

Intel® Atom® processors x7000RE Series is Designed for Industry 4.0



Digitization, automation, artificial intelligence and robotics are technologies coming together to drive Industry 4.0 initiatives in manufacturing companies worldwide. The promise of Industry 4.0 is a more connected, automated, safe and reliable manufacturing line that has the ability to analyze product defects or machine conditions and resolve issues or alert staff before there is a problem.

Implementing these initiatives, however, requires a lot of compute power located on factory floors and at network edge locations to power controllers, sensor networks, AI inferencing, industrial PCs, robotic arms and other systems.

Intel® architecture CPUs and other technologies have long played a key role in industrial solutions offering low power processors that have a wide temperature range and up to a 10-year lifespan. The Intel® Atom® x7000RE Series Processor is the latest generation of the company's value CPUs for industry. This single chip solution offers high performance at low power with integrated features that meet the needs of the most demanding Industry 4.0 applications. The Intel Atom processors x7000RE Series are based on Intel® 7nm process technology (Gracemont micro-architecture).

Table 1 lists the specifications for the four models in the product family. The Intel Atom processors x7000RE Series is designed with more cores and higher base frequency range than the previous generation Intel Atom processors x6000E Series, providing more processing capacity and flexibility for edge Industry 4.0 projects.

Some of the features built into this CPU family include:

Intel Atom Processors x7000RE Features

Environmental Ruggedization

The Intel Atom processors x7000RE Series is designed to run in industrial use conditions (up to 10 years at 100% activity at base frequency with no turbo). The device family has an extended temperature range of -40°C to 105°C. The Intel Atom processors x7000RE Series is also designed to withstand high levels of shock and vibration.

Value-Driven Performance

The Intel Atom processors x7000RE Series products feature between two cores and eight cores of highly efficient, value-driven data processing for a wide range of applications. The cores operate at between 1.0 GHz and 2.0 GHz with a burst mode of up to 3.6 GHz. In addition, the CPUs support Intel® Advanced Vector Extensions (Intel® AVX) which are designed to achieve high throughput in integer and floating point operations. The devices also support the Vector Neural Network Instructions (VNNI) which are part of the AVX-256 instruction set and accelerate convolutional neural network-based algorithms. The CPUs support fast memory accepting LPDDR5/DDR5/DDR4 memory modules with support for In Band Error Correction Code (IB ECC).

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Brand		Intel Atom x7211RE	Intel Atom x7213RE	Intel Atom x7433RE	Intel Atom x7835RE
Use Condition		Embedded, Industrial, Communication			
Junction Temperature (T _j)		-40 ~ 105°C			
TDP		6W	9W	9W	12W
CPU	Core Count	2	2	4	8
	HFM	1.0GHz	2.0GHz	1.5GHz	1.3GHz
	1C Turbo	3.2GHz	3.4GHz	3.4GHz	3.6GHz
	MC Turbo	2.9GHz	2.9GHz	2.7GHz	3.0GHz
GPU	EU Count	16	16	32	32
	HFM	400MHz	600MHz	600MHz	800MHz
	Turbo	1.0GHz	1.0GHz	1.0GHz	1.2GHz
Intel® TCC		Yes	Yes	Yes	Yes
TSN GbE MAC		Yes	Yes	Yes	Yes
Memory		4x16 LPDDR5 4800 MT/s 2x32 DDR5 4800 MT/s 1x64 DDR4 3200 MT/s Single Channel			
Display		3 Display Port, 4K60 HDR (1 pipe/1 port)			
HSIO		x9 configurable PCH HSIO lanes			
CNVi		No	No	No	No
IPU		Yes	No	Yes	Yes
TCSS		5Gbps	5Gbps	5Gbps	5Gbps

Table 1. Intel Atom processors x7000RE Series product SKUs.

Low TDP

The Intel Atom product family is Intel's premiere low-power line of processors, and the Intel Atom processors x7000RE Series live up to this with a thermal design power (TDP) ranging from 6W-12W. This power efficiency delivers higher performance per Watt and allows the devices to be used in smaller form factors.

UHD Graphics Processor Unit (GPU)

The Intel Atom processors x7000RE Series features an integrated graphics processing unit (GPU) that supports UHD (4k) graphics with three independent display outlets or can provide processing power for AI inference acceleration. The GPU features up to 32 execution units (EU) and a base clock speed of between 400MHz and 800MHz. The GPU can process all major data types including INT8.

Real-Time Workloads

To enable simultaneous processing of real-time workloads and best-effort workloads, the Intel Atom processors x7000RE Series supports Intel® Time-Coordinated Computing (Intel® TCC) including enhancements for IEEE 802.1 Time-Sensitive Networking (TSN). Intel TCC is a set of silicon and software optimizations that enable accurate clock synchronization and improved timeliness to reduce latencies. These timing technologies support smoother factory operations for applications such as robotics or advanced control. The Intel Atom processors x7000RE Series includes support for TSN over wireless and wired converged networks.

Functional Safety (FuSa) Feature¹

Increasingly important in industrial robotic applications, functional safety (FuSa) eliminates the risk of hazards that are caused by malfunctioning electrical or electronic systems. The new Intel Atom processors x7000FE Series will be designed with the features to meet the industrial FuSa standards (IEC 61508). This means incorporating FuSa hardware and software features in the CPUs with documentation for these features. They are also designed to meet a FuSa lifecycle.

¹will be only available on the new Intel Atom processors Series x7000FE

Wide Software Support

The Intel Atom processors x7000RE Series benefits from support for a wide variety of operating systems, real-time operating systems, hypervisors and boot firmware (see Table 3). In addition, the system supports two AI-specific software development kits:

- Intel® oneAPI Base Toolkit: is an open, standards-based, unified programming model that simplifies development and deployment of data-centric workloads across CPUs, GPUs, FPGAs and other accelerators.
- Intel® Distribution of OpenVINO™: Is a software toolkit for creating portable AI models and deploying industrial AI workloads faster.

Intel® Edge Controls for Industrial

Intel® Edge Controls for Industrial is a software reference platform that converges edge computing, artificial intelligence (AI), and real-time analytics to deliver best-in-breed industrial solutions. The platform delivers time-deterministic compute in a dense compute environment and adapts IT software including containerization, virtualization, and orchestration for industrial-grade requirements for real-time compute and high levels of operational availability. Its key features include:

- Time deterministic compute
- Workload convergence
- Application and platform management
- Industrial connectivity
- Controls application
- Functional safety

By harmonizing these features in a modular, usage-driven framework, Intel Edge Controls for Industrial makes it possible to develop and deploy solutions that take individual use cases and needs into account.

Application Categories

Some of the application categories that the Intel Atom processors x7000RE Series is designed for include:

Human Machine Interface

HMI allows operators to monitor the state of a process under control, modify control settings and manually override automatic control operations in the event of an emergency. These systems need the ruggedized nature of the Intel Atom processors x7000RE Series. The small size and low TDP of the devices make them ideal for portable HMI systems that are fanless or must support a wide temperature range.

Real-Time Applications

The Intel Atom processors x7000RE Series have been designed and tested to run in real-time factory floor applications such as machine controller or AI-based defect detection applications where the CPU must analyze sensor input and act on the data in real-time. For these applications, the efficient performance of the CPU cores is important as is the support for Intel TCC for real-time performance.

Artificial Intelligence / Machine Learning

The Intel Atom processors x7000RE Series have the features and performance to bring AI / ML to the factory floor quickly to stay competitive. Processing performance is provided by highly efficient cores, in addition to built-in GPU, and Intel® AVX2 with INT8 support. Additional GPUs, FPGAs or other accelerators can be added using PCIe Gen 3.0 lanes (up to nine). The Intel Atom processors x7000RE Series supports the Intel Distribution of OpenVINO toolkit which enhances industrial edge appliances with powerful AI acceleration.

Harsh Environment

Industrial systems are often installed outside of environmentally controlled locations and that exposure to temperature extremes can reduce uptime. With its extended temperature support, the Intel Atom processors x7000RE Series can work in systems that must operate in harsh locations like process controllers or industrial PCs deployed in outdoor locations. The CPU family's low TDP provides op-

portunities for fanless systems. The Intel Atom processors x7000RE Series is also engineered to withstand high levels of shock, vibration enabling the system to be on or near machinery with significant vibrations.

Industrial Connectivity

Connectivity is critical for Industry 4.0 applications, especially those that use robotics, industrial gateways or other systems. The Intel Atom processors x7000RE Series supports a full range of wired and wireless industrial connectivity features including:

Technology	CPU Options
PCIe	Up to 9x 1PCIe 3.0 lanes
USB	Up to 8xUSB 2.0 Up to 4xUSB 3.2 2xType C
Wireless	Wi-Fi 6E & Bluetooth 5.3
MIPI-CSI	8x MIPI-CSI
Ethernet	Up to 1x 2.5GbE Ethernet with TSN

Table 2. Connectivity options for Intel Atom processors x7000RE.

The Key to Smart Industrial Products

Within these applications, there are a number of products that can make use of the CPU. Some of these products include (see also Figure 1):

- Robotic controllers
- Motion controllers
- Programmable logic controller
- Data acquisition monitoring & diagnostics
- Remote management
- Legacy application portability

Category	Operating Systems / SDKs / Bootloaders/Hypervisors
Operating Systems	Windows 10 IoT Enterprise LTSC 2021
	Ubuntu, RHEL, WR Linux
	Celadon CiV (Android optimized for IA)
RTOS	Wind River VxWorks, QNX
	Zephyr RTOS
Hypervisors	KVM
	Real-Time Hypervisor
Boot Firmware	UEFI/BIOS and Intel® FSP
	Slim Bootloader and Intel® FSP
SDK	Intel oneAPI (base & IoT toolkits)
	OpenVINO

Table 3. Intel Atom processors x7000RE Series software compatibility.

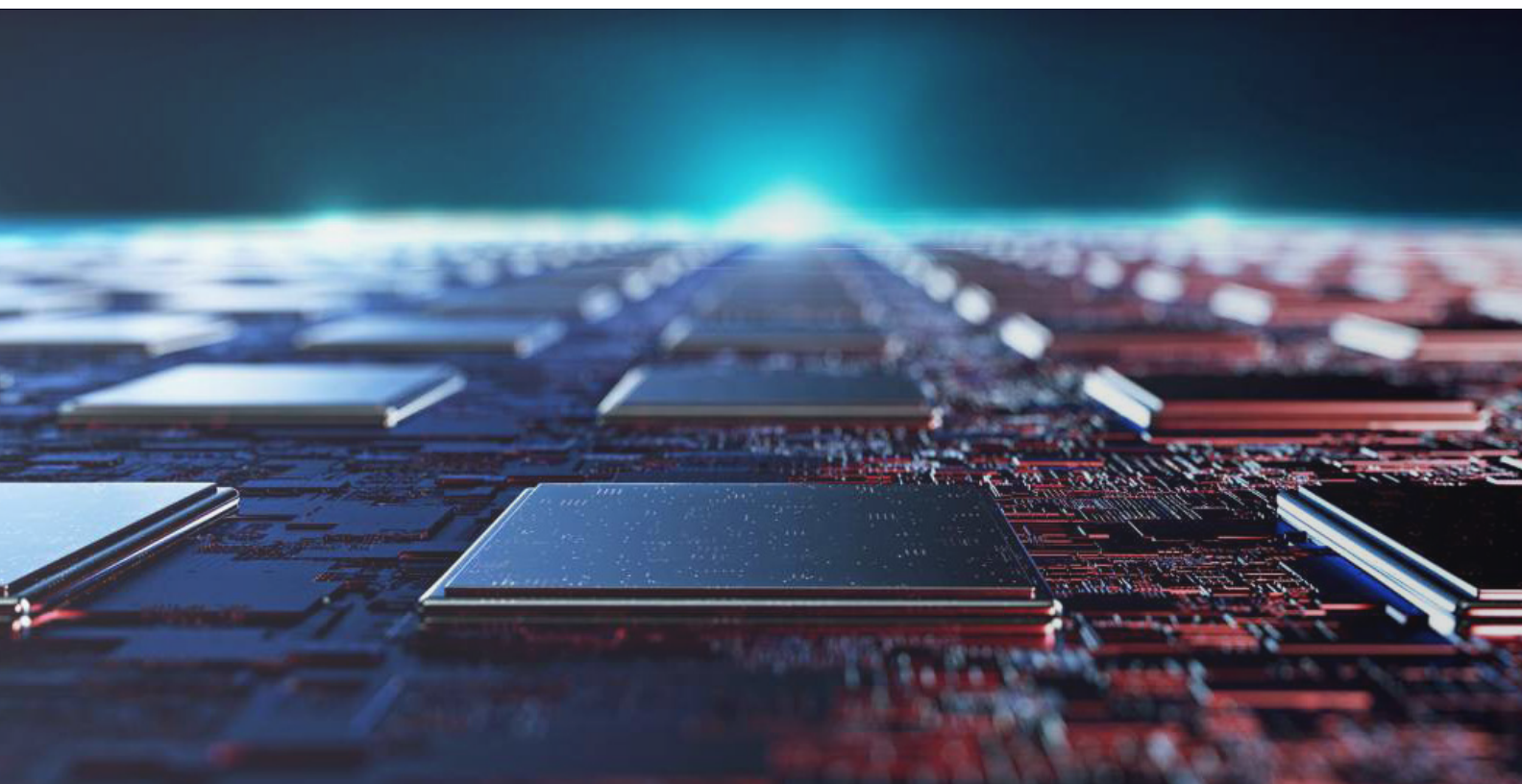


Figure 1. Markets and products for the Intel Atom processors x7000RE Series CPUs.

Conclusion

The Intel Atom processors x7000RE Series gives manufacturing companies cost-effective, ruggedized and low power edge compute performance. Advanced Industry 4.0 applications need value-driven performance to enable AI-based process improvement initiatives. The ruggedized nature of the device ensures 24 by 7 operation for up to 10 years in an

extended temperature range environment where vibrations and shock are present. Intel Atom processors x7000RE Series are for systems that will drive Industry 4.0 initiatives to improve manufacturing operations and help companies to realize better output with lower downtime, reduced operating cost through AI and safer factories for workers.



Learn More

[Intel Atom Processors x7000RE Series for the Edge](#)

[Intel Edge Controls for Industrial](#)

[Gracemont microarchitecture technical description](#)

Performance and Benchmarks

For more complete information about performance and benchmark results, visit intel.com/PerformanceIndex.

Industrial use conditions of up to 10 years, up to 100% active, no turbo, extended temperature (-40° C to 105° C).

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