RUTRONIK
ELECTRONICS WORLDWIDE

Embedded Highlights

RUTRONIK
EMBEDDED

V4.0.1

Combine Technologies
Realize EMBEDDED Designs

The perfect symbiosis for wireless internet connectivity, powerful mainboards, professional displays and innovative storage solutions.

RUTRONIK EMBEDDED

Content

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.

Components – Variety. Built-in.
The Product Portfolio from RUTRONIK

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

Logistics – Reliability. Built-in.
The Delivery Service from RUTRONIK

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

Quality – Security. Built-in.
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.

Boards & Systems

- **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 Supplies**
  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.
- **Sensors**
  Embedded applications often collect environmental data or have to provide an HMI. The sensor portfolio includes magnetic, optical and MEMS sensors, e.g. from market and innovation leaders Bosch Sensortec and STMicroelectronics. So called application specific sensor nodes (ASSNs) running fusion software combine different sensor types in a single package with up to nine degrees of freedom (DoF). Integrated proximity and ambient light sensors in combination with infrared LEDs provide touch-less gesture control functionality. With this portfolio and our sensor expertise, we are offering the optimum solution for your application.
- **Electromechanical Components**
  The whole world of IoT can't work without connectors and hard wiring, so at the end, RUTRONIK EMBEDDED is also taking care of your wired connectivity. Even inside an embedded system or DIN-rail mounted, we can provide you the needed solutions in combination with all the other components.

Storage

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.

Displays & Monitors

With our portfolio of active TFT solutions, passive LCDs, OLEDs and professional monitors, we can fulfill every demand for the visible front-end of an embedded system. Standards are also available, as well as fully customized or semi customized solutions. Especially with passive LCDs we still can offer different technologies to take care of the uncountable new and smart entry level designs for the IoT market. The latest touch technologies, as well as the best picture quality, RUTRONIK EMBEDDED is offering a huge portfolio for your embedded system design.

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, compatiblity and consortia.

RUTRONIK EMBEDDED

Boards & Systems

Storage

Displays

Wireless

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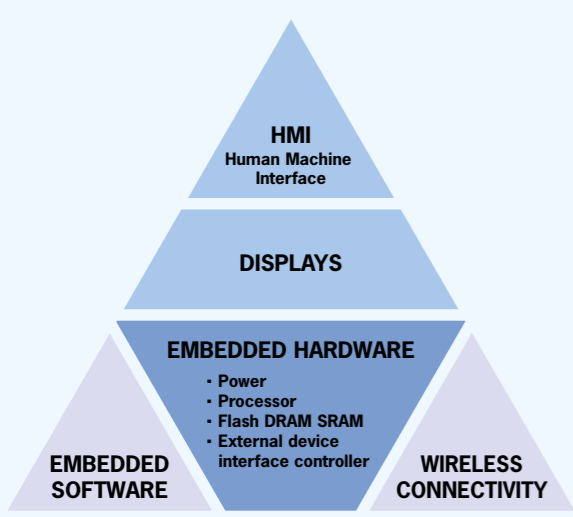based on ever faster, more powerful, smaller and energy-saving components. Suitable and standardized power supplies, sensors and electromechanical components which guarantee functional reliability even under extreme operating conditions

▪ **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

HMI
Human Machine Interface

DISPLAYS

EMBEDDED HARDWARE
- Power
- Processor
- Flash DRAM SRAM
- External device interface controller

EMBEDDED SOFTWARE

WIRELESS CONNECTIVITY

Cyber Physical Systems (CPS) comprise the networking of embedded systems via wired or wireless communications networks

Boards & Systems

Storage

Displays

Wireless

TRONIK BEDDED
The Result:
More Capabilities

RUTRONIK EMBEDDED

Linecard Boards & Systems

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), PC/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.

Types / Technologies	Aaeon	Advantech	ASUS	DFI	eCount	HMS	EKL	F&S	FSP	iEi	Intel	Kontron	Seco	Teleconnect	VIA
Mainboards / Embedded Boards															
Industrial Mainboards	X	X	X									X			X
Server Mainboards	X	X	X								X	X			
Workstation Mainboards		X	X								X	X			
Desktop Mainboards			X												
Computer on Modules	X			X				X				X	X		X
Base- / Evaluationboards	X			X				X				X	X		X
Single Board Computer	X	X	X					X				X	X		X
Slot Single Board Computer	X			X								X			
Backplanes	X			X											
Blade Computing	X														
Embedded Systems															
Industrial Servers	X											X			
Datacenter Servers		X										X			
Embedded Box-PCs	X	X	X									X	X		X
Embedded Panel PCs / Touch Panel PCs	X			X									X		
Desktop PCs	X	X	X									X			
Mobile PCs / Industrial Tablet PCs / Compute-Sticks	X											X	X		
Industrial Monitors / Industrial Touch Monitors	X			X	X							X			
Industrial Chassis	X			X								X			
Accessories															
Digital LCD Controllers (Scaler)					X										
Artificial intelligence Accelerator Modules & Cards	X	X	X								X	X	X		
Controller Cards (Digital / Analog / Mixed Signal)		X		X								X	X		
Graphic Cards	X	X	X									X	X		
HPC Cards	X											X			
Coolers & Heatspreaders	X	X	X					X				X	X	X	
Cables & Adapters	X	X	X	X						X	X	X	X		X
Wired Communication Modules & Systems															
Network Cards	X											X	X		
Network Switches / KVM Switches	X	X										X	X		
Industrial Bus & Protocol Solutions	X						X								
Wired Long-Range Network Solutions														X	
Power Supplies															
Industrial PC (IPC)									X						
Redundant Power Supplies									X						
AC/DC Adapter									X				X		
DC/DC Converters					X				X						
Uninterruptable Power Supplies (UPS)									X						
Processors															
Mobile Processors											X				
Desktop Processors											X				
Server Processors											X				
Chipsets											X				

Industrial Mainboards by Kontron

For more than 30 years, mainboards have been developed and produced in our Augsburg factory. Kontron puts special emphasis on highest product quality, long-term availability and direct technical support by the manufacturer. Mainboards by Kontron reliably work in thin clients, servers and complete system solutions for industrial customers. With an annual production volume of around 2.5 million units, Kontron is the leading European manufacturer of mainboards.

R&D
- Design know-how based on more than 30 years of experience with mainboard design
- Synergy between other designs (industrial mainboards are derived from Kontron standard portfolio)

Quality
- 3-Level inspection after production (AOI, ICT, UFT) on each board
- Due to 96% automatic production we are able to assure low RMA-rates (0.3% at present!)

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

Longevity
- Professional Lifecycle Management (ECN / PDN / LTB / EOL) announcements
- Longterm availability

Innovation
- Optimized Feature and design to reduce power comsumption
- Simplify product selection with new features (Dual Power Supply Option 12V DC & ATX)

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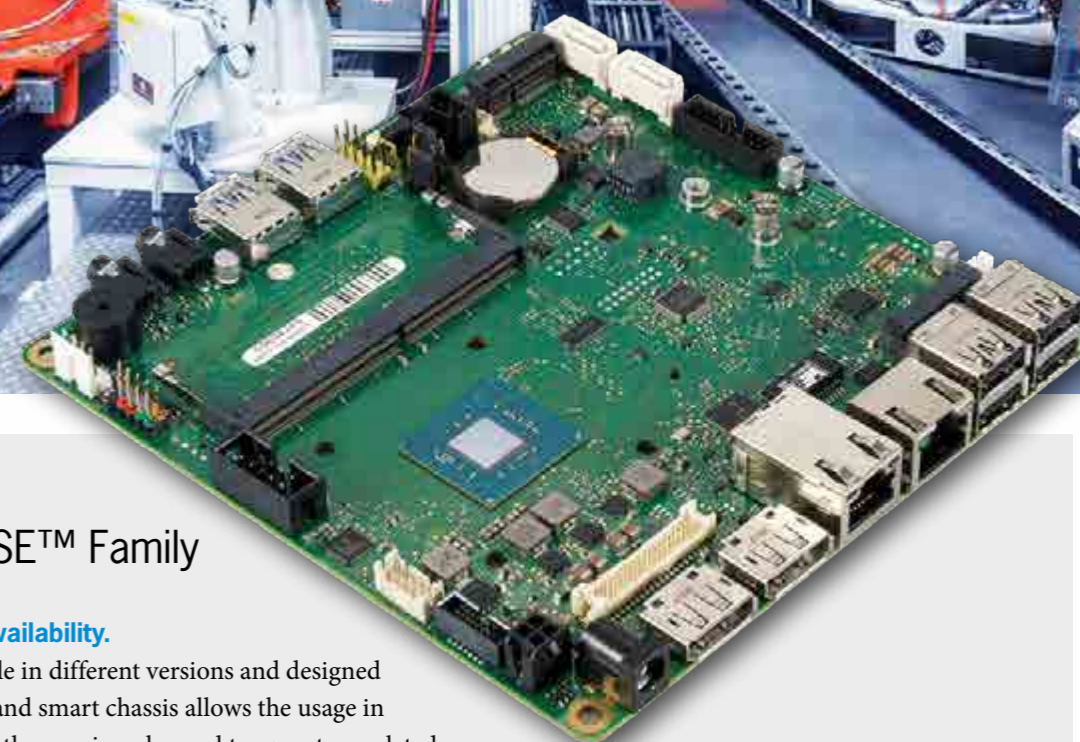
Mainboard SMARTCASE™ Family

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

Kontron Mainboards powered by the latest Intel® Technology Platforms

Intel® 8th Gen Core™ i Processor Series

D3544-S
- Mini-STX
- Intel® Gemini Lake SoC

D3543-S
- Mini-ITX
- Intel® Gemini Lake SoC

D3634-S
- Mini-ITX
- Intel® H310 Chipset
- LGA 1151 socket

D3633-S
- Mini-ITX
- Intel® Q370 Chipset
- LGA 1151 socket

D3641-S
- µATX
- Intel® C246 Chipset
- LGA 1151 socket

D3646-S
- ATX
- Intel® C246 Chipset
- LGA 1151 socket

Smartcase™ Series

SMARTCASE™ S Series

Key Features
- Mini-STX
- Intel® Gemini Lake SoC

Key Features
- Mini-STX
- Intel® 8th Gen Core™ Technology (LGA1151)
- 0.87l!

Key Features
- Mini-ITX
- Intel® Gemini Lake
- 2.48l

Key Features
- Mini-ITX
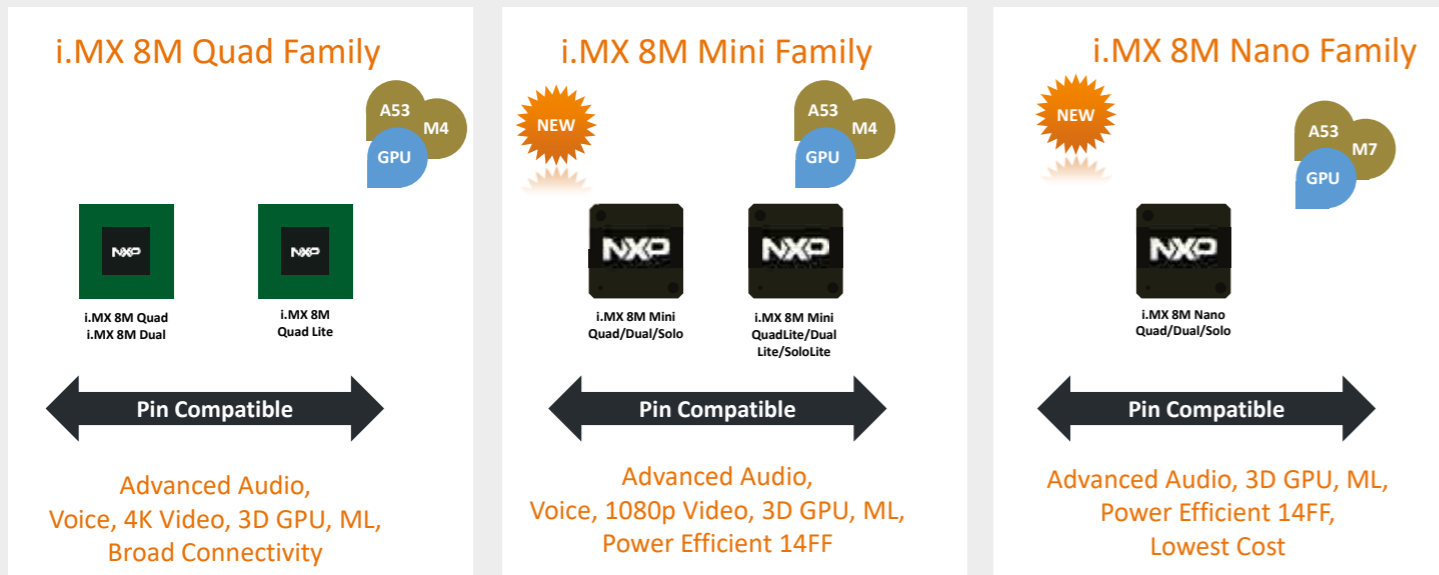- Intel® 6th / 7th / 8th Gen Core™ Technology (LGA1151)
- 2.48l

Embedded Boards & Systems by SECO

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). They 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

i.MX 8M Family

i.MX 8M Quad Family
A53 M4
GPU

i.MX 8M Quad
i.MX 8M Dual

i.MX 8M
Quad Lite

Pin Compatible

Advanced Audio,
Voice, 4K Video, 3D GPU, ML,
Broad Connectivity

i.MX 8M Mini Family
NEW
A53 M4
GPU

i.MX 8M Mini
Quad/Dual/Solo

i.MX 8M Mini
QuadLite/Dual
Lite/SoloLite

Pin Compatible

Advanced Audio,
Voice, 1080p Video, 3D GPU, ML,
Power Efficient 14FF

i.MX 8M Nano Family
NEW
A53 M7
GPU

i.MX 8M Nano
Quad/Dual/Solo

Pin Compatible

Advanced Audio, 3D GPU, ML,
Power Efficient 14FF,
Lowest Cost

Software Compatible (Including GPU Tools)
High-end ($$$) => Mid-end ($$) => Low-end ($)

i.MX

8X — 8M — 8

Quad — Mini — Nano

Quad	Mini	Nano
Dual	Dual	Dual
QuadLite	Solo	Solo
	QuadLite	
	DualLite	
	SoloLite	

Q7-C25
- i.MX 8M Quad
- i.MX 8M Dual
- i.MX 8M QuadLite

Q7-C26
- i.MX 8QuadMax
- i.MX 8QuadPlus
- i.MX 8Quad

SBC-C20
SBC with NXP i.MX 8M applications Processors in 3.5" form factor

SBC-C61
SBC with the NXP i.MX 8M Mini Processors

SBC-C43
Single Board Computer with NXP i.MX8 applications Processors in 3.5" form factor

SM-C12
SMARC standard module with NXP i.MX 8M processor

N-Series Intel Pentium / Celeron and x5-Series Atom SOCs

	Intel Celeron	Intel Pentium	Intel Atom	Intel Atom	Intel Atom
# of Cores	2	4	2	4	4
# of Threads	2	4	2	4	4
Processor Base Frequency	1.10 Ghz	1.10 Ghz	1.30 Ghz	1.60 Ghz	1.60 Ghz
Burst Frequency	2.40 Ghz	2.50 Ghz	1.80 Ghz	1.80 Ghz	2.00 Ghz
Cache	2 MB L2	2 MB L2	2 MB L2	2 MB L2	2 MB L2
TDP	6 W	6 W	6.5 W	9.5 W	12 W
Sceanrio Design Power (SDP)	4 W	4 W			

Q7-B03
Qseven® Rel. 2.1 with the Intel® Atom™ E39xx family, Intel® Celeron® N3350 and Intel® Pentium® N4200 SoCs

SM-B69
SMARC with the Intel® Atom™ E39xx Intel® Celeron® N3350 family,and Intel® Pentium® N4200 SoCs

COMe-C24-CT6
COM Express™ 3.0 Compact Type 6 Module with the Intel® Atom™ X Series, Intel® Celeron® J/N and Intel® Pentium® N Series

SBC-A80-eNUC
Embedded NUC™ SBC with the N-series Intel® Pentium®/Celeron®

SBC-B68-eNUC
Embedded NUC™ SBC with the Intel® Atom™ E39xx family, Intel® Celeron® N3350 and Intel® Pentium® N4200

SBC-C41-pITX
Intel® Atom™ X Series, Intel® Celeron® J / N Series and Intel® Pentium® N Series Processors

Ryzen Series

COMe-B75-CT6
COM Express™ Compact 3.0 Type 6 Module with the AMD Ryzen™ Embedded V1000 processors

Epyc Series

COMe-C42-BT7
COM Express™ Rel.3.0 Basic Type 7 module with the AMD EPYC™ Embedded 3000 Series of SoCs

Embedded Edge Computer Solutions by ASUS

ASUS
®
IN SEARCH OF INCREDIBLE

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. We not only provides international industry standard form factor models, but also offers customized hardware and software solutions for specific applications.

Wide Range Portfolio

	Industrial			Semi-Industrial & Developer	
Micro ATX	**Mini ITX**	**3.5" SBC**	**Pico ITX**	**Pico ITX**	**Nano SBC**
244 x 244 mm	170 x 170 mm	146 x 105 mm	100 x 72 mm	100 x 72 mm	86 x 54 mm
X86	X86	X86	ARM	ARM	ARM

H310M-IM-A Micro-ATX, H310I-HM-A R2.0 Mini-ITX, Q370HM-A Mini-ITX, C582S-IM-AA 3.5" SBC, E394S-IM-AA 3.5" SBC, E395S-IM-AA 3.5" SBC, IMX8P-IM-A Pico-ITX

Tinker Board Nano SBC, Tinker Edge R Pico-ITX, Tinker Edge T Pico-ITX

ASUS Edge Computer Proposition

ASUS's offers a wide range of long-lifecycle industrial motherboards and & single board computer in various form factors to serve different applications from customers. This boards 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.

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

Things — Node — Gateway — Edge Computer — Server

ASUS Node — PE100 — PE200 / PE400
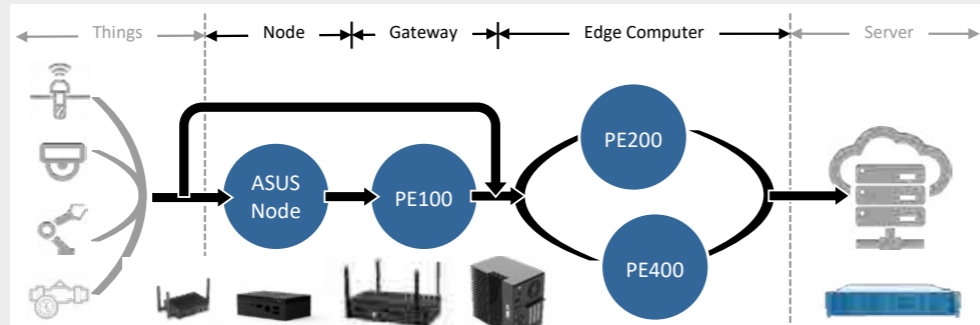
Sensor Fusion
- Data aggregation
- Data normalization
- Data processing
- Data forwarding

Edge Inference
- Secure virtualization
- Workload consolidation
- Real-time analytics (AI)

Data Center
- Data training
- Data analytics
- Data storage

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.

Workstation
Professional, ISV certified ESC/E series workstations have server-grade computing power, incredible expandability and advanced I/O, best suited for content creators, professional VR applications, and heavy entertainment loads.

Server and Workstation Motherboard
ASUS offers the most reliable server and workstation motherboards with industry-leading performance, high power-efficiency, and complete IT infrastructure management.

Accessories
OCP Mezzanine cards, high speed LAN cards, and ASUS-exclusive PIKE RAID cards provide the fastest interconnects and highest storage expandability for datacenter topology.

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

ESC8000 G4 Series (C621)	**HIGH-END Accelerator Server** - Asus-Exclusive PCIe Routing Switching design for 8 x GPUs - Supports up to 8 double-deck active & passive GPUs in 4U
ESC4000 G4 Series (C621)	**MAINSTREAM Accelerator Server** - Maximum flexible expansion slots 8+3 in the depth of 800 mm and 2U height - Supports up to 4 double-deck active & passive GPUs in 2U
E900 G4 (C621)	**HIGH-END WS SYSTEM** - Dual CPU Socket - 4 Double Deck Graphics
E800 (TBD)	**HIGH-END WS SYSTEM** - Single CPU Socket - 4 Double Deck Graphics
ESC700 G4 (C422)	**MAINSTREAM WS SYSTEM** - Single CPU Socket - 2 Double Deck Graphics
ESC500 G4 (C236) E500 GS (C246)	**ENTRY WS SYSTEM** - Single CPU Socket - 1 Double Deck Graphics
ESC500/510 G4 SFF (C236) E500 GS SFF (C246)	**ENTRY WS SYSTEM** - Single CPU Socket - 1 Low Profile Graphic

E900 G4
- Extreme 2P performance
- 4-Way NVIDIA® Quadro RTX™ support
- ECC memory
- Scale up & scale out
- Independent software vendor (ISV) certification

ESC700 G4
- Powerful performance and ECC memory
- Comprehensive IT infrastructure management software
- Multiple graphics card support
- Ultrafast storage and I/O options
- Dual Intel server-class Gigabit LAN

ESC500 G4
- Powerful performance with Intel® Xeon® E processor and ECC memory
- Supports up to three independent displays simultaneously via HDMI, DisplayPort, DVI-D and VGA
- High Speed USB 3.1
- Graphics card support, including NVIDIA® Quadro® M5000 (option)
- Independent software vendor (ISV) certification

Embedded Boards & Systems by DFI

DFI®

Founded in 1981, DFI is a global leading provider of high-performance computing technology across multiple embedded industries. With its innovative design and premium quality management system, DFI's industrial-grade solutions enable customers to optimize their equipment and ensure high reliability, long-term life cycle, and 24/7 durability in a breadth of markets including factory automation, medical, gaming, transportation, smart energy, defense, and intelligent retail.

1.8" SBCs

DFI's 1.8" SBC board measuring only 84mm x 55mm, is fanless and is ideal for space-constrained applications such as factory automation.

ALF051
- Intel Atom® Processor E3900 Series
- Single Channel LPDDR4 Memory Down up to 4GB
- 1 Mini DP++, 2 GbE, 1 COM, 3 USB
- 1 Mini PCIe, 1 SMBus
- Up to -40 to 85°C operating temperature

2.5" PICO-ITX

DFI's Pico-ITX SBC board (100 x 72 mm) support 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.

AL051
- Intel Atom® Processor E3900 Series & N Series
- Single channel DDR3L, 1 SODIMM up to 8GB
- 1 VGA, DP++, 1 LVDS, 2 GbE, 1 COM, 4 USB
- 1 Mini PCIe, 1 M.2
- Up to -40 to 85°C operating temperature

FS053
- MX6 Cortex-A9
- 1GB/2GB SDRAM Memory Down
- 1 HDMI,1 LVDS, 2 GbE, 2 COM, 2 USB
- 1 Mini PCIe, 1 SDMini-ITX

AL05P
- Intel Atom® Processor E3900 Series
- Memory down LPDDR4 up to 4GB
- 1 mini DP++, 1 GbE, 1 COM, 4 USB
- 1 PoE PD 802.3AF
- Up to -20 to 70°C operating temperature

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.

Configure by Demand

Applications	Panel	Box	Demand Panel PC
	7"	A	
	15"	B	
	21"	C	

Different Requirements → **Configure by Demand** → **Application Ready**

Mini-ITX

DFI's embedded Mini-ITX motherboard (measuring to only 170mm x 170mm) 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.

CS100
- 8th Gen Intel ® Core™ Processors
- Dual channel DDR4, 2 SODIMM up to 32GB
- 1 VGA, 1 LVDS, 1 DP++, 2 GbE, 2 COM, 12 USB
- 1 PCIe x16, 1 Full-size Mini PCIe (& mSATA)

GH171
- AMD® Ryzen™ V1000/R1000 Mini-ITX
- 2 DDR4 3200MHz ECC SODIMM up to 32GB
- Four independent displays: 4 DP++
- Multiple expansion: 1 PCIe x16, 1 M.2 M Key
- Rich I/O: 2 GbE, 6 COM, 3 USB 3.0, 6 USB 2.0

Industry-Specific Embedded System

The industry-specific embedded system family is designed to meet diversified application-specific requirements including medical, digital signage, gaming, etc.
It is built with high quality industrial-grade components to enable durable and reliable 24/7 operation in computing-demanding surroundings.

VC230-BT
- Anti-vibration and fanless In-Vehicle computer
- Supports ignition delay on/off function
- 1 mSATA, eMMC (optional), microSD (optional)
- Supports Wi-Fi, 3G, and GPRS application

MD711-SU
- 6th Generation Intel® Core™ Medical Computing System
- 2 DDR4 SODIMM up to 32GB
- 1x 2.5" SATA 3.0 drive bay
- Supports 1 PCIe 16, 1 Mini PCIe, 1 M.2 slot
- 4KV Isolated I/O ports: 2 Intel GbE, 2 COM, 2 USB 2.0
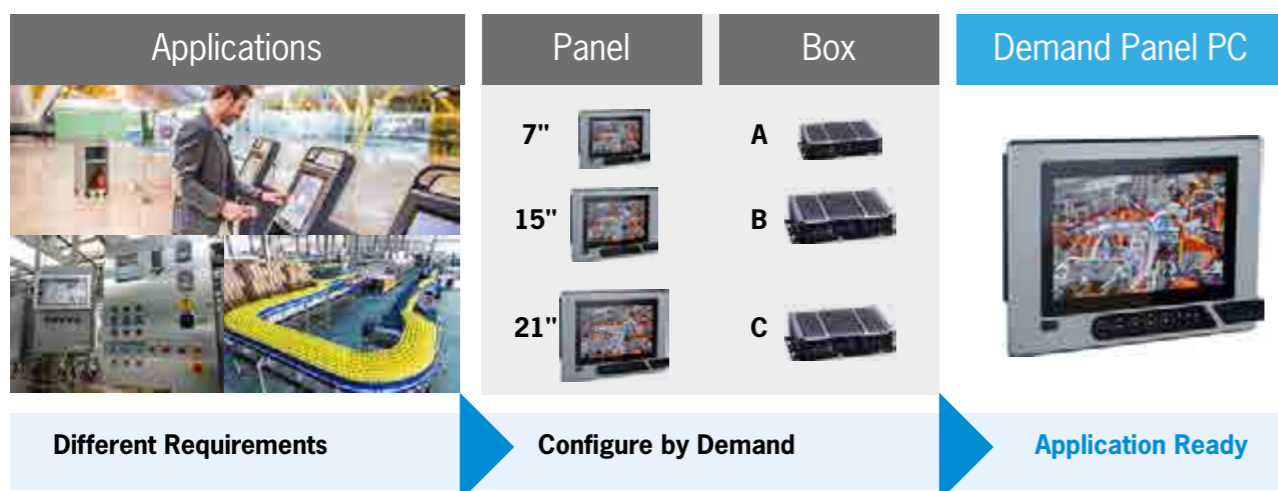
Fanless Embedded System

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.

EC800-AL
- Intel Atom® Processor E3900
- 2GB/4GB/8GB LPDDR4-2400 memory onboard
- Triple independent displays: 1 VGA/DVI-D + 2 DP/HDMI
- Supports 1 Mini PCIe & 2 M.2 slots
- Rich I/O ports: 2 Intel GbE, 2 COM, 4 USB

EC90A-AL
- Intel Atom® Processor E3900 Series
- 2GB/4GB LPDDR4 memory onboard
- DP++ supports up to 4096x2160 @ 60Hz
- Rich I/O ports: 2 Intel GbE, 1 COM, 3 USB

EC900-FS6
- ARM-based Fanless Embedded System
- 1GB/2GB DDR3L memory onboard
- 8GB/16GB eMMC for storage
- DIN Rail Mount
- Rich I/O ports: 2 GbE, 2 COM, 2 USB 2.0, 1 USB OTG

Embedded Boards & Systems by Advantech

ADVANTECH
Enabling an Intelligent Planet

Worldwide Leader in Embedded Design and Services
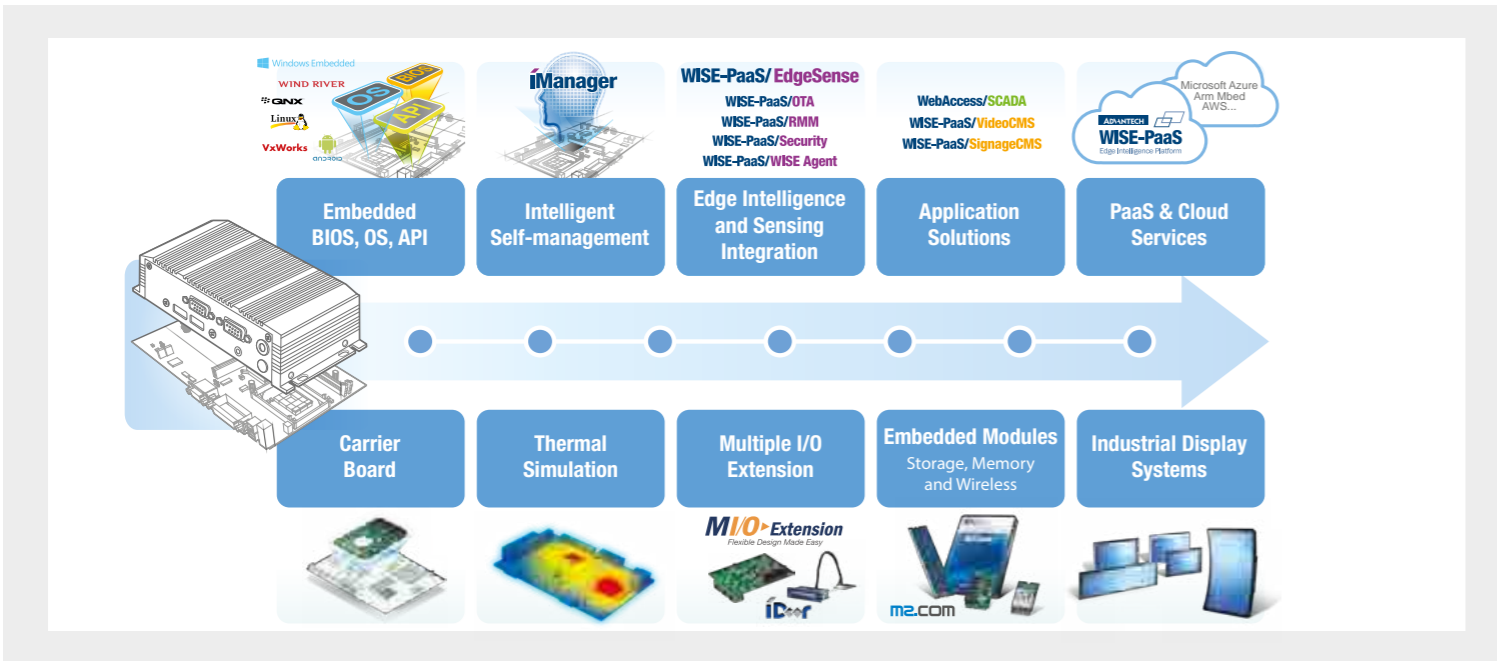
Computer On Modules

Accelerate Application Development with Dedicated Design-In Services

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, ETX, and Qseven, all of which offer additional design-in services that provide small form factor support while also supporting the latest Intel CPUs.
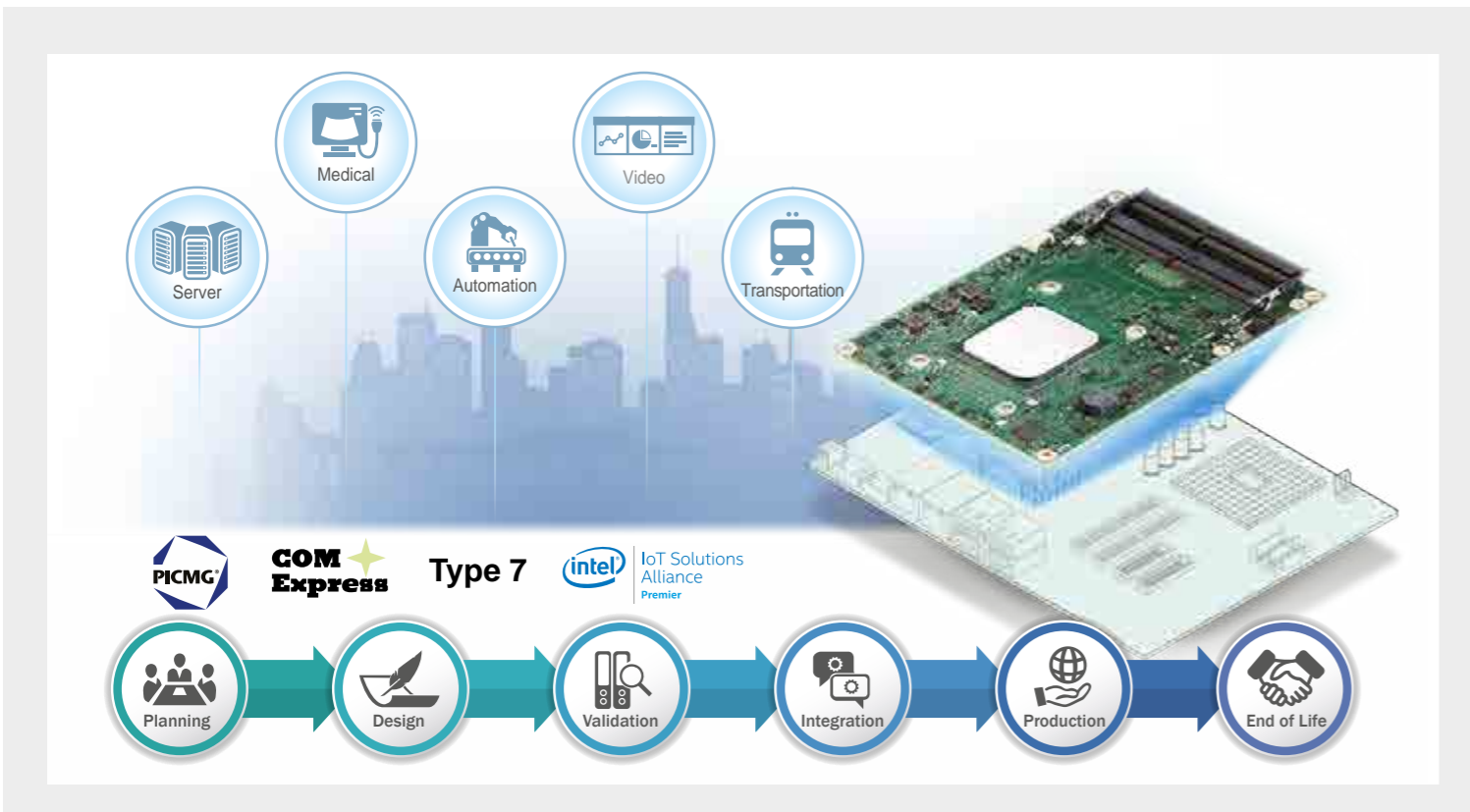
Fanless Embedded Computers

Modular System for Quick Equipment Integration

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.

Embedded Single Board Computers

Enabling Next-Generation Industrial Applications

Advantech offers compact industrial-grade embedded single-board computers (SBCs) with rugged design, high flexibility, and easy expansion capabilities. Our range of product offerings vary 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.

Embedded Boards with F&S

Intel® 1/2.5/10/25/40 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 100Gbp/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.

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 (Intel® Ethernet AVF)
- 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

Boards – Overview

efusG1C

armStoneA9r2 PicoCoreMX6SX

Board Family	armStone™	efus™	PicoCore™	QBliss	PicoCOM™	PicoMOD	NetDCU	PCOMnet
Board Type	SBC	COM	COM	COM	COM	COM	SOM	SBC
Baseboard Complexity	-	easy	easy	advanced	easy	easy	very easy	-
CPU Performance Up To (Cores)	Cortex-A9 (4)	Cortex-A53	Cortex-A53 (4)	Cortex-A9 (4)	Cortex-A9 (1)	Cortex-A9	Cortex-A9	Cortex-A9
Windows	✔	✔		✔	✔	✔	✔	✔
Linux	✔	✔	✔	✔	✔	✔	✔	✔
Standard	PicoITX Formfaktor	F&S	F&S	Qseven second source	F&S	F&S	F&S	F&S
LCD Interface	RGB LVDS	RGB LVDS	RGB, LVDS, MIPI-DSI	LVDS	RGB	RGB LVDS	RGB	EDT RGB
Screen	DVI	DVI	-	DVI	-	DVI	-	-
Color Depth Up To	24Bit	24Bit	24Bit	24Bit	18Bit	24Bit	24Bit	18Bit
Resolution Up To	FullHD	FullHD	1080p60	FullHD	WXGA	WXGA	FullHD	WVGA
DATA-BUS	-	-	-	-	-	✔	✔	-
Camera	-	✔	✔	✔	-	✔	-	-
Ethernet	2x	2x	2x	2x	2x	1x	2x	2x
Power Supply	5V	5V	5V	5V	3.3V	3.3V	5V	5V
Size (mm)	100x72	47x62.1	35x40	70x70	40x50	80x50	100x80	80x50
Plug Connector	66pin	MXM-2 230pin	2x 80pin	MXM-2 230pin	80pin	140pin	142pin	-

Intel® NUC Kits, Boards & Mini PCs
High-End Computing, Low-Profile Style

Intel Authorised Distributor

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.

RETAIL
• Smart Mirror
• Security System
• POS System

HOME
• Smart Washer/Dryer
• Smart Refrigerator
• Smart Vehicle Infotainment

UNIVERSITY
• Digital Signage
• Intelligent Vending
• Smart TV

OFFICE
• Office Collaboration
• Interactive Whiteboard
• All-In-One Workstation

FACTORY
• HVAC/Air Quality System
• Robotics Automation
• Inventory Movement
• Fleet Tracking
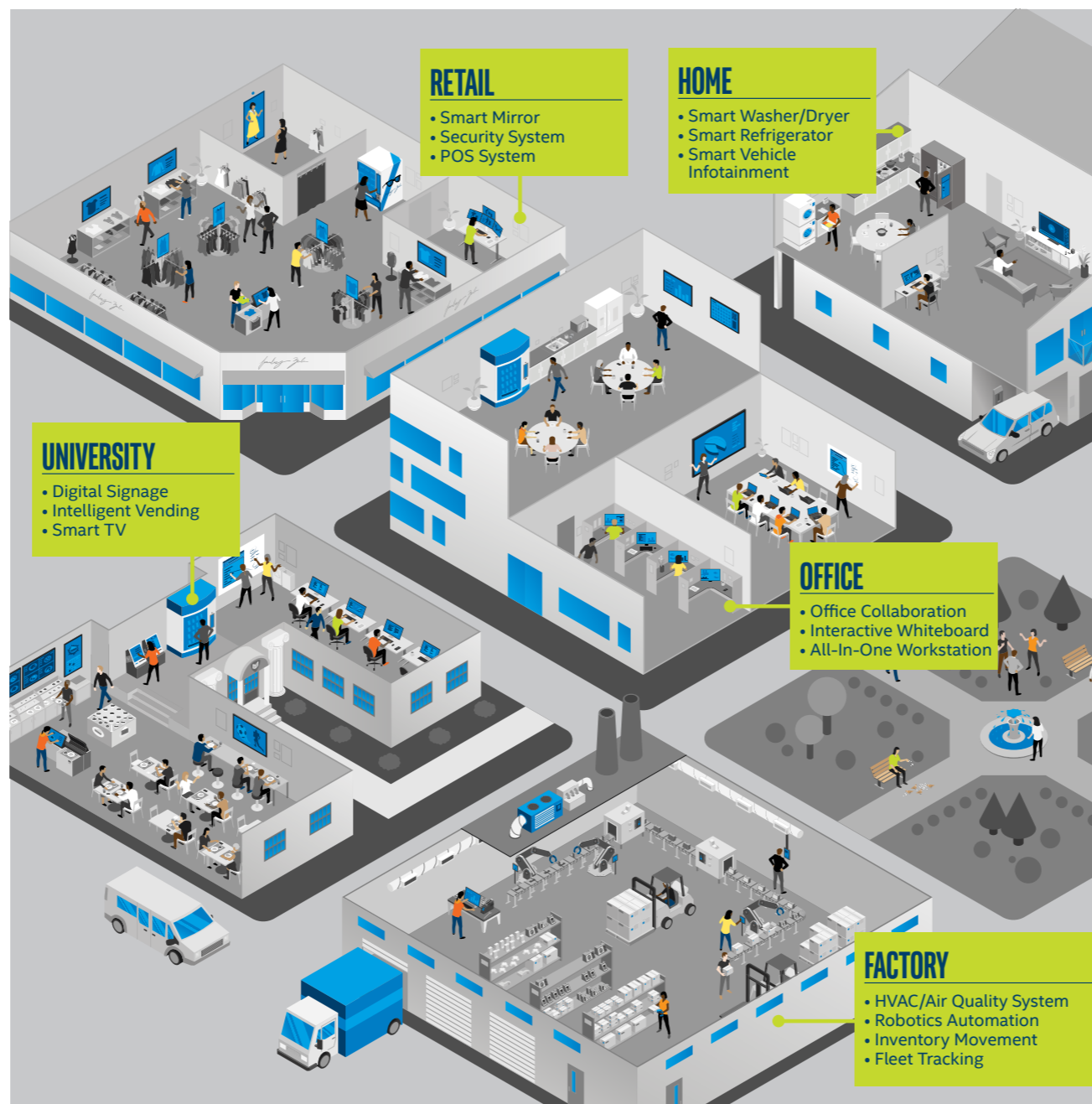
Intel® NUC Elements
Intel® NUC Elements High-Performance, Modular Elements for a Range of Verticals

Intel Authorised Distributor

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.

Intel® NUC Compute Elements

Intel® NUC NUC Rugged Board Elements

Intel® NUC Pro Board and Assembly Element

Intel® NUC Rugged Chassis

Intel® RealSense™

Intel ® RealSense™ offers multiple products based on technologies like LiDAR, Stereo and Coded Light to experience and measure the world.

LiDAR Camera L515

Camera Features	
Use Environment	Indoor
Technology	LiDAR
Depth FOV	70° x 55° (2 ±2°)
Depth Output Resolution & Frame Rate	Up to 1024 × 768 depth resolution. 30 fps
Minimum Depth Distance (Min-Z)	0.25 m
Maximum Distance	9 meters (VGA resolution, with a maximum Z error of 15.5 mm at that distance)
Max RGB Resolution & Frame Rate	1920 × 1080. 30 fps
Physical Parameters	
Form Factor	Camera Peripheral
Connectors	USB C* 3.1 Gen 1
Diameter × Height	61 mm × 26 mm
Major Components	
Optical Board	▪ Laser ▪ MEMS Mirror

Tracking Camera T265

Camera Features	
SLAM	**V SLAM, part of Intel® RealSense™ Technology** High precision Visual Inertial Odometry Simultaneous Localization and Mapping algorithms
VPU	**Intel® Movidius™ Myriad™ 2.0 VPU** Visual Processing Unit optimized to run V SLAM at low power
FOV	**Two Fisheye lenses with combined 163±5° FOV** The camera includes two OV9282 imagers with fisheye lenses for a combined, close to hemispherical 163±5° field of view for robust tracking even with fast motion
Inertial Measurement Unit (IMU)	**BMI055 IMU** The Inertial Measurement Unit, allows for accurate measurement of rotation and acceleration of the device, to feed into the V-SLAM algorithms
USB	**USB 3.1 Gen 1 Micro B**
Physical Parameters	
Dimensions	108 mm x 24.5 mm x 12.5 mm

Product Comparison

SKU	Baseline	Depth Sensors Shutter Type	Max. Depth Resolution Max. Frame Rate	Depth FOV (H × V)	Min. Depth Distance	Max. Range	MAX. RGB Resolution Max. Frame Rate	IMU	Dimensions
L515	N/A	Laser Scanning	Up to 1024 x 768, Up to 30 fps	70° × 55° (±2°)	0.25 m	Approx. 9 m	1920 × 1080 at 30 fps	N/A	(Diameter x H) 61 mm × 26 mm
D435i	50 mm	Global	Up to 1280 x 720, Up to 90 fps	87°±3° × 58°±1°	0.105 m	Approx. 10 m	1920 × 1080 at 30 fps	6DoF	(L x D x H) 90 x 25 x 25 mm
D435	50 mm	Global	Up to 1280 x 720, Up to 90 fps	87°±3° × 58°±1°	0.105 m	Approx. 10 m	1920 × 1080 at 30 fps	N/A	(L x D x H) 90 x 25 x 25 mm
D415	55 mm	Rolling	Up to 1280 x 720, Up to 90 fps	65°±2° × 40°±1°	0.16 m	Approx. 10 m	1920 × 1080 at 30 fps	N/A	(L x D x H) 99 x 20 x 23 mm

The Intel® RealSense™ Depth Camera is also available as Bulk Version for implementation in vending machines, robots, VR devices and other use cases.

Intel® Movidius™ & OpenVINO™
Accelerate Deep Learning Development At The Edge

What is the Intel® Movidius™ Neural Compute Stick?
This tiny, fanless deep learning device allows you to learn AI programming at the edge. It is powered by the same high-performance Intel® Movidius™ Vision Processing Unit (VPU) that can be found in millions of smart security cameras, gesture controlled drones, industrial machine vision equipment, and more.

Learn What You Can Do with a Neural Compute Stick 2
Enable rapid prototyping, validation, and deployment of deep neural network (DNN) inference applications at the edge.
The low-power vision processing unit (VPU) architecture enables an entirely new segment of AI applications that are not reliant on a connection to the cloud.

Neural Compute Engine: Hardware Based Acceleration for Deep Neural Networks
Myriad™X features the all-new Neural Compute Engine – a purpose-built hardware accelerator designed to dramatically increase performance of deep neural networks without compromising the low power characteristics of the Myriad VPU product line. Featuring an array of MAC blocks and directly interfacing with the intelligent memory fabric, the Neural Compute Engine is able to rapidly perform the calculations necessary for deep inference without hitting the so-called "data wall" bottleneck encountered by other processor designs. Combining the neural network performance of the 16 proprietary SHAVE cores with the neural compute engine, Myriad X delivers 10X the performance compared to previous generations*.

OpenVINO™ – Develop Multiplatform Computer Vision Solutions
Make your vision a reality on Intel® platforms—from smart cameras and video surveillance to robotics, transportation, and more.

Your Computer Vision Apps...Now Faster
Develop applications and solutions that emulate human vision with the Open Visual Inference & Neural Network Optimization (OpenVINO™) toolkit. Based on convolutional neural networks (CNN), the toolkit extends workloads across Intel® hardware and maximizes performance.

Inference Support
In addition to supporting processors with and without integrated graphics, this toolkit enables acceleration on an Intel® Programmable Acceleration Card and Intel® Movidius™ Vision Processing Unit. For the best experience, use the toolkit with the Intel® Movidius™ Neural Compute Stick and cards based on Intel® Arria® 10 FPGA GX.
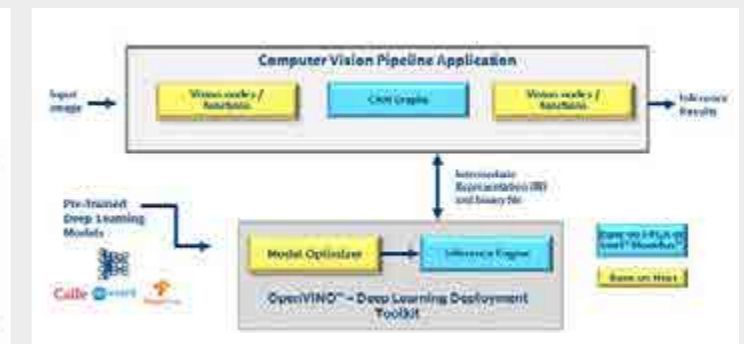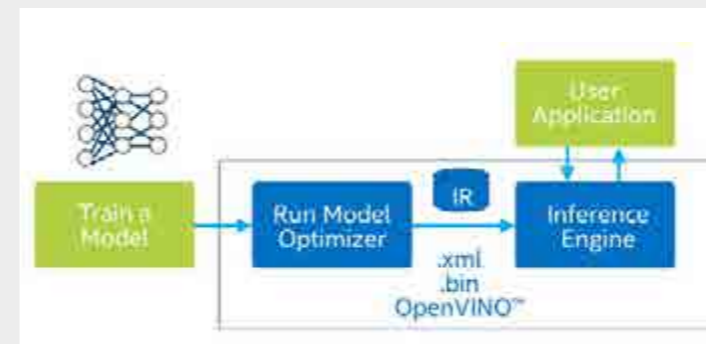
Artificial Intelligence Vision Accelerator Cards

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

TRAINING

Training with a large data set AND deep (many layered) neural network often leads to the highest accuracy inference

IMAGE RECOGNITION

Machines are able to meet or exceed human image & speech recognition e.g. tumor detection, document sorting, oil & gas search, defect detction, genome sequencing

All cards are based on Intel Movidius Myriad X and Intel Arria FPGA. Cards are designed to run pretrained models (inference).

iEi

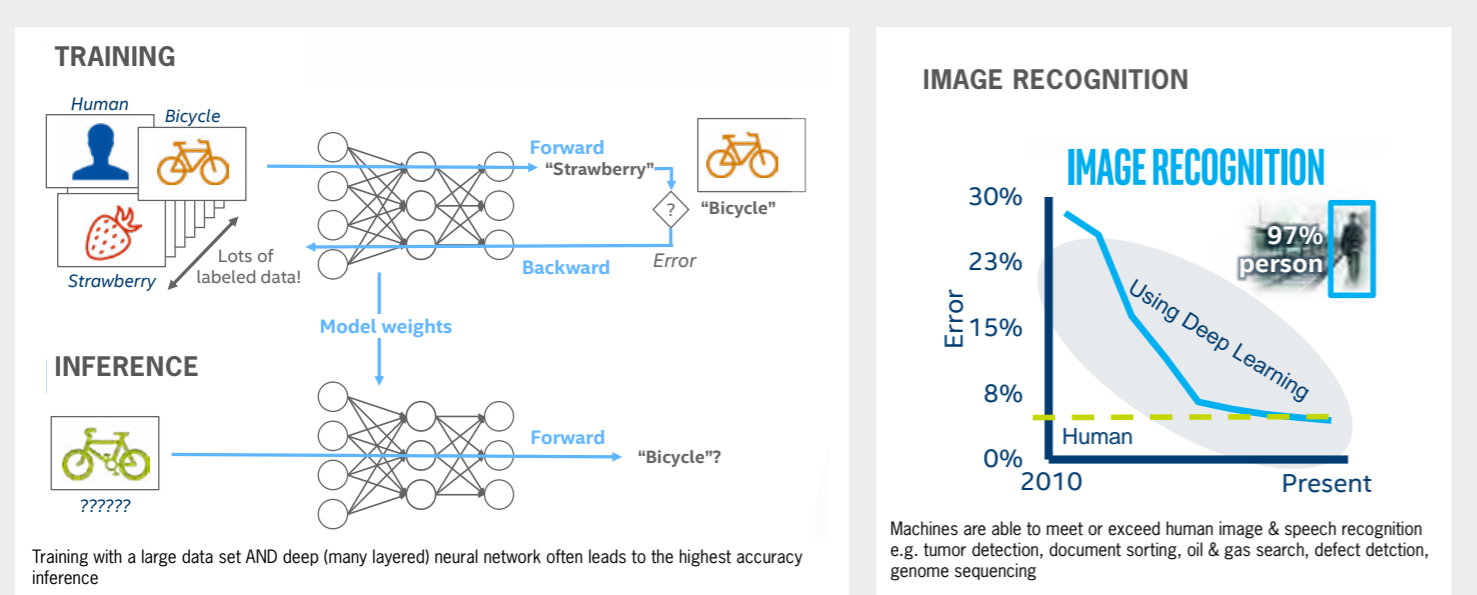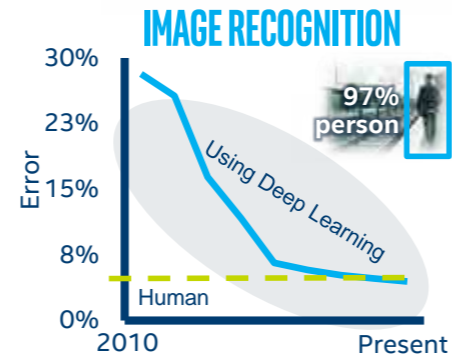| Type	Mustang-M2AE-MX1	Mustang-M2BM-MX2	Mustang-MPCIE-MX2	Mustang-V100-MX4	Mustang-V100-MX8	Mustang-F100
Chipset	1x Intel® Myriad X	2x Intel® Myriad X	2x Intel® Myriad X	4x Intel® Myriad X	8x Intel® Myriad X	1x Intel® Arria 10 1150GX
Formfactor	M.2 A+E Key	M.2 B+M Key	Mini PCIe	PCIe	PCIe	PCIe
Dimensions	22 x 30 mm	22 x 80 mm	50.5 x 30 mm	113 x 56 x 23 mm	169.54 x 56.16 mm	169.5 x 67.6 x 33.7 mm
Operating Temperature	-20 °C to 60°C	-20°C to 60°C	-20 °C to 60 °C	-20 °C to 60 °C	-20 °C to 60 °C	5 °C to 60 °C
Power Consumption	~ 4.5 W	~ 15 W	~ 7.5 W	~ 15 W	~ 25 W	~ 40 W

ADVANTECH Enabling an Intelligent Planet

Type	VEGA-320	VEGA-330
Chipset	1x Intel® Myriad X	2x Intel® Myriad X
Formfactor	M.2 A+E Key	Mini PCIe
Dimensions	22 x 30 mm	30 x 50.95 mm
Operating Temp.	0°C to 45 °C	0°C to 45 °C
Power Consumption	~ 3.8 W	~ 7.6 W

AAEON®

Type	AI Core X	AI Core XM 2280	AI Core XP4/ XP8
Chipset	1x Intel® Myriad X	2x Intel® Myriad X	4 / 8 Intel® Myriad X (via M.2 M Key Card)
Formfactor	Mini PCIe	M.2 B+M Key	PCIe
Dimensions	30 x 51 mm	22 x 80 mm	167 x 111 mm
Operating Temp.	0 ° to 60 °C	0 °C to 50 °C	0 °C to 50 °C
Power Consumption	< 4 W	~ 15 W	Depending on config.

Embedded Systems & Industrial PCs

 IT für Unternehmer

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 deskop 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 invironments 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

Embedded Systems & Industrial PCs

exone IT für Unternehmer

Pokini F2

Pokini

Small, Powerful, Customizable

The Pokini F2 is a small and fanless PC with great performace, various interfaces and excellent graphics. The embedded Intel CPU has enough power for handling digital-signage an 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 IPCs ready for 24/7 use, only rely on the Pokini F2.

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

Panel-PC

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 inno-vative 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
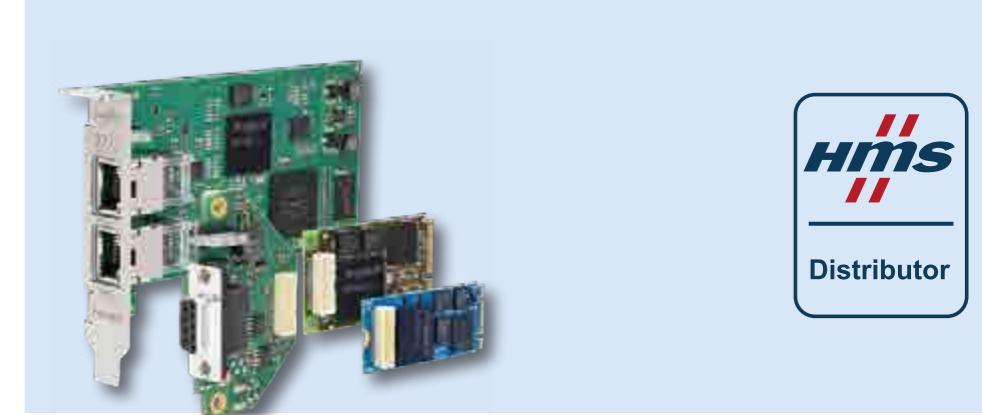
Ixxat INpact
Multi-Protocol Technology

HMS Distributor

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 real-time applications, making Ixxat INpact the ideal choice for demanding industrial applications.

Supported Protocols and Formats

Protocol / Interface Format	EtherNet/IP	EtherCAT	Powerlink	Modbus	Profinet IRT	Profinet IRT Fiber Optic	Profibus
Interface name	**INpact EIP Slave**	**INpact ECT Slave**	**INpact EPL Slave**	**INpact EIT Slave**	**INpact PIR Slave**	**INpact PIRFO Slave**	**INpact DPV1 Slave**
PCIe (standard slot-brackets)	✔	✔	✔	✔	✔	✔	✔
PCIe (low-profile slot-brackets)	✔	✔	✔	✔	✔	✔	✔
PCIe Mini	✔		✔	✔	✔	✔	✔
M.2	✔	✔		✔	✔		✔

Uniform Driver Interface for all INpact Cards

Industrial PC — Process data visualization — Connection to subsystems — Data acquisition — ... — Measurement and analysis — Hand-held

Common VCI Programming Interface

Multi-network support — EtherCAT, EtherNet/IP, POWERLINK, Modbus — Fiber Optic
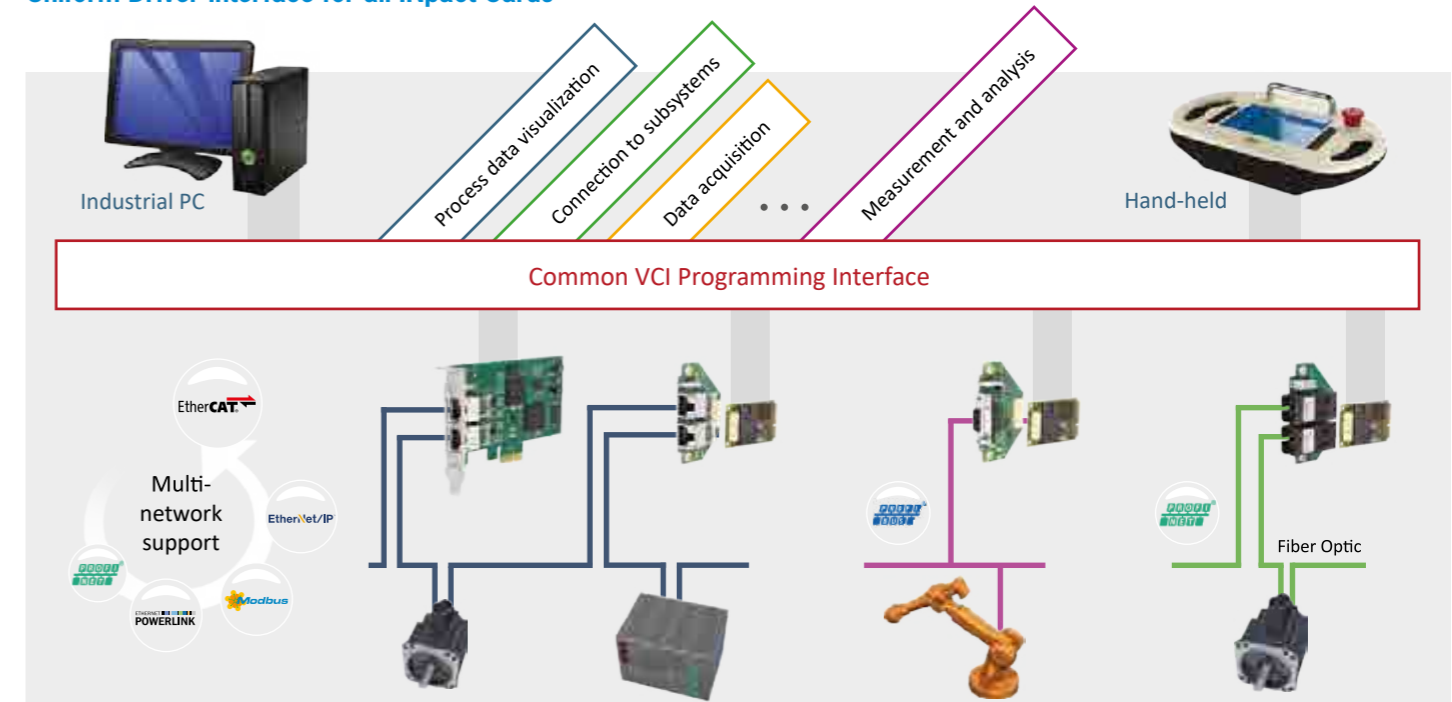
Intel® Processors for Every Usage

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 body cams 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 the use in extreme environmental conditions.

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

2nd Gen Intel® Xeon® – Scalable Processors

The Intel® Xeon® Scalable processor family provides the foundation for a powerful data center platform that creates an evolutionary leap in agility and scalability. Disruptive by design, this innovative processor sets a new level of platform convergence and capabilities across compute, storage, memory, network, and security. Enterprises and cloud and communications service providers can now drive forward their most ambitious digital initiatives with a feature-rich, highly versatile platform.

Higher Per-Core Performance:
Higher Per-Core Performance: Up to 56 cores (9200 series) and up to 28 cores (8200 series), delivering high-performance and scalability for compute-intensive workloads across compute, storage, and network usages.

Greater Memory Bandwidth/Capacity:
Support for Intel® Optane™ DC persistent memory. Support for six memory channels and up-to 4 TB of DDR4 memory, per socket, with speeds up-to 2933 MT/s (1 DPC)

Intel® Ultra Path Interconnect (Intel® UPI):
Four Intel® Ultra Path Interconnect (Intel® UPI) (9200 series) and up to three Intel® Ultra Path Interconnect (Intel® UPI) (8200 series) channels increase scalability of the platform to as many as two sockets (9200 series) and up to eight sockets (8200 series). Intel® Ultra Path Interconnect (Intel® UPI) offers the perfect balance between improved throughput and energy efficiency

Expanded I/O:
48 lanes of PCIe 3.0 bandwidth and throughput for demanding I/O-intensive workloads

Intel® Deep Learning Boost (Intel® DL Boost) with VNNI:
New Intel® Deep Learning Boost (Intel® DL Boost) with Vector Neural Network Instruction (VNNI) bring enhanced artificial intelligence inference performance, with up to 30X performance improvement over the previous generation4, 2nd Gen Intel® Xeon® Scalable processors help to deliver AI readiness across the data center, to the edge and back

Intel® Advanced Vector Extensions 512 (Intel® AVX-512):
With double the FLOPS per clock cycle compared to previous-generation Intel® Advanced Vector Extensions 2 (Intel® AVX2), Intel® AVX-512 boosts performance, and throughput for the most demanding computational tasks in applications, such as modeling and simulation, data analytics and machine learning, data compression, visualization, and digital content creation

Intel® Xeon® D-2100 Processor

The Intel® Xeon® D-2100 processor delivers Intel's most transformative and ground-breaking 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 3,00GHz offer an impressive performance level in every network based scenario. Thanks to it's 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.

PRODUCTIVITY THAT MEETS YOUR DEMANDS
INTEL® PENTIUM® PROCESSORS

This 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

8th Generation – Exceptional Platform Performance

The 8th Generation Intel® Core™ processors with up to six cores for more processing power and Turbo Boost Technology 2.0 to increase the maximum turbo frequency up to 4.7 GHz, and up to 12 MB of cache memory. Intel® Hyper-Threading Technology (Intel® HT Technology) delivers up to 12-way multitasking support in the 8th generation of Intel® Core™ processors.

Features

- An impressive portfolio of standard and unlocked systems for a broad range of usages and performance levels
- New system acceleration when paired with Intel® Optane™ memory to deliver amazing system responsiveness
- Intel® Turbo Boost Technology 2.0 to give you that extra burst of performance when you need it
- DDR4 RAM memory technology support, which allows systems to have up to 64 GB of memory and up to 2666 MT/s memory transfer speeds
- The ability to set an overclocked ratio per core with unlocked processors, when paired with select chipset SKUs, to provide you more control and more granularity for overclocking your platform

9th Generation – Latest Processors

Intel's Coffee-Lake-S architecture is the 9th generation of Intel's Core processors. The i5 top model Core i5-9600K offers 6 cores with a basic clock of 3.7 GHz, which reaches up to 4.3 GHz in turbo mode. It has 9 MB L3 cache available. The eight cores of the Core i7-9700K use 12 MB L3 cache and come in turbo mode at a whopping 4.9GHz. This is only topped by the front-runner Core i9-9900K, which clocks up to 5 GHz in Turbo mode and has 16 MB L3 cache. Its 8 cores, which can handle 16 threads, will establish an unprecedented level of performance in the consumer market. The TDP remains at a moderate 95 watts. To keep the temperatures of this high-performance processor at a moderate level, the cores were soldered directly to the heatspreader. So the best possible performance level is delivered to the consumer market. This processor is optimal for entertainment based applications. You could use it for elaborate gambling machines or other demanding use cases like Virtual Reality and 3D gaming or rendering. It's also well equipped for other demanding applications like video editing.

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 safty 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 / 2.4kW
- 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: 800W / 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)

2U Form Factor

With a height of max 70 mm, the 2U PSU is designed for 19" rack mountable systems with demand for more internal drive bays and more interface cards.

- Wattage: 300 W – 750 W
- 80 Plus Efficiency Levels: Standard/Bronze/Gold/Platinum
- Cable assembly: project based customization possible
- Typical applications: 2U 19" rack mountable systems (Industrial Servers, Network Appliances, Data Center)

Flex Form Factor

The Flex format is often used in small computer cases and sometimes called "mini-ITX" 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. Therefor 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 sufficient way to drive a device without integrating a PSU with DC voltages.
- Wattage: 15W – 250W
- Output DC Voltages:
  5V / 9V / 12V / 15V / 19V / 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 mini-ITX 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.
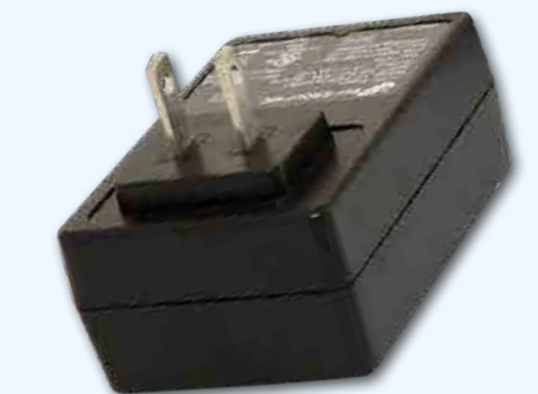
Electric Double Layer Capacitors (EDLC) by SECH

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.

Aluminium Foil   Seperator   Activated Carbon

Electrode   Electrolyte   Electrode

Packing (Rubber)
Aluminium Lead
Electrode
Case (Aluminium)
Seperator Paper/PP
Current corrector (Aluminium Foil)
Electrode (Activated Carbon)
Seperator
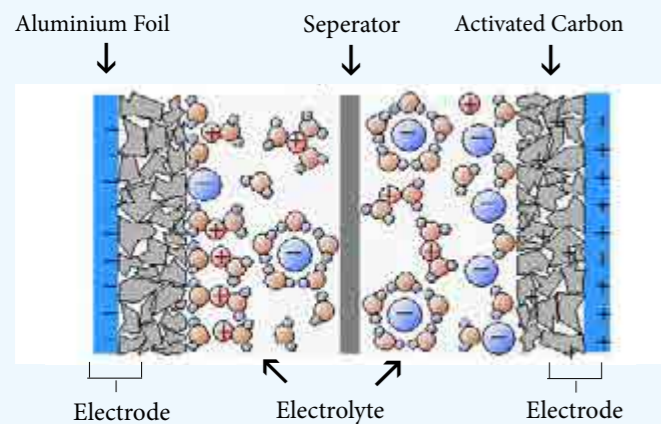
The charge in an Ultracapacitor is stored electrostatically by separating positive and negative charges. This means it is not a chemical reaction to store energy.

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.
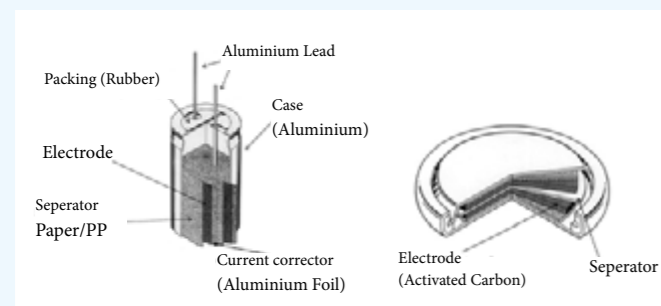
The key point of this technology is the special electrode with its surface coated with activated carbon.
The porous structure of this coating expands the surface significantly and allows a capacity up to thousands of Farad. The Electric Double Layer Capacitor does not have a typical dielectric rather it uses the electrolyte solution as a function of the dielectric.

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

Comparison to Batteries

Type	Batteries	EDLC	Conventional Capacitors
Time of Charge	1 to 5 h	0.3 to 30 s	10^3 to 10^{-6} s
Time of Discharge	0.3 to 3 h	0.3 to 30 s	10^3 to 10^{-6} s
Spec. Energy [Wh/kg]	20 to ~ 100	< 10	< 0.1
Lifetime [Cycles]	1,000	~ 1,000,000	~ 1,000,000
Spec. Power [W/kg]	< 1000	> 10,000	> 100,000
Efficiency	0.7 to 0.85	0.9 to 0.98	> 0.95

Electric Double Layer Capacitors (EDLC)

Product Lifetime — Temperature, Current, Voltage
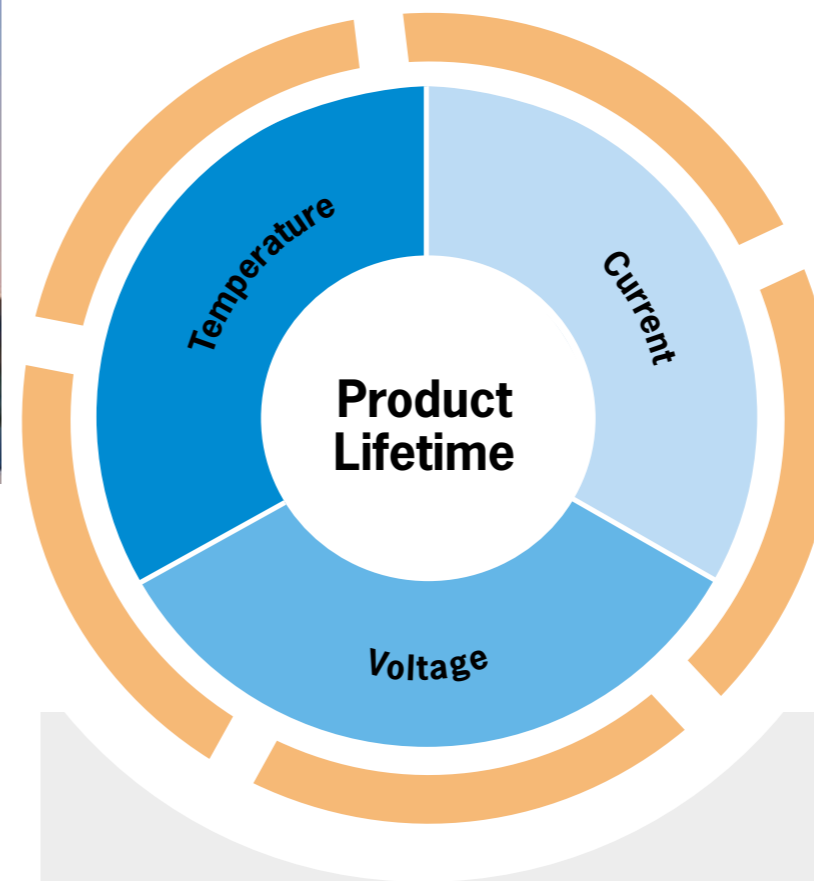
Typical Shapes

Technology	Flatpacks / Pouch Cells	SMD	Coin	Radial / Leaded	Snap-In	Screw / Weldable	Module
Capacitance	0.0068 F – 600 F	0.020 F – 0.47 F	0.047 F – 1.5 F	1.0 F – 100 F	100 F – 400 F	650 F – 3400 F	variable
Temperature	-20/-25 – 70/75/85 °C	-10/-25 – 60/70 °C	-25/-40 – 70/85 °C	-25/-40 – 60/65/70/85 °C	-25/-40 – 60/65/70/85 °C	-25/-40 – 60/65/85 °C	-40 – 60/65 °C
Operating Currents	mA / A	µA	µA / mA	mA / A	A	A	A

Portfolio

Technology	Flatpacks / Pouch Cells	Coin	Radial / Leaded	Snap-In	Screw / Weldable	Module
AVX	Focus Supplier		Product Available	Product Available	Product Available	Product Available
Eaton		Focus Supplier	Product Available	Product Available	Focus Supplier	Focus Supplier
Korchip		Product Available	Product Available	Product Available	Product Available	Product Available
Maxwell			Product Available	Product Available	Product Available	Product Available
SECH			Focus Supplier	Focus Supplier	Focus Supplier	Focus Supplier
Samwha			Product Available	Product Available	Product Available	Product Available
Vishay			Product Available			
Examples	▪ Barcode scanner ▪ Metering ▪ Personal locators (GPS/GSM) ▪ Wireless modems	▪ Backup of CMOS microcomputers ▪ Memory backup ▪ RTC ▪ Metering	▪ UPS ▪ Garden light ▪ Toys ▪ Solar battery operated circuits ▪ Metering ▪ Emergency light	▪ UPS ▪ Wind mill ▪ Electric car ▪ Electric scooter ▪ Power tools	▪ UPS ▪ Wind mill ▪ Electric car ▪ Electric scooter ▪ Power tools	▪ UPS ▪ Wind mill ▪ 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 2.3V- 3.3V. 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 (ie 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.

Linecard Storages & Memories

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.

Apacer · GOOD RAM Industrial · intel Authorised Distributor · KIOXIA · Panasonic · swissbit® · TEAC · TOSHIBA · Transcend®

ALLIANCE MEMORY · Apacer · apmemory · ESMT / EliteMT · FUJITSU · GOOD RAM Industrial · INSIGNIS · intel Authorised Distributor · KIOXIA · NANYA · ROHM · ST · swissbit® · Transcend® · Zentel

Storage Technologies

Type	Technology	Apacer	GoodRam	Intel	Kioxia	Panasonic	Swissbit	Teac	Toshiba	Transcend
Memory Modules										
	SDRAM		✓							
	DDR1	✓	✓							✓
	DDR2	✓	✓							✓
	DDR3	✓	✓							✓
	DDR4	✓	✓							✓
Flash Memory										
	SD/microSD	✓	✓			✓	✓			✓
	Compact-Flash	✓	✓				✓			✓
	CFast	✓	✓				✓			✓
	Flash-Module (USB/PATA/SATA)	✓					✓			✓
	USB-Sticks	✓	✓				✓			✓
	SSD 2.5"	✓	✓	✓	✓		✓			✓
	mSATA	✓	✓				✓			✓
	M.2	✓	✓	✓	✓		✓			✓
	EDSFF			✓						
	AiC			✓	✓					
Hard Disk Drives										
	HDD 2.5"								✓	
	HDD 3.5"								✓	
	Extern USB								✓	✓
Optical Drives										
	CD Drives							✓		
	DVD Drives							✓		
	BluRay Drives							✓		
	Medical Recorder							✓		
Accessories										
Card Reader										✓
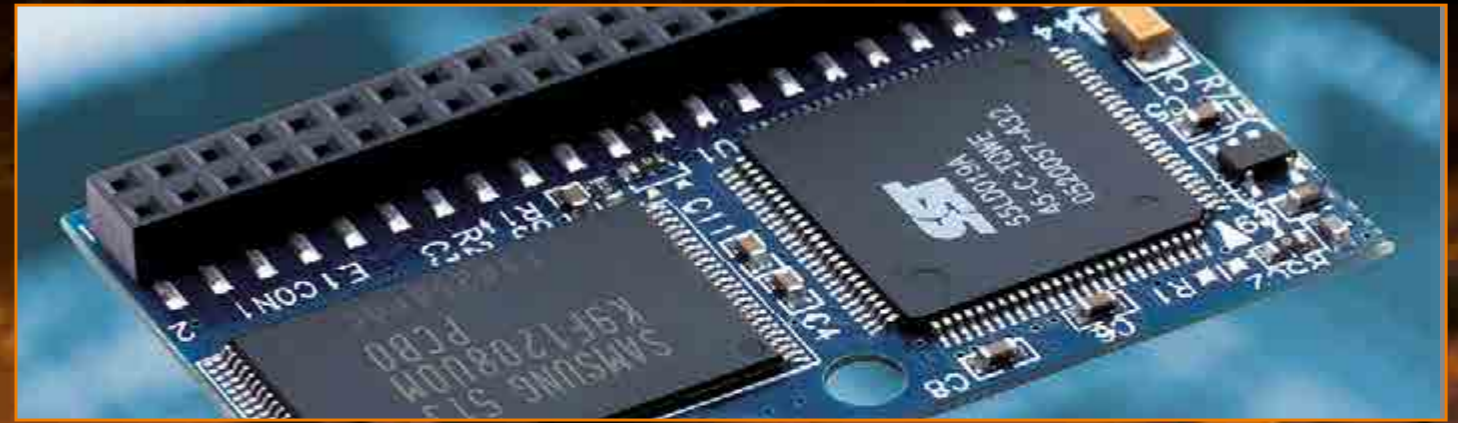
Memory Technologies

Technology	Type	Alliance	Apacer	AP Memory	ESMT/EliteMT	Fujitsu	GoodRam	Insignis	Intel	Kioxia	Nanya	Rohm	ST	Swissbit	Transcend	Zentel
EEPROM	Serial											E	E			
ReRAM	Serial					E										
FRAM	Serial/Parallel					E							E			
Flash	Serial NOR				E											
	Parallel NOR		E		E											
	Serial NAND				E					E						
	NAND				E					E						
	e-MMC™							E		E				E		
	UFS							E		E						
	SD/Micro SD		R				R			R				R	R	
	Compact Flash/Cfast		R				R			R				R	R	
	Flash Module (USB/PATA/SATA)		R				R			R				R	R	
	SSD (2.5"/mSATA/M.2)		R				R		R	R				R	R	
	Add-in Card								R							
	USB Sticks		R						R	R						
SDRAM	SDR	E			E		R	E					E	R	R	E
	DDR	E			E			E			E					E
	DDR2	E			E			E			E					E
	DDR3	E			E			E			E					E
	DDR4	E						E			E					E
	LPSDR	E				E					E					
	LPDDR	E				E					E					
	LPDDR2	E						E			E					
	LPDDR3							E			E					
	LPDDR4							E								
	Pseudo SRAM/IoT RAM	E		E												
	SDRAM Module														R	
	DDR Module		R				R								R	
	DDR2 Module		R				R								R	
	DDR3 Module		R				R								R	
	DDR4 Module		R				R								R	
SRAM	Low-Power	E														
	Fast	E														
	Synchronous	E														
	NVRAM													E		

E Embedded devices   R Removeable devices
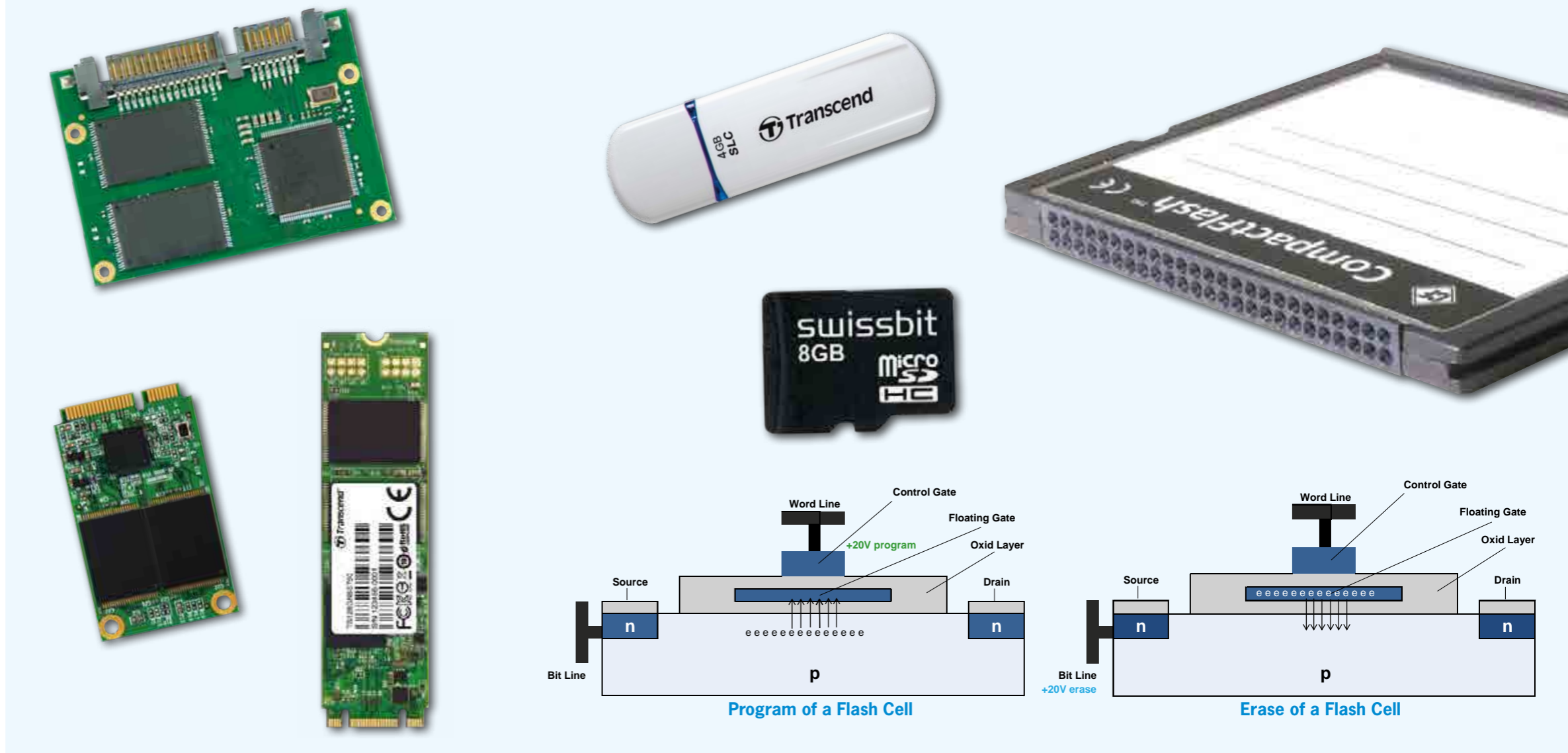
What Really Counts for a Flash Card

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.

Program of a Flash Cell

Erase of a Flash Cell
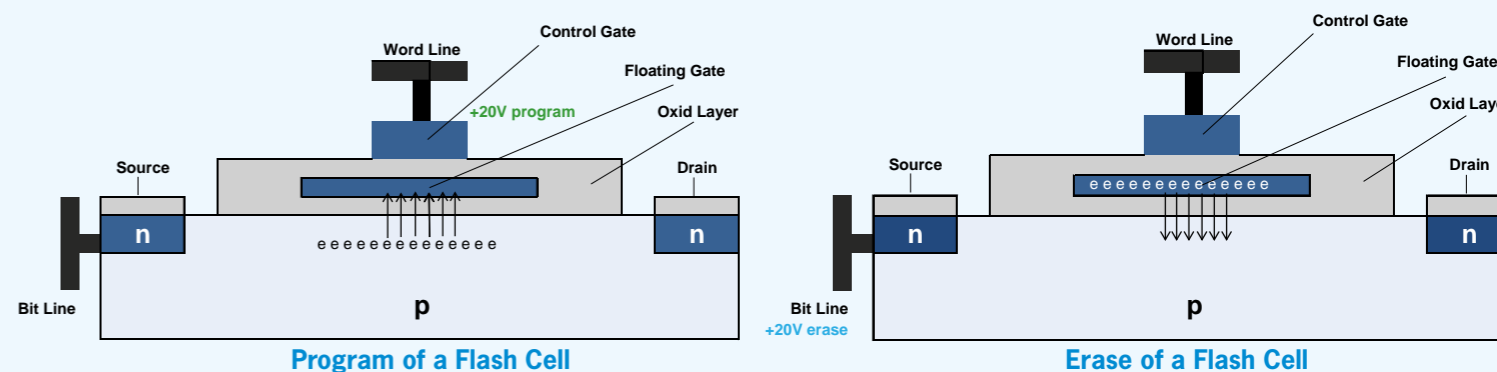
Flash Type	SLC	pSLC	MLC	TLC	pSLC	TLC	QLC
	2D	2D	2D	2D	3D	3D	3D
Bit per cell	1 Bit	1 Bit	2 Bit	3 Bit	1 Bit	3 Bit	4 Bit
ECC requirement (up to)	40bit	48bit	48bit	72bit	120bit	120 bit	160 bit
Program/Erase PEcycle	60k - 100k	20k	3k	500	20k - 50k	300 - 3k	250
Industrial Temperature Range	x	x	x		x	x	
Fixed BOM (Bill of Materials)	x	x	x		x	x	
Cost advantage per GB			+	++	+++	++	++++	+++++
Longevity products	+++	+	+		++	++	
Write Performance	++++++	++++	++	+	+++++	+++	

NAND Flash Technology
(Reliability vs. Cost)
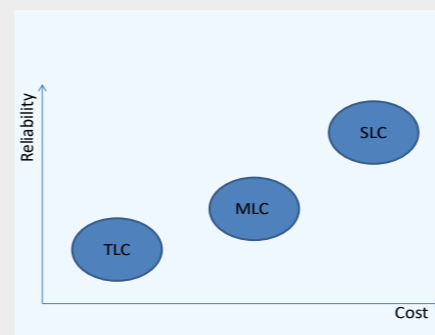
SLC	PSLC	MLC	TLC	QLC
1	1	11	111	1111
				1110
			110	1101
				1100
		10	101	1011
				1010
			100	1001
				1000
0		01	011	0111
				0110
			010	0101
				0100
	0	00	001	0011
				0010
			000	0001
				0000

Apacer
Access the best

Founded in 1997

Headquartered in Taiwan

Offices in 6 countries

580+ employees worldwide

Production in own manufactory

**ISO 9001, ISO 14001,
OHSAS 18001, IECQ CQ080000**

DRAM Module Solutions

Apacer
Access the best

Apacer – Industrial Memory Solutions

Market studies show that Apacer offers reliable, innovative, trendy and youthful products, fully living up to its promise. Using its witty slogan "Access the Best" to represent its effort to enhance brand value, Apacer dedicates itself in providing the best products and services. "Access" literally suggests total convenience and freedom in data reading, sharing and communication, while "Best" represents unparalleled quality. Apacer in fact promises users improved digital experiences with its line of memory modules and peripherals.

DRAM Module

Apacer's DRAM module technology development is focused on vertically integrating know-how in the semiconductor industry, which allows it to manufacture memory modules that satisfy the requirements of both quality and performance, yet can be easily integrated into various platforms. As leading memory module maker, Apacer has long been devoted to the industrial computer field, particularly the embedded systems.

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 CF6 64 GB	CFast ST170	USB Sticks
DDR	DDR2	DDR3	DDR4	Apacer *Access the best*

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 ingression 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

Industrial SSD Solutions

Apacer *Access the best*

Features

- SMART Read Refresh™ (Optional)
- Support TCG Opal 2.0/AES 256-bit encryption (Optional)
- Global Wear Leveling
- DataRAID™ (Optional)
- DataDefender™ (Optional)
- Flash bad block management
- S.M.A.R.T.
- Power Failure Management
- TRIM

Model Name	SV250-25	SM130-25	SV250-25
Interface	SATA 3.0 (6Gb/s)	SATA III (6 Gb/s)	SATA 3.0 (6 Gb/s)
Form Factor	2.5"	2.5"	2.5"
Capacity	30GB to 480GB	512 GB to 2 TB	30GB to 480 GB
NAND Support	3D TLC	TO 15 nm MLC	3D TLC
External DRAM	No	Yes	No
Est. R/W Speed (MB/sec)	560/520	530/510	560/520
Wide Temperature (-40 °C to 85 °C)	Yes	Yes	Yes

Double-Barreled Solution (DBS)

Apacer's latest innovation, Double-barreled Solution Cloud Edition, assists the development of industrial intelligence and enables the digital transformation of many industries. It provides an excellent solution for remote device management (RDM), so that the status of equipment and resources in an automated factory can be monitored and controlled in real-time, and turns reams of collected data into easy-to-understand dashboard readouts. Apacer's Double-barreled Solution (DBS) was named after its two separate components. The first was **CoreAnalyzer2**, a tool for real-time recording and accurate analysis of platform usage behavior to help customers understand which SSD and firmware was most suitable for their application. The second was **SSDWidget 2.0,** a smart monitoring solution that can monitor the health status of multiple SSDs in real time and effectively predict the end of a product's lifespan. The combined result of these two components working together meant that SSDs had longer lifetimes and no downtime.

DBS Cloud Edition Dashboard

Industrial Flash Disc Modules

Apacer *Access the best*

SATA Disc Module

Type	SV250-7LP2	ST170-7LP2	ST170-7LP2	SDM7-M 7P180D DP
Interface	SATA 3.1 (6Gb/s)	SATA 3.1 (6Gb/s)	SATA III (6Gb/s)	SATA III (6Gb/s)
Capacity	30GB to 120GB	30GB to 120GB	1GB to 16GB	32GB to 256 GB
NAND Support	3D TLC	3D TLC		
External DRAM	No	No		DRAM Cache for Enhanced Random Perform.
R/W	560/510	335/235	Up to 44/40 MB/s	Up to 525/355 MB/s
Wide Temp. (-40~85°C)	Yes	No		
VA Options	• Low-Density Parity-Check (LDPC) Code • Global Wear Leveling • Flash bad-block management • Flash Translation Layer: Page Mapping	• S.M.A.R.T. • Power Failure Management • ATA Secure Erase • TRIM	• S.M.A.R.T.	• SMART Utility • Core Technology • Wide Temperature / HW write protect

M.2 Disc Module

Type	PV310-M280	SV250-242	SV250-280
Interface	PCIe Gen3 x4	SATA 3.0 (6Gb/s)	SATA 3.0 (6Gb/s)
Capacity	240 GB to 960 GB	30GB~480GB	30GB~960GB
NAND Support	3D TLC	3D TLC	3D TLC
External DRAM	Yes	No	No
R/W	2660/2260	560/520	560/525
Wide Temp. (-40~85°C)	Yes	Yes	Yes
VA Options	• Low-Density Parity-Check (LDPC) Code • Global Wear Leveling • Flash bad-block management • Flash Translation Layer: Page Mapping • S.M.A.R.T. • Power Failure Management • TRIM • Hyper Cache Technology • Over-Provisioning • DataRAIDTM • SMART Read Refresh™ • Thermal Sensor • Thermal Management Technique (optional)	• Low-Density Parity-Check (LDPC) Code • Global Wear Leveling • Flash bad-block management • Flash Translation Layer: Page Mapping • S.M.A.R.T. • DataDefender™ • ATA Secure Erase • TRIM • Hyper Cache Technology • Over-Provisioning	• DataRAID™ • SAMRT Read Refresh™ • Thermal Sensor • Trusted Computing Group (TCG) Opal 2.0 (optional) • AES 256-bit hardware encryption • End-to-End Data Protection • SV250-242: Thermal Management Technique (optional) • SV250-280: Devslp

M.2 Disc Module

Type	UDM2A (Type C)	UDM2A (Type D LP)	UV110-UFD1	UT110-UFD2
Interface	USB 2.0	USB 2.0	USB 3.1 Gen1	USB 3.1 Gen1
Capacity	256 MB~32 GB	256 MB~32 GB	16GB to 256GB	32GB to 64GB
Connector	10-pin (2x5) female header in 2.54 mm			
R/W	Up to 44/41 MB/s	Up to 44/41 MB/s	Est. 260/120 MB/s	255/115 MB/s
Form Factor			USB flash drive	USB flash drive
Wide Temp. (-40~85°C)			Yes*	No
VA Options	• SMART Utility • Wide Temp.	• SMART Utility • Wide Temp.		

* Not supported on 16 GB

PATA Disc Module

Type	ADM5S 44P/2700-M	AFD257
Interface	ATA/IDE	PATA
Capacity	8 GB to 64 GB	8 GB to 128 GB
NAND Support		SLC
Form Factor		2.5"
R/W	Up to 100/46 MB/s	Est. R/W: Up to 100/95 MB/s
VA Options	• Smart Utility / Conformal Coating	• SMART Utility • Wide Temp.

swissbit ®

- **Founded in 2001**
- **Headquartered in Bronschhofen, Switzerland**
- **10 countries**
- **200+ employees worldwide**
- **Production - Made in Germany**
- **Certificates:
  ISO 9001, ISO 14001, ISO/TS 16949**

Swissbit Market Segmetns

Industry	Netcom	IoT	Automotive

Swissbit – Reliable Storage & Embedded IoT Solutions

Data is the fuel of the future and is driving global growth and change. Swissbit takes care of data by storing and protecting data reliably. As a leader in industrial storage and embedded IoT (Internet of Things) solutions, Swissbit drives the development of demanding industrial and IoT applications to make our lives easier, safer, and more comfortable. More than 5,000 customers around the world including Fortune 500 companies and the world's leading OEMs already rely on Swissbit for their critical data storage and security requirements.

Storage Technologies – Overview

2.5" SSD	M.2 SSD SATA / PCIe	mSATA SSD	SlimSATA SSD
eUSB Flash Module	SD Cards	microSD Cards	CFast Cards
CF Cards	USB Sticks	Managed NAND	Security Products

Swissbit System Competency

swissbit ®

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.

Conception	Development	Verification	Qualification	Production and Test
- Market analysis	- Hardware	- Product verification (DVT)	- Reliability (RDT)	- In-House production & test
- Product definition	- Firmware	- Debugging	- Life time calculation	- 100% final test (-40 to +85°C)
- Product features	- Design for test/production	- Optimization	- Joint customer qualification	- Yield management
- Feasibility studies	- Prototyping	- Compliance testing		- Subcontractor management
	- Software tools	- Compatibility testing		- Logistics
	- Test development			

Swissbit Life Time Monitoring

(Swissbit Lifetime Monitoring) for Windows is a utility program that reads status information from Swissbit products. It uses S.M.A.R.T. (Self-Monitoring, Analysis and Reporting Technology) and USB vendor specific commands to gather life time information. Swissbit delivers a Windows/Linux tool (free of charge). A SBLTM software library/API for Windows and/or Linux is available for a small one-time fee.
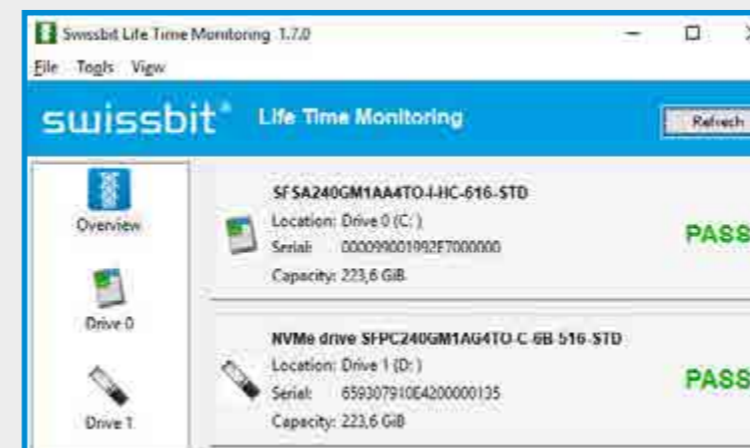
Swissbit supports a realistic evaluation of the WAF and the endurance of their SSDs and storage cards with help of the Swissbit Life Time Monitoring Tool and statistical data stored in the flash by the firmware. This tool can read out the real usage data, such as the number of writes and erase cycles, the bad block statistic, and successful ECC correction, and provides all the data necessary to extrapolate the life time of the device. All Swissbit products provide a high level of detailed information, by far exceeding industry standards.

Swissbit 3D NAND Products

Besides continuation of released products in the well known SLC and MLC technology Swissbit has released a wide range of real industrial grade products based on 3D TLC NAND. The Swissbit 3D NAND products support full industrial temperature range from -40 to 85°C with a cross temperature of 125K. This allows to write and read at any temperature combination within the specified range. Something that you can't expect from consumer grade products. All 3D NAND products are designed to withstand frequent temperature changes, are equipped with a strong error correction, thermal management and data encryption options. The Swissbit 3D NAND products are designed for high endurance and reliability. For demanding applications with a high endurance requirements Swissbit offers nearly each product family also in 3D NAND pSLC technology.

The Swissbit 3D NAND products comprise following products:

	3D TLC	3D pSLC	TLC range	pSLC range	Features
PCIe M.2 2280	N-10m2	N-16m2	120-960 GB	40-320 GB	x2 PCIe 3.1 / NVMe 1.2
PCIe M.2 2230-22110	N-20m2	N-26m2	15-240 GB	5-80 GB	x4 PCIe 3.1 / NVMe 1.3
2.5" SATA	X- 73	X- 76	30-960 GB	10-320 GB	Industrial SATA Gen3
2.5" SATA	X- 75		60-1920 GB		High end SATA Gen3
SATA M.2 2242 & 2280	X-75m2	X- 76m2	30-960 GB	10-320 GB	Industrial SATA Gen3
SATA mSATA	X-75m	X- 76m	30-960 GB	10-320 GB	Industrial SATA Gen3
SATA SlimSATA	X-75s	X- 76s	30-960 GB	10-320 GB	Industrial SATA Gen3
SD Memory Card	S- 30		32-256 GB		SD for Read Mostly Apps
microSD Memory Card	S- 30u		32-256 GB		uSD for Read Mostly Apps
SD Memory Card	S- 50		32-128 GB		Industrial grade SD
microSD Memory Card	S- 50u		32-256 GB		Industrial grade uSD
embedded USB		U- 58		8- 16 GB	USB module
PCIe BGA 1620	EN- 20	EN- 26	15-240 GB	5-80 GB	x4 PCIe 3.1 / NVMe 1.3

	SLC	everbit™ pSLC	durabit™ MLC	3D pSLC	3D TLC	3D QLC
Chip Capacity						
Cost per Bit						
Reliability & Endurance						
Industrial Temperature						
Write Performance						
ECC Requirement						
Data Retention						
Longevity						

***** maximum; **** highest; *** high; ** medium; * low

Swissbit Security Products

	PS- 45 / 45u	PS- 46 / 46u	PS- 450 / 450u	PU- 50n / 56n

GENERAL INFORMATION

COMPLIANCE	SD 3.0 SD, ASSD V1.1			USB 3.1
DATA TRANSFER	UHS-1 Speed class 10			USB 3.1 SuperSpeed
TEMPERATURE	- 25°C to 85°C			- 25°C to 85°C
COMPATIBLE TO	S- 45 / 45u	S-46 / 46u	S-450 / 450u	U-50n / U- 56n
FLASH TYPE	MLC	pSLC	SLC	MLC / pSLC

SECURITY PRODUCT MATRIX		SE Standard Edition	PE Premium Edition	Audit Trail / Fiscal	DP Data Protection
DEVICE	PS- 45 SD	8 GB – 16 GB	8 GB – 16 GB	8 GB	8 GB – 64 GB
	PS- 45u microSD	8 GB – 16 GB	8 GB – 16 GB	8 GB	8 GB – 32 GB
	PS- 46 SD	4 GB – 8 GB	4 GB – 8 GB		4 GB – 32 GB
	PS- 46u microSD	4 GB – 8 GB	4 GB – 8 GB		4 GB – 16 GB
	PS- 450 SD	4 GB – 32 GB	4 GB – 32 GB		4 GB – 32 GB
	PS- 450u microSD	0.5 GB – 2 GB	0.5 GB – 2 GB		0.5 GB – 2 GB
	PU-50n		8 GB - 16 GB*	8 GB	8 GB – 64 GB
SECURITY		Infineon / NXP smart card chip CC EAL 5+/6+ HW and OS Java card 3.0.1/ 3.0.4 Global Platform 2.2.1 / 2.2.2 Infineon JTOP/ NXP JCOP 3 RSA up to 2048 bit optional ECC up to 512 / 521 bit AES up to 256 bit SHA2 up to 512 bit RNG AIS31, FIPS-140 Compatible Middleware: •AET SafeSign •Cryptovision SCinterface 80 / 145 k EEPROM secure storage		NXP smart card chip BSI TR-03153 certified TSE SMAERS:EAL2 CSP: EAL4 384 bit encryption Validity of signature certificate: 5 or 7 years + 6 months for shelf storage Guaranteed 20 Mio signatures Signature processing time < 250 ms	Partitioning: •CD-ROM •Private •Hidden/WORM AES 256 bit flash encryption User and administrator PIN Configurable retry counter Unique ID Fast crypto wipe
DRIVERS / API		Windows Linux Android SDK available PKCS#11 Middleware		Windows Linux Android Embedded on request SDK available	Windows Linux RaspBerry Pi Arduino SDK available

Founded in 1988

Made in Taiwan

13 Offices Worldwide

Local Sales & Support in Germany

Monthly Production 14.7M pcs

Guaranteed Quality & Reliability

Efficient Life Cycle Management

Customized Solutions for any Application

ISO Certificates

Transcend®

| IATF 16949 | ISO 9001 | ISO 14001 | IECQ QC080000 | OHSAS 18001 |

- IATF 16949: Automotive Quality Management System
- ISO 9001: Quality Management System
- ISO 14001: Environment Management System
- IECQ QC080000: Hazardous Substances Process Management System
- OHSAS 18001: Occupational Health & Safety Management System

Transcend – Good Memories Start Here

Transcend Information. Inc. was founded in 1988 by Mr. Chung-Won Shu, Peter, with its headquarters in Taipei, Taiwan. Today, Transcend has become a leading global brand of digital storage, multimedia and industrial products with 13 offices worldwide. Not only do we design, develop, and manufacture all of our own products, but we also market and sell them. At Transcend, we uphold the highest quality and believe in professional service. As a customer-focused company, Transcend has the ability to quickly respond to the market's changing needs.

Complete Product Portfolio

Transcend®

Our Products Fulfill All Your Storage Needs

SSD Solutions

Flash Memory Modules

Memory Cards
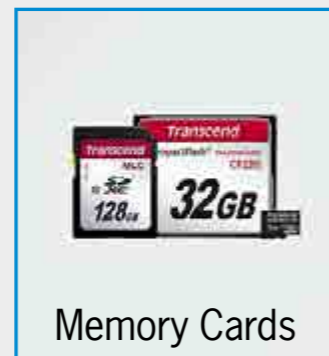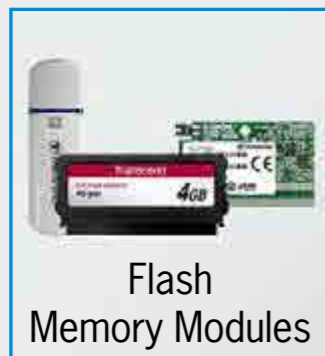
DRAM Modules

Advanced Services

Durability

Bad Block Management

TRIM

Read Disturbance

Wear Leveling

Garbage Collection

96-layer 3D NAND Flash

Reliabilty

Stability

Thermal Sensor

Anti-Sulfur

Wide Temperature

Corner Bond & Underfill

Conformal Coating

Intelligent Power Shield & Power Shield

Security

Management

Hardware Purge

TCG Opal Specifications

AES Encryption

SSD Scope Pro
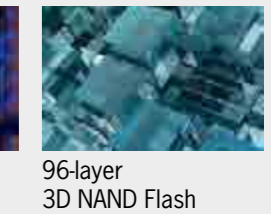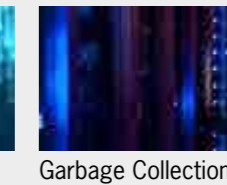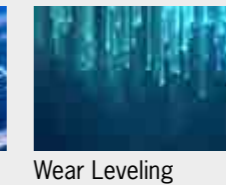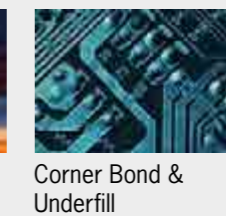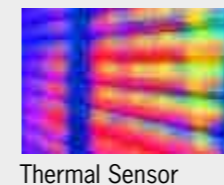
3D TLC NAND SSD Series

High Endurance 2.5", PCIe M.2, SATA III M.2, Half-Slim and mSATA SSDs made for the high-end embedded market

MTE662T

512GB
TS512GSSD452K

Transcend®

SSD452
Solid State Drive

SSD452K

HSD450T

MSA452T

NEW

DRAM Modules

Transcend®

DDR3

DDR2/DDR/SDRAM

DDR4
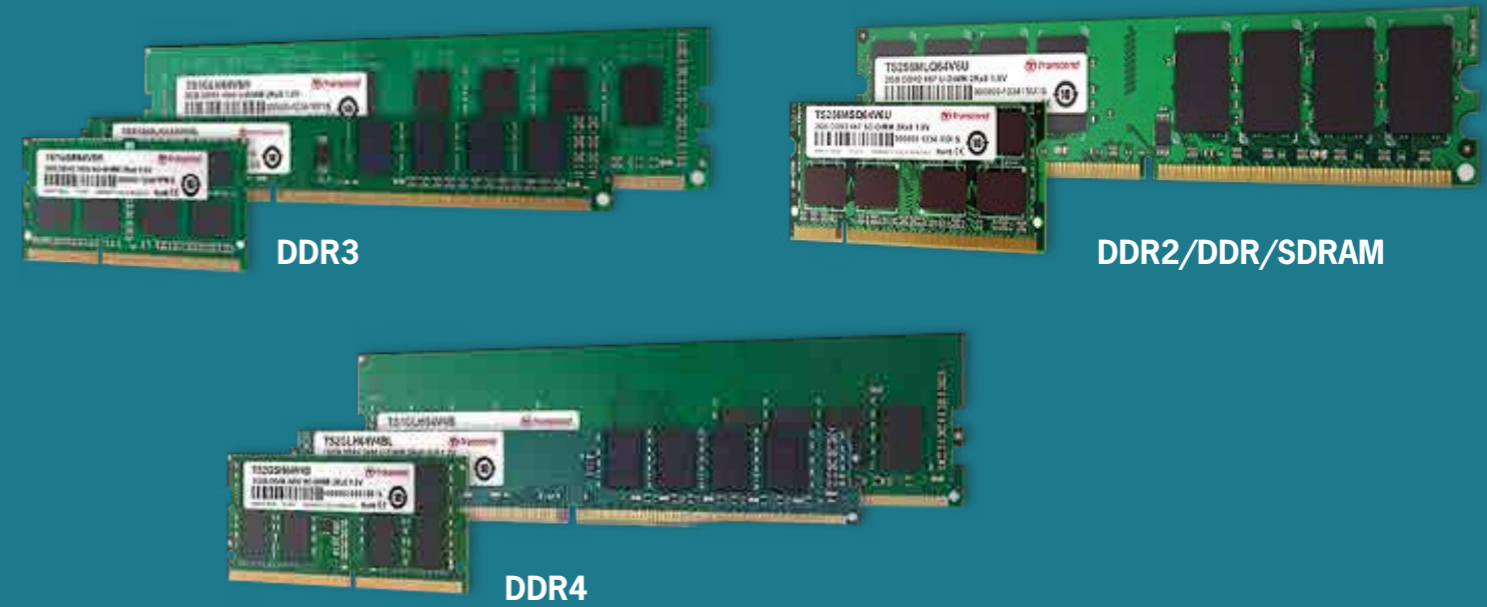
Transcend Flash Types

Transcend®

	3D TLC 96-layer	3D SLC Mode 96-layer	MLC	Super MLC	SLC
Endurance (P/E Cycles)	3K	50K - 100K	3K	30K	50K
Bit per Cell	3	1	2	1	1
Performance	▪▪	▪▪▪	▪▪	▪▪▪	▪▪▪
Cost	▪	▪▪	▪▪	▪▪▪	▪▪▪
Features	Suitable for SSDs and most industrial applications	High endurance solution that will substitute SLC in future	Majorly used in SSD and most industrial applications	More affordable than SLC, better performance than MLC	Where cost may be less important than disk lifetime

Applications

Embedded
Digital Entertainment
Internet of Vehicles
Healthcare
Cloud Computing
Industry 4.0
Military
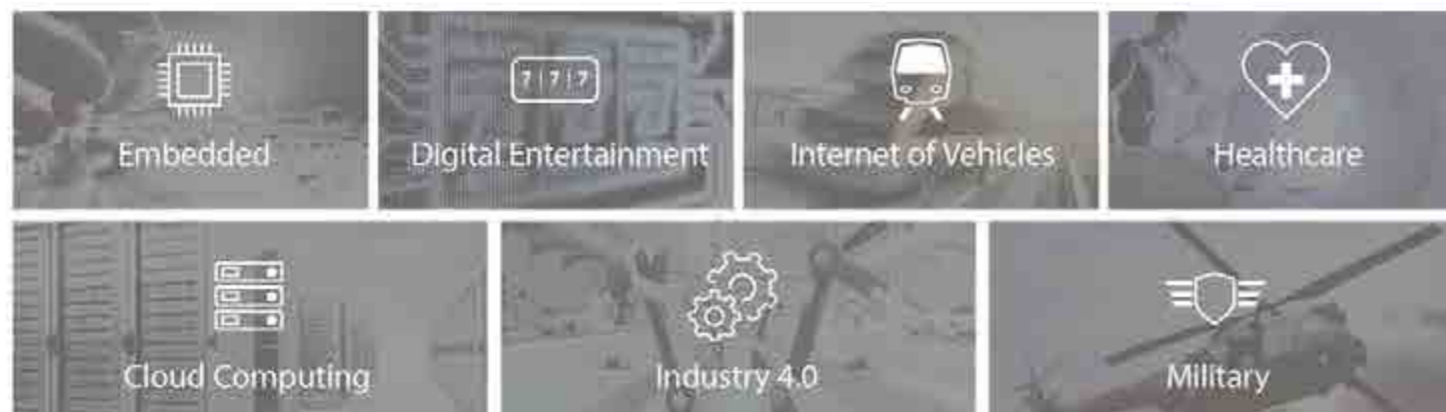
Extended Temperature	Server / Workstation	Standard	Low Profile
DRAM Generation			
DDR4, DDR3, DDR2	DDR4, DDR3, DDR2	DDR4, DDR3, DDR2	DDR4, DDR3, DDR2
Module Type			
U-DIMM SO-DIMM ECC DIMM ECC SO-DIMM	ECC DIMM ECC SO-DIMM R-DIMM	U-DIMM SO-DIMM	U-DIMM ECC DIMM R-DIMM
Frequency			
DDR4:2666,2400,2133 DDR3:1866,1600,1333 DDR2: 800,667	DDR4:2666,2400,2133 DDR3:1866,1600,1333 DDR2:800,667,400	DDR4:2666,2400,2133 DDR3:1866,1600,1333 DDR2:800,667,533	DDR4:2666,2400,2133 DDR3:1866,1600,1333 DDR2:667

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 NAND 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 axia means "value".

How to pronounce KIOXIA?
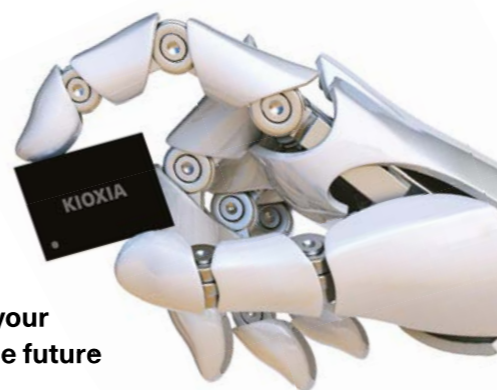
Store and save your memories for the future with KIOXIA

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® Gen3x4 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 2,300 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 2230 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 specification of BG4 self-encrypting drive (SED) will be released Q3 calendar year of 2019.

Product image may differ from the actual product.

Key Features

- KIOXIA 96-Layer BiCS FLASH™
- PCIe® Gen3 x4 NVMe™
- Capacities up to 1,024 GB
- M.2 1620 single package and
- M.2 2230 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

XG6 Series

Client SSD

The XG6 series utilizes KIOXIA's latest 96-layer, 3D TLC (3-bit-per-cell) flash memory. With 4th generation BiCS FLASH™ and SLC cache features, XG6 SSDs reach up to sequential read/write speeds of 3180 MB/s and 2960 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.

Product image may differ from the actual product.

Key Features

- KIOXIA 96-Layer BiCS FLASH™
- PCIe® Gen3 x4, 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
PCIe® / NVMe™ SSD
M.2 2280

XG6-P Series
PCIe® / NVMe™ SSD
M.2 2280

BG4 Series
PCIe® / NVMe™ SSD
M.2 2230

BG4 Series
PCIe® / NVMe™ SSD
M.2 1620

BiCS FLASH™

Product image may differ from the actual product.

XG6 Series

Utilizing 96-layer BiCS FLASH™ 3D flash memory, the XG6 Series is available in an M.2 2280, single-sided form factor with a PCIe® Gen3 x4 interface, supporting the NVMe™ command set. This provides a powerful combination power efficiency and high performance, consuming 4.7 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 2.01, under a different model number.

Model Number	Security Feature	Interface	Form Factor	User Capacity*1 (GB)	Performance (up to)*2		Typical Power Consumption (W)	Operating Temperature (°C)	Dimensions H / W / L (mm)	Typical Weight (g)	Power Supply Voltage (V)
					Sequential Read (MB/s)	Sequential Write (MB/s)					
KXG60ZNV256G	–	PCIe® Gen3 x4	M.2 2280	256	3,050	1,550	4.0	0 to 85	2.23 / 22.15 / 80.15	7.0	3.3
KXG60ZNV512G				512	3,100	2,800	4.1			7.3	
KXG60ZNV1T02				1,024	3,180	2,960	4.7				

XG6-P Series

Utilizing 96-layer BiCS FLASH™ 3D flash memory, the XG6-P Series is available in capacities up to 2,048 GB and has higher sequential write bandwidth than the previous generation. This series is designed for high-end workstations, gaming systems and for cost-optimized composable data center infrastructures. The XG6-P Series offers a Self-encrypting Drive (SED) option that supports TCG Opal version 2.01, under a different model number.

Model Number	Security Feature	Interface	Form Factor	User Capacity*1 (GB)	Performance (up to)*2		Typical Power Consumption (W)	Operating Temperature (°C)	Dimensions H / W / L (mm)	Typical Weight (g)	Power Supply Voltage (V)
					Sequential Read (MB/s)	Sequential Write (MB/s)					
KXG60PNV2T04	–	PCIe® Gen3 x4	M.2 2280	2,048	3,180	2,920	4.7	0 to 85	2.23 / 22.15 / 80.15	7.3	3.3

BG4 Series

In a compact, single-package form factor and based on 96-layer BiCS FLASH™ 3D flash memory, the BG4 Series is designed for thin and light performance-oriented use cases, such as ultra-mobile PCs, IoT devices and data center server boot. Available in capacities up to 1 TB, this series features Host Memory Buffer (HMB), PCIe® Gen3 x4 interface and supports the NVMe™ command set. The BG4 Series offers a Self-encrypting Drive (SED) option that supports TCG Opal version 2.01, under a different model number.

Model Number	Security Feature	Interface	Form Factor	User Capacity*1 (GB)	Performance (up to)*2		Typical Power Consumption (W)	Operating Temperature (°C)	Dimensions H / W / L (mm)	Typical Weight (g)	Power Supply Voltage (V)
					Sequential Read (MB/s)	Sequential Write (MB/s)					
KBG40ZNS128G	–	PCIe® Gen3 x4	M.2 2230	128	2,000	800	3.4	0 to 85 (T$_{SMART}$)	2.23 / 22.15 / 30.15	2.5	3.3
KBG40ZNS256G				256	2,200	1,400	3.6				
KBG40ZNS512G				512			3.5				
KBG40ZNS1T02				1,024	2,300	1,800	3.7		2.38 / 22.15 / 30.15	2.6	
KBG40ZPZ128G			M.2 1620	128	2,000	800	3.0		1.30 / 16.15 / 20.15	0.85	3.3 / 1.8 / 1.2
KBG40ZPZ256G				256	2,200	1,400	3.2				
KBG40ZPZ512G				512			3.1				
KBG40ZPZ1T02				1,024	2,300	1,800	3.4		1.50 / 16.15 / 20.15	1.00	

*T$_{SMART}$: Composite Temperature in SMART/Health Information

*1 : Definition of capacity: KIOXIA defines a megabyte (MB) as 1,000,000 bytes, a gigabyte (GB) as 1,000,000,000 bytes and a terabyte (TB) as 1,000,000,000,000 bytes. A computer operating system, however, reports storage capacity using powers of 2 for the definition of 1 GB = 2^30 = 1,073,741,824 bytes and therefore shows less storage capacity. Available storage capacity (including examples of various media files) will vary based on file size, formatting, settings, software and operating system, such as Microsoft Operating System and/or pre-installed software applications, or media content. Actual formatted capacity may vary.

*2 : Read and write speeds may vary depending on the host device, read and write conditions, and file size.

- Optional security feature compliant drives are not available in all countries due to export control and local regulations.

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- PCIe® and PCI Express® are registered trademarks of PCI-SIG.
- NVMe™ and NVM Express™ are trademarks of NVM Express, Inc.
- All other company names, product names, and service names mentioned herein may be trademarks of their respective companies.

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)*1 to safeguard data in case of unexpected power loss.

XD5 Series
PCIe® / NVMe™ SSD
M.2 22110

XD5 Series
PCIe® / NVMe™ SSD
2.5 inch

HK6 Series
SATA SSD
2.5 inch

BiCS FLASH™

Product image may differ from the actual product.

XD5 Series

Based on 64-layer BiCS FLASH™ 3D flash memory, the XD5 Series of PCIe® Gen3 x4 / NVMe™ SSDs is available in an M.2 Type 22110 or a 2.5 inch (7mm Z-height) form factor with capacities up to 3.84 TB and <7 W of active power consumption.
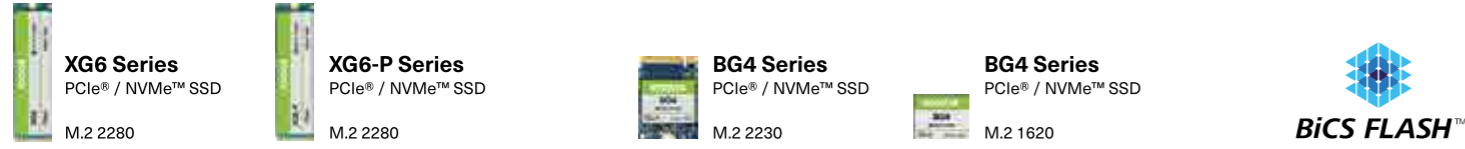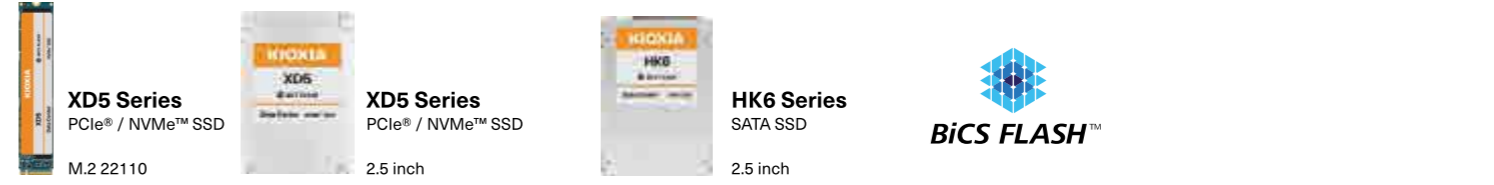
Model Number	DWPD*3	Interface	Form Factor	User Capacity*4 (GB)	Performance (up to)				Typical Power Consumption (W)	Operating Temperature (°C)	Dimensions H / W / L (mm)
					Sequential (128 KiB) (MB/s)		Random (4 KiB) (KIOPS)				
					Read	Write	Read	Write			
KXD5YLN13T84	< 1	PCIe® Gen3 x4	M.2 22110	3,840	2,700	815	240	21	< 7 W	0 to 70	3.88 / 22.15 / 110.15
KXD51LN11T92				1,920		895	250				
KXD51RUE3T84	1	PCIe® Gen3 x4	2.5 inch (7 mm Z-height)	3,840	2,700	815	240	21	< 7 W	0 to 70	7.2 / 70.1 / 100.75
KXD51RUE1T92				1,920		895	250				
KXD51RUE960G				960							

*KXD5YLN13T84 (3,840GB) is Sanitize Instant Erase (SIE) model. Regarding SIE feature, please refer to *2 note.   *Regarding XD5 series performance, please refer to *9 notes.

HK6-R Series / HK6-V Series

The HK6-R Series of 6 Gbit/s SATA SSDs is built with 64-layer BiCS FLASH™ 3D flash memory, and comes in a 2.5 inch (7 mm Z-height) form factor and capacities up to 7.68 TB. The HK6-R Series delivers a balance of reliability, performance and low power, and is designed for read-intensive workloads running on servers. The HK6-V Series of 6 Gbit/s SATA SSDs is built with 64-layer BiCS FLASH™ 3D flash memory, and comes in a 2.5 inch (7 mm Z-height) form factor and capacities up to 3.84 TB. The HK6-V Series delivers a balance of reliability, performance and low power, and is designed for mixed workloads running on servers and hyperconverged systems.

Model Number	DWPD*3	Interface	Form Factor	User Capacity (GB)	Performance (up to)				Typical Power Consumption (W)*8	Operating Temperature (°C)	Dimensions H / W / L (mm)
					Sequential (128 KiB) (MB/s) *5 *6		Random (4 KiB) (KIOPS) *5 *6 *7				
					Read	Write	Read	Write			
KHK61RSE7T68	1	SATA 6 Gbit/s	2.5 inch (7 mm Z-height)	7,680	550	530	83	23	5.5	0 to 70	7.2 / 70.1 / 100.4
KHK61RSE3T84				3,840			84	24			
KHK61RSE1T92				1,920				22			
KHK61RSE960G				960			85	18	5.0		
KHK61RSE480G				480		450	82	20	4.0		
KHK61VSE3T84	3	SATA 6 Gbit/s	2.5 inch (7 mm Z-height)	3,840	550	530	83	54	5.5	0 to 70	7.2 / 70.1 / 100.4
KHK61VSE1T92				1,920			84	55			
KHK61VSE960G				960				54	5.0		
KHK61VSE480G				480		450	82	43	4.0		

*There is no optional lineup which has security features in the HK6-V and HK6-R series.

*1 : PLP (Power Loss Protection): PLP supports the recording of data in buffer memory into flash memory, utilizing back up power of a capacitor in case of unexpected power loss.
*2 : Optional security features
 - PM5 and 2.5 inch of CM5 Series offer a range of security options; Sanitize Instant Erase (SIE), Self-Encrypting Drive (SED), and Self-Encrypting Drive (SED) with FIPS 140-2 validation or compliance. The Add-in card version of the CM5 has SIE and SED options.
 - Drive models with different security options have different part numbers.
 - The Sanitize Instant Erase (SIE) option supports Crypto Erase, which is a standardized feature defined by the technical committees (T10) of INCITS (the Inter National Committee for Information Technology Standards) or by NVM Express Inc..
 - SED (Self-Encrypting Drive) SSDs support TCG Enterprise SSC or TCG Opal SSC (Unsupported features are included in CM5 / SED optional model).
 - FIPS drives are designed to comply with FIPS 140-2 Level 2, which defines "Security Requirements for Cryptographic Modules" by NIST (the National Institute of Standards and Technology). PM5 Series is validated, CM5 series is planning to make FIPS 140-2 validated drives available.
 - For more details and the latest validation status of CM5 Series, please send an inquiry through the "Contact us" form in each region's website, https://business.kioxia.com/
 - Optional security feature compliant drives are not available in all countries due to export control and local regulations.
*3 : DWPD: Drive Write Per Day. One full drive write per day means the drive can be written and re-written to full capacity once a day every day for five years, the stated product warranty period. Actual results may vary due to system configuration, usage and other factors.
*4 : Definition of capacity: 1 terabyte (1 TB) = 1,000 gigabytes (GB), 1 GB = 1,000,000,000 (10^9) bytes
*5 : A kibibyte (KiB) means 2^10, or 1,024 bytes.
*6 : The performance specifications of the PM5 Series is based on testing in dual-port mode, running at 14 W of power. The performance of the CM5 Series is based on single-port mode (1x4).
*7 : Read and Write speeds may vary depending on the host device, read and write conditions, and file size.
*8 : IOPS: Input Output Per Second (or the number of I/O operations per second)
*9 : The PM5 Series can operate in a range of power modes: 9 W, 12 W, 14 W, 18 W (for MultiLink). The CM5 Series can operate in a range of power modes: 9 W, 11 W, 14 W, 16 W, 18 W.

Customers must refer to and comply with the latest versions of all relevant KIOXIA information, including without limitation, this document, the specifications, the data sheets and application notes for Product and the precautions and conditions set forth in the KIOXIA Reliability Handbook and the instructions for the application with which the Product will be used with or for.

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- NVMe is trademark of NVM Express, Inc.
- MultiLink SAS is a trademark of the SCSI Trade Association.
- All other company names, product names and service names mentioned herein may be trademarks of their respective companies.

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)[*1]. KIOXIA enterprise SSDs offer a range of security options[*2] designed for business critical data storage.

PM5 Series
SAS SSD
2.5 inch

CM5 Series
PCIe® / NVMe™ SSD
2.5 inch

Product image may differ from the actual product.

BiCS FLASH™

PM5 Series

Based on 64-layer BiCS FLASH™ 3D flash memory, the PM5 Series of dual-port 12 Gb/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[*2].

Model Number	DWPD [*3]	Interface	Form Factor	User Capacity (GB) [*4]	Performance (up to)				Typical Power Consumption (W) [*9]	Operating Temperature (°C)	Dimensions H / W / L (mm)
					Sequential (128 KiB) [*5 *6 *7] (MB/s)		Random (4 KiB) [*5 *6 *7 *8] (KIOPS)				
					Read	Write	Read	Write			
KPM51MUG3T20	10	SAS-3.0, single/dual port and MultiLink SAS™ support	2.5 inch	3,200	2,100	2,100	385	230	9 / 12 / 14	0 to 60	15.0 / 70.1 / 100.45
KPM51MUG1T60				1,600			370				
KPM51MUG800G				800			340				
KPM51MUG400G				400		1,260	270	150			
KPM51VUG6T40	3	SAS-3.0, single/dual port and MultiLink SAS™ support	2.5 inch	6,400	2,100	2,100	385	120	9 / 12 / 14	0 to 60	15.0 / 70.1 / 100.45
KPM51VUG3T20				3,200			370				
KPM51VUG1T60				1,600			340				
KPM51VUG800G				800		1,260	270	80			
KPM51VUG400G				400	1,470	680	180	70			
KPM51RUG15T3	1	SAS-3.0, single/dual port and MultiLink SAS™ support	2.5 inch	15,360	2,100	2,100	300	35	9 / 12 / 14	0 to 60	15.0 / 70.1 / 100.45
KPM51RUG7T68				7,680			385				
KPM51RUG3T84				3,840			370	55			
KPM51RUG1T92				1,920			340				
KPM51RUG960G				960		1,260	270	45			
KPM51RUG480G				480	1,470	680	180				

CM5 Series

Based on 64-layer BiCS FLASH™ 3D flash memory, the CM5 Series of dual-port PCIe®/ NVMe™ SSDs is available in 2.5 inch form factor. These SSDs feature Power Loss Protection (PLP) and offer a range of security/encryption options[*2]. The CM5 series is also available in 3 DWPD.

Model Number	DWPD [*3]	Interface	Form Factor	User Capacity (GB) [*4]	Performance (up to)				Typical Power Consumption (W) [*9]	Operating Temperature (°C)	Dimensions H / W / L (mm)
					Sequential (128 KiB) [*5 *6 *7] (MB/s)		Random (4 KiB) [*5 *6 *7] (KIOPS)				
					Read	Write	Read	Write			
KCM51RUG15T3	1	PCIe® Gen3 x4, single/dual port support	2.5 inch	15,360	3,350	3,040	590	35	18	0 to 60	15.0 / 70.1 / 100.45
KCM51RUG7T68				7,680			770	80	16		
KCM51RUG3T84				3,840			750	70	15		
KCM51RUG1T92				1,920	3,250	2,460	650	65	13		
KCM51RUG960G				960		1,250	370	50	11		

*1 : PLP (Power Loss Protection): PLP supports the recording of data in buffer memory into flash memory, utilizing back up power of a capacitor in case of unexpected power loss.
*2 : Optional security features
 - PM5 and 2.5 inch of CM5 Series offer a range of security options ; Sanitize Instant Erase (SIE), Self-Encrypting Drive (SED), and Self-Encrypting Drive (SED) with FIPS 140-2 validation or compliance. The Add-in card version of the CM5 has SIE and SED options.
 - Drive models with different security options have different part numbers.
 - The Sanitize Instant Erase (SIE) option supports Crypto Erase, which is a standardized feature defined by the technical committees (T10) of INCITS (the Inter National Committee for Information Technology Standards) or by NVM Express Inc..
 - SED (Self-Encrypting Drive) SSDs support TCG Enterprise SSC or TCG Opal SSC (Unsupported features are included in CM5 / SED optional model).
 - FIPS drives are designed to comply with FIPS 140-2 Level 2, which defines "Security Requirements for Cryptographic Modules" by NIST (the National Institute of Standards and Technology). PM5 Series is validated, CM5 series is planning to make FIPS 140-2 validated drives available.
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*4 : Definition of capacity: 1 terabyte (1 TB) = 1,000 gigabytes (GB), 1 GB = 1,000,000,000 (10^9) bytes
*5 : A kibibyte (KiB) means 2^10, or 1,024 bytes.
*6 : The performance specifications of the PM5 Series is based on testing in dual-port mode, running at 14 W of power. The performance of the CM5 Series is based on single-port mode (1x4).
*7 : Read and Write speeds may vary depending on the host device, read and write conditions, and file size.
*8 : IOPS: Input Output Per Second (or the number of I/O operations per second)
*9 : The PM5 Series can operate in a range of power modes: 9 W, 12 W, 14 W, 18 W (for MultiLink). The CM5 Series can operate in a range of power modes: 9 W, 11 W, 14 W, 16 W, 18 W.

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- NVMe is trademark of NVM Express, Inc.   - All other company names, product names and service names mentioned herein may be trademarks of their respective companies.

- ▪ **Founded in 1991**
- ▪ **Headquartered in Poland**
- ▪ **200 employees**
- ▪ **Own production line**
- ▪ **Certificate: ISO 9001**

Wilk Elektronik – About Company

GOODRAM Industrial

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.

1991 — The establishing of Wilk Elektronik as a memory modules distributor in Poland

1996 — The company becomes the largest distributor of memory products in Poland

2003 — Wilk Elektronik opens first memory module factory in Central and Eastern Europe

2008 — Wilk Elektronik signs a strategic cooperation agreement with Toshiba Electronics Europe

2009 — First GOODRAM SSD drive is produced using a fully automated production line

2013 — Wilk Elektronik invests in state-of-the-art SMT line, second to none in Europe

2013 — GOODRAM Industrial is introduced to the market as a sub-brand of GOODRAM

2017 — IRDM brand launches as an alternative for gamers and tech enthusiasts

2021 — Factory expansion is planned to double the production capacity

DRAM

GOOD RAM Industrial

DRAM (Dynamic Random Access Memory) modules are easy to install components, available for 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 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

Type	DDR1*	DDR2	DDR3	DDR4
Form Factors	184-pin DIMM 200-pin SO-DIMM	240-pin DIMM 200-pin SO-DIMM	240-pin DIMM 204-pin SO-DIMM	288-pin DIMM 260-pin SO-DIMM
Capacity	512MB to 1GB	1GB to 2GB	1GB to 8GB	4GB to 16GB
Peak Transfer Rate (MB/s)	Up to 3,200	Up to 6,400	Up to 14,900	Up to 25,600 (3,200MHz)
Voltage (V)	2.5	1.8	1.5/1.35	1.2
ECC option	Yes			
Operating Temperature (°C)	Standard grade: 0 to 70 Industrial grade: -40 to 85	Standard grade: 0 ÷ 85 Industrial grade: -40 to 85		
Storage Temperature (°C)	-40 to 85			
Key Features & Options	Single/Double Rank configuration DDR3/4 Very Low Profile size 100% functional tests High/Low temempartaure testing Build from major IC grades Long lifetime project support FIX BOM option PCN and EOL notification			

*DDR1 modules only for special request

NAND Base Solutions

GOOD RAM Industrial

SSD drives (Solid-state drives) for industrial usage are available in all mainstream form factors (2.5", mSATA, M.2 SATA). FLASH product group include SD/microSD, CompactFlash®, CFast and eMMC 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.

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.

Features
- Static and Dynamic Wear Levelling
- Bad Block Management
- TRIM
- S.M.A.R.T.
- NCQ
- Over-provisioning
- Low Power Management
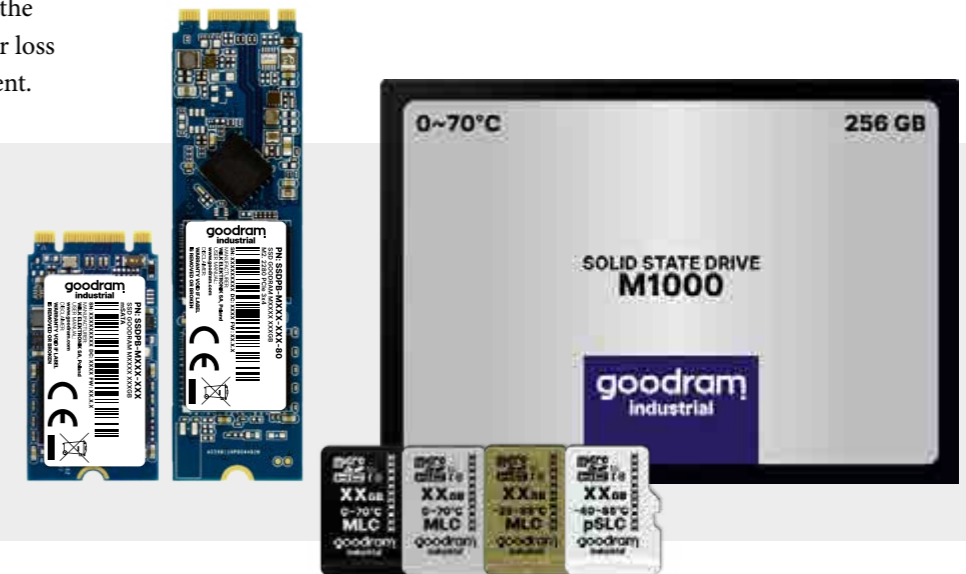
Intel® Solid-State Drive Product Families
Solid-State Drives - Client

Authorised Distributor

Key Advantages
- Boost your PC performance by replacing your HDD or SATA with an Intel® PCIe SSD
- Reliable Quality - Every Intel® 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 form your old drive to a new SSD
- Industry leading innovation - the 665p features 96-Layer 3D NAND technology
- Intel® 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

M.2

Flash memory has been a disruptive technology from its industrial inception in the early '90s and innovation is still ongoing after more than 25 years. Today the most advanced storage products use NAND flash and Intel® Optane™ with 3D-XPoint technology. Thanks to the technologies storage density, NAND and 3D-XPoint has changed our lives. Through continuous development, investment and improvement by Intel®, 3D NAND and Intel® Optane™ deliver outstanding value and capabilities to consumers and businesses alike.

2,5"   **U.2**   **AIC**

Series	660p	665p	905p	900p	800p	Intel Optane Memory M10	Intel Optane Memory H10 with Solid State Storage
Interface	PCIe 3.0x4	PCIe 3.0 x4	PCIe 3.0 x4	PCIe 3.0 x4	PCIe 3.0 x2	PCIe 3.0 x2	PCIe 3.0 x4
Technology	3D NAND QLC 64-Layer	3D NAND QLC 96-Layer	3D X-Point	3D X-Point	3D X-Point	3D X-Point	3D X-Point
Form Factor	M.2 x 80mm	M.2 x 80mm	U.2 x 15mm AIC M.2 x 110mm	U.2 x 15mm AIC	M.2 x 80mm	M.2 x 42mm M.2 x 80mm	M.2 x 80mm
Capacity	512GB 1TB 2TB	1TB 2TB*	380GB 480GB 960GB 1.5TB	280GB 480GB	58GB 118GB	16GB 32GB 64GB	16GB + 256GB 32GB + 512GB 32GB + 1024GB

Content   Content

Intel® Solid-State Drive Product Families
Solid-State Drives - Data Center

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
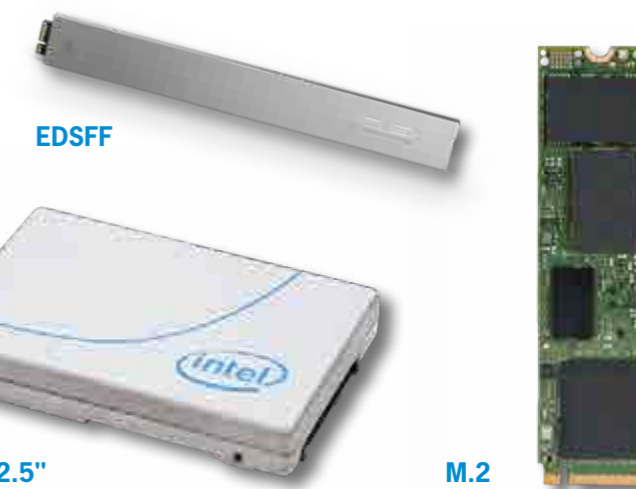
EDSFF

AIC   **U.2 & 2.5"**   **M.2**

Applications connected to the Internet already generate vast amount of hot and cold data and require a storage medium to save and access the data. Intel® provides future proof solutions for enterprise infrastructure with extraordinary performance, reliability and endurance. Intel® SSDs enable you to keep up with the ever-increasing demands of the data center with products that provide drive reliability, uncompromised data integrity and consistent performance in critical working environments.

Series	DC P4800X	DC P4800X with IMDT	DC P4801X	DC P4801X with IMDT	DC P4618	DC P4610	DC P4511	DC P4510	DC P4420	DC P4326	DC P4320	DC S4610	DC S4510	DC D4800X
Interface	PCIe 3.0 x4	PCIe 3.0 x4	PCIe 3.0 x4	PCIe 3.0 x4	PCIe 3.1 x8	PCIe 3.1 x4	PCIe 3.1 x4	PCIe 3.1 x4	PCIe 3.1 x4	PCIe 3.1 x4	PCIe 3.1 x4	SATA 3.0 6Gb/s	SATA 3.0 6Gb/s	PCIe 3.0 x2 x2
Technology	3D-Xpoint	3D-Xpoint	3D-Xpoint	3D-Xpoint	3D NAND TLC 64-Layers	3D NAND TLC 64-Layers	3D NAND TLC 64-Layers	3D NAND TLC 64-Layers	3D NAND QLC 64-Layer	3D NAND QLC 64-Layer	3D NAND QLC 64-Layer	3D NAND TLC 64-Layers	3D NAND TLC 64-Layers	3D-Xpoint
Form Factor	AIC U.2 x 15mm	AIC U.2 x 15mm	M.2 110mm U.2 x 15mm	M.2 110mm U.2 x 15mm	AIC	U.2 x 15mm	M.2 110 mm E1.S 5.9mm	U.2 x 15mm E1.L 9.5mm	U.2 x 15mm	U.2 x 15mm E1.L 18mm E1.L 9.5mm	U.2 x 15mm	2.5" x 7mm	2.5" x 7mm M.2 x 80mm	U.2 x 15mm
Capacity	375GB 750GB 1.5TB	375GB 750GB 1.5TB	100GB 200GB 375GB	100GB 200GB 375GB	6.4TB	1.6TB 3.2TB 6.4TB 7.68TB	1TB 2TB 4TB	1TB 2TB 4TB 8TB 15.36TB	7.68TB	15.36TB	7.68TB	240GB 480GB 960GB 1.92TB 3.84TB 7.68TB	240GB 480GB 960GB 1.92 3.84TB 7.68TB	375GB 750GB 1.5TB
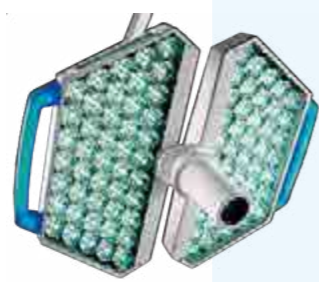
TEAC

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.

Operating room

- Shadowless lamp with camera
- Surgical microscopes
- Laparoscope
- Urological endoscopes
- Arthroscope
- Hysteroscope

UR-4MD

- Intuitive & Easy To Use
- Auto-sensing detects I/O & Video Resolution "automatically"
- Wide range of recording resolutions
  - 640x480~1920x1080 (30Hz/29.97Hz): Undiluted recoding resolution
  - 1920x1200 (Resize to 1728x1080): Supported Input resolution
- Multiple HD & SD inputs/outputs (SDI, DVI-D, S-Video and Composite)
- Simultaneous recording to multiple media (up to 2 External USB drives & 1 Internal HD)
- Networking (FTP & CIFS) RJ45 10/100/1000 Ethernet
- Remote control, Foot-switch, Card/Barcode reader and Keyboard (Optional)
- Compliance with Medical Standards

- Microscope
- Camera unit
- Recorder

TEAC
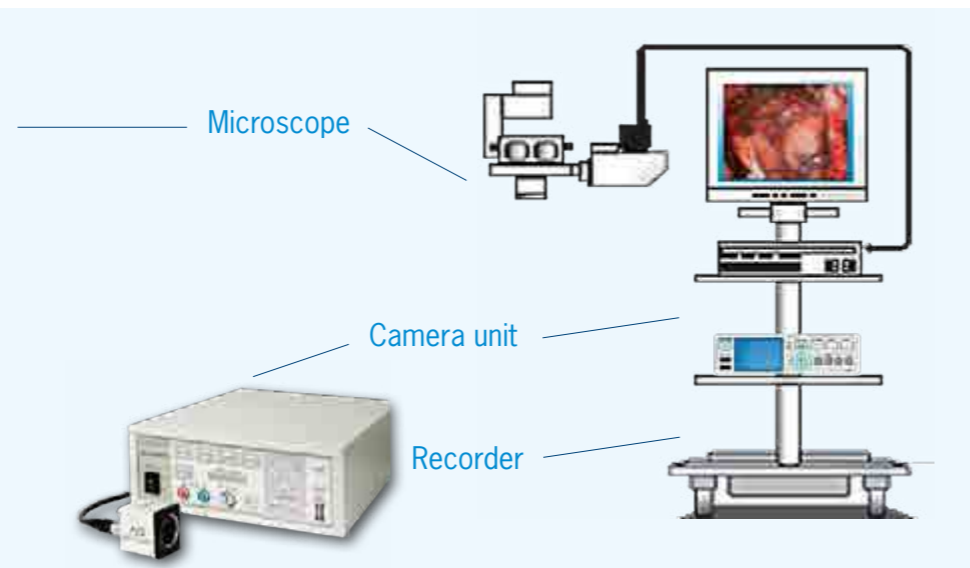
Optical Drives –
Ideal for Industrial Applications

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-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 fulfil 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
- Measure PI/PO error
- Total Power-on-Hour, CD/DVD write/read accumulate time

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. DV-W28SS-W combines fast DVD-recording, smooth DVD video playback with impressive CD-ROM performance.

Whether you are watching high definition movies, listening 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.

Disc Diameter	12cm
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
Relative Humidity	Operating: 10 to 80% (non-condensing) Non Operating: 10 to 95% (non-condensing) Transportation: 10 to 95% (non-condensing)
Current Consumtion	Standby/Sleep: 50mA (Avarage current max.) During starting / Seek: 1500mA (Max spikes less then 1ms)
MTBF	60.000POH (10% duty)
Safety Standards	Approved by UL, CUL, TÜV, CE and BSMI

RUTRONIK EMBEDDED

Linecard Displays

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.

4D SYSTEMS · **ADVANTECH** · **Displaytech Ltd.** · **DLC** · **DMC Co., Ltd.** · **ES&S** · **Han touch.com**

HIGGSTEC INC. · **HOLITECH Europe** · **RAYSTAR** · **SHARP** · **TIANMA** · **U.R.T.** · **VARITRONIX** · **YB**

Displays & Accessories

Type	Technology	4D Systems	Advantech	Displaytech	DLC	DMC	ES&S	HanTouch	Higgstec	Holitech	Raystar	Sharp	Tianma	URT	YB	Varitronix
TFT-Displays																
	TFT-Displays			X	X					X	X		X		X	X
	Smart Panels incl. Controller	X	X													
	SKD-Kits incl. Controller, Cable, Power Supply		X													
	Professional Monitors											X				
Passive LC-Displays																
	Character and Graphic Modules			X	X					X			X	X	X	X
	Customized Modules			X	X								X	X	X	X
	Turn Key Solutions			X											X	
	OLED's				X						X				X	
	Bi-Stable Displays													X		X
	E-Paper									X						
Accessories																
	Inverter		X													
	Cables and Connectors		X				X									
	Touches					X	X		X							

TIANMA

T-EVT

Reflected Light
Transmitted Light
Backlight Unit
Transflective Film
Transparent Electrode

R-EVT

Reflected Light
Transmitted Light
Transparent Electrode
Reflective Electrode

Transmissive

Transmitted Light
Transparent Electrode
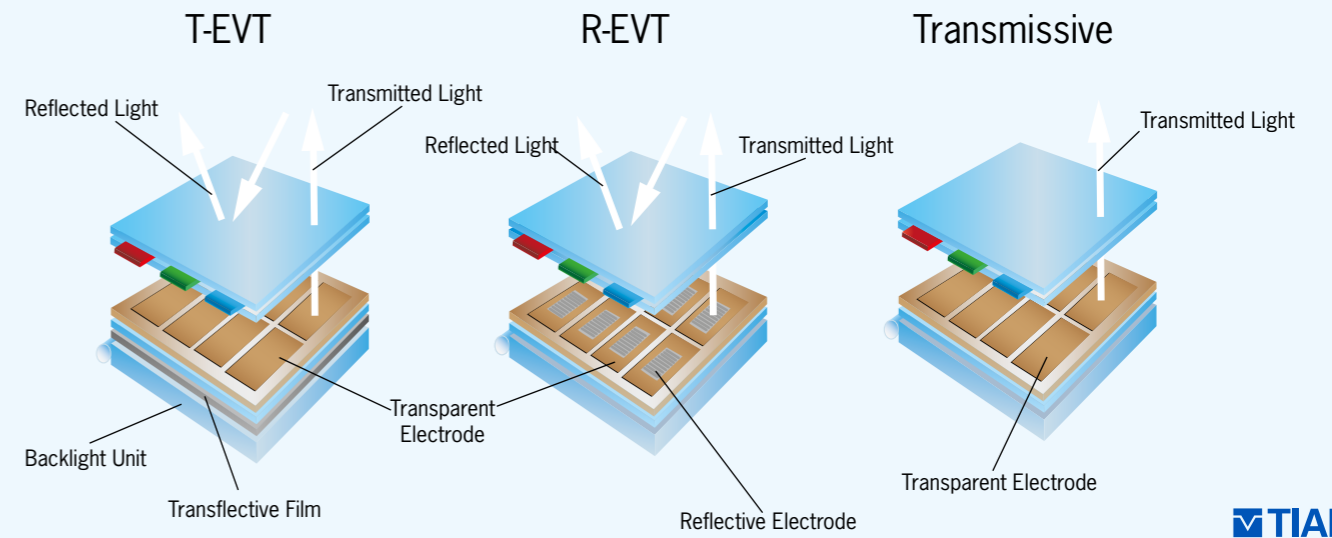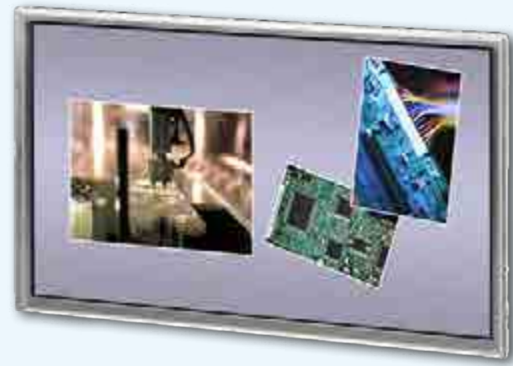
TIANMA

Cap Touch included

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
- Dual clock interface for EMI reduction
- Flicker-free
- Fast response times
- Wider viewing angle with Super-Fine technology (up/down ±85°)

TFT Standard Industrial Line

Display Size		Interface			Technology		Resolution	Touch incl.
Inch	Cm	RGB	LVDS	eDP	SFT	EVT		PCAP
5.7	15	x	x				QVGA / VGA	
6.5	17	x	x			x	VGA / XGA	xx
7.0	18		x			x	WVGA	xx
8.0	20		x				WVGA	
8.4	21	x	x		x	x	VGA / SVGA / XGA	xx
8.9	22		x				WSVGA	
9.0	23		x		x		WVGA / Full HD	
10.1	25		x		x		WXGA	
10.4	26	x	x		x	x	VGA / SVGA / XGA	xx
10.6	26.5		x		x		WXGA	xx
11.6	29			x	x		Full HD	
12.1	31	x	x		x	x	SVGA / XGA / WXGA	xx
15.0	38		x		x	x	XGA	xx
15.3	39		x		x		WXGA	xx
15.6	40		x	x	x		FWXGA / Full HD	
17.0	43		x				SXGA	
18.5	47		x	x	x		Full HD	
19.0	48		x		x		SXGA	
21.3	53		x		x		QXGA	
30.0	76			x	x		WQSXGA	

Basic Line

Display Size		Interface		Resolution	Touch incl.
Inch	Cm	RGB	Interface		PCAP
7	18	X	X	WVGA	
8.4	21		X	SVGA	
10.4	26		X	SVGA	
12.1	31		X	SVGA / XGA	
15	38		X	XGA	XX

SFT Technology
(Super Fine TFT)

High Luminance, Wide Color Gamut

With the SA-SFT and UA-SFT 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 200 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 gray-scale 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 with virtually no color deviation - a great picture no matter how you look at it.

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.
R-EVT: Reflective EVT
T-EVT: Transmissive EVT

T-EVT Brings You the Clearest, Sharpest Pictures Under the Sun

This revolutionary new T-EVT is a transmissive type that guarantees bright, easy-viewing displays even in bright sunlight. It's the history-making forerunner of a new generation of LCDs unaffected by changes in natural light - for bright, vivid color displays anytime.

Projected Capacitive Touch Panel

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.
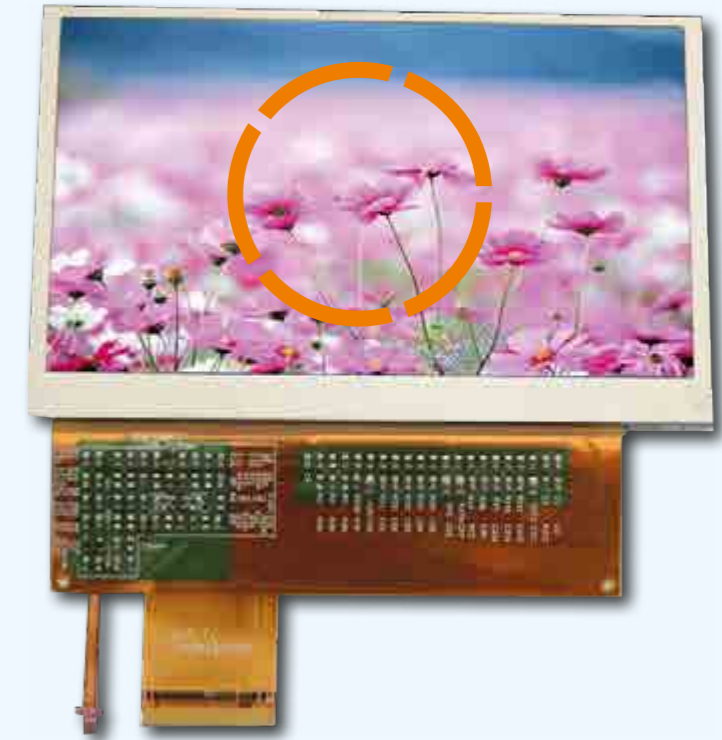
TFT Color Modules

TIANMA

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.

Focus Products

Display Size		Interface			Resolution	Technology	Lifetime in Hours	Touch incl.
Inch	Cm	RGB	LVDS	Others				
2.0	5.1			CPU	QCIF	TN	20k	
2.2	5.6	xx			QVGA	R-EVT	20k	
2.4	6.1			CPU	QVGA	TN	20k	
2.8	7.1	xx			QVGA	TN	30k	
3.0	7.6			CPU	QVGA	R-EVT	20k	
3.5	8.9	xx		CPU / SPI	QVGA / HVGA	TN	20k / 30k	RTP
4.0	10.2			MIPI	WVGA	SFT	20k	
4.3	11.0	xx			WQVGA	TN	20k / 30k	RTP / PCAP
5.0	12.7	xx			WVGA	TN	20k	RTP
5.7	14.5	xx			QVGA / VGA	TN	50k	
7.0	17.8	xx	xx		WVGA / WSVGA / WXGA	TN / SFT	20k / 30k / 50k	RTP / PCAP
8.0	20.3	xx			SVGA	TN	25k / 40k	
8.4	21.3	xx	xx		SVGA	TN	30k / 50k	
9.7	24.6		xx		XGA	TN	30k	
10.1	25.6		xx		WSVGA / WXGA	TN / SFT	30k / 50k	
10.4	26.5	xx	xx		SVGA	TN	30k	
12.1	30.8		xx		SVGA / XGA / WXGA	TN / SFT	30k / 50k	
15.0	38.1		xx		XGA	TN	30k / 50k	

Foster Products

Display Size		Interface			Resolution	Technology	Lifetime in Hours	Touch incl.
Inch	Cm	RGB	LVDS	Others				
2.3	5.8			CPU	QVGA	TN	20k	
2.4	6.1			CPU/SPI	QVGA	SFT	20k	
3.3	8.4			MIPI	320x320 round	TN	20k	
3.5	8.9	xx			QVGA	TN	20k	PCAP
4.3	11.0	xx			WQVGA / WVGA	TN / SFT	20k / 30k	RTP / PCAP
4.6	11.7			MIPI	WXGA	SFT	20k	
5.0	12.7	xx		MIPI	WVGA / WXGA	TN / SFT	20k / 50k	PCAP
5.7	14.5	xx			QVGA	TN	50k	RTP / PCAP
7.0	17.8	xx	xx		WVGA / WSVGA / WXGA	TN / SFT	20k / 30k / 50k	PCAP
8.0	20.3		xx		XGA	TN / SFT	30k	
10.1	25.6		xx		WSVGA / WXGA	TN / SFT	20k /30k / 50k	PCAP
10.4	26.5		xx		XGA	SFT	50k	
12.1	30.8		xx		SVGA / XGA / WXGA	TN / SFT	50k	PCAP
15.0	38.1			eDP	XGA	TN	30k	

TFT Technology by U.R.T.

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

Size		Resolution	Interface	Touch Panel
Inch	Cm			
2,9	7,37	320x120	RGB	Optional
3,9	9,91	480x128	RGB	Optional
4,6	11,68	800x320	RGB	Optional
5,8	14,73	800x320	RGB	Optional
6,1	15,49	800x240	RGB	Optional
6,5	16,51	800x320	RGB	Optional
8,8	22,35	1280x320	LVDS	Optional
9	22,86	1280x240	LVDS	Optional
12,3	31,24	1920x720	LVDS	Optional

Product Portfolio TFT

Size		Resolution	Interface	Touch Panel
Inch	Cm			
2,4	6,10	QVGA	MPU	PCAP, RTP
2,8	7,11	QVGA	MPU	PCAP, RTP
3,5	8,89	QVGA, VGA	RGB, MPU	PCAP, RTP
4,3	10,92	480RGBx272, 800x480	RGB	PCAP, RTP
5,0	12,70	800x480	RGB	PCAP, RTP
5,7	14,48	QVGA, VGA	RGB, MPU, LVDS	PCAP, RTP
7,0	17,78	800RGBx480, 1024x600	RGB, LVDS	PCAP, RTP
10,1	25,65	1280x800	LVDS	PCAP, RTP
10,4	26,42	XGA	LVDS	Optional
12,1	30,73	XGA, 1280x800	LVDS	Optional
15	38,10	XGA	LVDS	Optional
15,6	39,62	1366x768	LVDS	Optional
18,5	46,99	1366x768	LVDS	Optional

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.

TFT Portfolio

Size		Interface			Resolution	Technology	Lifetime in Hours	Touch incl.
Inch	Cm	RGB	LVDS	Others				
1.44	3.6			CPU	128x128	TN	20k	
1.77	4.5			MCU	128x160	TN	50k	
2.0	5.1	xx		MCU	160x240 / 176x220	TN	20k / 50k	
2.4	6.1	xx		MCU / SPI	240x320	TN / IPS	20k / 50k	PCAP
2.8	7.1	xx		MCU / SPI	240x320	TN / IPS	20k / 50k	RTP / PCAP
3.2	8.1			MCU / SPI	240x320	TN	50k	
3.5	8.9	xx		MCU / SPI	320x240 / 320x480	TN / IPS	20k / 50k	RTP / PCAP
3.97	10.1	xx			480x800	IPS	20k	
4.3	10.9	xx	xx		480x272	TN / IPS	20k / 50k	RTP / PCAP
4.5	11.4			MIPI	480x854	IPS	50k	RTP
5.0	12.7	xx			800x480	TN	20k	RTP / PCAP
5.5	14.0			MIPI	720x1280	IPS	50k	
7.0	17.8	xx			800x480	TN	50k	PCAP
9.0	22.9	xx			800x480	TN	20k	
10.1	25.6		xx		1280x800 / 1024x600	IPS	50k	PCAP
12.1	30.7		xx		1024x768	TN	50k	

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
- 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. Only one or two displays are available as standard products.

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

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.
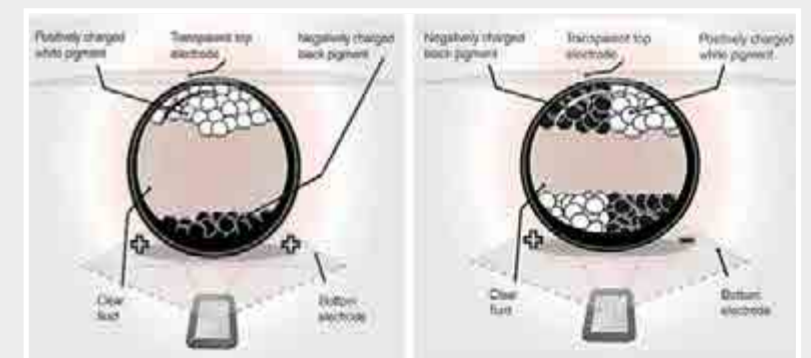
Standard Product List

Size (Inch)	Color	Resolution	OD (mm)	AA (mm)	DPI (mm)	IC
1.5	Black white/red/yellow	200×200	31.8×37.32	27×27	188	SSD1681
2.13	Black white/red/yellow	212×104	29.2×59.2	23.8×48.55	110	SSD1675
2.13	Black white/red/yellow	250×122	29.2×59.2	23.8×48.55	130	SSD1675
2.66	Black white/red/yellow	152×296	36.3×71.82	30.7×60.09	125	SSD1675
2.7	Black white/red/yellow	176×264	45.8×70.42	38.192×57.288	117	JD79651AA
2.9	Black white/red/yellow	128×296	36.7×79	29.06×66.9	112	SSD1675
3.7	black white red	240×416	53×92.99	47.04×81.536	130	HT0001
4.2	black white	400×300	91×77	84.8×63.6	119	SSD1608×2
4.2	Black white/red/yellow	400×300	91×77	84.8×63.6	119	SSD1619/UC8176
4.3	Black white/red/yellow	152×522	36.7×117.17	30.7×105.44	125	EK79686
7.5	Black white/red/yellow	640×384	170.2×111.2	163.2×97.92	99	UC8159
7.5	Black white/red/yellow	880×528	170.2×111.2	163.2×97.92	137	SSD1677
10.2	Black white/red/yellow	960×640	224×157	215.52×143.68	113	SSD1677
13.3	black/white	680x960	286.32x212.26	275.52x195.16		SSD1677
32	black/white	2560x1440	697.2x402.8	691.2x388.3		SSD1677
42	black/white	2160x2880	872.5x650	856.8x642.6		SSD1677

HOLITECH Europe

DLC-Display Specialist

DLC-Display Specialist
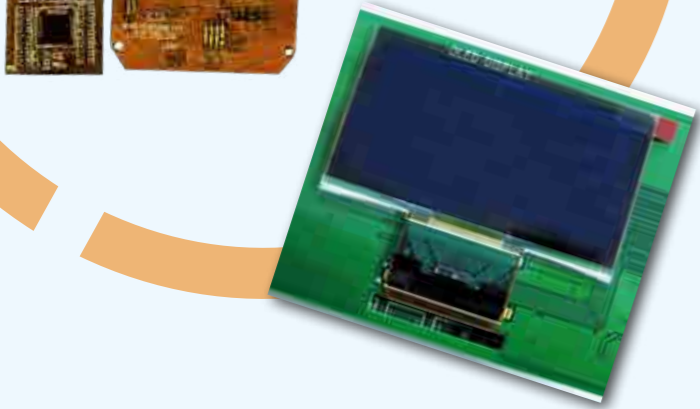
TFTs & OLEDs

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.

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 light themselves.

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.

Size		Resolution	Interface	Touch Panel
Size (Inch)	Cm			
0.9	2.29	80RGBx160	SPI	Optional
1.3	3.30	240RGBx240	SPI	Optional
1.44	3.66	128RGBx128	CPU	Optional
1.77	4.50	128RGBx160	CPU	Optional
1.9	4.83	170RGBx320	CPU	PCAP
2.0	5.08	QVGA, 480x360	CPU, RGB, MIPI	Optional
2.2	5.59	QVGA	CPU	Optional
2.4	6.10	QVGA	CPU	Optional
2.45	6.22	272RGBx480	RGB	Optional
2.83	7.19	QVGA	CPU/RGB	Optional
3.2	8.13	QVGA	RGB	Optional
3.5	8.89	320RGBx480, QVGA	SPI, MCU, RGB,	PCAP, RTP
3.95	10.03	480RGBx480	MIPI	Optional
4.3	10.92	480RGBx272, 800x480	RGB, MCU	PCAP, RTP
5.0	12.70	480x272, 640RGBx480, 800x480	RGB	PCAP, RTP
5.6	14.22	640RGBx480	RGB	Optional
5.7	14.48	QVGA, VGA	RGB, TTL, LVDS	PCAP, RTP
6.5	16.51	800RGBx480	RGB	PCAP
7.0	17.78	800RGBx480, 1024x600	RGB, TTL, LVDS	PCAP, RTP
8.0	20.32	800RGBx480, 800x600, 1024x600	RGB, LVDS	PCAP, RTP
8.4	21.34	800xRGBx600	LVDS	Optional
9.0	22.86	800RGBX480	RGB	Optional
10.1	25.65	1024RGBx600, 1280x800	RGB, LVDS	PCAP, RTP
10.2	25.91	800RGBx480	RGB	Optional
10.25	26.04	1920RGBx720	LVDS	Optional
10.3	26.16	1280RGBx480	LVDS	Optional
10.4	26.42	VGA, SVGA, XGA	TTL, LVDS	Optional
12.1	30.73	SVGA, XGA, 1280x800	LVDS	PCAP, RTP
12.3	31.24	1920RGBx720	LVDS	Optional
15	38.10	XGA	LVDS	Optional

DLC P/N	Size (Inch)	Dot Format	A.A. (mm)	Outline Size (mm)	Interface	Colors	Remarks
DLC0049AZOG-W-1	0.49	64x32	11.18x5.58	14.50x11.60	I2C	White	Monochrome
DLC0066ANOG-3	0.66	64x48	13.42x10.06	18.46x18.10	Parellel/SPI/I2C	Blue	Monochrome
DLC0066ANOG-W-4	0.66	64x48	13.42x10.06	18.46x18.10	Parallel/SPI/I2C	White	Monochrome
DLC0069AZOG-W	0.69	96x16	17.26x3.18	26.30x8.00	SPI	White	Monochrome
DLC0091CNOG-W	0.91	128x32	22.384x5.584	30.00x11.50	SPI	White	Monochrome
DLC0095DNOG-2	0.95	96x64	20.14x13.42	25.70x22.20	Parellel/SPI	Color	Passive Color
DLC0096DNOG-W-5	0.96	128x64	21.74x10.86	24.74x16.90	SPI/I2C	White	Monochrome
DLC0112AZOG	1.12	96x96	20.14x20.14	25.80x30.10	Parellel/SPI	Color	Passive Color
DLC0119AEOF	1.19	390x390	30.42	33.22x34.72	MIPI	16.7M	AMOLED,Round
DLC0129AZOF-1	1.29	128x96	26.28x19.71	33.00x25.80	Parallel/SPI	Color	Passive Color
DLC0130ANOG-W	1.30	128x64	29.42x14.70	34.50x23.00	Parellel/SPI/I2C	White	Monochrome
DLC0130CMOG	1.30	360x360	32.94	35.34x36.07	MIPI	16.7M	AMOLED,Round
DLC0132AZOG-W	1.32	128x96	26.86x20.14	32.50x29.20	Parallel/SPI/I2C	White	Monochrome
DLC0137AZOG	1.37	128x128	24.55x24.56	31.20x33.80	Parellel/SPI	Color	Passive Color
DLC0139BQOG	1.39	400x400	35.40	38.60x40.50	MIPI	16.7M	AMOLED,Round
DLC0141AEOG	1.41	320x360	23.84x26.82	26.04x31.78	MIPI	16.7M	AMOLED
DLC0145BNOF	1.45	160x128	28.78x23.02	35.80x30.80	Parallel/SPI	Color	Passive Color
DLC0146AZOF-1	1.46	128x128	26.279x26.284	33.50x33.50	Parallel/SPI	Color	Passive Color
DLC0150CNOG-W	1.50	128x128	26.86x26.86	33.80x36.50	Parallel/SPI/I2C	White	Monochrome
DLC0154BNOG-W-1	1.54	128x64	35.05x17.52	42.04x27.22	Parellel/SPI/I2C	White	Monochrome
DLC0160AZOG-Y	1.60	128x64	36.45x18.21	41.90x28.00	Parallel/SPI	Yellow	Monochrome
DLC0177AZOF-1	1.77	160x128	35.02x28.01	42.80x33.50	Parallel/SPI	Color	Passive Color
DLC0223ANOG-1	2.23	128x32	55.02x13.10	62.00x24.00	Parellel/SPI/I2C	B/Y/W	Monochrome
DLC0242BNOG-W-2	2.42	128x64	55.01x27.49	60.50x37.00	Parallel/SPI/I2C	White	Monochrome
DLC0293ANOG-B-2	2.93	20x2	73.52x11.52	84.50x19.28	Parellel/SPI/I2C	Blue	Monochrome
DLC0295AZOM	2.95	1080x1200	50.11x55.68	52.91x62.58	MIPI	16.7M	AMOLED
DLC0550ANOF	5.50	256x64	135.65x33.89	146.00x45.00	Parallel/SPI	B/G	Monochrome
DLC0550AZOM	5.50	1080x1920	68.299x121.421	70.66x128.36	MIPI	16.7M	AMOLED
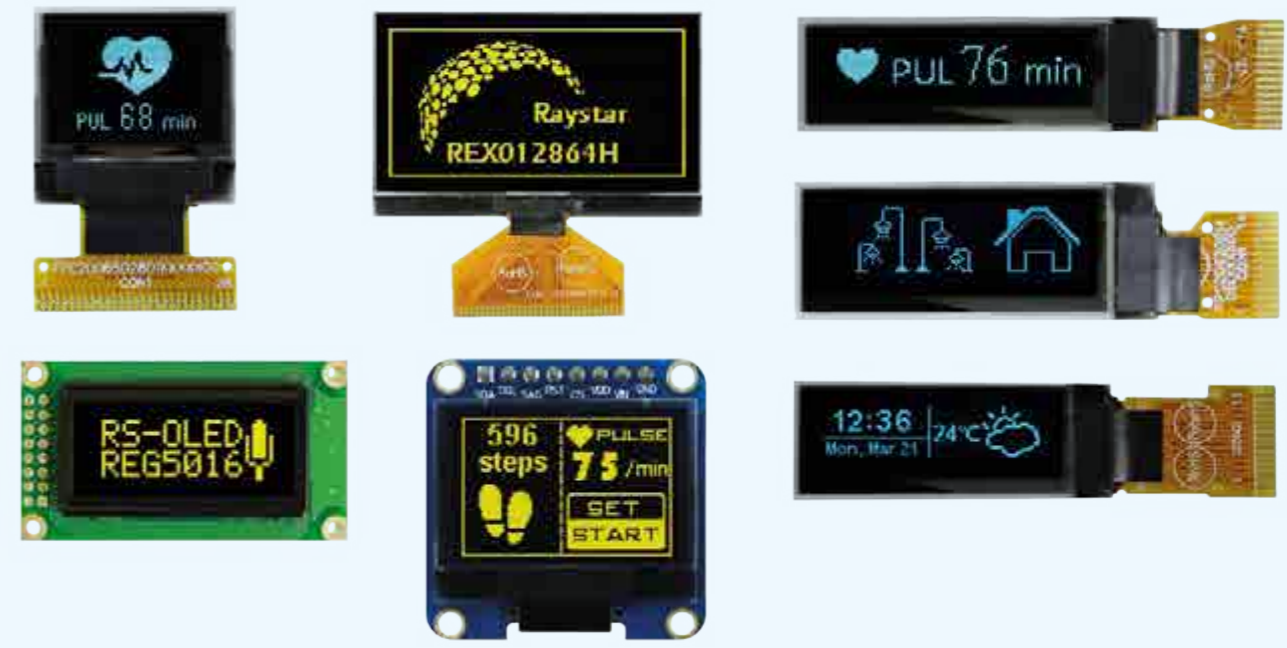
OLED and TFT Display Modules

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 upto 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 capacity 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 TFT outlines are 2.4", 2.8", 3.5", 3.9", 4.3", 4.6", 5", 5.2",5.7", 6.2", 7", 8", 9",10.1", 10.2", 12.1" and 12.3".

OLED Display Module – COB

Type	Size (")	Size (cm)	Outline (mm)	View Area (mm)	Active Area (mm)	Pixel Pitch (mm)	Interface
Character	1.20	3.0	58.00×32.00	38.00×16.00	28.16×11.86	0.60×0.70	default 6800, option 8080, SPI
Character	2.29	5.8	80.00×36.00	66.00×16.00	56.95×11.85	0.60×0.70	default 6800, option 8080, SPI
Character	2.29	5.8	85.00×36.00	66.00×16.00	56.95×11.85	0.60×0.70	default 6800, option 8080, SPI
Character	2.29	5.8	85.00×30.00	66.00×16.00	56.95×11.85	0.60×0.70	default 6800, option 8080
Character	2.29	5.8	84.00×44.00	66.00×16.00	56.95×11.85	0.60×0.70	default 6800, option 8080, SPI
Character	3.67	9.3	122.00×44.00	98.00×21.00	91.14×18.98	0.96×1.12	default 6800, option 8080, SPI
Character	3.08	7.8	116.00×37.00	85.00×18.60	77.30×11.85	0.65×0.70	default 6800, option 8080, SPI
Character	2.88	7.3	98.00×60.00	77.00×25.20	70.16×20.95	0.59×0.60	default 6800, option 8080, SPI
Character	2.88	7.3	98.00×60.00	77.00×25.20	70.16×20.95	0.59×0.60	default 6800, option 8080, SPI
Character	5.85	14.9	182.00×38.50	154.40×16.50	148.13×11.85	0.62×0.70	default 6800, option 8080, SPI
Graphic	1.26	3.2	58.00×32.00	38.00×16.00	29.96×11.16	0.60×0.70	default 6800, option 8080, SPI
Graphic	2.40	6.1	80.00×36.00	66.00×16.00	59.95×11.15	0.60×0.70	default 6800, option 8080, SPI
Graphic	2.40	6.1	85.00×36.00	66.00×16.00	59.95×11.15	0.60×0.70	default 6800, option 8080, SPI
Graphic	2.40	6.1	85.00×30.00	66.00×16.00	59.95×11.15	0.60×0.70	default 6800, option 8080
Graphic	2.40	6.1	84.00×44.00	66.00×16.00	59.95×11.15	0.60×0.70	default 6800, option 8080, SPI
Graphic	2.59	6.6	116.00×37.00	85.00×18.60	64.95×11.15	0.65×0.70	default 6800, option 8080, SPI
Graphic	3.84	9.8	122.0×44.0	98.00×21.00	95.94×17.86	0.96×1.12	6800
Graphic	2.44	6.2	98.00×60.00	77.00×25.20	58.95×19.15	0.59×0.60	default 6800, option 8080, SPI
Graphic	2.44	6.2	98.00×60.00	77.00×25.20	58.95×19.15	0.59×0.60	default 6800, option 8080, SPI
Graphic	4.90	12.4	182.00×38.50	154.40×16.50	123.95×11.15	0.62×0.70	default 6800, option 8080, SPI
Graphic	4.86	12.3	180.00×40.00	149.00×23.00	121.90×19.42	1.22×1.22	default 6800, option 8080, SPI
Graphic	2.44	6.2	98.00×60.00	77.00×25.20	58.95×19.15	0.59×0.60	default 6800, option 8080, SPI
Graphic	4.90	12.4	182.00×38.50	154.40×16.50	123.95×11.15	0.62×0.70	default 6800, option 8080, SPI

OLED Display Module – COG

Type	Size (")	Size (cm)	Outline (mm)	View Area (mm)	Active Area (mm)	Pixel Pitch (mm)	Interface
Character (W PCB)	1.23	3.1	53.00×20.00	36.00×10.00	30.69×5.94	0.34×0.36	default 6800, option 8080, SPI
Character (W/O FR)	2.26	5.7	68.50×17.50	58.22×13.52	56.22×11.52	0.60×0.70	6800, 8080, SPI, I2C
Character (W PCB)	2.26	5.7	84.00×44.00	58.22×13.52	56.22×11.52	0.60×0.70	default 6800, option 8080, SPI
Character (W/O FR)	2.93	7.4	84.50×19.28	75.52×13.52	73.52×11.52	0.65×0.70	6800, 8080, SPI, I2C
Graphic (W/O FR)	0.71	1.8	13.90×22.00	12.14×16.30	10.54×14.70	0.22×0.23	I2C
Graphic (W/O FR)	0.49	1.2	14.50×11.60	12.58×6.58	11.18×5.58	0.18×0.18	I2C
Graphic (W/O FR)	0.66	1.7	18.46×18.10	15.42×12.06	13.42×10.06	0.21×0.21	6800, 8080, SPI, I2C
Graphic (W/O FR)	0.84	2.1	29.10×9.20	23.10×5.50	21.10×3.50	0.22×0.22	I2C
Graphic (W/O FR)	0.68	1.7	19.80×12.32	17.298×6.418	16.298×5.418	0.17×0.17	6800, 8080, SPI, I2C
Graphic (W/O FR)	1.10	2.8	29.00×22.50	24.54×17.02	22.53×15.01	0.235×0.235	6800, 8080, SPI, I2C
Graphic (W/O FR)	2.23	5.7	62.00×24.00	57.02×15.10	55.02×13.10	0.43×0.41	6800, 8080, SPI, I2C
Graphic (W/O FR)	0.91	2.3	30.00×11.50	24.38×7.58	22.38×5.58	0.18×0.18	SPI
Graphic (W/O FR)	0.91	2.3	30.00×11.50	24.38×7.58	22.38×5.58	0.18×0.18	I2C
Graphic (W/O FR)	1.71	4.3	50.50×15.75	44.22×12.54	42.22×10.54	0.33×0.33	SPI, I2C
Graphic (W/O FR)	2.03	5.2	59.00×18.86	52.535×12.695	50.535×10.695	0.395×0.335	6800, 8080, SPI, I2C
Graphic (W/O FR)	1.54	3.9	42.04×27.22	37.05×19.52	35.05×17.51	0.27×0.27	6800, 8080, SPI, I2C
Graphic (W/O FR)	0.96	2.4	26.70×19.26	23.34×11.46	21.74×10.86	0.17×0.17	6800, 8080, SPI, I2C
Graphic (W/O FR)	0.96	2.4	26.70×19.26	23.94×12.06	21.74×10.86	0.17×0.17	6800, 8080, SPI, I2C
Graphic (W/O FR)	2.42	6.1	60.50×37.00	57.01×28.91	55.01×27.49	0.43×0.43	6800, 8080, SPI, I2C
Graphic (W/O FR)	2.42	6.1	60.50×37.00	57.01×28.91	55.01×27.49	0.43×0.43	6800, 8080, SPI, I2C
Graphic (W PCB)	2.42	6.1	75.00×52.70	57.01×29.49	55.01×27.49	0.43×0.43	default 8080,option 6800, SPI, I2C
Graphic (W/O FR)	2.70	6.9	73.00×41.86	63.41×32.69	61.41×30.69	0.48×0.48	6800, 8080, SPI, I2C
Graphic (W/O FR)	2.70	6.9	73.00×41.86	63.41×32.69	61.41×30.69	0.48×0.48	6800, 8080, SPI, I2C
Graphic (W/O FR)	1.29	3.3	34.50×23.00	31.32×15.61	29.42×14.20	0.23×0.22	6800, 8080, SPI, I2C
Graphic(W/O FR)	0.96	2.4	26.70×19.26	23.74×13.20	21.74×11.20	0.17×0.17	6800, 8080, SPI, I2C
Graphic(W/O FR)	2.70	6.9	73.00×41.86	63.41×32.69	61.41×30.69	0.48×0.48	6800, 8080, SPI, I2C
Graphic (W/O FR)	1.54	3.9	45.24×29.14	37.05×19.51	35.05×17.51	0.274×0.274	6800, 8080, 4-wire, SPI, I2C
Graphic (W/O FR)	1.50	3.8	33.80×36.50	28.86×28.86	26.86×26.86	0.21×0.21	6800, 8080, SPI, I2C
Graphic (W/O FR)	1.18	3.0	36.98×41.23	32.00×32.00	30.00×30.00	0.23×0.23	6800, 8080, SPI, I2C

OLED Display Module – TAB

Type	Size (")	Size (cm)	Outline (mm)	View Area (mm)	Active Area (mm)	Pixel Pitch (mm)	Interface
Graphic (W/O FR)	2.80	7.1	84.00×25.80	71.10×19.26	69.10×17.26	0.27×0.27	6800, 8080, SPI
Graphic (W/O FR)	3.12	7.9	88.00×27.80	78.78×21.18	76.78×19.18	0.30×0.30	6800, 8080, SPI
Graphic (W/O FR)	5.50	14.0	146.00×45.00	137.65×35.89	135.65×33.89	0.53×0.53	6800, 8080, SPI

GEN4-HMI Intelligent Displays	WORKSHOP4-IDE	Intelligent Displays for ARDUINO	Primary Displays for RASPBERRY PI & ASUS Tinker Board
Powerful, Sleek, Standalone. Rapid Application development for Fast Time-to-market	Software development suite 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

Global Leaders in the Design and Development of Intelligent Graphic Solutions

4D SYSTEMS
TURNING TECHNOLOGY INTO ART

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 trouble-shooting.

Never Doubt Quality

ISO 9001 - certified production factories deliver the most secure supply chain in display solutions.

gen4 HMI Display Modules Picaso Series

2.4"-3.2" | 240x320 px | ~150 cd/m²
5V Adaptors: Arduino, Raspberry Pi & ASUS

gen4 HMI Display Modules Diablo16 Series

2.4"-7.0" | 320x240 - 800x480 px
5V Adaptors: Arduino, Raspberry Pi & ASUS

microLCD Display Modules

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

Integrated Display Solutions

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

Wifi Display Solutions

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

gen4-IoD Display Modules

2.4"-3.2" | 320x240 px | 128 Kb RAM
5V Resistive Touch Displays

Primary Displays for Raspberry Pi

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

Primary Displ. for ASUS Tinker Board

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.

4 wire resistive		4 wire Glas / Glas		5 wire resistive	
Inch	cm	Inch	cm	Inch	cm
2.9 - 4	7.4 - 10.2	5	12.7	6.5	16.2
4.3	11	5.7	14.5	7	17.8
5.7	14.5	7	17.8	8.4	21.4
6.4	16.3	8.4	21.3	10.4	26.4
7	17.8	10.4	24.5	12.1	30.7
7.5	19	12.4	30.7	15	38.1
8	20.3	15.1	38.5	17	43.2
8.4	21.3	17.1	43.5	19	48.3
10.4	26.5	Available as clear type, and as AG/AR type		20.1	51
12.1	30.8			22	55.9
15	38.1			24	61
17	43.2			USB Controller: ETP-MB-5000UECG RS-232 Contr.: ETP-MB-5000RECG	
19	48.3				
USB Controller: HT-EBU4-3 RS-232 Contr.: HT-EBS4-2					

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.

Cap. Touch		SAW-Touch		IR Touch	
Inch	cm	Inch	cm	Inch	cm
5.8	14.7	8.4	21.4	15	38.1
6.8	17.3	10.4	26.4	17	43.2
7.3	18.5	12.1	30.8	19	48.3
8.5	21.6	15	38.1	32	81.3
10.8	27.4	17	43.2	42	106.7
12.4	31.5	19	48.3	Options: AG / AR, 6mm Glas	
15.7	39.9	21	53.3		
17.5	44.5	22	55.9		
19.4	49.3	Controller: HAT-EBUS-2 Options: clear, AG or AR and antivandalism type			
22.4	56.9				
26.3	66.8				
31.8	80.8				
Controller: C-3100					

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.

Proj. Cap. Touch	
Inch	cm
5.7	15.5
6.5	16.4
7 wide	17.8
8.4	21.3
9 wide	23
10.4	26.4
12.1	30.8
15	38.1
17	43.2
19	48.3
22 wide	55.9
Controller USB/RS232 available	

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

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.

Technology	Dot Color / Background	Features
TN, HTN	black / grey optional other	TN (Twisted Nematic) / HTN (Higher Twisted Nematic) is the most cost-effective technology
STN / grey, silver, blue	dark blue / yellow green	STN (Super Twisted Nematic) twisting angle up to 270° which gives almost ideal steepness of the characteristic optoelectronic curves improvement of the viewing angle
FSTN	black / white	FSTN (Film Super Twisted Nematic) high-contrast black and white representation by utilization of a decelerating film more cost-effective, lighter and flatter than DSTN
Vertical Alignment	Optional / black	VA, super black background, super wide viewing angle, high contrast ratio
FSC	Optional / positive, negative	FSC (Field Sequential Colour) No need of colour filter, low power consumption
FFSTN	black / white negative	FFSTN (Double Film Super Twisted Nematic) high-contrast black and white negative mode display optimal performance with white or multicolor backlights more cost-effective, lighter and flatter than DSTN ISTN for best contrast through the whole temp. range
CSTN	color	FSTN with color filter mask (passive matrix) passive driven not matrix white LED or CCFL illumination
ASTN	color/dark	compensation retardation film, low transmittance & high contrast
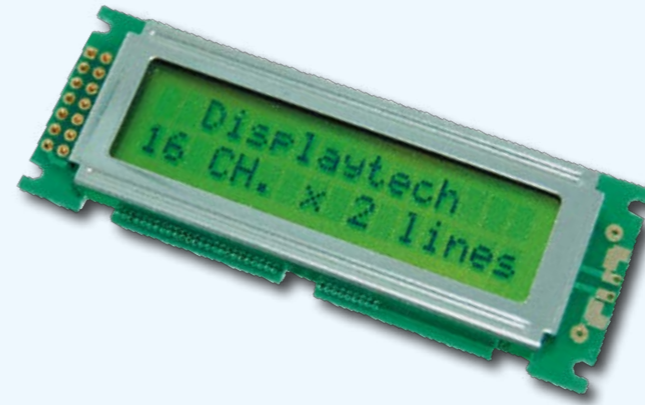
TN (Twisted Nematic) Displays

STN, Yellow-Green

STN, Blue mode
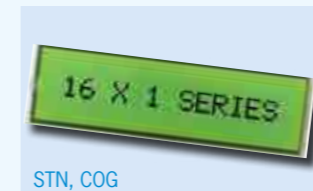
FSTN, positive, white Backlight

FSC (Field Sequential Colour)

FSTN, graphic LCD, RGB Backlight with FPC Connection

Vertical Alignment with different backlights

FSTN with green backlight

STN yellow-green, positive

STN, COG

STN blue mode, positive, white Backlight

FSTN, negative, white Backlight

STN yellow-green, positive, yellow-green Backlight

FSTN, negative, blue Backlight

LCD Standard Modules

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 fulfil 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

Characters x Lines	Model Number	Module Size W x H [mm]	View. Area W x H [mm]
16 x 1	161A	80.0 x 36.0	64.5 x 13.8
16 x 2	162A	80.0 x 36.0	64.5 x 13.8
16 x 2	162B	84.0 x 44.0	65.6 x 16.0
16 x 2	162C	80.0 x 36.0	64.5 x 14.8
16 x 2	162COG	66.0 x 27.7	61.0 x 15.7
16 x 2	162D	85.0 x 30.0	62.0 x 16.0
16 x 2	162E	80.0 x 36.0	65.6 x 16.0
16 x 2	162F	122.0 x 44.0	99.0 x 24.0
16 x 4	164A	87.0 x 60.0	61.8 x 25.2
20 x 2	202A	116.0 x 37.0	85.0 x 19.8
20 x 2	202B	122.0 x 44.0	99.0 x 24.0
20 x 4	204A	98.0 x 60.0	76.0 x 25.2
20 x 4	204B	98.0 x 60.0	76.0 x 25.2
24 x 2	242A	118.0 x 36.0	93.5 x 15.8
40 x 2	402A	182.0 x 33.5	154.5 x 15.8

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

Passive LCD Modules from Displaytech

Dots / Diagonal Size	Model Number	Module Size W x H [mm]	View. Area W x H [mm]
122 x 32	32122A	65.6 x 29.2	54.8 x 19.1
122 x 32	32122B	56.1 x 29.2	49.1 x 19.0
128 x 32	32128A	41.3 x 19.7	36.1 x 9.9
160 x 32	32160A	100.0 x 38.8	80.0 x 20.5
128 x 64	64128K	58.2 x 41.7	50.0 x 25.0
128 x 64	64128KX	58.2 x 41.7	50.0 x 25.0
128 x 64	64128L	68.8 x 49.2	60.6 x 33.1
128 x 64	64128LX	68.8 x 49.2	60.6 x 33.1
128 x 64	64128M	77.4 x 52.4	70.0 x 40.0
128 x 64	64128MX	77.4 x 52.4	70.0 x 40.0
128 x 64	64128N	74.0 x 41.7	50.0 x 25.0
128 x 64	64128P	93.0 x 70.0	70.7 x 38.8
128 x 64	64128Q	75.0 x 52.7	60.0 x 32.5
240 x 64	64240B	180.0 x 65.0	132.6 x 39.0
240 x 64	64240C	144.9 x 56.4	132.6 x 39.0
320 x 240 3.9" QVGA	240320E	91.5 x 70.5	80.55 x 61.1
320 x 240	240320FP	91.4 x 109.7	100.0 x 76.0
320 x 240 4.7" QVGA	240320G	109.7 x 91.4	100.0 x 76.0
320 x 240 3.9" QVGA	240320H	9.0 x 70.5	80.5 x 61.1
320 x 240	240320JP	70.5 x 91.5	61.1 x 80.55
240 x 128	128240A	144.0 x 104.0	114.0 x 64.0
240 x 128	128240C	77.4 x 52.4	70.0 x 35.0
240 x 128	128240D	98.7 x 67.7	92.0 x 53.0

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.

FSTN, graphic LCD, positive mode, reflective

FSTN, graphic LCD, negative mode, RGB backlight

FSTN, graphic LCD, blue mode, white backlight

FSTN, graphic LCD, negative mode, white backlight

STN, grey mode, white backlight

FSTN, graphic LCD, RGB backlight

FSTN, graphic LCD, blue mode, white backlight

FSTN, graphic LCD, amber backlight

Custom Design LCD Modules

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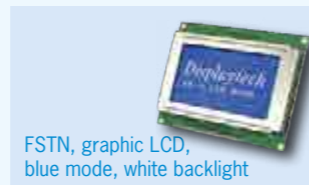Customized displays are manufactured according to the specification of our customers. Depending up on the size of the LCD panel and the LCD technology a reasonable minimum order quantity is required.

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 print circuit (FPC). TIANMA contributes solutions to the markets burgeoning demand for chip on glass (COG) technology.

Field Sequential Color (FSC)
With the new FSC-Technology there is no need to insert color filters to portray the colored Icons. In a FSC module a conventional TN-Cell is combined with a RGB Backlight. The 3 colors of the LED Backlight are sequentially switched on.
The frequency of the backlight is synchronous with the frequency of the display segments. As a result you can show up to 8 different colors (black, blue, green, cyan, red, magenta, yellow or white).

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

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
- Suitable for all kinds of color backlight and white backlight
- Wide temperature range (-30 °C to 85 °C)

Display Accessories
Rutronik is also able to supply different accessories for your LCDs from selected suppliers, as well as integration of turn key components.
It is possible to add other components like keys, LED or special connectors to a custom design LCD module.
With these options Rutronik and its partners can offer the complete solution to customers.

Connectors	Backlight	Bezel	Touchpanel
Rubber	LED	Plastic	Resistive
Connector	CFL	Metal	
Pins	EL		
FPC			
Heatseal			
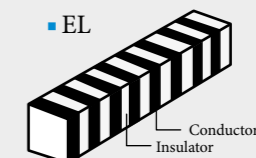
Conductor
Insulator

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-life-time, beginning from the first drawings up to the first samples producion and final mass producion.

EBN
OFF   ON
AC
Electric
Feld
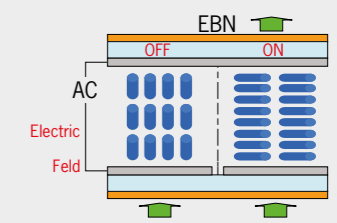
Visual Solutions

![SHARP]

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.

PN-40TC1
- BIG PAD for Huddle Office Meeting Spaces and Interactive Retail Signage
- 40" (100.33 cm) size with 1920 x 1080 pixels
- Fast and Responsive PCAP Capacitive 10 point Touch - up to 4 users
- Mini OPS Slot for flexible enhancement
- Sharp Pen Software for intuitive writing, drawing and annotation
- Sharp Touch Viewing Software for organising collaboration data
- Sharp Display Connect for latest BYOD wireless collaboration

Windows Collaboration Display
- Certified for Skype for Business and supported by Microsoft teams
- Integrated microphone, speakers and high-quality camera
- Seamless operation and conferencing with Microsoft Office 365
- Fast 'Plug and play' with single 8 m USB-C connector
- Brilliant eye-catching 4K image content
- Elegant edge to edge highly responsive PCAP 10-point touch
- Smart building management using the data from the IoT sensor hub

PN-86HC1
- 4K BIG PAD for Education, Training and Meeting Rooms
- 86" (217.4 cm) size with 3840 x 2160 pixels
- Fast Infrared (IR) 20 point touch
- Two built-in (10W) stereo loudspeakers which clearly and effectively fill larger rooms
- Integrated SoC Controller player for PC-less Whiteboarding and Media playback
- OPS slot for optional function enhancement
- Provides a natural 'Pen-on-Paper' experience using a passive pen or finger
- Intuitive control with full bezel button controls and on screen touch menu

Professional Monitors

![SHARP]

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!

PN-R706
- 70" (176.6 cm) display for professional 24/7 signage
- 1920 x 1080 pixels with 700 cd/m^2
- Flexible installation with Mini-OPS extension slot
- Contrast 5,000:1
- LED, Edge Lit
- Slim Bezel design with Speakers 10 W + 10 W
- Portrait, Landscape, Face-Up installation support
- Sharp UV^{2}A Display Technology

PN-M501
- 50" (125.7 cm) display for professional 24/7 signage
- 1920 x 1080 pixels with 450 cd/m^2
- Powerful and flexible stand-alone operation with embedded Android SoC
- Flexible performance upgrade with Mini-OPS Extension Slot
- Portrait, Landscape, Face-Up and Face-Down installation support
- Slim Bezel Design with speakers 7 W + 7 W
- Sharp e-Signage S player pre-installed on Android SoC

PN-HW861
- Make a bigger impact with the 86" display
- Showcase images and video in detail with 4K Ultra HD resolution (3840 x 2160 pixels)
- Enhanced and true representation of colour
- Continous display of content during business hours 16/7
- Show and hear content easily with integrated 4K USB media player and speakers
- Latest HDMI connectivity for 4 K at 60 Hz
- Slim, sleek and elegant design to suit any setting
- Flexible installation in portrait and landscape

RUTRONIK EMBEDDED

Linecard Sensors

Appealing to All Senses

MEMS · Optical · Sensor Modules · Humidity · Acceleration · Reflective · Proximity · Current · Microwave · Ambient Light · Magnetic · X-Ray Modules · Air-Flow · Hall Linear · Transmissive · Magneto-Resistive · Hall Switch · Pressure · Multi Island ICs · Temperature · Gyro · Shunt Members · Gas · Feel

BOSCH · BYD · COMUS · DIODES INCORPORATED · EPSON EXCEED YOUR VISION · EVERLIGHT · Infineon · LITEON · Melexis · muRata INNOVATOR IN ELECTRONICS · JRC · OMRON · OSRAM Opto Semiconductors · Panasonic · ROHM SEMICONDUCTOR · SENSIRION THE SENSOR COMPANY · ST life.augmented · TDK · TOSHIBA · VISHAY

Rutronik – THE Sensor Distributor

This is our self-conception when it comes to sensors. An industry leading sensor portfolio combined by state of the art products and an exemplified solution selling approach makes it easy for you to realize your sensing application. Let's go and appeal to all senses.

Sensor Products	Bosch AE	Bosch Sensortec	BYD	Comus	Diodes	Epson	Everlight	Infineon	LiteOn	Melexis	Murata	NJRC	Omron	Osram	Panasonic	Rohm	Sensirion	ST	TDK Micronas	Toshiba	Vishay	Sensor Products
MEMS																						**MEMS**
Absolute Orientation		I																I				Absolute Orientation
Acceleration	A I					I					I					I		A I				Acceleration
eCompass		I														I		I				eCompass
Gyroscope	A I	I				I					I					I		A I				Gyroscope
IMU (Acceleration + Gyro)	A I	I				I					I					I		I				IMU (Acceleration + Gyro)
Microphone								I				I						I				Microphone
Environmental																						**Environmental**
Air-Flow													I				I					Air-Flow
Gas		I									I						I					Gas
Humidity		I															A I	I				Humidity
Pressure	A I	I				I			A I	A	I		I		I	I	I	I				Pressure
Temperature		I														I	I	I			A I	Temperature
Particulate Matter													I				I					Particulate Matter
Optical																						**Optical**
Ambient Light							I		I				A I	A I		I					A I	Ambient Light
Camera Modules			I										I					I				Camera Modules
Far Infrared/Infrared							I			A I			A I	A I	I						A I	Far Infrared / Infrared
Fingerprint			I																			Fingerprint
Image			I																	I		Image
Proximity				I			A I		A I					A I		I		A I			A I	Proximity
Radar								A I				I										Radar
Reflective							I		I			A I	I	A I		I					I	Reflective
Time-of-flight							A I		A I									A I				Time-of-flight
Transmissive							I		I				I	A I						A I		Transmissive
Ultrasonic				I							I											Ultrasonic
Magnetic																						**Magnetic**
Geomagnetic		I																I				Geomagnetic
Hall Linear — non programmable					I			A I		A I									A I		I	Hall Linear — non programmable
Hall Linear — programmable								A I		A I									A I			Hall Linear — programmable
Hall Switch — single					A I			A I		A I					A I	A I			A I	A I		Hall Switch — single
Hall Switch — dual					I			A I		A I												Hall Switch — dual
Hall Switch — speed								A I		A I												Hall Switch — speed
Hall Switch — programmable					I			A I		A I									A I			Hall Switch — programmable
Magnetoresistive — switch											I											Magnetoresistive — switch
Magnetoresistive — 3D switch											I											Magnetoresistive — 3D switch
Magnetoresistive — linear								A I														Magnetoresistive — linear
Magnetoresistive — 2D sensor								A I											A I			Magnetoresistive — 2D sensor
Multiaxis Hall								A I		A I									A I			Multiaxis Hall
TMR								A I											A I			TMR
Current																						**Current**
Hall based ICs							I			A I									A I			Hall based ICs
Sensor Modules			I																			Sensor Modules

A Automotive qualified preferred   I Industrial

Motion Sensors

Bosch Sensortec – At the Core of Everyday Life

Our portfolio of motion sensors includes products for motion, orientation and gesture detection. Motion sensors are designed for several consumer electronics and IoT applications in the field of smartphones, wearables, smart home, drones, toys, virtual and augmented reality, gaming, as well as industrial applications.
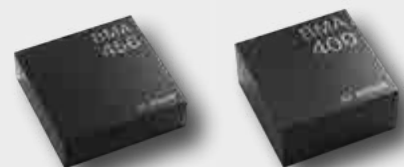
Sensing our world

Accelerometers

Part Number	Sensing Range (g)	Sensing Axis	Sensitivity (LSB/g)	Output Interface	Bandwidths (Hz)	Supply Voltage (V)	Supply Current (mA)	Operating Temp. (°C)	Package Type/ Size (mm)
BMA253	±2, ±4, ±8, ±16	X, Y, Z	1024, 512, 256, 128	SPI, I²C, 2 digital interrupt pins	8 to 1000	V_{DD}: 1.62 to 3.6 V_{DDIO}: 1.2 to 3.6	6.5 µA @40 Hz data rate (low-power mode) 130 µA @2kHz data rate (full operation)	-40 to +85	2.0x2.0x0.95
BMA280	±2, ±4, ±8, ±16	X, Y, Z	4096, 2048, 1024, 512	SPI, I²C, 2 digital interrupt pins	8 to 500	V_{DD}: 1.62 to 3.6 V_{DDIO}: 1.2 to 3.6	6.5 µA @40 Hz data rate (low-power mode) 130µA @2kHz data rate (full operation)	-40 to +85	2.0x2.0x0.95
BMA400	±2, ±4, ±8, ±16	X, Y, Z	1024, 512, 256, 128	SPI, I²C, 2 digital interrupt pins	0.24xODR or 0.48xODR (ODR from 12.5...800)	V_{DD}: 1.71 to 3.6 V_{DDIO}: 1.2 to 3.6	14 µA (max. performance) < 8 µA (typical use case) < 4 µA Independant of ODR (lower power mode)	-40 to +85	2.0x2.0x0.95
BMA423	±2, ±4, ±8, ±16	X, Y, Z	1024, 512, 256, 128	SPI, I²C, 2 digital interrupt pins	1.5 to 1600	V_{DD}: 1.62 to 3.6 V_{DDIO}: 1.2 to 3.6	13 µA @50 Hz data rate (low-power mode) 150 µA (full operation)	-40 to +85	2.0x2.0x0.95
BMA456	±2, ±4, ±8, ±16	X, Y, Z	16384, 8192, 4096, 2048	SPI, I²C, 2 digital interrupt pins	5 to 684 (ODR: 0.8 to 1600)	V_{DD}: 1.62 to 3.6 V_{DDIO}: 1.2 to 3.6	13 µA @50 Hz data rate (low-power mode) 150 µA (full operation)	-40 to +85	2.0x2.0x0.65

Gyroscopes

Part Number	Sensing Range (°/s)	Sensing Axis	Output Interface	Zero Rate Output (°/s)	Turn On Time (ms)	Supply Voltage (V)	Supply Current (mA)	Operating Temp. (°C)	Package Type/ Size (mm)
BMG250	±125, ±250, ±500, ±1000, ±2000	X, Y, Z	for primary UI IF: I²C up to 1Mhz 3w/4w SPI 2x digital interrupts for secondary OIS/EIS IF: 3w SPI up to 10MHz	±3	Suspend to normal mode 55 ms (typical) Fast start-up to normal mode 10 ms (typical)	V_{DDIO} 1.2 to 3.6 V_{DD} 1.7 to 3.6	Full operation 850 µA Suspend mode 3 µA Fast start-up 500 µA	-40 to +85	2.5x3.0x0.8

Sensing our world

Inertial Measurement Units

Part Number	Output Interface	Sensing Range	Sensing Axis	Supply Voltage (V)	Supply Current (mA)	Operating Temp. (°C)	Package Type/ Size (mm)
BMI055	I²C, SPI, 4x digital interrupts	(A): ± 2 g, ± 4 g, ± 8 g, ± 16 g (G): ± 125°/s, ± 250°/s, ± 500°/s, ± 1000°/s, ± 2000°/s	6-axis	V_{DD}: 2.4 to 3.6 V_{DDIO}: 1.2 to 3.6	Full operation: 5.15 mA Suspend mode: 6 µA	-40 to +85	3.0x4.5x0.95
BMI085	I²C, SPI, 4x digital interrupts	(A): ± 2 g, ± 4 g, ± 8 g, ± 16 g (G): ± 125°/s, ± 250°/s, ± 500°/s, ± 1000°/s, ± 2000°/s	6-axis	V_{DD}: 2.4 to 3.6 V_{DDIO}: 1.2 to 3.6	5.15 mA	-40 to +85	3.0x4.5x0.95
BMI088	I²C, SPI, 4x digital interrupts	(A): ± 3 g, ± 6 g, ± 12 g, ± 24 g (G): ± 125°/s, ± 250°/s, ± 500°/s, ± 1000°/s, ± 2000°/s	6-axis	V_{DD}: 2.4 to 3.6 V_{DDIO}: 1.2 to 3.6	5.15 mA	-40 to +85	3.0x4.5x0.95
BMI160**	I²C, SPI, 4x digital interrupts	(A): ± 2 g, ± 4 g, ± 8 g, ± 16 g (G): ± 125°/s, ± 250°/s, ± 500°/s, ± 1000°/s, ± 2000°/s	6-axis	V_{DD}: 1.71 to 3.6 V_{DDIO}: 1.2 to 3.6	Full operation: 950 µA Suspend mode: 3 µA	-40 to +85	2.5x3.0x0.8
BMI270	SPI, 2x digital interrupts	*(A): ± 2 g, ± 4 g, ± 8 g, ± 16 g (G): ± 125°/s, ± 250°/s, ± 500°/s, ± 1000°/s, ± 2000°/s*	6-axis	V_{DD}: 1.7 to 3.6 V_{DDIO}: 1.2 to 3.6	Full operation: 685 µA Suspend mode: 5 µA	-40 to +85	2.5x3.0x0.9

Absolute Orientation Sensors

Part Number	Output Inter- face	Linear Acceleration Full Scale (g)	Angular Rate Full Scale (dps)	Magnetic Full Scale Range (gauss)	Resolution	Supply Voltage (V)	Supply Current (Acc+Mag+Gyro) (mA)	Operating Temperature (°C)	Package Type/ Size (mm)
BMX055	I²C, SPI	(A): ± 2, ± 4, ± 8, ± 16	(G): ± 125°/s, ± 250°/s, ± 500°/s, ± 1000°/s, ± 2000°/s	±1300 µT (x, y axis) ±2500 µT (z axis)	(A): 0.98 mg (G): 0.004 °/s (M): 0.3 µT	V_{DD}: 2.4 to 3.6 V_{DDIO}: 2.4 to 3.6	Gyro @ full operation: 5 mA Acc @ full operation: 130 µA Acc @ wake-up mode: < 1 0µA Magnet sensor @ 10Hz ODR: 0.5 mA	-40 to +85	3.0x4.5x0.95
BMX160	I²C, SPI	(A): ± 2, ± 4, ± 8, ± 16	(G): ± 125°/s, ± 250°/s, ± 500°/s, ± 1000°/s, ± 2000°/s	±1300 µT (x, y axis) ±2500 µT (z axis)	(A): 0.061mg (G): 0.004°/s (M): 0.3 µT	V_{DD}: 1.71 to 3.6 V_{DDIO}: 1.2 to 3.6	Gyro @ full operation: 850 µA Gyro + Acc + Geomag: 1585 µA Geomag @ full operation: 660 µA Acc @ full operation: 180 µA Suspend mode: 5 µA Significant motion: 30 µA Step detector: 30 µA	-40 to +85	2.5x3.0x0.95

Magnetometers

Part Number	Sensing Range (gauss)	Sensing Axis	Sensiti- vity (%/K)	Output Interface	Output Noise (mgauss RMS)	Supply Voltage (V)	Supply Current (µA Max)	Operating Temperature (°C)	Package Type/ Size (mm)
BMM150	±13 (x,y-axis) ±25 (z-axis)	X, Y and Z axis	± 0.01	I² C and SPI (2 interrupt pins)	x, y-axis: 1.0 µT z- axis: 1.4 µT	V_{DD}: 1.62 to 3.6 V_{DDIO}: 1.2 to 3.6	170 µA (low-power preset) 500 µA (normal mode)	-40 to +85	CSWLP- (12 pin) 1.56x1.56x0.6 0.4 mm diagonal ball pitch

(A): Accelerometer, (G): Gyro, (M): Magnetometer   ** Queexo FingerSense Compatible

# Bosch Sensortec – At the Core of Everyday Life
Smart Sensors

Our portfolio of smart sensors is specifically designed for always-on sensor applications in smartphones, wearables and tracking devices. It offers flexible, low-power solutions for motion sensing and sensor data processing.

Part Number	Integrated Processor	Software Library	Software	Output Interface	Sensing Range (g)	Bandwidth Typ (Hz)	Current Consumption (mA Typ. @100 Hz ODR)	Supply Voltage (V)	Package Type / Size (mm)
BNO055	32 bit cortex M0+ microcontroller	BSX 3.0 full fusion	n/a	I²C, UART, HID-I²C	± 2 g, ± 4 g, ± 8 g, ± 16 g	BSX3 (Fusion) output data rate: 1000, 500, 250, 125, 63, 31, 16, 8	Suspend mode: 40 µA 9DOF @ 100 Hz Output data rate: 12.3 mA	V_{DD} 2.4 to 3.6 V_{DDIO}: 1.7 to 3.6	3.8x5.2x1.13
BMF055	33 bit cortex M0+ microcontroller, 256kB flash memory and 32kB SRAM memory	BSX fusion lite as additional lib. custom programmable.	n/a	I²C, UART, HID-I²C	± 2 g, ± 4 g, ± 8 g, ± 16 g	Depends on the custom specific sensor fusion	Depends on the custom specific sensor fusion	V_{DD} 2.4 to 3.6 V_{DDIO}: 1.7 to 3.6	3.8x5.2x1.13
BHA250	32 bit floating-point ARC EM4 MCU running @ 10 MHz 1.6 DMIPS/MHz performance, 3.41 CoreMarks/MHz 96 kByte ROM, 48 kByte RAM shared RAM for FIFO, features & extensions optimized for ultra-low-power sensor data fusion	BSX 3.0 fusion activity recognition, gesture recognition step detector, step counter	n/a	I²C up to 3.4 MBit/s 3xGPIO, 1xHost-INT	± 2 g, ± 4 g, ± 8 g, ± 16 g	BSX3 (Fusion) output data rate: 200, 100, 50, 25, 12.5	• eCompass @ 100 Hz ODR: 630 µA • Hub+Acc @ 100 Hz ODR: 430 µA • Activity recognition: 200 µA • Significant motion: 100 µA • Step detector: 100 µA • Suspend mode: 11 µA	V_{DD}: 1.71 to 3.6 V_{DDIO}: 1.2 to 3.6	2.2x2.2x0.95
BHA260 (upcoming)	32 bit floating-point ARC EM4 CPU with (up to 3.6 CoreMark/MHz) 256 kByte SRAM, 144 kByte ROM	BSX 4.0 fusion activity recognition, gesture recognition step detector, step counter custom programmable	n/a	• Host interface configurable as SPI or I²C • 2 master interfaces (1 selectable SPI/I²C and 1 I²C) • Up to 12 GPIOs	± 2 g, ± 4 g, ± 8 g, ± 16 g	BSX4 (Fusion) output data rate: 800, 400, 200, 100, 50, 25, 12.5, 6.25, 3.125, 1.5625	Fuser2 (running CoreMark) • long run mode (20 MHz): 950 µA • turbo mode (50 MHz): 2.8 mA Sensor algorithm oepration (incl. Sensor) • significant motion: 32 µA • step counter: 46 µA • activity recognition: 77 µA • Standby current: 8 µA	1.8	2.7x2.6x0.8
BHI160	32 bit floating-point ARC EM4 MCU running @ 10 MHz 96 kByte ROM, 48 kByte RAM	BSX 3.0 fusion activity recognition, gesture recognition step detector, step counter	n/a	I²C up to 3.4 MBit/s 3xGPIO, 1xHost-INT	(A): ± 2 g, ± 4 g, ± 8 g, ± 16 g (G): ± 125°/s, ± 250°/s, ± 500°/s, ± 1000°/s, ± 2000°/s	BSX3 (Fusion) output data rate: 200, 100, 50, 25, 12.5	• full 6DoF PDR: 1.3 mA • full 6DoF Fusion @ 100 Hz ODR: 1.2 mA • full 9DoF Fusion @ 100 Hz ODR: 1.3 mA • significant motion: 128 µA • step detector: 131 µA • suspend mode: 11 µA	V_{DD}: 1.71 to 3.6 V_{DDIO}: 1.2 to 3.6	3.0x3.0x0.95
BHI260 (upcoming)	32 bit floating-point ARC EM4 CPU with (up to 3.6 CoreMark/MHz) 256 kByte SRAM, 144 kByte ROM	BSX 4.0 fusion activity recognition, gesture recognition step detector, step counter custom programmable	n/a	• Host interface configurable as SPI or I²C • 3 master interfaces (selectable out of 2xSPI master and 2xI²C master) • Up to 25 GPIOs	(A): ± 2 g, ± 4 g, ± 8 g, ± 16 g (G): ± 125°/s, ± 250°/s, ± 500°/s, ± 1000°/s, ± 2000°/s	BSX4 (Fusion) output data rate: 800, 400, 200, 100, 50, 25, 12.5, 6.25, 3.125, 1.5625	Fuser2 (running COreMark) • long run mode (20 MHz): 950 µA • turbo mode (50 MHz): 2.8 mA Sensor Fusion (Hub+IMU) operation (calculating Game Rotation Vector) • 800 Hz ODR: 1.2 mA • 100 Hz ODR: 1.0 mA • Standby current: 8 µA	1.8	4.1x3.6x0.83

(A): Accelerometer, (G): Gyro, (M): Magnetometer
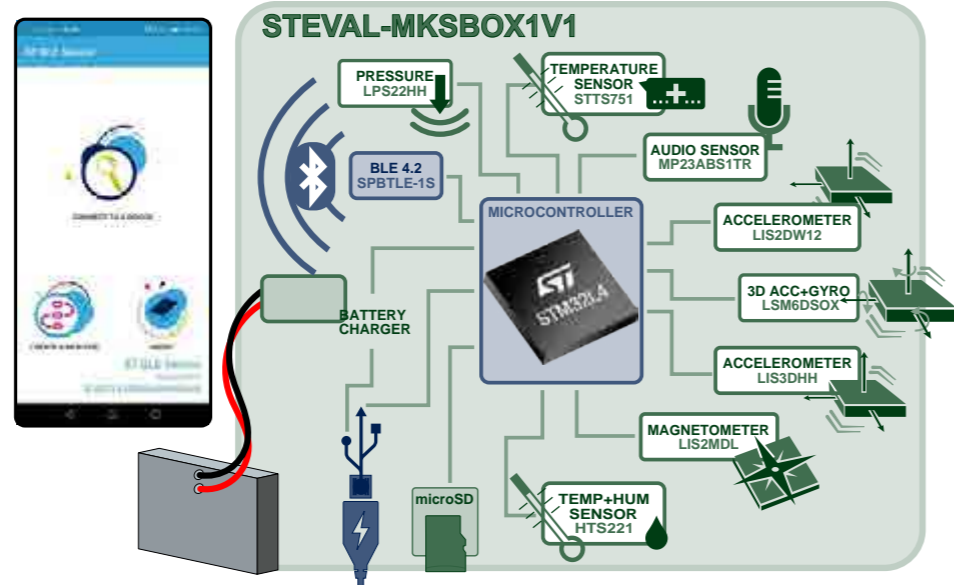
STEVAL-MKSBOX1V1

SensorTile.Box
STEVAL-MKSBOX1V1

The STEVAL-MKSBOX1V1 (SensorTile.box) is a ready-to-use box kit with wireless IoT and wearable sensor platform to help you use and develop apps based on remote motion and environmental sensor data, regardless of your level of expertise.

The SensorTile.Box board fits into a small plastic box with a long-life rechargeable battery, and the ST BLE sensor app on your smartphone connects via bluetooth to the board and allows you to immediately begin using the wide range of default IoT and wearable sensor applications.
In expert mode, you can build customs apps from your selection of SensorTile.Box sensors, operating parameters, data and output types, and special functions and algorithms available. This multi sensor kit therefore allows you to design wireless IoT and wearable sensor applications quickly and easily, without performing any programming.

SensorTile.Box includes a firmware programming and debugging interface that allows professional developers to engage in more complex firmware code development using the STM32 open development environment (STM32 ODE), which includes a sensing AI function pack with neural network libraries.

Description	Type
Low-voltage local digital temperature sensor	STTS751
iNEMO 6DoF inertial module	LSM6DSOX
3-axis MEMS accelerometer	LIS2DW12
3-axis digital output accelerometer	LIS3DHH
Digital 3-axis magnetometer	LIS2MDL
Digital nano pressure sensor	LPS22HH
MEMS analog bottomport microphone	MP23ABS1
Digital sensor for relative humidity and temperature	HTS221
Bluetooth smart connectivity v4.2	(SPBTLE-1S)
Programming and debugging interface for professional firmware development	Other

You can download the free ST BLE sensor app on your smartphone and almost immediately begin commanding the board with any of the following applications with ST high-precision sensors on the board:

- **Barometer app**
  allows you to configure the STTS751 temperature, LPS22HH pressure and HTS221. Humidity sensors to monitor environmental information in real time on your smartphone, or collect and graph the data against time on a plot screen.
- **Compass and level app**
  allows you to configure the LSM6DSOX accelerometer and gyroscope and LIS2MDL magnetometer sensors to monitor real time bearing and inclination sensor feedback data and plot the information over time.
- **Step counter app**
  allows you to configure the LSM6DSOX accelerometer to monitor you walking and running speeds and plot the information over time.
- **Baby crying app**
  allows you to configure the MP23ABS1 microphone sensor to detect human voice events such as a baby crying and send an alert to your smartphone as well as activate a LED on the sensor board.
- **Vibration monitoring app**
  allows you to configure the LSM6DSOX accelerometer and set up your board to "learn" the normal operation of motorized domestic or industrial equipment, and then monitor the same equipment for anomalous vibration for predictive maintenance purposes.
- **Data recorder and vehicle/goods tracking app**
  allows you to select and configure appropriate environmental and motion sensors to log the transportation and storage conditions that selected merchandise is subject to over time.
- **Compensated magnetometer app**
  allows you to build additional apps from the magnetometer output and a sensor fusion algorithm to compensate for disturbances from external magnetic-fields

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MEMS Sensors for Smart Industry 4.0
High-Performance & Ultra-Low-Power Sensing Solutions

ST's broad range of sensors includes 3-axis miniaturized accelerometers, 6-axis inertial modules, magnetometers/eCompass and pressure sensors. Scalable modules with up to 6-axis (3-axis accelerometer + 3-axis gyroscope or 3-axis magnetic, 3-axis magnetic, 1 pressure or temperature) with drivers as well as ST's open.

Key Applications
- Predictive maintenance and early failure detection
- Industrial IoT and connected devices
- Robotics, automation and drones
- Power saving and motion-activated functions
- Inertial navigational systems and motion tracking
- Antenna and platform pointing, leveling and stabilization
- Precision inclinometer and leveling instruments
- Appliances
- Optical image and lens stabilization
- Anti-tampering in smart meters
- Positional and distance sensor
- Presence detection, magnetic switch
- Variable magnetic-field monitoring
- Asset and parcel tracking, monitoring and shock detection and logging
- Building and structure monitoring

Benefits of 10-Year Product Longevity Commitment Program

Part No.	Description	Key Parameters	Package
IISDWB	Ultra-wide bandwidth, low-noise 3-axis digital accelerometer	• User-selectable full-scale: ±2/±4/±8/±16 g • Ultra-wide and flat frequency response range: from dc to 5 kHz ±3 dB point) • Ultra-low-noise density: down to 90 µg/√Hz in 3-axis mode /IIS3DWB 65 µg/√Hz in singleaxis mode	LGA-14L 2.5x3x0.83 mm
IIS2DH	3-axis accelerometer with digital output	3 µA consumption at 10Hz ODR; 185 µA consumption at wide bandwidth and ODR 5.3 Khz	LGA-12L 2.0x2.0x1 mm
IIS2DLPC	Ultra-low-power high-performance three-axis linear accelerometer with digital I²C/SPI output interface	• ±2g/±4g/±8g/±16g full scale • Ultra-low power consumption: 50 nA in power-down mode, below 1 µA in active low-power mode, 120 µA in high-performance mode • 10000 g high shock survivability	LGA 12L 2x2x0.7 mm
ISM330DHCX	System-in-package featuring a high-performance 3D digital accelerometer and 3D digital gyroscope tailored for Industry 4.0 applications.	• accelerometer with selectable full scale: ±2/±4/±8/±16 g • 3D gyroscope with extended selectable full scale: ±125/±250/±500/±1000/±2000/±4000 dps • Machine learning core and smart embedded functions and interrupts: tilt detection, free-fall, wake-up, 6D/4D orientation, click and double-click and high shock survivability	LGA 14L 2.5X3X.83 mm
ISM330DLC	iNEMO inertial module: 3-axis accelerometer and 3-axis gyroscope	Rate noise density in high-performance mode (HPM) Gyroscope: 3.8 mdps/√Hz; Accelerometer: 90 µg/√Hz	LGA-14L 2.5x3x0.83 mm
IIS3DHHC	High-performance 3-axis inclinometer with digital output	Meas. range: FS ± 2.5 g offset change with temp <0.4 mg/C Noise density: 45 µg/√Hz	CC LGA-16 5x5x1.7 mm Ceramic
IIS2MDC	High-accuracy, ultra-low-power, 3-axis: Digital output magnetometer	± 50 gauss magnetic dynamic range. 3 magnetic-field channels noise 3mGauss (rms)	LGA-12 2.0x2.0x0.7 mm
ISM303DAC	eCompass 3-axis magnetometer+3axis accelerometer High-performance, low-power, compact	3-axis mag. FS ±50Ga and 3-axis axl FS ±16g High-resolution, high-frequency and low-power modes	LGA-12L 2.0x2.0x1 mm

iNEMO

iNEMO-Inertial Modules

iNEMO inertial modules are inertial measurement units (IMU) which integrate complementary types of sensors to offer more compact, robust, and easy-to-assemble solutions compared to discrete MEMS products.
iNEMO System-in-packages (SiP) combine accelerometer, gyroscope and magnetometer in a monolithic 6-axis or 9-axis solution. The integration of multiple sensor outputs bring motion sensing systems to the level of accuracy required for the most demanding applications, such as enhanced gesture recognition, gaming, augmented reality, indoor navigation and localization-based services.
To further save power at system level, ST have designed iNEMO inertial modules with an embedded machine learning core. The MLC runs an in-sensor classification engine, offloading the main processor to either run different tasks or to be put to sleep and save power, while the built-in sensors identify motion data.

LSM6DSOX – Motion Sensor with Machine Learning for High-Accuracy, Battery-Friendly Activity Tracking

The LSM6DSOX is a system-inpackage IMU featuring a 3D digital accelerometer and a 3D digital gyroscope boosting performance and enabling always-on low-power features for an optimal motion estimation and user experience.
The LSM6DSOX contains a decision-tree and a machine learning core to classify motion data based on known patterns. Relieving this first stage of activity tracking from the main processor saves energy and accelerates motion-based apps such as fitness logging, wellness monitoring, personal navigation and fall detection.

Features
- Machine learning core (MLC) for advanced motion recognition and classification
- Finite state machine (FSM) for up to 16 custom movement recognition in low-power mode
- Dedicated OIS or control core with AUX interface
- I3C interface
- Data acquisition from up to 4 external sensors (sensor hub)
- High-accuracy, HW configurable, step counter 2.0
- Up to 9kB FIFO sensor data in compressed mode (3.5 kB uncompressed)

Applications
- Motion tracking and gesture detection
- Sensor hub
- Indoor navigation
- IoT and connected devices
- Smart power saving for battery-operated devices
- EIS and OIS for camera applications:
- Forklift/robots and machine control
- Vibration monitoring and compensation

Motion Sensors

Accelerometers

ST's state-of-the-art MEMS accelerometers include analog and digital sensors featuring up to ±400 g acceleration full scale and from 1.71 to 3.6 V supply voltage. Accelerometers have advanced power-saving features that make them suitable for ultra-low-power applications. These features include low-power mode, auto wake-up function and a FIFO buffer that can be used to store data, thus reducing the host processor loading and system power consumption. The small size and embedded features of ST's accelerometers make them an ideal choice for wearable applications and where long battery life is required.

Features
- Low-power consumption and smart ultra-low-power operating modes including always-on
- High-resolution: accuracy and stability
- Smart embedded features for less power hungry systems
- Ultra compact devices in packages smaller than 4 mm^3
- Selectable full-scale up to 16 g
- Advanced digital features
- Pin-to-pin compatible product family

Part Number	Description	Power cons. in PD Low-Power Mode Normal Mode (µA)	Key Parameters	Package Size (mm)
LIS2DW12	3-axis accelerometer, 12 to 14 bit resolution	0.05 0.38 @1.6Hz, 3 / 16 @50Hz 120 in HPM @50Hz	32-level, FIFO, self test, temp sensor, high-resolution very low-power	LGA-12, 2x2x0.7
LIS2DH12	3-axis accelerometer, 8 to 12 bit resolution	0.5 2 @1Hz, 6 @ 50Hz, 11 @50Hz	32-level, FIFO, self test, temp sensor, 12-bit resolution, low-power, cost-effective	LGA-12, 2x2x1
LIS2DE12	3-axis accelerometer, 8 bit resolution	0.5 2 @1Hz, 6 @50Hz	32-level, FIFO, self test, temp sensor, 8 bit resolution, low-power	LGA-12, 2x2x1

Digital Compasses

ST's digital compasses include combo solutions, with an accelerometer and magnetic sensor integrated in a single LGA package and standalone magnetometer, to give the possibility of designing a solution locating the magnetic sensor in the best position on the board in order to minimize magnetic interference.

Features
- Ultra-compact high-performance magnetometer module
- Wide magnetic sensor dynamic range and ultra-low magnetic offset
- Pin-to-pin compatible product family
- Embedded self test and temp. compensated

Part Number	Full Scale	Noise Density (Typ.)	Package Size (mm)	Key Features
LSM303AGR	2, ±4, ±8, ±16 g, ±50 gauss	220 µg/√Hz, 3 mgauss	LGA-12, 2x2x1	Ultra-low-power, high-perform., 3D digital accelerator sensor and 3D digital magnetic sensor
LSM303AH	±2, ±4, ±8, ±16 g, ±50 gauss	120 µg/√Hz, 3 mgauss	LGA-12, 2x2x1	Ultra-compact, high-perform. e-compass 3D accelerometer and 3D magnetometer module
LIS2MDL	±50 gauss full scale	3 mgauss	LGA-12, 2x2x0.7	3-axis magnetometer standalone, power consumption (@ODR=20Hz): 200 µA in high-resolution, 50 µA in low-power & 2 µA in power down

iNEMO® Inertial Modules

iNEMO System-in-packages (SiP) combine accelerometer, gyroscope and magnetometer in a monolithic 6-axis or 9-axis solution. The integration of multiple sensor outputs bring motion sensing systems to the level of accuracy required for the most demanding applications, such as enhanced gesture recognition, gaming, augmented reality, indoor navigation and localization-basd services.

Features
- Always-on 3D accelerometer and 3D gyroscope
- Android M compliant
- Pedometer, step detector and step counter
- Rate noise density 4mdps/√Hz (high perf. mode)
- Embedded self test and temperature sensor

Part Number	General Description	Common Features • Sensing Axes: X, Y, Z, Yaw, Pitch, Roll • Package (mm): VFLGA 2.5X3X0.86 14L • Angular Rate Range (°/s) typ: 2000 • Range (g) typ: ±2; ±4; ±8; ±16 • Supply Voltage (V) min.: 1.71 / typ.: 1.8 to 3.6		Current Consumpt. (µA)			
			Normal Mode) typ	High-Performance Mode typ	Low-Power Mode typ	Power Down Mode) typ
LSM6DSRX	iNEMO inertial module: 3D accelerometer and 3D gyroscope with embedded machine learning core.Digital output		700	1200	290	3
ASM330LHH	Automotive 6-axis inertial module: 3D accelerometer and 3D gyroscope		1300	-	-	3
ISM330DHCX	iNEMO inertial module: always-on 3D accelerometer and 3D gyroscope with digital output for industrial applications		-	-	350	100
LSM6DSL	iNEMO 6DoF inertial measurement unit (IMU), for smart phones and battery operated IoT, gaming, wearable and consumer electronics. ultra-low-power and high-accuracy. Digital output		450	650	290	3
LSM6DSO	iNEMO 6DoF inertial measurement unit (IMU), with advanced digital function, finite state machine. For battery operated IoT, gaming, wearable and consumer electronics. Digital output. Low-power consumption applications		-	550	26	3
LSM6DSR	iNEMO inertial module: 3D accelerometer and 3D gyroscope. Digital output for high-accurracy applications		700	1200	290	3
LSM6DSOX	iNEMO 6DoF inertial measurement unit (IMU), with Machine Learning Core, Finite State Machine and advanced Digital Function with full-scale acceleration range of ±2/±4/±8/±16 g and an angular rate range of ±125/±250/±500/±1000/±2000 dps		-	0.55 mA	-	-

Sensors Ecosystem: HW + SW

- **Sensor drivers and examples in source code**
- **SW Libraries: sensor fusion, man activity, calibration**
- **High level ready to use applications**

+

Unicleo-GUI Graphical User Interface
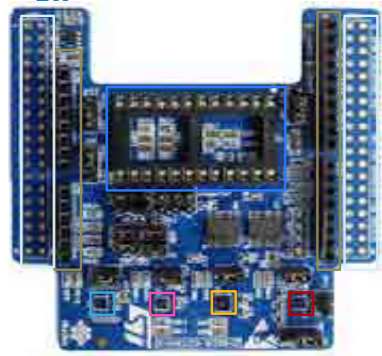
- ☐ ST Morpho connector
- ☐ Arduino UNO R3 connector
- ☐ DIL 24-pin
- ☐ Humidity
- ☐ Pressure
- ☐ 6-axis IMU
- ☐ E-Compass
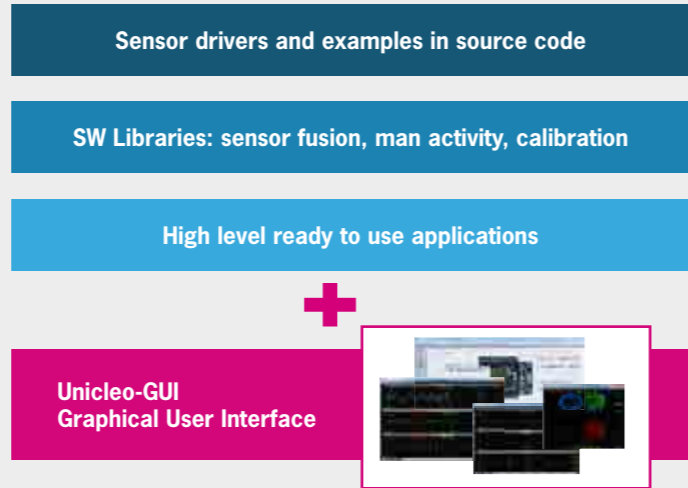
Smart Acoustic1 Software Package

4 MEMS Microphones Array
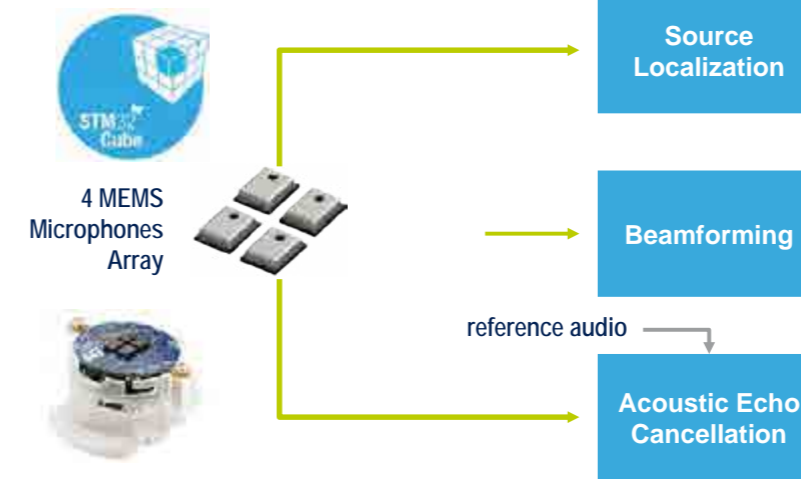
Source Localization
- User-selectable angle resolution
- User-selectable activation threshold
- Based on 4 MEMS microphones
- 360° localization range

Beamforming
- User-selectable beam direction
- User-selectable beamforming algorithm
- Based on 4 MEMS microphones
- GUI highlights the chosen microphone couple

reference audio

Acoustic Echo Cancellation
- Based on a single MEMS microphone
- Reference audio is stored on STM32 FLASH
- Uses Audio OUT to play back audio while streaming cleaned speech on USB

Design Support

ST has a wide product portfolio for wearable applications and provides solution to solve the most complex design challenge:
Single product evaluation boards, fast prototyping and development boards, solution evaluation boards and software development tools.

STM32 Nucleo
Development boards
- Set of boards based on STM32 microcontroller families
- Debugger/programmer functionality
- Expansion capabilities

STM32Cube
Development software
- SW libraries for each STM32 microcontroller family

X-NUCLEO
STM32 Nucleo expansion boards
- Set of boards with additional functions to STM32 Nucleo ones
- Pluggable boards on top of the STM32 Nucleo or stacked on another expansion board

X-CUBE
STM32Cube expansion software
- SW drivers of each X-NUCLEO

The STM32 open development environment is compatible with a number of IDEs including IAR EWARM, Keil MDK-ARM, ARM® mbed™ and GCC-based environments.

Product Evaluation Boards

ST proposes a wide range of evaluation boards that may be used to perform a comprehensive evaluation of ST's products reducing your development time. For MEMS and Environmental sensors, ST features the X-NUCLEO-IKS01A3 and X-NUCLEO-IKS02A1 boards which are compatible with the Arduino UNO R3 connector layout. Both boards interface with the STM32 microcontroller via the I²C pin, and it is possible to change the default I²C port. The X-NUCLEO-IKS01A3 is a motion MEMS and environmental sensor evaluation board and feautures motion , humidity, temperature and pressure sensors.

The X-NUCLEO-IKS02A1 is an industrial motion MEMS Sensor expansion board and it embeds industrial motion sensors and the IMP34DT05 digital microphone.

STM32 Open Development Environment

The STM32 open development environment is a fast and affordable way to prototype and develop innovative applications with state-of-art ST components based on the STM32 32-bit micro controller family and a comprehensive set of functions for sensing, connectivity, power, audio, motor control and more.

BlueCoin Development Kit

The STEVAL-BCNKT01V1 integrated development and prototyping platform for augmented acoustic and motion sensing for IoT applications builds on the listening and balancing capabilities of the human ear.

Augmented Hearing and Motion Sensing

- 3D accelerometer & gyroscope
- 3D accelerometer 3D magnetometer
- Barometer
- 4x Microphone
- Expansion connectors 2x buttons
- STM32 performance MCU
- Power management
- Bluetooth Low Energy processor
- SMD Antenna
- Balun Filter
- 8 LEDs

25 mm
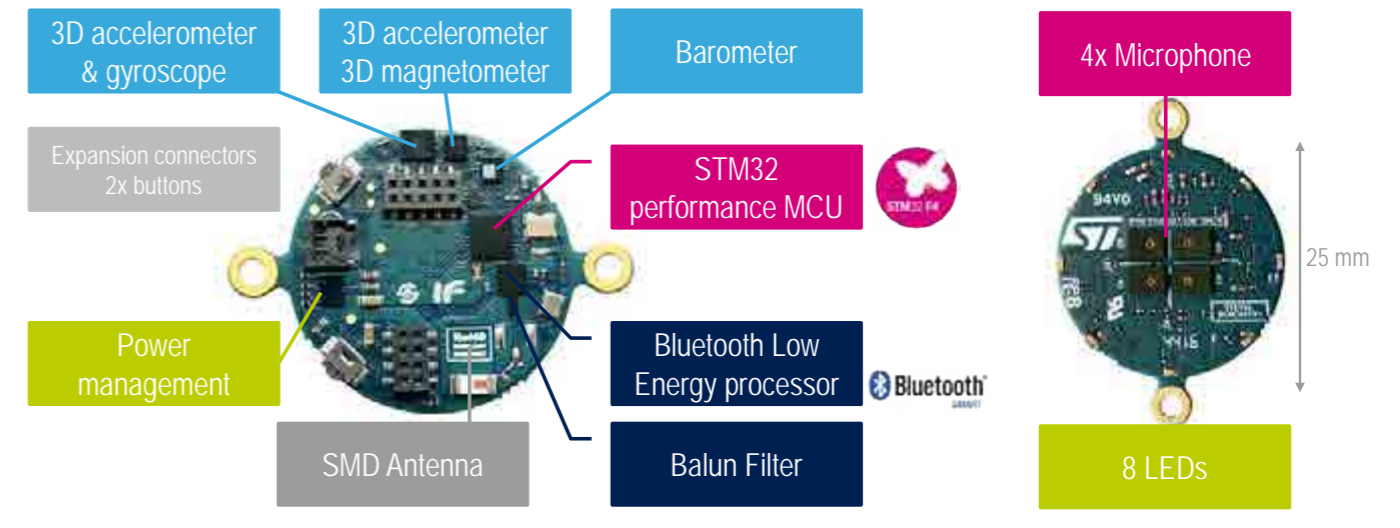
MEMS Microphones

Voice control is a wide spreading trend across many portable applications, making the interaction easier, faster and smoother. It enables fashionable designs by reducing the number of button.

Features
- Tiny packages
- Low-power consumption
- High-performance
- Solution to integrate more sensors in a single package

Part Number	General Description	Package	Output Type	Port location	Signal to noise ratio (dB)*	Sensitivity (dBFS)	Frequency response	Power supply rejection ratio	Supply Voltage (V) min	Supply Voltage (V) typ	Supply Voltage (V) max
IMP34DT05	MEMS audio sensor omnidirectional digital microphone for industrial applications	HCLGA 4MM X 3 MM X 1.00 MM MICRO	Digital	Top	-	−26 dBFS ±3 dB	20Hz-20Khz	-72	1.6	1.8	3.6
MP23ABS1	High performance MEMS audio sensor single ended analog bottom-port microphone	RHLGA 2.65X3.5X1.08(MAX) MM 4L	Analog	Bottom	64	-38 dBV ±1 dB	20Hz-20Khz	60	1.52	2.75	3.6
MP34DT05-A	MEMS audio sensor omnidirectional digital microphone	HCLGA 4MM X 3 MM X 1.00 MM MICRO	Digital	Top	64	−26 dBFS ± 3 dB	20Hz-20Khz	-72	1.6	1.8	3.6
MP34DT06J	MEMS audio sensor omnidirectional stereo digital microphone	HCLGA 4MM X 3 MM X 1.00 MM MICRO	Digital	Top	64	−26 dBFS ± 1 dB	20Hz-20Khz	-72	1.6	1.8	3.6

*A-weighted @ 1 Khz

BOSCH **infineon**

Environmental Sensors
for IoT & Consumer Electronics Applications

Our portfolio of environmental sensors includes barometric pressure sensors, as well as integrated environmental sensors. These integrated environmental sensors combine barometric pressure, relative humidity, gas and ambient temperature sensing functions. Environmental sensors are ideally suited for indoor air quality measurement, sport & fitness monitoring, weather forecast, home automation control, internet of things, GPS-enhancement and indoor navigation.

Humidity and Gas

Part Number	Description	Output Interface	Measurement Range	Power Consumption	Supply Voltage (V)	Operating Temperature (°C)	Package Type/ Size (mm)
BME280	The unit combines individual high linearity, high-accuracy sensors for pressure, humidity and temperature.	I²C, SPI	Humidity 0…100% rH Pressure 300 … 1100 hPa Temperature -40 … 85°C	Sleep mode 0.1 µA 1.8 µA @ 1Hz (H,T) 2.8 µA @Hz (P, T) 3.6 µA @ 1Hz (H, P, T)	V_{DDIO} 1.2 to 3.6V V_{DD} 1.71 to 3.6V	-40 to +85	2.5x2.5x0.93
BME680	The unit integrates for the first time low-power and highly accurate gas, pressure, humidity and temperature sensors in one tiny package.	I²C, SPI	Gas 0 to 500 IAQ (equivalent to 0.2 to 20 mg/m³ TVOC levels) Humidity 0 to 100 % rH Pressure 300 to 1100 hPa Temperature -40 … 85°C	Sleep mode 0.15 µA 2.1 µA @ 1Hz (H,T) 3.1 µA @ 1Hz (P, T) 3.7 µA @ 1 Hz (H, P, T) 0.09 - 12 mA (P/H/T/Gas) depending on operation mode	V_{DDIO} 1.2 to 3.6V V_{DD} 1.71 to 3.6V	-40 to +85	3.0x3.0x0.93

Barometric Pressure Sensors

Part Number	Pressure Range	Pressure Type	Digital Interface	Supply Voltage (V)	Supply Current (mA)	Operating Temperature (°C)	Package Type/ Size (mm)
BMP280	300 … 1100 hPa	B	I²C and SPI	V_{DDIO}: 1.2 to 3.6 V_{DD}: 1.71 to 3.6	2.74 µA @ 1 Hz	-40 to +85	2.0x2.5x0.95
BMP388	300 … 1250 hPa	B	I²C and SPI	V_{DDIO}: 1.2 to 3.6 V_{DD}: 1.65 to 3.6	2.7 µA @ 1 Hz	-40 to +85	2.0x2.0x0.75

Digital Barometric Air Pressure Sensor

Infineon's digital barometric air pressure sensors are best choice for enhanced navigation experience, activity level monitoring, gesture recognition and weather monitoring just as well as for mobile applications and wearables.

DPS310

DPS310 provides ultra-high-precision up to ±5 cm and ±0.06 hPa relative accuracy. The pressure sensing element is based on a unique capacitive principle, which is totally different from piezoelectric technology employed in most of the pressure sensors available in today's market. The capacitive technology enables high-accuracy during temperature changes, which is important for smartphones, wearable and personal navigation devices.

Target Aplications
- Internet of things
- Wearable electronics e.g. health and sports gadgets
- Indoor navigation floor detection
  e.g. in shopping malls and parking garages
- Outdoor navigation in personal navigation devices
- Dead-reckoning e.g. in tunnels
- Local weather station

Application Benefits
- Ultra-high-precision
- High measurement accuracy over wide pressure and temperature range
- Easy implementation due to compact size
- Low system level energy consumption due to FIFO

DPS422

The DPS422 is a monolithic chip solution and ultra-small critical area (sensitive area) and offers robustness against environment. It is capable of measuring both pressure and temperature. Pressure sensing is carried out using a capacitive sensor element, guaranteeing high-accuracy over temperature. The small 2.0x2.5x0.73 mm package makes the DPS422 ideal for mobile applications and wearable devices

Specifications

Key product features	DPS310	DPS422
Operating pressure range	300…1200 hPa	
Operating temperature range	-40 …85°C	
Pressure level precision	< 0.5 Pa	0.5 Pa
Temperature accuracy	0.5º	< 0.4ºC
Pressure temperature sensitivity	0.5 Pa/K	
Measurement time, low power mode	3 ms	
Average current consumption, low power mode, 1 Hz	3 µA	
Standby current	< 1 µA	
Supply voltage	V_{DDIO}: 1.2 – 3.6 V; V_{DD}: 1.7 – 3.6 V	
Operating modes	Command (manual), background (automatic), standby	
Interface	I²C and SPI, both with optional interrupt	
Package	8 pins LGA: 2.0 x 2.5 x 1.0 mm	8 pins WLGA 2.0 x 2.5 x 0.73 mm

Orderable Part Number
- ››DPS310: DPS310XTSA1
- ››DPS422: on request

Functional Block Diagram

SENSIRION
THE SENSOR COMPANY
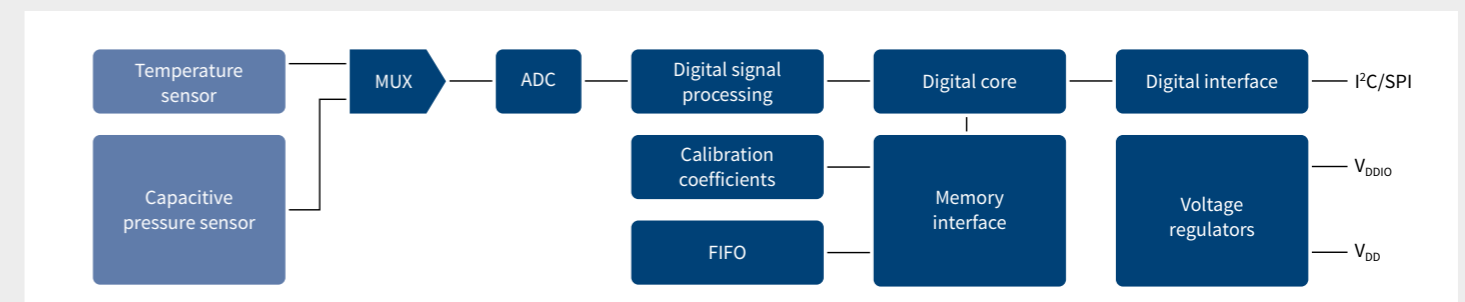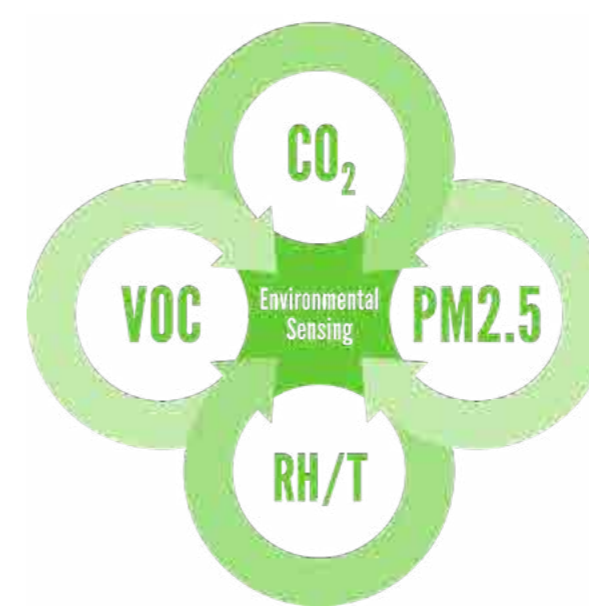
Environmental Sensing
We Measure the Key Environmental Parameters

SENSIRION
THE SENSOR COMPANY

Environmental conditions have a major impact on our well-being, comfort, and productivity. Sensirion's sensor solutions provide detailed and reliable data on key environmental parameters such as humidity, temperature, volatile organic compounds (VOCs), particulate matter (PM2.5), and CO_2. Environmental sensing opens up new possibilities to create smarter devices that improve our comfort and well-being as well as increase energy efficiency in a wide variety of applications.

Particulate Matter Sensor SPS30

The SPS30 particulate matter (PM) sensor represents a new technological breakthrough in optical PM sensors. Its measurement principle is based on laser scattering and makes use of 's innovative contamination-resistance technology. This technology, together with high-quality and long-lasting components, enables accurate measurements from the device's first operation and throughout its lifetime of more than eight years. PM2.5 and PM10 refer to particulate matter with particle diameter up to 2.5 microns and 10 microns, respectively, and are among the most dangerous air pollutants. Due to their small size, PM2.5 particles can travel deep into the human lung and cause a variety of health issues; for instance, by triggering asthma attacks or contributing to cardiovascular disease. The SPS30 will enable the implementation of innovative air quality monitoring devices that prevent air pollution damage.

Features
- Unique long-term stability due to 's innovative contamination-resistance technology
- Advanced particle size binning provided through calibrated digital output
  - Mass concentration: PM1.0, PM2.5, PM4 and PM10
  - Number concentration: PM0.5, PM1.0, PM2.5, PM4 and PM10
- Small, ultra-slim package

Applications
- Air purifiers
- HVAC equipment
- Demand-controlled ventilation systems
- Air conditioners
- Air quality and environmental monitors
- Smart home and IoT devices

Multi-Pixel Gas Sensor Platform SGP30

The multi-pixel gas sensor platform SGP creates new possibilities for the measurement of indoor air quality. The SGP offers a complete gas sensor system integrated into a very small 2.45x2.45x0.9 mm DFN package featuring an I2C interface and fully calibrated air quality output signals.
Sensirion's MOXSens® Technology provides the SGP with an unmatched robustness against contamination by siloxanes resulting in unique long-term stability and accuracy. The SGP further combines multiple metal-oxide sensing elements – the pixels – on one chip to provide more detailed air quality signals. The unprecedented combination of long-term stability and multi-pixel technology makes the SGP a perfect choice for indoor air quality monitoring in mobile, smart home and appliance applications.

Features
- Outstanding long-term stability based on Sensirion's MOXSens® Technology
- Calibrated indoor air quality signals
  - SGP30: tVOC, CO_2eq
  - SGPC3: tVOC (ultra-low-power consumption)
- Very small DFN package and I²C interface
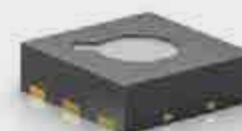
Temperature Sensor STS3x

The STS3x is Sensirion's newest high-accuracy digital temperature sensor series. The STS3x temperature sensor utilizes the industry-proven CMOSens® Technology and wins over users with its increased intelligence, reliability, and improved accuracy specifications. The STS3x temperature sensor gives a fully calibrated, linearized, and supply-voltage-compensated digital output and has an outstanding accuracy of up to ±0.1°C (typical). There are three versions available: the standard version, STS31, guarantees an accuracy of ±0.2 °C over a temperature range of 0 to 90 °C, while the low-cost version, STS30, has an temperature range of 0 to 65 °C. The high-end version STS35 is the most accurate temperature sensor available with an accuracy of ±0.1 °C over a temperature range of 20 to 60 °C.

Features
- Compact package: 2.5x2.5x0.9 mm
- Wide supply voltage range: 2.15 - 5.5 V
- Alert function, two user selectable I²C addresses
- Outstanding accuracy of up to ±0.1°C (typical)

CO_2 and RH/T Sensor Module SCD30

CMOSens® Technology for IR detection enables highly accurate carbon dioxide measurement at a competitive price. Along with the NDIR measurement technology for CO_2 detection, a best-in-class Sensirion humidity and temperature sensor is also integrated on the same sensor module. Ambient humidity and temperature can be outputted by Sensirion's algorithm expertise through modeling and compensating of external heat sources without the requirement for any additional components. Thanks to the dual-channel principle for the measurement of carbon dioxide concentration, the sensor compensates for long-term drifts automatically by design. The very small module height allows easy integration into different applications.

Features
- Outstanding stability due to compensation of long-term drifts by dual channel principle
- Three sensor signals based on Sensirion CMOSens® Technology
  - Absolute carbon dioxide concentration
  - Relative humidity and temperature
- Small form factor and thinnest package

* Comming up soon: SCD40 miniaturized version based on photoacoustic principle
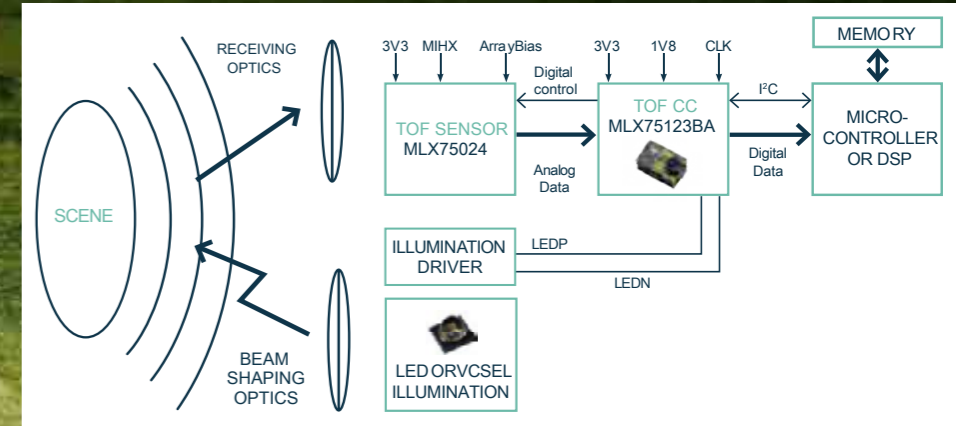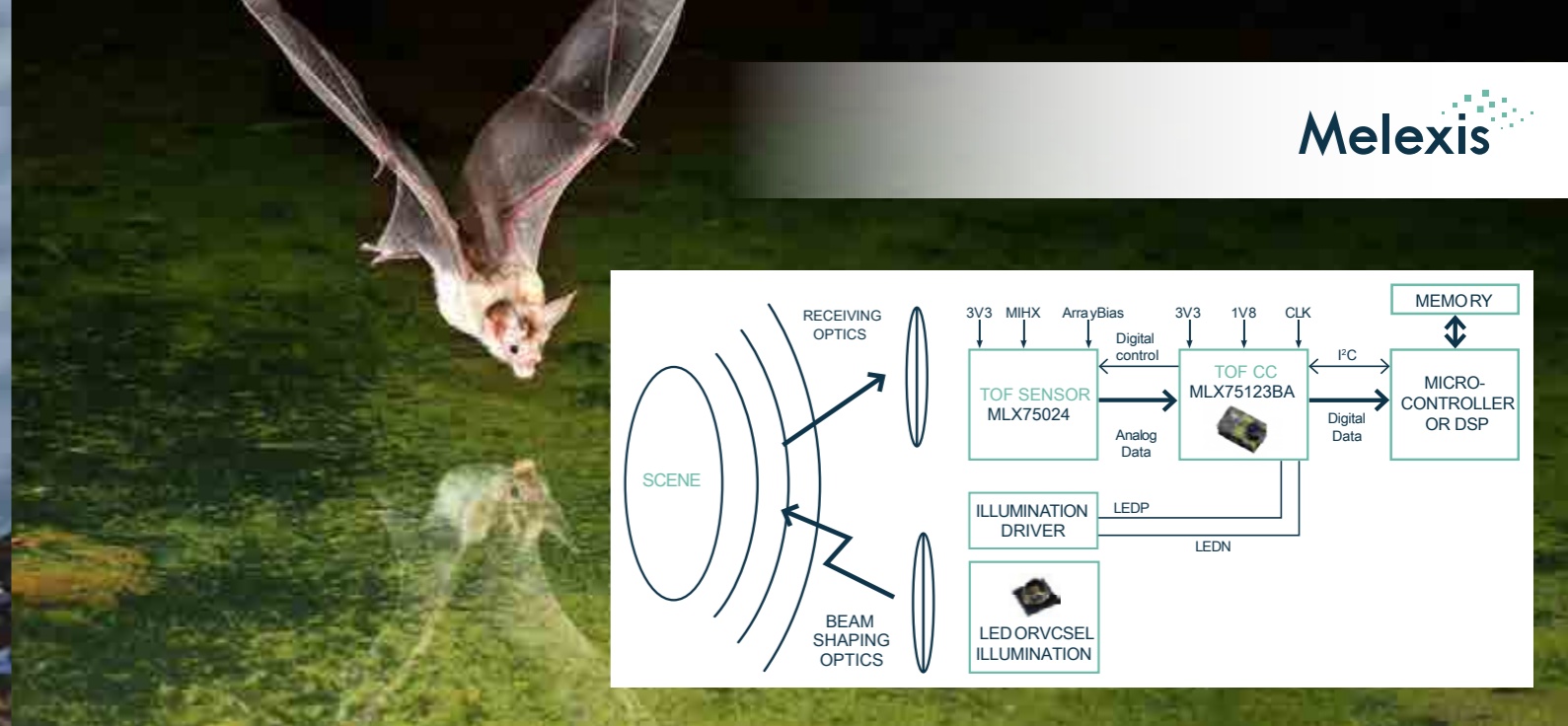
32X24 Pixel Thermal Imager
MLX90640 & MLX90641 – Infrared Array

See the Unseen

Like the pit viper, get access to the thermal world around you. This thermal camera sensor includes optics, a calibrated I²C output and comes in two resolutions:

- 16x12 pixels (MLX90641)
- 32x24 pixels (MLX90640)

Features

- Measures calibrated object temperature between -40 to 300 °C
- Typical target object temperature accuracy of ±1 °C
- Two different field of view (FoV) options: 55°x35° or 110°x75° (wide angle)
- Low-noise equivalent temperature difference (NETD) 0.1K RMS at 4Hz refresh rate
- Enhanced thermal stability (MLX90641)
- Extended operating temperature range (MLX90641: -40 to 125°C)
- Programmable refresh rate (0.5 … 64 Hz)
- I²C compatible digital interface
- No re-calibration needed
- 4-pin TO39 package including optics
- Evaluation board available

Applications

- People detection, for example in building automation systems
- Fire detection/prevention
- Industrial and cooking applications
- Surveillance and air conditioning systems
- Automotive interior comfort (MLX90641)

Analog Ratiometric / PWM
MLX90340 – Position Sensor

Flexible Sensing for Industrial Solutions

The MLX90340 is an absolute position sensor based on the Melexis Triaxis® Hall technology targeted for various applications in consumer and industrial markets. With a reduced set of core parameters compared to other Triaxis sensors in the portfolio, the MLX90340 only targets the essential: position sensing with the greatest ease of designing a magnet. It still offers the best flexibility to measure a 360 degrees rotational (end-of-shaft or through-shaft) and up to a +/- 20 mm linear magnet movement.

Features

- Absolute position sensor (± 1° accuracy) – 12 bits resolution
- Programmable linearization algorithm: arbitrary points (4 points) or 17 points piecewise linear output compensation
- Programmable magnetic mapping XY, XZ, YZ
- 5 V supply
- Magnet field range from 20 to 70 mT
- SOIC-8 package and redundant TSSOP-16 package
- Temperature range: Heavy-duty industrial [-40 to 150 °C] - Industrial [-40 to 85 °C] - Consumer [-20 to 85 °C]
- Ratiometric analog output or PWM open-drain/ push-pull output [100 Hz to 1 kHz]
- 4 different pre-programmed analog version [90, 180, 270, 360 °]

Applications

- Motorcycle
- Heavy-duty industrial
- Consumer
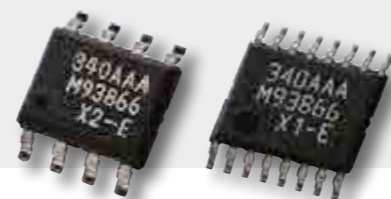
QVGA Time-of-Flight Chipset
MLX75024 & MLX75123 – Real-Time- 3D Imaging with Time-of-Flight Sensor

The MLX75024 time-of-flight sensor together with the new MLX75123 companion chip provides enhanced performances with backward compatibility with the previous QVGA ToF Sensor MLX75023. The MLX75024 ToF sensor supports up to QVGA resolution with a two times higher sensitivity and has a built-in temperature sensor for easier system calibration. The new MLX75123, which controls the ToF sensor, the illumination unit and delivers the data stream to the host processor, has now four general purpose outputs and a new power-up control circuit to further simplify the design of a very compact 3D camera.

MLX75024 ToF Sensor

- 1/3" optical time-of-flight sensor (4.8x3.6 mm)
- QVGA resolution, 320x240 pixels with selectable gain
- Up to 600 Hz raw correlation frame rate @ 40 MS/s, Tint = 100 s
- BGA package 6.6x5.5x0.6 mm with anti-reflective coating
- Demodulation frequency up to 40 MHz
- Embedded temperature sensor

MLX75123 Companion Chip

- Programmable modulation frequencies to avoid module-to-module crosstalk
- Up to 8 raw phases per frame
- Pre-processed difference & sum output modes to reduce the data bandwidth
- Continuous or triggered operation modes
- Region-of-interest (ROI) selection and binning
- Per-phase statistics & diagnostic
- 4 general-purpose output
- 12-bit parallel camera interface up to 80 Mpix/s
- Configurable over I²C up to 400 kHz
- Chipset is available for automotive (-40/+105) and industrial (-20/+85) temperature ranges

Evaluation Board

The EVK75024 is available to evaluate the MLX75024 & MLX75123 ToF chipset under extreme background light conditions. The flexible design enables any designer to develop the necessary system know-how and experience for use in their application. Its modular concept allows to use the chipset board standalone and combine it with the user's illumination and image processing solution.
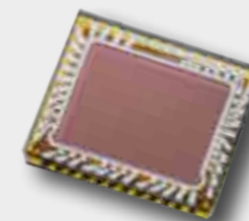
HVC-P2 (Human Vision Components)

Benefits
- People's conditions recognizable simply by mounting an HVC on equipment, regardless of the CPU performance of a customer's equipment, simply mounting an HVC on the equipment enables the customer to obtain the results of advanced image processing as a sensor output.
- Full range of functions, ten different sensing functions are incorporated to recognise the intentions and conditions of people from a variety of perspectives.
- High-precision: accurate recognition of people's conditions and intentions is enabled under a variety of situations in which a customer's equipment is used

Specifications

Part Number	B5T-007001-010
Horizontal Detection Area (angle of view)	50 deg: 54°±3°; 90 deg: 94°±5°
Vertical Detection Area (angle of view)	50 deg: 41°±3°, 90 deg: 76°±5°
Detection Distance (differs per function)	3.2-16.7 m (HVC-P2 50 deg), 1.6-8.6 m (HVC-P2 90 deg)
Dimensions (WxLxH)	45 x 45 x 8.2mm (main board for both types), 25 x 25 x 8.7mm (camera board 50deg type), 25 x 25 x 15.7mm (camera board 90deg type)

Outdoors
- Estimate interest and purchase behaviour of people to store goods of interest
- Vending machines recommending drinks to people

Home
- Home appliances matching movement of people
- AC units targeting people
- Robots matching people
- Lights targetting only people

Workplace
- AC units targeting people
- Lights targeting only people
- Hands free machine operation
- Doors opening to registered people

Main Features
- Camera module angle of view: 2 models (50deg. and 90deg.) available
- Multiple functions (10 functions): Body detection, face detection, hand detection, face direction estimation, gaze estimation, blink estimation, age estimation, gender estimation, expression estimation and face recognition
- User friendly: easy implemenation through UART or USB

Face Detection	Face Recognition	Gender Estimation	Age Estimation	Expression Estimation
	Jane	Female	25	Happy
Facial Pose Estimation	Gaze Estimation	Blink Estimation	Hand Detection	Human Body Detection
Right 30°				
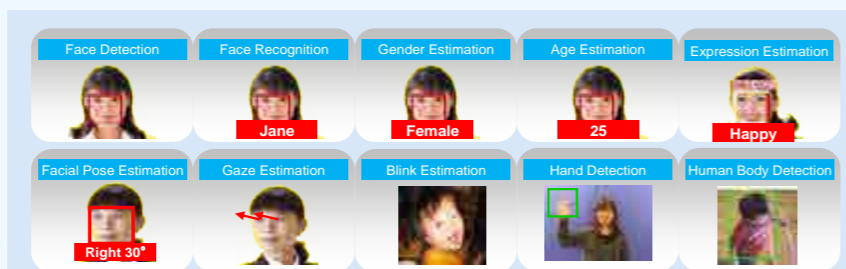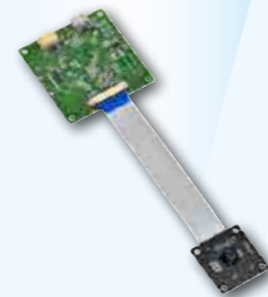
Function	Result
Face Detection, Body Detection, Hand Detection	Result count (max:35), center coordinates (X & Y), detection size (pixel), degree of confidence
Face Direction Estimation	Yaw degree, pitch degree, roll degree, degree of confidence
Gaze Estimation	Yaw degree, pitch degree
Blink Estimation	Blink degree (left-side eye/right-side eye)
Age Estimation	Age, degree of confidence
Gender Estimation	Gender, degree of confidence
Expression Estimation	5 expressions: "neutral", "happiness", "surprise", "anger", "sadness" and their respective score, Expression degree (positive/negative)
Face Recognition	Individual recognition result, score
Image output	Choose one: none, 160x120 pixels, 320x240 pixels Image format: 8-bit Y data

Transmissive Optical Sensors

The new TCUT transmissive sensors in a compact transmissive sensor include two infrared emitters and three or four phototransistor detectors, located face-to-face in a surface mount package.

3-Channel Transmissive Optical Sensor for „Turn and Push" Encoding

TCUT1630X01

Features
- Combines infrared emitter and three phototransistors
- Dimensions: 5.5x5.85x7 mm
- AEC-Q101 qualified
- Gap (in mm): 3
- Aperture (in mm): 0.3
- Typical output current under test: IC = 1.3 mA
- Emitter wavelength: 950 nm
- Operating temp.: -40 to +105 °C
- Moisture sensitivity level (MSL): 1

Applications
- Sensors for motion, speed, and direction
- Steering angle detection (ESP)
- Sensors for "turn and push" encoding
- Position sensors in climate control panels

4-Channel Transmissive Optical Sensor for Absolute and Incremental Encoding

TCUT1800X01

Features
- Combines two infrared emitters and four phototransistors
- Dimensions: 5.5x5.85x7 mm
- AEC-Q101 qualified
- Gap (in mm): 3
- Aperture (in mm): 0.3
- Typical output current under test: IC = 1.3 mA
- Emitter wavelength: 950 nm
- Operating temp.: -40 to +105 °C
- Moisture sensitivity level (MSL): 1

Applications
- Optical encoders that requires high-resolution (can detect up to 16 positions)
- Ignition locks and adaptive headlights
- Encoder for interior turn knobs (climate panel, e-shifter, iDrive)
- Control system valve or vane feedback position sensing

Fully Integrated Proximity & Ambient Light Sensors

Featuring Filtron technology, the sensor combines photo detectors for proximity and ambient light, a signal conditioning IC.

New Fully Integrated Automotive Grade Proximity and Ambient Light Sensor for Gesture Recognition

VCNL4035X01

Features
- Offers excellent background light cancellation capabilities
- AEC-Q101 qualified
- Supports I^{2}C bus communication interface
- High object detection distances up to 500 mm
- Ambient light photo-diode offers detection from 0.004 lx to 16 klx
- High ALS accuracy of ± 10 %
- Excellent temperature compensation: -40 to +105 °C
- Proximity function uses intelligent cancellation to eliminate cross-talk
- Supply voltage range of 2.5 to 3.6 V
- I^{2}C bus voltage range from 1.8 to 5.5 V
- A 16-bit ADC, and a driver for up to three external IREDs in one compact 4x2.36x0.75 mm surface-mount package.

VCNL4035X01 Gesture Board
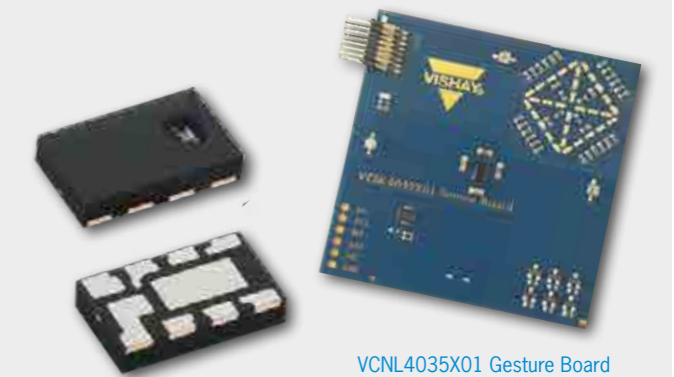
Micropower Triaxis Magnetometer
MLX90393 – World´s Smallest 3D Magnetometer for Position Sensing

The MLX90393 is offering maximal flexibility at minimal size. With its 3x3 mm or 2.5x2 mm footprint, it can fit in the tiniest of assemblies. It provides a digital output proportional to the sensed magnetic flux density along the 3 perpendicular axes of symmetry of the sensor.

But the miniature sensor is mostly characterized by the fact that it can interchange measurement speed for both current consumption and noise on the digital output signal, making it the raw building block for any magnetic sensing application up to 85°C. An external microcontroller can then combine the measurement data in order to define the position of the magnet with respect to the sensor. All this at a selectable dutycycle of 0.1 to 100%.

Features & Benefits
- Micropower (2.2 – 3.6 V, 2.5 µA idle current)
- Low-voltage I/O (1.8 V – V_{dd})
- SPI (3+4-wire) & I²C interface, slave node
- 16-bit XYZ magnetic and thermal measurement
- QFN3x3 package, 16 leads
- UTDFN-8 2.5x2 mm
- In-application programmable (gain, mode, axes, …)
- Ta = -20 ... 85 °C

Applications
- Sensing element for the internet of things (IoT)
- Metering
  - Impeller-based meters 360° impeller position detection incl. anti tampering
  - Meter mechanical counter digit readout
  - General tri-axial anti tampering detection
  - Gauss-meter
- HMI
  - Joystick w/push
  - Rotary knob w/push
  - Lever/slide switch linear stroke
- Valve position, industrial sensing
- Robotics & factory automation
- Home security
  - Tamper proof door/window opening detection
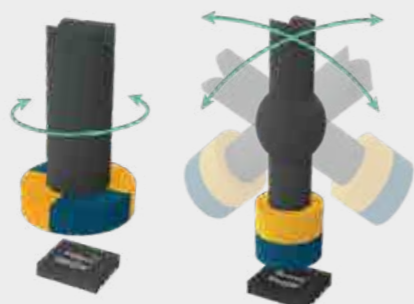
HMI: Human-Machine Interface
The MLX90393 lends itself for a wide variety of human-machine interfaces such as joystick (gimball, ball & socket) with push detection, rotary knobs with push function and linear strokes by levers or sliding switches.
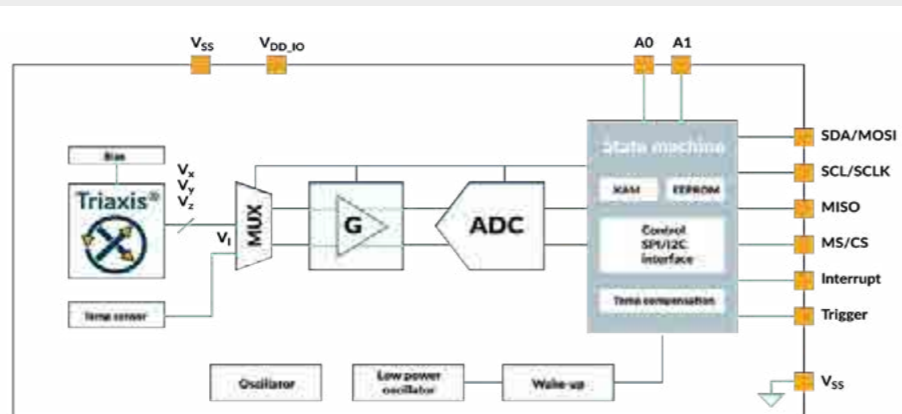
Hall Latch & Switches
MLX92211/21/31/32/41/42– Programmable & Pre-programmed

Melexis presents a revolutionary concept: a perfectly customized Hall latch or switch for your applications. A virtually unlimited set of versions at a great price.

Programmable
You programme the latch/switch.

Available Types
- 2-wire latch/switch: MLX92242
- 3-wire latch/switch: MLX92232

Benefits
- Rapid prototyping
- High-accuracy

Pre-Programmed
Melexis programmes the latch/switch.

Available Types
- 2-wire latch: MLX92221
- 2-wire switch: MLX92241
- 3-wire latch: MLX92211
- 3-wire switch: MLX92231

Benefits
- Drop-in replacements and second sourcing
- Total cost of ownership (TCO) optimization

Evaluation Tool

Key Applications
- Smart appliances and consumer devices
- Building automation and energy
- Industry and medical
- Automotive and transportation

Key Specifications
- Wide magnetic latch range: ±0.4 mT to ±80 mT
- Wide magnetic switch range: ±1.5 mT to ±66 mT
- Programmable hysteresis: 0 mT to 36 mT
- Programmable magnet T_C coefficient: 0 to -2000 ppm/°C
- Wide operating voltage range: from 2.7 V to 24 V

MICRONAS

MICRONAS

High-Precision and Robust Multi-Purpose Linear Hall Sensors
For Distance and Small Angle Measurements

Multi-Axis Sensor
For Direct Angle and Linear Position

MICRONAS

HAL 18xy Universal and Cost-Effective

HAL188x/HAL1890 are entry-level linear HALL-Effect sensors with ratiometric line-ar analog or SENT output (SAE J2716 Rev. 4). They offer a cost-effective solution for small distance or angle measurement. HAL 1880 and HAL 1890 are programmable. HAL 1881-1883 are pre-programmed.

HAL 18xy
HAL 188x / HAL 1890 is a universal, value-optimized Hall-effect sensor family

HAL/C 83x Robustness Proven in Use

This family brings over 10 years know-how and a proven-in-use quality expe-rience. It offers high temperature stabi-lity, EMC robustness with HAC830 and flexibility thanks to selectable output (Analog & PWM) for HAL835.

HAC830
Proven Linear Technology in smallest form factor on the market including capacitors

HAL/R 24xy Versatile and High-Precision

The versatile HAL/R 24x5 fami-ly offers extended measurement for distance up to two times magnet length & angle up to 180° and state-of-the-art diagnostic functions for applications under stringent condi-tions. Single and dual versions in dif-ferent packages are offered.

HAR24xy
Redundancy in a very thin package

Device	Characteristics	Output	Package
HAL 1880	± 40 to ± 160 mT magnetic range	Analog (10-bits)	TO92UA
HAL 1881- HAL 1883	± 50 to ± 100 mT magnetic range	Analog (10-bits)	TO92UA
HAL 1890	± 40 to ± 160 mT magnetic range	SENT (SAE J2716 Rev. 4) (10-bits)	TO92UA
HAL 830/HAC 830	± 30 to ± 150 mT magnetic range	Analog (12-bits)	TO92UT/TO92UP
HAL835	± 15 to 150 mT magnetic range	Analog (12-bits) & PWM (125Hz, 11bits)	TO92-UT
HAL2420	± 25 to 200 mT magnetic range	Analog (12-bits)	TO92-UT, SOIC8
HAL2425	Programmable temperature compensation	Analog (12-bits) with 16 programmable set points	TO92-UT, SOIC8
HAL2455	for sensitivity and offset continuous self-test	PWM (2kHz, 12-bits) with 16 programmable set points	TO92-UT, SOIC8

Target Applications
- Pedal
- EGR
- Transmission
- Gear position sensor
- Throttle
- Turbo-charger
- Joystick

HAL 37xy/HAR 37xy/HAC 37xy

Key Features
- Unique „Virtual Offset Feature" to
  - reduce magnet size & cost
  - Accuracy of <0.5 % full scale for linear or angular measurements
- No output linearization required for rotary applications
- High ESD protection according to stringent requirements of the automotive industry
  - ESD protection 8 kV (active Pins)
- Wide junction temp. range from -40 to 170 °C
- SOIC-8 SMD and TO92UG four pin l eaded package
- TO92UF package with caps
- "Open source" programming interface & software
- ISO 26262 Ready

Additional Features
- Supply voltage range 4.5 V to 5.5 V
- Programming via sensors output TTL-Level (0 V… 5 V)
- Memory w. redundancy & lock function
- AEC-Q100 qualification

Various Safety Features
- Wire-break & Over/Undervoltage detection
- Full signal path & memory supervision
- Overflow and state machine self-test
- Magnet lost detection

HAR 37xy
Redundancy in SOIC8 Package thanks to stacked die Technology
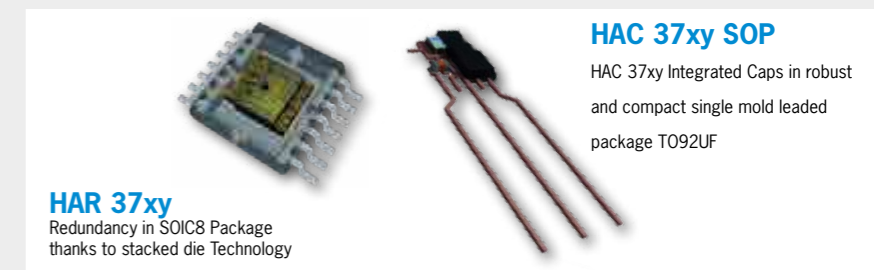
HAC 37xy SOP
HAC 37xy Integrated Caps in robust and compact single mold leaded package TO92UF

Device Number	Output Format	Magnetic Field Axis	Accuracy [%FS]	Min. Magnetic Field Amplitude [mT]	Setpoints	Magnetic Setup
HAL/HAR/HAC3725	Analog	XY	± 0.75	± 20	33	End of shaft
HAL/HAR/HAC3726		YZ	* *			Off-axis or linear position
HAL/HAR/HAC3727		XZ	* *			Off-axis or linear position
HAL/HAR/HAC3735	PWM or SENT SAE-J2716 Rev. 2010	XY	± 0.5 %			End of shaft
HAL/HAR/HAC3736		YZ	* *			Off-axis or linear position
HAL/HAR/HAC3737		XZ	* *			Off-axis or linear position

* * Available on request. Depends on magnetic setup

Target Applications
- Clutch position
- Turbo-charger actuators
- Chassis position sensors
- Fuel level
- EGR Valve
- Transmission
- Various valves for engine management

RUTRONIK EMBEDDED

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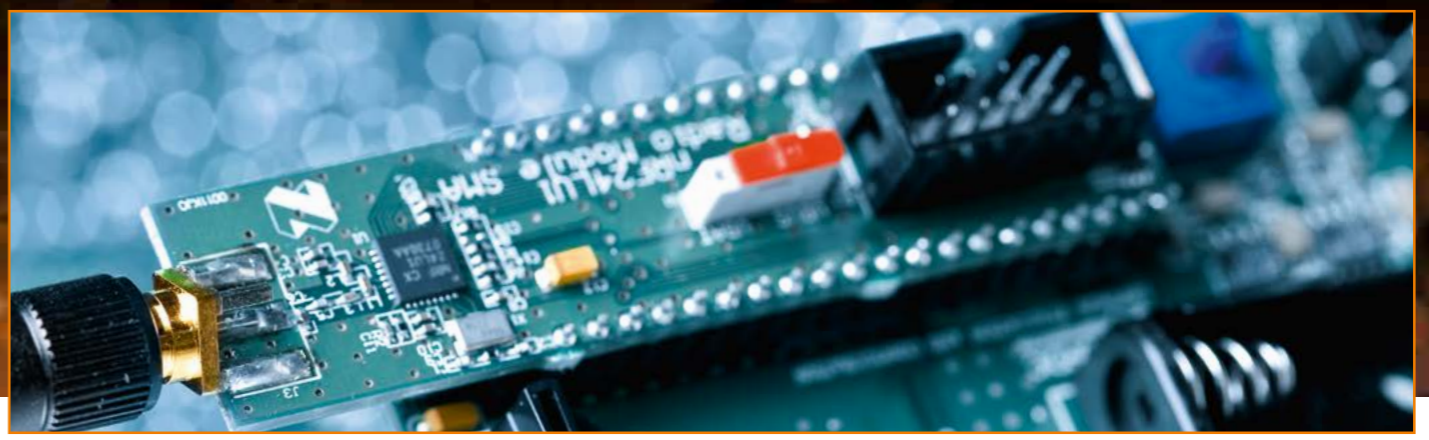
Make your application smart by connecting it wirelessly to the Internet of Things. RUTRONIK EMBEDDED has the newest solutions for using a smartphone, WiFi access point or a mobile communication network as gateway for your device. Our understanding of the right wireless solution covers hardware, drivers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

Wireless Technologies	2J Antenna	Advantech	AVX	Chinmore	EnOcean	Fujitsu	Garmin	GNS	Gradconn	iDTRONIC	Infineon	InsightSiP	Intel	Melexis	Murata	Nordic Semiconductor	Panasonic	Pulse	Redpine Signals	Rohm Semiconductor	Schreiner Group	SILEx	STMicroelectronics	Telic	Telit	Yageo
Bluetooth																										
Bluetooh Classic Modules with Software Stack		X				X		X									X		X	X			X		X	
Bluetooth LE (Low Energy Standard) Modules		X			X	X	X					X			X	X	X		X	X		X	X		X	
Chip sets Bluetooth Classic																	X						X			
Chip sets Bluetooth LE																X	X									
GSM/GPRS/UMTS/LTE/ NB-IoT																										
Modules		X																								X
With integrated GPS		X																						X	X	
Chips and chip sets													X													
Telematic Devices																									X	
Telemetry Devices																									X	
GNSS																										
GPS Modules		X				X		X																	X	
Glonass/others Modules								X																	X	
GNSS Chips																							X			
Patch Modules (with Antenna)						X		X																	X	
ISM/SRD Radio																										
Receiver Chips											X			X												
Transceiver Modules					X		X					X					X						X			
Transceiver Chips											X			X			X					X	X			
Transmitter Chips											X			X			X						X			
NETWORK Solution					X							X					X	X					X			
Gateway Solution		X																								
USB Sticks					X						X						X									
RFID/NFC																										
Passive Reader Modules										X											X					
Passive Transponder Chips						X								X	X		X						X			
Passive Transponder Devices										X				X	X		X					X				
Passive Reader Chips														X									X			
NFC Pairing Chip						X	X					X			X	X	X								X	
ZigBee™																X					X					
Chip Sets																X					X					
Modules					X										X					X	X					
Software Stack																				X						
WLAN																										
802.11 Modules		X			X										X		X		X	X			X			X
802.11 Chips																				X						
802.11 Cards		X													X					X			X			
Software Stack					X												X		X	X			X			X
Accessories																										
Adapter Cables	X	X		X					X									X								
Antennas (internal)	X		X															X								X
Antennas (external)	X	X		X														X								
Antennas (surface mounted)	X		X														X	X								X
SIM-card Holders			X						X																	
Special Wireless Technologies																										
ADS-B								X																		
TMC								X																		
LoRa		X										X					X							X	X	
Sigfox																							X			

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.

Dimensions & Key Features

- mini PCIe full-size single-sided
- M.2 (NGFF) 42 mm
- 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

Telit Card	Description	Region	Technology
FN980m	M.2 dual-side, up to 5.7 Gbps Downlink, 7x Carrier Aggregation DL (2x UL), MIMO, 256 QAM, VoLTE, full GNSS support	Europe, North America, APAC	5G (eMBB)
LM960	Mini PCIe Data Card, up to 1.2 Gbps Downlink, 5x Carrier Aggregation DL, 4x4 MIMO, full GNSS support	Worldwide	LTE Cat 18
LM940	Mini PCIe Data Card, up to 600 Mbps Downlink, 3x Carrier Aggregation DL, MIMO, 256 QAM, full GNSS support	Worldwide	LTE Cat 11
LE910C4	Mini PCIe Card, up to 150 Mbps Downlink, MIMO, VoLTE, full GNSS support	Europe, North America, Latin America, APAC, China, India	LTE Cat 4
LE910C1	Mini PCIe Card, up to 10 Mbps Downlink, MIMO, VoLTE, full GNSS support	Europe, North America, Latin America, APAC	LTE Cat 1
ME910C1	Mini PCIe Data Card, up to 1 Mbps Downlink, GNSS optional	Worldwide	LTE-M / NB-IoT

FN980m
Advanced LTE/5G M.2 Data Card
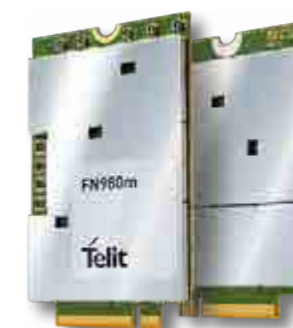
Enabling a new generation of 5G state-of-the-art data cards featuring Sub-6 and mmWave technologies with LTE, WCDMA & GNSS support. Industrial-grade M.2 form factor suitable - among others - for following applications: High Power Fixed Wireless access, enterprise routers and gateways, indoor/outdoor 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 / 3CA 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, n5, n7, n12, n14, n20, n28, n30, n41, n66, n71, n77, n78, n79
- 5G FR2 Bands: n257, n258, n260, 261
- LTE Bands: 1, 2, 3, 4, 5, 8, 9, 12, 13, 14, 17, 18 19, 20, 26, 28, 71, 25, 66, 39, 29 (DL), 30, 32, 7, 38, 40, 41, 42, 43, 46 (LAA), 48 (CBRS), 34, 27
- 5G 4x4 MIMO support on bands n1, n2, n7, n66, n3, n77, n78, n79, n41 and n30
- 4G 4x4 MIMO support on bands 32, 4, 66, 3, 2, 25, 1, 30, 40, 41, 7, 43, 42, 46, 48
- WCDMA Bands: 5, 8, 3, 4, 2, 1, 9, 19
- FOTA Support
- Dimensions: 30 x 50 x 3.5mm
- Data throughput with 5G: up to 5.5 DL / 2.7 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: RED & GCF (planned), others (under evaluation)

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

Cellular Data Cards

LM960 – Advanced LTE Data Card

The LM960 Mini PCIe data card delivers high speed data rates via Advanced LTE and offers a cellular connection for products in network appliance environments. This data card is well-suited for products that demand high throughput such as routers, mobile gateways and access points, to provide the most advanced 4G LTE connectivity, ensuring a rich and seamless user experience. Based on LTE Category 18, the LM960 mPCIe data card achieves download rates up to 1.2 Gbps. It supports 4x4 MIMO, 5x downlink carrier aggregation and 2x uplink carrier aggregation. The product supports multiple RF frequency bands and band combinations to accommodate global deployments.

Key Benefits
- Standard Mini PCIe Data-card form factor
- LTE Cat 18: high-speed with data rates of up to 1.2 Gbps download and 150 Mbps upload
- Full GNSS support: GPS, GLONASS, Galileo, Beidou
- Data only card

Features & Specifications
- Form Factor: PCI Express Mini Card type (mPCIE)
- Dimension: 50.95 x 30 x 2.8mm
- Chipset: Qualcomm SDX20
- Global SKU
- 4x4 MIMO
- 5x DL Carrier Aggregation
- 2x UL Carrier Aggregation
- Support for CBRS Band
- LAA up to 60MHz

Application Fields
- Routers
- Mobile Gateways
- Access Points

- Support for Firstnet B14
- Full GNSS support - GPS, GLONASS, Galileo, Beidou
- RF Bands:
  - LTE FDD: B1, B25(B2), B3, B66(B4), B26(B5), B7, B8, B12(17), B13, B14, B20, B28, B29(DL), B30, B32(DL), B71
  - LTE TDD: B38, B39, B40, B41, B42, B46(DL), B48
  - WCDMA: B1, B2, B4, B5, B8
- Temperature Range: -40 to +85°C
- Operating Voltage: 3.1V – 3.6V
- Interfaces: Standard mPCIe interface, USB 2.0/3.0, Dual SIM, GPIOs
- Approvals: FCC/IC, PTCRB, CE/GCF, AU

LM940 – LTE Cat 11 Mini PCIe Data Card

The Telit LM940 LTE Cat 11 data card delivers high-speed data rates via Advanced LTE and offers a cellular connection for products in network appliance environments. This data card is well-suited for products that demand high throughput such as routers, mobile gateways and access points.

Based on LTE Category 11, the LM940 mPCIe data card achieves download rates up to 600 Mbps supported by the 3GPP release 11 with MIMO and LTE Carrier Aggregation. The product supports multiple RF frequency bands and band combinations to accommodate global deployments. Furthermore the LM940 offers full GNSS support with GPS, GLONASS, Galileo and Beidou.

Features & Specifications
- LTE Bands:
  1-5, 7, 8, 12, 13, 17, 20, 25, 26, 28, 29, 30, 38, 40, 41, 66
- Data Throughput:
  Up to 600 Mbps Downlink & 75Mbps Uplink
- Operating Temperature: -40 °C to +85 °C
- Interfaces: mPCIe, USB 2.0/3.0, Dual SIM, GPIOs, DVI
- 32 bit ARM Cortex-A7 up to 1.19 GHz running the Linux operating system
- GNSS: GPS, Glonass, BEIDOU, Galileo
- Certifications: FCC/IC/PTCRB/GCF/RED/RCM
- Dimension: 50.95 x 30 x 2.8 mm
- Standard Mini PCIe Data card form factor
- LTE Cat 11: Exceptionally high-speed with data rates of up to 600 Mbps download and 75 Mbps upload

- Full GNSS support
- Increased connectivity performance with Carrier Aggregation 3CA, MIMO and 256 QAM
- Up to 4 independent firmware images selectable at boot to support different network operator requirements
- 3G fallback technology
- USB drivers for Windows 7, 8x, 10 and Linux (Kernel 4.10)
- Oberating voltage: 3.1-3.6V
- Network carriers: AT&T, Sprint, T-Mobile US, Verizon

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EFT/POS and Vending

Security Applications

Electricity, Gas and Water

Metering Applications

Medical Applications

Digital Signage
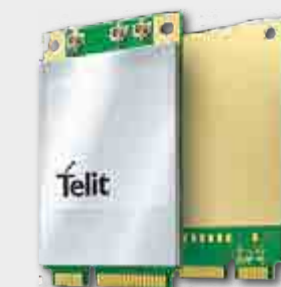
LE910C4 & LE910C1 Mini PCIe

Telit

M2M Terminals

Telic

Advanced LTE Cat. 4 and LTE Cat. 1 mPCIe 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 a temperature range from -40 to +85°C and support several interfaces, like GPIOs, USB 2.0 HS, UART, 1.8/3V SIM and RF pad, RX Div. & MiMO pad.

The Mini PCIe Cards have following country approvals: 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.

Version	LE910C1-NA	LE910C1/C4-AP	LE910C1-NS	LE910C1/C4-EU	LE910C1/C4-NF	LE910C1-SA	LE910C1-SV	LE910C1-ST	LE910C1/C4-LA	LE910C4-CN
Market	North America (AT&T)	APAC (Telstra/NTT-Docomo)	North America (Sprint)	EMEA	North America (Public Safety, AT&T, FirstNet, T-Mobile, Verizon)	North America (FirstNet, AT&T)	North America (VZW)	North America (TMO US)	LATAM	China, India
4G Bands	B2, B4, B12	B1, B3, B5, B8, B9, B18 (B26), B19, B28	B2, B4, B5/B26, B12, B25	B1, B3, B7, B8, B20, B28A	B12, B14, B4, B2, B5, B13, B66, B71	B4/66, B2, B12, B14	B4, B13	B4/66, B2, B12, B71	B1-5, B7, B28	B1, B3, B5, B8, B38-41, B34, B39
3G Bands	B1, B2, B4, B5, B8	B1, B5, B6, B19, B8	-	B1, B3, B8	B2, B4, B5	-	-	-	B1, B2, B4, B5	B1, B8
2G Bands	B2, B3, B5, B8	-	-	B3, B8	-	-	-	-	B2, B3, B5, B8	B3, B8

GSM and UMTS Terminals for M2M Applications

Telic's GSM and UMTS terminals are targeted towards professional and industrial M2M applications which require wireless connectivity provided in a robust and reliable casing.

Key Benefits
- By integrating terminals from Telic, 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

Key Features
- Modules based on Telit or Cinterion
- Dual band and quad band support for 2G (GSM/GPRS)
- Dual band or penta band support for 3G (UMTS and HSPA/HSPA+)
- Industry standard RS232 interface on all products
- Ultra-low power consumption mode in selected products for battery-powered applications

Categories	Features	GT910 G	HT910 E	HT910 G	LT910 E	NT910 G
Modules	Supplier	Telit	Telit	Telit	Telit	Telit
Category	Product Category	Basic 2G	UMTS/HSPA	UMTS/HSPA	LTE/GSM/GPRS	LTE-M/NB-IoT
General	Part Number	06308	06301	06303	06307	06311
Air Interface	2G Frequency Band	2G Quad	2G Dual (900/ 1800 MHz)	2G Quad	2G Dual (900/1800 MHz)	2G Quad
	3G Frequency Band		3G Dual (900/ 2100 MHz)	3G Penta		
	HSPA DL		7.2 Mbit/s	21 Mbit/s		
	HSPA UL		5.7 Mbit/s	5.7 Mbit/s		
	LTE DL				10 Mbit/s	300 kbps
	LTE UL				5 Mbit/s	375 kbps
Interfaces	RS232 Interface	D-Sub (9-pin)	D-Sub (9-pin)	D-Sub (9-pin)	D-Sub (9-pin)	D-Sub (9-pin)
	USB 2.0	Mini-USB	Mini-USB	Mini-USB	Mini-USB	
	Audio (analog)					Mini-USB
	Antenna	FME	FME	FME	FME	FME
	LEDs	1 GSM + 2 Configurable	1 GSM + 2 Configurable	1 GSM + 2 Configurable	1 GSM+ 2 Configurable	1 GSM + 2 Configurable
Software	Robust 1.8/3 V SIM Card Holder	•	•	•	•	•
	Programmable		Python	Python	AppZone	AppZone
	Firmware Update	Serial/FOTA	FOTA	FOTA	FOTA	FOTA
	TCP/IP Stack	•	•	•	•	•
Input/Outputs	Analog Inputs		1	1	1	1
	Digital Inputs					
	Outputs		1 (optional)	1 (optional)	1 (optional)	1 (optional)
Electrical Characteristics	Voltage Range	5V - 36V	5V - 32V	5V - 32V	5V - 32 V	5V - 32V
	Standby (@ 12V)	≈ 19 mA (*)	≈ 20 mA (*)	≈ 23 mA (*)	~12 mA (*)	~12 mA (*)
	Low Power Mode (@ 12V)	~2 mA (*)	≈ 10 mA (*)	≈ 11 mA (*)	~ 2 mA (*)	~ 2 mA (*)
Hardware Characteristics	Operating Temp.	-30 to +75°C	-30 to +80°C	-30 to +80°C	-30 to +80°C	-30 to +75°C
	Size			77 x 66 x 26mm		
	Weight	91g	91g	91g	91g	91g
Certificates	CE	•	•	•	•	•
	e1	•				
	FCC	•				

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

EWM-C117FL   **EWM-C141M201E**   **EWM-NB147F01E**   **EWM-G109H01E**
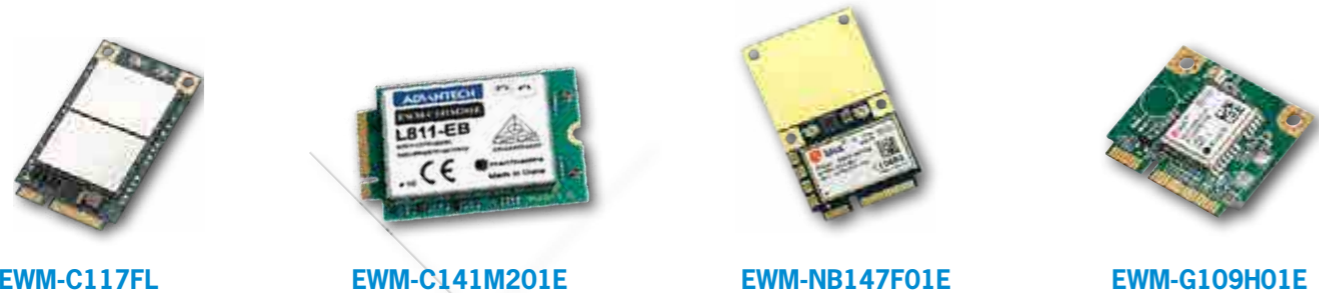
Cellular Mini PCIe Data Cards

ADVANTECH
Enabling an Intelligent Planet

GNSS

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, WinCE 5.0/6.0, Linux 2.4.x/2.6.x, Mac
- 50.85 x 29.9 x 6.2 mm

EWM-C141M201E

4G / LTE M.2 Card

Features

- M.2 Key-B Card
- LTE CAT4
- 4G LTE FDD:
  - 1, 3, 5, 7, 8, 20, 28,
- 3G bands:
  - 1, 5, 8,GPRS: 850(B5), 900(B8), 1800(B3),1900(B2)
- Intel 7120M Chipset
- FDD LTE Max150Mbps(DL) / 50Mbps(UL)
- USB 2.0 Interface
- Dimension: 30 x 42 x 3.2mm
- Tx Power / Rx Sensitivity
  - Tx: 33 dBm   Rx: -110 dBm

EWM-NB147F01E

LTE Cat M1 / NB-IoT Full size mini PCIe Card

Features

- u-blox SARA-R410-02B LTE Cat M1 / NB1 engine.
- Bands = 1, 2, 3, 4, 5, 8, 12, 13, 17, 18, 19, 20, 25, 26, 28 (and band 39 in M1-only)
- Build-in micro SIM card holder
- Low idle mode current
- Standard mini PCIe full-size 30 mm x 50.95 mm
- Temperature range: -40 to +85°C.
- Manufactured in ISO/TS 16949 certified production sites.
- Mini PCIe Signal Type USB2.0.

EWM-G109H01E

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
- Time Pulse Config.: f=0.25…10 MHz
- Dynamics < 4 g
- Operating Temperature -40 to +85 °C

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EWM-G110H01E

Industrial GPS USB Half Mini PCI-E Card

Features

- 72-channel u-blox M8 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 second / Aided starts 3 second
- SBAS: WAAS, EGNOS, MSAS
- Accuracy 2.5 m CEP
- RoHS compliance
- 1 USB 2.0
- PCI-Express Mini or Half Mini Card form factor

2J antennas

2JR02ba2

GNSS USB Receiver with Telit SL869 Receiver

Features

- Interface: USB 2.0
- Cable length: up to 10 m
- Impedance: 50 Ohm
- Polarization: RHCP
- Gain: 3dBiC
- Voltage supply: 3.7 V to 6 V
- Current: 65 mA Max.
- Operating temperature: -45 °C to +85 °C

WiFi

EWM-W170H01E

IEEE 802.11 ac/a/b/g/n Half-size Mini PCIe Card

Features
- Main Chipset: QCA 9377-7
- Interface: PCI Express mini-card rev. 1.2
- Data Rate: Up to 433 Mbps
- Security: WEP 64/128-bit, WPA, WPA2
- OS Supported: Windows 7/8.1/10
- Operating temperature: -20 to +70 °C

EWM-W162M201E

Low Cost Extended Temperature IEEE802.11 a/b/g/n/ac + Bluetooth 4.2 2x2 MIMO M.2 Card

Features
- Main Chipset: Marvell 88W8897P
- Interface: PCI Express
- WLAN Signal Protocol: PCIe Differential
- Bluetooth Signal Protocol: USB Differential
- Data Rate: Up to 866.7 Mbps
- Security: 64/128 bit WEP, WPA, WPA2
- OS Supported: Linux
- Operating temperature: -30 to +85 °C

EWM-W168H01E

802.11 a/b/g/n/ac + Bluetooth 4.2 Half-size Mini PCIe Card

Features
- IEEE 802.11 a/b/g/n/ac + Bluetooth 4.2 HS standard
- Realtek RTL8822BE-VG Chipset
- WiFi: PCI-e BT:USB Interface
- Windows 7/8.1/10
- 2Tx/2Rx
- Up to 866.7 Mbps Data Rate
- WEP/WPA2, WAPI, 802.11i
- Operating temperature: 0 to 70° C
- 26.65 x 29.85 x 3.95 mm

EWM-W190H01E

802.11 a/b/g/n/ac + Bluetooth 4.2 2T2R Mini PCIe Card

Features
- Microsoft Windows/Linux/Android Support
- Support for BT & WLAN Co-existence
- RoHS Compliance
- Frequency Band(2.4/5GHz)
- WPA, WPA2 security support
- Bluetooth V4.2, V4.1, V4.0 LE, V3.0+HS, Bluetooth V2.1+EDR system, version 1.1, 1.2 and 2.0
- Two-stream spatial multiplexing up to 867Mbps data rate
- Output power up <=+10 dBm
- -40 to +85 °C operating temperature

WiFi

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
- IEEE 802.11a/b/g/n compliant 2.4/5 GHz dual band
- 2x2 MIMO performance with data rate up to 300 Mbps
- PCI Express Mini Card 1.2 compliant
- Supports open source ath9k driver
- Linux supplicant available on request for WPA/WPA2-PSK & 802.1x EAP
- Customized Driver development available on request
  - Freescale i.MX 6 support
  - IEEE 802.11e QOS support available
- IEEE 802.11e QOS support

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)/ a/n/e/h/i
- Wide band 80 MHz mode
- Silex Linux reference driver with IEEE802.11x EAP support
- High density modulation mode (256QAM)
- Max data transfer rate: 1.3 Gbps

WiFi

silex technology

SX-SDMAC

802.11 a/b/g/n/ac Plus Bluetooth SDIO Wi-Fi Module

Features:
- Based on the QCA9377-3 Chipset
- Dual Band SDIO Wi-Fi Module with 802.11ac WLAN plus BT 4.1
- Link Rate up to 433 Mbps
- Bluetooth 4.1 BR/EDR/LE Smart Ready
- SDIO 3.0 WLAN Host Interface
- Pin Compatibility with SX-SDMAN Offers an Upgrade Path
- FCC/IC/ETSI/TELEC Modular Certification

SX-SDMGN-2830

Low Power embedded 802.11b/g/n SDIO Module

Features:
- IEEE 802.11b/g/n conformity (2.4 GHz)
- Single stream 1 x 1 SISO technology and 20MHz bandwidth mode. (Throughput up to 72.2Mbps)
- Low Power Consumption / Small Form Factor
- Data rates of 1 - 54 Mbps for 802.11b/g, 7.2 - 72.2 Mbps for 802.11n
- Support SDIO 2.0 as host interface for wireless LAN
- Supports TDMA/FDMA Bluetooth Coexistence
- 40 pin connector
- Upgrade Path to Dual-Band Solution

SD-320AN

Wireless Serial Device Server

Features
- Device Interface: Single serial port: RS-232
- Industry-leading security including WPA, WPA2, and WEP, plus 802.1x authentication with the most commonly used EAP types
- Dual band IEEE 802.11a/b/g/n support on the SD-320AN allows communication in the 2.4 GHz and 5 GHz bands. Radio interference in the commonly used 2.4 GHz band can be avoided by utilizing 5 GHz.
- 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).
- No special drivers or applications are needed to use the serial devices: Drivers and applications that worked when the serial device is directly connected to the computer will continue to work across the network connected to the SD-320AN.

SX-ND-4350WAN

Wireless Network Display Adapter

Features
- Wireless LAN access point
- Immediate response to touch input and Video, without visible latency
- Bidirectional data transfer with various USB devices
- Software that allows to search for NetDA devices, connect to and disconnect from monitor and query connection status
- Screen Sharing to any browser in same network

SX-ND-4350WAN is an interactive display adapter, and also functions as a wireless access point.

The product connects to the network and the display in a presentation or classroom environment.

ANT™

GARMIN

What is ANT™

ANT™ is a practical wireless sensor network protocol. It offers an ultra-low-power, short-range wireless technology running on the 2.4 GHz ISM band. It handles peer-to-peer, star, tree and fixed mesh topologies. Application examples for ad-hoc mesh techniques are also available.

More Information
www.rutronik-tec.com/ant
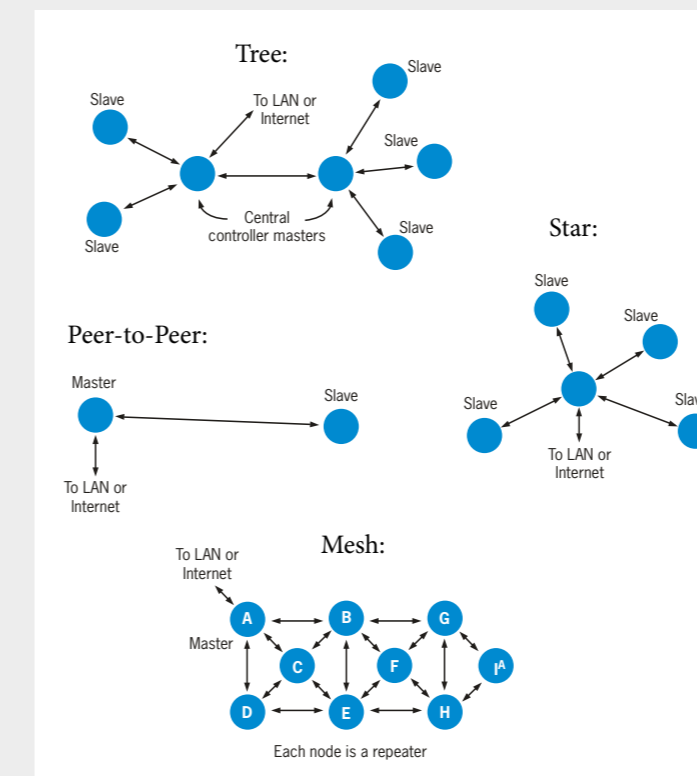
ANT USB Stick – ANT USB-m

Key Benefits
- The ANTUSB-m is a USB dongle that provides a quick and easy solution for Windows PC, Mac and Android equipment with an USB type A port to connect to ANT wireless networks
- Provides enhanced ANT core features, such as proximity search and frequency agility
- Up to 8 ANT channels available
- WHQL certified Windows driver for Windows XP, Vista, 7 and 8
- No driver installation required on Mac OS X10 and above

Key Features
- 78 selectable RF channel
- ANT channel combined message rate up to 190 Hz (8byte data playload)
- Minimum message rate per ANT channel 0.5 Hz
- Burst transfer rate up to 60 Kbps (true data throughput)
- -40 °C to +85 °C operating temperature

Application Fields
Applications running on computers or equipment often act as the hub node of a network. Through the use of the ANT USB stick the application can receive, store, analyze and display data collected from ANT sensors or other wearable or portable hub devices, e.g. watches and bike computers.
The application may also serve as the gateway to the Internet for cloud computing.
The ANTUSB-m is a miniature design. When plugged in, the majority of the body is buried inside the computer or equipment.

Intel Dual Band Wireless-AC M.2 Cards

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

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

More Speed
Up to six times faster, speedy enough to stream multiple Blu-Ray quality videos, Netflix movies and YouTube videos simultaneously

More Capacity
Up to three times the capacity, so your WiFi can handle more users, more devices, more high-quality video streaming and bigger downloads

More Coverage
Better speeds and reliability at greater distances from your WiFi Access Point, so you stay connected in more places

More Battery Life
Transfers data more quickly, so your devices use less power and last longer between charges.

Intel Dual Band Wireless-AC 9260

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.
The AX200 is coming with a PCIe interface for WiFi and a USB interface for Bluetooth 5. The AX201 is a CRF (Companion RF) module hat uses the Intel proprietary interface (CNVio2) and therefor can be only used with selected Intel chipsets and platforms.
Both the Intel WiFi 6 AX200 and AX201 support 2x2 WiFi 6 technology including new features as Uplink/Downlink OFDMA, 1024QAM and data rates up to 2.4 Gbps which results in smooth streaming of high resolution videos, fewer dropped connections and faster connections farther away from the router and in dense environments.

Type	Intel WiFi 6 AX200	Intel WiFi 6 AX201
Code Name	Cyclone Peak 2	Harrison Peak 2
Estimated SW Support until	Q4 2025	
TX/RX Streams	2x2	
Bands	2.4 GHz, 5 GHz, 160 MHz	
Max Speed	2.4 Gbps	
Integrated Bluetooth	V5	
Form Factor	M.2 2230; M.2 1216 (SMD)	
Supported Operating System	Windows 10, 64-bit, Google Chrome OS, Linux	
System Interface Type	PCIe (WiFi), USB (BT)	CNVio2

Intel Dual Band Wireless-AC 9260
The Intel Dual Band Wireless-AC 9260 supports the WLAN Standard IEEE 802.11ac and is the first WLAN module providing Gigabit Wi-Fi speeds with 1.73Gbps when using 160MHz 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.

Features
- WLAN standard IEEE 802.11ac
- Bluetooth v5
- Form factor: M.2 card
- Dimensions: 22mm x 30mm x 2.4mm
- Operating Temperature: 0 to +80 °C
- Security features:
  - WPA / WPA2 / 802.1X authentication
  - 64bit and 128bit WEP / 128bit AES-CCMP encryption
- TX/RX is 2×2
- Up to 1.73Gbps
- Interfaces: PCIe, USB
- Operating Systems: Microsoft Windows 10* OS, Linux, Chrome
- Supported under vPro
- FCC / IC / CE certified

Intel Dual Band Wireless-AC 9560
The Intel Dual Band Wireless-AC 9560 supports the WLAN standard 802.11ac and the Bluetooth version 5, which provides higher range (4x), faster transmission speed while reducing power consumption. Due to MU-MIMO and 160MHz channels with 1.73Gbps the Wireless-AC 9560 provides increased speed, fast downloads and long battery life.

Features
- WLAN standard 802.11ac
- Bluetooth v5
- Form factor: M.2 card
- Operating temperature: 0 °C to +80 °C
- Security features: WPA, WPA2, AES-CCMP
- TX/RX: 2×2
- Up to 1.73 Gbps
- uFL antenna connector
- Interfaces: PCIe, USB
- Operating systems: Microsoft Windows 10, Linux (limited feature support), Chrome
- FCC / IC / CE certified

Intel Dual Band Wireless-AC 8265
The Intel Dual Band Wireless-AC-8265 supports the WLAN Standard IEEE 802.11ac and the Bluetooth version 4.2. The 4th Generation of Intel Wireless Technology provides improvements in speed, capacity and coverage as well as battery lifetime. The module offers up to three times faster speed in bigger distance to the router, up to three times better network coverage and three times larger capacities as the downlink MU-MIMO allows a parallel connection of more devices to one network. Furthermore the Wireless-AC offers a longer battery lifetime due to a faster data transfer.

Features
- WLAN standard IEEE 802.11ac
- Bluetooth v4.2
- Form factor: M.2 card
- Operating Temperature: 0 to +80 °C
- Security features:
  - WPA / WPA2 / 802.1X authentication
  - 64 bit and 128 bit WEP / 128 bit AES-CCMP encryption
- Full support for latest Microsoft Windows 10 OS
- uFL antenna connector
- Interfaces: PCIe, USB
- FCC / IC / CE certified
- TX/RX is 2×2
- Up to 433 Mbit/s
- Up to 867 Mbps

Transponder Applications Examples

ISO and Hybrid Cards
Available 125 kHz, 13.56 MHz and UHF IC technologies. Cards can be customized with different personalization and encoding options.

Smartlabels and Tickets
Adhesive labels 13.56 MHz and UHF, CD/DVD labels and paper tickets.
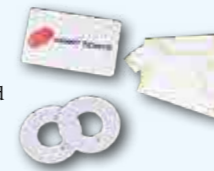
Special Tags
On-metal tags, high temperature tags, UHF hard tags, nail tags, etc.
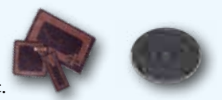
Keyfobs and Wristbands
All keyfobs and wristbands are waterproof and can be printed and personalized.

Disctags
These tags are all available with different diameters, with printing and with/without centre hole.

RFID

iDTRONIC

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

The RFID Stick Reader EVO is Available in the Following Versions

Freq.-Range	Frequency	Standard
UHF	868 – 916 MHz	Standard ISO 18000-6C incl. Class 1 Gen 2
HF	13.56 MHz	ISO 14443 A/B, ISO 15693 MIFARE Family

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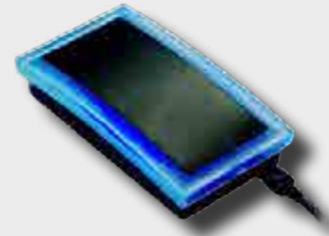
Product Features
- Dimensions: 125 x 70 x 26 mm
- Housing-Material: ABS
- Power Supply: 5 V_{DC} , via USB
- Operating Systems: Windows XP/7, Linux
- Antenna: Integrated
- Interface: USB 2.0, cable length 1.2 m

The Desktop Reader EVO is Available in the Following Versions

Freq.-Range	Supported Standards / Card Types
UHF	ISO 18000-6C incl. Class1 Gen2
HF	MIFARE® Classic 1K, 4K; MIFARE Ultralight®; MIFARE Pro; AT88RF020; 66CL160S; SR176; SRIX4K (TYPE-B); I-Code2; TI RFid Tag-it HF-I; EM4135; EM4034 Read only UID of all other ISO 14443A/B, ISO 15693 cards
LF	ISO 11784, ISO 11785
LEGIC	ISO 14443A/B; ISO 15693; LEGIC Prime/Advant
TEMIC	TEMIC 55x7

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 IP65 or IP54)
- Available for
  - UHF 860–960 MHz (ISO18000-6C, EPC Class1 Gen2),
  - HF 13.56 MHz (ISO15693, ISO14443, ISO 18000-3) and
  - LF 125 kHz (ISO18000-2, ISO11784/11785)
- Solutions for Near Field, Short-, Mid- and Long-Range appl.
- Contr. with integr. antenna or for running 1, 2 and 4 antennas
- Extended range of application specific antennas
- Outstanding read / write performance and reading distances
- Possibility of using different RFID standards in parallel in one application
- Multiple Interface Options (RS232/485, Ethernet, Profibus, etc.)
- 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 Read 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 RJ45 for UHF CX Controller)

Passive RFID Transponders – Overview

With its large portfolio of chips iDTRONIC covers the total frequency bandwith of LF, HF and UHF RFID Transponders.

Freq.	IC Version	ISO-Standard	Memory Cap.
LF	EM4200	ISO 11785 (FDX-B)	8 Byte
	EM4450/4550	ISO 11784 / 85	125 Byte
	Atmel Temic 5567	ISO/IEC 11784/785	28 Byte
	NXP Hitag 1	ISO 10536.1.	256 Byte
	NXP Hitag 2	ISO 10536.1.	32 Byte
	NXP Hitag S256	ISO 11784 / 85	32 Byte
	NXP Hitag S2048	ISO 11784 / 85	256 Byte
HF	NXP Mifare Ultralight (UL)	ISO 14443 A	64 Byte
	NXP Mifare Ultralight (UL) C	ISO 14443 A	192 Byte
	NXP Mifare Classic Mini	ISO 14443 A (1-3)	320 Byte
	NXP Mifare Classic 1K	ISO 14443 A	1024 Byte
	NXP Mifare Classic 4K	ISO 14443 A	4096 Byte
	NXP Mifare MF1S20 (mini)	ISO 14443 A	320 Byte
	NXP Mifare MF1S50 (1K)	ISO 14443 A	1024 Byte
	NXP Mifare MF1S70 (4K)	ISO 14443 A	4096 Byte
	NXP Mifare DESFire EV1 (2K)	ISO 14443 A (1-3)	2048 Bytes
HF	NXP Mifare DESFire EV1 (4K)	ISO 14443 A (1-3)	4096 Byte
	NXP Mifare DESFire EV1 (8K)	ISO 14443 A (1-3)	8192 Byte
	NXP I-Code SLI	ISO 15693	128 Byte
	NXP I-Code SLI-S	ISO 15693	256 Byte
	LEGIC MIM256	ISO 14443 A	256 Byte
	LEGIC MIM1024	ISO 14443 A	1024 Byte
	TI Tag-it HF-I	ISO 15693	256 Byte
	LEGIC Advant 1024	ISO 14443 / 15693	128 Byte
	LEGIC Advant 2048	ISO 14443 / 15693	256 Byte
	STM SRI512	ISO 14443 B	64 Byte
	STM LRI2K	ISO 15693	256 Byte
	STM SRI4K	ISO 14443 B	512 Byte
UHF	NXP NTAG203	ISO/IEC 14443A	168 Byte
	Alien UHF Higgs 3 Gen2	ISO/IEC 18000-6C	64 Byte
	UHF U-Code Gen2	ISO 18000-6C	16 Byte

Freq.-Range	Desktop Reader	Various Controller with integrated Antenna	Various Controller with up to 4 ports for external Antenna	M30 Cylindrical Reader (metal)	Various M18/M30 Cylindrical Antennas	Various other short range, mid range and long range Antennas
LF Reading Distance	Up to 10 cm	Up to 15 cm	Up to 30 cm	Up to 8 cm	Up to 11 cm	Up to 23 cm
HF Reading Distance	Up to 15 cm	Up to 15 cm	Up to 15 cm	Up to 12 cm	Up to 6 cm	Up to 30 cm
UHF Reading Distance	Up to 30 cm	Up to 3 m	Up to 10 m	up to 50 cm*	Up to 20 cm	Up to 10 m

*IP67

Internal Antennas

Manufacturer	Part	GSM/2G	UMTS/3G	LTE/4G	5G (Sub6Ghz)	ISM Standard	Bluetooth	WLAN	GNSS	Antenna Type	Frequencies	Peak Gain (dBi)	Efficiency (%)	Size (mm)	Polarization	Cable Length (mm)	Connector	Impedance
2J	2JF0415P					x				FPC / Adhesive	868 MHz / 915 MHz	2.7 / 3.6	58 / 77	25 x 70 x 0.2	Linear	100	U.FL compatible	50
	2JF0302Pa							x		FPC	2.4 GHz / 5 GHz	3.2 / 5.0	>50% / >64%	22.4 x 20.6 x 0.2	Linear	100	U.FL / I-PEX	50
	2JF0424P	x	x	x						FPC	968-960 MHz / 1710-2170 MHz / 2500-2700 MHz	1.5 / 3.1 / 3.5	58% / 74% / 61%	136.8 x 32.6 x 0.2	Linear	150	U.FL / I-PEX	50
	2JP0424P	x	x	x						FPC	968-960 MHz / 1710-2170 MHz / 2500-2700 MHz	1.2 / 4.0 / 5.6	56% / 66% / 78%	113 x 8.5 x 0.8	Linear	100	U.FL / I-PEX	50
AVX ethertronics	WxP3015W08							x		FPC	2.4-2.48 GHz / 5.15-5.85 GHz	< 3.0 / < 6.7	65% / 61%	30 x 15.5 x 0.8	Linear	100	U.FL compatible	50
	1002289	x	x	x						FPC	698-960 MHz / 1710-2690 MHz	* / *	7400% / 5800%	53.6 x 25.1 x 0.2	Linear	25	U.FL compatible	50
molex	1052630003	x	x	x						FPC / Adhesive	824-960 MHz / 1710-2690 MHz	2.2 / 3.0	*	106.7 x 13 x 0.1	Linear	200	U.FL compatible	50
	479501011					x	x	x		FPC / Adhesive	2.4 GHz / 5 GHz	3.0 / 4.8	>80 / >75	35.9 x 15.9 x 0.1	Linear	150	U.FL compatible	50
	1052620001					x				FPC / Adhesive	868 MHz / 915 MHz	0.4 / 1.4	*	79 x 10 x 0.1	Linear	100	U.FL / I-PEX	50
	2084820150					x	x	x		FPC / Adhesive	2.4 GHz / 5 GHz	3.2 / 5.7	62% (Port1), 72% (Port2) / 70% (Port1), 66% (Port2)	55.2 x 19.2 x 0.16	Linear	150	U.FL / I-PEX	50
	2065600100								x	FPC / Adhesive	1561 MHz / 1575 MHz / 1602 MHz	0.9 / 1.0 / 1.37	>72 / >72 / >73	40.4 x 15.4 x 0.1	Linear	100	U.FL / I-PEX	50

Manufacturer	Part	GSM/2G	UMTS/3G	LTE/4G	5G (Sub6Ghz)	ISM Standard	Bluetooth	WLAN	GNSS	Antenna Type	Frequencies	Peak Gain (dBi)	Efficiency (%)	Size (mm)	Polarization	Cable Length (mm)	Connector	Impedance
molex	2069950150				x	x	x			FPC / Adhesive	2.4 GHz / 5 GHz	2.6 / 3.4	>55 / >71	20.5 x 20.5 x 3	Linear	150	U.FL / I-PEX	50
	1462340100	x	x	x						FPC / Adhesive	698 MHz / 1500 MHz / 2.7 GHz	1.8 / 2.8 / 5.0	>70	140 x 20 x 0.1	Linear	100	U.FL / I-PEX	50
	2072350100	x	x	x						FPC / Adhesive	824 MHz / 1710 MHz	0 / 4.3	>30 / >60	40.4 x 15.4 x 0.1	Linear	100	U.FL / I-PEX	50
Pulse	W3915	x	x						x	PCB	880-960 MHz / 1710-2170 MHz / 1565-1605 MHz	1 / 2 / 0.5	50 / 75 / 55	74 x 19	Linear	100	U.FL compatible	50
	W3334B0150				x	x	x			Adhesive	2400-2500 MHz / 4900-6000 MHz	4 / 5.5	50 / 70	4.3 x 15.3 x 0.1	Linear	150	U.FL compatible	50
	W3554B0140	x	x	x						FPC / Adhesive	698-960 MHz / 1400-1600 MHz / 1710-2690 MHz / 3300-3800 MHz / 4900-6000 MHz	1.9 / 2.5 / 3.2 / 3.3 / 3.5	45 / 53 / 66 / 57 / 37	30 x 120 x 0.2	Linear	143	U.FL compatible	50
	W3312XXXXXX					x				FPC / Adhesive	863-928 MHz	0.8	45	75 x 15	Linear	100	U.FL compatible	50
Yageo	ANTX100P001B24553						x	x		PCB	2400 - 2500 MHz / 5150 - 5875 MHz	4.6 / 3.9	81 / 62	50 x 10 x 0,95	Linear	100	U.FL / I-PEX	50
	ANTX100P001BWPEN3		x	x						PCB	850-960 MHz / 1800-2100 MHz	5.1 / 5.0	68 / 76	50 x 10 x 0,95	Linear	100	U.FL / I-PEX	50

*Not specified by supplier

External Antennas

Manufacturer: 2J

Part	Picture	GSM / 2G	UMTS / 3G	LTE / 4G	5G (Sub6Ghz)	ISM Standard	Bluetooth	WLAN	GNSS	Antenna Type	Frequencies	Peak Gain (dBi)	Eff. (%)	VSWR	Size (mm)	Polarization	Cable Length (mm)	Connector	Impedance (Ohm)
2J3704M		x	x							Magnetic Mount	824 - 960 MHz	~1.7	~49	~1.6:1	30.9 x 71.5	Linear	3000	SMA-Male	50
											1710 - 2170 MHz	~0.3	~28	~1.8:1	30.9 x 71.5	Linear	3000	SMA-Male	50
2J6604B		x	x			x	x	x		Body Mount	824 - 2400 MHz	~2.2	*	<2.6:1	77.4 x 15.9	Linear	2500	FME-Female	50
2J6200PF		x	x						x	Adhesive Mount	824 - 960 MHz	~1.5	~43	~1.6:1	Ø77 x 12	Linear	3000	SMA-Male	50
											1710 - 2170 MHz	~0.5	~32	~2.4:1					
2J6602B						x	x	x		Screw Mount	2410 - 2490 GHz	~4.9	~48.7	~1.5:1	Ø77.3 x 15	Linear	3000	RP-SMA-Male	50
											4920 - 5925 GHz	~4.5	~29.2	~1.5:1					
2J5115-XXX						x				Adhesive Mount, Flexible	433/ 868/ 915 MHz	3,4	62,4	1,2	122 x 14 x 6	Linear	3000	multiple connectors available	50
2J0102						x	x	x		Connector Mount	2410 - 2490 GHz	~4.0	~60	~1.4:1	56 x 9.5	Linear	-	RP-SMA-Male	50
											4920 - 5925 GHz	~5.2	~83	~1.7:1					
2J6A24BA		x	x	x						Screw Mount	698 - 960 MHz	~0.8	~35	~2.8:1	Ø77.3 x 65.5	Linear	3000	SMA-Male	50
											1710 - 2170 MHz	~2.5	~51	~1.7:1	Ø77.3 x 65.6				
											2500 - 2700 MHz	~3.4	~49	~1.3:1	Ø77.3 x 65.7				
2J3024M		x	x	x						Magnetic Mount	698-960 MHz	~1.0	~47	~1.9:1	Ø31 x 72	Linear	3000	SMA-Male	50
											1710 - 2170 MHz	~2.4	~39	~1.5:1					
											2500 - 2700 MHz	~2.1	~36	~1.3:1					
2J6700B		x	x				x	x	x	Body Mount	824 - 2170 MHz	2.2 max	*	<2:1	77.3 x 36.5	Horizontal	2500	C1(Mobile): FME-Female; C2 (Navigation): SMA-Male	50
											1575.42 MHz	*	*	<1.2:1		RHCP			
2J0B15						x				Connector Mount	433/ 868/ 915 MHz	1.2	69.3	1.8	44-48 x 19,1 x 9	Linear	-	SMA-Male-R/A	50
2J6050PGF		x	x	x		x	x	x	x	Adhesive Mount	698-960 MHz	~2.9	~55.6	~2.2:1	80 x 76 x 16	Linear	3000	SMA-Male	
											1710 - 2170 MHz	~3.2	~56.0	~1.2:1					
											2500 - 2700 MHz	~2.1	~38.7	~2.2:1					
											2410 - 2490 MHz	~3.2	~50	~1.3:1				RP-SMA-Male	50
											4920 - 5925 MHz	~4.2	~30	~1.3:1					
											1575 - 1606 MHz	*	*	<=1.4:1 dB		RHCP		SMA-Male	
2J7624B		x	x	x		x	x	x	x	Screw Mount	698-960 MHz	2.6	56	2.1:1	Ø50 x 50.08	Linear	3000	SMA-Male	50
											1710 - 2170 MHz	3.2	56	1.8:1					
											2500 - 2700 MHz	1.4	38	2.5:1					
2jw1483		x	x	x	x					Connector Mount	617-960 MHz	0.4	~50	1.6	192 x 20 x 18	Linear	-	SMA-Male	50
											1427 - 2690 MHz	0.6	~52	1.7					
											3300 - 3800 MHz	1.6	~28	6.3					
2JW1183-C952B		x	x	x	x					Connector Mount	617-960 MHz	1.1	~37.1	2.0	135 x 19 x 10	Linear	-	SMA-Male	50
											1427 - 2690 MHz	0.5	~43.3	2.6					
											3300 - 5000 MHz	0.3	~35.1	2.3					
											5150 - 5925 MHz	1.6	~41.9	2.2					
2JW0124		x	x	x						Connector Mount	698-960 MHz	0.4	~62	2.4	171 x 38 x 13.8	Linear	-	(RP-)SMA-Male	50
											1710 - 2170 MHz	2.6	~75	1.6					
											2500 - 2700 MHz	1.3	~50	2.2					

Manufacturers: AVX ethertronics, chinmore, molex, Pulse

Manufacturer	Part	Picture	GSM / 2G	UMTS / 3G	LTE / 4G	5G (Sub6Ghz)	ISM Standard	Bluetooth	WLAN	GNSS	Antenna Type	Frequencies	Peak Gain (dBi)	Eff. (%)	VSWR	Size (mm)	Polarization	Cable Length (mm)	Connector	Impedance (Ohm)
AVX ethertronics	1002857									x	Helical	1575 MHz	~3.0	27	2.0:1 max	Ø15.0 x 34.93	RHCP	-	SMA-Male	50
	9000984						x				Screw Mount	790 MHz	~2.2	40	2.0:1	196 x 13	Linear	-	SMA-Male	50
												868 MHz	~2.2	80						
												915 MHz	~3.4	75						
	X9001546		x	x	x						Connector Mount	698-960 MHz	*	~40	*	168×18	Linear	-	SMA-Male	50
												1710 - 2690 MHz	*	~50	*					
chinmore	AA-C02MT07FME-397		x								Magnetic Mount	900 MHz	~0.45	75	1.26:1	Ø26.7 x 79	Linear	3000	FME-Female	50
												1800 MHz	~1.05	48	1.69:1					
	AA-C13M05SMA-1107		x								Magnetic Mount	900 MHz	~1.71	60	1.85:1	Ø52.2 x 343.7	Linear	3000	SMA-Male	50
												1800 MHz	~3.68	63	1.69:1					
	EM-B10.0X106-069						x	x			Connector Mount	2.4 GHz	~3.5	45	1.7:1	Ø67.5 x 108.0	Linear	-	SMA-Male	50
	EM-W117G-2ANT-240						x				Connector Mount	868 MHz	0~3	*	2.0:1	Ø37 x 112.6	Vertical	-	SMA-Male	50
	GS-10D174MCX-198									x	Adhesive Mount	1575.42 MHz	~3.8	*	2.0:1	38.2 x 34.2	RHCP	300	MCX-Male	50
	CA-C09-1SMAM-094		x								Adhesive Mount	840-960 MHz	~3.06	59	1.72:1	129.5 x 22.8	Linear	3000	SMA-Male (90°)	50
												1760 - 1860 MHz	~5.23	88	1.30:1					
	EM-B9.3X33.0-168						x	x			Connector Mount	2.4 GHz	1.3	*	2.0:1	Ø9.4 x 33	Vertical	-	SMA-Male	50
	EM-9.10X55.8-058		x	x							Connector Mount	824-960 MHz	~2.3	*	2.5:1	Ø6.5 x 56.6	Vertical	-	SMA-Male	50
												1710 - 2170 MHz	~2.5							
	EM-W79B-7ANT-108		x	x							Connector Mount	824 - 2170 MHz	~2.8	*	5.6:1	Ø9.3 x 114	Vertical	-	FME-Female	50
	CA-C09-1FMEF-019		x	x							Adhesive Mount	900 - 1800 MHz	~1,78	42	1.36:1	129.5 x 22.8	Linear	3000	FME-Female	50
													~4.77	81	1.45:1					
molex	2068663000						x	x	x	x	Adhesive Mount	824 - 1710 MHz	~0.5	21	3 max	Ø77 x 15	Linear, RHCP	3000	FAKRA	50
												1575 MHz	~2.7	23						
												2.4 GHz	3.0	27						
	W5028x						x	x	x		Connector Mount	2.4-2.5 GHz	1.9	>80	*	Ø10 x 128	Vertical	-	RP-SMA-Male	50
												5.15-5.85 GHz	3.8	>50						
Pulse	W5084x		x	x	x	x					Connector Mount	698-960 MHz	2	58	3 max	228.84	Vertical	-	TNC-Male/SMA-Male	50
												1400 - 2690 MHz	4	78	3.6 max					
												3400 - 3700 MHz	5	60	3 max					
	W5017									x	Connector Mount	868-928 MHz	0.9	70	2.5 max	179	Vertical	-	SMA-Male	50

RUTRONIK EMBEDDED

Linecard
Electromechanical Components

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.

Batteries, Thermal Management, Fuses & Relays

Electromechanical Components	3M	Adam Tech	ADDA	Alysium	Amphenol	Assmann WSW	AVX	C&K	Comus	Conquer	Coto	Delta	Diptronics	Eaton	EEMB	Finder	Fischer Elektronik	Fujitsu	Gradcom	HongFa	InnoTape	JAE	Jamicon	Keystone	Knitter-Switch	Kyocera	Littelfuse	Lumberg	Lutronic	Molex	MPE Garry	Nexem	NF Forward	Omron	Panasonic	Preci-Dip	Pulse	Relpol	Renata	RF Plast	Saft	Samsung SDI	Sauro	Schurter	Siba	Sumida
Batteries																																														
Lithium Ion																																										X				
Lithium Polymer						X																												X												
Nickel Batteries (NiMH, NiCd)																																		X												
Lead Acid																																		X												
Lithium Metal						X																												X			X		X							
Alkaline																																		X												
Battery Holder		X																						X										X												
Thermal Management																																														
AC Fans		X															X																													
DC Fans		X										X					X																													
CPU Cooler		X										X																																		
Blowers		X										X					X																													
Heatsinks					X												X																									X				
Heat Contacting Foils	X																X			X														X												
Heat Pads	X																X			X														X												
Fuses																																														
5x20 Fuses												X		X													X																	X	X
6.3x32 Fuses												X		X													X																	X	X
Automotive Fuses																											X																		
Subminiature Fuses												X		X													X																	X	X
SMT Fuses												X		X													X																	X	X
Resettable Fuses												X		X																															
Fuseholders 5x20												X		X													X																	X	X
Relays																																														
Signal Relays											X	X	X																	X	X		X												
HF Relays												X	X																	X			X												
Power Relays											X	X	X																	X	X	X	X												
Automotive Relays												X	X																	X	X														
Security Relays											X		X																	X			X												
Photomos Relays							X																										X												
Solid State Relays								X					X																	X															
Reed Sensor									X																																				
Reed Relays								X	X																																				
Reed Switch								X	X																																				
Proximity								X																																					
Tilt & Tip-Over Switches								X																																					
Timer Relays													X																					X											
Industrial Relays													X																					X											
Sockets													X	X																				X											

Switches, Connectors, Cables & Terminal Blocks

Electromechanical Components	3M	Adam Tech	ADDA	Alysium	Amphenol	Assmann WSW	AVX	C&K	Comus	Conquer	Coto	Delta	Diptronics	Eaton	EEMB	Finder	Fischer Elektronik	Fujitsu	Gradcom	HongFa	InnoTape	JAE	Jamicon	Keystone	Knitter-Switch	Kyocera	Littelfuse	Lumberg	Lutronic	Molex	MPE Garry	Nexem	NF Forward	Omron	Panasonic	Preci-Dip	Pulse	Relpol	Renata	RF Plast	Saft	Samsung SDI	Sauro	Schurter	Siba	Sumida
Switches																																														
Automotive Switches							X						X												X																			X		
Tact Switches							X						X												X									X	X											X
DIP Switches							X						X												X										X										X
Slide Switches							X						X												X																				X
Pushbutton Switches							X						X												X																				X
Rotary Position Switches							X																		X																				
Rotary Coded Switches							X						X												X													X							
Encoder Switches							X																		X															X					
Toggle Switches							X																		X																				
Membran Keypads																									X																		X	X	
Rubber Keypads																									X																		X	X	
Navigation Switches							X						X												X																				
Industrial Switches							X																		X																		X		
Rocker Switches							X																		X																		X		
Detect / Micro Switch							X						X												X																		X	X	
Interconnect Solutions / Connectors																																														
Board to Board	X	X			X	X	X															X				X				X	X			X	X	X							X		
Wire to Board	X	X			X	X	X															X								X				X	X	X									
Wire to Wire	X	X			X	X	X															X								X					X	X									
Crimp Terminals		X			X	X	X															X								X					X	X									
FFC/FPC		X		X	X	X	X															X								X			X		X										
Socket		X			X	X	X																							X					X				X						
USB		X			X	X	X																							X													X		
USB Type C		X			X	X	X															X								X													X		
Memory	X	X			X	X	X	X														X								X					X										
Audio/Video		X			X	X	X															X								X						X									
Modular Jacks		X			X	X	X																							X											X				
Power Inlet, Power Outlet, IEC 60320, Valve		X			X	X	X																							X			X										X		
D-Sub		X			X	X	X																							X													X		
High Speed		X			X	X	X																							X											X				
FAKRA		X			X																									X															
DIN 41612	X	X			X	X	X	X																																					
DIN Connector, Mini I/O, Chinch, Military, Tool, Audio, DC Power		X			X	X	X																												X										
Circular Connectors M8, M12, others		X			X	X	X																																	X		X			
EV charging AC, DC, Combined		X			X																								Lutronic X																
Coaxial Connector		X			X	X	X																					Lumberg X											X						
Terminal Blocks		X			X	X	X																										X												
Accessory like Jumper, Cap, Holder, Clip		X																																				X						X	
Customized Connect.		X			X	X	X	X																						X			X							X	X				
Tools		X																															X					X	X						
Cable & Cable Assembly																																														
Round Cable		X		X	X	X																																								
Flat Cable	X			X	X		X																																							
FFC/FPC		X		X	X	X	X																												X				X						
Accessory like Cable Tie		X																																											
Standard Assembly, PnP cable (like Patch Cable)	X	X		X	X																									X									X						
Customized Assembly		X		X	X	X	X																							X								X							X

Electromechanical Components

I/O Connector
Amphenol ICC
USB Type-C Connector

Features
- Similar size as Micro USB
- Tailored for emerging product designs
- Supports high speed transmission up to 10Gb/s
- Up to 10,000 mating cycles
- Extended 5A current rating for USB Power delivery

Benefits
- Reversible plug and cable orientation for better user experience
- Smaller connector size saves space
- Meets USB power delivery protocol
- Supports audio and video signal output with alternate mode

Wire-to-Wire Connector
Amphenol
Heavymate, MPN Series C146

- Hybrid interconnection
- High current up to 250 A
- Pole size from 3 up to 280 poles
- Voltage up to 1000 V
- IP65 to IP68
- High corrosion resistance
- Superior contact technology (Radsok & stamped contacts)
- Very robust & vibration proof housing

I/O Connector
JAE

DX07 – USB Type-C Connector

receptacle front view

plug with paddle card

receptacle top mount
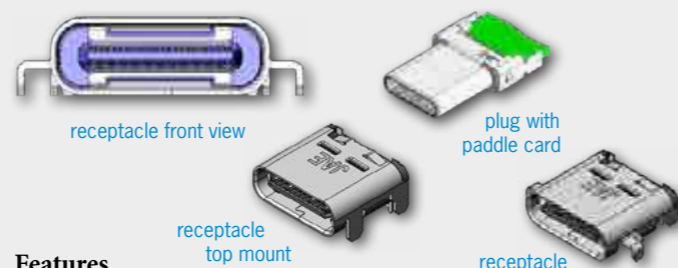
receptacle

Features
- Reversible plug that enables insertion and removal in the right side up or up side down orientation
- Supports USB 3.1/3.2 transmission speeds of up to 20 Gbps
- Maximum 5 A of power
- Includes plugs, receptacles and harnesses – 2 waterproofed versions available

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

Board-to-Board Connector
Amphenol ICC
Airmax Backplane Connectors
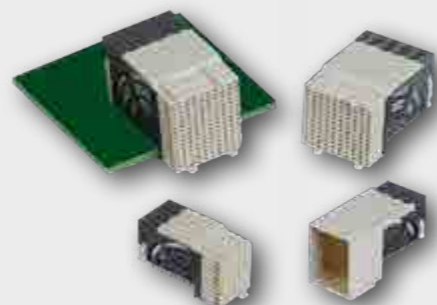
Features
- Up to 25 Gbs per differential pair
- Over 10 years history of high volume production
- Full product platform (right angle, coplanar, orthogonal, cable.
- PCIe, CompactPCI, SAS, SBB, SSI, OIF 25G, QPI 8G

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

Wire-to-Board Connector
AVX INTERCONNECT
A KYOCERA GROUP COMPANY

Series 70-9296
Single contacts
- Flat
- Low cost
- Coplanar
- PCB mating

Series 00-9296
Poke Home Vertical Top Entry
- Unique 1-piece vertical WTB to compete with 2-piece

Series 9176-500
Single IDC contact
- Low cost
- Single
- Gas tight

Series 9176-700
Capped IDC
- Integrated cap
- Simplifies assembly

Series 70-9159
Single 2pc contacts
- Flat
- Low cost
- Coplanar
- PCB mating

High-Power Connectors
Amphenol
RADLOK™

Features
- DC Voltage Rating: 1000 V;
- Current Rating: 70 A - 400 A
- Tool-Free Mechanical Locking
- High cycle durability (500 mating cycles)
- Operating temperature -40 °C to +125 °C

Benefits
- Quick locking feature to replace a cable lug
- Pre-assembled & supplied with cable
- Reliable, easy to install, rugged, and cost effective
- Colors: orange, red, and black

FFC Cable & Connector Solutions
ALYSIUM
Alysium FFC

Features
- Pitch: 1.25 mm / 1.0 mm / 0.5 mm
- Shielding for high frequency applications

Benefits
- High density
- Reduced connection costs
- Custom design
- Easy to insert

Modular Jacks
ADAM TECH
MTJ Series

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
- Through-hole or SMT mounting

Memory & Media Card Reader
Amphenol

Features
- Operating temperature: -20°C to +60°C
- Mechanical lifetime 300,000 mating cycles
- SMT and TMT available
- Secure contact to all cards designed according to ISO 7816

Benefits
- Highly reliable data transmission
- Landing, self-cleaning contacts
- Suitable for automatic reflow process or wave soldering
- Correct orientation of SIM card

Memory & Media Card Reader
molex

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

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

Power Supply Connector — **mpe** GARRY

Power In- and Outlets IEC 60320

Features
- 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,

Amphenol ICC

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 RJ45
- Ensures high temperature resistance

Fuses — SCHURTER ELECTRONIC COMPONENTS

SMD-Chip Fuses

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

Type
USFF 1206, USF 1206, USI 1206, UST 1206, USF 0603, USF 0402

Features and Benefits
- Numerous current ratings from 50 mA to 25 A
- High rated voltages up to 125 V_{AC} / V_{DC}
- 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 — SCHURTER ELECTRONIC COMPONENTS

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

DIN Rail Mounting

Description
- Chassis: DIN rail montage
- 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

Relays — finder · OMRON · relpol S.A.

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

Switches — C&K

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, thumbwheel 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 component for all application-specific requirements.

CRD Series
10mm DIP Coded Rotary Switches

- Process sealed – withstands soldering and cleaning
- Thru-hole & 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
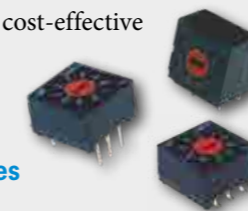
RTE Series
Low Profile Rotary DIP Switches

- Miniature size with robust metal cover
- 2, 3, 4, 10 and 16 positions
- Variety of codings available
- Vertical and reverse versions
- 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

JAMICON®

Kaimei 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.

Kaimei 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
- Dialectric 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)

Model No.	JF0825B1EK01CCGJKR	JF0925B1EK00CCGJKR	KF1225B1LK02CCGJJR
Dimension (mm)	80x80x25	92x92x25	120x120x25
Type	DC	DC	DC
Voltage (V)	12	12	12
Bearing	2 Ball	2 Ball	2 Ball
Airflow (CFM)	18.93	30.86	56.29
Noise (dBA)	13.9	23.1	27.2
Speed (RPM)	1500	1700	1500
Input Power (W)	0.72	1.08	1.56
Input Current (A)	0.06	0.09	0.13
Cable Length (mm)	290+-10 mm	285+-10 mm	265+-10 mm
Rutronik No.	FAN4030	FAN4031	FAN4032
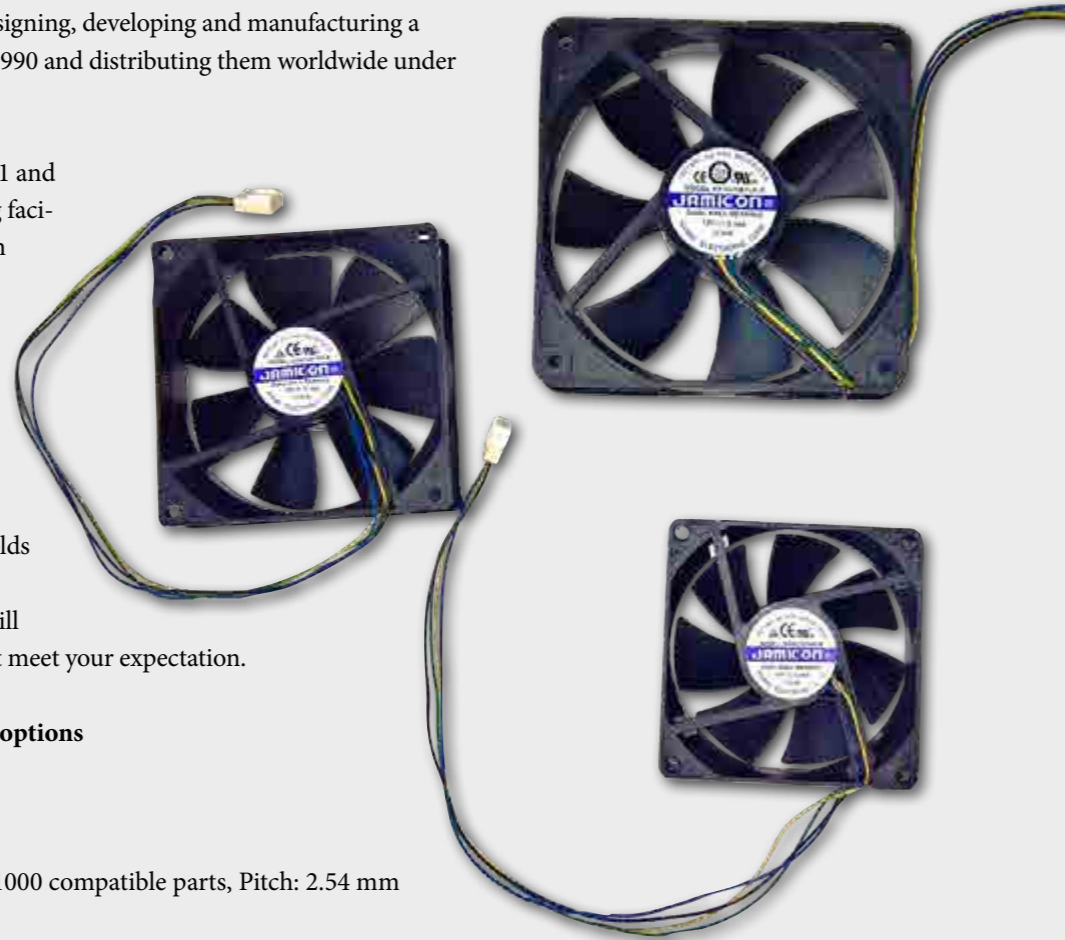
Cases

Aluminum & Design Cases

fischer elektronik
to cool to protect to connect

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

Aluminum Cases
- Shell and extruded assembled cases
- Combination cases
- Tube cases
- Heat dissipation cases
- Miniature Aluminum cases
- Customized cases

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

Heatsinks
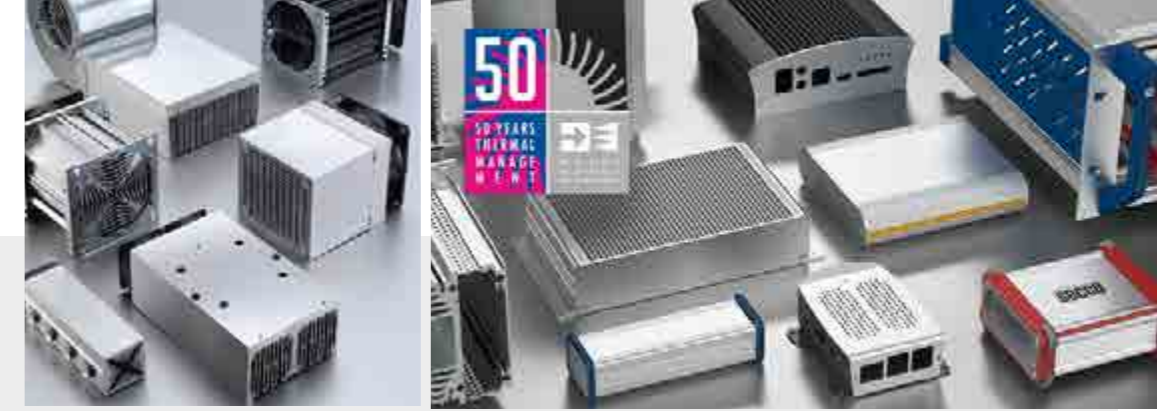
ASSMANN WSW components

Heatsinks with Solder Pin

- With solder pin
- Retaining spring for transistors
- Delivered in black anodized finish
- Thermal resistance 6 to 16K/W

Attachable Heatsinks

- For TO-220 packages
- For TO-220 packages with straight solder pin
- For TO-220 packages with angled solder pin
- Thermal resistance >16K/W

Small Heatsinks

- Heatsinks for IC-module
- U-heatsinks for transistor TO-220 packages
- Special heats. for TO-220/SOT-32 packages
- SMD heatsink for D-Pak packages
- Stamped finger-shaped heatsinks
- Thermal resistance > 16K/W

Stamped CPU Heatsink

For PGA (pin grid array), BGA (ball grid array) and other high power components.

The new development series is a combination of cross-cut and finger-shaped heatsinks. Optimally used to mount the heatsink on the PCS via „Push Pins".

Advantages
The advantage of this new heatsink design improves the air convection.

Optional
- Alternative material thickness
- Modifications of all dimensions and perforations
- Special surface treatments
- Customer made heatsink attachement methods
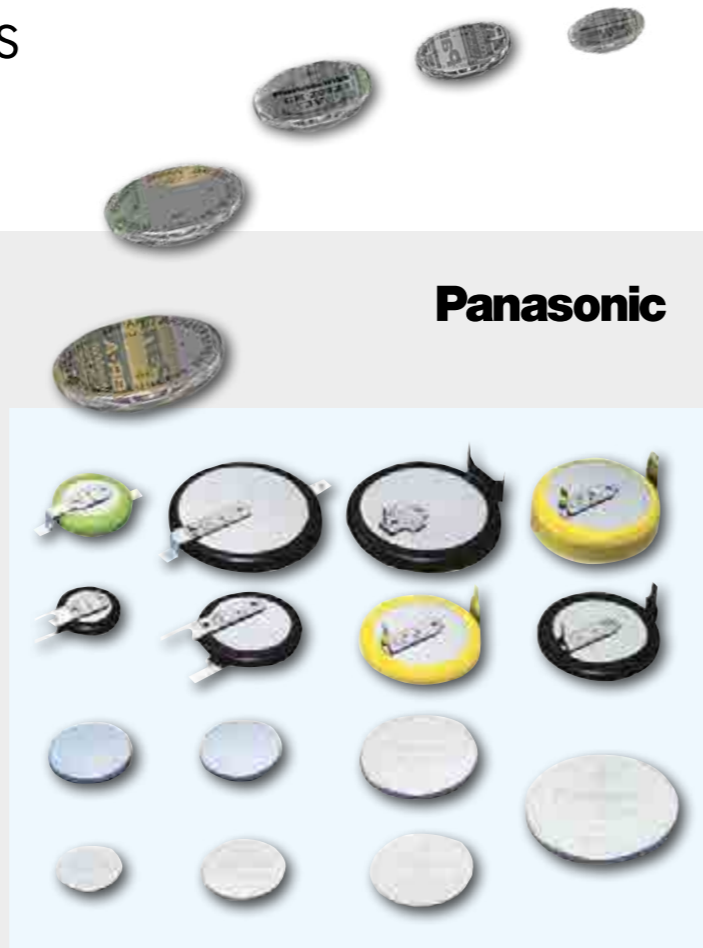
Heatsink on PCB
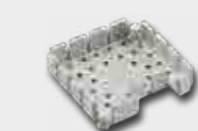
Stamped CPU heatsink

Stamped CPU heatsink + thermal pad

Electromechanical Components

Batteries

Lithium Metal Coin Cells

Panasonic

Features	Benefits
Wide portfolio of coin sizes and variety of pin types	Different ways of contacting at different space
• Low self discharge rates • High energy desities up to 375 Wh/kg • Wide temperature range	Long-term energy, reliability and storability
Direct support at the world leading manufacturer of lithium metal coin cells	High quality, best technical solution, safety and conformity
Unique diversity of technologies	Special series for lasting back-up (BR), rechargeable usage (VL,ML,MT), high temp. up to 125°C (BR-A)

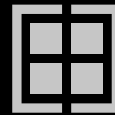| Type	Primary Battery		Rechargeable Battery		
	CR	BR	VL	ML	MT
Material Anode	MnO2	(CF)n	V2O5	LixMnOy	LixOy
Material Kathode	Li	Li	LiAl	LiAl	LixTiOy
Nom. Voltage (V)	3.0	3.0	3.0	3.0	1.5
Operating Temp. Range (°C)	−30 to +60	−30 to +80	−20 to +60	−20 to +60	−10 to +60
Self-discharge (per year) under standard conditions	1.0 %	1.0 %	2.0 %	2.0 %	2.0 %
Average Discharge Voltage (V)	-	-	2.85	2.5	1.2
Charge Voltage (V)	-	-	3.25 to 3.55	2.8 to 3.2	1.6 to 2.6
Cut-off Voltage (V)	2.0	2.0	2.5	2.0	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 1V or discharge limit voltage (charge/discharge for 100% of discharge depth)

Battery Holders

Variety of Battery Holders

KEYSTONE ELECTRONICS CORP.

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

Committed to excellence

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