



## Product Information

### ***CompactPCI<sup>®</sup> Serial*** • SBF-CROSSOVER

#### Multi I/O Card

Quad USB 3.0 • Dual GbE • RS-232 • PE Mini Card Socket

Document No. 8921 • 12 October 2018



## General

*The SBF-CROSSOVER is a peripheral slot card for CompactPCI® Serial systems, equipped with four individual USB 3.0 compliant controllers, and two Gigabit Ethernet NICs, all wired for front I/O. In addition, a PCI Express® Mini Card socket is provided on-board, which can be used e.g. for a fieldbus I/O module such as CAN FD. Furthermore, a quad port UART is available for RS-232 or RS-485 communication.*

The SBF-CROSSOVER can be installed into any PCI Express® enabled peripheral slot of a CompactPCI® Serial backplane (PCIe® x4 or fat pipe slot recommended for optimum performance). All on-board devices are PCI Express® based. The front panel USB and Ethernet jacks are wired to individual controllers each, thus achieving the full data throughput on all connectors concurrently.



## Feature Summary

### *General*

- ▶ PICMG® CompactPCI® Serial standard (CPCI-S.0) peripheral slot card
- ▶ Single Size Eurocard 3U 4HP 100x160mm<sup>2</sup>
- ▶ CPCI-S backplane connector P1
- ▶ PCIe® x4 upstream - Gen2 (5GT/s) required for optimum performance

### *PCI Express® Interface*

- ▶ PCI Express® 9-port 12-lane packet switch PEX8614
- ▶ Upstream port: PCI Express® x4 Gen2 (5GT/s) supported
- ▶ Downstream ports: 8 x PCIe® x1 (4 x USB controllers, 2 x Ethernet NICs, 1 x Mini Card socket, 1 x UART)

### *USB*

- ▶ 4 x Texas Instruments PCI Express® dual port USB 3.0 controller TUSB7320
- ▶ USB 3.1 Gen1 (formerly USB 3.0) xHCI (eXtensible host controller interface) SuperSpeed supported
- ▶ USB 2.0 high-speed, full-speed, low-speed supported
- ▶ 4 x front panel Type-A USB 3.0 host connectors
- ▶ V<sub>BUS</sub> (+5V) 1.5A high current power switches assigned to front panel connectors
- ▶ Option on-board Type-A connector, suitable for on-board USB stick
- ▶ USB 2.0 wired to PCIe® Mini Card socket

### *Networking*

- ▶ Two networking interface controllers (NIC), 1000BASE-T, 100BASE-TX, 10BASE-T connections
- ▶ Intel® I210-IT -40°C to +85°C operating temperature GbE controllers w. integrated PHY
- ▶ IPv4/IPv6 checksum offload, 9.5KB Jumbo Frame support, EEE Energy Efficient Ethernet
- ▶ IEEE 802.1Qav Audio-Video-Bridging (AVB) enhancements for time-sensitive streams
- ▶ IEEE 1588 and 802.1AS packets hardware-based time stamping for high-precision time synchronization
- ▶ Two GbE ports via RJ45 front panel jacks (option 2 x M12-X connectors with mezzanine module P01)

## Feature Summary

### *UART*

- ▶ Diodes® (Pericom®) PCI Express® quad port UART PI7C9X7954
- ▶ High performance 950-class UART
- ▶ 16C550 software compatible
- ▶ 128-Byte FIFO for each transmitter/receiver
- ▶ Baud rate up to 15Mbps
- ▶ XON/XOFF in-band flow control
- ▶ CTS/RTS or DSR/DTR out-of-band control & driver enable signal for PartyLine operation
- ▶ Data frame 5, 6, 7, 8 and 9 bits
- ▶ Clock prescaling 4 to 46
- ▶ Windows® WHQL device driver support
- ▶ Two on-board RS-232 transceivers MAX3243, pin headers suitable for attachment of D-Sub 9-pin connectors by means of micro-ribbon flat cable
- ▶ Two UART channels wired for pin headers suitable for SU\*-series modules (isolated RS-232 or isolated RS-485)
- ▶ Custom specific F/P design for additional D-Sub or Micro-D connectors (8HP or wider)

### *PCI Express® Mini Card*

- ▶ PCI Express® Mini Card socket, full-size or half-size modules
- ▶ Micro SIM card holder associated (15mm x 12mm ETSI TS 102 221 V9.0.0, Mini-UICC)
- ▶ PCI Express® Mini Cards of both styles supported: USB and PCIe® based
- ▶ Suitable for wireless applications
- ▶ Suitable for fieldbus modules e.g. CAN-FD, and industrial Ethernet modules (real time networking)
- ▶ Custom specific F/P design for additional pigtail SMB antenna connectors (8HP or wider)
- ▶ Custom specific F/P design for non-radio applications e.g. CAN-FD (8HP or wider)

### *Applications*

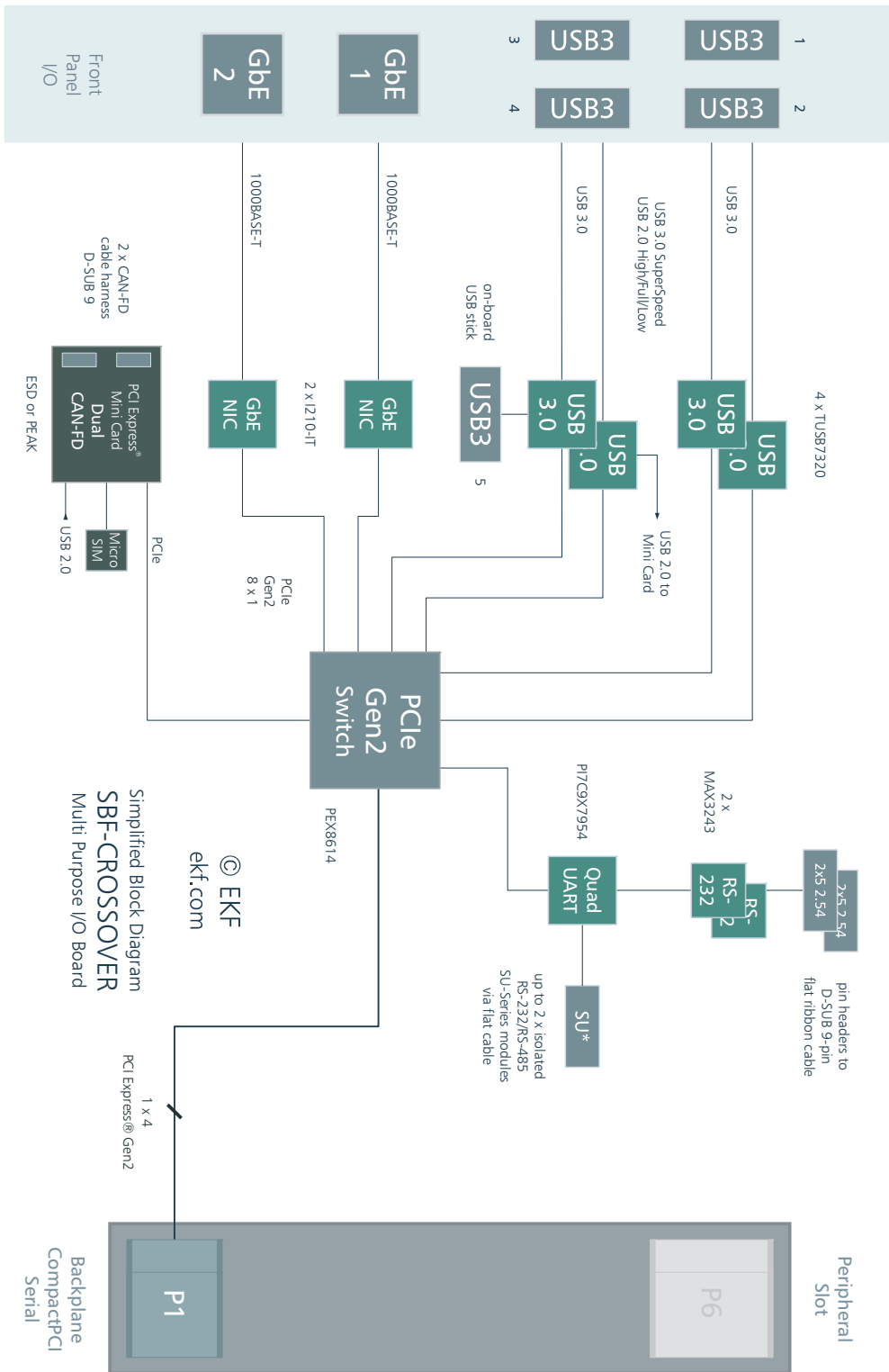
- ▶ Mixed I/O: USB - Ethernet - UART - fieldbus or wireless
- ▶ Flexible usage by means of Mini Card socket (PCIe® or USB module)
- ▶ Data acquisition, data translation, gateway
- ▶ Fieldbus or real time networking
- ▶ IIOT, edge computing

## Feature Summary

*Environment & Regulation*

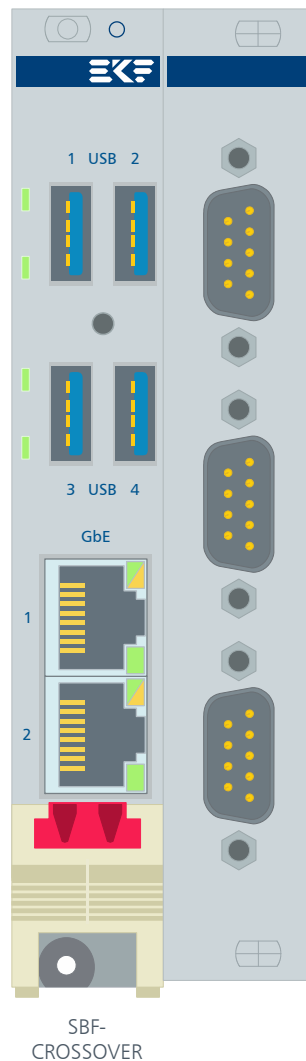
- ▶ Designed & manufactured in Germany
- ▶ ISO 9001 certified quality management
- ▶ Long term availability
- ▶ Rugged solution (coating, sealing, underfilling on request)
- ▶ RoHS compliant
- ▶ Operating temperature: -40°C to +85°C (industrial temperature range)
- ▶ Storage temperature: -40°C to +85°C, 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 24.6 years
- ▶ EC Regulations EN55022, EN55024, EN60950-1 (UL60950-1/IEC60950-1)

Block Diagram



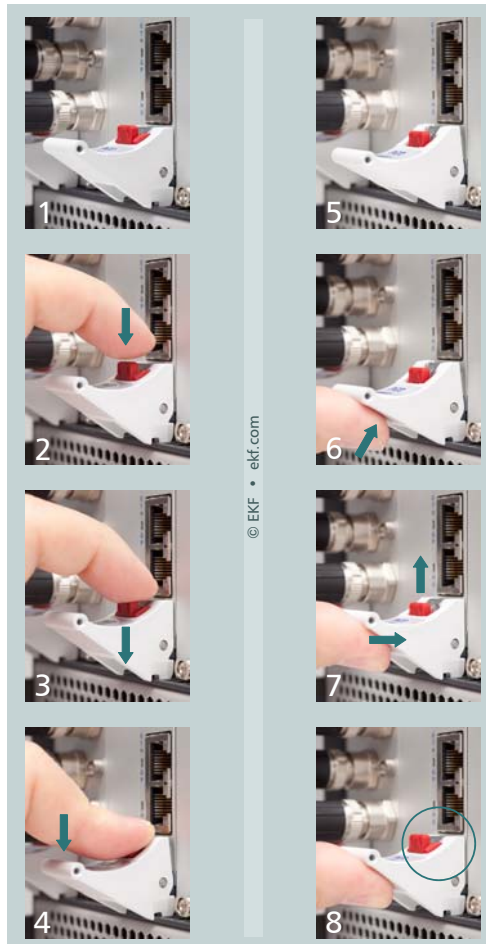
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Simplified Block Diagram  
SBF-CROSSOVER  
Multi Purpose I/O Board

## Front Panel



The SBF-CROSSOVER is available with several front panel layouts, typically 4HP or 8HP front panel width. Shown above is an 8HP solution with D-Sub connector openings (to be used e.g. with RS-232 or CAN-FD). Since the Mini Card socket and the UART connectors allow for many front panel connector alternates, EKF offers custom specific front panel design.

Please note: The front handle is provided with a built-in microswitch, which is used to disable the on-board power circuit when released. Vice versa, the *on-board devices are enabled not before the handle gets locked*. Please refer to the illustration below and make sure that the eject lever has reached its final position for proper board operation, as shown in picture 8. A gentle click should be audible, when the red actuator pin moves into its raised position, indicating that the board is locked and ready for use.



1 - 4: remove board

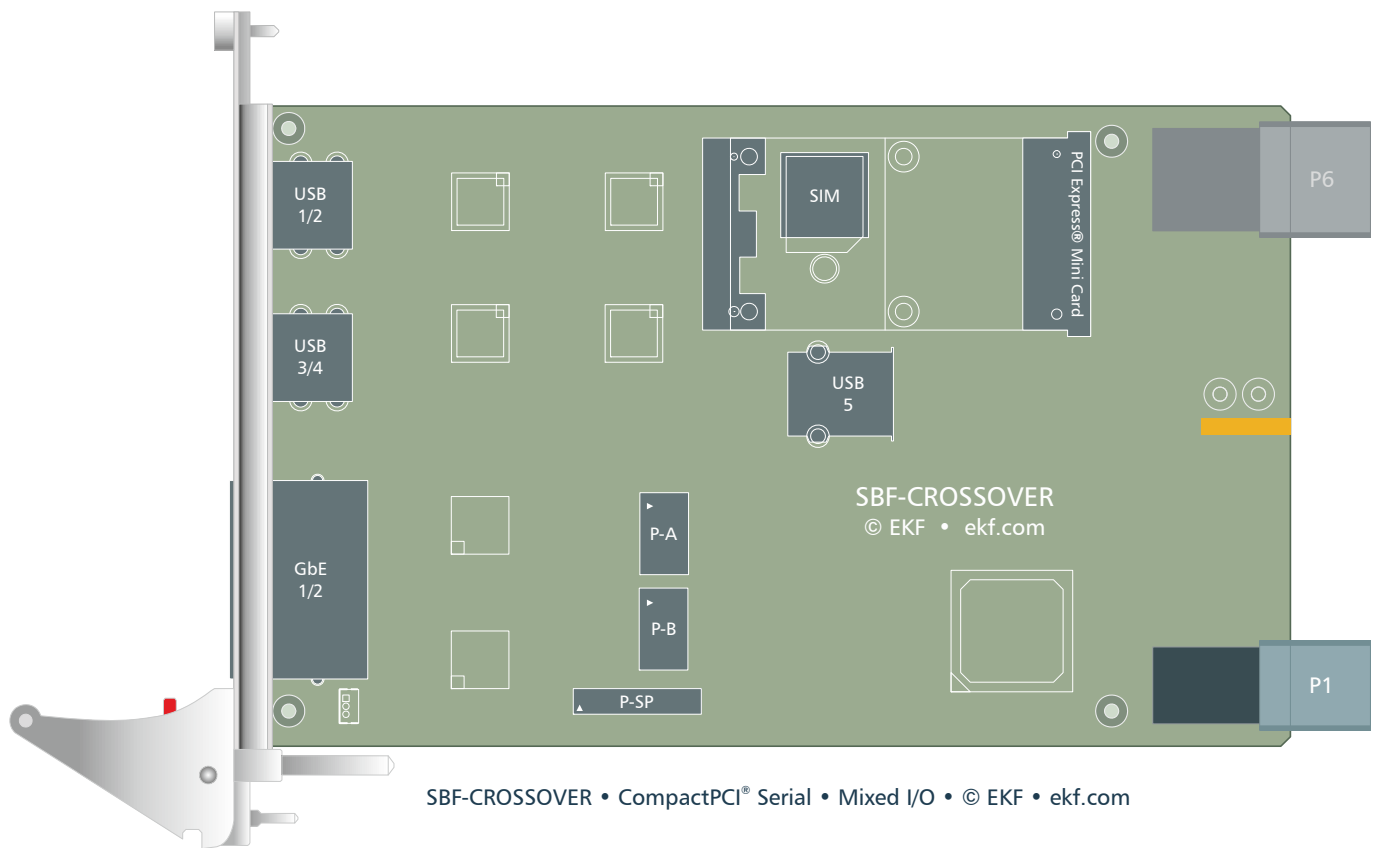
5 - 8: install board

1 & 8: on-board power enabled

2-7: on-board power disabled

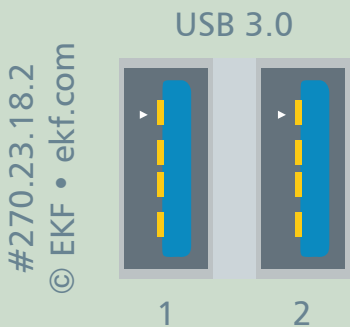


## Component Orientation



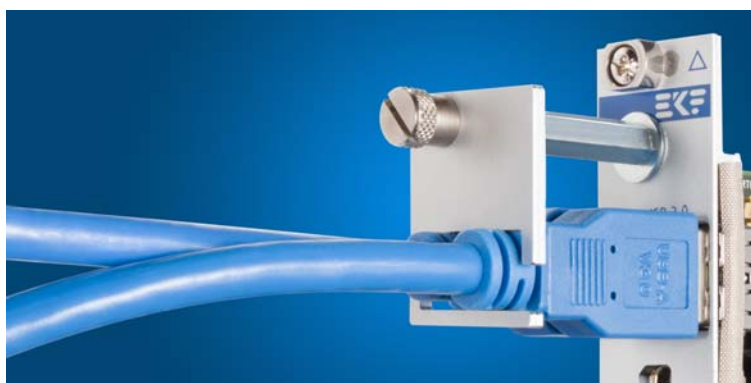
## USB Connectors

The SBF-CROSSOVER is equipped with four front panel receptacles for USB 3.0 or USB 2.0 Type-A cable connectors (USB root hub). Since the SBF-CROSSOVER USB ports are associated to individual SuperSpeed xHCI controllers, up to the maximum USB 3.0 data transfer rate will be available on all connectors simultaneously, when the board is operated in a CompactPCI® Serial PCIe® x4 or fat pipe peripheral slot. An exception exists with respect to the receptacle #4, which shares its performance with an optional on-board USB 3.0 connector for USB sticks. Another shared resource (receptacle #3) is the USB 2.0 connection required for some PCIe® Mini Cards (please refer also to the block diagram).

USB 1 - 4 • Dual USB 3.0 Receptacles		
USB 3.0 dual Type-A receptacle, stacked, 18-position		
	1	$V_{BUS} +5V, 1.5A \text{ max}^{1)}$
	2	USB D-
	3	USB D+
	4	GND
	5	SS RX-
	6	SS RX+
	7	GND
	8	SS TX-
	9	SS TX+


<sup>1)</sup> +5V via 1.5A current-limited electronic power switch. Power rail may be switched off by software independently for each port.

Each SBF-CROSSOVER USB connector provides +5V ( $V_{BUS}$ ) for powering external devices. Electronic switches limit the maximum output current of each individual USB connector to a safe level. Front panel LEDs are provided to indicate the power state and initialization status of each F/P USB port. For rugged applications EKF offers custom specific USB cable connector retainer solutions (similar picture below).



## Ethernet Connectors

Both Ethernet ports on the SBF-CROSSOVER are based on individual I210IT PCIe® to Ethernet controllers, i.e. offer different MAC addresses, hence suitable for simple network attachment or flexible usage as router or gateway.

Gigabit Ethernet Ports 1/2 (RJ45)			
 <p>270.02.08.5</p>	Port 1	1	NC1_MDX0+
		2	NC1_MDX0-
		3	NC1_MDX1+
		4	NC1_MDX2+
		5	NC1_MDX2-
		6	NC1_MDX1-
		7	NC1_MDX3+
		8	NC1_MDX3-
	Port 2	1	NC2_MDX0+
		2	NC2_MDX0-
		3	NC2_MDX1+
		4	NC2_MDX2+
		5	NC2_MDX2-
		6	NC2_MDX1-
		7	NC2_MDX3+
		8	NC2_MDX3-

The lower green LED of each front panel connector indicates LINK established when continuously on, and data transfer (activity) when blinking. If the lower green LED is permanently off, no LINK is established. The upper green/yellow dual-LED signals the link speed 1Gbit/s when lit yellow, 100Mbit/s when lit green, and 10Mbit/s when off.

## Mini Card Host Connector

The SBF-CROSSOVER is provided with a PCI Express® Mini Card host connector. It is suitable for PCIe® based modules, and also USB 2.0 driven Mini Card modules. After inserted, the Mini Card has to be fixed by a snap-in latch (full-size modules 50.80mm length), or will have to be secured manually by screws (mini size modules 26.80mm length), in order to withstand shock and vibration.

The on-board dual port USB controllers are Texas Instruments TUSB7320 which is USB 2.0 & USB3.0 compliant. With respect to the mini card socket, only the USB 2.0 high speed internal controller section is in use.

MC1				
PCI Express® Mini Card Socket (255.4.1.052.14) & Latch (255.4.1.052.94)				
	PCIE_WAKE#	1	2	+3.3V
	COEX1 (GPIO2/6/10/14)	3	4	GND
	COEX2 (GPIO3/7/11/15)	5	6	+1.5V
	CLKREQ# (NC)	7	8	UIM_C1
	GND	9	10	UIM_C7
	PCIE_CLK-	11	12	UIM_C3
	PCIE_CLK+	13	14	UIM_C2
	GND	15	16	UIM_C6
	UIM_C8	17	18	GND
	UIM_C4	19	20	W_DIS1# (GPIO0/4/8/12)
	GND	21	22	RST#
	PCIE_RN	23	24	+3.3V
	PCIE_RP	25	26	GND
	GND	27	28	+1.5V
	GND	29	30	SMB_CLK
	PCIE_TN	31	32	SMB_DAT
	PCIE_TP	33	34	GND
	GND	35	36	USB_D-
	GND	37	38	USB_D+
	+3.3V	39	40	GND
+3.3V	41	42	LED_WWAN#	
GND	43	44	LED_WLAN#	
RSV (NC)	45	46	LED_WPAN#	
RSV (NC)	47	48	+1.5V	
RSV (NC)	49	50	GND	
W_DIS2# (GPIO1/5/9/13)	51	52	+3.3V	

Power: The socket can supply a Mini Card with +3.3V/1.5A and +1.5V/1A

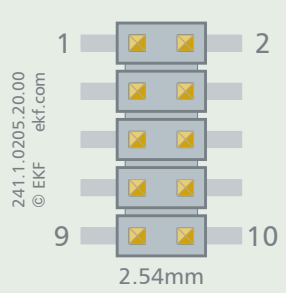
The Mini Card socket is not suitable for some proprietary modules, which may provide special services, e.g. voice I/O, resulting in conflicts with the host connector pin assignment. Be sure that your Mini Card complies with the PCI Express® Mini Card Specification (PCI-SIG). Furthermore, mSATA modules are not supported.

Full size Mini Cards are fixed by a latching (snap-in) element at the module end. A half size Mini Card must be fastened manually by screws M2.5x4mm through corresponding M2.5 soldered nuts provided on the SBF-CROSSOVER PCB. 0.5mm height nylon washers are required in addition as spacing elements between the PCB nuts and the half size Mini Card. Another approach would be to use a mechanical extender on half size Mini Cards, as shown below:



## RS-232 Connectors

The SBF-CROSSOVER is provided with a PCIe® based quad port UART. Two ports (0 - 1) are wired to on-board MAX3234EI RS-232 transceivers, and available via two 2x5 pin headers for attachment of 1.27mm pitch micro ribbon flat cables, with an IDC type male D-Sub 9-pin connector at the cable ending for front panel mounting. Pin 1 of the pin headers must match pin 1 of the D-Sub connectors, with pin 10 left open, for the typical PC COM port pin assignment.

P-A & P-B • RS-232 Serial I/O				
2.54mm Pin Headers • 241.1.0205.20.00				
	DCD (D-Sub Pin 1)	1	2	DSR (D-Sub Pin 6)
	RXD (D-Sub Pin 2)	3	4	RTS (D-Sub Pin 7)
	TXD (D-Sub Pin 3)	5	6	CTS (D-Sub Pin 8)
	DTR (D-Sub Pin 4)	7	8	RI (D-Sub Pin 9)
	GND (D-Sub Pin 5)	9	10	NC

When assembling a flat cable harness, it is recommended that the colour-marked wire would be assigned to pin 1 for both connectors at both cable endings.

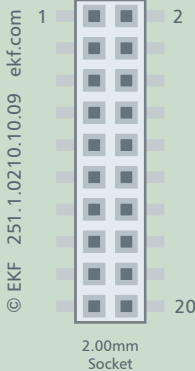
The MAX3234EI RS-232 (TIA/EIA-232) transceivers can be used for up to 500kbit/s (typical) data transfer rate.

## TTL-Level UART Ports

Two UART ports are available in addition from the optional on-board socket SP, as TTL-level signals. This connector is suitable for attachment of one or two EKF SU\*-series PHY modules via a micro ribbon flat cable assembly. A PHY module is a transceiver from TTL level signals to a specific symmetric or asymmetric interface standard, e.g. EIA-485 or RS-232E.

SUE-RS232	Isolated RS-232 module, front connector Micro-D 9-position
SUF-RS485	Isolated RS-485 module, front connector Micro-D 9-position
SUG-RS232	Isolated RS-232 module, front connector RJ45
SUH-RS485	Isolated RS-485 module, front connector RJ45
SUI-RS232	Isolated RS-232 module, front connector standard D-SUB 9-position
SUJ-RS485	Isolated RS-485 module, front connector standard D-SUB 9-position

EKF offers suitable modules with galvanic isolation. With a 8/12HP assembly, these modules can be mounted into the front panel. Please contact [sales@ekf.de](mailto:sales@ekf.de) for availability of different SU-series modules (inquiries for custom specific PHY or transition modules welcome). Also custom specific front panel design can be done.

SP • TTL-Level Serial I/O				
2mm low profile socket • 251.1.0210.10.09				
	+5V	1	2	GND
	RTS# (2)	3	4	RXD (2)
	TXD (2)	5	6	+3.3V
	Driver Enable (2)	7	8	CTS# (2)
	Receiver Enable# (2)	9	10	GND
	Receiver Enable# (3)	11	12	GND
	Driver Enable (3)	13	14	CTS# (3)
	TXD (3)	15	16	+3.3V
	RTS# (3)	19	18	RXD (3)
	+5V	19	20	GND

The connector SP is wired for a simplified UART handshake scheme - the sideband signals DCD, DSR, DTR and RI have been omitted since not required for the EKF SU\* modules. Hardware handshake is established by CTS/RTS only.

## CompactPCI® Serial Backplane Connector

P1 CompactPCI® Serial Peripheral Slot Backplane Connector												
EKF Part #250.3.1206.20.02 • 72 pos. 12x6, 14mm Width												
P1	A	B	C	D	E	F	G	H	I	J	K	L
6	GND	PE TX02+	PE TX02-	GND	PE RX02+	PE RX02-	GND	PE TX03+	PE TX03-	GND	PE RX03+	PE RX03-
5	PE TX00+	PE TX00-	GND	PE RX00+	PE RX00-	GND	PE TX01+	PE TX01-	GND	PE RX01+	PE RX01-	GND
4	GND	<i>USB2+</i>	<i>USB2-</i>	GND	PE CLK+	PE CLK-	GND	<i>SATA TX+</i>	<i>SATA TX-</i>	GND	<i>SATA RX+</i>	<i>SATA RX-</i>
3	<i>USB3 TX+</i>	<i>USB3 TX-</i>	GA0	<i>USB3 RX+</i>	<i>USB3 RX-</i>	GA1	SATA SDI	SATA SDO	GA2	SATA SCL	SATA SL	GA3
2	GND	I2C SCL	I2C SDA	GND	RSV	RSV	GND	RST#	WAKE#	GND	PE EN#	SYS EN#
1	+12V	STBY	GND	+12V	+12V	GND	+12V	+12V	GND	+12V	+12V	GND

pin positions printed white: not connected



SBF-CROSSOVER Links	
SBF-CROSSOVER Home	<a href="http://www.ekf.com/s/sbf/sbf.html">www.ekf.com/s/sbf/sbf.html</a>
CompactPCI® Serial Overview	<a href="http://www.ekf.com/s/smart_solution.pdf">www.ekf.com/s/smart_solution.pdf</a>

Driver Software	
Intel I210 Networking Controller	<a href="http://www.intel.com">www.intel.com</a>
Texas Instruments TUSB7320 xHCI Driver	<a href="http://www.ti.com/product/tusb7340#toolssoftware">www.ti.com/product/tusb7340#toolssoftware</a>
Diodes/Pericom PI7C9X7954 UART	<a href="http://www.ekf.com/s/sbf/drv/">www.ekf.com/s/sbf/drv/</a>

Ordering Information

For popular SBF-CROSSOVER SKUs please refer to  
[www.ekf.com/liste/liste\\_21.html#SBF](http://www.ekf.com/liste/liste_21.html#SBF)

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