies in the 0151, 0185 and 0141 series from DINKLE:

1. Time efficient connection

With the sophisticated Push-In Design, these connectors eliminate the need for tools and allow easy connection of a variety of conductors, saving over 60% of wiring time compared to conventional screw terminals.

2. Versatility in operation

The angled cable entry simplifies wiring tasks and enables the realisation of multi-row layouts. It also offers a space-saving double-pinning option that optimises the overall space utilisation of the PCB. With pitch sizes from 2.54-10mm and



0151 series cover

0185 series with LED

a maximum rated current of 24A, paired with a rated voltage of up to 1000V, they are perfect for applications such as PLCs, I/O modules, HMIs, controllers, drives, sensors and much more.

3. Increased operating efficiency

Optional built-in LED indicators ensure clear recognition of the operating status and thus offer intuitive identification, simplifying maintenance tasks.

4. Adaptation to the requirements of automated production processes

Tape & reel packaging significantly reduces assembly time and therefore increases overall production efficiency. High temperature resistant THR (Through-Hole-Reflow) versions with a pin length of 2.6mm are available as an option. Thanks to these features, the 0151, 0185 and 0141 series fulfil strategic needs and meet the high requirements of modern automation systems.

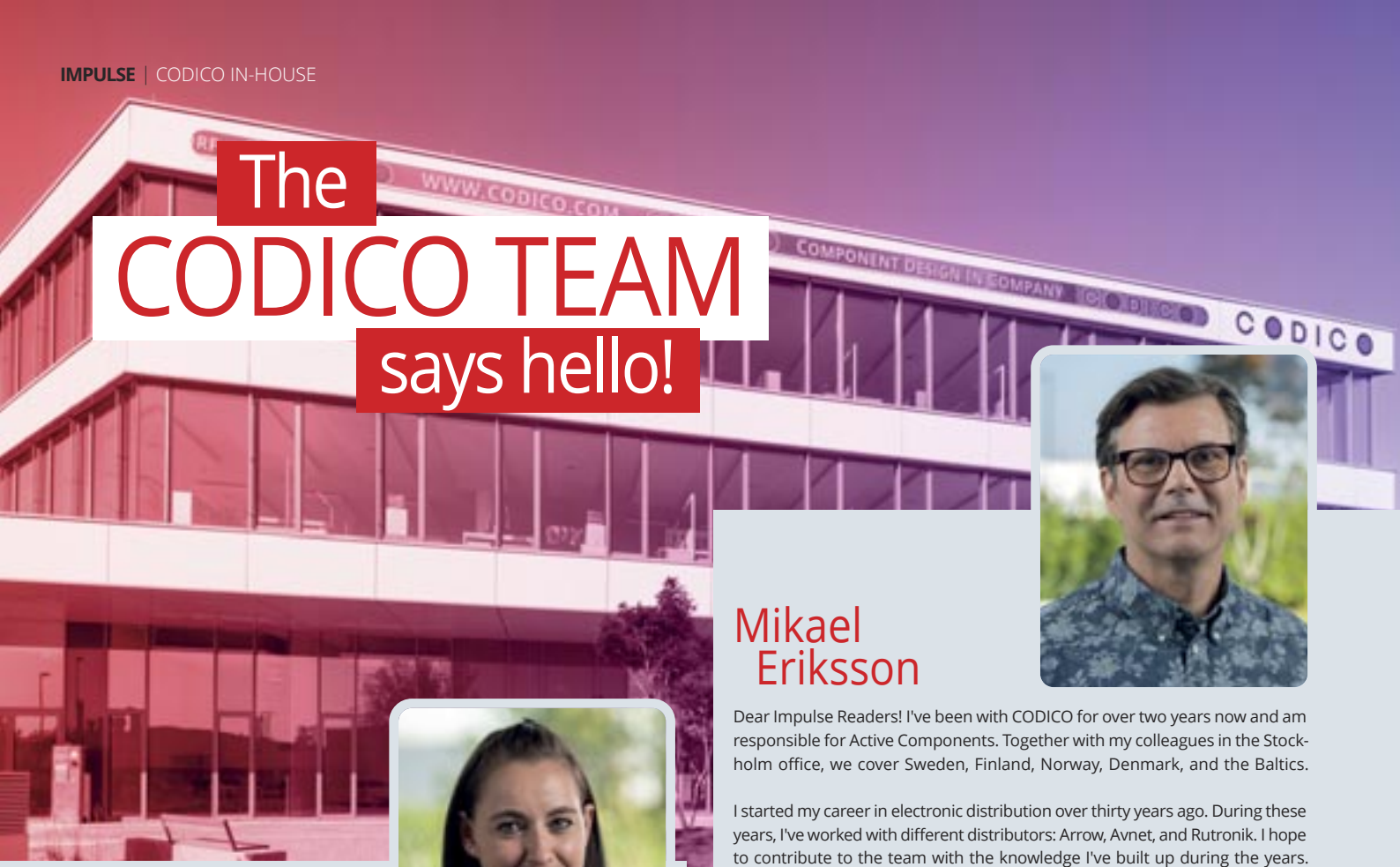
Contact CODICO for more information:

S11

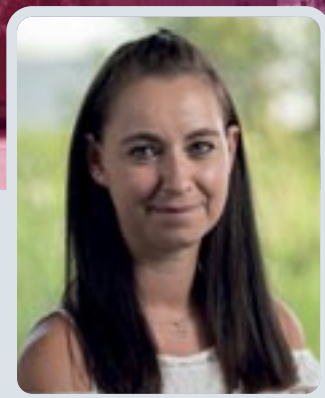
Christian Sichtar, +43 1 86305 134
christian.sichtar@codico.com

Pitch sizes

0151 series



The CODICO TEAM says hello!



Madelene Dvorak

Dear readers! I am delighted to introduce myself to you. My name is Madelene Dvorak, I have been part of the CODICO family for almost 5 years and I work in the logistics department.

I have been interested in logistics for a long time and I am therefore very grateful that I have been given the opportunity to work in this exciting and varied department at CODICO. Previously, I was Shop Manager at DREI for 8 years and was then able to gain experience in receivables management at the Credit Protection Association.

My area of responsibility in logistics is the organisation of shipping, the preparation of export documents and the handling of complaints. Initially, it was a challenge to keep track of the logistical processes, but thanks to the active training and support of my colleagues, I quickly familiarised myself with them. Once a year, I am also responsible for dispatching the Christmas presents. Together with my colleagues from the marketing department and the warehouse, we manage the x-mas challenge every single year.

I like to spend my free time in nature, especially in the mountains of Austria - always with me: my Jack Russell Terrier, he has been with me for almost 17 years and we have already covered many kilometres and metres of altitude together.

I prefer the cold season as I also enjoy snowshoeing and, unfortunately far too rarely, skiing. I would like to learn another winter activity, namely ice swimming, I've read a lot about it but I don't quite dare to go into the cold water yet, but let's see what next winter brings.

D01

Madelene Dvorak, +43 1 86305 326
madelene.dvorak@codico.com

Mikael Eriksson

Dear Impulse Readers! I've been with CODICO for over two years now and am responsible for Active Components. Together with my colleagues in the Stockholm office, we cover Sweden, Finland, Norway, Denmark, and the Baltics.

I started my career in electronic distribution over thirty years ago. During these years, I've worked with different distributors: Arrow, Avnet, and Rutronik. I hope to contribute to the team with the knowledge I've built up during the years.

CODICO is a relatively new distributor in the Nordic region, which presents an interesting challenge to build business with new customers. To achieve this, it's important that we are active and visible at exhibitions, in electronic magazines, and during customer visits. With our strong linecard featuring suppliers who are top in their respective markets, we have a good chance to attract customers. This is also the feedback I receive from the market.

Looking at my project list after these years, I see many customers I've never heard of before, indicating that electronics are entering new markets constantly. This is why I'm still in the distribution of electronics. I've tried a few times to leave this market but have always come back. I appreciate the long-term relationships built with customers, working on both projects and ongoing businesses. You can't do all of this alone, so working closely with our suppliers and their expertise is crucial. Additionally, the strong support from within the CODICO organisation – project managers, field application engineers (FAEs), inside sales, and other departments – is invaluable.

On the personal side, I'm married with two grown-up children and a nine-month-old granddaughter. My wife and I live in a house about 30km north of Stockholm. In my free time, I enjoy running in the forest and working out in our garage where we've set up a gym. Golf is a significant interest for me, and my local golf club is just 2km from home. I also enjoy listening to all kinds of music and finding moments to play the instruments I have at home – synthesizer, saxophone, harmonica, and guitar.

Four times a year, CODICO invites all employees for a week of training during Academy Week, which I find unique. It provides the opportunity to meet suppliers, project managers, FAEs, and other colleagues. Being well-trained gives confidence in daily work.

From the beginning of my time at CODICO, I've felt a genuinely friendly atmosphere in the company, which has made me feel very welcome. Building up new markets like we're doing in the Nordics takes time, but I'm confident we will succeed. I hope to continue working here for many years to come and contribute to the team.

D02

Mikael Eriksson, +46 705670183
mikael.eriksson@codico.com

Claudia Winkler

Dear Impulse readers, my name is Claudia Winkler and I am a Management Assistant at CODICO. I started at CODICO in January 2019 as HR Generalist and in August 2020 I switched to my current role – Assistant to the Management Board. I am delighted to be able to introduce myself to you this time as Sven Krumpel's »antechamber lady« – as I can also clear up a few misconceptions at the same time.

First of all: Yes, I have my own office, that's true. However, it is not – as is often assumed – directly in front of Mr Krumpel's office, where I reign as the »antechamber dragon«, but next to it. Simply so that the short official channels can be maintained, because close cooperation and repeated consultations with Mr Krumpel are very important in my job. I wouldn't generally describe myself as an »antechamber dragon« and I hope that nobody feels that way. Both Sven Krumpel and I have an open-door policy that is actually practised. I try to have an open ear for all colleagues, support them with their concerns and make their working lives a little easier.

This collaboration is something I particularly enjoy. My work is very varied, so I never get bored. It ranges from the usual assistant activities for the management to fleet management and recruiting support. But when it comes to planning our annual surprise Christmas party, in which only Sven and Karin Krumpel and I are involved, the challenge of realising all the sparkling ideas is sometimes great. The Christmas party is always a surprise for all employees, so we want each one to be as unique as possible – and so far we've always succeeded. Every year, I am delighted when we succeed in realising this and the CODICO family enjoys the evening!

You may be wondering why I am writing CODICO family?I can answer that quite simply: CODICO is a family! A big, loud and perhaps sometimes a little chaotic family, but we are a family! The feeling starts in the morning with the coffee machine and is especially great and lovely when you come back to the office after a few days away and hear: it's great to have you back! We've missed you! You think I'm not telling you the truth?

I can reassure you, I'm not lying and recently heard exactly these words from some colleagues when I returned to the office after a few days away. If you have ever been to our office in Perchtoldsdorf, you may have already experienced this sense of community.

I usually find my balance after work with my family. As an aunt of four, there's always something going on! Whether it's going for a walk with the youngest, who has just been born, or a visit to the trampoline park with the eldest, who recently celebrated his 5th birthday, it doesn't matter to me. It can be pretty much anything and I really enjoy this time. The energy of the little ones is sometimes surprising and wonderful to experience – even if after a day together, after I've left the children with their parents again, I'm usually much more tired as an aunt than the little bundles of energy. I am proud to be part of the CODICO family and look forward to further challenges.

D03

Claudia Winkler, +43 1 86305 115
claudia.winkler@codico.com

Napoleon Bifsa

Dear Impulse readers! After 5 wonderful years in the CODICO family, it is a pleasure for me to introduce myself to you!

My journey began in 1985 in the village of Ilias in southern Albania. I am one of those who left their homeland for a better future, not once, but twice. When I was 5 years old, my family left Albania for a better future in Greece-Thessaloniki. There I discovered my first great passions, basketball and bouzouki (Greek musical instrument), which were to accompany me for many years to come! However, the opportunities in the most beautiful city in Greece were limited and so I moved on to Athens at the age of 17. What began with music as a hobby developed into my profession. Parallel to my studies, I played with my band in various venues for several years. Along the way, I also obtained a bachelor's degree in business administration and a degree in sound engineering. After working in various jobs in Athens, I came to the conclusion that the career prospects in Greece did not meet my expectations and so I moved on, this time to Austria. Quote: »What never happened is what we didn't long for enough«.

When I later joined CODICO, I was impressed by the organisation and the modern facilities from the very first moment. But what impressed me even more was the way the employees, starting with the bosses of the company, Karin and Sven Krumpel, treat each other. Respectful and always ready to help. In the difficult times they stand by your side, in the good times they surprise you! I have got to know many good colleagues and valuable people from different countries and cultures here and I always find it fascinating to talk to everyone!

At CODICO I work in the warehouse. This means that I am responsible, together with my colleagues, for the correct processing of our goods traffic. We attach great importance to accuracy and quality and are therefore an important link in our company's customer service chain (Customer Service Operations). Thanks to the latest automated systems (warehouse management software, AKL) available to us, the entire process of storing - processing - despatching goods is considerably faster and easier for us. But despite the pressure or tiredness that sometimes accompanies us, there are many moments of spontaneous laughter! One of my personal highlights at the company is the Academy Week. This takes place roughly every three months and makes everyday life in the company a little livelier. The highlight is the annual Christmas party. Here, all employees enjoy celebrating together, dancing, having fun and the endeavours of our management to entertain us in the best possible way.

As a person, I am characterised by optimism, but always accompanied by critical thinking. Also the need to do things my own way and the will to develop and strive for new challenges because I can't stand the monotony! At CODICO there are opportunities for professional development and that motivates me a lot. In my free time (when I'm not playing with my 5-year-old daughter Viktoria), I play basketball, go on day trips with my family to various places of interest or simply out into nature. I enjoy reading recommended books and when I'm back home in my village, I like fishing, snorkelling and beekeeping.

In conclusion, I would like to say that I enjoy my job and look forward to many new challenges. CODICO's values, »responsibility, family, dynamism«, make me proud and happy to be part of this great family. At the end of the day, it's not the destination that matters, but the journey...

D04

Napoleon Bifsa, +43 1 86305 214
napoleon.bifsa@codico.com

CODICO GmbH | Zwingenstrasse 6–8 | 2380 Perchtoldsdorf | Austria
Phone: +43 1 86 305–0 | Fax: +43 1 86 305–5000
office@codico.com | www.codico.com