OnRISC Baltos
Hardware Manual

Edition: September 2015

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1. Overview

The OnRISC Baltos is a RISC industrial embedded computer, based on the Ti Sitara AM3352 ARM Cortex-A8 processor and System-On-Chip. It provides a great variety of interfaces like LAN, USB, CAN-Bus, I²C, serial interface and digital I/O, this makes it easy to connect various industrial devices to the Baltos. Linux operating system is provided, it can boot from the SD-Card on the front side, or from internal Flash Memory.

Compact dimensions and DIN Rail mounting capability make the Baltos to a space saving and flexible mounting industrial computer. It is feasible to be installed even in space limited environments. Direct Wall mounting is an option as well.

With RISC based architecture the Baltos has 3 Watt min. power consumption, and needs no fans. Working in the temperature range from -20°C up to 75°C the Baltos can be used under harsh industrial conditions. Therefore the Baltos is downright designed for industrial automation.

This manual covers the two models Baltos iR 5221 and Baltos iR 3220. Both are very similar, the differences are pointed out with the description of the hardware components.

Figure 1: Baltos iR 3220 and Baltos iR 5221 on DIN Rail

1.1. Product Features

	OnRISC Baltos
CPU	Ti Sitara AM3352 ARM Cortex-A8 RISC CPU, 600MHz
RAM	256 MB DDR3 RAM
Flash	256 MB NAND Flash for boot Linux OS
SD-Slot	1 x Standard size
USB	2 x 2.0 High Speed as Host
	1 x USB/OTG (Baltos iR 5221 only)
LAN	4 x 10/100 Fast Ethernet with integrated switch
	2 x 10/100 Fast Ethernet on Baltos iR 3220
WAN	1 x 10/100/1000 Gigabit Ethernet
WLAN	optional, IEEE 802.11b/g/n
CAN-Bus	1 x CAN-Bus 20 kbps to 1 Mbps (Baltos iR 5221 only)
Serial Ports	2 x RS 232 / RS 422 / RS 485 up to 3.7 Mbps
Digital I/O	4 x input signals
	4 x output signals (32 mA max.)
Console Port	RS 232, up to 115200bps
I²C	max. 400 kHz
RTC	yes
Watch Dog Timer	yes
MiniPCIe-Slot	yes, with SIM Card Slot
Reset Button	HW Reset
Power Input	12-50V DC
Power Consumption	0.3A @ 12V min.
Dimensions (W x L x H)	154 x 104 x 50 mm
Antenna	The case is prepared for two antenna sockets, e.g. WLAN and GPS

Table 1: Product Hardware Specifications

1.1.1. Ethernet

Two independent ports for Ethernet are available in Baltos, with separate MAC Addresses. One port is implemented as GigaLAN for 10/100/1000 Mbit/s, the other provides an internal Ethernet switch for Fast Ethernet function 10/100 Mbit/s. The Baltos iR 5221 provides four Fast Ethernet ports, on Baltos iR 3220 there are two of them.

1.1.2. USB

Two USB Host ports for USB 2.0 High Speed allow to connect any devices.

On Baltos iR 5221 only: there is one extra port type USB 2.0 OTG for Host and Device operation mode.

1.1.3. CAN-Bus

On Baltos iR 5221 only: one CAN port for CAN 2.0A and 2.0B is available. The port operates from 20 kbit/s up to 1 Mbit/s.

1.1.4. Serial Ports

Two serial ports are provided in RS 232/422/485 modes that can be configured by software or by DIP switch. For the detailed information about the supported modes refer to the Table 2.

	RS 232	RS 422	RS 485
Modes	full duplex	full duplex	2-wire: half duplex, without echo 4-wire: full duplex
Signals	TxD, RxD, RTS, CTS, DTR, DSR, DCD, RI, GND	Tx+/-, Rx+/-, GND	2-wire: Data+/-, GND 4-wire: Tx+/-, Rx+/-, GND
Data Direction Control			by driver, via RTS
Speed	up to 500 kbps	up to 3 Mbps	up to 3 Mbps

Table 2: Serial Interface Specifications

1.1.5. Digital I/O

Four input and four output signals at TTL level are provided. For input signals the change of at least one input signal generates an interrupt. See Section 3.3 on page 12 for electrical characteristics.

1.1.6. I²C

One port for external I²C function is provided. The signals originate in a repeater, to protect the internal circuits from external misconfiguration or signal shorting.

1.1.7. WLAN

The OnRISC Baltos is available with an optional built-in WLAN function as of IEEE 802.11b/g/n for wireless connection.

2. Appearance

This is how the OnRISC Baltos systems look like on the top, front and bottom sides.

2.1. Baltos iR 5221

(a) Top View   (b) Front View   (c) Bottom View
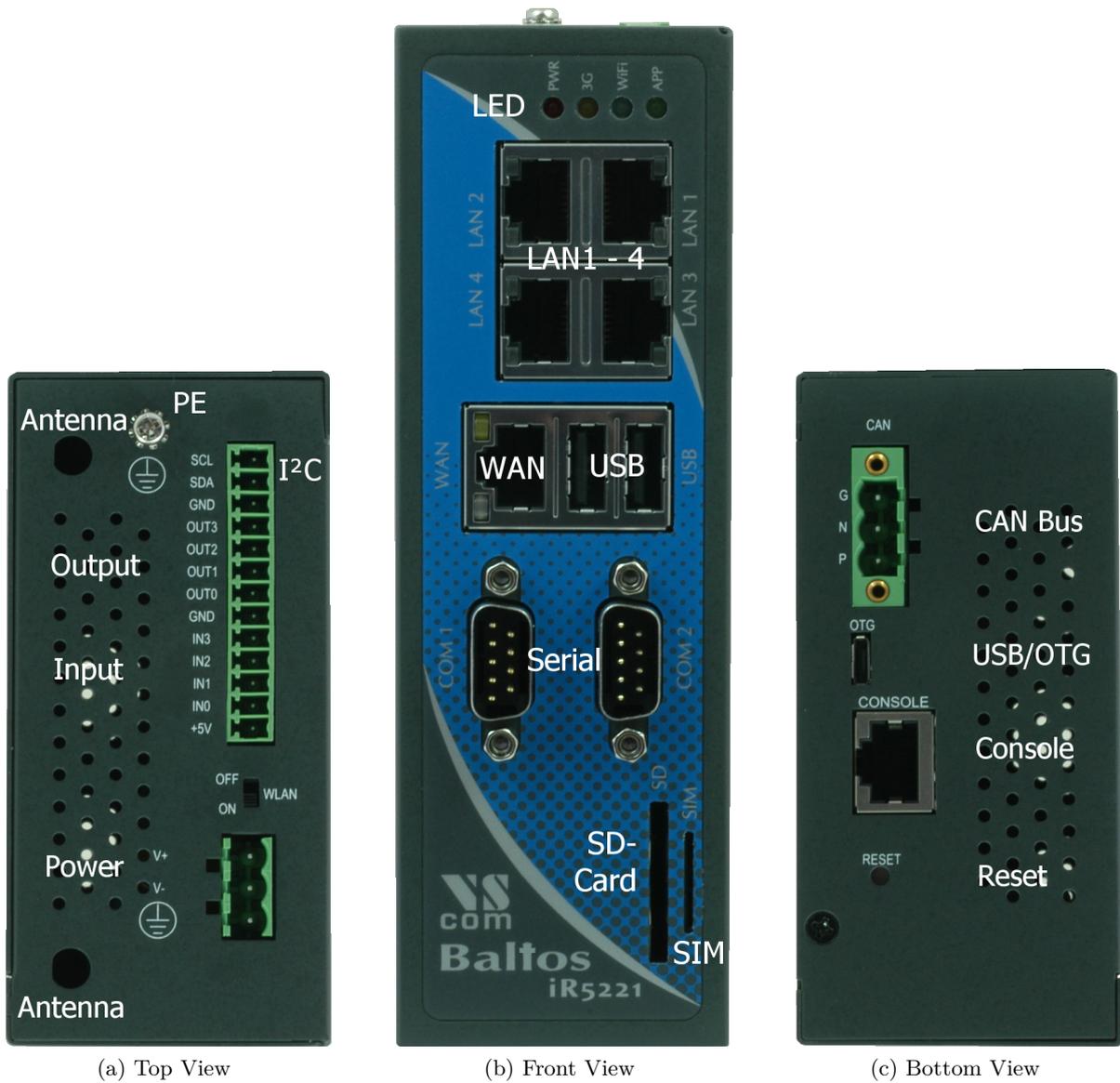
Figure 2: Appearance Baltos iR 5221

2.2. Baltos iR 3220

(a) Top View   (b) Front View   (c) Bottom View

Figure 3: Appearance Baltos iR 3220

The Baltos iR 3220 provides two ports for LAN, the CAN Bus connector and the USB/OTG port are not implemented.

2.3. Backside for Mounting
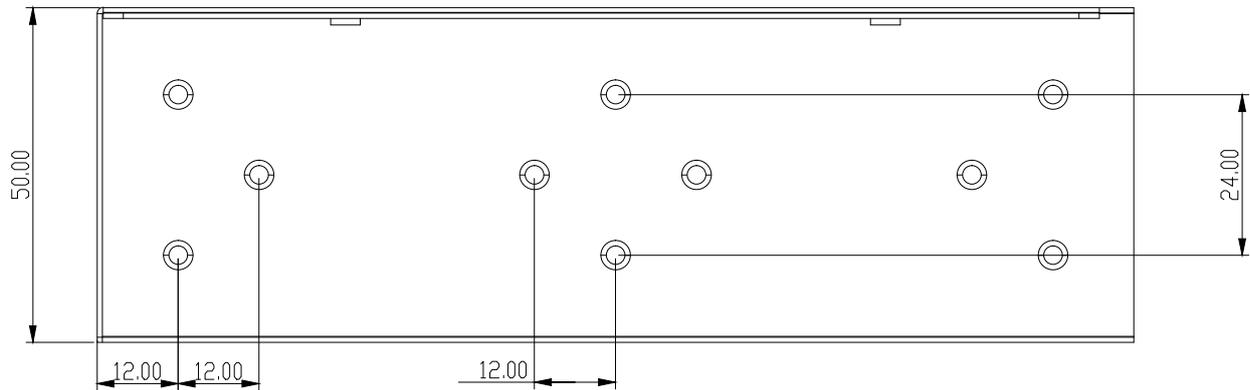
Figure 4: Mounting Positions Baltos

This are the positions of screws for mounting. The groups of three on the left and right (actually top and bottom) hold the metal plates for wall mounting.

The group of four in the middle is for the DIN Rail mounting clamp. This may be mounted in standard orientation, or turned by 90° to provide for a (seldom used) horizontal fixture on the DIN Rail.

3. Position of Connectors and Functions

First the connectors and functions located on the top side of Baltos are described. The next components are those on the front side, finally followed by those on the bottom side.

3.1. Power

The OnRISC Baltos device is powered by a single power supply in a wide range from 12 V to 50 V DC. A suitable power supply adapter is available as add-on component, and part of the starter kit package. Connect the cable to the power jack at the top side of Baltos, and plug the adapter into the socket. The Power LED (red) on Baltos will light. You can connect a power supply of your choice, providing the technical requirements are met.

> **Warning:** disconnect the Baltos from power supply before performing installation or wiring. The wire size must follow the maximum current specifications. The maximum possible current in the power wires as well as in the common wires must be taken under consideration. If the current rises above the maximum ratings, the wiring can overheat, causing serious damage to your equipment. When powered, the Baltos's internal components generate heat, and consequently the outer case may feel warm to the touch.

3.1.1. Connection and Polarity

Power is connected via three clamps on a terminal block, located on the top side of Baltos.

Warning: do not confuse the CAN connector at the bottom side for power input. Such may damage the CAN bus port.

Clamp	3	2	1
Function	PE	V-	V+

Table 3: Power Connector

V+ and V- are clamps for DC voltage supply. PE is the clamp to connect the case and shields of connection cables to Protective Earth. PE is internally connected to logic ground, which is on the level of V-supply line.
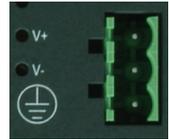
Figure 5: Power Connector

Attention: Never connect the Terminal block for power supply in reversed direction, i.e. turned by 180°. This would connect the power between V- (logic ground) and case/protective ground. High current is the result, causing damage inside the system.

3.1.2. Grounding

Grounding and wire routing help limit the effects of noise due to electromagnetic interference (EMI). Run the ground connection from the ground screw to the grounding surface prior to connecting devices.

In noisy environments the case of Baltos shall be directly connected to Protective Earth. This is the purpose of the dedicated PE Screw on the case top side.

Figure 6: PE Screw

3.2. WLAN Switch

The WLAN switch on the top side is used to disable the WLAN function. Provided the Baltos is equipped with a WLAN module. Otherwise software may just read this switch for other purposes.

Figure 7: WLAN Switch

3.3. Digital I/O

The functions of Digital Input and Output are located on the 13 clamp terminal block on the top side of Baltos. Also available on this terminal block is the function of I²C and an auxiliary power output.

1	**2**	**3**	**4**	**5**	**6**
+5V	IN 0	IN 1	IN 2	IN 3	GND

(a) Input connects

7	**8**	**9**	**10**
OUT 0	OUT 1	OUT 2	OUT 3

(b) Output connects

11	**12**	**13**
GND	SDA	SCL

(c) I²C connects

Table 4: Digital Input/Output: Connector
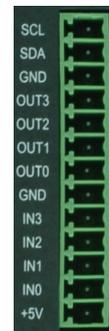
Figure 8: Digital Input / Output Connector

3.3.1. Digital Input

The OnRISC Baltos provides four digital input channels. The signals IN 0 to IN 3 are located on clamps 2 to 5 of the terminal block, the reference GND is on clamp 6. A signal change on an input channel will generate an interrupt.

Input High	TTL level (2.0 to 5.0V)
Input Low	TTL level (0.0 to 0.8V)

Table 5: Digital Input: Electrical Characteristics

3.3.2. Digital Output

The OnRISC Baltos provides four digital output channels. The signals OUT 0 to OUT 3 are located on clamps 7 to 10 of the terminal block, the reference GND is on clamp 6 and 11. The output ports can source some milliAmpere output in High status, with decreasing voltage when the current rises. In Low status they can sink significant current, enough to drive small relays.

Output High	Source 32mA@TTL (2.0 to 5.0V)
Output Low	Sink 64mA@TTL (0.0 to 0.6V)

Table 6: Digital Output: Electrical Characteristics

3.3.3. I²C Interface

The I²C interface operates with a maximum frequency of 400 kHz (Fast Mode). The connector for I²C is located on the terminal digital I/O block and has three contacts: SCL, SDA and GND (clamps 11 to 13). When required the I²C device can be powered with the VCC auxiliary output of the digital I/O terminal block.

3.3.4. Auxiliary Power

+5V is an auxiliary power output of 5V DC, for max. 500 milliAmpere. This may be used to drive special driver circuits connected at Digital-I/O. For example +5V may drive a relay controlled by the output signals, or power a small I²C-controlled display. The GND for auxiliary power is on clamps 6 and 11.

3.4. Antenna Locations

The OnRISC Baltos is prepared for adding two antenna sockets of the usual SMA type. These may be used for functions like WLAN, UMTS/LTE wireless or GPS receivers. The positions are covered by plastic caps. Both antenna positions are on the top side.
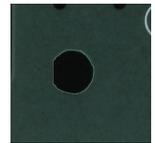
Figure 9: Antenna location

3.5. LED

The front side starts with a group of four LEDs.

PWR (Red) lights when power is applied to the Baltos. System software may generate short blinks for certain events.

3G (Yellow) is controlled by a UMTS/LTE modem card in the mini PCIe expansion slot.

WIFI (Blue) signals operation status of WLAN function.

APP (Green) is free to use by customers application, e.g. as some ready light.

Figure 10: Front LED

3.6. LAN

The first Ethernet port in Baltos is for 10/100 Mbps Fast Ethernet. This connects to an internal Ethernet switch, with 2 (Baltos iR 3220) or 4 (Baltos iR 5221) external connectors. Devices or systems connected to these ports can communicate with each other, without involving the CPU of Baltos.

Each of the LAN ports are the usual RJ45. When the connect is done the Link LED on RJ45 (right) will light. When data traffic occurs on the network, this LED will blink. It depends on your network or devices whether a 100 Mbit or a 10 Mbit connect will be established. The Speed LED (left) lights for 100Mbps connections.
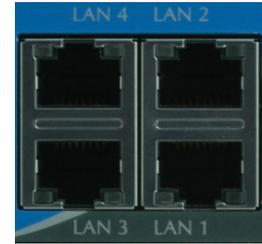
Figure 11: LAN ports

3.7. WAN

The second Ethernet port in Baltos is for 10/100/1000 Mbps Gigabit Ethernet. The connector is the usual RJ45, integrated with USB ports.

When the connect is done the Link LED on RJ45 (green, left) will light. When data traffic occurs on the network, this LED will blink. It depends on your network or devices whether a 1000 Mbit, a 100 Mbit or a 10 Mbit connect will be established. The Speed LED (yellow, right) lights for 10 and 100 Mbps connections.

This Ethernet interfaces supports Auto-MDI(X) feature.

Figure 12: WAN port and USB connectors

3.8. USB

The OnRISC Baltos provides two USB 2.0 Host interfaces. They can be used for Mass Storage Devices, like Flash- or Hard Drive, Bluetooth and WLAN adapters etc.

The ports are integrated with the Gigabit Ethernet WAN port, see figure 12.

3.9. Serial

The OnRISC Baltos provides two DSub-9 male connectors. All three modes of operating RS 232, RS 422 or RS 485 are entirely configurable by software. For the pinout refer to the Table 7 on the next page. If the configuration by software is not used, the default operation mode of each port is configured by a DIP switch. The DIP switch may be overridden by software, if the user chooses to do so. Check section 4.4 on page 18 for details.

Pin	RS 232	RS 422	RS 485 2-wire
1	DCD	Tx- (A)	Data- (A)
2	RxD	Tx+ (B)	Data+ (B)
3	TxD	Rx+ (B)	
4	DTR	Rx- (A)	
5	GND	GND	GND
6	DSR		
7	RTS		
8	CTS		
9	RI		

Table 7: Serial DSub-9 Pinout

Figure 13: COM Ports

Please note the function of the GND signal in RS 422 and RS 485 modes: this signal must also be connected between the serial devices. So in reality a 2-wire and a 4-wire connection need 3 wire and 5 wire respectively. With the exception of very special configurations, a serial connection in RS 422/RS 485 mode without GND connection violates the specifications for RS 422 and RS 485 standards.

3.9.1. DIP Configuration for Serial Ports

The right side of the case has a small opening slit. This is provided to access the DIP switches for serial configuration. With a small pen or screw driver the configuration can be changed without opening the case.
The current setting of the switches is readable by software. If the user or software decides to do this, the software can override the active configuration, i.e. change the operation mode. Please check section 4.4 on page 18 for details about this function.

Figure 14: DIP Switches

3.10. SD-Slot

The OnRISC Baltos provides an SD-Slot on the front side of the case, for cards in standard size. The slot supports cards as SD 2.0 or SDHC type, to allow up to 32 GB of capacity. Class 10 cards are supported as well.
If an operating system is installed on the SD Card, the OnRISC Baltos will boot this software.

Figure 15: SD and SIM Slot

3.11. SIM-Slot

A SIM-Slot is located right next to the SD-Slot, see figure 15. A Mini SIM card in this slot is accessed by a UMTS/LTE modem card in the mini PCIe expansion slot.

3.12. Reset

The Reset button is the front most component on the bottom side of Baltos.

With Reset button you can restart the OnRISC Baltos without removing the power. The Reset button should be used only in situations, where reboot command is not available, to avoid file system integrity errors.

Figure 16: Reset Button

3.13. Console Port

The console port (RS 232) has an RJ45 connector on the bottom side. An adapter cable to DSub-9 female is available as part of the Starter Kit (5.2).

Pin	Signal
3	GND
4	TxD
5	RxD

(a) Console RJ45

Pin	Signal
2	TxD
3	RxD
5	GND

(b) Console   DSub-9 female

Figure 17: Console Port

Table 8: Serial Console Port

3.14. USB/OTG

Only available on Baltos iR 5221: A connector of micro-AB type provides one extra USB channel. This port can operate in Host or Device Mode, the hardware detects if the connected device is a Host (PC) or some device (printer, external HDD etc.). Hence the designation as USB/OTG.

Figure 18: OTG

3.15. CAN Bus

CAN bus is only available on Baltos iR 5221. The connector for CAN bus is a terminal block with three clamps. Available signals are CAN High, CAN Low and CAN GND. Termination of CAN bus (120 Ω) shall be implemented on the cable.

Clamp	G	N	P
Function	CAN_GND	CAN_L	CAN_H

Table 9: CAN bus Connector

Figure 19: CAN Bus

4. Internal Components

No components inside the case of OnRISC Baltos are for service by the user. It is encouraged not to open the case unless specifically instructed to do so. The following information of location and function are for reference only. Six screws fix the left, bottom and rear[1] side.
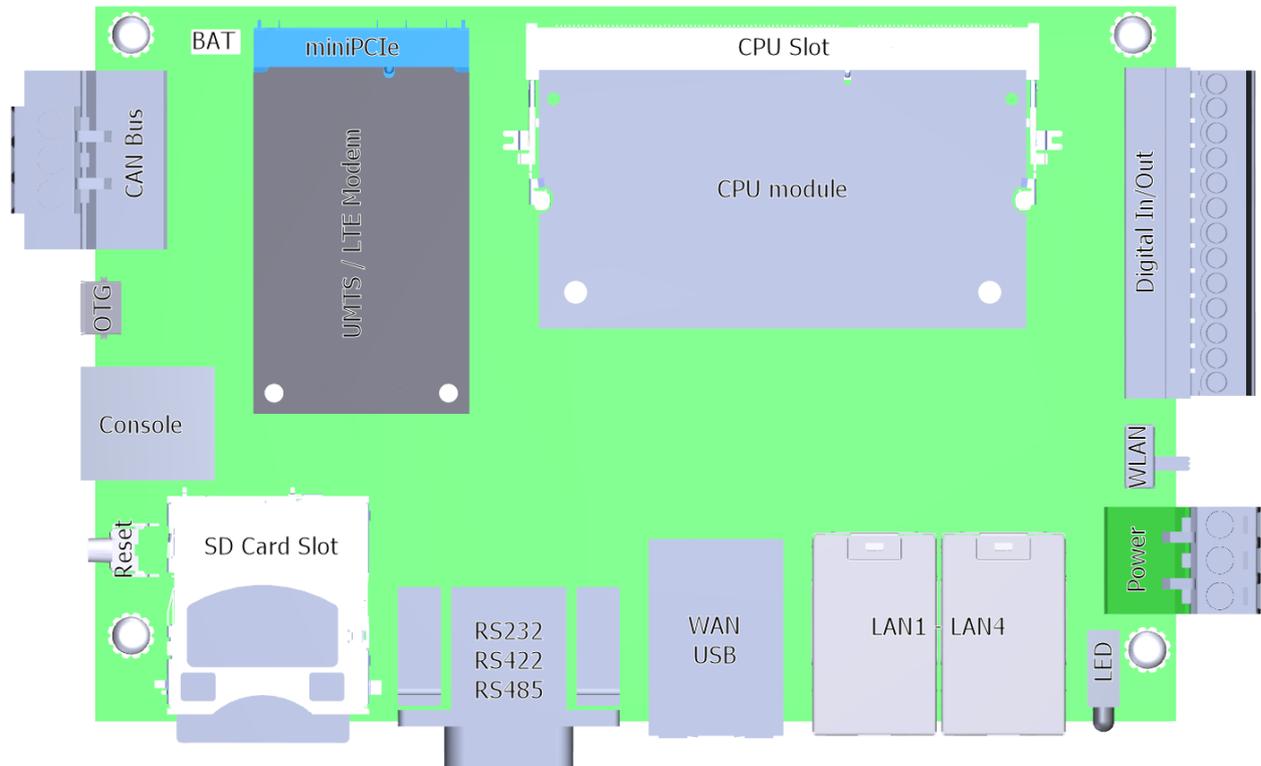
Figure 20: System Board

Figure 20 shows schematically how the interior of Baltos looks like, when the case is opened. There are only four components not specified yet, three of them are shown here.

4.1. CPU Module

This module looks similar to a DRAM card, but in fact this is where all the computation takes place. Also the NAND Flash memory to boot the system is located here, with the DRAM.

If your Baltos provides WLAN function, the cable from the antenna socket ends here also.

4.2. UMTS/LTE (3G/4G)

There is one expansion slot to hold a Mini PCI Express Card, in long size format. This slot supports the data signals for USB 2.0, so the selected card must operate on USB. PCI Express is not available. Typical cards placed into this expansion slot are Wireless communication cards. The expansion card in this slot controls the SIM card.

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[1]orientation when mounted on DIN Rail

If this function is required, usually the Baltos is ordered and shipped with a suitable card already mounted and connected to the antenna socket. Expansion cards with GPS function for an active antenna are tested as well.

Systems Baltos shipped after September 2015 provide the extended option to perform a reset on the installed card. This is performed by switching power off and on again, selectively only to the expansion slot. Due to implementation this requires to activate the power to the slot before operating an installed card. This may be done just once in the startup process.
Our sample Linux installation in the starter kit will have this operation implemented. Please refer to the User Manual for details on how to do this in your system installation. Applications without installed expansion card do not have to care about this new function at all.

4.2.1. SIM Card

If the miniPCIe card is for mobile communication by GSM/GPRS/EDGE/UMTS/LTE, it will use a SIM card for the account data to access the providers network. This SIM card shall be inserted into the special slot, which is connected to the miniPCIe slot. The slot for SIM cards is accessible on the front side, i.e. when the case is closed.

Note: There are add-on cards with an integrated SIM slot. Depending on the particular model both slots may be functional, i.e. a SIM card may be placed either in the external or the integrated slot.

4.3. Battery

The small connector labeled as BAT on the rear side connects a so called BIOS battery pack. It consists of a CR2032 type Lithium battery with cable. This battery provides the backup power for the Real Time Clock.

4.4. DIP Switches

There are two blocks of DIP switches, not shown in figure 20 on the preceding page. This is because they are on the other side, accessible without opening the case. The switches are used to configure the operation mode of the serial ports.

The front most switch (the left when seen from the right side) is for the serial port labeled as COM1, and the other is for COM2. The switches define the default configuration, software may check and override this. The switch labeled 4 on each block controls the termination in RS 422 and RS 485 modes, by attaching $120\,\Omega$ to the receiving lines; that switch has no effect in RS 232 mode.

S1	S2	S3	Mode
Off	Off	Off	Port disabled
On	Off	Off	RS 232
On	On	On	RS 422
On	On	Off	RS 485 Full Duplex
Off	On	Off	RS 485 Standard

(a) Operation Mode

S4	Termination for RS 422 / RS 485
On	Active 120 Ω
Off	Inactive

(b) Termination

Table 10: Configuration Serial Port

In RS 232 and RS 422 Mode data may be received while transmitting. This also applies to RS 485 Full Duplex Mode, which is also referred to as 4-wire connection.

The RS 485 Standard Mode is alternatively referred to as Half Duplex Mode, 2-wire connection or Bus Mode. It uses the same two wires for transmit and receive. So it would be possible to simultaneously receive the same data the port just transmitted, this is often named an Echo. The serial port in Baltos intentionally suppresses this Echo. In the rare situations where this Echo is required, the port should be set as this:

- Configure the port for RS 485 Full Duplex Mode
- Connect Tx+ with Rx+ in the cable
- Connect Tx- with Rx- in the cable

When the system starts the operating system, naturally no application has control over the serial ports. This may result in undesired behavior of the port signals, e.g. RTS changing from active to inactive or something other.

To avoid this situation set the DIP switches to 'Port disabled' mode; the external signals are inactive in this configuration. When the application is operating it can change the operation mode to whatever is required.

4.5. JTAG

Only for low-level developers there is a connector for JTAG function. How to use that is not the purpose of this manual, so the connector is only mentioned for documentation. Intentionally it is not shown in figure .

5. Product Support Information

The following services are provided on www.vscom.de and www.visionsystems.de for the customers to support our products:

- driver updates
- product information
- user's manual updates

For special technical support issues please use our FAQ system faq.visionsystems.de.

5.1. Accessories in Package

The OnRISC Baltos systems are accompanied by some accessories in a plastic bag.

5.1.1. Mounting

For fixing the system there is a DIN Rail clamp (silver color), this shall be mounted in the middle of the rear side of the case (see figure 4 on page 10). It may be mounted in four orientations, but it is recommended to mount for an upright position of the system.

Also an option is wall mounting, provided by two metal plates (dark color). Please again check figure 4, there are three screw positions on either top and bottom end of the rear side. Attach one plate at each end with the supplied screws.

5.1.2. CAN Bus

There is one terminal block with 3 clamps, which also has fixing screws at the left and right side. This is only available with Baltos iR 5221 system, and is dedicated to the CAN Bus connector at bottom side of the system (see figure 2c on page 8). Plug the terminal block into the connector, and fix by the screws on the side. Connect the CAN Bus cables to the clamps.

Note: Do not confuse this connector with the power supply input.

5.1.3. Digital Input/Output

There is one long terminal block (13 clamps) to insert in the connector at the top side of the system, please refer to figure 2a on page 8. Insert the terminal block with the srews facing to the left side, and insert the connection wires from the top.

5.1.4. Power Supply

There is one terminal block with 3 clamps, intended for the top side also (figure 2a on page 8). Do not confuse that with the CAN Bus connector in Baltos iR 5221 system.

5.1.5. Ferrite Core

This ferrite core is intended to reduce EMI to and from the power supply cables. Feed the cables through the core, and fix it near the power supply input of OnRISC Baltos.

5.2. Starter Kit

For easy start of developing software applications Vision Systems provides a Ready-to-Run or Starter kit. This shall be ordered as an add-on to the Baltos system. It consists of:

- 4 GB SD card with Linux operating system
- Power adapter 12V @ 1.5A, 18W
- Adapter cable for serial console port
- Development software on DVD
- Documentation on DVD

A. History

July 2014 Release of Hardware Manual

October 2014 Modifications in Layout

December 2014 Add Baltos iR 3220

January 2015 Top Speed Serial Ports

September 2015 Reset Function on 3G/4G Slot