Embedded Highlights

Combine Technologies
Realize EMBEDDED Designs

Ready-to-use computer systems, barebones and components in perfect symbiosis with wireless connectivity, displays and storage solutions
Committed to Excellence

Consult – Know-how. Built-in.
The Technical Competence from RUTRONIK.

Worldwide and individual consulting on the spot: by competent sales staff, application engineers and product specialists.

The Product Portfolio from RUTRONIK.

Wide product range of semiconductors, passive and electromechanical components, displays & monitors, boards & systems, storage and wireless technologies for optimum coverage of your needs.

The Delivery Service from RUTRONIK.

Innovative and flexible solutions: from supply chain management to individual logistics systems.

Quality Management without Compromise.
The integrated management system (IMS) encompasses quality control, information security, environmental protection, occupational health and safety.

Combine Technologies – Realize EMBEDDED Designs

RUTRONIK EMBEDDED - the most reliable option for future-orientated purchase of embedded components from one hand.

We are well-known as distributor of embedded boards & systems, power supplies, storage components, TFT displays, passive LCDs, professional monitors, as well as wireless connectivity solutions, sensors and all needed electromechanical components to build up an intelligent embedded system for the emerging IoT market.

Embedded Boards & Systems
Whether industrial mainboards, single board computers, computer-on-modules or complete embedded systems, like panel PCs, box PCs, 19” rack systems, or industrial monitors for harsh environments, with our selected partners we cover almost any customers requirement.

Power Supply
One of the most critical part in any embedded system is the power supply, so that a reliable partner is needed, to build up a reliable system. RUTRONIK EMBEDDED is taking care of this issue with its partners. So we can provide solutions with medical approvals as well as standard industrial power supplies in the well-known standards and as open frame solutions.

More and more systems in the IoT market need to resist against power grid failures with an uninterruptable power supply.
This can be realized by a classic battery driven UPS or by Super Caps. Our specialists can guide you through your system design, starting with the power supply and ending with the intelligent platform above.

Electromechanical Components

EMBEDDED

Displays & Monitors

Flash memories become more and more important in industrial applications, even as a simple 2.5” SSD or as a flash card in different form factors. Also HDDs, RAM and ODDs for industrial and rough applications with high reliability in industrial grade quality and with a reasonable longevity, are still needed. With our partners we can provide all of the demanded solutions in a good balance between reliability and price.

Wireless

Make your application embedded by connecting it wirelessly to the Internet of Things. RUTRONIK EMBEDDED has the newest solutions for using a smartphone, WiFi access point or a mobile communication network as gateway for your device. Our understanding of the right wireless solution covers hardware, drivers or transmission protocol, application profiles, security aspects, certifications, long-term considerations as well as political aspects regarding standards, compatibility and consortia.
The performance of embedded systems is growing disproportionately; one of the reasons for this is the improvement of intelligent sensors and actuators. There are more and more autonomous systems which record and process data, responding very specifically to it. When the systems are networked together wirelessly or wired via IP protocol this creates the Internet of Things. Machines, systems, appliances and small smart everyday objects will become part of the so-called Cyber Physical Systems (CPS) in the future.

Individual System Solutions

Combine Technologies

The performance of embedded systems is growing disproportionately; one of the reasons for this is the improvement of intelligent sensors and actuators. There are more and more autonomous systems which record and process data, responding very specifically to it. When the systems are networked together wirelessly or wired via IP protocol this creates the Internet of Things. Machines, systems, appliances and small smart everyday objects will become part of the so-called Cyber Physical Systems (CPS) in the future.

All systems are characterized by certain common characteristics: Programming capability, storage capacity, functional user interfaces and communication links. Embedded systems require integrated vision when selecting the components because there are complex dependencies between the real physical and the virtual digital world. RUTRONIK EMBEDDED complies stringently with this integrated analysis, enabling it to develop always the right solution.

- **Boards & Systems**
  - based on ever faster, more powerful, smaller and energy-saving components. Suitable and standardized power supplies, sensors and electromechanical components which guarantee functional reliability even under extreme operating conditions

- **Storage**
  - solutions in compact sizes with any number of read/write cycles with the highest storage density

- **Displays**
  - and touch systems, which provide the user a perfect visualization and operation of the real world and facilitate intuitive operation and the interaction of extremely complex systems

- **Wireless**
  - technologies facilitate the global linking of processes and databases in all conventional transmission standards and in a matter of seconds

Cyber Physical Systems (CPS) comprise the networking of embedded systems via wired or wireless communications networks.
RUTRONIK EMBEDDED offers a huge portfolio of mainboards, specially designed for industrial and semi-industrial applications. The selection ranges from industrial mainboards, single board computers, computer-on-modules (COM), PCI-104, blade computers, PICMG and backplanes, IPC and servers to box and panel PCs and HMI. These include ARM-based solutions as well as boards with the latest x86 processors.
Industrial Motherboards by Kontron

Kontron offers a comprehensive portfolio of high quality, longevity and competitive motherboards from small pico-ITX up to full size ATX form factor. They support latest processors and chipset platforms and provide a proven set of features to fulfill the demands of various applications of different vertical markets like Industrial Automation, POI, POS, Digital Signage, Medical, Casino Gaming, Video Surveillance or Transportation. The Kontron motherboards offer an outstanding quality “Made in Germany”. In addition, a corresponding portfolio on chassis kit solutions (SMARTCASE™) is available in different versions and designed for different motherboards. The thin and smart chassis allows the usage in horizontal and vertical position, partly even in enhanced temperature related environments.

Kontron Motherboards powered by the latest Intel® and AMD Technology Platforms

R&D
- Design know-how based on more than 30 years of experience with motherboard design
- Comprehensive validation tests, extensive functional tests and certifications

Quality
- 100% 3D AOI (automated optical inspection), ICT (in circuit test), FFT (final function test)
- High degree of automation (approx. 96%)

Reliability
- Optimized Motherboard designs (less components)
- less heat
- less power consumption
- less risks
- 1st supplier qualified material only

Innovation
- Optimized Feature and design to reduce power consumption
- Simplify product selection with new features

Technical Support
- 1st level support: Distribution partners
- 2nd level support: Direct technical support from Kontron
- Competitive price models

SMARTCASE™ Kit Solution

Flexible. Versatile. Long Term Availability.

The chassis kit solutions are available in different versions and designed for different motherboards. The thin and smart chassis allows the usage in horizontal and vertical position, partly even in enhanced temperature related environments.

SMARTCASE™ Series

- S511 + MiniSTX + AMD Ryzen™ Embedded R2000 Technology + 0.87 Liter
- S520 + MiniSTX + 9th Gen Intel® Core™ i technology (LGA1151) + 0.87 Liter
- S711 + MiniITX + AMD Ryzen™ Embedded R2000 Technology + 2.48 Liter
- S720 + MiniITX + 9th Gen Intel® Core™ i technology (LGA1151) + 2.48 Liter
Ideal Technological Partner for Cutting-Edge Solutions

SECO is an Italian industrial group with a strong international presence that operates in the sector of high technology in the miniaturization of computers and the Internet of Things (IoT). SECO designs and produces in-house embedded systems and IoT solutions: from the single microcomputer to integrated and "ready-to-use" systems.

The company offers its customers a complete range of products and services with specific expertise in numerous industrial sectors.

### N-Series Intel Pentium / Celeron and x5-Series Atom SoCs

<table>
<thead>
<tr>
<th>Processor</th>
<th>Intel</th>
<th>Intel</th>
<th>Intel</th>
<th>Intel</th>
<th>Intel</th>
</tr>
</thead>
<tbody>
<tr>
<td># of Cores</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td># of Threads</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Processor Base Frequency</td>
<td>1.30 GHz</td>
<td>1.30 GHz</td>
<td>1.60 GHz</td>
<td>1.60 GHz</td>
<td>2.00 GHz</td>
</tr>
<tr>
<td>Burst Frequency</td>
<td>2.40 GHz</td>
<td>2.55 GHz</td>
<td>1.80 GHz</td>
<td>1.80 GHz</td>
<td>2.40 GHz</td>
</tr>
<tr>
<td>Cache</td>
<td>2 MB L2</td>
<td>2 MB L2</td>
<td>2 MB L2</td>
<td>2 MB L2</td>
<td>2 MB L2</td>
</tr>
<tr>
<td>TDP</td>
<td>6 W</td>
<td>6 W</td>
<td>8.5 W</td>
<td>9.5 W</td>
<td>12 W</td>
</tr>
<tr>
<td>Scenario Design Power (SCP)</td>
<td>4 W</td>
<td>4 W</td>
<td>4 W</td>
<td>4 W</td>
<td>4 W</td>
</tr>
</tbody>
</table>

#### NAOS (formerly Q7-B03)
Qseven® Rel. 2.1 with the Intel® Atom® E39xx family, Intel® Celeron® N3350 and Intel® Pentium® N4200 SoCs

#### JAGER (formerly SM-B69)
SMARC with the Intel® Atom® E39xx family, Intel® Pentium® N3350 family, and Intel® Pentium® N4200 SoCs

#### MIRANDA (formerly COMe-C24-C76)
COM Express™ 3.0 Compact Type 6 Module with the Intel® Atom® X Series, Intel® Celeron® J/N and Intel® Pentium® N Series

#### Ryzen Series

**CHARON (formerly COMe-B75-CT6)**
COM Express™ Rel.3.0 Basic Type 7 module with the AMD Ryzen™ Embedded V1000 processors

**THEBE (formerly COMe-C42-BF7)**
COM Express™ 3.0 Basic Type 7 module with the AMD EPYC™ Embedded 3000 Series of SoCs

#### Epyc Series

**Ryzen Series**
Embedded Edge Computer Solutions by ASUS

Industrial Motherboards and Single Board Computers
ASUS offers a wide range of long-lifecycle industrial motherboards and single board computer in various form factors to serve different applications from customers. ASUS industrial motherboards and single board computer are manufactured with extremely durable, industrial-grade components to ensure 24/7 reliable operation in industrial settings and harsh environments like extreme temperatures, power fluctuations and high humidity. Also, ASUS provides the longevity supply guarantee, optimized service and completed reference documents for our customers. ASUS not only provides international industry standard form factor models, but also offers customized hardware and software solutions for specific applications.

Wide Range Portfolio

<table>
<thead>
<tr>
<th>Micro ATX</th>
<th>Mini ITX</th>
<th>3.5” SBC</th>
<th>Pico ITX</th>
<th>Nano SBC</th>
</tr>
</thead>
<tbody>
<tr>
<td>244 x 244 mm</td>
<td>170 x 170 mm</td>
<td>146 x 105 mm</td>
<td>100 x 72 mm</td>
<td>86 x 54 mm</td>
</tr>
</tbody>
</table>

ASUS Edge Computer Proposition
At the very frontier of AIoT and Cloud computing, edge computer is in charge of processing, filtering, analyzing and acting on data received in real-time, which not only reduces the traffic of data also provides lower latency and the cost of data transmission. ASUS IoT Edge computer is built for 24/7 stability and reliability, combined with our world-class after-sales service and guaranteed long-term availability - your investment for the duration of the product lifecycle is maximized.

PE200U
Intel® Core™ i7/i5/i3 Processor, Intelligent Edge Computer with mini PCIe slot, DDR4 2400 MHz, DP, HDMI, Dual LAN, Multiple COM, 12-24 V DC

PE200S
Intel® Atom™ X Series Processor, Intelligent Edge Computer with mini PCIe slot, DDR3L 1866 MHz, DP, HDMI, Dual LAN, Multiple COM, 12-24 V DC

ASUS Server and Workstations

Why ASUS for Server Business?
Accelerator Server
For AI and visual computing, the ESC series accelerator servers deliver extreme performance and stability with patterned electronic designs and high availability (HA) thermal solutions.

Rack/Tower Server
ASUS offers a comprehensive rack/tower server product line featuring high computing density, high expandability, and high manageability, ideal for multi-workload.

Benefits
• Focused and unique flexibility + customization
• 5yr longevity supply
• NL hub operation fulfill demand 80+% in 1 week
• Warranty service
• 3 year advanced replacement service
• A local FAE team provide technical support in zero time difference

ASUS Server

![ASUS Server Image](image_url)

Why ASUS for Server Business?
Accelerator Server
For AI and visual computing, the ESC series accelerator servers deliver extreme performance and stability with patterned electronic designs and high availability (HA) thermal solutions.

Rack/Tower Server
ASUS offers a comprehensive rack/tower server product line featuring high computing density, high expandability, and high manageability, ideal for multi-workload.

Benefits
• Focused and unique flexibility + customization
• 5yr longevity supply
• NL hub operation fulfill demand 80+% in 1 week
• Warranty service
• 3 year advanced replacement service
• A local FAE team provide technical support in zero time difference
Embedded Boards & Systems by DFI

1.8” SBC
The 1.8” SBC board (84 mm x 55 mm) is a motherboard in an ultra-small and light-weight Pi size, not only has the specification complying with industrial requirements, but also offers the product life cycle up to 15 years to ensure device operation and maintenance with seamless drivers, software, and BIOS update.

3.5” SBC
DFI’s 3.5” embedded SBC board (146 x 102 mm) is featured with rich I/O, and supports various internet connections. Extended operating temperature and wide input voltage range are industrial features that can meet most of industrial grade applications.

2.5” Pico-ITX
DFIs Pico-ITX SBC board (100 x 72 mm) supports low power consumption and fanless design with rich I/O connectivity in order to target space-limited embedded applications like site management and IoT gateway.

Module Panel PC
Adaptive Display Platform (ADP) Technology is an advanced configure solution for Panel PC. It is a flexible modular system which provides easy maintenance, installation and configuration for customers.

Fanless Embedded System
DFI’s compact embedded systems, including fanless embedded computer and fanless embedded box pc powered by state-of-the-art processors, deliver low power consumption in an ultra-small size as well as efficient fanless thermal solutions. The systems are also designed with IP30 rating, wide voltage input, and extended operating temperature. Making them ideal candidates for industrial applications in harsh environments.

Mini-ITX
DFI’s embedded Mini-ITX motherboard measuring to only 170 mm x 170 mm is designed with a variety of I/O connectors for low power solution with passive cooling and DC input features and for desktop solution with high performance.

This compact and highly integrated board delivers rich I/O and expansion slots; which makes it an ideal solution for KIOSK, gaming, and digital signage, etc.

ATX
DFI’s ATX (measuring 305 mm x 244 mm) embedded motherboards feature a high computing capability, rich I/O connectivity, high integration, and great expandability for graphics cards, motion control cards, and memory. The robust processors and add-on powerful GPU make it an ideal solution for industrial automation and medical imaging, like machine vision, defect inspection, MRI, and CT imaging that require reliability & add-on-card expandability.

www.rutronik.com/
Accelerate Application Development with Dedicated Design-In Services

Computer On Modules

To help customers accelerate the development of their core competencies, computer-on-module (COM) systems can be utilized to reduce the time and effort involved in designing new carrier boards.

Advantech's COM series includes the COM-Express series, COM-HPC, and Qseven, all of which offer additional design-in services that provide small form factor support while also supporting the latest Intel and AMD CPUs.

Industrial Grade
Design
EMI/ESD
Optimized
Service
Wireless
Connectivity
Small
Form Factor
I/O Extension
Firmware
Customization
Fanless
Solution
Wide Temp
Embedded
Software
IoT Cloud
Capability
Effective Integration Services

Reliable & Rugged
Compact & Flexible

Enabling Next-Generation Industrial Applications
Embedded Single Board Computers

Advantech offers compact industrial-grade embedded single-board computers (SBCs) with rugged design, high flexibility, and easy expansion capabilities. Our range of product offerings varies from the 2.5" Pico-ITX and 3.5" SBC, to PC/104 and 5.25" EBX.

Moreover, our innovative multi-I/O expansion design, which features multiple integrated I/Os and flexible design can facilitate system development, maximize resource efficiency, and assist integrators in providing optimized solutions that are more cost-effective.

Worldwide Leader in Embedded Design and Services

Planning Design Validation Integration Production End of Life

Modular System for Quick Equipment Integration

Fanless Embedded Computers

Advantech provides full customization services including a selection of offerings for I/O modules, OS software, and peripherals. You can choose from a flexible range of modular I/O options without concern for additional customization time, NRE, or costs.

With our modular I/O design, you can rapidly implement your applications with maximal benefits.

Diverse Solution Packages

Microsoft Azure
Arm Mbed
AWS...

Embedded BIOS, OS, API
Intelligent Self-management
Edge Intelligence and Sensing Integration
Application Solutions
PaaS & Cloud Services

Machine Automation
Factory Automation
Diverse Solution Packages

Microsoft Azure
Arm Mbed
AWS...

Embedded BIOS, OS, API
Intelligent Self-management
Edge Intelligence and Sensing Integration
Application Solutions
PaaS & Cloud Services
Embedded Boards with F&S

Board Strategy
If during development phase or a later redesign the requirement for higher processor power or more interfaces comes up, this can lead to serious problems. But this is not valid for boards by F&S Elektronik Systeme. Every board family by F&S Elektronik Systeme offers pin and software compatible boards. More boards are introduced annually and are added to the board family or replace faced out boards (not before 10 years). With this board strategy by F&S Elektronik, the customer has to take no risks. Depending on the customer’s requirements, one of the board families can be employed, every board family meets different conditions.

F&S Project Guarantee
F&S Elektronik Systeme offers a project guarantee for all its customers. We will solve together all upcoming problems during development (hardware as well as software) and fulfill your wishes. Aim is to complete the customer’s project successfully and to continue supporting after the start of the series production and throughout the lifetime of the project. Another important feature of the project guarantee is the long-term availability of at least 10 years. Our project guarantee paved the way for F&S boards in numerous applications of major customers all over Europe.

<table>
<thead>
<tr>
<th>Board Family</th>
<th>armStone™</th>
<th>efus™</th>
<th>PiccCore™</th>
<th>QB80x</th>
<th>PiccCOM™</th>
<th>PiccMOD</th>
<th>OSM</th>
<th>NeuDCU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Board Type</td>
<td>SBC</td>
<td>COM</td>
<td>COM</td>
<td>COM</td>
<td>COM</td>
<td>COM</td>
<td>COM</td>
<td>S9M</td>
</tr>
<tr>
<td>Boardboard Complexity</td>
<td>-</td>
<td>easy</td>
<td>easy</td>
<td>easy</td>
<td>easy</td>
<td>-</td>
<td>easy</td>
<td>very easy</td>
</tr>
<tr>
<td>Windows</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Linux</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Standard</td>
<td>FMU/F2</td>
<td>FMU/F2</td>
<td>Open source</td>
<td>FMU/F2</td>
<td>FMU/F2</td>
<td>FMU/F2</td>
<td>OSM</td>
<td>Open Standard Module</td>
</tr>
<tr>
<td>LCD Interface</td>
<td>RGB</td>
<td>RGB</td>
<td>RGB, LVDS, MIPI-CSI</td>
<td>LVDS</td>
<td>RGB</td>
<td>RGB, LVDS</td>
<td>TFT</td>
<td>MIPI-F2D1, RGB</td>
</tr>
<tr>
<td>Screen</td>
<td>DVI</td>
<td>DVI</td>
<td>-</td>
<td>DVI</td>
<td>DVI</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Color Depth Up To bits</td>
<td>24bits</td>
<td>24bits</td>
<td>24bits</td>
<td>24bits</td>
<td>1080p60</td>
<td>1080p60</td>
<td>1080p60</td>
<td>-</td>
</tr>
<tr>
<td>Resolution Up To px</td>
<td>FullHD</td>
<td>FullHD</td>
<td>1080p60</td>
<td>FullHD</td>
<td>1080p60</td>
<td>HDMI</td>
<td>HDMI</td>
<td>FullHD</td>
</tr>
<tr>
<td>Display BUS</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Camera</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Ethernet</td>
<td>2x</td>
<td>2x</td>
<td>2x</td>
<td>2x</td>
<td>2x</td>
<td>1x</td>
<td>1x</td>
<td>2x</td>
</tr>
<tr>
<td>Power Supply</td>
<td>5V</td>
<td>5V</td>
<td>3.3V</td>
<td>3.3V</td>
<td>5V</td>
<td>5V</td>
<td>5V</td>
<td>5V</td>
</tr>
<tr>
<td>Size (mm)</td>
<td>100x72</td>
<td>47x62.1</td>
<td>35x48</td>
<td>70x70</td>
<td>40x50</td>
<td>80x50</td>
<td>30x30</td>
<td>160x80</td>
</tr>
<tr>
<td>Plug Connector</td>
<td>68pin</td>
<td>M0N2-2 230pin</td>
<td>2x 80pin</td>
<td>M0N2-230pin</td>
<td>80pin</td>
<td>140pin</td>
<td>-</td>
<td>142pin</td>
</tr>
</tbody>
</table>

Intel® 1/2.5/10/25/40/100 GbE Ethernet Adapters

The Intel® Ethernet 800 Series with flexible Ethernet port configuration supports different link modes and speeds, includes powerful capabilities to accelerate network performance, and delivers workload-optimized performance and consistent application performance for latency-sensitive workloads. Move data faster with Intel® Ethernet 800 Series with throughput up to 100Gb/s.

Features
- Supports multiple port speeds with a single architecture: 100/50/25/10/1GbE
- Application Device Queues (ADQ)
- Dynamic Device Personalization (DDP)
- Enhanced Data Plane Development Kit (DPDK)
- iWARP and RoCEv2 Remote Direct Memory Access (RDMA)
- Intel® Ethernet Adaptive Virtual Function
- Enhanced server virtualizations: 256 VFs, 768 VSIs
- Optimized Advanced Transmission Scheduler
- Extensive Network protocol support
- IEEE1588/Precision Time Protocol

Intel® Ethernet products are customers’ choice for extensive compatibility, performance assurance, broad product selection, and world-wide support.

Overview Intel® Ethernet 800 Series supports up to 100Gb/s throughput for a variety of workloads.

Enterprise
- Broad physical interfaces support, thorough test and validation with ecosystem devices for compatibility
- Extensive Microsoft solution support

Communications
- Flexible Ethernet Port Configuration with link modes supporting different fan-in or fan-out connections
- DDP, with fully programmable pipeline, can add or modify protocols on-demand allowing for fast-paced innovations
- Enhanced DPDK for Network Functions Virtualization acceleration, advanced packet forwarding, and highly efficient packet processing
- IEEE1588 Precision Time Protocol (v1 and v2) with per-packet time stamping

Cloud
- Up to 100Gb/s throughput for diverse workloads in modern data centers
- Support both iWARP and RoCEv2 RDMA, selectable via software per port for low-latency, high-throughput workloads
- Application Device Queues (ADQ) to increase application predictability, reduce application latency and improve application throughput.
Intel® NUC Kits, Boards & Mini PCs
High-End Computing, Low-Profile Style

Ultra Small Form Factor | Space Saving | Versatile Usage | Performance | Stunning Visuals | Low Power Usage

Pint-sized Power
The Intel® NUC is a mini PC with the power of a desktop, packing features for entertainment, gaming, and productivity in a 4x4 form factor.

Energy Optimized, Media Savvy
With Intel® NUC, you get an immersive media experience and responsive interaction while consuming a small amount of power relative to a full-sized PC.

Flexibility for Future Growth
Due to its portable size and ease of installation, the Intel® NUC makes it easy to add devices and scale up rapidly based on changing productivity needs.

Intel® NUC Elements
Intel® NUC Elements High-Performance, Modular Elements for a Range of Verticals

Start with an Intel NUC Compute Element with the exact processor you need and plug it into an Intel NUC Board Element, your own board, or another third-party board, then embed it into your solution to create unique solutions for your customers’ needs.

From embedded deployments to rugged systems in unique environments, to full systems in a business or vertical environment, the Intel NUC Elements let you deliver custom solutions with minimal R&D time.
Embedded Systems & Industrial PCs

Founded 1989 in southern Germany, exone has established to a leading german manufacturer for PC Systems. With three brands, exone covers professional IT-Systems for the classical business field, industrial PCs, tablets, workstations and servers. Their fanless Box-PCs, Panels and Gateways are made for harsh environments and long time availability. With now over 30 years of experience, an own R&D department and two production lines, exone is proud to offer quality computer Systems made in germany.

Industrial Systems with Long Time Availability

**Calmo Tiny - Small, Smaller, Tiny**
The demand for small computer systems is constantly increasing in industrial environments. However, the performance of these systems must not be limited by the compactness of the housing dimensions. With the Calmo TINY series you can rely on the smallest PCs, with the latest and most powerful Intel CPU technology and 100% industrial quality. Designed for 24x7 continuous operation and stability in the temperature range of 0 - 55 °C, we offer additional functions such as TPM, GPIO, Watch Dog and a wide range input of 8 – 24 volts in addition to these two core features. The Calmo TINY - a mini industrial system at the highest level!

**Highlights**
- Latest Intel® Gemini Lake processor technology
- Two monitor operation with UDH possible
- Optional serial interface
- Optional USB 3.1 type C (fuse-proof)
- Wide range input from 8 to 24 V
- Suitable for digital signage

**Calmo E**
Calmo E can do both desktop and automation tasks. With up to 32 GB RAM and NVMe SSD it is providing enough power for nearly every usecase in business, production environment and even in digital signage. The simple design of the Calmo E is fanless and therefore noiseless, the integrated VESA-Mount makes it easier to fix the ipc to machines, displays or shelves. Calmo E is reduced to the essential interfaces, this is shown also by the price.

**Highlights**
- Only focused interfaces
- German case design
- Intel Core CPUs
- Passive cooling

**Calmo XS - x-Trasmall Box-IPC with Professional Interfaces**
Control-units, digital-signage-player and hardware-firewalls are getting smaller but smarter. Besides that, they are often installed in production environments or badly reachable. Our new Calmo XS gives you all features of our Calmo TINY, but you get something on top! It is IP40 dustproof and gives you room for a 2.5" SSD, two serial ports, 8 - 24 V direct input and WiFi 6. Use the Power of its embedded Celeron and Pentium CPUs and benefit from their energy-saving architecture. Bring your display-solution, your dusty workspace and your machine-control-unit to the next level – with our new Calmo XS.

**Highlights**
- WiFi 6
- 1x RS485/422/232, 1x serial 4-wire
- Phoenixport or DC-Jack usable
- 8 to 24 VDC-in
- 2.5" SSD
- USB 3.1 Type C

**Pokini F2**
Small, Powerful, Customizable
The Pokini F2 is a small and fanless PC with great performance, various interfaces and excellent graphics. The embedded Intel CPU has enough power for handling digital-signage and office apps as well as machine control programs. The full aluminum case is fanless and able to cool the unit. Trust in our experience, get 5 years of full warranty for free. Only rely on quality PCs ready for 24/7 use, only rely on the Pokini F2.

**Highlights**
- Fanless case
- Powerful and flexible
- Intel embedded CPU
- Available through 2028

**PanelPC**
Industrial Hardware - Made in Germany
On the way to unstoppable digitization, traditional production sites need high-performance and robust computers. Clear and brilliant images combined with intuitive operation using the latest touch technology, help to increase the degree of effectiveness in process flows. The classic operation of the computing unit with mouse, keyboard and a separate display is replaced and combined by the industrial panel-pc at the same time. A compact and innovative housing design for integration in standard production control cabinets or for mounting on corresponding mounting systems is assembled in our german factory. Our panel-pc series fit today's and tomorrow's requirements, we only offer exactly fitting solutions.

**Highlights**
- State-of-the-art capacitive P-CAP touch technology (10-point touch)
- Operation with latex, work and ESD gloves possible
- Fanless and attractive housing design
- Variety of interfaces through expansion options
- Concept, development and production in Germany
- Customizable, celeron up to Intel embedded CPU
- Available through 2028
Depth Cameras
Intel® RealSense™ D400 Series

Designed for easy setup and portability, Intel® RealSense™ D400 series cameras feature high depth resolution and include active infrared (IR) stereo with standard or wide field of view. For high-precision applications, choose the D415 with rolling shutter. If your application is fast-moving or outdoors, select either the D435 or D435i camera which feature a global shutter. For longer range applications, the D455 features wide field of view and global shutter on the depth and RGB sensors.

Specifications

<table>
<thead>
<tr>
<th>Type</th>
<th>D415</th>
<th>D435 / D435i / D435f</th>
<th>D455 / D457</th>
<th>D405</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth Technology</td>
<td>Active IR Stereo</td>
<td>Active IR Stereo</td>
<td>Active IR Stereo</td>
<td>Global Shutter</td>
</tr>
<tr>
<td>Technology</td>
<td>Rolling Shutter</td>
<td>Global Shutter</td>
<td>Global Shutter</td>
<td>Global Shutter</td>
</tr>
<tr>
<td>Depth FOV (H x V)</td>
<td>85° x 45°</td>
<td>87° x 58°</td>
<td>87° x 58°</td>
<td>87° x 58°</td>
</tr>
<tr>
<td>Depth Resolution</td>
<td>up to 1280x720</td>
<td>up to 1280x720</td>
<td>up to 1280x720</td>
<td>up to 1280x720</td>
</tr>
<tr>
<td>Depth Accuracy</td>
<td>±2% at 2 m</td>
<td>±2% at 2 m</td>
<td>±2% at 4 m</td>
<td>±2% at 0.5 m</td>
</tr>
<tr>
<td>Depth Frame Rate</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>RGB Sensor Technology</td>
<td>Rolling Shutter</td>
<td>Rolling Shutter</td>
<td>Global Shutter</td>
<td>Global Shutter</td>
</tr>
<tr>
<td>RGB Sensor FOV</td>
<td>90° x 65°</td>
<td>90° x 65°</td>
<td>90° x 65°</td>
<td>90° x 65°</td>
</tr>
<tr>
<td>Resolution (L x D x H)</td>
<td>90 mm × 25 mm × 25 mm</td>
<td>124 mm × 26 mm × 29 mm</td>
<td>87° x 58°</td>
<td>87° x 58°</td>
</tr>
</tbody>
</table>

Depth Modules & Processors
Intel® RealSense™ D400 Series

For the integration of Intel® RealSense™ technology into higher volume products, depth modules can offer the best compromise between price and flexibility. Multiple different configurations are offered to better suit your needs and product requirements. Designed for easy system integration, all modules feature an imaging sub-system with stereo sensors. When paired with an Intel® RealSense™ Vision Processor, depth data can be output via USB to any platform.

Specifications

<table>
<thead>
<tr>
<th>Type</th>
<th>D415</th>
<th>D430</th>
<th>D450</th>
<th>D401</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use Environment</td>
<td>Indoor / Outdoor</td>
<td>Indoor / Outdoor</td>
<td>Indoor / Outdoor</td>
<td>Indoor / Outdoor</td>
</tr>
<tr>
<td>Image Sensor Technology</td>
<td>Global Shutter</td>
<td>Global Shutter</td>
<td>Global Shutter</td>
<td>Global Shutter</td>
</tr>
<tr>
<td>Depth FOV (H x V)</td>
<td>85° x 45°</td>
<td>85° x 58°</td>
<td>87° x 58°</td>
<td>84° x 58°</td>
</tr>
<tr>
<td>Depth Resolution</td>
<td>1280x720</td>
<td>1280x720</td>
<td>1280x720</td>
<td>1280x720</td>
</tr>
<tr>
<td>Depth Frame Rate</td>
<td>Up to 90 fps</td>
<td>Up to 90 fps</td>
<td>Up to 90 fps</td>
<td>Up to 90 fps</td>
</tr>
<tr>
<td>RGB Sensor Technology</td>
<td>Rolling Shutter</td>
<td>Global Shutter</td>
<td>Global Shutter</td>
<td>Global Shutter</td>
</tr>
<tr>
<td>Interface</td>
<td>USB 3.1 Gen 1 / GMSL/FAKRA</td>
<td>USB 3.1 Gen 1 / GMSL/FAKRA</td>
<td>USB 3.1 Gen 1 / GMSL/FAKRA</td>
<td>USB 3.1 Gen 1 / GMSL/FAKRA</td>
</tr>
<tr>
<td>Dimensions (L x D x H)</td>
<td>90 mm x 20 mm x 23 mm</td>
<td>90 mm x 25 mm x 25 mm</td>
<td>124 mm x 26 mm x 29 mm</td>
<td>42 mm x 42 mm x 23 mm</td>
</tr>
</tbody>
</table>

Ordering Information

- **Intel® RealSense™ Depth Modules**
  - **D415** (Bulk): 82635ASRCDVKHV
  - **D435** (Bulk): 82635AWGDVKPRQ
  - **D455** (Bulk): 82635DSITR50P

- **Intel® RealSense™ Vision Processor D4 Card**
  - **D430** (Bulk): 82635DSD405

- **Intel® RealSense™ Vision Processor D4 Board V3**
  - **D450** (Bulk): 82635DSD450

- **Intel® RealSense™ Vision Processor D401** (Bulk): 82635DSD450

Recommended Accessories

- **Intel® RealSense SDK 2.0**
  - Intel® OpenVINO™ integration
  - Fast and easy data integration tool
  - Open Source cross platform library


Intel® RealSense Technology

Intel® RealSense Technology is a cross platform library that uses Intel® RealSense™ Depth Modules & Processors to deliver a comprehensive solution for computer vision and 3D perception. This technology is supported on Windows, Linux, and macOS, and can be programmed in Python, C/C++, and C#. It is compatible with various frameworks and wrappers such as ROS, OpenNI, PCL, and UnrealEngine4.

Accessories

- **OpenCV**
- **MATLAB**
- **Node.js**
- **LabVIEW**
- **Unity**

Contact

www.rutronik.com/EMBEDDED
Artificial Intelligence Vision Accelerator Cards

Vision hardware is popular. Without difficulty it provides a wide range of information which can be extracted. What appears simple on the one hand can be difficult to manage on the other hand when it comes to requirements like:

- A minimum of processing time and power consumption when thinking of edge applications
- Possibility to deal with huge amounts of data and scale with different workloads
- Maximum precision in image recognition is like to find a needle in the haystack

All cards are based on Intel Movidius Myriad X, Intel Arria FPGA and Google Coral Edge.

Cards are designed to run pretrained models (inference).

**Type** | Mustang-M2AE-MX4 | Mustang-M2BM-MX2 | Mustang-MPCIe-MX2 | Mustang-V100-MMX4 | Mustang-V100-MRX8 | Mustang-F100 | MUSTANG-T100
---|---|---|---|---|---|---|---
**Chipset** | 1x Intel® Myriad™ X | 2x Intel® Myriad™ X | 2x Intel® Myriad™ X | 4x Intel® Myriad™ X | 8x Intel® Myriad™ X | Intel® Arria™ 10 | 5x Google® Coral
**Formfactor** | M.2 2230 (A+E Key) | M.2 2230 (A+E Key) | miniPCIe | miniPCIe | miniPCIe | PCIe 2.0 x8 | PCIe 2.0 x8
**Dimensions** | 22 x 30 mm | 22 x 30 mm | 30 x 51 mm | 113 x 56 x 23 mm | 175 x 56 x 24 mm | 170 x 62 x 44 mm | 186 x 64 x 18 mm
**Operating Temp.** | -20 to +60 °C | -20 to +60 °C | -20 to +60 °C | -20 to +60 °C | -20 to +60 °C | -20 to +60 °C | -20 to +60 °C
**Power Consumption** | ~7.5 W | ~7.5 W | ~15 W | ~25 W | ~30 W | ~40 W | ~15 W

**Type** | VEGA-320 | VEGA-330 | VEGA-340-04A1 | VEGA-340-06A1
---|---|---|---|---
**Chipset** | 1x Intel® Myriad™ X | 2x Intel® Myriad™ X | 4x Intel® Myriad™ X | 8x Intel® Myriad™ X
**Formfactor** | M.2 2230 (A+E Key) | miniPCIe 2.0 x1 | miniPCIe 2.0 x1 | miniPCIe 2.0 x1
**Dimensions** | 22 x 30 mm | 30 x 51 mm | 171 x 69 mm | 171 x 69 mm
**Operating Temp.** | 0 to +55 °C | 0 to +55 °C | 0 to +55 °C | 0 to +55 °C
**Power Consumption** | ~3.8 W | ~7.6 W | ~8.7 W | ~9.6 W
Ixxat INpact
Multi-Protocol Technology

Ixxat INpact includes the Anybus CompactCom technology with the Anybus NP40 network processor – used within millions of industrial devices globally. The FPGA-based Anybus NP40 network processor provides all functions required to handle the communication between the different Industrial Ethernet and fieldbus networks and the PC-based application. The powerful multi-network approach of the NP40-based Ixxat INpact enables easy connection of PC-based or embedded slave applications to EtherNet/IP, EtherCAT, Powerlink, Modbus TCP, PROFINET IRT, PROFINET IRT Fiber Optic and PROFIBUS. Anybus NP40 provides high performance for realtime applications, making Ixxat INpact the ideal choice for demanding industrial applications.

Supported Protocols and Formats

<table>
<thead>
<tr>
<th>Protocol / Interface Format</th>
<th>EtherNet/IP</th>
<th>EtherCAT</th>
<th>Powerlink</th>
<th>Modbus</th>
<th>Profinet IRT</th>
<th>Profinet IRT Fiber Optic</th>
<th>Profinbus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface name</td>
<td>INpact EIP Slave</td>
<td>INpact ECT Slave</td>
<td>INpact EPL Slave</td>
<td>INpact EIT Slave</td>
<td>INpact PIR Slave</td>
<td>INpact PROFO Slave</td>
<td>INpact DPV1 Slave</td>
</tr>
<tr>
<td>PCIe (standard slot-brackets)</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
</tr>
<tr>
<td>PCIe (low-profile slot-brackets)</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
</tr>
<tr>
<td>PCIe Mini</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
</tr>
<tr>
<td>M.2</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
</tr>
</tbody>
</table>

Uniform Driver Interface for all INpact Cards

Industrial PC

Common VCI Programming Interface

KSwitch Series Portfolio Overview

Kontron has launched its new KSwitch portfolio for the Industrial Automation market, which provides a lot of options to enable wired Ethernet connectivity at the Edge. The Industrial Ethernet Switches of the KSwitch portfolio are suitable for Fast Ethernet, Gigabit Ethernet and in the future also 10 Gigabit networks. The new single-chip design offers more reliability and cost-efficiency in smaller mechanical dimensions, combined with a performance increase and a reduction of the power consumption, which pays back over the product's lifecycle. Recently, a new family of Industrial Ethernet Switches enabled for Time Sensitive Networking (TSN) has been added to the portfolio: the KSwitch D10 MMT Series.

Kontron INpact includes the Anybus CompactCom technology with the Anybus NP40 network processor – used within millions of industrial devices globally. The FPGA-based Anybus NP40 network processor provides all functions required to handle the communication between the different Industrial Ethernet and fieldbus networks and the PC-based application. The powerful multi-network approach of the NP40-based Kontron INpact enables easy connection of PC-based or embedded slave applications to EtherNet/IP, EtherCAT, Powerlink, Modbus TCP, PROFINET IRT, PROFINET IRT Fiber Optic and PROFIBUS. Anybus NP40 provides high performance for realtime applications, making Kontron INpact the ideal choice for demanding industrial applications.

Supported Protocols and Formats

<table>
<thead>
<tr>
<th>Protocol / Interface Format</th>
<th>EtherNet/IP</th>
<th>EtherCAT</th>
<th>Powerlink</th>
<th>Modbus</th>
<th>Profinet IRT</th>
<th>Profinet IRT Fiber Optic</th>
<th>Profinbus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface name</td>
<td>INpact EIP Slave</td>
<td>INpact ECT Slave</td>
<td>INpact EPL Slave</td>
<td>INpact EIT Slave</td>
<td>INpact PIR Slave</td>
<td>INpact PROFO Slave</td>
<td>INpact DPV1 Slave</td>
</tr>
<tr>
<td>PCIe (standard slot-brackets)</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
</tr>
<tr>
<td>PCIe (low-profile slot-brackets)</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
</tr>
<tr>
<td>PCIe Mini</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
</tr>
<tr>
<td>M.2</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
</tr>
</tbody>
</table>
Intel® Processors for Every Usage

All embedded products based on Intel’s 14nm technology are available for 15 years from launch, helping to minimize engineering, maintenance and support costs.

Intel® Atom® Processors

The Intel® Atom® x5 and x7 processors offer 2 to 4 cores with a clockrate of up to 1.6 GHz. The development of this CPU was focused on power saving and an extended temperature range. This makes this an ideal processor for a wide range of industrial use cases. Thanks to the BGA socket it can be used in extreme working conditions.

Extended Temperature Range
The Intel® Atom® x5 and x7 processors support the industrial extended temperature range of -40 to +85 °C with a junction temperature of up to 110 °C. They can be used outdoors in public applications like digital signage or vending machines.

Stunning Visual Experiences
Intel® Atom® x5 and x7 support up to 24MP still image capture and 1080p60 video encode/decode.

It could be used for entry-level single-display surveillance devices like bodycams or mobile streaming devices.

Long-Lasting Performance
Enhanced battery life and Intel® Display Power Saving Technology (DPST) and Intel® Display Refresh Rate Switching Technology (DRRS Technology) allow you to keep working and playing by reducing panel backlight and refresh rate opportunistically.

The TDP range from 5 to 12W makes this an ideal energy saving processor to reduce your costs.

Intel Atom® C Processor
Intel Atom® C processor, a system-on-a-chip (SoC) design, delivers efficient intelligence into smaller spaces at the network edge. Used in a variety of light scale-out workloads that require very low power, high density and high I/O integration including network routers, switches, storage, security appliances, dynamic web serving, and more.

With a junction temperature of up to 100 °C this processor is also ready for use in extreme environmental conditions.

Atom® C3000 Processors - Use Less Energy
Atom® C3000 processors deliver a range of Thermal Design Power from 8.5 to 32 watts.

Flexible Design To The Edge
From 2 to 16 cores with speeds up to 2.2 GHz, these processors allow you to deploy light scale-out workloads to the network edge. Integrated Intel® QuickAssist Technology (Intel® QAT) and Intel® Ethernet deliver additional value-add throughput in data transmission, security and compression acceleration.

4th Gen Intel® Xeon® - Scalable Processors

Designed to accelerate performance across the fastest-growing workloads in artificial intelligence (AI), data analytics, networking, storage, and high-performance computing (HPC). These processors have the most built-in accelerators of any CPU on the market. They help bring a zero-trust security strategy to life while unlocking new opportunities for business collaboration and insights - even with sensitive or regulated data - with advanced security technologies. You can scale across multiple clouds and edges to meet your deployment needs. And Intel® Xeon® Scalable processors offer the most choice and flexibility in cloud selection, with smooth application portability.

Higher per-core performance
New architecture with higher per-core performance than the previous generation. Up to 60 cores per socket and one, two, four, or eight sockets per system.

Advanced memory bandwidth/capacity
DDR5 memory provides up to 1.5x the bandwidth and speed of DDR4, for 4,800 megatransfers per second (MT/s).

Improved I/O:
The platform features 80 lanes of PCIe Gen5 per socket, for dramatically improved I/O compared to earlier platforms. It provides CXL 1.1 to support high fabric bandwidth and attached accelerator efficiency.

4th Gen Intel® Xeon® Scalable processors support technologies that let you scale and adapt as workload requirements change.

Intel® Xeon® D-2100 Processor
The Intel® Xeon® D-2100 processor delivers Intel’s most transformative and groundbreaking data center processor architecture in a form factor optimized for flexible, scalable, high-density network, storage, and cloud edge solutions. It brings the architectural innovations of the Intel® Xeon® Scalable Platform to a system-on-a-chip (SoC) processor for lower-power, high-density solutions, integrating essential network, security, and acceleration capabilities. The 4-16 Cores that run with up to 3.00 GHz offer an impressive performance level in every network based scenario. Thanks to its high core count and the amazing performance this CPU is optimal for big data analytics, cloud services or all other demanding applications in data centers for example.
Intel® Pentium® and Celeron® Processors

These processors are great options for value-segment buyers who need basic functionality at an affordable price. The processors are ideal for everyday computing like basic productivity, browsing visually stunning webpages, streaming 4K Ultra HD video, and editing photos. Whether it’s a notebook, convertible, Chromebook®, All-in-One, mini PC or desktop PC, Intel® Pentium® and Celeron® processor-based PCs offer reliable performance at an affordable price for value-oriented buyers. With 2 to 4 cores and clockrates of up to 3.7 GHz this processor offers a wide field of applications in the entry-level segment.

Intel® Core™ Processors

13th Generation - Beyond performance
The 13th Gen Intel® Core desktop processors deliver the next generation of breakthrough core performance. Now with up to 24 cores (8 Performance-cores and 16 Efficient-cores) and up to 32 threads, plus Performance-cores are capable of reaching 5.8 GHz with Intel® Thermal Velocity Boost to elevate performance. Intel® Turbo Boost Max Technology 3.0 further strengthens lightly threaded performance by identifying the best-performing Performance-cores. Meanwhile, additional E-cores enable an increase in Intel® Smart Cache (L3) for more efficient processing of larger data sets and better performance. The P-core and E-core L2 cache has also increased compared to the previous generation of Intel® processors, minimizing the amount of time spent swapping data between cache and memory to speed up your workflow. Unleash the power of next-level performance with the 13th Gen Intel® Core desktop processor advantage.

Features
- Performance-core (P-core)
- Efficient-core (E-core)
- Performance Hybrid Architecture
- Intel® Thread Director
- PCIe 5.0 up to 16 Lanes
- Up to DDR5 5600 MT/s
- L3 and L2 Cache

12th Generation - Performance where you need it most
The 13th Gen Intel® Core desktop processors deliver the next generation of breakthrough core performance. Now with up to 24 cores (8 Performance-cores and 16 Efficient-cores) and up to 32 threads, plus Performance-cores are capable of reaching 5.8 GHz with Intel® Thermal Velocity Boost to elevate performance. Intel® Turbo Boost Max Technology 3.0 further strengthens lightly threaded performance by identifying the best-performing Performance-cores. Meanwhile, additional E-cores enable an increase in Intel® Smart Cache (L3) for more efficient processing of larger data sets and better performance. The P-core and E-core L2 cache has also increased compared to the previous generation of Intel® processors, minimizing the amount of time spent swapping data between cache and memory to speed up your workflow. Unleash the power of next-level performance with the 13th Gen Intel® Core desktop processor advantage.

Features
- Intel® Thread Director
- Built for gaming on the go
- Best overclocking experience
- Smart solutions for enthusiasts and creators
- Nearly 3x faster connectivity

Power Supply - the Heart of the System

Since Rutronik understands its role in the embedded market as a provider of all components that are needed to build an embedded system, power supplies round off our portfolio to meet the demands for one stop sourcing. The field of industrial power supplies is huge and it is the job of an embedded partner to support customers from the beginning of a project to its mass production stage. In the following we are providing an overview of the different fields of power supplies to show our competence and to give our customers an idea what they can expect.

FSP Product Conversion Notice
According to the implementation date of the new norm EN62368-1:201 (valid on 20.12.2020) for Audio/Video, Information and Communication technology equipment, FSP Group has started the transition of its complete range of power supply products for the safety standard EN62368-1.

Uninterruptable Power Supplies (UPS)
If a system has to be available also in cases when the power grid is down and if there is demand for taking care of a reliable system shutdown in power failure situations an UPS is needed. We can propose also typical UPS solutions for the industrial market and we will show you in the following the range of available designs.

Line Interactive Solutions
As a typical solution with pure sine wave AC output, line interactive UPS systems are recommended for various applications to take care of power failures in industrial power grids. It stabilizes the power in any IT installation.
- Wattage: 880W / 1.6kW / 1.8kW / 2.4kW / 2.7kW / 4.8kW / 5.4kW / 8.0kW / 9.0kW / 16kW / 24kW / 30kW / 210kW
- Chassis Designs: Rack / Tower
- Typical applications: systems with demand for availability in case of power failures (Industrial Workstations, Industrial Servers, Medical Systems)

Online Solutions
For higher demands in case of reliability, throughput and for Input Power Factor Correction and if it is necessary to also cover current fluctuations in the power grid, online systems are the more powerful and more reliable solutions. Such systems can also be used in combination with generators and are recommended in real industrial power grids, like factories with many different machines with high lagging loads or even in generator grids.
- Wattage: 600W / 1.6kW / 1.8kW / 2.4kW / 2.7kW / 4.8kW / 5.4kW / 8.0kW / 9.0kW / 16kW / 24kW / 30kW / 210kW
- Chassis Designs: Rack / Tower
- Typical applications: systems with demand for highest availability in case of power failures (Industrial Networks, Industrial Servers, Server Farms, Complete Networks)
Power Supply – the Heart of the System

**Industrial PC (IPC) Power Supplies**

A typical IPC Power Supply is converting AC or DC voltage into the ATX standard output voltages, so that it can power up a standard Industrial Mainboard in mini-ITX, micro-ATX or ATX form factor used in all possible industrial applications. Under FSP IPC Power Supply portfolio, there are a lot of different form factors and power levels available. We also supply fanless ATX PSU, DC/DC ATX PSU, and specially designed PSU for POE or medical applications. The power consumption of the target system has to be investigated and calculated well. Also the chassis dimension and the cooling solution has to be considered in order to match with the Power Supply.

**1U Form Factor**

A 1U PSU is designed for 1U rack mount server or desktop chassis with a maximum height of 40.5 mm.

- Wattage: 250 W – 750 W
- 80 Plus Efficiency Levels: Standard/Bronze/Gold/Platinum
- Cable assembly: project based customization possible
- Medical versions available
- Typical applications: 1U 19" rack mountable systems (Industrial Servers, Telecom Devices)

**Flex Form Factor**

The Flex format is often used in small computer cases and sometimes called “miniITX” PSU. It can be used with a mini-ITX board, to reduce the system dimensions and so it is better for custom designs with its compact size. Now with Flex form factor we could achieve to supply up to 400W power max.

- Wattage: 100 W – 500 W
- 80 Plus Efficiency Levels: Standard/Bronze/Silver/Gold
- Cable assembly: project based customization possible
- Medical versions available
- Typical applications: small systems with mini-ITX boards (POS/POI, Digital Signage, Small IPC, KIOSK)

**ATX PS/2**

The most popular form factor in the IT market is the typical ATX PSU, also called PS/2. Here we have the biggest portfolio up to 1,200 W for high performance workstations.

- Wattage: 250W – 1,200W
- 80 Plus Efficiency Levels: Standard/Bronze/Silver/Gold/Platinum
- Cable assembly: project based customization possible
- Medical versions available
- Typical applications: typical PC Systems and Workstations, mainly combined with ATX Boards (IPC’s, Industrial Automation, Industrial Workstations, Gaming)

**Redundant Solutions**

For a better fail-safe performance sometimes it is necessary to use a redundant PSU to take care of the system runtime in the maintenance of the PSU itself. So the second (redundant) part can take over the job from the down one. Therefore we provide several designs from slim compact 1U (1HE) form factor up to solutions for high performance servers or workstations with high power load up to 1,400 W. Interesting are also the versions in standard ATX PS/2 format with 190x150x86 mm, that can be used in standard ATX chassis.

- Wattage: 80 W – 1,400 W
- 80 Plus Efficiency Levels: Standard/Silver/Gold/Platinum
- Cable assembly: project based customization possible
- Typical applications: systems with demand for redundancy (Data Center, Networking, Surveillance, Storage Server, Broadcasting)
Power Supply – the Heart of the System

AC/DC Adapter
Even when the PSU shouldn’t be integrated into the system itself, an AC/DC adapter is recommended. So the variety of possible applications is huge, same as our adapter provided by FSP Group. In your daily life we can find external AC/DC power supplies everywhere e.g. for mobile phones, tablets or notebooks. Also a lot of medical devices are getting their power from AC/DC adapters. FSP AC/DC adapter wide range portfolio offers high efficiency, high altitude and slim size for special applications & medical application.

Wall Mount Adapters
The easiest and lightest way to bring the converted DC power to a system is a Wall Mount Adapter that is plugged into an AC wall socket with only one DC cable to the device.
- Wattage: 10W – 65W
- Output DC Voltages: 5V / 6V / 9V / 12V / 15V / 24V
- Medical versions available
- Typical applications: typical transportable systems and systems with special demands regarding EMC (Tablets, Charger, Medical Devices, Set-top Box)

Desktop Adapters
If more power is needed and if it is useful for the environment and the application itself, a Desktop Adapter is the more efficient way to drive a device without integrating a PSU with DC voltages.
- Wattage: 15W – 250W
- Output DC Voltages: 5V / 9V / 12V / 15V / 24V / 30V / 36V / 48V
- Medical versions available
- Typical applications: systems without an integrated PSU and a demand for more than 24W (Notebooks, Medical Devices, POS/POI, Digital Signage, Thermal Printer)

DC/DC Converters
To convert a single voltage DC power into the ATX voltages for a Mainboard, a DC/DC converter might be the smallest and easiest solution. It can be mounted into small cases and approved together with the whole system. In combination with one of our AC/DC Adapters it could be an interesting solution to drive a miniITX board with ATX voltage input with an external PSU to reduce the size of the chassis.
- Wattage: 67W – 150W
- Input DC Voltages: 12V
- Output Voltages: ATX (+3.3V / +5V / +12V / -12V / 5V Stdby)
- Typical applications: systems without an integrated PSU and the demand for ATX voltages (POS/POI, Digital Signage, Industrial Printer Systems)

ITX Solutions
To integrate a PSU into a small custom chassis without external converters an ITX solution can fulfill the requirements better than any other solution. It combines the AC input with the ATX output voltages in an efficient way in one solution, suitable in small chassis.
- Wattage: 55W – 150W
- Output Voltages: ATX (+3.3V / +5V / +12V / -12V / 5V Stdby)
- Typical applications: systems with the demand for ATX voltages and less on space, where the PSU can’t or shouldn’t be external (Industrial Printer Systems, Small IPC’s, Portables)

Other Open Frame Solutions
The more specific a system solution is designed, the more specific the PSU has to be. To cut down the costs for a fully custom design for an AC/DC converter, we offer a broad range of open frame solutions in 2” by 4” and smaller, with or without a metal case around. Many solutions are also available for the medical market.
- Wattage: 25W – 1,100W
- Output Single DC Voltages: diverse from 3.3V to 48V
- Output Multi DC Voltages: diverse from 3.3V to 48V in dual or triple voltage designs
- Typical applications: custom system designs with integrated PSU to drive Boards and peripheral components, like TFT’s, thermal printers or FAN’s (Medical Systems, Industrial, Automation, Gaming. Specific Systems with demand for DC voltages)

Open Frame Solutions
When it comes to specific custom chassis designs or voltage combinations, it can’t be served from one of the former shown standards, an Open Frame PSU could be the best solution compared to a complete separate and fully custom designed PSU. The field of available solutions is various and there are many different combinations between AC or DC input and DC output possible. To give an idea about this area of PSU solutions we show in the following only the big range in general. To find the best compromise between size, power and availability, we support you in your projects as detailed as possible.
Server Components

Server Mainboards & Accessories

**Server Motherboards**
ASUS server motherboards combine high-quality components, feature-rich design and superior inhouse design expertise for your custom compute needs.

**Server Motherboards**
ASUS server accessories are compatible, dependable and easy to adopt, enabling smooth server-system performance upgrades and expansion.

Server Mainboards & Chassis

**Server Motherboards**
Advantech server boards support Intel Xeon Processor, DDR4, IPMI 2.0 with KVM and Quad LANs features. Our server board enables various system configurations and diverse options of modules to help fulfill various field application.

**Server Chassis**
From 1U to 4U Rackmount Server Chassis, Advantech aim to provide the best solutions and fulfill the most complex requests from different industrials. The tower chassis series are IPC chassis featuring enhanced storage and high-efficiency power supplies beneficial to Industrial server and application such as AOI.

Server Boards & Accessories

**Server Boards**
Optimized for high-performance computing, hyper-converged infrastructure, outstanding storage performance.

Whether customers need a server under their desk or a high-performance data center workhorse, Intel Server Boards deliver performance, security, and flexibility.

**SAS/ RAID**
Intel RAID solutions deliver custom storage options for a variety of business needs, at a range of price points.

**Server Chassis**
Built on a foundation of industry-leading, high-quality technology and with the purpose to work with Intel server boards and Intel Xeon processors to meet the most demanding compute use requirements.

Data Center SSDs

**Enterprise Hard Drives**

- **Enterprise Performance HDD - AL Series**
  - 2.5” SAS Hard Drive
  - Dualport SAS interface
  - 24/7 operation
  - 5-year warranty
  - Unlimited workload (TB/year)
  - MTTF of 2 mill. hours
  - Persistent Write Cache technology
  - Flexibility in block size and SIE and SED options

Use for:
- Enterprise server & storage systems
- Business database server with high workloads
- Big data analytics
- Virtualized storage systems

- **Enterprise Capacity HDD - MG Series**
  - 3.5” SATA or SAS Hard Drive
  - 24/7 operation
  - 5-year warranty
  - Toshiba Stable Platter Technology
  - Persistent Write Cache technology
  - 550 TB/year workload
  - Rotational Vibrations sensor
  - Flexibility in block size and SIE and SED options

Use for:
- Enterprise server & storage systems
- Cloud & hyperscale storage systems
- Big data, distributed file systems
- Enterprise archive & data recovery systems
- Industrial server & storage systems

**Data Center SSDs**

Explore drives optimized for real-world performance with industry-leading quality and reliability. Solidigm draws on decades of technical innovation to offer a broad portfolio of drives – all with industry-leading quality and reliability, optimized for the data center, the edge, and everything in between.

- **D7 Series**: SSD D7 Series drives are tuned for real-world mixed and performance-sensitive read workloads. The highest performing family of TLC 3D NAND SSDs delivers the right balance of speed, endurance, and capacity.
- **DS Series**: The SSD DS Series performance is optimized for read and sequential workloads. This value-optimized family of SSDs features capacities ranging from 960 GB to 30.72 TB.

**PCIE U.3 Data Center SSD**
Swissbit’s N4200 U.3 Data Center SSD enables server engineers to achieve reliable, high storage capacity that delivers consistently high performance and low latency. The N4200 is able to measure its respective workload. Thanks to this unique feature, the workload profile can be analyzed and the firmware configured accordingly, tailored to a specific workload profile, e.g. for web, streaming, application and cache servers.

The firmware optimally matched to the workload profile keeps write amplification low and improves endurance. This innovative approach is designed specifically to tackle complex cloud applications delivering the best and most consistent throughput and latency in the industry.
Server Components

Data Center SSDs

KIOXIA Data Center SSDs which are equipped with flash memory, firmware and a controller developed by KIOXIA are suitable for cloud-based applications run in an industry standard server environment to be scaled out in a cloud. These data center SSDs are optimized for a balance of performance, low latency and data protection, and provide power loss protection (PLP) to safeguard data in case of unexpected power loss.

Enterprise SSDs

Enterprise SSDs are suitable for high-performance Tier 0 computing, server and storage systems that require high levels of performance and reliability. KIOXIA Enterprise SSDs equip the flash memory and controller developed by KIOXIA and offer high reliability, data protection incorporating power-loss-protection (PLP) and encryption technology to support enterprise environments and applications. Light weight and low power consumption will make the systems more energy efficient.

FD Series

• PCIe® / NVMe™ SSDs
• Scale-out and cloud applications
• 2.5” / E3.5 form factor
• Up to 13.36TB (2.5“) and 7.68TB (E3.5) capacity

XD Series

• EDSFF E1.S (9.5 / 15 mm) form factor
• Addresses specific requirements of hyperscale applications
• Performance, power and thermal requirements according to OCP Datacenter NVMe™ SSD Specification

Server Components

DRAM Solutions

Server DRAM

While experiencing exponential expansion, storage server and cloud service providers also confront difficulties with data integrity, reliability, and other factors that are crucial to perpetual up-time. Boot drives, server DRAM, and other uncommon embedded form factors are areas of expertise for ATP.

Today, ATP is regarded as a strategic supplier by more than 70% of the businesses included in Gartner’s Magic Quadrant reports for Primary Storage, Data Center and Cloud Computing, and WAN-Edge Infrastructure.

Industrial DRAM Solutions

RDIMM (ECC Registered DIMM) is a JEDEC-compliant design applicable for enterprise servers and cloud data centers. With a register between the memory module and the system’s memory controller, the RDIMM improves overall system stability and increases memory module quantity.

Furthermore, it supports ECC function to detect and correct data errors, and a built-in temperature-monitoring thermal sensor to prevent overheating and improve the memory module’s reliability.

Registered DRAM

<table>
<thead>
<tr>
<th>Registered DRAM</th>
<th>2 GB</th>
<th>4 GB</th>
<th>8 GB</th>
<th>16 GB</th>
<th>32 GB</th>
<th>64 GB</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDR3 REG DIMM 1366 MHz 0°C - +85°C</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>DDR3 REG DIMM 1600 MHz 0°C - +85°C</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>DDR3 REG DIMM 1866 MHz 0°C - +85°C</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

s = ready to order at Rutronik
Server Components

Processors & FPGAs

Intel® Xeon® Scalable Processors

4th Gen Intel® Xeon® Scalable processors feature built-in accelerators and advanced security technologies for the most in-demand workload requirements — all while offering the greatest cloud choice and application portability.

Intel® Xeon® Platinum

Advanced 2, 4 & 8 socket performance, designed for the most demanding workloads & services from the edge to cloud.

Intel® Xeon® Gold

Up to 4 socket scalable performance, advanced reliability, and advanced security solutions.

Intel® Xeon® Silver

Performance and power efficiency for entry compute, network and storage.

Intel® Xeon® Bronze

Reliability and serviceability for small business and storage server solutions.

Intel® Xeon® CPU Max Series

Maximize bandwidth with the Intel® Xeon® CPU Max Series, the only x86-based processor with high-bandwidth memory (HBM).

Architected to supercharge the Intel® Xeon® platform with HBM, Intel® Max Series CPUs deliver up to 4.8x better performance compared to competition on real-world workloads, such as modeling, artificial intelligence, deep learning, high performance computing (HPC) and data analytics.

Intel® Xeon® Processors

Optimized performance, scale and efficiency across a broad range of data center, edge and workstation workloads. Elevate business productivity with the consistent open Intel® architecture you know and trust.

Intel® Xeon® W

Designed for creative professionals, delivering performance for VFX, 3D rendering, 3D CAD (workstation).

Intel® Xeon® D

Innovative system-on-a-chip processors for workload optimized performance at limited space and power.

Intel® Xeon® E

Essential, business-ready performance, expandability and reliability for entry server solutions.

Intel® FPGA Portfolio

Accelerate innovation with a comprehensive suite of innovative FPGA products unified by a single architecture, enhanced by Intel’s design, software, and manufacturing leadership, with optimizations across all levels of performance, power efficiency, and form factor to address a wide breadth of workloads.

Server PSU

Redundant power solutions

for data center / cloud, storage server, 5G & AI applications.

Uninterruptable power supplies (UPS)

for the server room – highest power factor with the most compact size, modular design decreases MTTR and increases reliability of UPS system.

Server PSU

Delta offers some of the most energy efficient power products in the industry, including switching power supplies, telecom power, and PV inverters. Delta has also developed the world’s first server power supply certified as 80 Plus Titanium.
Electric Double Layer Capacitors (EDLC)

Electric Double Layer Capacitors (EDLC) also known as Ultracapacitors or Supercapacitors are proven rechargeable alternative energy storage devices. The EDLC-technology is not a new one and was developed in the middle of the last century, but now the technology becomes more and more important and the number of different applications are uncountable. The Electric Double Layer Capacitors are mainly used in tandem with a battery but in some cases the real option is to replace the battery. The EDLCs are an ideal source of back-up and peak-power.

The charge in an Ultracapacitor is stored electrostatically by separating positive and negative charges. This means it is not a chemical reaction to store energy.

That is the reason why an Electric Double Layer Capacitor can be charged and discharged up to 1,000,000 times and much faster than a battery.

Basically, there are two different types of constructions: On the one hand the stacked and on the other hand the wound construction forms. The construction of the wound types is similar to the construction of ordinary radial electrolytic capacitors. Available with a maximum cell voltage between 2.1 and 3.3 V, capacities of up to 3400 F can be reached with these cells.

The stacked construction form called “coin types” generally offers a capacitor voltage of 5.5 V (integrating cells in row). Available with capacities of up to 1.5 F, these cells are used especially in RTC applications and as memory backup.

The key point of this technology is the special electrode with its surface coated with activated carbon.

The porous structure of this coating expands the surface significantly and allows a capacity up to thousands of Farad. The Electric Double Layer Capacitor does not have a typical dielectric rather it uses the electrolyte solution as a function of the dielectric.

The following table shows a comparison between Batteries, EDLC, and Conventional Capacitors:

### Comparison to Batteries

<table>
<thead>
<tr>
<th>Type</th>
<th>Batteries</th>
<th>EDLC</th>
<th>Conventional Capacitors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time of Charge</td>
<td>1 to 5 h</td>
<td>0.3 to 30 s</td>
<td>10^1 to 10^3 s</td>
</tr>
<tr>
<td>Time of Discharge</td>
<td>0.3 to 3 h</td>
<td>0.3 to 30 s</td>
<td>10^1 to 10^3 s</td>
</tr>
<tr>
<td>Spec. Energy [Wh/kg]</td>
<td>20 to ~ 100</td>
<td>&lt; 10</td>
<td>&lt; 0.1</td>
</tr>
<tr>
<td>Lifetime [Cycles]</td>
<td>1,000</td>
<td>~ 1,000,000</td>
<td>~ 1,000,000</td>
</tr>
<tr>
<td>Spec. Power [W/kg]</td>
<td>&lt; 1,000</td>
<td>&gt; 10,000</td>
<td>&gt; 100,000</td>
</tr>
<tr>
<td>Efficiency</td>
<td>0.7 to 0.85</td>
<td>0.9 to 0.98</td>
<td>&gt; 0.95</td>
</tr>
</tbody>
</table>

Benefits:

- Fast charge/discharge cycles (only a few seconds)
- High charge/discharge currents (up to hundreds of Amps)
- Long lifetime (up to over 1 million cycles)
- Very long operating lifetime (up to 10 years and even more)
- No memory effect
- Reliable operation in harsh environments
- Wide operating temperature range (40 °C up to +85 °C)
- Virtually maintenance free
- Higher energy vs. electrolytic capacitors
- Higher power vs. batteries
- Series- and parallel-connection possible

**Benefits**

- Fast charge/discharge cycles (only a few seconds)
- High charge/discharge currents (up to hundreds of Amps)
- Long lifetime (up to over 1 million cycles)
- Very long operating lifetime (up to 10 years and even more)
- No memory effect
- Reliable operation in harsh environments
- Wide operating temperature range (40 °C up to +85 °C)
- Virtually maintenance free
- Higher energy vs. electrolytic capacitors
- Higher power vs. batteries
- Series- and parallel-connection possible

**Benefits**

- Fast charge/discharge cycles (only a few seconds)
- High charge/discharge currents (up to hundreds of Amps)
- Long lifetime (up to over 1 million cycles)
- Very long operating lifetime (up to 10 years and even more)
- No memory effect
- Reliable operation in harsh environments
- Wide operating temperature range (40 °C up to +85 °C)
- Virtually maintenance free
- Higher energy vs. electrolytic capacitors
- Higher power vs. batteries
- Series- and parallel-connection possible

**Benefits**

- Fast charge/discharge cycles (only a few seconds)
- High charge/discharge currents (up to hundreds of Amps)
- Long lifetime (up to over 1 million cycles)
- Very long operating lifetime (up to 10 years and even more)
- No memory effect
- Reliable operation in harsh environments
- Wide operating temperature range (40 °C up to +85 °C)
- Virtually maintenance free
- Higher energy vs. electrolytic capacitors
- Higher power vs. batteries
- Series- and parallel-connection possible
Electric Double Layer Capacitors (EDLC)

Typical Shapes

<table>
<thead>
<tr>
<th>Technology</th>
<th>Flatpacks / Pouch Cells</th>
<th>SMD</th>
<th>Coin</th>
<th>Radial / Leaded</th>
<th>Snap-In</th>
<th>Screw / Weldable</th>
<th>Module</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacitance</td>
<td>0.0068 F – 600 F</td>
<td>0.020 F – 0.47 F</td>
<td>0.047 F – 1.5 F</td>
<td>1.0 F – 100 F</td>
<td>100 F – 400 F</td>
<td>650 F – 3400 F</td>
<td>variable</td>
</tr>
<tr>
<td>Temperature</td>
<td>-20/-25 – 70/75 °C</td>
<td>-15/-25 – 60/70 °C</td>
<td>-25/-40 – 70/80 °C</td>
<td>-25/-40 – 60/65/100/85 °C</td>
<td>-21/-40 – 60/65/100/85 °C</td>
<td>-25/-40 – 60/65 °C</td>
<td>-40 – 60/65 °C</td>
</tr>
<tr>
<td>Operating Currents</td>
<td>mA / A</td>
<td>µA</td>
<td>mA / µA</td>
<td>mA / A</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
</tbody>
</table>

Portfolio

<table>
<thead>
<tr>
<th>Technology</th>
<th>Flatpacks / Pouch Cells</th>
<th>Coin</th>
<th>Radial / Leaded</th>
<th>Snap-In</th>
<th>Screw / Weldable</th>
<th>Module</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVX</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eaton</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kemet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Korchip</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maxwell</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SECH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Samwha</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vishay</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Examples
- Barcode scanner
- Backup of CMOS microcontrollers
- Battery backup
- UPS
- Wind mill
- Electric scooter
- Power tools
- Garden light
- Solar battery operated circuits
- Nurse call
- Electric car
- Emergency light
- Electric scooter
- Power tools
- Electric car
- Electric scooter
- Power tools

Focus Supplier  Product Available

Lifetime Advantage over Batteries

The lifetime of an Electric Double Layer Capacitor is significantly affected by three factors: voltage, temperature and current. Due to its construction and the very low-viscosity state-of-the-art electrolytic acetonitrile, electric double layer capacitors operate at very low voltages of 2.5 V – 3.3 V. Since overvoltages can decompose the electrolyte and thus irreversibly damage the capacitor, the EDLC should be operated only within its specifications. In order to obtain a positive influence on the service life over the voltage, it is recommended to operate the capacitor below its rated voltage. Another critical factor related to the lifetime is the temperature - the ambient temperature and the resulting self-heating. The self-heating depends largely on the strength of the currents and the cycle frequency (charging and discharging). The higher the currents are and the higher the frequency of the cycles, the higher is the self-heating, which must be added to the ambient temperature in order to estimate the actual temperature load of the supercaps. In a supercap, high temperatures lead to a decrease in capacity and an increase in the ESR over time. The higher the temperature (ambient temperature + self-heating), the faster the aging process progresses and the faster the so-called end-of-life criteria (e.g. 30% loss of capacity, doubling of the ESR) are achieved. It is important to know that the EDLC is functional even after reaching the end-of-life criteria.

Compared to batteries, the technology of the supercaps has a higher current carrying capacity as well as a higher cycle stability, which allow a significantly longer life of up to 10 years compared to batteries.
Rutronik offers hard disks, flash memory, DRAM modules and optical drives in all technologies and sizes which are explicitly suitable for industrial applications. Hard disks still remain a popular medium for storing data securely for long periods. However, flash-based memory solutions are the first choice for applications which are exposed to stronger vibrations or shocks. A number of factors determine selection of the appropriate memory.

Suppliers

Storage

<table>
<thead>
<tr>
<th>Memory Modules</th>
<th>Apacer</th>
<th>ATP</th>
<th>Goodram</th>
<th>Intel</th>
<th>KIOXIA</th>
<th>Swissbit</th>
<th>Solidigm</th>
<th>TEAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDR1</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DDR2</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DDR3</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DDR4</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DDR5</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Flash Memory

<table>
<thead>
<tr>
<th>SD/microSD</th>
<th>Apacer</th>
<th>ATP</th>
<th>Goodram</th>
<th>Intel</th>
<th>KIOXIA</th>
<th>Swissbit</th>
<th>Solidigm</th>
<th>TEAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compact Flash</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CFast</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flash Module (USB/PATA/SATA)</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

USB-Sticks

| SSD 2.5"       | ✔      | ✔   | ✔       |       |        |         |         |     |
| hSATA          | ✔      | ✔   | ✔       |       |        |         |         |     |
| M.2            | ✔      | ✔   | ✔       |       |        |         |         |     |
| Add-In Card (AIC) | ✔ | ✔ | ✔ |       |        |         |         |     |
| eEDF           | ✔      | ✔   | ✔       |       |        |         |         |     |
| Persistent Memory Module | ✔ | ✔ | ✔ |       |        |         |         |     |

Hard Disc Drive

| 2.5" rollout USB | ✔ | ✔ | ✔ |       |        |         |         |     |

Optical Drives

| CD-Drives for Audio/CE | ✔ | ✔ | ✔ |       |        |         |         |     |
| DVD-Drives | ✔ | ✔ | ✔ |       |        |         |         |     |
| Blu-ray-Drives | ✔ | ✔ | ✔ |       |        |         |         |     |
| Media Recorder | ✔ | ✔ | ✔ |       |        |         |         |     |

Accessories

| Card Reader | ✔ | ✔ | ✔ |       |        |         |         |     |

Memories

<table>
<thead>
<tr>
<th>Technology</th>
<th>Type</th>
<th>Apacer</th>
<th>ATP</th>
<th>Atmel</th>
<th>Fujitsu</th>
<th>Giantec</th>
<th>Goodram</th>
<th>Infineon</th>
<th>Insignis</th>
<th>Intel</th>
<th>KIOXIA</th>
<th>Nanya</th>
<th>Rohm</th>
<th>Solidigm</th>
<th>Swissbit</th>
<th>Transcend</th>
<th>Zentel</th>
</tr>
</thead>
<tbody>
<tr>
<td>EEPROM</td>
<td>Serial</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>ReRAM</td>
<td>Serial</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>SRAM</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

Storage Technologies

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Apacer</th>
<th>ATP</th>
<th>Goodram</th>
<th>Intel</th>
<th>KIOXIA</th>
<th>Swissbit</th>
<th>Solidigm</th>
<th>TEAC</th>
</tr>
</thead>
</table>

Storage & Memories – Linecard

Rutronik offers hard disks, flash memory, DRAM modules and optical drives in all technologies and sizes which are explicitly suitable for industrial applications. Hard disks still remain a popular medium for storing data securely for long periods. However, flash-based memory solutions are the first choice for applications which are exposed to stronger vibrations or shocks. A number of factors determine selection of the appropriate memory.
What Really Counts for a Flash Card

Unfortunately, it happens far too often that flash cards from one and the same manufacturer sometimes fail in an application. How is it possible, that one card works in an application and another one suddenly fails in the same application, although according to the product code, it is the same card?

There is a simple and plausible answer to this question. A flash card's function has four main characteristics which must be considered: The PCB, the Flash Chips, the controller and the firmware. The so-called bill of materials (BOM).

When these 4 components are put together you have a finished flash card that is ready for use.

In the industry, before an application goes into production, a sample is tested to establish the functionality. If the tests are successful, the item will be approved for purchase by the development department. If a batch should suddenly have a BOM that differs from the tested sample, the card may completely fail in the application owing to incompatibility. This can be compared with a small faulty cog in a large mechanism.

In other words: production stops and significant costs result. This is not just a theoretical scenario. Almost all manufacturers frequently change their BOM to reduce costs, without publishing this or marking the items. Without further ado, new firmware is introduced for example, or a new controller, which can have catastrophic consequences in certain applications. Cards from manufacturers like these are not suited for industrial applications.

The leading manufactures Swissbit and Apacer have by contrast addressed this problem and have focussed on the industrial market.

They offer special industrial compact flash cards and guarantee a fixed bill of materials, so that all of the cards supplied will be identical to the tested samples with no changes being made without a published product change notification (PCN).

To guarantee and check this continuity, Swissbit item designations, specify exactly which controller and which flash chips etc. are used. If anything in the BOM is changed, the item designation is also changed.

In addition to the fixed BOM, Swissbit and Apacer exclusively use flash chips with SLC technology as, in contrast to the cheaper MLC technology, these are suitable for industrial use due to longer life, higher speed, lower error rate and lower power consumption.

<table>
<thead>
<tr>
<th>Flash Type</th>
<th>SLC</th>
<th>pSLC</th>
<th>MLC</th>
<th>TLC</th>
<th>pSLC</th>
<th>TLC</th>
<th>QLC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit per cell</td>
<td>2D</td>
<td>2D</td>
<td>2D</td>
<td>2D</td>
<td>2D</td>
<td>2D</td>
<td>2D</td>
</tr>
<tr>
<td>ECC requirement (up to)</td>
<td>48 bit</td>
<td>48 bit</td>
<td>72 bit</td>
<td>122 bit</td>
<td>122 bit</td>
<td>122 bit</td>
<td></td>
</tr>
<tr>
<td>Program/Erase P/E cycle</td>
<td>20k</td>
<td>500</td>
<td>20k-50k</td>
<td>300-3k</td>
<td>250</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial Temperature Range</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Fixed BOM (Bill of Materials)</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Cost advantage per GB</td>
<td>+++</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Longevity products</td>
<td>++++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td></td>
</tr>
<tr>
<td>Write Performance</td>
<td>++++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td></td>
</tr>
</tbody>
</table>

NAND Flash Technology (Reliability vs. Cost)
Apacer - Industrial Memory Solutions

Apacer Technology offers a wide range of industrial SSDs, digital consumer products, and memory modules. With its strong R&D, design, manufacturing, and marketing, the company has become a leading global manufacturer in the industry. Apacer is devoted to implementing our core value “Becoming Better Partners” and continually creates innovative, diversified storage solutions and hardware/software integration services for various industries.

Storage Technologies - Overview

- M.2 SSD
- 1.8” / 2.5” SSD
- mSATA/ mSATA mini
- Half-slim SSD
- Flash Modules
- SDXC 128 GB
- micro SDXC (WT) 128 GB
- Industrial CH710-CF
- Industrial SH250-CFast
- USB Sticks
- DDR
- DDR2
- DDR3
- DDR4
- DDR5

DDR5
Industrial Memory Modules

Anti-Sulfuration

- Anti-sulfuration memory modules are mainly used in equipment exposed in highly contaminated environment.
- World’s first anti-sulfuration memory modules
- Solves corrosion problems effectively and increases overall system lifespan
- Ensures product reliability and durability
- Widely recognized and awarded patents in many countries

Underfill

- Apacer underfill technology ensures products continue to operate normally in high vibration and in extreme environmental conditions.
- Strengthens the solder joints between solder balls and printed circuit board
- Increases the product’s resistance against shock and vibration
- Reduces thermal stress damage
- Complies with MIL-STD-810G
- Increases product reliability and lifespan

Conformal Coating

- Enhances reliability of products by applying coatings on the surface of printed circuit boards.
- The protective film can safeguard devices from dust ingestion and liquid immersion.
- Uses automated spraying to maintain precise coating thickness
- Enhances product reliability
- Prolongs DRAM modules lifespan

Wide Temperature

- Especially designed for harsh climates and special environmental conditions.
- Operating temperature range: -40 °C ≤ TC ≤ 85 °C
- All industrial-grade components
- (DRAM, resistors and capacitors) ensure stability and reliability
- High/Low temp. test/Temp.cycling test
- Power cycling test
In order to meet the demands of the factory automation industry, Apacer offers high-performance industrial SSD and memory solutions, and provides a variety of value-adding technologies to help ensure reliability, stability and data integrity.

Featured Technologies for Factory Automation Applications

- **Anti-Sulfuration**
  Apacer’s world’s first patented anti-sulfuration DRAM modules and anti-sulfuration SSDs with the industry’s highest level of anti-corrosion ANSI/ISA 71.04 G3 Certification can meet the needs of industrial products facing harsh environments.

- **SLC-liteX**
  Apacer’s 3D NAND SLC-liteX technology breaks through the limitations of existing technology and provides up to 100,000 P/E cycles, which is over 33 times more than MLC or industrial 3D TLC.

- **Data Integrity**
  - CoreSnapshot
  - DataDefense™

- **Power Stability**
  - CorePower
  - DataDefense™

- **Longevity**
  - SLC-liteX
  - Conformal Coating

- **Survivability**
  - Anti-Sulfuration
  - Conformal Coating
  - Nano Coating (IP57)
  - Safety
  - Wide Temperature

Recommended Industrial SSD Solutions

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Feature</td>
<td>Anti-Sulfuration, Conformal Coating</td>
<td>DataDefense™</td>
<td>AES 256-bit Encryption</td>
<td>CorePower</td>
<td>Conformaplay, Anti-Sulfuration</td>
<td>CorePower</td>
<td>AES 256-bit Encryption, High Endurance, SLC+Cheat</td>
<td>CorePower</td>
<td>AES 256-bit Encryption, High Endurance, SLC+Cheat</td>
</tr>
<tr>
<td>Form Factor</td>
<td>M.2 2280</td>
<td>M.2 2280</td>
<td>2.5”</td>
<td>M.2 2280</td>
<td>M.2 2280</td>
<td>M.2 2280</td>
<td>M.2 2280</td>
<td>M.2 2280</td>
<td>M.2 2280</td>
</tr>
<tr>
<td>Interface</td>
<td>PCIe Gen3 3.0</td>
<td>SATA 3.2</td>
<td>PCIe Gen3 3.0</td>
<td>SATA 3.2</td>
<td>PCIe Gen3 3.0</td>
<td>SATA 3.2</td>
<td>PCIe Gen3 3.0</td>
<td>SATA 3.2</td>
<td>PCIe Gen3 3.0</td>
</tr>
<tr>
<td>NAND Flash Type</td>
<td>M.2 240-pin</td>
<td>M.2 240-pin</td>
<td>M.2 240-pin</td>
<td>M.2 240-pin</td>
<td>M.2 240-pin</td>
<td>M.2 240-pin</td>
<td>M.2 240-pin</td>
<td>M.2 240-pin</td>
<td>M.2 240-pin</td>
</tr>
<tr>
<td>Capacity</td>
<td>120~150 GB</td>
<td>120~150 GB</td>
<td>120~150 GB</td>
<td>120~150 GB</td>
<td>120~150 GB</td>
<td>120~150 GB</td>
<td>120~150 GB</td>
<td>120~150 GB</td>
<td>120~150 GB</td>
</tr>
<tr>
<td>External DRAM</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Standard Operating Temp. (°C)</td>
<td>0 ~ + 70</td>
<td>0 ~ + 70</td>
<td>0 ~ + 70</td>
<td>0 ~ + 70</td>
<td>0 ~ + 70</td>
<td>0 ~ + 70</td>
<td>0 ~ + 70</td>
<td>0 ~ + 70</td>
<td>0 ~ + 70</td>
</tr>
<tr>
<td>MTBF (Hours)</td>
<td>&gt; 3,000,000</td>
<td>&gt; 3,000,000</td>
<td>&gt; 3,000,000</td>
<td>&gt; 3,000,000</td>
<td>&gt; 3,000,000</td>
<td>&gt; 3,000,000</td>
<td>&gt; 3,000,000</td>
<td>&gt; 3,000,000</td>
<td>&gt; 3,000,000</td>
</tr>
<tr>
<td>Recommended Applications</td>
<td>Motion Automation</td>
<td>IPC</td>
<td>Wire EDM Cutting</td>
<td>CNC System</td>
<td>Wire EDM Cutting</td>
<td>CNC System</td>
<td>Wire EDM Cutting</td>
<td>CNC System</td>
<td>Wire EDM Cutting</td>
</tr>
</tbody>
</table>

Recommended Industrial DRAM Solutions

<table>
<thead>
<tr>
<th>Model</th>
<th>UDIMM</th>
<th>SDIHM</th>
<th>ECC UDIMM</th>
<th>ECC SDIHM</th>
<th>UDIMM</th>
<th>SDIHM</th>
<th>ECC UDIMM</th>
<th>ECC SDIHM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory Technology</td>
<td>DDR4</td>
<td>DDR4</td>
<td>ECC DDR4</td>
<td>ECC DDR4</td>
<td>DDR5</td>
<td>DDR5</td>
<td>ECC DDR5</td>
<td>ECC DDR5</td>
</tr>
<tr>
<td>Frequency</td>
<td>2666</td>
<td>2666</td>
<td>2666</td>
<td>2666</td>
<td>2666</td>
<td>2666</td>
<td>2666</td>
<td>2666</td>
</tr>
<tr>
<td>Density</td>
<td>2GB/4GB/8GB/16GB/32GB</td>
<td>4GB/8GB/16GB/32GB</td>
<td>8GB/16GB/32GB</td>
<td>8GB/16GB/32GB</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage</td>
<td>1.35V</td>
<td>1.35V</td>
<td>1.35V</td>
<td>1.35V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power Consumption</td>
<td>1.35W</td>
<td>1.35W</td>
<td>1.35W</td>
<td>1.35W</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dimensions</td>
<td>1.23” x 1.18”</td>
<td>1.23” x 1.18”</td>
<td>1.23” x 1.18”</td>
<td>1.23” x 1.18”</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Optional*
Swissbit - Reliable Storage & Embedded IoT Solutions

Data is the fuel of the future and is driving global growth and change. As trusted partner Swissbit empowers the digital and connected world by reliably storing and protecting data in industrial, security and IoT applications. As a leader in industrial storage and embedded IoT (Internet of Things) solutions, Swissbit develops and manufactures true industrial storage and security products “Made in Germany” with long-term availability, high reliability, custom optimization and low total cost of ownership.

Swissbit System Competency

Swissbit owns all core processes from the conception to volume production of our products. This allows us to design and produce optimal solutions for demanding applications.

System-in-Package

System-in-Package (SiP) is the umbrella term for using advanced packaging and assembly technologies to integrate and test sensitive bare silicon dies or chips (active circuits) and supporting components (passives) into robust finished modules or components. Together with integrated software or firmware this will create a fully functional system solution.
Swissbit 3D NAND Products

OEMs’ of various industries require a variety of memory and storage solutions. In contrast to typical consumer devices, Swissbit’s embedded memory and storage solutions are designed for highest reliability under extreme environmental conditions. They come with a large feature set tailored to the demands of the industrial, automotive, and IoT markets and with our commitment to long-term availability. Swissbit’s embedded memory and storage solutions portfolio covers all relevant interfaces and form factors including SD and microSD memory cards, CompactFlash™ and CFast™ cards, 2.5” SATA SSDs, SLIM SATA and mSATA SSDs, M.2 in SATA and PCIe NVMe, USB Flash Drives (UFD) and modules. Our sophisticated flash handling algorithms optimize performance and life of the SLC, MLC and 3D NAND flash used in our products.

Swissbit Life Time Monitoring

The Swissbit Life Time Monitoring Tool (SLTMT) provides a detailed overview of the life time status of Swissbit products.

This includes the standard S.M.A.R.T. parameter as well as down to the single block Flash utilization numbers.

The tool can be used to extrapolate the life time expectation of a product in a real application by taking two snapshots before and after the test and evaluating the consumption through the test phase.

Download: www.swissbit.com/en/support/sltmt

Swissbit Security Products

Swissbit offers unique hardware security for reliably protecting data and devices. Swissbit’s modular security products are based on standard interfaces and offer system manufacturers a range of hard-ware-based cyber security solutions for the protection of data and devices. Security products are variations of storage products with various security features. The security product series in USB, microSD, and SD form factors address the growing demand for mobile, portable and industrial security. They offer unique hardware security which is very suitable for retrofit and updates in the field.

iShield Products

Secure Data, Video and Photo Recording

The microSD card Swissbit iShield Camera is a simple and retrofittable security solution especially for the encryption and access protection of video recordings. It is host-independent, i.e. plug-and-play, and can be used with a large number of camera types. The solution also includes the “iShield Camera Card Tool” (iCCT) software.

Security Editions

Easy-to-integrate and Retrofittable Hardware-based Security Products

Swissbit provides easy-to-integrate and retrofittable hard-ware-based security products together with software development kits (SDK) and customization services, enabling manufacturers to offer systems with secured devices, secure data storage, and secure data communication.

Standard Edition SE

The Standard Edition SE fits best into authentication and PKI (Public Key Infrastructure) use cases.

Premium Edition PE

The Premium Edition PE combines high end smartcard security with state of the art data protection.

Data Protection DP

The Data Protection DP cards and USB drive offer AES encrypted data protection.

Raspberry Pi Edition

Secure Boot Solution for Raspberry Pi

The Swissbit Secure Boot Solution for Raspberry Pi allows encryption and access protection of data stored on the microSD card by various configurable security policies. It protects the boot image and software installation against manipulation, unwanted copying, or removal of a system from a defined network. The Swissbit Secure Boot Solution for Raspberry Pi consists of a Swissbit PS-45u DP microSD card “Raspberry Edition” and a Swissbit Secure Boot SDK for Raspberry Pi with secured devices, secure data storage, and secure data communication.
Transcend - Good Memories Start Here

Transcend Information Inc. was founded in 1988 by Peter Shu. It is headquartered in Taipei, Taiwan. Today, Transcend has become a leading global brand of digital storage, multimedia and industrial products with 13 offices worldwide. All products are designed, developed, manufactured, tested and sold inhouse. Highest quality, professional service and the ability to quickly respond to the market's changing needs are the main focus of the company.

Complete Product Portfolio

Our Products Fulfill All Your Storage Needs

- SSD Solutions
- DRAM Modules
- Flash Memory Modules
- Memory Cards

Advanced Technologies

Durability:
- Corner Bond
- Underfill
- Extended Temperature
- Power Loss Protection
- Thermal Sensor

Reliability:
- Read Disturbance
- Garbage Collection
- Wear Leveling
- TCG Opal
- Conformal Coating

Security:
- Anti-Sulfur Technology
- AES Encryption
- Hardware Purge
- TCG Opal
- Power Shield (PS)

Stability:
- Dynamic Thermal Thrusting
- TRIM
- Bad Block Management
- Conformal Coating

NAND Flash Technologies:
- TLC, MLC, SLC mode

Capacities:
- 2GB - 1TB
- 4GB - 512GB
- 32GB - 256GB
- 8GB - 32GB

Temperature:
- 25°C up to 85°C
- 5°C up to 70°C
- -25°C up to 85°C
- -40°C up to 85°C
Key features of Transcends BiCS5 and BiCS4 SSDs

- BiCS5 112-layer write performance UP 50% compared to BiCS4
- Extended temp. (-20°C - 75°C), optional wide temp. (-40°C - 85°C)
- Corner Bond (Controller + DRAM)
- 30µ” PCB Gold Fingers
- Anti-Sulfur resistors*
- Dynamic Thermal Throttling
- Optional: MLC, SLC mode
* BiCS5 only

Flash Types

<table>
<thead>
<tr>
<th>Type</th>
<th>3D TLC BiCS5</th>
<th>3D TLC BiCS4</th>
<th>3D TLC SLC Mode BiCS4</th>
<th>MLC</th>
<th>MLC SLC Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Layer</td>
<td>112-Layer</td>
<td>96-Layer</td>
<td>96-Layer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Endurance (P/E Cycles)</td>
<td>3,000</td>
<td>3,000</td>
<td>10,000</td>
<td>3,000</td>
<td>30,000</td>
</tr>
<tr>
<td>Bit per Cell</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Performance</td>
<td>★★</td>
<td>★★</td>
<td>★★★★</td>
<td>★</td>
<td>★★★★</td>
</tr>
<tr>
<td>Cost</td>
<td>★</td>
<td>★★</td>
<td>★</td>
<td>★</td>
<td>★★</td>
</tr>
<tr>
<td>Features</td>
<td>For price sensitive applications, that need high endurance/ performance</td>
<td>Suitable for SSDs and most embedded applications</td>
<td>High endurance solution that substitutes SLC</td>
<td>Majorly used in SSD and most embedded applications</td>
<td>More affordable than SLC, better performance than MLC</td>
</tr>
</tbody>
</table>

Embedded Applications - Transcend products are widely used in various areas of industry

- Transportation
  - In-Vehicle Infotainment System
  - Navigation System
- Healthcare
  - Medical Tablet
  - MRI and Ultrasound System
- Networking and Telecom
  - Data Center Server
  - Video Streaming Server
- Automation
  - Robot Control
  - Process Control/Util and Terminal
- Defense
  - Rugged PC and Laptop
  - Ground Control and Communication Station
- Embedded Application
  - Industrial and Panel PC
  - Fanless PC
- Gaming
  - Slot Machine
  - VR/AR Gaming Machine
- AlOT
  - Smart Manufacturing Factory
  - Self-service Store

DRAM Modules

<table>
<thead>
<tr>
<th>Wide Temperature (-40 to 95 Grad)</th>
<th>Server / Workstations</th>
<th>Standard</th>
<th>Low Profile</th>
</tr>
</thead>
<tbody>
<tr>
<td>DRAM Generation</td>
<td>DDR4, DDR3(L), DDR2</td>
<td>DDR5, DDR4, DDR3(L), DDR2</td>
<td>DDR4, DDR3(L), DDR2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module Type</th>
<th>U-DIMM</th>
<th>ECC U-DIMM</th>
<th>R-DIMM</th>
<th>ECC R-DIMM</th>
</tr>
</thead>
<tbody>
<tr>
<td>U-DIMM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ECC U-DIMM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R-DIMM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ECC R-DIMM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Frequency</th>
<th>DDR4: 3200, 2666, 2400, 2133</th>
<th>DDR5: 4800</th>
<th>DDR4: 4800</th>
<th>DDR4: 3200, 2666, 2400, 2133</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDR3(L): 1866, 1600, 1333</td>
<td>DDR4: 3200, 2666, 2400, 2133</td>
<td>DDR4: 3200, 2666, 2400, 2133</td>
<td>DDR3(L): 1866, 1600, 1333, 1066</td>
<td></td>
</tr>
<tr>
<td>DDR2: 800, 667</td>
<td>DDR3(L): 1866, 1600, 1333</td>
<td>DDR4: 3200, 2666, 2400, 2133</td>
<td>DDR4: 3200, 2666, 2400, 2133</td>
<td></td>
</tr>
</tbody>
</table>

www.rutronik.com/EMBEDDED
Toshiba Memory is now KIOXIA

Our company name has changed. But our product range, quality, service and reliability are still the same.

KIOXIA Europe GmbH (formerly known as Toshiba Memory Europe GmbH) is the European based subsidiary of KIOXIA Corporation, a worldwide leading supplier of Flash Memory, Solid State Drives (SSDs) and Retail Products (USB, Memory Cards, SSDs).

Toshiba Memory is known as the inventor of NANO flash memory in 1987 and was the first in the world to begin mass-producing it in 1991. Under its new name, KIOXIA remains a storage leader today with its BICS FLASH™ 3D technology, focusing on innovation, quality and reliability. This technology is an important component in almost all electronic devices where data need to be stored. KIOXIA is leading a new era by providing advanced memory solutions to enrich people’s lives. By evolving “memory”, KIOXIA creates uplifting experiences and changes the world.

A new start with a new unique name

The name KIOXIA is a merger of two different words: the Japanese word kioku means “memory” and the Greek word axios means “value”.

How to pronounce KIOXIA?

Store and save your memories for the future with KIOXIA

KIOXIA

The Inventor of Flash Memory

Made in Japan

WORLD'S LARGEST FABRICATION™

All KIOXIA flash memory wafer manufacturing is done in Japan (Yokkaichi and Kitakami).

HIGH QUALITY & RELIABILITY

With stringent quality control, we are dedicated to providing high quality products.

100% IN-HOUSE FLASH MEMORY

KIOXIA flash memory is used in 100% of our consumer memory and storage products.

BG4 Series

Client SSD

The BG4 series is a line-up of compact single package NVMe™ SSDs with capacities up to 1,024 GB, and leverages a PCIe® Gen4x4 interface and KIOXIA’s 96-layer TLC BICS FLASH™ with higher bandwidth and improved flash management and Host Memory Buffer (HMB) technology. BG4 SSDs deliver best-in-class read performance in single package SSDs, of up to 3,000 MB/s (sequential read) and up to 390K IOPS (random read), with active power consumption of up to 3.7 W (Typ.).

The BG4 series is available in four capacities of 128 GB, 256 GB, 512 GB and 1,024 GB in surface-mount M.2 1620 single package or removable M.2 2280 module form factor options, making them suitable for thin and light system designs for ultra-thin PCs, as well as embedded devices and server boot in data centers.

The BG4 series is with the option of a Self-Encrypting Drive (SED) model* supporting TCG Opal Version 2.01.

*Availability of the SED model line up may vary by region. The specifications of BG4 self-encrypting drive (SED) will be released 64 calendar year of 2019.

XG6 Series

Client SSD

The XG6 series utilizes KIOXIA’s latest 96-layer, 3D TLC (tactile-per-cell) flash memory. With 4th generation BICS FLASH™ and SLC cache features, XG6 SSDs reach up to sequential read/write speeds of 3100 MB/s and 2900 MB/s respectively and deliver up to 355,000 random read and 365,000 random write IOPS. In addition to high performance, XG6 carries on the low power design of the XG family, consuming 4.7 W or less in active mode and less than 3 mW in stand-by mode.

The new XG6 series is optimized for power-sensitive mobile PCs, performance-oriented gaming PCs, as well as data center environments for server-boot, caching and logging.

Available in a compact M.2 2280 single-sided form factor, the XG6 series comes in three capacity models of 256 GB, 512 GB and 1,024 GB, each with the option of a Self-Encrypting Drive (SED) model supporting TCG Opal Version 2.01.

Key Features

KIOXIA 96-Layer BICS FLASH™

PCIe® Gen4x4 NVMe™

Capacities up to 1,024 GB

M.2 1620 single package and

M.2 2280 single-sided form factor

TCG OPAL 2.01 Optional for SED

Key Applications

Ultra-mobile PCs

2-in-1 notebook PCs

IoT/embedded devices

Server and storage array boot drives

Key Features

KIOXIA 96-Layer BICS FLASH™

PCIe® Gen4x4 NVMe™

Capacities up to 1,024 GB

M.2 2280 Single-sided

TCG OPAL 2.01 Optional for SED*

Key Applications

Thin performance notebook PCs

High-performance desktop PCs

Gaming PCs

Server-boot, caching & logging use in data centers

* Availability of the SED model line up may vary by region.
Client SSDs

Leveraging state-of-the-art BICS FLASH® 3D flash memory with in-house designed controllers and firmware, KIOXIA client SSDs come in a variety of form factors, including a compact and lightweight “single-package SSD.” They also offer a variety of capacities, performance and security options, and are well-suited for mobile computing, desktop PCs and workstations.

XG6 Series

Utilizing 64-layer BICS® 3D FLASH® flash memory, the XG6 Series is available in an M.2 2280, single-ended factor with a PCIe® Gen 3 x4 interface, supporting the NVMe™ command set. This provides a powerful combination of power, efficiency, and high performance, consuming 7.9 W or less with over 3,000 MB/s sequential read performance, respectively. The XG6 Series offers a self-encrypting drive (SED) option that supports TCG Opal version 2.1, under a different model number.

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Security Feature</th>
<th>Interface</th>
<th>Form Factor</th>
<th>User Capacity (GB)</th>
<th>Sequential Read (MB/s)</th>
<th>Sequential Write (MB/s)</th>
<th>TypicalPower (W)</th>
<th>Operating Temperature (°C)</th>
<th>Dimensions (W x H x L) (mm)</th>
<th>Typical Weight (g)</th>
<th>Power Supply Voltage (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>KG6XN2280V4E0</td>
<td>-</td>
<td>PCIe® Gen 3 x4</td>
<td>M.2 2280</td>
<td>288</td>
<td>2,600</td>
<td>1,560</td>
<td>7.9</td>
<td>5 to 70</td>
<td>22.2 X 22.2 X 7.8</td>
<td>2.65</td>
<td>5.0</td>
</tr>
<tr>
<td>KG6XN4280V4E0</td>
<td>-</td>
<td>PCIe® Gen 3 x4</td>
<td>M.2 2280</td>
<td>512</td>
<td>2,600</td>
<td>1,000</td>
<td>7.9</td>
<td>5 to 70</td>
<td>22.2 X 22.2 X 7.8</td>
<td>2.65</td>
<td>5.0</td>
</tr>
<tr>
<td>KG6XN8280V4E0</td>
<td>-</td>
<td>PCIe® Gen 3 x4</td>
<td>M.2 2280</td>
<td>1,024</td>
<td>2,600</td>
<td>7.3</td>
<td>7.9</td>
<td>5 to 70</td>
<td>22.2 X 22.2 X 7.8</td>
<td>2.65</td>
<td>5.0</td>
</tr>
</tbody>
</table>

XG6-P Series

Utilizing 64-layer BICS® 3D FLASH® flash memory, the XG6-P Series is available in capacities up to 1,048 GB and has higher sequential read bandwidth than the previous generation. This series is designed for high-end workstations, gaming systems and for cost-optimized consumer storage infrastructures. The XG6-P Series offers a self-encrypting drive (SED) option that supports TCG Opal version 2.1, under a different model number.

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Security Feature</th>
<th>Interface</th>
<th>Form Factor</th>
<th>User Capacity (GB)</th>
<th>Sequential Read (MB/s)</th>
<th>Sequential Write (MB/s)</th>
<th>TypicalPower (W)</th>
<th>Operating Temperature (°C)</th>
<th>Dimensions (W x H x L) (mm)</th>
<th>Typical Weight (g)</th>
<th>Power Supply Voltage (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>KG6XP2280V4E0</td>
<td>-</td>
<td>PCIe® Gen 3 x4</td>
<td>M.2 2280</td>
<td>2,944</td>
<td>2,600</td>
<td>2,000</td>
<td>7.9</td>
<td>5 to 70</td>
<td>22.2 X 22.2 X 7.8</td>
<td>2.65</td>
<td>5.0</td>
</tr>
</tbody>
</table>

BG4 Series

In compact, single-package form factor and based on 64-layer BICS® FLASH™ 3D flash memory, the BG4 Series is designed for thin and light performance-oriented use cases, such as ultrabook PCs, IoT devices and data center server books. Available in capacities up to 1.9 TB, the BG4 Series features Host Memory Buffer (HMB), PCIe® Gen 3 x4 and supports the NVMe™ command set. The BG4 Series offers a self-encrypting drive (SED) option that supports TCG Opal version 2.1, under a different model number.

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Security Feature</th>
<th>Interface</th>
<th>Form Factor</th>
<th>User Capacity (GB)</th>
<th>Sequential Read (MB/s)</th>
<th>Sequential Write (MB/s)</th>
<th>TypicalPower (W)</th>
<th>Operating Temperature (°C)</th>
<th>Dimensions (W x H x L) (mm)</th>
<th>Typical Weight (g)</th>
<th>Power Supply Voltage (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>KB4G2280V1E0</td>
<td>-</td>
<td>PCIe® Gen 3 x4</td>
<td>M.2 2280</td>
<td>128</td>
<td>2,000</td>
<td>800</td>
<td>2.6</td>
<td>5 to 70</td>
<td>22.2 X 22.2 X 7.8</td>
<td>2.65</td>
<td>5.0</td>
</tr>
<tr>
<td>KB4G4280V1E0</td>
<td>-</td>
<td>PCIe® Gen 3 x4</td>
<td>M.2 2280</td>
<td>256</td>
<td>2,000</td>
<td>1,000</td>
<td>2.6</td>
<td>5 to 70</td>
<td>22.2 X 22.2 X 7.8</td>
<td>2.65</td>
<td>5.0</td>
</tr>
<tr>
<td>KB4G8280V1E0</td>
<td>-</td>
<td>PCIe® Gen 3 x4</td>
<td>M.2 2280</td>
<td>512</td>
<td>2,000</td>
<td>700</td>
<td>2.6</td>
<td>5 to 70</td>
<td>22.2 X 22.2 X 7.8</td>
<td>2.65</td>
<td>5.0</td>
</tr>
<tr>
<td>KB4G16280V1E0</td>
<td>-</td>
<td>PCIe® Gen 3 x4</td>
<td>M.2 2280</td>
<td>1,024</td>
<td>2,000</td>
<td>380</td>
<td>2.6</td>
<td>5 to 70</td>
<td>22.2 X 22.2 X 7.8</td>
<td>2.65</td>
<td>5.0</td>
</tr>
</tbody>
</table>

Data Center SSDs

Leveraging state-of-the-art BICS FLASH® 3D flash memory with in-house designed controllers and firmware, KIOXIA data center SSDs are designed for cloud-based applications running on scale-out cloud and traditional server deployments. These data center SSDs are optimized for a balance of performance, low latency and data protection, and provide power loss protection (PLP) to safeguard data in case of unexpected power loss.

XDS Series

Based on 64-layer BICS® 3D flash memory, the XDS Series of PCIe® Gen 3 x4 / NVMe™ SSDs is available in an M.2 Type 22110 or a 2.5 inch (7 mm/9.5 mm) form factor with capacities up to 3.84 TB and 8 and 16 active power consumption.

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Interface</th>
<th>Form Factor</th>
<th>User Capacity (GB)</th>
<th>Sequential Read (MB/s)</th>
<th>Sequential Write (MB/s)</th>
<th>TypicalPower (W)</th>
<th>Operating Temperature (°C)</th>
<th>Dimensions (W x H x L) (mm)</th>
<th>Typical Weight (g)</th>
<th>Power Supply Voltage (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>KBX5NCT2824E</td>
<td>PCIe® Gen 3 x4</td>
<td>M.2 22110</td>
<td>512</td>
<td>2,600</td>
<td>1,520</td>
<td>7.9</td>
<td>5 to 70</td>
<td>22.2 X 22.2 X 7.8</td>
<td>2.65</td>
<td>5.0</td>
</tr>
<tr>
<td>KBX5NCT2724E</td>
<td>PCIe® Gen 3 x4</td>
<td>M.2 22110</td>
<td>1,024</td>
<td>2,600</td>
<td>1,520</td>
<td>7.9</td>
<td>5 to 70</td>
<td>22.2 X 22.2 X 7.8</td>
<td>2.65</td>
<td>5.0</td>
</tr>
</tbody>
</table>

HXK Series

The HXK Series of 2.5 inch SATA® SSDs is built with 64-layer BICS FLASH® 3D flash memory, and comes in a 2.5 inch (7 mm/9.5 mm) form factor and capacities up to 7.68 TB. The HXK Series delivers a balance of reliability, performance and low power, and is designed for read-intensive workloads running on servers. The HXK Series is available in M.2 Type 22110 or 2.5 inch (7 mm/9.5 mm) form factors and capacities up to 3.84 TB. The HXK Series delivers a balance of reability, performance and low power, and is designed for mixed workloads running on servers and hyperconverged systems.

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Interface</th>
<th>Form Factor</th>
<th>User Capacity (GB)</th>
<th>Sequential Read (MB/s)</th>
<th>Sequential Write (MB/s)</th>
<th>TypicalPower (W)</th>
<th>Operating Temperature (°C)</th>
<th>Dimensions (W x H x L) (mm)</th>
<th>Typical Weight (g)</th>
<th>Power Supply Voltage (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>KBX8HCT2716E</td>
<td>SATA® 6 Gb/s</td>
<td>2.5 inch</td>
<td>1,920</td>
<td>1,900</td>
<td>850</td>
<td>8.3</td>
<td>5 to 70</td>
<td>22.2 X 22.2 X 7.8</td>
<td>2.65</td>
<td>5.0</td>
</tr>
<tr>
<td>KBX8HCT2732E</td>
<td>SATA® 6 Gb/s</td>
<td>2.5 inch</td>
<td>3,840</td>
<td>1,900</td>
<td>850</td>
<td>8.3</td>
<td>5 to 70</td>
<td>22.2 X 22.2 X 7.8</td>
<td>2.65</td>
<td>5.0</td>
</tr>
</tbody>
</table>

All information provided in this datasheet is subject to change without prior notice. For the latest and detailed specification, please consult our website or contact your local KIOXIA representative.
Enterprise SSDs

Leveraging state-of-the-art BICS FLASH™ 3D flash memory with in-house designed controllers and firmware, KIOXIA enterprise SSDs optimize high performance, endurance and reliability to run mission critical applications in enterprise data center environments. To meet the demands of highly transactional and high-bandwidth workloads, these SSDs feature high levels of performance and data protection with power-loss-protection (PLP™). KIOXIA enterprise SSDs offer a range of security options designed for business critical data storage.

PM5 Series

Based on 19-nm BICS FLASH™ 3D flash memory, the PM5 Series of dual-port 12Gb/s SAS SSDs is available in a 2.5 inch (15 mm Z height) form factor with capacities up to 15.3 TB. These SSDs feature Power Loss Protection (PLP™) and offer a range of security/encryption options.1

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Form Factor</th>
<th>User Capacity (GB)</th>
<th>Performance (up to)</th>
<th>Total Power Consumption</th>
<th>Dimensions (W x H x D, mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>KPM5MS1G01T73</td>
<td>2.5 inch</td>
<td>1,000</td>
<td>Sequential (1,000 MB/s)</td>
<td>9.9/24.6/280</td>
<td>500 x 25.4 x 20.2</td>
</tr>
<tr>
<td>KPM5MS2G01T73</td>
<td>2.5 inch</td>
<td>2,000</td>
<td>2,000</td>
<td>9.9/24.6/280</td>
<td>500 x 25.4 x 20.2</td>
</tr>
<tr>
<td>KPM5MS4G01T73</td>
<td>2.5 inch</td>
<td>4,000</td>
<td>4,000</td>
<td>9.9/24.6/280</td>
<td>500 x 25.4 x 20.2</td>
</tr>
<tr>
<td>KPM5MS8G01T73</td>
<td>2.5 inch</td>
<td>8,000</td>
<td>8,000</td>
<td>9.9/24.6/280</td>
<td>500 x 25.4 x 20.2</td>
</tr>
<tr>
<td>KPM5MS16G01T73</td>
<td>2.5 inch</td>
<td>16,000</td>
<td>16,000</td>
<td>9.9/24.6/280</td>
<td>500 x 25.4 x 20.2</td>
</tr>
</tbody>
</table>

200 employees

Headquartered in Poland

Wilk Elektronik - About Company

GOODRAM Industrial is a brand of Wilk Elektronik SA – Polish memory manufacturer and distributor with nearly 30 years of experience in the memory business. Known for its strict quality policy, flexibility and post-sales support, GOODRAM is the only European memory manufacturer with its own lab, R&D department, state-of-the-art production site, test field and support team. All in-house, under one roof. GOODRAM stands for quality, reliability and support – we believe the industry needs customized solutions for very specific needs. Designing our own testing procedures ensures the modules we produce are tailored to match our customers needs perfectly. Add low MOQ’s, fixed BOM and long-term post-sales support to the mix to achieve the highest possible quality of customer service. It all boils down to guaranteeing our partners the highest reliability possible throughout the module’s lifetime.

GOODRAM Industrial is a brand of Wilk Elektronik SA – Polish memory manufacturer and distributor with nearly 30 years of experience in the memory business. Known for its strict quality policy, flexibility and post-sales support, GOODRAM is the only European memory manufacturer with its own lab, R&D department, state-of-the-art production site, test field and support team. All in-house, under one roof. GOODRAM stands for quality, reliability and support – we believe the industry needs customized solutions for very specific needs. Designing our own testing procedures ensures the modules we produce are tailored to match our customers needs perfectly. Add low MOQ’s, fixed BOM and long-term post-sales support to the mix to achieve the highest possible quality of customer service. It all boils down to guaranteeing our partners the highest reliability possible throughout the module’s lifetime.
DRAM (Dynamic Random Access Memory) modules are easy to install components, available for a wide range of industrial applications including IPC, Rugged PC, Barebone systems etc. GOODRAM DRAM memory modules are available in all the most popular types (DDR1-DDR4) and form factors (DIMM, VLP DIMM, SODIMM), as well as supporting ECC Register or ECC, standard (0/+70°C) or extended (-40/+85°C) temperature range. During the production process all DRAM memory modules are tested in motherboards using our state-of-art testing software, ensuring 100% of modules leaving our production line are working.

**DRAM Memory Modules**

<table>
<thead>
<tr>
<th>Type</th>
<th>DDR1*</th>
<th>DDR2</th>
<th>DDR3</th>
<th>DDR4</th>
<th>DDR5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form Factors</td>
<td>184-pin DDR4</td>
<td>204-pin SODIMM</td>
<td>240-pin DDR4</td>
<td>204-pin SODIMM</td>
<td>240-pin DDR4</td>
</tr>
<tr>
<td>Capacity</td>
<td>512 MB to 1 GB</td>
<td>1 GB to 2 GB</td>
<td>1 GB to 8 GB</td>
<td>4 GB to 16 GB</td>
<td></td>
</tr>
<tr>
<td>Peak Transfer Rate (MB/s)</td>
<td>Up to 3,200</td>
<td>Up to 6,400</td>
<td>Up to 14,900</td>
<td>Up to 25,600 (3,200 MHz)</td>
<td></td>
</tr>
<tr>
<td>Voltage (V)</td>
<td>2.5</td>
<td>1.8</td>
<td>1.5/1.35</td>
<td>1.2</td>
<td>1.1</td>
</tr>
<tr>
<td>ECC option</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating Temperature (°C)</td>
<td>Standard grade: 0 to 70 Industrial grade: -40 to 85</td>
<td>Standard grade: 0 to 85 Industrial grade: -40 to 85</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage Temperature (°C)</td>
<td>-40 to 85</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Key Features &amp; Options</td>
<td>Single/Double Rank configuration, 100% functional tests, Very Low Profile size, 100% functional tests, Low Power Management,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NAND Base Solutions**

SSD drives (Solid State Drives) for industrial usage are available in all mainstream form factors (2.5", mSATA, M.2 SATA). Flash product group includes SD/microSD, CompactFlash®, eMCP cards. MicroSD cards are currently the smallest standard memory form factor with implemented controller. It is widely used in industrial solutions because of small dimensions and relatively low cost. The smallest capacities are usually enough for industrial SDK and OS like Linux. The Industrial Flash cards, beside the form factor, vary from consumer cards. Most important differences is NAND grade, which is the same as used in SSD’s – so called Major Grade and they have fixed list of components.

**Industrial cards based on wide range of NAND technologies:**

- 3D TLC: 3,000 P/E cycles + MLC: 3,000 P/E cycles
- pSLC: 20,000 P/E cycles + SLC: 60,000 P/E cycles

The industrial cards controller is more complex, with available options helping to increase the endurance and reliability – software power loss protection and general Flash management.

**Features**

- Static and Dynamic Wear Levelling
- Bad Block Management
- TRIM
- S.M.A.R.T.
- NCQ
- Over-provisioning
- Low Power Management

Our products support standard (0/+70°C) and extended (-40/+85°C) temperature range. Depending on customer’s requirements, we can offer 3D TLC, MLC, pSLC, SLC type flash solutions, which provide a range of Program/Erase cycles between 3,000 and 60,000.
Solid-State Drive Client Products
Go faster, store more on your PC

Performance, reliability, and capacity - all in a single, affordable PC drive
Take your PC to a new level of responsiveness and reliability. Designed for work and play, Solidigm SSDs deliver excellent storage for any application with exceptional reliability and power efficiency.

Key Advantages
- Boost your PC performance by replacing your HDD or SATA with an Solidigm PCIe SSD
- Reliable Quality - Every Solidigm SSD is subject to rigorous testing standards above and beyond the standard quality requirements
- Easy Upgrade or Install - With Intel® Data Migration Software, you can conveniently copy data from your old drive to a new SSD
- Industry leading innovation - 96-Layer 3D NAND technology
- Solidigm quality and reliability - backed by 5 years warranty

Target Applications
- High-end computing
- Performance gaming
- Workstation
- Digital content creation
- Engineering: FEA, fluid dynamics, CAD
- Mobile computing
- Digital Signage
- POS, Kiosk, Vending machines

About Solidigm
Solidigm is a leading global provider of innovative NAND flash memory solutions. Solidigm technology unlocks data’s unlimited potential for customers, enabling them to fuel human advancement. Born of the combination of Intel’s longstanding innovation in memory products and SK hynix’s international leadership and scale in the semiconductor industry, Solidigm became a standalone U.S. subsidiary under SK hynix in December 2021. Headquartered in San Jose, CA, Solidigm is powered by the inventiveness of close to 2,000 employees in 20 locations around the world.

High-capacity NVMe SSDs for everyday computing
The PC has evolved to reach performance levels once thought unachievable
But the ultimate measure of innovation is the real-world experience of users - whether they are working, playing, or creating content.

- Accomplish more. Work and stay productive on data-intensive applications with performance that supports read/write tasks
- Play more. Enjoy each new level while gaming with reduced load times and accelerated performance
- Create more. Design, edit, and save graphics, photos, videos, and more with high capacity and responsiveness

<table>
<thead>
<tr>
<th>P44 Pro Series</th>
<th>P41 Plus Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultra-fast and power-efficient PCIe 4.0 NVMe SSDs, delivering class-leading performance for the most demanding PC use cases including gaming, content creation, and more.</td>
<td>Cutting-edge PCIe 4.0 SSDs, engineered for real-world workload and applications from daily student and office work to enthusiast-level gaming and content creation.</td>
</tr>
<tr>
<td>Interface</td>
<td>PCIe 4.0 x4, NVMe</td>
</tr>
<tr>
<td>Form Factor</td>
<td>M.2 2280</td>
</tr>
<tr>
<td>Capacity</td>
<td>2 TB - 512 GB</td>
</tr>
<tr>
<td>Interface</td>
<td>PCIe 4.0 x4, NVMe</td>
</tr>
<tr>
<td>Form Factor</td>
<td>M.2 2280: M.2 2230</td>
</tr>
<tr>
<td>Capacity</td>
<td>2 TB - 512 GB</td>
</tr>
</tbody>
</table>
Solid-State Drive Data Center Products
Modernize your Data Center

Solidigm draws on decades of technical innovation to offer a broad portfolio of drives all with industry-leading quality and reliability, optimized for the data center, the edge, and everything in between.

Key Advantages
- High capacity per drive, server and rack
- Improved manageability and serviceability
- Efficient thermal design
- Reduced maintenance cost and total cost of ownership
- High throughput (IOPS/s)
- Ultra-low latency
- Excellent quality of service
- Ultra-high endurance

Target Applications
- Cloud storage
- Scale out storage
- Hard drive replacement
- Virtualization
- In-memory database

D7 Series (formerly manufactured by Intel Corporation)
SSD D7 Series drives are tuned for real-world mixed and performance-sensitive read workloads. The highest performing family of TLC 3D NAND SSDs delivers the right balance of speed, endurance, and capacity.

D7-P5510
- High performing PCIe 4.0 drives
- Standard endurance
- Up to 7.68TB of capacity
- Performance-sensitive, read-intensive, and/or sequential workloads

D7-P5600
- Balanced read/write performance for mixed workload applications
- Available in 1.6TB, 3.2TB and 6.4TB capacities
- Strong blend of performance, endurance, and capacity

D7-P5500
- Consistently high performance for mixed workload applications
- Designed for mixed-workload applications

D7-P5520
- High-performing PCIe 4.0 SSDs
- Standard endurance
- Up to 15.36TB of capacity
- Designed for read-intensive workloads

D7-P5530
- Mid-endurance PCIe 4.0 SSDs
- Capacities up to 12.8TB
- Designed for mixed-workload applications

D7-P5540
- High-performance PCIe 3.0 SSDs
- Standard endurance
- Up to 15.36TB of capacity
- Designed for read-intensive workloads

D7-P5550
- Performance-sensitive, read-intensive, and/or sequential workloads

D5 Series (formerly manufactured by Intel Corporation)
The SSD D5 Series performance is optimized for read and sequential workloads. This value-optimized family of SSDs features capacities ranging from 960 GB to 30.72 TB.

D5-P5316
- Read-optimized PCIe 4.0 drives
- Available in capacities up to 30.72TB
- Delivering industry-leading storage efficiency for read-intensive and sequential workloads
- Essential endurance, helping reduce storage costs for compute servers

D5-P5420
- Value endurance drives with good read performance
- Massively capacities up to 30.72TB
- Ideal for consolidating storage footprints and reducing operational costs

D5-P4320
- Standard-endurance SATA drives
- Capacities up to 30.72TB
- Increasing server efficiency and boosting IOPS/TB performance over legacy HDDs for cloud storage

D3 Series (formerly manufactured by Intel Corporation)
The SSD D3 Series includes a wide range of products tuned for mixed read/write and read-intensive workloads. This SATA family of TLC NAND SSDs accelerates storage performance and reduces operating expenses (OpEx) on legacy infrastructure.

D3-S4520
- Standard-endurance SATA drives
- Capacities up to 7.68TB
- Increasing server efficiency and boosting IOPS/TB performance over legacy HDDs for cloud storage

D3-S4620
- Mid-endurance SATA drives
- Available in a range of capacities up to 3.84TB
- Increased server efficiency and boosting IOPS/TB performance over legacy HDDs for compute server workloads

www.rutronik.com/EMBEDDED
HD Medical Video Recorder

Based on many years of experience and product knowledge of medical imaging and recording, TEAC introduces the UR-4MD and UR-50BD, the solution for undiluted high-definition medical recording.

Excellent quality recording provided by TEAC UR-4MD and UR-50BD maximizes the efficiency of studies.

DV-W5600 – Industrial Writer

TEAC’s new professional DV-W5600 is the world’s most efficient and accurate CD/DVD recorder and verifier for qualified applications. It offers hundred per cent quality control for all discs. Originally designed for PC use, DV-W5600 has some special functions added to fulfill requirements in industrial use.

Equipped with TEAC’s typical very long product lifecycle, a stable and reliable platform is assured.

Features
- SATA Interface
- High accuracy of try open position
- Reduces the mis-loading of the disc by Auto-Loader
- Improving the throughput by immediate transition to verify mode
- Very quick verify mode
- Fast tray operation
- Improvement of reliability and maintenance system
- Support new discs by adjusting new write strategies
- Error report by blinking LED
- Accumulative turn-on time on Laser Diode
- Total Power-on-Hour, CD/DVD write/read accumulate time
- Compliance with Medical Standards

Optical Drives – Ideal for Industrial Applications

Advantages at a glance
- Space-saving “SlimLine” housing
- Attractive design
- Innovative technology
- Has been on the market as long as the PC
- Very high quality standard
- Long life cycle
- High compatibility
- Modified to industrial standards
- Custom solutions possible

DV-W28SS-B93 – Slim Slot Loading DVD / CD Recorder

TEAC’s slimline 8x DVD-Recorder DV-W28SS-W offers the most comfortable slot-in mechanism for your convenience.


Whether you are watching high definition movies, listening to music or playing DVD title, the TEAC 8x slimline DVD-Recorder DV-W28SS-W with its robust and extremely reliable slot-in mechanism is the perfect multimedia companion for your notebook or PC.

Interface SerialATA Revision 3.1
Access Time 140ms typ CD-ROM
150ms typ DVD-ROM
Data Buffer 1MB
Loading Mechanism Slot Loading Type
Ambient Temp. Operating: 5 to 45 °C
Non-Operating: 10 to 95% (non-condensing)
Transportation: 10 to 95% (non-condensing)
Relative Humidity 0 to 80% (non-condensing)
Non-Operating: 10 to 95% (non-condensing)
Current Consumption Standby/Sleep: 50mA (Average current max.)
During starting / Seek: 1500mA
(Max spikes less than 1ms)
MTBF 60,000POH (10% duty)
Safety Standards Approved by UL, CUL, TÜV, CE and BSMI
For up-to-date HMI solutions, RUTRONIK EMBEDDED offers all types of TFT & LCD displays with separate or integrated touch function in all technologies. These include high-end and low-cost models, displays for indoor and outdoor use with excellent clarity of display even in direct sunlight, expanded temperature range and a high degree of robustness. The sizes range from diagonals of 0.9 to 90 inches for active TFT and many different passive LCD solutions. In addition semi and full customization is possible.
TFT Technology by Tianma

**Standard Industrial Line**
- Long-term availability
- Long time phase-out strategy for industrial applications
- Low power consumption
- 3.3 V operation
- True Colour with brilliant colours

**SFT Technology (Super Fine TFT)**

**High Luminance, Wide Color Gamut**
With the SA5FT and UA5FT technologies Tianma has achieved improved panel transmissivity, resulting in higher luminance and wider color gamut displays allowing customers to view clear and vivid color images in bright environments.

**High Definition**
Tianma offers products with pixel density of up to 220 pixels/inch and resolution of up to 5M pixel displays. That means customers enjoy faithful reproduction of high-precision images down to the finest details – from the fine text and lines of CAD and DTP to the delicate nuances of nature images and imaging data for medical purposes.

**Quick Response**
Tianma is developing the SFT technology, which features low dependence on response time between grayscale levels, to achieve uninterrupted full-motion video.

**Ultra-wide Viewing Angle, Reduced Color Shift**
LCDs with SFT Technology feature a new ultra-wide 170° (right/left and up/down) viewing angle while minimizing the color shift phenomenon that occurs as luminance changes with viewing angle. The result is a new and definitive benchmark in image quality.

**EVT Technology (Enhanced View TFT)**

**R-EVT Guarantees High-visibility in All Outdoor Light Environments**
R-EVT maximizes the high ambient light visibility features of a reflective-type LCD along with the low ambient light visibility features of a transmissive-type LCD to deliver high picture quality in all possible light environments.

**T-EVT: Transmissive EVT**

**R-EVT Guarantees High-visibility in All Outdoor Light Environments**

**T-EVT: Transmissive EVT**

**PCAP by Tianma as a One-stop Shop Solution**
Tianma provides factory installed touch panels which have an external touch controller as option. Thanks to the in-house design and manufacturing capabilities they are able to offer high quality, integrated PCAP products direct from the factory as a one stop shop solution with full factory warranty.

Tianma provides factory tuned PCAP products, drivers and offer special tuning software as part of Tianma total PCAP solutions, in order to better support customer’s needs and help ease adoption of Tianma’s PCAP based modules.

Due to the fact that the requirements of the customers are very individually, most requests need to be handled as a custom solution. Customized options are different surface film, optical bonding and customized cover glasses.
TFT Color Modules

TFT Color Modules

The following TFT Color graphic modules are produced in their own TFT factory in Shanghai. This will greatly benefit Tianma and their customers by guaranteeing long-term availability of the products. With currently three 4.5 TFT production lines and one 5.0G TFT production line Tianma Group is now one of the largest manufacturers of small and medium size TFT modules worldwide.

Tianma's products offer a lot of technical advantages such as wide viewing angle, high contrast, high brightness and fast response time and are produced for industrial, telecommunication and automotive applications.

TFT Technology by U.R.T.

U.R.T. products are widely applied in a broad range of applications and markets.

With advancing technologies in digital, dot matrix and graphic LCD panels and modules, U.R.T. is always committed to produce LCD products with the highest level of contrast, wide viewing angles, long life, and high reliability.

Bartype TFT Portfolio

<table>
<thead>
<tr>
<th>Size</th>
<th>Resolution</th>
<th>Interface</th>
<th>Touch Panel</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0</td>
<td>7.37</td>
<td>1280x1024</td>
<td>RGB</td>
</tr>
<tr>
<td>3.9</td>
<td>9.91</td>
<td>1280x1024</td>
<td>RGB</td>
</tr>
<tr>
<td>4.6</td>
<td>11.68</td>
<td>1280x1024</td>
<td>RGB</td>
</tr>
<tr>
<td>5.8</td>
<td>15.49</td>
<td>1280x1024</td>
<td>RGB</td>
</tr>
<tr>
<td>6.5</td>
<td>16.51</td>
<td>1280x1024</td>
<td>RGB</td>
</tr>
<tr>
<td>8.0</td>
<td>22.35</td>
<td>1280x1024</td>
<td>RGB</td>
</tr>
<tr>
<td>10.1</td>
<td>26.42</td>
<td>1280x1024</td>
<td>RGB</td>
</tr>
<tr>
<td>12.1</td>
<td>30.73</td>
<td>1280x1024</td>
<td>RGB</td>
</tr>
<tr>
<td>15.0</td>
<td>38.10</td>
<td>1280x1024</td>
<td>RGB</td>
</tr>
<tr>
<td>15.6</td>
<td>39.62</td>
<td>1280x1024</td>
<td>RGB</td>
</tr>
<tr>
<td>18.5</td>
<td>46.99</td>
<td>1280x1024</td>
<td>RGB</td>
</tr>
</tbody>
</table>

Product Portfolio TFT

<table>
<thead>
<tr>
<th>Size</th>
<th>Resolution</th>
<th>Interface</th>
<th>Touch Panel</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.4</td>
<td>6.10</td>
<td>QVGA</td>
<td>MPU</td>
</tr>
<tr>
<td>2.8</td>
<td>7.11</td>
<td>QVGA</td>
<td>MPU</td>
</tr>
<tr>
<td>3.5</td>
<td>8.89</td>
<td>QVGA, VGA</td>
<td>RGB, MPU</td>
</tr>
<tr>
<td>4.3</td>
<td>10.92</td>
<td>480x320x72, 800x600</td>
<td>RGB</td>
</tr>
<tr>
<td>5.8</td>
<td>12.70</td>
<td>800x600</td>
<td>RGB</td>
</tr>
<tr>
<td>7.0</td>
<td>17.8</td>
<td>1280x800</td>
<td>RGB</td>
</tr>
<tr>
<td>10.1</td>
<td>25.7</td>
<td>1024x768</td>
<td>RGB</td>
</tr>
<tr>
<td>10.4</td>
<td>26.4</td>
<td>1024x768</td>
<td>RGB</td>
</tr>
<tr>
<td>12.1</td>
<td>30.7</td>
<td>1024x768</td>
<td>RGB</td>
</tr>
<tr>
<td>15.0</td>
<td>38.1</td>
<td>1024x768</td>
<td>RGB</td>
</tr>
<tr>
<td>15.6</td>
<td>39.6</td>
<td>1024x768</td>
<td>RGB</td>
</tr>
<tr>
<td>18.5</td>
<td>46.99</td>
<td>1024x768</td>
<td>RGB</td>
</tr>
</tbody>
</table>
TFT Technology by Yeebo

Yeebo with the headquarter located in Hong Kong is producing with multiple, highly automated production lines which have latest state of the art equipment to meet the requirements of most applications.

With their experienced and professional design team they are able to tailor their service to meet every individual need from the customers. With a portfolio with a focus on 1.44” up to 7” and some additional panels up to 12.1” they meet the requested sizes and features for the European industrial market.

E-Papers

1-Dot-Matrix E-Papers

Matrix displays are intended for applications requiring the display of many different forms of text and images. These displays comprise of a large array of pixels. These individual pixels are controlled by a TFT array.

Holitech offers a range of standard products for 1.5” up to 42”. Most of the sizes are available in:
- Black white | Black White Red | Black White Yellow | Black white | Black White Red | Black White Yellow
- Frozen (supports temperatures below 0°C)

Tooling for Dot-Matrix displays should be discussed case by case and could only be done for big volumes if we get the needed TFT support.

Segmented E-Papers

Segmented displays are intended for applications where the display requirements can be met using predefined segments that can be turned on or off.

Segmented Displays are in general customized solutions.

Tooling for segmented displays can be made for small quantities (starting from 1000pcs) and costs between 8$k ~ 10$k

How does E-Paper work?

The two pigment electronic ink system is made up of millions of tiny microcapsules, each about the diameter of a human hair. Each microcapsule contains negatively charged white particles and positively charged black particles suspended in a clear fluid.

When a positive or negative electric field is applied, corresponding particles move to the top of the microcapsule where they become visible to the viewer. This makes the surface appear white or black at that spot.

TFT Portfolio

<table>
<thead>
<tr>
<th>Size (inch)</th>
<th>Interface</th>
<th>Resolution</th>
<th>Technology</th>
<th>Lifetime In Hours</th>
<th>Touch Incl.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.44</td>
<td>3.6</td>
<td>CPU</td>
<td>128x128</td>
<td>TN</td>
<td>20k</td>
</tr>
<tr>
<td>1.77</td>
<td>4.5</td>
<td>MCU</td>
<td>128x160</td>
<td>TN</td>
<td>50k</td>
</tr>
<tr>
<td>2.0</td>
<td>5.1</td>
<td>MCU</td>
<td>160x240 / 320x220</td>
<td>TN</td>
<td>20k / 50k</td>
</tr>
<tr>
<td>2.4</td>
<td>6.1</td>
<td>MCU / SPI</td>
<td>240x320</td>
<td>TN / IPS</td>
<td>20k / 50k / PCAP</td>
</tr>
<tr>
<td>2.8</td>
<td>7.1</td>
<td>MCU / SPI</td>
<td>240x320</td>
<td>TN / IPS</td>
<td>20k / 50k / RTP / PCAP</td>
</tr>
<tr>
<td>3.2</td>
<td>8.1</td>
<td>MCU / SPI</td>
<td>300x320</td>
<td>TN</td>
<td>50k</td>
</tr>
<tr>
<td>3.5</td>
<td>8.8</td>
<td>MCU / SPI</td>
<td>320x480</td>
<td>TN / IPS</td>
<td>20k / 50k / RTP / PCAP</td>
</tr>
<tr>
<td>3.97</td>
<td>10.1</td>
<td>MCU / SPI</td>
<td>480x640</td>
<td>IPS</td>
<td>20k</td>
</tr>
<tr>
<td>4.3</td>
<td>10.9</td>
<td>MFI</td>
<td>480x720</td>
<td>TN / IPS</td>
<td>20k / 50k / RTP / PCAP</td>
</tr>
<tr>
<td>4.5</td>
<td>11.4</td>
<td>MFI</td>
<td>480x640</td>
<td>IPS</td>
<td>50k</td>
</tr>
<tr>
<td>5.0</td>
<td>12.7</td>
<td>MFI</td>
<td>800x800</td>
<td>IPS</td>
<td>50k</td>
</tr>
<tr>
<td>5.5</td>
<td>14.0</td>
<td>MFI</td>
<td>720x1200</td>
<td>IPS</td>
<td>50k</td>
</tr>
<tr>
<td>7.0</td>
<td>17.8</td>
<td>MFI</td>
<td>800x800</td>
<td>TN</td>
<td>20k</td>
</tr>
<tr>
<td>9.0</td>
<td>22.9</td>
<td>MFI</td>
<td>800x800</td>
<td>TN</td>
<td>20k</td>
</tr>
<tr>
<td>10.2</td>
<td>25.6</td>
<td>1280x800 / 1024x608</td>
<td>TN</td>
<td>20k / 50k</td>
<td></td>
</tr>
<tr>
<td>12.1</td>
<td>30.7</td>
<td>1920x1080</td>
<td>TN</td>
<td>50k</td>
<td></td>
</tr>
</tbody>
</table>
Rutronik’s new partner DLC offers monochrome, TFT and OLEDs including further components related to displays. DLCs convinces with its wide range of products, especially in the field of TFTs and OLEDs. We are able to offer a big choice of transflective, high-brightness and IPS technologies and guarantee excellent viewing angles and high temperature ranges. Our collection boasts more than 200 TFT and monochrome displays, as well as over 20 models of monochrome OLED displays, all of which are available in sizes ranging from 1.4 to 19 inches.

### TFT Displays & OLEDs

DLC offers TFT Displays & OLEDs with excellent viewing angles and high temperature ranges. Our collection boasts more than 200 TFT and monochrome displays, as well as over 20 models of monochrome OLED displays, all of which are available in sizes ranging from 1.4 to 19 inches.

### TFT Displays & OLEDs

#### TFT Displays

- **Size (In.)**: Various sizes ranging from 1.4 to 19 inches.
- **Resolution**: Various resolutions to suit different applications.
- **Interface**: Options include SPI, MIPI, LVDS, and parallel/SPI/I2C.
- **Touch Panel**: Optional depending on requirements.

#### OLED Displays

- **Size (In.)**: Various sizes ranging from 1.4 to 19 inches.
- **Resolution**: Various resolutions to suit different applications.
- **Interface**: Options include SPI, MIPI, LVDS, and parallel/SPI/I2C.
- **Touch Panel**: Optional depending on requirements.

---

### OLEDs Offer Many Advantages over Both LCDs and LEDs

The plastic, organic layers of an OLED are thinner, lighter and more flexible than the crystalline layers in an LED or LCD. Because the light-emitting layers of an OLED are lighter, the substrate of an OLED can be flexible instead of rigid. OLED substrates can be plastic rather than the glass used for LEDs and LCDs.

OLEDs are brighter than LEDs. Because the organic layers of an OLED are much thinner than the corresponding inorganic crystal layers of an LED, the conductive and emissive layers of an OLED can be multi-layered. Also, LEDs and LCDs require glass for support, and glass absorbs some light. OLEDs do not require glass. OLEDs do not require backlighting like LCDs. LCDs work by selectively blocking areas of the backlight to make the images that you see, while OLEDs generate their own light.

Because OLEDs do not require backlighting, they consume much less power than LCDs. This is especially important for battery-operated devices such as cell phones.

OLEDs are easier to produce and can be made to larger sizes. Because OLEDs are essentially plastics, they can be made into large, thin sheets. It is much more difficult to grow and lay down so many liquid crystals.

OLEDs have large fields of view, about 170 degrees. Because LCDs work by blocking light, they have an inherent viewing obstacle from certain angles. OLEDs produce their own light, so they have a much wider viewing range.

---

### DLC P/N Table

<table>
<thead>
<tr>
<th>DLC P/N</th>
<th>Size (In.)</th>
<th>Dot Format</th>
<th>A.A (mm)</th>
<th>Outline Size (mm)</th>
<th>Interface</th>
<th>Colors</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>DLC0146AZOF-1</td>
<td>0.94</td>
<td>64x64</td>
<td>11.18x9.58</td>
<td>14.53x11.80</td>
<td>SPI</td>
<td>White</td>
<td>Monochrome</td>
</tr>
<tr>
<td>DLC0219BSOG</td>
<td>0.66</td>
<td>64x48</td>
<td>13.42x9.06</td>
<td>18.46x12.10</td>
<td>SPI</td>
<td>White</td>
<td>Monochrome</td>
</tr>
<tr>
<td>DLC0219ASOG</td>
<td>0.66</td>
<td>64x48</td>
<td>13.42x9.06</td>
<td>18.46x12.10</td>
<td>SPI</td>
<td>White</td>
<td>Monochrome</td>
</tr>
<tr>
<td>DLC0219BSOG</td>
<td>0.69</td>
<td>96x64</td>
<td>17.26x14.8</td>
<td>25.05x20.0</td>
<td>SPI</td>
<td>White</td>
<td>Monochrome</td>
</tr>
<tr>
<td>DLC0219BSOG</td>
<td>0.91</td>
<td>128x64</td>
<td>22.36x18.98</td>
<td>30.10x25.5</td>
<td>SPI</td>
<td>White</td>
<td>Monochrome</td>
</tr>
<tr>
<td>DLC0219BSOG</td>
<td>0.95</td>
<td>192x96</td>
<td>27.40x22.42</td>
<td>38.10x33.1</td>
<td>SPI</td>
<td>White</td>
<td>Monochrome</td>
</tr>
<tr>
<td>DLC0219BSOG</td>
<td>0.95</td>
<td>192x96</td>
<td>27.40x22.42</td>
<td>38.10x33.1</td>
<td>SPI</td>
<td>White</td>
<td>Monochrome</td>
</tr>
<tr>
<td>DLC0219BSOG</td>
<td>0.96</td>
<td>128x64</td>
<td>21.74x17.06</td>
<td>27.40x22.42</td>
<td>SPI</td>
<td>White</td>
<td>Monochrome</td>
</tr>
<tr>
<td>DLC0219BSOG</td>
<td>1.12</td>
<td>128x64</td>
<td>21.74x17.06</td>
<td>27.40x22.42</td>
<td>SPI</td>
<td>White</td>
<td>Monochrome</td>
</tr>
<tr>
<td>DLC0219BSOG</td>
<td>1.29</td>
<td>128x64</td>
<td>26.28x20.71</td>
<td>33.05x27.0</td>
<td>SPI</td>
<td>White</td>
<td>Monochrome</td>
</tr>
<tr>
<td>DLC0219BSOG</td>
<td>1.30</td>
<td>128x64</td>
<td>29.42x24.70</td>
<td>38.10x33.1</td>
<td>SPI</td>
<td>White</td>
<td>Monochrome</td>
</tr>
<tr>
<td>DLC0219BSOG</td>
<td>1.32</td>
<td>128x64</td>
<td>26.06x20.14</td>
<td>32.15x23.7</td>
<td>SPI</td>
<td>White</td>
<td>Monochrome</td>
</tr>
<tr>
<td>DLC0219BSOG</td>
<td>1.39</td>
<td>400x400</td>
<td>82.40</td>
<td>38.10x33.1</td>
<td>SPI</td>
<td>White</td>
<td>Monochrome</td>
</tr>
<tr>
<td>DLC0219BSOG</td>
<td>1.41</td>
<td>520x520</td>
<td>87.40</td>
<td>38.10x33.1</td>
<td>SPI</td>
<td>White</td>
<td>Monochrome</td>
</tr>
<tr>
<td>DLC0219BSOG</td>
<td>1.45</td>
<td>146x146</td>
<td>20.32x17.02</td>
<td>26.28x20.7</td>
<td>SPI</td>
<td>White</td>
<td>Monochrome</td>
</tr>
<tr>
<td>DLC0219BSOG</td>
<td>1.46</td>
<td>146x146</td>
<td>20.32x17.02</td>
<td>26.28x20.7</td>
<td>SPI</td>
<td>White</td>
<td>Monochrome</td>
</tr>
<tr>
<td>DLC0219BSOG</td>
<td>1.50</td>
<td>146x146</td>
<td>20.32x17.02</td>
<td>26.28x20.7</td>
<td>SPI</td>
<td>White</td>
<td>Monochrome</td>
</tr>
<tr>
<td>DLC0219BSOG</td>
<td>1.54</td>
<td>146x146</td>
<td>20.32x17.02</td>
<td>26.28x20.7</td>
<td>SPI</td>
<td>White</td>
<td>Monochrome</td>
</tr>
<tr>
<td>DLC0219BSOG</td>
<td>1.60</td>
<td>146x146</td>
<td>20.32x17.02</td>
<td>26.28x20.7</td>
<td>SPI</td>
<td>White</td>
<td>Monochrome</td>
</tr>
<tr>
<td>DLC0219BSOG</td>
<td>1.77</td>
<td>146x146</td>
<td>20.32x17.02</td>
<td>26.28x20.7</td>
<td>SPI</td>
<td>White</td>
<td>Monochrome</td>
</tr>
<tr>
<td>DLC0219BSOG</td>
<td>2.23</td>
<td>146x146</td>
<td>20.32x17.02</td>
<td>26.28x20.7</td>
<td>SPI</td>
<td>White</td>
<td>Monochrome</td>
</tr>
<tr>
<td>DLC0219BSOG</td>
<td>2.42</td>
<td>146x146</td>
<td>20.32x17.02</td>
<td>26.28x20.7</td>
<td>SPI</td>
<td>White</td>
<td>Monochrome</td>
</tr>
<tr>
<td>DLC0219BSOG</td>
<td>2.93</td>
<td>146x146</td>
<td>20.32x17.02</td>
<td>26.28x20.7</td>
<td>SPI</td>
<td>White</td>
<td>Monochrome</td>
</tr>
<tr>
<td>DLC0219BSOG</td>
<td>3.0</td>
<td>146x146</td>
<td>20.32x17.02</td>
<td>26.28x20.7</td>
<td>SPI</td>
<td>White</td>
<td>Monochrome</td>
</tr>
<tr>
<td>DLC0219BSOG</td>
<td>3.95</td>
<td>146x146</td>
<td>20.32x17.02</td>
<td>26.28x20.7</td>
<td>SPI</td>
<td>White</td>
<td>Monochrome</td>
</tr>
</tbody>
</table>

---

### Displays & Systems

- TFT Displays
- OLED Displays
- Monochrome Displays
- Passive Color Displays
- LVDS Displays
- Parallel/SPI/I2C Displays

---

### TFT Displays & OLEDs

The plastic, organic layers of an OLED are thinner, lighter and more flexible than the crystalline layers in an LED or LCD. Because the light-emitting layers of an OLED are lighter, the substrate of an OLED can be flexible instead of rigid. OLED substrates can be plastic rather than the glass used for LEDs and LCDs.

OLEDs are brighter than LEDs. Because the organic layers of an OLED are much thinner than the corresponding inorganic crystal layers of an LED, the conductive and emissive layers of an OLED can be multi-layered. Also, LEDs and LCDs require glass for support, and glass absorbs some light. OLEDs do not require glass. OLEDs do not require backlighting like LCDs. LCDs work by selectively blocking areas of the backlight to make the images that you see, while OLEDs generate their own light.
Specialized in Standard and Custom OLED Modules
Raystar Optronics, Inc., located at Central Taiwan Science Park, is one of the leading OLED display suppliers founded by a group of elites being in the related field for more than 10 years. Its production line includes small to medium size OLED modules for a variety of industrial and consumable applications. Raystar is one of the leading display providers of monochrome character, graphic and alphanumeric OLED panels. Our Portfolio covers all types of PM OLEDs in the size of 0.49 inch up to 5.85 inch in every color variation without a MOQ.

TFTs
Raystar is also a professional TFT (Thin Film Transistor) Modules Manufacturer. The TFT display modules include TFT LCD displays, TFT displays with resistive or capacitive touch screen options and TFT displays with control board, higher brightness or wider viewing angle TFT display modules, monochrome TFT and Bar Type TFT display modules. We can offer customization in backlight or FPC service. Available small TFTs from 0.96” to 5”, midsize TFT from 5.7” to 10.4” and bar type TFTs in 3.9”, 4.6”, 5.2” and 12.3”.

### OLED Display Module - COB

<table>
<thead>
<tr>
<th>Structure</th>
<th>Size (&quot;)</th>
<th>Size (cm)</th>
<th>Outline (mm)</th>
<th>Viewing Area (mm)</th>
<th>Active Area (mm)</th>
<th>Interface</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>COB</td>
<td>1.2</td>
<td>3.0</td>
<td>50x32</td>
<td>38x16</td>
<td>28.16x11.86</td>
<td>6800,8080,SPI</td>
<td>Character OLED</td>
</tr>
<tr>
<td>COB</td>
<td>1.26</td>
<td>3.2</td>
<td>50x32</td>
<td>38x16</td>
<td>28.16x11.86</td>
<td>6800,8080,SPI</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COB</td>
<td>1.6</td>
<td>4.1</td>
<td>55.7x32</td>
<td>46x14.5</td>
<td>38.95x11.85</td>
<td>6800,8080,SPI</td>
<td>Character OLED</td>
</tr>
<tr>
<td>COB</td>
<td>1.7</td>
<td>4.3</td>
<td>55.7x32</td>
<td>46x14.5</td>
<td>38.95x11.85</td>
<td>6800,8080,SPI</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COB</td>
<td>2.25</td>
<td>5.7</td>
<td>80x38</td>
<td>66x16</td>
<td>56.95x11.85</td>
<td>6800,8080,SPI</td>
<td>Character OLED</td>
</tr>
<tr>
<td>COB</td>
<td>2.29</td>
<td>5.8</td>
<td>80x38</td>
<td>66x16</td>
<td>56.95x11.85</td>
<td>6800,8080,SPI</td>
<td>Character OLED</td>
</tr>
<tr>
<td>COB</td>
<td>2.29</td>
<td>5.8</td>
<td>85x38</td>
<td>66x16</td>
<td>56.95x11.85</td>
<td>6800,8080,SPI</td>
<td>Character OLED</td>
</tr>
<tr>
<td>COB</td>
<td>2.29</td>
<td>5.8</td>
<td>85x30</td>
<td>66x16</td>
<td>56.95x11.85</td>
<td>6800,8080,SPI</td>
<td>Character OLED</td>
</tr>
<tr>
<td>COB</td>
<td>2.4</td>
<td>6.1</td>
<td>80x38</td>
<td>66x16</td>
<td>59.95x11.15</td>
<td>6800,8080,SPI</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COB</td>
<td>2.4</td>
<td>6.1</td>
<td>85x30</td>
<td>66x16</td>
<td>59.95x11.15</td>
<td>6800,8080,SPI</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COB</td>
<td>2.4</td>
<td>6.1</td>
<td>89x30</td>
<td>66x16</td>
<td>59.95x11.15</td>
<td>6800,8080,SPI</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COB</td>
<td>2.4</td>
<td>6.1</td>
<td>94x44</td>
<td>66x16</td>
<td>59.95x11.15</td>
<td>6800,8080,SPI</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COB</td>
<td>2.44</td>
<td>6.2</td>
<td>98x60</td>
<td>77x25.2</td>
<td>58.95x19.15</td>
<td>6800,8080,SPI</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COB</td>
<td>2.44</td>
<td>6.2</td>
<td>98x60</td>
<td>77x25.2</td>
<td>58.95x19.15</td>
<td>6800,8080,SPI</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COB</td>
<td>2.5</td>
<td>6.6</td>
<td>116x37</td>
<td>85x18.6</td>
<td>64.95x21.15</td>
<td>6800,8080,SPI</td>
<td>Character OLED</td>
</tr>
<tr>
<td>COB</td>
<td>2.8</td>
<td>7.3</td>
<td>98x60</td>
<td>77x25.2</td>
<td>70.16x20.85</td>
<td>6800,8080,SPI</td>
<td>Character OLED</td>
</tr>
<tr>
<td>COB</td>
<td>3.08</td>
<td>7.8</td>
<td>116x37</td>
<td>85x18.6</td>
<td>77.3x21.15</td>
<td>6800,8080,SPI</td>
<td>Character OLED</td>
</tr>
<tr>
<td>COB</td>
<td>3.12</td>
<td>8.1</td>
<td>122x44</td>
<td>98x21</td>
<td>91.24x18.98</td>
<td>6800,8080,SPI</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COB</td>
<td>3.17</td>
<td>8.3</td>
<td>122x44</td>
<td>98x21</td>
<td>95.94x17.86</td>
<td>6800,8080,SPI</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COB</td>
<td>4.0</td>
<td>12.4</td>
<td>182x38.5</td>
<td>154x41.5</td>
<td>123.93x21.15</td>
<td>6800,8080,SPI</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COB</td>
<td>5.35</td>
<td>14.9</td>
<td>182x38.5</td>
<td>154x41.5</td>
<td>148.13x21.15</td>
<td>6800,8080,SPI</td>
<td>Character OLED</td>
</tr>
</tbody>
</table>

### OLED Display Module - COF

<table>
<thead>
<tr>
<th>Structure</th>
<th>Size (&quot;)</th>
<th>Size (cm)</th>
<th>Outline (mm)</th>
<th>Viewing Area (mm)</th>
<th>Active Area (mm)</th>
<th>Interface</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>COF</td>
<td>2.8</td>
<td>7.1</td>
<td>84x25.8</td>
<td>71.14x18.264</td>
<td>69.08x17.250</td>
<td>6800,8080,SPI</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COF</td>
<td>3.12</td>
<td>7.9</td>
<td>88x27.8</td>
<td>78.78x21.18</td>
<td>78.78x21.18</td>
<td>6800,8080,SPI</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COF</td>
<td>3.67</td>
<td>8.3</td>
<td>122x44</td>
<td>98x21</td>
<td>91.24x18.98</td>
<td>6800,8080,SPI</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COF</td>
<td>5.5</td>
<td>14.0</td>
<td>146x45</td>
<td>137.85x33.93</td>
<td>125.65x33.89</td>
<td>6800,8080,SPI</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COF+CF6+FR</td>
<td>2.8</td>
<td>7.1</td>
<td>85x30.8</td>
<td>71.14x18.264</td>
<td>69.08x17.250</td>
<td>6800,8080,SPI</td>
<td>OLED Touch</td>
</tr>
<tr>
<td>COF+CF6+FR</td>
<td>3.12</td>
<td>7.9</td>
<td>88x27.8</td>
<td>78.78x21.18</td>
<td>78.78x21.18</td>
<td>6800,8080,SPI</td>
<td>OLED Touch</td>
</tr>
<tr>
<td>COF+CF6+FR</td>
<td>5.5</td>
<td>14.0</td>
<td>147x45</td>
<td>137.85x33.93</td>
<td>125.65x33.89</td>
<td>6800,8080,SPI</td>
<td>OLED Touch</td>
</tr>
</tbody>
</table>
OLED Display Module - COG

<table>
<thead>
<tr>
<th>Structure</th>
<th>Size (&quot;')</th>
<th>Outline (mm)</th>
<th>View Area (mm)</th>
<th>Active Area (mm)</th>
<th>Interface</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>COG</td>
<td>0.49</td>
<td>1.2</td>
<td>14.5 x 11.6</td>
<td>12.18 x 9.58</td>
<td>SPI, I2C</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COG</td>
<td>0.66</td>
<td>1.7</td>
<td>18.5 x 15.2</td>
<td>15.42 x 12.08</td>
<td>6800, 8080, SPI, I2C</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COG</td>
<td>0.68</td>
<td>1.7</td>
<td>19.3 x 16.2</td>
<td>16.29 x 14.51</td>
<td>6800, 8080, SPI, I2C</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COG</td>
<td>0.71</td>
<td>1.8</td>
<td>13.9 x 22.2</td>
<td>11.14 x 16.3</td>
<td>SPI</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COG</td>
<td>0.84</td>
<td>2.1</td>
<td>26.8 x 21.2</td>
<td>23.18 x 18.34</td>
<td>SPI, I2C</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COG</td>
<td>0.91</td>
<td>2.3</td>
<td>30 x 11.5</td>
<td>26.38 x 14.54</td>
<td>6800, 8080, SPI, I2C</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COG</td>
<td>0.91</td>
<td>2.3</td>
<td>30 x 11.5</td>
<td>26.38 x 14.54</td>
<td>SPI</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COG</td>
<td>0.96</td>
<td>2.4</td>
<td>30 x 11.5</td>
<td>26.38 x 14.54</td>
<td>SPI, I2C</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COG</td>
<td>0.96</td>
<td>2.4</td>
<td>30 x 11.5</td>
<td>26.38 x 14.54</td>
<td>SPI</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COG</td>
<td>1.04</td>
<td>2.6</td>
<td>35.4 x 23.5</td>
<td>27.56 x 18.38</td>
<td>SPI</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COG</td>
<td>1.1</td>
<td>2.8</td>
<td>31.5 x 31.5</td>
<td>24.54 x 17.82</td>
<td>SPI, I2C</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COG</td>
<td>1.23</td>
<td>3.1</td>
<td>53 x 20</td>
<td>38 x 10</td>
<td>SPI, I2C</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COG</td>
<td>1.28</td>
<td>3.3</td>
<td>51.5 x 36.5</td>
<td>39 x 10</td>
<td>SPI, I2C</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COG</td>
<td>1.5</td>
<td>3.8</td>
<td>34.2 x 45.5</td>
<td>27.56 x 18.38</td>
<td>SPI, I2C</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COG</td>
<td>1.54</td>
<td>3.9</td>
<td>42.4 x 54.4</td>
<td>34.54 x 23.44</td>
<td>SPI, I2C</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COG</td>
<td>2.19</td>
<td>7.3</td>
<td>92.3 x 13.3</td>
<td>75.52 x 13.52</td>
<td>I2C, I2C</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COG</td>
<td>2.26</td>
<td>7.7</td>
<td>92.3 x 13.3</td>
<td>75.52 x 13.52</td>
<td>SPI</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COG</td>
<td>2.42</td>
<td>8.1</td>
<td>75.3 x 12.7</td>
<td>57.02 x 12.7</td>
<td>SPI, I2C</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COG</td>
<td>2.7</td>
<td>8.9</td>
<td>92.4 x 23.3</td>
<td>75.52 x 13.52</td>
<td>SPI</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COG</td>
<td>2.7</td>
<td>8.9</td>
<td>92.4 x 23.3</td>
<td>75.52 x 13.52</td>
<td>SPI, I2C</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COG</td>
<td>2.7</td>
<td>8.9</td>
<td>92.4 x 23.3</td>
<td>75.52 x 13.52</td>
<td>SPI</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COG</td>
<td>2.7</td>
<td>8.9</td>
<td>92.4 x 23.3</td>
<td>75.52 x 13.52</td>
<td>SPI, I2C</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COG</td>
<td>2.7</td>
<td>8.9</td>
<td>92.4 x 23.3</td>
<td>75.52 x 13.52</td>
<td>SPI</td>
<td>Graphic OLED</td>
</tr>
<tr>
<td>COG</td>
<td>2.7</td>
<td>8.9</td>
<td>92.4 x 23.3</td>
<td>75.52 x 13.52</td>
<td>SPI, I2C</td>
<td>Graphic OLED</td>
</tr>
</tbody>
</table>

OLED with Rotary Switch and Capacitive Touchscreen

Raystar has developed a new OLED rotary switch module which adopts REX128128D COG OLED module with Projected Capacitive Touch Panel (PCAP).

The diameter of active area is Ø30.0 mm (1.18” diagonal), and the resolution is 128x128 pixels. This OLED module uses IC SSD1327 supporting 4-line SPI and I2C interfaces. PCAP touch panel with surface hardness 6H uses IC IT7529 which supports I2C interface and 1-point touch. There are 3 emitting colors to choose from, including white, yellow, sky blue. It also features 4-bit grayscale; there are 16 shades of gray which can represent different intensity information.

This OLED switch is suitable for applications that require to be operated through rotation or touch, for instance, coffee maker, audio visual equipment, smart appliances, and so on.

Further Specifications:
- Module dimension: 0.016 x 21.56 mm
- Pixel size: 0.210 x 0.210 mm
- Pixel pitch: 0.235 x 0.235 mm
- Display Mode: Passive Matrix
- Duty: 1/128 Duty
- Display Color: White / Yellow / Sky Blue

Get a running demo of this high-end PMOLED now at Rutronik and lift your application to a new level!
Global Leaders in the Design and Development of Intelligent Graphic Solutions

Smart TFT Modules
4D Systems Creates Tailored Display Solutions for Enterprise Manufacturers, Engineering Companies, Design Houses and Hobbyists

Jump Start Development Time
Deliver rapidly and efficiently with products designed specifically for ease of integration and swift application development.

4D Systems Workshop4 IDE
Created for multiple development environments benefiting a range of users from the pro-maker to the most demanding engineer.

Scales With You
Seamless solutions from low volume to high volume applications without the need to invest in new software development.

Community Built for Sharing
Forums, code, documentation, and the latest new projects from 4D customers, and 4D engineers.

Human Services
Seasoned electronics and software engineers are on stand-by supporting fast implementation and troubleshooting.

Never Doubt Quality
ISO 9001 - certified production factories deliver the most secure supply chain in display solutions.

Powerful, Sleek, Standalone. Rapid Application development for Fast Time-to-market
Rapid Application development for all the 4D range of intelligent displays. Fast development and deployment
4D Systems provides the hardware to easily connect Arduino to intelligent Displays
Showcasing your Pi output

gen4 HMI Display Modules
Picaso Series
2.4" | 92 | 240x320 px | ~150 cd/m²
5V Adaptors: Arduino, Raspberry Pi & ASUS

Integrated Display Solutions
3.5" | 5.0" | 480x320 - 480x854 px
5V Panel mountable smart display controller

Wi-Fi Display Solutions
1.44" 9.0" | 128x128 - 800x480 px
5V Adaptors: Arduino, Raspberry Pi & ASUS

microOLED Display Modules
0.96" 1.77" | 96x64 - 160x128 px
5V Non-Touch Displays

Primary Displays for Raspberry Pi
4.3" 7.0" | 480x272 - 800x480 px
5V Resistive & Capacitive Touch Displays

Audio & Camera
Sound module and camera with different lenses available

Accessories
Programming adaptors, USB cables, bezels for open frame displays

Modules On The Go (MOTG)
Modules for WiFi, RS-232, RS-485, MP3, Bluetooth - adaptor PCB available
Touch Systems

Resistive Touch Technologies
A resistive touch sensor has two layers that are not in contact with each other
- An outside flexible layer, coated on the inside with a conductor, e.g. ITO (Indium Tin Oxide)
- Non-conductive separator “dots”, e.g. mica or silica, small enough to not be noticeable
- An inside supporting layer of glass, coated on its face with conductor (ITO)

Around the outside of the viewing area is a printed circuit pattern. When the outside flexible layer is pressed against the inside layer, the resulting voltages can be measured in more than one direction. By comparing these voltages to the starting voltage, the point where the touch happened can be calculated. Resistive sensors are simple and relatively inexpensive. The flex required to push the surfaces together can eventually fail the flexible layer.

The flex requires some pressure, so force is required to make contact. The presence of two layers in addition to the LCD can reduce brightness by 10-20%. On the plus side, a new flexible glass outer layer is now available to improve wear and chemical resistance. Overall, the technology is simple and predictable, so resistive sensors remain the most common form of touch sensor.

Capacitive Touch Technologies
A capacitive touch sensor is a simple supporting sheet of glass with a conductive coating on one side. Around the outside of the viewing area is a printed circuit pattern. This pattern sets a charge across the surface, which is disturbed by the finger touching the screen. There are various technologies that detect the touch differently: some can even detect near-touches without making contact. All capacitive sensing methods look for electrical disturbance, so the electrical characteristics of the touching object are important.

One finger is much like another, but a glove, a stylus or other types of objects may change the response or not respond at all. Capacitive sensors are built right on a single glass layer: They don’t break down by from flexing, but they may be subject to abrasion of the ITO coating. The single layer transmits light well, so brightness reduction is only 5-15%. The contact requires no pressure, so the force required to make touch is insignificant.

Projected Capacitive Technology
Projected Capacitive Touch (PCT, also PCAP) technology is a variant of capacitive touch technology. This technology allows two points recognition and light touch inputs. Work with gloves as well as cover glass make flat designs possible. These features make the technology a good choice for industrial and medical applications.

Projected Cap. Touch

<table>
<thead>
<tr>
<th>Inch</th>
<th>cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.7</td>
<td>14.5</td>
</tr>
<tr>
<td>6.5</td>
<td>16.8</td>
</tr>
<tr>
<td>7</td>
<td>17.8</td>
</tr>
<tr>
<td>8</td>
<td>20.3</td>
</tr>
<tr>
<td>9</td>
<td>23</td>
</tr>
<tr>
<td>10.4</td>
<td>26.4</td>
</tr>
<tr>
<td>12.1</td>
<td>30.8</td>
</tr>
<tr>
<td>15</td>
<td>38.1</td>
</tr>
<tr>
<td>17</td>
<td>43.2</td>
</tr>
<tr>
<td>19</td>
<td>48.3</td>
</tr>
<tr>
<td>22</td>
<td>55.9</td>
</tr>
</tbody>
</table>

Controller: C-0110 available

Features
- High durability
- High transmission
- Two points touch is available
- Input with glove is possible
- High resolution

Options: clear, AG or AR

USB Controller: HAT-EBUS-2
Options: AG / AR, 6mm Glass
Passive LCD Modules

Rutronik's application team – the engineering bridge to a wide field of display solutions with an excellent supplier portfolio.

The main area of activities of our display department is to offer customized solutions. Due to our experience in the display market we will provide you with the best solution and the most suitable manufacturers for your requirements.

The philosophy of the display department is to give you our best engineering consultancy in project work. We are the worldwide interface between customers, suppliers, R+D, Quality Management, Production and Purchase Department.

Passive LCD Modules from Displaytech

Liquid crystal displays, in the form of passive matrix LCDs, are increasingly found in all areas of everyday life. Their use is no longer restricted to technical applications. We are able to fulfill your standard passive LCD requirements with a lot of different module types. In which you can choose several individual parameters, like nearly all kinds of backlight colours, different temperature ranges and different technologies.

We cover the most common alphanumeric and graphic LCD sizes. All displays are available in transmissive, transflective and reflective mode.

Passive LCD Modules from Displaytech

<table>
<thead>
<tr>
<th>Characters x Lines</th>
<th>Model Number</th>
<th>Module Size W x H [mm]</th>
<th>View Area W x H [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 x 1</td>
<td>161A</td>
<td>80.0 x 36.0</td>
<td>64.5 x 13.0</td>
</tr>
<tr>
<td>16 x 2</td>
<td>162A</td>
<td>80.0 x 36.0</td>
<td>64.5 x 13.0</td>
</tr>
<tr>
<td>16 x 2</td>
<td>162B</td>
<td>84.0 x 44.0</td>
<td>65.6 x 16.0</td>
</tr>
<tr>
<td>16 x 2</td>
<td>162C</td>
<td>80.0 x 36.0</td>
<td>64.5 x 14.0</td>
</tr>
<tr>
<td>16 x 2</td>
<td>162COG</td>
<td>84.0 x 44.0</td>
<td>65.6 x 16.0</td>
</tr>
<tr>
<td>16 x 2</td>
<td>162D</td>
<td>85.0 x 35.0</td>
<td>62.0 x 16.0</td>
</tr>
<tr>
<td>16 x 2</td>
<td>162E</td>
<td>80.0 x 36.0</td>
<td>65.6 x 16.0</td>
</tr>
<tr>
<td>16 x 2</td>
<td>162F</td>
<td>122.0 x 44.0</td>
<td>93.5 x 15.8</td>
</tr>
<tr>
<td>16 x 2</td>
<td>162G</td>
<td>118.0 x 36.0</td>
<td>93.5 x 15.8</td>
</tr>
<tr>
<td>20 x 4</td>
<td>204A</td>
<td>98.0 x 60.0</td>
<td>76.0 x 25.2</td>
</tr>
<tr>
<td>20 x 4</td>
<td>204B</td>
<td>98.0 x 60.0</td>
<td>76.0 x 25.2</td>
</tr>
<tr>
<td>24 x 2</td>
<td>242A</td>
<td>118.0 x 36.0</td>
<td>93.5 x 15.8</td>
</tr>
<tr>
<td>40 x 2</td>
<td>402A</td>
<td>182.0 x 33.5</td>
<td>154.5 x 15.8</td>
</tr>
</tbody>
</table>

Displaytech offers a wide variety of standard display products to meet the requirements of your specific application. From monochrome graphic displays to segmented TN LCDs, Displaytech has many standard products that are commercially available off the shelf and suitable for most industrial, medical and consumer products.

Each of the standard products is unique due to the display technology, diagonal size or integrated display controller. To simplify your search for the perfect display, Displaytech provides all documentation relevant to each LCD module on the specific product page. Next to each product you will find the following items: data sheets for both the display and the integrated driver IC.
LCD Standard Modules

Displaytech offers a full line of monochrome COG and graphic LCD modules with or without your choice of backlight. Our selection of 128x64, 128x32, 128x240 and 240x64 graphic FSTN LCD modules are our most popular! The popularity of these displays allows Displaytech to offer highly competitive pricing and flexible stocking options.

Passive LCD Modules from Displaytech

<table>
<thead>
<tr>
<th>Date / Diagonal Size</th>
<th>Model/Number</th>
<th>Module Size W x H (mm)</th>
<th>View Area W x H (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>128 x 64</td>
<td>32123A</td>
<td>65.6 x 29.2</td>
<td>54.8 x 19.1</td>
</tr>
<tr>
<td>128 x 64</td>
<td>32123B</td>
<td>56.1 x 29.2</td>
<td>49.1 x 13.0</td>
</tr>
<tr>
<td>128 x 64</td>
<td>32128A</td>
<td>41.9 x 19.7</td>
<td>36.1 x 9.9</td>
</tr>
<tr>
<td>160 x 64</td>
<td>32160A</td>
<td>100.0 x 36.8</td>
<td>80.0 x 29.5</td>
</tr>
<tr>
<td>128 x 64</td>
<td>64128B</td>
<td>58.2 x 41.7</td>
<td>50.0 x 25.0</td>
</tr>
<tr>
<td>128 x 64</td>
<td>64128B</td>
<td>58.2 x 41.7</td>
<td>50.0 x 25.0</td>
</tr>
<tr>
<td>128 x 64</td>
<td>64128CL</td>
<td>68.8 x 49.2</td>
<td>60.5 x 31.1</td>
</tr>
<tr>
<td>128 x 64</td>
<td>64128B</td>
<td>68.8 x 49.2</td>
<td>60.5 x 31.1</td>
</tr>
<tr>
<td>128 x 64</td>
<td>64128CM</td>
<td>77.6 x 52.4</td>
<td>70.0 x 36.0</td>
</tr>
<tr>
<td>128 x 64</td>
<td>64128CM</td>
<td>77.6 x 52.4</td>
<td>70.0 x 36.0</td>
</tr>
<tr>
<td>128 x 64</td>
<td>64128BN</td>
<td>74.0 x 41.7</td>
<td>50.0 x 25.0</td>
</tr>
<tr>
<td>128 x 64</td>
<td>64128BP</td>
<td>93.0 x 70.0</td>
<td>70.7 x 38.8</td>
</tr>
<tr>
<td>128 x 64</td>
<td>64128Q</td>
<td>75.0 x 32.7</td>
<td>80.0 x 31.5</td>
</tr>
<tr>
<td>240 x 64</td>
<td>64240B</td>
<td>180.0 x 65.0</td>
<td>132.8 x 39.0</td>
</tr>
<tr>
<td>240 x 64</td>
<td>64240C</td>
<td>144.6 x 56.4</td>
<td>132.8 x 39.0</td>
</tr>
<tr>
<td>320 x 240 3.5&quot; QVGA</td>
<td>240320B</td>
<td>91.5 x 105.5</td>
<td>80.55 x 101.1</td>
</tr>
<tr>
<td>320 x 240 3.5&quot; QVGA</td>
<td>240320BP</td>
<td>91.5 x 105.5</td>
<td>80.55 x 101.1</td>
</tr>
<tr>
<td>320 x 240 3.5&quot; QVGA</td>
<td>240320CG</td>
<td>105.6 x 61.4</td>
<td>100.0 x 37.6</td>
</tr>
<tr>
<td>320 x 240 3.5&quot; QVGA</td>
<td>240320CM</td>
<td>91.5 x 105.5</td>
<td>80.55 x 101.1</td>
</tr>
<tr>
<td>320 x 240 3.5&quot; QVGA</td>
<td>240320BP</td>
<td>105.6 x 61.4</td>
<td>100.0 x 37.6</td>
</tr>
<tr>
<td>320 x 240 3.5&quot; QVGA</td>
<td>240320CM</td>
<td>91.5 x 105.5</td>
<td>80.55 x 101.1</td>
</tr>
<tr>
<td>320 x 240 3.5&quot; QVGA</td>
<td>240320BP</td>
<td>105.6 x 61.4</td>
<td>100.0 x 37.6</td>
</tr>
<tr>
<td>320 x 240 3.5&quot; QVGA</td>
<td>240320CM</td>
<td>91.5 x 105.5</td>
<td>80.55 x 101.1</td>
</tr>
<tr>
<td>320 x 240 3.5&quot; QVGA</td>
<td>240320BP</td>
<td>105.6 x 61.4</td>
<td>100.0 x 37.6</td>
</tr>
<tr>
<td>320 x 240 3.5&quot; QVGA</td>
<td>240320CM</td>
<td>91.5 x 105.5</td>
<td>80.55 x 101.1</td>
</tr>
<tr>
<td>320 x 240 3.5&quot; QVGA</td>
<td>240320BP</td>
<td>105.6 x 61.4</td>
<td>100.0 x 37.6</td>
</tr>
</tbody>
</table>

Custom Design LCD Modules

Customized displays are manufactured according to the specification of our customers. Depending upon the size of the LCD panel and the LCD technology a reasonable minimum order quantity is required.

Module Technologies

Rutronik’s partners are implementing a variety of integrated circuit mounting techniques in designs of printed circuit boards used with standard and custom made liquid crystal modules. The company has a full production line for incorporating surface mount technology (SMT), chip on board (COB), tape automated bonding (TAB) and flexible printed circuit (FPC). TIANMA contributes solutions to the markets burgeoning demand for chip on glass (COG) technology.

Vertical Alignment

With the Vertical Alignment technology the Liquid Crystal molecules are perpendicular. Vertical Alignment leads to a very dark background and wide viewing angle.

Suitable for low and medium information content, automotive, industrial and medical applications.

Main Advantages of Vertical Alignment:

- Super black background
- Super high contrast ratio
- Super wide viewing angle
- Wide temperature range

Display Accessories

Rutronik is also able to supply different accessories for your LCDs from selected suppliers, as well as integration of turn key components.

With these options Rutronik and its partners can offer the complete solution to customers.

Connectors

- Rubber
- Connector
- Pins
- FPC
- Heatseal

Customized displays are manufactured according to the specification of our customers. Depending upon the size of the LCD panel and LCD technology a reasonable minimum order quantity is required. Our team will consult you with the most fitting supplier for your customized LCD project. We will support you for the whole project lifecycle, beginning from the first drawings up to the first samples production and final mass production.

Main Advantages of FSC:

- No need of color filters
- Low power consumption
- LCD glass is very economical due to the TN COG technology
- No need of high-end microprocessors
Visual Solutions

From commercial displays for digital signage, through to interactive displays for a true pen-on-paper experience, Sharp has a visual solution for every need. Our professional display solutions and video walls are ideal for any environment where clear communication of complex information is essential. Our large format display will get your message across in crowded and busy locations such as shopping malls and transport hubs. And for smaller spaces, we have a range of best-in-class visual business solutions with sizes starting from 32". Whatever your application, need or environment, you’ll find a digital display to suit in our range of visual solutions.

Professional Monitors

Our innovative choice of professional smart displays ranges from a conveniently-sized 40" right through to our attention-grabbing 90" large format display. You can bring content to life with our 8K resolution display and see fine details clearly with our Ultra High Definition (UHD) 4K resolution displays. Even our standard High Definition (HD) displays will help your business communicate easily and colleagues to collaborate effectively. We have a solution to suit every application including retail stores, design studios, public spaces, transport hubs, corporate buildings, meetings rooms and more!

From commercial displays for digital signage, through to interactive displays for a true pen-on-paper experience, Sharp has a visual solution for every need. Our professional display solutions and video walls are ideal for any environment where clear communication of complex information is essential. Our large format display will get your message across in crowded and busy locations such as shopping malls and transport hubs. And for smaller spaces, we have a range of best-in-class visual business solutions with sizes starting from 32". Whatever your application, need or environment, you’ll find a digital display to suit in our range of visual solutions.

Monitors
Wireless Technologies - Linecard

Make your application smart by connecting it wirelessly to the Internet of Things. RUTRONIK EMBEDDED has the newest solutions for using a smartphone, WiFi access point or a mobile communication network as gateway for your device. Our understanding of the right wireless solution covers hardware, drivers or transmission protocol, application profiles, security aspects, certifications, long-term considerations as well as political aspects regarding standards, compatibility and consortia.

Suppliers

<table>
<thead>
<tr>
<th>Suppliers</th>
</tr>
</thead>
<tbody>
<tr>
<td>2J</td>
</tr>
</tbody>
</table>

Bluetooth

- Classic Modules
- Low Energy Modules
- Dual Mode System on Chips
- Low Energy System on Chips
- Bluetooth Devices (Beacons, Key Finders, Dongles etc.)
- Modules with integrated Antenna

GSM/ GPRS/ UMTS/ LTE/ NB-IoT/ 5G

- Modules
- Antennas
- SIM-Card Holders
- Antennas (surface mounted)
- Antennas (external)
- Antennas (internal)
- Adapter Cables
- Energy Harvesters

GNSS

- Modules
- Chips
- GPS/GNSS Cards
- GPS/GNSS Chips
- Ultra High Precision
- Modules with integrated Antennas

ZigBee

- System-on-Chip
- Modules
- Gateway Solution

RFID/ NFC

- Reader Modules
- Transponder Chipset
- NFC Reader Chipset

Long Range Wide Area Network

- LoRa
- Sigfox

Hardware Security Solutions

- Antifraud
- Trusted Computing

Proprietary Wireless

- Receiver Chipset
- Transmitter Module
- Transmitter Chipset
- Gateway Solution

Wireless

- Modules WiFi a/b/g/n/ac
- Modules WiFi a/b/g/n/ac/ax
- Modules SubGHz-WiFi (ah)
- Modules WiFi a/b/g/n/ac/ah

Accessories

- Adapter Cables
- Antennas (inserted)
- Antennas (external)
- Antenna (surface mounted)
- Bluetooth Holders
- NFC Holders

Special Wireless Techn.

- UMTS
- LTE
- GPRS
- GMSK

UMB

- Adapter Cables
- Energy Harvesters

Make your application smart by connecting it wirelessly to the Internet of Things. RUTRONIK EMBEDDED has the newest solutions for using a smartphone, WiFi access point or a mobile communication network as gateway for your device. Our understanding of the right wireless solution covers hardware, drivers or transmission protocol, application profiles, security aspects, certifications, long-term considerations as well as political aspects regarding standards, compatibility and consortia.
Cellular Data Cards

mPCIe and M.2 (NGFF)

The robust line from Telit of high-speed industrial-grade PCI-SIG® standards-based modules come in the architecture your project needs whether it be to enable mobile computing, networking, or industrial IoT. The plug-and-play design simplifies integration and is available in two form factors: Mini PCI Express (mPCIe) and M.2.

Features & Specifications

- 5G sub6 FDD and TSS, 5A and NSA operations
- 5G core network Opt. 3a/3x and Opt. 2
- 3G: HSPA+ Rel. 8
- GNSS gpsOne Gen 9 Band L1 on dedicated RF connector
- 4x4 MIMO DL support
- 2x2 MIMO UL support
- 4 antenna connectors for LTE/Sub-6
- 5G FR1 Bands: n1, n2, n3, n5, n7, n8, n12, n13, n14, n18, n20, n25, n26, n28, n29, n30, n34, n39, n40, n41, n48, n66, n71, n75, n76, n77, n78, n79
- LTE Bands: 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 34, 38, 39, 40, 41, 42, 43, 46, 48, 66, 71
- WCDMA Bands: 1, 2, 3, 4, 5, 6, 8, 9, 19
- FOTA support
- Dimensions: 30 x 52 x 2.3 mm
- Operating temperature range: -40 °C to +85 °C
- Chipset: Qualcomm® Snapdragon™ X65
- Drivers support: Windows 10, Linux
- Supply voltage: 3.3 VDC
- Approvals: FCC, IC, RED, NCC, JATE/TELEC, KCC, RCM, PTCRB, GCF, various MNOs

Telit FN990Axx data cards enable the next generation of state-of-the-art 5G data cards. They feature sub-6 GHz only technology with LTE, WCDMA and GNSS support. These data cards lay the foundation for business worldwide to future-proof IoT, enterprise applications and video.

Dimensions & Key Features

- mini PCIe fullsize single-sided
- M.2 (NGFF)
- Industrial temperature range: 40 to 85 °C
- Optional GNSS
- Certified with regulatory bodies and mobile operators worldwide

mPCIe and M.2 Modules in Global Variants

<table>
<thead>
<tr>
<th>Telit Card</th>
<th>Description</th>
<th>Region</th>
<th>Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>FN990A40/FN990A28</td>
<td>M.2 Data Card, sub-6 GHz only version, up to 4.9 Gbps Downlink, 7x Carrier Aggregation DL (4x UL), 4x MIMO, 256 QAM, full GNSS support</td>
<td>Worldwide</td>
<td>5G 3GPP Release 16</td>
</tr>
<tr>
<td>FN880/FN880m</td>
<td>M.2 Data &amp; Voice Card, sub-6 GHz + millimetre version, up to 5.5 Gbps Downlink, 7x Carrier Aggregation DL (2x UL), 4x MIMO, 256 QAM, full GNSS support</td>
<td>Worldwide</td>
<td>5G 3GPP Release 15</td>
</tr>
<tr>
<td>LM983</td>
<td>Mini PCIe Data Card, up to 1.2 Gbps Downlink, 5x Carrier Aggregation DL, 4x MIMO, full GNSS support</td>
<td>Worldwide</td>
<td>LTE Cat 18</td>
</tr>
<tr>
<td>LNL02A12</td>
<td>M.2 Data Card, up to 600 Mbps Downlink, 4x Carrier Aggregation DL, 2x MIMO, 64 QAM, full GNSS support</td>
<td>Worldwide</td>
<td>LTE Cat 12</td>
</tr>
<tr>
<td>LM980</td>
<td>Mini PCIe Data Card, up to 600 Mbps Downlink, 3x Carrier Aggregation DL, MIMO, full GNSS support</td>
<td>Worldwide</td>
<td>LTE Cat 11</td>
</tr>
<tr>
<td>LNL02A8</td>
<td>M.2 Data Card, up to 300 Mbps Downlink, 2x Carrier Aggregation DL, 2x MIMO, 64 QAM, full GNSS support</td>
<td>Worldwide</td>
<td>LTE Cat 6</td>
</tr>
<tr>
<td>LD15C4</td>
<td>Mini PCIe Data &amp; Voice Card, up to 150 Mbps Downlink, MIMO, full GNSS support</td>
<td>Regional &amp; Worldwide Versions available</td>
<td>LTE Cat 4</td>
</tr>
<tr>
<td>ME910C1/ME910G1</td>
<td>Mini PCIe Data Card, up to 1 Mbps Downlink, full GNSS support</td>
<td>LTE M / NB-IoT</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type</th>
<th>FN990A40</th>
<th>FN990A28</th>
</tr>
</thead>
<tbody>
<tr>
<td>4G Carrier Aggregation</td>
<td>4G Cat 20, up to 7xCA</td>
<td>4G Cat 19, up to 5xCA</td>
</tr>
<tr>
<td>5G (NSA) Data Throughput</td>
<td>Up to 4.9 Gbps DL / 0.55 Gbps UL</td>
<td>Up to 3.4 Gbps DL / 0.55 Gbps UL</td>
</tr>
<tr>
<td>5G (SA) Data Throughput</td>
<td>Up to 4.5 Gbps DL / 0.90 Gbps UL</td>
<td>Up to 3.5 Gbps DL / 0.90 Gbps UL</td>
</tr>
<tr>
<td>Chipset</td>
<td>Qualcomm® Snapdragon™ X85</td>
<td>Qualcomm® Snapdragon™ X82</td>
</tr>
</tbody>
</table>
FN980m Advanced LTE/5G M.2 Data Card

Enabling a new generation of 5G state-of-the-art data cards featuring Sub-6 and mmWave technologies with LTE, WCDMA & GNSS support. Ideal for industrial-grade M.2 form factor suitable - among others - for following applications: High Power Fixed Wireless access, enterprise routers and gateways, indoor/outdoor CPE, video broadcasting & surveillance. Support of Qualcomm QTM525 & QTM527 mmWave antennas.

Features & Specifications
- 5G Sub-6 and mmWave FDD and TDD, SA & NSA operations
- 5G core network Opt. 3a/3x and Opt. 2
- 4G: 7CA, up to 20 layers DL , 2CA UL, 256 QAM DL/UL
- 3G: HSPA+ Rel. 8 (DL/UL 42/11 Mbps)
- GNSS: gpsOne Gen9 L1 band on dedicated RF connector, L5 shared with cellular
- Voice support: VoLTE, VoNR (under evaluation), PCM audio over USB
- 4 antenna connectors for LTE/Sub-6
- 4 mmWave antennas supported
- 5G FR1 Bands: n1, n2, n3, n7, n8, n12, n20, n25, n28, n38, n40, n41, n48, n66, n71, n77, n78, n79
- 5G FR2 Bands: n257, n258, n260, 261
- LTE Bands: 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 34, 38, 39, 40, 41, 42, 43, 48, 66, 71
- WCDMA Bands: 1, 2, 4, 5, 6, 8, 9, 19
- Dimensions: 30 x 50 x 3.5 mm
- Data throughput with 5G: up to 5.5 DL / 1.5 UL Gbps
- Operating temperature range: -40°C to +85°C
- 1.8/3 V SIM Interface
- Interfaces: USB 3.1 gen2, 2.0 and PCIe gen3
- Drivers support: Windows 10, Linux
- Supply voltage: 3.3 VDC
- Approvals: KCC, FCC, PTCRB, RED, GCF, Various MNOs

Key Benefits
- Standard M.2 (NGFF) Data-card form factor
- 4G/5G 3GPP Release 15
- 4G Cat. 20 up to 7x Carrier Aggregation
- 3G HSPA+ 3GPP Release 8
- State of the art GNSS receiver
- 4x4 MIMO support
- WCDMA Bands: 1, 2, 3, 4, 5, 6, 8, 9, 19
- Dimensions: 30 x 42 x 2.4 mm
- Operating temperature range: -40°C to +85°C
- 1.8/3 V SIM Interface
- Interfaces: GPIOs, USB 3.0
- Drivers support: Windows 10, Linux
- Supply voltage: 3.3 VDC
- Approvals: CE/RED, FCC, IC, JATE/TELEC, PTCRB, GCF, various MNOs

LN920A12 / LN920A6 High Speed LTE M.2 Data Cards

Telit family LN920 is a compact data card with versions available in Category 12 and 6 worldwide. Designed in M.2 (NGFF) form factor, it is the natural evolution towards 5G technology. It’s suitable for high-performance industrial as well as consumer applications including fixed wireless access, enterprise routers and gateways, indoor and outdoor CPE and mobile computing.

Features & Specifications
- 3GPP Release 12 compliant
- Standard M.2 (NGFF) form factor
- LTE Bands: 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 34, 38, 39, 40, 41, 42, 43, 48, 55, 66, 71
- WCDMA Bands: 1, 2, 4, 5, 6, 8, 9, 19
- Embedded GNSS receiver (GPS, GLONASS, Beidou, Galileo)
- Chipset: Qualcomm® SDX12
- 2x2 MIMO support
- 2 antenna connectors for LTE
- 1 antenna connector for GNSS
- FOTA support

<table>
<thead>
<tr>
<th>Type</th>
<th>LN920A12</th>
<th>LN920A6</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTE Category</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>Max. DL Throughput</td>
<td>600 Mbps</td>
<td>350 Mbps</td>
</tr>
<tr>
<td>Max. UL Throughput</td>
<td>150 Mbps</td>
<td>50 Mbps</td>
</tr>
<tr>
<td>DL Carrier Aggregation</td>
<td>Up to 5xCA</td>
<td>Up to 2xCA</td>
</tr>
</tbody>
</table>
**LE910Cx-EU**

**Features**
- Telit Modules based on the Telit module series xE910
- D-Sub (9-pin)
- -30 to +80°C
- 91g
- FOTA
- 5V - 32 V
- X 1, 5, 6, 8, 19 ~2 mA (*)
- 1, 2, 3, 4, 5, 7, 28

**AppZone**
- Cellular, GNSS & Services
- North America (all)
- Extremely efficient low-power mode for battery-powered applications

**Industrial interfaces according to RS232-standard**

**300 kbps**

**10 Mbit/s**

**375 kbps**

**~12 mA (*)**

**~2 mA (*)**

**Certificates**
- FCC/IC, PTCRB, GCF, RCM, Jade/Telec, RED

**Application Fields**
- Ideal platform for IoT applications, mobile data and computing devices with ultra-compact design and extended operating temperature range.

The Mini PCIe Cards have following country approvals: FCC/IC, PTCRB, GCF, RCM, Jadel/Telec, RED

---

**M2M Terminals**

**GSM, NB-IoT and 4G Terminals for M2M Applications**

Telit’s GSM, NB-IoT and LTE terminals are targeted towards professional and industrial M2M applications which require wireless connectivity provided in a robust and reliable casing.

**Key Features**
- Modules based on the Telit module series xE910
- Industrial interfaces according to RS232-standard integrated in all products
- Extremely efficient low-power mode for battery-powered applications

**Key Benefits**
- By integrating terminals from Telit, you can fully focus on the core competencies required in your specific application area and avoid the cost of developing, testing and certifying terminal related functionality
- Easily swap 2G, 3G with 4G terminals when required by having a real migration path for these mobile network technologies

<table>
<thead>
<tr>
<th>Categories</th>
<th>Features</th>
<th>GT910 G</th>
<th>LE910 E</th>
<th>NT910 G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modules</td>
<td>Supplier</td>
<td>Telit</td>
<td>Telit</td>
<td>Telit</td>
</tr>
<tr>
<td>Category</td>
<td>Product Category</td>
<td>Basic 2G</td>
<td>LTE/GSM/GPS</td>
<td>LTE/NB-IoT</td>
</tr>
<tr>
<td>General</td>
<td>Part Number</td>
<td>8F528S</td>
<td>8E1111</td>
<td>8E1111</td>
</tr>
<tr>
<td>Air Interface</td>
<td>2G Frequency Band</td>
<td>2G Quad</td>
<td>2G Dual (900/1800 MHz)</td>
<td>2G Quad</td>
</tr>
<tr>
<td></td>
<td>3G Frequency Band</td>
<td>LTE DL</td>
<td>10 Mbps</td>
<td>300 Kbps</td>
</tr>
<tr>
<td></td>
<td>LTE UL</td>
<td>LTE UL</td>
<td>5 Mbps</td>
<td>375 Kbps</td>
</tr>
<tr>
<td>Interfaces</td>
<td>RS232 Interface</td>
<td>D-sub (9-pin)</td>
<td>D-sub (9-pin)</td>
<td>D-sub 9-pin</td>
</tr>
<tr>
<td></td>
<td>USB 2.0</td>
<td>MHS/USB</td>
<td>MHS/USB</td>
<td>MHS/USB</td>
</tr>
<tr>
<td></td>
<td>Audio (analog)</td>
<td>PME</td>
<td>PME</td>
<td>PME</td>
</tr>
<tr>
<td></td>
<td>LEDs</td>
<td>LED</td>
<td>LED</td>
<td>LED</td>
</tr>
<tr>
<td></td>
<td>Software</td>
<td>Robust 1.8/3 V</td>
<td>AppZone</td>
<td>AppZone</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SW Card Holder</td>
<td>Programmer</td>
<td>Programmer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Firmware Update</td>
<td>AppZone</td>
<td>AppZone</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TCPP/IP Stack</td>
<td>TFTP</td>
<td>TFTP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TCP/IP Stack</td>
<td>TFTP</td>
<td>TFTP</td>
</tr>
<tr>
<td>Inputs/Outputs</td>
<td>Analog inputs</td>
<td>Digital inputs</td>
<td>Digital inputs</td>
<td>Digital inputs</td>
</tr>
<tr>
<td></td>
<td>Outputs</td>
<td>Outputs</td>
<td>Outputs</td>
<td>Outputs</td>
</tr>
<tr>
<td></td>
<td>Voltage Range</td>
<td>5V - 36 V</td>
<td>5V - 36 V</td>
<td>5V - 36 V</td>
</tr>
<tr>
<td>Electrical Characteristics</td>
<td>Standby @ 12V</td>
<td>~12 mA (*)</td>
<td>~12 mA (*)</td>
<td>~12 mA (*)</td>
</tr>
<tr>
<td></td>
<td>Low Power Mode @ 12V</td>
<td>~2 mA (*)</td>
<td>~2 mA (*)</td>
<td>~2 mA (*)</td>
</tr>
<tr>
<td>Hardware Characteristics</td>
<td>Operating Temp.</td>
<td>-40 ~ 85°C</td>
<td>-40 ~ 85°C</td>
<td>-40 ~ 85°C</td>
</tr>
<tr>
<td></td>
<td>Weight</td>
<td>91g</td>
<td>91g</td>
<td>91g</td>
</tr>
<tr>
<td>Certificates</td>
<td>CE</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>FCC</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*Measurement averaged (including peaks) over a 1 min measurement interval.*

---

**LE910C1** / **LE910C4**

**LTE Cat 1 & Cat 4 Mini PCIe Data Cards**

The LE910Cx series Mini PCIe (mPCIe) modules are optimized for LTE low category networks and are available in single mode and 3G/2G fallback options. In addition to VoLTE support, the LE910Cx series are swappable with other modules in the xE910 mPCIe family.

The LE910Cx series has an additional GNSS Receiver integrated. It comes with built in UDP/TCP/FTP and SMTP stacks.

Both, LE910C1 and LE910C4, can be controlled over AT commands according to 3GPP TS 27.005, 27.007 as well as Telit Custom AT commands. They operate at an industrial temperature range from -40 to +85°C and support several interfaces like GPIOs, USB 2.0, UART and PCM. Data throughput of LTE Cat 1 cards reach max. speeds of 10/5 Mbps in DL/UL whereas LTE Cat 4 versions offer up to 150/50 Mbps in DL/UL. The LE910C1 and LE910C4 families from Telit are either available with Linux OS, some dedicated versions with ThreadX OS.

---

**Application Fields**
- Ideal platform for IoT applications, mobile data and computing devices with ultra-compact design and extended operating temperature range.

**Version**

<table>
<thead>
<tr>
<th>Version</th>
<th>LE910C1-EU</th>
<th>LE910C1-NF</th>
<th>LE910C1-AP</th>
<th>LE910C1-AD</th>
<th>LE910C1-CN</th>
<th>LE910C1-MAI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market</td>
<td>EMEA</td>
<td>North America incl MNOs</td>
<td>APAC</td>
<td>LATAM</td>
<td>China, India</td>
<td>Worldwide</td>
</tr>
<tr>
<td>4G Bands</td>
<td>1, 3, 7, 8, 20, 28A</td>
<td>2, 4, 5, 12, 13, 14, 66, 71</td>
<td>1, 3, 5, 8, 14, 19, 28,</td>
<td>1, 2, 3, 4, 5, 6, 7, 28</td>
<td>1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 19, 20, 28</td>
<td>1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 19, 20, 28</td>
</tr>
<tr>
<td>3G Bands</td>
<td>1, 3, 8</td>
<td>2, 4, 5</td>
<td>1, 3, 5, 8, 19</td>
<td>1, 2, 4, 5</td>
<td>8</td>
<td>1, 2, 4, 5, 8, 19</td>
</tr>
<tr>
<td>2G Bands</td>
<td>3, 8</td>
<td>3, 8</td>
<td>3, 8</td>
<td>3, 8</td>
<td>3, 8</td>
<td>3, 8</td>
</tr>
<tr>
<td>OS Linux</td>
<td>Linux</td>
<td>Linux</td>
<td>Linux</td>
<td>Linux</td>
<td>Linux</td>
<td>Linux</td>
</tr>
<tr>
<td>Lightweight LTE Cat 1</td>
<td>Lightweight LTE Cat 1</td>
<td>Lightweight LTE Cat 1</td>
<td>Lightweight LTE Cat 1</td>
<td>Lightweight LTE Cat 1</td>
<td>Lightweight LTE Cat 1</td>
<td>Lightweight LTE Cat 1</td>
</tr>
</tbody>
</table>
| *Various further regional versions are available both of Linux as well as ThreadX based OS.*

---

**Boards & Systems | Storage | Displays | Wireless Boards & Systems | Storage | Displays | Wireless**
### GNSS

**EWM-G10H01E**

**Industrial GPS USB Half Mini PCIe Card**

**Features**
- 72-channel u-blox NEOM8 engine
  - GPS/QZSS L1 C/A
  - GLONASS L1 L10F, BeiDou B1, SBAS L1 C/A: WAAS/EGNOS/MSAS, Galileo-ready E1B/C.
- U-Blox M8 position engine with over 2 million effective correlators featuring < 1 s acquisition, -160 dBm cold start acquisition sensitivity and 20 Hz update rate.
- Supports u-blox' Assist Now Online / Assist Now Offline / AssistNow Autonomous A-GPS services and is OMA SUPL / 3GPP compliant
- Open sky cold start: 26 s
- Aided starts: 2 s
- SBAS: WAAS, EGNOS, MSAS
- Accuracy: 2.5 m CEP
- RoHS compliance
- 1 USB 2.0
- PCIExpress Mini or Half Mini Card

**AIW-344**

**Wide-Temp 4G/LTE, Full-size Mini PCIe Card**

**Features**
- Qualcomm MDM9x07
  - 4G LTE FDD: Band 1, 3, 5, 7, 8, 20, 28
  - 4G LTE TDD: Band 38, 40, 41, 42, 43
- Antenna: 2 LTE Antenna coaxial Connectors + 1 GPS antenna connector
- Low power idle mode current
  - Windows 7/8 x10, Linux
- Standard mini PCIe full-size: 29.9 mm x 50.85 mm
- Time Pulse Config.: f=0.25…10 MHz
- Dynamics: < 4 g
- Operating Temperature: -40 to +85 °C

**AIW-355**

**5G_SUB6G/LTE/WCDMA M.2 3052 Card**

**Features**
- M.2 KeyB Card
- 5G NR SUB6: NR: n1, n3, n5, n8, n20, n28, n41, n77, n78, n79
- 4G LTE FDD: Band 1, 3, 5, 7, 8, 19, 20, 28
- 4G LTE TDD: Band 38, 40, 41, 42, 43
- Qualcomm SDX55 Chipset
  - 4 x 4 NR Sub6 EN-DC MAX 4.1 Gbps (DL) / 525 Mbps (UL)
  - USB 3.0/3.1 Interface
  - Windows 10, Linux (Ubuntu 20.04)
  - Dimension: 30 x 52 x 2.3 mm

**EWM-C117FL**

**Wide-Temp 4G/LTE, Full-size Mini PCIe Card**

**Features**
- 4G/LTE Bands Cat. 4, 3G UMTS/HSPA, 2G GSM/GPRS/EDGE
- HSDPA 7.2Mbps, HSUPA 5.76Mbps
- u-blox TOBY-L2
- Operating temperature: -40 to +85 °C
- PCI Express mini-card rev. 1.2
  - 2 RF Antenna Coaxial Connectors
- Windows 7/8.x/10, WWCE 5.0/6.0, Linux 2.4.x/2.6.x, Mac
  - 50.85 x 29.9 x 6.2 mm

### Cellular

**EWM-C110H01E**

**Embedded Multi-GPS/GNSS Module**

**Features**
- Half-size Mini PCIe card
- Multi-GNSS (GPS, GLONASS, BeiDou Galileo, QZSS and SBAS)
- Receiver Type
  - 72 Channels
  - GPS/QZSS L1 C/A, GLONASS L1 L10F, BeiDou B1, SBAS L1 C/A: WAAS/EGNOS/MSAS, Galileo-ready E1B/C.
- Time-To-First-Fix (GPS + GLONASS)
  - Cold Start: 26 s
  - Hot Start: 1.5 s
  - Aiding Start: 2 s
- Sensitivity (GPS + GLONASS)
  - Tracking & Navigation: -167 dBm
  - Reacquisition: -160 dBm
  - Cold Start: -148 dBm
- Horizontal Pos. Accuracy
  - SBAS: 2.0 m
- DR/SM Multi-GNSS (GPS, GLONASS, BeiDou Galileo, QZSS and SBAS)
- Low power idle mode current
  - Windows 7/8 x10, Linux
- Standard mini PCIe full-size: 29.9 mm x 50.85 mm
- Time Pulse Config.: f=0.25…10 MHz
- Dynamics: < 4 g
- Operating Temperature: -40 to +85 °C
### WiFi

**EWM-W172H01E**
USB 802.11ac/a/b/g/n 2T2R Wi-Fi + Bluetooth 4.2 Mini PCIe Card

**Features**
- Main Chipset: Realtek RTL8822BU-CG
- Interface: PCI Express mini-card rev. 1.2
- Form Factor: USB signal with Half-size Mini PCIe card
- Security: WEP 64/128-bit, WPA, WPA2
- OS Supported: Windows 7, 8.x, 10 / Linux / Android
- Operating temperature: -20 to +70 °C

**AW-154**
IEEE 802.11ac/a/b/g/n and BT 5.0 M.2 2230 Module

**Features**
- Main Chipset: NXP 828897
- WiFi: PCI-E Bluetooth: UART
- Linux (open source), Recommend Kernel V4.0 and above
- 2Tx/2Rx
- WAPI, WEP 64 / 128-bit, WPA, WPA2
- Operating temperature: -30 to +85 °C
- 30 x 22 x 2.85 mm

**EWM-W157M201E**
USB 802.11ac/a/b/g/n 2T2R Wi-Fi + Bluetooth 4.2 Mini PCIe Card

**Features**
- Main Chipset: Realtek RTL8822CE-CG
- Interface: Wi-Fi: PCIe, Bluetooth: USB
- Form Factor: M.2 2230, A-E Key card
- Security: WPA, WPA2, WPA3
- OS Supported: Windows 7/8.x/10
- Operating temperature: 0 to +70 °C

**SX-PCEAN2**
802.11 a/b/g/n Mini PCIe Radio Module with Industrial Temperature Support

**Features**
- Atheros AR9582 [commercial] / AR9592 [Industrial] highly integrated chip set
- Support for BT & WLAN Co-existence
- RoHS Compliance
- Frequency Band (2.4/5Ghz)
- Silex Linux reference driver with IEEE802.11x EAP support
- Max data transfer rate: 1.3 Gbps

**SX-PCEAC**
802.11a/n/ac PCI Express Wireless LAN Module

**Features**
- Qualcomm Atheros QCA9880 chipset
- 3x3 SU-MIMO enhances high speed and stability
- IEEE 802.11ac/Wave1 (Wave1 a/n/e/h/i)
- Wide band 80 MHz mode
- Silex Linux reference driver with IEEE802.11x EAP support
- High density modulation mode (256QAM)
- IEEE 802.11e QOS support

**EWM-W193H01E**
802.11 ac/a/b/g/n + 'BT 5.0 Half Mini PCIe Module

**Features**
- Windows 10, Linux (Open Source), Recommend Kernel v4.0 and above
- Support for BT & WLAN Co-existence
- RoHS Compliance
- Frequency Band (2.4/5GHz)
- WAPI, WEP 64/128-bit, WPA, WPA2 security support
- 30x2RX
- Operating temperature: 0 to +70 °C
- 30 x 26.8 x 2.5 mm

**EWM-W157M201E**
USB 802.11ac/a/b/g/n 2T2R Wi-Fi + Bluetooth 4.2 Mini PCIe Card

**Features**
- Main Chipset: Realtek RTL8821CE-CG
- WiFi: PCI-E Bluetooth: UART
- Form Factor: USB
- Wi-Fi: PCI-E
- Bluetooth: USB
- Security: 64 / 128-bit WEP
- OS Supported: Windows 7/8.x
- Operating temperature: 0 to +70 °C

**EWM-W172H01E**
USB 802.11ac/a/b/g/n 2T2R Wi-Fi + Bluetooth 4.2 Mini PCIe Card

**Features**
- Main Chipset: NXP 88W8997
- WiFi: PCI-E Bluetooth: UART
- Linux (open source), Recommend Kernel V4.0 and above
- 2Tx/2Rx
- WAPI, WEP 64 / 128-bit, WPA, WPA2, WPA3
- Operating temperature: -30 to +85 °C
- 30 x 22 x 2.85 mm

**SX-PCEAN2**
802.11 a/b/g/n Mini PCIe Radio Module with Industrial Temperature Support

**Features**
- Atheros AR9582 [commercial] / AR9592 [Industrial] highly integrated chip set
- Support for BT & WLAN Co-existence
- RoHS Compliance
- Frequency Band (2.4/5Ghz)
- Silex Linux reference driver with IEEE802.11x EAP support
- Max data transfer rate: 1.3 Gbps

**SX-PCEAC**
802.11a/n/ac PCI Express Wireless LAN Module

**Features**
- Qualcomm Atheros QCA9880 chipset
- 3x3 SU-MIMO enhances high speed and stability
- IEEE 802.11ac/Wave1 (Wave1 a/n/e/h/i)
- Wide band 80 MHz mode
- Silex Linux reference driver with IEEE802.11x EAP support
- High density modulation mode (256QAM)
- IEEE 802.11e QOS support
Based on Qualcomm QCA2066 Bluetooth 5.0 HS and BLE Dual band IEEE 802.11a/b/g/n/ac support on the SD-330AC Form Factors:
- Short Range

Newracom NRC7292 SoC Tri-Band Wi-Fi Module with Bluetooth v5.0 (BR/EDR/LE Compliant)

WLAN: USB 2.0 Bluetooth v5.2 Dedicated SPI interface for host SX-PCEAX-M2: 22.0mm x 30.0mm x 2.7mm

WLAN Encryption: WEP, TKIP, AES Bluetooth: USB 1.1 Operating modes: STA + SoftAP, P2P Group owner, Supports Bluetooth for Class-1 and Class-2 SX-PCEAX-SMT: 14.0mm x 8.0mm x 1.9mm

Interface:
- Device interface: Single serial port: RS-232C
- Industry-leading security including WPA and WPA2, plus 802.1x
- 1-stream MU-MIMO 802.11ac Rx Diversity with Wi-Fi BT co-existence
- Operating modes: STA and SoftAP, P2P Group owner, Virtually any client device can remotely control and monitor your serial devices including computers (Windows, Mac, Linux), mobile devices (Android, iOS), and virtual servers (VMware, Citrix, Microsoft Terminal Server and Hyper-V) for your serial devices including computers (Windows, Mac, Linux), mobile devices (Android, iOS), and virtual servers (VMware, Citrix, Microsoft Terminal Server and Hyper-V)

www.rutronik.com/
The ANTUSB-m is a USB dongle that provides a quick and easy product integration into different housing designs (original PTM form factor). It is highly flexible, simply attach it where the data is required – on walls, ceilings, windows, doors, furniture, or active devices such as air-conditioning units, towel dispensers, and valuable assets (printers, copiers, medical equipment, and vending machines etc.).

Features:
- Seamless integration into smart systems due to wireless communication based on open standards (EnOcean; Bluetooth®)
- One sensor equals a basket of metadata for highly efficient building automation, smart home, IoT (e.g., space optimization management, digitized facilities services, predictive maintenance, activity measurement, artificial intelligence)
- AES-128 security

USB Gateway: USB300 / USB 400J / USB500U

USB 300/400J/500U is a small USB stick which connects gateways and smart home servers to the world of EnOcean-based radio products.

Features:
- Frequency/antenna:
  - USB 300: 868.300 MHz / PCB antenna
  - USB 500U: 902.875 MHz / PCB antenna
- Modulation type:
  - USB 300: ASK 868 MHz
  - USB 500U: FSK 902 MHz
- Operating temperature:
  - 20°C to +50°C (max. 90% r.h.)

Easyfit Bluetooth Single / Double Rocker Wall Switch EWSSB / EWSDB

USB 300/400J/500U is a small USB stick which connects gateways and smart home servers to the world of EnOcean-based radio products.

Features:
- Radio Transmitter:
  - PTM 215B pushbutton module with integrated antenna
- Energy Source:
  - Electro-dynamic energy generator, maintenance free
- Frequency / Protocol:
  - 2.4 GHz / Bluetooth Low Energy (BLE)
- Range: Within one room (up to 10 m line of sight)
- Channels: 2 or 4 (single or double rocker with medial position, pressed/released)

Easyfit IoT Multi-Sensor

The EMSI, which is based on the STM 550 multsensor, is a true all-round talent among the energy self-sufficient wireless sensors. EMSI enables the realization of wireless energy harvesting sensors that communicate on the basis of the BLE and the EnOcean radio standard.

The EMSI is available in 868 MHz (Europe), 902 MHz (North America), 928 MHz (Japan) and 2.4 GHz BLE. Wall or device mounted sensor applications for measuring humidity, temperature, acceleration/orientation or lighting are the key applications of the EMSI Multi-Sensor.

Features:
- Self-powered via ambient indoor light - maintenance-free, no battery changes required thanks to energy harvesting technology
- One size fits all – easy product integration into different housing designs (original PTM form factor)
- Highly flexible, simply attach it where the data is required – on walls, ceilings, windows, doors, furniture, or active devices such as air-conditioning units, towel dispensers, and valuable assets (printers, copiers, medical equipment, and vending machines etc.)

More Information
www.rutronik-tec.com/ant
Intel Dual Band IEEE 802.11 ac and ax M.2 Cards

Intel Wireless M.2 cards with Bluetooth offer the industry’s most advanced connectivity technologies, including highly integrated system platforms, power-saving functionality and advanced Wi-Fi features that optimize any WiFi environment.

Intel Dual Band IEEE 802.11 ac M.2 Cards

Devices with Intel® Wireless-AC technology inside (IEEE 802.11 ac) offer up to three times higher data rates, a better network coverage and the possibility to connect more devices to one network, compared to previous WiFi standards.

<table>
<thead>
<tr>
<th>Type</th>
<th>Intel Dual Band Wireless</th>
<th>Intel Dual Band Wireless</th>
<th>Intel Dual Band Wireless</th>
<th>Intel Dual Band Wireless</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code Name</td>
<td>Jefferson Peak 2</td>
<td>Thunder Peak 2</td>
<td>Jefferson Peak 1</td>
<td>Jefferson Peak 1</td>
</tr>
<tr>
<td>Estimated SW support end</td>
<td>Q4 2024</td>
<td>Q4 2024</td>
<td>Q4 2024</td>
<td>Q4 2024</td>
</tr>
<tr>
<td>TX/RX Streams</td>
<td>2x2</td>
<td>2x2</td>
<td>1x1 diversity</td>
<td>1x1</td>
</tr>
<tr>
<td>Bands</td>
<td>2.4 GHz, 5 GHz</td>
<td>2.4 GHz, 5 GHz</td>
<td>2.4 GHz, 5 GHz</td>
<td>2.4 GHz, 5 GHz</td>
</tr>
<tr>
<td>Max Speed</td>
<td>1.73 Gbps</td>
<td>1.73 Gbps</td>
<td>433 Mbps</td>
<td>433 Mbps</td>
</tr>
<tr>
<td>Integrated Bluetooth</td>
<td>V5.1</td>
<td>V5.1</td>
<td>V5.1</td>
<td>V5.1</td>
</tr>
<tr>
<td>From Factor</td>
<td>M.2 2230</td>
<td>M.2 2230</td>
<td>M.2 2230</td>
<td>M.2 2230</td>
</tr>
<tr>
<td>Supported Operating Systems</td>
<td>Microsoft Windows 10, Linux, Chrome</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>System Interface Type</td>
<td>CNVi, GPDF</td>
<td>PCIE, USB</td>
<td>CNVi, GPDF</td>
<td>CNVi, GPDF</td>
</tr>
</tbody>
</table>

Intel Dual Band IEEE 802.11 ax M.2 Cards

Compared to the WiFi 5 solutions (IEEE 802.11 ac), WiFi 6 solutions (IEEE 802.11 ax) provide higher data rates, lower latency and longer battery lifetime.

<table>
<thead>
<tr>
<th>Type</th>
<th>Intel Wi-Fi 6 AX200</th>
<th>Intel Wi-Fi 6 AX2001*</th>
<th>Intel Wi-Fi 6E AX210 (E = extended/enhanced)</th>
<th>Intel Wi-Fi 6E AX2101*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code Name</td>
<td>Cyclone Peak 2</td>
<td>Harrison Peak 2</td>
<td>Typhoon Peak 2</td>
<td>Garfield Peak 4</td>
</tr>
<tr>
<td>Estimated SW support end</td>
<td>Q4 2023</td>
<td>Q4 2023</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TX/RX Streams</td>
<td>2x2</td>
<td>2x2</td>
<td>2x2</td>
<td>2x2</td>
</tr>
<tr>
<td>Bands</td>
<td>2.4 GHz, 5 GHz</td>
<td>2.4 GHz, 5 GHz, 6 GHz</td>
<td>2.4 GHz, 5 GHz</td>
<td>2.4 GHz, 5 GHz, 6 GHz</td>
</tr>
<tr>
<td>Max Speed</td>
<td>2.4 Gbps</td>
<td>2.4 Gbps</td>
<td>2.4 Gbps</td>
<td>2.4 Gbps</td>
</tr>
<tr>
<td>Integrated Bluetooth</td>
<td>V5.2</td>
<td>V5.2</td>
<td>V5.2</td>
<td>V5.2</td>
</tr>
<tr>
<td>From Factor</td>
<td>M.2 2230</td>
<td>M.2 2230</td>
<td>M.2 2230</td>
<td>M.2 2230</td>
</tr>
<tr>
<td>Supported Operating Systems</td>
<td>Windows 10, 64-bit, Google Chrome OS, Linux</td>
<td>Windows 10, 64-bit, Google Chrome OS, Linux</td>
<td>Windows 10, 64-bit, Google Chrome OS, Linux</td>
<td>Windows 10, 64-bit, Google Chrome OS, Linux</td>
</tr>
<tr>
<td>System Interface Type</td>
<td>PCIE (BMW), USB (BT)</td>
<td>CNVi2</td>
<td>PCIE (BMW), USB (BT)</td>
<td>CNVi2</td>
</tr>
</tbody>
</table>

Applications
- Consumer
- PCs / Laptops
- Transportation / Surveillance
- Medical devices
- Logistics
- Digital Signage

Intel Dual Band Wireless-AC 9260

The Intel Dual Band Wireless-AC 9260 supports the WLAN standard IEEE 802.11 ac and is the first WLAN module providing Gigabit WiFi speeds with 1.73 Gbps when using 160 MHz channels. Fast downloads and longer battery life times are therefore possible. The Bluetooth v5 functionality offers 4x the range of Bluetooth v4.2 at the same power consumption, 2x speed and better broadcasting functionality.

Improved Gigabit download speed is provided in combination with Intel Core processors. Simultaneous data transmission from one access point to multiple clients and 3x better downlink network capacity are possible due to downlink MU-MIMO.

Intel WiFi 6 AX200

The Intel WiFi 6 AX200 supports the WLAN standard IEEE 802.11 ax. With the new features UL and DL OFDMA and 1024QAM, Target Wake Time and spatial reuse, the AX200 enables smooth streaming of high-resolution videos, stable and faster connections farther away from the router and in dense environments. Fast up- and downloads, lower latency and longer battery life compared to previous WiFi standards are supported as well.

Bluetooth 5.2 provides 4x range over Bluetooth 4.2, doubles data rates and adds new enhanced data broadcasting, enabling seamless location-based services and simpler pairing for Bluetooth devices.

Kit Options

Intel Dual Band Wireless-AC 9260 Embedded Kit

Intel Dual Band Wireless-AC 9260 Industrial Kit

Intel WiFi 6 (ax)-Desktop Kit AX200

Intel WiFi 6 AX210

The Intel WiFi 6 AX210 supports dual-stream WiFi in the 2.4 GHz, 5 GHz and 6GHz bands as well as Bluetooth 5.2 and WiFi 6 R2 features with UL MU-MIMO. By implementing WiFi 6E technology supporting the 6 GHz band that includes 1200 MHz of new contiguous spectrum (>2x compared to 5 GHz) with more Gigabit WiFi options and exclusivity to WiFi 6 products.

Intel WiFi 6 AX210 module maximizes WiFi 6 and Gigabit WiFi benefits enabling greater network flexibility, faster downloads, sharing and backups as well as reduced latency and improved reliability.

Kit Options

Intel Dual Band Wireless-AC 9260 Embedded Kit

Intel Dual Band Wireless-AC 9260 Industrial Kit

Intel WiFi 6 (ax)-Desktop Kit AX200

Common Features
- Optimized external antenna (2 pcs.)
- Standard size mounting bracket with RF cables installed
- Low profile mounting bracket
- Quick Start Guide
- Safety and Regulatory information
- Requires motherboards with available M.2 connector key E for wireless

For more information, visit www.rutronik.com/EMBEDDED.
**RFID Stick Reader Evo**

The RFID Stick Reader Evo is a compact RFID reader and writer with adjustable performance. Its practical USB interface is used for the fast transfer of data as well as the power supply. Thanks to the IP40 protection class, it can withstand dust and other foreign objects up to 1 mm.

**Product Features**
- Dimensions: 83.5 x 36 x 11.2 mm
- Housing Material: ABS
- Power Supply: 5V DC, via USB
- Operating Systems: Windows XP, Vista, 7, 8, 8.1, 10
- Antenna: Integrated
- Interface: USB VCP, HID

**Desktop Reader EVO**

iDTRONIC’s Desktop Reader EVO is an easy-to-use RFID Reader/Writer which uses the USB 2.0 interface for high-speed data transfer. A Multi-LED illuminated frame is included, turning on during reading process. It comes with a full SDK and a MS Windows based application SW. Additionally, Keyboard Emulation (KEMU) is optional for all versions.

**Product Features**
- Dimensions: 125 x 70 x 26 mm
- Housing Material: ABS
- Power Supply: 5 V DC, via USB
- Operating Systems: Windows XP/7, Linux
- Antenna: Integrated
- Interface: USB 2.0, cable length 1.2 m

**Transponder Applications Examples**

<table>
<thead>
<tr>
<th>ISO and Hybrid Cards</th>
<th>Up to 15 cm</th>
<th>Up to 8 cm</th>
<th>Up to 13 cm</th>
<th>1024 Byte</th>
<th>Interface: USB VCP, HID</th>
<th>Power Supply: 5 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO/IEC 14443A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISO 11784/88</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISO 11784/88</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISO 11784/88</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**BLUEBOX Professional RFID**

BLUEBOX professional RFID is a family of highly sophisticated RFID controllers, readers, antennas and solutions allowing easy system integration.

**BLUEBOX Unique Advantages:**
- Ruggedized product design and enclosures
- All components minimum IP67 or IP54
- Available for:
  - UHF 860-960 MHz (ISO18000-6C, EPC Class1 Gen2)
  - HF 13.56 MHz (ISO15693, ISO/IEC 14443A/B, ISO 18000-3)
  - LF 125 kHz (ISO18000-2, ISO1784/1785)
- Solutions for Near Field, Short, Mid- and Long-Range appl.
- Contr. with integr. antenna or for running 1, 2 and 4 antennas
- Integrated Webserver for remote access to Controller
- Suitable for Stand-Alone operation
- Integrated I/O ports
- Micro SD slot for memory extension
- Diagnostic interface
- Several Standard Reader modes like Buffered Read Mode, Scan Mode, Notification Mode, RSSI Mode
- Unique SDK for all BLUEBOX products
- BLUEBOX SHOW applications software
- M12 connections for trouble-free and secure connection and installation (optional RJ 45 for UHF CX Controller)
### Internal Antennas

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Part</th>
<th>Picture</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-PEX</td>
<td>W3334B0150</td>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
</tr>
<tr>
<td>Pulse</td>
<td>2JF0424P</td>
<td><img src="image3.png" alt="Image" /></td>
<td><img src="image4.png" alt="Image" /></td>
</tr>
<tr>
<td>Pulse</td>
<td>2JF0442P</td>
<td><img src="image5.png" alt="Image" /></td>
<td><img src="image6.png" alt="Image" /></td>
</tr>
<tr>
<td>I-PEX</td>
<td>W3334B0150</td>
<td><img src="image7.png" alt="Image" /></td>
<td><img src="image8.png" alt="Image" /></td>
</tr>
<tr>
<td>Yageo</td>
<td>WM34010150</td>
<td><img src="image9.png" alt="Image" /></td>
<td><img src="image10.png" alt="Image" /></td>
</tr>
<tr>
<td>molex</td>
<td>WM34010140</td>
<td><img src="image11.png" alt="Image" /></td>
<td><img src="image12.png" alt="Image" /></td>
</tr>
<tr>
<td>molex</td>
<td>WM3311XXXXX</td>
<td><img src="image13.png" alt="Image" /></td>
<td><img src="image14.png" alt="Image" /></td>
</tr>
<tr>
<td>molex</td>
<td>ANTX100P01824533</td>
<td><img src="image15.png" alt="Image" /></td>
<td><img src="image16.png" alt="Image" /></td>
</tr>
<tr>
<td>molex</td>
<td>ANTX100P018W069X</td>
<td><img src="image17.png" alt="Image" /></td>
<td><img src="image18.png" alt="Image" /></td>
</tr>
</tbody>
</table>

### Antennas Specifications

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Part</th>
<th>Picture</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-PEX</td>
<td>W3334B0150</td>
<td><img src="image19.png" alt="Image" /></td>
<td><img src="image20.png" alt="Image" /></td>
</tr>
<tr>
<td>Pulse</td>
<td>2JF0424P</td>
<td><img src="image21.png" alt="Image" /></td>
<td><img src="image22.png" alt="Image" /></td>
</tr>
<tr>
<td>Pulse</td>
<td>2JF0442P</td>
<td><img src="image23.png" alt="Image" /></td>
<td><img src="image24.png" alt="Image" /></td>
</tr>
<tr>
<td>I-PEX</td>
<td>W3334B0150</td>
<td><img src="image25.png" alt="Image" /></td>
<td><img src="image26.png" alt="Image" /></td>
</tr>
<tr>
<td>Yageo</td>
<td>WM34010150</td>
<td><img src="image27.png" alt="Image" /></td>
<td><img src="image28.png" alt="Image" /></td>
</tr>
<tr>
<td>molex</td>
<td>WM34010140</td>
<td><img src="image29.png" alt="Image" /></td>
<td><img src="image30.png" alt="Image" /></td>
</tr>
<tr>
<td>molex</td>
<td>WM3311XXXXX</td>
<td><img src="image31.png" alt="Image" /></td>
<td><img src="image32.png" alt="Image" /></td>
</tr>
<tr>
<td>molex</td>
<td>ANTX100P01824533</td>
<td><img src="image33.png" alt="Image" /></td>
<td><img src="image34.png" alt="Image" /></td>
</tr>
<tr>
<td>molex</td>
<td>ANTX100P018W069X</td>
<td><img src="image35.png" alt="Image" /></td>
<td><img src="image36.png" alt="Image" /></td>
</tr>
</tbody>
</table>

---

*Not specified by supplier*
On request, RUTRONIK EMBEDDED will also put together individual kits for you which precisely meet the specific needs of your application. In addition to the primary components, these also contain all necessary inverters, cables, connection solutions and power supplies. We adapt the peripheral products precisely to your requirements, thereby offering you in cooperation with our partners a tailored solution for your system.
## Electromechanical Components

### Interconnect Solutions

<table>
<thead>
<tr>
<th>Connectors</th>
<th>Adam Tech</th>
<th>Alysium</th>
<th>Amphenol</th>
<th>Assmann WSW</th>
<th>KYOCERA AVX</th>
<th>Gradconn</th>
<th>JAE</th>
<th>Lumberg</th>
<th>Molex</th>
<th>MPE Garry</th>
<th>Pancon</th>
<th>Preci-Dip</th>
<th>Pulse</th>
<th>Sauro</th>
<th>Sumida</th>
</tr>
</thead>
<tbody>
<tr>
<td>Board to Board</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wire to Board</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wire to Wire</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crimp Terminals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FFC/FPC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flooding - STB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socket</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>USB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>USB Type C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Memory</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Audio/Video</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modular Jacks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power Inlet, Power Outlet, IEC 60309, Valine</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D-Sub</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highspeed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FAKRA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DIN 41612</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DIN Connector, Mini, I/O, Chord, Military, Test, Audio, DC Power</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Circular Connectors IBM, M12, others</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EV Charging AC, DC, Combined</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coaxial Connector</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Terminal Blocks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accessory like Jumper, Cap, Holder, Clip</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customized Connectors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tools</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Cable & Cable Assembly

| EV Charging Cable           |           |         |          |             |             |          |     |         |       |           |        |           |       |       |        |
| FFC/FPC                    |           |         |          |             |             |          |     |         |       |           |        |           |       |       |        |
| Flat Cable                 |           |         |          |             |             |          |     |         |       |           |        |           |       |       |        |
| MCI Cable                  |           |         |          |             |             |          |     |         |       |           |        |           |       |       |        |
| Round Cable                |           |         |          |             |             |          |     |         |       |           |        |           |       |       |        |
| USB-Type C Cable           |           |         |          |             |             |          |     |         |       |           |        |           |       |       |        |
| Accessory like Cable tie  |           |         |          |             |             |          |     |         |       |           |        |           |       |       |        |
| Standard Assembly, PoE cable (like patch cable) |           |         |          |             |             |          |     |         |       |           |        |           |       |       |        |
| Customized Assembly        |           |         |          |             |             |          |     |         |       |           |        |           |       |       |        |
**Electromechanical Components**

**I/O Connector**

**DX07 – USB Type-C Connector**

**Features**
- Reversible plug - insertion in the right side up or up side down orientation
- High-speed transmission up to 40 Gbps
- Up to 10,000 mating cycles
- Extended 5 A current rating for USB power delivery and up to 100 W
- 16 and 24 pin version
- IP68

**Benefits**
- Plugs and receptacles
- Supports audio and video signal output with alternate mode
- Enhanced side wall of middle plate stabilizes contact performance
- Wiggle free

---

**I/O Connector**

**USB Type-C Connector**

**Features**
- Reversible plug - insertion in the right side up or up side down orientation
- USB4 receptacle up to 40 Gbps data rates (20 Gbps x2), else USB 3.1/3.2
- Maximum 5 A of power supply (USB Power Delivery Support)
- Plugs, receptacles and harnesses
- Waterproof receptacle - IPX7 or higher
- 16-position version, supporting USB2.0 (480 Mbps) transmission

**Benefits**
- Design for high mechanical strength
- Lock structure with high durability
- 2-row SMT type space-saving contact mounting area (pure and hybrid)
- Available in on-board, mid-mount and vertical type

---

**I/O Connector**

**Modular Jacks & Magnetic Jacks RJ45**

**Features**
- Voltage rating up to 150 V AC
- Current rating up to 1.5 A
- Contact resistance: Max. 20 mΩ (initial)
- Operating temperature: -40 °C to +85 °C

**Benefits**
- Magnetic and ferrite-filtered types available
- 4, 6, 8, and 10 positions available
- Single, stacked or ganged
- Throughhole or SMT mounting

---

**I/O Connector**

**HDMI 2.1 DC04**

**Features**
- HDMI Category 3 approved connector
- Supporting formats such as 4K120 Hz, 8K60Hz, and dynamic HDR
- Specification approved connectors (supporting 48 Gbps bandwidth)
- Number of Positions: 19 positions
- Operating Temperature Range: -20 °C to +85 °C

**Benefits**
- Reduced crosstalk by optimizing isolation between terminals for each channel
- Impedance characteristics improved with molded-in contacts
- Enhanced robustness with original shell structure
- Contact tip in mating area is protected by insulator for improved reliability

---

**I/O Connector**

**Memory Card Combo Connector**

**Features**
- Compact size with small footprint and low profile height
- Free insertion and withdrawal of microSD card
- Antistubbing contact terminal design
- Card polarization feature
- Pull support and push pull card eject options
- Multiple PCB hold-down pins

**Benefits**
- Prevents microSD card from becoming stuck when inserted incorrectly into the micro SIM slot
- Prevents contact stubbing and ensures smooth insertion and withdrawal of the card
Electromechanical Components

**Amphenol**

**Board-to-Board Connector**

Airmax Backplane Connectors

**Features**
- Up to 25 Gbs per differential pair
- Over 10 years history of high volume production
- Full product platform (light angle, coplanar, orthogonal, cable)
- PCIe, CompactPCI, SAV, SBB, SSI, OF 25G, QPI 8G

**Benefits**
- Front housing provides guidance and protect pins
- Standard guidance and power modules can be placed as needed
- Rear plastic organizers unitize the block
- Enhanced for optimized cost & improved performance

---

**PCI-SIG M.2 Connector**

SM3 Series

**Features**
- Compliant with PCI Express M.2 Specification
- Transmission of PCIe Gen4 (on board type), PCIe Gen3 (mid mount type), USB3.0, DisplayPort, SATA, and others
- Number of Contacts: 67 positions
- Operating Temperature Range: -40 °C to +80 °C
- Mating Cycles: 60 times

**Benefits**
- Three on-board types of different product height and two mid-mount types
- Products with 4.1 mm product height can mount 1 mm height Arts on the bottom side of the module
- 4 polarizing keys are available for compatibility with multiple modules used in different applications.

---

**I/O Connector**

D-Sub Connector FCT Series

**Features**
- Power and Signal, Standard / High Density / Mixed Layout / Backshells / Hoods
- Current: 5.0, 7.5, 40.0 A
- IP Rating: IP20, IP67
- Coaxial, High Power, High Voltage contacts
- Machined, Pneumatic, Stamped Crimp contacts

**Benefits**
- Front housing provides guidance and protect pins
- Standard guidance and power modules can be placed as needed
- Rear plastic organizers unitize the block
- Enhanced for optimized cost & improved performance
- Still a reliable solution in a broad range of applications and various industries
- Time-tested for signal transmission, communications, power distribution
- Readily available in a wide variety of materials and plating combinations
- Cable assemblies incl. backshell, strainrelief, connector protection and cable dressing

---

**Server and Storage System**

PCIex Mini Card MM60 Series

**Features**
- Compatible with the PCI Express Mini Card Electromechanical Specification
- Connecting with modules, PCI Express communication
- Number of Contacts: 52 positions
- Operating Temperature Range: 40 °C to +85 °C
- Durability Mating Cycles: 50 times

**Benefits**
- Retention latch part available to fix module to connector
- Latch has mechanisms on both sides for module ejection
- Two types of module mounting heights are available
- Connector and latch are compatible with automatic mounting

---

**Server and Storage System**

Alysium FFC

**Features**
- Pitch: 0.5, 0.8, 1.0, 1.25 mm (Cable)
- Pitch: 0.3 mm to 0.50 mm (Connectors for Alysium and I-PEX products)
- Pin Count: 4 to 60 (Connectors)
- Type: ZIF, Non-ZIF, Non-ZIF Auto-lock
- Horizontal and vertical types

**Benefits**
- High wiring density with reduced connection costs
- Shielding for high frequency applications
- Custom design
- Impedance matched LVDS FFCs
- Anti-whisker designs (incl. inhouse Au plating)
- Eco-GreenTM - zero halogen, non-phosphorus types

---

**Wire to Board Connectors**

2.54 mm Pin Header

**BergStik**

**Features**
- B2B connections
- THT, SMT, PIP, PF options
- 2 to 72 positions
- Stack heights up to 65 mm
- Current rating of 3 A per contact
- Up to 100 mating cycles
- Operating temp. -45 °C to +125°C

**Benefits**
- A standard, proven family
- Cost-efficient solution
- For mid-end applications

**EconoStik**

**Features**
- B2B connections
- THT and SMT options
- Only vertical SMT
- 2 to 72 positions
- Current rating of 3A per contact
- Up to 50 mating cycles (1 μ" gold)
- Operating temp. -45 °C to +125°C

**Benefits**
- For mid-end applications
- pre-stressed, dual beam contact design
- Cost-efficient solution

---

**Dubox**

**Features**
- B2B and W2B connections
- THT, SMT options
- 1 to 130 positions
- Current rating of 3 A per contact
- Up to 200 mating cycles
- Operating temp. -45 °C to +125°C

**Benefits**
- For mid-end applications
- pre-stressed, dual beam contact design
- Cost-efficient solution
# Electromechanical Components

## Wire to Board Connector

### Amphenol

### Minitek Pwr 3.0 Connector

**Features**
- 2 to 24 circuits for dual row and 2 to 12 circuits for single row.
- 3.00 mm pitch power contacts
- Current rating up to 5 A per contact, 12 A per contact (HCC)
- Voltage Rating: 600 Vrms
- Operating Temperature: -40 °C to +105 °C

**Benefits**
- Wire-to-wire and wire-to-board configurations
- Blind mating interface (BMI) option
- Flexible and comprehensive solution
- Glow wire compliant option

## Power Connector

### RADLOK Series

**Features**
- DC current up to 500 A @ 85°C (Radlok), DC voltage up to 1000 V
- Operating temperature: -40 °C to +125 °C
- Single wire connection, 90° plug orientation
- Field installable plug or overmolded plug / cable assembly
- 2.4 mm to 14 mm contact diameter, 10 mm² to 150 mm² cable diameter
- Different color coding (available in black, red and orange color)
- Quick lock and press-to-release design
- IP40 mated

**Benefits**
- Quick audible lock clip, current Rating: 750 A at 25 °C
- Termination: busbar, termination crimp, pin to pin, screw

## I/O Connector

### Amphenol

### Industrial Mini I/O Connector

**Features**
- Voltage rating 30 V
- Current rating 0.5 A
- Operating temperature: -40 °C to +85 °C
- Durability: up to 1.500 mating cycles

**Benefits**
- Saves up to 75 % of space
- Reduces contact failure
- Protects plug from accidental pulling and unplugging
- More compact size compared to conventional RJ 45
- Ensures high temperature resistance

### ix Industrial™ IP20 Connector

**Features**
- 75 % smaller than RJ 45
- 360° shielding through mated pair
- High data rate perform. for 10G Ethernet, with PoE capability
- 5000 mating cycles
- Field terminable IDC plugs with solder options

**Benefits**
- Fully qualified second source intermateable with other vendors’ products
- Supports Ethernet/IP and common protocols including Profinet, DeviceNet, EtherCAT, Modbus and others
- High durability
- Controlled mating for Ethernet, Signal/Bus, other ports

## I/O Connector

### Amphenol

### Micro-Fit Connector System

**Features**
- 2 to 24 loaded circuits: single and dual row
- Pitch: 3.00 mm
- Current rating: 10.5 A per contact max (Micro-Fit), 12.5 A (Micro-Fit+)
- Voltage rating: 600 V
- Operating temp. range : -40° to +105 °C (upto 125 °C)
- Terminal Position Assurance (TPA) available

**Benefits**
- Wire-to-Wire, Wire-to-Board, Board-to-Board configurations
- Blind Mate Interface (BMI) system available (Micro-Fit)
- Compact pitch
- UL94-V0/Glow-Wire Combo Resin

## I/O Connector

### Amphenol

### Mini-Fit Connector System

**Features**
- 2 to 24 loaded circuits: single and dual row
- Pitch: 4.20 mm
- Current rating: 13.0 A per contact max (Mini-Fit), 20.5 A (Mini-Fit MAX)
- Voltage rating: 600 V
- Operating temp. range: -40 ° to +105 °C (up-to 125 °C)
- Terminal Position Assurance (TPA) available (Mini-Fit MAX)

**Benefits**
- Wire-to-Wire, Wire-to-Board, Board-to-Board configurations
- Blind Mate Interface (BMI) system available (Mini-Fit)
- Compact pitch
- UL94-V0/Glow-Wire Combo Resin

## Power Connector

### Wire to-Wire, Wire to-Board, Board to-Board

### Amphenol

### Wire to-Wire, Wire to-Board, Board to-Board

### molex

### Wire to-Wire, Wire to-Board, Board to-Board

**Features**
- 2 to 24 loaded circuits: single and dual row
- Pitch: 4.20 mm
- Current rating: 13.0 A per contact max (Mini-Fit), 20.5 A (Mini-Fit MAX)
- Voltage rating: 600 V
- Operating temp. range: -40 ° to +105 °C (up-to 125 °C)
- Terminal Position Assurance (TPA) available (Mini-Fit MAX)

**Benefits**
- Wire-to-Wire, Wire-to-Board, Board-to-Board configurations
- Blind Mate Interface (BMI) system available (Mini-Fit)
- Compact pitch
- UL94-V0/Glow-Wire Combo Resin

---

**Connectors**

- **Amphenol**
  - Minitek Pwr 3.0 Connector
  - ix Industrial™ IP20 Connector
  - Micro-Fit Connector System
  - RADLOK Series
  - Mini-Fit Connector System

**Power Connector**

- **RADLOK Series**
  - DC current up to 500 A @ 85°C (Radlok), DC voltage up to 1000 V
  - Operating temperature: -40 °C to +125 °C
  - Single wire connection, 90° plug orientation
  - Field installable plug or overmolded plug / cable assembly
  - 2.4 mm to 14 mm contact diameter, 10 mm² to 150 mm² cable diameter
  - Different color coding (available in black, red and orange color)
  - Quick lock and press-to-release design
  - IP40 mated

**Benefits**

- Quick audible lock clip, current Rating: 750 A at 25 °C
- Termination: busbar, termination crimp, pin to pin, screw
**Electromechanical Components**

**Industrial Connector**
- **Amphenol X-LOK Series**
  - **Features**
    - Push and lock design
    - Various sealing caps
    - Large variety of receptacles and cable assemblies available
  - **Benefits**
    - Waterproof/IP68
    - Temperature Range -40 °C to 105 °C
    - High durability (up to 1000 mating cycles)
    - Ruggedized design for tough location
    - Audible and tactile feedback

**Power Connector**
- **Amphenol Heavymate MPN Series C146**
  - **Features**
    - Hybrid interconnection
    - High current up to 250 A
    - Pole size: 3 up to 280 poles
    - Voltage up to 1000 V
    - IP65 to IP68
  - **Benefits**
    - High corrosion resistance
    - Superior contact technology (Radsok & stamped contacts)
    - Very robust & vibration proof housing

**Server and Storage System**
- **DDR4 Memory Module Sockets**
  - **Features**
    - 260 position connectors on 0.50 mm pitch
    - Right angle and vertical orientation
  - **Benefits**
    - Right angle and vertical orientation

- **DDR5 Memory Module Sockets**
  - **Features**
    - Provide 288 contacts on 0.85 mm pitch
    - Complies to JEDEC P580, conform to JEDEC MO-339
  - **Benefits**
    - Vertical orientation
    - Smaller pitch and lower operating voltage

- **DDR4 SO-DIMM Sockets**
  - **Features**
    - 262 positions connector on 0.50 mm pitch
  - **Benefits**
    - Right angle and vertical orientation

**Antenna**
- **Amphenol DDR4 5G External Antenna**
  - **Features**
    - Frequency: 698-960 MHz, 1.71-2.69 GHz, 4.2 GHz, 4.45 GHz
    - Protocol: BLE, BT, Thread, WiFi, Zigbee
    - Cabled 2x2 MIMO Antenna, 4x4 MIMO Antenna
    - Compatible with U.FL / I-PEX MHF Connectors
  - **Benefits**
    - Double sided TESA adhesive
    - Self adhesive mounting on metal and non-metal surface
    - Highly compact, sidefed monopole antenna
    - Solder pad for Core, Solder pad for Ground
    - Micro-coaxial cable (50, 100, 150, 200, 250, 300 mm options)
    - 4x4 MIMO design

**I/O Connector**
- **Lumberg Serie 15: Audio 3.5 mm Connector**
  - **Features**
    - Regarding JIS C6560 JC35J3A
    - 3.5mm 3 way / Stereo
    - Right Angle for PCB
    - Surface Mount Technology (SMT)
    - Temperature Range -20 °C to 70 °C
    - 34 V AC/DC and 1 Amps
  - **Benefits**
    - Mating Cycles >5000
    - Plastic Bag
    - On Reel
Electromechanical Components

Power Supply Connector

Power in-and-Outlets acc. IEC 60320

- Design: Inlet, outlet, combi/multi
- Mounting: Horizontal, vertical, bottom, snap-in, rewireable cable connector
- Cable termin.: Screw, quick connection, solder lug
- Board termin.: Through hole
- Voltage selector: With, without
- Rated current: 2.5 A, 6.3 A, 10 A (15 A acc. UL), 16 A (20 A acc. UL)
- Configuration: C8, C14-C18, C20-C24.

Relays

Industrial Relays

Focus at Rutronik is the Power Relay Group

Rutronik offers a broad range of high quality products for all applications as well as special approved parts for white good applications, home automation, renewable energy, and industrial exercise. Our suppliers provide all approvals like UL, VDE, CSA, TÜV etc. We offer different contact materials so you can select the best solution for your need. All available coil voltages can be offered.

Applications
- Fans (motors)
- Door motors
- Alarm lighting
- Contact loads
- Pump motors
- Heater element
- Lighting applications
- Smart meter
- White goods
- Battery protection
- Sensors
- Lighting
- Mobile devices
- Semiconductor protection

Fuses

SMD-Chip Fuses

SCHURTER offers a broad range of high-quality chip fuses, which are developed specially for low-loss and precise overcurrent protection in secondary circuitry.

Type
- USFF 1206, USF 1206, US1 1206, UST 1206, USF 0603, USF 0402

Features and Benefits
- Numerous current ratings from 50 mA to 25 A
- High rated voltages up to 252 VAC / VDC
- High breaking capacity of up to 600 A (internal tests)
- Super-Quick-Acting (FF), Quick-Acting (F) and Time-Lag (T) versions
- Precise, low power dissipation, resistant to vibrations and pulses

Applications
- Secondary protection on SMD PCBs
- Industrial electronics
- Smart meters
- Battery protection
- Sensors
- Lighting
- Mobile devices
- Semiconductor protection

Main Filter

1-Stage Filter for 1- and 3-phase Systems

DIN Rail Mounting

Description
- Chassis: DIN rail mounting
- Line filter in industrial version, 1 stage, high attenuation
- Especially effective against asymmetrical interferences in the frequency range
- From 100 kHz up to 30 MHz
- Easy and time saving handling

Characteristics
- Protection against interference voltage from the mains
- Possible interferences generated in the equipment are strongly attenuated
- Especially designed for electric switch and control cabinets
- Suitable for use in equipment according to IEC/UL 60950

Approvals
- VDE Certification
- UL File

Switches

DIP & Code Switches

C&K Components is a leader in interface and switch technology. C&K offers more than 55,000 part numbers that are built, priced and delivered as standard catalog items, including tactile, navigation, detect, toggle, rocker, pushbutton, rotary, key, slide, DIP, thumb-wheel and illuminated switch products, along with smart card and high-reliability connectors. C&K has built its reputation as a customer-focused organization, providing superior support, flexibility and solutions at competitive prices. Whether it’s a standard, special or custom product, C&K will deliver a cost-effective solution.

CRD Series

10mm DIP Coded Rotary Switches

- Process sealed - withstands soldering and cleaning
- Thruhole & surface mount models
- Crisp, positive detent ensures actuation
- Computer & peripherals
- RoHS compliant
- Mechan. life: 30,000 steps min.
- Operating temperature: -20 °C to 85 °C

RTE Series

Low Profile Rotary DIP Switches

- Miniature size with robust metal cover
- 2, 3, 4, 10 and 16 positions
- Variety of codings available
- RoHS compliant
- Mechanical life: RTE02/03: 1,500 actuations; RTE04/10/16: 20,000 actuations
Electromechanical Components

Brushless Fans Provide Cooling Solutions for Embedded Systems

Kaimel Electronic Corp. has been designing, developing and manufacturing a broad line of AC and DC fans since 1990 and distributing them worldwide under the brand name Jamicon.

Kaimel Electronic Corp. has ISO 9001 and ISO14001 certificated manufacturing facilities in their home country of Taiwan as well as in China and Malaysia. In order to provide their services to various industries, recently their Shenzhen factory has obtained certification of TS16949 in 2014.

As the electronics industry matured and diversified, Jamicon always upholds its strict quality control policy.

We value our customers needs and will continually develop the products that meet your expectation.

FANS are equipped with following options
- Auto-Restart
- Speed Control
- PWM
- Connector: Housing Molex 470541000 compatible parts, Pitch: 2.54 mm

Features
- Operating Temperature: -10 °C to +70 °C
- Storage Temperature: -40 °C to 70 °C
- Safety Certificate: UL, CUL, TÜV, CE
- Insulation resistance: More than 10M ohm at 500 V.D.C.
- between lead and housing
- Diclectric strength: 700 V.A.C for 3 sec (max. 5 mA between lead and housing)

Benefits
- Exceptional airflow performance and high static pressure
- Locked Motor protection: designed to meet UL, CUL, TÜV
- Polarity protection: reverse connection at the rated voltage will not cause any damage
- 2 Ball Bearing (very long life time)

Cases
Aluminum & Design Cases

Features
- Extremely low losses of air due to optimized fin geometry
- Milled flat semiconductor mounting surface
- Segment cooling aggregates
- Miniature cooling aggregates
- Heatsink cooling aggregates
- Hollow fin cooling aggregates with axial fan
- High performance brazed cooling aggregates
- High performance heatsinks with hollow fin profile
- High performance cooling aggregates with radial fan
- Protection grid for fans

Design Cases
- Aluminum cases with plastic design elements
- Cases with high IP-protection
- Cases for heat dissipation
- Large selection between different sizes and options
- Customizing and individual configuration

FANs are equipped with following options
- Auto-Restart
- Speed Control
- PWM
- Connector: Housing Molex 470541000 compatible parts, Pitch: 2.54 mm

Features
- Operating Temperature: -10 °C to +70 °C
- Storage Temperature: -40 °C to 70 °C
- Safety Certificate: UL, CUL, TÜV, CE
- Insulation resistance: More than 10M ohm at 500 V.D.C.
- between lead and housing
- Diclectric strength: 700 V.A.C for 3 sec (max. 5 mA between lead and housing)

Benefits
- Exceptional airflow performance and high static pressure
- Locked Motor protection: designed to meet UL, CUL, TÜV
- Polarity protection: reverse connection at the rated voltage will not cause any damage
- 2 Ball Bearing (very long life time)

Cases
Aluminum & Design Cases

Features
- Extremely low losses of air due to optimized fin geometry
- Milled flat semiconductor mounting surface
- Segment cooling aggregates
- Miniature cooling aggregates
- Heatsink cooling aggregates
- Hollow fin cooling aggregates with axial fan
- High performance brazed cooling aggregates
- High performance heatsinks with hollow fin profile
- High performance cooling aggregates with radial fan
- Protection grid for fans

Design Cases
- Aluminum cases with plastic design elements
- Cases with high IP-protection
- Cases for heat dissipation
- Large selection between different sizes and options
- Customizing and individual configuration

FANs are equipped with following options
- Auto-Restart
- Speed Control
- PWM
- Connector: Housing Molex 470541000 compatible parts, Pitch: 2.54 mm

Features
- Operating Temperature: -10 °C to +70 °C
- Storage Temperature: -40 °C to 70 °C
- Safety Certificate: UL, CUL, TÜV, CE
- Insulation resistance: More than 10M ohm at 500 V.D.C.
- between lead and housing
- Diclectric strength: 700 V.A.C for 3 sec (max. 5 mA between lead and housing)

Benefits
- Exceptional airflow performance and high static pressure
- Locked Motor protection: designed to meet UL, CUL, TÜV
- Polarity protection: reverse connection at the rated voltage will not cause any damage
- 2 Ball Bearing (very long life time)
Electromechanical Components

Batteries
Lithium Metal Coin Cells

**Features**
- Wide portfolio of coin sizes and variety of pin types
- Low self discharge rates
- High energy densities up to 375 Wh/kg
- Wide temperature range
- Direct support at the world leading manufacturer of lithium metal coin cells
- Unique diversity of technologies

**Benefits**
- Different ways of contacting at different space
- Long-term energy, reliability and storability
- High quality, best technical solution, safety and conformity
- Special series for lasting back-up (BR), rechargeable usage (VL, ML, MT), high temp. up to 125°C (BR-A)

---

**Type** | **Primary Battery** | **Rechargeable Battery**
---|---|---
**Material Anode** | MnO2 | LiFePO4 | LiFePO4
**Material Cathode** | Li | Li | LiAl | LiAl | LiTiOy | LiTiOy
**Nom. Voltage (V)** | 3.0 | 3.0 | 3.0 | 3.7 | 3.7 | 3.7
**Operating Temp. Range (°C)** | -30 to +60 | -30 to +60 | -30 to +60 | -30 to +60 | -30 to +60 | -30 to +60
**Self-discharge (per year) under standard conditions** | 1.0% | 1.0% | 2.0% | 2.0% | 2.0% | 2.0%
**Average Discharge Voltage (V)** | 2.85 | 2.5 | 2.85 to 3.55 | 2.8 to 3.2 | 2.5 | 1.2
**Charge Voltage (V)** | 3.0 | 2.0 | 3.25 to 3.55 | 2.8 to 3.2 | 3.0 | 1.0
**Cut-off Voltage (V)** | 2.0 | 2.0 | 2.5 | 2.0 | 1.0 | 1.0
**Charge-discharge Cycles** | 1,000 charge/discharge partly (charge/discharge for 10% of discharge depth) | 1,000 charge/discharge partly (charge/discharge for 10% of discharge depth) | 500 charge/discharge up to 3V or discharge limit voltage | 500 charge/discharge up to 3V or discharge limit voltage | 100% charge/discharge for 100% of discharge depth | 100% charge/discharge for 100% of discharge depth

---

**Battery Holders**
Variety of Battery Holders

- Coin, horizontal
- Coin, vertical
- Coin, retainer
- Coin, contact

---

Next generation e-commerce

**FASTER. EASIER. JUST MORE PERSONAL.**

rutronik24.com

---

www.rutronik.com/EMBEDDED Boards & Systems | Storage | Displays | Wireless