



## Product Information

### SPX-PHASE

# **CompactPCI<sup>®</sup> Serial** • Quad M.2 WWAN Module Carrier

Document No. 8322 • 3 April 2023



## General

*The SPX-PHASE is a peripheral slot card for CompactPCI® Serial systems. The board serves as a quad carrier for M.2 3042 style WWAN modules, e.g. 3G or 4G (LTE) modems, and also forthcoming technologies beyond 4G. Four front panel Mini SIM card slots are provided, related to the M.2 module sockets.*

*The R/F module connectors are strapped to an on-board 4:1 R/F combiner circuit. While maintaining good isolation between the inputs, the combiner has its low loss R/F sum port wired to the SMA type front panel antenna connector, for minimum external antenna cabling effort.*

As an option, the SPX-PHASE can be equipped with a custom specific 8HP or 12HP front panel, providing up to six or twelve more antenna connectors, which would be strapped directly to the module W.FL type R/F jacks, hence bypassing the R/F combiner circuit.

An on-board PCI Express® to quad USB 3.0 5Gbps controller is used as upstream connection from the M.2 sockets to the CompactPCI® Serial CPU card.

The SPX-PHASE is well suited especially for higher throughput applications which require WWAN bandwidth aggregation.



## Feature Summary

### *General*

- ▶ PICMG® CompactPCI® Serial (CPCI-S.0) standard peripheral slot card
- ▶ Single Size Eurocard 3U 4HP 100x160mm<sup>2</sup>
- ▶ CompactPCI® Serial backplane connector P1
- ▶ Suitable for PCIe x1 Gen2 peripheral slots

### *USB Controller*

- ▶ Texas Instruments PCI Express® to quad-port USB 3.0 controller TUSB7340
- ▶ PCI Express® x 1 Gen2 interface for optimum performance
- ▶ USB 3.0 xHCI (eXtensible host controller interface) SuperSpeed supported
- ▶ USB 2.0 high-speed, full-speed, low-speed supported
- ▶ Drivers available for download

### *M.2 Sockets*

- ▶ 4 x M.2 sockets, for 30mm x 42mm or 22mm x 42mm cards, B-key
- ▶ Socket 2 WWAN configuration according to PCI Express M.2 Specification Rev. 1.1 2016
- ▶ USB controlled host I/F, USB 3.0 and USB 2.0
- ▶ Future proof by USB 3.0 SuperSpeed, maximum data rate 5Gbps full duplex
- ▶ Legacy compliant 2G/3G/4G (LTE) by USB 2.0 480Mbps
- ▶ +3.3V power supply, 3.7A typ. current limited electronic power switches, option I2C controlled M.2 socket power on/off
- ▶ F/P Mini SIM card holder associated to each socket, 2 x dual-slot
- ▶ Suitable for 25mm x 15mm 2FF UICC, often referred to as 'Standard SIM'
- ▶ Front panel screw lock solution available for Mini SIM cards
- ▶ Front panel LED array associated to M.2 modem LED outputs
- ▶ Common F/P antenna connector SMA R/P for simplified external antenna cabling
- ▶ Custom specific F/P design for additional pigtail antenna connectors (8HP/12HP width)

*R/F Combiner/Splitter Circuit*

- ▶ Mini-Circuits SEPS-4-272+, on-board soldering, 4:1
- ▶ 690-2700MHz, 50 Ohm
- ▶ Isolation 20dB typ.
- ▶ Insertion loss 7dB typ. 800-2200MHz
- ▶ Active antenna DC current 1A max. (250mA per port)
- ▶ On-board R/F strapping from M.2 WWAN modules (e.g. diversity antenna connector) to combiner/splitter via e.g. Hirose W.FL or I-PEX MHF4 or Murata HSC (2x2mm<sup>2</sup>) coaxial connectors and cable assemblies
- ▶ Combiner/splitter bypassing option w. pigtail antenna connectors (custom specific F/P required e.g. 8HP width)

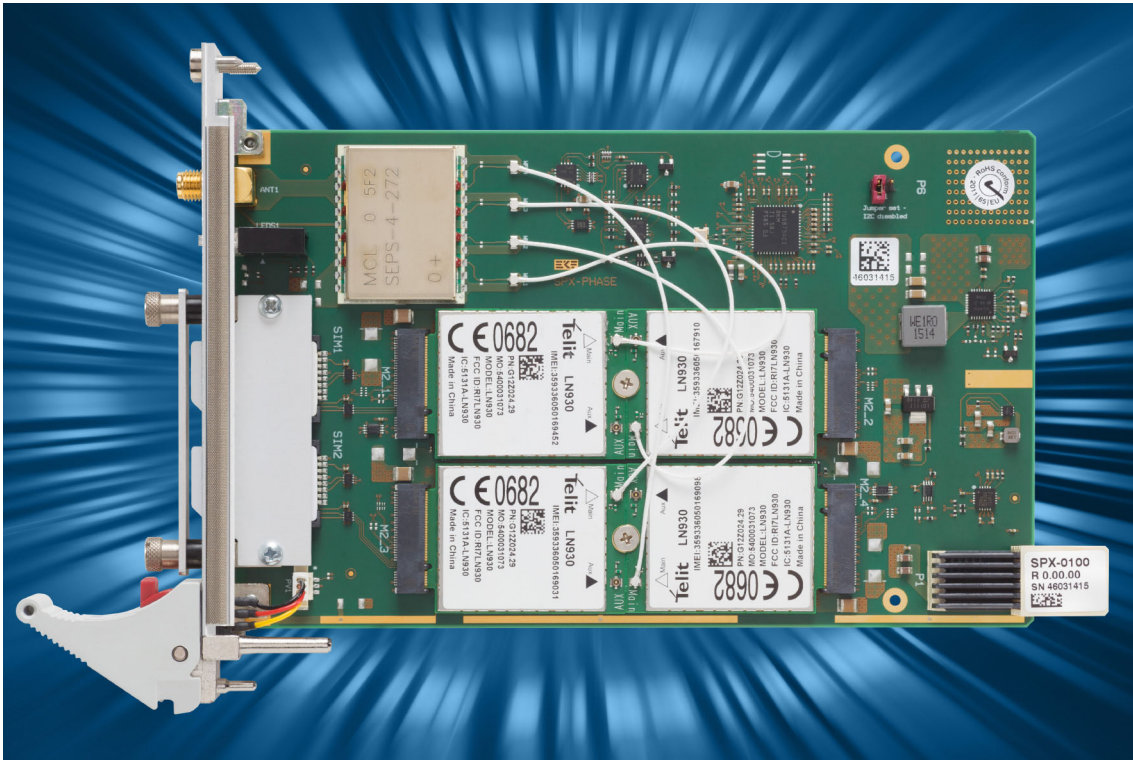
*Applications*

- ▶ WWAN e.g. 3G 4G LTE with or w/o data transfer rate aggregation
- ▶ Railway, transportation
- ▶ Industrial IoT networking

*Environment & Regulation*

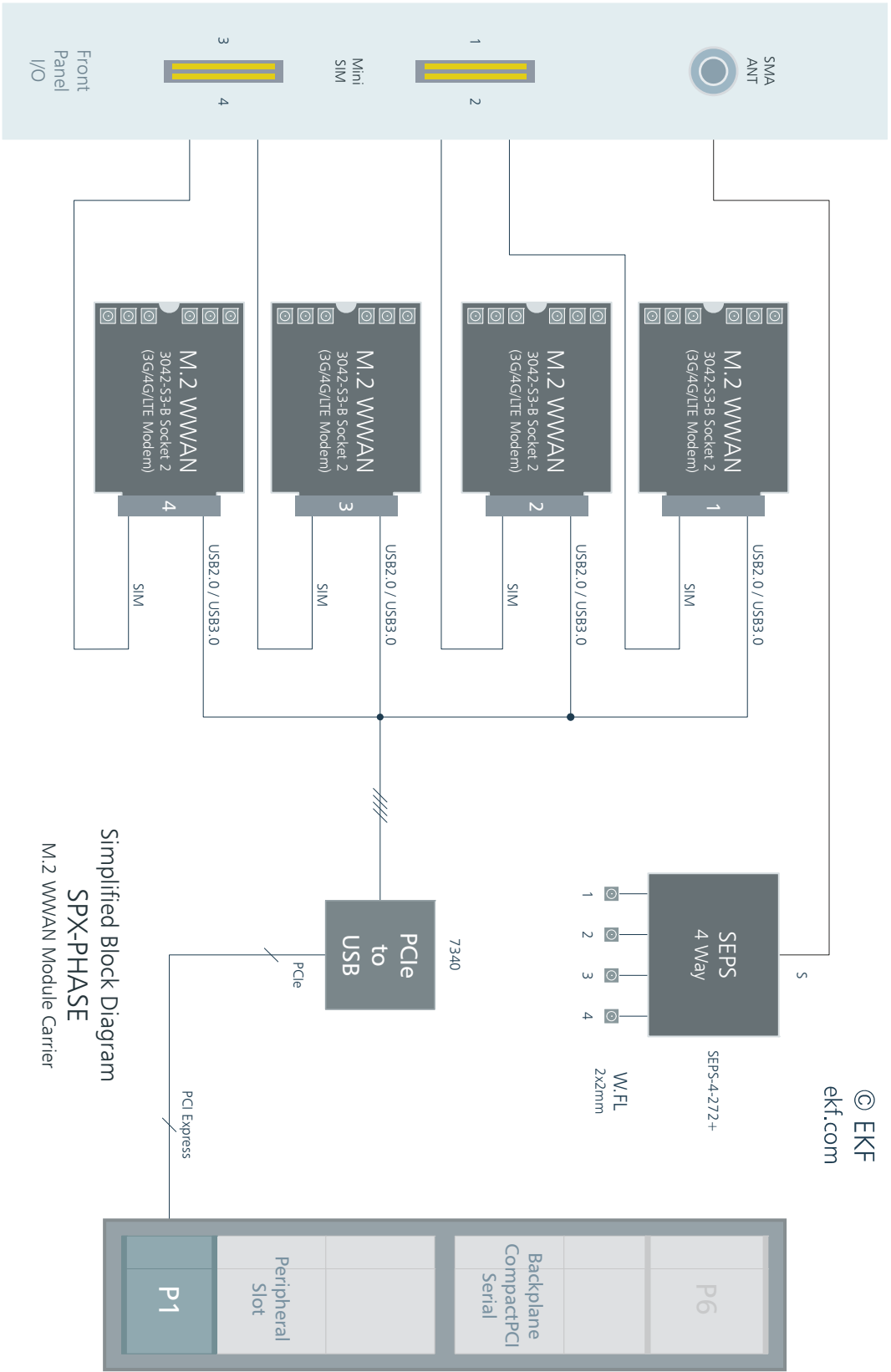
- ▶ Designed & Manufactured in Germany
- ▶ ISO 9001 certified quality management
- ▶ Long term availability
- ▶ Rugged solution (coating, sealing, underfilling on request)
- ▶ RoHS compliant
- ▶ Operating temperature: -40°C to +85°C industrial temperature range
- ▶ Storage temperature: -40°C to +85°C, 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 58.6 years
- ▶ EC Regulations EN55022, EN55035, EN60950-1 (UL60950-1/IEC60950-1)

items are subject to changes



SPX-PHASE w. SIM Card Screw Lock

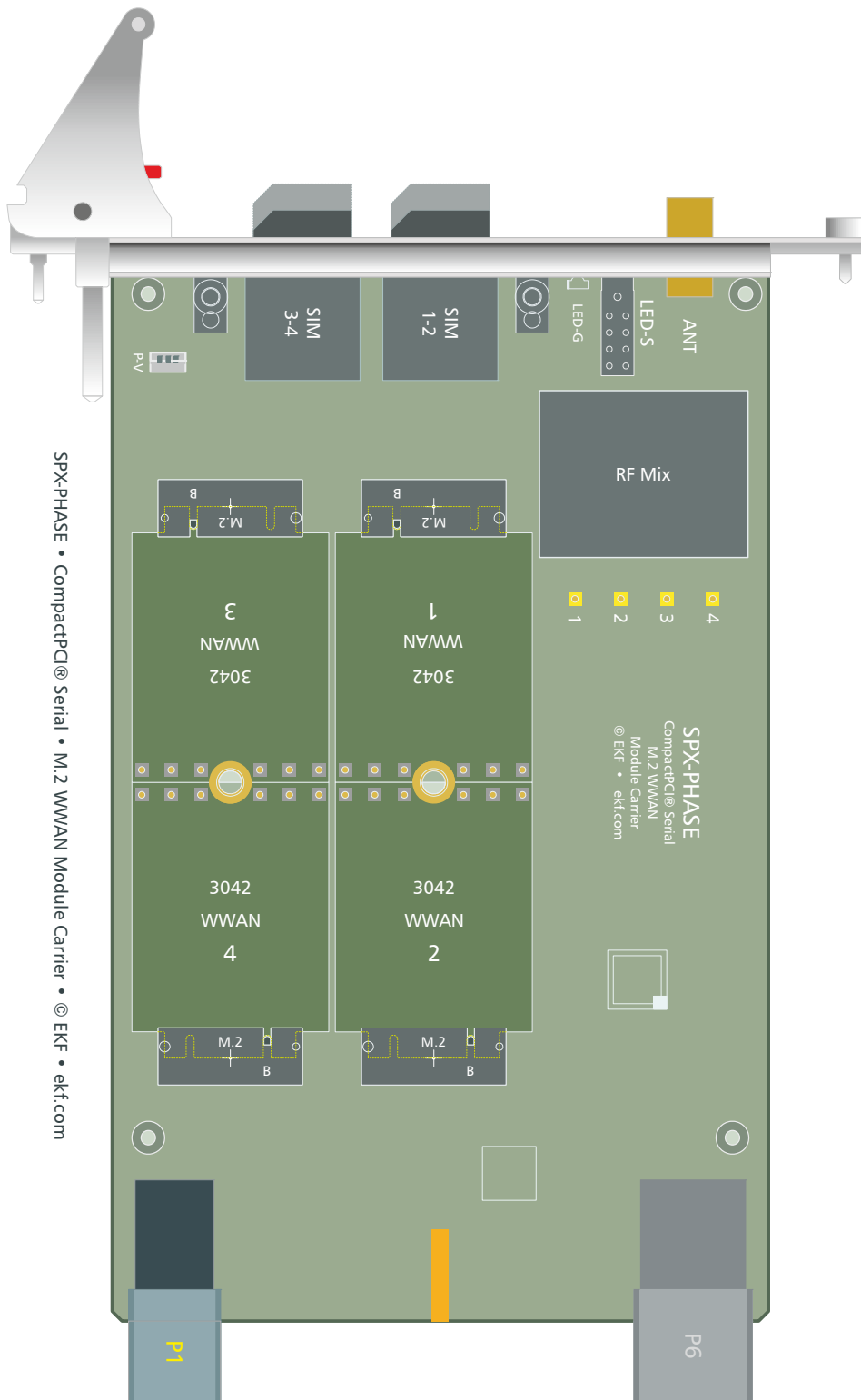
Block Diagram



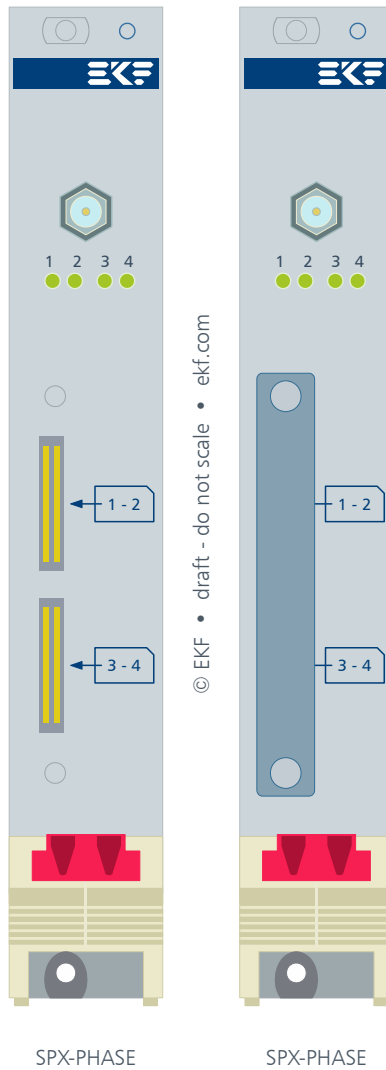
Simplified Block Diagram  
SPX-PHASE  
M.2 WWAN Module Carrier

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Component Assembly



### Front Panel



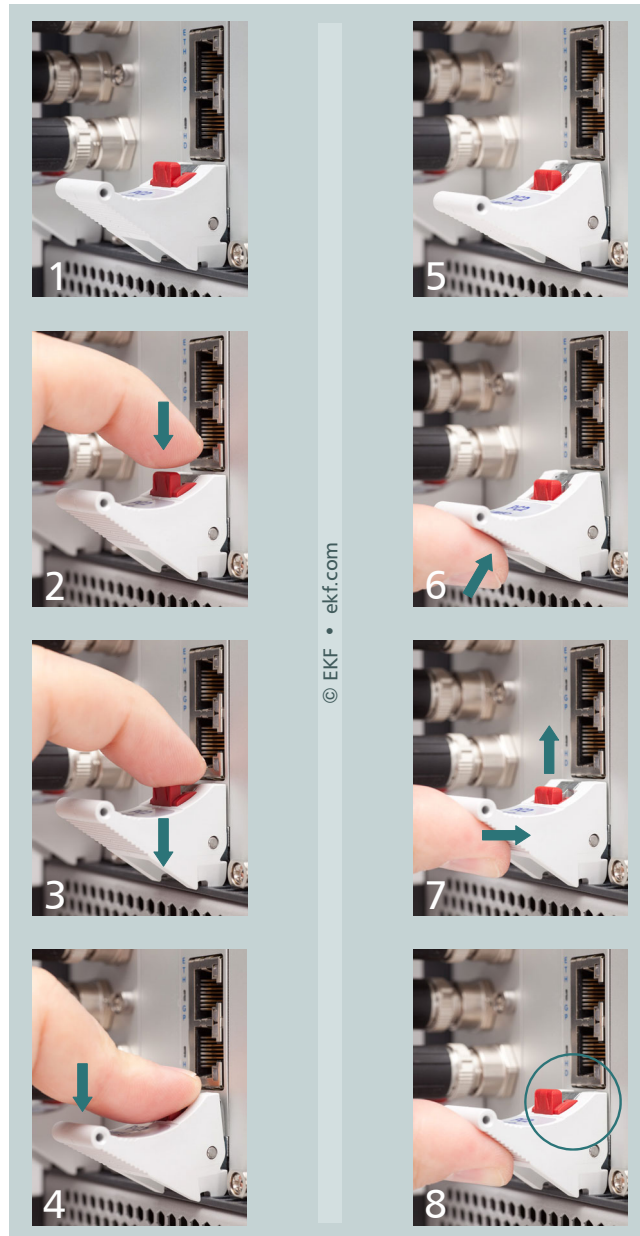
SPX-PHASE

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*LED Assignment  
defined by M.2 WWAN module manufacturer*



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

## M.2 Sockets

M.2 Sockets			
Key B WWAN Module USB 3.0			
Pin 1 - 38			
EKF Part #255.50.1.2242.10			
CFG_3 *	1	2	+3.3V
GND	3	4	+3.3V
GND	5	6	FCPO# 2)
USB_D+	7	8	NC (W_DISABLE#) 2)
USB_D-	9	10	GPIO9_LED1# 4)
GND	11	12	B Key
B Key	13	14	B Key
B Key	15	16	B Key
B Key	17	18	B Key
B Key	19	20	NC (GPIO_5)
CFG_0 *	21	22	NC (GPIO_6)
NC (WAKE_WWAN#)	23	24	NC (GPIO_7)
NC (DPR)	25	26	NC (GPIO_10)
GND	27	28	NC (GPIO_8)
USB3_Tx- 1)	29	30	UIM-RESET 5)
USB3_Tx+ 1)	31	32	UIM-CLK 5)
GND	33	34	UIM-DATA 5)
USB3_Rx- 1)	35	36	UIM-PWR 5)
USB3_Rx+ 1)	37	38	NC

\* by default NC, option 10k pull-up +3.3V

- 1) pin assignment according to M.2 Specification - device point of view. The SPX-PHASE however is controller (host) and receives SuperSpeed data from pins 29/31, and sends data to pin 35/37.
- 2) Full\_Card\_Power\_Off - connected to on-board I2C controlled GPIO output.
- 3) Not connected by default (wireless permanent enabled). May be controlled by I2C GPIO (stuffing option).
- 4) Wired to front panel LED array.
- 5) Wired to associated front panel Mini SIM card slot

M.2 Sockets			
Key B WWAN Module USB 3.0			
Continued • Pin 39 - 75			
GND	39	40	NC (GPIO_0)
NC	41	42	NC (GPIO_1)
NC	43	44	NC (GPIO_2)
GND	45	46	NC (GPIO_3)
NC	47	48	NC (GPIO_4)
NC	49	50	NC
GND	51	52	NC
NC	53	54	NC
NC	55	56	NC
GND	57	58	NC
NC (ANTCTL0)	59	60	NC (COEX3)
NC (ANTCTL1)	61	62	NC (COEX_RXD)
NC (ANTCTL2)	63	64	NC (COEX_TXD)
NC (ANTCTL3)	65	66	NC (SIM_DETECT)
RESET# 1)	67	68	NC (SUSCLK 32kHz)
CFG_1 *	69	70	+3.3V
GND	71	72	+3.3V
GND	73	74	+3.3V
CFG_2 *	75		

\* by default NC, option 10k pull-up +3.3V

- 1) Buffered CompactPCI® Serial backplane signal RST#

I<sup>2</sup>C

Any M.2 socket 3.3V power rail can be individually switched on/off, by means of I<sup>2</sup>C controlled 2.5A power switches AP2511A. With respect to Linux tools you can use the command lines as indicated below:

```
i2cdetect -l //Show I2C busses
i2cdetect -r -y 2 //Show addresses of available I2C devices
on bus 2 (Synopsys DesignWare I2C adapter)

i2cset -y 2 0x75 0x02 //Activate I2C switch of the SPX at
address 0x75 (Slot where the SPX is inserted)
i2cget -y 2 0x3d 0x00 //Read out the I/O port of the SPX
i2cset -y 2 0x3d 0x03 0x0f //Configure I/O port Bits [7:4] as output
i2cset -y 2 0x3d 0x01 0xea //Power off module on socket M2_1
(0xea=M2_1; 0xda=M2_2; 0xba=M2_3; 0x7a=M2_4)
i2cset -y 2 0x3d 0x01 0xfa //Power on modules (if actually turned
off)
```

## P1 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	<i>PE TX02+</i>	<i>PE TX02-</i>	GND	<i>PE RX02+</i>	<i>PE RX02-</i>	GND	<i>PE TX03+</i>	<i>PE TX03-</i>	GND	<i>PE RX03+</i>	<i>PE RX03-</i>
5	<i>PE TX00+</i>	<i>PE TX00-</i>	GND	<i>PE RX00+</i>	<i>PE RX00-</i>	GND	<i>PE TX01+</i>	<i>PE TX01-</i>	GND	<i>PE RX01+</i>	<i>PE RX01-</i>	GND
4	GND	<i>USB2+</i>	<i>USB2-</i>	GND	<i>PE CLK+</i>	<i>PE CLK-</i>	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	<i>SATA SDI</i>	<i>SATA SDO</i>	GA2	<i>SATA SCL</i>	<i>SATA SL</i>	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 italic/white: not connected

For signal descriptions please refer to PICMG CPCI-S.0 R2.0 CompactPCI® Serial Specification

SPX-PHASE Links

SPX-PHASE Home	<a href="http://www.ekf.com/s/spx/spx.html">www.ekf.com/s/spx/spx.html</a>
CompactPCI® Serial Wireless Solutions	<a href="http://www.ekf.com/s/serial.html#SP">www.ekf.com/s/serial.html#SP</a>
CompactPCI® Serial Overview	<a href="http://www.ekf.com/s/serial_concise.pdf">www.ekf.com/s/serial_concise.pdf</a>
CompactPCI® Serial - All You Need to Know	<a href="http://www.ekf.com/s/smart_solution.pdf">www.ekf.com/s/smart_solution.pdf</a>

Driver Software

USB 3.0 TUSB7340 xHCI Driver	<a href="http://www.ti.com/product/tusb7340#toolssoftware">www.ti.com/product/tusb7340#toolssoftware</a>
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Ordering Information

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





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