



CPC522

3U CompactPCI CPU Module

User Manual

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The product described in this manual is compliant with all related CE standards.

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Safety requirements

This Fastwel Group's product is developed and tested for the purpose of ensuring compliance to the electric safety requirements. Its design provides long-term trouble-free operation. The service life of the product can be significantly reduced due to the improper handling during unpacking and installation. Therefore, in the interests of your safety and in order to ensure proper operation of the product, you should follow the recommendations below.

Conventions



Caution, High Voltage!

This sign and text warn of the dangers associated with electrical discharges (> 60 V) when touching the device or any part of it. Failure to follow the precautions mentioned or prescribed in the regulations may endanger your life or health, and may result in damages to the equipment. Please also read the below subparagraph dedicated to the rules for working with high voltage.



Attention! Static-sensitive device!

This sign and text indicate that electronic boards and their components are sensitive to static electricity, so care should be taken when handling this device and performing inspections to ensure integrity and functionality of the device.



Warning! Hot surface!

This sign and inscription warns of the dangers associated with touching hot surfaces of the unit.



Attention!

This sign is aimed at drawing your attention to aspects of this User Manual that, if not fully understood or ignored, may endanger your health or cause damages to the equipment.



Note

This sign is used to text fragments that should be read carefully.

Safety requirements

This Fastwel Group product has been developed and tested to ensure compliance with electrical safety requirements. Its design provides long-term fail-safe operation. The product's life cycle may be significantly shortened due to mishandling during unpacking and installation. Therefore, for your own safety and for ensuring proper operation of the device, you should follow the recommendations given below.

Rules for safe handling with high voltage



Attention!

All operations with this device should only be performed by personnel with sufficient qualifications.



Caution, High Voltage!

Before installing the board in the system, make sure that the mains power supply is off. The same also applies to the installation of expansion boards.

There is a serious risk of electric shock during installation, repairs, and maintenance of the device, so always unplug the power supply cord while carrying out of works. The same also applies to the other power supply cables.

Instructions for board handling



Static-sensitive device!

Electronic boards and their components are sensitive to static electricity. Therefore, special attention should be given when handling these devices to ensure their safety and operability.

- ✓ Do not leave the board in the non-operating position without protective packaging.
- ✓ If possible, always work with the board in workplaces protected against static electricity.

Should this not be possible, the user should remove the static charge before touching the product with their hands or tools. The best way to do so is by touching any metal part of the system enclosure.

General rules of usage

- ✓ In order to keep the warranty, the product must not be altered or changed in any way. Any changes and improvements unauthorized by Fastwel Group other than those contained in this User Manual or received from the technical support service of Fastwel Group in the form of a set of instructions for their implementation will void the warranty.
- ✓ This device should be installed and connected only to systems that meet all necessary technical and climatic requirements. This also applies to the operating temperature range of a particular version of the board. You should also consider the temperature limits of the batteries installed on the board.
- ✓ Follow the instructions in this User Manual only when performing all necessary installation and configuration operations.
- ✓ Retain the original packaging for storing products in the future or to transport in case of a warranty claim. If it is necessary to transport or store the board, pack it the same way as it was packed at the time of receipt.
- ✓ Proceed with extra caution when handling and unpacking the device. Follow the instructions given below.
- ✓ It is not allowed to connect external equipment, communication interface cables without disconnecting the power supply of the product and connected external equipment.

MANUFACTURER'S WARRANTIES

Warranty liabilities

The manufacturer guarantees that CPC522 meets the requirements of technical specifications provided that the Consumer complies with the operating conditions, transportation, storage, installation and mounting, set by the operational documents.

The manufacturer guarantees that the products supplied by it will not show any manufacturing defects and materials used in compliance with the rules of operation and maintenance during the warranty period established at the moment. The Manufacturer's obligation under this warranty is to repair or replace, free of charge, any defective electronic component included in the returned product.

Products that failed through the Manufacturer's fault during the warranty period will be repaired free of charge. In other cases, the Consumer will be billed based on current remuneration rates and the cost of consumables.

Right of limitation liability

The manufacturer is not responsible for any damages caused to the Consumer's property due to the failure of the product in the process of its use.

Warranty period

The warranty period for the manufacturer's products is 36 months from the date of sale (unless otherwise provided by the delivery agreement).

For customized products, the warranty period is 60 months from the date of sale (unless otherwise provided by the delivery agreement).

The warranty set forth above does not extend to and shall not apply to:

1. Products, including software, which have been repaired or altered by other than Fastwel personnel, unless Buyer has properly altered or repaired the products in accordance with procedures previously approved in writing by Fastwel.
2. Products, which have been subject to power, supply reversal, misuse, neglect, accident, or improper installation.

Returning a product for repair

1. Apply to Fastwel Company or to any of the Fastwel's official representatives for the Product Return Authorization.
2. Attach a failure inspection report with a product to be returned in the form, accepted by customer, with a description of the failure circumstances and symptoms.
3. Carefully package the product in the antistatic bag, in which the product had been supplied. Failure to package in antistatic material will VOID all warranties. Then package the product in a safe container for shipping.
4. The customer pays for shipping the product to Fastwel or to an official Fastwel representative or dealer.

Transportation, Unpacking and Storage

Transportation

The modules should be transported in the separate manufacturer's packaging (container), consisting of an individual antistatic packaging and a cardboard box, in closed transport (road, rail, air in heated and sealed compartments) under storage conditions 5 according to the GOST standard 15150-69 or under storage conditions 3 for sea transportation.

It is allowed to transport the modules packed in individual antistatic bags in manufacturer's group packaging (container).

Transportation of packaged modules should be carried out in accordance with the rules of transportation of goods currently valid for this type of transport.

During handling operations and transportation, the packed modules should not be subjected to sudden shocks, drops, impacts and precipitation. The packed modules should be placed on the vehicle in such a way as to preclude their further movements.

Unpacking

Before unpacking, after transportation at negative ambient temperatures, the modules must be kept for 6 hours under storage conditions 1, in accordance with the GOST standard 15150-69.

Do not place the packed modules near any heat sources before unpacking.

When unpacking the modules, it is necessary to observe all precautions to ensure their safety, as well as marketable condition of manufacturer's consumer packaging.

When unpacking, it is necessary to check the modules for any external mechanical damages after transportation.

Storage

Storage conditions of the modules 1 comply with the GOST standard 15150-69.

1 Introduction

The CPC522 CPU Module is designed in the 3U CPCI Serial form-factor with the purpose of using it in real-time systems, production control, high-speed data acquisition and data processing system. The CPC522 CPU Module is an extension of the 3U CPCI modules manufactured by Fastwel Group. The module is based on the Intel Coffee Lake H processors.

The CPC522 Module uses high-speed I/O interfaces (PCI-Express Gen 3, 2.5Gigabit Ethernet, USB 3.1 Gen1) and supports state-of-the-art video processing technologies. The modular design of the product enables flexible configuration for specific applications, thereby optimizing the price-performance ratio.

To extend the functionalities of the CPC522, the MIC584 mezzanine module is designed, a detailed description of which can be found in the relevant User Manual.

1.1 Module versions

The CPC522 Module's versions are specified in the table below,

Table 1-1 Versions of the CPC522 Module

	Version	CPU	RAM	Heatsink	Temperature
1	CPC522-01	Intel Coffee Lake H, E-2276ML 2 GHz, 6C 25W, 32G SSD	16 GB 2666 DDR4	4HP	0...+70°C
2	CPC522-02	Intel Coffee Lake H, Core i3- 9100HL 1.6 GHz, 4C 25W, NO SSD	8 GB 2666 DDR4	4HP	0...+70°C

Description of the supplied configurations:

CPC522-01: 3U CPCI Serial Module, 4HP, made in the standard 3U Eurocard format , Xeon E-2276ML 2GHz Processor, 12MB Cache, 6 x Cores 12 threads 25W, 16GB RAM, SSD 32GB with low heat sink, designed for operation within the commercial temperature range.

CPC522-02: 3U CPCI Serial Module, 4HP, made in the standard 3U Eurocard format, Core i3-9100HL 1.6Ghz Processor, 6MB Cache, 4 x Cores 4 threads 25W, 8GB RAM, no SSD, with low heatsink, designed for operation within the commercial temperature range.

The options available:

\Coated* - version with the conformal coating

\OEM – with a limited scope of supply

**Note**

For all versions of the CPC522, forced cooling must be provided.

1.2 Technical specifications

● Processor

- Intel Coffee Lake H, E-2276ML 2 GHz, 25W, 6 x cores, 12 MB cache (CPC522-01);
- Intel Coffee Lake H, Core i3-9100HL 1.6 GHz, 25W, 4 x cores, 6 MB cache (CPC522-02)

● RAM

- DDR4-2666 with ECC 16 GB, soldered, two-channel (for CPC522-01);
- DDR4-2666 with ECC 8 GB, soldered, two-channel (for CPC522-02);

● Integrated Graphics Card Intel® UHD Graphics P630

- Base frequency – 350 MHz;
- Graphics Maximum Dynamic Frequency – 1.15 GHz;
- Maximum memory size supported by the processor – 64 GB;
- Supported 4K@60 Hz;
- 2 x DisplayPort outputs (resolution up to 4096x2304@60Hz) are routed to the front panel;
- 1 x DisplayPort interface is routed to the front panel connector;

● LPC Bus

- Routed to the mezzanine connector;

● PCI-E Bus

- Processor hosts. Support of PCI-E 3.0 (up to 8 GT/s);
 - Routed to the backplane connector's with support of up two x8 devices;
- PCH hosts. Support of PCI-E 3.0 (up to 8 GT/s). Up to 10 PCI Express ports;
 - 8 x lines are routed to the backplane connector with support of up to two x4 devices;
 - 4 x lines are routed to the backplane connector with support of up to four x1 devices;
 - 2 x lines are routed to the mezzanine connector with support of two x1 devices or one x2 device. Can be configured as one or two SATA III interfaces depending on M2 interface configuration.
 - 2 x lines are routed to the M2 drive connector. One line can be configured as a SATA III interface depending on the type of drive installed.
 - 2 x lines are used by 2.5 Gb Ethernet controllers.

● SMBus

- Compatibility with the 2.0 specification;
- Speed up to 100 Kb/s;

● FLASH BIOS

- 2x 128 Mb SPI-Flash;
- **SATA III interface**
 - Five ports are routed to the backplane connectors;
 - Two ports that are multiplexed with PCI Express interface, are routed to the mezzanine connector;
 - One port is used by an internal SATA drive;
 - One SATA III port can be used by an M2 interface depending on the type of drive installed.
- **Integrated SATA SSD**
 - 32 GB 3D NAND Flash;
 - Interface: SATA III;
- **2 x ports LAN 10BASE-T_e, 100BASE-TX, 1000BASE-T and 2500BASE-T**
 - The two ports are routed to the front panel connectors;
- **USB ports**
 - 6 x USB 3.1 ports (10 Mb/s):
 - 2 x ports are routed to the front panel connectors;
 - 4 x ports are routed to the backplane connectors;
 - 12 x USB 2.0 ports:
 - 8 x ports are routed to the backplane connectors;
 - 2 x ports are routed to the front panel connectors;
 - 2 x ports are routed to the mezzanine connector;
- **FRAM**
 - 32 KB (1 KB for storing BIOS Setup settings and serial number of the device);
 - Implemented on the SPI FPGA bus;
- **Real-Time Clock**
 - Powered from the lithium battery CR2032 (3V);
- **Audio support**
 - HD Audio interface is routed to the mezzanine connector
- **Watchdog timer**
 - Internal timer with a possibility of software-based control
- **SGPIO interface**
 - Signaling support in accordance with the SFF-8485 specification;
- **Hardware monitoring**
 - Implemented via SMBus interface;
 - Monitoring of three supply voltages;
 - Monitoring of CPU temperature;
 - Monitoring of PCB temperature;
 - Power monitoring;
- **LED indication**

The LEDs indicators for start diagnostics, drives activity, user LEDs are routed to the front panel. The LEDs are described in the table below.

Table 1-2 Description of LEDs

#	Mnemonics	Description
1	SYS	Red-blue two-color LED. Blue – “Power Off» mode. Red – hardware fault.
2	STG	Red-greed two color LED. Red – activity of SATA and microSD drives. Green – reserve.
3	GP	Red-green two color LED. Red – programmable. Green – programmable. Green LED indicates the status of the start-up process during start.
4	OVH	Red-yellow two-color LED. Red – processor overheating. Green – reserve.

- **Software compatibility:**
 - Windows 10 IoT Enterprise 64bit;
 - Linux Debian 9;
- **Power supply requirements:**
 - Supply voltage +12V, +5V_STBY.
- **MTBF:**
 - Min. 100,000 hours.
- **Module’s weight:**
 - Max. 0.450 kg.

1.3 Operating environmental parameters

- **Operating temperature range:**
 - Industrial version: from - 40°C to +85°C;
 - Commercial version: from 0°C to +70°C.
- **Humidity:**
 - Up to 80%, non-condensing;
 - Up to 98%, non-condensing, for /Coated option.
- **Resistance to vibration/single shocks:**
 - 2g/50g for CPC522 Module.

1.4 Delivery checklist

The module’s delivery checklist includes:

- CPC522 Module
- The IMES.467941.0540 installation kit includes:
 - Rack IMES.711141.007-07 – 1 pcs.
 - Screw DIN7985-M2,5x4-A2 – 1 pcs.
- Packaging.

1.5 Packaging information

The CPC522 module is packed in a box, which has the following dimensions: 350 x 260 x 70 mm. Module's packaged weight is max. 1 kg.



Note

Retain the original anti-static bag and consumer packaging till the end of the warranty period.

1.6 Appearance and layout of the CPC522 components

The figures below will help to identify the components and understand their arrangement and functions. There may be slight differences in the module versions that are not reflected in the diagrams and figures.

1.6.1 Appearance of CPC522

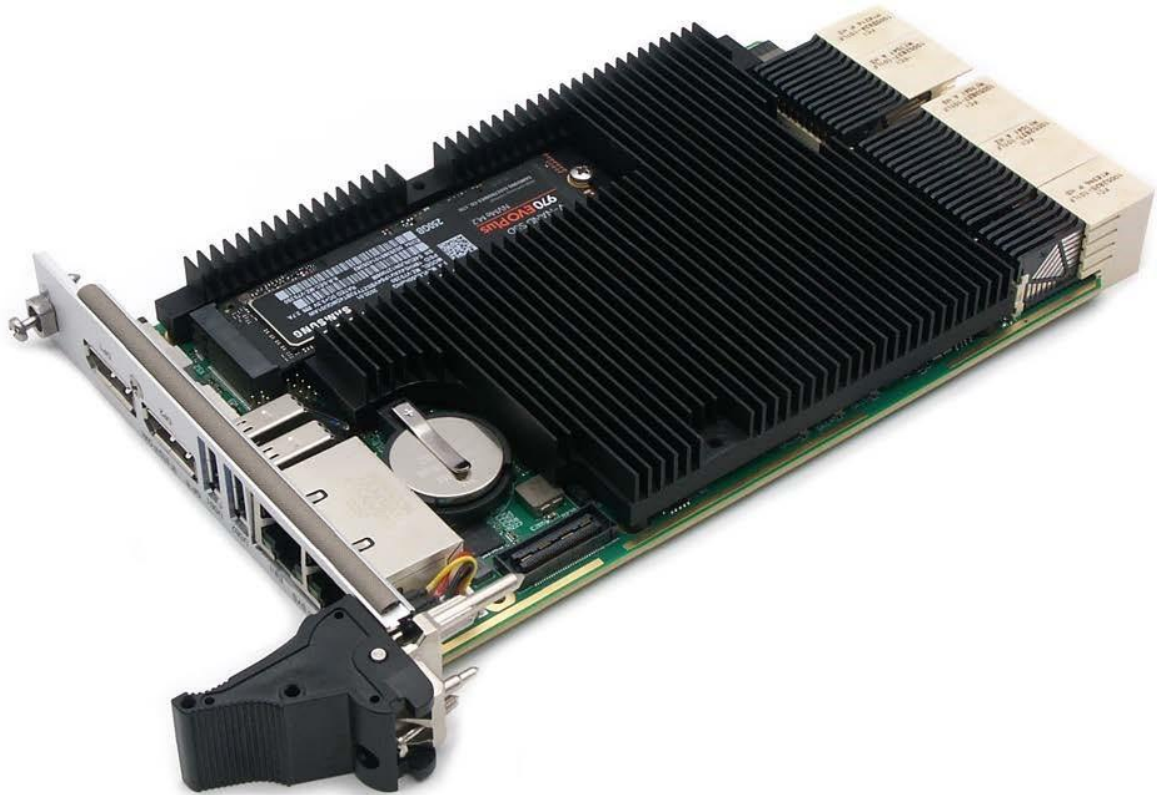


Fig. 1-1 Appearance of the CPC522 Module

The appearance of the module's versions may slightly differ from the one shown in the figure.

Fig. 1-1 shows the CPC522 Module with the SSD installed (not included into the Delivery Checklist).

1.6.2 Layout of main components

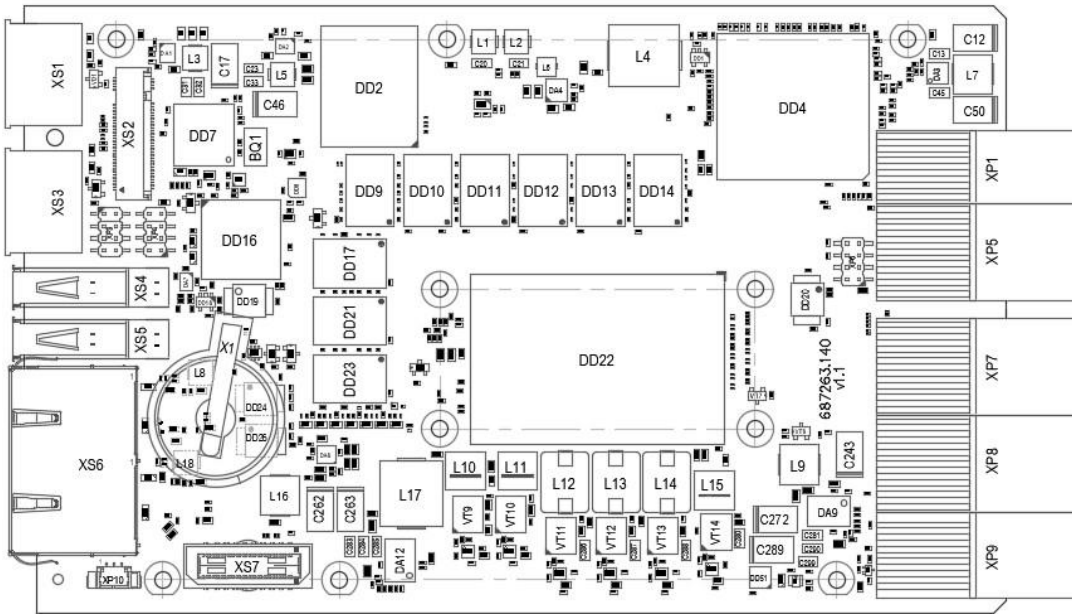


Fig. 1-2 Layout of main components on the CPC522 board (top view)

This figure shows the top side of the CPC522 board. Heatsink is not shown.

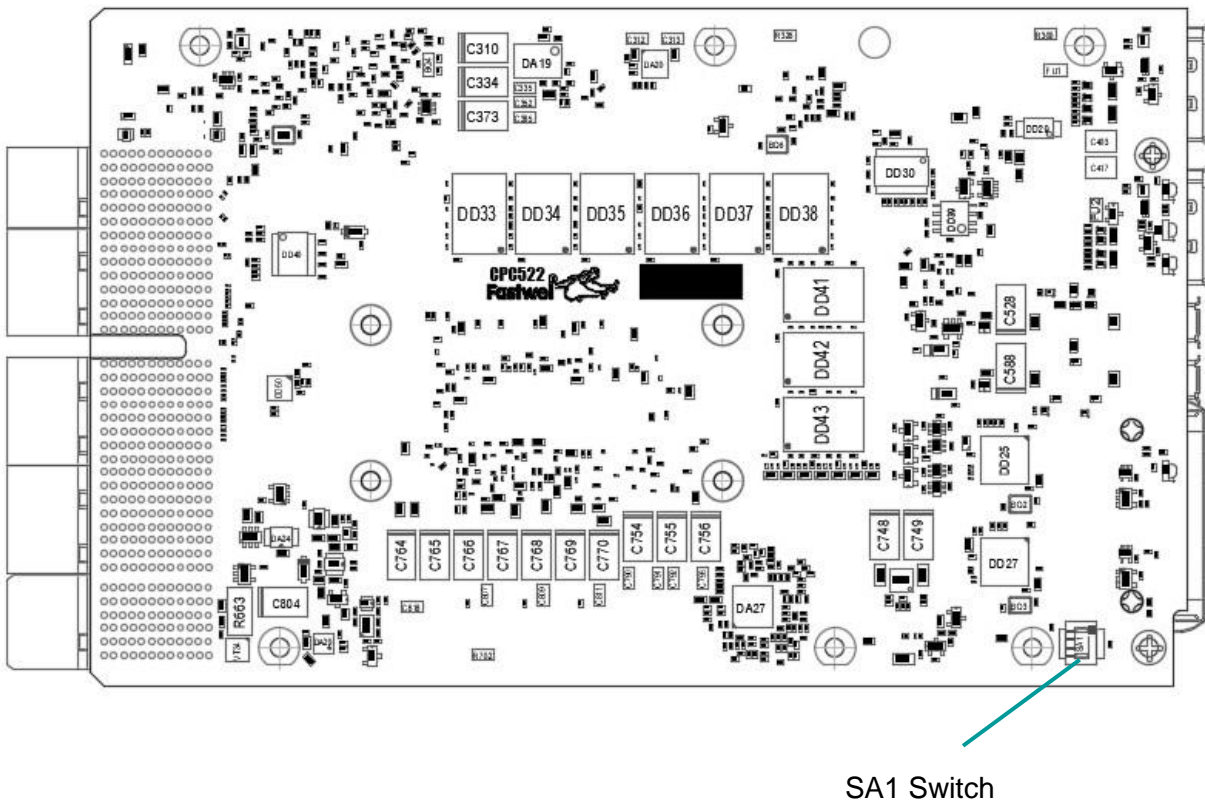


Fig. 1-3 Layout of main components of the CPC522 Module (bottom view)

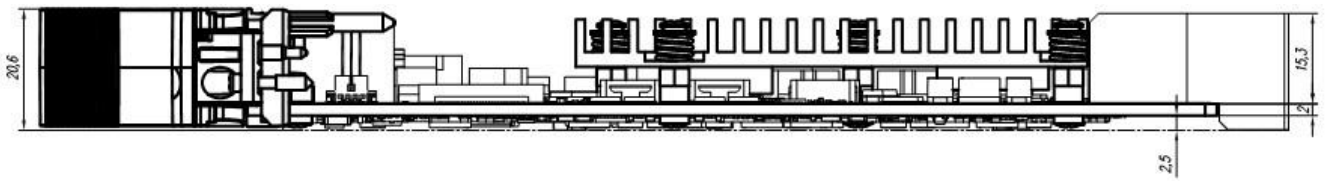


Fig. 1-4 CPC522 Module with the installed R1 heatsink (4HP)

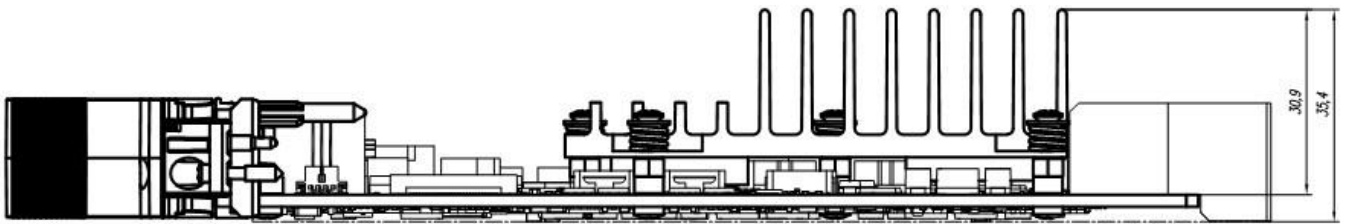


Fig. 1-5 CPC522 Module with the installed with the increased heatsink R2 (8HP)

1.6.3 Front panel

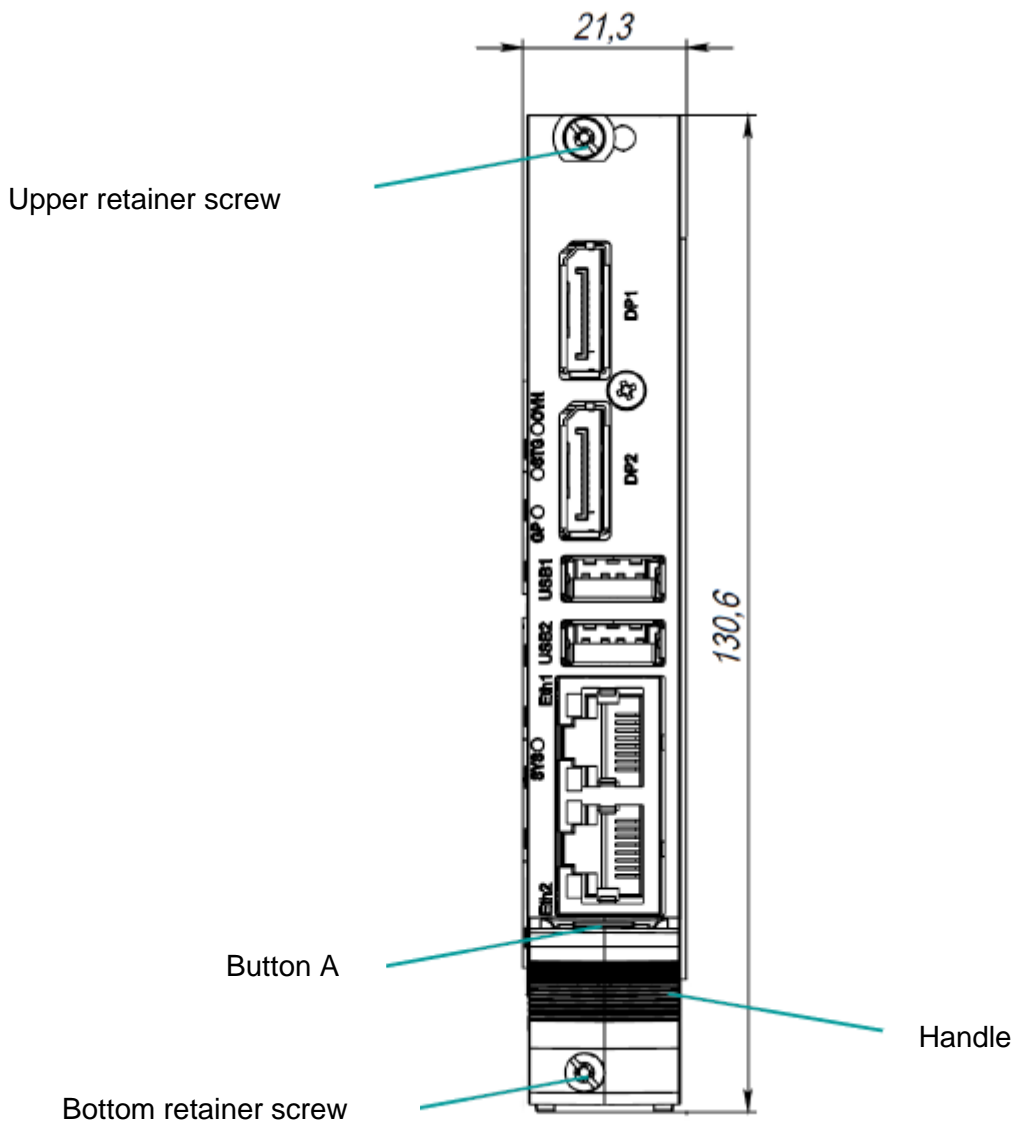


Fig. 1- 6 Front panel of the CPC522 Module (front view)

Button A fulfils mechanical function: it is used to install/remove the CPC522 (see subparagraphs **4.2 CPC522 Installation procedure** and **4.3 Removal procedure**). Button A is also a programmable switch designed for manual system initialization, if required.

2. Functional description

2.1 Block diagram

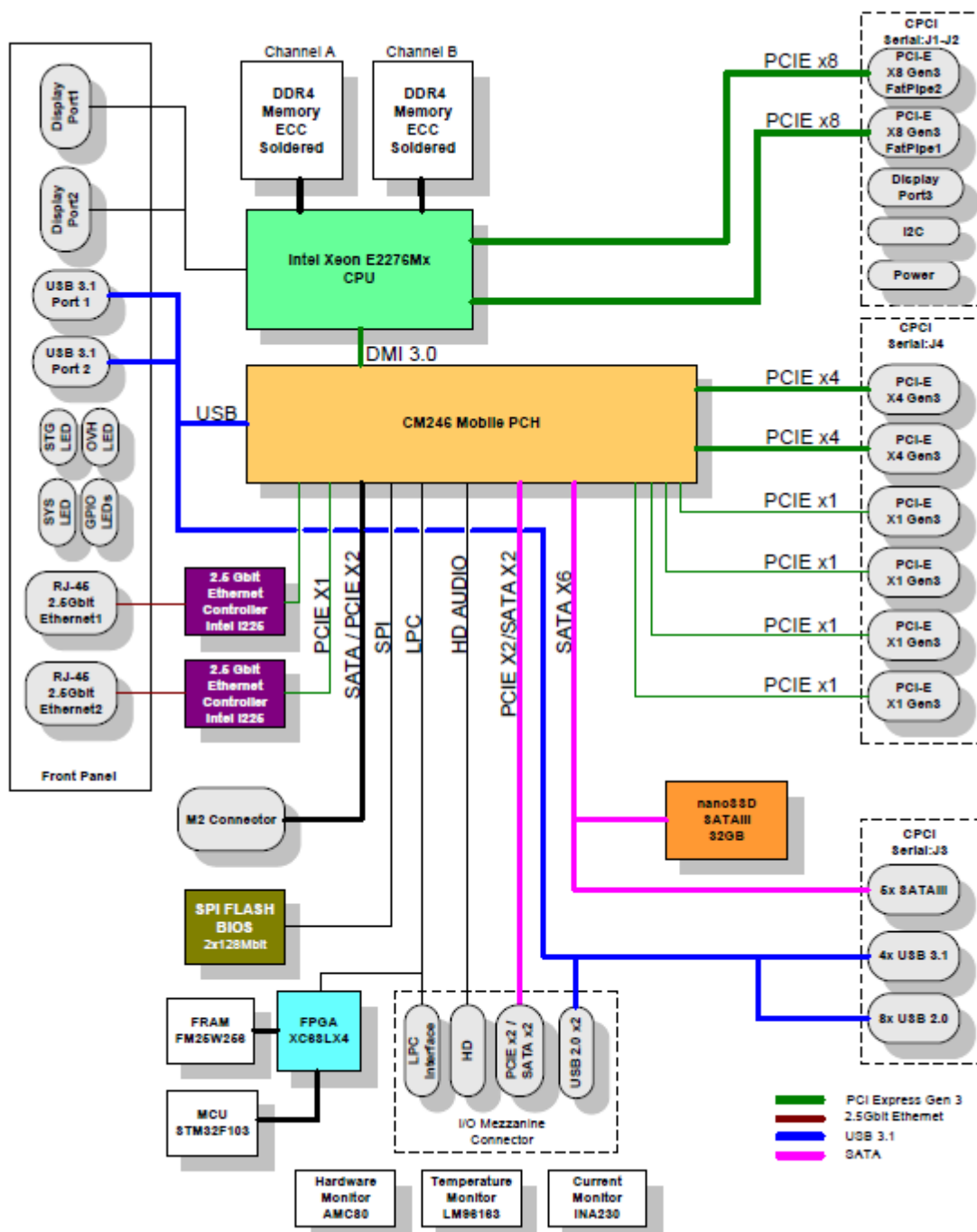


Fig. 2-1 Block diagram of CPC522

2.2 Options for system expansion

For expanding the functionalities of the CPU module and to connect peripheral devices to it, the following interface modules are used: the MIC584 mezzanine and the KIC550 (or KIC550RC) interface module.

The peripherals (audio, video interfaces, serial ports, etc.) are connected to the CPC522 module through the following interface modules:

The MIC584 mezzanine module contains the following set of interfaces:

- 2xUSB 2.0
- 2xSATA
- Audio IN/OUT/MIC
- 4xRS-232
- 2xRS-485
- LPT
- PS/2 keyboard + mouse

KIC550/KIC550RC module contains the following set of interfaces:

- 1xUSB 2.0/3.0
- 2.5" SATA HDD interface
- CFast interface

For more detailed information on the interface modules, please refer to the documents listed in Table 2-1.

Table 2-1 Interface Modules Used for expanding the I/O Capabilities of the CPC522

Description	Description	Connectors
MIC584	Mezzanine expansion module (description is given in the User Manual IMES.421459.584 RE).	XS6 connector
KIC550	Interface module for expanding the functionalities of the processor module (description is given in the IMES.421459.550 User Manual)	Compact PCI Serial connector

2.3 Peripheral devices

The CPC522 module is equipped with the following peripherals:

2.3.1 Timers

The CPC522 module is equipped with the timers of the several types:

■ RTC - Real-Time Clock

The PCH includes an MC146818A compatible real-time clock with 256 bytes of battery-powered CMOS memory. It has timekeeping functions, an alarm function, a function of programmable periodic intermittent interruption, and a 100-year calendar.

■ Counter/Timer

As in PC/AT, the module is equipped with three 8254 type counters/timers integrated into the PCH.

■ Additional timer

The PCH includes an additional programmable timer that prevents the system from locking up during startup. The first timer overflow generates an SMI# signal that causes a subroutine to exit the software system hanging. If the timer overflows for the second time, a system reset signal is generated to get the system out of the hardware hanging.

■ Watchdog Timer

The watchdog is designed to eliminate system blocking, both at startup and during operation. When the watchdog is triggered a Reset, interrupt or SMI signal is generated. The actuation time is set via the BIOS Setup menu. The watchdog monitors the execution of the BIOS code at system startup.

The watchdog is implemented in the FPGA as an LPC bus device. The timer consists of a 24-bit counter register [Timer Current Value Register], decremented at 32.768 kHz, and an initial value register [Timer Initial Value Register]. When the counter register is zeroed, either an interrupt, an NMI, or an automatic reset of the board can be generated. The actuation times can be set within the range from 0 to 512 seconds inclusively, in increments of 30.52 μ s.

By default, without pre-initialization the watchdog operate delay time is set to the maximum of 512 seconds. Below you can see the formula for calculating the T_{WD} delay time (μ s) depending on the decimal value in the Timer Initial Value Register (K_{WD}):

$$T_{WD} [\mu s] = K_{WD} * 10^6 / 2^{15}$$

For example, the decimal value $K_{WD} = 1$ (000001h) corresponds to a 30.52 μ s delay time, and $K_{WD} = 16777215$ (FFFFFFh) corresponds to a delay time of 512 seconds.

The counter can be reset to its initial value in several ways:

- By writing any number to the [Timer Current Value Register]
- By writing any number to port 80h (the mode is enabled in the [Timer Init Register])

By writing or reading from addresses in two windows (the base addresses of the windows are specified in the corresponding registers [Window Base Address], the address mask is specified in the [Windows 1&2 Address mask register], the mode is selected in the [Timer Init Register]). The size of the windows is 1 to 16 bytes depending on the value of the mask in the register.

Accessing the watchdog timers

The configuration of the device is based on a Plug-and-Play architecture. The watchdog registers can be accessed via the standard I/O registers (index and data) when entering the configuration mode.

CONFIG PORT	302h	Write
INDEX PORT	302h	Read/Write
DATA PORT	303h	Read/Write

Configuration mode

The device enters configuration mode when the following configuration key is written to CONFIG PORT:

Configuration key = <46h> <57h>

The device exits configuration mode when the following configuration key is written to CONFIG PORT:

Configuration key = <57h> <46h>

INDEX and DATA ports are available only in the configuration mode.

Device programming

Sequence of operations when programming the device

- Enter the configuration mode:

```
MOV  DX, 302H
MOV  AL, 46H
OUT  DX, AL
MOV  AL, 57H
OUT  DX, AL
```

- Write the number of the logical device to the LDN register (watchdog timer has a logical number 1):

```
MOV  DX, 302H
MOV  AL, 7
OUT  DX, AL
MOV  DX, 303H
MOV  AL, 1
OUT  DX, AL
```

- The watchdog timer registers are available for reading and writing. For example, reading the 3eh status register and writing its value back:

```
MOV  DX, 302H
MOV  AL, 3EH
OUT  DX, AL
```



```
MOV DX, 303H
IN AL, DX
OUT DX, AL
```

- Exit configuration mode:

```
MOV DX, 302H
MOV AL, 57H
OUT DX, AL
MOV AL, 46H
OUT DX, AL
```

Global configuration registers

INDEX	Type	HARD RESET	Configuration register
7h	R/W	01h	Logical Device Number

Logical Device Number register (index 7h)

Index = 7h		
Bit	Name	Description
7:0	LDN	Write/Read: Writing to this register selects the logical device

Configuration registers of logical device 1 (WDT)

INDEX	Address of I/O port	Type	HARD RESET	Configuration register
30h	-	R/W		Activate
38h	Base+0	R/W		Timer current value [7:0]
39h	Base+1	R/W		Timer current value [15:8]
3ah	Base+2	R/W		Timer current value [23:16]
3bh	Base+3	R/W	00h	Timer initial value [7:0]
3ch	Base+4	R/W	40h	Timer initial value [15:8]
3dh	Base+5	R/W	00h	Timer initial value [23:16]
3eh	Base+6	R/W	00h	Status register
3fh	Base+7	R/W	03h	Control register
60h	-	R/W		Base[15:8] - I/O port base address bits[15:8]

61h	-	R/W		Base[7:3] - I/O port base address bits[7:3] Base[2:0] – must be 0;
70h	-	R/W	00h	Primary interrupt select
F0h	-	R/W	00h	Reserved
F1h	-	R/W	00h	Timer Init Register
F2h	-	R/W	00h	Window 1 base address bits[7:0]
F3h	-	R/W	00h	Window 1 base address bits[15:8]
F4h	-	R/W	00h	Window 2 base address bits[7:0]
F5h	-	R/W	00h	Window 2 base address bits[15:8]
F6h	-	R/W	FFh	Window 1 Mask bits [7:4] Window 2 Mask bits [3:0]

Activate register

Index = 30h		
Bit	Name	Description
7:1	-	Not used
0	Activate	Write/Read: 1 – This logical device is enabled 0 – This logical device is disabled

I/O port base address registers

Index = 60h		
Bit	Name	Description
7:0	I/O_Base_Adress[15:8]	Write/Read: Bits 15:8 of the base address of the current logical device
Index = 61h		
Bit	Name	Description
7:0	I/O_Base_Adress[7:0]	Write/Read: Bits 7:0 of the base address of the current logical device

Primary interrupt select register (index 70h)

Index = 70h		
Bit	Name	Description
7:4	-	Not used

3:0	Interrupt_select	Write/Read: 00h – interrupt is disabled 01h – IRQ1 02h – SMI 03h – IRQ3 04h – IRQ4 05h – IRQ5 06h – IRQ6 07h – IRQ7 08h – IRQ8 (interrupt is disabled) 09h – IRQ9 0ah – IRQ10 0bh – IRQ11 0ch – IRQ12 0dh – IRQ13 (interrupt is disabled) 0eh – IRQ14 (interrupt is disabled) 0fh – IRQ15 (interrupt is disabled)
-----	------------------	--

Timer Init register

Index = F1h		
Bit	Name	Description
7:5	-	Not used
4	P80E	Write/Read: counter reset during writing to port 80h 1 – enabled 0 – disabled
3	WND2_WR_EN	Write/Read: Counter reset during write cycle to the window 2 1 – enabled 0 – disabled
2	WND2_RD_EN	Write/Read: Counter reset during read cycle to window 2 1 – enabled 0 – disabled
1	WND1_WR_EN	Write/Read: Counter reset during write cycle to the window 1 1 – enabled 0 – disabled
0	WND1_RD_EN	Write/Read: Counter reset during read cycle from window 1 1 – enabled 0 – disabled

Window 1 port base address registers

Index = F2h		
Bit	Name	Description

7:0	Window1_Base_Adress[7:0]	Write/Read: Bits 7:0 of the base address of window 1
Index = F3h		
Bit	Name	Description
7:0	Window1_Base_Adress[15:8]	Write/Read: Bits 15:8 of the base address of window 1

Window 2 port base address registers

Index = F4h		
Bit	Name	Description
7:0	Window2_Base_Adress[7:0]	Write/Read: Bits 7:0 of the base address of window 2
Index = F5h		
Bit	Name	Description
7:0	Window2_Base_Adress[15:8]	Write/Read: Bits 15:8 of the base address of window 2

Windows 1&2 address mask register

Index = F6h		
Bit	Name	Description
7:4	Window1_MASK[3:0]	Write/Read: Bits 3:0 of the address mask of window 1
3:0	Window2_MASK[3:0]	Write/Read: Bits 3:0 of the address mask of window 2

Description of I/O registers of WDT controller

Timer Current Value Register [23:0]

Base+0h		
Bit	Name	Description
7:0	Timer_Current_Value[7:0]	Write/Read: Bits 7:0 of the current timer value
Base+1h		
Bit	Name	Description
7:0	Timer_Current_Value[15:8]	Write/Read: Bits 15:8 of the current timer value
Base+2h		

Bit	Name	Description
7:0	Timer_Current_Value[23:16]	Write/Read: Bits 23:16 of the current timer value

Timer Initial Value Register [23:0]

Base+3h		
Bit	Name	Description
7:0	Timer_Initial_Value[7:0]	Write/Read: Bits 7:0 of the initial counter value
Base+4h		
Bit	Name	Description
7:0	Timer_Initial_Value[15:8]	Write/Read: Bits 15:8 of the initial counter value
Base+5h		
Bit	Name	Description
7:0	Timer_Initial_Value[23:16]	Write/Read: Bits 23:16 of the initial counter value

Status Register

Base+6h		
Bit	Name	Description
7:3	-	Reserved
2	STM	Write/Read: The second timeout flag. It is set to "1" under the condition TMF=1 and RSTE=1. Reset by writing "1" to this bit.
1	SME	Read: SMI timeout generation flag. Set to "1" if SMI mode is selected in the interrupt register (index 70h).
0	TMF	Write/Read: Timeout Flag. Set to "1" when the timer counter is zeroed. This flag generates an interrupt. Reset by writing "1" to this bit or by writing to port 80h or by accessing windows 1 and 2 (if these modes are enabled).

Control Register

Base+7h		
Bit	Name	Description

7:2	-	Reserved
1	CNTE	Write/Read: Timer decrement 1 – enabled 0 – disabled
0	RSTE	Write/Read: Board reset by timeout 1 - Reset is enabled 0 - Reset is disabled

2.3.2 Battery

The CPC522 Module uses one 3.0 V lithium battery to power the real-time clock. Please, use RENATA CR2032 or compatible models (see 4.4.3 Battery replacement). Operation of the module without battery is possible. Without a battery the clock data may be inaccurate.

2.3.3 Devices on local SMBus

The CPC522 is equipped with SMBus (System Management Bus) that provides system monitoring and configuration functions. The bus uses a 2-wire I2C™ interface and has several serial devices connected to it, an SPD EEPROM and a switchable bus segment with hardware monitors (LM96163 Remote Diode Digital Temperature Sensor, AMC80A System Hardware Monitor, INA230 Current, Voltage and Power Monitor). The segment with monitors can be software-connected to the BMC. In this case the information of the hardware monitors is accessed via the BMC serial port, access via SMBus will be blocked.

Table 2 - 2 SMBus device addresses

#	SMBus address	Device
1	0xA0h и 0xA4h	SPD EEPROM memory module
2	0x50h	AMC80A System Hardware Monitor
3	0x80h	INA230 Current, Voltage and Power Monitor
4	0x4Ch	LM96163 Remote Diode Digital Temperature Sensor (RAM Sensor)

The temperature monitor controls the temperature of the memory chips. The temperature monitor can provide information to the tools for software monitoring the current state of the system on request, this ensures that the module operates in a safe temperature mode.

2.3.4 Non-volatile Memory

2.3.4.1 SSD module of M2 format

There is an XS2 connector with an “M” key on the board to install an M2-type SSD (see Figure 1-2). The M2 interface supports 3 x M2 drive form factors: 2240, 2260 and 2280. The drives can be connected either via SATA III or PCI Express Gen3 x2 with a maximum throughput of up to 16Gbps. Switching between interface types is automatic. For mounting the M2 module, the installation kit includes a screw to attach the module to the heatsink, and an optional rack for mounting modules with the 2240 and 2260 form factors.

2.3.4.2 Integrated SSD

The CPC522 modules have a 32GB SATA III SSD soldered onto the board.

2.3.4.3 Fast memory (FRAM) for saving user data

The board contains a non-volatile fast serial-access FRAM memory (32-KB) for storing service information: 1 KB is used by the manufacturer and 31 KB - for user's critical data. The registers and programming of the FRAM device are described further.

2.3.4.3.1. FRAM registers (logic device 3)

INDEX	I/O port address	Type	HARD RESET	Configuration register
30h	-	R/W		Activate
	Base+0	R/W	00h	FRAM address value [7:0]
	Base+1	R/W	00h	FRAM address value [14:8]
	Base+2	R/W	00h	FRAM data value [7:0]
	Base+3	R/W	00h	FRAM Control register [7:1] – reserved [0] – autoincrement mode
60h	-	R/W		Base[15:8] - I/O port base address bits[15:8]
61h	-	R/W		Base[7:3] - I/O port base address bits[7:3] Base[2:0] – must be 0;

Working with FRAM requires you to set the base address of the device and activate it (LDN=3) in the same way as the watchdog timer. Further work with FRAM is performed in the I/O area as relating to the set base address. Bit <0> in the control register (Base + 3) enables the automatic address increase mode when reading/writing the data register (base + 2).

2.3.4.3.2. FRAM device programming

The sequence of actions during the initialization of the device:

- Enter the configuration mode

```
MOV DX, 302H
MOV AL, 46H
OUT DX, AL
MOV AL, 57H
OUT DX, AL
```

- Write the number of the logical device to the LDN register (FRAM has logical number 3)

```
MOV DX, 302H
MOV AL, 7
OUT DX, AL
MOV DX, 303H
MOV AL, 3
OUT DX, AL
```

- Set the base address of the device in the I/O area (310h for example):

```
MOV DX, 302H
MOV AL, 60H
OUT DX, AL
MOV DX, 303H
MOV AL, 3H
OUT DX, AL
```

```
MOV DX, 302H
MOV AL, 61H
OUT DX, AL
MOV DX, 303H
MOV AL, 10H
OUT DX, AL
```

- **Activate the device:**

```
MOV DX, 302H
MOV AL, 30H
OUT DX, AL
MOV DX, 303H
MOV AL, 1H
OUT DX, AL
```

- **Exit the configuration mode:**

```
MOV DX, 302H
MOV AL, 57H
OUT DX, AL
MOV AL, 46H
OUT DX, AL
```

Further work with FRAM is carried out in the I/O area at addresses 310h-313h.

- **Write the data byte (32h) to FRAM at the address (144h)**

```
MOV DX, 310H
MOV AL, 44H
OUT DX, AL
MOV DX, 311H
MOV AL, 01H
OUT DX, AL
MOV DX, 312H
MOV AL, 32H
OUT DX, AL
```

- **Read the data byte from FRAM at the address (101h)**

```
MOV DX, 310H
MOV AL, 01H
OUT DX, AL
MOV DX, 311H
MOV AL, 01H
OUT DX, AL
MOV DX, 312H
IN AL, DX
```


2.4 Module interfaces

2.4.1 CompactPCI Serial connectors

The CPC522 module is designed in accordance with the CompactPCI Serial bus architecture. The module uses 5 x CompactPCI Serial interface connectors (see Figure 1- 1).

2.4.2 Connector for mezzanine module installation

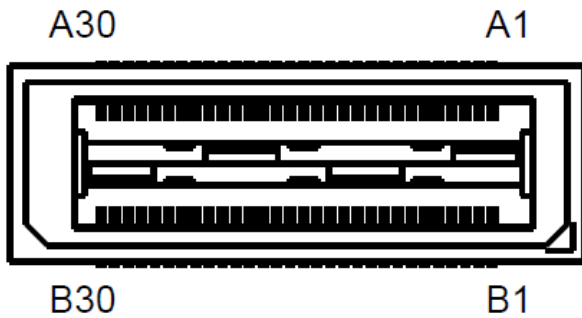


Fig. 2- 2 XS7 connector for installation of MIC584 mezzanine module

The XS7 connector is located on the top side of the CPC522 board (see Figure 1- 2).

Table 2-3 Assignment of XS7 connector pins for installing the MIC584 mezzanine on the CPC522

Pin	Assignment	Pin	Assignment
A1	+5V	B1	+5V
A2	+5V	B2	+5V
A3	USB_PN0	B3	USB_PN1
A4	USB_PP0	B4	USB_PP1
A5	GND	B5	GND
A6	SATA_TXN0	B6	SATA_RXN0
A7	SATA_TXP0	B7	SATA_RXP0
A8	GND	B8	GND
A9	SATA_TXN1	B9	SATA_RXN1
A10	SATA_TXP1	B10	SATA_RXP1
A11	GND	B11	GND
A12	AZ_BITCLK	B12	LPC_AD0
A13	GND	B13	LPC_AD1
A14	AZ_SYNC	B14	LPC_AD2
A15	AZ_RST#	B15	LPC_AD3
A16	AZ_SDIN	B16	LPC_FRAME#
A17	AZ_SDOUT	B17	GND
A18	+3.3V	B18	SERIRQ
A19	KBRST#	B19	+3.3V
A20	-	B20	-

A21	+3.3V
A22	PLT_RST#
A23	GND
A24	CLK_33MHZ
A25	GND
A26	CLK_14MHZ
A27	GND
A28	CLK_32KHZ
A29	GND
A30	+5VA

B21	+3.3V
B22	SMB_CLK
B23	SMB_DATA
B24	GND
B25	USB_OC#0
B26	USB_OC#1
B27	+3.3VA
B28	INIT_3V3
B29	BIOS_DIS#
B30	+5VA

2.4.3 Keyboard / mouse interface

A keyboard/mouse can be connected to the CPC522 via the USB port on the front panel. In addition, the PS/2 keyboard/mouse interface is implemented on the MIC584 mezzanine via the LPC interface and is available through the MIC584 expansion module (see the description of the MIC584 User Manual). The keyboard and mouse connector (PS/2 6-pin MiniDIN) is located on the front panel of the MIC584 module.

2.4.4 USB interfaces

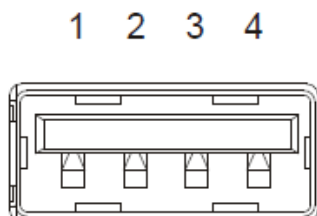
CPC522 has the following USB ports:

- 6 x USB 3.1 ports (5 Gb/s)
 - 2 x USB 3.1 ports are routed to the front panel connectors;
 - 4 x USB 3.1 ports are routed to the backplane connectors;
- 12 x USB 2.0 ports;
 - 8 x USB 2.0 ports are routed to the backplane connectors;
 - 2 x USB 2.0 ports are routed to the front panel connectors;
 - 2 x USB 2.0 ports are routed to the mezzanine connector.

* When using USB 3.1 backplane, 4 x USB 2.0 ports are recycled by USB 3.1 ports.

The ports support high-speed, full-speed, low-speed and super-speed modes. USB 2.0 high-speed mode allows you to transfer data at 480 Mb/s, which is 40 times faster than full-speed USB 1.1. Each port enables connection of one USB peripheral. To connect more devices to the module an external hub must be used.

The front panel USB power supply source is protected by a 2.5A automatic fuse.



The front panel of the CPC522 has 2 x standard USB 3.1 Gen1 Type A connectors: USB1 and USB2.

Fig. 2- 3 USB1 and USB2 connectors

2.4.5 DisplayPort

- The DisplayPort 1 and 2 connectors on the front panel of the CPC522 (see subsection 1.6.3) are designed to connect digital monitors up to 4096x2304@60Hz. The output also allows you to

connect DVI-D monitors via a passive adapter. An additional DisplayPort 3 interface is routed to the P2 connector of the backplane.



Fig. 2- 4 DisplayPort connector

Table 2-4 Assignment of the DisplayPort connector pins

Pin	Assignment
1	LANE0+
2	GND
3	LANE0-
4	LANE1+
5	GND
6	LANE1-
7	LANE2+
8	GND
9	LANE2-
10	LANE3+
11	GND
12	LANE3-
13	AUX_EN#
14	CONFIG2
15	AUX+
16	GND
17	AUX-
18	HP_DETECT
19	GND
20	+3.3V

2.4.6 Serial interfaces (RS-232 and RS-485)

The serial interfaces (implemented through the LPC interface) are available only when using the MIC584 mezzanine expansion module (see the description given in the MIC584 User Manual). Six serial ports are implemented on the MIC584:

- COM1 (RS232) port, a 9-pin D-Sub connector on the front panel of the MIC584 module;
- COM2-COM4 (RS232) ports, routed to the 10-pin double-row connectors (IDC2-10) XP11-XP13 of the MIC584 module;
- COM5, COM6 (RS485) ports, routed to the 10-pin two-row connector (IDC2-10) XP7 of the MIC584 module.

The serial ports are fully compatible with the 16C550 controller and include a complete set of matching and modem control signals, support generation of masked interrupts and data rates of up to 460.8 Kb/s.

2.4.7 Parallel port interface

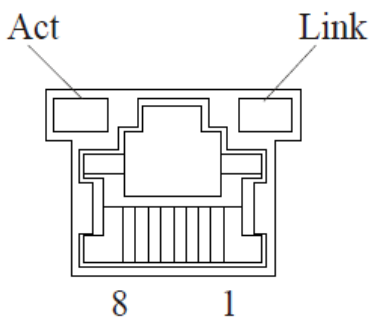
The standard parallel interface (IEEE1284, ECP/EPP/SPP) is implemented on the MIC584 mezzanine through an LPC interface and is available only through the MIC584 mezzanine expansion module (see the description given in the MIC584 User Manual).

2.4.8 External interface 2.5 Gigabit Ethernet

The module includes 2 x Intel® i-225LM Ethernet controllers that support 100Base-TX/1000Base-T/2500 Base-T protocols. The controllers are connected to the system's PCI-E bus.

The RJ45 Gigabit Ethernet connectors are located on the front panel of the CPC522 and are specified as Eth1 and Eth2.

The interfaces provide automatic baud rate detection and switching between 100Base-TX and 1000Base-T, 2500Base-T.



There are two 2.5 Gigabit Ethernet ports on the front panel of the CPC522 board.

Fig. 2- 5 External view of the RJ45 Ethernet connector

2.4.8.1 Pin assignment of RJ45 connectors

The RJ45 connectors enable the use of 100Base-TX, 1000Base-T, and 2500Base-T interfaces from the front panel.

Table 2 - 5 RJ45 Gigabit Ethernet connector pin assignments

Pin	100Base-TX		1000Base-T/2500Base-T	
	I/O	Signal	I/O	Signal
1	O	TX+	I/O	BI_DA+
2	O	TX-	I/O	BI_DA-
3	I	RX+	I/O	BI_DB+
4	-	-	I/O	BI_DC+
5	-	-	I/O	BI_DC-
6	I	RX-	I/O	BI_DB-
7	-	-	I/O	BI_DD+
8	-	-	I/O	BI_DD-

2.4.8.2 LEDs of the external interface channel status

The green “Line” LED lights up if the line is connected at 2.5 Gb/s, blinks at 1 Hz if the line is connected at 1 Gb/s and doesn’t light up if the line is 100 Mb/s.

The green “Act” LED (Activity) lights up if the computer is receiving or sending packets via the RJ45 connector.

2.4.9 SATA interface

■ SATA interface:

- Support of RAID 0, 1, 5, 10;
- One port is permanently routed to the mezzanine connector;
- One port is switchable between M2 connector and mezzanine connector;
- Five ports are routed to the backplane connector;
- One port is used by a soldered SSD.

Please note that the MIC584 module is available in two versions: MIC584-01 and MIC584-02, and both of them are compatible with the CPC522 Module. The MIC584-01 version has SATA connectors to which the CPC522-0x module's SATA ports are routed. The MIC584-02 has no SATA connectors. If the user installs the MIC584-02 mezzanine module on the CPC522, the CPC522 board with MIC584-02 will be fully functional except for the 2 x SATA channels, which will not be implemented. For a detailed description of the MIC584, refer to the relevant User Manual.

2.4.10 HD (high definition) audio:

Audio interface is implemented on the MIC584 mezzanine module:

- Linear input/output;
- Headphone output;
- Mic output.

A more detailed description of the audio interface is given in the MIC584 User Manual.

2.5 LEDs

The front panel of the CPC522 module contains the LED indicators described in the table below:

Table 2-6 Identification of LEDs and function of the CPC522 module

#	Mnemonics	Description
1	SYS	Two-color red and blue. Blue – “Power Off” mode. Red - hardware malfunction. Blinking red light serves diagnostic purposes and is also a sign of malfunction.
2	STG	Red - SATA and microSD drive activity.
3	GP	Two-color red-green. Red - programmable. Green - programmable. Green LED indicates the status of the startup process when starting up.
4	OVH	Two-color red-green. Red – overheating of processor, memory and PCH. Orange blinking - overheating of the processor, memory and PCH before the critical point (borderline state).

Signaling system is supported in accordance with the SFF-8485 specification.

2.5.1 GP LED indicator configuration and control registers (logic device 5)

Table 2-7 GP indicator configuration and control registers

INDEX	I/O port address	Type	HARD RESET	Configuration register
30h	-	R/W	00h	Activate. Bit [0] in "1" – LED module is active.
-	Base+0	R/W	01h	LED data register [3:0]. The other bits are unimportant and read as "0".
60h	-	R/W	-	Base[15:8] - I/O port base address bits[15:8]
61h	-	R/W	-	Base[7:0] - I/O port base address bits[7:0]

To work with the GP indicator you must set the base address of the device and activate it (LDN=5) similar to the watchdog timer or FRAM module. GP indicator operation is controlled by the LED register. Modification of the LED register is performed in the I/O area with respect to the set base address.

2.5.2 LED register initialization

Sequence of actions when initializing the device:

- Enter configuration mode

```
MOV DX, 302H
MOV AL, 46H
OUT DX, AL
MOV AL, 57H
OUT DX, AL
```

- Write the number of the logical device to the LDN register (FRAM has logical number 5)

```
MOV DX, 302H
MOV AL, 7
OUT DX, AL
MOV DX, 303H
MOV AL, 5
OUT DX, AL
```

- Set the base address of the device in the I/O area (31Dh for example):

```
MOV DX, 302H
MOV AL, 60H
OUT DX, AL
MOV DX, 303H
MOV AL, 3H
OUT DX, AL
MOV DX, 302H
MOV AL, 61H
OUT DX, AL
MOV DX, 303H
MOV AL, 1DH
OUT DX, AL
```

- Activate the device:

```

MOV DX, 302H
MOV AL, 30H
OUT DX, AL
MOV DX, 303H
MOV AL, 1H
OUT DX, AL

```

- Exit the configuration mode:

```

MOV DX, 302H
MOV AL, 57H
OUT DX, AL
MOV AL, 46H
OUT DX, AL

```

2.5.2.1 Assignment of individual bits of the LED register

Assignment of individual LED control register bits is shown in Table 2-8:

Table 2-8 Assignment of bits of the LED control register

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Reserve bits. Read as "0".				GP red LED Bit1	GP red LED Bit0	GP green LED Bit1	GP green LED Bit0

The GP LED is bicolor and physically contains 2 independent red and green LEDs. Therefore a green, red or orange color is available (red and green simultaneously on), depending on the combination of LEDs lit up. Accordingly an independent software control of each of the LEDs by means of the LED register is supported. The state of each LED is described by two bits. The following combinations are supported (see Table 2-9):

Table 2-9 Combinations of GP LED control bits

Bit1	Bit0	Status
0	0	The LED is off
0	1	The LED is blinking at the frequency of 8 Hz
1	0	The LED is blinking at the frequency of 1 Hz
1	1	The LED is on permanently

3 Use of CPC522

The CPC522 module is designed for operation as part of Compact PCI Serial systems. The module meets the following specifications:

1. CPCI-S.0 R1.0
2. Compact PCI Plus IO R1.0

Below are the options for building various systems based on the CPC522 module.

3.1 Compact PCI Serial system

3.1.1 Inter-module connections

The Compact PCI Serial system allows all the advantages of the new processors in terms of their computing capacity and the speed characteristics of the inter-module connections.

According to the specification [1] for a standard 9-slot backplane, a system slot can support the following inter-module connection functionalities:

- Up to 2 x PCI Express x8 channels (Fat Pipe);
- Up to 6 x PCI Express x4 channels;
- Up to 8 x USB 2.0/3.0 channels;
- Up to 8 x SATA channels;
- Up to 8 x Gigabit Ethernet channels;

The Gigabit Ethernet interface can be of the Star or Full Mesh type.

From among the above interfaces, the CPC522 module supports:

- 2 x PCI Express x8 Gen 3 (Fat Pipe) channels
- 2 x PCI Express x4 Gen 3 channels – processor lanes
- 4 x PCI Express x1 Gen 3 channels – PCH CM246 lines
- 8 x USB 2.0 channels
- 4 x USB 3.0 channels
- 5 x SATA channels

Supported interfaces make it possible for you to build powerful and compact systems with scalability options. In addition, the absence of cable inter-module and inter-device connections allows for increased reliability and maintainability.

Standard Compact PCI Serial system includes one processor module (host) installed in a system slot (System) in red color and a set of peripheral modules installed in peripheral slots (Perip.). The system is implemented with the “Star” topology.

Please note that the number of available SATA and USB 3.0 channels for the CPC522 module is less than eight. Therefore, the SATA interface is supported in slots 8 to 4, and USB 3.1 in slots 5 to 8 (see Figure 3 - 1).

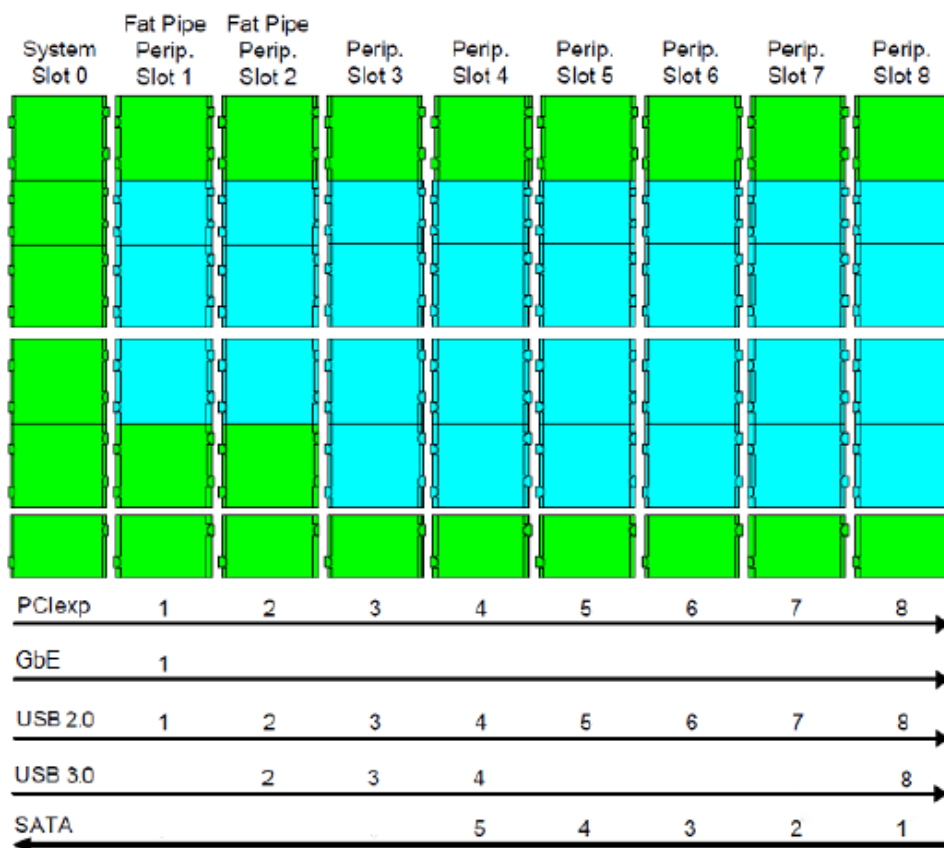


Fig. 3- 1 Numbering of the interfaces supported by the CPC522 in the Compact PCI Serial backplane.

3.1.2 Interaction with power supply

The CPC522 has a universal power supply circuit that allows the power supply (PSU) to operate in two modes: with support of PSU control (similar to the control used in an ATX PSU) and without the control support.

The power supply control is supported by the CPC522 module, in which case the power supply source must support the control function and have:

- a built-in +5V standby power supply voltage with a minimum load current from 1A;
- a “power on” input (PS_ON#).

The control logic of a power supply is determined by the FPGA microcode of the CPC522 CPU module. It can be controlled in any of the following ways: by the “Power Button” on the 19” frame control panel, by the programmable extractor lever button (see subparagraph 5.1), or by the ACPI software module of the operating system used. The “Power Button” is connected to the “Utility” connector, which is located on the Compact PCI Serial backplane. In addition to that, this connector is used to connect the power supply control input (PS_ON#), as well as the external “Reset” button.

3.1.3 Features of information storage system implementation

According to the specification [1] the CPC522 module supports the information storage devices installed in the backplane expansion slots. The drives are numbered from the far right slot (see Figure 3-2).

As mentioned before, the CPC522 module supports up to 5 SATA drives (0 through 4) simultaneously. Other backplane slots are not supported for operation with SATA drives.

All SATA lines support transfer rates up to 6 Gb/s.

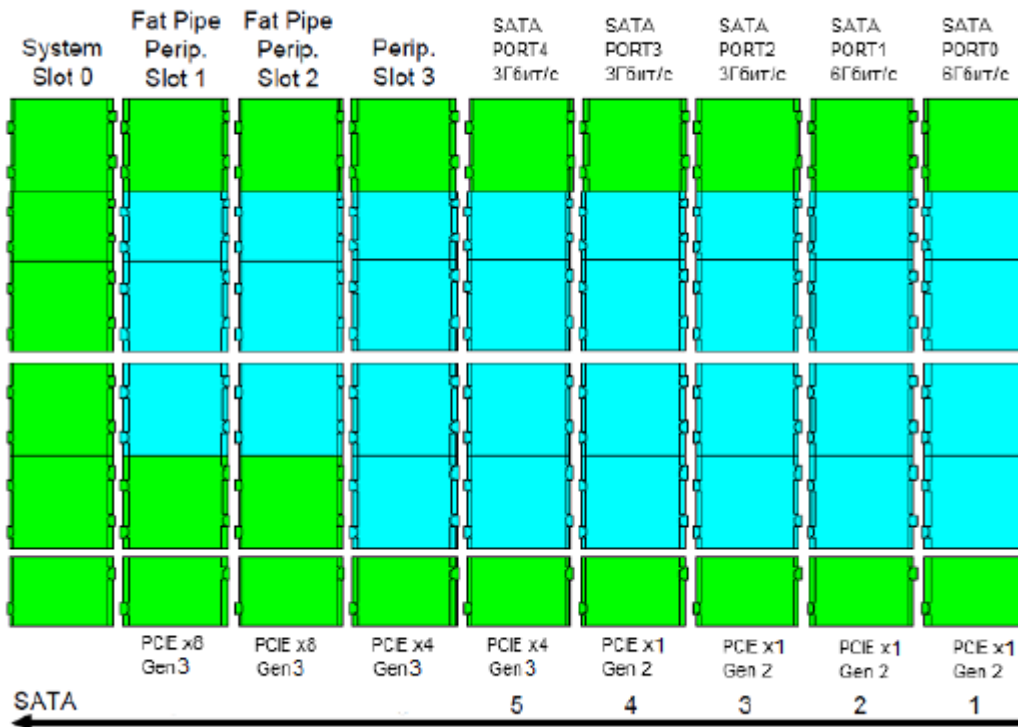


Fig. 3-2 Location of the CPC522 supported SATA lines on the backplane

The SATA controller installed on the CPC522 enables both the operation with single drives and organization of the so called software RAID-arrays.

The mode of operation can be set through the BIOS menu: “Advanced” – “SATA Configuration” – “SATA Mode Selection”. The following options are possible:

- AHCI – connecting drives by Serial ATA protocol;
- IDE – connecting drives by an ATA compatible protocol;
- RAID – connecting Serial ATA drives with the ability to organize the drives in an array.

In AHCI mode (the default), all drives on ports 0-4 are available.

In AHCI mode (by default), all drives on ports 0-4 are available. All Serial ATA protocol features such as NCQ, Link Power state and others are supported. Transfer rates are correspond to the ones stated.

IDE mode is intended for use with legacy operating systems that do not support the Serial ATA protocol. In this mode only drives connected to SATA ports 0-3 are available. Thus, the presence of two IDE controllers with four drives is simulated. And the speed of SATA drives does not depend on the emulated UDMA mode and can reach 3 Gb/s.

The SATA controller hardware (Rapid Storage Technology) allows organizing an array of storage devices connected to the SATA ports.

The available options for organizing the array, are as follows:

- RAID 0 (Striping). In this case the RAID is written/read simultaneously on all drives of the array (up to 6 drives are supported), thus increasing the performance of the storage system by several times. In this case, the total capacity of the array will be equal to twice the capacity of the smallest disk in the array, while error tolerance remains low.

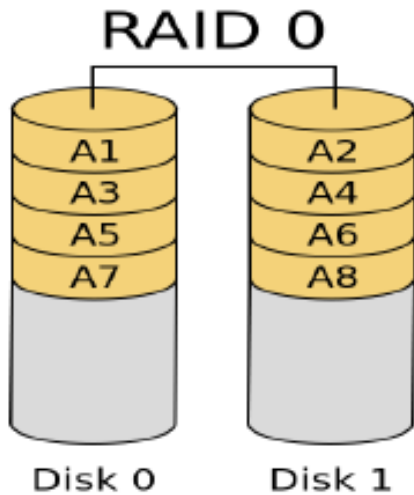


Fig. 3-3 RAID 0 diagram

- RAID 1 (Mirroring). This option allows you to increase the reliability of information storage by “mirroring” information to the second disk of the array. The performance of the storage system in this case is lower, and the total capacity of the array is equal to the capacity of the smallest disk in the array.

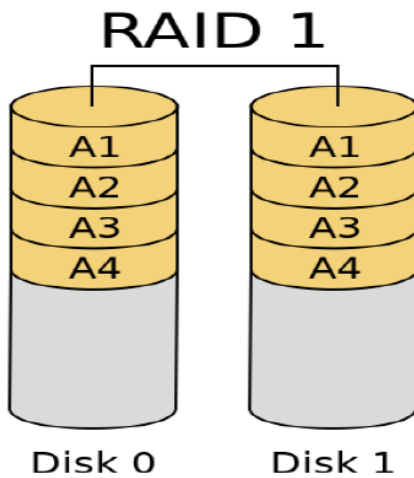


Fig. 3-4 RAID 1 diagram

- RAID 10. A mirrored array in which data is written sequentially on several disks, as in RAID 0. This architecture is a RAID 0 type array with RAID 1 segments instead of individual disks. You will need 4 x SATA drives to build a RAID 10 array.

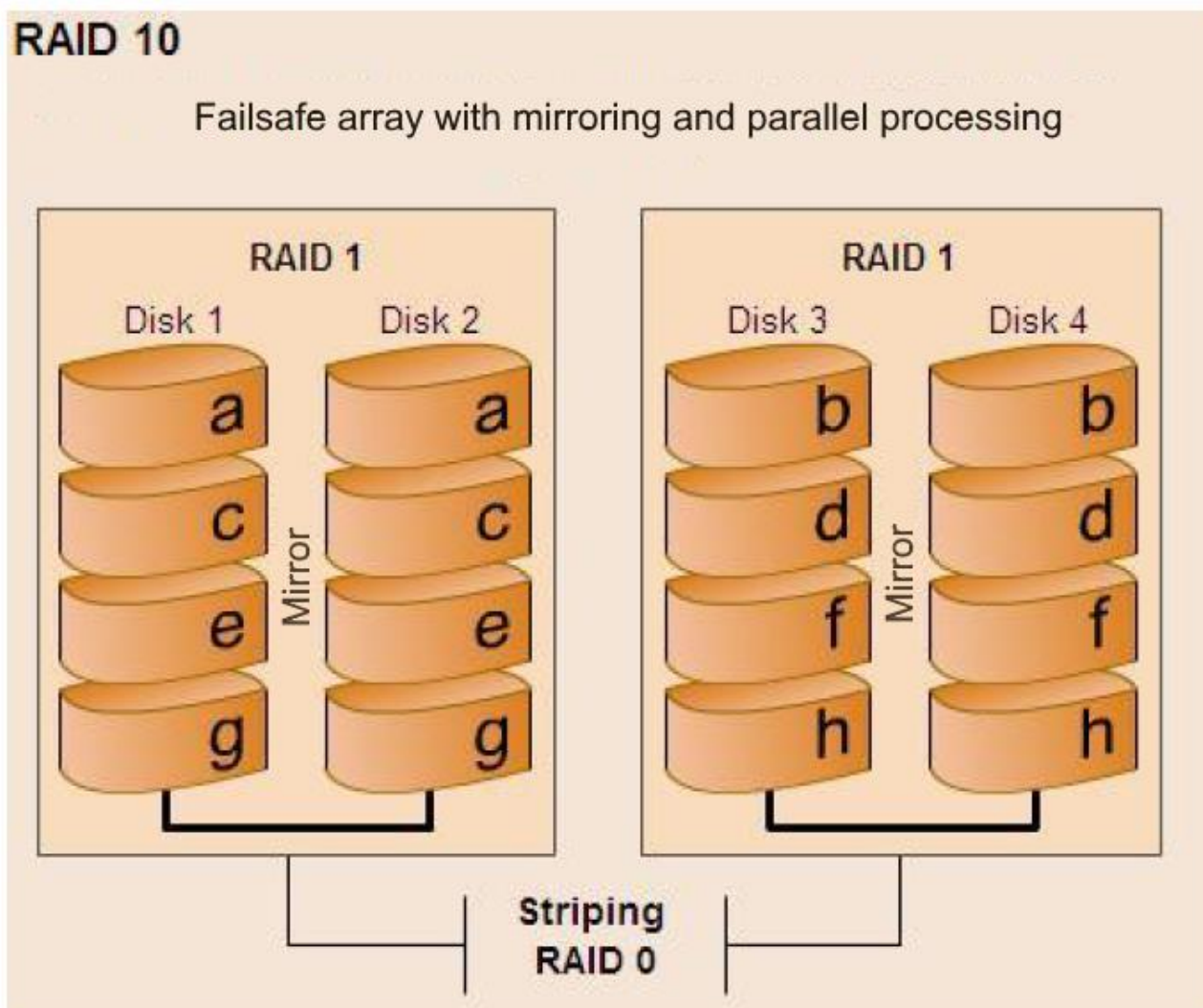


Fig. 3- 5 RAID 10 diagram

- RAID 5. This option provides high storage efficiency while maintaining fault tolerance for 3 or more disks. Data blocks and checksums are cyclically written to all disks within the array. The RAID5 disk capacity is calculated using the formula $(n-1) \times \text{hddsize}$, where n is the number of disks in the array and hddsize is the size of the smallest disk. The write operation on the RAID 5 volume takes additional resources and the performance declines since additional computation and write operations are required, but the read operation (compared to a separate disk) would be an advantage because data streams from several disks in the array can be processed in parallel. RAID 5 works well for applications requiring large amounts of data storage while maintaining fault tolerance.

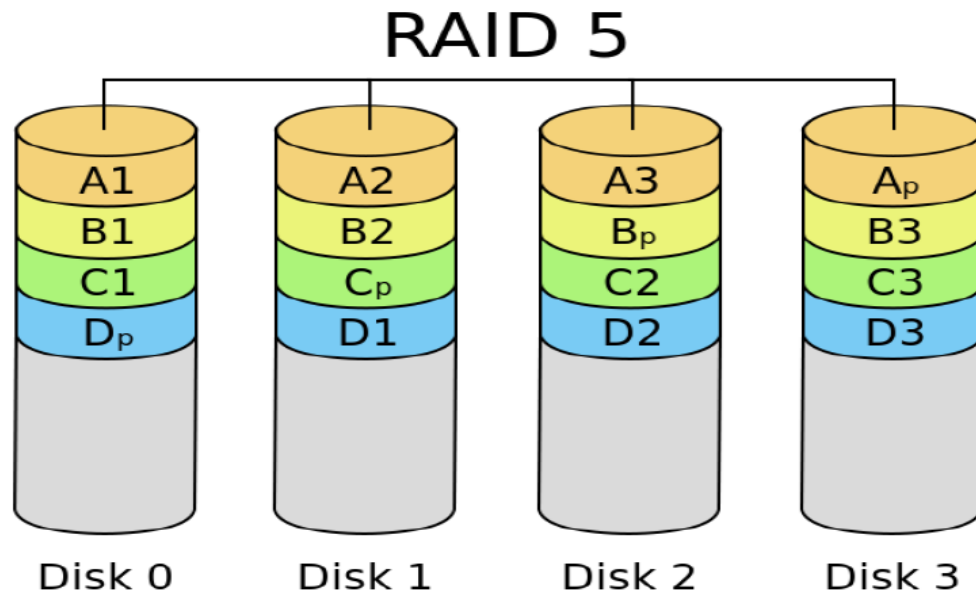


Fig. 3- 6 RAID 5 diagram

* For more information on RAID using Intel chipsets, see the “Intel Rapid Storage Technology. User Guide. Rev.1.0”.

As a carrier module for SATA disk drive you can use KIC550/KIC550RC module or a similar one, manufactured by FASTWEL Group.

If you're using the KIC550/KIC550RC module for storage system it is possible to use both SATA interface and PCI Express interface for data transfer. In this case one of the drives installed on the KIC550/KIC550RC module is available through the SATA interface, and the other one - through the PCI Express interface (through the PCI Express-SATA Bridge installed on the KIC550/KIC550RC module). The total number of drives can be increased. This can be achieved by reconfiguring the KIC550/KIC550RC module to work with PCI Express only, where both drives on the KIC550/KIC550RC module are available through the PCI Express interface. Then the drives on the KIC550/KIC550RC modules in peripheral slots 8 through 4 will have a hybrid PCI Express+SATA interface, and in slots 3 through 1, only the PCI Express interface. The backplane slots where the PCI Express interfaces are available, supported by the CPC522 module, are shown in Figure 3-2. For more information on working with the KIC550/KIC550RC module, see www.fastwel.com.

4 CPC522 Installation

The CPC522 module can be installed into the system with little effort. However, the following rules, warnings, and procedures must be strictly followed in order to properly install the module, avoid damages to the product, system components, and prevent personal injuries.

4.1 Safety requirements

When handling the CPC522, strictly follow the safety requirements below. FASTWEL Group shall not be held liable for any damages resulting from failure to comply with these requirements.



Careful!

When handling the module, be careful because the cooling heatsink can get very hot. Do not touch the heatsink when removing the module.

Also, do not place the module on any surface or in any container until both the module and the heatsink have cooled down to the room temperature.



Attention!

Turn off the power supply of the CompactPCI system before installing the module in a free slot. Failure to do so may threaten your health or life, or result in damage to the system or the module.



Device sensitive to Electrostatic Discharge (ESD)!

The CompactPCI module contains elements that are sensitive to electrostatic discharges. To prevent damages to the module the following precautions should be observed:

- Remove static charge from clothing before touching the module, also remove charge from tools before use.
- Do not touch electronic components and connector pins.
- If you have a professional workplace with anti-static protection, don't forget to use it.

4.2 CPC522 installation procedure

To install the CPC522 into the system, follow the procedure below:

1. Make sure that all safety requirements listed in the previous chapter are met.



Attention!

Failure to follow these instructions may cause damages to the module and lead to system

malfunctions.

2. Before installing, make sure that the module is configured to meet the requirements of the application. Refer to the appropriate sections of this chapter for information on installing peripherals and I/O devices. Refer to the MIC584 User Manual for relevant information on installing the MIC584 module on the CPU module.

3. If the CPC522 will operate with a mezzanine module, connect the mezzanine module to the appropriate CPC522 connector before installing the CPC522 in the system, see subparagraphs 2.4.2 and 5.5.



Attention!

The following operations should be performed with care so as not to damage either the CPC522 or other devices in the system.

4. To install the CPC522, follow these steps:

- Before the installation, make sure that the power to the system is turned off.



Attention!

Do not apply force when moving the module card along the guide rails or loading the module connector into the backplane's host slot. Use the handle on the front panel to slide the module into the slot.

- Carefully slide the module into the required slot, sliding it along the guide rails until it touches the backplane connector.
- Use the front panel handle to slide the module down into the backplane connector. The module is considered to be fully inserted when the raised handle snaps.
- Secure the module with the two retaining screws on the CPC522 front panel (see Figure 1- 6)
- Connect all the required external interface cables to the module.
- Make sure that both the CPC522 and all connected cables are securely fastened.

The CPC522 module is now ready for operation.

4.3 Module removal procedure

In order to remove the module, perform the following operations:

1. Make sure that the safety requirements listed in paragraph 4.1 are met. Pay special attention to the warning regarding the heatsink temperature!

**Attention!**

The following operations should be performed with care so as not to damage the CPC522 module or other devices in the system.

2. Before you start the removal of the CPC522 module, make sure that the power to the system is turned off.
3. Disconnect all interface cables from the module.
4. Unscrew the retaining screws on the front panel.

**Attention!**

When handling the module, be careful because the heatsink can get very hot. Do not touch the heatsink when replacing the module.

5. Unlock the front panel handle by pressing button A and pulling it down, remove the module from the backplane connector (see Figure 1-6). After the module has been removed from the backplane connector, pull it out of the enclosure along the guide rails.
6. Dispose of the module at your discretion.

4.4 Installation of the CPC522 peripherals

A wide variety of peripherals can be connected to the CPC522 module, and installation methods vary significantly. The following sections provide general installation guidelines only, not detailed algorithms.

4.4.1 Installation of SSD M2

The CPC522 module is equipped with an XS2 connector for M2 SSDs. Carefully slide the drive located in accordance with the M2 drive into the connector along the guide rails and slightly press on it so that the pins enter the connector all the way in.

**Attention!**

The SSD installed in the XS2 slot must be rated for the same temperature range as the CPC522. Otherwise proper operation of the module within the specified temperature range is not guaranteed.

**Attention!**

Be careful when replacing the SSD, because the cooling heatsink can be very hot.

4.4.2 Connection of USB devices

The CPC522 module supports any USB computer peripheral Plug&Play standard (e.g. keyboard, mouse, printer etc.).



Note

All USB devices can be connected and disconnected while the power supply of the devices and head system is switched on.

4.4.3 Battery replacement

To replace the lithium battery, use the same battery or the one recommended by the manufacturer for replacement. Suitable models include RENATA CR2032 or other compatible models.



Important note:

Polarity must be observed when replacing the battery.

The used battery should be disposed in accordance with the relevant regulations.

The expected life of a 190 mAh battery is approximately 5-6 years provided that the battery operates 8 hours a day at 30°C. However, battery life is highly dependent on operating temperature and the amount of time the system is turned off.

It is recommended to replace the battery after 4-5 years of operation without waiting until the end of its service life.

4.5 Installing the MIC584 Mezzanine Module

The MIC584 module is installed in XS7 slot of the CPC522 board. Refer to the MIC584 User Manual for the procedure to install the MIC584 module on the processor module.

4.6 Installing the software

The procedure for installing the Ethernet drivers and other peripherals installed on the module is given in the files accompanying the drivers.

This User Manual also does not describe how to install operating systems. Refer to the documentation provided with the operating system.

5 System setup

5.1 Reset of BIOS settings to factory defaults and set the module to transparent mode

If the system fails to boot (e.g. due to an incorrect BIOS configuration or incorrect password), the settings stored in CMOS can be cleared using the SA1 switch at the bottom of the board - see Figure 1-3.

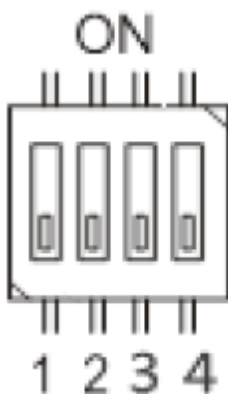


Fig. 5-1 The SA1 operation mode switch of the CPC522 module

The SA1 switch is used to perform the following actions:

- Resetting the BIOS Setup to the default settings;
- Selecting the location of the BMC Firmware loader: internal/external (via UART).

The SA1 switch positions are described in the table:

Table 5-1 Possible configuration options of the CPC522 module with the use of the SA1 switch

No. of the switch (marked on the enclosure)	Switch assignment	SA1 switch position (see Fig. 5-1)	Function
1	Reset of BIOS Setup to the default settings	ON	Reset BIOS Setup to default settings *
		OFF	Operating mode
2	Reserved Switch	ON	Reserved
		OFF	Reserved
3	Extractor lever button blocking	ON	Extractor lever button on the CPC522 is blocked
		OFF	Extractor lever button on the CPC522 is enabled

4	Loading Firmware to BMC	ON	Internal loader
		OFF	External loader (UART)

* Sequence of BIOS settings reset to factory default settings:

1. Turn off the power supply.
2. Remove the CPC522 module from the crate.
3. Turn the operation mode switch SA1.1 to ON position.
4. Insert the CPC522 into the crate.
5. Enter BIOS Setup and select "Load Setup Defaults".
6. Exit the BIOS Setup and save.
7. Turn off the power supply.
8. Remove the CPC522 module from the crate.
9. Return the SA1.1 switch to the OFF position.
10. Insert the CPC522 module into the crate.
11. Turn on the power supply.

6 Phoenix® BIOS

Your computer has an adapted version of the Phoenix® BIOS, which is a standard system for IBM PC AT-compatible computers. It supports Intel® x86 and compatible processors and provides low-level support for processor, memory, and I/O subsystems.

The BIOS Setup is used to modify BIOS settings and control special modes of computer operation. This program is started by pressing the "Del" key and uses a menu system to make changes and to enable or disable special functions. It allows the user to change basic system settings. These settings are stored in a special memory area in the flash BIOS chip which stores the information when the system power is turned off.

7 Additional information

7.1 Temperature mode control

The CPC522 CPU operates in severe thermal conditions. This requires special measures to keep the temperature of the processor chip within acceptable limits. The following sections provide the information necessary for system developers to comply with CPC522 temperature standards and requirements.

7.1.1 Passive temperature control

The structure of the temperature control mode of the CPC522 can be represented as certain functions whose purpose is to protect the processor and reduce its power consumption. The use of thermal control circuits allows the processor to maintain a safe operating temperature without the need for special software drivers and interrupt handling procedures.

Processor thermal protection features:

1. The “Catastrophic shutdown detector” technology ensures that the processor shuts down if it’s impossible to maintain the chip temperature below 105°C by any means of passive or active temperature control. This function is always active to ensure that the processor is protected in any case. After the “Catastrophic shutdown detector” has been triggered the CPU module goes into Soft-Off mode (S5). To restart the module, a power cycle must be performed. If the overheating is not eliminated, the “Catastrophic shutdown detector” will be triggered again.
2. Enhanced SpeedStep®: when the crystal core temperature exceeds 100°C, processor will dynamically switch to low-power consumption mode with reduced core operating voltage and internal multiplication factor.
3. TDP (Thermal Design Power) is configurable. The TDP parameter specified in the processor documentation describes the requirements applied to the cooling system performance. Three configurations are available: TDP Nominal (default), Minimum (TDP Down), and Turbo (TDP Up). If heat dissipation is sufficient, the processor's TDP can be increased (TDP Up) and, accordingly, its clock speed will increase in Turbo Boost mode (by default, it is turned off). And the other way round, if external conditions do not allow the processor to fully dissipate heat, then the processor’s TDP must be lowered (TDP Down).
4. The Remote Diode Digital Temperature Sensor (LM96136) is designed for acquisition of information on the temperature of the memory chips. This data can be used by the control program to implement necessary measures.

If the CPC522 module works under operating conditions considered to be normal for CompactPCI, with a sufficient air circulation, there is no need to use the temperature control functions. However, when the ambient conditions are non-optimal, the thermal management functions are enabled to ensure stable operation. Thermal management provides the developers with the ability to create well-priced solutions without compromising reliability or system integrity.



Attention!

All thermal conditions control functions should be turned off during benchmarks problems and verification tasks. Otherwise erroneous results may be obtained.

7.1.2 Cooling system of the CPC522 module

Specially designed cooling heatsinks provide the best basis for stable operation and long-term reliability. When these heatsinks are used along with a system housing that provides controlled airflow characteristics, controlled dissipation of thermal energy is guaranteed.

All the versions of the CPC522 are equipped with optimally designed heatsinks. Their size, shape and design ensure the best possible coefficients of thermal resistance (R_{th}). In addition, they are designed to actively use the forced ventilation system of modern CompactPCI Serial systems.

While designing solutions based on the CPC522 the developer should consider the thermal performance of the overall system. A system enclosure that meets the heat dissipation requirements must be used. When making thermal calculations, the contribution of peripherals to the overall system heat dissipation should also be considered.

The peripherals, in turn, must have thermal characteristics that match the operating temperature range of the module and the system in general.



Attention!!!

Since FASTWEL Group shall not be responsible for damages to the CPC522 module and other equipment caused by processor overheating, system developers and end users are strongly advised to make sure that the CPC522 environment meets the temperature requirements.

7.2 Power consumption of the CPC522 module

The module is powered by +5V standby voltage and +12V main voltage. It is necessary to consider the requirements that are essential for stable and reliable operation of the module. Table 7-1 shows the maximum allowable supply voltages, exceeding which may result in module damages. The power supplies with which the CPC522 module will be used must be tested to ensure they meet these requirements.

Table 7-1 Power consumption parameters of CPC522

Voltage (V)	Minimum (V)	Maximum (V)	Consumption current MAX (A)
Standby +5V_	4.75	5.25	2
+12	11.4	12.6	6

If the supply voltage exceeds these limits, the functionality of the module is not guaranteed.

The backplane must provide optimum distribution of power supply voltages. It is recommended to use only those backplanes where each of the power supply rated values is implemented by two layers of tracks.

Connections between the power supply lines and the backplane should provide minimum losses and guarantee stable performance parameters. Long feeding lines, light-gauge conductors, and high-resistance connections should be avoided.

If possible, power supplies with voltage monitoring should be used. This may require the use of an appropriate backplane.

The power supply capacity should be sufficient to accommodate possible deviations in the electronic components characteristics.

7.2.1 Starting and average current consumption of the module

During the tests the maximum starting and the maximum average current consumption were measured.

Table 7-2 Results of measuring maximum starting currents and maximum average currents

Module	Maximum starting (short-term) current (+12V)*	Maximum current (+12 V)**
CPC522	3.2A	5.2A

* Estimated values of maximum current consumption are indicated.

** Values from laboratory test reports of current consumption.

7.3 Compliance with safety requirements of CPC522

The CPC522 module complies with general safety requirements for information technology equipment according to GOST R IEC 60950-2002 standard (for equipment connected to 600 V electricity mains).

7.4 Operating Conditions of the CPC522 module

The device maintains its performance capability under the following climatic and mechanical conditions:

Table 7-3 Parameters of climatic and mechanical effects

Effect type	Parameter name	Parameter value	Document
Temperature change	Low temperature	- 40 (0*) °C	GOST 28209 Test Nb
	High temperature	+ 85 (+70*) °C	
Humidity	Relative humidity	Up to 80%, non-condensing	GOST 28209
Damp heat (+55 °C) (for devices with conformal coating) **	Relative humidity	Up to 93%	GOST 28216 Db test
Sinusoidal vibrations	Frequency range (Hz)	10...150	GOST 28203
	Acceleration, g	2	
Single shocks	Peak acceleration, g	50	GOST 28213
	Duration, ms	11	
Multiple shocks	Peak acceleration, g	25	GOST 28215
	Duration, ms	6	
	Number of shocks	1000	

* For commercial versions.

** For /COATED versions only. Only the strength of the device is guaranteed.

Table 7-4 Requirements for electromagnetic compatibility

Requirement type	Reference document
Industrial radio interference from information technology equipment. Standards and testing methods.	GOST R 51318.22-99 Class A (CISPR 22-97)
Immunity of computer and information technology equipment to electromagnetic interference. Requirements and test methods	GOST R 51318.24-99 (CISPR 2497)

**Note**

The tested devices meet the declared requirements for mechanical loads provided that the following conditions are met: additional fastening of USB devices (e.g., fixation with mastic compound) is required.

ANNEX A

Terms and abbreviations

Abbreviation	Definition
ACPI	Advanced Configuration and Power Interface
BIOS	Basic Input-Output System
BMC	Baseboard Management Controller
DAC	Digital-Analog Converter
DDR SDRAM	Double Data Rate Synchronous Dynamic Random Access Memory
DMA	Direct Memory Access
ECC	Error Correction Code
EEPROM	Electrically Erasable Programmable Read-Only Memory
ESD	Electrostatically Sensitive Device Electrostatic Discharge
I ² C™	Inter-Integrated Circuit
LCD	Liquid crystal display
LPC	Low Pin Count
MDI	Media Dependent Interface
PC	Personal Computer

PM	Peripheral Management Controller
RTC	Real Time Clock
SMBus	System Management Bus
SSD	Solid State Drive
UART	Universal Asynchronous Receiver-Transmitter
USB	Universal Serial Bus

ANNEX B: DISCLAIMER

This Disclaimer contains special operating conditions of Fastwel in the following areas: intellectual property, warranty policy, conditions of the order and delivery.

1 INTELLECTUAL PRORETY

1.1 If any infraction, interference, improper use, illegitimate exploitation and/or violation of the industrial and/or intellectual property rights of any third party and/or property, exploitation during the use of Fastwel Embedded Module will take place – Fastwel does not guarantee to replace the materials, computer programs, procedures or equipment affected by the complaint and under no circumstances doesn't bear responsibility in any form for possible refusal in case of such a replacement.

1.2 Use of the Fastwel products as well as the objects of intellectual property containing in them, in the ways and for the purposes, not provided by the present user manual and datasheet isn't allowed without preliminary written approval of Fastwel.

1.3 Fastwel is not responsible for possible incidents and losses, related to the operation of end devices, in which the original Fastwel equipment is used.

2 WARRANTY POLICY

2.1 When the detected flaws in an element can be corrected without decreasing the foreseen technical features and functionality for it, User may demand Fastwel the urgent correction of the failures in additionally agreed period and an increasing of the period of the guarantee of the element equal as the time elapsed from the formal request to repair the failures, until the receipt of the repaired element. All costs associated to the correction of failures, included those of assembly, dismantle, transport, tests, etc., if they exist, shall be prosecuted according the Warranty Policy of Fastwel.

3 ORDER AND DELIVERY CONDITIONS

3.1 The general rule is that all Fastwel equipment prices are determined with due consideration of delivery under the EXW terms and conditions (Incoterms 2010). Delivery of the products under other terms and conditions should be preliminary agreed and stated in writing between the parties.

3.2 Unless otherwise expressly agreed with Fastwel, all the deliveries of Fastwel equipment will be carried out only after the official purchase order is obtained and provided that the ordered products have been prepaid in full. Other terms and conditions of cooperation should be made in writing.

3.3 Any delivery of Fastwel electronics is submitted with the right package in accordance with the current rules and standards in the Member States of the European Economic Area. The purchaser independently bears all risks regarding the compliance of package and marking of Fastwel products with legislation requirements being in effect at the place of purchased products destination (in the buyer's country). The specified condition excludes unequivocally any liability of Fastwel for possible non-compliance of package and marking of products with the requirements of legislation of the country of products destination.

3.4 In general, all components of the supply are properly protected with respect to freight, in order to avoid any damage to the supply, third parties, environmental damages or unrelated goods, as consequence of wrong packaging.

3.5 Each package unit is labeled on the exterior area with the indications of product's Part Number and Serial Number.

3.6 The support documents for the order should be made either in English or in Russian unless otherwise agreed between parties in writing.

3.7 Fastwel does not pay penalties and does not cover costs associated with delay in the delivery of the products caused by actions of the third parties, force-majeure etc. - Fastwel doesn't bear any responsibility for non-execution or inadequate execution of the obligations in a case when it is caused by actions of the third parties (for example producers or suppliers of accessories), force majeure etc.

3.8 Fastwel declares that independently and at any time without damage, it has an exclusive right to define and change functionality architecture, bill of materials of its products without any preliminary coordination and approvals of the third parties.

4 OTHER CONDITIONS

4.1 Fastwel has the obligation to respect the current Russian legislation (including, but not limited to environmental, labor, social laws) in each moment and to apply it to its embedded electronics considering all and each execution phase, that is to say, from the design until the commissioning and subsequent maintenance. In this regard Fastwel is not liable to the user or other persons in connection with possible changes of the company's rules (including, but not limited to warranty, ordering policy) caused by changes of the Russian legislation.

4.2 Unless otherwise expressly agreed in writing, Fastwel provides no training for assembly\installation\adjustment\operation of its equipment.