



# EPPC-T10

## Embedded 64-bit PowerPC® T1014 Single Board Computer



## Hardware Manual

to Product I.2007.02

## NOTE

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This manual contains important information and instructions on safe and efficient handling of the EPPC-T10. Carefully read this manual before commencing any work and follow the instructions.

The manual is a product component, please retain it for future use.

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## Document History

The changes in the document listed below affect changes in the hardware as well as changes in the description of the facts, only.

Rev.	Chapter	Changes versus previous version	Date
1.0	-	First English manual	2017-10-17
1.1	-	Note on Conformity under Safety Instructions inserted	2019-05-07
	1.	Block circuit diagram corrected → 32 Kbit EEPROM	
	2.7	Description of EEPROM changed	
	2.9, 2.10	Note on cabling inserted	
	8.	Chapter numbers revised	
	8.1, 8.2	Note on cabling inserted	
	9.	New chapter: "Conformity"	

Technical details are subject to change without further notice.

## Classification of Warning Messages and Safety Instructions

This manual contains noticeable descriptions, warning messages and safety instructions, which you must follow to avoid personal injuries or death and property damage.



This is the safety alert symbol.

It is used to alert you to potential personal injury hazards. Obey all safety messages and instructions that follow this symbol to avoid possible injury or death.

### DANGER, WARNING, CAUTION

Depending on the hazard level the signal words DANGER, WARNING or CAUTION are used to highlight safety instructions and warning messages. These messages may also include a warning relating to property damage.



#### **DANGER**

Danger statements indicate a hazardous situation which, if not avoided, will result in death or serious injury.



#### **WARNING**

Warning statements indicate a hazardous situation that, if not avoided, could result in death or serious injury.



#### **CAUTION**

Caution statements indicate a hazardous situation that, if not avoided, could result in minor or moderate injury.

### NOTICE

Notice statements are used to notify people on hazards that could result in things other than personal injury, like property damage.



#### **NOTICE**

This NOTICE statement indicates that the device contains components sensitive to electrostatic discharge.



#### **NOTICE**

This NOTICE statement contains the general mandatory sign and gives information that must be heeded and complied with for a safe use.

### INFORMATION



#### **INFORMATION**

Notes to point out something important or useful.



## Safety Instructions

- When working with the EPPC-T10 follow the instructions below and read the manual carefully to protect yourself from injury and the EPPC-T10 from damage.
- Do not use damaged or defective cables to connect the EPPC-T10.
- In case of damages to the device, which might affect safety, appropriate and immediate measures must be taken, that exclude an endangerment of persons and domestic animals and property.
- Current circuits which are connected to the device have to be sufficiently protected against hazardous voltage (SELV according to EN 60950-1).
- The EPPC-T10 may only be driven by power supply current circuits, that are contact protected. A power supply, that provides a safety extra-low voltage (SELV) according to EN 60950-1, complies with this conditions.
- Do not open the housing of the EPPC-T10 except for service issues (see page 20 ff.).
- The EPPC-T10 has to be securely installed before commissioning.
- The permitted operating position is specified as shown (Figure: 3). Other operating positions are not allowed.
- Never let liquids get inside the EPPC-T10. Otherwise, electric shocks or short circuits may result.
- Protect the EPPC-T10 from dust, moisture and steam.
- Protect the EPPC-T10 from shocks and vibrations.
- The EPPC-T10 may become warm during normal use. Always allow adequate ventilation around the EPPC-T10 and use care when handling.
- Do not operate the EPPC-T10 adjacent to heat sources and do not expose it to unnecessary thermal radiation. Ensure an ambient temperature as specified in the technical data.



### DANGER

Hazardous Voltage - **Risk of electric shock** due to unintentional contact with uninsulated live parts with high voltages inside of the system into which the EPPC-T10 is to be integrated.

- All current circuits which are connected to the device have to be sufficiently protected against hazardous voltage (SELV according to EN 60950-1) before you start with the installation.
- Ensure the absence of voltage before starting any electrical work



### DANGER

Risk of personal injury due to explosion or leakage of the battery!  
Improper usage of the battery such as overheating, short-circuiting or mechanical damage may cause an explosion or leakage.

- Do not replace the battery by an incorrect type.
- Do not recharge the battery.
- Insert the battery properly, with the +/- terminals correctly oriented.
- Dispose used batteries according to the national instructions.



### NOTICE

**Electrostatic discharges may cause damage to electronic components.**

To avoid this discharge the static electricity from your body *before* you open the EPPC-T10.

## Qualified Personnel

This documentation is directed exclusively towards personnel qualified in control and automation engineering. The installation and commissioning of the product may only be carried out by qualified personnel, which is authorized to put devices, systems and electric circuits into operation according to the applicable national standards of safety engineering.

## Conformity

The EPPC-T10 is an industrial product and meets the demands of the EU regulations and EMC standards printed in the conformity declaration at the end of this manual.

**Warning:** In a residential, commercial or light industrial environment the EPPC-T10 may cause radio interferences in which case the user may be required to take adequate measures.

## Data Safety

This device is equipped with an Ethernet or other interface which is suitable to establish a connection to data networks. Depending on the software used on the device, these interfaces may allow attackers to compromise normal function, get illegal access or cause damage.

esd does not take responsibility for any damage caused by the device if operated at any networks. It is the responsibility of the device's user to take care that necessary safety precautions for the device's network interface are in place.

## Intended Use

The intended use of the EPPC-T10 is the operation as controller for machine control (factory automation).

The guarantee given by esd does not cover damages which result from improper use, usage not in accordance with regulations or disregard of safety instructions and warnings.

- The EPPC-T10 is intended for operation in a control cabinet.
- The operation of the EPPC-T10 in hazardous areas, or areas exposed to potentially explosive materials is not permitted.
- The operation of the EPPC-T10 for medical purposes is prohibited.

## Service Note

The EPPC-T10 does not contain any parts that require maintenance by the user. The EPPC-T10 does not require any manual configuration of the hardware, except the change of battery or the configuration via jumper or DIP switches. Unauthorized intervention in the device voids warranty claims.

## Disposal

Devices which have become defective in the long run have to be disposed in an appropriate way or have to be returned to the manufacturer for proper disposal. Please, make a contribution to environmental protection.

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## Typographical Conventions

Throughout this manual the following typographical conventions are used to distinguish technical terms.

Convention	Example
File and path names	<code>/dev/null</code> or <code>&lt;stdio.h&gt;</code>
Function names	<code>open()</code>
Programming constants	<code>NULL</code>
Programming data types	<code>uint32_t</code>
Variable names	<code>Count</code>

## Number Representation

All numbers in this document are base 10 unless designated otherwise. Hexadecimal numbers have a prefix of 0x. For example, 42 is represented as 0x2A in hexadecimal .

## Abbreviations

CPU	Central Processing Unit
HW	Hardware
I/O	Input/Output
n.a.	not applicable
OS	Operating System
SDK	Software Development Kit

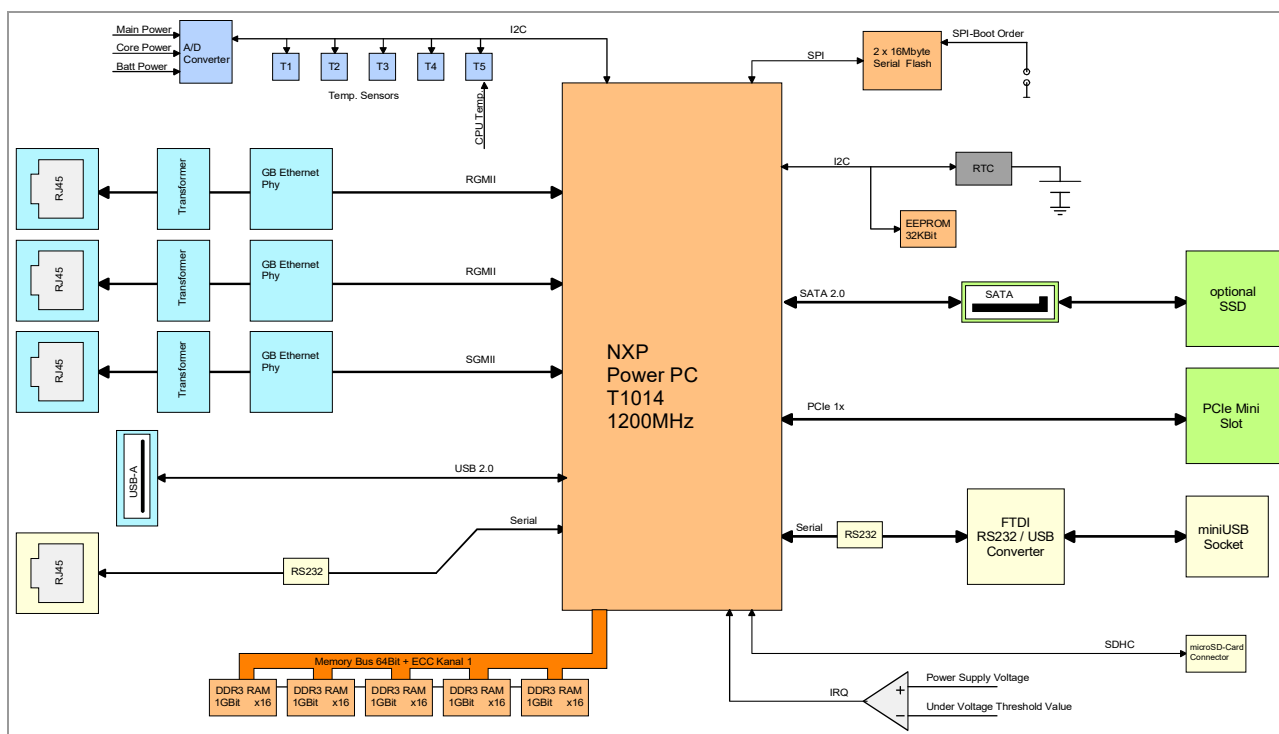
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# 1. Overview



**Figure 1: Block circuit diagram**

The EPPC-T10 is a single board computer with 3 independent Ethernet interfaces.

The embedded NXP® QorIQ® T1014 with 1.2 GHz features one 64-bit e5500 Power Architecture® processor core with high performance data path acceleration architecture (DPAA) and network peripheral interfaces.

The local memory bus is 64 bits wide plus 8 bits ECC with an overall capacity of 512 Mbyte. 16 Mbyte SPI Flash for boot loader and 32 Kbit I²C EEPROM for U-Boot environment offer non-volatile memory spaces.

The EPPC-T10 features a second 16 Mbyte 'fallback' SPI Flash, used for system recovery if a system crash occurs during a firmware update. Alternatively it can be used for application software.

The EPPC-T10 is equipped with 3 independent Gigabit Ethernet interfaces accessible at the front panel, which give an excellent base for EtherCAT® applications.

For connection of the RS-232 interface an easily accessible RJ45 connector is provided. Additionally a Terminal is accessible via mini-USB connector for configuration of the system.

The USB host port supports USB 2.0 high-speed.

An RTC with battery backup is equipped on the EPPC-T10.

The Flash memory carries the standard boot program "Das U-Boot" and enables the EPPC-T10 to boot various operating systems from on-board Flash, network, USB, microSD™ card or optional SSD. A BSP is available for Linux®. Others on request.

The esd EtherCAT Master Stack is available for several operating systems.

Customized options are available for customized series production in reasonable quantities. Please contact our sales team for detailed information.

Customized options are for example:

- CPU Type  
The EPPC-T10 is also available with the power saving dual-core QorIQ CPU T1022 or with the quad-core QorIQ CPU T1042 on request.
- Memory  
The memory can be extended with larger DDR3 RAM and Flash.  
An additional serial or parallel MRAM memory, that is suitable for capturing continuous logging data, is available on request.
- SSD  
A built-in solid state disc can be equipped.
- BSPs  
Please ask for OS-9®, QNX®, VxWorks® or other BSPs.
- PCI Express  
A PCIe® slot for development can be equipped. The case size can be customized as needed.  
The PCIe slot can be used for example for a customized PMC-Add-on. Please ask for further information.
- Ethernet  
An additional Ethernet interface (4<sup>th</sup> interface) can be equipped.

## 2. Technical Data

### 2.1 General technical Data

Temperature range	Operation: 0°C ... +55°C Storage: -40°C ... +70°C Transport: -40°C ... +70°C
Humidity	Operation: 5% ... 90%, non-condensing Storage: 5% ... 90%, non-condensing
Protection class	IP20
Form factor/ Dimensions	124 mm x 31 mm x 160 mm (length x width x height) with top hat rail mounting clamp
Weight	ca. 400 g

### 2.2 Power Supply

Power supply voltage	16V ... 32 V DC (Power fail signalling from < 20V)
Power consumption	Typical 12 W maximum 20 W
Protective circuits	Reverse voltage protection via an ideal diode, Protection against short-circuit of the internal voltages

### 2.3 CPU Kernel

CPU	NXP T1014NSN7MQB
CPU Specification	1.200 MHz CPU-Clock 800 MHz RAM-Clock 0-105 °C operating junction temperature
Cache	32 KByte L1 instruction-cache and 32 KByte data-cache per core 256 KByte L2 cache per core 256 KByte L3 cache
Interfaces	Integrated DDR3 RAM controller Integrated Ethernet controller Integrated DUART Integrated I <sup>2</sup> C interfaces
Core	e5500 Core with double-precision Floating Point Unit
Development Connector	2x8 Pin connector, 2.54 mm pitch, with IEEE1149.1 (JTAG) With signals for: - Manufacturing test (Boundary Scan) - Software-Debugging (i.e. ABATRON Debugger) - Initial programming of the serial Boot Flash (U-Boot)

## 2.4 Memory - Interface

Size	512Mbyte
Technology	Double data rate SDRAM type 3
Data rate (theoretical maximum)	800 MHz RAM clock, 1600 x 64 MBit/s
Interface	1 x 64 Bit + ECC consisting of 4 x16 devices + 1 x16 device for ECC

## 2.5 Real Time Clock (RTC)

Type	Epson RX8035
Connection	I <sup>2</sup> C bus
Accuracy	-5 ppm at T <sub>amb</sub> = 25 °C (< 13 s/month)
Battery type	Lithium manganese dioxide battery, coin cell 3 V, battery type CR2032
Buffering	Battery CR2032, at least 5 years battery life at 25°C
Maintenance / Service	The battery can be easily changed. The battery holder is located inside the enclosure, see page 22. For a change of the battery without data loss, a storage capacitor, connected with the RTC, allows a change of the battery without interruption of supply voltage within 15 seconds.

## 2.6 Boot – ROM

Size	16 MByte
Type	Serial NOR Flash
Connection	Serial Peripheral Interface min. 50 MHz data rate
Data retention	100 000 Programming/erase cycles, 20 years data retention
Content	Boot Sequenzer Preboot Loader Bootloader Firmware (U-Boot)
Fail Save Mechanism	Second Flash with „Fallback“ firmware. Switchable via jumper.

## 2.7 EEPROM

Size	- 32 Kbit I2C EEPROM for U-Boot environment Internal use only: - 32 Kbit I2C EEPROM for Bootstrapping, - 4 Kbit I2C EEPROM for SPD info DDR RAM
Type	Serial CMOS EEPROM
Connection	I <sup>2</sup> C Bus
Data retention	1 000 000 Programming/erase cycles, 20 years data retention
Operating mode	Fast (400KHz) I <sup>2</sup> C protocol
Content	- Serial number of the board - MAC addresses - U-Boot environment - SPD data of the DDR-RAM

## 2.8 Connectors

### 2.8.1 Connectors in the EPPC-T10 Enclosure

Name	Label	Function	Type
X711	RS-232	Serial 1 (RS-232)	RJ45 socket without LEDs
X100	24 V	Power supply voltage	Phoenix-Contact MC1,5/3-GF-3,81
X1300	ETH1	Ethernet 1	RJ45 socket with integrated LEDs
X1400	ETH2	Ethernet 2	RJ45 socket with integrated LEDs
X1600	ETH3	Ethernet 3	RJ45 socket with integrated LEDs
X1200	USB	USB-Host	USB socket type-A
X450	Terminal	Serial 0	Mini-USB connector type-B
X700	SD-Card	SD-Card slot	MOLEX_5027740891

### 2.8.2 Connectors on the Main Board (internal)

Name	Function	Type
X2000	SATA Interface	Molex 67800-8001 or similar
X2001	SATA Power	FCI 76384-304LF
Connectors for installation and test purposes only:		
X800	JTAG Interface	2 x 8-pole plug connector 2.54 mm pitch
X2410	BOUNDARY Scan / JTAG	2 x 5-pole plug connector 2.54 mm pitch

## 2.9 Ethernet Interfaces

Number	3
Standard	IEEE 802.3, 10Base-T, 100Base-TX, 1000Base-T
Bit rate	10/100/1000 MBit/s
Controller	Integrated in the CPU
Electrical isolation	Transformer, integrated in the RJ45 socket
Connector	RJ45 sockets with integrated Link and Activity LEDs



### NOTICE

Cables of category CAT5e or higher have to be used to grant the function in networks with 1000 Mbit/s. esd grants the EC conformity of the product if the wiring is carried out with shielded twisted pair cables of category CAT5e or higher.

## 2.10 Serial Interface

Number	1 asynchronous serial interface
Controller	integrated in CPU - 16550 compatible
Bit rate	Value range: 9600 Baud ... 115200 Baud Default setting: 9600 Baud, 8 Bit, No Parity 1 Stop-Bit
Physical interface	RS232 with RxD, TxD, RTS, CTS
Software	Standard operating system driver
Connector	Serial 1: RJ-45 connector



### NOTICE

For the serial interface shielded cables have to be used.  
esd grants the EC conformity of the product if the wiring is carried out with a shielded cable with a maximum wire length of 30 m.

## 2.11 Terminal Interface

Number	1 asynchronous serial interface
Controller	integrated in CPU - 16550 compatible
Bit rate	Value range: 9600 Baud ... 115200 Baud Default setting: 115200 Baud, 8 Bit, No Parity 1 Stop-Bit
Physical interface	TTL with RxD, TxD, converted with FTDI to USB 2.0
USB bit rate	Max. 480 MBit/s
Software	FTDI driver, see "Configuration and Console Access" on page 26
Connector	Mini-USB connector type-B

## 2.12 USB - Host Interface

Number	1
Standard	USB specification Rev. 2.0
Bit rate	Max. 480 MBit/s
Topology	Host controller integrated in CPU
Max. current per port @5V	500 mA, short-circuit protected
Software support	- OHCI-Host controller- and device driver for the U-Boot
Connector	USB socket type-A

## 2.13 SATA Interface

Number	1
Standard	SATA Specification Rev. 2.5
Type	Standard SATA data plug connector plus one connector for the supply voltage of the SATA devices
Topology	Connected directly with the SATA port of the Host CPU
Power supply voltage	3,3 V with max. 1A 5 V with max. 0,75A

## 2.14 Monitoring Circuitry

Temperature monitoring	4 x TMP100 + 1 x ADT7461 connected with the I <sup>2</sup> C Bus of the CPU to monitor the ambient temperature and the thermal diode of the CPU
Voltage monitoring	By means of 12-bit ADC which is connected via I <sup>2</sup> C to the CPU and possibly required circuits for signal conditioning. Monitoring of - Voltage supply - Battery voltage (RTC) - 3.3 V, 5 V, core voltages

### 3. PCB View with Connectors

#### 3.1 PCB Top Layer

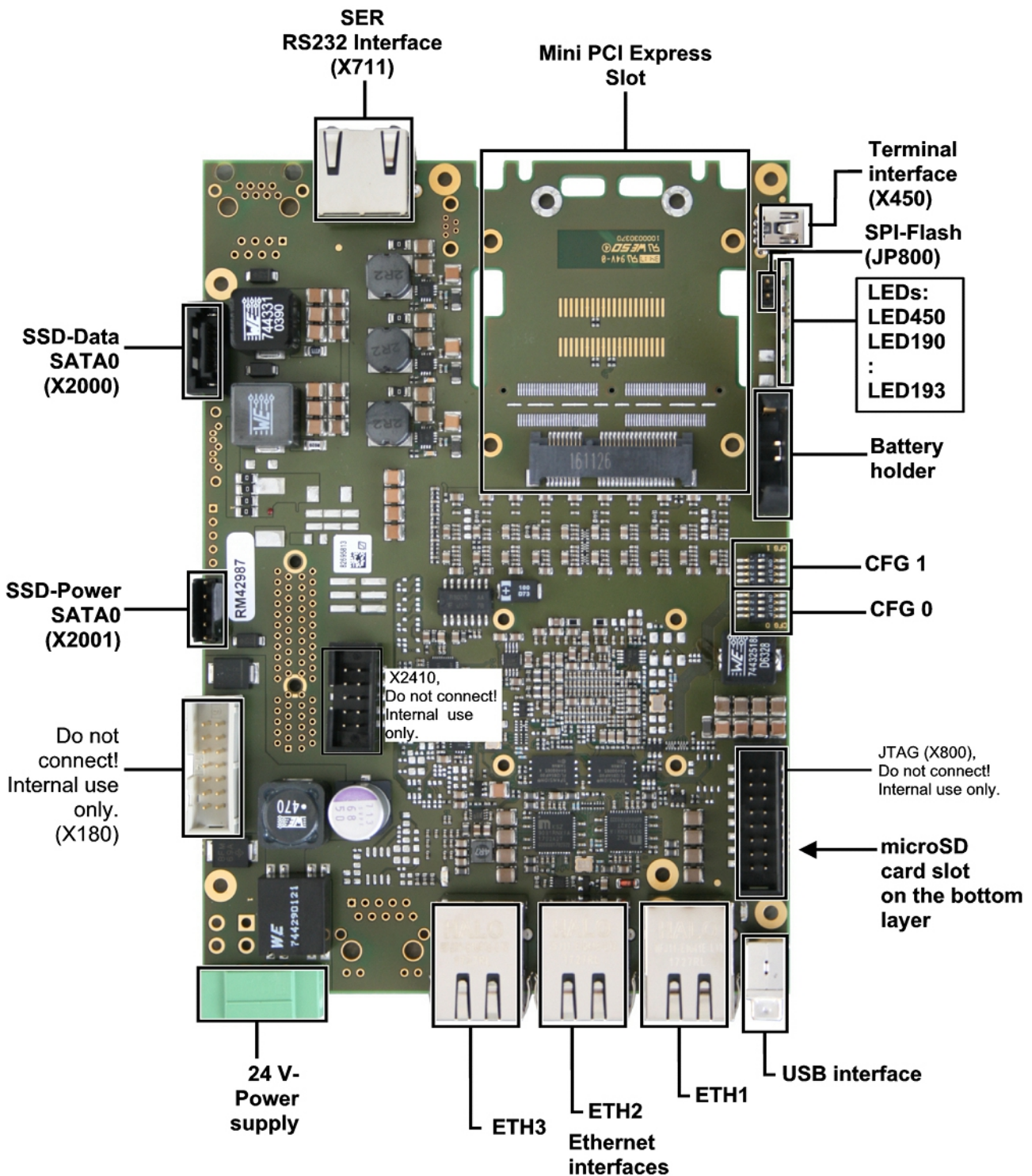


Figure 2: PCB top view



#### NOTICE

Read chapter "Hardware Installation and Change of Battery" on page 20, before you start with the installation of the hardware!

See also page 30 for signal assignment of the connectors.



## 4. EPPC-T10 View

### 4.1 Operating position



**Figure 3:** EPPC-T10 mounted on the mounting hat rail

See also page 30 for signal assignment of the connectors.



#### **NOTICE**

Read chapter “Hardware Installation and Change of Battery” on page 20, before you start with the installation of the hardware!

4.2 Front Side with LEDs, Terminal Interface and SD-Card Slot



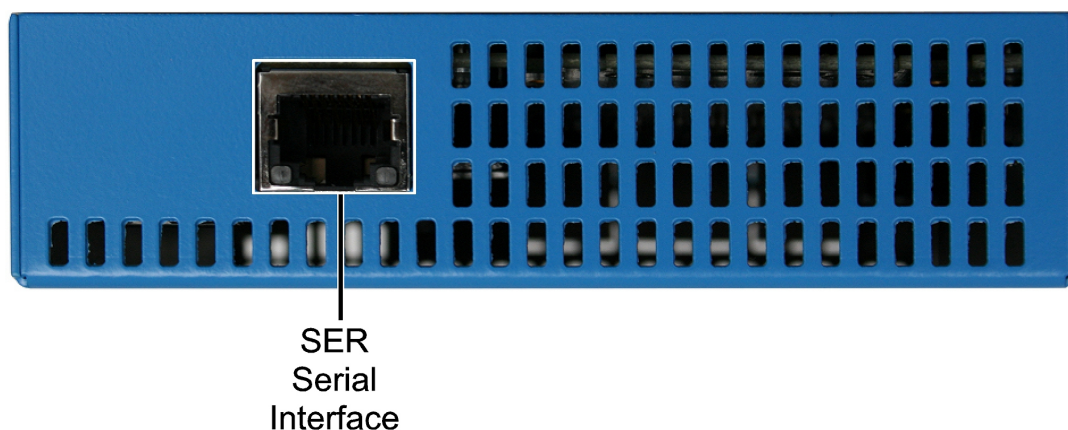
Figure 4: LEDs and connectors in the front panel

4.2.1 LEDs in the Front Panel

LED	Colour	Meaning (LED on)	LED name in schematic diagram
Term	Green	Traffic on Terminal interface	LED450
PWR	Green	Power supply voltage on	LED190
RUN	Green	CPU-RUN	LED191
BATT	Red	Low battery	LED192
Over Temp	Red	Temperature error, overtemperature	LED193

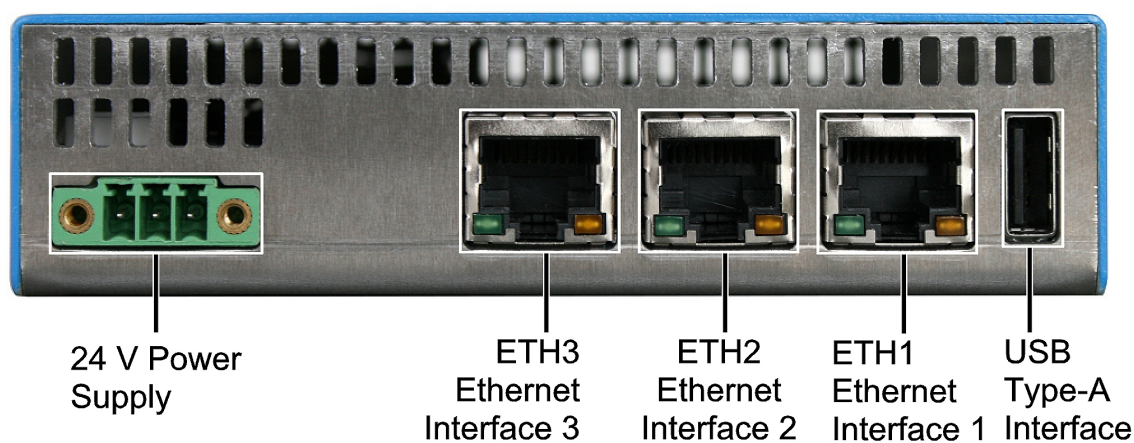
Table 1: Display function when LED on

### 4.3 Front View Upper Side with Serial Interface



**Figure 5:** Front panel on upper side

### 4.4 Front View Bottom Side with Ethernet, USB and 24V-Power Supply



**Figure 6:** Front panel on bottom side

#### 4.4.1 Ethernet LEDs

The Ethernet LEDs are integrated in the RJ45 sockets of the Ethernet interfaces (ETH1, ETH2 or ETH3).

LED	Colour	Display function	Meaning
Activity	green	flashing	Ethernet activity, data are transmitted
Link	yellow	on	Ethernet connection established, Ethernet bit rate: 10/100/1000 Mbit/s

**Table 2:** Description of RJ45-LEDs

## 5. Hardware Installation and Change of Battery



### NOTICE

Read the safety instructions at the beginning of this document carefully, before you start with the hardware installation!



### DANGER

Hazardous Voltage - **Risk of electric shock** due to unintentional contact with uninsulated live parts with high voltages inside of the system into which the EPPC-T10 is to be integrated.

- Disconnect all hazardous voltages (mains voltage) before opening the system.
- Ensure the absence of voltage before starting any electrical work.
- Cover or block off adjacent live parts.



### NOTICE

**Electrostatic discharges may cause damage to electronic components.**

- To avoid this, discharge the static electricity from your body *before* you touch the EPPC-T10.
- Furthermore, you should prevent your clothes from touching the EPPC-T10, because your clothes might be electrostatically charged as well.

### 5.1 Installation

#### Procedure:

1. Discharge your body as described above.
2. If necessary configure the hardware (dip switches or jumper) before you start with the installation. See chapter "Prepare Configuration (DIP-Switches, JP800)" page 23.
3. Make sure that no risk arises from the system into which the EPPC-T10 shall be inserted.



### DANGER

Hazardous Voltage

**Risk of electric shock** due to unintentional contact with uninsulated live parts with high voltages inside of the system into which the EPPC-T10 is to be integrated.

- Disconnect all hazardous voltages (mains voltage) before opening the system.
- If the system does not have a flexible mains cable, but is directly connected to mains, disconnect the power supply via the safety fuse and make sure that the fuse cannot switch on again unintentionally (i.e. with caution label).
- Ensure the absence of voltage before starting any electrical work
- Cover or block off adjacent live parts.

4. Mount the EPPC-T10 on the carrier rail.
5. Connect the interfaces (Ethernet, Serial, USB, 24 V power supply voltage).
6. Connect the system to mains again (mains connector or safety fuse).
7. Switch on the system and the peripheral devices.
8. End of hardware installation.
9. Set the interface properties in your operating system. Refer to the documentation of the operating system.

## 5.2 Demounting

### Procedure

- A1. Switch off the 24 V supply voltage of the EPPC-T10 and if necessary other network participants.
- A2. Disconnect all connectors (24V, ETH, SER, USB).

**DANGER**

Hazardous Voltage

**Risk of electric shock** due to unintentional contact with uninsulated live parts with high voltages.

- Disconnect all hazardous voltages (mains voltage) before opening the system.
- If the system does not have a flexible mains cable, but is directly connected to mains, disconnect the power supply via the safety fuse and make sure that the fuse cannot switch on again unintentionally (i.e. with caution label).
- Ensure the absence of voltage before starting any electrical work.
- Cover or block off adjacent live parts.

- A3. Remove the system from the carrier rail

## 5.3 microSD Card

The microSD card slot is located on the PCB bottom layer. It is accessible via the cut-out in the front panel of the EPPC-T10, see Figure 4, page 18.

The card holder comes with a push-push-locking mechanism, therefore use a suitable blunt tool to eject the microSD card.



## 5.4 Change of Battery

The EPPC-T10 comes with a RTC (Real Time Clock), which is energised with a battery. The battery is plugged in a holder directly on the board.

Battery type: BR2032, 3V.

For a change of the battery without data loss, a storage capacitor, connected with the RTC, allows a change of the battery without interruption of supply voltage within 15 seconds.

### Procedure:

1. Demount the module as described in chapter: "5.2 Demounting".

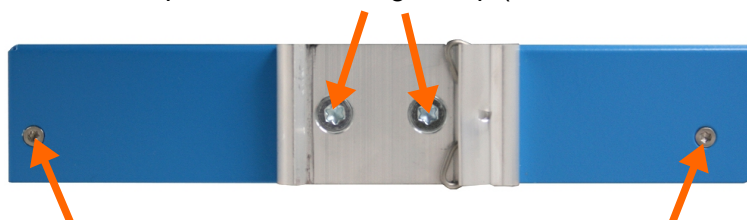


#### NOTICE

**Electrostatic discharges may cause damage to electronic components.**

- To avoid this, please discharge the static electricity from your body *before* you touch the EPPC-T10.
- Furthermore, you should prevent your clothes from touching the EPPC-T10, because your clothes might be electrostatically charged as well.

2. The battery is inside the case of the EPPC-T10, on the PCB top layer.  
Loosen the 2 screws of the top hat rail mounting clamp (use Torx T20 screw driver).



Loosen the 4 screws in the EPPC-T10 case (2 in the back panel and 2 in the front panel; use Torx T10 screw driver).  
Open the case of the EPPC-T10.

3. Make sure you have the new battery ready for use. To avoid data loss, the battery has to be replaced within 15 seconds!  
Remove the old battery carefully out of the holder (see Figure 2, page 16.).

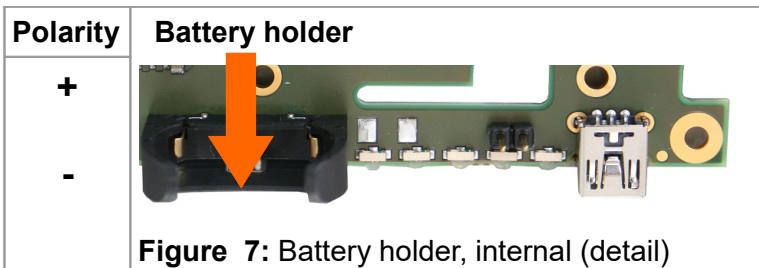


#### DANGER

**Risk of personal injury due to explosion or leakage of the battery!**  
Improper usage of the battery such as overheating, short-circuiting or mechanical damage may cause an explosion or leakage.

- Do not replace the battery by an incorrect type.
- Do not recharge the battery.
- Insert the battery properly, with the +/- terminals correctly oriented.
- Dispose used batteries according to the national instructions.

4. Verify the correct polarity of the new battery and carefully insert it into the battery holder.



5. Close the case of the EPPC-T10 and fasten the 4 screws again.
6. Position the top hat rail mounting clamp and fix it with the screws.
7. Install the module as described in chapter: "5.1 Installation".

## 5.5 Prepare Configuration (DIP-Switches, JP800)

The EPPC-T10 comes with a jumper JP800 and two DIP switches, which are equipped on the PCB top layer.

### Procedure:

1. Demount the module as described in chapter: "5.2 Demounting".

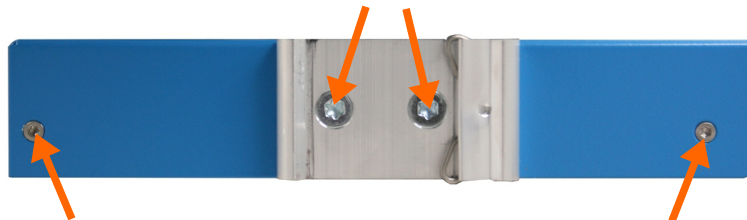


#### NOTICE

**Electrostatic discharges may cause damage to electronic components.**

- To avoid this, please discharge the static electricity from your body *before* you touch the EPPC-T10.
- Furthermore, you should prevent your clothes from touching the EPPC-T10, because your clothes might be electrostatically charged as well.

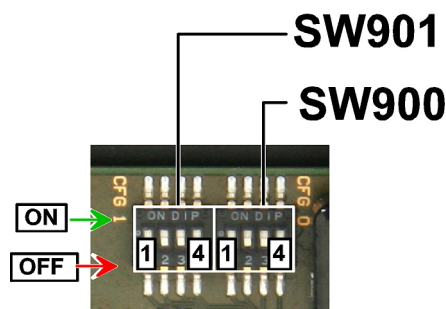
2. The DIP-switches and the Jumper are inside the case of the EPPC-T10.  
Loosen the 2 screws of the top hat rail mounting clamp (use Torx T20 screw driver).



Loosen the 4 screws in the EPPC-T10 case (2 in the back panel and 2 in the front panel; use Torx T10 screw driver).  
Open the case of the EPPC-T10.

3. The DIP-switches and the jumper are equipped on the PCB top layer (see Figure 2, page 16 for the position).
4. For the configuration of the DIP-Switch see chapter "Configuration via DIP Switch", page 24.  
For the configuration of the Jumper see chapter "Configuration via Jumper JP 800 ", page 24
5. Close the case of the EPPC-T10 and fasten the 4 case screws again.
6. Position the top hat rail mounting clamp and fix it with the screws.
7. Install the module as described in chapter: "5.1 Installation".

### 5.5.1 Configuration via DIP Switch



**Figure 8:** DIP Switch internal (Detail)

For the position of the DIP switches on the PCB top layer, please refer to Figure 2, page 16.  
On delivery the DIP switches are all off.

DIP-Switch	Pin	Description	
<b>SW901 (CFG1)</b>	1	LC_IO23	User-defined via drivers (see chapter „Via CPU GPIO register the settings can be handled as shown in the following table. “, page 29)
	2	LC_IO22	
	3	LC_IO21	
	4	LC_IO20	
<b>SW900 (CFG0)</b>	1	LC_IO15	User-defined via drivers (see chapter „Via CPU GPIO register the settings can be handled as shown in the following table. “, page 29)
	2	LC_IO14	
	3	LC_IO13	
	4	LC_IO12	

**Table 3:** DIP switch SW901, SW900

### 5.5.2 Configuration via Jumper JP 800

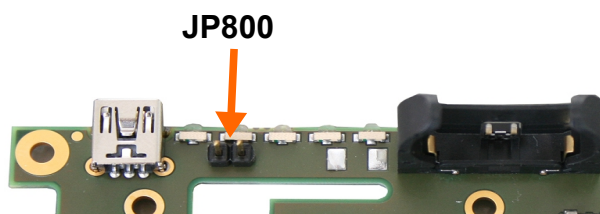
Via the jumper SPI-Flash a Fail Save Mechanism can be enabled.

For the position of the Jumper on the PCB top layer, please refer to Figure 2, page 16.

On delivery the Jumper is not set.

Jumper JP180	Meaning
Jumper set	Switch to second Flash with „Fallback“ Firmware
Jumper not set	Fail Save Mechanism disabled

**Table 4:** Jumper JP180



**Figure 9:** Jumper internal (Detail)



## 5.6 Software Support

The flash memory carries the standard boot program “Das U-Boot” and enables the EPPC-T10 to boot various operating systems from on-board Flash, network, USB, microSD card or optional SSD. BSP is available for Linux. Others on request.

The esd EtherCAT Master is available for the BSPs developed by esd (see page 37).  
For detailed information about the driver availability for your operating system, please contact our sales team: [sales@esd.eu](mailto:sales@esd.eu)

## 5.7 Firmware License

The complete local firmware is stored in the internal flash and can be updated as required. The EPPC-T10 module can be configured by serial console.

Bootloader	“Das U-Boot” (Saving / editing of variables, e.g. IP-addresses)
License information	GNU This product uses the open source-bootloader “Das U-Boot”. The U-Boot-source code is released under the terms of the GNU Public License (GPLv2+). The complete text of the license is contained in the esd-document “3rd Party Licensor Notice” as part of the product documentation. esd provides the complete bootloader-source code on request. esd strives to restore all changes on the bootloader into the official sources. The homepage of the U-Boot project is: <a href="http://www.denx.de/wiki/U-Boot">http://www.denx.de/wiki/U-Boot</a> .
Update Mechanism	Ethernet
System Boot	The system can be configured so that it can boot from one of the two SPI-Flash memories (selectable via jumper). Fixed system settings as MAC address and configurable settings (e.g. IP address) are stored in U-Boot variables in the EEPROM, which is connected via I <sup>2</sup> C.

## 6. Software

### 6.1 Configuration and Console Access

Use an USB cable with miniUSB connector (Terminal interface, see EPPC-T10 front panel, page 18) to connect the EPPC-T10 to a PCs USB port. Install the driver if necessary.

Current drivers can be downloaded from :<http://www.ftdichip.com/>.

Now open a terminal program and point to the new COM port of the EPPC-T10.

The default communication parameters are 115 200 baud, 8N1 (8 data bits, no parity, 1 stop-bit, no hardware handshake).

After power-on you will see the bootloader start-up messages being output on the serial console. When you see the message 'Press SPACE ....', hit the space key to stop booting and to access the interactive bootloader console. At the prompt you can use an extensive command set to do configuration, debugging or testing tasks. Enter help (followed by hitting the RETURN key) to get a full list of all supported commands.

#### 6.1.1 Start Message

After the connection of the power supply voltage, the Bootloader prompts the message on the serial console interface (default configuration: 115 200 baud, 8N1):

```
U-Boot 2016.03.07-17497-g8b3188c-dirty (Sep 18 2017 - 10:24:56 +0200)

CPU0:  T1014, Version: 1.1, (0x85210211)
Core:  e5500, Version: 2.1, (0x80241021)
Clock Configuration:
  CPU0:1200 MHz, CPU1:1200 MHz,
  CCB:400 MHz,
  DDR:800 MHz (1600 MT/s data rate) (Asynchronous), IFC:66.667 MHz
  QE:200 MHz
  FMAN1: 400 MHz
  QMAN: 200 MHz
L1:    D-cache 32 KiB enabled
       I-cache 32 KiB enabled
Reset Configuration Word (RCW):
  00000000: 0810000c 0c000000 00000000 00000000
  00000010: 88000000 00008002 ec027000 21002000
  00000020: 00000000 affebaff 00000000 00036760
  00000030: 00000200 c1560a04 00000000 00000006
Board: eppct10/T1014, HW: 1
Boot from SPI
SERDES Reference Clocks:
SD1_CLK1=100.00MHZ, SD1_CLK2=125.00MHZ
I2C:   ready
SPI:   ready
DRAM:  Detected UDIMM esd_CPU-T10_512MB
Found timing match: n_ranks 1, data rate 1666, rank_gb 0
      clk_adjust 10, wr1vl_start 6, wr1vl_ctrl_2 0x708080a, 0 of 1 controllers are interleaving.
512 MiB (DDR3, 64-bit, CL=11, ECC on)
L2:    256 KiB enabled
Corenet Platform Cache: 256 KiB enabled
Using SERDES1 Protocol: 136 (0x88)
MMC:   FSL_SDHC: 0
Bus 0 was idle
Bus 1 was idle
Bus 2 was idle
PCIE1: Root Complex, no link, regs @ 0xfe240000
PCIE1: Bus 00 - 00
PCIE2: Root Complex, no link, regs @ 0xfe250000
PCIE2: Bus 01 - 01
PCIE3: Root Complex, no link, regs @ 0xfe260000
PCIE3: Bus 02 - 02
In:    serial
Out:   serial
Err:   serial
Net:   Fman1: Uploading microcode version 106.4.17
```

```

FM1@DTSEC2, FM1@DTSEC3, FM1@DTSEC4
reset_phy 194
PARAM: @1fffe000
memsize=0x20000000, base=0x20000000
do_painit 803 nextbase 0x1fffe000 size 0x1000
Hit any key to stop autoboot: 0

```

The start message contains information about

- Version of the bootloader
- Configuration of the CPU (e.g. clock frequency, memory extension)
- Hardware revision of the CPU module

After the transmission of the start message (see above) the operating system is loaded.

The loading procedure can be stopped by pushing the SPACE key.

In this case you get to the bootloader prompt („=>“).

Now the bootloader can be configured by a variety of commands.

## 6.1.2 Firmware Configuration

The configuration of the bootloader is stored in the so called environment variables. Enter the command `printenv` for a listing of all environment variables.

The following output contains the complete environment of the EPPC-T10 unit in the state of delivery:

```

env print
baudrate=115200
bdev=sda3
bootargs=root=/dev/ram rw console=ttyS0,115200
bootcmd=setenv bootargs root=/dev/ram rw console=$consoledev,$baudrate $othbootargs;setenv
ramdiskaddr 0x02000000;setenv fdtaddr 0x00c00000;setenv loadaddr 0x1000000;bootm $loadaddr
$ramdiskaddr $fdtaddr
bootdelay=10
bootfile=uImage
consoledev=ttyS0
eth1addr=00:02:27:a0:10:39
eth2addr=00:02:27:a0:10:3a
eth3addr=00:02:27:a0:10:3b
ethact=FM1@DTSEC2
ethaddr=00:02:27:a0:10:38
ethprime=FM1@DTSEC4
fdtaddr=0x00c00000
fdtfile=eppct10/eppct10.dtb
fman_ucode=0x1ff5f950
hwconfig=fsl_ddr:ctlr_intlv=cacheline,bank_intlv=BANK_INTLV
load=tftpboot 0x14000000 10.0.0.190:/tftpboot/xmc_cpu_t10/u-boot-with-spl-pbl-eppc1014.bin
loadaddr=0x10000000
mem=524280k
netdev=eth0
nfsboot=setenv bootargs root=/dev/nfs rw nfsroot=$serverip:$rootpath ip=$ipaddr:$serverip:
$gatewayip:$netmask:$hostname:$netdev:off console=$consoledev,$baudrate $othbootargs;tftp $loadaddr
$bootfile;tftp $fdtaddr $fdtfile;bootm $loadaddr - $fdtaddr
pram=8
preboot=echo Add "painit" to preboot command
ramdiskaddr=0x02000000
ramdiskfile=eppct10/ramdisk.uboot
reload_env=i2c dev 1 && eeprom read 2 0x50 0x14000000 0 0x1000 && env import -t 0x14000004 0x1000
rootpath=/opt/nfsroot
serial#=EPPC-CPU-T10_F_GA000015
uboot=u-boot-with-spl-pbl-eppc1014.bin
ubootaddr=0x10001000
update=sf probe 0 && sf update 0x14000000 0 0xd0000
update2=sf probe 2 && sf update 0x14000000 0 0xd0000
usb1:dr_mode=host,phy_type=utmi

Environment size: 1486/4092 bytes

```

## Software

Variables can be modified or added with the command `setenv`. For example:

```
=> setenv ipaddr 180.1.10.34
```

All variables are stored in an EEPROM on the CPU module. Changes are only stored in the EEPROM after a final call of `saveenv`:

```
=> saveenv
```

Some of the changes only become effective after a restart.

The following table contains the most important environment variables of the unit:

Name	Function
<i>baudrate</i>	Baud rate on the console interface.
<i>netmask</i> <i>ipaddr</i>	IP address and net mask: network settings for the unit
<i>serverip</i>	TFTP server from which the boot images are loaded
<i>serial#</i>	Serial number of the EPPC-T10; with name and individual serial number from AA000001, e.g.: EPPC-CPU-T10_AA000001
<i>bootcmd</i>	This variable contains the commands that trigger the real boot procedure of the operating system (e.g. Linux).
<i>bootdelay</i>	Boot delay specified in seconds. During this period of time the automatic boot procedure can be terminated by pressing the space bar.
<i>load</i> <i>update</i>	Script variables for the update of the bootloader.

## 6.2 Update of the Bootloader

The U-Boot bootloader is able to update itself. A bootloader update should only be carried out if it is really necessary, because in an error case (e.g. mains voltage decrease during the update) the unit might become non-functional and needs service.

For an update the new version of the bootloader has to be stored with the file name `uboot=u-boot-with-spl-pbl-eppc1014.bin` to the TFTP server.

Then the following command has to be called at the bootloader console:

```
=> run load update
```

First the command loads the new bootloader via TFTP into the main memory of the CPU module (see environment variable *load*). In the second step the flash memory of the bootloader is deleted and after that the new bootloader is written in the flash (see environment variable *update*). The update procedure is finished, if the bootloader is prompted. After a reset the new bootloader is active.

## 6.3 Operating System and Drivers

Operating system	Linux
Version	4.1
Driver	If available, the standard drivers of the operating system are used (e. g. Ethernet, PCI, Serial)

## 7. CPU

The general function of the NXP QorIQ T014 is not described in this manual.

Further information about the CPU can for example be downloaded from the website of the manufacturer NXP: <http://www.nxp.com/>

Base Address	Functionality
0xF FE13 3008	GPIO register (see chapter 7.1)
0xF FFD0 0000	Optional MRAM (Customized option on request only. The optional MRAM is connected to the CPU via the local bus.)

**Table 5:** Base address

### 7.1 User configuration via GPIO register

Via CPU GPIO register the settings can be handled as shown in the following table.

Address	Register name	Bits					
		31 ... .. 20	19 ... .. 16	15 ... .. 13	12	11 ... .. 8	7 ... .. 0
0xFE133008	GPIO_4	reserved	SW900	reserved	Reset Disable	SW901	reserved

**Table 6:** CPU register GPIO\_4

#### Description

Name	Access	Description
SW900	ro	Read back the setting of the configuration DIP switch SW900
SW901	ro	Read back the setting of the configuration DIP switch SW901



#### NOTICE

Reserved values must be written with the value that is read before.

The switches are equipped on the PCB top layer as described in Figure 2 on page 16.

Read chapter “Configuration via DIP Switch” on page 24 for further information about the switches.

Bit	LC_IO	SW900 Pin
19	LC_IO12	4
18	LC_IO13	3
17	LC_IO14	2
16	LC_IO15	1

Bit	LC_IO	SW901 Pin
11	LC_IO20	4
10	LC_IO21	3
9	LC_IO22	2
8	LC_IO23	1

### 7.2 Watchdog

The watchdog is described in the manual:

“EREF: A Programmer’s Reference Manual for Freescale Embedded Processors”.

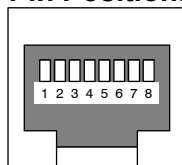
The manual can be downloaded from the NXP website.

## 8. Connector Assignments

### 8.1 Serial 1 - RS232 (X711)

Connector type: RJ45- connector in the case, bottom side

**Pin Position:**



Position	Signal
1	-
2	RTS (out)
3	GND
4	TXD (out)
5	RXD ( in )
6	GND
7	CTS ( in )
8	-



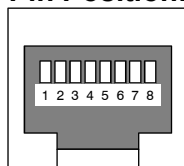
#### **NOTICE**

For the serial interface shielded cables have to be used.  
esd grants the EC conformity of the product if the wiring is carried out with a shielded cable with a maximum wire length of 30 m.

## 8.2 Ethernet ETH1 - 3 (X1300, X1400, X1500)

Connector type: RJ45- connector, in the case, upper side

**Pin Position:**



Position	Signal
1	MDI 0 +
2	MDI 0 -
3	MDI 1 +
4	MDI 2 +
5	MDI 2 -
6	MDI 1 -
7	MDI 3 +
8	MDI 3 -



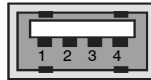
### NOTICE

Cables of category CAT5e or higher have to be used to grant the function in networks with 1000 Mbit/s. esd grants the EC conformity of the product if the wiring is carried out with shielded twisted pair cables of category CAT5e or higher.

### 8.3 USB (X1200)

Connector type: USB socket type-A in the case, bottom side

**Pin Position:**

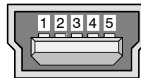


Position	Signal
1	USB - PWR+
2	Data -
3	Data +
4	USB - PWR-

### 8.4 Terminal Interface (X450)

Connector type: Mini-USB socket type-B, in the case, front panel (see page 18)

**Pin Position:**



Position	Signal
1	USB - PWR+
2	Data -
3	Data +
4	-
5	USB - PWR-



## 8.5 24V Power Supply Voltage (X100)



### DANGER

The EPPC-T10 may only be driven by power supply current circuits, that are contact protected. A power supply, that provides a safety extra-low voltage (SELV) according to EN 60950-1, complies with this conditions.

The power supply voltage is connected via the Phoenix Contact connector plug - MC 1,5/ 3-STF-3.81 with screw-connection, which is located in the bottom side of the case.

For Conductor Connection/Conductor Cross Sections see the following chapter.

### Pin Position:



Figure 10: 24V Connector

Position	Signal
1	+24V
2	FE
3	GND

### Signal description

+24V... power supply voltage +24 V,  
permissible operating voltage range is: +16VDC ... +32 VDC.

FE... functional earth contact (EMC)(connected to mounting rail potential)

### 8.5.1 Conductor Connection/Conductor Cross Sections

The following table contains an extract of the technical data of the plug connectors.

Characteristics	Power Supply Voltage 24 V <sup>1</sup>
Connector type plug component (Range of articles)	MC 1,5/ 3-STF-3,81 (1827716)
Connection method	screw connection
Stripping length	9 mm
Conductor cross section solid min./max.	0.14 mm <sup>2</sup> /1.5 mm <sup>2</sup>
Conductor cross section stranded min./max.	0.14 mm <sup>2</sup> /1.5 mm <sup>2</sup>
Conductor cross section stranded, with ferrule without plastic sleeve min./max.	0.25 mm <sup>2</sup> /1.5 mm <sup>2</sup>
Conductor cross section stranded, with ferrule with plastic sleeve min./max.	0.25 mm <sup>2</sup> /0.5 mm <sup>2</sup>
Conductor cross section AWG/kcmil min./max.	28/16
2 conductors with same cross section, solid min./max.	0,08 / 0,5 mm <sup>2</sup>
2 conductors with same cross section, stranded min./max.	0,08 / 0,75 mm <sup>2</sup>
2 conductors with same cross section, stranded, ferrules without plastic sleeve, min./max.	0,25 / 0,34 mm <sup>2</sup>
2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, min./max.	0,5 / 0,5 mm <sup>2</sup>
Minimum/Maximum AWG according to UL/cUL	30/14

<sup>1</sup> Technical Data from the Phoenix Contact website, PCB Connectors, Product list PCB connectors

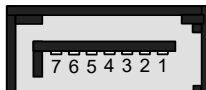
### 8.6 Internal Connectors

The internal connectors are inside of the EPPC-T10 and are only accessible with case opened.

#### 8.6.1 SATA 0 (X2000)

Connector type: 7-pin SATA connector socket

Pin Position:

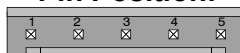


Position	Signal
1	GND
2	TX Data + (out)
3	TX Data - (out)
4	UGND
5	RX Data - ( in )
6	RX Data + ( in )
7	GND

#### 8.6.2 SATA- Power 0 (X2001)

Connector type: 5-pin DUBOX

Pin Position:



Position	Signal
1	3,3V
2	GND
3	5,0V
4	GND
5	12V

### 8.6.3 Backup-Battery and Front LEDs, JTAG


**NOTICE**
**Do not connect!**

These connectors are for esd internal use only.

The internal connectors are inside of the EPPC-T10 and are only accessible with case opened.

#### 8.6.3.1 Backup-Battery and Front LEDs (X180)

Position	Signal
1	Power LED
2	LED 3,3V OK
3	LED 5V OK
4	LED Power OK
5	LED Run
6	LED Error
7	LED SATA
8	LED Battery OK
9	LED Spare
10	3.3V (currently not used)
11	GND (connected with Pin 14)
12	Reset
13	UBATT+ Backup battery
14	GND (connected with Pin 11)

#### 8.6.3.2 JTAG CPU (X800)

Signal	Position		Signal
TDO	1	2	QACK#
TDI	3	4	TRST#
Pull Up 4K7	5	6	1.8 V
TCK	7	8	
TMS	9	10	
CPU-SRST#	11	12	
CPU-HRST#	13	14	
CPU-CKSTO#	15	16	GND

## 9. Conformity

### EU-KONFORMITÄTSERKLÄRUNG EU DECLARATION OF CONFORMITY



Adresse **esd electronics gmbh**  
Address **Vahrenwalder Str. 207**  
**30165 Hannover**  
**Germany**

esd erklärt, dass das Produkt  
*esd declares, that the product*  
**EPPC-T10**

Typ, Modell, Artikel-Nr.  
*Type, Model, Article No.*  
**I.2007.02**

die Anforderungen der Normen  
*fulfills the requirements of the standards*

**EN 61000-6-2:2005,**  
**EN 61000-6-4:2007/A1:2011**

gemäß folgendem Prüfbericht erfüllt.  
*according to test certificate.*

**H-K00-0687-17**

Das Produkt entspricht damit der EU-Richtlinie „EMV“  
*Therefore the product conforms to the EU Directive 'EMC'*

**2014/30/EU**

Das Produkt entspricht den EU-Richtlinien „RoHS“  
*The product conforms to the EU Directives 'RoHS'*

**2011/65/EU, 2015/863/EU**

Diese Erklärung verliert ihre Gültigkeit, wenn das Produkt nicht den Herstellerunterlagen  
entsprechend eingesetzt und betrieben wird, oder das Produkt abweichend modifiziert wird.  
*This declaration loses its validity if the product is not used or run according to the manufacturer's  
documentation or if non-compliant modifications are made.*

Name / Name T. Bielert  
Funktion / Title QM-Beauftragter / QM Representative  
Datum / Date Hannover, 2019-03-25

Rechtsgültige Unterschrift / *authorized signature*

I:\Texte\Doku\MANUALS\Embedded\EPPC-T10\Konformitaet\EPPC-T10\_CE-Konformitaetserklaerung\_2019-03-25.odt

## 10. Order Information

Type	Properties	Order No.
EPPC-T10	EPPC-T10 Embedded QorIQ T1014 PowerPC CPU Board, 1.2 GHz, 512 Mbyte RAM	I.2007.02
Software		
EPPC-T10-Linux-Adaption	Board Support Package	I.2007.77
EPPC-T10-Linux-Support	Support for BSP 12 months Linux support	I.2007.67
EtherCAT Master-Linux/PowerPC	EtherCAT Master, Operating system: Linux, CPU architecture: PowerPC, Object code, Runtime license for a single site	P.4500.03
EtherCAT Master Project Bundle	10x EtherCAT Master runtime licence, 1x EtherCAT Workbench, 12 month support and update service Please indicate your operation system, version and target architecture. This bundle can be extended with additional project licences	P.4503.01

**Table 7:** Order information

### PDF Manuals

For availability of English manuals see table below.

Please download the manuals as PDF documents from our esd website [www.esd.eu](http://www.esd.eu) for free.

Manuals		Order No.
EPPC-T10-ME	Hardware manual in English	I.2007.21

**Table 8:** Available manuals

### Printed Manuals

If you need a printout of the manual additionally, please contact our sales team: [sales@esd.eu](mailto:sales@esd.eu) for a quotation. Printed manuals may be ordered for a fee.