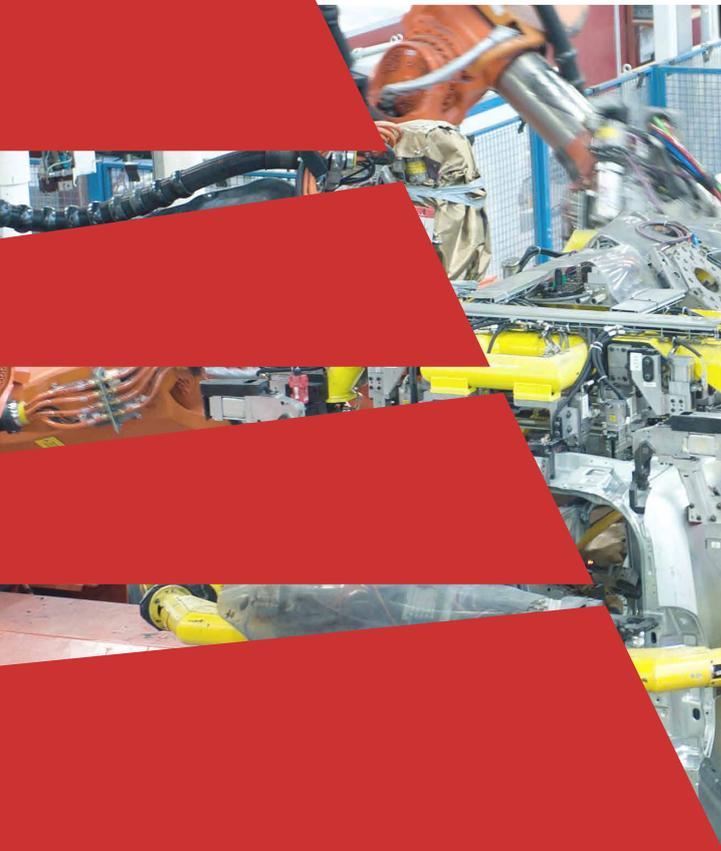


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# *Optimized Versatility*



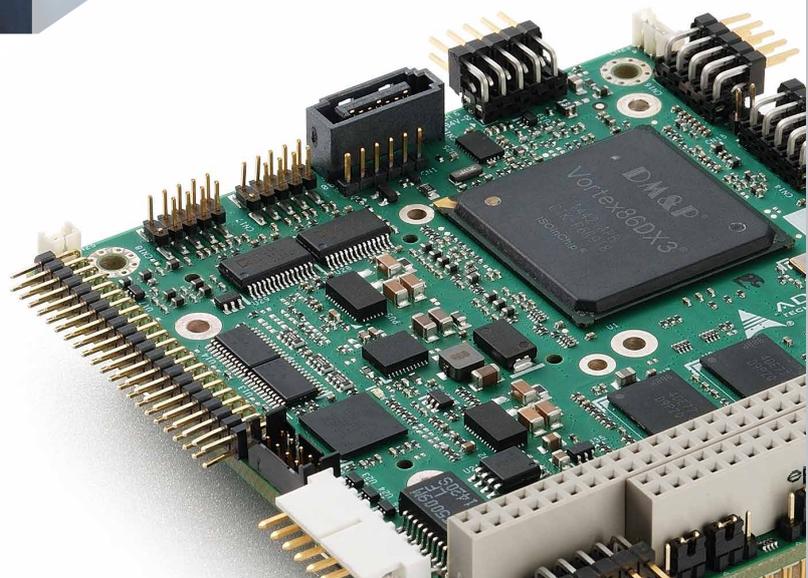
## **PC/104**

ADLINK's PC/104 solution family delivers compact, modular flexibility combined with industry-proven performance and durability



For military, medical, automation, and a range of similar verticals, PC/104 delivers a wealth of proven benefits. The form factor's stackable design allows for excellent scalability mixed with compute density and x86-based programming ease. For embedded applications where cost, size, and/or weight restraints are key, PC/104 can provide the cost-effective, capable solutions organizations need to support legacy and forward-looking efforts simultaneously.

Common wisdom is clear: Don't fix what isn't broken. For decades, the PC/104 form factor has spanned many generations of processors and interfaces, always with the goal of making computing solutions as compact, modular, and enduring as possible. PC/104 remains the favored form factor for embedded solutions in markets where vibration, fluctuating power, granular debris, and round-the-clock use can't be allowed to interrupt critical application uptime.



In 1992, twelve of the computing industry's top systems companies formed the PC/104 Consortium to help adapt proven desktop technologies into embedded applications. One of these founders, Ampro, brought 16 years of PC/104 leadership and innovation when ADLINK Technology acquired it in 2008. Ever since, ADLINK has helped lead the charge by keeping PC/104 amply supported, relevant, and able to meet next-generation embedded needs.

ADLINK boasts world-renowned leadership in many embedded technologies, including being an Executive Member of the PCI Industrial Computer Manufacturers Group (PICMG) and a Premier Member of the Intel® Internet of Things Solutions Alliance. Most recently, ADLINK partnered with NVIDIA to become part of the graphics leader's "AI at the Edge" initiatives. All this cooperation serves to inform and extend ADLINK's work with PC/104 and the PC/104 Consortium, of which ADLINK's Roy Keeler is now vice president.

ADLINK's vision for PC/104 remains timeless: to design, manufacture, and support the world's most dependable and flexible product family built for demanding, SWaP-sensitive (size, weight, and power) applications. Some of these may require the fastest possible processors, such as the Intel® Core™ i7.

Others may need extremely low-power chips meant to survive for decades on solar energy. Across the PC/104 spectrum, ADLINK leverages its Asia-based manufacturing facilities to meet all production needs with assiduous attention to solution validation and quality control.

That mission of bringing desktop advantages into embedded PC/104 products has never faltered. Just as the latest interfaces and components now enable clients with next-gen capabilities in technologies such as artificial intelligence and virtual reality, so too will manufacturers like ADLINK bring these features to the embedded market via PC/104. With so much data to amass and analyze in an Internet of Things-centric world, "AI at the edge" will only become increasingly critical. PC/104 platforms bring that versatile world within reach.



## The PC/104 Advantage

The original PC/104 specification spent five years in development, from when it was originally conceived within Ampro in 1987 to final ratification by the PC/104 Consortium. In those early days, the IBM PC was king, and the AT platform's ISA bus became the industry's de facto internal data connectivity interface for several years starting in the mid-1980s. Many markets, especially the military, wanted to enjoy the benefits of desktop computing but without the costs commonly associated with proprietary military computing designs. However, these markets also needed industrial- and military-class ruggedness in their designs. PC/104, built around ISA bus technology, became the answer.

From its inception, PC/104 was designed to be flexible for the integration of future developments. For example, the PCI bus

superseded ISA and hit its mainstream stride in 1994. Three years later, the PC/104 Consortium released the PC/104-Plus specification, which supported both ISA and PCI on one board, providing both legacy and contemporary solution support. For several generations of processor platforms, this flexibility was a PC/104 hallmark.

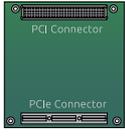
All PC/104 variants feature stackable modularity. Unlike form factors that require boards to be plugged into large, costly backplanes, PC/104 boards can stack and slot into one another with the simplicity of building blocks. This enables remarkably compact yet robust designs, such as solutions for the United Launch Alliance's 4 x 4 x 4 inch CubeSat platform. Despite boasting a nearly 30-year history, PC/104 shows every sign of remaining essential throughout the embedded market and expanding its reach into new applications, especially where high-compute, low-power needs dominate at network edges.

# PC/104: Facts in Brief

Conventional desktop motherboards (e.g., microATX) can be adapted for rugged, high-vibration environments, but doing so requires significantly larger, heavier cases and special mountings to secure add-on cards. For comparison, imagine the precautions involved in transporting a wall-sized pane of glass at speed down a dirt road compared to transporting a small window. Size alone can impact the durability of a board, which is why PC/104 is more resistant to stress than larger form factors, even when stacked to several layers. ADLINK also outfits some of its PC/104 models with "Extreme Rugged" environmental tolerances, such as operating temperatures from -40°C to +85°C and conformal coating.

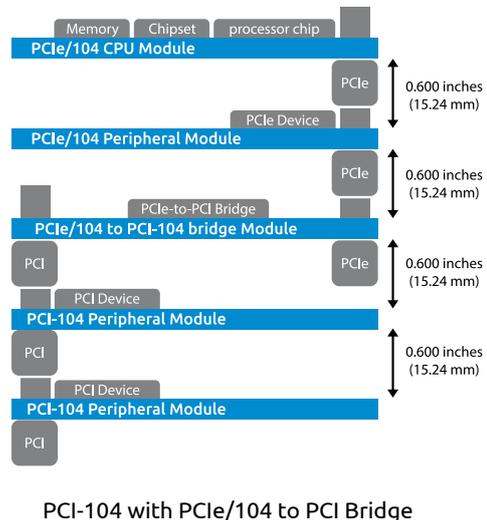
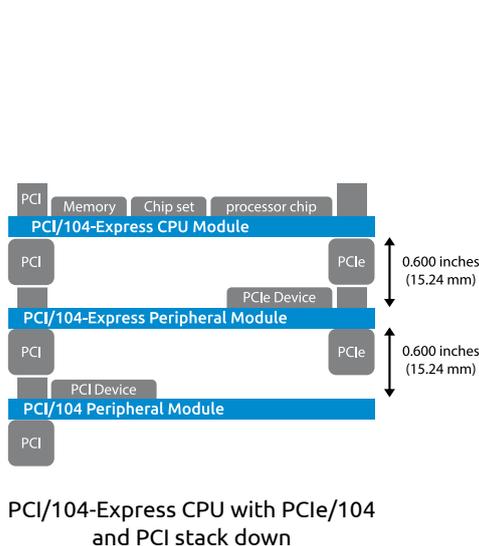
PC/104 boards (measuring 90 x 96 mm) feature a mounting hole at each corner. The standoffs that fit through these holes, combined with stackable bus connectors on the board's top and bottom, provide excellent rigidity and ruggedness. A PC/104 stack can include function-specific boards such as a CPU (single-board computer), power supply, storage, networking, and peripherals. Miniaturization has increasingly enabled several of these functions to exist on one board, further reducing the size of PC/104's system dimensions.

To date, there are five major specifications in the PC/104 family.

Specification	
 <p><b>PC/104</b></p>	<p>PC/104 supports the ISA bus and encompasses both 8-bit (64 pins) and 16-bit (104 pins) versions. The conventional ISA edge connector slots are replaced by pin-compatible 40- and 64-contact male/female headers that join together for very solid design rigidity. Power consumption stays within 1-2W per module.</p>
 <p><b>PCI-104</b></p>	<p>Once PCI became entrenched in the market, it became clear that many solutions would not need ISA support. To increase solution simplicity and lower board costs, PCI-104 eliminated ISA from the board layout. Topside component height decreased by 0.1" and underside clearance increased from 0.10" to 0.19".</p>
 <p><b>PCIe/104</b></p>	<p>By 2008, the PC/104 Consortium understood that trends in adoption patterns were changing and that a standard without PCI would be advantageous. Like PCI/104-Express, PCIe/104 comes in Type 1 and Type 2 variants.</p>
 <p><b>PC/104-Plus</b></p>	<p>The Ampro-developed PC/104-Plus specification (delivered to the PC/104 Consortium in 1996 and adopted in 1997) adds support for a 120-pin, 32-bit PCI connector. The PCI bus is located on the opposite side of the board from the ISA connector. Both connectors ISA and PCI busses can be active simultaneously.</p>
 <p><b>PCI/104-Express</b></p>	<p>The PC/104 Consortium adopted PCI Express (PCIe) technology into its fourth-specification in 2008. Other enhancements include support for more busses. Type 1 of PCI/104-Express allows for four PCIe x1 links, two USB 2.0 ports, and one PCIe x16 link. Type 2 trades the x16 link for two PCIe x4 links, two USB 3.0 ports, two SATA ports, and LPC.</p>

As shown in the figures below, all PC/104 specifications are designed for interoperability and backward compatibility with prior specifications, thus combating obsolescence and extending investment value. Note that boards that are separated by more than one PC/104 "generation" may not stack directly, there must be a requirement "bridging"

connectors between the board and an intermediate board to interface between the two specifications. In other cases, a dedicated bridge module may be required, such as a PCIe/104 board stacking with a PCI-104 board using a PCIe/104 to PCI-104 bridge module. The figure below provides examples of these scenarios.



# PC/104 Boards and Applications

With a long history of serving the world's embedded computing market, ADLINK provides a diverse range of compact computing solutions for vertical markets, including numerous PC/104 boards in various specifications. Below are the flagship single-board computer (SBC) products representing ADLINK's state of the art designs for each member of the PC/104 family.

## PC/104 — ADLINK CM1-86DX3

This ISA-based board straddles the line between legacy support and modern performance. At the board's heart runs an i686-compatible Vortex86DX3 processor, a 1.0 GHz dual-core design loaded with multiple cache levels and I/O features. The board offers 2GB of soldered DDR3, two video ports (one VGA, one LVDS), one SATA and one CFast storage connection, and a pair of Ethernet ports (one Fast Ethernet, one Gigabit). Despite this range of capabilities, the CM1-86DX3 averages a mere 6-7W power draw. The board also supports ADLINK's SEMA, our intelligent middleware that allows customers to monitor and control their devices.



**Market target:** The CM1-86DX3 provides a high-performance upgrade path for organizations already invested in PC/104 solutions with ISA peripherals, such as boards for FireWire storage, GPS, and multi-monitor display controllers. Note that this board's low power configuration allows it to run without any active cooling or even a heatsink, so solutions can remain thinner and silent. The CM1-86DX3 also features ADLINK's Extreme Rugged levels of higher ruggedness and reliability through conformal coating, Highly Accelerated Life Test (HALT) shock and vibration testing, extended life cycle support, and many other attributes that cater to the demands of challenging vertical applications.

## PC/104-Plus — ADLINK CM2-BT2

The CM2-BT2 provides an easy transition between legacy ISA investments and more modern applications. The board features a quad-core, 1.91 GHz Intel Atom® Processor E3845. Based on 22 nm fabrication, the CPU integrates seventh-generation Intel HD Graphics, enabling dual-display support and Intel® Quick Sync Video for accelerated video decoding. Accompanying the processor are 4GB of DDR3L memory, Intel® HD Audio, Gigabit Ethernet, SATA 3 Gb/s port (optionally two), three USB 2.0 ports, and VGA, and LVDS graphics output.



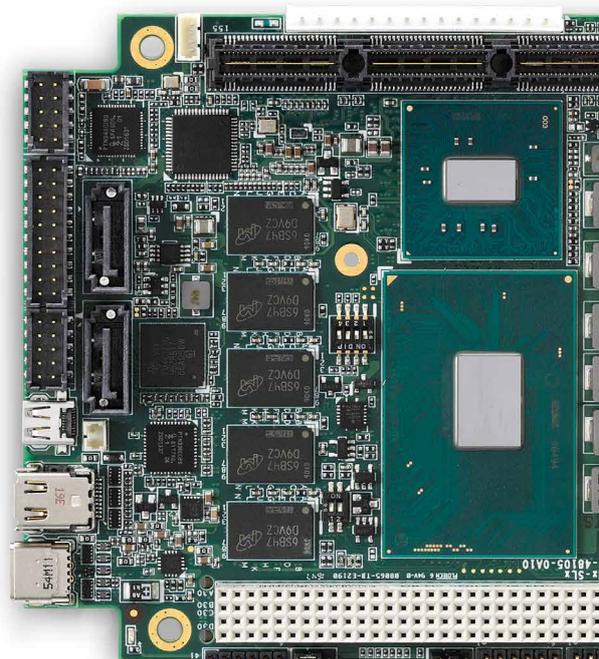
**Market target:** With both ISA and PCI busses, the CM2-BT2 supports prior legacy applications while opening up new opportunities, especially those relying on multimedia and video decompression. This solution expands storage options while maintaining a low power envelope. (the CPU boasts a 6W TDP). ADLINK improves the CM2-BT2'S value further with SEMA support and Extreme Rugged qualification.

## PCI/104-Express — ADLINK CMx-SLx

ADLINK once again brings modern desktop performance and functionality to the compact PC/104 landscape with the CMx-SLx. This board's base model offers the sixth-generation Intel® Core™ Processor i3-6102E (2 cores, 1.9 GHz, 25W TDP), although variant models feature the Core™ i3-6100E (2 cores, 2.7 GHz, 35W) and the Xeon® E3-1505L v5 (4 cores, 2.0/2.8 GHz, 25W). Graphics are provided by Intel's ninth-generation integrated graphics core, which features ample video decode acceleration and simultaneous triple display output across HDMI, DisplayPort, and LVDS. ADLINK supplies 8GB or 16GB of surface-mounted DDR4-ECC RAM and a range of onboard SLC- or MLC-based SSD storage from 8GB to 64GB. Gigabit Ethernet, two 6 Gb/s SATA ports, one USB 3.1 port, six USB 2.0 links, and a Trusted Platform Module (TPM) round out the CMx-SLx's high-performance, security-minded capabilities.



**Market target:** With SEMA and Extreme Rugged availability, backed by a broad range of Intel processors targeted at maximizing performance within a low power envelope, the CMx-SLx excels in high compute density applications. The PCI/104-Express specification embraces has an established history of over a decade, and the board's modern storage options, combined with ADLINK's CPU selections, enable AI-centric applications at the network edge without sacrificing security or durability. The CMx-SLx also supports SEMA and Extreme Rugged options.



# PC/104 Key Trends and Verticals

As noted earlier, PC/104 now stands at a crossroads. Looking to the past, two decades of legacy solutions stand, much of it still in use. As those solutions remain viable and valuable; both ADLINK and the PC/104 ecosystem will continue to make sure they remain supported and optimized for years to come. However, the future beckons and PC/104 provides a unique set of attributes that offer particular value in applications that require compute performance and low power consumption in a remarkably compact form factor — all while appealing to constrained budgets.

Trends and vertical markets abound in which these qualities prove essential. Following are a few examples that may serve to spark additional ideas on how PC/104 may aid your organization.

## AI at the Edge

Imagine a microsurgical procedure of the near future in which a patient goes under the knife, but the instruments are manipulated in part by AI-controlled robots. A human doctor stands over the table, conducting the operation, but his or her hands grip computerized controls rather than stainless steel instruments. The AI monitors every move, making sure that every tiny tremor or accidental misjudgment is eradicated. In such situations, there is no time to gather data, transmit to the cloud, await analysis, and receive instructions. In some situations, especially those where split seconds can mean the difference between life and death, the limits of latency and physics will not tolerate a cloud-based AI solution. Intelligence must assist from the network's edge – in this case near to or inside the robots.

As virtualized medicine evolves, expect AIs to control more of the procedure, especially in routine operations, as doctors assume a more remote, supervisory role. The cost benefits of this development are obvious, but so is the need for increasingly capable AI at the edge.

More broadly, expect edge intelligence to be needed wherever work gets done and productivity bottlenecks. Consider how much time is cumulatively wasted every day by people waiting unnecessarily at timer-controlled traffic intersections. Imagine how much more effective targeted advertising will be when display platforms can serve passerby-optimized content the instant that viewers come into range. Every split second lost to latency accumulates into vast amounts of lost opportunity.

Not least of all, examine AI's potential to transform industrial preventative maintenance. One example might be air flow through manufacturing floor ventilation conduits. Sensors can detect vibrations and turbulence. Cycled through edge-based monitoring systems, analysis of this data can signal early warning indicators that trigger maintenance before unforeseen ventilation failure forces factory production downtime. Alternatively, consider intelligent monitoring of robotic assembly tools. Input feedback may range from vibration levels to output speed analysis to camera-based confirmation of part placement. In such situations, edge intelligence may spot faults before cloud-based solutions would, yielding fewer failures, higher accuracy, and less disruption further down the production line.

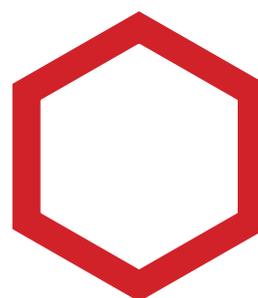
## SWaP Still Dominates

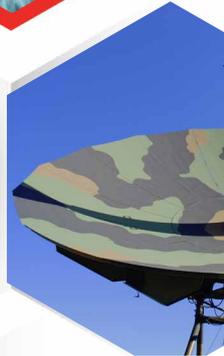
In all the above examples (and countless others), size, weight, and power (SWaP) can all play important roles. In a sense, SWaP has been the dominant trend in computing since its inception. PC/104's downsizing of large platforms into a compact modular stack showcases the process, as does the migration of bulky desktop systems into sleek tablets and smartphones. The propensity for smaller circuits to accelerate speed while simultaneously requiring less power makes SWaP developments a virtuous cycle.

Military and aerospace applications perennially lead SWaP efforts, because space and weight always constrain the ability to implement hardware, and the challenge is compounded if systems must function in the field, far away from a steady, unlimited power supply. Drones offer a perfect example. Outfitted with equipment such as cameras, radar, LIDAR, navigation systems, weapons and collision avoidance, drones need more onboard processing power than ever (again, edge intelligence matters). Every bit of extra weight may impact flight characteristics, and internal systems size might even force changes to the drone's external design.

The aforementioned CubeSat effort offers a perfect example of the SWaP paradigm in action. For over 15 years, schools, governments, and businesses have designed CubeSats to perform various functions. Each "1U" CubeSat unit measures 10 x 10 x 11.35 cm and is limited to 1.33 kg (2.9 lb.). The costs of placing every kilo into orbit are immense, and designers struggle to eke computing performance from every watt. PC/104 solutions excel here, not least because of the extreme conditions involved with deployment and operating in space.

In general, expect PC/104 to continue playing an important role in military, medical, automation, and other vertical fields where SWaP constraints thrive and the need for edge intelligence continues to climb.







## ADLINK & PC/104: Standing on The Shoulders of Success

Ever since the days of Ampro and the founding of the PC/104 Consortium, the world's vertical markets have been stronger and better able to address their rigorous computing needs because of PC/104. When ADLINK adopted Ampro's experience and position in the embedded computing world, it also accepted the responsibility of continuing innovation in the small form factor market and improving both quality and value whenever possible. Certainly, PC/104 enjoys a rich, accomplished past, but today's trends point the way to the form factor being more beneficial than ever in the future. To make that tomorrow rich with applied data, ADLINK will continue to leverage its expertise in integration, ruggedized designs, and the creation of novel, reliable solutions for an Internet of Things-centric world.





## ADLINK PC/104 Innovation

In our pursuit to be the world's leading PC/104 supplier, ADLINK relies on a world-class team of in-house engineers and designers. The company owns and operates its own manufacturing facilities to maintain direct quality control over all production aspects. ADLINK also manages system integration, customer support, and extended life cycle support on an ever-increasing range of solutions. This holistic approach to the embedded computing market enables ADLINK to deliver exceptional value, combining low product cost with outstanding levels of client service, including integration services and product customization capabilities.

ADLINK's approach to PC/104 spans a compelling range of benefits:

### Open Standards & Architecture

- Multiple vendors for vertical solutions
- Mix and match with PC/104-compatible board solutions from suppliers across the industry
- Extensive OS & software support for system development
- Validation and pilot programs ensure solution compatibility

### Configuration Flexibility

- Multiple system configurations
- Compatibility with all PC/104-compliant enclosures
- Easy, modular stacking

### Easy to Service

- Standardized mountings
- Modules simply pull apart and push back together
- Lower mean time to repair (MTTR)

### Ruggedized (on select models)

- Excellent shock and vibration characteristics
- Meets multiple MIL-STD requirements
- Smart cooling system, allows operating temperature range as wide as -40°C to 85°C

### Longevity

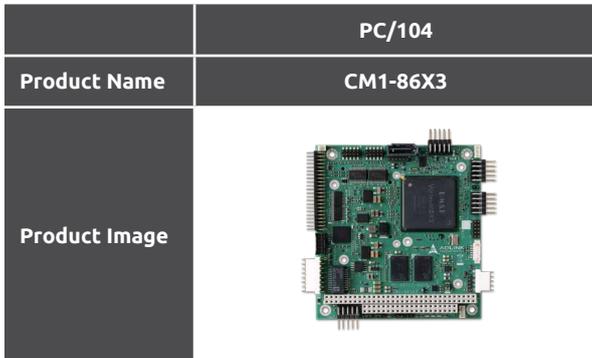
- Minimum 5-year life cycle
- Extended life cycle service available for long life cycle customer programs



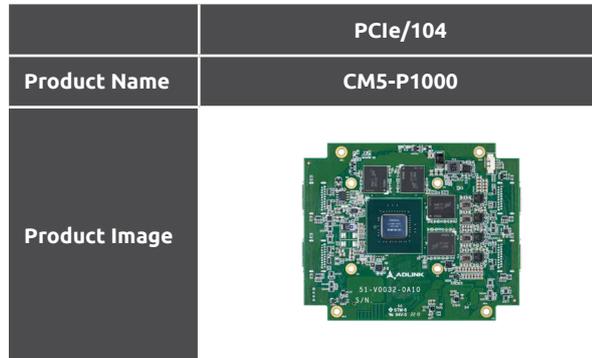
# PC/104 Family

	PCI/104-Express	PCI-104	PC/104-Plus
Product Name	CMx-SLx	CM3-BTx	CMx-BTx
Product Image			
CPU	Intel® Core™ i3-6102E 1.9GHz Options: Intel® Core™ i3-6100E 2.7GHz Intel Xeon® E3-1505L v5 2.0/2.8GHz	Intel Atom® E3845 (4C), 1.91 GHz, Intel Atom® E3815 (1C) 1.46 GHz	Intel Atom® E3800 Series SoC
Cache	Core™ i3 = 3MB (Option: Xeon® processor = 8MB)	Primary 32 KiB, 8-way L1 instruction cache and 24 KiB, 6-way L1 write-back data cache	Primary 32 KB, 8-way L1 instruction cache and 24 KB, 6-way L1 write-back data cache
Memory	Up to 16 GB soldered ECC DDR4	Up to 4 GB DDR3L SO-DIMM	Up to 4 GB DDR3L SO-DIMM
SATA	2x SATA 6Gbit/s and 1x SATA to onboard SATA-SSD	1x SATA 3G/s shared with mSATA (opt. 2nd SATA 3Gb/s port w/o mSATA support)	1x SATA 3G/s shared with mSATA (opt. 2nd SATA 3Gb/s port w/o mSATA support)
Serial Port	2x RS-232	2x RS-232/485 (with full handshake) 2x RS-232/485 (TX, RX, CTS, RTS only)	4x RS-232/422/485
USB	1x USB 3.1, 6x USB 2.0	3x USB 2.0 (1x on mSATA)	3x USB 2.0
GPIO	8	8	8
Audio	HDA (available on DisplayPort & HDMI port)	HDA	HDA
LAN	2x GbE	2x GbE	2x GbE
Graphics	Intel® HD Graphics	Intel® HD graphics	Intel® HD graphics
Video	HDMI/DVI, DisplayPort	VGA	VGA
Flat Panel	Single channel 18/24-bit LVDS	Single/dual channel 18/24-bit	Single/dual channel 18/24-bit
SEMA Support	Yes	Yes	Yes
Operating Temperature	0°C to +60°C -40°C to +85°C (opt.)	0°C to +60°C -40°C to +85°C (opt.)	0°C to +60°C -40°C to +85°C (opt.)
OS support	Windows 10, Windows 7, Linux, VxWorks 7, QNX 6.6	Windows 7, Windows 8, WEC7, Linux, QNX, VxWorks	Windows 7, Windows 8, WEC7, Linux, QNX, VxWorks
Dimensions (W x L)	117.4 x 96 mm	90 x 96 mm	90 x 96 mm

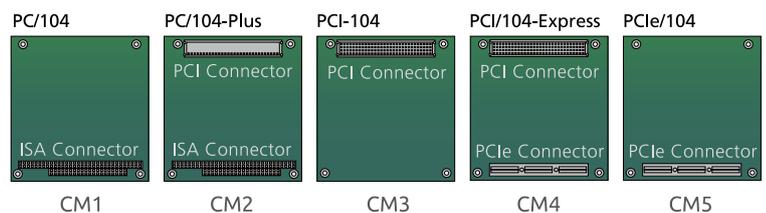
Note: All specifications are subject to change without further notice.



<b>CPU</b>	Vortex86DX3 SoC
<b>Cache</b>	L2: 512kB
<b>Memory</b>	2 GB soldered DDR3L
<b>SATA</b>	1x SATA 1.5Gb/s (or CFast)
<b>Serial Port</b>	2x RS-232 2x RS-232/422/485
<b>USB</b>	2x USB 2.0
<b>GPIO</b>	8
<b>Audio</b>	-
<b>LAN</b>	1x GbE 1x 10/100 Mbit
<b>Graphics</b>	Integrated 2D graphics
<b>Video</b>	VGA
<b>Flat Panel</b>	LVDS Single channel 18/24-bit TTL/TFT
<b>SEMA Support</b>	Yes
<b>Operating Temperature</b>	0°C to +60°C -40°C to +85°C (opt., contact for availability)
<b>OS support</b>	WES2009, WES7, Linux, QNX WEC7, Windows CE 6.0 (by request)
<b>Dimensions (W x L)</b>	90 x 96 mm



<b>GPU</b>	NVIDIA Quadro P1000
<b>Memory</b>	4GB GDDR5
<b>CUDA#</b>	640
<b>TFLOPs</b>	1.8
<b>Video</b>	4x DisplayPort
<b>Operating Temperature (Operating)</b>	CT: 0°C to +60°C WT: -40°C to +85°C
<b>OS support</b>	Windows 10, Windows 7, Linux drivers, 64 bit
<b>Dimensions (W x L)</b>	116 x 96 mm



ADLINK PC/104 product line naming rule



IoT Solutions  
Alliance  
Premier



PREFERRED  
PARTNER

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