



Product Information

SCA-THUNDER • CompactPCI® Serial CPU Card

Mobile Intel® Core™ Ultra H Processor

Preliminary



General

The SCA-THUNDER is a rich featured high performance 5HP (also legacy 4HP) 3U CompactPCI® Serial CPU board, equipped with a powerful Intel® Core™ Ultra processor (Meteor Lake H platform) for advanced industry use cases. Multiple different compute engines - P-cores, E-cores, Intel® Arc™ GPU, and Intel® AI Boost - work together to accelerate e.g. AI-augmented industrial process control (AIPC) or machine control.

The SCA-THUNDER front panel is provided with three 2.5Gbps RJ45 Ethernet jacks for networking, and up to four 10Gbps USB Type-C receptacles (DisplayPort Alternate Mode enabled) for versatile USB device and display attachment, up to 4 x 4k displays.

The SCA-THUNDER is equipped with up to 96GB DDR5 RAM. Up to 48GB memory-down are provided for rugged applications, and another 48GB are available via the SODIMM socket. On-board mass-storage solutions are based on a variety of low profile mezzanine expansion cards available, which accommodate amongst other functions a fast PCI Express® Gen4 x 4 NVMe® SSD module.

Full support for CompactPCI® Serial backplanes is provided, e.g. a fat pipe slot for a PCIe® Gen5 x 8 peripheral card (with CPCI-S.0 R4.0 to come). As an option, up to eight Gigabit Ethernet ports are available via the backplane connector P6 by means of a mezzanine module.



CPU Card w. Low Profile Mezzanine

Feature Summary

General

- ▶ PICMG® CompactPCI® Serial (CPCI-S.0) CPU card (system slot controller)
- ▶ Form factor single size Eurocard (board dimensions 100x160mm²)
- ▶ Mounting height 3U
- ▶ Front panel width 4HP for current CPCI-S.0 R3.0 backplanes
- ▶ Front panel width 5HP for future CPCI-S.0 R4.0 backplanes
- ▶ F/P width 4HP/5HP with low profile mezzanine module assembly
- ▶ F/P width 8HP/12HP (9HP/13HP) as an assembly with optional mezzanine side cards
- ▶ Front panel I/O connectors for typical system configuration (3 x 10Gbps USB Type-C DP Alt Mode, 3 x 2.5Gbps Ethernet RJ45)
- ▶ Backplane communication via PCI Express® up to Gen5, SATA 6G, USB3, 2.5Gbps Ethernet
- ▶ New AirMax VSe® backplane connectors
- ▶ Variety of local mezzanine expansion options, COTS and custom specific boards

Processor Characteristics

- ▶ Intel® Core™ Ultra processors series-1 (H type)
 - ▶ Formerly known as Meteor Lake H platform
 - ▶ Up to 16 cores, up to 22 threads
 - ▶ Multiple compute engines in one SoC: P-cores, E-cores, Intel®Arc™ GPU and Intel® AI Boost NPU
 - ▶ Up to 96GB DDR5-5600 RAM, dual channel
 - ▶ Intel® Arc™ graphics up to eight X^e cores, up to 128 execution units, up to 4 displays 4 x 4k or 2 x 8k
 - ▶ Integrated Neural Processing Unit (NPU)
 - ▶ 28 PCIe® lanes Gen4/5
 - ▶ 28W/45W base power
 - ▶ BGA soldered for optimum reliability
 - ▶ Max. operating temperature 110°C
 - ▶ Intel® pilot program for custom use conditions that have more challenging condition requirements
-
- ▶ Line-up Intel® Core™ Ultra processors (as of 2024-04):
 - ▶ Core™ Ultra 9 185H: 16 cores, 22 threads, 24MB L3 cache, 8 X^e 128 EUs, vPro®
 - ▶ Core™ Ultra 7 165H: 16 cores, 22 threads, 24MB L3 cache, 8 X^e 128 EUs, vPro®
 - ▶ Core™ Ultra 7 155H: 16 cores, 22 threads, 24MB L3 cache, 8 X^e 128 EUs
 - ▶ Core™ Ultra 5 135H: 14 cores, 18 threads, 18MB L3 cache, 8 X^e 128 EUs, vPro®
 - ▶ Core™ Ultra 5 125H: 14 cores, 18 threads, 18MB L3 cache, 7 X^e 112 EUs

Feature Summary

AI (Artificial Intelligence) Resources

- ▶ Intel® Deep Learning Boost DP4a - 8-bit INT acceleration on X^e graphics
- ▶ Intel® Deep Learning Boost VNNI - 8-bit INT acceleration on CPU cores as part of Intel® AVX instructions
- ▶ Intel® NPU - Integrated Neural Processing Unit V 2.7 (Intel® AI Boost)
- ▶ Intel® GNA - Gaussian & Neural Accelerator V 3.5 - a low-power neural coprocessor

- ▶ Intel® OpenVINO™ (Open Visual Inference and Neural network Optimization) toolkit - deploy high-performance, deep learning inference
- ▶ WindowsML
- ▶ DirectML
- ▶ ONNX RT
- ▶ Intel® Edge Software Hub - edge computation software and packages
- ▶ Intel® DevCloud for the Edge - allows you to actively prototype and experiment with AI workloads for computer vision

Firmware

- ▶ Phoenix® UEFI (Unified Extensible Firmware Interface)
- ▶ Phoenix SCT (SecureCore Technology)
- ▶ ACPI
- ▶ Fully customizable by EKF
- ▶ Secure Boot and Measured Boot supported - meeting all demands as specified by Microsoft®
- ▶ Windows®, Linux and other (RT)OS supported
- ▶ Intel® AMT vPro® supported for eligible processors (disabled by default, must be enabled via BIOS setup)

Main Memory

- ▶ Integrated memory controller up to 96GB DDR5 5600 MT/s, dual channel
- ▶ DDR5 soldered memory up to 48GB (ultra rugged basic memory)
- ▶ DDR5 SO-DIMM memory module socket up to 48GB (memory expansion option)

Feature Summary

Graphics

- ▶ Intel® ARC® graphics
- ▶ Up to 4 displays 4k, up to 2 displays 8k
- ▶ Up to 8 x Xe graphics engine cores
- ▶ Up to 128EU
- ▶ DisplayPort DP2.1
- ▶ Max. resolution 7680 x 4320 @ 60Hz
- ▶ DirectX 12.2
- ▶ Encode/decode H.264, H.265, AV1, VP9

- ▶ Display front panel options:
- ▶ 3 x Type-C connectors for either DisplayPort and USB usage
- ▶ 4th DisplayPort optional via Type-C connector on low profile mezzanine card S40 or S48

Networking

- ▶ Up to 11 Ethernet networking interfaces in total
- ▶ 3 x Front 2.5GBASE-T RJ45 - 3 x Intel® I226-IT NIC
- ▶ 2.5GBASE-T, 1000BASE-T, 100BASE-TX, 10BASE-T connections
- ▶ RJ45 Front port 1 - Intel® vPro®/AMT (Wake on LAN) with eligible processors
- ▶ Option 8 x 1000BASE-T backplane w. S80-P6 mezzanine module - Marvell® Peridot switch
- ▶ Option 4 x 1000BASE-T backplane w. S82-P6 mezzanine module - 4 x Intel® I210-IT NIC
- ▶ Option 4 x 2.5GBASE-T backplane w. S83-P6 mezzanine module - 4 x Intel® I226-IT NIC
- ▶ Option 4 x 2.5GBASE-T RJ45 front w. SCJ-VEENA side card - 4 x Intel® I226-IT NIC (8HP assembly)
- ▶ Option 4 x 1000BASE-T M12-X front w. SCL-RHYTHM side card - 4 x Intel® I210-IT NIC (8HP assembly)
- ▶ Option RJ45 port 1 jack (vPro®/AMT) replacement by M12-X connector w. S02-M12 mezzanine (8HP)

Security

- ▶ Trusted Platform Module SLM9670
- ▶ TPM 2.0 for highest level of certified platform protection
- ▶ Infineon Optiga™ cryptographic processor
- ▶ Conforming to TCG 2.0 specification

Feature Summary

Front Panel I/O (4HP)

- ▶ 3 x 2.5Gbps Ethernet RJ45 receptacles
- ▶ 2.5GBASE-T, 1000BASE-T, 100BASE-TX, 10BASE-Te
- ▶ Intel® vPro®/AMT supported (port 1 RJ45 connector - must be enabled via BIOS settings)
- ▶ 3 x 10Gbps USB Type-C receptacles DisplayPort Alt Mode
- ▶ USB and/or DisplayPort usage
- ▶ USB 3.2 Gen 2x1 (formerly USB 3.1 Gen2) SuperSpeed+ 10Gbps
- ▶ USB-PD downstream facing ports 5V/3A (Infineon CYPD5225 EZ-PD™ CCG5 controller)
- ▶ DisplayPort 2.1
- ▶ Additional Type-C front I/O with low profile mezzanine e.g. S40 or S48

Front Panel I/O (8/12HP)

- ▶ Variety of side cards available, common front panel 8HP/12HP with CPU card
- ▶ For backplanes with system slot right aligned
- ▶ Various I/O ports e.g. UART, Audio, RJ45 Ethernet, M12-X Ethernet, Wireless (SMA)
- ▶ Custom specific front panel and side card design

CompactPCI® Serial Backplane Resources

- ▶ PICMG® CPCI-5.0 CPU card & system slot controller
- ▶ 8 x PCIe Gen5¹ up to 32GT/s (fat pipe peripheral card slot)
- ▶ 8 x PCIe Gen4¹ up to 16GT/s (2 peripheral card slots x4)
- ▶ 5 x PCIe Gen3 up to 8GT/s (5 peripheral card slots x1)
- ▶ 2 x SATA 6G
- ▶ 8 x USB2, 4 x USB3 5Gbps
- ▶ Option 8 x Gigabit Ethernet Marvell 88E6390 switch (S80-P6 low profile mezzanine expansion card)
- ▶ Option 4 x Gigabit Ethernet Intel® I210-IT NIC (S82-P6 low profile mezzanine expansion card)
- ▶ Option 4 x 2.5Gigabit Ethernet Intel® I226-IT NIC (S83-P6 low profile mezzanine expansion card)
- ▶ New backplane connectors AirMax VSe® up to 25Gbps per differential pair according to CompactPCI® Serial R3.0 (backward compatible to backplanes with AirMax VS® 12.5Gbps)
- ▶ 4HP CPU card front panel width when the adjacent board to the right is equipped with legacy AirMax VS® connectors (e.g. peripheral cards according to the CompactPCI® Serial R2.0 connector specification)
- ▶ 5HP CPU card front panel width and backplane slot pitch according to CompactPCI® Serial R4.0 when the adjacent board to the right is also equipped with the new AirMax VSe® connectors (e.g. multi CPU card system)

¹ The CPU is PCIe® Gen4 or Gen5 capable on these links (specified with CompactPCI® Serial R3.0)

Feature Summary

Local Expansion & Mezzanine Mass Storage Options

- ▶ Mezzanine side card connectors for optional local expansion
- ▶ Low profile mezzanine modules available (4HP front panel)
- ▶ Side cards available (8HP F/P assembly)
- ▶ HSE1 - PCIe Gen4 x4, 1 x USB3 10Gbps & 2 x USB2
- ▶ HSE2 - PCIe Gen3 (configurable 2x2, 4x1), 4thDisplayPort
- ▶ EXP - Legacy interface (eSPI, Audio, UART, I2C, GPIO)

- ▶ 4HP Low profile mezzanine module preferred options:
- ▶ S20-NVME Mezzanine module - M.2 2280 NVME SSD socket, 1 x Type-C USB F/P connector
- ▶ S40-NVME Mezzanine module - 1 x M.2 2280 NVME SSD socket, 1 x M.2 2280 SATA SSD socket, 2 x Type-C USB F/P connectors (1 connector enabled for DisplayPort alternate mode)
- ▶ S42-MC Mezzanine module - M.2 2280 NVME SSD socket, 2 x PCIe® Mini Card sockets
- ▶ S48-SSD Mezzanine module - 1 x M.2 2280 PCIe® x4 Gen4 SSD socket, 1 x M.2 2280 PCIe® x4 Gen3 SSD socket, Type-C USB F/P connector (enabled for DisplayPort alternate mode - 4th display)
- ▶ S80-P6 Mezzanine module - M.2 2280 NVMe SSD socket, 8 x Gigabit Ethernet via P6 backplane connector (switch based solution)
- ▶ S82-P6 Mezzanine module - M.2 NVMe SSD socket, 4 x GbE NIC via P6 backplane connector
- ▶ S83-P6 Mezzanine module - M.2 NVMe SSD socket, 4 x 2.5GbE NIC via P6 backplane connector
- ▶ Custom specific storage & I/O module design

- ▶ 8HP Mezzanine side card options:
- ▶ SCJ-VEENA Short side card - M.2 2280 NVMe SSD socket, 4 x 2.5GbE NIC, front panel RJ45, USB3
- ▶ SCL-RHYTHM Short side card - M.2 2280 NVMe SSD socket, 4 x GbE NIC, front panel M12-X
- ▶ SCZ-NVM - M.2 22110 NVMe SSD socket, quad UART, DisplayPort & USB3 connectors
- ▶ S02-M12 - RJ45 port 1 (vPro®/AMT) replacement by M12-X connector (top or bottom mount)
- ▶ Custom specific side card design - I/O and storage

- ▶ Backplane Coupler:
- ▶ SCX-PCIE - M.2 2280 NVMe/SATA SSD socket, PCIe® Mini Card socket, 3 x USB3, 3 x GbE RJ45 connectors, coupler for secondary CompactPCI® Serial backplane
- ▶ ECX-PCIE - Front I/O same as SCX, coupler for CompactPCI® Express secondary backplane

RT OS Board Support Packages

- ▶ Available on request

Applications

- ▶ High performance industrial and embedded computing, for x86 based software
- ▶ Automation, process control, test systems, demanding applications
- ▶ Edge computing, AI deep learning

Feature Summary

Environmental & Regulatory

- ▶ Suitable e.g. for industrial, transportation & instrumentation applications
- ▶ Designed & manufactured in Germany
- ▶ ISO 9001 certified quality management
- ▶ Long term availability
- ▶ Rugged solution
- ▶ Coating, sealing, underfilling on request
- ▶ Lifetime application support
- ▶ RoHS compliant
- ▶ Operating temperature 0°C to +70°C
- ▶ Operating temperature -40°C to +85°C (industrial temperature range) on request
- ▶ Storage temperature -40°C to +85°C, max. gradient 5°C/min
- ▶ Humidity 5% ... 95% RH non condensing
- ▶ Altitude -300m ... +3000m
- ▶ Shock 15g 0.33ms, 6g 6ms
- ▶ Vibration 1g 5-2000Hz
- ▶ MTBF tbd years (MIL-HDBK-217F, SN29500 @+40°C)
- ▶ EC Regulatory EN55035, EN55032, EN62368-1 (CE)

all items may be subject to technical changes w/o further notice

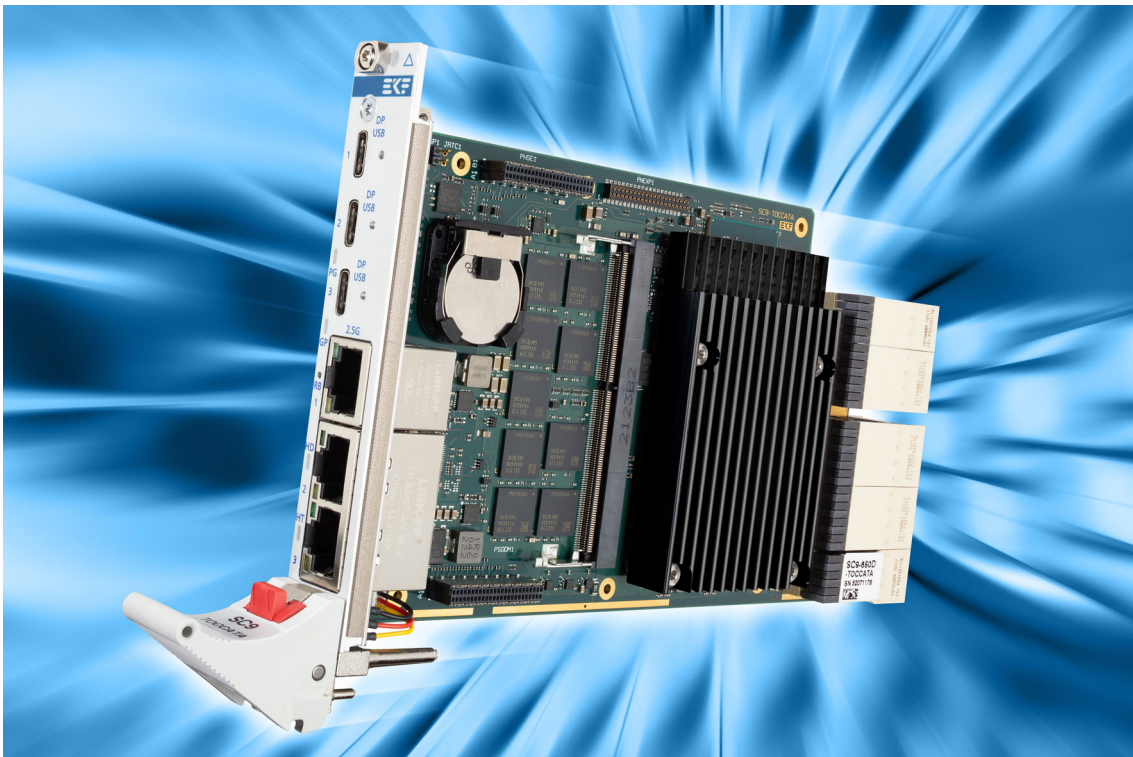


CompactPCI® Serial

While mechanically compliant to CompactPCI® Classic, CompactPCI® Serial (PICMG® CPCIS.0) defines a completely new card slot, based on PCI Express®, SATA, Gigabit Ethernet and USB serial data lines. Up to 6 high-speed backplane connectors P1 - P6 are provided on a system slot controller such as the SCA-THUNDER, which can be considered as a root hub with respect to most signal lines. A passive backplane is used for distribution of a defined subset of I/O channels from the system slot to each of up to eight peripheral slots in a CompactPCI® Serial system.

Most CompactPCI® Serial peripheral slot cards require only the backplane connector P1, which comprises PCIe®, SATA and USB signals, resulting in a concise and inexpensive peripheral board design. More powerful peripheral cards profit from two so called Fat Pipe slots (PCIe® x 8).

The SCA-THUNDER is a native CompactPCI® Serial CPU card, suitable for usage in a pure CPCI Serial environment. Due to its generous backplane capabilities (21 x PCI Express® up to Gen5, 4 x USB3, 2 x SATA 6G, up to 8 x GbE), very powerful industrial systems can be built.



Local Expansion

The SCA-THUNDER is equipped with a set of high-speed local expansion interface connectors, which can be optionally used to attach either a low profile mezzanine module (fits into the 4HP front panel envelope) or a side card for an 8HP or even 12HP assembly in total.

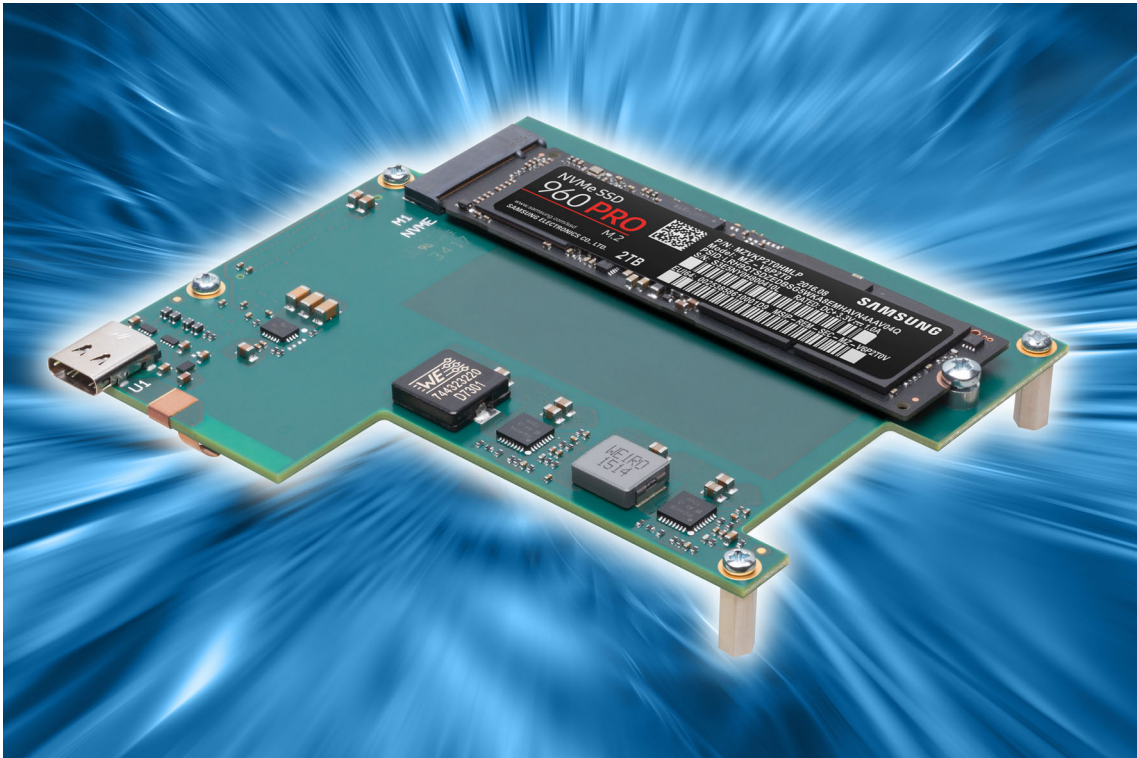
The connectors HSE1 and HSE2 are high speed connectors, as required for PCI Express® Gen4 and USB3 10Gbps. The socket EXP is used as a legacy interface (e.g. HD Audio, UART) and not required for many mezzanine modules. All mezzanine connectors allow board-to-board heights of 10.0mm (S20, S40, S48), 10.8mm (S80, S82), and 18.7mm (e.g. SCJ, SCL side cards 8HP assembly).

HSE1 is assigned to a PCIe® Gen4 x4 link, derived directly from the CPU. On a 4HP low profile mezzanine module or 8HP side card this link is wired to a fast Gen3 or Gen4 NVMe® SSD housed in an M.2 socket, typically used as boot device and general mass storage. In addition, HSE1 brings a 10Gbps USB3 port, often used for front I/O.

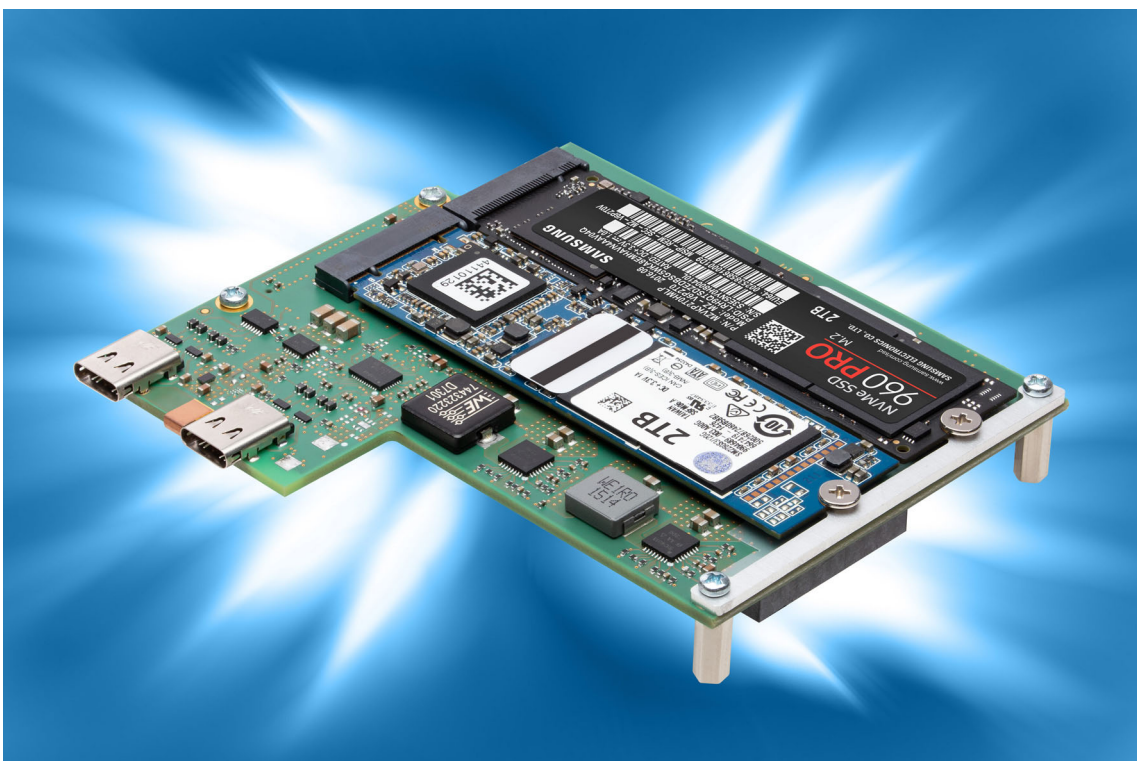
HSE2 provides another four PCIe® Gen3 lanes, configurable for link widths 2x2 or 4x1, and in addition a 4th DisplayPort video output. Some mezzanine modules such as the S20 get along with the HSE1 connector alone, others such as S40, S48 or S80 depend on both HSE1 and HSE2 for full functionality.

Related Information Mezzanine Connectors

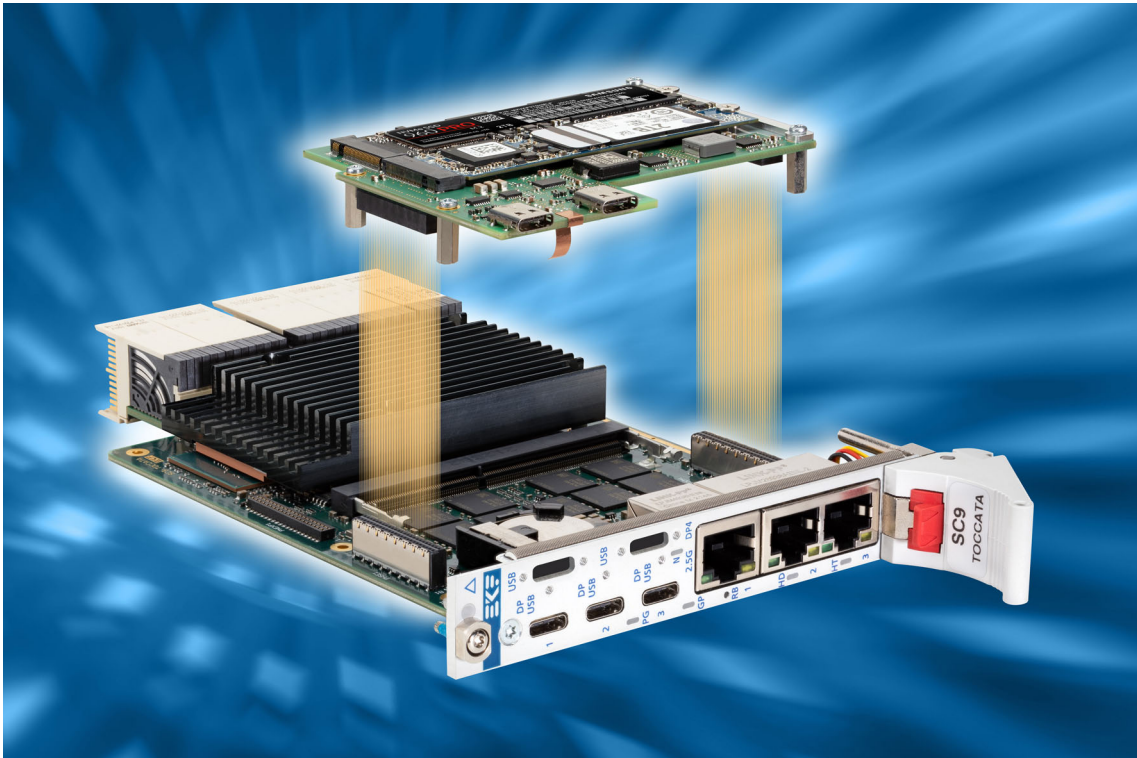
https://www.ekf.com/s/mezzanine_connectors.pdf



S20-NVME Low Profile Mezzanine Module



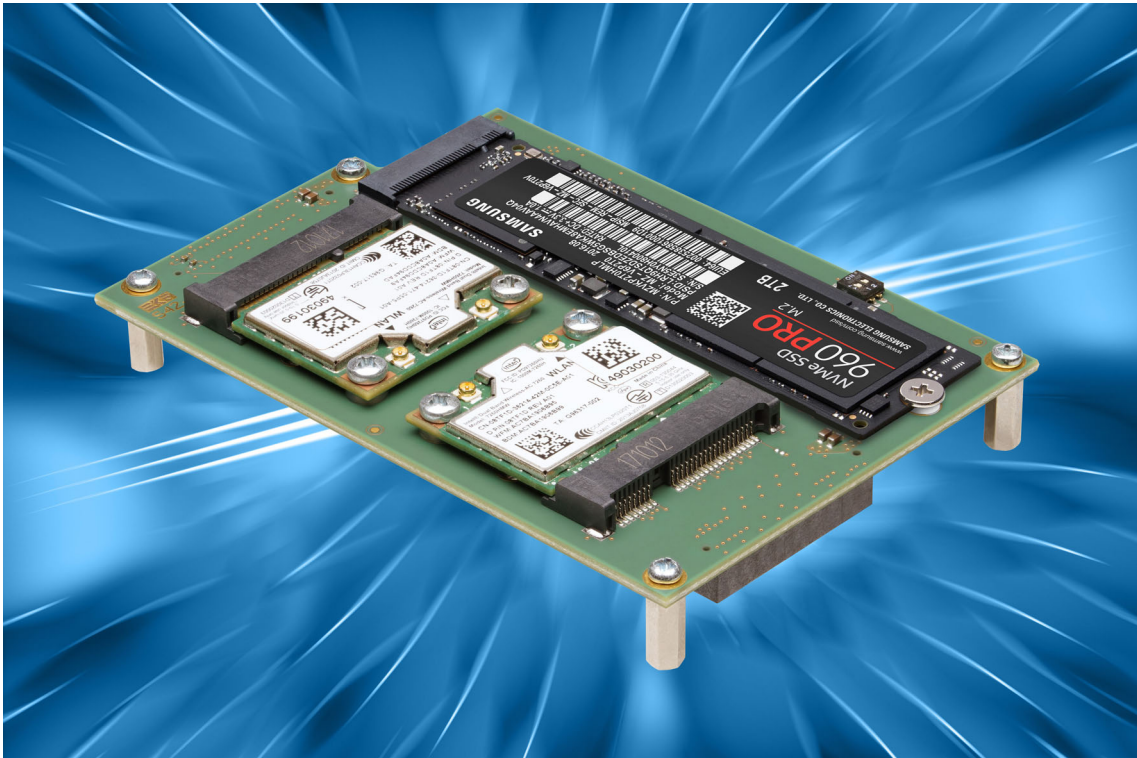
S40-NVME Low Profile Mezzanine Module



CPU Card w. S40



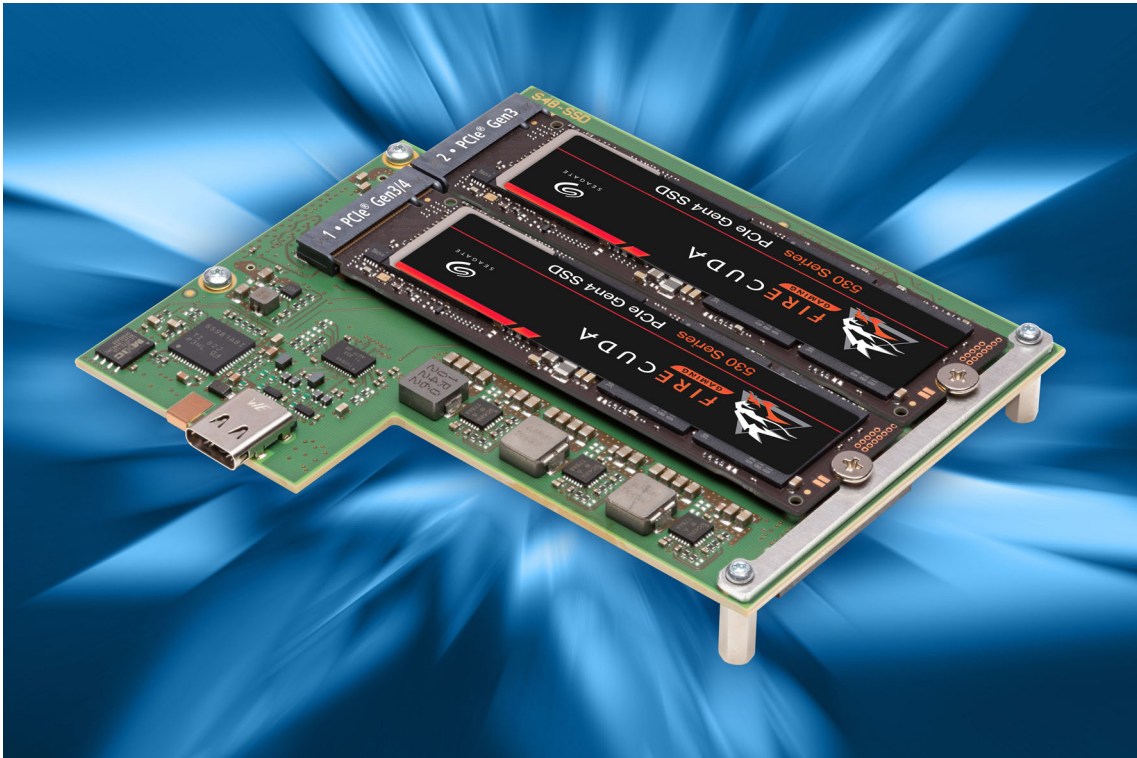
CPU Card w. S40



S42-MC Mezzanine Module



CPU Card w. S42 8HP Assembly



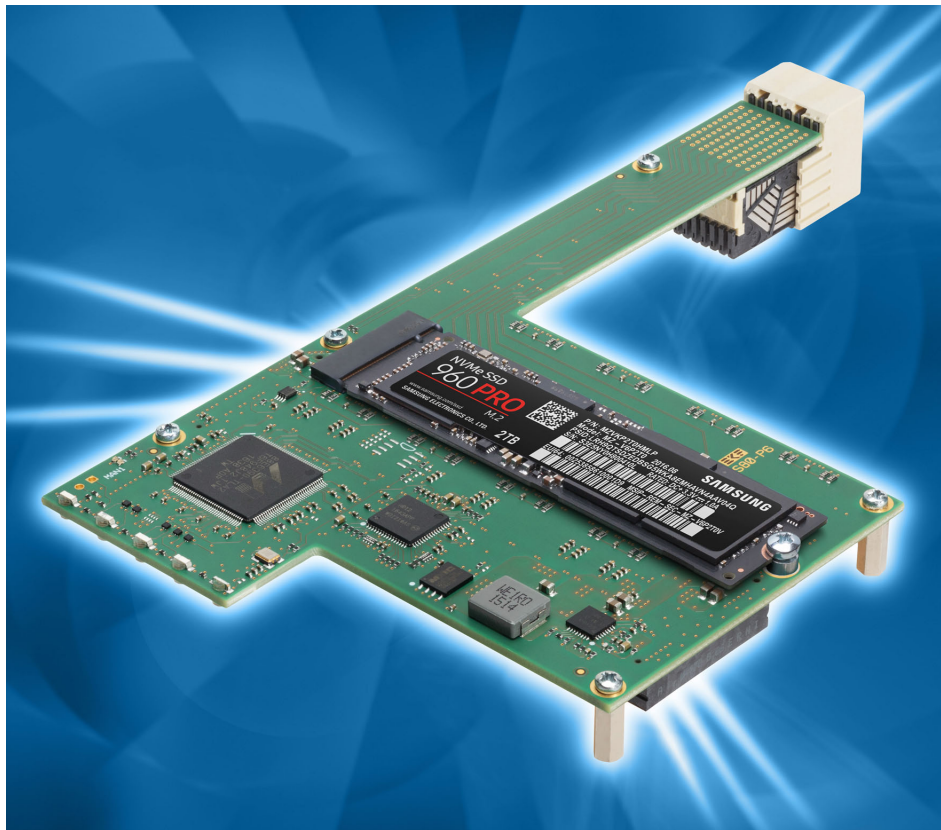
S48-SSD Low Profile Mezzanine Module



CPU Card w. S48



CPU Card w. S48



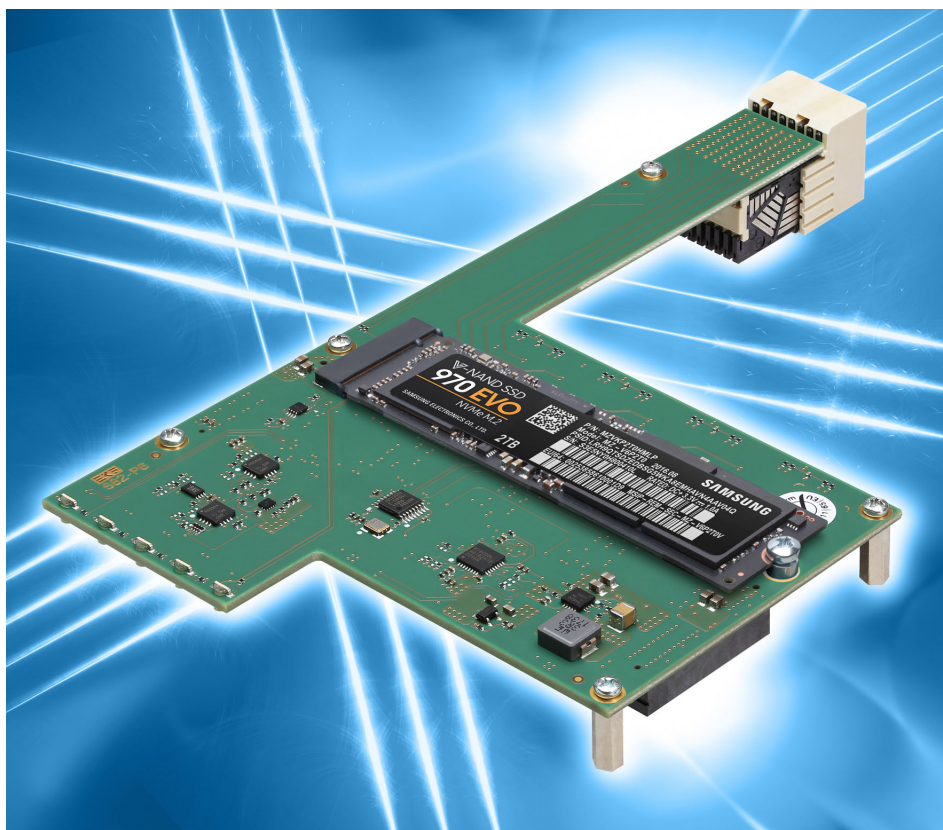
S80-P6 Low Profile Mezzanine Module



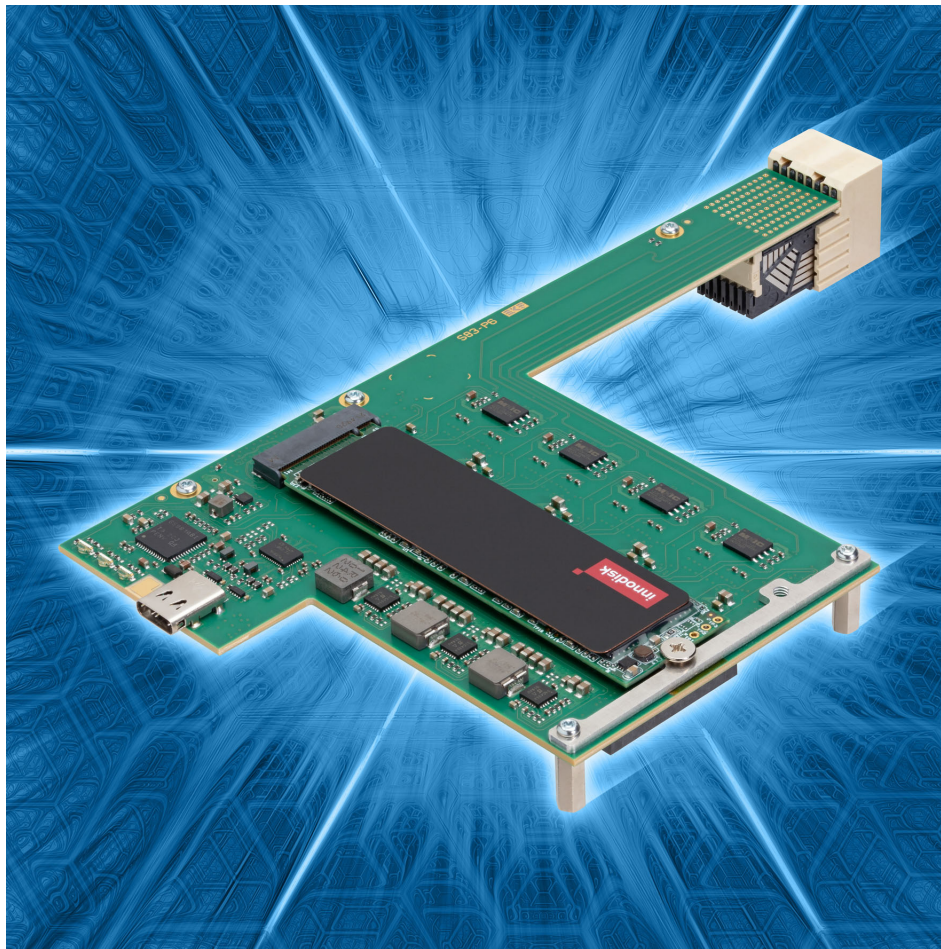
CPU Card w. S80



CPU Card w. S80



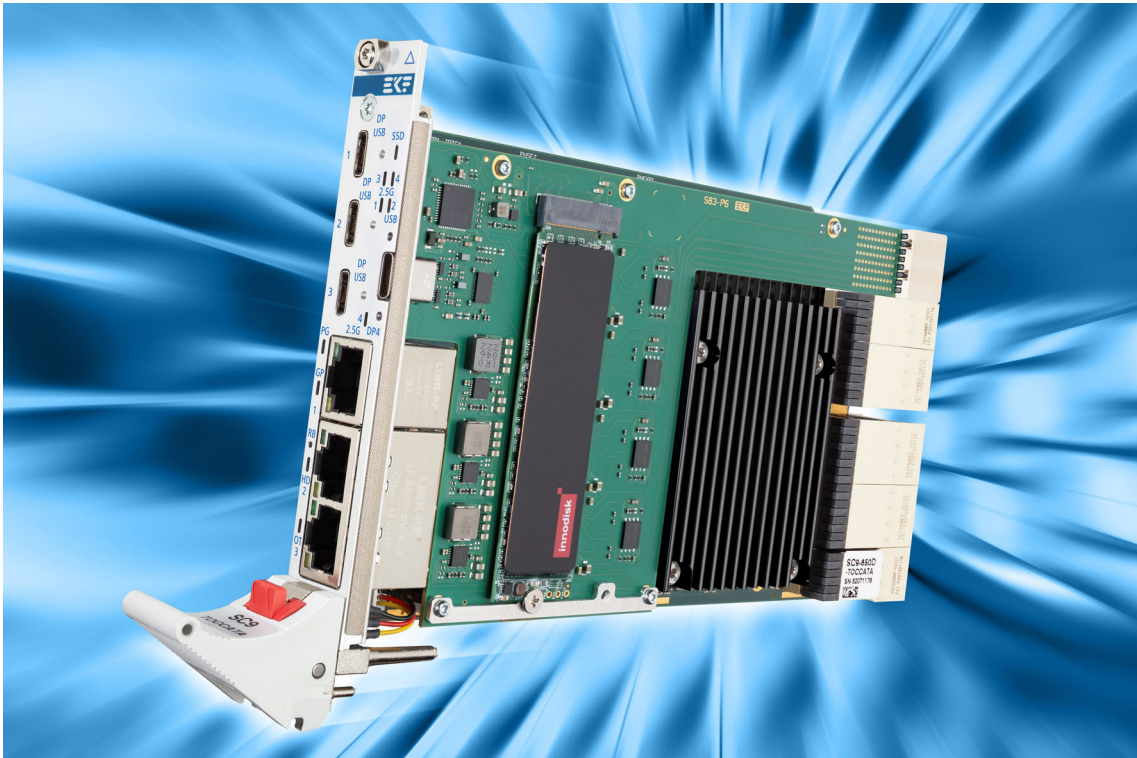
S82-P6 Low Profile Mezzanine Module



S83-P6 Low Profile Mezzanine Module



CPU Card w. S83



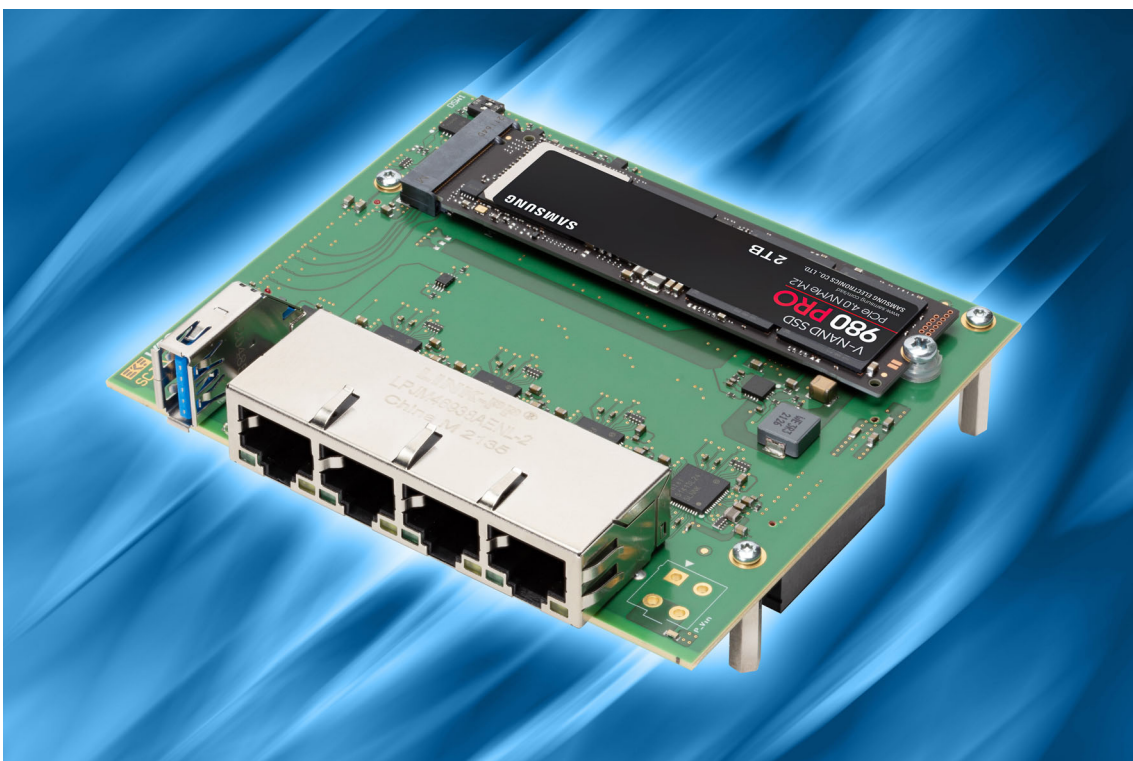
CPU Card w. S83



CPU Card w. S83



CPU Card w. SCJ-VEENA 8HP Assembly



SCJ-VEENA Side Card

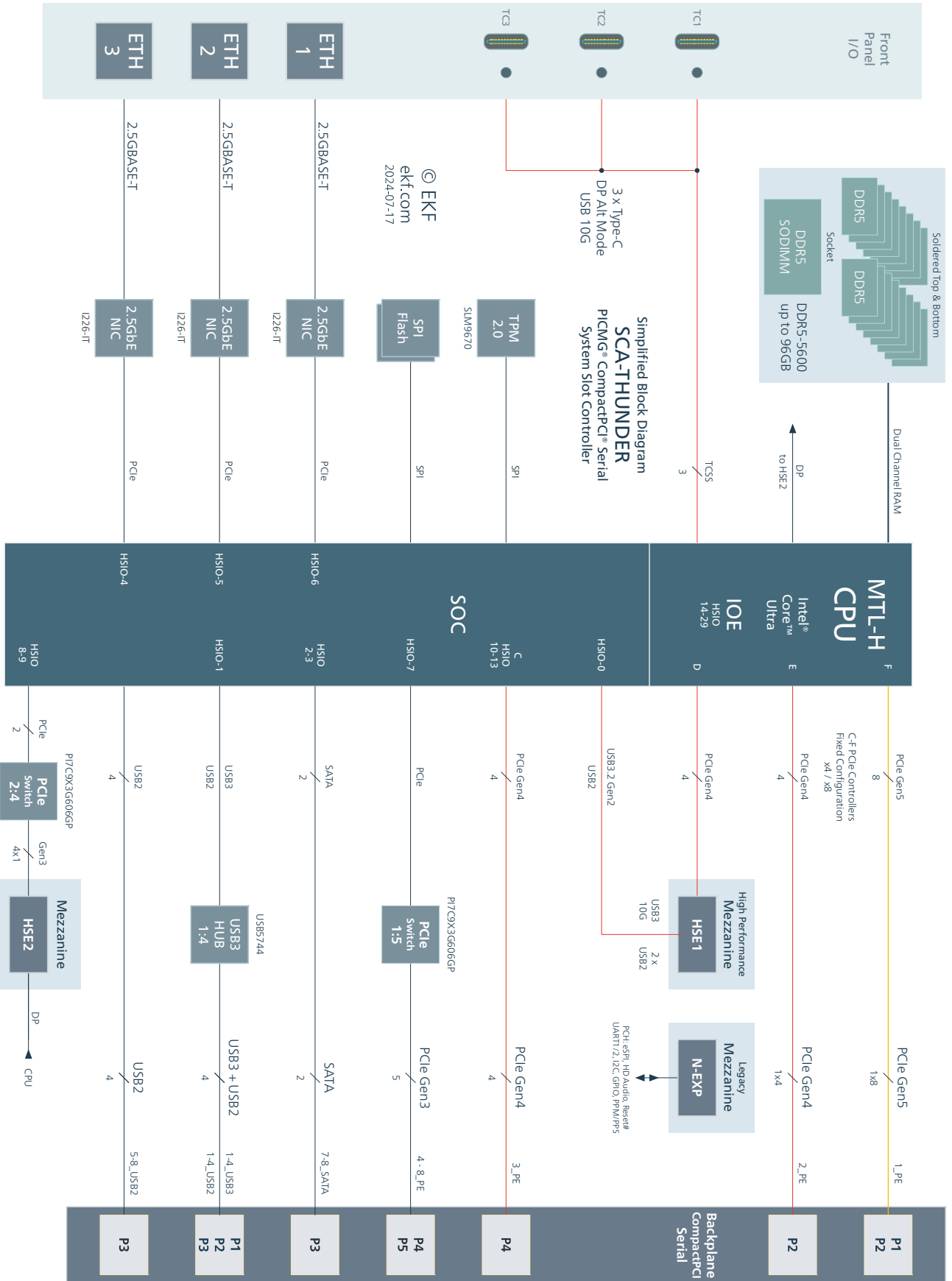


CPU Card w. SCL-RHYTHM 8HP Assembly

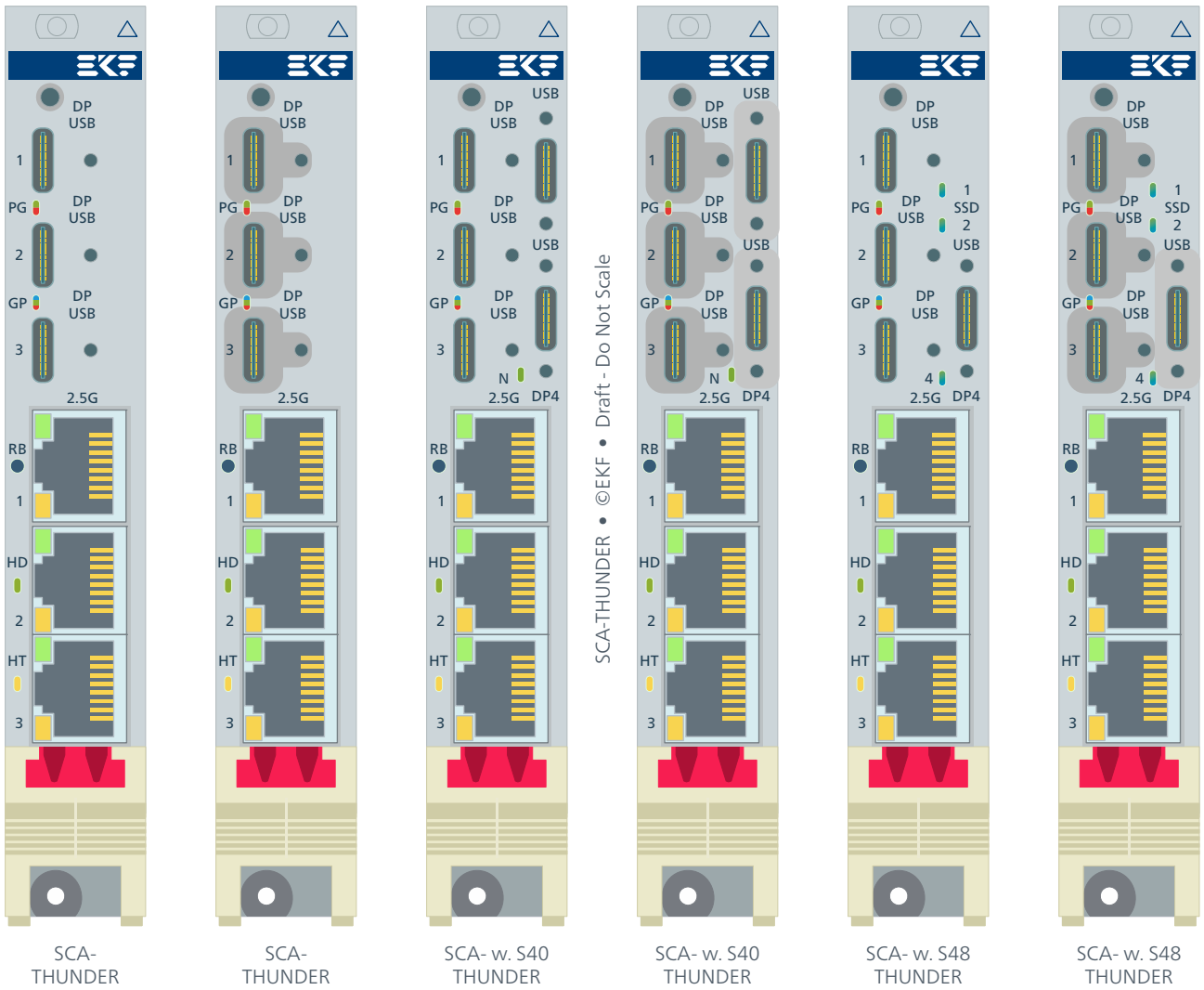


CPU Card w. SCZ-NVM 8HP/12HP Assembly

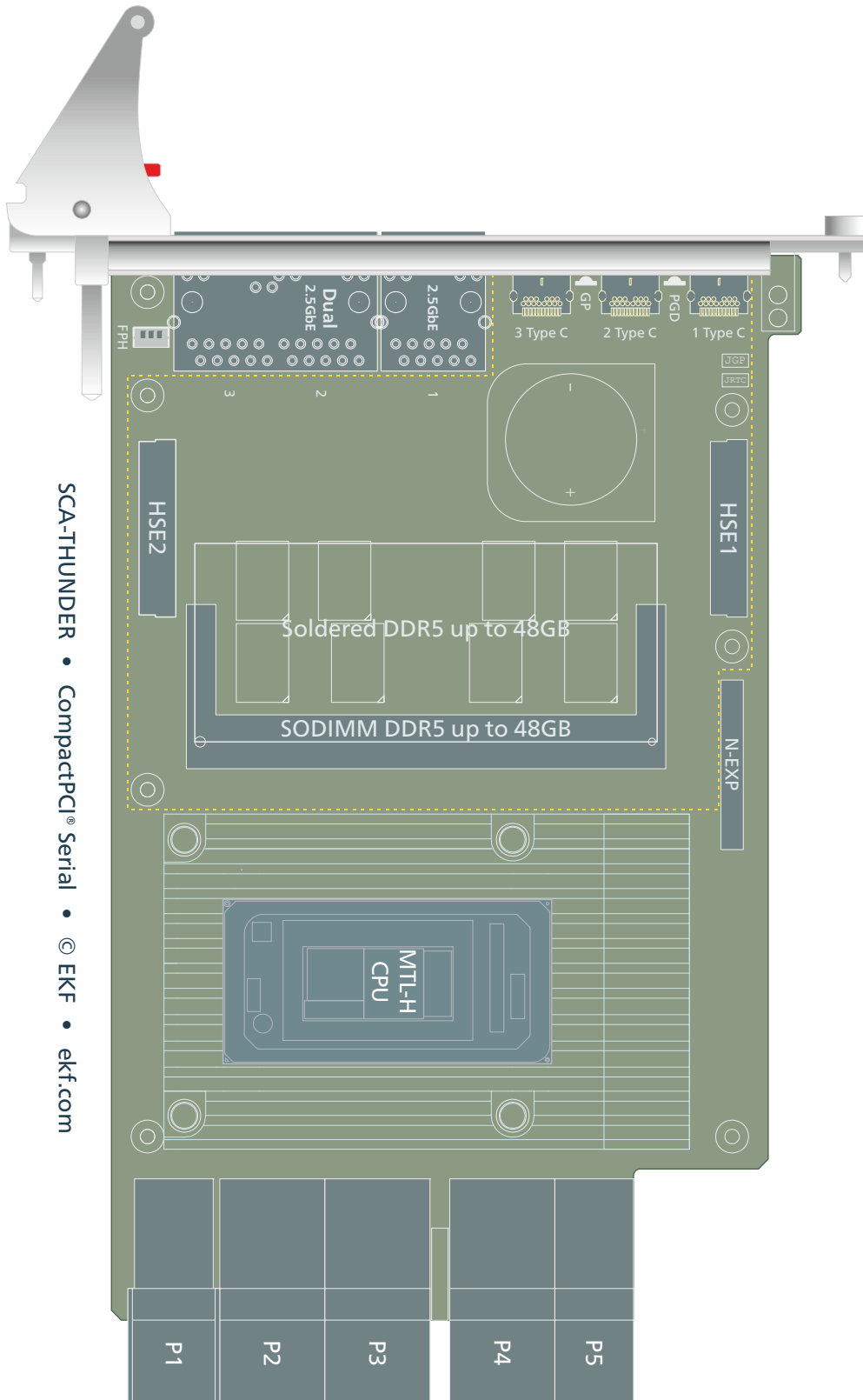
Block Diagram



Front Panel



Component Orientation



SCA-THUNDER • CompactPCI® Serial • © EKF • ekf.com

Backplane Resources

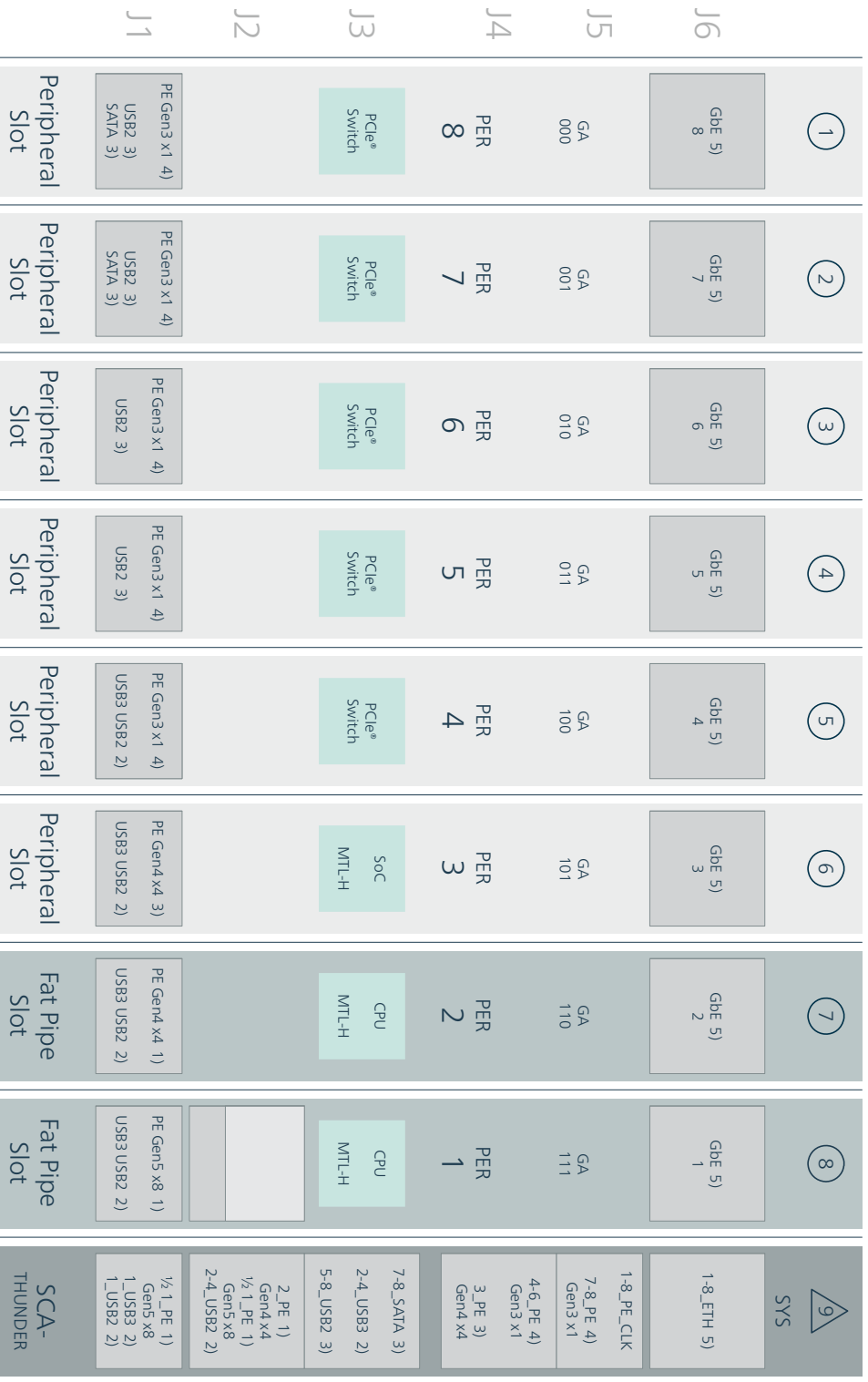
SCA-THUNDER • Resources w. 1+8 Slots Backplane (System Slot Left Aligned Version)

	1	2	3	4	5	6	7	8	9
J6	1-8_ETH 5)	GbE 5) 1	GbE 5) 2	GbE 5) 3	GbE 5) 4	GbE 5) 5	GbE 5) 6	GbE 5) 7	GbE 5) 8
J5	1-8_PE_CLK 7-8_PE 4) Gen3 x1	GA 111	GA 110	GA 101	GA 100	GA 011	GA 010	GA 001	GA 000
J4	4-6_PE 4) Gen3 x1 3_PE 3) Gen4 x4	PER 1	PER 2	PER 3	PER 4	PER 5	PER 6	PER 7	PER 8
J3	7-8_SATA 3) 2-4_USB3 2) 5-8_USB2 3)	CPU MTL-H	CPU MTL-H	SoC MTL-H	PCIe® Switch	PCIe® Switch	PCIe® Switch	PCIe® Switch	PCIe® Switch
J2	2_PE 1) Gen4 x4 ½_1_PE 1) Gen5 x8 2-4_USB2 2)								
J1	½_1_PE 1) Gen5 x8 1_USB3 2) 1_USB2 2)	PE Gen5 x8 1) USB3 USB2 2)	PE Gen4 x4 1) USB3 USB2 2)	PE Gen4 x4 3) USB3 USB2 2)	PE Gen3 x1 4) USB3 USB2 2)	PE Gen3 x1 4) USB2 3)	PE Gen3 x1 4) USB2 3)	PE Gen3 x1 4) USB2 3) SATA 3)	PE Gen3 x1 4) USB2 3) SATA 3)
SCA-THUNDER	Fat Pipe Slot	Fat Pipe Slot	Peripheral Slot	Peripheral Slot	Peripheral Slot	Peripheral Slot	Peripheral Slot	Peripheral Slot	Peripheral Slot

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- 1) MTL-H CPU PCIe® Gen4/5 speed not specified by CPCL1-5.0 - subject to PICMG® working group
- 2) USB5744 Hub
- 3) SoC
- 4) P17C9X3G606GP PCIe® Switch
- 5) J6/P6 Gigabit Ethernet requires e.g. S80/S82 low profile mezzanine module

SCA-THUNDER • Resources w. 1+8 Slots Backplane (System Slot Right Aligned Version)



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1) MTL-H CPU PCIe® Gen4/5 speed not specified by CPCI-S.0 - subject to PICMG® working group
 2) USB5744 Hub
 3) SoC
 4) PI7C9X3SG606GP PCIe® Switch
 5) J6/P6 Gigabit Ethernet requires e.g. S80/S82 low profile mezzanine module

Related Information	
SCA-THUNDER Home	https://www.ekf.com/s/sca/sca.html
S20-NVME Low Profile Mezzanine	https://www.ekf.com/s/s20/s20.html
S40-NVME Low Profile Mezzanine	https://www.ekf.com/s/s40/s40.html
S42-MC Low Profile Mezzanine	https://www.ekf.com/s/s42/s42.html
S48-SSD Low Profile Mezzanine	https://www.ekf.com/s/s48/s48.html
S80-P6 Low Profile Mezzanine	https://www.ekf.com/s/s80/s80.html
S82-P6 Low Profile Mezzanine	https://www.ekf.com/s/s82/s82.html
S83-P6 Low Profile Mezzanine	https://www.ekf.com/s/s83/s83.html
<i>S84-P6 Low Profile Mezzanine</i>	<i>1 x 10G Backplane Ethernet (KR)</i>
<i>S85-P6 Low Profile Mezzanine</i>	<i>4 x 5G Backplane Ethernet (5GBASE-T)</i>
<i>SCG-MULTIGIG Mezzanine Side Card</i>	<i>2 x 10GBASE-T M12-X</i>
<i>SCI-MULTIGIG Mezzanine Side Card</i>	<i>2 x 10GBASE-T RJ45</i>
SCJ-VEENA Mezzanine Side Card	https://www.ekf.com/s/scj/scj.html
SCL-RHYTHM Mezzanine Side Card	https://www.ekf.com/s/scl/scl.html
SCX-PCIE Mezzanine Side Card	https://www.ekf.com/s/scx/scx.html
SCZ-NVM Mezzanine Side Card	https://www.ekf.com/s/scz/scz.html
ECX-PCIE Mezzanine Side Card	https://www.ekf.com/e/ecx/ecx.html
Mezzanine Connectors Explained	https://www.ekf.com/s/mezzanine_connectors.pdf

General Information CompactPCI® Serial	
CompactPCI® Serial Concise Overview	https://www.ekf.com/s/serial_concise.pdf
CompactPCI® Serial All You Need to Know	https://www.ekf.com/s/smart_solution.pdf
CompactPCI® Serial Home	https://www.ekf.com/s/serial.html

Ordering Information

For popular SCA-THUNDER SKUs please contact sales@ekf.de

Beyond All Limits: EKF High Performance Embedded



Industrial Computers Made in Germany
boards. systems. solutions.

Document No. 10446 • 17 July 2024

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