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emPC-X

embedded PC

(Hardware Manual)

Version 1.1

refers to product revision no.
1.0

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About this Manual

This is the hardware manual for the emPC-X embedded PC.

Throughout the manual, the term emPC-X is used to identify the all systems. When required, the CPU options are identified explicitly.

Conventions

If numbers are specified in this manual, they will be either decimal or hexadecimal. We use C-notation to identify hexadecimal numbers (the 0x prefix).

If we refer to low active signal names, they will suffixed by a “#” character.

Some parts of the contains notices you have to observe to ensure your personal safety, or to prevent damage to property. These are visually marked with the following alert symbols:

**DANGER**

Indicates that death or severe personal injury *will* result if proper precautions are not taken.

**WARNING**

Indicates that death or severe personal injury *may* result if proper precautions are not taken.

**CAUTION**

Indicates that *minor* personal injury can result if proper precautions are not taken.

**NOTICE**

Indicates that damage to equipment can result if proper precautions are not taken.



Indicates information that we think you should have read to save your time by avoiding common problems. Important suggestions that should be followed will also be marked with this sign.

Acronyms and Abbreviations

| | |
|------|---|
| EMC | Electromagnetic capability. |
| ESD | Electrostatic discharge. |
| GND | System ground potential. Inside the product this is connected to the metal housing, which might be connected to protective earth by the installation. There exist some isolated reference grounds for communication interfaces or IO. These reference signals are referred to as GND-x, where x indicates function. |
| SELV | Safety extra low voltage. |

1 Introduction

The emPC-X platform is a flexible computer system. It consists of one CPU board and can be expanded with a variety of IO expansion boards. The boards are stacked together and are inserted into a rail mounted housing. This allows flexible system building. Internal busses are documented, so users can build application specific IO expansion boards.

| Order-No.: | Product | Interfaces |
|--------------|-------------------------|---|
| SY-EPC-40001 | emPC-X/A-E3815/0 | ATOM E3815, 2 GB DDR2, DVI, 3 x USB 2.0, 2 x Ethernet, 2 x RS232 (console) |
| SY-EPC-40000 | emPC-X/A-E3815/1 | ATOM E3815, 2 GB DDR2, DVI, 3 x USB 2.0, 2 x Ethernet, 1 x RS232 (console). 1 x CAN/CANopen |
| SY-EPC-40002 | emPC-X/A-E3815/0 | ATOM E3815, 2 GB DDR2, DVI, 3 x USB 2.0, 2 x Ethernet, 2 x CAN/CANopen |
| SY-EPC-40004 | emPC-X/A-E3815/4 | ATOM E3815, 2 GB DDR2, DVI, 3 x USB 2.0, 2 x Ethernet, 4 x CAN/CANopen |
| SY-EPC-41001 | emPC-X/A-E3825/0 | ATOM E3825, 2 GB DDR2, DVI, 3 x USB 2.0, 2 x Ethernet, 2 x RS232 (console) |
| SY-EPC-41000 | emPC-X/A-E3825/1 | ATOM E3825, 2 GB DDR2, DVI, 3 x USB 2.0, 2 x Ethernet, 1 x RS232 (console). 1 x CAN/CANopen |
| SY-EPC-41002 | emPC-X/A-E3825/0 | ATOM E3825, 2 GB DDR2, DVI, 3 x USB 2.0, 2 x Ethernet, 2 x CAN/CANopen |
| SY-EPC-41004 | emPC-X/A-E3825/4 | ATOM E3825, 2 GB DDR2, DVI, 3 x USB 2.0, 2 x Ethernet, 4 x CAN/CANopen |

Table 1: emPC-X standard products

1.1 Features

1.1.1 Standard Products

- Intel ATOM E38xx CPU
- 512 kB to 1 MB of L2 cache
- 2 GB DDR3L 1066 MT/s
- Fanless cooling concept
- System memory 2 GB DDR3 (1GB with Solo)
- 128 kB of MRAM which does not require battery backup
- Internal CFast Socket for SATA SSD
- SD card socket (Option)
- DVI-D graphic interface on front panel (Single Link)
- Single channel LVDS on internal connector
- 2 x 10/100/1000 Mbit/s Ethernet
- 3 x USB 2.0 interface (480Mbit/s)
- Battery backed up RTC
- System Power supply 9..34 VDC

- Reset Push Button and Power LED
- 2 male 9pin D-SUB connectors, utilized by serial ports or CAN
- Power supply monitor

1.1.2 Hardware Customization

Due to its flexible system architecture, the emPC-X can be customized if the standard products do not provide optimum features or price. Customization is possible even at moderate quantities. Ask sales department for details.

Following you find a (non-complete) list of possible customization:

- Without MRAM for price reduction.
- Serial ports can be modified for RS485 physical layer (optionally isolated)
- More CAN ports are possible by using expansion cards (in a larger housing)
- More serial ports are possible
- Digital/Analog-IO expansion card
- Customer specific expansion cards
- Other mounting options (e.g. flange mount)

1.1.3 Software

Supported by

- Windows 7, Windows 8
- Windows 7 Embedded Standard
- Linux

Contact Janz Tec for more information about the available software packages.

1.2 Functional Overview

The emPC-X is built upon a couple of standard building blocks, as shown in figure 1.

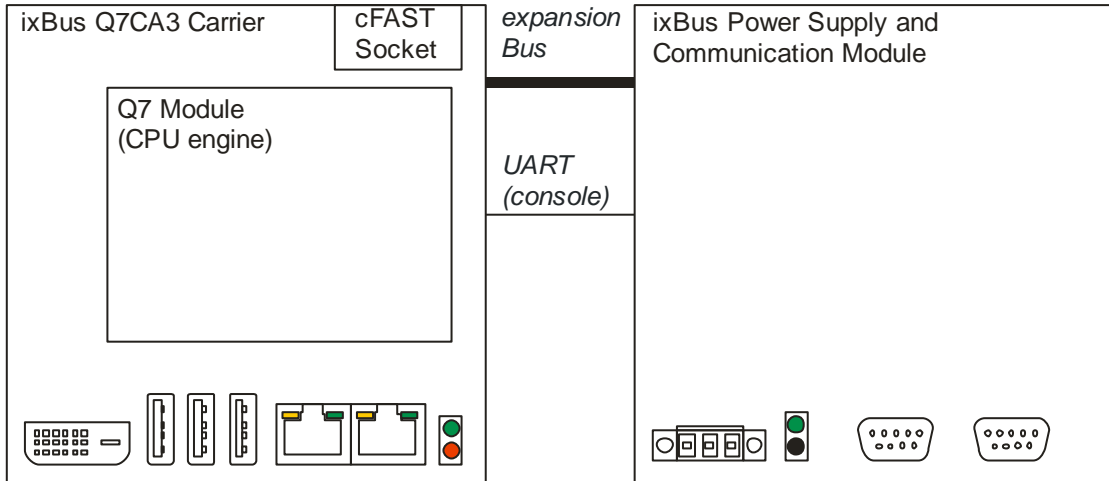


figure 1: block diagram (2 PCB variant shown)

The system consists of the following building blocks:

- Congatec Q7 module (QA3 series)
- Janz Tec ix-Bus Q7CA3 carrier module
- Janz Tec ix-Bus power supply and communication module
- Optionally additional IO modules

Refer to Congatec documentation for details on the Q7 Module.

Refer to Janz Tec ixBus System Reference Manual for details on the Janz Tec specific building blocks.

2 Safety Instructions

Refer to page iii for explanation of the warning notice system.

The product described in this documentation may be operated only by personnel qualified for the specific task in accordance with the relevant documentation for the specific task, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products.

2.1 Installation and Maintenance

**DANGER: Electrical Shock**

Danger to life.

This product operates with 9.34 V DC SELV power supply. Do not connect this product to an improper power supply.

**DANGER: Electrical Shock**

Danger to life.

The IO interfaces (connectors) of the product are only suited to be connected to SELV circuits. Use interfaces (connectors) for their intended use only.

**CAUTION: Explosive Risk**

The installed computer board is equipped with a Lithium battery.

Danger of explosion if battery is incorrectly replaced. Replace only with battery of the same or equivalent type.

**WARNING: Burns Hazard**

The product generates considerable amount of heat. The housing transports this heat to the environment and therefore gets hot. **Caution when touching the housing, burns hazard!**

2.2 Ambient and Environmental Conditions

**DANGER: Explosive Risk**

Do not operate the product in potentially explosive atmosphere.

**WARNING**

This product does **NOT** fulfil the requirements for a fire enclosure according to EN 60950-1 in all possible mounting positions. In these mounting positions, installation is only permitted above concrete or other non inflammable materials.

**CAUTION: Damage**

Do not operate the product beyond the specified ambient conditions. Do not cover the vent slots of the product.

**NOTICE: EMI**

This product is a class A device. This product may cause radio interference. In this case the user must take adequate measures.

3 Installation



WARNING: Burns Hazard

The product generates considerable amount of heat. The housing transports this heat to the environment and therefore gets hot. **Caution when touching the housing, burns hazard!**

The product can be operated with DC power supply from 9 to 34 V.

3.1 Mounting

The emPC-X is intended for DIN rail mount. Refer to figure 2 for the recommended mounting orientation.

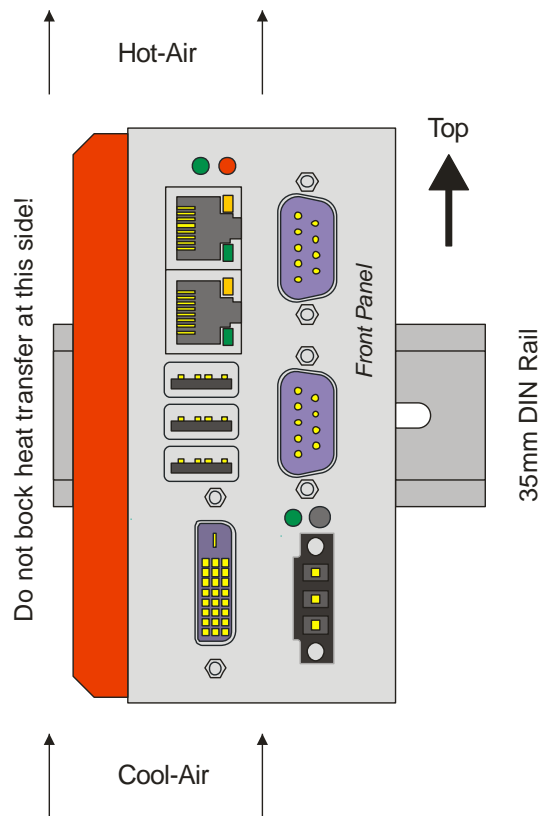


figure 2: emPC-X mounting options



WARNING

This product does **NOT** fulfil the requirements for a fire enclosure according to EN 60950-1. Installation is only permitted above concrete or other non inflammable materials.



CAUTION: Damage

Do not operate the product beyond the specified ambient conditions. Do not cover the vent slots of the product.

Install the product such that the venting holes at the top and bottom of the housing are not blocked.

The ambient temperatures **below**, **left**, **right** and in **front** of the product must not exceed the specified maximum ambient temperature.

Cooling requirements depend on the mounting conditions (e.g. nearby heat sources) as well as the actual power dissipation in the product. At light loads, the mounting conditions might be relaxed. It is recommended to check the cooling conditions in the user application. Temperature sensors are available inside the emPC-X.

3.2 Connectors and Operators

The emPC-X is equipped with differing interfaces. The following interfaces are common for all systems: DVI-D, 2 x USB 2.0, 2 x 10/100/1000 Mbit/s Ethernet. Depending on which alternative was ordered additional interfaces are available. The following table shows the standard systems.

| Product | Interface | Windows | Linux | Address |
|----------|--------------------|---------------|-------------|-------------------|
| emPC-X/0 | Serial-0 (Console) | COM2 | ttyS1 | 0x2f8/IRQ3 |
| | Serial-1 (Console) | COM1 | ttyS0 | 0x3f0/IRQ4 |
| emPC-X/1 | Serial (Console) | COM1 | ttyS0 | 0x3f0/IRQ4 |
| | CAN | CAN0/mpcan_00 | /dev/pcan_0 | MOD_BASE |
| emPC-X/2 | CAN0 | CAN0/mpcan_00 | /dev/pcan_0 | MOD_BASE |
| | CAN1 | CAN1/mpcan_01 | /dev/pcan_1 | MOD_BASE + 0x200 |
| emPC-X/4 | CAN0 | CAN0/mpcan_00 | /dev/pcan_0 | MOD0_BASE |
| | CAN1 | CAN1/mpcan_01 | /dev/pcan_1 | MOD0_BASE + 0x200 |
| | CAN2 | CAN0/mpcan_10 | /dev/pcan_2 | MOD1_BASE |
| | CAN3 | CAN1/mpcan_11 | /dev/pcan_3 | MOD1_BASE + 0x200 |

Table 2: Interfaces connected to D-SUB

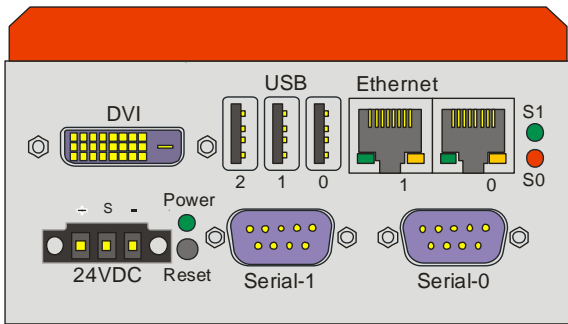


Figure 3: emPC-X/0 interfaces

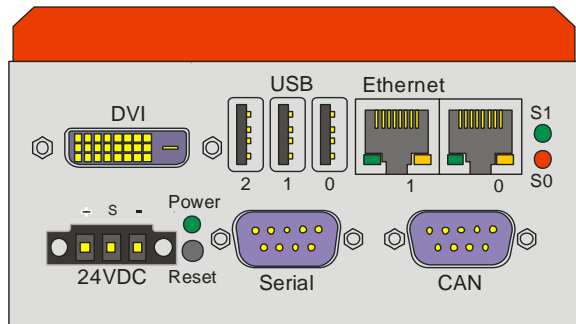


Figure 4: emPC-X/1 interfaces

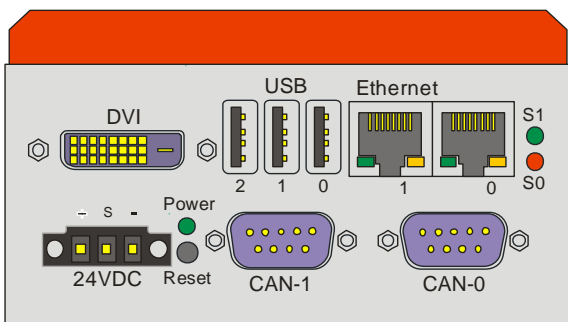


Figure 5: emPC-X/2 interfaces

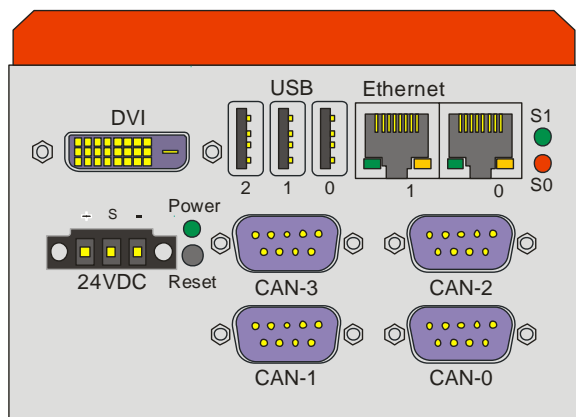
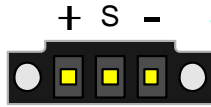


Figure 6: emPC-X/4 interfaces

3.2.1 POWER IN

The system power supply is connected with a 3 pin screw terminal with 5.08 mm pitch.



| Pin | Description |
|-------|---------------------------|
| 1 (+) | +9 ..34 VDC |
| 2 (S) | Control input (0 .. 34 V) |
| 3 (-) | GND |

Figure 7: Power connector

Table 3: Power connector pin assignment

A suitable mating connector is Phoenix Contact 1900895. Equivalent Models exists from other vendors.



DANGER: Electrical Shock

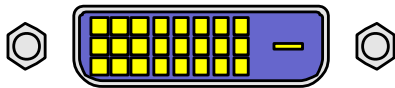
The product may only be operated with power supplies which can be considered SELV circuits.



Internal system GND is connected to the housing and routed to the power supply connector.

3.2.2 Graphics connector (DVI)

Combined digital and analog graphics connectors. The digital interface provides single link only.

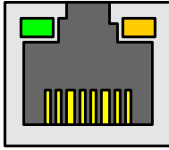


| | | | |
|----|-----------|----|----------------|
| 1 | TMDS 2- | 13 | N/C |
| 2 | TMDS 2+ | 14 | +5V |
| 3 | SHIELD | 15 | GND |
| 4 | N/C | 16 | Hotplug detect |
| 5 | N/C | 17 | TMDS 0- |
| 6 | DDC clock | 18 | TMDS 0+ |
| 7 | DDC data | 19 | SHIELD |
| 8 | N/C | 20 | N/C |
| 9 | TMDS 1- | 21 | N/C |
| 10 | TMDS 1+ | 22 | SHIELD |
| 11 | SHIELD | 23 | TMDS C+ |
| 12 | N/C | 24 | TMDS C- |

table 4: DVI-D connector

3.2.3 Ethernet Interfaces (Ethernet1 and Ethernet2)

Ethernet interfaces of the motherboard. The Ethernet physics is 10/100/1000BaseT, available through the shielded modular jack at the connector panel. Twisted pair cable can be used to connect to this port.

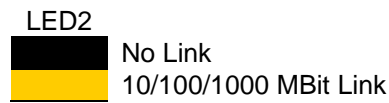


| | | | |
|---|-------|---|-------|
| 1 | MDI0+ | 5 | MDI2+ |
| 2 | MDI0- | 6 | MDI2- |
| 3 | MDI1+ | 7 | MDI3+ |
| 4 | MDI1- | 8 | MDI3- |

1

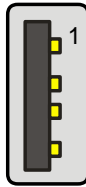
table 5: Ethernet connector

The two LEDs indicate Ethernet status as follows:



3.2.4 USB type A receptacle (USB0, USB1 and USB2)

Three USB interfaces are available at the connector panel.



| | |
|---|--------------------------------|
| 1 | +5V, I _{MAX} = 500 mA |
| 2 | USB- |
| 3 | USB+ |
| 4 | GND |

table 6: USB connector

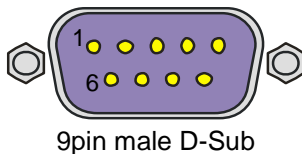


NOTICE

Although each port can deliver supply current of 500 mA, the overall load on USB0 to USB2 interfaces should be limited to 900 mA to prevent power supply from overheating.

3.1 RS232 (Console)

The RS232 (Console) serial interface is provided by Super IO W83627 chip, hence it is a legacy compatible serial port. The connector is a standard 9 pin D-SUB plug, but the interface is connected with four wires only, table 7 shows the pin out.

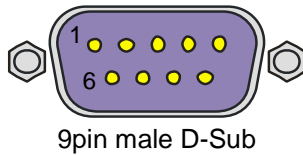


| | | | |
|---|------|---|------|
| 1 | n.c. | 6 | n.c. |
| 2 | RxD | 7 | RTS |
| 3 | TxD | 8 | CTS |
| 4 | n.c. | 9 | n.c. |
| 5 | GND | | |

table 7: RS232 (Console) connector

3.2 RS232

Additional serial interfaces might be implemented by a XR16V2750 dual UART chip. This type of serial port has proprietary implementation over the internal expansion bus. Hence it needs special software driver. For a description of UART registers refer to the EXAR manual. The UART clock input is 14,7456MHz to allow error free generation of standard baud rates. This RS232 variant provides all 8 interface signals as shown in table 8.



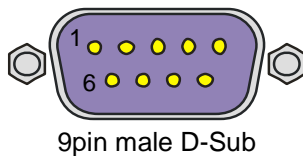
| | | | |
|---|-----|---|-----|
| 1 | DCD | 6 | DSR |
| 2 | RxD | 7 | RTS |
| 3 | TxD | 8 | CTS |
| 4 | DTR | 9 | RI |
| 5 | GND | | |

table 8: RS232 connector

3.3 RS485

In the RS485 variant, there are only the differential signals D+ and D- provided. The transceiver is enabled to send data, when RTS# of the corresponding UART is low. Data received on the RS485 will always be seen on the UART's RxD input. This is regardless of the RTS# state. It is however possible to modify the hardware, so that transmitted data is not received (RTS# low disables receiver).

When the receiver is enabled and no data is send (MARK=1), then D+ > D-.

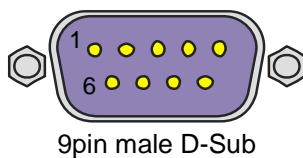


| | | | |
|---|--------|---|--------|
| 1 | n.c. | 6 | GND |
| 2 | B / D+ | 7 | A / D- |
| 3 | GND | 8 | n.c. |
| 4 | n.c. | 9 | n.c. |
| 5 | n.c. | | |

table 9: RS232 connector

3.4 CAN

The CAN interface is implemented with a SJA1000 controller chip. The connector is a standard 9 pin D-SUB plug with a pin out shown in table 10. The CAN interface is isolated and has a software switchable 120 Ohm termination.



| | | | |
|---|------|---|-------------------|
| 1 | n.c. | 6 | GND |
| 2 | CANL | 7 | CANH |
| 3 | GND | 8 | n.c. |
| 4 | n.c. | 9 | VEXT ¹ |
| 5 | n.c. | | |

table 10: CAN connector

¹ This signal is optionally available to provide power to supply an external transceiver module

3.5 SD Card

The optional SD card slot can be accessed from the front panel. It is protected by a cover (see figure 8).

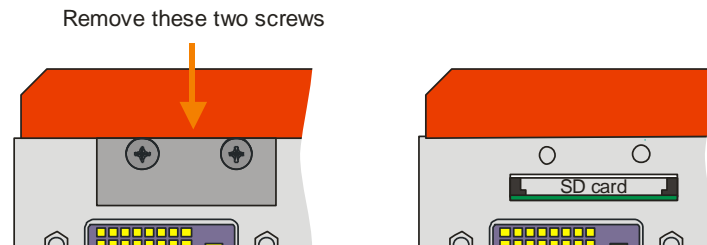


figure 8: emPC-X SD card cover removal

After having removed the SD card cover, push the card to eject it.



NOTICE

Removing and installing the SD card is possible when the system is running. However, ensure that the operating system is ready for card removal before you push the card. Otherwise, you might lose data.

To install the SD card push it into the socket until the card locks. Then install the cover.

4 Maintenance



NOTICE

Always follow common ESD practice when you service the product!

To open the housing, you can remove the back panel or the front panel. Different maintenance tasks require one of them to be removed, others require full disassembly.

| Task | Back Panel | | Remarks |
|-----------------|------------|--|----------------------|
| Replace CFast | remove | | |
| Replace Battery | | | Complete disassemble |

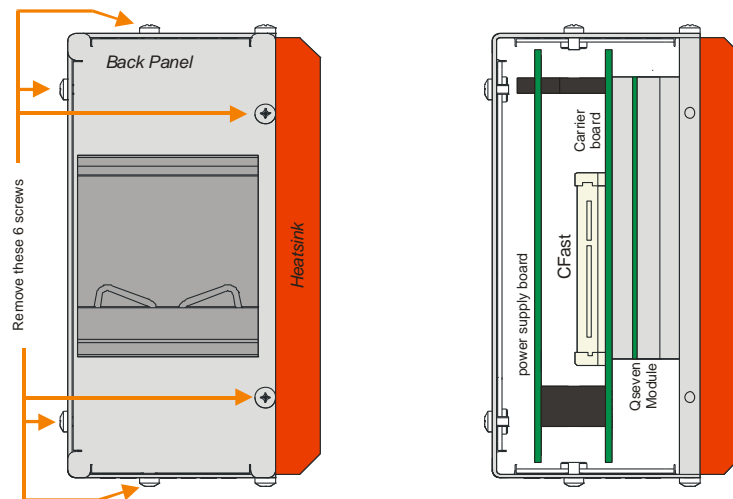


figure 9: emPC-X back panel removal

4.1 CFast Card Replacement



NOTICE

Power must be turned off before removing or inserting the CFast card

Refer to figure 9 to identify the location of the CFast card.

4.2 Battery Replacement



CAUTION

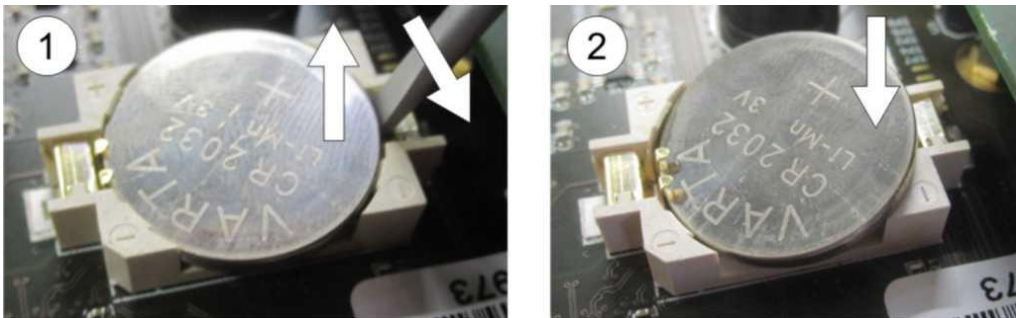
The installed computer board is equipped with a Lithium battery. Danger of explosion if battery is incorrectly replaced. Replace only with battery of the same or equivalent type (3-volt lithium coin cell battery).

- Do not attempt to recharge the battery.
- Do not disassemble, crush, puncture, short external contacts, or dispose of in fire or water.

Compatible battery type: CR2032 (3 Volt lithium coin cell battery)

The battery is used for backing up the system time when the power supply is removed.

1. Turn off the computer properly through the operating system, then turn off any external devices.
2. Disconnect the power supply from the power inlet and disconnect any external devices.
3. Disassemble the housing and locate the battery on the power supply board.
4. Remove the battery from the holder (See figure 10)
5. Insert the new battery (See figure 10)
6. Reassemble the housing



1. Removal: Insert screwdriver at right side and bend so that the battery pops outs. Use only gentle force, otherwise the battery holder might be damaged.
The use a plastic tool is preferred to avoid shorting the battery
2. Insertion: Align new battery to the left side of the holder and gently press down on the right side of the battery until the battery snaps into the holder.

figure 10: Removing and replacing coin cell battery

5 Appendices

5.1 Technical Data

emPC-X/A-E3815

emPC-X/A-E3825

Processing Core

| | |
|---------------|--|
| CPU | A-E3815: Intel Atom E3815 (1x1.46GHz, 512kB L2 Cache) A-E3825: Intel Atom E3825 (2x1.33GHz, 1MB L2 Cache) |
| Qseven Module | Congatec QA3 |

Memory

| | |
|-----------------|-----------------------|
| Main Memory | 2 GB DDR3L, 1066 MT/s |
| Nonvolatile RAM | 128 kB MRAM |

Storage

| | |
|------------------|--------------------------------------|
| CFast | 1 x internal socket with SATA 3 GB/s |
| SD card (Option) | 1 x Socket at front panel |

Video

| | |
|------------------|--|
| Controller | Chipset graphics: Intel®HD Graphics with support for DirectX11 OpenGL 3.0, OpenCL 1.2, OpenGLES 2.0, full HW acceleration for decode/encode of MPEG2, H.264, MVC |
| Memory Interface | Shared with main memory 1 x DVI-D single link connector on front panel, up to 1280x1024 1 x Single channel LVDS on internal connector, up to 1024x768 |

External Interfaces (connector panel)

| | |
|----------------------|--|
| Video | 1 x DVI-D |
| Ethernet | 1 x 10/100/1000 Mbit/s Ethernet (Ethernet 0: Intel i210) 1 x 10/100/1000 Mbit/s Ethernet (Ethernet 1: Intel i210) |
| USB | 3 x USB2.0 (max 500mA per port, max 900mA all ports in total) |
| CAN (Option) | SJA1000 controller <ul style="list-style-type: none"> • ISO/DIS 11898-2 (isolated from logic), • software switchable 120 Ohm termination resistor |
| Serial Port (Option) | Console UART: <ul style="list-style-type: none"> • RS232 (4 wire) • RS485, optionally isolated from logic Xicor 16V2750 (Port expansion): <ul style="list-style-type: none"> • RS232 (full featured) • RS485, optionally isolated from logic |

Expansion

| | |
|--------|--|
| iX-Bus | Internal 8/16 bit interface for IO and low speed peripherals |
|--------|--|

Indicators and Switches

| | |
|-----------|---|
| Reset | Pushbutton |
| Status | LED for power supply status (green) |
| User LEDs | 2 programmable LEDs (S0 – red and S1 - green) |

System

| | |
|--------------------|---|
| Housing | galvanized steel sheet, outside painted |
| Battery | CR 2032, for real time clock |
| Temperature Sensor | Accessible via Qseven module I2C |
| Watchdog | Yes, implemented in Qseven module |

Power Requirements

| | |
|----------------------|---|
| Power Supply | DC power, 9 .. 34 V (lower limit with adjustable UVL) |
| Inv.-pol. protection | Yes |
| Fuse | Internal melting fuse in DC in, GND is unfused |
| potential separation | No, GND (Pin 3 in Table 3) is connected to case |
| Inrush Current (max) | TBD |
| Power Dissipation | Without external load or expansion cards |
| | A-E3815: TBD |
| | A-E3825: 15W (max) |

External Load Capabilities

| | |
|-----------|--|
| +5V (USB) | Max. 0.5 A per USB port, max 0.9 A for al USB ports in total |
|-----------|--|

Environmental Specifications

| | |
|-------------------------------|--|
| Ambient Temperature operating | A-E3815: 0 .. 50 °C A-E3825: 0 .. 50 °C |
| | at sea level, derating of 1 °C per 300 m above sea level to a maximum of 2000 m. |
| Temperature storage | -20..+75 °C ²⁾ |
| Humidity | 5%..95% r.H., non condensing |
| Protection Class | IP20 |

Physical Dimensions

| | |
|--------------|--|
| Size (WxHxD) | Including connectors and rail mounting bracket |
| | 2 DSUB: 65.0 x 115.5 x 116.0 mm |
| | 4 DSUB: 82.6 x 115.5 x 116.0 mm |
| Weight | 2 DSUB: 830 g |
| | 4 DSUB: TBD |

5.2 References

These references direct you to manuals and specifications that you might need to know when you attempt to program the product. Most of the documents can be downloaded from the Internet. Look for the WWW servers of the component/chip manufacturers.

- [1] **SJA1000 Product specification**, Philips Semiconductor, Jan 04, 2000
- [2] **ixBus System Reference Manual**, Janz Tec AG

WWW-References

Janz Tec AG

www.janztec.com

5.3 Dimensions

Refer to figure 11 for the housing dimensions.

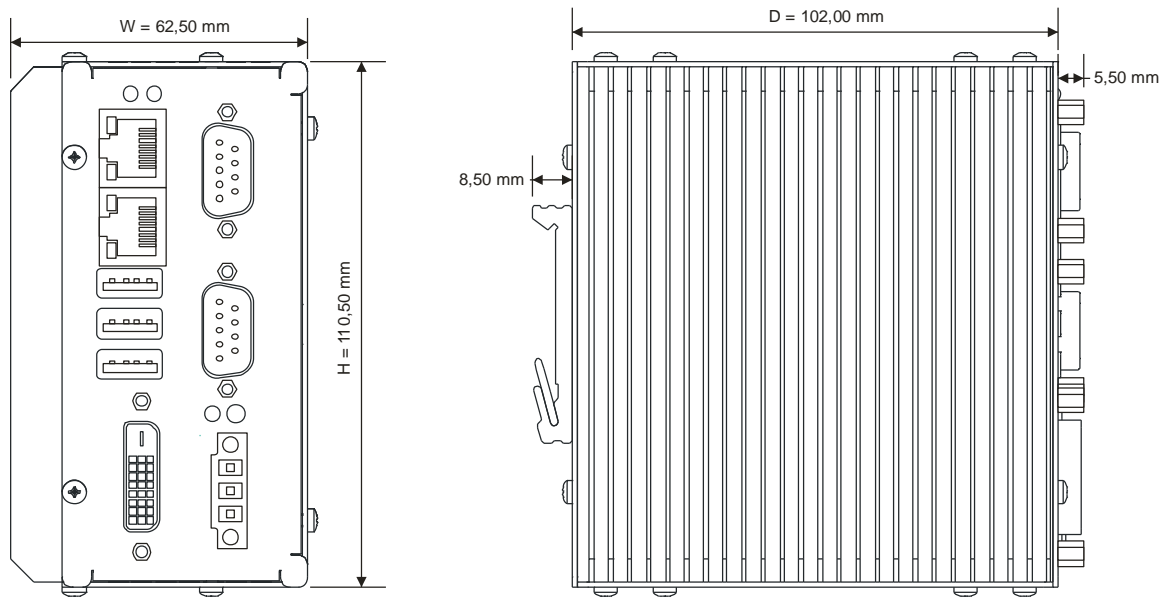


figure 11: housing dimensions (2 DSUB system shown)

emPC-X Systems with different IO options just differ in dimension W

| Slot Variant | W |
|--------------|---------|
| 2 DSUB | 62.5 mm |
| 4 DSUB | 80.1 mm |
| | |

5.4 Product History

| Version | Release Date | Name | Changes |
|---------|--------------|------|--|
| V1.0 | 2014-12-21 | | <ul style="list-style-type: none">• Released |
| | | | <ul style="list-style-type: none">• |
| | | | <ul style="list-style-type: none">• |
| | | | <ul style="list-style-type: none">• |

5.5 Manual History

| Version | Release Date | Name | Changes |
|---------|--------------|------|--|
| V1.0 | 2015-01-19 | as | <ul style="list-style-type: none">• Initial release |
| V1.1 | 2015-01-22 | as | <ul style="list-style-type: none">• Added "Do not cover the vent slots of the product" to the safety instructions• Added additional notes to the section "Mounting" |
| | | | <ul style="list-style-type: none">• |
| | | | <ul style="list-style-type: none">• |