

ENGLISH

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QUALCOMM:

Smart Cameras & Robotics

RUBYCON's New Snap-In Type

AMPHENOL ICC: Automotive Connectors

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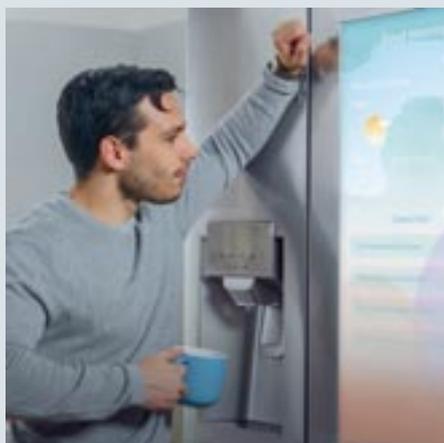
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QUALCOMM is the world's leading wireless technology innovator and the driving force behind the development, launch, and expansion of 5G. Today, their foundational technologies enable the mobile ecosystem and are found in every 3G, 4G and 5G smartphone.

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# All eyes on you! CODICO Quality Award

The reliability of our suppliers plays a major role at CODICO – more so than ever in the challenging times of COVID-19.

If there are delays in delivery, incorrect or incomplete deliveries, or if deliveries are even cancelled completely, this usually leads to production difficulties for our customers. To prevent this, we have analysed and evaluated the strengths and weaknesses of our international suppliers again this year and informed about the results. Careful supplier selection, evaluation and development contribute to more security and transparency in procurement processes, not only in times of crisis.

Under this motto, our suppliers were evaluated again this year on the basis of comparable criteria and the best were honoured with the CODICO QUALITY AWARD. The three categories »Delivery Reliability, Logistics Service and Sales Service« are particularly important to us.

This award represents recognition for our suppliers who have best managed to meet the high and diverse requirements of our customers in addition to price and delivery time.

Congratulations and many thanks to our suppliers for the excellent performance and the trustful cooperation! Would you like to learn more about our QMS system? Please contact

**D01**

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**Sven Krumpel**  
CEO CODICO

## → Spring awakening in autumn

Dear readers,

We are wide awake! No sign of autumn blues, incipient frost or wafts of fog! From an entrepreneurial point of view, I feel spring fever. Growth, hope, joy, sunshine. We are visiting customers again, working with engineers on exciting new projects, attending trade fairs.

That motivates me. In the last few months – soon we will have to talk about years – I have experienced that we are very resilient. More than we thought. General uncertainty – always poison for the economy – has descended on people and companies. But it is subsiding. With the restrictions lifted, we are gaining a new freedom. Businesses are striving to catch up and build up.

We can confirm the upswing predicted by economic researchers. Of course, like the entire electronics industry, we are confronted with global problems in the supply chains and supply bottlenecks. But we are thinking about new things: Localisation – or better »glocalisation«, as futurologists call it – and the reduction of dependencies are being made a public issue and intensively discussed. It is up to us not only to talk, but also to act. New solutions for logistics concepts, close cooperation with our manufacturers, individual advice from our product managers and field sales engineers to find the ideal solution for our customers are all part of our daily service.

My positive thinking is nothing completely new. Experience makes us smarter. And history also confirms this opinion. The last great pandemic – the Spanish flu – brought an unprecedented social, cultural and economic upswing in the 1920s. Are we in for another Roaring Twenties? Golden times that provided a new zeitgeist and new beginnings for almost an entire decade? We at CODICO are definitely infected by this awakening!

▶ Sven Krumpel





# SMART CAMERAS & ROBOTICS

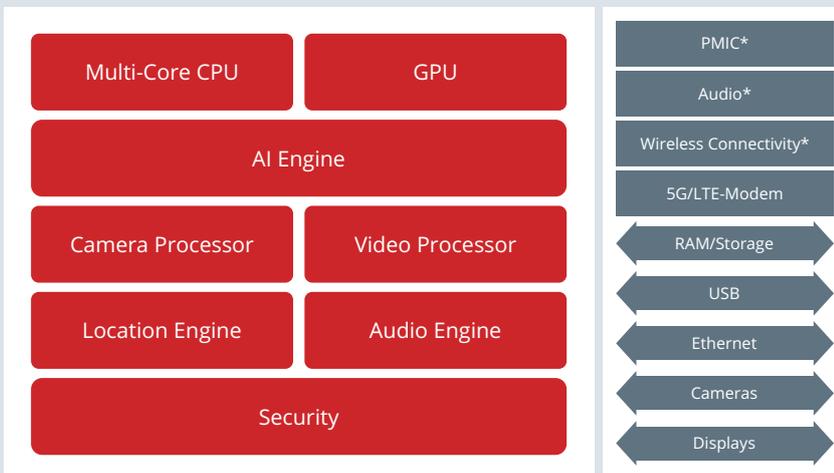
## The Newest IoT-Solutions from QUALCOMM Technologies



QUALCOMM® is the world's leading wireless technology innovator and the driving force behind the development, launch, and expansion of 5G. Today, their foundational technologies enable the mobile ecosystem and are found in every 3G, 4G and 5G smartphone.

They bring the benefits of mobile to new industries, including automotive, the internet of things (IoT), and computing, and are leading the way to a world where everything and everyone can communicate and interact seamlessly. QUALCOMM Technologies recently extended its support for the IoT ecosystem by introducing seven new solutions to help enable the proliferation of next-generation IoT devices. This material provides an overview of QUALCOMM Technologies' latest IoT solutions, and applications and use cases in Smart Cameras and Robotics.

**Diagram 1: Overview of the SoC platforms for Smart Camera and Robotics applications**

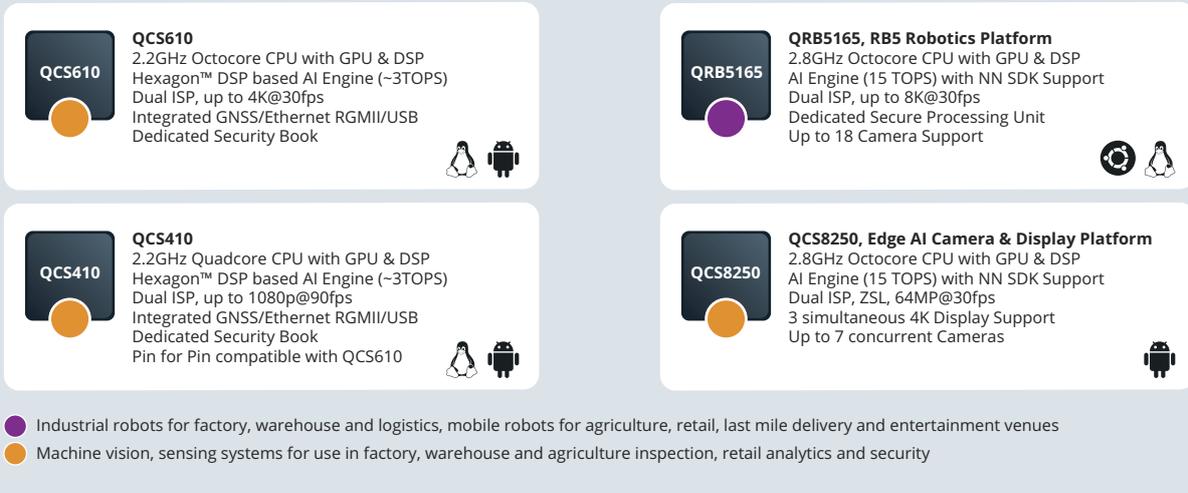


### Overview of QUALCOMM Technologies' highly integrated machine vision and Artificial Intelligence (AI) processing platforms

With the growing adoption of 5G, edge computing and AI technologies across a broad set of new industries, QUALCOMM Technologies developed a powerful roster of cutting-edge solutions, which combined the very best of their compute, multimedia and AI technologies into highly integrated System-on-Chip (SoC) platforms. Their of-

\*Power management (PMIC), audio codec and wireless connectivity devices are also available from QUALCOMM Technologies  
 \*QUALCOMM Technologies also offers SoCs with integrated, on-chip 5G cellular modem capability

**Diagram 2: QUALCOMM Technologies timeline for smart camera and robotics applications**



fering is enhanced with feature rich software releases, software development kits (SDKs) and technical support collateral to help enable a new set of customers to develop innovative smart camera and robotics solutions for industrial, warehouse, factory and retail applications.

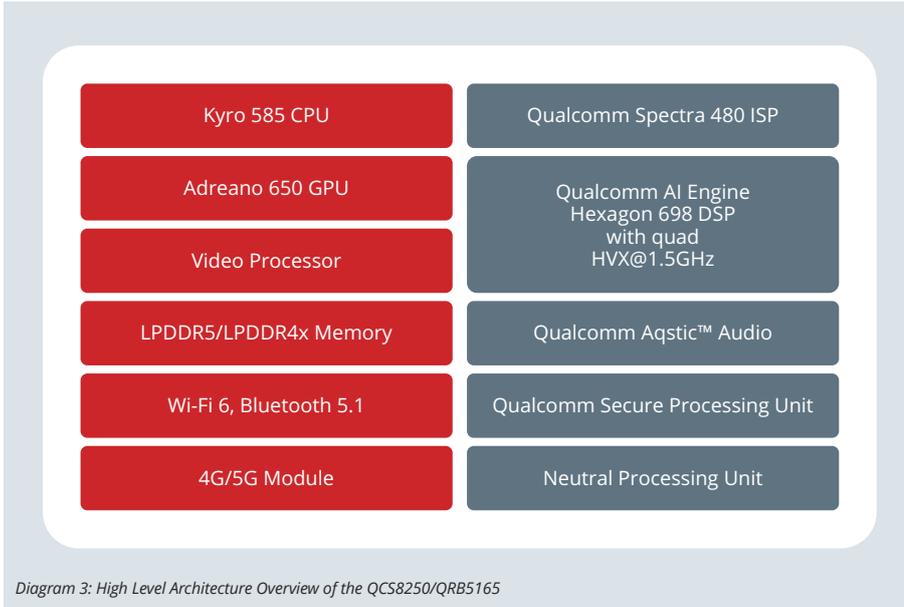
These highly integrated platforms offer multi-core, powerful heterogenous compute, (a com-

ination of CPU, GPU, and DSP processing capabilities) and dedicated AI processing, camera, and video processing capabilities. They can be combined with QUALCOMM Technologies' cellular, wireless connectivity and power management devices to deliver a complete platform solution for an end customer. QUALCOMM Technologies and trusted partners have incorporated these technologies into reference designs and hard-

ware development kits. These hardware resources are enabled by a fully featured software development environment to accelerate product development and time to commercialization.

Let's take a look at the key features offered in the latest QUALCOMM Technologies platforms for smart camera and robotics applications. ▶





The QUALCOMM® QCS410 and QUALCOMM® QCS610 delivers powerful computing for on-device camera processing and machine learning, with exceptional power and thermal efficiency. Both solutions integrate a powerful image signal processor (ISP) and the QUALCOMM® AI Engine, along with a heterogeneous compute architecture including highly optimized custom CPU, GPU and DSP for accelerated AI performance and processing capability running Linux and Android. These platforms are used in smart cameras for retail, end of line or process monitoring systems for factory or warehouse applications, smart displays, video conferencing and enterprise security equipment.

The QUALCOMM® QCS8250 is a powerful platform delivering multi-core GPU, GPU and DSP compute combined with up to 7 concurrent cameras as well as support for 3 simultaneous 4K displays. It can deliver an impressive 15 TOPS of processing power for AI enhanced applications. With Android 10, the QCS8250 enables customers to deliver feature rich, innovative applications to launch quickly.

The combination of powerful hardware and a feature rich suite of software makes it an ideal platform for automated checkout and retail monitoring systems, multi-screen, high resolution smart displays, service robots, and warehouse, logistics

and factory-based quality control and process inspection systems.

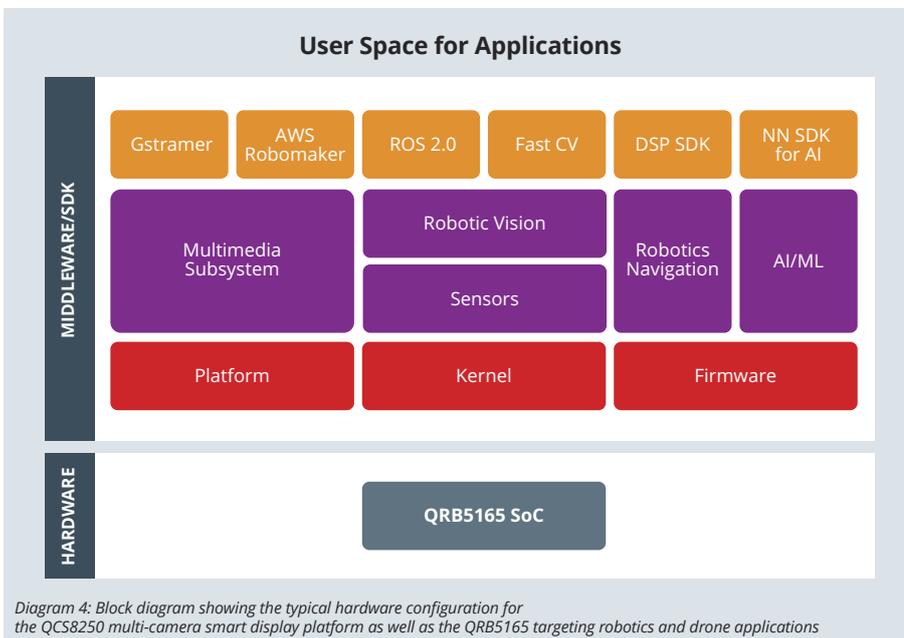
Although the QUALCOMM® QRB5165 shares a common SoC architecture (heterogenous compute, concurrent cameras and displays, as well as dedicated AI engine) to the QCS8250, the software environments differentiate these platforms from each other. The QRB5165 is built to focus on robotics applications, and this demands a software environment that delivers low latency. The QRB5165 operating system is based on Ubuntu Linux. On top of the OS, QUALCOMM Technologies have built several SDKs and tools to help customers implement the key features of a typical robot, including object detection and tracking algorithms, obstacle avoidance, vSLAM, 3D mapping. This powerful and feature rich platform is used in applications such as professional cleaners, drones, public safety robots and AGVs.

These platforms meet the requirements for industrial and robotics applications. The QRB5165 also offers extended temperate range support.

**QUALCOMM Technologies’ development framework enables rapid software development and facilitates easier roadmap development**

Furthermore, to support customers with quicker product development, QUALCOMM Technologies created a Linux based development framework which includes tools to combine customers’ application software and algorithms with open-source operating systems (Linux and/or Android) and QUALCOMM Technologies’ proprietary BSP, firmware and drivers. They also provide the flash and debug tools to support on-device debugging and development. In addition to the development framework, QUALCOMM Technologies provides SDKs to enable customers to leverage the differentiating features on the SoC. For example, the QUALCOMM® Neural Network SDK for AI is used to port and execute AI models directly on the compute cores (CPU, GPU) including the dedicated Snapdragon® Neural Processing Engine.

The QCS610 and QCS410 embedded software architecture, shown in Diagram 5, below the Linux Embedded Platform Development Kit (LEPDK), is a combination of QUALCOMM Technologies’ proprietary code and proven and widely used open-source components. It is based on the Yocto Linux distribution (Poky release), and it uses



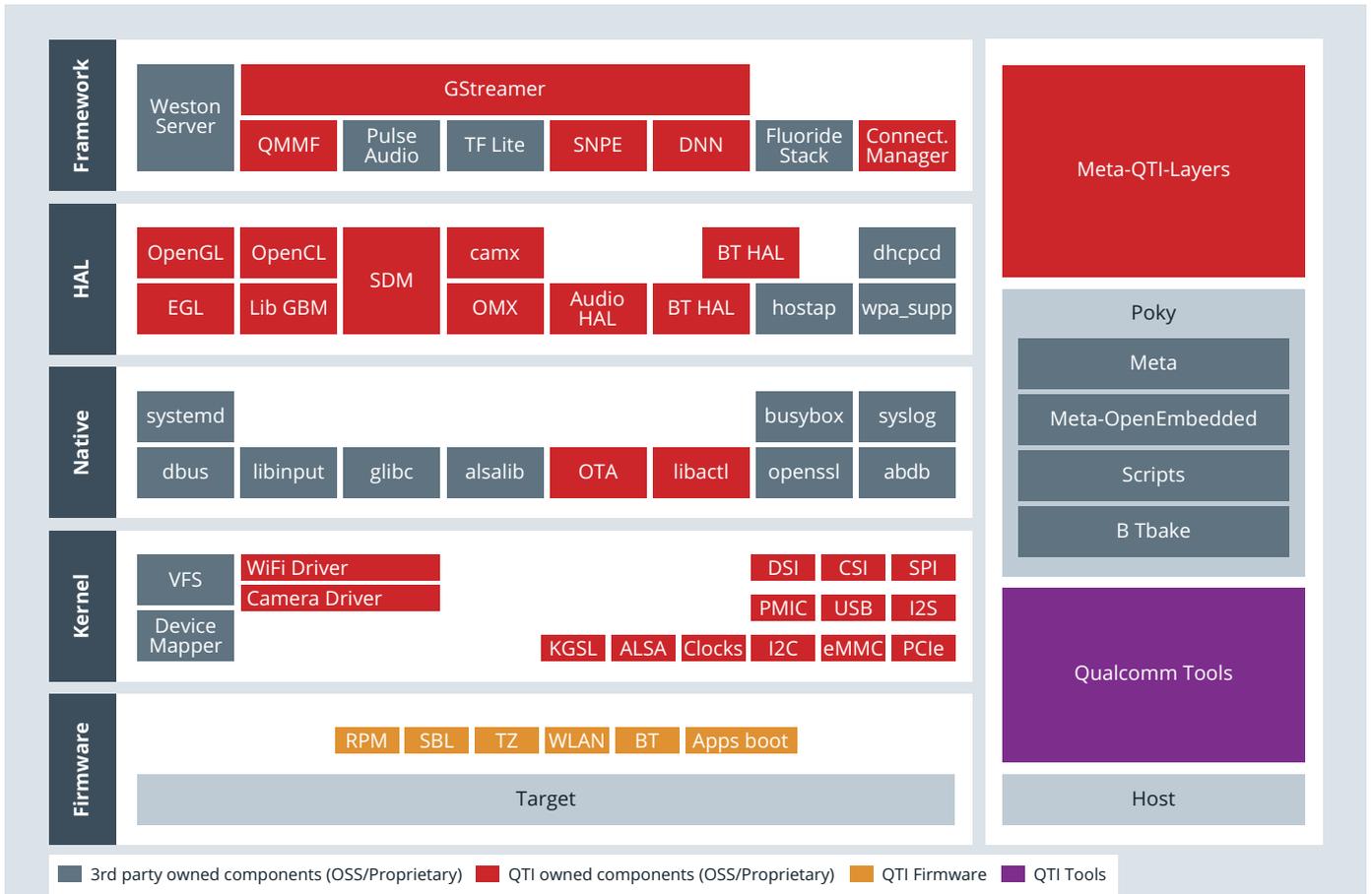


Diagram 5: Linux Platform Development kit architecture overview for QCS610 and QCS410

open-source components such as GStreamer to enable camera, video, multimedia and AI applications. As a family of smart camera products, full software compatibility is maintained between the QCS410 and QCS610. The SoCs are also pin for pin in compatibility, making the transition from one to the other more seamless for the customer.

The software architecture shown in Diagram 5 is common for each SoC and enables the end customer to build a roadmap of products easier as applications developed for one SoC can be re-used in follow on projects or completely new product categories that leverages a more powerful SoC.

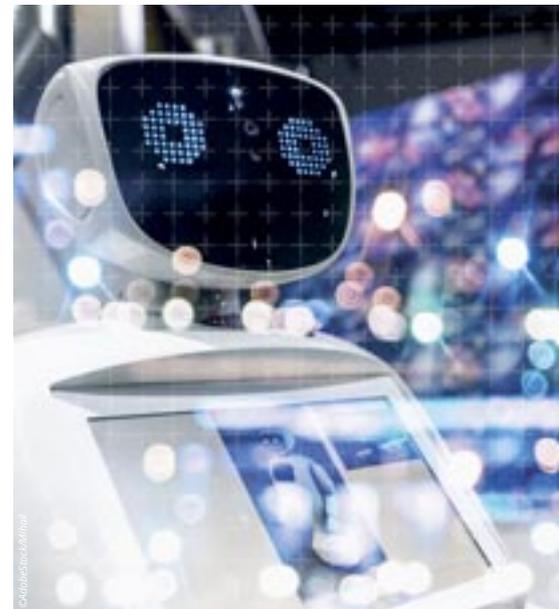
**AI deployment made easy with the QUALCOMM Neural Processing SDK for AI**

QUALCOMM Technologies have developed a suite of tools to enable end customers to differentiate their final products using innovative AI technologies. In the case of the QCS610, this could be a camera product with an AI algorithm

that automatically identifies the speaker in a conferencing system or identifies the actions of consumers in a retail environment. In the case of the QRB5165, this could be an AI-enhanced navigation or an object detection and avoidance algorithm for a warehouse robot or drone.

The QUALCOMM Neural Processing SDK for AI allows engineers to take their own or third-party AI models which have been developed and trained in widely used AI development frameworks such as Caffe, Caffe2, TensorFlow and ONNX and deploy and optimize these models specifically for the SoC and specific edge applications. The AI developer can choose to deploy their AI model on the powerful QUALCOMM Neural Processing Engine, which is optimised for inference acceleration, the multi-core CPU or even the GPU depending on the resource, latency, memory footprint requirements of their AI solution.

QUALCOMM's Neural Processing SDK for AI capabilities are continuously improved to optimize the efficiency and performance of AI applications for these SoC platforms.



QUALCOMM QCS610, QUALCOMM QCS410 QUALCOMM Neural Processing SDK, QUALCOMM QCS8250, QUALCOMM Neural Network SDK, QUALCOMM AI Engine, Snapdragon and QUALCOMM QRB5165 are products of QUALCOMM Technologies, Inc. and/or its subsidiaries.

A01

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# RADAR SENSORS

## Non-Contact Switching Made Easy



The ongoing corona pandemic has made people much more aware than in the past of the potential risk of infection and the need for more hygiene. Washing and disinfecting our hands has become part of our daily lives, so it should not come as a surprise that people are uncomfortable touching the control elements of various devices, especially in the case of publicly accessible systems and equipment.

The manufacturers of door controls, automatic vending machines, information kiosks, and even pedestrian traffic signal controls are aware of that, and are now developing new non-contact switching and actuating mechanisms. The technologies used differ depending on the intended purpose. Where the objective is to detect proximity or movement in front of the device, the choice will fall on passive infrared (PIR), ultrasound, optical, or radar sensors.

With the exception of the radar sensors, all said sensors require visual contact between them and the approaching object. In the case of ultrasound

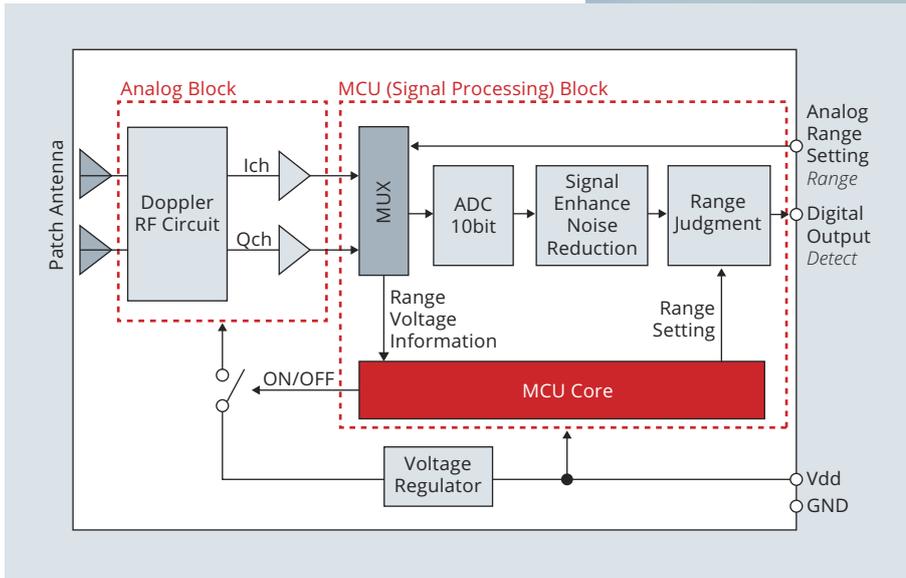
sensors, air is used as the medium, PIR sensors detect temperature changes, and visual systems such as time-of-flight (ToF) sensors use light, making visual contact with the object absolutely necessary.

This means that the design of such systems is subject to certain limits. The front panel must always feature an aperture through which the sensor can detect the object. As a rule, these systems are fitted with a white fresnel lens (PIR), a red cover (ToF), or a simple hole (ultrasound sensors), which many find a rather subpar and unappealing design.

The situation is completely different in the case of radar sensors, since these use a microwave signal for which non-metallic materials are not an obstacle. This hidden mounting capability opens new design opportunities for such systems, and detection often goes unnoticed by those detected.

New Japan Radio offers radar sensor modules for industrial use. These range from a simple doppler module for proximity detection to sophisticated modules that can detect several moving and stationary objects and also measure their distance from the sensor in metres. Due to their compact size and performance, doppler modules are particularly suitable for non-contact switching applications.

New Japan Radio developed the NJR4266F2A3 specifically for this purpose, and optimised it for distances from 20cm to max. 80cm. In addition



to complete HF and analogue processing, the module also features MCU-based signal processing and the required power supply.

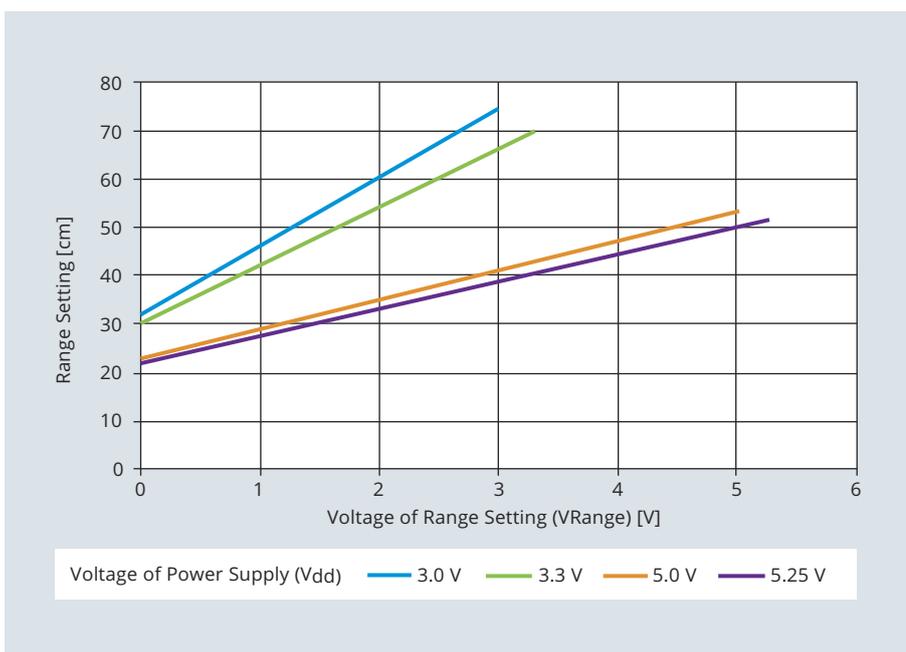
The algorithm used was optimised accordingly, so that a movement like, e.g. a person approaching the sensor or waving a hand will create a digital switching signal at the output. The detection distance can be adjusted using an analogue voltage at the »analog range setting« pin. An external MCU is not necessarily needed for operation, since the digital switching output can be used directly. Where an MCU is involved, it can be woken up via an INT input. In this case, the analogue voltage for the distance setting can also be generated by the MCU via the internal DAC.

This saves a lot of time and makes life much easier for system developers, since the module is ready-to-use, and they can focus on the actual application. No additional algorithms or software components are required.

**Today, non-contact switching is applied in many areas, such as:**

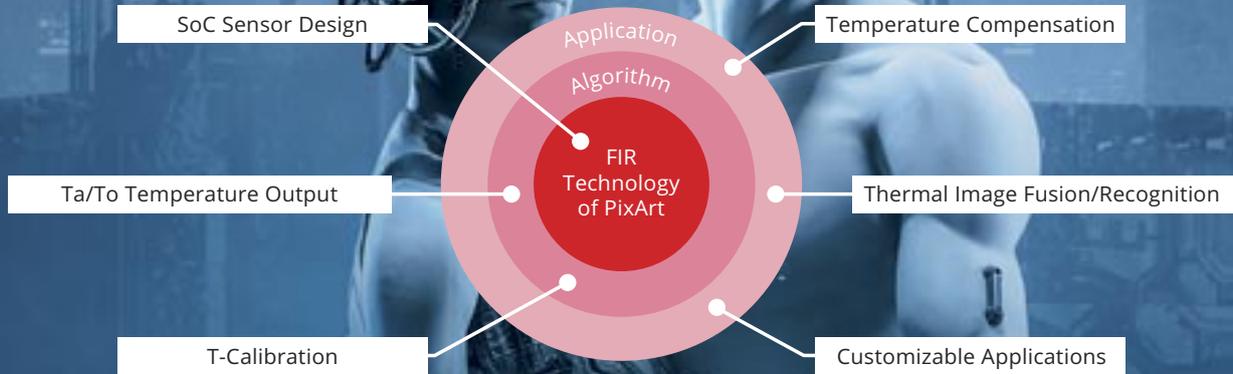
- Door openers
- Pedestrian traffic signals
- Device/System wake-up
- Close proximity switches
- Switching on of video systems upon movement detection
- Building security as part of an alarm system
- Device wake-up from power-saving mode
- Non-contact Outdoor/Indoor light switches

The operation of a radar sensor only requires four connections. In addition to the aforementioned two pins, only a VCC and GND connection are needed. These must be supplied with a voltage between 3.0 and 5.25 V. With a 3.3V power supply, their electricity consumption is a mere 1.9mA. The module's dimensions are 17.2×27.3×5.2mm. In case we attracted your interest, just send us a corresponding query.



A02

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# I KNOW YOU!

## Intelligent Low Power Object Detection



With today's popularity of Artificial Intelligence (AI), AI technology is now finding its way into smaller IoT devices, even from the sensor perspective. Performing AI calculation on the sensor delivers great benefits including bandwidth saving, computation-cost saving, power saving, faster response rate, and data security reinforcement. PIXART's Low-Power Intelligent Object Detection (LIOD) technology specially designed for applications that require detection capabilities with the least power consumption.

PIXART's LIOD product consists of an ultra-low-power CMOS image sensor and an ultra-low-power image-processing chip. The sensor is able to detect both objects and motions,

and therefore can be applied to a variety of applications, including the detection of human faces and bodies, as well as report their positions.

### Below are the key advantages of the LIOD sensors

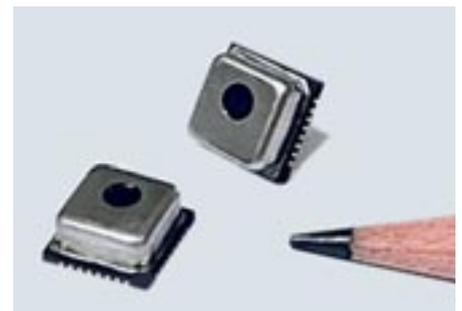
- Provide motion detection functionalities with a power consumption rate of less than 100µW, making them applicable on always-on devices.
- Integrated with a Hard-Wired Deep Learning Engine that helps to save a large amount of computing cost on the host side.
- Instead of outputting bulky image data that occupies data bandwidth, the sensor can directly deliver readily usable information (e.g. object position, size, etc) in real-time.

23.65	23.07	24.06	24.19	24.97	25.03	24.54	23.59
23.52	24.24	24.32	24.58	25.18	24.64	25.06	23.81
24.47	24.62	24.75	28.32	30.37	26.69	25.15	24.69
23.45	23.53	24.65	29.27	29.48	26.38	24.95	26.67
23.8	22.9	24.1	28.23	28.04	24.5	21.77	23.49
24.83	25.28	25.76	29.95	30.28	25.52	23.16	23.37
24.58	28.28	28.27	28.45	30.05	28.3	28.37	23.52
30.96	30.56	28.43	29.04	27.45	27.51	27.95	30.64

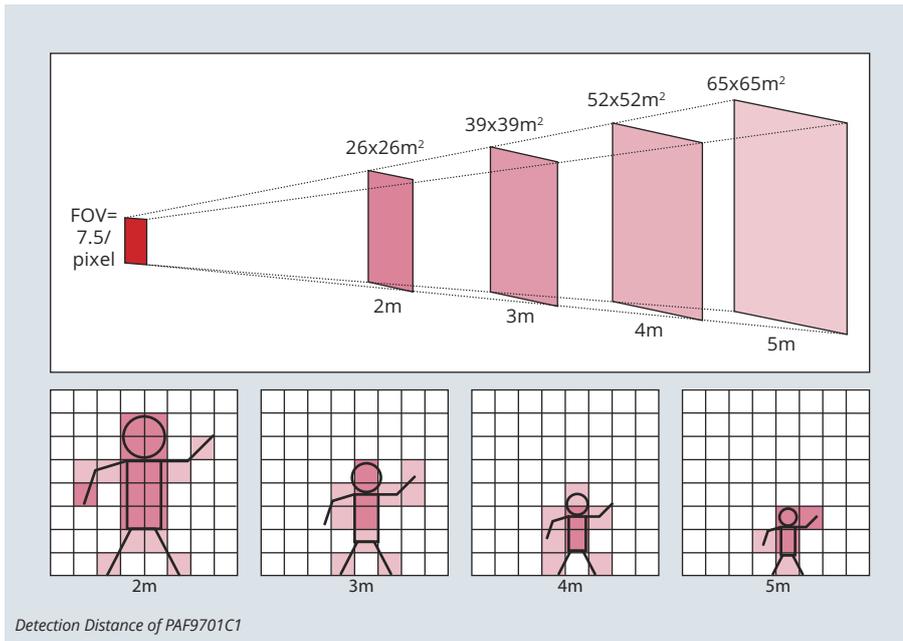
Thermal information (°C) detected from PAF9701C1



A low-resolution thermal image obtainable by combining the output of PAF9701C1 with PixArt imaging sensors



PAF9701C1



PIXART's FIR (Far Infrared) sensing technology mainly detects far-infrared heat radiation with a wavelength in the range of 5~15 $\mu$ m. By converting energy into temperature through its algorithm, the FIR sensor is able to contactless measure the temperature of objects, making it suitable to apply in a wide variety of day-to-day temperature sensing applications.

The sensor **PAF9701C1** has a resolution of 64 pixels and can directly output calibrated and readable temperature values. Owing to its built-in algorithm, FIR sensor array is designed to identify the distribution of a thermal object in the detected space/area and outputs its thermal information.

**PAG7920LT:** Image Sensor is a QVGA Global Shutter Image Sensor in a Ultra-low power design that support smart motion detection, Auto-exposure and auto-gain control functionality and ROI (Region of Interest) functionality.

**PAG7681LS:** DSP provides object and motion detection system solution under the lowest power consumption. Supports image input in FHD, HD, VGA and QVGA formats has an Hard-Wired Deep Learning engine integrated. Built-in with PixArt's proprietary Human/Face detection algorithm, Supports color ISP function and JPEG encoding and output.

Due to the COVID-19 pandemic, measuring and record forehead temperature has become an es-

sential part of our daily lives. By combining that 3 sensors

- **PAF9701C1;** FIR sensor with heat sink
- **PAG7920LT;** Image Sensor
- **PAG7681LS;** DSP chip-set

in one single thermal detection device, the device will be able to quickly identify human beings, measure their forehead temperature, and record the temperature to making sure anyone who enters the indoor space will be automatically measured and recorded.

### Highly-integrated evaluation boards available

PIXART provides a highly integrated evaluation board for the **PAF9701C1** that is easy to integrate

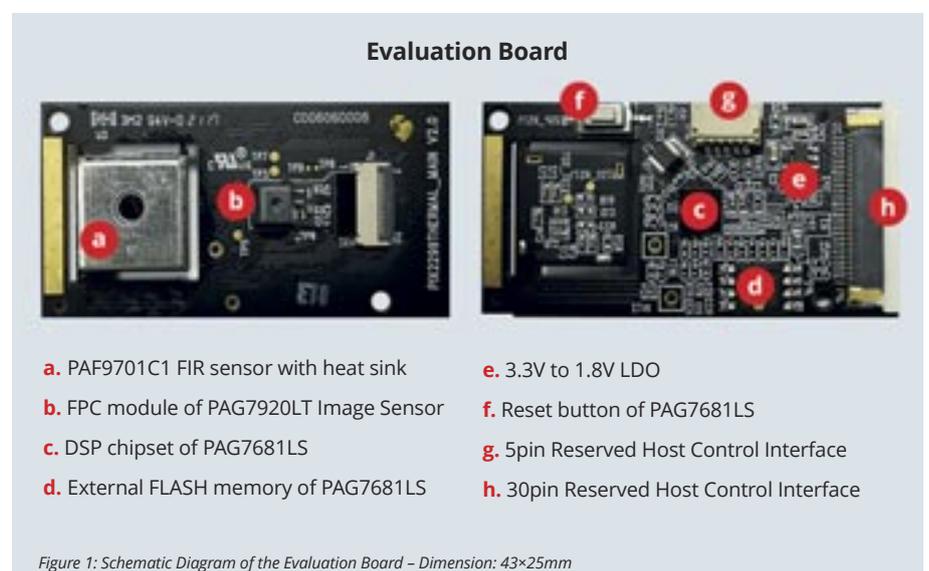


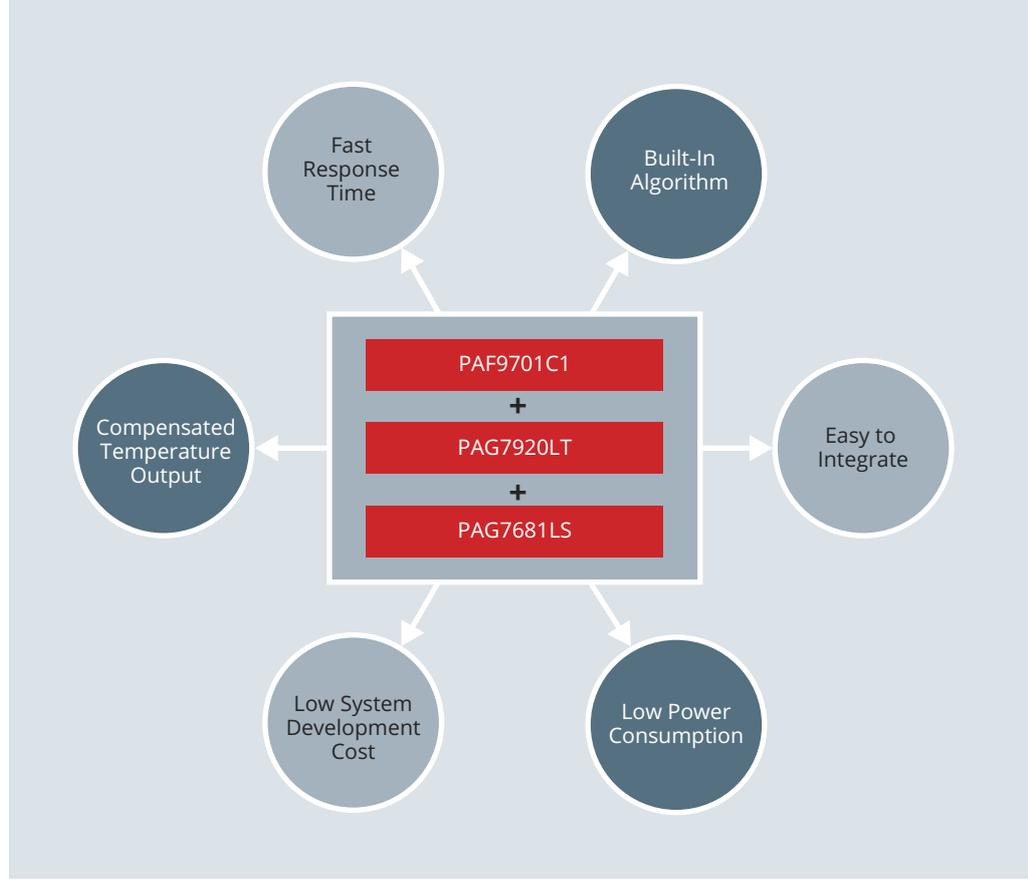
An example of data output by the 3-in-1 device

and offers fast verification and system prototype. With 240 $\times$ 240 resolution and consisting of the **PAF9701** (FOV(H,V) = 60 degrees), a **PAG7920LT** image sensor with lens set (FOV(H) = 72.5 degrees), and **PAG7681LS** SoC chip, this 3-in-1 evaluation board (as shown in Figure 1) comes with face detection, temperature result computation, and control setup capabilities to realize a comprehensive smart forehead sensing solution.

The system powered by a 3.3V of power supply and its communication interface is I2C. With its default configuration, the recommended sensing distance of the evaluation board is between 50cm and 100cm.

Note: PIXART also provides a complete reference design guide and library for the evaluation board.





### Connection method of PIXART's 3-in-1 evaluation board explained

By controlling **PAF9701C1** through **PAG7681LS**'s DSP, the architecture adopted by this evaluation board is particularly suitable for outputting thermal values.

As shown in Figure 2, the circuit connection of the evaluation board allows **PAG7681LS** to obtain thermal data from **PAF9701C1** and then directly output the forehead temperature value to the host processor. The process flow shows in Figure 3.

Note that the algorithm for forehead temperature calculation is embedded in **PAG7681LS**'s DSP.

While **PAG7920LT** and **PAG7681LS** are mainly responsible for face and mask recognition, the algorithm will link the face position data with the temperature distribution data detected by **PAF9701C1** to compute the compensated temperature values. Under uniform background with the detecting human being 50cm away from the sensor, the evaluation board is able to achieve high accuracy of  $37\pm 0.5^{\circ}\text{C}$ . Note that the accuracy may be affected by factors such as forehead

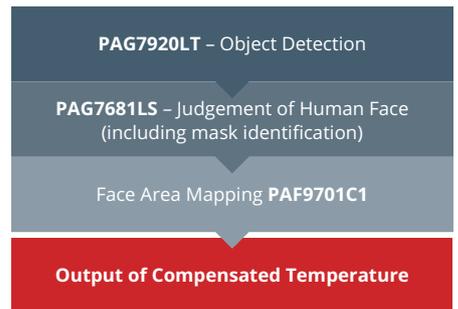


Figure 3: Process flow of the evaluation board

size, hair interference, background situation, and sensing distance. For customers who anticipate their 3-in-1 device to output both the thermal data AND the image data; or simply require more flexibility to tailor for specific applications, feel free to purchase the three sensors (**PAG7920LT**, **PAG7681LS**, **PAF9701C1**) from PIXART and establish the connection architecture your own way (for instance, allowing the host processor to directly control the three sensors).

With the correct configuration and suitable connection method, this 3-in-1 solution can support applications such as indoor thermal detection, and living-creature (e.g. human body, pet, etc.) detection. With each purchased sensor, CODICO will provide its porting guide with detailed IC information, so that customers can customize their circuits, computations, and outputs.

A03

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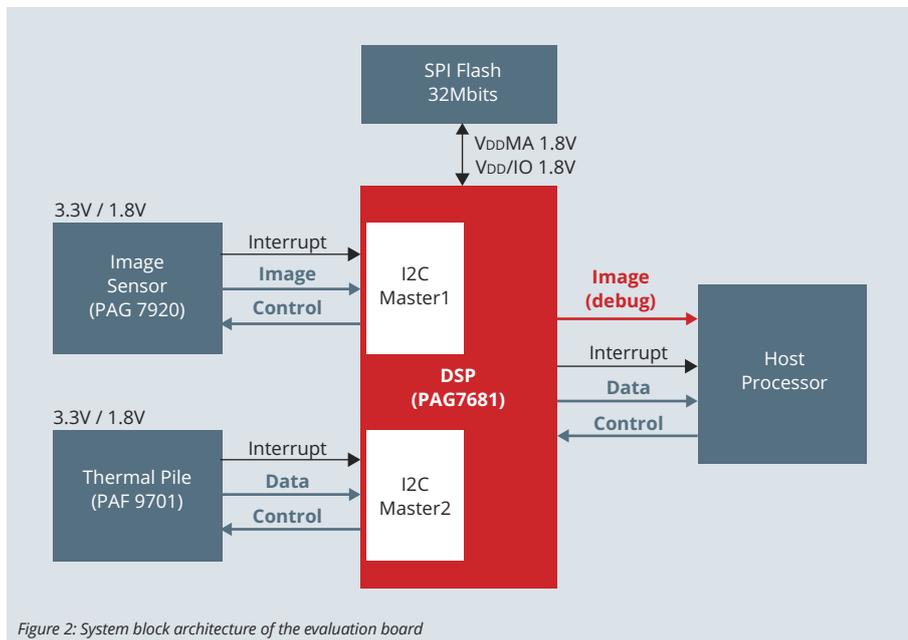


Figure 2: System block architecture of the evaluation board

# EIGHT-BRICK MODULE

© iStockphoto/3D motion

## RPA150E Series: Ultra-Wide Input Rated up to 150W!



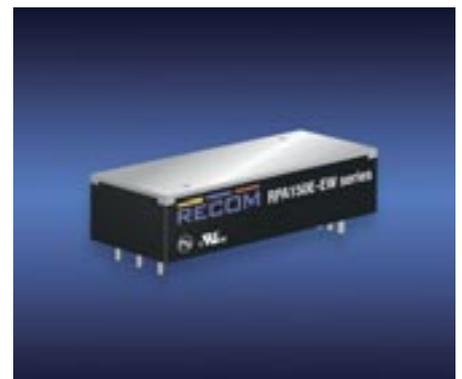
RECOM has launched an eight-brick (58.4×22.9×13.5mm) DC/DC converter series with 9-60VDC input featuring 12, 24 or 48VDC outputs and a competitive 150W power rating.

The all new RPA150E series comes with an industry standard pin-out. Its outputs are adjustable over an astonishing  $\pm 20\%$  range covering 28VDC for avionic systems and 57VDC for Power over Ethernet (PoE) applications. The ultra-wide 6:1 input range from 9-60VDC covers all nominal SELVs including nominal 12, 24, and 48VDC. Due to its sufficient voltage margin the telecom footprint can be accommodated in 48 and 12VDC battery charging systems voltage withstanding 12VDC battery cranking voltage dips.

The efficiency of the RPA150E is high, up to 92% typical, allowing operation up to +85°C with marginal derating. For cooling, both is equally possible, a slight airflow or baseplate cooling. The industrial rated Isolation of 3kVDC prim/sec and

2.25kVDC prim/baseplate or sec/baseplate allows seamless integration into literally any industrial application. The RPA150E offers standard control and protection features include remote on/off, under-voltage lockout, over-voltage, over-current, and over-temperature. The converter is designed for an operational altitude of 5,500m.

Safety certifications for the converter include UL62368-1, CAN/CSA-C22 No. 62368-1, and the parts are EMC-compliant to EN55032 and EN55011 with a recommended external filter network. With suitable external components, the RPA150E series is compliant with EN50155 and EN45545-2 railway functional and safety standards along with EN50121-3-2 railway EMC standard.



The ultra-wide input range of the RPA150E is a cost effective solution to suit numerous applications including but not limited to PoE, railway, E-mobility as well as in a broad range of industrial applications. Amongst others, the new RPA150 offers a three-year warranty.

A04

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# DISPLAYS IN IOT APPLICATIONS

Even if we are not always aware of it, today we are surrounded by devices and sensors that communicate over the Internet. Many of these are equipped with displays, which provide users with on-site information and also allow for easier operation.

CODICO has been dealing with the topic of IoT from the perspective of wireless transmission for quite some time, so it's more than natural to now also look at the displays involved.

## What is IoT?

IoT stands for Internet of Things, but what do we actually mean by that? IoT is a system consisting of computers, devices, sensors, machines, and even humans and animals connected with each other – wirelessly or via cable –, each having a unique identifier, a so-called UID. IoT devices have the ability to collect, process, and transmit data without human interaction. Some examples are: implanted heart monitors that record and send parameters; biochip transponders in cattle, monitoring and transmitting their feeding beha-

viour and milk production, or crash sensors in cars that automatically alert first responders in case of an accident. As the examples show, IoT devices can be found in all sectors – from manufacturing and transport to medicine, from agriculture and smart homes to wearables.

Now let's take a look at the displays used in these IoT devices. We will be using case examples to show which technologies are used and where.

## OLED displays

Let's stay with the wearables. This market has seen a dramatic growth: a total of 105 million devices were sold worldwide in the 1st quarter of 2021, which corresponds to a 34.4% increase over the previous year. Demand for these devi-

ces also grew because of the COVID pandemic. The crisis significantly increased the need for such devices to monitor patients in home settings. The best-known examples in this area are definitely fitness trackers. OLED displays are the best choice here, and these devices use almost exclusively this technology. The advantages are self-evident: OLEDs are thin because they are self-illuminated and do not require a backlight, they have a high contrast, can be easily read from all angles, and can operate in a wide temperature range. Another advantage is that the organic materials they are made of can be easily attached to a plastic substrate. This also makes flexible displays possible. Our partner WISECHIP manufactures such flexible OLED displays. They can be easily integrated in a wristband (bending radius of minimum 40mm), and they can also be attached to curved surfaces for a variety of other applications. In addition, they also come in round shapes, such as those found in smartwatches. Their power consumption is well below that of



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TFT displays. Despite their energy efficiency, many manufacturers prefer to switch off the display after a certain time in battery operation to increase battery life. Though the role of displaying information is important, the possibility of interaction is also of essence. This is why touchscreens have also become established in small OLED displays, because they allow the user to interact with the device.

### TFT LC displays

IoT, however, is not only limited to small, portable, or battery-powered devices. The very first attempt was the famous refrigerator with integrated TFT LCD screen, which could be used to download recipes from the Internet. In the meantime, several versions of it are available. Washing machines and other household appliances, however, are increasingly interconnected, either to inform the user about the end of a washing programme, or to start it when sufficient power from the home's own photovoltaic system is available. Let's take a (professional) coffee machine as an example. Fitted with a large colour display that can be used to select the type of coffee, such a machine gathers all parameters like the amount of coffee consumed, the number of grinding cycles, etc., and contacts the service technician when a predetermined value is reached. When not in use, the display also doubles as a billboard, showing advertising video clips downloaded over the Internet. Heating installations also communicate with temperature sensors and react accordingly, or they can be activated and adjusted from a distance via smartphone. A display in the heating installation itself is also the current state of the art.

Most of these systems use mid-sized TFT displays, which require a constant power supply because of their backlight. TFT displays offer a good

colour quality, are easy to read, and have a good contrast and response times. Our manufacturers also offer small TFT sizes beginning at 0.96", which are predestined for IoT applications. Due to their small size, their power consumption for the backlight is lower, also making them interesting for battery-powered applications. Moreover, all these displays can be fitted with a touchscreen.

### EPD (Electro-Phoretic Displays)

Some IoT applications rely on battery operation, so energy efficiency plays an essential role here. Bistable displays, like EPDs, are thus a suitable option. They only need power to change the screen content, and continue to display the information when switched off. Their disadvantage is that (depending on the resolution) it may take considerable time to change the content. Therefore, such displays are more suitable for static contents. Their main area of application are electronic price tags in supermarkets. By using electronic information channels, companies can automate the management of such content. Prices and text can be changed any time – a click in the central content management system will suffice. Other applications for these displays are door signs for conference rooms, timetables, labels for telephones, temperature sensors, etc. That is, wherever little power is available and content rarely changes. EPDs offer an excellent contrast, they are well readable from all angles, and only need energy to change their content. Their disadvantage is that the temperature range is currently limited, not allowing operation below 0°C or -10°C. But this technology is under constant development. Moreover, it is possible to carry out a partial update of the screen via software. Therefore, small parts of the screen can be changed quickly. Furthermore, manufacturers are currently working on expanding the temperature

range and adding colour. So we can expect quite a few advancements in the future.

The applications described above are just a fraction of what is possible in the Internet of Things when it comes to the displays used. Of course, the IoT is an ever-growing sector that offers a lot of room for experimentation. Manufacturers are constantly looking for more energy-efficient display options that offer the best possible user interface.

At CODICO, we provide support to numerous customers for such projects and have already amassed a wealth of expertise. We will be happy to discuss a project with you so we can work out a solution together.

A05

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# XC8110/11

## Load Switch with Ideal Diode Function from TOREX

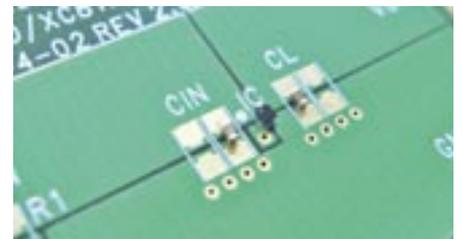


A diode is said to be an »ideal diode« when it is forward biased, acting as a perfect conductor, without allowing leakage current. Equally, when the diode is reversed biased, it acts as a perfect insulator with zero current through it. Whilst this perfect diode remains elusive our new IC comes very close to achieving this goal.

Essentially, this new series is a small line switch with ultra-low on resistance and ideal diode functionality, where the ideal diode portion has very low VF – only 20 mV. The typical VF of a standard schottky barrier diode is 300~400mV in comparison and although this is still not so large, if used in a battery powered application, this loss will greatly shorten the life of the battery. As a result, the voltage and power loss with the XC8110/11 is much smaller than that of

a schottky barrier diode and it helps extend battery life and reduce thermal issues – see Figure 1.

Operating voltage with the XC8110/8111 is 1.5~6.0V and the maximum output current is 0.5A (XC8110) or 1A (XC8111). A simple circuit can be configured using only 2 capacitors (Figure 2). The XC8110/8111 features a number of protection & prevention circuits including over current limit with foldback, thermal shutdown, inrush cur-



rent prevention (which operates like a soft-start function to prevent inrush current from the power source at start-up) and not just reverse current prevention, but »true« reverse current prevention.

There are two types of reverse current prevention, one which has no voltage drop but needs a

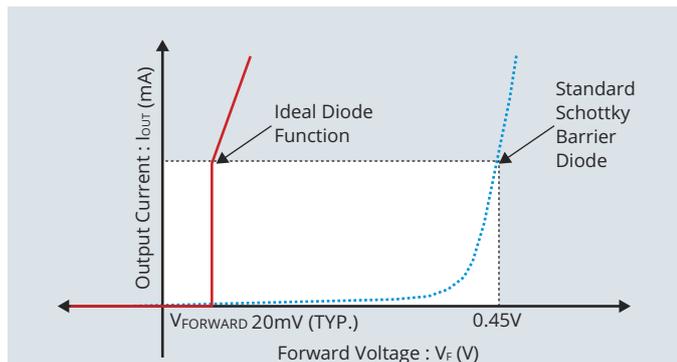


Figure 1: V-I Curve of Ideal Diode

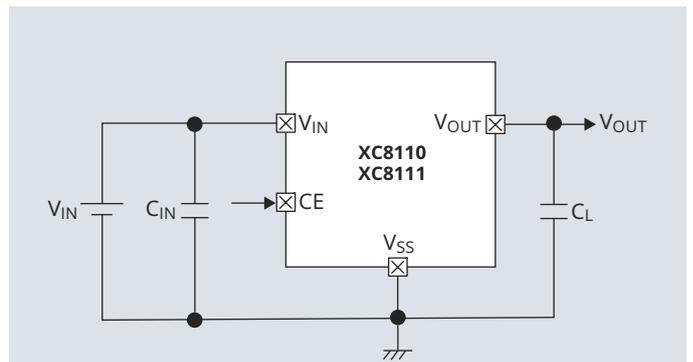
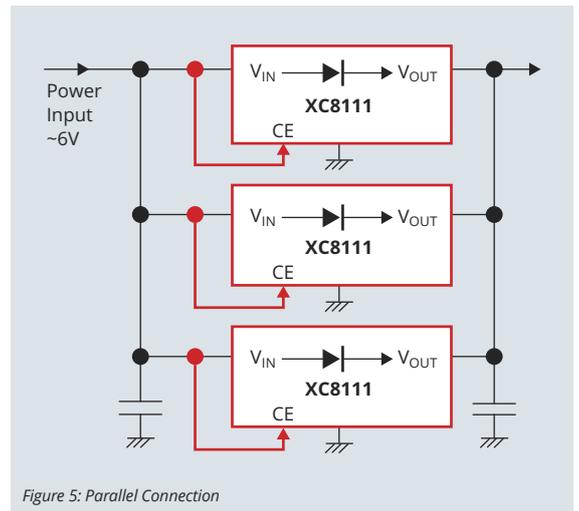
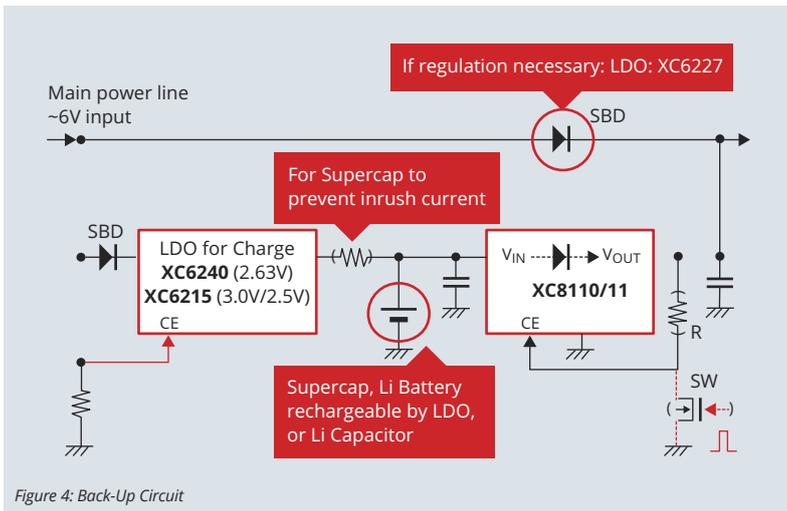


Figure 2: Typical Application Circuit



high level of reverse current to be present before it can be sensed and stopped and a second which can sense & stop the reverse current even at very low levels of current such as 1mA. The first type is commonly found in standard load switches and LDOs with reverse current functions. The second type is featured in the XC8110/8111 and is called »true reverse current prevention«. With the XC8110/8111,  $V_{OUT}$  is regulated as  $\gg V_{IN} - 20mV \ll$  and this operation realizes to detect reverse bias and prevent reverse current with a comparator. It should be noted that  $V_{OUT}$  is 20mV lower than  $V_{IN}$  under all conditions so even if  $I_{OUT} = 0$ .

The XC8110/8111 is a very versatile IC that can be used in multiple applications and circuits, some of which are highlighted below.

### Application Example 1 OR Connection of Power Lines

The XC8110/8111 is suitable for use in an OR circuit configuration as shown in Figure 3: Automa-

tic power line selection is realised from 2 or more power lines, there is no voltage drop due to the low  $V_F$  of the XC8110/8111 and in addition, the quiescent current of  $V_{IN}$  is  $0\mu A$  when reverse biased making it ideal for use in a back-up circuit.

### Application Example 2 Back-Up Circuit

As highlighted, the XC8110/8111's ideal diode has no  $V_F$  drop and this is very important for MCUs and SoCs which can operate at 1.6~3.8V. These MCUs and SoCs can also use the voltage of a Li battery (re-chargeable by LDO or Supercap) directly for a longer period.

In addition, the XC8110/11 can be shut down by adding a resistor (R) and a switch (SW) to the CE pin. This realizes a storage mode that disconnects the battery during storage or shipping thereby reducing battery drain over long periods. The circuit can be woken up at a later date by applying an external power supply and as long as the voltage from the external power supply is

high, the current consumption from the Li battery and Supercap will be  $0\mu A$ . A typical power schematic for such a circuit is shown in Figure 4.

### Application Example 3 Large Current Output by Parallel Connection

The XC8111 can be configured in a parallel connection for large current and/or low  $R_{on}$ . Of course, the start-up and protection functions highlighted previously still work fine even when used in such a configuration (Figure 5). The output current that can be supported in this configuration is shown in Figure 6.

The XC8110/11 series is available in SOT-25, USP-6B06 and an ultra-small WLP-4-02 (0.82 x 0.82 x 0.5mm) packages. For more information on the XC8110/11 (including the latest datasheet) just ask us.

A06

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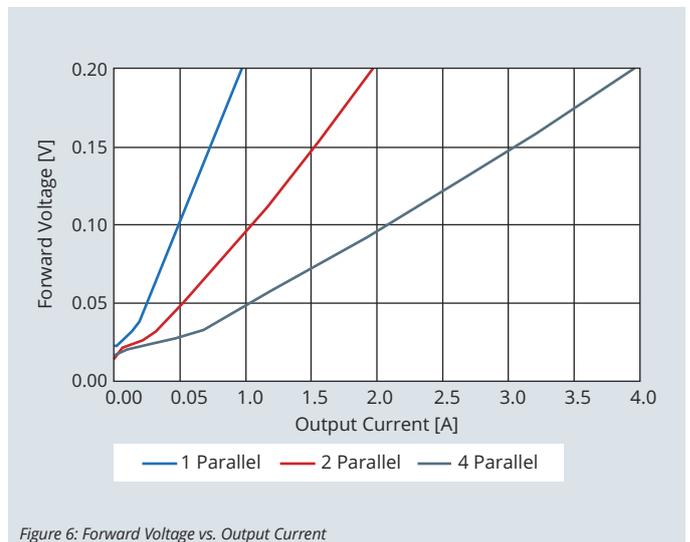
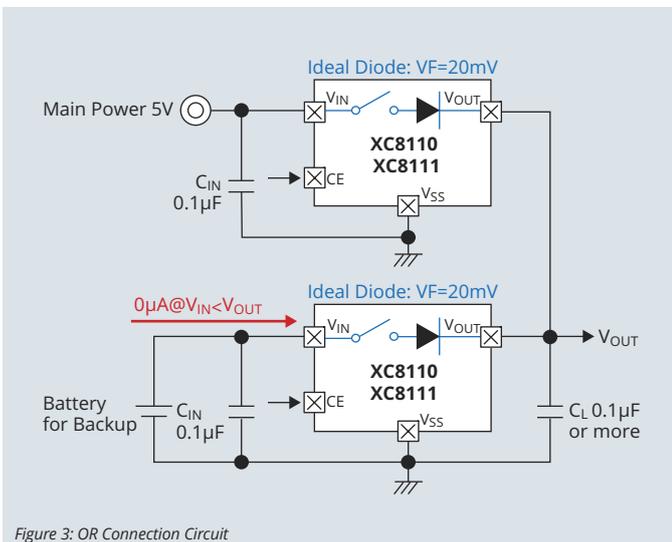


Figure 3: OR Connection Circuit

Figure 6: Forward Voltage vs. Output Current

# GRAND

## World's Smallest Grade 1 AEC-Q100 36V Buck DC/DC

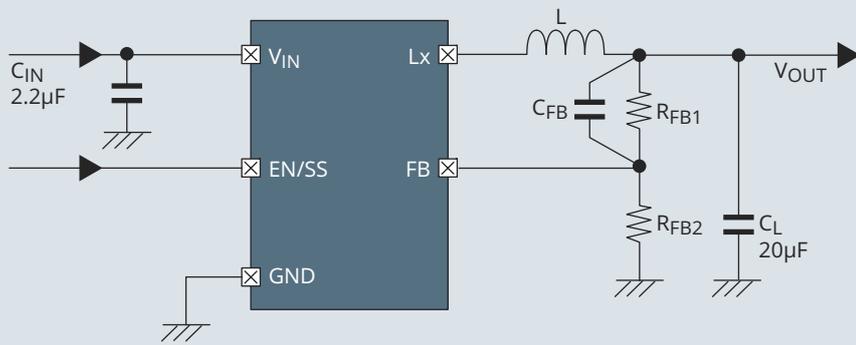


Figure 1: Typical Application Circuit

### The XD9707/08 family are synchronous step-down DC/DC converters certified for automotive use.

It can operate from 3.0~36V (absolute max. 40V) and deliver loads up to 600mA. Output voltage is set externally within a range of 1.8V~12V and the quiescent current is only 13.5µA (XD9708) in operation. The XD9707/08 has an enable pin which allows the DC/DC to be placed in stand-by mode with a stand-by current of just 1.65µA.

without burst modes. The XD9707/08 works with small Low ESR ceramic capacitors and comes with a high switching frequency of 2.2MHz. An extremely small DC/DC circuit can be implemented with a minimal number of external components – see Figure 1. This new DC/DC also features adjustable soft start, over current, under voltage, short-circuit & thermal shutdown pro-

Whilst the XD9707 is fixed PWM control, the XD9708 is automatic PFM/PWM control and is designed for high efficiencies at low output loads

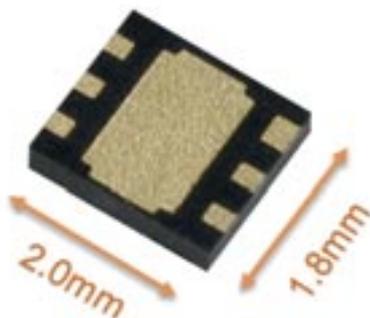


Figure 2: XD9707/08 USP-6C Package

tection circuits. Being AEC-Q100 Grade 1 certified, the operating temperature is to 125°C and in the USP-6C package which measure 2.0×1.8×0.6mm (Figure 2) an extremely small DC/DC circuit can be implemented.

The XD9707/08 is suitable for use in a number of different automotive applications such as automotive camera modules or for small units with a direct connection to the 12V battery as shown in Figure 3.

TOREX can also provide AEC-Q100 certified solutions for the RESET and secondary regulation requirements from the 5.0V output. Samples or evaluation boards for the XD9707/08 can be requested via CODICO. The evaluation boards are custom made to the customer's specific requirements. Test data is provided with each board.

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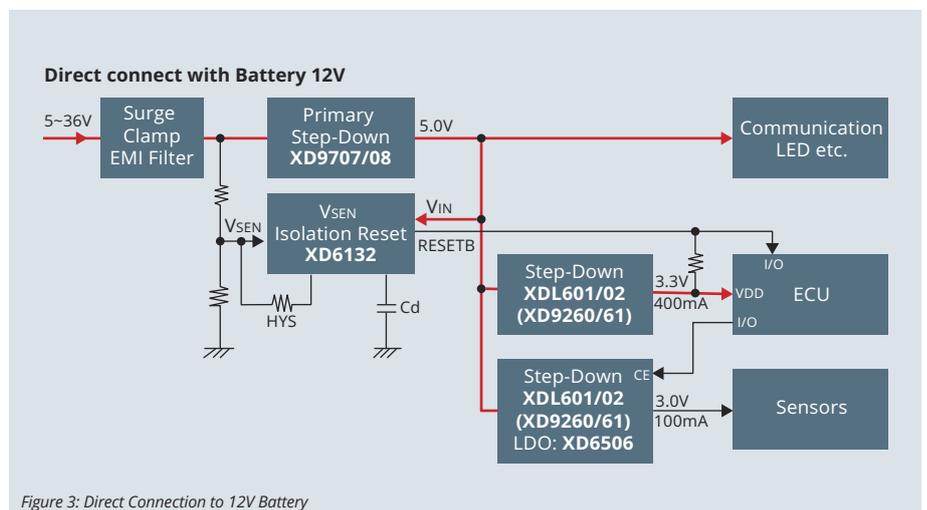


Figure 3: Direct Connection to 12V Battery

# CLEVER: EDLCs

## EATON PHVL – Supercaps With Low Self-Discharge

The new EDLCs of PHVL series are ideal for a long life, reliable energy storage. These two-cell supercapacitor packs with low self-discharge and low leakage current can be used to extend battery life, provide pulse power or backup power for longer periods.

**E**ATON PHVL offers 3.9V operating voltage with ultra-low self-discharge and leakage current and ultra-low ESR for high power density with eco-friendly materials for a green power solution. At room temperature, PHVL has an 80 to 90% lower leakage current than standard PHV series resulting in longer battery life when connected in parallel with a primary battery and longer backup duration for devices such as real time clocks. 5V surge voltage can extend the battery life additionally.

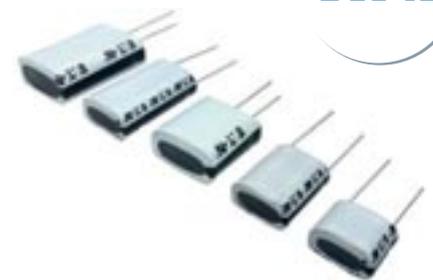
Applications for EATON PHVL supercapacitor packs include water and gas meters, battery assist for peak power, IoT sensors, long-duration discharges, RTC and memory backup. These pro-

ducts have the same size, capacitance and configurations as EATON's PHV series.

For systems operating on a primary battery, like smart meters, PHVL can extend the battery life by 10-20% over solutions with PHV series. Likewise, to provide backup for low power devices like real-time clocks, PHVL can provide up to 20% longer backup times than battery-only solutions. In emergency power applications that could be disconnected from a charging source, PHVL can also extend the backup time.

### Features and benefits:

- Maximum rated operating voltage: 3.9V
- Surge voltage: 5V


**EATON**

### Applications

- Water and gas meters
- IoT devices/sensors
- RTC or memory backup
- Industrial controls
- Vehicle tracking
- Vehicle telematics
- Automotive E-call

- Capacitance range 0.47 to 5F
- Operating temperature range: -40 to 85°C
- Ultra-low leakage current and self-discharge
- Ultra low ESR of down to 70mΩm
- Low profile design for space saving (bent lead option available)
- Dimensions (W×L×H) 9×17.3×14.5mm to 11×21.3×32.5mm
- Halogen and lead-free, REACH and RoHS-compliant

For more detailed data, samples or a quotation kindly contact us.

**P01**

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# MAKE THE MOST OF YOUR SSR

## Solid State Relay with Fieldbus Interface

CELDUC® relays offers an optional module ECOM0010: Combined with our SU/SUL/SUM, it is a compact solution providing a communication interface, a current monitoring and a PID temperature controller.



The ECOM is the most compact solution available on the market that incorporates the latest measuring and control technology. By reducing wiring costs and minimizing the size of electrical cabinets, this solution is the answer to your needs.

### Temperature controller PID, current monitor and communication interface: ECOM module

Here are the main features of CELDUC's Optional Module ECOM :

#### 1. Communication Interface

ECOM allows a Real-time monitoring via an RS485 link and MODBUS RTU protocol.



Modbus RTU is an open serial protocol derived from the Master/Slave architecture originally developed by Modicon (now Schneider Electric). It is a widely accepted serial level protocol due to its ease of use and reliability. Modbus RTU is widely used within Building Management Systems (BMS) and Industrial Automation Systems (IAS).

A direct control is possible by HMI or PLC with MODBUS RTU protocol.

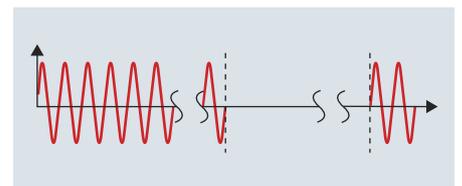
Other communication protocols are possible (e.g. Ethernet IP, Ethercat, Profinet...) through a Modbus RTU converter Gateway.

#### 2. Load status and relay diagnostics



#### 3. PWM mode to control load power

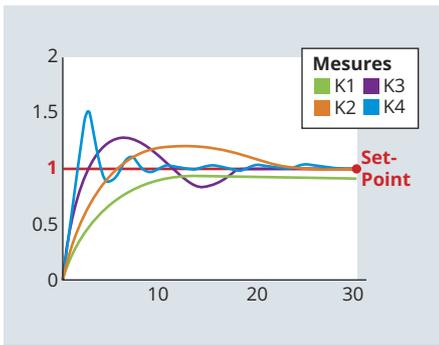
Pulse width modulation (PWM) is a great method of controlling the amount of power delivered to a load without dissipating any wasted power.



The duty cycle and cycle time can be set-up via the communication interface. Logic outputs OUT1 and OUT2 can be used to control another Solid State Relay.

#### 4. Current monitoring and alarms up to 50A with current transformer





### 5. Temperature measurement, PID control and alarms

The thermocouple is a simple, widely used component for measuring temperature. An Insulated input is available for thermocouples type J, K, T, E.

Logic outputs OUT1 and OUT2 of the ECOM module can be used for heating and cooling. PID setting is with automatic or manual tuning. Automa-

tic tuning will always be active and will constantly analyse the difference setpoint-process (error). If this difference is greater than the value selected on parameter 7 (Max Gap Tune), the ECOM will decide when and how to modify PID parameters.

The manual procedure allows the user a greater exibility on deciding when to update PID algorithm parameters.

## CELPAC 2G: the 22.5mm wide SSR solution

This CELDUC's range of Solid State Relays & Contactors is a cost-effective, reliable and small-size solution! More and more the seek for cost reduction implies easy and quick assembling in electrical cabinets, and in the smaller space if possible: the new generation of our CELPAC products is the answer.

### 1. Performances & Reliability

- Maximum voltage up to 1600V (690VRMS), 600 and 1200VAC as standard
- Thyristor rating up to 75A
- Large input range: 3-32VDC with regulated current models
- Models available with AC input control
- Yellow Input status LED
- Over-voltage protection on the input,
- New generation of TMS<sup>2</sup> technology for thyristors for a longer life expectancy
- Quick and easy connections
- Designed according to European standards EN60947-4-3 (IEC947-4-3) and EN60950 (VDE0805 reinforced insulation)
- UL-cUL
- IP20 protection with removable flaps (SU range) or cover (SA range)
- Other protection devices in option: RC snubber, VDR, self turn-on
- Fixation screws compatible with SO or SC relays in hockey puck style

### 2. Price-effective & small-size solution

- With an installation width of only 22.5mm, our CELPAC<sup>®</sup> solid state relays and contactors take up the least possible space
- Reduced assembly time, simple wiring

- Reduced maintenance thanks to a very long service life
- A single screwdriver for both: the output and input

### 3. Two different models to satisfy all your needs

CELDUC<sup>®</sup> relais offer two models in order to provide multiple, simple and fast connections.



SA range with screw connection on inputs

SU range with pluggable connector on inputs

- SA range: with screws connection – transparent protective cover – for mounting on your heatsink or panel mount
- SU range: with pluggable connector on inputs – removable flaps for protection – for mounting on your heatsink or panel mount

### 4. »Ready to use« versions

Some models are »ready to use« mounted on 22.5mm heatsink (SAL or SUL) or 45mm heatsink (SAM or SUM).

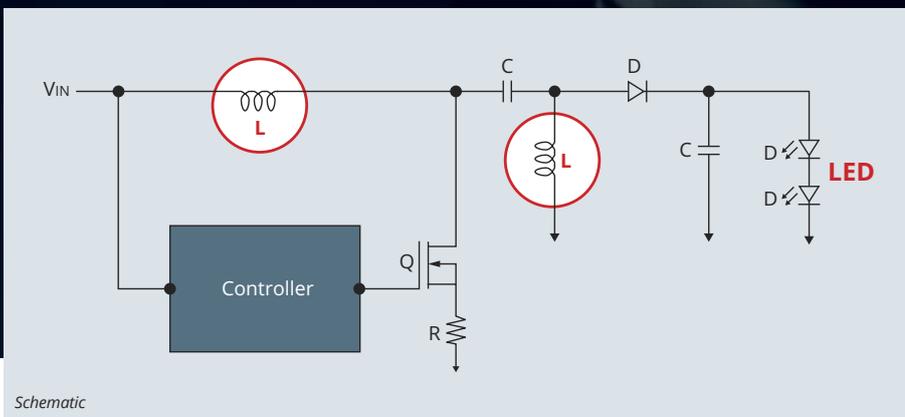
P02

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# 2x2IN1 NEWS FROM EATON



## HCSA: The new 2in1 molded inductor, for SEPIC applications.

SEPIC stands for »Single Ended Primary Inductance Converter« and it is a popular buck-boost topology that allows the output voltage to be higher or lower than the input voltage. Compared to a typical buck-boost converter, the SEPIC output polarity is the same as the input (schematic). SEPIC circuits generally require two identical inductors that can be individual inductors or a dual-winding inductor. Dual winding inductors with a high coupling coefficient are preferred because the technique uses less space, reduces leakage inductance, which results in overall increased circuit efficiency. Due to the molded

structure, the HCSA1V1008 can achieve a higher power density than comparable products in ferrite technology. This series is perfect for industrial and automotive SEPIC converters up to 50W.

This offers great solutions for simple head and tail light, as well as ambient light applications and other power supplies for infotainment and ADAS.



## CMLA: The all-round Common Mode Choke for automotive applications

In the automotive industry, there is a wide variety of standards relating to common-mode and differential-mode noise. Many OEMs take these standards as a basis to generate their own tightened guidelines. With the new CMLA series, common mode noise can be filtered in the range of approximately 3 to 500MHz and differential noise from 30 to 70MHz. The current capability of up to 8A and the small form factor make the

CMLA ideal for automotive applications as power line filters for ECUs, infotainment and LED drivers. All sizes are AEC-Q200 qualified and can operate in a temperature range from -40 to 125°C.



P03

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	Common Mode Impedance (typical @100MHz)	Rated Current (maximum, ΔT +40°C)	Rated Voltage (maximum)	Dimensions W×D×H (maximum)
CMLA0706-701-R	500Ω	4A	100VDC	8.0x6.2x4.0mm
CMLA0907-701-R	500Ω	5A	100VDC	10.0x7.5x4.8mm
CMLA1211-701-R	500Ω	8A	100VDC	13.0x11.5x7.0mm



# DURABLE

## Extremely High Ripple Current Capability



SUN Electronic Industries Corp. (SUNCON) is continuously improving their products of the electrolytic-hybrid capacitor portfolio. Latest series is HVHY that has a significantly higher ripple current capability compared to previous series.

The market demand of electrolytic-hybrid capacitors is continuously increasing. Not only automotive industry is requesting such high performance capacitors – also in industrial power supplies as DC-link, filter or buffer capacitor for e.g. battery power tools, DC motor control, battery powered vacuum cleaner or control units for heating systems the properties of this technology are appreciated.

The result is a miniaturized, space saving solution. Depending on the use case, and number of capacitors used in parallel, a cost reduction by part count reduction can also be achieved compared to a previous solution.

HVHY series provides the highest rated ripple current in compact dimensions, which is 5,500mA in 10x12.5mm at 105°C with a guaranteed lifetime of 10,000hrs. At a case size of 8x10.5mm, still 4,500mA are achieved. Those properties make HVHY series an ideal choice for demanding applications, where the temperature is not that high, and space is a limiting factor.

For more information and samples do not hesitate to contact us.

P04

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### Features

- Rated Voltage: 25V, 35V
- Capacitance Range: 150µF to 470µF
- ESR@100kHz/20°C: 14mΩ to 20mΩ
- Temperature Range: -55°C to 105°C
- Guaranteed Lifetime: 10,000hrs



# MINI

## SMD Hybrid Capacitor Miniaturization



SUN Electronic Industries Corp. (SUNCON) has added small dimension versions with a diameter of 5mm only to their 125°C/4,000hrs-series HVPF and HVPC. Thus, the advantages and features of electrolytic-hybrid capacitors can also be used in a smaller space.

**D**imensions of 5x6mm are completely new in the portfolio of SUNCON which have specified a rated ripple current of up to 850mArms with a capacitance of 56µF. With such small case size you are able to place a high performance capacitor very flexible on the PCB.

HVPF series provides 500 to 550mArms with 4,000hrs guaranteed lifetime at 125°C. Capacitance range is from 10 to 33µF, voltage range 25 to 63V. HVPC is a miniaturized 4,000hrs/125°C series with higher ripple current capability and higher capacitance values provided in this

small case size 5x6mm. This means 750 to 850mArms rated ripple current and capacitance/voltage ratings of 56µF/25V and 33µF/35V.

Additionally SUN Electronic Industries has added dimensions of 6.3x6 and 6.3x7.7mm to this miniaturized HVPC series, which provides 25V with 100/150µF and 35V with 56/100µF with rated ripple currents of 1,200mArms to 1,800mArms. Such small sizes and high performance make those capacitors ideal for DC power supply circuits of space-constrained applications. Both series are AEC-Q200 certified.

### SPECIFICATION DETAILS HVPC

VOLTAGE (V)	CAPACITANCE (µF)	DIMENSIONS (mm)	RATED RIPPLE CURRENT @100kHz, 125°C (mArms)	ENDURANCE (H)	RATED TEMPERATURE (°C)
25	56	5x6	850	4000	-55 to 125
25	100	6.3x6	1300	4000	-55 to 125
25	150	6.3x7.7	1800	4000	-55 to 125
35	33	5x6	750	4000	-55 to 125
35	56	6.3x6	1200	4000	-55 to 125
35	100	6.3x7.7	1700	4000	-55 to 125

### Miniaturization through capacitance increase

SUNCON is also working on increasing the capacitance value while maintaining the same dimensions for products with diameters of 8 and 10mm. Latest achievements of up to 75% capacitance increase are shown in the datasheets of HVPX and FVF series. The focus is on the voltage range of 50 to 80V. All products are AEC-Q200 certified and anti-vibration socket versions are available.

#### HVPX-series

##### 125°C/4,000hrs/high ripple current

- Up to now: 10x10.5mm/80V/33µF ► **new 56µF**
- Up to now: 10x12.5mm/80V /39µF ► **new 68µF**

#### FVF-series

##### 150°C/4,000hrs/high ripple current

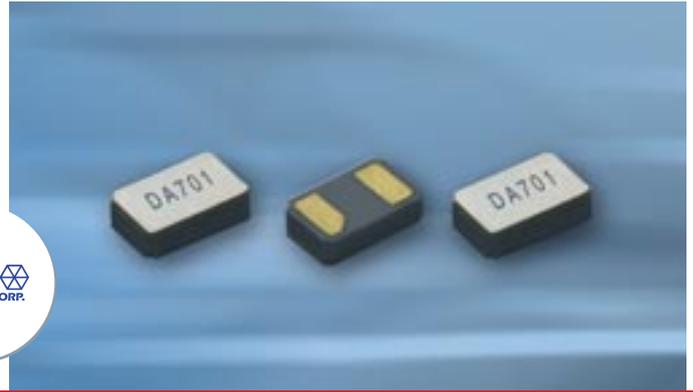
- Up to now: 10x10.5mm/63V/82µF ► **new 100µF**
- Up to now: 10x16.5mm/63V/150µF ► **new 180µF**

For more details please do not hesitate to contact us!

**P05**

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# 32.768KHz CRYSTAL



Today, the electronic components market suffers from major shortages everywhere. Quartz crystals are no exception, and finding any can be quite challenging.

In particular 32.768kHz crystals (sometimes called »Tuning Fork Xtal«) used for watches present the most critical bottleneck today. The most sought-after packages in the European market are the 3215 or 2012 sizes, but production capacity is extremely limited. Why the shortage? Apart from the situation caused by CODIV-19, there are two major reasons for this.

One is the 5G boom, which began in 2019. Today, almost all new smartphones are compatible with the 5G mobile network. Already since 2019, 32kHz crystals have been used to prepare for the 5G boom.

Another reason is the shortage of ceramic packages. Today, the main size for 32kHz crystals is 3215 (3.2x1.5mm) and 2012 (2.0x1.2mm). This trend in crystal sizes has remained unchanged for a decade, but prices have fallen. This also affects the suppliers of ceramic packages. These sizes are already mature in the market and, when looking at future trends, it will be difficult for both quartz and material suppliers to increase production capacity for the 3215 and 2012 sizes.

The future of 32.768kHz quartz lies in the smaller 1610 size (1.6x1.0mm). Daishinku (known as KDS), one of the big players in the crystal market, has reacted to the demand by increasing production capacity. With its DST1610A product series, KDS already has the largest share of 1610/32kHz crystals, and will increase its current production capacity by 50% as of 2022. For upcoming projects using 32kHz crystals, the main focus will therefore be on the 1610 size. However, we also recommend that you consider switching even for

ongoing projects if you have space in your current PCB design or urgent production needs. Recent lead times for 3215 and 2012 sizes are 60 weeks, that's more than a year. A design change will result in a much faster delivery.

If you change 3215 and 2012 sizes to a smaller enclosure, you won't have to worry about the specifications. ESR may be an important consideration for you due to the smaller size of the crystal blank. Although the current small quartz products are sealed under vacuum conditions, the 1610 size already reaches 80kΩ as standard, which is equivalent to the larger sizes.

## When replacing larger sizes with 1610, there are three factors to keep in mind:

1. Side castellation of the terminals often helps to check the soldering junction. Due to the smaller size, side castellation is not possible with the DST1610A. The terminals are located only on the bottom side.
2. The maximum drive level cannot be »extremely« high. This is often true for all smaller crystals, because as the crystal blank gets smaller, the drive level cannot remain as strong as with larger sizes. By analyzing the oscillation circuit, it is possible to check whether the quartz is under a high drive level or not.
3. The oscillation span may not be the same for larger sizes. As with the drive level, we recommend analyzing the circuit when you create a new layout. Often the stray capacitances of your circuit will change, which might affect the matching of crystal and oscillation circuit. However, our suppliers can check your circuit with the new 1610 size as a service.

## Now is the Perfect Timing to get Smaller Sizes in Reasonable Time!

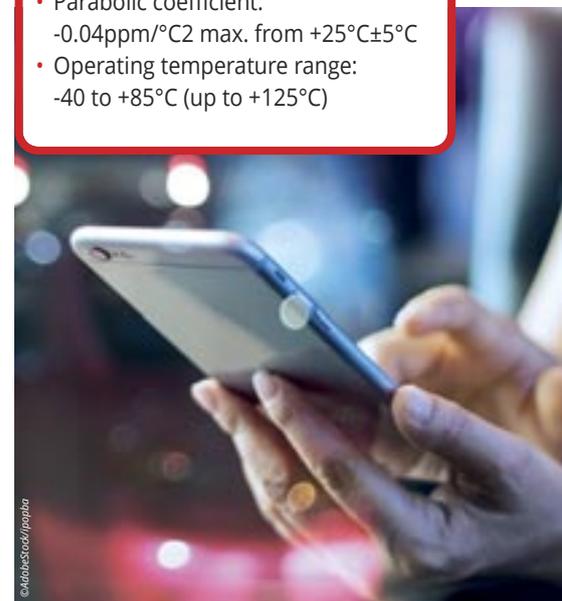
Market shortages present us with a difficult situation. But they are often an incentive to move forward. Please keep this in mind when planning the next step. We will always be here to support you. If you have any questions or any sample requests, please ask me or check our Sample Shop.

P06

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## Features

- Size: 1.6x1.0mm
- Frequency: 32.768kHz
- Load capacitance: 6pF, 7pF, 9pF, 12.5pF
- Frequency tolerance: ±20ppm (at 25°C)
- Equivalent series resistance: 80kΩ (50kΩ possible)
- Parabolic coefficient: -0.04ppm/°C<sup>2</sup> max. from +25°C±5°C
- Operating temperature range: -40 to +85°C (up to +125°C)



# EVAL BOARD BY CODICO

## Our Contribution to Home Automation

In our issue 02/2020, we wrote about the comparison between capacitor power supplies and non-isolated high-voltage bucks. In the meantime, we have been thinking hard about how to best support our customers who want to get a foothold in this sector.

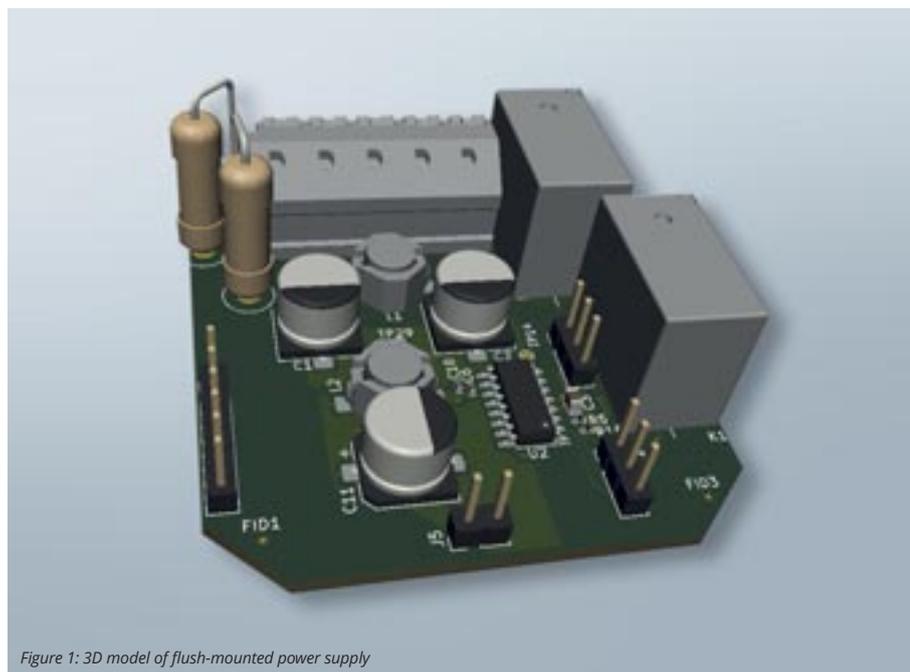


Figure 1: 3D model of flush-mounted power supply



The result is an Eval Board for customers operating in the field of home automation. Figure 1 shows the 3D model of a flush-mounted power supply. The framework parameters for the power supply were as follows:

- Form factor Flush-mounted power supply
- Creepage and clearance in compliance with the IEC 61000-1-2 standard
- Additional PCB for a customised microcontroller
- 16A relay for the implementation of a roller blind control
- Current monitoring using ISABELLENHÜTTE shunts to allow for a safety function
- High-voltage inductors on the output side of the buck converter
- External switch detection (ideal for integration in existing systems)

### SAGAMI inductors

As can be seen in illustration 1, there are two different versions of SAGAMI inductors. The L1 inductor is positioned between the two input capacitors (C1, C2) in the 400V circuit. The rectified alternating current is smoothed at this position, so it is possible to use a standard inductor. In this particular case, we used a 7E06NA-102M-GB by SAGAMI.

GOODSKY

ISABELLENHÜTTE

SAGAMI

SunCon  
SUN Electronic Industries Corp.

VITROHM



res. When the winding of the inductor is damaged, inductance is virtually not available. In this unfortunate case, it would be as if the inductor went into saturation and the internal current limiter in the HV buck would adjust the control, resulting in only limited voltage output. This would be tantamount to a complete system failure.

### How do you solve this problem?

Sagami is using a new composition of the isolation in the area of the copper wire, which allows for higher peak voltages, giving the product greater reliability through a defined and specific component.

### 400V input filter capacitor

The 400V input filter capacitor is produced by SUN Electronic Industries Corp., a Japanese manufacturer of qualitative and reliable electrolytic and hybrid capacitors. Special properties:

- Dielectric strength
- Long lifetime
- AEC-Q200

### Safety resistances

The safety resistance comes from our manufacturer Vitrohm (CRF series). This resistance is an excellent choice for alternating current applications. Vitrohm's product stands out because of its special structure, which enables it to carry out three functions:

- Limiting of the inrush current
- ESD pulse suppression
- No spark when a safety is triggered

### Current sense resistor

The current sense resistor is supplied by our partner ISABELLENHÜTTE (VMP series). This measuring shunt is suitable for alternating current measurement signals, and is not the source of any ferromagnetic influence (magnetic reversal effects). Thanks to the patented structure of the

ISA-PLAN series, this resistance should be considered the benchmark in the market. Here are a few key properties:

- 2W power rating at 110°C
- Constant currents up to 20A possible
- AEC-Q200 certified
- High pulse resistance

### GOODSKY relay

The relay comes from Taiwanese manufacturer GOODSKY, one of the top relay makers worldwide. The market considers the following product characteristics to be true highlights.

- Half the footprint compared to the previous RT/RZ standard
- 105°C max. ambient temperature
- Very long electrical lifetime
- several models like glow wire materials, reflow version, T&R packing, ex-proof,....

We will be happy to provide documents on this Eval Board in connection with a specific project. The following documents are available:

- Gerber data
- Schemata
- Parts list
- STP data
- Commissioning documents

P07

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Inductor L2 is a new development by SAGAMI, designed to meet certain quality requirements of these non-isolated 220V flush-mounted power supplies. This new series meets the specifications for operation at 400VDC and goes by the name CER\*V.

### Why do we need a new HV inductor?

Illustration 2 shows the drawing of a 230VAC circuit, which is rectified and subsequently transformed to a lower direct current using a non-isolated HV buck converter. This HV buck is depicted in illustration 2 as a switch. The HV buck's control circuit adjusts a certain pulse-pause-ratio, thus reaching the desired voltage. It is precisely in such a case that 400VDC are connected to the inductor for a short time. Searching for the dielectric strength on the datasheet of an inductor usually yields disappointing results. Most manufacturers specify it at around 100VDC or not at all.

### Is this relevant?

The question whether this is relevant is certainly justified, because many manufacturers of electronic components do exactly that and have been doing it for quite some time, even though they are plagued by undesirable and sometimes inexplicable errors, e.g. total power supply failure.

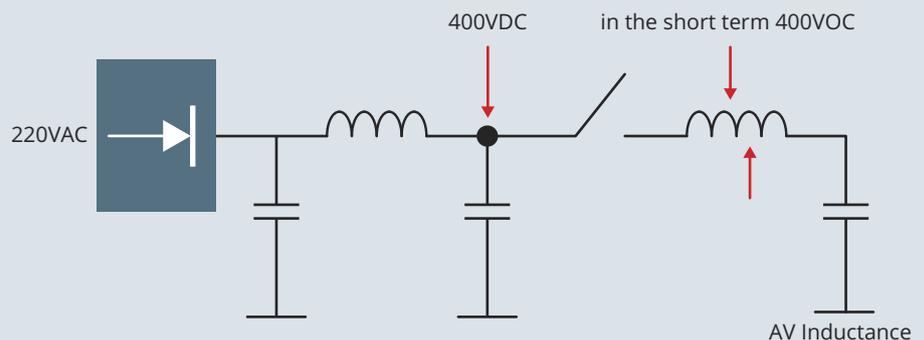


Figure 2: Schematic

# FLAGSHIP SPECIFICATIONS

## RUBYCON's New Snap-In Type

RUBYCON expanded their series chart of snap-in type electrolytic capacitors, making their portfolio the largest in the market.

### The new RUBYCON capacitors

- GXH series and G XK series for a lifetime of 7,000hrs at 105°C
- NXH series and NXK series for a lifetime of 10,000hrs at 105°C
- THH series and THK series for a lifetime of 2,000hrs at 125°C

### Key Features

#### GX series (105°C/7,000hrs)

Voltage: 160-500V  
 Capacitance: 68-1.000uF (inside 400V-500V range)  
 Ripple current: 0.67-2.89Arms/120Hz/105°C

#### NX series (105°C/10,000hrs)

Voltage: 400-500V  
 Capacitance: 100-820uF  
 Ripple current: 0.9-2.75Arms/120Hz/105°C

#### TH series (125°C/2,000hrs)

Voltage: 400-450V  
 Capacitance: 82-1.000uF  
 Ripple current: 0.77-2.86Arms/120Hz/125°C

### For all 3 series (GXK, NXK, THK)

Size: ø22x25 to ø35x60  
 Basic temperature range: -25--+105°C/+125°C (-40°C possible)  
 EC-Q200 compliant

These new capacitor series provide top specifications compared to other competitors, especially the GXK, NXK, and THK series. Compared to other products in the market, these series reduce both product diameter and length by 5mm or even 10mm while providing a higher ripple current and longer lifetime. All new series are also partly available for the automotive market. More and more electric vehicle applications (like on-board chargers) require higher capacitance and longer lifetime in a high voltage range. However, there is a limited number of suppliers capable of catering to such a demanding and high quality market. RUBYCON is the most reliable quality supplier for electrolytic capacitors, since they stand out in terms of superior material selection.

## Applications

- Suitable for DC-link applications requiring high voltage and high capacitance, like industrial environments
- DC-link in photovoltaic inverters
- 5G small cells
- Automotive on-board chargers
- Fanless power supplies

### RUBYCON snap-in series definition

This also makes the definition within snap-in type series much clearer.

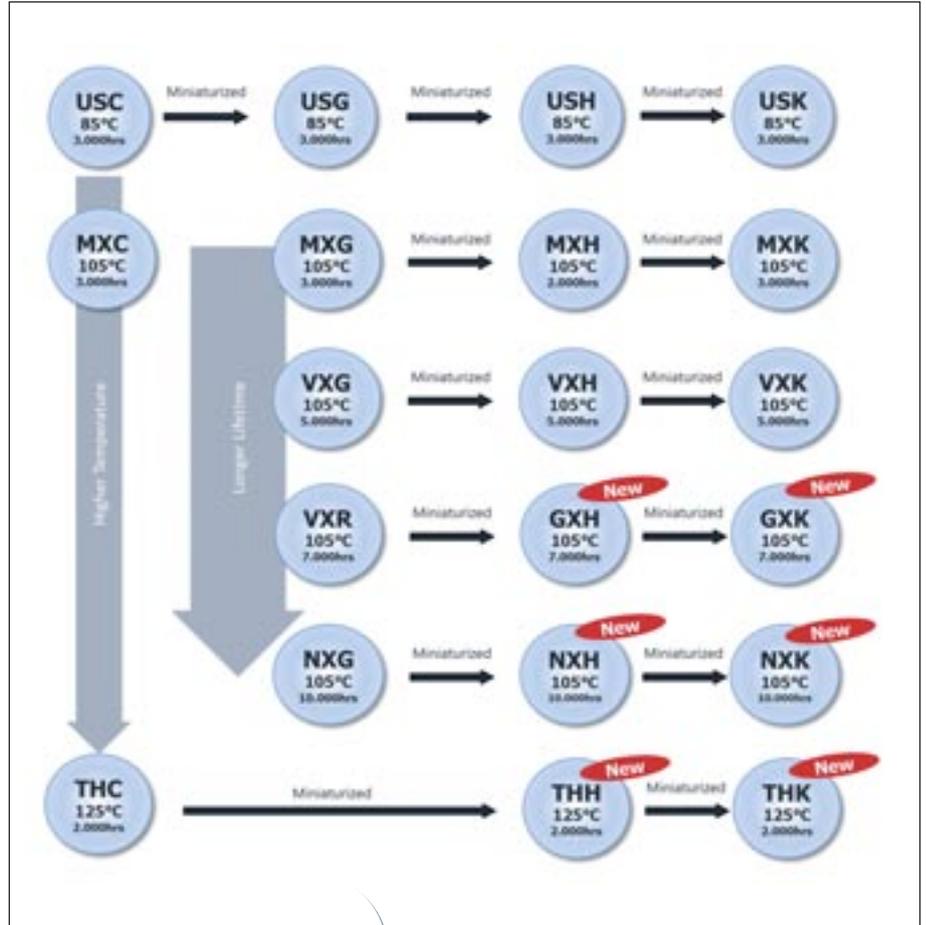
#### RUBYCON snap-in series

- US series: 85°C/3,000hrs
- MX series: 105°C/2,000 to 3,000hrs
- VX series: 105°C/5,000hrs (except special VXR and VXS)
- GX series: 105°C/7,000hrs **-NEW-**
- NX series: 105°C/10,000hrs **-NEW-**
- TH series: 125°C/2,000hrs **-NEW-**

The last letter stands for miniaturization grade, from low to high as C ▶ G ▶ H ▶ K  
(e.g. MXC ▶ MXG ▶ MXH ▶ MXK)

»K-ending« series are the flagship specification of each category. They use very sophisticated materials, which makes them more expensive at the moment. In addition to these »K-ending« series, »H-ending« series like GXH, NXH and THH series are being developed to be high-runners and cost effective. If you don't need downsizing, these »H-series« will therefore be suitable for you.

It is always difficult to understand capacitor information based on the series name or part num-



ber. Each supplier has different definitions and rules, and sometimes part numbering is difficult to understand. RUBYCON part numbering, on the other hand, is easy, and the series names are clear for customers to understand.

#### RUBYCON part numbering

Example PN:

**450 NXK 470 M EFC EN 35x40**  
 ① ② ③ ④ ⑤ ⑥ ⑦

- ① Rated voltage
- ② Product series
- ③ Capacitance value
- ④ Capacitance tolerance (generally M=±20%)
- ⑤ Option code (where you can see the standard or customized specification)
- ⑥ Terminal forming code
- ⑦ Product dimension (diameter× height (mm))

If you have any questions, or need information on other RUBYCON series (SMD, THT), feel free to contact us.

**P08**

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# POWER TO ELECTRICAL VEHICLE



Our partner SONG CHUAN is constantly focusing on new innovative relays for high end applications. A few years ago, SONG CHUAN shifted their strategic focus to developing relays for green energy applications.

Their relay series 118 is a new platform, which offers a complete family of very powerful one and 2 pole relays from 48 to 100A. It is perfectly suitable for applications such as wall boxes, cord sets or photovoltaic inverters. The main task assigned to SONG CHUAN's R&D team for this next-generation component was to meet the following criteria:

- Low and stable contact resistance over the lifetime
- Coil power optimization
- Product size – miniaturization
- Pin layout

While the first two points are all about heat management to avoid demanding and costly cooling solutions, the remaining criteria allow for a simple mechanical design and pcb layout. Here you can find 2 examples how to design your charger:

## Design Concept – Option 1

### Low profile 118 – 1 pole version

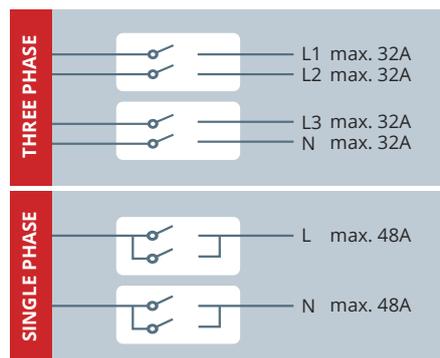
Application: Single phase charging of 22kW and carrying current max. 100A, using 2 pieces of one-pole 118 relays.



## Design Concept – Option 2

### Low profile 118 – 2 pole version

Application: Single phase charging of 11kW and carrying current max. 48A using 2 pcs of 118 – 2 pole relays and each relay with the 2 poles con-



### Outline Dimensions

### Wiring Diagram (Bottom view)

ected in parallel. Three phase charging of 22KW and carrying current max. 32A using 2 pcs of 118 – 2 pole relays.

### Main relay features at a glance:

- 1 and 2 pole NO contact – 40A/100A rating
- 1,8mm contact gap, 2.1mm optional
- 12 and 24VDC coil, class F coils system
- Olding power only 1.0W at 85°C ambient
- Reinforced insulation 8mm
- Meets UL 508, IEC 61810 and requirements of IEC 62955 Mode 3

P09

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# OCXOs

## TXC Expanded Their Lineup



Driven by the growth of IoT distribution, various kinds of information are increasing rapidly. Large amounts of data are needed at high speed and more accuracy.

An OCXO is needed for those high frequency reference signals with low noise and high purity clock, required in radio equipment and measurement instruments. TXC is expanding their OCXO lineup for those various inquires, mainly into 3 directions:

- Smaller size
- Higher temperature
- Lower phase noise

Size is the most obvious one. In our Impulse 01-2021, we introduced TXC's OH series as today's smallest size 7×5mm OCXO. Now TXC announced an even smaller size, the new OK series offering 5.5×3.7mm. This small size could be reached by using their patent ThermSym™ technology positioning the heater between the crystal and the IC. This 5.7×3.7mm size will help saving space for small cells, radio units and servers against any other OCXO in the market. As next target, TXC is aiming 3.2×2.5mm for future 6G mobile communication.

Beside ThermSym™ used in OK series, now TXC is improving the existing lineup to reach higher temperature rating with their new patent ThermSym NEXT™. All current lineups will have this improved specification at same product and size. Today's smallest 7×5mm OH series can reach <math>\pm 10\text{ppb}</math> at -40~85°C and <math>\pm 20\text{ppb}</math> at -40~105°C. OE series (14×9mm) and OG series (9×7mm)

will reach <math>\pm 3\text{ppb}</math> at -40~85°C and <math>\pm 10\text{ppb}</math> at -40~105°C. ThermSym NEXT™ is a hybrid system of OCXO and TCXO technology. The IC algorithm has two steps. At lower temperature the heater controls the temperature and clock stability. When the outside temperature suddenly rises and exceeds the manageable internal temperature, then stronger temperature compensation function works to keep the clock stability flat.

Another direction is lower phase noise together with keeping size smaller. The new MA series reached -172dBc/Hz@100kHz with keeping 14×9mm size. Low phase noise type OCXOs often have bigger package size like 36×27mm. Phase noise usually comes from the oscillation loop circuit. To reduce this noise you need a noise suppression circuit at the output side. MA series offers this function in a smaller size while keeping the stability at <math>\pm 20\text{ppb}</math> over -40~85°C. This MA series will be suitable for millimeter wave 5G communication to keep your communication faster and reliable.

OCXOs still have many possibilities and ways to grow. Each supplier has its own technology to reach better specification even to 0.01ppb. You should not miss this trend and turn a blind eye to this future. If you have any questions or any sample requests, please do not hesitate to contact me.

### Features

#### OK series (The smallest in the market)

Size: 5.5×3.7mm

Frequency: 10~52MHz

Stability: <math>\pm 50\text{ppb}</math> in -40~85°C

Aging: <math>\pm 5\text{ppb}/\text{day}</math>

Frequency Holdover (50ppb): >10 days

Sample Available Now / MP from Q2/2022

#### OH series (New specification)

Size: 7×5mm

Frequency: 6~54MHz

Stability: <math>\pm 10\text{ppb}</math> in -40~85°C / <math>\pm 20\text{ppb}</math> in -40~105°C

Aging: <math>\pm 2\text{ppb}/\text{day}</math>

Frequency Holdover (50ppb): >15 days

Sample from Feb 2022 / MP from end of 2022

#### OE series and OG series (New specifications)

Size: OE 14.4×9.4mm / OG 9.5×7.3mm

Frequency: 6~54MHz

Stability: <math>\pm 3\text{ppb}</math> in -40~85°C / <math>\pm 10\text{ppb}</math> in -40~105°C

Aging: <math>\pm 0.5\text{ppb}/\text{day}</math>

Frequency Holdover (50ppb): >1.5 month

Sample from End of 2021 / MP from Q3/2022

#### MA series (Low Phase Noise)

Size: 14.4×9.4mm

Frequency: 10~52MHz

Stability: <math>\pm 20\text{ppb}</math> in -40~85°C

Phase Noise: -172dBc/Hz @100kHz

Aging: <math>\pm 1\text{ppb}/\text{day}</math>

Frequency Holdover (50ppb): >15 days

Sample Available Now / MP from Q1/2022

P10

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# NEW GENERATION

## DC-Link Film Capacitors



KEMET has recently introduced a new generation of power film caps for DC-link and DC filter applications. Thus, KEMET offers a wide range of different specifications with features such as miniaturization or harsh environment withstanding (THB 85°C/85% R.H./1,000hrs at VR; 135°C).

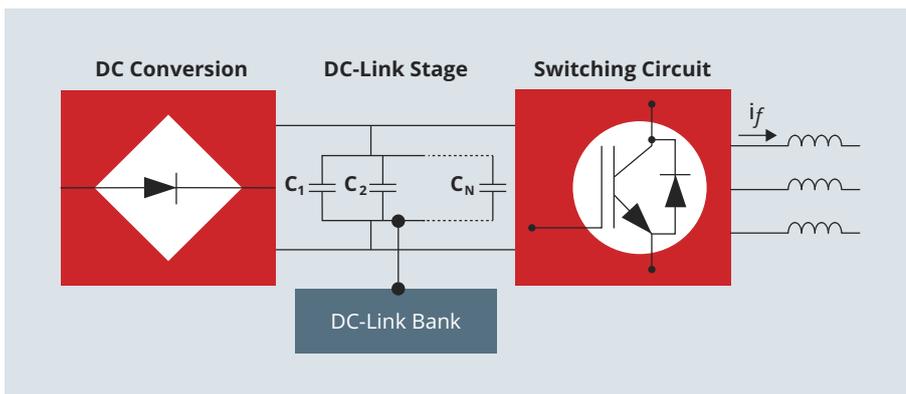
**D**C-link capacitors are often found in power inverter, motor drives and high-power charging circuits, and are utilized as input/output filter as well. They use thin polypropylene film as

their dielectric and are found in power converter circuits between the input and output stages for DC smoothing and energy storage. The intermediate DC step allows noise-reduced power transfer when converting between AC sources of different power, voltage or frequency conditions and store energy to provide instantaneous current to downstream circuits and in some application fail-safe power loss operations.

These capacitors are stable over temperature, frequency and time. They have a low dissipation factor, excellent self-healing capability and long operational lifetimes.

### Key Requirements

- DC-link capacitors must be able to withstand high power, high ripple currents and a large amount of charge/discharge cycles. They often experience high slew rates which can be detri-



Series	C4AQ-M	C4AQ-P	C4AK	C4AU
Key Features	<ul style="list-style-type: none"> <li>• miniaturized</li> <li>• high dV/dt</li> <li>• highest peak &amp; ripple current</li> <li>• lowest ESR</li> </ul>	<ul style="list-style-type: none"> <li>• long life time 4000hrs@125°C</li> <li>• high dV/dt</li> <li>• high peak current</li> </ul>	<ul style="list-style-type: none"> <li>• max. temperature 135°C</li> <li>• long life time 1000hrs@135°C/4000hrs@125°C</li> <li>• THB 85°C/85%/1000hrs/Vr</li> </ul>	<ul style="list-style-type: none"> <li>• THB 85°C/85%/1000hrs/Vr</li> <li>• high dV/dt</li> <li>• high peak current</li> </ul>
Capacitance Range	1.1 to 210µF	1 to 210µF	1.5 to 60µF	1 to 210µF
Voltage Range (V <sub>NDC</sub> ) @85°C	500 to 1200VDC	450 to 1100VDC	700 to 900VDC	500 to 1200VDC
Temperature Range	-55 to +105°C	-55 to +125°C	-55 to +135°C	-55 to +105°C
Max. Temperature	+125°C	+125°C	+135°C	+125°C
Life Expectancy@max. Temp.	200h (@0.5xV <sub>OP85</sub> )	4000h (@V <sub>OP85</sub> )	1000h (@V <sub>OP135</sub> )	200h (@0.5xV <sub>OP85</sub> )
Life Expectancy@V <sub>NDC</sub> /85°C	60000h	100000h	100000h	20000h
THB	60°C/95% RH, 1000h, Vr	85°C/85% RH, 1000h, 55% Vr	85°C/85% RH, 1000h, Vr	85°C/85% RH, 1000h, Vr
Max. dv/dt	90V/µs	80V/µs	40V/µs	90V/µs

mental if a suitably robust capacitor is not selected.

- DC-link capacitors are used in windmills, solar farms and other renewable energy source circuits; they must operate reliably and safely in harsh environments.

### Product lineup of the latest series

Due to miniaturization **C4AQ-M** series allows more potential energy storage, better ripple and higher frequency performance (lower total ESL). C4AQ-M supplies the highest current density for low temperature applications (≤70°C).

**C4AQ-P** is a 125°C long life time version for higher currents and pulses, and first to market of that kind.

**C4AK** offers the highest maximum temperature and the highest operation life of the lineup, which is actually first to market with such a specification. C4AK and C4AQ-P are the most effective solutions in ripple current per volume for high temperature applications (≥70°C). At 105°C e.g. C4AQ-P and C4AK are allowing an about 11-12 times higher ripple current than standard C4AQ-series.



Those solutions allow fewer parallel capacitors and thus smaller PCB area and better extended-reliability.

With **C4AU** KEMET offers a THB grade IIB tested power film capacitor for harsh environments.

The portfolio of those 4 new series offers a capacitance range from 1µF to 210µF and voltages of up to 1200VDC @85°C. All series have AEC-Q200 certification and low profile versions are available.

Considering the temperature we are talking about the hot spot temperature. This is the internal point of the capacitor where the temperature reaches the maximum value and is depending on the ambient temperature plus self-heating generated by the ripple current.

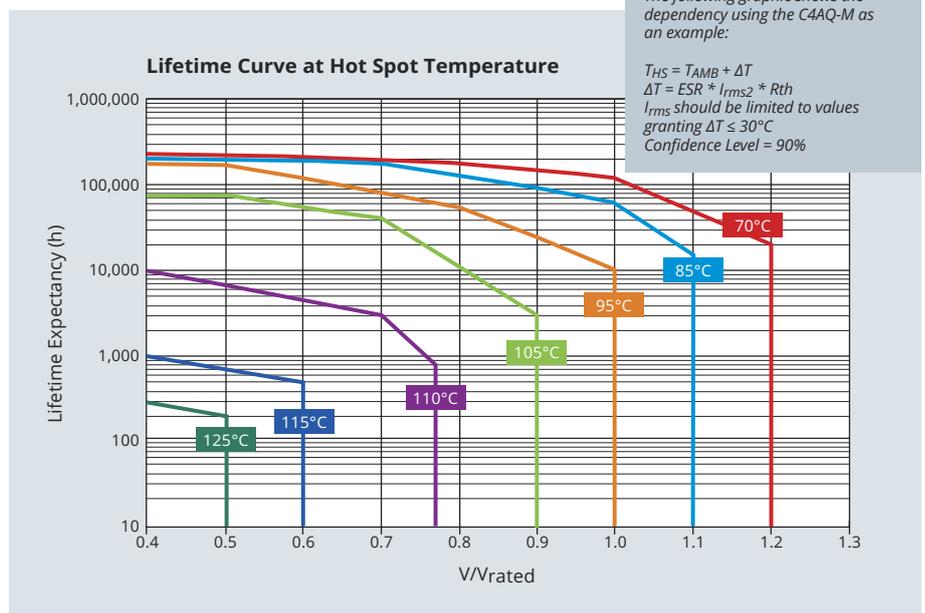


The lifetime depends not only on the temperature but also on the applied voltage (see picture lifetime curve).

For more information and samples, please do not hesitate to contact us.

**P11**

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# Customized Harsh Environment Battery Connectors

# BATTERY PACK

Amphenol  
ICC

AMPHENOL ICC offers customized battery or charger connectors and terminals meeting general industry standards.

These reliable and robust interconnection systems feature enhanced durability. These connectors are available in various pin configurations and connector sizes to suit wide range of applications including cordless power tools, battery-charging connection for E-bikes, lawn mowers and robotic vacuum cleaners. In addition, completely customized panel-to-panel or panel-to-cable solutions are also possible. The current rating with up to 40 Amps covers the entire low and medium power segment. In order to have a reliable electrical connection the connector uses dual beam contact design for receptacle contacts. There are also weatherproof solutions to make the battery connectors suitable for harsh environment applications.

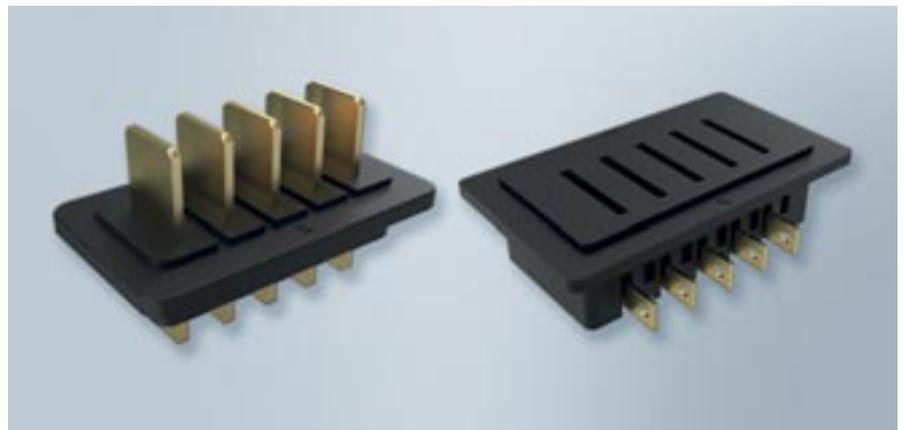
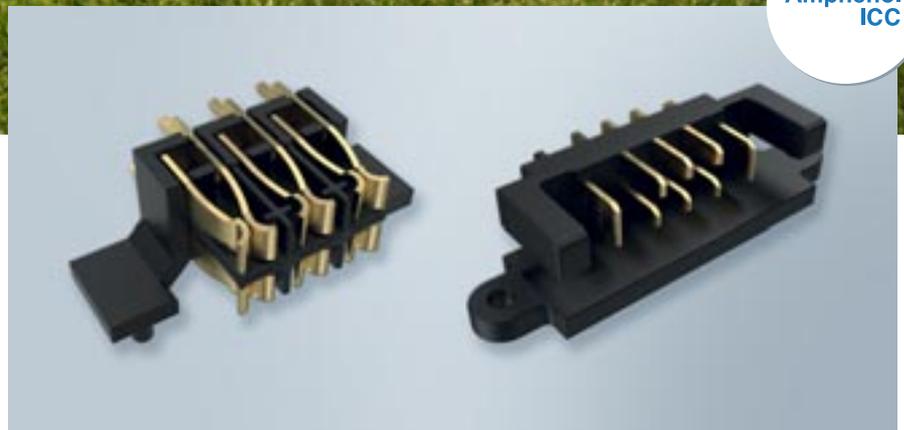
S01

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#### GENERAL SPECIFICATION

Operating Voltage	Up to 300V
Current	Up to 40A*
Operating Temperature	-40 to +150°C
IP Sealing	IP67, IP68*
Durability	Up to 4000 mating cycles*
Termination	Wire crimp termination, flow solder, welding

\*Standard specification – can be upgraded/modified based on the requirements



# WIRELOCK®

## The Automotive Wire-to-Board Connector



More reliability with low mating forces in automotive quality.

**A**MPHENOL ICC's WireLock® is a 1.80mm pitch wire-to-board connector system. Its compact design addresses the growing demand for miniaturization in the automotive application market. WireLock® is a double row connector system offering four coding types with different

colors to avoid visual mismatching. TPA and CPA features ensure a secured connection, adding to the safety of the entire system. The connector has nominal current carrying capacity of 3A and supports cable wire gauge from 22AWG to 26AWG. WireLock® is available in 10 to 40 positions in double row with vertical and horizontal TH and SMT configurations. The connector can be applied in the automotive industry as well as in industrial applications and robotics. It meets the requirements of USCAR-2 V2 and QC-T1067. 1-2017.

FEATURES		BENEFITS
Reflow Tin plating process for terminal	◀ ▶	Low mating and un-mating force
Current rating 3A with each contact	◀ ▶	Meet higher power Amps performance
Terminal-Position-Assurance (TPA)	◀ ▶	Ensures proper terminal insertion position and retention
Four different coding with different colors	◀ ▶	Visual and mechanical mismatching prevention system
Connector positioning assurance (CPA)	◀ ▶	Ensures that connectors are properly mated and locked together
Wire gauge up to 22AWG	◀ ▶	Meet wide gauge application requirement

S02

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Amphenol  
ICC



# TRENDS IN ELECTRIC VEHICLES

## Automotive Connectors

Amphenol  
ICC

AMPHENOL's connectors show innovative technology and solutions that support the growth in the automotive industry, particularly in plating, signal integrity performance, and power management. Their range of high-power connectors support various features in Electric Vehicles and EV charging and their Battery Management Systems.

### EV Battery Management Systems

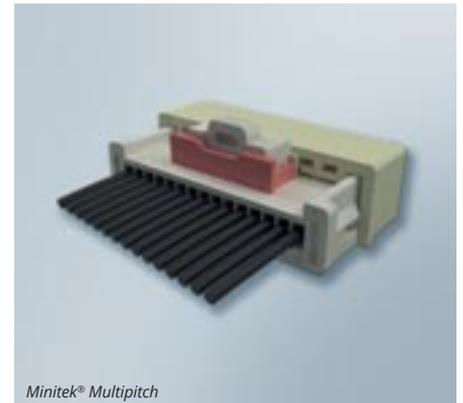
The performance of an EV is largely determined by the Battery Management System (BMS) within the vehicle. BMS monitors the voltage, current, temperature, and life of battery cells, along with catering to other functions like checking faults and estimating available energy as well as remain-

ing useful lifetime. AMPHENOL offers a range of compact, flexible high performing automotive grade connectors for these power circuit designs.

AMPHENOL ICC's Automotive connectors include Minitek MicroSpaceXS™ Crimp-to-Wire connectors which are an ideal choice for BMS. The uni-

que design of the Minitek™ MicroSpaceXS™ makes this solution and contact pitch (1.27mm) compatible with LV214 Severity-3 and USCAR-T2V2. The right choice when high vibration endurance, primary latch, TPA, CPA, Poka Yoke, Kojiri safe are required with flexible configurations. The connector has nominal current carrying capacity of up to 4A and cable external diameter up to 1.4 mm.

**Minitek® Multipitch** Wire-to-Board connectors are offered in 1.25 and 1.50mm compact pitch sizes. While 1.25mm connectors have a current-carrying capacity of 1A and external cable diameter from 28 to 26AWG, the 1.50mm connec-



tors come with a current-carrying capacity of 2A and external diameter from 28 to 24 AWG. Apart from the wire-to-board and crimp-to-wire connectors, AMPHENOL also has a range of FFC/FPC connectors with front flip and slider mechanisms that go into a BMS. Front flip and slider lock mechanisms promote strong FFC/FPC retention making it easier to use and tolerate vibration.

As mentioned in the earlier article, the new **WireLock®** also addresses the growing demand for miniaturization in the automotive application market. The USCAR-2 V2 compatible connector ensures proper terminal insertion position and retention with TPA and CPA features.

## EV Charging Stations

With a wide portfolio of power products supporting 15A-1000A ratings, low contact resistance, high thermal support and component modularity, AMPHENOL offers various solutions for the modern EV charging station. While PwrBlade® connectors go into various EV chargers including Level 2, Level 3, superfast chargers, custom power products like EazyPwr™ IP67 field installable connectors with up to 125A per contact are ideal for wireless charging stations.

**PwrBlade® family** contains series PwrBlade®, PwrBlade+ and PwrBlade ULTRA®. All of them provides power contacts for AC/DC power distribution and signal contacts for power control. Number and placement of power and signal contacts are highly configurable for custom power needs.

**EazyPwr™** IP67 field installable connector provides the next generation of custom power with up to 125A per contact. The metal latching system ensures a reliable connection between the mated pair. The water-tight plug and screw-on



PwrBlade+® Connector for EV Charging



EazyPwr™ IP67 Field Installable Connector

cap can be removed easily. Wide range of customizable components to fit specific application needs.

AMPHENOL's busbar connector and cable solutions are ultrasonically welded and provide current carrying capacity up to 200A/contact to the heavy-duty AC/DC power inverters, supporting superfast charging stations.

**PwrBlok®** connectors provide a high current power interconnection with quick connect/disconnect function for space constrained board-to-board, board-to-busbar, and busbar-to-busbar power distribution applications. The connectors provide a wide current carrying capacity from 65 to 140A, based on specific pin size. It comes with press-fit PCB tails for mounting on both circuit boards and busbars.

**SheerPwr™** Circular is a high-current, low-impedance interface designed for connecting busbars to PCBs. It uses a robust and compliant power contact mounted in a circular orientation. The result is a power socket, designed to mate with traditional machined pins, which provides repeated low resistance, high mis-alignment and high current carrying capabilities.

**BarKlip®** I/O connector provides a convenient method of distributing up to 200A between busbars, cables and PCBs. It features 14 fully independent cantilevered beams, providing a true compliant spring to adjust for variations in busbar alignment and surface finish.

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PwrBlok® Connectors



SheerPwr™



BarKlip®



# PAIR, WIRES, INTERFACES

Amphenol LTW

© Amphenol LTW

AMPHENOL-LTW offers three mechanical interfaces for Single Pair Ethernet cables, which are all designed and made according to IEEE 802.3bp standard. The three mechanical mating interfaces come with a minimum water protection class of IP67 giving you the freedom to choose the interconnection suitable to your needs and requirements for industrial and ruggedized applications.

## What is Single Pair Ethernet?

Single Pair Ethernet (SPE) cables simplify the process of connecting and powering edge devices by extending the range and bandwidth of a single twisted pair. They allow stable, uninterrupted connectivity from remote field devices to the cloud, even in the roughest situations, thanks to excellent shielding and jacketing choices. With the ability to integrate data and power delivery with Power over Data Line (PoDL), you can benefit from increased uptime, process efficiency and operational benefits.

With AMPHENOL-LTW's proprietary SPE interfaces you have the freedom of choices for your

MPE vs SPE	SPEED	DIRECTION	DATA RATE
FAST ETHERNET	100Mbit/s per twisted pair	uni-directional	100BASE-TX
GBIT ETHERNET	250Mbit/s or 2.5Gbit/s per twisted pair	bi-directional	1GBase-T or 10GBase-T
SINGLE PAIR ETHERNET	100Mbit/s or 1Gbit/s per twisted pair	bi-directional	100Base-T1 or 1000BASE-T1

MPE means Multi Pair Ethernet, which utilizes two or four wire pairs

requirements and budget. The new SPE layouts are integrated in the following connector families who have already been successfully established on the market:

### 1. M12 (Screw Threaded & Push-Pull)

Beside the standard M12 range the SPE interface is also available on the world's first true backward compatible push-pull cable plug, called MPronto-12. It saves over 80% installation time compared with a standard M12 screw thread mating couple and can be used with all M12\*1.0 threaded sockets available on the market.

### 2. FLOS+ (Push-Pull)

AMPHENOL-LTW's FLOS+ series is a robust metal circular connector with push-pull locking system ensuring a reliable mechanical mating and unmating process in less than a second.

### 3. X-Lok (Push-Lock)

The X-Lok series includes a large variety of different connector sizes and pin configurations with a push-lock mechanism providing the best blind mating practice for a quick and easy connection. It gives an audible feedback during the mating process and achieves IP68 waterproof protection to prevent your devices from the damage of water ingress.

### Advantages with SPE

- Providing low power and simply networking on end-point sensors
- More cost effective, smaller and lighter than standard 4 pairs Ethernet cable
- Compatible 802.3 10/100/1000 Base-T1 data rates
- Receptacles have minimum IP67 waterproof rating in unmated condition
- Available in double ended and field installable versions
- Vibration resistance up to 20g (10-2,000Hz)
- Supporting PoDL (Power Over Data Lines)

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MPronto-12



FLOS+



X-Lok

# DINKLE SERIES 0177

## The Best Partner for Power Supplies




In order to promote the progress of smart manufacturing in Europe, it is important to focus on the realization of ultra-high-speed connections between machine-to-machine communication and the new technologies of the Industrial Internet of Things (IoT).

According to statistics, there were 7.6 billion active IoT devices in the world by the end of 2019, and the number is expected to grow to 24.1 billion by the end of 2030. In the next 10 years of intelligent manufacturing, there will be a large number of industrial IoT devices, such as mobile devices, sensors, inverters, etc., which are connected to manufacturing equipment. It means that a smaller size power supply with higher power current load is becoming one of the most important pieces of equipment within the Smart

Factory and Industry 4.0. That is why DINKLE introduces the 0177 series, which is the best solution for the new generation of power supplies.

This terminal block series with front entry offers a wide range of voltage options depending on the available pitch sizes between 3.50mm and 10mm. The highest voltage is up to 600V/66A under UL (IEC up to 1000V/76A). There is a choice of versions with horizontal and vertical wire insertion direction.

### Save and fast wiring

Thanks to the advanced push-in design, ferruled or solid wires do not require a tool for the insertion which results in saving more than 60% of wiring time. For a stranded wire connection without ferrules, the terminal point can be easily opened from the front side by using a screwdriver.

### Flexible combinations

The square housing fits in any modular application. The stackable design allows a flexible combination of terminal blocks with different colors or alphanumeric printing according to customer requirements. It notably reduces wire configuration errors.

### Firm connection for stable current output

The 0177 series supports multiple or zig-zag solder pins which are tightly connected to the PC board. This structure ensures the stability of the high current transmission.

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# HIGH-SPEED FPC

## The Future of Fast Data Transmission

Conventional technologies such as Flexible Flat Cables and Flexible Printed Circuits (FFC/FPC) or micro-coaxial cables cannot cope with requirements for extremely high reliability and continuously increasing data transmission rates between internal printed circuit boards. The Y-FLEX technology of YAMAICHI Electronics solves this problem. With the Y-FLEX high-speed FPC you can establish data rates of 56Gbps (PAM4) over a cable length of 100mm.

The suitability of the Y-FLEX cable for high data transmission rates is realised with characteristics such as LCP (Liquid Crystal Polymer) as base material, the contacting of various layers with so-called silver bumps and the special, 100 percent reproducible production process. In order to achieve particularly high transmission speeds, it is important to match the Y-FLEX specifically to the appropriate FFC/FPC connector. In principle, the Y-FLEX mating face can be adapted to any standard ZIF, non-ZIF or LIF connector. However, specially developed high-speed ZIF or non-ZIF connectors such as the HF507 series from Yamaichi are the most suitable for achieving optimal performance.

### Y-FLEX compared with FFC and standard FPC

The biggest difference between Y-FLEX and standard FPCs lies in the insulation material. Compared with the standard polyimides used in conventional FPCs, the LCP insulation material in the Y-FLEX exhibits a much lower dielectric constant

and a much lower dissipation factor at high frequencies. As a result, attenuation is much lower, and the data transmission rates are much higher than in standard FPCs. Moreover, LCP has superior hygroscopic properties compared with those of standard polyimide. This makes processing easier and allows trace spaces and widths of less than 30µm to be realised with exceptionally high accuracy. Use in high relative humidity conditions is also much more stable.

### Y-FLEX compared with micro-coaxial cables

Transfer standards such as PCIe Gen 4 (16 GT/s), USB 3.2 Gen 2 (10 Gbps) or eDP HBR 3 (8.1 Gbps) can be reached without any problems with Y-FLEX. In the latest measurements performed on the current Y-FLEX generation, data rates of 56 Gbps (PAM4) were even realised over a cable length of 100 mm. Owing to the described manufacturing process (above all the precision etching and use of the LCP material as an insulator), the Y-FLEX has one very decisive advantage:



it is 100% reproducible. This means that all conductive traces are completely identical and thus achieve unprecedented constant transmission characteristics over their entire lengths. In contrast, in a coaxial cable, the relationship between inner and outer conductors differs along the cable due to the braid structure. An even more decisive influencing factor is the assembly of the individual coaxial conductors on the connector at the end of the line. There may be length and thus signal runtime differences in individual lines here.

### Fit for future markets

A leading manufacturer of mobile communications and high-frequency measurement technology recognised the outstanding technology of Y-FLEX several years ago and now uses it in a variety of projects, e.g. in 5G testers and body scanners. In addition to measurement technology, Y-FLEX is used, for example, in autonomous vehicles, data networking, image processing and medical technology.

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# RIGHT ANGLE

## HIROSE ix Industrial™ Now Also Available as Right Angle Plug

**HRS** HIROSE  
ELECTRIC  
EUROPE BV

HIROSE is expanding its range of the IEC-compliant Industrial-Ethernet-Connectors, the ix Industrial™, with an angled cable plug.

ix Industrial™ was launched in 2017 and is used in a variety of industrial markets, including factory automation, robotics and machine vision. The ix Industrial™ has been adopted by several well-known manufacturers of Ethernet applications due to its space-saving and durable design.

HIROSE released the new angled cable connector due to market needs for space-saving routing when space is limited on the connection side of the device interface. With the angled version, the connector is free from stresses caused by bending the cable. While the straight cable connector

is already part of the ix Industrial™ product line, the angled version allows the cable to be pulled out at right angles to the mating axis, reducing the height of the device interface connection and making it easier to route the cable in tight spaces.

The ix Industrial™ offers flexibility in wiring. Different termination methods (solder and IDC), two coding options, and both downward and upward angled connector types are available.

To meet the requirements in different operating environments where industrial equipment is used, HIROSE is currently considering the development of a waterproof type and a variant with an integrated pulse transformer.

Would you like to purchase your ix Industrial™ connectors already assembled? Please feel free to contact Julia Reiterer. Various configurations of ix-to-ix and ix-to-RJ45 in A or B coding are available.

**S07**

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# CONNECTORS FOR AGV/AMR



The use of Automated Guided Vehicles (AGVs) and Autonomous Mobile Robots (AMRs) in smart factories and in the logistics industry is on the rise. HIROSE introduces the most suitable connectors for AGV/AMR.

**D**emand for AGV/AMR applications for unmanned goods transportation is increasing as manufacturing plants evolve into smart factories with the proliferation of Industry 4.0. Increasing demand for AGV/AMR is also seen in distribution warehouses, due to the increased volume of goods handled by the proliferation of e-commerce.

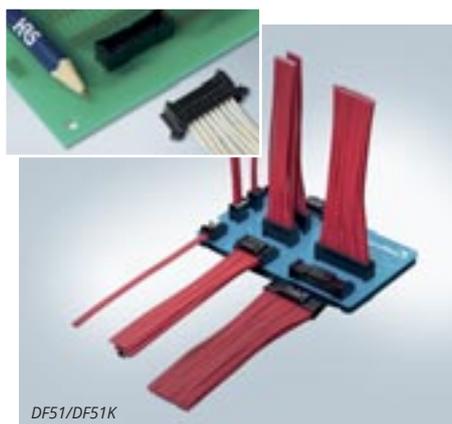
In recent years, AGV/AMR has been used not only for transporting goods in factories and warehouses, but also for delivery, security, cleaning, and food delivery. With such advances in functionality, the number of mounted components, including cameras and LiDAR, increases, resulting in the need to save space and wiring inside the device.

These devices must be rugged enough to withstand vibrations during travel. There are also cases where water resistance and high-speed transmission performance are required. HIROSE offers various high-performance connectors for all these demanding functional requirements.

HIROSE offers a wide range of connectors for use in AGV/AMR, including internal connectors such as board-to-board connectors and power supply connectors for batteries and motors.



DF60



DF51/DF51K



LF Serie

	IX INDUSTRIAL™	DF60	DF51/DF51K	LF	FX23/FX23L	U.FL	ZE05
	Interface Connector	Power Wire-to-Board Connector	Signal Wire-to-Board Connector	Shielded & Waterproof Circular Connector	High Speed Board-to-Board Connector	Small Coaxial Connector	Automotive Wire-to-Board Connector
Camera	✓			✓	✓		
Diagnosis (For External Communication)	✓						
Main PCB to Sub PCB		✓	✓		✓		✓
LiDAR	✓			✓			
Motor Signal			✓	✓			✓
Motor Power		✓					
Sensor			✓	✓	✓		
Battery		✓	✓				✓
Wi-Fi Module						✓	

and a maximum current rating of 2A ensures a stable connection. Various configurations are available: straight, angled and inline in single or double row. The series is available with side locking (DF51) and center locking (DF51K).

### LF Series

The LF series is a small, rugged circular connector with metal housing. IP67 and IP68 compliant, this product can be safely used in locations where there is a risk of condensation or water damage. In addition, the small and robust shield design prevents interference signals. Different variants are available: straight and right angle, solder or crimp connection, power/signal/hybrid layouts.

### F23/FX23L

The FX23 and FX23L are board-to-board floating connectors with 0.5mm pitch. The large floating range of  $\pm 0.6\text{mm}$  in the X and Y directions enables automated mounting of multiple connectors on one PCB. FX23 and FX23L support 8+Gbps high speed and have power contacts supporting 3A/pin. A wide variety of stacking heights are available, from 8 to 30mm.

### U.FL Series

The U.FL Series is small coaxial connector with mating height of 1.9 to 2.4mm. It has a very small board mounting area of 7.7mm<sup>2</sup> and supports up to 18GHz frequency. The plug is compatible with ultra-fine fluororesin cables and is available in two types: solder and solderless.

### ZE05

The ZE05 Series is a wire-to-board interface connector for automotive application. The space-saving design with size 05 terminal and 2mm pitch contributes to miniaturization. The series can withstand high temperatures up to 125°C. The unique terminal design has a double layer spring construction that enables three contact points for high contact reliability and vibration resistance.

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### DF60

The DF60 series is a wire-to-board connector for internal power supply with max. 65A. The positive lock and 5-point contact design provide high contact reliability. Finger protection and keying variations are available for safe use. Three connection orientations are available: straight, right angle and in-line.

### DF51/DF51K

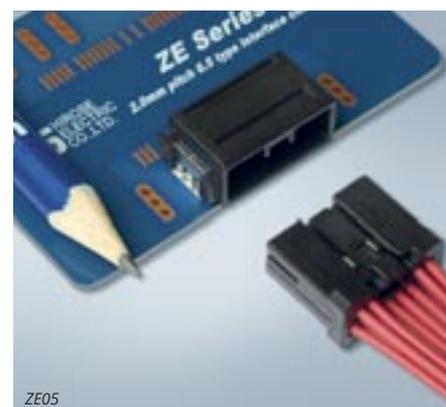
The wire-to-board connector with a pitch of 2mm



FX23



U.FL Serie



ZE05



# KNOWLEDGE

## Why Ignoring Antennas Is Limiting IOT Device Performance



© QIETEL

When deploying connected devices, people seldom give consideration to the antenna but poor siting of the antenna in the device and/or integration issues between the antenna and other components can cause IoT device performance to suffer or fail completely, writes Colin Newman, Director of Antenna Business Development (Global) at QUECTEL Wireless Solutions.

Antenna selection and integration needs to be given greater attention with users considering specifying pre-integrated components from the same manufacturer, for both module and antenna, to streamline a successful design and accelerate time to market.

Unless having experience designing with antennas, it can be a daunting challenge to make them work. Often there is not a quick or easy resolution because the issue might not be with the antenna itself and this uncertainty means antennas are often overlooked and left to later in the design process. However, to achieve the best performing design, antenna selection and position in your device should be considered first.

Antennas only work well in certain positions so priority should be given to their placement over and above any other components. If they are wrongly placed, performance is immediately compromised before any other influencing factors come into play.

IoT devices have evolved over the years to become more complex and smaller in size. Many products today are similar or smaller than a smartphone, and support just as many radios. This puts even more pressure on the design which needs to allow sufficient isolation between each antenna and address compromised performance caused by shorter ground plane lengths on the host printed circuit board (PCB).

Antennas are being asked to do more with less

Digital components and wireless modules have greatly reduced in size while increasing performance over the years. This 'die-shrinking' process cannot be applied to antennas as easily because of their physical requirements. Typically, everyone wants their company's latest device to be the smallest and best performing wireless device on the market. As a result, engineering departments have the task of making this happen within tight physical product constraints.

An external dipole antenna, which is increasingly adopted in IoT devices to ensure optimal connectivity, has two radiating elements while most embedded antennas typically use a monopole structure. With a Monopole antenna, the second radiating element is the host PCB ground plane and radio frequency (RF) layout and this design element is critical to the antenna's performance and often the cause of many underperforming designs. An important part of this challenge is

that there is no way of fixing or improving this later on, after the design stage. This is why QUECTEL offers to review customers' RF front end designs at the architecture stage, providing detailed and consistent feedback on what to expect, and helping to limit delay and cost associated with redesigning late in the development cycle.

For the device to perform well, the antenna and RF front-end (RFFE) must match the receiver's capabilities and specification. If it does not, performance will be compromised. By using a single vendor for both the antenna and RF module, companies can rely on the vendor's engineering teams, which have already worked together, to make sure there is compatibility between both products when they were developed.

The RFFE is often what makes or breaks a wireless design and this consists of the antenna and RF module as well as a third item, the RF interconnect between the two. No matter how good the performance of the antenna and the RF module, a poor interconnect/RF layout will significantly reduce performance and it cannot be resolved without a costly redesign and delay to the schedule. If multiple vendors are used, challenges emerge as to who is responsible for providing the interconnect support and each vendor can point to the other as the cause of any issues.

However, by using a single manufacturer, like QUECTEL, you can be assured that the supplier already knows how their two components need to be connected and a single point of engineering support for both components can be provided. A further benefit is that, if your product requires network certification, the antenna, module and interconnect all play a vital part in achieving approval. Again, using a single supplier means their engineering team has experience with the whole RF front-end and can help with all these aspects as well as providing their own pre-compliance testing. With success in IoT reliant on rapid time-to-market and cost optimization, this approach is a simple way to achieve both rapid development and cost efficiency.

You only know how well your wireless device is working once your design is complete and prototypes have been built and tested so any performance issues or failure to achieve network certification need to be resolved quickly and with the minimum of modifications. Working with a distributor like Codico who provides the key components greatly helps reducing additional engineering costs and accelerating time-to-market of the device.

In development, having fewer suppliers helps forge a closer working relationship, and build trust



and loyalty which can be especially valuable in times of component allocation issues. That trust and loyalty helps provide early access to new manufacturer developments and roadmaps so that, as a customer, you are ahead of new product launch dates.

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# POGO-PINS: 5 DESIGN- RULES



## What You Need to Know, When Implementing a Pogo Pin Connector in Your Design.



**P**ogo Pins or spring loaded connectors have become very popular in recent years due to their versatile application and long durability. Especially for industrial applications pogo pins are often preferred to flat spring connectors which usually require a stamping process. That makes customizations very expensive and in many cases unfeasible. In this article we will explore the most important design rules for engineers that want to use a Pogo Pin connector in their device.

### 1. Current

Pogo Pins have very different inner structures that meet the needs of a variety of applications. What influences the current a pogo pin connector can carry?

**Number of Contact Points:** The ball design maximizes the number of contact points, thereby allowing a higher and more stable flow of current.

**Spring Force:** The higher the spring force, the better the plunger is pressed against the wall of the barrel, resulting in a stable current flow.

**Material:** Different material types can heavily influence the conductivity of the pin, but also the roughness is important to increase the current flow.

The most common design is the »Bias Tail« which can usually carry currents of 2 Amps. It is also

the most cost effective design. The »Back Drill« is used when there is very limited space. Due to the free floating plunger, this design has the risk of micro disconnections due to vibrations. As a result current will flow through the spring and burn it. We usually recommend to use this design, for low currents around 1 Amp. The 3rd design, »Ball«, has an additional ball inside the pin to stabilize the currentflow. This design can be used even under strong vibrations and can carry up to 5 Amps.



### 2. Housing Design Rules

The plastic should have a wall thickness of no less than 0.4mm. This ensures, that there are no cracks, when the pins are press-fitted into the housing. The thickness is increased, if you are looking for a water proof connector. Those connectors are often glued which needs additional space.

### 3. Environmental Factors

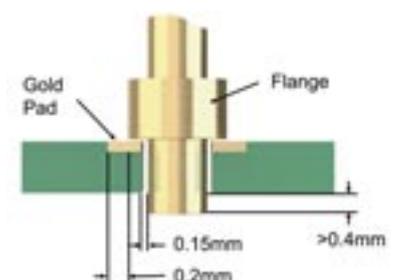
Pogo Pins can be used in many different environments. On a smart watch or hearing aid, a pin may get in contact with sweat which causes galvanic corrosion. Often it is not enough to simply increase the gold plating thickness. Instead, C.C.P.

uses their proprietary »AP plating« which is much more resistant to this type of corrosion. An additional benefit is the higher hardness as compared to gold.

Another factor maybe be vibrations. Especially, when transferring a signal, a stable connection is very important. A high springforce combined with an additional cap inside the pin, often helps to stabilize the current. Not every pogo pin can be used for every application. If you wish to use the pogo pin at extreme temperatures such as below -40°C or above 230°C different materials are use to avoid male functions.

### 4. Installation

As a rule of thumb, the hole in the PCB should have the radius of the "Pogo Pin Tail + 0.3mm". The soldering gold pad should generally be radius of the »flange + 0.4mm«. The tail itself should be at least »Thickness of PCB + 0.4mm« long. These numbers may vary at smaller pitch sizes and also depend on the tolerances the PCB assembler is operating with.



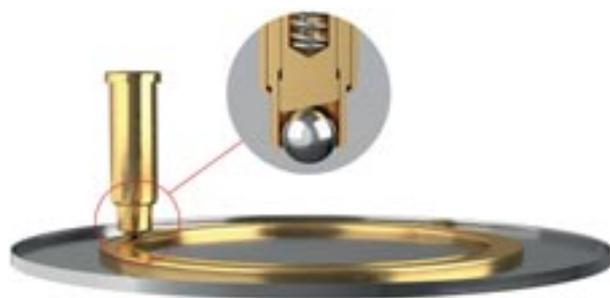
How to design the FPC footprint for pogo pin connectors? For Flex PCBs the rules are similar as for normal PCBs. Only the tale of the pin should be »Thickness of FPC + 0.1mm«.

How to design the PCB for SMT mounted pogo pin connectors? The soldering pads should be »Radius of the Pogo Pin + 0.5mm«.

## 5. Rules for Mating

Generally, pogo pins should not be mated at an angle that exceeds 5°. The general rule of thumb is, that the greater the angle is, the lower the life cycle of the pogo pin becomes. The maximum mating angle is about 18°. Please note, that at this angle the expected life cycle is significantly reduced. The friction between the plunger and the inner wall of the barrel increases at a constant rate when mating the pin. This leads to the abrasion of the plating inside of the pogo pin. The result may be corrosion and more importantly an increased electrical resistance.

If you wish to mate a pogo pin horizontally you may choose a ball point pogo pin:



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# Circular Connector Y-Circ P Push-Pull

The successful series of the Y-Circ P Push-Pull circular connector have now been expanded to include a 90° angled cable connector with a flexible cable outlet direction.

YAMAICHI Electronics has been continuously expanding its Y-Circ P circular connector portfolio for years. The series extensions are always geared to the needs of the market in order to offer customers the most optimal solution. The angled Y-Circ P connectors with the type designation »AB' and »AR« have a flexible cable outlet. It can be oriented in 8 different positions during the installation of the connector. This guarantees an optimal cable outlet direction – ideal in applications with reduced space.

As with all Y-Circ P connectors, the installation is particularly easy, as the elbow consists of two parts. This way the cable has to be bent only at the very end. Internal coding in the housing enables a robust connector and a long service life with guaranteed 5,000 mating cycles despite the flexible and compact design.

Internal coding in the housing enables a robust connector and a long service life with guaranteed 5,000 mating cycles despite the flexible and compact design. Various standard pin assignments are available for all sizes. Customised pin assignments can be implemented quickly and flexibly thanks to our own production and development in Germany. The online configurator helps with the correct combination and generates the appropriate type number for easy ordering: <https://configurator.yamaichi.de>

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# PANTA<sup>®</sup> SMD

The Cost-Effective Alternative to Rigid Flex



Compared to the rigid-flex PCB, SUMIDA flexible connections with PANTA<sup>®</sup> SMD offers a more cost-effective alternative.

Especially due to the advantages that the SMD solution offers several layout options and is cheaper than the rigid-flex, SUMIDA has been able to successfully replace the rigid-flex in several cases. The use of the SMD jumper offers the advantage of combining a familiar pick-and-place process with reflow soldering and the use of standard FR4 PCB material, which reduces unit costs.

Since then, this SMD solution has been widely used in automotive and industrial applications.

Product features include use in automotive, industrial and medical applications, meeting part accuracy and tolerance requirements for standard pick-and-place machines and vibration resistance.

## Features

- Use in automotive, industrial and medical technology sectors
- Meets part accuracy and tolerance requirements for standard pick-and-place machines
- Vibration resistance
- Processing according to standard soldering profiles DIN EN 61760-1/ J-STD-020
- Subsequent angling of the connected PCBs of up to 180° possible

	SMD		SMD R		
Pitch (mm)	0.5	0.93	1	1.25	1.27
Pin number max.	8 to 32	4 to 25	4 to 16	4 to 16	4 to 16
Bridging length (mm)	11.2	11.2	20 - 40	20 - 40	20 - 40

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# TEAM HONEYBEE

In CODICO Central Park – the 12,000m<sup>2</sup> recreational area opened in 2020 for all employees and their families - new residents moved in this spring. How many exactly? That's not so easy to answer! The number of honey bees adapts to the seasonal conditions and grows from 8,000 to 10,000 in winter to over 40,000 in summer, only to shrink again.

**F**our hives have started their work here and not only provide valuable products such as honey and beeswax, they also support Central Park's ecosystem.

Bees are crucial for almost all ecosystems on our planet, as they ensure the pollination of a large part of the plants and thus the richness of the food chain. This is where shared co-evolution plays a crucial role: many flowers need bees to reproduce; bees in turn need flowers to gather food. At CODICO, there is plenty for our honey bees to do; after all, at our site we have ensured that countless ornamental, vegetable and site-adapted wild plants, herbs and fruit trees serve as food sources for our honey bees.

## Cooperation with the city bees

Responsibility for the CODICO honey bees lies with beekeeper Christiane Aschauer, who oversees the CODICO bee project in cooperation with the »Stadtbienen e.V.« with a great deal of enthusiasm and know-how. She regularly checks whether our honey bees are really doing well.

*»The colonies have settled in well. I am particularly fascinated by how the four bee swarms have become sensual works of art in just a few weeks: white honeycomb, full of brood, pollen nectar and honey... with thousands of little worker bees, a few drones and a queen. Sensual because you hear, taste, smell, feel and see. At CODICO, a new flower splendour is emerging from week to week – a beautiful place to accompany the honey bees in their development and the emergence of the basis of life for the bee colonies. What fascinates me about honey bees is that they appeal to and excite all our senses, and at the same time invite us to ask questions. Questions about biology and ecology, but also about philosophy, about right and wrong, death and life, and about ourselves.«*

## What can we learn from the bees?

Our processes are designed to be as efficient and energy-saving as possible. Bees collect nectar with the least amount of energy and charge the highest yield for their flights. High productivity, efficient logistics – true masters of process optimisation.

## Why bees at CODICO?

We take responsibility for making our thoughts and actions sustainable. Honey bees enable us to experience the processes in nature up close, to gain an understanding of (complex) interrelationships, to sharpen our awareness of details and the overview, and to harvest high-quality products. Honey bees inspire, they are a »door opener« into the fascinating world of insects.

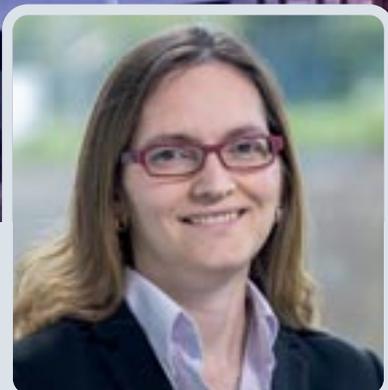
The honey bee is only one of over 600 bee species. While the honey bee has a big lobby, it is above all the many wild bee species that are highly endangered. Besides land sealing and diseases, the use of pesticides is especially problematic. We want to counteract this with our contribution. In CODICO Central Park and the adjacent green spaces, we rely on plants adapted to their location and a high level of diversity. We consciously decide against the use of pesticides and synthetic chemical fertilisers.

With our project, we support not only the »gentle« and the »wild« bees, but the entire local biodiversity and species diversity.

**D02**

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# The CODICO TEAM says hello!



## Raffaella Petronio

Dear Impulse readers, I'm pleased to introduce myself. I've been working at CODICO since 2017, based in the Treviso office. I am an inside sales representative for active components.

I was born in Trieste, where I lived till I got the university degree in »Statistics and computer Science for business«. After that, I got a specialization in »Marketing and new products development« at Fondazione Cuoia, one of the most important management schools in Italy, located near Vicenza.

I worked for several companies in different industries in the North East of Italy, especially in the Veneto region. This allowed me to be open-minded and interested in innovation, which is an ideal attitude for working in the electronics sector. Being part of CODICO is really interesting because of the international and multicultural environment.

I spend my free time with friends, going for walks, trekking, or visiting art exhibitions and museums. I also enjoy watching musicals at the theatre. Summer for me is synonymous with beaches, sun and sea. Winter is suitable for reading books and enjoying hot cups of tea.

I am really good at finding or helping to find solutions, so don't hesitate to call or write an email if you have any inquiries.

**D03**

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## Achim Stahl

I have been working at CODICO since 2016, that's already 5 years. The sheer momentum in the semiconductor market and the multitude of different tasks involved in my work make it all feel like yesterday. I have spent a great part of my professional life dealing with sounds. Whether it is analogue modems, fax modems, DSL transceivers, or audio processors, it is always about correctly detecting audible or non-audible – probably because of age – sounds and then separating them from noise. I already had contact with people from CODICO in the past, when I was working at Conexant and CODICO was our distributor. Meanwhile, Conexant found a new home at Synaptics and myself at CODICO. As a rule, I deal with several manufacturers whose products send and receive on all media – air, wire, optical fibre.

I very much enjoy project work, and the most rewarding experience is to bring an idea from development to serial production, then manage to get the certification for the communication interfaces, and finally celebrate a successful launch together with the customer. The bandwidth of technical application possibilities that our product portfolio offers makes every single day an exciting experience. Since early 2021, I have been supporting our PLC team in the business development of our electrical charging communication portfolio in North America. Accompanying these innovative and ingenious companies from Silicon Valley up close and personal is in many ways a thrilling experience.

I live with my wife Claudia in a 200 year-old house in the countryside, surrounded by a large garden with a lot of fruit trees and shrubs in the garden, which makes us almost autonomous in this respect. Since we do not possess a robot lawn mower, garden work spares me the gym. We have to share the garden harvest with the snails and the ants, though we still hope that one day useful creatures will also settle here - hope springs eternal. When the weather allows, we go out hiking. A few years ago, we discovered our ideal travel destination, the Kvarner Bay in Croatia: it offers clear water for swimming, an excellent seafood cuisine, and a large variety of good, enjoyable wines.

**D04**

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## Andrea Karolyi

After 5 years at CODICO, it's time to introduce myself. I work in Order Administration, where I am in charge of orders in Poland, Hungary, and for some key accounts. My previous workplace was a multinational group, and thus a completely different world in which people hardly have an opportunity to get to know those they work together. Being a family business, CODICO puts a great emphasis on good working relationships between colleagues and on cooperation in teams. The company takes several small steps during work life to achieve this, such as regular events, or our huge, wonderful garden, which brightens up every working day. Every three months, we get together with colleagues from all over the world, and we can discuss

After work, outdoors is my element. I look forward to every weekend, because we spend all our free time in nature, be it on a mountain bike or hiking, travelling all over the place, and I very much enjoy spending time on mountains and in forests. We go on magnificent tours, which satisfies both my passion for landscapes and my longing for extreme physical challenge. This week, I completed my annual challenge, my third Stoneman Mountainbike Tour, almost a »mission impossible« for me, and I am very happy to have managed. It is an unbelievably beautiful route, and despite the enormous physical strain – always uphill –, the breathtaking landscape kept me stunning all the time, enjoying spectacular views worthy of a picture frame all the way to the finishing line. I embark on several long tours, always following a new route, but I am not a thoroughly trained, health-aware athlete, since my main objective is to be in nature and to enjoy the landscapes.

This brings me to my next passion, which stems from the beauty I am constantly surrounded by on my tours, photography. I am also interested in the vegetation around me, which means I tend to take ten consecutive pictures of one and the same flower. In addition to that, I keep a fairly beautiful garden on our patio and our balcony, plus the little "jungle" inside the flat. Part and parcel of that jungle is my small-size female tiger, who is always there to lift my spirits and seems pretty happy to keep me company during my home office tasks. Perhaps I should also mention my affection for sweets. In my family, I am the one in charge of birthday cakes, and I very much enjoy baking delicious personalised cakes, mostly based on my own ideas.

I am sure that my attitude to my leisure time adventures also has a major impact on my work, and it also helps me find the best possible solution to the problems we may sometimes face in the company. On Mondays, I sometimes look forward to be back at the office where I can finally work in peace.

My motto is: don't mind the weather, you can do it if you really want. Should you have any questions about an open order, or need tips on beautiful hiking and biking routes, I will be happy to help.

D05

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## All the best Ragnar!

We would like to introduce our colleague of many years, Mr Ragnar Knotzer, on the occasion of his retirement.

»Ragi« – as some colleagues were allowed to call him - trained as a forwarding agent and came to CODICO from Schenker in 1996. In a customs department that was still small, he was the only male employee among a group of women, but they nurtured him thanks to his professional experience.

Back then in the Mühlgasse, customs documents still had to be written by hand or with a typewriter and the forwarding labels had to be entered individually into the system. Over time, our old-school customs specialist was assisted by assistants who gratefully accepted his Bora-Bora bonus points.

His trademark style was jacket, shirt and tie. He also wore these accessories when moving to the warehouse and during the annual warehouse inventory. We like to think back to his upside-down computer mouse with a smile. His passion for collecting business cards of various shipping salesmen was legendary. His botanical love is also reflected in his garden with 42 different maple plants. Cavallino in Italy became his favourite domicile, whether it was for two or for six with his children.

A cosy morning tea in the garden is part of his habits at any time of the year, just like a gin and tonic or Big John as a sun-downer after a busy day at customs.

We wish our »Ragi« all the best for his well-deserved retirement – we will miss him!

D06

▼ The CODICO Logistics Team



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