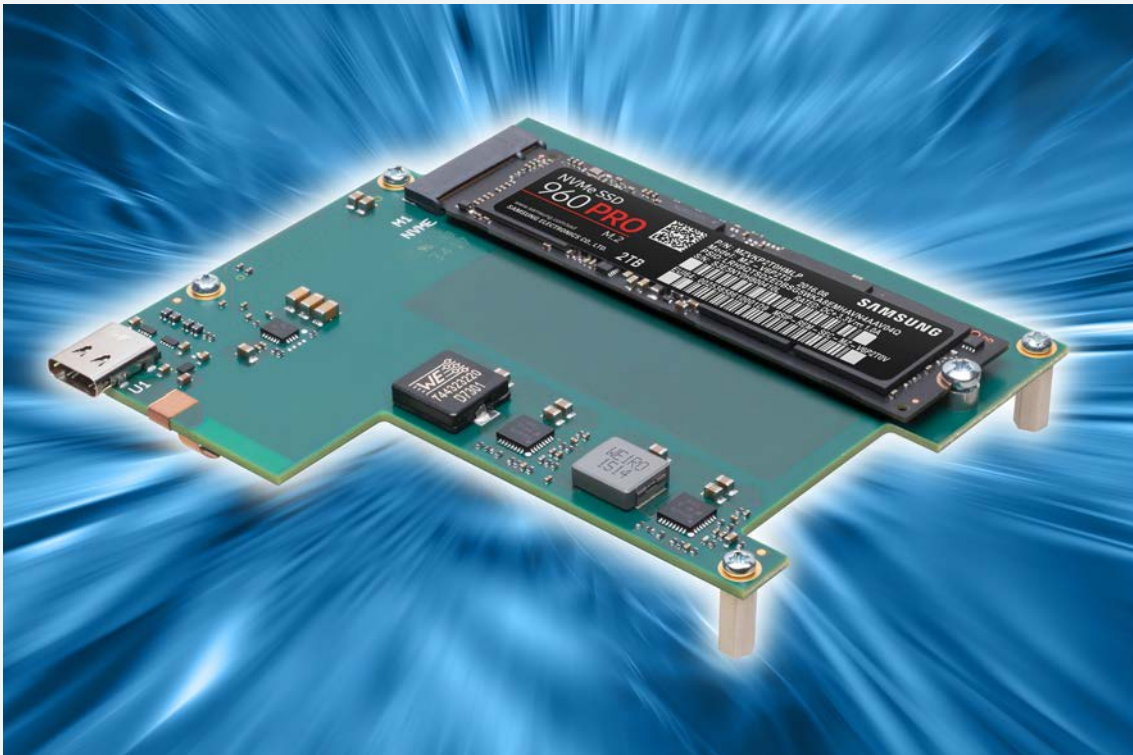Technical Information

S20-NVME

NVMe SSD Storage & Type-C Front I/O Mezzanine Module

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Contents

About this Manual

This manual is a short form description of the technical aspects of the S20-NVME, required for installation and system integration. It is intended for the advanced user only.

Edition History

Ed.	Contents/Changes	Author	Date
1	Technical Information S20-NVME, English, preliminary edition Text #8531, File: s20_ti.wpd	jj	12 May 2017
2	MTBF added	jj	9 June 2017
3	Photos added	jj	2 October 2017
4	Photo added Type-C screw locked cable connector	jj	18 May 2018
5	Status preliminary removed	jj	17 April 2020
5.1	Minor changes e.g. logo, 40-years banner, SC9	jj	12 September 2022

Related Documents

For a description of CPU cards which may act as carrier board with respect to the S20-NVME, please refer to the correspondent CPU user guide, available by download (change URL accordingly for other potential carrier cards).

Download S20-NVME Carrier Card User Guides	
SC5-FESTIVAL	www.ekf.com/s/sc5/sc5.html
SC9-TOCCATA	www.ekf.com/s/sc9/sc9.html

Nomenclature

Signal names used herein with an attached '#' designate active low lines.

Trade Marks

Some terms used herein are property of their respective owners, e.g.

▸ Intel, Atom™, Core™, XEON®: ® Intel
▸ CompactPCI, CompactPCI PlusIO, CompactPCI Serial: ® PICMG
▸ Windows: ® Microsoft
▸ EKF, ekf system: ® EKF

EKF does not claim this list to be complete.

Legal Disclaimer - Liability Exclusion

This document has been edited as carefully as possible. We apologize for any potential mistake. Information provided herein is designated exclusively to the proficient user (system integrator, engineer). EKF can accept no responsibility for any damage caused by the use of this manual.

Standards

Reference Documents		
Term	Document	Origin
CompactPCI® Serial	CompactPCI Serial Specification, PICMG® CPCI-S.0	www.picmg.org
DisplayPort	DisplayPort Alt Mode on USB Type-C	www.vesa.org
M.2	PCI Express M.2 Specification Revision 1.1	www.pcisig.com
NVMe	NVM Express 1.2.1 specification	www.nvmexpress.org
SATA	Serial ATA Specification	www.sata-io.org
USB	Type-C Cable and Connector Specification Rev. 1.2 Type-C Locking Connector Specification Rev. 1.0 Universal Serial Bus Power Delivery Specification Rev. 3.0	www.usb.org

Product Description

Overview

Available as a mezzanine add-on expansion board e.g. to the SC5-FESTIVAL and successor CPU carrier cards, the main purpose of the S20-NVME is to provide a mass storage solution, by means of an NVMe (PCIe x4) M.2 SSD module. M.2 (formerly NGFF) has been established as a standard by the PCI-SIG® and is very popular for industrial applications (IoT).

The S20-NVME accommodates an M.2 module with key ID M (PCIe x4) up to 22mm x 80mm (2280), fixed by screw lock. NVMe SSD modules are available from several manufacturers, with a maximum capacity of 2TB as of current.

In addition, a front panel Type-C receptacle is provided on the S20-NVME, for use as USB 3.1 Gen 1 (5Gbps) host port (DFP). Dual screw locking Type-C cable connectors are supported. External devices attached can be sourced via V_{BUS} up to 3A/5V.

The S20-NVME connects to the mezzanine expansion connector HSE1 of the CompactPCI® Serial CPU carrier board, maintaining the 4HP (20.32mm) total assembly height (low profile mezzanine module). The S20-NVME can be used together with an additional side card (8HP in total) attached to the CPU HSE2 connector.

S20-NVME Mounted on Carrier CPU Card

Feature Summary

Feature Summary

Form Factor

▸ Proprietary size mezzanine module 84.3mm x 95mm
▸ Fits basically into the 4HP (20.3mm) envelope of the CPU carrier board
▸ Typically delivered as a ready to use assembly unit (including SC4-CONCERTO or successor CPU card)
▸ Mounting position right (on top of a CPU board)

Host I/F Connector HSE1

▸ High speed mezzanine connector
▸ Suitable for PCI Express® Gen3, USB 3.0 SuperSpeed
▸ Bottom mount male connectors HSE1 (high speed expansion)
▸ Mating with the carrier card female connector HSE1
▸ Board-to-board height 10.0mm for a 4HP assembly
▸ Cutout around carrier card connector HSE2 - allows additional side card use (8HP front panel width in total)
▸ PCI Express® x4 support, dedicated to the NVMe SSD module M.2 socket
▸ 1 x USB 3.1 Gen1 (5Gbps) support, dedicated to the Type-C USB front panel I/O connector
▸ Power sourcing 12V/1.5 A maximum continuous current (2 pins)

M.2 Module Connector

▸ M.2 socket key Id M, for 1 x NVMe (PCIe x4) SSD, M.2 size up to 2280
▸ Power switch for M.2 module undervoltage lockout, short-circuit protection, quick discharge
▸ PCIe x4 sourced via HSE1 mezzanine connector
▸ Maximum (theoretical) 32Gbps I/O data transfer rate (Gen3 PCIe 8GT/s)
▸ Module dimensions 2230/2242/2260/2280, screw fixed
▸ Module height (Label) S1-S5, D1-D4

Feature Summary

Type-C Front Panel Connector

▸ Type-C front panel receptacle
▸ Suitable for Type-C compliant USB cable assemblies
▸ Support for Type-C locking plugs (dual screw) according to the 'Locking Connector Spec. Rev. 1.0'
▸ V_{BUS} over voltage, surge, and ESD protection
▸ Host mode USB 3.1 Gen 1 (5Gbps SuperSpeed), passed through from HSE1 mezzanine connector (CPU carrier card USB host controller e.g. PCH)
▸ Downstream Facing Port (DFP) controller and power switch, up to 5V/3A V_{BUS}
▸ 10Gbps MUX for Type-C flip control (signal flow according to the cable plug orientation)
▸ USB 3.1 Gen 2 ready (10Gbps SuperSpeed+) for future CPU chipset generation

Applications

▸ Low profile mezzanine module for EKF CPU Cards (SC4-CONCERTO and later)
▸ 4HP assembly CPU carrier board and S20-NVME mezzanine card
▸ M.2 based mass storage, M.2 PCIe x4 socket (NVMe)
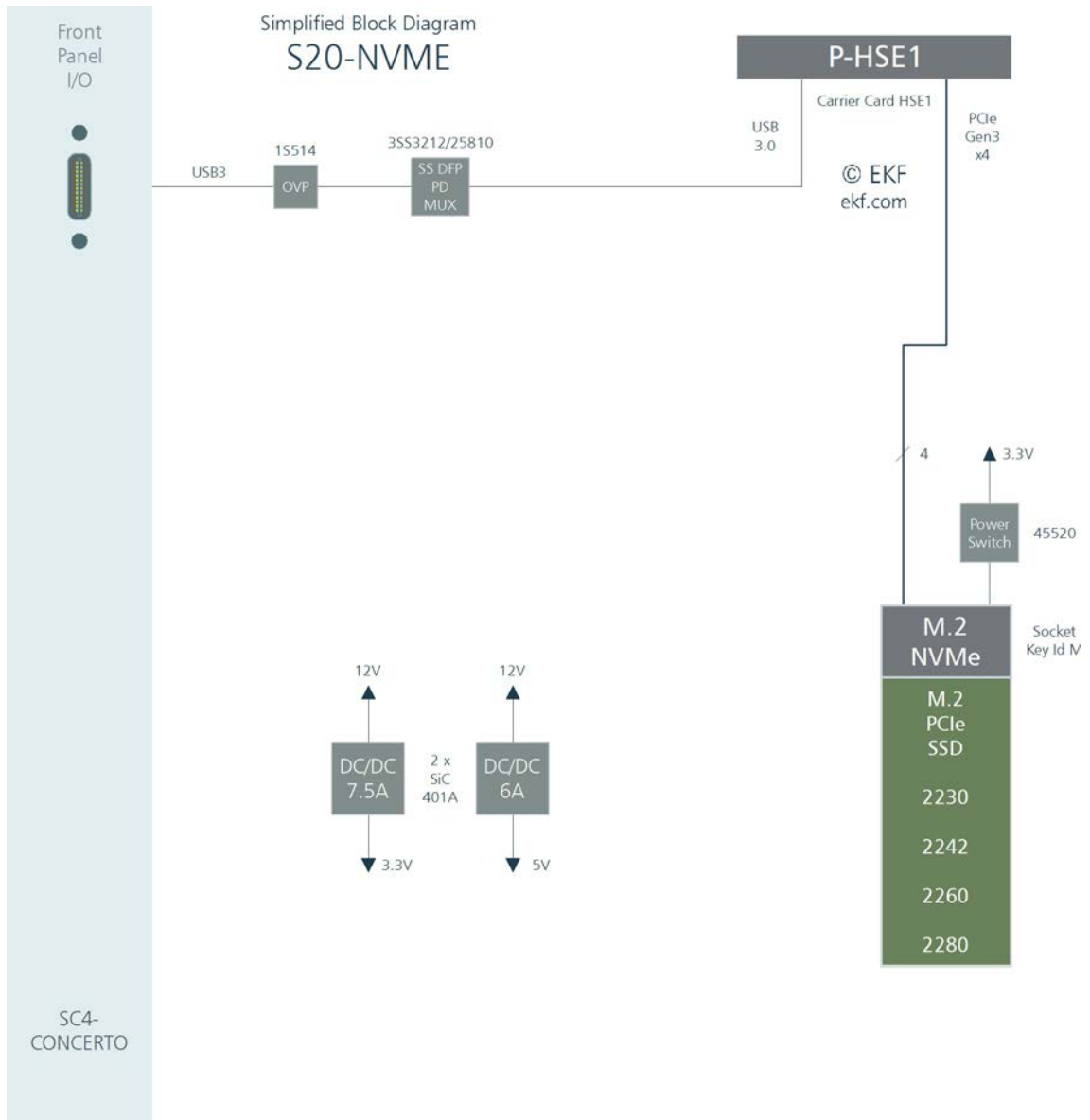▸ Front panel I/O connector Type-C, dual screw locking, USB 3.1 Gen 1

Environment & Regulatory

▸ Designed & manufactured in Germany
▸ Certified quality management according to ISO 9001
▸ Long term availability
▸ Rugged solution
▸ Coating, sealing, underfilling on request
▸ RoHS compliant
▸ Operating temperature 0°C to +70°C (commercial temperature range) available
▸ Operating temperature -40°C to +85°C (industrial temperature range) available
▸ 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 141.8 years
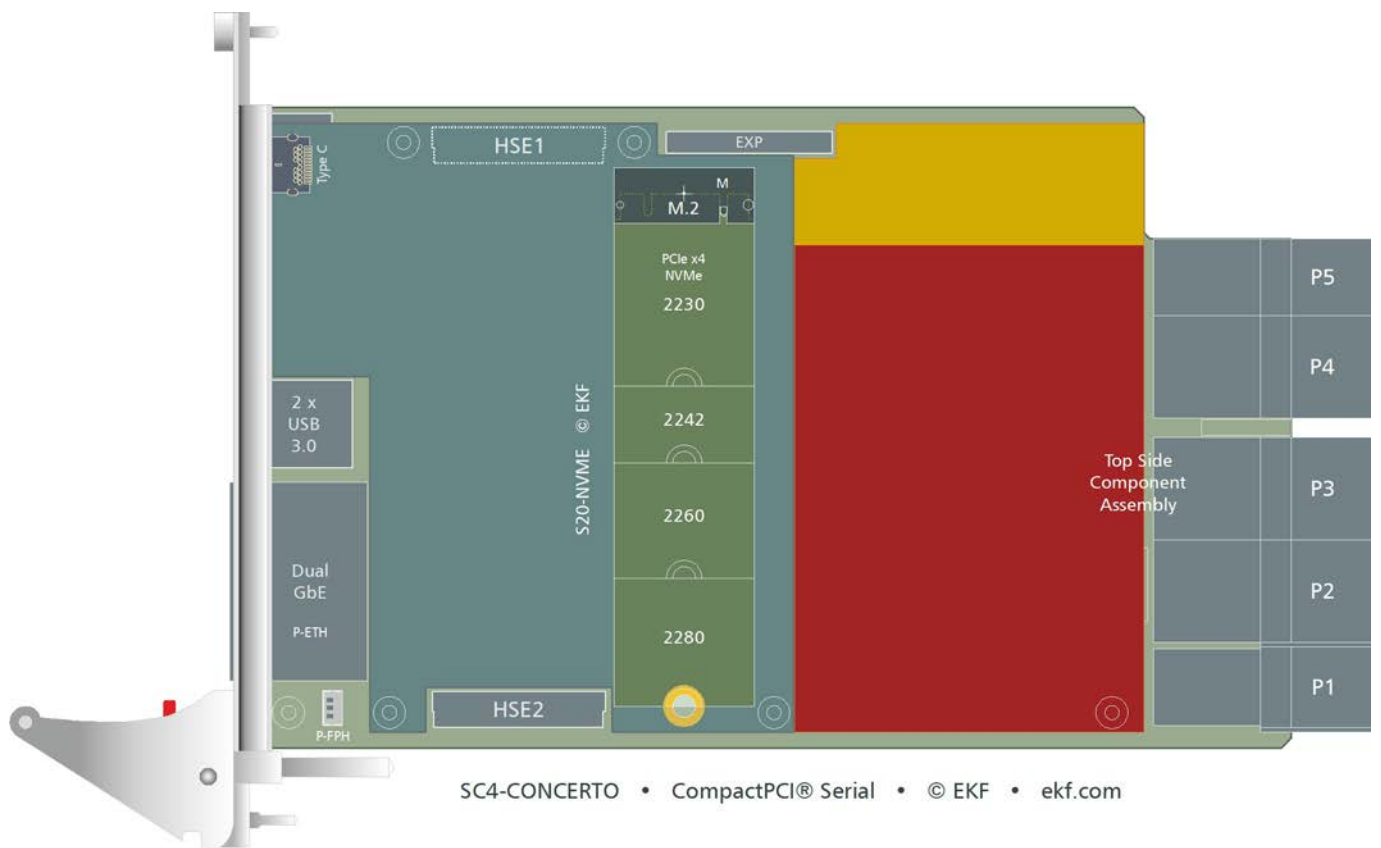▸ EC Regulations EN55022, EN55024, EN60950-1 (UL60950-1/IEC60950-1)

Items are subject to changes
Custom specific modifications or development on request

Block Diagram

Simplified Block Diagram
S20-NVME

Front Panel I/O

USB3 1S514 OVP

3SS3212/25810 SS DFP PD MUX

P-HSE1

USB 3.0

Carrier Card HSE1

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PCIe Gen3 x4

4 3.3V

Power Switch 45520

M.2 NVMe Socket Key Id M

M.2 PCIe SSD

2230

2242

2260

2280

12V 12V

DC/DC 7.5A 2 x SiC 401A DC/DC 6A

3.3V 5V

SC4-CONCERTO

Top View Component Assembly
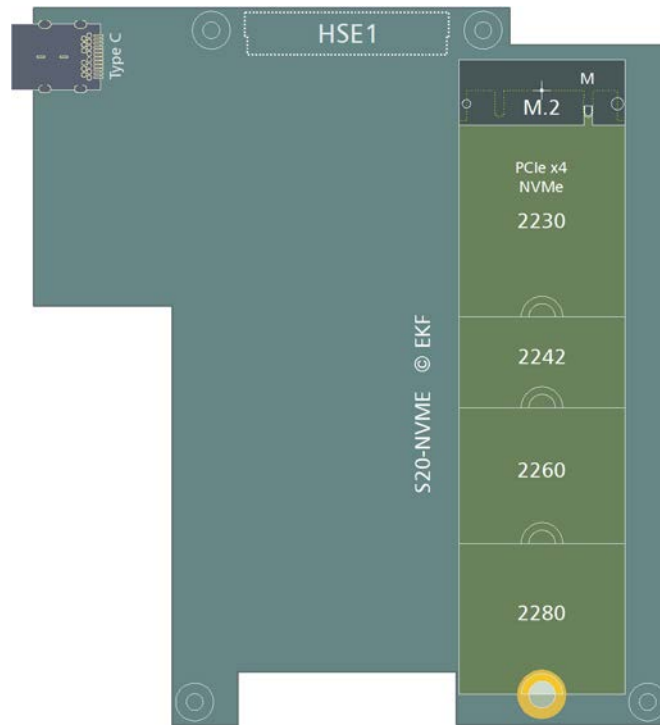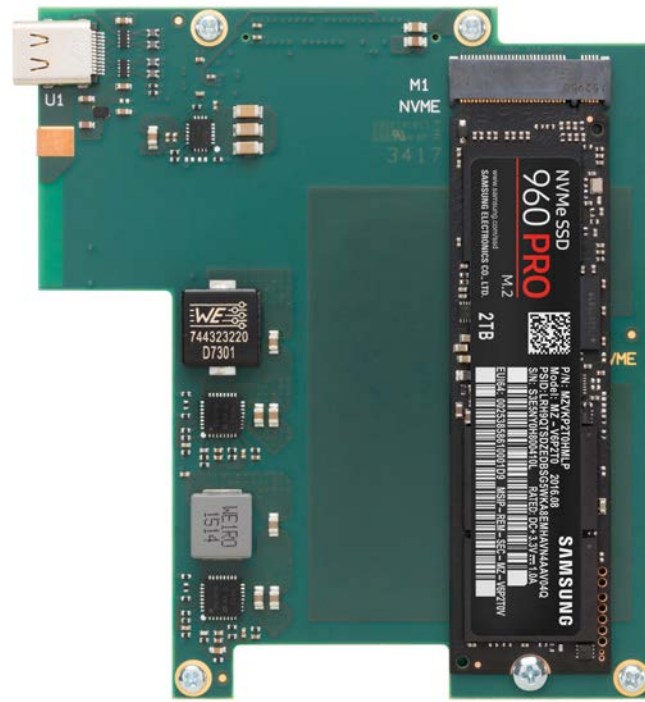
Front Panel

SC5- w. S20
FESTIVAL
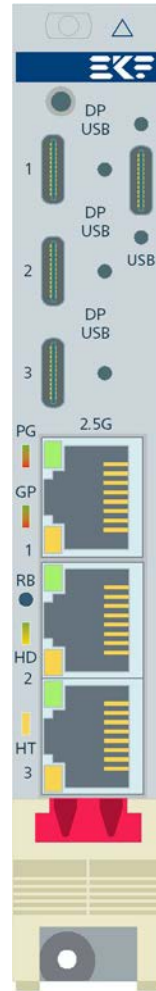
SC9- w. S80
TOCCATA

For rugged applications, the front panel is provided with M2 threads, suitable for dual screw Type-C locking plugs, according to the 'USB Type-C Locking Connector Specification' (15mm pitch).

Technical Reference - Connectors

M.2 SSD Host Connector

The S20-NVME is provided with an M.2 (formerly NGFF) module host connector. The socket is M-keyed, for PCIe x4 based SSD modules. After inserted, the M.2 module must be locked manually by a screw (M2.5 threaded inserts provided on the PCB), in order to withstand shock and vibration. The S20-NVME accepts module sizes up to 2280.

An NVMe protocol SSD is suitable for demanding applications, but some legacy operating systems may not provide NVMe drivers. There are also PCIe x4 based SSDs available for OEMs which comply with the AHCI (SATA) protocol, for legacy systems. When ordering PCIe based SSD modules, be sure to chose the version which is most suitable for your application.
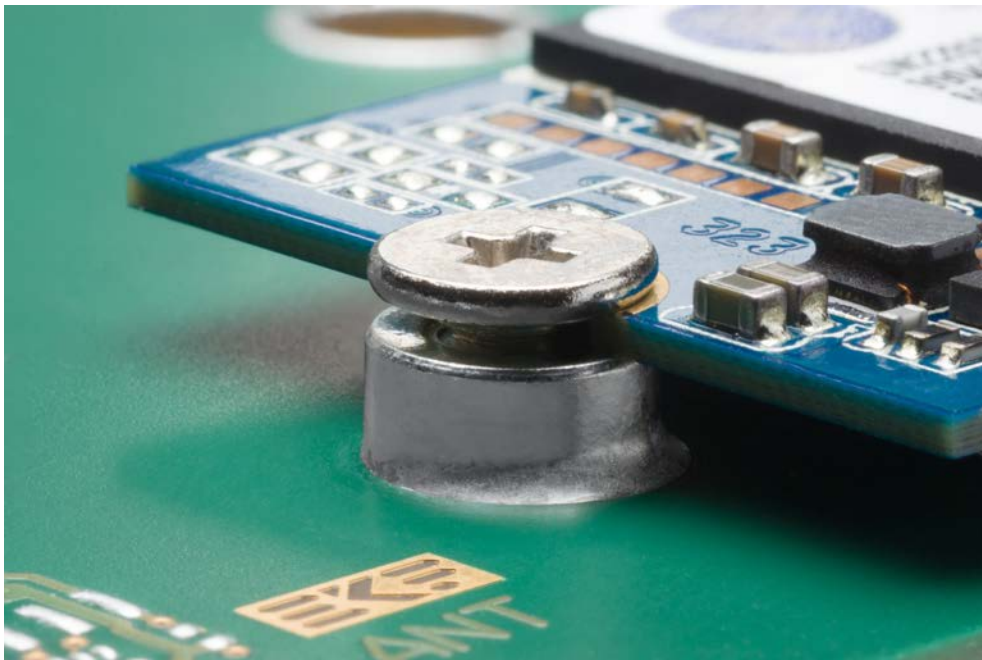
M.2 Module Fixation (Picture Similar)

NVMe PCIe x4 M.2 M-Key • Pin 1 - 38 EKF Part #255.50.2.2223.10			
GND	1	2	+3.3V
GND	3	4	+3.3V
PETN3	5	6	NC
PETP3	7	8	NC
GND	9	10	LED1#
PERN3	11	12	+3.3V
PERP3	13	14	+3.3V
GND	15	16	+3.3V
PETN2	17	18	+3.3V
PETP2	19	20	NC
GND	21	22	NC
PERN2	23	24	NC
PERP2	25	26	NC
GND	27	28	NC
PETN1	29	30	NC
PETP1	31	32	NC
GND	33	34	NC
PERN1	35	36	NC
PERP1	37	38	NC

NVMe PCIe x4			
M.2 M-Key continued • Pin 39 - 75			
GND	39	40	SMB_CLK *
PETN0	41	42	SMB_DATA *
PETP0	43	44	ALERT *
GND	45	46	NC
PERN0	47	48	NC
PERP0	49	50	PERST#
GND	51	52	CLKREQ#
REFCLKN	53	54	PEWAKE#
REFCLKP	55	56	RSV
GND	57	58	RSV
M-Key	59	60	M-Key
M-Key	61	62	M-Key
M-Key	63	64	M-Key
M-Key	65	66	M-Key
NC	67	68	SUSCLK
PEDET	69	70	+3.3V
GND	71	72	+3.3V
GND	73	74	+3.3V
GND	75		

* Logic level 1.8V signals - LSF0204 level shifter to 3.3V on-board

PCI Express® M.2 Specification Socket 3 PCIe-based Module Pinout (Module Key M)
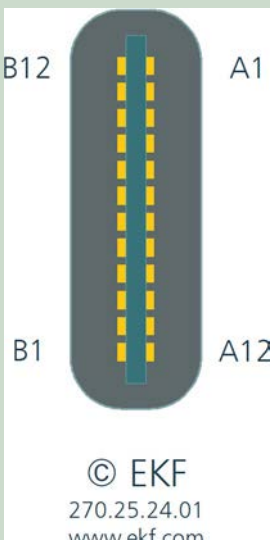
Type-C Front I/O

The S20-NVME mezzanine is equipped with a Type-C front panel connector, to be used as USB 3.1 Gen 1 DFP (Downstream Facing Port, aka host). The receptacle is suitable for a standard Type-C USB cable assemby. Fur rugged applications, fixing threads are provided for a dual-screw locked cable connector, according to the 'Type-C Locking Connector Specification Rev. 1.0'.

The Type-C connector USB port is derived from the CPU carrier card across the mezzanine connector HSE1. An integrated DFP controller and power switch is combined with a 10Gbps MUX for Type-C flip control (signal flow according to the cable plug orientation). This circuitry is ready for USB 3.1 Gen 2 (10Gbps SuperSpeed+), for future CPU chipset generation. Based on the USB PD BMC protocol (CC signals used for communication w. UFP), +5V V_{BUS} power supply is provided up to 3A on this connector, and a circuit protection prevents from damages caused by external V_{BUS} over voltage, surge, and ESD.

Type-C Receptacle - Upper Position Front Panel - USB DFP				
	GND	b12	a1	GND
	RX1+	b11	a2	TX1+
	RX1-	b10	a3	TX1-
	V_{BUS}	b9	a4	V_{BUS}
	SBU2 *	b8	a5	CC1
	D-	b7	a6	D+
	D+	b6	a7	D-
	CC2	b5	a8	SBU1 *
	V_{BUS}	b4	a9	V_{BUS}
	TX2-	b3	a10	RX2-
	TX2+	b2	a11	RX2+
	GND	b1	a12	GND

B12   A1

B1   A12

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* 100k PD - not in use for USB

A TPS25810 USB Type-C DFP controller & power switch (setup for 3A V_{BUS} PD) is wired to the CC1/CC2configuration channel pins of the Type-C receptacle. The controller delivers a polarity signal for the HD3SS3212 high speed multiplexer which reflects the Type-C cable plug orientation (flip control). As result, the USB SuperSpeed signals (TX/RX) are routed appropriate either to the A-contacts, or B-contacts. TVS diodes and common mode filters are provided for signal protection, and a TPD1S514 OVP circuit prevents from externally applied over-voltage across the V_{BUS} pins.

Please note that the Type-C receptacle USB port is derived from the CPU carrier card across the HSE1 mezzanine connector. With respect to the SC4-CONCERTO CPU, this is an USB 3.1 Gen 1 (5Gbps SuperSpeed) connection, but further CPU boards may also deliver Gen 2 (10Gbps SuperSpeed+).

Mezzanine Connectors HSE1, HSE2

The S20-NVME is provided with a male mezzanine connector on the bottom side of the PCB, which mates with the female mezzanine connector on the carrier CPU card, for a resulting board-to-board mounting height of 10.0mm.

HSE1

HSE1 is used to pass a PCIe x4 link from the CPU carrier card to the on-board M.2 NVMe connector. In addition, a SuperSpeed USB 3.1 Gen1 channel is wired across HSE1 to the upper front panel Type-C connector.

HSE2

HSE2 is an additional local expansion connector which may be provided on the CPU carrier card. It is not in use on the S20-NVME. Instead, a cutout is provided on the PCB shape, which would allow to combine the CPU carrier with both the low profile S20-NVME mezzanine, and via HSE2 also an additional side card, for a total 8HP front panel width assembly. With respect to the cutout around HSE2, the S20-NVME differs from similar low profile mezzanine modules e.g. the S40-NVME, which would not be suitable to be used together with a side card.

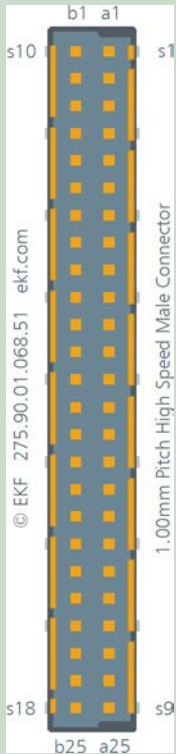Carrier card connector 8mm female ERNI Microspeed 275.90.08.068.01
Supplement 1mm male connector for nominal height 9mm (C4*, B2B 9.5mm)
Supplement 2mm male connector for nominal height 10mm (S2*, S4*, B2B 10.0mm)
Supplement 2mm male connector for nominal height 10mm (S6*, S8*, B2B 10.8mm)
Supplement 10mm male connector for nominal height 18mm (SC* side card, B2B 18.7mm)

High Speed Expansion P-HSE1			
CFG_34 *	b1	a1	CFG_12 *
3_PCIE_TXP	b2	a2	1_PCIE_TXP
3_PCIE_TXN	b3	a3	1_PCIE_TXN
GND	b4	a4	GND
3_PCIE_RXN	b5	a5	1_PCIE_RXN
3_PCIE_RXP	b6	a6	1_PCIE_RXP
GND	b7	a7	GND
4_PCIE_TXP	b8	a8	2_PCIE_TXP
4_PCIE_TXN	b9	a9	2_PCIE_TXN
GND	b10	a10	GND
4_PCIE_RXN	b11	a11	2_PCIE_RXN
4_PCIE_RXP	b12	a12	2_PCIE_RXP
GND	b13	a13	GND
2_USB3_TXP	b14	a14	1_USB2_P
2_USB3_TXN	b15	a15	1_USB2_N
GND	b16	a16	GND
2_USB3_RXP	b17	a17	2_USB2_P
2_USB3_RXN	b18	a18	2_USB2_N
GND	b19	a19	GND
PCIE_CLK_P	b20	a20	1_2_USB_OC#
PCIE_CLK_N	b21	a21	PLTRST#
+5VS [1]	b22	a22	+3.3VS [1]
+5VS [1]	b23	a23	+3.3VS [1]
+5VPS [2]	b24	a24	+3.3VA [3]
+12VPS [2]	b25	a25	+12VPS [2]

* CFG_12 and CFG_34 = open on S20 (10k PU on CPU carrier board) indicating that a PCIe x4 link is requested

1) Power rail switched on in S0 state only
2) Power rail switched on in S0-S4 state
3) Power always on

Ordering Information

Ordering Information
For popular S20-NVME SKUs please refer to www.ekf.com/liste/liste_21.html#S20

Please note that the S20-NVME is a carrier card which typically comes <u>without</u> M.2 module(s) populated, unless otherwise expressly ordered. Photos shown within this document and at other places may be equipped with M.2 modules just for application demonstration. If you need a turnkey solution with M.2 NVMe and/or M.2 SATA storage modules populated, please contact sales@ekf.com before ordering.

Alternate Products

Low Profile CPU Card Mezzanine Storage Modules	
S40-NVME	M.2 NVMe & M.2 SATA, 2 x Type-C
S48-SSD	Dual M.2 NVMe, 1 x Type-C
S80-P6	M.2 NVMe & P6 Backplane Connector (8 x Gb Ethernet switch)
S82-P6	M.2 NVMe & P6 Backplane Connector (4 x Gb Ethernet NIC)

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