

ENGLISH

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 **electronica 2024**  
Messe München | November 12-15  
VISIT CODICO @ BOOTH C3.558



# Robotics: Qualcomm's New Development Kits

RUBYCON's E-Cap Evolution  
FunctionMAX From HIROSE

# CONTENTS



## 14 | Robotics: Qualcomm's New Development Kits

Qualcomm Technologies has launched the new Qualcomm® RB3 Gen 2 and Qualcomm® RB3 Gen 2 Lite development kits, offering cutting-edge AI performance for industrial and robotics applications. These kits enable quick and easy development of innovative products focusing on energy-efficient edge AI and industry-leading performance.

## ACTIVE COMPONENTS

- 04** | SYNAPTICS' Family of SoCs for AI-native Embedded Computing
- 07** | RECOM – Medical Power Supply with Household Appliance Approval
- 08** | Introduction: AMPAK's new SOM AP72611
- 10** | Two revolutionary IoT Device Families from Qualcomm Technologies
- 13** | Wi-Fi7: COMPEX introduces new DBS Modules
- 14** | The Qualcomm® RB3 Gen 2 and Qualcomm® RB3 Gen 2 Lite Development Kits
- 18** | MPM54322 – Powering FPGAs with Dual-Output Modules
- 22** | Robust Audio Vibration Sensor from KNOWLES
- 23** | QUECTEL: High-Performance LoRa Module KG200Zen
- 24** | Ready for the Future: QUECTEL's Wi-Fi6/6E Modules
- 26** | SENSEAIR – Platform for Detecting Refrigerant Leaks
- 27** | SILVERTEL's High-Power PSE Modules on »Golden Blocks«
- 28** | Ultra Small 60V 300mA Buck DC/DC from TOREX



## PASSIVE COMPONENTS

- 31** | SUNCON: High-Performance THT Hybrid Capacitors
- 32** | EATON's New High-Voltage AC and DC Overcurrent Protection
- 34** | The new ZLR, AEW, and LEW Series from RUBYCON
- 36** | RUBYCON's MXZ Series: 10% More Capacity at the Same Size
- 38** | ISABELLENHÜTTE: Precision in Low-Resistance Values
- 40** | Miniaturised High-Capacitance Hybrid Capacitors from PANASONIC
- 42** | PANASONIC: Electronic Ballasts & LED Drivers
- 44** | Lighting Loads Control: CELDUC's Solid State Relays

## CONNECTORS

- 46** | AMPHENOL: Applications for Battery Connectors
- 48** | DINKLE's 0105 Series: The Heart of Energy Storage Systems
- 50** | Pioneering Energy Storage Solutions from SINBON
- 52** | AMPHENOL: PCI Express® Flip CEM Edge Card Connector
- 53** | YAMAICHI's Y-Circ P Series with Additional Crimp Contacts
- 54** | FunctionMAX Floating Board-to-Board Connectors from HIROSE
- 56** | HIROSE's ZG05HV – For High Temperatures & Voltages
- 57** | Waterproof: The CPT1 Series from CVILUX
- 58** | SOURIAU's UTL 4W4

## CODICO IN-HOUSE

- 03** | CODICO is Distributor of the Year
- 59** | 8 Years of CODICO Sample Shop
- 60** | CODICO electronica 2024 Calendar
- 62** | CODICO Team

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# Distributor of the Year

For the 17th time, the trade magazine 'ELEKTRONIK' presented the »Distributor of the Year« awards. On July 23, 2024, we were proud to receive a total of four awards in Munich. We were honored in the following categories:

- Special award for »Sustainability«
- Overall performance in the category Specialist Distributor for Semiconductors, Embedded, Displays, and Components
- Supply Chain Performance in the category Specialist Distributor for Semiconductors, Embedded, Displays, and Components
- Digitalization in the category Specialist Distributor for Semiconductors, Embedded, Displays, and Components

»I am truly delighted that we were recognized in such important categories this year. I would like to thank the 'ELEKTRONIK' readers for their votes and the entire CODICO team for their dedication,« said CODICO CEO Sven Krumpel, expressing his gratitude for the awards.



Thank you for voting for us! Our awards in the 2024 »Distributor of the Year« election highlight our ongoing commitment to excellence in supply chain performance and digitalization. They reinforce our position as a reliable partner and innovation leader. We are particularly proud of the sustainability award, which validates our holistic approach and dedication to sustainable and social initiatives.

**D01**

▼ Birgit Punzet, +43 1 86305 209  
birgit.punzet@codico.com



Sven Krumpel  
CEO CODICO

# Editorial

## Good News

Dear Readers,

I'm excited to kick off this edition with some great news! Lately, it feels like most of the media is filled with negative stories and developments. In the midst of this, we often lose sight of the many positive topics that deserve to be shared and that can offer us a fresh perspective on the world.

In addition to the Distributor of the Year award (see also the article on the left), CODICO was also honored with the 'Elektronik' magazine's Jury Award for »Sustainability«! The jury recognized our Central Park – a 12,000m<sup>2</sup> area featuring outdoor workspaces, sports zones, corporate farming areas, a swimming pond, a garden kitchen, and plenty of room for socializing. They highlighted our commitment to »not just using the space for profit but creating something sustainable and long-lasting in harmony with the needs of our employees.« This award truly means a lot to me. It's important for us to provide the flexibility of home office and the perks of remote work, but at the same time, create an attractive office environment where employees genuinely enjoy coming to work. I'm always happy when I can meet my team face-to-face.

For us, sustainability is not just a trend or buzzword – it's deeply rooted in our corporate culture. We firmly believe that as a company, we have a responsibility in ecological, economic, and social terms. This award affirms that we are on the right track with our thinking and actions.

However, this prize is not the end of our sustainability journey, and we won't be resting on our laurels. Rather, I see it as motivation to continue contributing to more »Good News,« driving progress, and inspiring trust, motivation, and innovation.

And one more positive note: We warmly invite you to visit us at electronica 2024 in Munich, Hall C3, Booth 558. We'd be happy to send you a free entry ticket, just email us at [marketing@codico.com](mailto:marketing@codico.com). We look forward to meeting you!

▼ Sven Krumpel





# ASTRA

## SYNAPTICS ASTRA™ Family of SoCs & SDK for AI-Native Embedded Compute



synaptics

Founded to advance the state-of-the-art in artificial neural networks (ANNs), SYNAPTICS has compiled a rich portfolio of AI technologies that it infuses across all its product lines, including the fast-growing Edge AI segment of the IoT. Early on, the three key elements of every IoT platform were emphasised: sensing, processing, and connectivity.

**1. Sense:** This domain focuses on developing technologies that enable devices to perceive the environment and user inputs more naturally and intuitively, whether through vision, sound, touch, voice, or other sensory inputs.

**2. Process:** Here, SYNAPTICS emphasise the importance of processing these inputs effectively. Our technologies ensure that Edge devices understand user commands and respond to them quickly, intelligently, and efficiently.

**3. Connect:** The third domain is about connectivity. SYNAPTICS has developed various best-in-class wireless connectivity solutions that ensure seamless and robust communication between devices, facilitating a more interconnected and smarter environment.

While working to develop next-generation IoT device user experiences, it became clear that AI was becoming an increasingly important part of customers' Edge device strategy. Yet those customers found available solutions fragmented, poorly supported, and ultimately unsatisfactory given the power, performance, cost, and time-to-market constraints.

This led SYNAPTICS to use its expertise in AI, hardware, software, and tools to present the Astra »AI-Native« compute platform of the IoT at the embedded world 2024 conference. Astra extends the company's long history of Edge AI innovation, from early work on touchpads to more recent work on AI for multimedia processing,

feature extraction, voice and image analysis, and PCs. This work has been applied to Astra to form a general-purpose AI platform explicitly designed to enable rapid development and deployment of a vast array of Edge AI applications.

Astra answers the need of Edge AI application developers for a new generation of high-performance, accelerated platforms for embedded computing, with appropriate and carefully tuned performance, power, connectivity, I/O, and cost profiles. Embedded AI platforms need five fundamental components: accelerated and scalable SoC hardware, a complete kit of platform software, standards-based wireless connectivity, a robust AI framework, and a thriving partner ecosystem.

The Astra platform marks a significant step forward in the commitment to enhancing intelligent device capabilities. It's built on five fundamental pillars:



The five fundamental pillars of the Astra platform

**1. Compute Solutions:** Astra offers advanced microprocessors and microcontroller units designed specifically for high-performance and low-power IoT applications.

**2. Adaptive AI Framework:** The framework adapts to various AI workloads, optimising performance across a range of devices and applications.

**3. Unified Software Experience:** It provides a cohesive software environment that simplifies development and deployment, ensuring developers can focus on innovation rather than integration.

**4. Partner Solution Ecosystem:** Astra is supported by an extensive network of industry partners, creating a robust ecosystem that enhances the platform's capabilities and integration opportunities.

**5. Wireless Connectivity:** Critical for IoT, Astra includes built-in support for the latest wireless standards, ensuring devices are always connected and data is seamlessly transferred.





### The SYNAPTICS Family of Edge AI processors

These processors are at the core of SYNAPTICS' innovation, offering both performance and efficiency for Edge computing:

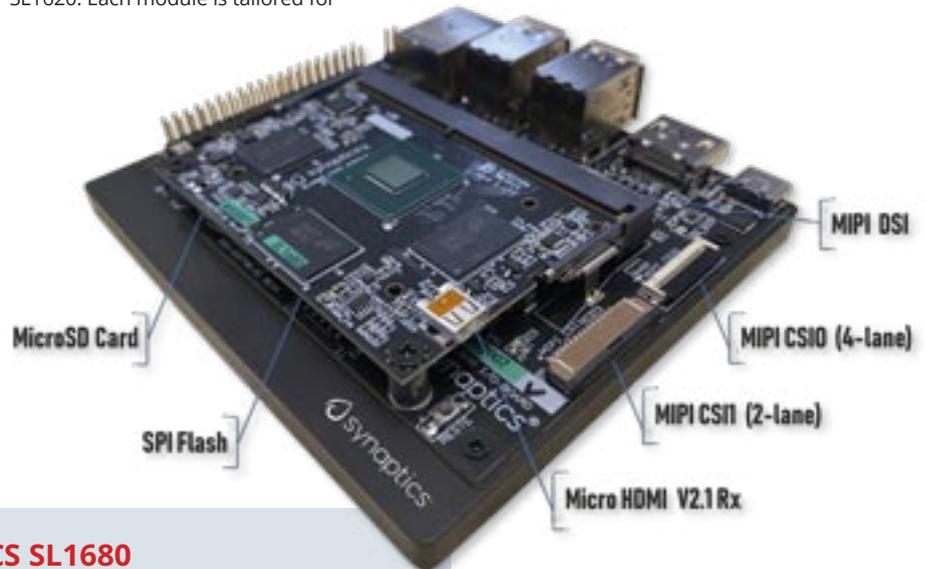
- 1. High-Performance MPUs and MCUs:** The microprocessor units (MPUs) and microcontroller units (MCUs) are designed for high-speed, efficient processing, capable of handling complex AI and machine learning algorithms at the Edge.
- 2. Connectivity MCUs:** In addition to processing power, connectivity is key in Edge devices. The MCUs are equipped with integrated support for various communication standards like Wi-Fi, Bluetooth LE and Zigbee, ensuring that devices can communicate seamlessly in a distributed network.

SYNAPTICS provides the Astra Machina™ Foundation Series development kit for evaluation and software development. This development kit is

specifically designed to streamline and enhance the process of building, testing, and optimising applications on the Astra platform.

#### THIS KIT COMPRISES

**1. Core Modules:** These are three interchangeable core modules – the SL1680, SL1640, and SL1620. Each module is tailored for



different performance and power requirements, providing scalability and flexibility in application developments.

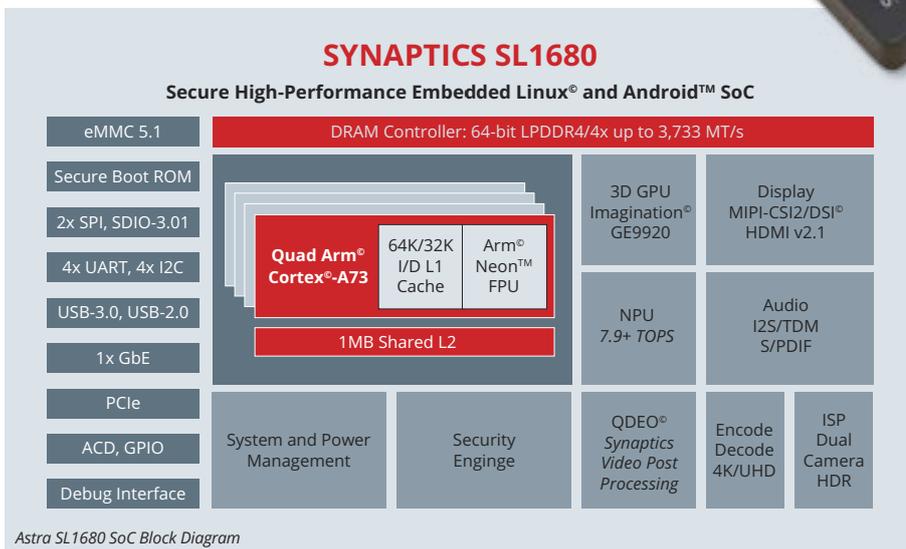
**2. Common I/O Board:** The I/O board is the foundation for the core modules, featuring all necessary I/O connections and supporting a wide array of peripherals and expansion options.

#### THE SOCS IN DETAIL

- The SL1680 is based on a quad-core Arm® Cortex®-A73 64bit CPU, a 7.9 TOPS NPU, a high-efficiency, feature-rich GPU, and a multimedia accelerator pipeline. It is ideal for home and industrial control, smart appliances, home security gateways, digital signage, displays, point-of-sale systems, and scanners.
- The SL1640 is optimised for cost and power and is based on a quad-core Arm Cortex-A55 processor, a 1.6+ TOPS NPU, and a GE9920 GPU. It is ideal for smart home appliances, enterprise conferencing, smart speakers, displays and signage, as well as consumer and industrial control panels.

- The SL1620 is also based on a quad-core Arm Cortex-A55 CPU subsystem, a feature-rich GPU for advanced graphics and AI acceleration, superior audio algorithms, and dual display support. Its applications include enterprise multimedia conferencing, smart appliances, home security gateways, digital signage, displays, point-of-sale systems, and smart speakers.

For further information or samples, please do not hesitate to contact us.



**A01**

▶ Achim Stahl, +49 89 1301 439 14  
 achim.stahl@codico.com

## RACM15E-K Series

# DIN RAIL PLUS



### Medical Power Supply with Household Approvals and OVC III.

The RACM15E-K series from RECOM is rated up to 15W output for 80-275VAC input and is available in two mechanical formats. The open-frame (OF) version with »Molex™« connectors, sized 3.1×0.9×0.8 inches (80×23.8×22mm) and a PMAD version with IP20 rated enclosure for chassis or DIN rail mounting and push-in terminals that accept stranded and solid wire, sized 3.2×1.1×1.1 inches (83×26.4×29.5mm). The parts fit a standard 1.5 »module« DIN rail slot with no restriction on spacing to adjacent modules.

The series provides single regulated outputs of 3.3V (12W rated), 5, 12, 15, 24, and 30VDC rated at 15W, all fully protected against over-voltage, overload, and short circuits. In overload, the parts have a constant current limit characteristic, suitable for non-linear loads, with a self-resetting »hiccup« mode for short circuits. The operating temperature range is -40°C to +85°C, derating from 50°C ambient in still air.

The RACM15E-K series comes with the following comprehensive certifications: IEC/EN62368-1, IEC/EN60335-1, IEC61558, and IEC60601-1/ANSI/AAMI ES60601-1 for safety. In medical applications, the parts are rated 2MOPP, over-voltage category II (OVCII) to 5,000m altitude and meet »BF« touch current specifications for applied-part

applications. The parts can be used in OVCIII environments up to 3,000m according to IEC61558-2-16 and IEC60335-1. The no-load current is typically less than 100mW, meeting eco-design requirements and they comply with conducted EMI standard EN55032 Class B with a floating load.

Due to their high efficiency of up to 86%, the RACM15E-K parts are cool-running and achieve long life and high reliability, with an MTBF of over one million hours according to MIL-HDBK-217.

Typical applications for the series include industrial automation, industrial measurement equipment, medical homecare devices, building automation, monitoring, and household equipment.

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

**A02**

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



RACM15E-K Series

# SMARTER CITIES

## SOM AP72611



AP72611 Carrier Board

### New AMPAK SOM based on SYNAPTICS SL1620 SoC and Syn43711 Wi-Fi6E chipsets for Smart Building, Smart City and Smart Home applications.

AMPAK released the AP72611, based on SYNAPTICS SL1620, a member of the new Family of Astra™ enabled SoCs. The SL1620 has an A55 quad-core Arm processor running up to 1.9GHz and an Imagination BXE-2-32 GPU.

The SYNAPTICS SL-series of embedded processors are highly integrated AI-native Linux® and Android™ System on Chip (SoCs) optimised for multi-modal consumer, enterprise, and industrial IoT workloads with hardware accelerators for edge inferencing, security, video, graphics, and audio. The SL1620 is designed and optimised for embedded applications that require powerful processing, advanced AI capability, and 3D gra-

phics. This chip comes with Linux® OS, superior audio algorithms, a variety of peripherals, dual displays, companion SYNAPTICS SoC for connectivity and audio front end.

The SL1620 incorporates high-performance compute engines, including a quad-core Arm® Cortex®-A55 CPU subsystem, a high-efficiency, feature-rich GPU for advanced graphics and AI acceleration, superior audio algorithms, and dual displays. The SL1620 supports the SYNAPTICS Astra™ IoT platform, delivering a unified experience through standards-based approaches, open software frameworks, and full-featured AI toolkits. In combination with SYNAPTICS' wireless

connectivity portfolio, the SL1620 enables cost-optimised system solutions with performance-per-watt benefits for the IoT.

For Connectivity the AMPAK AP72611 has the SYNAPTICS SY43711 Wi-Fi6E 1x1 radio on board. This is a very low-power solution with very high throughput, but also possible to be used in battery-powered applications.

The SYN43711 integrates Wi-FITM 6/6E and Bluetooth™ 5.3 radios on a single state-of-the-art System on Chip (SoC) to reduce the space, cost, power, complexity, and time to market of wirelessly enabled IoT devices. The Wi-Fi radio is IEEE 802.11ax compliant, with legacy support for 802.11a/b/g/n/ac and has a 1x1 antenna arrangement for a throughput of up to 600Mbps. The Bluetooth 5.3 radio features LE Audio, allowing multiple concurrent Bluetooth audio streaming connections.

AMPAK offers a variety of Wi-Fi and Bluetooth modules for the AP72611, ranging from Wi-Fi4



over Wi-Fi up to Wi-Fi6E capable solutions. The following options are available:

- AP6212: Wi-Fi4 SYN43436S combo module
- AP6203BM:Wi-Fi4 SYN430132 combo module
- AP6256: Wi-Fi5 SYN43456 combo module
- AP6611S: Wi-Fi6E SYN43711 combo module
- AP6281S: Wi-Fi6E SYN4381 Wi-Fi, Bluetooth, 802.15.4 (Thread) module

The SOM is supported by the ASTRA SW framework from SYNAPTICS. ASTRA is a comprehensive SW environment that allows for the seamless integration of AI models, including custom models, to run on the Arm quad-core or GPU. The ASTRA framework can be downloaded from GitHub after registration at no extra cost.

An evaluation board with a carrier board for simple prototyping is available in the CODICO Sample Shop.

A03

▼ Achim Stahl, +49 89 1301 438 14  
achim.stahl@codico.com

#### AP72611 PRODUCT FEATURES, INTERFACES AND MEMORY CONFIGURATION

##### CPU

- Quad-core Arm® Cortex®-A55 up to 1.9GHz

##### GPU

- Imagination™ BXE-2-32 / Dual-core (2 pixels per clock)
- Clock frequency up to 800MHz
- Supports OpenGL® ES™ 3.2, OpenCL™ 3.0, EGL™ 1.5, Vulkan® 1.3, Android™ NN API through IMGDNN AP

##### SECURITY

- On-chip 32KBit anti-fuse OTP
- True random number generator
- DRM engine supports
- AES, DES, 3DES, SHA1/SHA2/MD5, RSA, ECC

##### AUDIO

- TDM/PDM and DVFA audio
- 8 to 96/192KHz and slot size 8/16/24/32bit

##### MEMORY INTERFACES

- DRAM 32Bit DDR4-2666 up to 8GB memory space
- 4GB NAND 8Bit parallel SLC (64Bit ECC per 2KB of data)

##### PERIPHERALS

- One USB 3.0 Host and One USB 2.0 On-The-Go (OTG) Interface
- Four TWISI 2-wire buses (I2C compatible) and two high-speed UART Interfaces
- Two SPI controllers, with up to four slave devices supported on each Interface
- 72Bit pin-shared GPIOs
- Rectangular keyboard matrix controller up to 80 keys (8x10)
- 4 PWMs and on-chip temperature sensor

##### VIDEO/DISPLAY INTERFACES

- MIPI Display Serial Interface (DSI) up to 1080p60 screen resolution
- RGB Digital Parallel Interface (DPI) / CPU-type Display Bus Interface (DBI)
- RGB 16bpp (565), 18bpp (666) and 24bpp (888) output formats
- 1080p30 screen resolution and refresh rate

##### ETHERNET

- 802.3 (G)MAC supports RGMII and RMII
- 802.1 p/q tagging (VLAN) in hardware
- IEEE 1588 Precision Time Protocol (PTP) with PPS output signal

##### IEEE 802.11 KEY FEATURES

- TX and RX low-density parity check (LDPC) support for improved range and power efficiency
- Dual-stream spatial multiplexing up to 1200Mbps data rate
- 20/40/80MHz channels for 5GHz and 6GHz radio, and 20MHz channels for 2.4GHz radio
- Client MU-MIMO

##### BLUETOOTH KEY FEATURES

- Complies with Bluetooth Core Specification Version 5.3, with provisions for supporting future specifications
- With Bluetooth Class 1 or Class2 transmitter operation



# EFFICIENT

## Qualcomm Technologies Introduces Two Revolutionary IoT Device Families



Qualcomm Technologies, Inc. introduces two Wi-Fi IoT device families that create new opportunities to make IoT devices more power-efficient and compact in terms of energy savings and integrated features. The Qualcomm® QCC730 family with its Wi-Fi4 dual-band capability is aimed at extremely energy-sensitive battery applications, which extends conventional operating times many times over. The Qualcomm® QCC74x family, with its tri-radio approach and multimedia features, has been optimised for applications where high multifunctionality is required in the smallest form factor, because devices with QCC74x are true all-rounders.

### QCC730

#### Up to 88% Energy Saving

##### Wi-Fi4, dual-band

The new IoT Wi-Fi4 SoC QCC730 offers power savings of up to 88% compared to previous in-house IoT products thanks to the new 22nm ultra-low-leakage (ULL) process from TSMC and a new power management system developed by Qualcomm Technologies. This significantly extends battery life, which is increasingly required in applications such as wireless cameras, video doorbells, door locks, sensors, smart buildings and smart tags.

QCC730 is based on an Arm® Cortex®-M4F processor, which is clocked at 60MHz and has access to 1.5MB RRAM (NVM) and 640KB SRAM. RRAM is referred to as Resistive Random Access Memory, a non-volatile electronic RAM memory type that stores information by changing the electrical resistance of a weakly conductive dielectric. Of the 1.5MB, 600KB are available for the application. However, the non-volatile memory space can be expanded using XiP (eXecute in Place) via the integrated QSPI interface. XiP technology enables the processor to execute program code directly from an external serial flash memory without having to copy the code to RAM first.

The TCP/IP stack runs on the M4F processor, layer 2 (MAC) and layer 1 (PHY) are designed as dedicated HW and support Wi-Fi4 in dual band mode (1×1 DB 2.5GHz and 5GHz). In order to keep the power in radio operation as low as possible, the performance of the transceiver has been throttled to HT20 and MCS3 (Modulation Coding Scheme), which limits the transmission bandwidth to 20MHz and only allows a maximum of 16-QAM symbol modulation and a coding rate of ½. Nevertheless, these parameters result in a maximum TCP/UDP data throughput of 16/23Mbps, which should be more than enough for the IoT applications mentioned above. In addition, MCS 3 favors a much more robust



transmission compared to higher indices in terms of SNR and RSSI sensitivity, which results in higher reliability, range and security.

In order to place greater emphasis on security, all security algorithms have been implemented as dedicated hardware, not least to speed up their execution and save energy. These include among others Secure Boot, Secure Storage and Trusted Execution Environment (TEE).

Up to 15 GPIOs are available to the user, whereby various serial interfaces such as SPI, Master QSPI, I2C and UART can be freely assigned to the GPIOs using a multiplexer.

QCC730 can be used in hostless and hosted mode. Hostless means that no additional external intelligence or memory is required. The application runs directly on the device, freeRTOS is available as an operating system. QCC730 can sup-

port hosted mode, however there are two types of hosted mode, Radio Co-Processor (RCP) and Network Co-Processor (NCP). For hosted RCP mode, the user application and the full radio stack resides on the external Host, whereas for the hosted NCP mode, the radio stack is still on the QCC730 and only the user application run from the external Host.

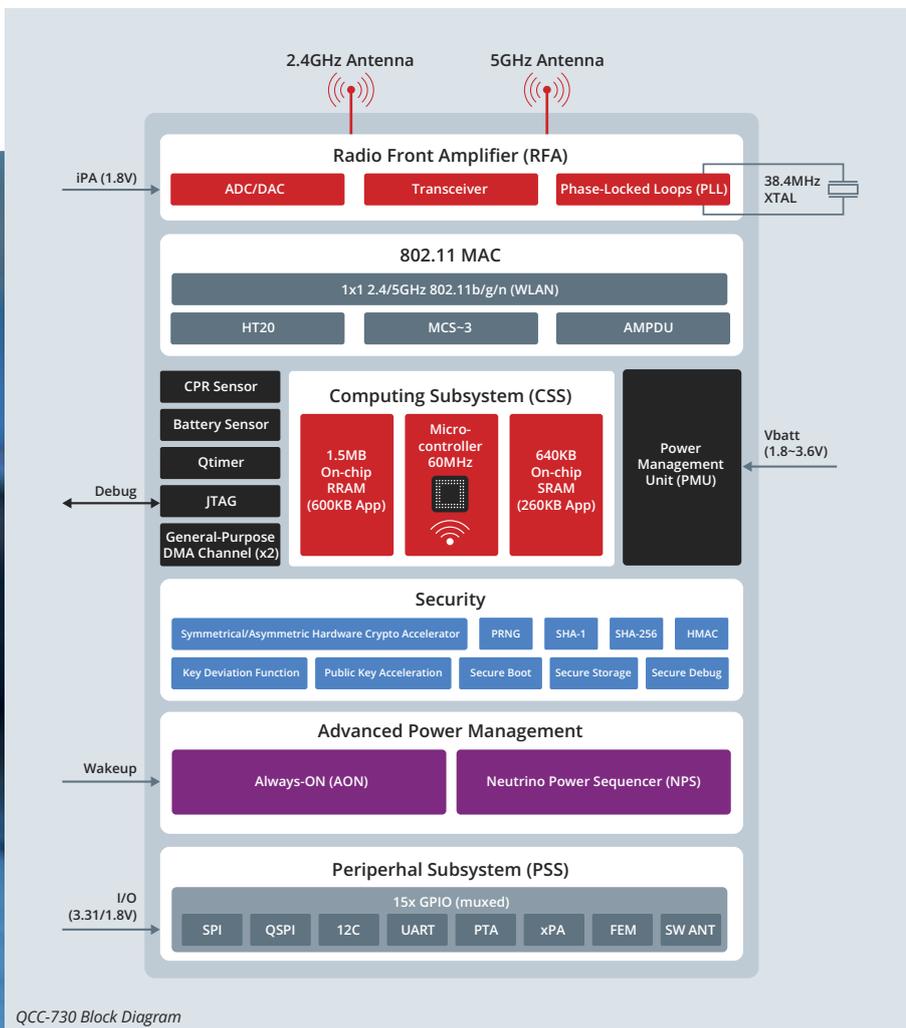
The device is offered in a 3.3×3.58×0.55mm, 0.35mm pitch, 90-ball WLCSP package.

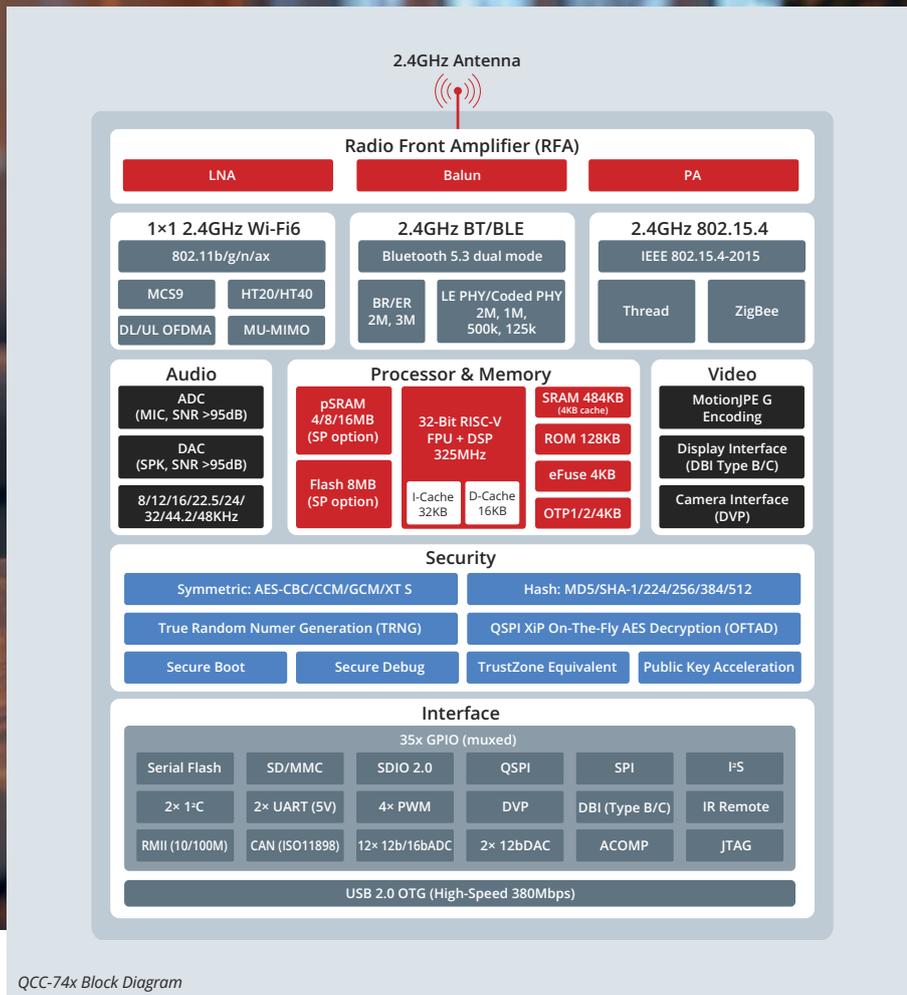
## QCC74x

### Tri-Radio + Multimedia

[Wi-Fi6] + [Bluetooth/BLE 5.3] + [OpenThread 1.3/ZigBee-ready 3.0]

Compared to the QCC730 family, the QCC740 family goes one step further and offers Bluetooth 5.3 qualifications and IEEE 802.15.4 (Thread and Zigbee-ready) in addition to Wi-Fi6. But unlike conventional tri-radio combination chipsets on the market, the new QCC740 family is offered with a wide range of on-chip features, including a powerful 32-bit RISC-V microcontroller (FPU + DSP) up to 325MHz with 48KB cache, 484KB



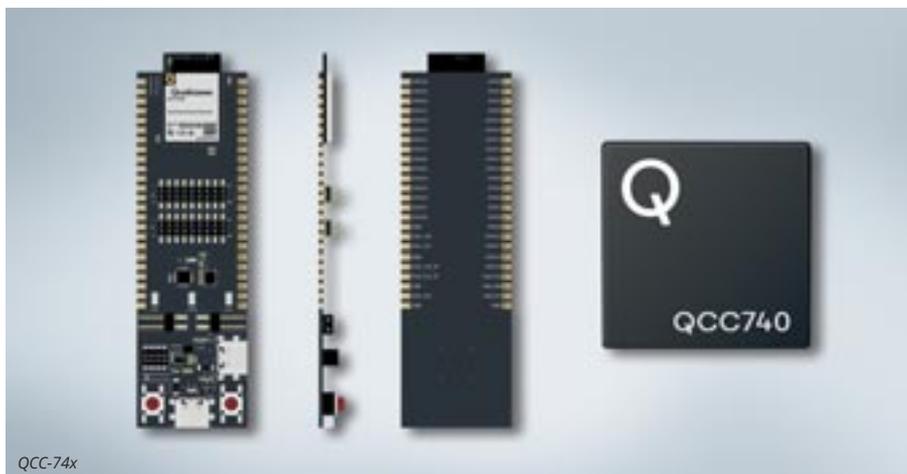


QCC-74x Block Diagram

SRAM and 128KB ROM, as well as optional 4/8/16MB pSRAM and 8MB NOR Flash System-in-Package (SiP). In addition, the new device family offers multimedia functions such as audio/video codecs and interfaces and up to 35 GPIOs that support many digital but also analog interfaces such as QSPI, SDIO, SD card, SPI, UART, I2C, I2S, PWM, 12-bit ADC, 12-bit DAC, ACOMP, IR remote, RMII (10/100 Ethernet), CAN (ISO11898). The integrated security engine also supports nu-

merous security services such as Secure Boot/Debug, Hash, AES, True Random Number Generation (TRNG), Trusted Execution Environment (TEE), On-the-Fly AES Decryption (OTFAD) and public key accelerators.

This all-in-one design approach and the resulting features make this device family an attractive choice for applications where high performance and security are required at reduced cost, such



QCC-74x

as smart appliances, industrial IoT, smart home devices, medical devices and IoT hubs/gateways. In order to meet as many of these applications as possible, Qualcomm Technologies offers various versions that differ in the following characteristics:

- Housing: [QFN-56, 7x7x0.85mm, 0.4mm pitch] or [QFN-40, 5x5x0.85mm, 0.4mm pitch]
- pSRAM: 0/4/8/16MB
- Flash: 0/4/8MB
- Temperature range: -40 to +105°C without embedded memory) or -40 to +85 °C (with embedded memory)

Development kits are already available in CODICO's Sample Shop.

Qualcomm branded products are products of Qualcomm Technologies, Inc. and/or its subsidiaries.

For further questions please contact:

**A04**

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

# WI-FI7

The new Wi-Fi7 modules WLE7002E25D and WLT7002E25D-E, from COMPEX are based on the QCN6224 and QCN9274-I radio chipsets from Qualcomm's Waikiki series and support MU-MIMO 2x2 on 2.4GHz and 5GHz in DBS (Dual Band Simultaneous) mode.

## Features

- DBS operation: Supports 2.4GHz and 5GHz bands simultaneously
- Standard size form factor: Easy integration into existing systems through Mini-PCIe or M.2 interface via PCIe 3.0
- MLO (Multi-Link Operation): Increases throughput, lowers latency, and improves reliability
- Diplexer design: Combines the 2.4GHz and 5GHz signals into a single dual-band antenna, reducing the number of antennas from four to two
- Open source Ath12k support: Compatible with Qualcomm and third-party platforms such as Marvell, NXP, and x86 platforms
- Industrial temperature range: -40 to +85°C

A05

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

## COMPEX Introduces New DBS Modules

| COMPEX             |                      |  |  |  |  |
|--------------------|----------------------|---|---|---|---|
| MODEL              |                      | WLE7002E25D   | WLE7002E25D-I   | WLT7002E25D-E   | WLT7002E25D-E-I   |
| ORDERING ITEM CODE |                      | WLE7002E25D 7A0624XN-TE   | WLE7002E25D 7B0974XN-I-TE   | WLT7002E25D 7A0624XN  | WLT7002E25D 7B0974XN-TE   |
| Platform           | Chipset Code         | QCN-6224-0-MSP264-TR-01   | QCN-9274-1-MSP264-TR-01-0-01  | QCN-6224-0-MSP264-TR-01   | QCN-9274-1-MSP264-TR-01-0-01  |
|                    | Interface            | PCIe 3.0, miniPCIe  | PCIe 3.0, miniPCIe  | PCIe 3.0, M.2 E Key   | PCIe 3.0, M.2 E Key   |
|                    | Linux Support        | ath12k  | ath12k  | ath12k  | ath12k  |
|                    | Mainline Kernel      | From 5.4.213 upward   | From 5.4.213 upward   | From 5.4.213 upward   | From 5.4.213 upward   |
|                    | Windows Support      | No available  | No available  | No available  | No available  |
| Wi-Fi              | Standard             | Wi-Fi7  | Wi-Fi7  | Wi-Fi7  | Wi-Fi7  |
|                    | Band                 | 2.4GHz & 5GHz, DBS  | 2.4GHz & 5GHz, DBS  | 2.4GHz & 5GHz, DBS  | 2.4GHz & 5GHz, DBS  |
|                    | MIMO                 | MU 2x2  | MU 2x2  | MU 2x2  | MU 2x2  |
|                    | Monitor Mode         | Yes   | Yes   | Yes   | Yes   |
|                    | Power (Per Chain)    | 2.4GHz@20dBm, 5GHz@20dBm  | 2.4GHz@20dBm, 5GHz@20dBm  | 2.4GHz@20dBm, 5GHz@20dBm  | 2.4GHz@20dBm, 5GHz@20dBm  |
|                    | Receiver Sensitivity | TBD   | TBD   | TBD   | TBD   |
|                    | Clients              | 128   | 512   | 128   | 512   |
|                    | Antenna Connector    | 2x U.FL   | 2x U.FL   | 2x U.FL   | 2x U.FL   |
| Spec.              | Power Supply         | 3.3V  | 3.3V  | 3.3V  | 3.3V  |
|                    | Temperature Range    | -20°C to 70°C   | -40°C to 85°C   | -20°C to 70°C   | -40°C to 85°C   |
|                    | Dimension (mm)       | 30x50.8x13  | 30x50.8x13  | 30x52x13  | 30x52x13  |
|                    | Reference Design     | WK03.2  | WK03.2  | WK03.2  | WK03.2  |

# ROBOTICS

## The Development Kits RB3 Gen 2 & RB3 Gen 2 Lite

Qualcomm Technologies' latest releases, the Qualcomm RB3 Gen 2 and Qualcomm RB3 Gen 2 Lite development kits, provide leading edge AI performance for long life industrial and robotics applications.

The newly released Qualcomm® RB3 Gen2 and RB3 Gen2 Lite development kits break new ground in the Industrial market. These development kits incorporate a comprehensive package of hardware and software production ready deliverables provided by Qualcomm Technologies to enable customers to quickly and easily develop exciting new products incorporating low-power edge AI use cases and industry leading performance. The Qualcomm RB3 Gen 2 family of kits are built around the highly integrated Qualcomm® QCS6490 and Qualcomm® QCS5430 processors from Qualcomm Technologies which deliver integration and performance for battery powered handhelds, tablets, Edge boxes and other Edge AI applications.

In this article we will firstly describe the Qualcomm RB3 Gen 2 development kits in some detail from a hardware and supporting software perspective and we will explore the Qualcomm® processor capabilities and supporting software components which complement these exciting new development kits from Qualcomm Technologies.

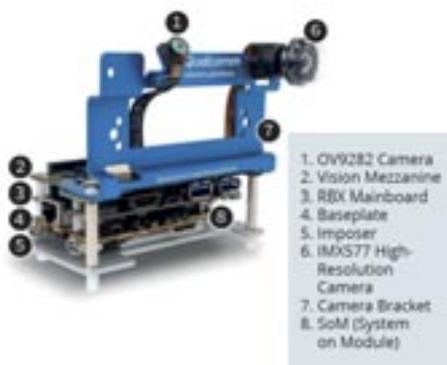


Figure 1: Qualcomm RB3 Gen 2 and Qualcomm RB3 Gen 2 Lite development kit overview

Firstly, a look at the development kits (Figure 1 and 2).

The Qualcomm RB3 Gen 2 and Qualcomm RB3 Gen 2 Lite hardware development kits are compliant with the 96Boards open hardware speci-

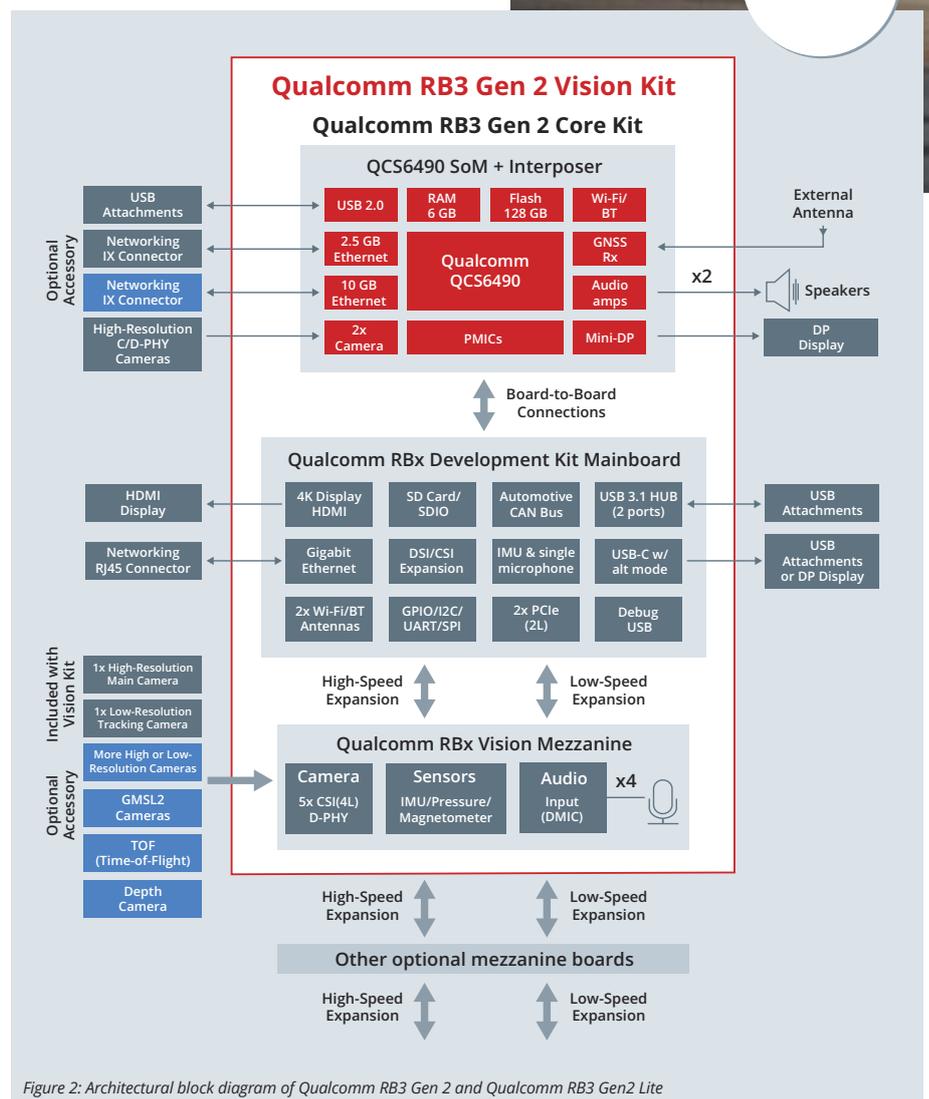
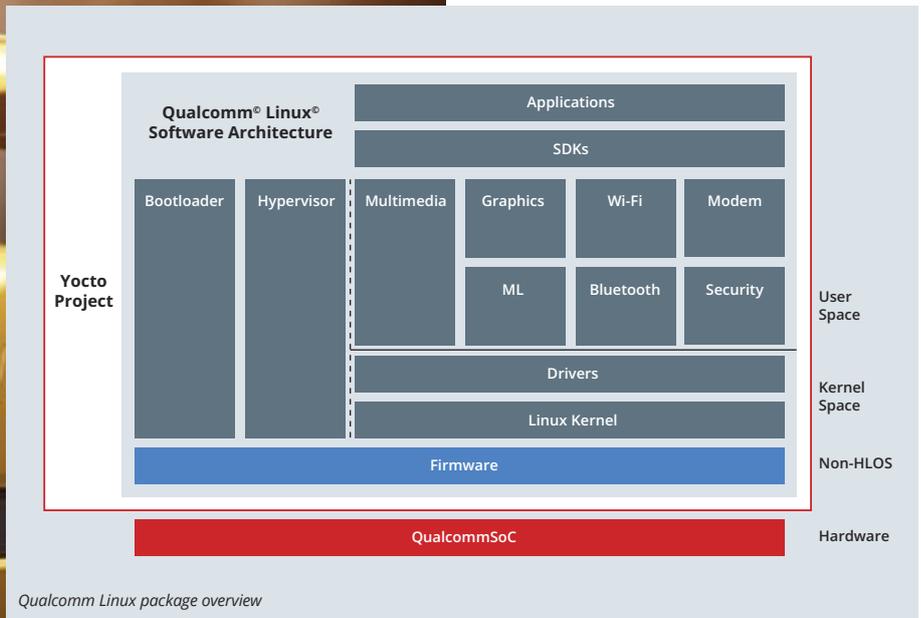


Figure 2: Architectural block diagram of Qualcomm RB3 Gen 2 and Qualcomm RB3 Gen2 Lite



Qualcomm Linux package overview

fication which means they have been architected as a collection of stacked, interconnected mezzanine boards. The hardware included in the Qualcomm RB3 Gen 2 and Qualcomm RB3 Gen 2 Lite kits consists of a mainboard connected to a SOM and interposer board which hosts the QCS6490 processor on the Qualcomm RB3 Gen 2 and the QCS5430 processor on the Qualcomm RB3 Gen 2 Lite. The processor capabilities and differences will be covered later in this article.

The SOM incorporates other important components required such as power management, RAM and Flash memories as well as high performance and wireless connectivity. Additionally, a vision mezzanine is provided which incorporate two pre-integrated cameras, a high-resolution camera based on the Sony IMX577 image sensor and for robotics and tracking applications a camera based on the OV9282 image sensor. The Qualcomm RB3 Gen2 and RB3 Gen2 lite have been designed to additionally support 5G on a mezzanine for cellular connectivity and also a sensor mezzanine which incorporates IMU, magnetometer, pressure sensor support as well as microphone support

for audio applications. The 5G and sensor mezzanines are not provided by default and must be ordered separately. In order to enable customer to develop their products more quickly, the design files for the Qualcomm RB3 Gen 2 and Qualcomm RB3 Gen 2 Lite have also been made available for customers on Qualcomm.com.

Both the Qualcomm RB3 Gen 2 and Qualcomm RB3 Gen 2 Lite are offered as Vision Kits and Core Kits here is a table showing the differences between the two.

| VISION KIT  | CORE KIT                        |
|---|---------------------------------|
| Mainboard with SOM + Interposer                     | Mainboard with SOM + Interposer |
| 12V power supply                                    | 12V power supply                |
| USB-C cable   | USB-C cable                     |
| Mini speakers                                       | Mini speakers                   |
| Mounting bracket for Vision Mezzanine               |                                 |
| Vision Mezzanine (Includes IMX577 & OV9282 sensors) |                                 |

The exciting hardware of the Qualcomm RB3 Gen 2 and Qualcomm RB3 Gen 2 Lite develop-

ment kits, are supported by a comprehensive and highly documented set of tools and SDKs have been integrated into an LTS Yocto Linux distribution which is known as Qualcomm® Linux® software stack. The Qualcomm Linux is based on a Long Term Support (LTS) kernel which means developers have software support for security patches and bug fixes over the long product life-cycles of industrial devices.

Building upon the Yocto Linux OS and middleware, Qualcomm Technologies has incorporated a set of dedicated product and function SDKs to enable engineers to leverage the full features and performance of the Qualcomm RB3 Gen 2 and Qualcomm RB3 Gen 2 Lite kits for their vertical applications. A short summary of the SDKs is listed below.

| PRODUCT SDKS                                 |  |
|--|--|
| Qualcomm® Intelligent Multimedia Product SDK | Dedicated to delivering the camera, video and AI capabilities of the QCS6490 and QCS5430 SOCs      |
| Qualcomm® Intelligent Robotics Product SDK   | Dedicated to delivering ROS and VSLAM support on the QCS6490 and QCS5430 for Robotics applications |
| FUNCTION SDKS                                |  |
| Qualcomm® Neural Processing SDK              | Tools and an environment to run deep neural networks   |
| Qualcomm® AI Engine Direct SDK               | API and modular accelerator libraries to support AI software development                           |
| Qualcomm Intelligent Multimedia SDK          | Providing hardware accelerated plugins for camera, video and graphic applications                  |
| Qualcomm Intelligent Robotics SDK            | Provides functional Robot Operating System (ROS) nodes   |



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Another important software resource for the Qualcomm RB3 Gen 2 and Qualcomm RB3 Gen 2 Lite kit is the Qualcomm® AI Hub which is a platform designed to streamline the development and deployment of artificial intelligence (AI) applications directly on devices powered by Qualcomm Technologies processors. It offers a collection of pre-optimized AI models and tools to help developers create efficient and high-performing

AI solutions. The Qualcomm AI Hub provides a variety of cutting-edge machine learning models tailored for specific tasks like vision, speech, and natural language processing. These models are optimized for performance and efficiency on devices with Qualcomm® Technology. This exciting platform simplifies the development process by offering tools and resources to convert and optimize AI models for different Qualcomm Techno-

logies processors. This saves developers time and effort by leveraging pre-optimized models and development tools. The Qualcomm AI Hub models are designed to run efficiently on devices with Qualcomm Technology, providing optimal performance and battery life. In summary, Qualcomm AI Hub aims to make it easier for developers to create innovative AI applications that take full advantage of the capabilities of devices powered by Qualcomm Technology.

| Qualcomm RB3 Gen 2   |   | Qualcomm RB3 Gen 2 Lite   |   |
|--|---|---|---|
| <b>QCS6490</b>   |   | <b>QCS5430</b>  |   |
| Purpose-built with support for multi-OS and Wi-Fi6E, powerful connections and reduced latency, accelerated AI and expanded interfaces for IoT industrial and commercial use cases. |   | Built to support Wi-Fi6E for premium connectivity, high-level performance, and edge-AI-powered camera capabilities with the option to upgrade features over-the-air via software now or later, according to your product needs. |   |
|   | <b>CPU</b><br>1×A78@2.7GHz<br>3×A78@2.4GHz<br>4×A55@1.9GHz  |    | <b>CPU</b><br>2×A78@2.1GHz<br>4×A55@1.8GHz                |
|   | <b>GPU</b><br>A643@812MHZ<br>(MH3.0 95+ fps)                |    | <b>GPU</b><br>A642L@315MHZ<br>(MH3.0 45-48fps)            |
|   | <b>AI-cDSP</b><br>2×HVX 4K-HMX 1.45GHz<br>(12.15 INT8 TOPS) |    | <b>AI-cDSP</b><br>2×HVX 2K-HMX 912MHz<br>(~3.5 INT8 TOPS) |
|   | <b>Display</b><br>FHD+ 144Hz                                |    | <b>Display</b><br>FHD+ 120Hz                              |
|   | <b>Camera</b><br>3×22MP/36 + 22 MP 30                       |    | <b>Camera</b><br>2×22MP30 + 2IFE-lite                     |

The power behind the Qualcomm RB3 Gen 2 and Qualcomm RB3 Gen 2 Lite development kits is found in the Qualcomm Technologies’ processors powering these kits. Let’s have a look at the major differences between the QCS6490 and QCS5430 and the benefits of selecting these SOCs for your next intelligent Edge AI product.

The QCS6490 and QCS5430 are pin for pin compatible processors targeting different segments and products in the IoT industry. As you can see above the major performance differences lie in the CPU, AI and Camera ISP performance. The architecture is common across both devices which means a customer can reuse their hardware and software investment across both devices for different products.

The QCS5430 offers additional benefits in the form of feature packs that enable incremental

|  |   |   |   |
|--|---|---|---|
| <h3>FP1</h3> <p>Comes pre-loaded on the RB3 Gen 2 Lite Development Kits. Good for retail point of sale, ECR, panels, and Kiosks.</p> | <h3>FP2</h3> <p>Provides increased CPU capabilities. Mid-tier option for Industrial handhelds and dash cameras.</p> | <h3>FP2.5</h3> <p>Mid- to high-Tier option for AI/Edge box, Surveillance, Robotics, and Drone controller use cases.</p> | <h3>FP3</h3> <p>Highest AI capabilities for premium performance. Ideal for AI/Edge box, Surveillance, Robotics, and Drone controller use cases with increased AI needs.</p> |
|--|---|---|---|

Feature packs for the QCS5430

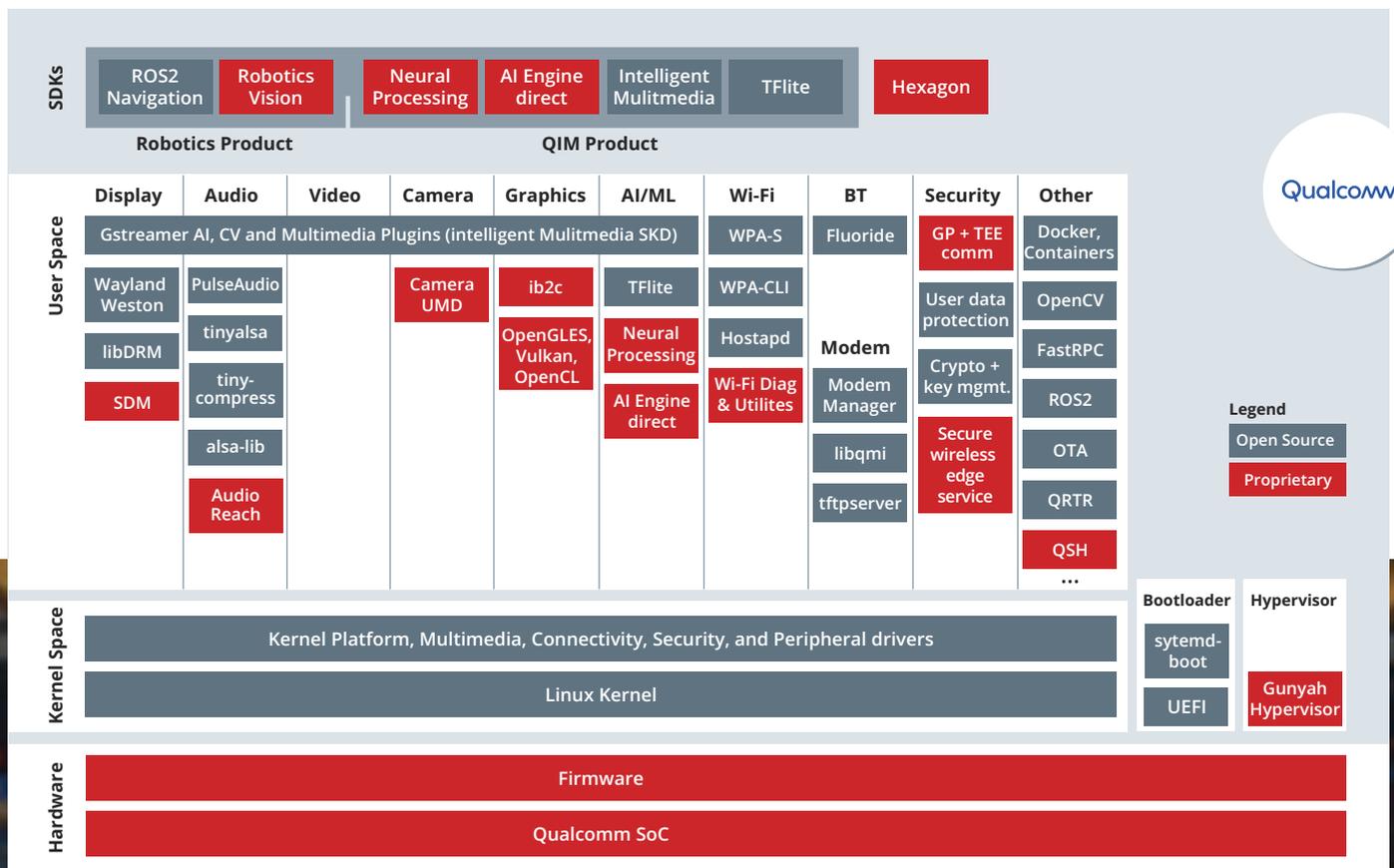
performance upgrades in CPU and AI for customers whose application requires additional compute but where it does not justify the move to the QCS6490. Engineers can experiment with the features packs below via an evaluation key. Further details can be provided by your CODICO representative.

Qualcomm branded products are products of Qualcomm Technologies, Inc. and/or its subsidiaries. The registered trademark Linux® is used pursuant to a sublicense from the Linux Foundation, the exclusive licensee of Linus Torvalds, owner of the mark on a worldwide basis.

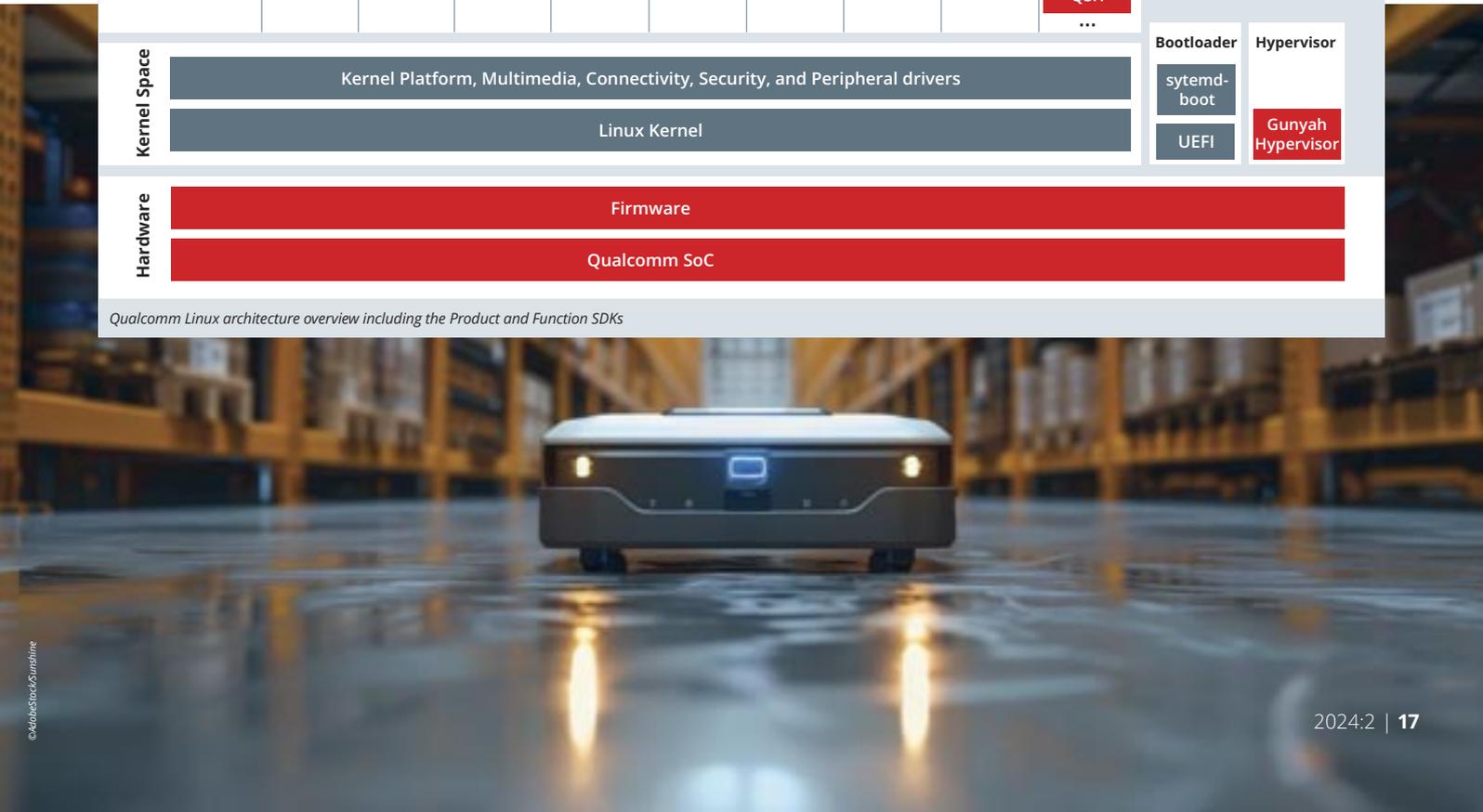
The Qualcomm RB3 Gen 2 and Qualcomm RB3 Gen 2 Lite kits are available now from CODICO via the Sample Shop.

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



Qualcomm Linux architecture overview including the Product and Function SDKs



# MPM54322



## FPGAs: Balancing Efficiency, I/O Voltage Range, Voltage Tolerance, and Size

The increasing demand across telecommunication systems, data storage, and field-programmable gate arrays (FPGAs) has driven the evolving complexity and requirements of power delivery, particularly for voltage regulators (VRs). Most areas of VR applications require a balance between efficiency, I/O voltage range, voltage tolerance, and size. It is crucial to meet the demands of FPGA power rails while providing precise voltage control.

With the increased number of power rails, designers must find solutions for both high-current and low-current rails. Multiple-phase power supplies achieve higher current delivery with reduced inductor size requirements, and multiple-output power supplies allow designers to power several FPGA rails with a single IC. As a result, designers can meet all the modern requirements for power delivery with reduced board space and simplified design.

This article discusses using multiple-output power supplies to meet the FPGA power rail require-

ments with the MPM54322, a dual-output power module. Key considerations for powering FPGAs include voltage rail regulation as well as proper start-up, and safe shutdown of FPGA power rails.

### FPGA voltage rail regulation load transients and voltage ripple

Modern field-programmable gate array systems require a higher number of power rails with varying voltage and current requirements. Advanced FPGA designs often require up to 8 power rails depending on the features of the FPGA, such as double data rate (DDR) memory, high-speed

transceivers, or any other peripheral devices. Most FPGA-based systems are supplied with a 12V bus, and the required voltages of the different FPGA power rails vary between 0.65V and 3.3V.

Voltage ripple tolerance is the primary objective of power supply design as one of the strictest regulations for powering FPGAs. The tolerance is specified in the manufacturer's datasheet, but generally, the voltage ripple tolerance must not exceed  $\pm 3\%$  of the rated voltage or  $\pm 30\text{mV}$ .

The complexity of meeting such requirements can be demonstrated with a load transient test that was conducted with the MPM54322, a 3A, dual-output power module. To better emulate the behaviour of the FPGA, transients were generated using a load slammer, which performs load steps with very high slew rates up to  $130\text{A}/\mu\text{s}$ .

## Ensuring proper start-up soft-start control

Start is a critical requirement for FPGA power rails to ensure a reliable start-up and prevent potential damage to the device. This feature is implemented in voltage regulators that control the  $V_{OUT}$  rise time during start-up. This is particularly important for FPGA design due to their large capacitive load on the power rails. Without SS, the inrush current during start-up can be very high, potentially causing voltage droop on the input supply and damage to the FPGA or other components.

Most FPGA vendors specify a soft start time ( $t_{SS}$ ) of about 10ms for their devices. By increasing the voltage gradually with  $t_{SS}$ , the inrush current is limited, and a smooth start-up sequence is achieved. Failure to meet the SS requirements can lead to various issues, such as unreliable or non-monotonical start-up and potential damage to the FPGA.

To ensure reliable operation, it is crucial to select VRs that meet the SS requirements specified by the FPGA vendor. Regulators like the MPM54322 provide an adjustable  $t_{SS}$  that can be fine-tuned to the specific requirements of the FPGA and power supply design. The MPM54322 can have  $t_{SS}$  as short as 1ms and as long as 14ms in the start-up sequence (Figure 2).

## MPS-patented FLEX-timer sequence control

The MPM54322 uses FLEX-timer sequence control to better control the order in which the different power rails are initiated. This sequence control scheme uses a master-slave structure where the control signals of all the power management ICs (PMICs) are connected for sequence coordination (see Figure 3).

One of the PMICs is configured as the master to generate a clock signal, while the other PMICs are configured as slaves that receive the clock signal. The start-up and shutdown sequences of all the power rails are synchronised by the clock signal.

When the control signal is asserted, the start-up sequence begins with the master PMIC generating the clock outputs, and the slave PMICs counting the clock signal. For each power rail, the rail turns on when the counted clock signal cycle reaches a pre-defined delay.

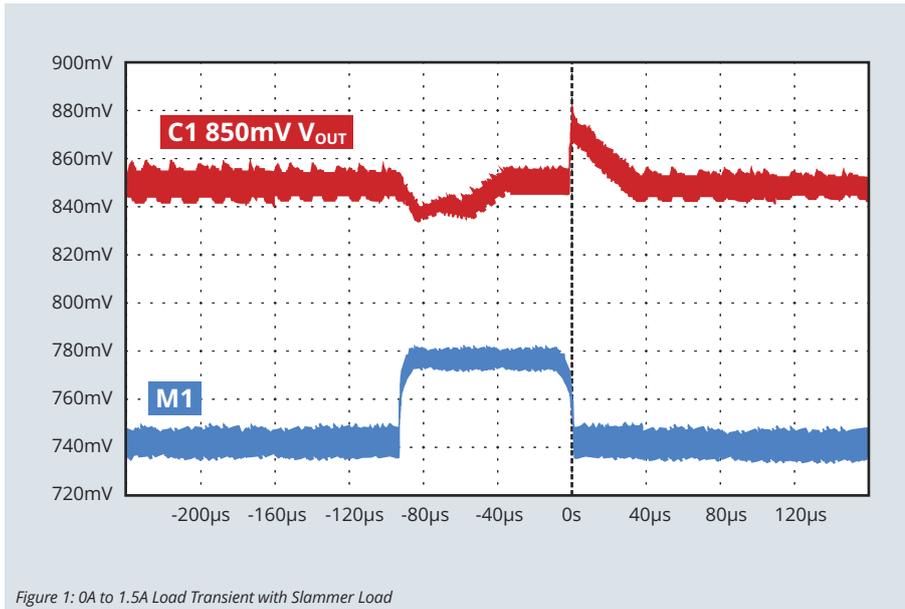


Figure 1: 0A to 1.5A Load Transient with Slammer Load

In the load transient test, the load steps up from 0A to 1.5A and is powered by one of the module's 3A outputs. This test was carried out with an input voltage ( $V_{IN}$ ) of 12V and an output voltage ( $V_{OUT}$ ) of 0.85V to emulate the most common core power rails of modern FPGA designs (Figure 1).

The load transient test demonstrates excellent transient response with  $\pm 22.5\text{mV}$  voltage peaks during the  $130\text{A}/\mu\text{s}$  transitions. In addition, the output voltage ripple is within the FPGA core rail's tolerance requirements due to MPS's adaptive constant-on-time (COT) control. By using COT control, the power supply delivers the required energy to the load much quicker than traditional peak current mode control. As a result, stable voltage

can be maintained during power transients without requiring high output capacitance.

## Start-up and shutdown sequencing

Field-programmable gate array applications have multiple power rails connected to multiple voltage regulators. During the board's start-up, a set order for starting up the rails must be maintained to optimize system efficiency and minimize start-up current peaks. However, implementing a sequencer might not be a feasible option since the board space can be very limited. Multiple-output power modules, such as the MPM54322, use MPS-patented FLEX-timer sequence control, which allows accurate control of the start-up and shutdown timing of all VRs without a sequencer.

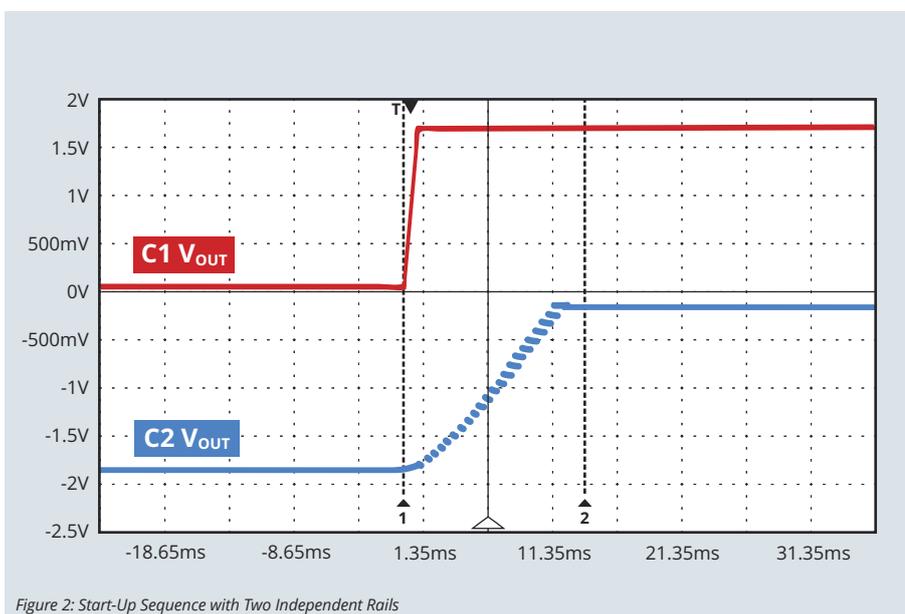


Figure 2: Start-Up Sequence with Two Independent Rails

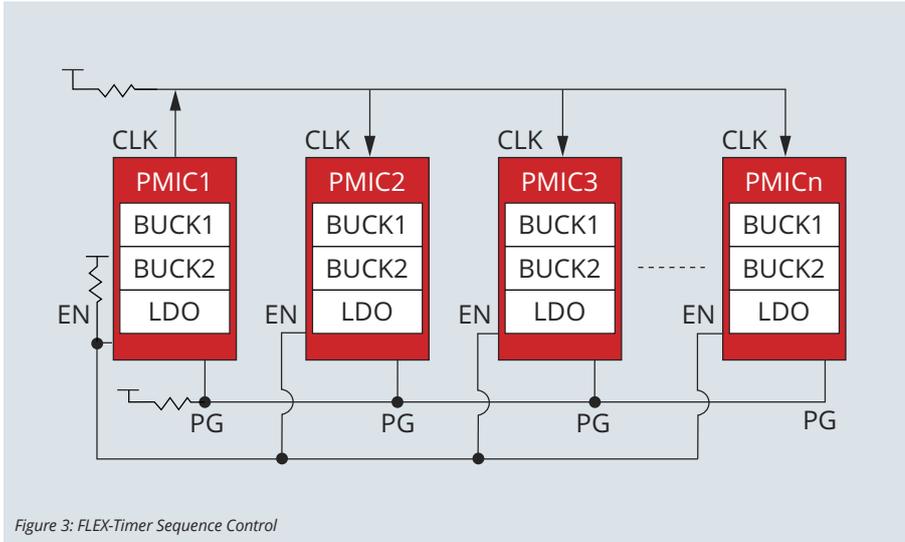


Figure 3: FLEX-Timer Sequence Control

Once the master PMIC clock cycle reaches a pre-set number and a status signal indicates that all enabled power rails have finished the SS process, the master PMIC stops the clock output, and the start-up sequence completes.

During shutdown, if the control signal is not present, the master PMIC starts generating the clock outputs, and the slave PMICs count the clock signals. For each power rail, the rail turns off when the counted clock signal cycle reaches a pre-defined delay. When the master PMIC clock cycle reaches the set number, the master PMIC stops the clock output, and the shutdown sequence finishes.

This sequence control scheme provides a synchronised and coordinated start-up and shut-

down process across multiple power rails managed by different PMICs, without introducing an additional sequencer module.

### Ensuring safe shutdown using active discharge

$V_{OUT}$  spikes can severely damage the FPGA through the power rails. When the load is suddenly removed, the energy stored inside the output capacitors ( $C_{OUT}$ ) can cause high voltage spikes while discharging. To prevent these hazards, the MPM54322 implements the output's active discharge.

The purpose of active discharge is to quickly discharge a PMIC's  $C_{OUT}$  when the load is suddenly removed or the power turns off. Since FPGA power modules use large decoupling capa-

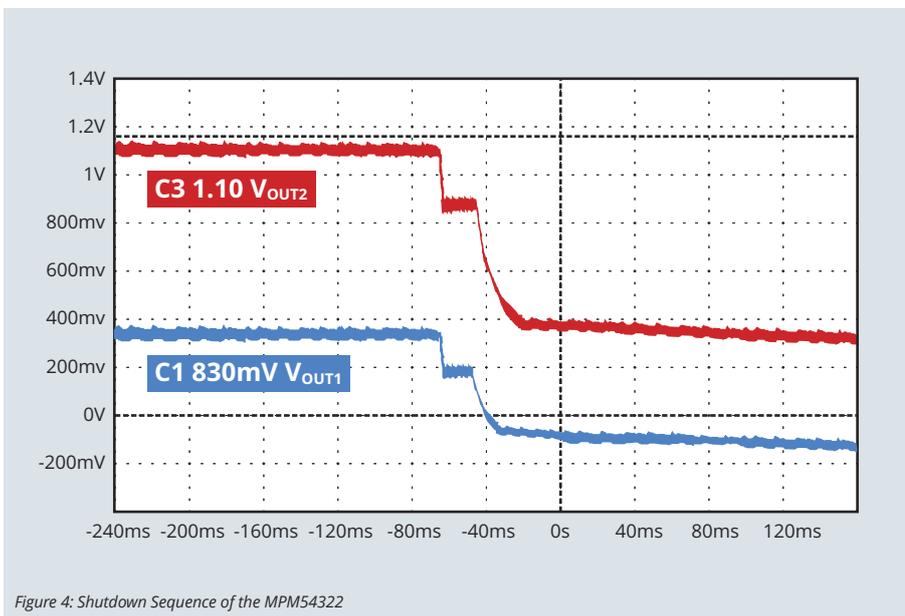


Figure 4: Shutdown Sequence of the MPM54322



citers for stability and optimal voltage regulation, active discharge helps quickly discharge these capacitors, preventing voltage spikes while maintaining the proper shutdown sequence and timing.

Active discharge is performed when the part is disabled, and the output of the internal digital-to-analog convertor (DAC) ramps down.  $V_{OUT}$  ramps down smoothly with the reference voltage. When the DAC output reaches 850mV and 650mV, it stops at these levels, and soft shutdown completes. The output then gradually discharges through the feedback resistors. Figure 4 shows the shutdown sequence of the MPM54322.

### Introducing the MPM54322

MPS offers a wide selection of flexible and scalable multiple-output power modules. The MPM54322 is a 3A, dual-output power module that integrates two high-efficiency step-down DC/DC converter ICs, a low-dropout (LDO) regu-

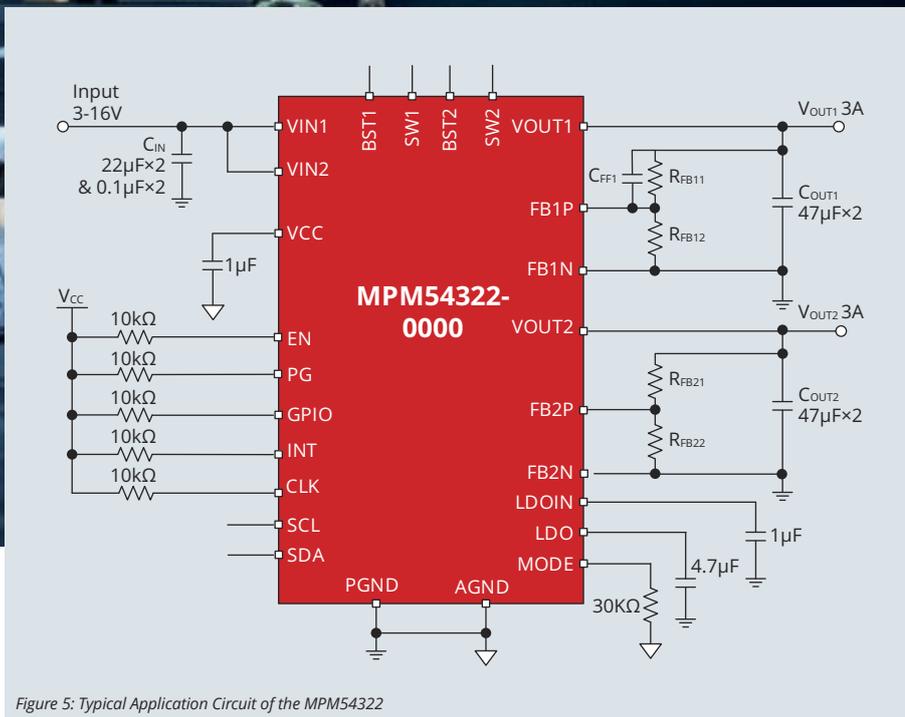


Figure 5: Typical Application Circuit of the MPM54322

lators, and passive components (including two inductors for the DC/DC converters) onto a single over-molded package. The MPM54322's two outputs can be used separately to power the two independent rails of the field-programmable gate array, or they can be paralleled for up to 6A of current. Figure 5 shows the typical application circuit of the MPM54322.

As previously discussed, FPGA systems include many rails for separate systems not related to FPGAs. The same multiple-output power modules can be used to start up other subsystems as well. Given the varying voltages and currents, using parts differentiated with digital suffixes can result in problems during production and the set-up process, causing potential damage to the FPGAs. To address this issue, the MPM54322

provides up to 10 multiple-time programmable (MTP) pages (determined by the resistor connected to the MODE pin), allowing the user to switch between preset adjustable configurations for different voltages.

## CONCLUSION

With the increasing power requirements of FPGAs, advanced multiple-output VRs are necessary for designing power supplies with reduced board space that can keep pace with advanced FPGA applications.

Advanced power supplies like the MPM54322 enable fast transient response and accurate voltage regulation, in addition to featuring SS and MPS-patented FLEX-timer sequence control to ensure safe system start-up and shutdown. Furthermore, as systems become more complex, the MPM54322 allows designers to easily select among the 10 MTP pages for different output configurations using the same device, without having to reconfigure or use different part numbers.

For more information, explore MPS's full portfolio of power modules at CODICO.

A07

▶ Thomas Berner, +49 89 1301 438 15  
thomas.berner@codico.com

Author: Tomas Hudson, Product Marketing Engineer  
and Nicolay Garcia, Applications Engineer at MPS



# ROBUST AUDIO VIBRATION SENSOR



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## With High-Bandwidth and Low-Noise for Sound Pickup in Harsh Environments

Coming from many years of MEMS microphone development KNOWLES has defined a completely new sensor product: the V2S200D voice vibrations sensor. This sensor uses vibration to reject ambient noise.

This capability allows its use in new areas, such as emergency vehicle detection and voice commands, which have recently emerged and demonstrate the need to reliably pick up sounds external to the vehicle. In addition, it is useful for applications like predictive maintenance, where changes in an engine's profile over time can indicate a potential failure.

KNOWLES' porthole-less V2S200D vibration sensor is a robust alternative to traditional capacitive MEMS microphones and is specifically designed to deal with the demanding environments of automotive applications. With its small size, high signal-to-noise ratio (SNR), and large bandwidth, the V2S200D achieves performance comparable to a traditional MEMS microphone with a port-

hole. However, the porthole can make MEMS microphones susceptible to dust, water and other polluting substances.

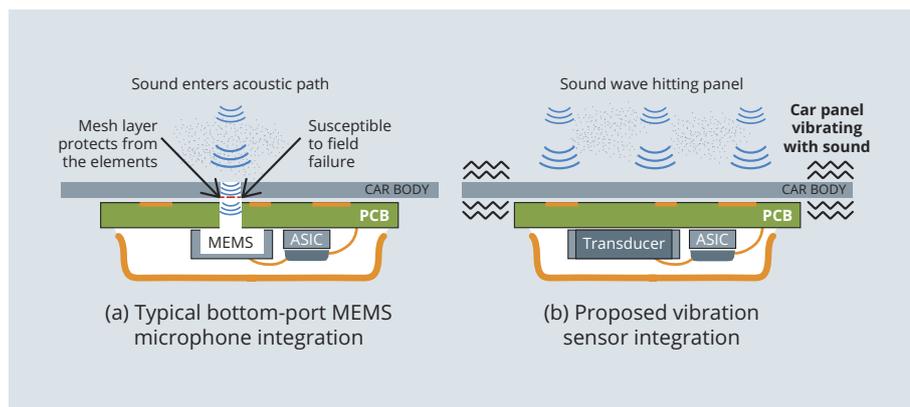
The PDM output interface facilitates seamless integration with vehicle electronic systems, offering automotive OEMs and Tier 1 suppliers a more dependable, high-performance, and cost-effective alternative.

The V2S200 consists of a transducer, a low-noise input buffer and a sigma-delta modulator. These components provide high vibration sensitivity suitable for picking up audio via bone or metal shield conduction in devices such as vehicles, wearables, earphones or other applications where a flat response to vibration and excellent acoustic isolation are required. Additionally, the V2S200 offers various clock modes for wide compatibility with audio codecs.

For further information, please contact:

**A08**

▶ Achim Stahl, +49 89 1301 439 14  
achim.stahl@codico.com



# IoT EXPERT

## High-Performance LoRa Modules




In the rapidly evolving world of IoT, reliable and efficient wireless communication modules are essential.

The QUECTEL KG200Z stands out as a high-performance LoRa module designed for long-range wireless transmission applications that demand ultra-low power consumption. Engineered with an ARM Cortex-M4 core, this compact module supports multiple modulation schemes, such as LoRa, (G)FSK, (G)MSK, and BPSK, ensuring versatile connectivity solutions.

### Superior connectivity & performance

The KG200Z adheres to the LoRaWAN® standard protocol, operating within the global 470-510MHz and 863-928MHz frequency bands. This module offers impressive receiver sensitivity and robust AES hardware encryption, ensuring secure and reliable data transmission. With a compact form factor of 12.0x12.0x1.8 mm, it seamlessly integrates into size-constrained applications while delivering outstanding performance. Notably, it houses the powerful STMicroelectronics STM32WLE5JC16 chipset, which enhances its performance capabilities.

The KG200Z's ability to connect wirelessly to both local and global IoT networks enables secure end-to-end communication, mobility, and localised services for a myriad of IoT applications. From smart locks and door sensors to gas and water meters, pet tracking, and air quality monitoring, the KG200Z excels in delivering reliable data transmission over long distances, making it a ver-

satile solution for various use cases. In addition, the module can support dual-stack operation, offering both LoRaWAN® and «wireless M-Bus» functionalities.

### Key highlights of the QUECTEL KG200Z

- Long transmission distance: Capable of 2-5km in urban areas and 10-15km in suburban regions
- Ultra-low power consumption: Consumes just 1.7µA in deep sleep mode, making it ideal for battery-operated devices
- High receiver sensitivity: Achieves up to -136dBm, ensuring robust connectivity even in challenging environments
- Compact and cost-effective: The module's small size and LGA package facilitate easy integration and cost-effective deployment
- Strong anti-interference: Delivers stable network connections with high resistance to interference
- Wide operating temperature range: Functions reliably between -40°C and +85°C, suitable for various environmental conditions
- Multiple interfaces: Includes SWD, JTAG, DMA, USART, SPI, and I2C for flexible application support

### Simplified integration and robust security

The KG200Z's LGA package simplifies soldering and testing, streamlining the integration process.

The module's multiple interfaces, including SWD, JTAG, DMA, USART, SPI and I2C, provide developers with the flexibility needed for diverse applications. The incorporation of AES-256bit hardware encryption ensures that data security is never compromised, making the KG200Z a trustworthy component for critical IoT applications.

### Strategic partnership with «The Things Industries»

Enhancing its appeal, the KG200Z is now integrated with the «Works with The Things Stack» and «Secured by The Things Stack» certifications through a strategic partnership with «The Things Industries». This collaboration ensures that users benefit from robust, secure LoRaWAN® solutions, providing comprehensive end-to-end encryption and key management, further cementing the KG200Z's position as a leading choice for IoT applications.

For developers seeking a powerful, compact, and secure LoRa module for their IoT solutions, the QUECTEL KG200Z offers an exceptional blend of performance, reliability, and ease of integration. Its broad application range, coupled with its advanced features and robust design, positions the KG200Z as a winning choice in the IoT landscape.

A09

▶ Joachim Strohschenk, +49 89 1301 438 17  
joachim.strohschenk@codico.com

# UNBEATABLE

QUECTEL builds best-in-class Wi-Fi6/6E modules based on renowned chipmakers like Qualcomm, Realtek, and NXP, ensuring exceptional performance, seamless integration, and robust connectivity solutions for a wide range of applications. The standout features of each module in the QUECTEL Wi-Fi6/6E series are detailed below, highlighting the unique attributes that set them apart in the world of wireless technology.

## FC65E: Top-notch performance with tri-band support

The FC65E is a Wi-Fi6E module featuring the Qualcomm QCA2065 chipset, offering tri-band support across 2.4GHz, 5GHz and 6GHz. This module is ideal for applications requiring extensive bandwidth and high-speed connectivity, such

as high-definition video streaming and virtual reality.

## FC62E: Dual-band efficiency

With the Qualcomm QCA2062 chipset, the FC62E provides robust dual-band Wi-Fi6 capabilities on 2.4GHz and 5GHz bands. It is perfect for versatile

applications needing reliable dual-band functionality, including smart home devices and IoT sensors.

## FC66E Series: Dual-band simultaneous connectivity

The FC66E series, powered by the Qualcomm QCA2066 chipset, supports dual-band simultaneous (DBS) operations on 2.4GHz, 5GHz and 6GHz, making it a standout choice for environments that benefit from Wi-Fi6E's expanded spectrum and dual-band functionality. This series also integrates seamlessly with QUECTEL's 5G modules, enhancing overall connectivity performance.

Ready For The Future:  
QUECTEL's Wi-Fi6/6E Modules

QUECTEL

| WI-FI6/6E MODULES         |                 |                 |                  |                 |                 |                 |                 |                                  |                |
|---------------------------|-----------------|-----------------|------------------|-----------------|-----------------|-----------------|-----------------|----------------------------------|----------------|
| MODULE                    | FC65E           | FC62E           | FC66E            | FC64E           | FC06E           | FGS060N         | FCS866R         | FCE863R                          | FGS061N        |
| Wi-Fi Version             | Wi-Fi6E         | Wi-Fi6          | Wi-Fi6E          | Wi-Fi6          | Wi-Fi6          | Wi-Fi6          | Wi-Fi6          | Wi-Fi6                           | Wi-Fi6         |
| Chipset                   | QCA2065         | QCA2062         | QCA2066          | QCA2064         | QCA2064         | IW612           | RTL8852BS-CG    | RTL8852BE                        | IW611          |
| Bands                     | 2.4/5/6GHz      | 2.4/5GHz        | 2.4/5/6GHz (DBS) | 2.4/5GHz (DBS)  | 2.4/5GHz (DBS)  | 2.4/5GHz        | 2.4/5GHz        | 2.4/5GHz                         | 2.4/5GHz       |
| Bluetooth                 | 05.02.24        | 05.02.24        | 05.02.24         | 05.02.24        | 05.02.24        | 5.2. Thread     | 05.02.24        | 05.02.24                         | 05.02.24       |
| Main Interface            | PCIe, UART, PCM | PCIe, UART, PCM | PCIe, UART, PCM  | PCIe, UART, PCM | PCIe, UART, PCM | SDIO, UART, SPI | SDIO, UART, PCM | PCIe, UART, PCM                  | SDIO, UART     |
| MIMO                      | 2x2             | 2x2             | 2x2              | 2x2             | 2x2             | 1x1             | 2x2             | 2x2                              | 1x1            |
| Operating Temperature     | -30°C to +75°C  | -30°C to +75°C  | -30°C to +75°C   | -30°C to +75°C  | -30°C to +75°C  | -40°C to +85°C  | -20°C to +70°C  | -20°C to +70°C<br>-40°C to +85°C | -40°C to +85°C |
| DBS                       | No              | No              | Yes              | Yes             | Yes             | No              | No              | No                               | No             |
| Coexistence with Cellular | No              | No              | Yes              | Yes             | No              | No              | No              | No                               | No             |
| Form Factor               | LGA             | LGA             | LGA              | LGA             | LGA             | LGA             | LGA             | LGA                              | LGA            |
| Variants with 3 Antennas  | No              | No              | Yes              | Yes             | No              | No              | Yes             | Yes                              | N              |

Variants of the FC66E can support three antennas (two for Wi-Fi and one for Bluetooth), making it ideal for applications like high-performance computing and industrial automation.

### FC64E Series: Reliable dual-band performance

Featuring the Qualcomm QCA2064 chipset, the FC64E series supports dual-band simultaneous (DBS) Wi-Fi6 operations on 2.4GHz and 5GHz. It is designed for reliable performance and integrates smoothly with QUECTEL's 5G modules, ensuring superior connectivity. The FC64E also offers variants with three antennas, suitable for advanced applications like augmented reality (AR) and set-top boxes.

### FC06E: Enhanced dual-band with front-end module

The FC06E, also powered by the Qualcomm QCA2064 chipset, offers dual-band simultaneous Wi-Fi6 with additional front-end module (FEM) capabilities, providing enhanced performance for high-demand applications such as smart city infrastructure and telemedicine.

### FGS060N: Versatile connectivity with thread support

The FGS060N, utilising the IW612 chipset, supports both Wi-Fi6 and 802.15.4 standards, including Thread. This makes it a versatile choice for applications requiring both Wi-Fi and low-power wireless mesh networking, such as IoT gateways and secure enterprise networking, operating reliably in extreme temperatures.

### FCS866R: Robust performance with SDIO interface

The FCS866R, featuring the RTL8852BS-CG chipset, provides reliable Wi-Fi6 dual-band performance with an SDIO interface, making it suitable for various applications with specific interface requirements. It also has variants with three antennas, enhancing its suitability for high-traffic environments like stadiums and large public venues.

### FCE863R: Reliable dual-band with optional wide temperature range

The FCE863R, powered by the RTL8852BE chipset, supports dual-band Wi-Fi6 and offers an optional extended temperature range, making it versatile for different environmental conditions. With va-

riants supporting three antennas, it is perfect for applications like industrial IoT and outdoor networking.

### FGS061N: Industrial-grade performance

The FGS061N, with the IW611 chipset, is designed for industrial applications, offering robust Wi-Fi6 dual-band performance and reliable operation in harsh environments. This module is ideal for applications like manufacturing automation and remote monitoring.

QUECTEL's Wi-Fi6/6E modules are designed to meet the growing demands of modern wireless applications, offering advanced features, robust performance, and reliable connectivity. Whether for industrial, consumer, or specialised applications, QUECTEL provides a module that fits every need, ensuring superior connectivity and performance. Explore the future of wireless communication with QUECTEL's cutting-edge Wi-Fi6/6E modules.

A10

▶ Joachim Strohschenk +49 89 1301 438 17  
joachim.strohschenk@codico.com



EXTREMELY

COOL

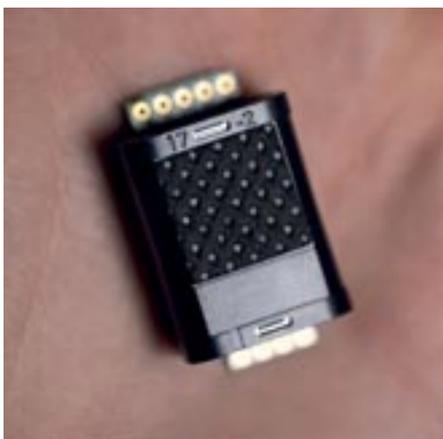
## Platform for Refrigerant Leak Detection

SENSEAIR continues to expand its refrigerant product lineup by adding R290 to the existing R32 and R454 A/B/C sensors and commencing production for the protective casing RDS.

With a comprehensive lineup for detecting A2L and A3 refrigerant leaks, SENSEAIR has positioned itself as a one-stop shop for refri-

gerant detection applications. Whether the product needs to meet EU or US market standards and regulations, the sensor currently used by the customer can be seamlessly replaced with SENSEAIR Sunlight sensors during development.

The RDS, short for Refrigerant Detection System, expands the application possibilities of SENSEAIR products. Essentially, it is a standard Sunlight sensor mounted on a main circuit board and protected by a casing. With its Modbus interface, it allows for rapid iterations and quick deployment, even in aftermarket solutions. Featuring IP67, this enclosure is ideal for unpredictable and harsh environments. It ensures that measurements remain reliable even under extreme conditions.



Both products R32 and R290 use the same underlying technology and, of course, offer the same advantages. Like all SENSEAIR products, these systems are powered by reliable NDIR technology, which provides fast and accurate measurements with minimal energy consumption. Immunity to poisoning and the ABC algorithm ensure accurate readings throughout the 15-year maintenance-free lifespan, saving time and money and making it a small investment with a significant payoff. The Sunlight series complies with IEC standards 60079-29-1 and 60335-2-40 ed.7, as well as UL 60335-2-40 ed.4.

It is important to mention that the CO<sub>2</sub> sensors Sunlight, Sunrise, S8, and the newly introduced S88 from SENSEAIR all meet the requirements of the latest 62.1-2022 addendum ab from ASHRAE.

A11

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

# GOLDEN POE

## SILVERTEL's High Power PSE Module on Golden Blocks



SILVERTEL announces the release of the Ag6810 High Power PSE module in a miniature, surface-mount format. The Ag6810 is designed with a reduced footprint to make implementation of Power over Ethernet easier than ever, especially where space is at a premium.

The Ag6810 is a single channel, IEEE802.3bt compliant (backwards compatible to .af & .at revisions and fully compliant) PSE module with the capability of providing signature recognition and power delivery to support PoE, PoE+, and PoE++ systems, from 15.4W up to 99W. For PoE++ systems, the module will provide power over all four pairs.

Measuring only 28x18x5mm, this device can be deployed in single-port or multi-port systems, squeezing the most out of the available space. The Ag6810 is aimed at applications such as edge computing, extenders, media converters, CCTV DVRs, home and professional networking, industrial automation, IoT, and AI where ease of implementation, simplicity of use, and space efficiency is essential.

The Ag6810 is a small, surface-mount module with golden block terminals, well known from its PD siblings, the Ag9900-LPB &-MTB, the Ag5700-LPB and the Ag59600-LPB. The Ag6810 comes in trays or tape & reel formats, ideal for automated handling and surface-mount placement. The interconnect format allows close thermal coup-

ling to the host PCB. Being a high-efficiency converter ( $\geq 98\%$ ), losses are minimised and, with very few additional components required to configure the product, implementation is quick and very straightforward.

The Ag6810 provides dual signature recognition and control, essential for PoE++ system compliance, allowing the PoE negotiation process to be initiated and controlled. As a direct result of this, the module can be used to power two PoE+ (IEEE802.3at) PDs, thereby providing dual-port power, from one PSE module. Power delivery levels can be easily set via hardware configuration, thereby ensuring that the PSE limits the maximum pre-requisite power to the connected PD requesting it.

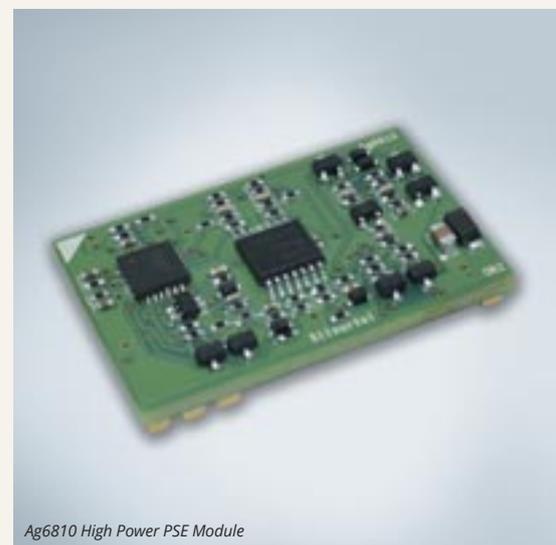
A useful feature of the Ag6810 is that the output port can be turned off, reducing power consumption to an absolute minimum when inactive, making it ideal for energy-efficient applications. Turning the port back on with a PD connected will initiate the power negotiation process. Connection status is determined via the Status output from the module.

The module is rated over the industrial temperature range ( $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ) and protected from output overload and output short-circuit conditions. Designed and manufactured in the UK, and fully RoHS compliant, the Ag6810 complements SILVERTEL's extensive range of low cost, compact and highly-featured power management modules.

Data sheets, samples and evaluation boards are available via CODICO.

**A12**

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



Ag6810 High Power PSE Module

# FORESIGHT

## Ultra Small 60V 300mA Buck DC/DC Solution From TOREX



TOREX has released a new 60V, 300mA, low quiescent current synchronous step-down DC/DC converter which is an ideal solution for space-constrained industrial applications operating from 12V/24V or higher input voltages.

In fact, power supply inputs of >40V are becoming more common, and this creates a thermal problem due to the heat generated if a simple LDO is used to regulate down from this level. Using the XC9702 buck DC/DC solves this problem, as well as the issues of large fluctuations

in the power supply line due to impedance, load fluctuations, and induction from motors.

Despite its high voltage tolerance, the XC9702's low power consumption contributes to the increasingly stringent requirements for standby

power consumption reduction in recent years, as well as to the efficiency improvement and downsizing of various industrial equipment.

### XC9702 series

The XC9702 series is a 60V, 300mA low quiescent current (12µA), synchronous step-down DC/DC converter. With a 0.75V (±1.5%) reference voltage, the output voltage can be set freely within a range of 2.5V to 12V using externally connected resistors. The control method is selectable via the MODE pin and can be set to PWM only or to automatic PWM/PFM switching for high levels of efficiency across the full load spectrum. The XC9702 supports an operating ambient temperature of up to 125°C.

The soft-start time can be adjusted externally by connecting a capacitor (CSS) to the SS pin. The series can be used with small, low ESR ceramic capacitors (Figure 1).

### Ultra-low ripple voltage

The XC9702 supports ultra-low output ripple voltage, even when the step-down ratio is very wide. Even when stepping down from 48V to 5V, the ripple voltage is <20mV (Figure 2).

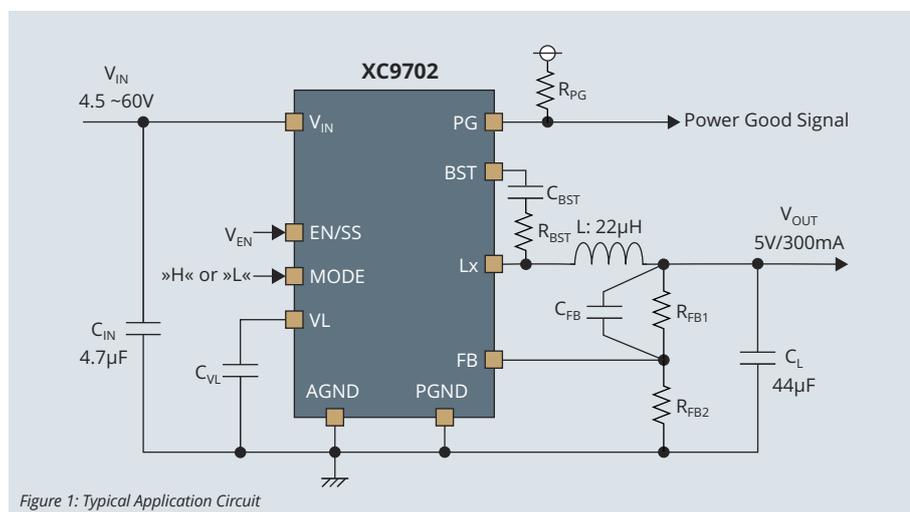


Figure 1: Typical Application Circuit

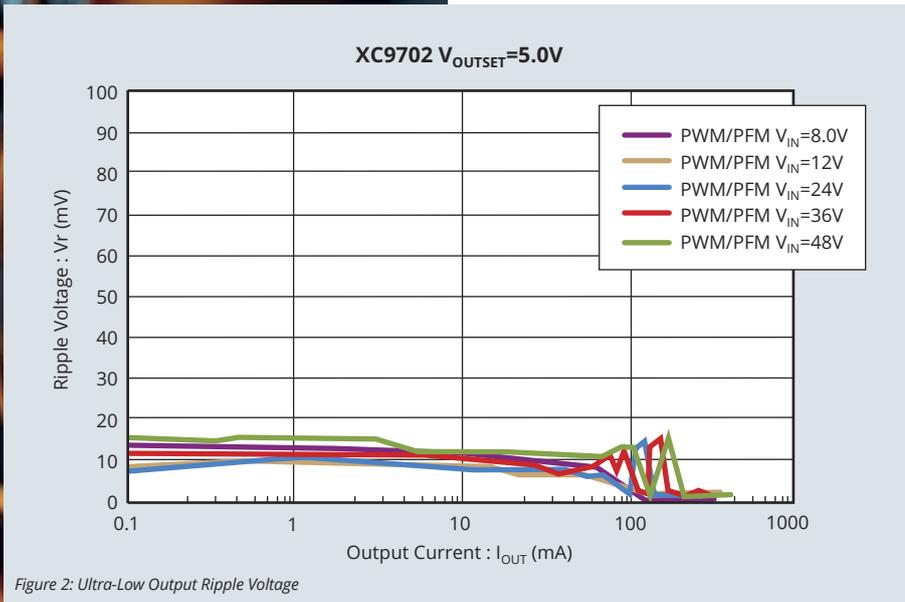


Figure 2: Ultra-Low Output Ripple Voltage

### Application block diagrams for small industrial sensors

The XC9702 can be used to supply power to MCUs, sensors, etc., by stepping down from 12V/24V or higher to 5V, and then stepping down from this 5V rail to 3.3V, 3.0V, etc., using small

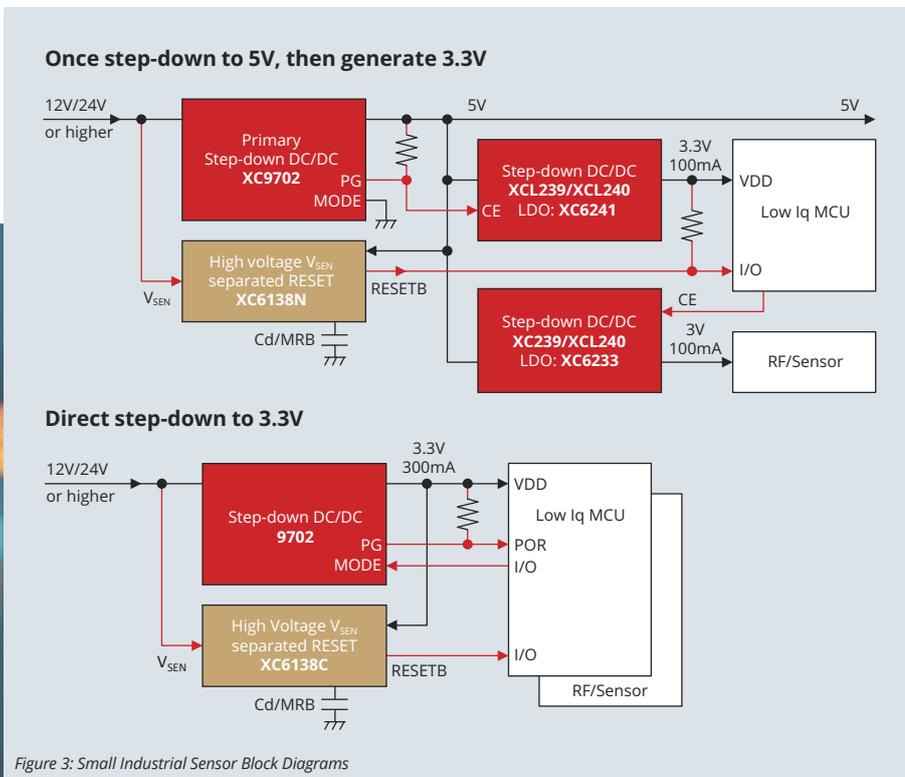


Figure 3: Small Industrial Sensor Block Diagrams

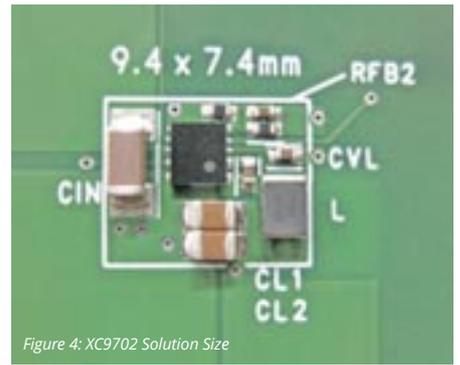


Figure 4: XC9702 Solution Size

buck Micro DC/DC (integrated inductor) or an LDO Voltage Regulator. The sequence of the subsequent power supply can be controlled with the PG function of the XC9702. The XC6138 voltage detector can be used to supervise the 12V/24V power input and can also be used to monitor the output to the MCU, as shown below (Figure 3).

The control method can be changed dynamically with the MODE pin.

- MODE »H« = PWM ⇒ Low noise (for sensors, etc.)
- MODE »L« = PWM/PFM ⇒ High efficiency at light load

The total solution size of the XC9702 with the USP-10B package is only 9.4x7.4mm which is 69.6mm<sup>2</sup> (Figure 4), achieving the world's smallest class mounting area for a comparable 60V IC.



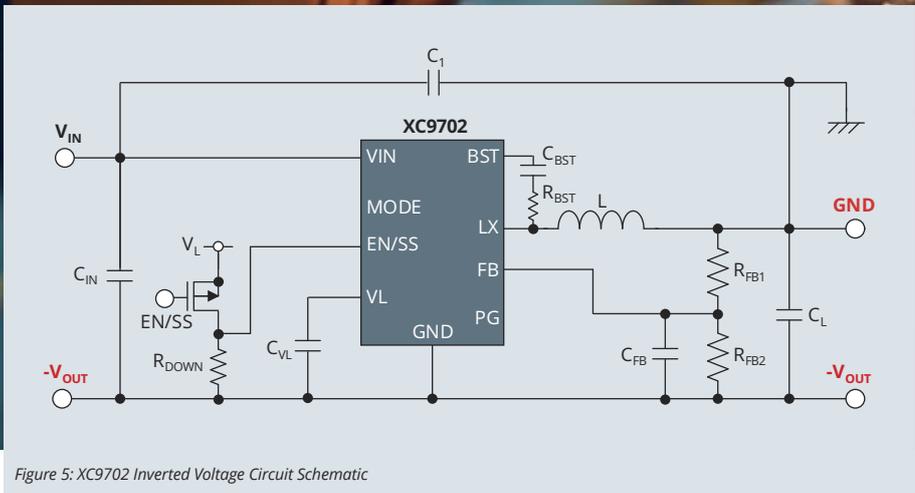
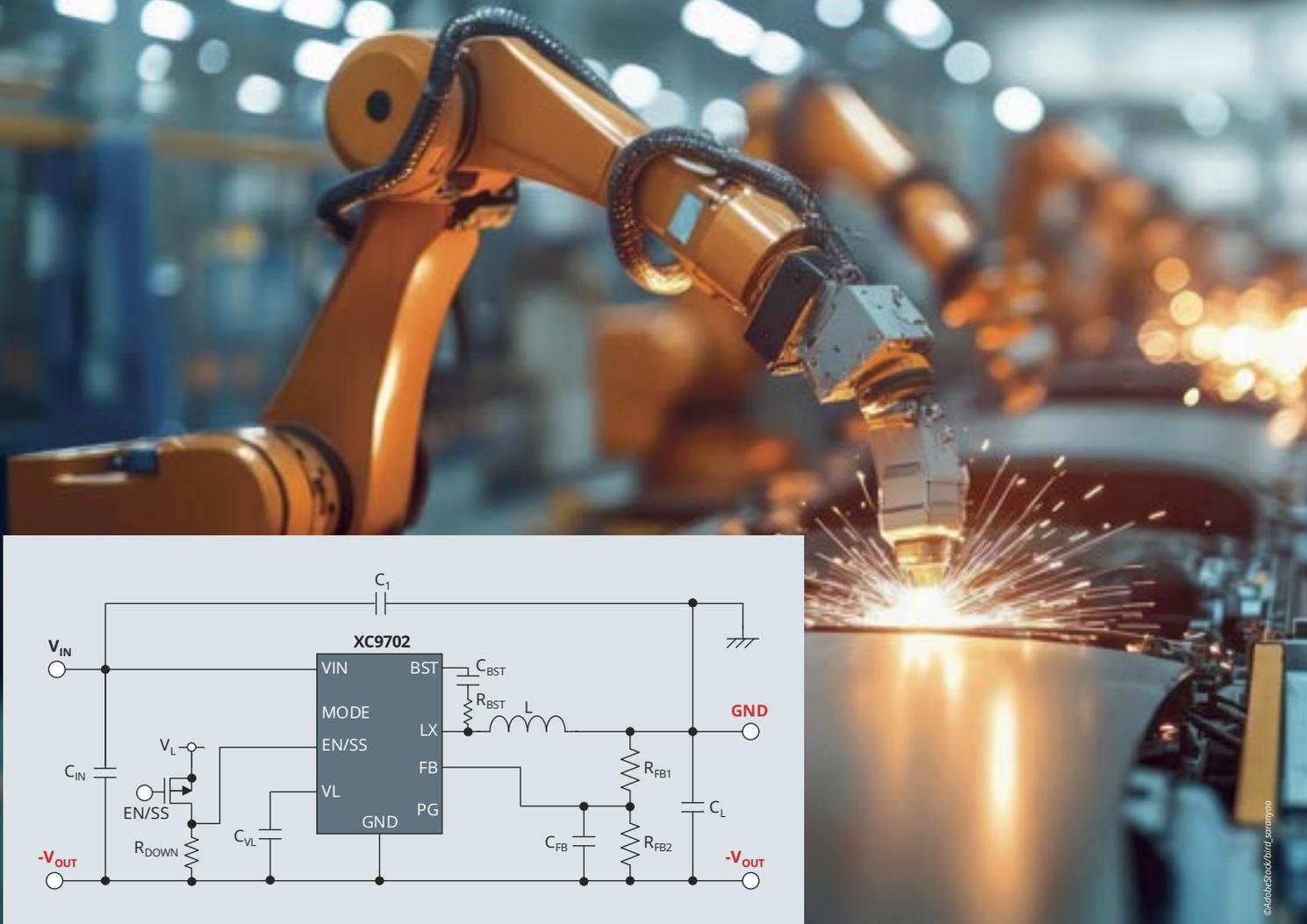


Figure 5: XC9702 Inverted Voltage Circuit Schematic

### The XC9702 as a voltage inverter

The XC9702 step-down DC/DC converter can also be configured to provide a negative output voltage between -2.5V and -12V from a positive input voltage of 5V/12V/24V (Figure 5).

This is useful for applications that require a negative output voltage rail such as for powering Op Amps or as a gate drive bias voltage (floating

power supply/negative power supply). The output current that can be supported in this configuration is between 50mA and 100mA maximum.

### Package options

The XC9702 is available in either a HSOP-8N package (6.2x5.2x1.7mm) or a small USP-10B package measuring only 2.6x2.9x0.6mm (Figure 6).

Samples and evaluation boards for the XC9702 can be requested via CODICO.

A13

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

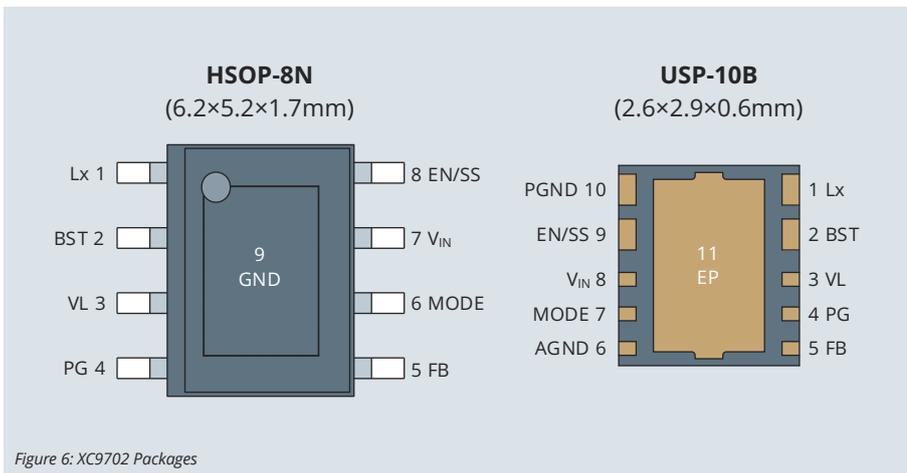


Figure 6: XC9702 Packages

## FEATURES

- **Wide Input Voltage Range**  
Up to 60V (66V Ab. Max.)  
Supports high step-down ratio
- **Wide Operating Temperature Range**  
-40°C to 125°C  
Thermal Shutdown @ 160°C
- **Low Current Consumption**  
Only 12µA quiescent current  
0.8µA in standby mode
- **Space Saving Solution**  
Ultra-small package (2.6x2.9x0.6mm)  
Small coil size (2.5x2.0x1.2mm)
- **MODE Pin**  
Switch between PWM and PWM/PFM operation using the MODE pin

# HIGH-PERFORMANCE

## THT Hybrid Capacitors

For demanding applications with higher temperature and ripple current requirements, where space constraints are also a challenge, Al-electrolytic polymer hybrid capacitors could be the ideal solution. Compared even to the best available low-ESR e-caps, they provide a better ripple current capability, longer life time and temperature performance in even smaller dimensions.

Due to market requirements and suitable target applications, the development of hybrid capacitors initially began with SMD versions. Over time, some manufacturers have also developed THT versions, as they have seen a significant increase in interest in such versions.

If the goal is to miniaturise a THT-equipped power supply that currently uses low-ESR e-caps for output filtering while maintaining the THT layout, leaded versions of high-performance, compact hybrid capacitors might be the answer. For example, while you might need three low-ESR electrolytic capacitors (12.5×30mm each) in parallel to handle a 10A ripple current load, using only two of the latest hybrid capacitors (10×15mm each) not only reduces the number of required capacitors but also provides a smaller size. This saves space on the PCB and enables a lower-profile design.

On the other hand, a low-profile design could be realised with 2 pieces of such hybrid capacitors

instead of 5 pieces of 10×16mm electrolytic capacitors to reduce the size. Additionally, the life time is increased as well. For example, a standard E-Cap rated at 10,000 hours at 105°C compares to a hybrid cap at 4,000 hours at 125°C. Considering the Arrhenius formula, the hybrid capacitor has a guaranteed life time of 16,000 hours at 105°C while maintaining the same ripple current capability.

The new FEF and FEC series from SUN Electronic Industries Corp., the inventor of Al-electrolytic polymer hybrid capacitors, set new standards in this field.

FEF and FEC are THT versions of their top SMD series. The FEF series with the highest ripple current capability and FEC, the one with the highest capacitance. However, in terms of ripple current capability, the FEC series is also highly competitive. Both series are AEC-Q200 certified and rated for operation up to 135°C, with a guaranteed life time of 4,000 hours.



FEF & FEC

### SPECIFICATION OVERVIEW FEF

|                        |                            |
|------------------------|----------------------------|
| Temperature range:     | -55 to +135°C              |
| Voltage range:         | 25 to 80V                  |
| Capacitance range:     | 22 to 680µF                |
| Dimensions:            | 6.3×7.2 to 10×15mm         |
| ESR:                   | 11 to 60mΩ@20°C/100kHz     |
| Ripple current @125°C: | 2 to 5.7A <sub>rms</sub>   |
| Ripple current @135°C: | 1.4 to 4.1A <sub>rms</sub> |

### SPECIFICATION OVERVIEW FEC

|                        |                            |
|------------------------|----------------------------|
| Temperature range:     | -55 to +135°C              |
| Voltage range:         | 16 to 35V                  |
| Capacitance range:     | 220 to 1,800µF             |
| Dimensions:            | 8×9.5 to 10×15mm           |
| ESR:                   | 11 to 27mΩ@20°C/100kHz     |
| Ripple current @125°C: | 3.1 to 5.2A <sub>rms</sub> |
| Ripple current @135°C: | 1.5 to 2.5A <sub>rms</sub> |

For price, delivery times, or samples, please don't hesitate to contact CODICO!

P01

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



# CHARGE SAFELY

## EATON's New High-Voltage AC and DC Overcurrent Protection in Electric Vehicle Applications

With growing power requirements across various applications, circuit protection is now more critical than ever before to protect sensitive components from damage, prevent malfunction, and ensure safety and reliability to meet current and emerging industry standards. Overcurrent or overload issues are a recurring issue in onboard chargers (OBCs), as well as in power distribution units for energy, industrial, and automotive applications. Engineers and OEMs are seeking cost-effective and compact circuit protection to meet the design trends of higher power density applications.

**F**ast charging capabilities have become the standard in the automotive industry, such as OBCs in the 3-phase charging infrastructure of electric vehicles (EVs). OBCs deliver high-density power to charge energy storage devices, such as batteries and supercapacitor modules. Consequently, there is a higher risk of damaging fault currents, which can lead to overheating or short circuits. To mitigate these risks, engineers and designers integrate overload protection devices, such as fuses, to protect sensitive electronics and prevent safety hazards. Due to the high temperatures typical in automotive applications, fuses

must perform reliably under a wide range of operating temperatures. They must also be lightweight and compact for seamless integration into the space-constrained, component-dense PCBs.

Engineers responsible for circuit protection and safety will benefit from using fusible solutions that offer high voltage ratings, compact footprints, and termination styles that simplify integration into various applications. Cartridge fuses, also known as ferrule fuses, protect power lines, cables, and equipment from overcurrent and short circuits. They contain a thin wire designed

to melt and open the circuit when a temperature threshold is reached or when the current exceeds the fuse's maximum rated capacity. Cartridge fuses provide cost-effective overload protection in a variety of electronic applications.

EATON's Bussmann™ series of new xEV fuses offer a wide range of high voltage, up to 1000V DC-rated and up to 500V AC-rated overcurrent protection devices for electric vehicle power management, with current ratings of up to 80A. The new xEV fuses are available in 10mm (ELV10, EUC10, EDC10, EVM10, EXM10, EKM10) and 14mm dia-



EATON 14mm fuses

©Autodesk/Plumbez

gers, 3-phase EVSE charging infrastructure, and onboard EV powertrain and distribution systems.

P02

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

Author: Gabor Nagy, Application Engineer at EATON Electronics Division



EATON 10mm fuses

meters (EAC14, EXC14 EKC14). Some of these families have more compact or shorter lengths than standard footprints, providing higher power density without sacrificing performance or reliability.

EATON's xEV fuses are well-suited for PCB integration in automotive power management and conversion systems. Automotive applications for EATON's xEV fuses include onboard charging

### HIGHLIGHTS

- Designed to JASO D622, ISO8820-8, GB/T31465 and manufactured according to ISO9001 & IATF16949 certifications
- More compact footprints compared to other 10 and 14mm cartridge fuse diameters
- High up to 1,000V DC and up to 500V AC voltage ratings within the 10 and 14mm diameters
- Up to 80A rated currents
- Multiple termination styles with cartridge, bolt-down, and PCB
- Allows ease of integrating fuses in customer applications
- Provides an optimal balance of footprint, cost, and ratings

# HIGHER CAPACITIES



## RUBYCON's New Series: ZLR, AEW and LEW



©MadsSteenKjeller

The goal of the RUBYCON engineering team has always been »miniaturisation«, with a clear goal of achieving »10% higher capacity than currently available« to introduce as a new series. RUBYCON is working in two main directions to meet this target:

### 1. Using a higher capacity foil

Naturally, using a higher capacitance aluminum foil will increase the capacitance value of the capacitor, just like the powder-laminated foil from the MXZ series presented in another article. However, it is not as simple as just using high-capacitance aluminum foil. An electrolyte must be developed that can withstand the required voltage while maintaining the high-capacitance advantages of the aluminum foil. Additionally, finding a separator paper that is compatible with both the aluminum foil and electrolyte, while enduring the necessary voltage and current, is crucial. This lies at the core of electrolytic capacitor development.

High-capacitance aluminum foil is characterized by a large surface area. In other words, it is a brittle

aluminum foil because it has numerous recesses on its surface. This type of aluminum foil must be carefully rolled up to avoid tearing the foil or destroying the brittle surface. The technical capabilities of the manufacturers of electrolytic capacitors are clearly demonstrated by the foil winding process.

### 2. Increase the dimensions of the foil used

The second way to increase the capacitance is to increase the surface area of the anode and cathode foil. The difficulty here lies in maintaining the existing housing size. The larger the dimensions of the entire winding element, the higher the capacitance – assuming the same foil is used. The key question is: How can this be achieved?

One example is increasing the width of the foil used. A winding tolerance of just a few tenths of a millimetre must be taken into account for the size of the element. However, if the production processes are optimised and these tolerances are reduced to a minimum, the capacity can be increased by this effort. The aim is to make efficient use of the available space in the cup.

Another approach is to wind the film more tightly, thereby increasing its length. However, due to the brittle nature of the foil, as described earlier, this is more challenging than it might initially seem.

Both methods require a very high level of technical expertise, which RUBYCON has at its production sites and applies for this purpose. This know-how also ensures the product quality that RUBYCON is known for.

RUBYCON is currently focusing not only on direction 1, but increasingly on direction 2. Several new series have been launched recently, with

more to follow. These series stand out on the market due to their high capacitance and compact size.

### AEW and LEW series

#### High voltage radial type with higher capacitance and ripple current

The AEW series (105°C, 3,000 hours) and the LEW series (105°C, 12,000 hours) have been announced as an updated, miniaturised version of the HXW series (105°C, 3,000 hours) and the LXW series (105°C, 12,000 hours).

The AEW series is 10% smaller than the HXW series (Table 1).

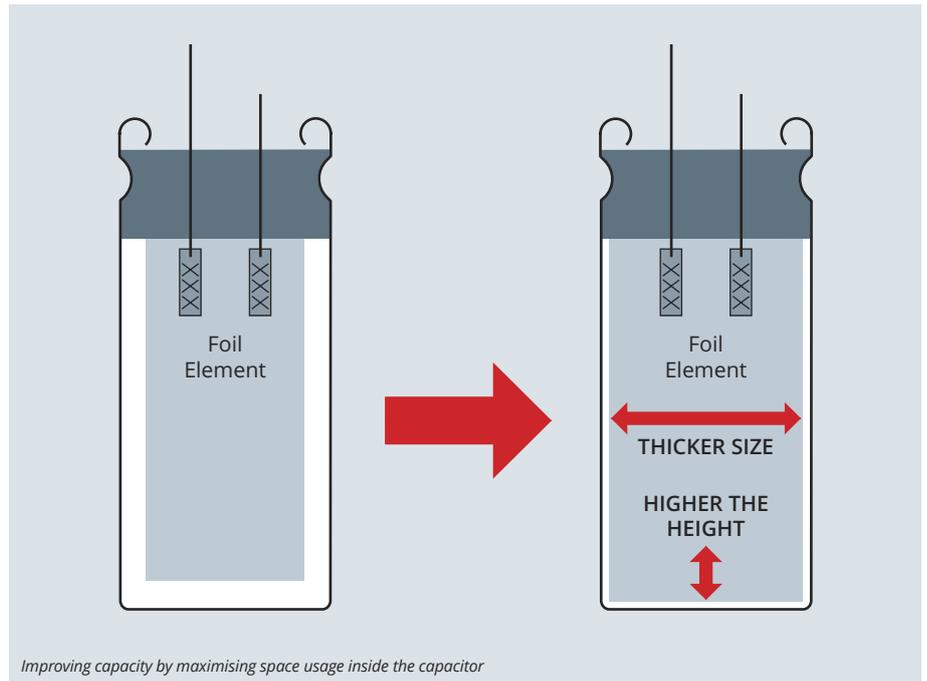
#### AEW series outline

- Temperature range: -40 to +105°C
- Lifetime: 105°C, 3,000 hours
- Rated voltage: 400~450V DC
- Size:  $\varnothing 14.5 \times 20$  to  $\varnothing 18 \times 50$ mm
- Capacitance: 47 to 300 $\mu$ F

LEW series will have 14% size down from LXW series (Table 2).

#### LEW series outline

- Temperature range: -40 to +105°C
- Lifetime: 105°C, 12,000 hours
- Rated voltage: 400 to 450V DC
- Size:  $\varnothing 14.5 \times 20$  to  $\varnothing 18 \times 50$ mm
- Capacitance: 47 to 270 $\mu$ F



### ZLR series

#### The new upper class of the famous Z series

RUBYCON's Z-series were the most pioneering series of water-based electrolytic capacitors with extremely low impedance, and it continues to lead the market today.

The previous top model, the ZLH series (10,000h/105°C) with the lowest ESR, has now been replaced by the ZLR series. The ZLR series offers approximately 20-40% more capacitance at the

same size, while the ripple current is also up to 10% higher (Table 3).

#### ZLR series outline

- Temperature range: -40 to +105°C
- Lifetime: 105°C, 6,000 to 10,000 hours
- Rated voltage: 16 to 35V DC
- Size:  $\varnothing 5 \times 11$  to  $\varnothing 16 \times 25$ mm
- Capacitance: 56 to 5,600 $\mu$ F

P03

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

Table 1: Specification comparison examples between HXW and AEW

| VOLTAGE [Vdc] | SERIES | SIZE [mm] [D×L] | CAPACITANCE [ $\mu$ F] | LIFETIME 105°C [hours] | RIPPLE CURRENT [Arms/120Hz] | CHANGE             |
|---------------|--------|-----------------|------------------------|------------------------|-----------------------------|--------------------|
| 450           | HXW    | 16×50           | 180                    | 3,000                  | 1.15                        |                    |
|               | AEW    | <b>16×45</b>    | 180                    | 3,000                  | 1.10                        | Size 10% down      |
|               | AEW    | 16×50           | <b>200</b>             | 3,000                  | <b>1.19</b>                 | Capacitance 10% up |

Table 2: Specification comparison examples between LEW and LXW

| VOLTAGE [Vdc] | SERIES | SIZE [mm] [D×L] | CAPACITANCE [ $\mu$ F] | LIFETIME 105°C [hours] | RIPPLE CURRENT [Arms/120Hz] | CHANGE             |
|---------------|--------|-----------------|------------------------|------------------------|-----------------------------|--------------------|
| 450           | LXW    | 16×35           | 100                    | 12,000                 | 0.75                        |                    |
|               | LEW    | <b>16×30</b>    | 100                    | 12,000                 | 0.75                        | Size 14% down      |
|               | LEW    | 16×35           | <b>120</b>             | 12,000                 | <b>0.86</b>                 | Capacitance 20% up |

Table 3: Specification comparison examples between ZLR and ZLH

| VOLTAGE [Vdc] | SERIES | SIZE [mm] [D×L] | CAPACITANCE [ $\mu$ F] | LIFETIME 105°C [hours] | RIPPLE CURRENT [Arms/120Hz] | IMPEDANCE ( $\Omega/20^\circ\text{C}$ ) | CHANGE             |
|---------------|--------|-----------------|------------------------|------------------------|-----------------------------|---|--------------------|
| 16            | ZLH    | 12.5×25         | 2,700                  | 10,000                 | 2,900                       | 0.015                                   | Capacitance 44% up |
|               | ZLR    | 12.5×25         | <b>3,900</b>           | 10,000                 | 3,140                       | <b>0.013</b>                            |                    |
| 25            | ZLH    | 12.5×25         | 1,800                  | 10,000                 | 2,900                       | 0.015                                   | Capacitance 22% up |
|               | ZLR    | 12.5×25         | <b>2,200</b>           | 10,000                 | 3,140                       | <b>0.013</b>                            |                    |
| 35            | ZLH    | 12.5×25         | 1,200                  | 10,000                 | 2,900                       | 0.015                                   | Capacitance 25% up |
|               | ZLR    | 12.5×25         | <b>1,500</b>           | 10,000                 | 3,140                       | <b>0.013</b>                            |                    |

# E-CAP EVOLUTION

## RUBYCON's MXZ Series: 10% More Capacity for the Same Size



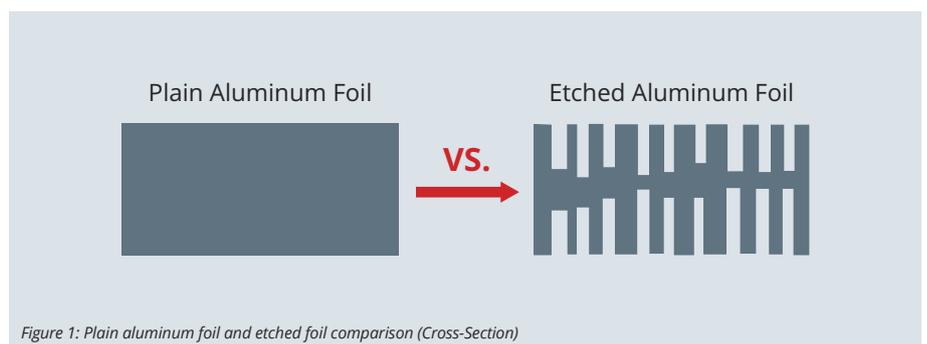
RUBYCON has released the new MXZ series (105°C, 3,000 hours), which offers around 10% more capacity for the same size compared to the MXT series. This advancement in electrolytic capacitors is due to the further development of the aluminum foil. As a result, the MXZ series can handle a higher currents and greater capacitance, marking a significant step forward in capacitor technology.

The capacitance of an aluminum electrolytic capacitor is primarily determined by the total surface area of the anode and cathode foil. Therefore, even with aluminum foils of the same size, a foil with a rougher, more uneven surface naturally has a larger surface area (Figure 1). For this reason, the miniaturisation of electrolytic capacitors depends on how much the surface area of aluminum foil of the same size can be increased compared to earlier versions.

The most common method now is chemical etching. This method enlarges the surface area by creating numerous tiny recesses on the surface

of the aluminum foil through chemical etching. All aluminum electrolytic capacitors that are currently on the market use chemically etched foils.

The MXZ series uses aluminum foil that has been processed with powder coating instead of chemical etching. While traditional chemical etching is considered a subtractive process that creates recesses in the aluminum foil, powder coating is an additive process that applies layers of aluminum powder to the foil – a completely opposite approach. The multi-layer lamination of this powder has made it possible to produce aluminum foil with an even larger surface area.





RUBYCON'S MXZ

res a high degree of technical skill. High capacitance aluminum foil is more difficult to wind than low capacitance foil, which directly affects the winding speed during production and the size of the capacitor.

As a result, the smallest size of the MXZ series is currently 22×50mm and is only available as a snap-in capacitor. Nevertheless, modern requirements call for higher power density and better efficiency, and the MXZ series will make a significant contribution to these requirements.

**Product overview of the MXZ series**

- Temperature range: -25 to +105°C
- Lifetime: 105°C, 3,000 hours
- Rated voltage: 450V DC
- Size: ø22×50 to ø45×100mm (Standard spec up to ø35mm)

P04

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

Compared to RUBYCON's MXT series of the same size, which uses chemically etched films, the MXZ series offers around 10% higher capacity and can achieve slightly higher rated current values. The MXT series itself was launched in 2022 and is therefore relatively new. However, if you compare the MXZ series with the currently widely used

MXG series, there is a nominal current increase of around 15-25% for the same size, while capacity increases by 75-95%. In terms of capacity requirements, one MXZ can replace two MXGs.

Whether chemically etched or powder-coated, handling high-capacitance aluminum foil requi-

**Available Capacitance Table of MXZ series (450V, 105°C, 3,000Hrs)**

| L    | Ø22   |       | Ø25   |       | Ø30    |       | Ø35    |       |
|------|-------|-------|-------|-------|--------|-------|--------|-------|
| 50L  | 430µF | 1.84A | 580µF | 2.12A | 870µF  | 2.49A | 1170µF | 2.68A |
| 55L  | 490µF | 2.00A | 650µF | 2.30A | 980µF  | 2.69A | 1280µF | 2.88A |
| 60L  | 540µF | 2.15A | 720µF | 2.47A | 1080µF | 2.88A | 1420µF | 3.08A |
| 65L  | -     | -     | -     | -     | 1190µF | 3.07A | 1530µF | 3.25A |
| 70L  | -     | -     | -     | -     | 1300µF | 3.25A | 1670µF | 3.45A |
| 75L  | -     | -     | -     | -     | 1360µF | 3.40A | 1810µF | 3.63A |
| 80L  | -     | -     | -     | -     | 1460µF | 3.57A | 1950µF | 3.82A |
| 85L  | -     | -     | -     | -     | 1570µF | 3.74A | 2090µF | 4.00A |
| 90L  | -     | -     | -     | -     | 1670µF | 3.91A | 2230µF | 4.17A |
| 95L  | -     | -     | -     | -     | 1780µF | 4.07A | 2370µF | 4.34A |
| 100L | -     | -     | -     | -     | 1880µF | 4.23A | 2510µF | 4.51A |

Capacitance table applies to capacitance tolerance M (±20%), Ripple current is reference value (Unit: Arms/120Hz)



# DESIGN FREEDOM

## ISABELLENHÜTTE: Precision at Very Low Resistance Values



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With the introduction of the WAX product family and the FMx series, ISABELLENHÜTTE has successfully closed the gap within its own portfolio in the resistance range from 0.5 to 6mΩ. This expansion enables the production of current-measuring resistors with very low resistance values while reducing the component size at the same time.

The WAX product family includes two series, WAK and WAF, which cover a power range from 6 to 7W with resistance values between 0.487 and 1mΩ. The WAK series is available in size 1206, while the WAF series is offered in 1213. In comparison, the ISA-WELD® family (welding technology) offers a power range from 3 to 15W and covers resistance values from 6.8 to 0.1mΩ, with sizes ranging from 1216 to 5930.

The WAK and WAF current-measuring resistors from ISABELLENHÜTTE are ideal for applications where compact design and high efficiency are essential. These shunts are particularly used in small, mobile electrical devices such as drones, e-scooters and e-bikes. In this type of application,

precision current measurements with minimal space requirements and low weight are crucial. The WAX product family offers the ideal solution, as they guarantee high performance and reliability while being small in size. Such characteristics make them the preferred choice for developers seeking efficient components for modern, space-saving designs.

At the same time ISABELLENHÜTTE has added a new manufacturing technology with the WAX family – Roll-CLAD technology.

With the new manufacturing process, ISABELLENHÜTTE is establishing an alternative production process where two different metal strips are bon-

ded together using a cold rolling process. In this procedure, two rollers apply high pressure to the strips to ensure a reliable connection. The carrier material is copper, while the second strip consists of the specially developed resistance materials MANGANIN® or ZERANIN®.

Once the composite material is produced, it is punched to the desired dimensions and moulded. Combining these materials not only improves the electrical properties but also increases the mechanical strength and thermal stability of the components.

Additionally the typical high quality standard of ISABELLENHÜTTE, which is reflected in the efficient heat dissipation and excellent resistance stability even at high temperatures, needs to be emphasised. These properties guarantee a long service life and reliability of the shunts in their respective applications.



WAF 1213

**Key features**

- Resistance range: 0.487, 0.5, 0.991 and 0.1mΩ
- Size: 1206 and 1213
- Tolerances: 1% and 5%
- TCR: up to ±40ppm/K or <100ppm/K
- Power rating: up to 7W@70°C
- Excellent long-term stability
- Temperature range: -65 to +175°C
- Super-low inductance with <0.5nH, suitable for high-frequency signals
- AEC-Q200 qualified

P05

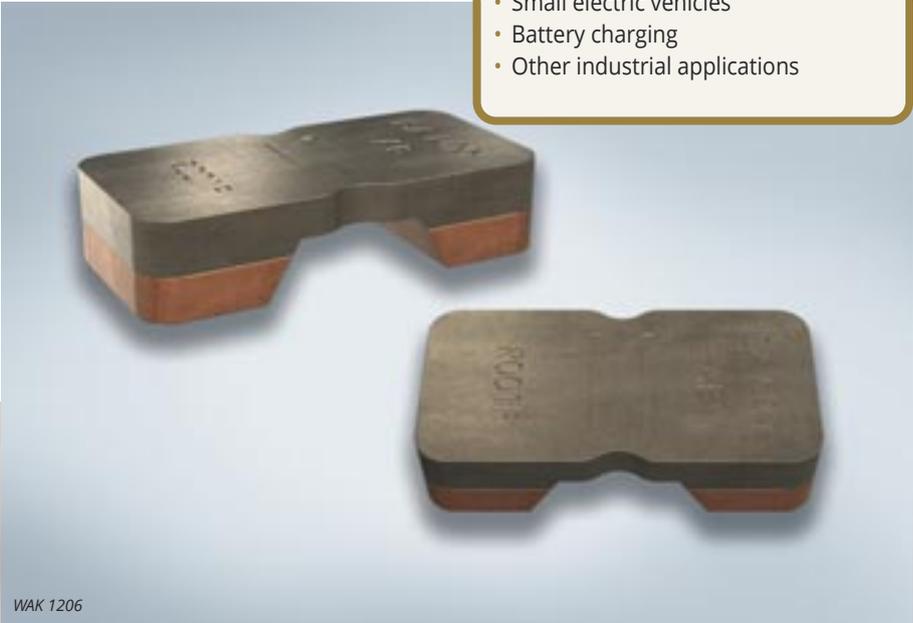
▶ Selma Jakupovic, +43 1 86305 127  
selma.jakupovic@codico.com

**APPLICATIONS**

- Automotive
- Small electric vehicles
- Battery charging
- Other industrial applications

The WAX product family enables ISABELLENHÜTTE to meet the demand for compact, high-performance shunts that can be used in a wide range of modern electronic applications. The expansion of the portfolio underlines the ambition of ISABELLENHÜTTE to continuously provide advanced solutions for a dynamically growing market.

The Roll-CLAD Shunts, WAK and WAF, are AEC-Q200 qualified and are in mass production.



WAK 1206



# SPACE SAVING



## Miniaturised High-Capacitance Hybrid Capacitors



In 2024 PANASONIC Industry introduced another »top-of-the-market« product. With the latest SMD-series »ZL« of their Al-electrolytic polymer hybrid capacitor portfolio, PANASONIC achieves the highest capacitance value per case size and voltage, exceeding most of the competitor's products. Additionally, the ESR is on a very low level for such high-capacitance versions.

However, this is not the only strength of the new ZL-series. The rated temperature range is specified with up to 135°C with a guaran-

teed lifetime of 2,000 to 4,000 hours, and small case sizes such as 5×5.8mm, 6.3×5.8mm and 6.3×7.7mm are also available. Competition at

such a high capacitance level, especially with a 5mm diameter, is very limited, and a 135°C rating is rarely found.

The following table compares PANASONIC's previous high-capacitance series, ZKU and ZTU (with diameters of 8 and 10mm). ZTU, which is an improved version of ZKU in terms of ESR and ripple current capability, is not available in 5 or 6mm



ZL-C



ZL-D8 Antivibration



ZL-F Antivibration



ZL-G

diameters. This means that the new ZL series now offers a capacitor in the smaller dimensions that has improved the above-mentioned parameters and is additionally specified at 135°C.

This great combination of high capacitance, low ESR, and high ripple current capability in one component, ranging from dimensions of 5x5.8 to 10x10.2mm, contributes to miniaturised designs, especially – but not only exclusively – important for automotive applications. The use of

more temperature-resistant materials increases reliability. Additionally, the AEC-Q200-compliant ZL series offers vibration-proof versions that can withstand shocks of up to 30G, available in diameters from 6 to 10mm.

Tailored for use in various automotive components, including water & oil pumps, cooling fans, high-current DC to DC converters, and advanced driver-assistance systems (ADAS), the ZL series also proves invaluable in various industrial power

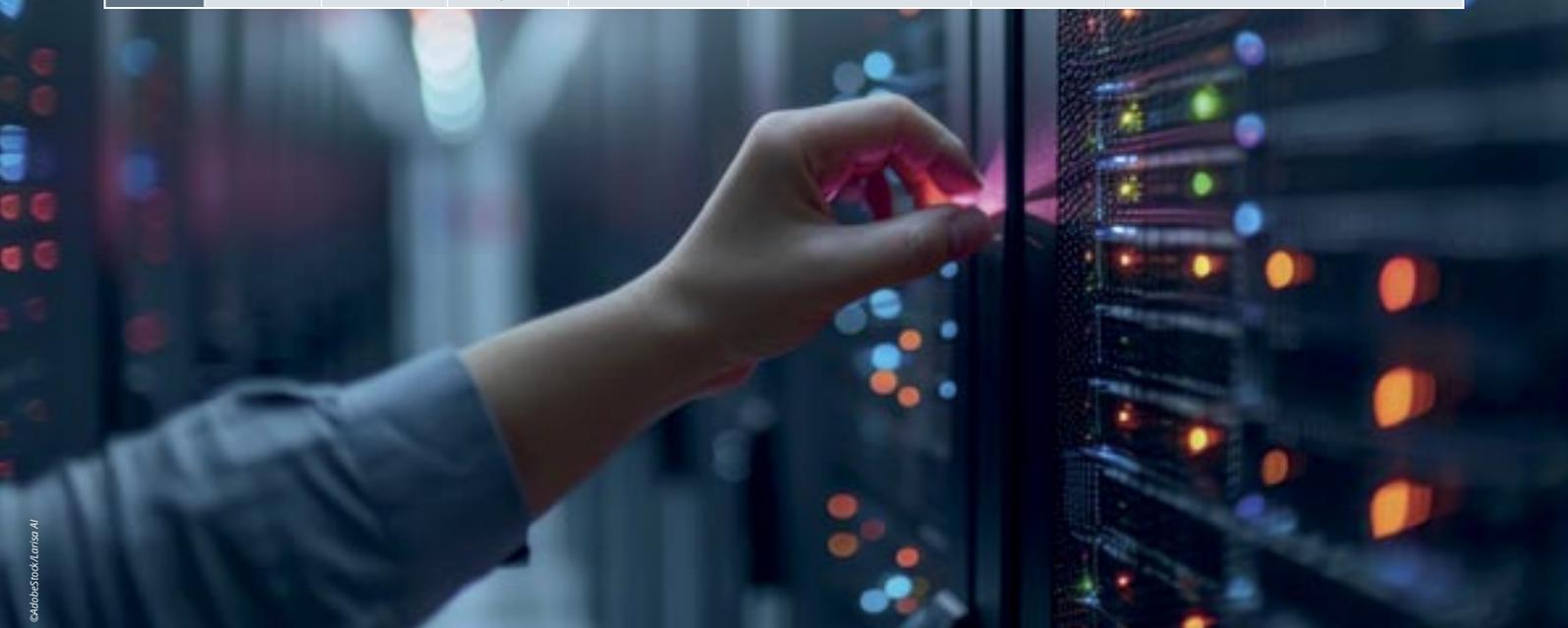
supplies, cooling systems, solar power systems, and communication infrastructure equipment such as base stations, servers, routers, and switches.

For further information, samples, or an offer, don't hesitate to contact CODICO.

**P06**

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

| SERIES | VOLTAGE (V) | CAPACITANCE (µF) | DIMENSIONS (mm) | ESR (mΩ @20°C/100kHz) | RATED RIPPLE CURRENT (mA rms @125°C/100kHz) | LIFETIME (h) | RATED RIPPLE CURRENT (mA rms @135°C/100kHz) | LIFETIME (h) |
|--------|-------------|------------------|-----------------|-----------------------|---|--------------|---|--------------|
| ZL     | 25          | 82               | 5x5,8           | 58                    | 1000  | 4000         | 600   | 2000         |
| ZKU    | 25          | 56               | 5x5,8           | 80                    | 850   | 4000         |   |              |
| ZL     | 35          | 47               | 5x5,8           | 60                    | 900   | 4000         | 550   | 2000         |
| ZKU    | 35          | 39               | 5x5,8           | 100                   | 750   | 4000         |   |              |
| ZL     | 25          | 150              | 6,3x5,8         | 38                    | 1500  | 4000         | 800   | 2000         |
| ZKU    | 25          | 100              | 6,3x5,8         | 50                    | 1300  | 4000         |   |              |
| ZL     | 35          | 82               | 6,3x5,8         | 40                    | 1400  | 4000         | 700   | 2000         |
| ZKU    | 35          | 68               | 6,3x5,8         | 60                    | 1200  | 4000         |   |              |
| ZL     | 25          | 220              | 6,3x7,7         | 24                    | 2000  | 4000         | 1000  | 2000         |
| ZKU    | 25          | 180              | 6,3x7,7         | 30                    | 1800  | 4000         |   |              |
| ZL     | 35          | 150              | 6,3x7,7         | 26                    | 1900  | 4000         | 900   | 2000         |
| ZKU    | 35          | 120              | 6,3x7,7         | 35                    | 1700  | 4000         |   |              |
| ZL     | 25          | 470              | 8x10,2          | 18                    | 3000  | 4000         | 2000  | 4000         |
| ZKU    | 25          | 330              | 8x10,2          | 27                    | 2000  | 4000         |   |              |
| ZTU    | 25          | 330              | 8x10,2          | 22                    | 2900  | 4000         | 1800  | 4000         |
| ZL     | 35          | 270              | 8x10,2          | 20                    | 2900  | 4000         | 1900  | 4000         |
| ZKU    | 35          | 220              | 8x10,2          | 27                    | 2000  | 4000         |   |              |
| ZTU    | 35          | 220              | 8x10,2          | 22                    | 2900  | 4000         | 1800  | 4000         |
| ZL     | 25          | 680              | 10x10,2         | 14                    | 3400  | 4000         | 2300  | 4000         |
| ZKU    | 25          | 560              | 10x10,2         | 20                    | 2800  | 4000         |   |              |
| ZTU    | 25          | 560              | 10x10,2         | 16                    | 3500  | 4000         | 2200  | 4000         |
| ZL     | 35          | 470              | 10x10,2         | 16                    | 3300  | 4000         | 2200  | 4000         |
| ZKU    | 35          | 390              | 10x10,2         | 20                    | 2800  | 4000         |   |              |
| ZTU    | 35          | 390              | 10x10,2         | 16                    | 3500  | 4000         | 2200  | 4000         |



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# SAVING ENERGY

## Electronic Ballasts and LED Drivers & Their Impact on Lighting Systems

### What are electronic ballasts?

Electronic ballasts regulate the current from the supply line voltage, ensuring proper lamp start and operation. Older magnetic models are simple, including inductors, capacitors, and resistors, whereas modern electronic ballasts use solid-state circuitry to eliminate flicker and increase efficiency. They drive various lighting loads, including LEDs, fluorescent lamps, induction fluorescent (IF), and high-intensity discharge (HID) lamps. Each type has unique start-up characteri-

stics that must be considered by control suppliers to ensure compatibility and longevity (see Figure 1).

### The proliferation of electronic ballasts

Governments worldwide are pushing for energy savings in lighting systems, phasing out magnetic ballasts in favor of electronic ones, particularly for technologies like LED, CFL, and IF. Control manufacturers must ensure their products are com-

patible with these new fixtures as electronic ballasts become more common.

### Challenges and solutions in lighting applications

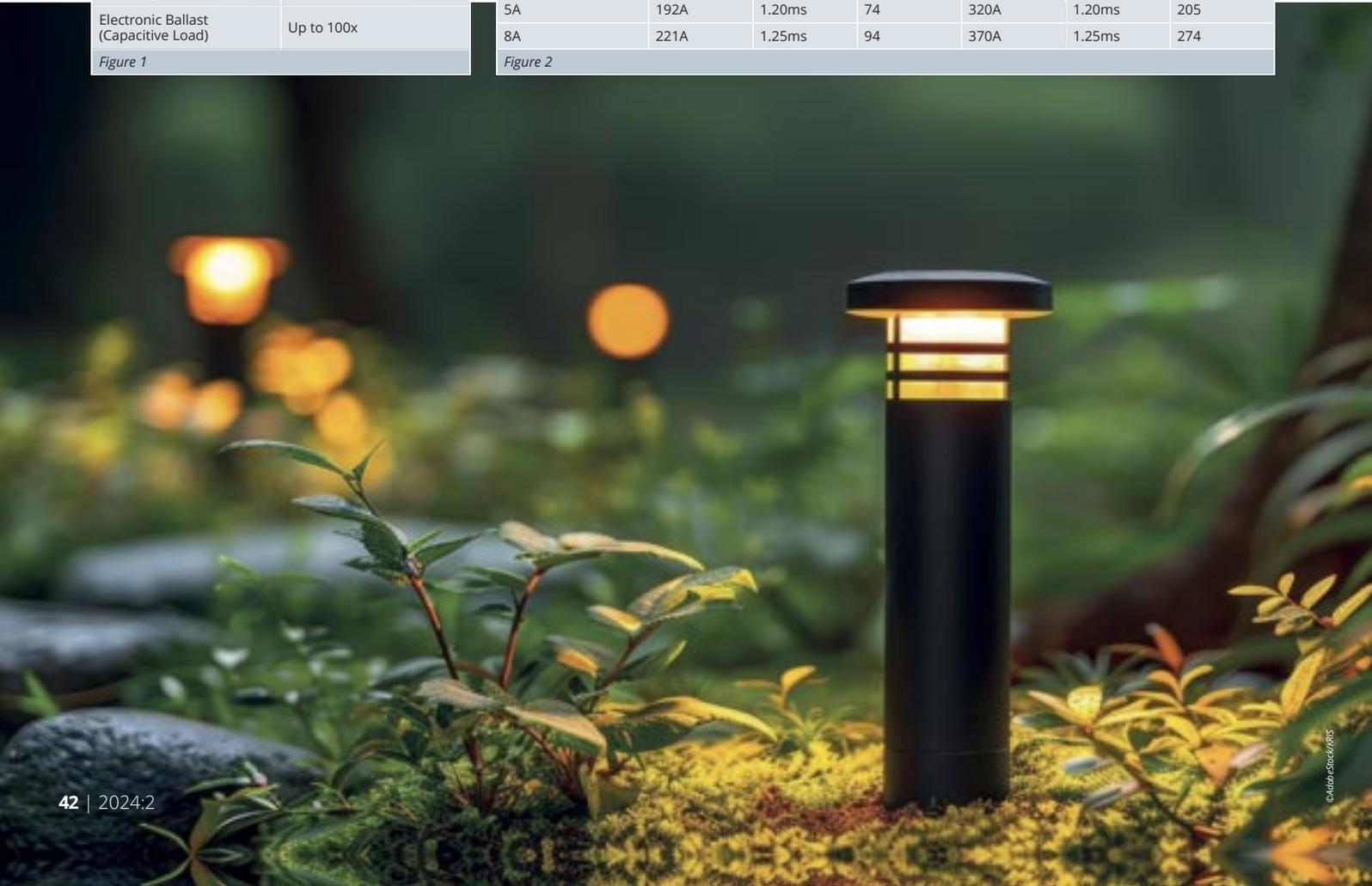
Traditional lighting controls have not met expectations with new lighting technologies due to the high inrush currents caused by electronic drivers, potentially damaging the controls. Updated designs address these issues:

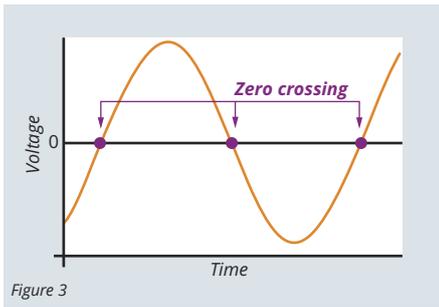
| TYPE OF LOAD                                  | INRUSH CURRENT VS. STEADY STATE CURRENT |
|---|---|
| Incandescent Lamp                             | 10 – 15x                                |
| Fluorescent or HID Lamp with Magnetic Ballast | Up to 15x                               |
| Electronic Ballast (Capacitive Load)          | Up to 100x                              |

Figure 1

| EXAMPLE OF LOAD REQUIREMENTS        |              |             |                                       |          |             |                                       |
|-------------------------------------|--------------|-------------|---------------------------------------|----------|-------------|---------------------------------------|
|                                     | @120 VAC     |             |                                       | @277 VAC |             |                                       |
| Ballast Steady Input Current Rating | Peak Current | Pulse Width | I <sup>2</sup> t (A <sup>2</sup> sec) | Peak     | Pulse Width | I <sup>2</sup> t (A <sup>2</sup> sec) |
| 2A                                  | 144A         | 0.70ms      | 41                                    | 205A     | 0.85ms      | 76                                    |
| 5A                                  | 192A         | 1.20ms      | 74                                    | 320A     | 1.20ms      | 205                                   |
| 8A                                  | 221A         | 1.25ms      | 94                                    | 370A     | 1.25ms      | 274                                   |

Figure 2





### 1. Using high-current rated relays

Inrush currents at turn-on, produced by some electronic ballasts, can cause premature relay contact failures. These inrush currents can be much higher than those experienced with traditional tungsten or magnetic ballast loads because many electronic ballasts employ large energy storage capacitors (Figure 2).

### 2. Implementing zero-crossing

This cost-effective method limits the relay switching current by monitoring the AC supply voltage and timing the switching when the voltage level passes through zero volts (Figure 3).

### 3. Employing lighting control with solid-state relays

Reliable but generate heat and require costly cooling solutions.

## Compact Energy Efficiency

### Tackling 320A inrush current in smart lighting with latest energy-saving DW type from PANASONIC Industry.

One solution for lighting and smart home applications is to use a high-current rated relay. PANASONIC developed DW-YL, a new low-profile/



ADW1212YL

high-inrush latching relay that can manage the high inrush currents caused by electronic drivers (Figure 4).

- High inrush: 320A for 1.2ms
- Nominal load: 20A
- Low-profile type

### PANASONIC DW-YL relay for smart home application

Smart home and intelligent lighting are core areas in the revolution toward eco-friendly energy. The light sources commonly used for these purposes are not only beneficial but can also place high demands on electrical components. Capacitive loads in ballasts and drivers, for instance, can generate significant inrush currents. The latest PANASONIC High Inrush Type DW-YL relay, a latching relay rated up to 20A, can easily ma-

nage such loads and meets a wide range of ratings and standards.

The DW-YL relay can handle up to 320A for 1.2ms, making it ideal for capacitive loads and high inrush current scenarios. This versatility provides customers with great flexibility across various applications. Additionally, the relay's low height of just 15.8mm and small PCB footprint enable a compact design.

The DW relay offers high switching performance while maintaining minimal to no energy consumption. A permanent magnet maintains the current state without continuous energy consumption. Therefore, polarised relays are highly efficient and help improve the power consumption of your application.

Or, more briefly: Eco-friendly energy only makes sense if the components are also optimised for efficiency.

#### Features

- Small area on PCB: 10mm width
- Sensitive coil, low power consumption
- TV8 rating
- High inrush capability up to 320A
- Low profile type (height = 15.8mm)
- UL/C-UL, VDE certified

| COMPARISON                | STANDARD TYPE                     | NEU: DW-YL                        |
|---------------------------|-----------------------------------|-----------------------------------|
| Bezeichnung               | ADW8 ••• HLW, ADW1 ••• HLW        | ADW8 ••• YLW, ADW1 ••• YLW        |
| Inrush current            | 100A                              | 320A                              |
| Size                      | 24x10x15,8mm                      | 24x10x15.8mm                      |
| Standard                  | TV-8                              | TV-8                              |
| Resistance                | 16A, 277V AC                      | 20A, 250V AC                      |
| Electronic ballast        | 2A, 277V AC (Inrush current 205A) | 5A, 277V AC (Inrush current 320A) |
|                           | 5A, 120V AC (Inrush current 192A) | 5A, 120V AC (Inrush current 192A) |
| SET/RESET time            | Max. 15ms                         | Max. 10ms                         |
| Maximum switching current | 16A                               | 20A                               |
| Dielectric strength       | Open contacts 1.000V AC           | Open contacts 1.000V AC           |
|                           | Contact and coil 5.000V AC        | Contact and coil 5.000V AC        |
| Rated operating power     | 400mW (L2), 200mW (L1)            | 400mW (L2), 200mW (L1)            |
| Ambient temperature       | -40 to 70°C (8A to 16A)           | -40 to 85°C (8A to 20A)           |
|                           | -40 to 85°C (8A oder less)        | -40 to 85°C (8A oder less)        |

Figure 4

P07

Wolfgang Weiß, +43 1 86305 334  
wolfgang.weiss@codico.com

# LET THERE BE LIGHT

## Lighting Loads Control: The Solid State Relay Solution

Lighting loads are defined by the energy used to power electric lights, mostly in commercial buildings and public areas. But they can be quite complex to control, as they can be either inductive or capacitive.

Lighting technology has evolved a lot in these past few years as the use of incandescent lights is being slowly, but surely replaced by LEDs, compact fluorescent bulbs and halogen bulbs.

### Quick introduction to different lamp technologies

**Lighting can either be generated by incandescence or luminescence.**

Incandescence is a phenomenon that occurs when a substance emits light when heated. An incandescent bulb consists of a glass bulb containing a filling gas. The tungsten filament connected to the electrical connections is then heated to high temperature by an electric current,

emitting light. It is said to produce warm light. The perfect example of incandescent light is the »classic« light bulb. It produces light by heating a wire filament contained in a glass bulb full of gas to a temperature that results in the generation of light.

Luminescence is the production of light by materials at low temperatures (gas or vapour). Compared to incandescence, which produces light through the heat released, luminescence is said to produce cold light, as the light is produced without intense heating of the material. The perfect example would be a Light Emitting Diode (LED). Unlike an incandescent bulb, LEDs have no fila-

ment, but are made up of layers of several semiconductor materials. These materials offer no resistance to the current, thus avoiding energy loss while creating light.

### How to control different lighting loads

#### Dimming

A dimmer is a type of control equipment that allows to adjust the lighting from zero to full power. Dimming is accomplished by changing the light's incoming voltage. Dimmers depend on the kind of loads or lights. Dimming is not suitable for every kind of lamp charges. For instance, it is not suitable for fluorescent lamps.

#### AC-55a loads (discharge lamps)

Large inrush current flows through discharge lamps when they are turned on (approximately



FIGURE 1: SOLID STATE RELAYS FOR AC-55A LOADS



FIGURE 2: SOLID STATE RELAYS FOR AC-55B LOADS



FIGURE 3: SOLID STATE RELAYS FOR LED LOADS



FIGURE 4: OPEN LOAD DETECTION



10 to 25 times higher than the rated current in specific conditions). Solid state relays are then really adapted to control these kinds of loads (Figure 1).

**AC-55b loads (incandescent and fluorescent lights)**

Incandescent lights are common in many households and businesses, but few people are aware of the complex control systems that make them work. The inrush current characteristics of this load is similar to the surge characteristic of the thyristors used in AC solid state relays outputs, making them the best fit for this application. The most common way to dim incandescent lights is with phase control. With this technique, the AC waveform is interrupted so that only part of each half-cycle reaches the bulb. The brightness is then controlled by varying the time after zero-crossing at which the waveform is turned on or off. High-power dimmers also use random solid state relays.

To regulate the brightness of an incandescent bulb, control systems also use Pulse Width Modulation (PWM). This solution involves rapidly turning the bulb on and off at a very high frequency (invisible to the human eye). By varying the duration of each pulse, the control system can effec-

tively adjust the amount of time during which the bulb is illuminated, without affecting the overall brightness (Figure 2).

**LED loads**

Controlling LEDs is not as simple as controlling incandescent lights. Incandescent lights are all inherently dimmable without needing additional circuitry. LED lights, on the other hand, perform differently in terms of dimming performance and control compatibility, requiring additional information before a LED bulb can be successfully controlled (Figure 3).

**Open load detection**

Open load detection can identify a faulty module

or broken wire, but it cannot detect partial failure. LEDs are often arranged in multiple parallel strings in numerous applications. Hence, it is crucial to detect whether any LED strings in the array are non-operational, even if the rest of the strings are functioning. By employing precise load current measurement, the celduc ESUC current monitoring module can identify this issue by detecting a definite alteration in output current due to a partial open resulting from a string failure (Figure 4).

P08

▶ Arnold Geitzenauer, +43 1 86305 124  
arnold.geitzenauer@codico.com

**CONCLUSION**

**The Future of Lighting Control**

As we witness the ongoing development of technology, it is highly probable that we will encounter more advanced and adaptable control systems capable of not only regulating brightness but also adjusting color, temperature, and other aspects. Current lighting technologies such as LEDs and other solid state lighting solutions are already presenting fresh opportunities for controlling lighting, while the Internet of Things (IoT) is facilitating unparalleled connectivity and automation.

Solid state relays, with their rapid switching, extended lifespan, and superior dependability, represent an exceptional option for integration into light control systems.

# POWER UP WITH AMPHENOL

## Exploring Battery Connector Applications

Amphenol  
COMMUNICATIONS SOLUTIONS

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The future of technology is focused on energy efficiency and sustainability. With this approach focusing on environmentally friendly battery-powered solutions, innovations such as e-bikes, electric forklifts, and energy storage systems are significant steps towards this future. AMPHENOL is at the forefront of this movement with a range of battery connectors that strongly support this vision.

**B**attery connectors play a critical role in ensuring efficient power transfer and reliable performance. AMPHENOL's extensive range of battery connectors offers solutions for both charging and discharging, providing robust connections to meet specific requirements, whether standard or custom.

Designed for durability and long-term performance, AMPHENOL's rugged battery connectors deliver reliable connections even under the most demanding conditions. From industrial power connectors to portable and fixed battery charger/discharger connectors, the versatile product range is suitable for a wide array of applications. Through advanced engineering and rapid prototyping, AMPHENOL offers custom battery connector solutions that are precisely tailored to power innovative designs. In short, they are durable, versatile and customisable to your needs,

and comply with industry standards to ensure safety and performance.

### Battery connectors in different target markets and applications

#### ESS - Energy Storage Systems

One of the most important applications for bat-

tery charging connectors is in Energy Storage Systems (ESS), which are becoming increasingly popular in commercial and residential applications. ESS are large electrical grid installations that include lithium-ion batteries, inverters and power conditioning systems (PCS).

For example, AMPHENOL's EnergyKlip™ family of products is powering today's home ESSs: EnergyKlip™ uses contact technology designed specifically for the energy market. The EnergyKlip™ EK160 connectors can maintain up to 160A per contact, while the EK350 variant supports up to 350A per contact. This series includes an optional IP67-sealed version to ensure performance in

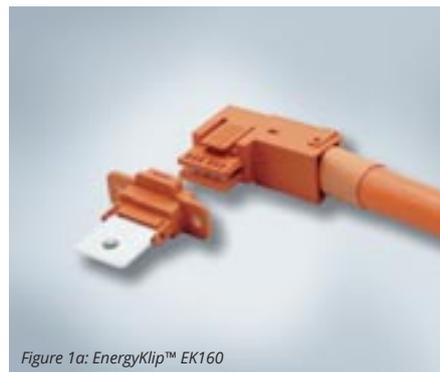


Figure 1a: EnergyKlip™ EK160



Figure 1b: EnergyKlip™ EK350



harsh environments and is ideal for interconnecting battery modules within the ESS. Available in both cable and flex busbar versions, is suitable for a wide range of system designs. Its future-proof design ensures long-term reliability and functionality (Figure 1a and 1b).

### E- Mobility

With the advent of electric vehicles in commercial and industrial settings, there is a significant shift away from reliance on fossil fuels. As more sustainable models become readily available, AMPHENOL is playing an important role in bridging these gaps. AMPHENOL provides state-of-the-art interconnect solutions for EV charging stations, e-bikes, e-scooters, electric forklifts, and electric and hybrid electric powertrain applications in battery electric vehicles, hybrid electric vehicles, and other electric vehicles.

AMPHENOL's IPC or Industrial Power Connector series is designed to accommodate two separate contacts, depending on the power rating. It is an ideal connector solution for battery connections, e-mobility charging, and other DC power distribution applications and can vary in size depending on the power rating (Figure 2).



Figure 2: IPC M120

It is widely used in e-mobility applications such as forklifts, industrial equipment, and robotics.

### E-Bike

When it comes to electrically powered vehicles, e-bikes are very popular due to their lightweight, ease of use and comfort.

The Highly Durable Swappable Docking Connector is a custom swappable battery connector. Available in two power and six signal contact configurations and it can carry a continuous current from 15A to 70A. Designed for 10,000 mating cycles, it is also IP67-rated, making it suitable for harsh environments (Figure 3a and 3b).

### Power Tools

Power tools make life easier with their ease of use and cordless functionality. AMPHENOL plays an important role in providing the critical power tool battery connectors needed for these electric tools. You can choose from a range of products to best suit your tool, whether it is an electric jackhammer, saw, grinder, or drill.

The battery connector for cordless power tools and vacuum cleaners is designed to provide an



Figure 3a: DURASWAP™

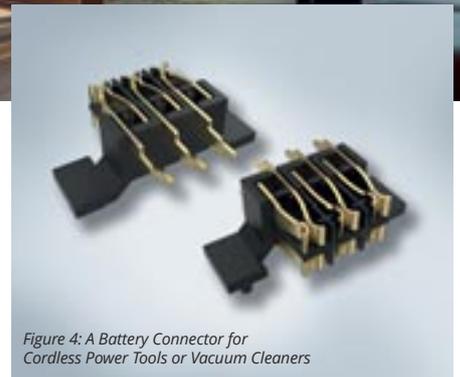


Figure 4: A Battery Connector for Cordless Power Tools or Vacuum Cleaners

optimal power solution with high current capabilities and exceptional durability. With enhanced IP protection and extended connector life, it ensures superior performance in demanding environments. With flexible termination options, including wire-to-wire, board-to-board and wire-to-board solutions for battery charging and discharging, these connectors can be tailored to specific work requirements.

In addition, they are RoHS compliant, feature high temperature resistant housings to operate from -15 to +85°C, and also offer plug polarisation to ensure safe and reliable connections for your cordless power tools and vacuum cleaners (Figure 4).

S01

Julia Reiterer, +43 1 86305 162  
julia.reiterer@codico.com



Figure 3b: DuraEV™

# DINKLE's 0105 SERIES

## The Core Connector of Energy Storage Battery Systems



The DINKLE 0105 Energy Storage Connector is designed to connect battery modules in Energy Storage Systems (ESS). It provides a compact, fast, and stable connection covering the most common applications of outdoor and industrial or commercial energy storage systems. It has a plug and play design and is easy and quick to install, offering a wide variety of sockets to suit different battery models and capacities.

The 0105 Energy Storage Connector is UL4128 rated and withstands a voltage of 1,500V DC. Both the plug and socket offer high protection, preventing electric shock when not connected and achieving an IP67 protection level when connected.

It features positive and negative polarity and anti-mismatch structures to prevent errors when connecting battery terminals. The orange (positive) and black (negative) colour coding allows easy identification of battery poles, reducing the risk of incorrect connections.

The 350A plug has a patented secondary locking mechanism to prevent accidental detachment and provide additional safety protection (see Figure 1).

Depending on on-site requirements the connection can be selected between crimp, vertical threaded bolts or horizontal busbars with elongated holes and busbars with threaded holes. Bolt materials include stainless steel and galvanised iron, which can be chosen according to cost and size. Stainless steel screws have higher strength and corrosion resistance, while galvani-



Figure 1: Advantages

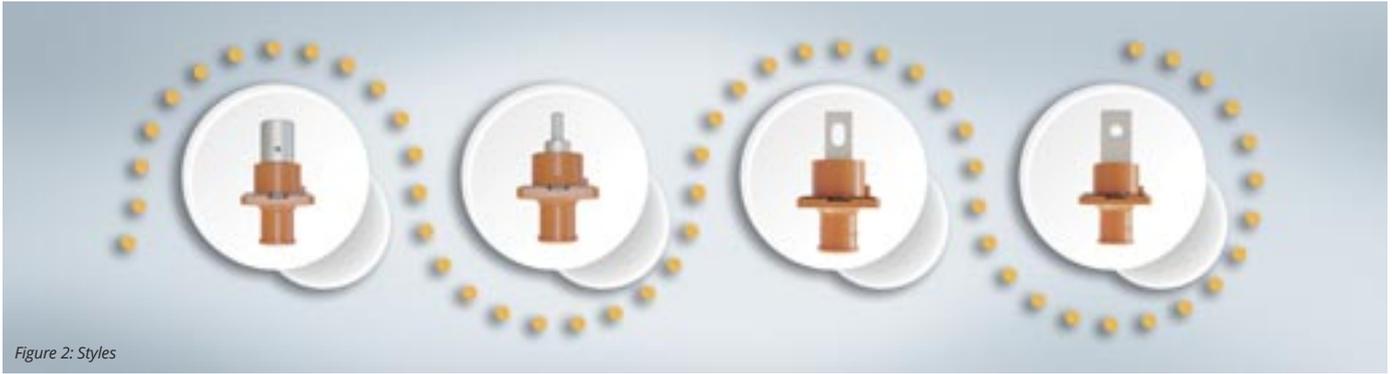


Figure 2: Styles

sed iron screws are suitable for industrial environments (Figure 2).

The 360-degree rotatable design meets the needs of blind mating and adapts to the optimum angle for heavy-duty wiring, preventing reverse polarity and mis-mating (Figure 3).

The 0105 series supports energy storage and transmission applications, eliminating wiring constraints and enabling higher power distribution.



Figure 3: Rotation

This provides the clean energy industry with more reliable, faster, and safer connections! Typical application fields are solar power plants, industrial or commercial energy storage, large-scale electric vehicles, and distribution boxes.

S02

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

**Overview of the Product Series**

| Color                | ORANGE POSITIVE             | BLACK NEGATIVE | ORANGE POSITIVE                  | BLACK NEGATIVE | ORANGE POSITIVE                   | BLACK NEGATIVE |
|----------------------|-----------------------------|----------------|----------------------------------|----------------|-----------------------------------|----------------|
| Product Number       | 0105-0160                   | 0105-0206      | 0105-0110                        | 0105-0210      | 0105-0120                         | 0105-0220      |
| Wiring               | 16 - 25mm <sup>2</sup>      |                | 50 - 70mm <sup>2</sup>           |                | 95 - 120mm <sup>2</sup>           |                |
| Capacity             | 4 - 6 AWG                   |                | 1/0 - 2/0 AWG                    |                | 3/0 - 4/0 AWG                     |                |
| Rated Current (A)    | 76 - 120A                   |                | 200 - 250A                       |                | 300 - 350A                        |                |
| Rated Voltage (V)    | 1500                        |                | 1500                             |                | 1500                              |                |
| Degree of protection | IP 67                       |                | IP 67                            |                | IP 67                             |                |
| Certifications       | RoHS, IP67, 48hrs Saltspray |                | RoHS, cUL, IP67, 96hrs Saltspray |                | RoHS, cUL, IP67, 96 hrs Saltspray |                |

| Terminal Type |            | CRIMP     |           | THREADED BOLT |           | BUSBAR THREADED HOLE |           | BUSBAR ELONGATED HOLE |           |
|---------------|------------|-----------|-----------|---------------|-----------|----------------------|-----------|-----------------------|-----------|
|               |            | ORANGE    | BLACK     | ORANGE        | BLACK     | ORANGE               | BLACK     | ORANGE                | BLACK     |
| Rated Current | 76 - 120A  | 0105-116A | 0105-126A | 0105-116B     | 0105-126B | 0105-116C            | 0105-126C | 0105-116D             | 0105-126D |
|               | 200 - 250A | 0105-111A | 0105-121A | 0105-111B     | 0105-121B | 0105-111C            | 0105-121C | 0105-111D             | 0105-121D |
|               | 300 - 350A | 0105-112A | 0105-122A | 0105-112B     | 0105-122B | 0105-112C            | 0105-122C | 0105-112D             | 0105-122D |



# DRIVING SUSTAINABILITY



## SINBON: Pioneering Energy Storage Solutions

In the rapidly evolving era of technology, ensuring the coexistence of technology advancement and sustainability has become a crucial global issue. To achieve the United Nations' 2050 net-zero emissions goal, energy storage devices are playing an increasingly vital role. Whether it's electric vehicles, smart grids, or portable electronic devices, stable and efficient energy storage solutions are indispensable.

As a professional electronic connectivity integration design service provider, SINBON Electronics is dedicated to offering professional and rapid energy storage solutions, helping various fields achieve sustainable energy efficiency improvements. In 2014, SINBON first ventured into the microgrid application field by assisting clients in producing voltage and temperature acquisition cables. With the rising demand for power and energy storage batteries, the team has planned to expand its layout in this field. To date, with its highly customized integration ser-



Figure 1: Temperature Collection Cable Assembly

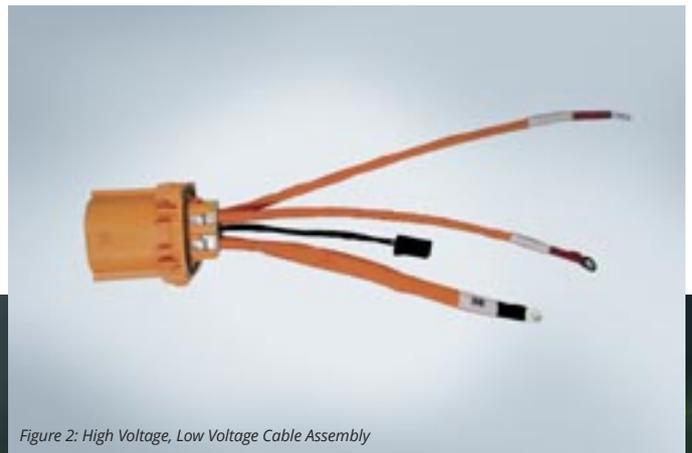


Figure 2: High Voltage, Low Voltage Cable Assembly





Figure 3: Cells Contact System

vice capabilities, SINBON's microgrid applications cover electronic components for PV systems, power converters, and various energy storage cabinets, playing a critical role in multiple application scenarios and ensuring smooth energy conversion and safe operation. SINBON also offers a variety of cable components for microgrid applications, such as lightning arrester protection harnesses, grid-connected control harnesses, and signal control system harnesses (Figure 1 and 2).

In terms of energy storage cabinets, SINBON also excels, engaging in harnesses, electrode modules (Cell Contacting System; CCS), and integrated cover plates. They can deliver corresponding products for both air-cooled and liquid-cooled energy storage cabinets, as well as for home energy storage fields (Figure 3).

### The advantages of using SINBON's energy storage application products include:

#### High-Efficiency Energy Management

Centralised control and management of multiple energy storage components improve the system's energy conversion efficiency.

#### Reliability and Safety

Multiple protection mechanisms, such as voltage and current monitoring and fault isolation, ensure stable operation.

#### Flexibility and Scalability

Adaptable to different scales and types of energy storage equipment, facilitating system expansion and upgrades.

#### Fault Diagnosis and Maintenance Convenience

Centralised management allows for quick detection and location of faults, reducing maintenance time and costs.

SINBON Electronics' energy storage application products stand out due to their unique advantages. The products use tinned copper wire and aluminum terminals with ultrasonic welding

technology, ensuring excellent mechanical and electrical performance, which enhances the overall system's reliability. The materials used are also selected for safety and quality, featuring fire-retardant properties and fully complying with UL safety standards, ensuring product safety and durability in various harsh environments. These advantages make SINBON Electronics' energy storage application products highly competitive in the market, providing customers with reliable and efficient solutions.

As product iterations and updates continue to emerge, SINBON's energy storage solutions cover a wide range of applications, including electric vehicles, electric bicycles, electric scooters, wind energy, solar energy, and the power grid, actively promoting the coexistence of technology and sustainable development. Looking ahead, SINBON will continue to invest in research and innovation, striving to lead the advancement of energy storage technology and provide robust support for the global energy transition.

Please contact CODICO for more information about energy storage solutions.

S03

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

# PCI EXPRESS® FLIP CEM

## Card Edge Connector with Extend Differential Signalling to 32Gbps NRZ



The PCIe® Gen 5 Flip CEM is a new 1.0mm pitch vertical card edge connector that follows the standard PCIe® mating interface. It is designed with a different footprint, as the contacts are »JJ« type or »LL« type, providing a maximum saving of up to 19.5% in keepout area. The current Flip CEM supports 32Gbps (Gen 5), and the mating side supports backward compatibility with PCIe® 4/3/2/1 cards.

The Flip CEM is ideal for use when the PCIe® connector needs to be placed close to the edge of the PCB. The Flip CEM connector with »JJ« or »LL« contacts can prevent the trace from going inside the connector, causing a stub.

When board space is limited, especially the connector footprint near the board edge, the Flip connector offers advantages for both, signal integrity and breakout routing.

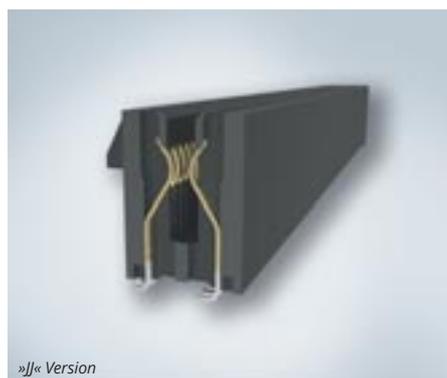
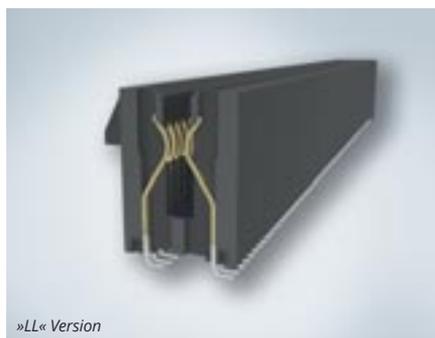
Standard CEM connectors require additional space outside the footprint for breakout or use VIPP design, which increases cost. The Flip CEM breakout is within the footprint and requires no additional space.

The »JJ« and »LL« variants of the PCI Express® Flip CEM Card Edge Connectors, rated for Gen 6, will be released soon.

S04

Julia Reiterer, +43 1 86305 162  
julia.reiterer@codico.com

|                               | STANDARD TYPE | FLIP-TYP    |
|-------------------------------|---------------|-------------|
| Solder Pad to PCB Edge        | 1.00mm        | 2.00mm      |
| Connector Housing to PCB Edge | 1.90mm        | 0.50mm      |
| CL of AIC to PCB Edge         | 5.60mm        | 4.20mm      |
| Solder Pad Size               | 0.53×2.00mm   | 0.53×1.40mm |
| Solder Pad to Center Line     | 3.60/3.60mm   | 1.50/3.60mm |



| FEATURES   |     | BENEFITS   |
|--|-----|--|
| Contact types of »JJ« and »LL« are available                     | ◀ ▶ | Able to meet different customer soldering requirements                                   |
| Supports X8, X16 standard links as per PCI-SIG CEM specification | ◀ ▶ | Provides excellent performance and additional options for extreme bandwidth applications |
| Backward mating  | ◀ ▶ | Backward mating compatible with Gen 1/2/3/4 specifications                               |
| RoHS compliant   | ◀ ▶ | Meets environmental, health, and safety requirements                                     |
| Low-halogen material   | ◀ ▶ | Meets next-generation requirements   |

# NEXT STEP

## YAMAICHI Expands Its Y-Circ P Series with Additional Crimp Contacts

With the Y-Circ P push-pull circular connector, YAMAICHI Electronics offers various connector series in IP50 and IP68 in different sizes, pin counts, and contact types. To round off the portfolio, new crimp contacts with diameters of 1.6 and 2.0mm are now available.

YAMAICHI Electronics can now also supply pin assignments in sizes 15 and 18 with crimp contacts. The necessary contacts with a contact diameter of 1.6mm are available in versions for 0.5-1.0mm<sup>2</sup> and 1.0-1.5mm<sup>2</sup> strand cross-sections, while the 2.0mm version is available for cross-sections up to 4.0mm<sup>2</sup>.

### Important extension for high-voltage pin assignments

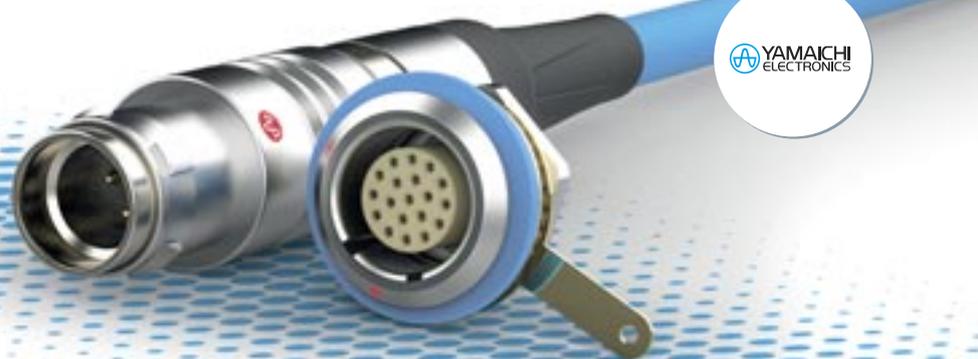
Both contact diameters are available in male and female versions in order to be able to adapt to any application. These crimp contacts are an important extension for high-voltage and other customised mixed layouts, which YAMAICHI can realise in a short time and without high investment costs.



Y-Circ-P-Crimp Size 18



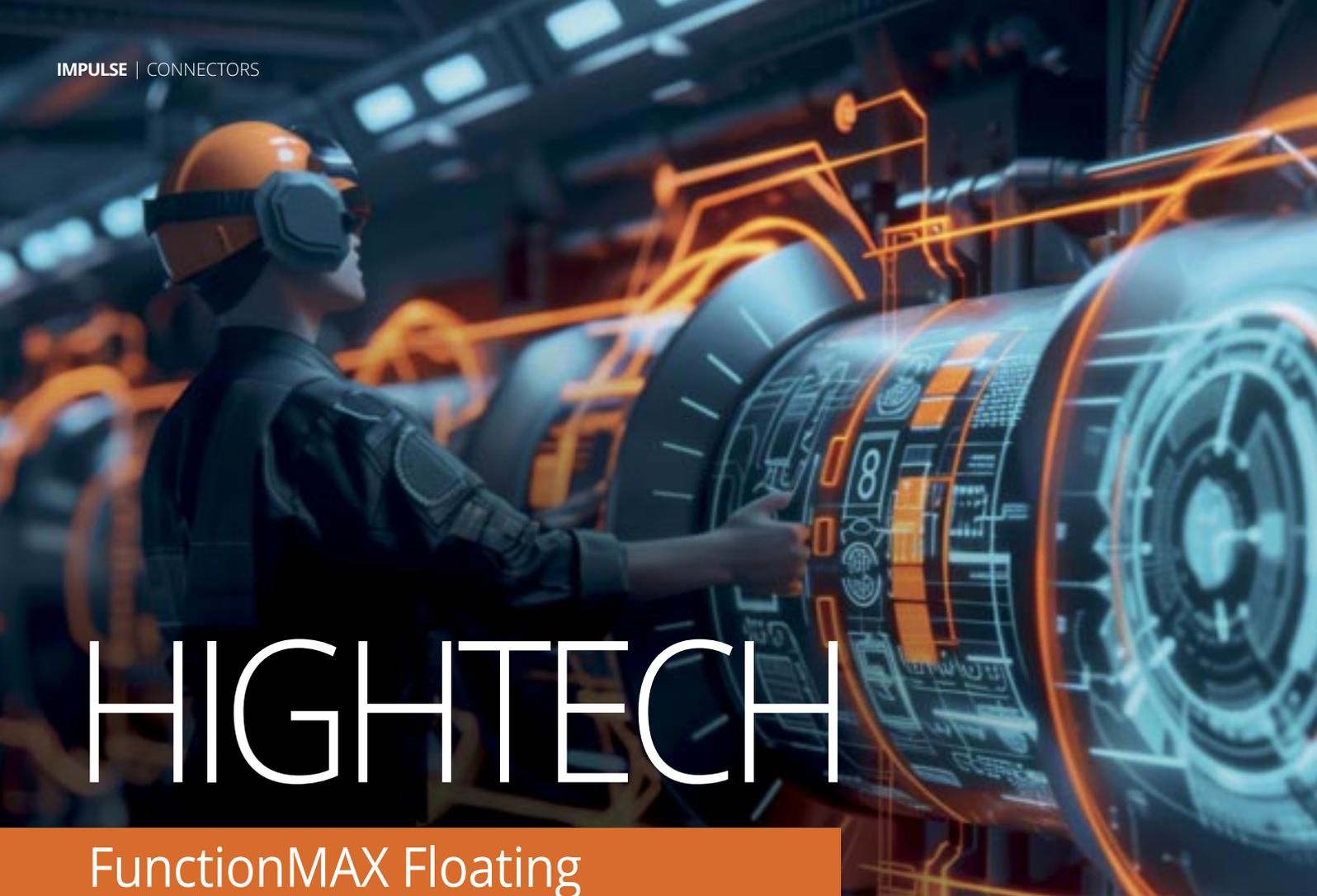
Y-Circ-P-Crimp Size 15



YAMAICHI  
ELECTRONICS

505

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



# HIGHTECH

## FunctionMAX Floating Board-to-Board Connectors

Recently, HIROSE has been working even more vigorously on research and development for two key issues: floating interface design and high-speed transmission. The connectors were introduced to meet the demand for floating connectors that can absorb mounting misalignment in applications where multiple stacked connectors are used.

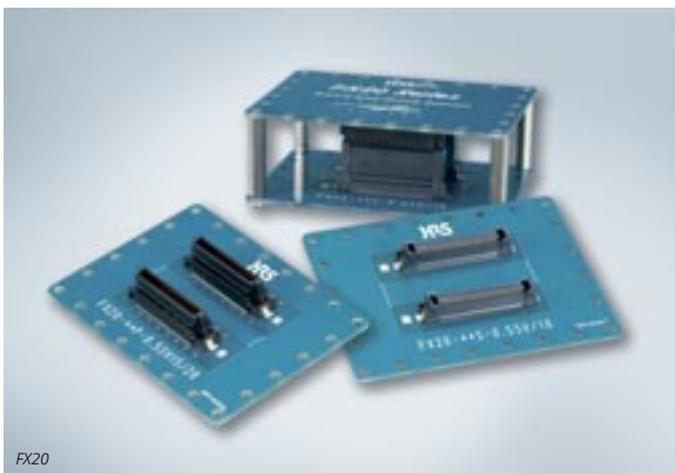
As the name »FunctionMAX« implies, this product family is a series of HIROSE board-to-board connectors designed to meet all the needs of the industrial market with maximum function-

ality. FunctionMAX is compatible with all types of industrial equipment due to its wide range of product variations. HIROSE's floating connectors can handle high currents and high-speed trans-

mission. These series have additional unique features to meet the requirements of various industrial applications.

### Floating connections correct alignment issues caused by assembly errors

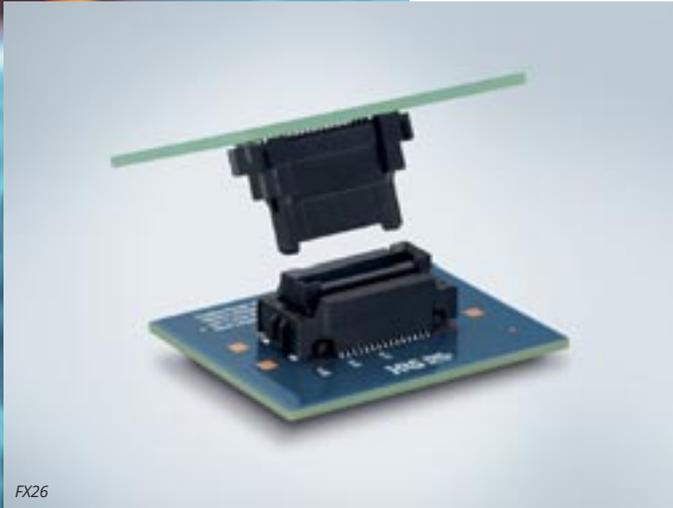
The floating design provides some »play« between the contacts during mating, allowing the connector to absorb alignment errors. Ordinary connectors can only be used when the center li-



FX20



FX23/23L



FX26



FX27

©Autodesk/AviraFox

nes are perfectly aligned. Floating connectors can be used even if the center lines are not perfectly aligned. The joint moves with the mating connector. Terminal spring design controls movement and allows moving parts. Protective parts prevent stress generated by movement from affecting the mounting leads.

#### Benefits of floating

- Multiple floating connectors can be used on the same PCB
- These connectors contribute to the device design by absorbing assembly errors and helping to reduce the need for corrective rework
- The spring section of the connector absorbs stress caused by misalignment. This reduces stress on the assembled parts. This also improves reliability and prevents solder cracking

#### High-Speed transmission

HIROSE's connectors meet the requirements of high-speed communication with their solid performance and design for fields such as telecommunications, automotive, factory automation, and medical equipment.

#### FX20 series with 0.5mm pitch

The header has a unique floating structure embedded within the fixed base of the housing. This allows for alignment movement in XY directions of  $\pm 0.6\text{mm}$  minimum to compensate for mounting misalignment, vibration and dimensional errors. The independent two-point contact provides high contact reliability and resistance to vibration and shock.

#### FX23/23L series with 0.5mm pitch

This series achieves two functions in one connector: floating function and high-speed transmission. The connector has a hybrid structure with power and signal contacts. Four built-in power contacts capable of carrying up to 3A each are located along the mating guides to save space. The signal contacts can carry 0.5A each. The connectors are also suitable for use with conformal coatings applied after soldering.

#### FX26 series with 1.0mm pitch

This high-specification series was developed with

the aim of creating a product with specifications that could be used in the engine room. Two-point contact with a vibration resistant and floating design that can be safely used in continuous vibration and high temperature environments up to  $140^{\circ}\text{C}$ . Its unique floating structure solves the problem of contact failure caused by vibration.

#### FX27 series with 0.8mm pitch

The FX27 series is a floating edge card connector designed to support applications requiring PCI Express Gen 1 (2.5Gbps) high-speed data transfers. The structure of the FX27 series provides a flexible stacking height depending on the length of the interposer board. By using an interposer, a stacking height of 22mm (minimum) can be achieved. The FX27 offers the ultimate in design flexibility, allowing designers to customize their original interposer board with chip components.

506

Julia Reiterer, +43 1 86305 162  
julia.reiterer@codico.com

|                          | FX20                              | FX23/23L                         | FX26                        | FX27                            |
|--------------------------|-----------------------------------|----------------------------------|-----------------------------|---------------------------------|
| Pitch                    | 0.5mm                             | 0.5mm                            | 1.0mm                       | 0.8mm                           |
| Pin count                | 20-140                            | 20-120                           | 20-60                       | 40-120                          |
| Connection               | Parallel (15-30mm)<br>Right Angle | Parallel (8-30mm)<br>Right Angle | Parallel (12-25mm)          | Parallel (~22mm)<br>Right Angle |
| Rating (Current/Voltage) | 0.5A, AC 50V                      | 0.5A/3A, AC 50V                  | 0.7A, AC 125V               | 0.5A, AC 100V                   |
| Floating Range           | $\pm 0,6\text{mm}$                | $\pm 0,6\text{mm}$               | $\pm 0,7\text{mm}$          | $\pm 0,6\text{mm}$              |
| Temperature Range        | up to $85^{\circ}\text{C}$        | up to $105^{\circ}\text{C}$      | up to $140^{\circ}\text{C}$ | up to $105^{\circ}\text{C}$     |
| High Speed Transmission  |                                   | 8Gbps                            |                             | 2,5Gbps                         |
| Additional Features      |                                   | Power/Signal Hybrid              |                             |                                 |

# VERY RELIABLE



## HIROSE's ZG05HV Series: High Voltage Wire-to-Board Connectors

Due to its unique housing design, the ZG05HV can support high voltages, withstanding voltages up to 3,000V AC. This ensures sufficient creepage and clearance between contacts, allowing it to withstand high-rated voltages while remaining compact.

Thanks to its innovative design and materials, the ZG05HV series is suitable and reliable in harsh environments. It can withstand temperatures up to 125°C, meeting stringent automotive requirements that allow the connector to be placed close to engine compartments.

The depth of the ZG05HV provides electric shock protection, preventing the insertion of a finger

and increasing assembly safety. The mating key design features a contact position assurance feature that ensures easy mating and prevents partial insertion of the contacts into the housing.

The ZG05HV's double-layer spring design and 3-point contact provide excellent contact reliability and optimum vibration resistance. The ZG05HV, designed for wire-to-board connections, accom-

modates 22 to 24 AWG wire and is available in female and male housings in black or orange.

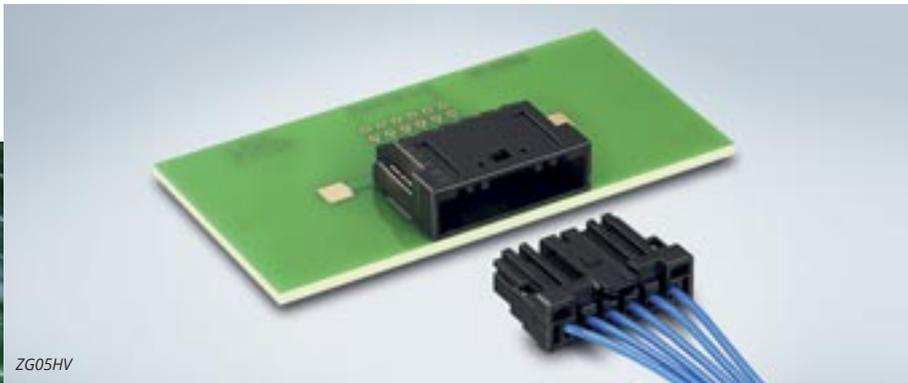
Suitable applications include battery packs and automotive applications.

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Julia Reiterer, +43 1 86305 162  
julia.reiterer@codico.com

### FEATURES

- Contact pitch [mm]: 3.3
- Number of contacts: 6
- Rated Current [A]: 1
- Rated Voltage [V]: AC/DC 1,000
- Operating temperature range [°C]: -40 to +125
- Mating cycles: 30
- Termination AWG: 22-24
- Automotive standard-compliant



ZG05HV

# WATERPROOF

## The CPT1 Series from CVILUX



CPT1 is an environmentally sealed connector designed specifically for cable-to-cable applications. This connector series is ideal for harsh environments and can be used in industrial and commercial transportation applications, such as on the engine or transmission, under the hood, on the chassis or in the driver's cab.

Manufactured from UL94-V0 thermoplastics, the connector series can withstand a wide operating temperature range of up to 125°C. Its IP67 rating makes it waterproof and dustproof. The integrated locking mechanism ensures correct insertion of the connector and prevents unintentional disconnection due to vibrations.

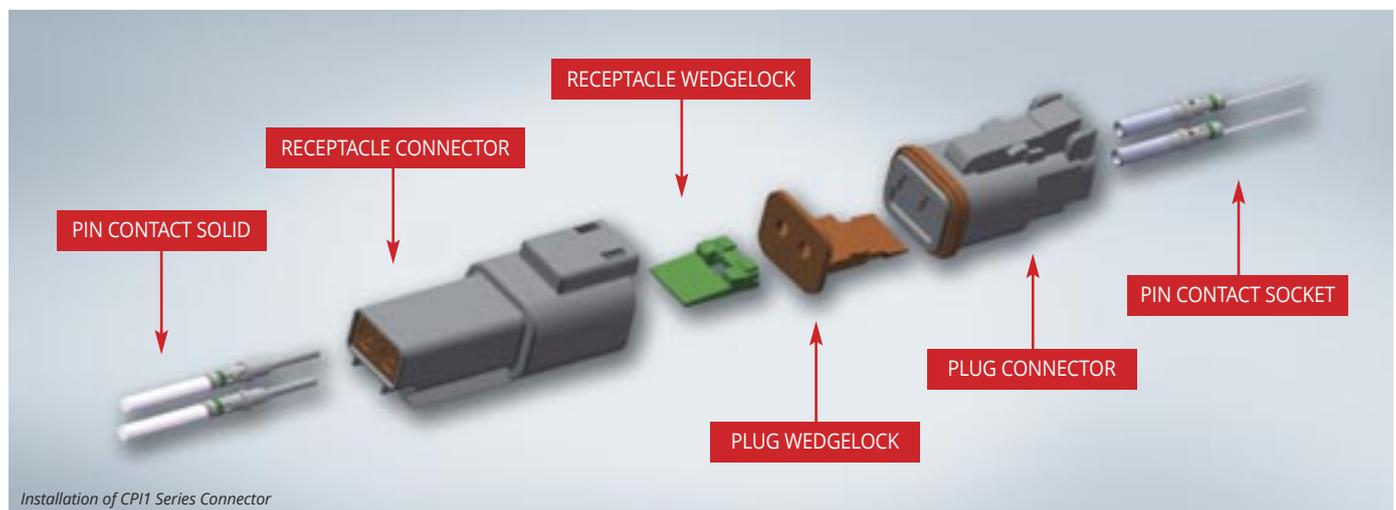
Several modifications are available to increase design flexibility and meet application-specific requirements. Options include plug and receptacle wedge locks and a variety of connector body colors. The wedge locks ensure contact alignment and retention.

Available in 2, 3, 4, 6, 8, and 12-cavity designs with a contact current rating of 13A.

For signal-level circuits in harsh environments, where even a small degradation of the connection can be critical, the CPT1 series universal connectors provide the required reliability and performance at the lowest cost.

S08

Julia Reiterer, +43 1 86305 162  
julia.reiterer@codico.com





# EXTREME

## SOURIAU UTL 4W4: Electrification is Everywhere



SOURIAU

The UTL series has been very successful in the outdoor industrial market due to its high sealing performance (IP68/IP69K) and extreme UV resistance with F1 material to UL746C. The new 4W4 hybrid layout of this connector series is ideal for battery connection applications. Not only does it streamline designs by replacing two separate connections with a single solution, it also contributes to cost savings by reducing inventory and improving overall system efficiency.

The SOURIAU UTL 4W4 hybrid connector features both power and signal contacts seamlessly integrated into a compact design. This innovative connector reduces costs, streamlines inventory and simplifies design processes.

Originally designed for consumer battery charging, the 4W4 layout can transfer up to 44A simultaneously across 4 contacts. The conductor connection range is from 1.5 to 10mm<sup>2</sup> (AWG16 to 8). To ensure the high currents are maintained, the power contacts have a silver-plated surface with

good thermal conductivity and low electrical contact resistance. Another advantage is the low contact force, which enables the connector system to achieve a minimum of 1,000 mating cycles.

The four additional signal lines with cross-sections from 0.05 to 2.50mm<sup>2</sup> (AWG30 to 14) help to implement a Battery Management System (BMS), CAN bus or Ethernet interface. The integration of Last-Mate First-Break contacts allows the system to be connected and disconnected under load.

In addition, the UTL series has a push- & press-to-release coupling system that allows quick connections, even in blind conditions, with an audible click to confirm a secure, correct connection. The connector's small size and easy-to-use latching mechanism means it is also easy to use when wearing work gloves.

Unlike conventional EV charging connectors, which are only connected during the charging process, the UTL 4W4 series is designed for permanent connection over a wide operating range. With an IP68/69K rating, the connector system offers optimum protection against the ingress of foreign bodies and liquids, is vibration resistant and has high UV resistance.

The design also provides good protection in unmated condition, particularly at the receptacle, which is typically mounted on the battery side.



UTL 4W4-Plug &amp; Receptacle

The spring-loaded sealing cap provides IP44 protection even when the connector is unplugged.

The connector is ideal for overmoulded cable solutions. A backshell and cable gland are available as an option for low volume or prototype applications. A version without the self-closing cap is also possible.

In addition to batteries, the UTL 4W4 series can also be used to safely connect larger industrial equipment such as air conditioners, small construction equipment, construction dryers and portable lighting solutions. The SOURIAU UTL 4W4 enables engineers to optimise space with-

out sacrificing performance. Whether in telecommunications, automotive or industrial applications, this connector series offers excellent reliability and connectivity.

### Summary

#### Tough

- IP68/69K in mated condition
- Spring-loaded, self-closing cap IP44
- F1 rated plastic, UV resistance for minimum 5 years
- Salt spray: >1,000 hours
- Ideal for outdoors, humid, corrosive, high vibration and other harsh environments

#### Safe

- UL, CSA, and IEC qualified
- Last-mate first-break signal contacts
- Designed to be mated and unmated under load
- Touch-proof plug

#### Easy Mating

- Quick & easy mating: push-lock, blind mating
- Locking confirmation: audible and tactile click to confirm mating
- High mating cycles (>1,000)

Unlock new possibilities for your designs and contact us for more information or support.

S09

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

### APPLICATIONS

- Mobility (light EVs, motorcycles, cargo bikes, small boats)
- Robotics (UGVs, warehouse handling, industrial, security, drones)
- Hybrid off-road
- Vehicle attachments
- Construction machinery

## A CODICO Success Story

### 8 Years of the CODICO Sample Shop: High-Level Technical Consultation.

Nearly eight years ago, CODICO launched its Sample Shop online. The goal at the time was to provide existing and potential customers with real added value—making samples available online at the start of a project, while offering consultation and technical expertise during the sample ordering process. CODICO has shown that even in the online world, personal contact and professional support are possible.

Today, the Sample Shop offers internet users over 5,500 sample items. Most of these items are

free of charge, with only a few requiring payment. The product range focuses on active and passive components, with many manufacturers coming from areas such as powerline communication, capacitors, and relays, to name just a few.

In addition to the benefit of free shipping, the shop stands out for its user-friendliness, fast delivery, and professional filtering options that help customers select the right sample.

Moreover, the system identifies the relevant contact person for the user – a true specialist who will handle all questions and provide expert consultation. When ordering from the CODICO Sam-

ple Shop, customers not only receive the desired product but, if necessary, also the familiar design-in support.

### Try it out for yourself!

Visit [www.codico.com/shop](http://www.codico.com/shop) where the perfect sample or demo board awaits. We wish you a successful online shopping experience!

D02

▶ Miriam Kaitan, +43 1 86305 129  
miriam.kaitan@codico.com



# CODICO Calendar

## ACTIVE COMPONENTS

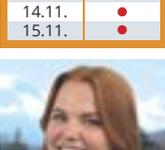
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|--|---|---|--|--|---|---|---|
| <br><b>Leonardo BAZZACO</b><br>12.11. ●<br>13.11. ●<br>14.11. ●<br>15.11. ● | <br><b>Thomas BERNER</b><br>12.11. ●<br>13.11. ●<br>14.11. ●<br>15.11. ● | <br><b>Peter BJÖRKSTRAND</b><br>12.11. ●<br>13.11. ●<br>14.11. ●<br>15.11. ● | <br><b>Klaus BUCHENBERG</b><br>12.11. ●<br>13.11. ●<br>14.11. ●<br>15.11. ● | <br><b>Vasily BUDKÓ</b><br>12.11. ●<br>13.11. ●<br>14.11. ●<br>15.11. ● | <br><b>Thomas CARMODY</b><br>12.11. ●<br>13.11. ●<br>14.11. ●<br>15.11. ● | <br><b>Peter DEGENHART</b><br>12.11. ●<br>13.11. ●<br>14.11. ●<br>15.11. ● | <br><b>Andreas DIRSCHL</b><br>12.11. ●<br>13.11. ●<br>14.11. ●<br>15.11. ● |
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**HR**

# electronica2024

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| <br>Arnold<br>GEITZENAUER<br>12.11. ●<br>13.11. ●<br>14.11. ●<br>15.11. ● | <br>Jens<br>HÄNDT<br>12.11. ●<br>13.11. ●<br>14.11. ●<br>15.11. ●            | <br>Sven<br>HEINEN<br>12.11. ●<br>13.11. ●<br>14.11. ●<br>15.11. ●      | <br>Peter<br>HUCK<br>12.11. ●<br>13.11. ●<br>14.11. ●<br>15.11. ●   | <br>Yasunobu<br>IKUNO<br>12.11. ●<br>13.11. ●<br>14.11. ●<br>15.11. ●    | <br>Thomas<br>JELL<br>12.11. ●<br>13.11. ●<br>14.11. ●<br>15.11. ●      | <br>Sebastian<br>KLUS<br>12.11. ●<br>13.11. ●<br>14.11. ●<br>15.11. ●       | <br>Pasi<br>KUUSRAINEN<br>12.11. ●<br>13.11. ●<br>14.11. ●<br>15.11. ●   |
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# The CODICO TEAM says hello!



## Nicole Rott



Dear Impulse Readers, I'm delighted to introduce myself in this edition of our magazine.

I've been working at CODICO for eight years now, during which time I've gained many valuable experiences. After three years in internal sales, I had the opportunity, after a short maternity leave, to join the product management team. I started as an assistant and, after completing various technical training courses, I am now responsible for electromechanical power PCB relays. This has allowed my colleague, Michael Blaha, to gradually transition into his well-deserved semi-retirement.

What I find particularly impressive is the unique sense of camaraderie and charm within CODICO, something I had never experienced in such a large company before. The management is just as approachable and accessible as any other employee, creating a very pleasant working atmosphere.

As a mother of two young children, I greatly appreciate the flexibility that CODICO offers us parents. The ability to work from home, use part-time or flex-time arrangements is a luxury I do not take for granted. This flexibility is especially important to me, as I live in Wiener Neustadt, about forty kilometers away from the company. With two children, it's often a logistical challenge to juggle everything.

In my free time, when I'm not out and about with my children, you'll usually find me with a book or e-reader in hand. I love books. I live books.

My motto is: »A life without books is possible, but pointless.«

D03

▼ Nicole Rott, +43 1 86305 313  
nicole.rott@codico.com



## Franz-Joseph Toifl

Dear Impulse Readers, my name is Franz-Joseph Toifl, and I am the head chef here at CODICO. My journey to CODICO wasn't exactly the most typical one, as it all started with a simple idea: to bring new energy to the office and provide meals for my colleagues after the first COVID lockdown. What began as a "pop-up kitchen" in the Central Park kitchen, originally planned for three months, has now stretched to over four years, during which I've had the pleasure of treating my colleagues at CODICO to my menus.

I try to cater to all tastes with my dishes and aim to enhance the overall well-being of everyone here. Over the years, I've certainly learned a thing or two about my colleagues' eating habits, and I do my best to accommodate all their preferences. Making sure my guests are happy has always been a top priority for me in my job.

Of course, to serve good food, you need to start with quality ingredients. That's why I'm very grateful for the exceptional support I receive from Sven and Karin Krumpel here at CODICO, which allows me to do just that. So, I cook for my colleagues every day using high-quality ingredients, and hopefully, I get to see them head back to their desks with a smile on their faces.

Anyone who's ever taken a stroll through Central Park at CODICO or regularly dines with me has probably noticed my strong preference for loud and rock music that echoes through the kitchen daily. As the saying goes: Everyone can listen to good music, I just need to turn it up loud enough.

To balance my work, I try to spend as much time as possible with my three children, supporting them in every way I can. With their ages being just 1, 3, and 4 years old, it can be quite a challenge at times, but I cherish every moment when they're happy and content. Besides that, I enjoy cycling or walking in nature to stay fit and take in the fresh air – always accompanied, of course, by plenty of music.

D04

▼ Franz-Joseph Toifl, +43 1 86305 359  
franz-joseph.toifl@codico.com

## Fatima Biscocho-Faustino



My name is Fatima Biscocho-Faustino. Normally, I would welcome you right as you step into the CODICO Headquarters, but today, I have the opportunity to say hello to you this way. My role involves managing the reception, handling emails and faxes (yes, they still exist), filtering out spam, and trying to make every guest and colleague feel welcome. I've been working here for over four years now. My start was shaped by the lockdown: almost all teams were working from home, and the building was undergoing renovations. But together, we managed everything, and despite the circumstances, I had a good start. CODICO allows me to work part-time (23 hours per week), so I still have plenty of time for my children alongside my job. That means a lot to me.

My colleague Barbara and I make a well-coordinated team. We know each other well, understand how the other thinks, and help each other out. This brings me a lot of joy here. In my role, I try to create a feel-good atmosphere. It's important to me to be helpful and considerate. The most common question I'm asked here and how I can make people happy is: »Do you have something sweet?« And yes, most of the time, we can help with that.

My parents are from the Philippines, but I was born and raised here in Vienna. My family consists of my husband, who is also from the Philippines, as well as my nine-year-old daughter and my six-year-old son. He's starting school this year, and I'm really looking forward to that.

My native language is German, but I also speak Tagalog. I spoke Tagalog with my parents, and during my former job at the Philippine Embassy, where I worked for 12 years, I was able to use and improve my Tagalog skills. In my family, we speak a colorful mix of German, English, and Tagalog. However, my children understand more than they speak and would love to learn the Filipino language even better.

This summer, I visited my family in the Philippines – the first time in five years. I took a vacation, visited relatives, spent a lot of time at the beach with the kids, went snorkeling, and ate a lot of delicious food (my insider tip: the typical Filipino dish Adobo).

At home, I only cook Filipino food. Since my pregnancies, cooking and baking have become my passion. I love cooking for others. My coworkers are big fans of my cinnamon rolls. In October, I'm taking a macaron-making course in Vienna. In a group of four, we'll learn how to make macarons ourselves. After trying the original French ones (from Pierre Hermé), I want to be able to make them too!

I'm very happy to be part of the CODICO family and to support the team.

**D05**

▼ *Fatima Biscocho-Faustino, +43 1 86305 368*  
*fatima.biscocho-faustino@codico.com*



## Monika Emeresz

Normally, one of my tasks is to review the Impulse texts, but this time I have the chance to introduce myself. I started working in the marketing department in February 2020. Just three weeks later, I was supposed to attend the embedded world trade fair. I was already looking forward to meeting many new colleagues in person for the first time, seeing the exhibition booth and the trade fair game, and getting to know the atmosphere of the industry. The decision not to attend this trade fair was made at the very last minute – we were supposed to leave for Nuremberg the next day, and our booth was almost completely set up.

For two years, there were no trade fairs and no legendary CODICO Christmas party, which I had already heard rave reviews about. The first Academy Week – the big get-together for all employees, held four times a year – didn't take place again until September 2021. Now, with so many trade fairs keeping us busy in the marketing department, people might wonder what we actually did during that time. But in 2020, we had other priorities and focused heavily on our online presence, organized webinars, launched our website relaunch in October, and put a special emphasis on the monthly newsletter. Organizing the newsletter is one of my responsibilities and one of my favorite tasks. I am also in charge of the Christmas campaign. The Christmas gift shipping in 2020 was a special challenge due to the many changes, but together with my colleagues from logistics and the warehouse, we managed it well. At this point, I want to say a big thank you for the support!

Was it harder to start during the pandemic? Absolutely not. Patient, friendly colleagues who really take the time to explain tasks, fantastic IT support, and perfectly prepared work instructions made the onboarding process easy. In addition, there is a strong focus on continuing education with regular training sessions. I was very happy to participate in the small-group English course, and I also appreciate the opportunity to do sports twice a week during the lunch break.

I was born on World Book Day, which suits me perfectly. My parents recognized early on that a book could keep me perfectly entertained, and that hasn't changed to this day. Luckily, eBooks now exist, preventing my home from being completely overrun by physical books.

Otherwise, I feel most at home with sand under my feet – preferably at the beach, but ideally on a beach volleyball court. It's a passion I share with my husband. Even when my shoulder, elbow, or Achilles tendon starts to ache, I'll keep playing until my teammates chase me off the court. Luckily, the team is aging alongside me! Our court is – quite ideally – located across from a small wine tavern, and as a true child of the wine-growing region, there's no better place for me to go out. Especially in summer, when one wine festival follows another.

The next professional challenge on the agenda is the electronica trade fair in Munich. We're already in the middle of preparations. Together with my colleagues, I'll be managing the reception at our booth. Come by – I look forward to seeing you!

**D06**

▼ *Monika Emeresz, +43 1 86305 320*  
*monika.emeresz@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](http://www.codico.com)