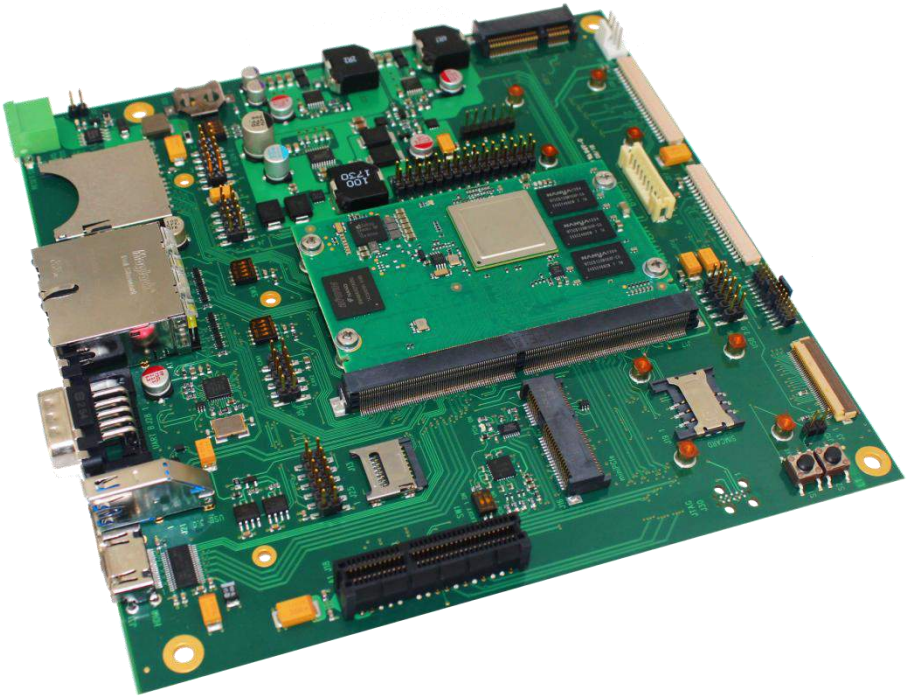
emCON Bvari

Hardware Manual

Rev3 / 27.09.2018



emtrion GmbH

Revision: **3 / 27.09.2018**

Rev	Date/Signature	Changes
1	19.07.2018/Sch	First revision
2	10.09.2018/Sch	Voltage range edited
3	27.09.2018/Sch	Chapter (First Configuration) 4 removed
		Chapter 4.2 - CPU->Ethernet port assignment corrected
		Chapter 5.2 - Ambiguous statement removed

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1 Introduction

The emCON Base Bvari is a carrier board for CPU modules of emtrion´s emCON family.

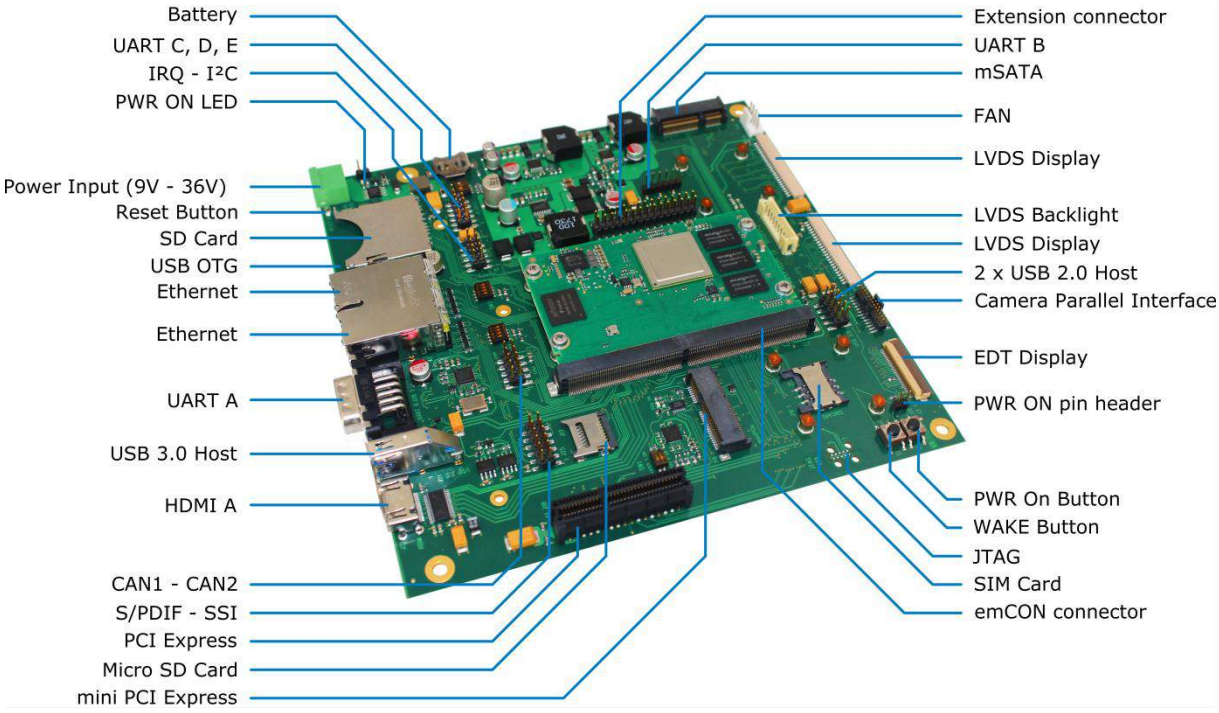
The Bvari supports high speed interfaces like PCI Express, mini PCI Express, mSATA, USB 3.0, HDMI or 1000Base-T Ethernet as well as common low speed interfaces like CAN, UART, I²C and SPI.

The board dimensions are designed according to the mini - ITX form factor, so it fits a wide range of standard cases if required.

This hardware manual describes the physical and electrical characteristics of the board. It covers the use of Bvari with all supported core modules but only gives additional details that are specific to the base. For this reason, it has to be used together with the manuals of the core.

Most interfaces of the Bvari base board are common to all core modules. Relevant differences between these boards are explicitly mentioned in this manual.

2 Connector Overview

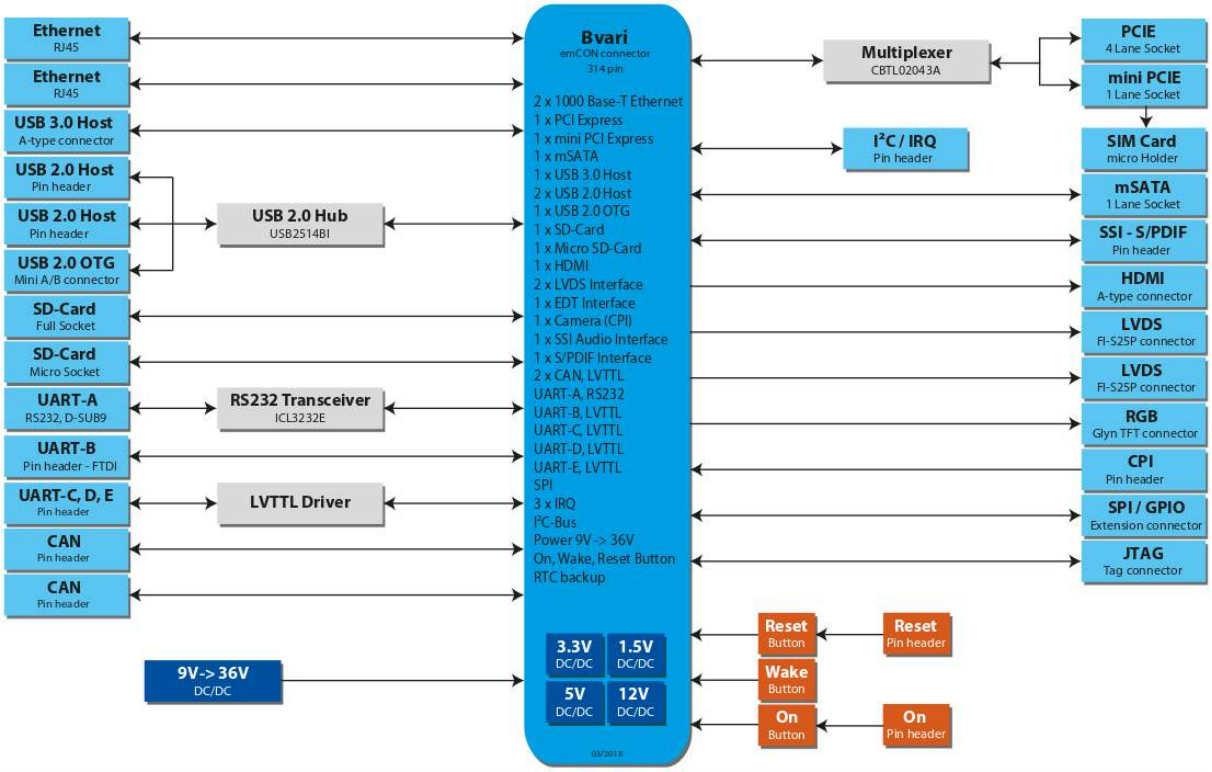


3 Handling Precautions

Please read the following notes prior to installing CPU module to the Bvari base board. They apply to all ESD (electrostatic discharge) sensitive components:

- Before installing a CPU module the Bvari base board needs to be configured depending on the used CPU module. Further information can be found later in this document.
- Before touching the base board it is recommended that you discharge yourself by touching a grounded object.
- Be sure all tools required for installation are electrostatic discharged as well.
- Before installing (or removing) a CPU module, unplug the power cable from your main supply.
- Also switch off the power supply before you plug or unplug cables at not ESD protected connectors.
- Handle the board with care and try to avoid touching its components or tracks.

4 Functional Overview



Block Diagram of the available Interfaces and their connectivity

4.1 List of features

The emCON Bvari Baseboard provides the following interfaces and functions. Depending to the used CPU module there will be some differences which are described later in the document.

- 314 pin emCON connector for processor modules
- 2 x 10/100/1000 Base-T Ethernet interface at Dual RJ45 connectors.
- PCI Express 4 Lane socket
- miniPCI Express socket for plugging half and full sized modules with SIM Card Holder *1
- mSATA socket
- USB 3.0 Host interface at USB-A connector
- USB 2.0 OTG Device interface at Type-MINI A/B connector
- 2 x USB 2.0 Host interface at pin header for external connectors
- SD Card socket
- Micro SD Card socket
- HDMI A connector
- 2 x LVDS interface with 12V power source for display backlight
- 18 bit RGB interface for EDT TDT displays with integrated capacitive touch controller
- Camera Parallel Interface (CPI) connector
- Audio S/PDIF Interface pin header *1
- Audio SSI Interface pin header *1
- 2 x CAN interface with LVTTL level at pin header *1
- RS232 serial interface with flow control RTS/CTS at DSub-9 connector
- Debug UART serial interface with flow control RTS/CTS at pin header
- 3 x UART serial interface (LVTTL) without flow control at pin header *1
- 30 pin Extension connector with the following features:
    - 2 x SPI
    - 1 x I^2C
    - 8 x GPIO
    - External reset input
- I^2C and 3 x IRQ at pin header
- ON, WAKE, RESET button
- 3-bit CPU boot mode control by DIP switches
- ARM compliant JTAG at TAG-connector
- Battery holder for RTC backup, CR1225
- 9V-36V power term block
- 5V (optional 12V) PWM controlled output for fan at 4-pin header

*1 expandable with PHY or driver boards. Ask emtrion for further information.

4.2 Interface supportability

The Interfaces of the Bvari Baseboard are differently supported by the various CPU modules. The list shows the possible interfaces for each CPU module.

Feature	RZ/G1C	RZ/G1E	RZ/G1H	RZ/G1M	i.MX6	LS1021A
Ethernet 1	100Base-T	1000Base-T	1000Base-T	1000Base-T	1000Base-T	-
Ethernet 2	-	100Base-T	100Base-T	-	-	1000Base-T
USB 3.0 Host	-	-	x1	x1	-	x1
USB 2.0 Host	x1	x1	x1	x1	x1	-
USB 2.0 Device	x1	x1	x1	x1	x1	-
USB 2.0 OTG	-	-	-	-	x1	x1
LCD Interface (RGB)	x1	x1	x1	x1	x1	-
LCD Interface (LVDS)	x1	x1	x2	x1	x2	-
LCD Interface (HDMI)	-	-	-	-	x1	-
PCIe	-	-	1 Lane	1 Lane	1 Lane	2 Lane
miniPCIe	-	-	x1	x1	x1	x1
mSATA	-	-	x1	x1	x1	x1
SD Card (full)	x1	x1	x1	x1	x1	x1
SD Card (micro)	x1	x1	x1	x1	x1	-
Camera (CPI)	x1	x1	x1	x1	x1	-
Audio (S/PDIF)	-	-	-	-	x1	-
Audio (SSI)	x1	x1	x1	x1	x1	-
CAN (LVTTL)	x2	x2	x2	x2	x2	x2
UART (LVTTL)	x3	x3	x5	x5	x5	x3
GPIO	x6	x6	x8	x8	x8	x5
SPI	x2	x2	x2	x2	x1	x1
I^2C	x2	x2	x2	x2	x2	x1

5 Functional Description

5.1 emCON interface

emCON is an emtrion specific interface between emCON CPU modules and carrier boards. The interface consists of a 314 pin MXM 3.0 connector (J17) which is commonly used for graphic modules.

Most of the peripheral functions of the CPU boards are available at this connection. Power is also supplied by the emCON interface.

Mechanical characteristics and a general pinout specification can be found later in this document. Individual differences of the CPU boards can be found in their appropriate manuals.

Note:
The pin assignment is specific for the emtrion boards and must not be used for other boards.

5.2 Ethernet

On the Backside of the Board two 10/100/1000 Mbit Ethernet interfaces are available via RJ45 dual connector (J22). To adapt the Ethernet interface to different PHYs on the CPU modules, the center taps of the magnetics can either be connected to the PHY specific DC voltage source (Current mode) on pin GBE**x**_VCC of the emCON connector or are AC coupled to GND by 100nF capacitors (Voltage mode).

This is done by the two DIP switches SW2 (GBE2 port) and SW3 (GBE1 port). To AC couple a port to GND, the 4 sliders of the respective DIP-switch has to be set to OFF, otherwise the port is connected to the DC Voltage. Two LEDs show the signal traffic (LINK_LED#, green) and 100 Mbit transfer speed (SPEED_LED#, yellow).

Watch:
The sliders of a DIP switcher (e.g. SW2) must always have the same position.
Note:
Voltage mode is mostly used in Gbit and current mode in 10/100 Mbit applications.

5.3 PCI Express

A PCI Express slot (J18) for up to four lanes is located on the baseboard. This serial and bidirectional point to point interface has to be activated via DIP-Switch “SW1”. Slider 1 has to be OFF and slider 2 has to be ON.

While the PCI Express slot is active, the mini PCI Express socket is deactivated. Simultaneous use of the two PCI Express interfaces is not possible.

5.4 miniPCI Express

There is a slot (J16) available for connecting half sized or full sized PCI Express mini card modules. The connector provides one PCI Express Lane, USB-Host, I^2C, SIM socket (J19), 3.3V and 1.5V power supply. This serial and bidirectional point to point interface has to be activated via DIP-Switch "SW1". Sliders 1 and 2 have to be OFF.

By driving the signal PCIE_DISABLE# of the emCON connector low it is possible to disable the wireless capabilities of a plugged mini PCI Express card. While the miniPCI Express card slot is active, the PCI Express socket is deactivated. Simultaneous use of these two PCI Express interfaces is not possible.

5.5 mSATA

A slot (J2) for mSATA (mini-SATA) is available on the Bvari Baseboard. One LED controlled by PIN 49 (DA/DSS) on the connector is used as activity signal.

5.6 USB 3.0 Host

On the backside of the baseboard one USB 3.0 Host connector (J21) is available. The super speed signals are wired directly to the emCON connector, while the signals for the USB 2.0 compatibility are supplied from a USB Hub.

5.7 USB 2.0 Host

Two USB 2.0 host interfaces are accessible at pin header (J6). The used EMC filters are dimensioned for high speed mode with 480 Mbaud. Furthermore one USB 2.0 host interface is located at the miniPCI Express socket. Each of the USB 2.0 host interfaces are supplied from a USB Hub which is connected to the USB port of the CPU board.

The following table shows which USB interface is connected to which port of the USB hub.

USB Hub Port	Connector	Function
1	USB 3.0 Host	USB 2.0
2	miniPCIe Socket	USB 2.0
3	USB 2.0 Host	USB 2.0
4	USB 2.0 Host	USB 2.0

As soon as the hardware configuration process is completed, the "PRTPWR" pins of the USB Hub ports enable the outputs of power switches which supply the VBUS of the USB Host connectors. If a port detects an over current condition, VBUS will be turned off to protect the circuitry from overloading. The power switches can provide up to 5W.

The switched VBUS signal is routed to the emCON connector. The CPU module has the possibility to check the availability of VBUS.

5.8 USB 2.0 Device/OTG

A USB Device/OTG interface is available at the USB Mini-AB connector (J7). The data signals are directly connected to the emCON connector. Therefore all characteristics of the interface depend on the used CPU module.

The VBUS power switch is controlled by the signal USBOTG_PEN# of the CPU module and by the ID pin of the USB connector. Only if the USBOTG_ID signal is driven low by a connected OTG cable, the VBUS supply can be driven by the CPU module (USBOTG_PEN#) with a maximum of 2A.

The CPU is an OTG B-device (Client respectively Device) if nothing or a mini USB-B OTG connector is plugged in (ID = floating). With a plugged mini USB-A OTG connector (ID=GND) the CPU gets an OTG A-device (Host) and supplies the VBUS Pin.

The interface of the CPU module must be configured according to the level of the ID pin.

5.9 Micro SD-Card

A micro SD-Card socket (J13) is available. All signals are directly connected to the emCON interface SDC2 without any further provisions. Thus the characteristics depend on the used CPU board. The write protect signal of the SDC2 interface is connected to GND, so the micro SD-Card is always writeable. The hinge type socket has no options for a card detect, therefore the card detect signal of the SDC2 interface is also connected to GND.

5.10 SD-Card

On the backside a SD-Card socket (J29) is available. All signals are directly connected to the emCON interface SDC1 without any further provisions. Thus the characteristics depend on the used CPU board. Write protect and card detect is available at the socket.

5.11 Graphic Output

All display interfaces are directly driven by the CPU module via emCON connector. Therefore the characteristics of the interfaces depend on the used CPU module. The Bvari provides connectors for different display types.

- HDMI A connector J31
- LVDS connectors J27 and J28
- EDT display connector J3

5.11.1 HDMI

A standard monitor with HDMI interface can be connected at connector (J31) at the backside of the baseboard. The HDMI signals of the emCON connector are directly routed to it.

The I^2C interface for display identification (DDC) and the hot plug signal are also connected to the emCON pins.

5.11.2 LVDS

The LVDS connectors (J26, J27) are provided to connect TFT displays with LVDS interface. The pinout of the connector conforms to a family of TFT displays that is available from the company EDT. Four differential data pairs are connected to drive displays with either 18 bpp or 24 bpp color depth.

The signals LVDS1_BL_CTRL and LVDS1_BL_EN are routed to the pin header J1 together with a 12V supply for additional backlight support.

5.11.3 EDT TFT

A TFT LCD display with 18 bpp color resolution can be connected to the connector (J3). The pinout of the connector conforms to a family of TFT displays that is available from the company EDT. Besides that other TFT displays can also be connected with an appropriate adapter.

In principal these displays are offered either with integrated 4-wire resistive touch interface or with projected capacitive touch interface. The connector J3 is realized only for displays with capacitive touch interface. In this case a capacitive touch controller is located on the back side of the display. The touch controller is connected to the I^2C interface I2C1 of the emCON connector. The touch controller's wake input is driven by GPIO_4. The touch controller's interrupt output is connected to the signal IRQ_TOUCH2#. Further details about the touch controller can be found in the display's data sheet.

The backlight of the display is enabled by the signal LCD_BL_EN of the emCON interface. Additionally the brightness can be controlled by the signal LCD_BL_CTRL. This signal should be driven by a PWM output.

The 3.3 V power supply of a display, which is connected to J3, can be switched on and off by the signal LCD_PANEL_EN from the emCON connector. The power supply is enabled while the signal is high.

Since different displays use different pixel clock slopes to latch the data the active clock slope can be configured by the resistors R51 and R116. By default the pixel clock signal is inverted, therefore R51 is placed and R116 is unplaced. For a not inverted clock signal, R51 have to be unplaced and R116 placed.

5.12 Camera Parallel Interface

The interface CPI1 of the emCON connector is specified to connect a CMOS camera sensor with 8 bit data bus, pixel clock, HSYNC and VSYNC. These signals are routed to the pin header (J12).

Besides the camera data interface the I^2C interface I2C1 and 3.3V and 5V supplies are available at the 26 pos pin header.

5.13 Audio

The pin header (J25) includes two audio interfaces:

- S/PDIF
- I^2S

Additional an I^2C interface and a 3.3V supply is available at the pin header. With the Bvari specific expansion boards, various audio plug options can be provided.

5.14 CAN

The LVTTL transmit and receive signals of two CAN channels are directly connected from the emCON connector to the pin header (J5). Additionally 3.3 V supply and GND are connected.

A connection to a CAN network is possible with the Bvari specific expansion boards.

5.15 UART

The Bvari provides connectors for up to 5 serial interfaces.

5.15.1 UART A (Debug)

Interface UART A on pin header (J8) is connected directly as LVTTL signal to the emCON connector. Besides the data lines, RTS and CTS flow control signals are connected. The pinout is designed for FTDI connections.

5.15.2 UART B

Interface UART B is realized as RS232 interface at a standard D-Sub 9 connector (J28). Besides the data lines, RTS and CTS flow control signals are connected. The RS232 transceiver is located on the baseboard.

5.15.3 UART C, D, E

The interfaces UART C, UART D and UART E share connector (J24). They are connected directly as LVTTL signals to the emCON connector. They all consist only of transmit and receive lines.

5.16 Extension Connector

The pin header (J14) features 8 x GPIO, 2 x SPI interface, an I^2C-Bus interface, an active low reset input signal Bvari_RESO# and an active low reset output signal RESO#_EXTCON.

The GPIO pins GPIO_[8:1] and the SPI interfaces SPI1 and SPI2 are directly connected to the emCON connector. The output high level of the I^2C interface is 3.3V

5.17 JTAG

For debugging emCON CPU modules the JTAG signals are provided at the emCON connector and routed to the pin header (J30). The pinout conforms to the ARM JTAG specification.

5.18 I²C Bus

At the emCON Base Bvari are several I²C-Bus clients, which connect directly or via I²C-hub to the emCON connector. It is not allowed to put two or more I²C-bus hubs in series.

The list below shows the connection tree for the I2C1 signal:

Device	Connection	Slave	Chip Address (7Bit)
EDT Interface	Hub port 2	Touch controller	Depends on used touch controller
Camera – CPI	Hub port 3	CAM-IF	Depends on used camera
PCIe	Hub port 4	PCIe - Module	Depends on used module
mini PCIe	Hub port 4	miniPCIe - Module	Depends on used module
mSATA	Hub port 4	mSATA - Module	Depends on used module
Board ID	direct		0x3a
Audio	Hub port 1		Depends on used module
Extension Connector	direct		Depends on used device

Further addresses are allocated by I²C devices used at the CPU modules. Please refer to the hardware manual of the used CPU module.

The I²C Signal at the Extension Connector (J14) and the I2C2 Signal at the pin header (J4) are not ESD protected. Before touching these connectors it is recommended that you discharge yourself by touching a grounded object.

5.19 Board ID

A plugged CPU module can read the board ID code via the I²C interface I2C1 at the 7-bit address 0x3A.

5.20 FAN

A connector (J9) is provided to supply a fan with 5V (optional 12V). By a low side switch, which is controlled by the PWM signal PWM_FAN of the emCON connector the fan speed can be controlled.

5.21 Reset Button

A reset button (S3) is placed on the baseboard. A reset of the CPU module (e.g. by a software reset) also resets the Bvari base board.

Pressing this button immediately lows the signal POWERFAIL# of the emCON interface. Pressing the button longer than 4 s additionally causes the signal BVARI_RESI# of the emCON interface to turn low. The signal RESO#_EXTCON at the extension connector (J14) has the same behavior as the button S3.

5.22 WAKE and ON Button

Two push buttons marked as WAKE and ON are provided for power management features. While pressed, these keys drive the appropriate signals WAKEUP# and ON_OFF# of the emCON interface low. Furthermore an external ON button can be plugged at the pin header (J10).

The use of these buttons depends on the plugged CPU module.

5.23 Power On LED

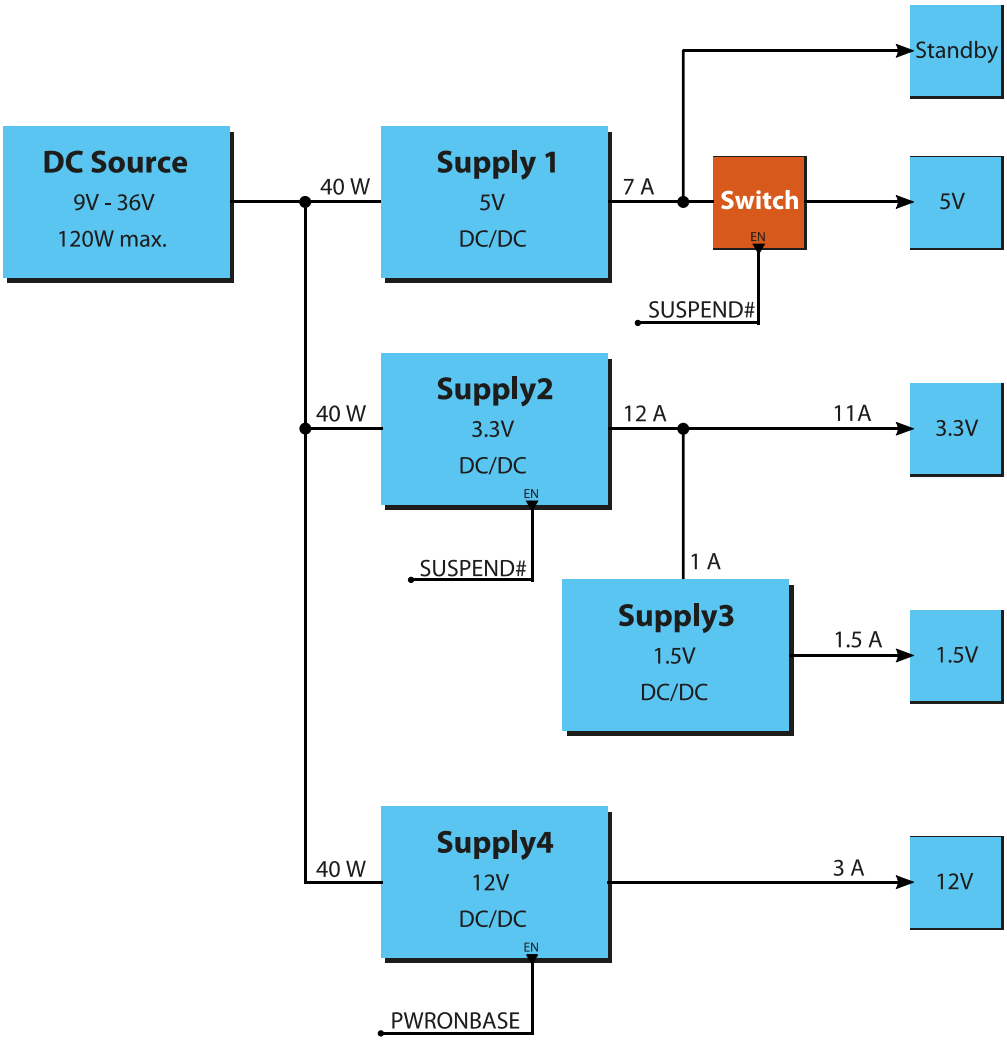
The LED (D5) is active if the signals POWER_ON_BASE and SUSPEND# are both high. An external LED can be plugged at the pin header (J11), which supplies 3.3V when the board is on.

5.24 Backup Battery

A battery holder J12 for lithium coin cell CR1225 is available to supply the RTC of the CPU boards.

5.25 Power Supply

The Bvari has a wide range power supply input at the term-block (J20), on the backside of the baseboard. The primary power supply can vary between +9 V and +36 V (± 5%) with a maximum power consumption of 120 W. The voltage is protected from reverse polarity.



For the most operating situations a typical total power consumption of 50 W is realistic.

Optional the right angle term block (J20) can be replaced with a vertical term block (J15), where an adapter to an external power socket (exp. 2mm power jack) can be attached. This is useful for case mounting options. In this case the electrical specifications of the used power socket have to be considered especially the point maximum voltage and current consumption.

5.25.1 5 V Supply

The 5 Volt on the baseboard are generated directly from the main power supply by a buck switch. There are two 5 V power rails. One is constant and used only for the VCC_STANDBY input for the CPU module. The second is switched and generated to supply the interfaces and all other components. The switched 5 V is active as soon as the SUSPEND# signal from the CPU module is higher than 3.0 V and the 5 V Voltage is generally stabilized.

5.25.2 3.3 V Supply

The 3.3 Volt on the baseboard are generated directly from the main power supply by a buck switch. The buck switch is enabled, if the SUSPEND# signal from the CPU module is higher than 3.0 V and the 5 V Voltage is generally stabilized. This feature is realized to avoid latch up effects at power up and power down.

5.25.3 12 V Supply

The 12 Volt on the baseboard are generated directly from the main power supply by a buck boost switch. The buck switch is enabled, if the POWER_ON_BASE signal from the CPU module is pulled high. This supply is needed for PCI Express modules and the LVDS backlight support.

5.25.4 1.5 V Supply

The 1.5 Volt on the baseboard are generated from the 3.3 V power supply by a buck switch. So, if the 3.3 V supply is deactivated, the 1.5 Volt is too. This supply is needed for miniPCI Express and the mSATA modules.

6 Pin Assignments

6.1 emCON connector (J17)

Pin	Signal	Interface		Signal	Pin
1E20	GND	Power		VCC 5V	2E20
1E19	GND			VCC 5V	2E19
1E18	GND			VCC 5V	2E18
1E17	GND			VCC 5V	2E17
1E16	GND			VCC 5V	2E16
1E15	GND			VCC 5V	2E15
1E14	GND			VCC 5V	2E14
1E13	GND			VCC 5V	2E13
1E12	GND			VCC 5V	2E12
1E11	GND			VCC 5V	2E11
1E10	BAT			VCC_STANDBY	2E10
1E9	BOOT_MODE_3	Manufacturing	Misc	TAMPER	2E9
1E8	BOOT_MODE_2			POWER_ON_BASE	2E8
1E7	BOOT_MODE_1			IRQ_TOUCH1#	2E7
1E6	JTAG_RESET#			IRQ_TOUCH2#	2E6
1E5	JTAG_MOD			IRQ_1	2E5
1E4	JTAG_TRST#			IRQ_2	2E4
1E3	JTAG_TMS			IRQ_3	2E3
1E2	JTAG_TDO			RESO#	2E2
1E1	JTAG_TDI			RESI#	2E1
1	JTAG_RTCK			POWERFAIL#	2
3	JTAG_VCC			SUSPEND#	4
5	JTAG_TCK			ON_OFF#	6
7	GND	Power		WAKEUP#	8
9	UART-A_RXD	UART-A		PWM_FAN	10
11	UART-A_TXD		Power	GND	12
13	UART-A_RTS		UART-C	UART-C_RXD	14
15	UART-A_CTS			UART-C_TXD	16
17	UART-B_RXD	UART-B	UART-D	UART-D_RXD	18
19	UART-B_TXD			UART-D_TXD	20
21	UART-B_RTS		UART-E	UART-E_RXD	22
23	UART-B_CTS			UART-E_TXD	24
25	GND	Power		GND	26

27	GPIO_1	**GPIO**	**PCIe1**	PCIe_DISABLE#	**28**
29	GPIO_2			PCIe_RESET#	**30**
31	GPIO_3			PCIe_CLK1_P	**32**
33	GPIO_4			PCIe_CLK1_N	**34**
35	GPIO_5			GND	**36**
37	GPIO_6			PCIe_RX1_P	**38**
39	GPIO_7			PCIe_RX1_N	**40**
41	GPIO_8			PCIe_TX1_P	**42**
43	GND	**Power**		PCIe_TX1_N	**44**
45	n/c	**RGB**	**PCIe2**	GND	**46**
47	n/c			PCIe_RX2_P	**48**
49	n/c			PCIe_RX2_N	**50**
51	n/c			PCIe_TX2_P	**52**
53	n/c			PCIe_TX2_N	**54**
55	n/c			GND	**56**
57	LCD_D17			PCIe_CLK2_P	**58**
59	LCD_D16			PCIe_CLK2_N	**60**
61	LCD_D15		**PCIe3**	GND	**62**
63	LCD_D14			PCIe_RX3_P	**64**
65	LCD_D13			PCIe_RX3_N	**66**
67	LCD_D12			PCIe_TX3_P	**68**
69	GND			PCIe_TX3_N	**70**
71	LCD_D11		**PCIe4**	GND	**72**
73	LCD_D10			PCIe_RX4_P	**74**
75	LCD_D9			PCIe_RX4_N	**76**
77	LCD_D8			PCIe_TX4_P	**78**
79	LCD_D7			PCIe_TX4_N	**80**
81	LCD_D6		**Power**	GND	**82**
83	LCD_D5		**RFU / Parallel Camera (CPI2)**	n/c	**84**
85	LCD_D4			n/c	**86**
87	LCD_D3			n/c	**88**
89	LCD_D2			n/c	**90**
91	LCD_D1			n/c	**92**
93	LCD_D0			n/c	**94**
95	LCD_PCLK			n/c	**96**
97	LCD_HSYNC			n/c	**98**
99	LCD_VSYNC			n/c	**100**
101	LCD_DE			n/c	**102**
103	LCD_BL_CTRL			n/c	**104**
105	LCD_BL_EN			n/c	**106**
107	LCD_PANEL_EN			n/c	**108**
109	CAN2_RX	**CAN2**	**CAN1**	CAN1_RX	**110**
111	CAN2_TX			CAN1_TX	**112**
113	GND	**Power**		GND	**114**

115	SPI1_SCK	**SPI1**	**SPI2**	SPI2_CS1#	**116**
117	SPI1_CS0#			SPI2_CS0#	**118**
119	SPI1_MOSI/D0			SPI2_MOSI	**120**
121	SPI1_MISO/D1			SPI2_MISO	**122**
123	SPI1_CS1#/D2			SPI2_SCK	**124**
125	SPI1_D3				
133	CPI1_D0	**Parallel Camera (CPI1**			
135	CPI1_D1		**MIPI CSI-2**	n/c	**134**
137	CPI1_D2			n/c	**136**
139	CPI1_D3			n/c	**138**
141	CPI1_D4			n/c	**140**
143	CPI1_D5			n/c	**142**
145	CPI1_D6			n/c	**144**
147	CPI1_D7			n/c	**146**
149	CPI1_CLK			n/c	**148**
151	CPI1_HSYNC			n/c	**150**
153	CPI1_VSYNC			n/c	**152**
155	GND	**Power**		GND	**154**
157	LVDS1_BL_CTRL	**LVDS 1**	**I2C 1**	I2C1_SCL	**156**
159	LVDS1_BL_EN			I2C1_SDA	**158**
161	TP2		**I2C 2**	I2C2_SCL	**160**
163	GND			I2C2_SDA	**162**
165	LVDS1_D0_P		**LVDS 2**	LVDS2_D0_P	**164**
167	LVDS1_D0_N			LVDS2_D0_N	**166**
169	LVDS1_D1_P			LVDS2_D1_P	**168**
171	LVDS1_D1_N			LVDS2_D1_N	**170**
173	LVDS1_D2_P			LVDS2_D2_P	**172**
175	LVDS1_D2_N			LVDS2_D2_N	**174**
177	LVDS1_D3_P			LVDS2_D3_P	**176**
179	LVDS1_D3_N			LVDS2_D3_N	**178**
181	LVDS1_CLK_P			LVDS2_CLK_P	**180**
183	LVDS1_CLK_N			LVDS2_CLK_N	**182**
185	GND	**Power**		GND	**184**

187	SPDIF_IN	**SPDIF**	**HDMI**	HDMI_CLK_P	**186**
189	SPDIF_OUT			HDMI_CLK_N	**188**
191	I2S_RXD	**I2S**		HDMI_D0_P	**190**
193	I2S_TXD			HDMI_D0_N	**192**
195	I2S_TXFS			HDMI_D1_P	**194**
197	I2S_TXC			HDMI_D1_N	**196**
199	I2S_RXFS			HDMI_D2_P	**198**
201	I2S_RXC			HDMI_D2_N	**200**
203	I2S_MCLK			GND	**202**
205	SATA_RX_P	**SATA**		HDMI_HPD	**204**
207	SATA_RX_N			HDMI_CEC	**206**
209	SATA_TX_P			HDMI_SCL	**208**
211	SATA_TX_N			HDMI_SDA	**210**
213	GND	**Power**		GND	**212**
215	USBOTG_ID	**USB OTG**	**USB Host**	GND	**214**
217	USBOTG_D_P			USBH_D_P	**216**
219	USBOTG_D_N			USBH_D_N	**218**
221	USBOTG_VBUS			USBH_VBUS	**220**
223	USBOTG_OC#			USBH_OC#	**222**
225	USBOTG_PEN#			USBH_PEN#	**224**
227	n/c			USBH_SSRX_P	**226**
229	n/c			USBH_SSRX_N	**228**
231	GND			GND	**230**
233	n/c			USBH_SSTX_P	**232**
235	n/c			USBH_SSTX_N	**234**
237	GND	**Power**		GND	**236**
239	SDC1_CLK	**SDC 1**	**SDC 2**	SDC2_CLK	**238**
241	SDC1_CMD			SDC2_CMD	**240**
243	SDC1_D0			SDC2_D0	**242**
245	SDC1_D1			SDC2_D1	**244**
247	SDC1_D2			SDC2_2	**246**
249	SDC1_D3			SDC2_3	**248**
251	SDC1_CD#			GND	**250**
253	SDC1_WP			GND	**252**
255	GND	**Power**		GND	**254**
257	GBE1_MDI0_P	**Gigabit Ethernet 1**	**Gigabit Ethernet 2**	GBE2_MDI3_N	**256**
259	GBE1_MDI0_N			GBE2_MDI3_P	**258**
261	GBE1_MDI1_P			GBE2_MDI2_N	**260**
263	GBE1_MDI1_N			GBE2_MDI2_P	**262**
265	GBE1_MDI2_P			GBE2_MDI1_N	**264**
267	GBE1_MDI2_N			GBE2_MDI1_P	**266**
269	GBE1_MDI3_P			GBE2_MDI0_N	**268**
271	GBE1_MDI3_N			GBE2_MDI0_P	**270**
273	GND			GND	**272**
275	GBE1_LED_10_100#			GBE2_LED_10_100#	**274**
277	GBE1_LED_1000#			GBE2_LED_1000#	**276**
279	GBE1_LED_TRAFFIC#			GBE2_LED_TRAFFIC#	**278**
281	GBE1_VCC			GBE2_VCC	**280**

6.2 Ethernet (J22)

Type: Dual Rj45 Jack with magnetic (2x16 pin)

Pin	Signal
A1	GBE2 - TRD3_C
A2	GBE2 - TRD3_N
A3	GBE2 - TRD3_P
A4	GBE2 - TRD2_P
A5	GBE2 - TRD2_N
A6	GBE2 - TRD2_C
A7	GBE2 - TRD4_C
A8	GBE2 - TRD4_P
A9	GBE2 - TRD4_N
A10	GBE2 - TRD1_N
A11	GBE2 - TRD1_P
A12	GBE2 - TRD1_C
A13	GBE2 - LEDY_K
A14	GBE2 - LEDY_A
A15	GBE2 - LEDG_K, LEDO_A
A16	GBE2 - LEDG_K, LEDO_A

Pin	Signal
B1	GBE1 - TRD3_C
B2	GBE1 - TRD3_N
B3	GBE1 - TRD3_P
B4	GBE1 - TRD2_P
B5	GBE1 - TRD2_N
B6	GBE1 - TRD2_C
B7	GBE1 - TRD4_C
B8	GBE1 - TRD4_P
B9	GBE1 - TRD4_N
B10	GBE1 - TRD1_N
B11	GBE1 - TRD1_P
B12	GBE1 - TRD1_C
B13	GBE1 - LEDY_K
B14	GBE1 - LEDY_A
B15	GBE1 - LEDG_K, LEDO_A
B16	GBE1 - LEDG_K, LEDO_A

6.3 PCI Express (J18)

Type: 4 Lane connector

Pin	Signal	Pin	Signal
B1	12V	**A1**	pulled GND
B2	12V	**A2**	12V
B3	12V	**A3**	12V
B4	GND	**A4**	GND
B5	I2C1_SCL	**A5**	pulled GND
B6	I2C1_SDA	**A6**	pulled 3.3V
B7	GND	**A7**	n/c
B8	3.3V	**A8**	pulled 3.3V
B9	pulled GND	**A9**	3.3V
B10	3.3V AUX	**A10**	3.3V
B11	WAKEUP#	**A11**	PCIE_RESET#
B12	n/c	**A12**	GND
B13	GND	**A13**	PCIE_CLK1_P
B14	PCIE_TX1_P	**A14**	PCIE_CLK1_N
B15	PCIE_TX1_N	**A15**	GND
B16	GND	**A16**	PCIE_RX1_P
B17	TP6	**A17**	PCIE_RX1_N
B18	GND	**A18**	GND
B19	PCIE_TX2_P	**A19**	n/c
B20	PCIE_TX2_N	**A20**	GND
B21	GND	**A21**	PCIE_RX2_P
B22	GND	**A22**	PCIE_RX2_N
B23	PCIE_TX3_P	**A23**	GND
B24	PCIE_TX3_N	**A24**	GND
B25	GND	**A25**	PCIE_RX3_P
B26	GND	**A26**	PCIE_RX3_N
B27	PCIE_TX4_P	**A27**	GND
B28	PCIE_TX4_N	**A28**	GND
B29	GND	**A29**	PCIE_RX4_P
B30	n/c	**A30**	PCIE_RX4_N
B31	TP7	**A31**	GND
B32	GND	**A32**	n/c

6.4 miniPCI Express (J16)

Type: 52 pin socket

Pin	Signal	Pin	Signal
1	WAKEUP#	2	3V3
3	n/c	4	GND
5	n/c	6	1V5
7	n/c	8	SIM_PWR
9	GND	10	SIM_DATA
11	PCIE_CLK1_N	12	SIM_CLK
13	PCIE_CLK1_P	14	SIM_RESET
15	GND	16	SIM_VPP
17	n/c	18	GND
19	n/c	20	PCIE_DISABLE#
21	GND	22	PCIE_RESET#
23	PCIE_RX1_N	24	3V3
25	PCIE_RX1_P	26	GND
27	GND	28	1V5
29	GND	30	I2C1_SCL
31	PCIE_TX1_N	32	I2C1_SDA
33	PCIE_TX1_P	34	GND
35	GND	36	USBH_P2_DM
37	GND	38	USBH_P2_DP
39	3V3	40	GND
41	3V3	42	TP3
43	GND	44	TP4
45	n/c	46	TP5
47	n/c	48	1V5
49	n/c	50	GND
51	n/c	52	3V3

6.5 SIM Card (J19)

Type: 7 pin socket

Pin	Signal
1	VCC
2	RES
3	CLK
5	GND
6	VPP
7	IO

6.6 mSATA (J2)

Type: 52 Pin socket

Pin	Signal	Pin	Signal
1	n/c	2	3.3V
3	n/c	4	GND
5	n/c	6	1.5V
7	n/c	8	n/c
9	GND	10	n/c
11	n/c	12	n/c
13	n/c	14	n/c
15	GND	16	n/c
17	n/c	18	GND
19	n/c	20	n/c
21	GND	22	n/c
23	SATA_RX_P	24	3.3V
25	SATA_RX_N	26	GND
27	GND	28	1.5V
29	GND	30	I2C1_SCL
31	SATA_TX_N	32	I2C1_SDA
33	SATA_TX_P	34	GND
35	GND	36	n/c
37	GND	38	n/c
39	3.3V	40	GND
41	3.3V	42	n/c
43	TP10	44	n/c
45	n/c	46	n/c
47	n/c	48	1.5V
49	DAS/DSS LED	50	GND
51	Pulled GND	52	3.3V

6.7 USB 3.0 Host (J21)

Type: USB 3.0 A connector (9 pin)

Pin	Signal
1	VBUS
2	USBH_P1-
3	USBH_P1+
4	GND
5	USBH_SSRX_N
6	USBH_SSRX_P
7	GND
8	USBH_SSTX_N
9	USBH_SSTX_P

6.8 USB OTG (J7)

Type: USB mini AB connector (5 pin)

Pin	Signal
1	VBUS
2	USBOTG_D_N
3	USBOTG_D_P
4	USBOTG_ID
5	GND

6.9 USB 2.0 Host (J6)

Type: 2 pos 10 pin header

Pin	Signal	Pin	Signal
1	VBUS	2	VBUS
3	USBH_P4-	4	USBH_P3-
5	USBH_P4+	6	USBH_P3+
7	GND	8	SGND
9	n/c	10	n/c

6.10 LVDS (J26, J27)

Type: 2 x 30 pin connector

Pin	Signal
1	n/c
2	n/c
3	3.3V
4	GND
5	LVDS1_CLK_N
6	LVDS1_CLK_P
7	3.3V
8	GND
9	LVDS1_D0_N
10	LVDS1_D0_P
11	LVDS1_D1_N
12	LVDS1_D1_P
13	LVDS1_D2_N
14	LVDS1_D2_P
15	LVDS1_D3_N
16	LVDS1_D3_P
17	n/c
18	n/c
19	n/c
20	n/c
21	n/c
22	n/c
23	n/c
24	n/c
25	n/c
26	n/c
27	pulled 3.3V
28	GND
29	n/c
30	n/c

Pin	Signal
1	n/c
2	n/c
3	3.3V
4	GND
5	LVDS2_CLK_N
6	LVDS2_CLK_P
7	3.3V
8	GND
9	LVDS2_D0_N
10	LVDS2_D0_P
11	LVDS2_D1_N
12	LVDS2_D1_P
13	LVDS2_D2_N
14	LVDS2_D2_P
15	LVDS2_D3_N
16	LVDS2_D3_P
17	n/c
18	n/c
19	n/c
20	n/c
21	n/c
22	n/c
23	n/c
24	n/c
25	n/c
26	n/c
27	pulled 3.3V
28	GND
29	n/c
30	n/c

6.11 LVDS Backlight (J1)

Type: 5 pin connector

Pin	Signal
1	12V
2	LVDS1_BL_CTRL
3	GND
4	GND
5	LVDS1_BL_EN

6.12 HDMI (J31)

Type: 19 pin connector

Pin	Signal
1	HDMI_D2_P
2	GND
3	HDMI_D2_N
4	HDMI_D1_P
5	GND
6	HDMI_D1_N
7	HDMI_D0_P
8	GND
9	HDMI_D0_N
10	HDMI_CLK_P
11	GND
12	HDMI_CLK_N
13	TMDS_CEC
14	n/c
15	I2C1_SCL
16	I2C1_SDA
17	GND
18	5V
19	HDMI_HPD

6.13 EDT (J3)

Type: 40 pin connector

Pin	Signal
1	n/c
2	RESO#_DISP
3	BLUE LCD_D5
4	BLUE LCD_D4
5	BLUE LCD_D3
6	BLUE LCD_D2
7	BLUE LCD_D1
8	BLUE LCD_D0
9	GND
10	GREEN LCD_D11
11	GREEN LCD_D10
12	GREEN LCD_D09
13	GREEN LCD_D08
14	GREEN LCD_D07
15	GREEN LCD_D06
16	GND
17	RED LCD_D17
18	RED LCD_D16
19	RED LCD_D15
20	RED LCD_D14
21	RED LCD_D13
22	RED LCD_D12
23	GND
24	LCD_PCLK_OUT
25	GPIO4 / WAKE#
26	LCD_HSYNC
27	LCD_VSYNC
28	LCD_DE
29	LCD_BL_EN
30	3.3V
31	GND
32	GND
33	3.3V
34	3.3V
35	IRQ_TOUCH2#
36	LCD_BL_CTRL
37	I2C1_SCL
38	TP9
39	I2C1_SDA
40	TP8

6.14 Camera Parallel Interface (J12)

Type: 2 pos 13 pin header, 1.27 mm pitch

Pin	Signal	Pin	Signal
1	n/c	2	GND
3	5V	4	GND
5	CPI1_D0	6	CPI1_D1
7	CPI1_D2	8	CPI1_D3
9	CPI1_D4	10	CPI1_D5
11	CPI1_D6	12	CPI1_D7
13	GND	14	GND
15	CPI1_VSYNC	16	n/c
17	CPI1_HSYNC	18	GND
19	CPI1_CLK	20	BVARI_RESO#
21	3.3V	22	GND
23	I2C1_SCL	24	I2C1_SDA
25	3.3V	26	GND

6.15 SD Card (J29)

Type: SD Sockel, 13 Pin

Pin	Signal
1	SDC1_D3
2	SDC1_CMD
3	GND
4	3V3
5	SDC1_CLK
6	GND
7	SDC1_D0
8	SDC1_D1
9	SDC1_D2
10	SDC1_CD#
11	SDC1_WP
12	GND
13	GND

6.16 micro SD Card (J13)

Type: microSD Sockel hinge, 12 Pin

Pin	Signal
1	SDC2_D2
2	SDC2_D3
3	SDC2_CMD
4	3V3
5	SDC2_CLK
6	GND
7	SDC2_D0
8	SDC2_D1
9	GND
10	GND
11	GND
12	GND

6.17 Audio (J25)

Type: 2 pos 12 pin header

Pin	Signal	Pin	Signal
1	GND	2	3.3V
3	I2S_MCLK	4	SPDIF_OUT
5	I2S_RXC	6	SPDIF_IN
7	I2S_RXFS	8	GND
9	I2S_RXD	10	I2C1_SCL
11	I2S_TXD	12	I2C1_SDA

6.18 CAN (J5)

Type: 2 pos 10 pin header

Pin	Signal	Pin	Signal
1	3.3V	2	3.3V
3	GND	4	GND
5	CAN1_TX	6	CAN2_TX
7	CAN1_RX	8	CAN2_RX
9	n/c	10	n/c

6.19 IRQ / I2C2 (J4)

Type: 2 pos 10 pin header

Pin	Signal	Pin	Signal
1	IRQ_1	2	3.3V
3	IRQ_2	4	GND
5	IRQ_3	6	GND
7	GND	8	I2C2_SCL
9	GND	10	I2C2_SDA

6.20 Extension Connector (J14)

Type: 2 pos 30 pin connector

Pin	Signal	Pin	Signal
1	GND	**2**	3V3
3	SPI1_CS0#	**4**	SPI1_CS1#/D2
5	SPI1_SCK	**6**	SPI1_D3
7	SPI1_MISO/D1	**8**	GPIO_1
9	SPI1_MOSI/D0	**10**	GPIO_2
11	GND	**12**	GPIO_3
13	SPI2_CS0#	**14**	GPIO_4
15	SPI2_SCK	**16**	GPIO_5
17	SPI2_MISO	**18**	GPIO_6
19	SPI2_MOSI	**20**	GPIO_7
21	GND	**22**	GPIO_8
23	I2C1_SCL	**24**	BVARI_RESO#
25	I2C1_SDA	**26**	BVARI_EXTCON
27	GND	**28**	3V3
29	SPI2_CS1#	**30**	3V3

6.21 UART-A (J8)

Type: 6 pin header

Pin	Signal
1	GND
2	UART-A_RTS
3	3.3V
4	UART-A_RXD
5	UART-A_TXD
6	UART-A_CTS

6.22 UART-B (J28)

Type: DSUB-9 male

Pin	Signal
1	n/c
2	UART-B_RXD
3	UART-B_TXD
4	n/c
5	GND
6	n/c
7	UART-B_RTS
8	UART-B_CTS
9	n/c

6.23 UART- C, D, E (J24)

Type: 2 pos 12 pin header

Pin	Signal	Pin	Signal
1	3.3V	2	n/c
3	GND	4	n/c
5	UART_E_TXD	6	UART_C_RXD
7	UART_E_RXD	8	UART_C_TXD
9	UART_D_TXD	10	GND
11	UART_D_RXD	12	3.3V

6.24 JTAG (J30)

Type: TAG-Connect

Pin	Signal	Pin	Signal
1	JTAG_VCC	10	JTAG_RESET#
2	JTAG_TMS	9	JTAG_TRST#
3	GND	8	JTAG_TDI
4	JTAG_TCK	7	JTAG_RTCK
5	n/c	6	JTAG_TDO

6.25 RTC Battery Holder (J23)

Type: Battery Holder for CR1225

Pin	Signal
1	GND
2	BAT +

6.26 DC Power (J20, J15)

Type: 2 pin Term Block

Pin	Signal
1	VCC
2	GND

6.27 FAN (J9)

Type: 4 pin header

Pin	Signal
1	GND
2	5V / 12V
3	n/c
4	PWM_FAN_5V#

6.28 External ON Button (J10)

Type: 2 pin header

Pin	Signal
1	GND
2	ON_OFF#

6.29 External ON LED (J11)

Type: 2 pin header

Pin	Signal
1	3.3V
2	GND

7 Technical Characteristics

7.1 Electrical Specifications

Electrical Specification	
Supply Voltage	+9 -> 36V ±5%
Power consumption max.	max. 120W depending on core module and connected peripherals
Power consumption typ.	For the most operating situations a typical total power consumption between 10W and 50 W is realistic.

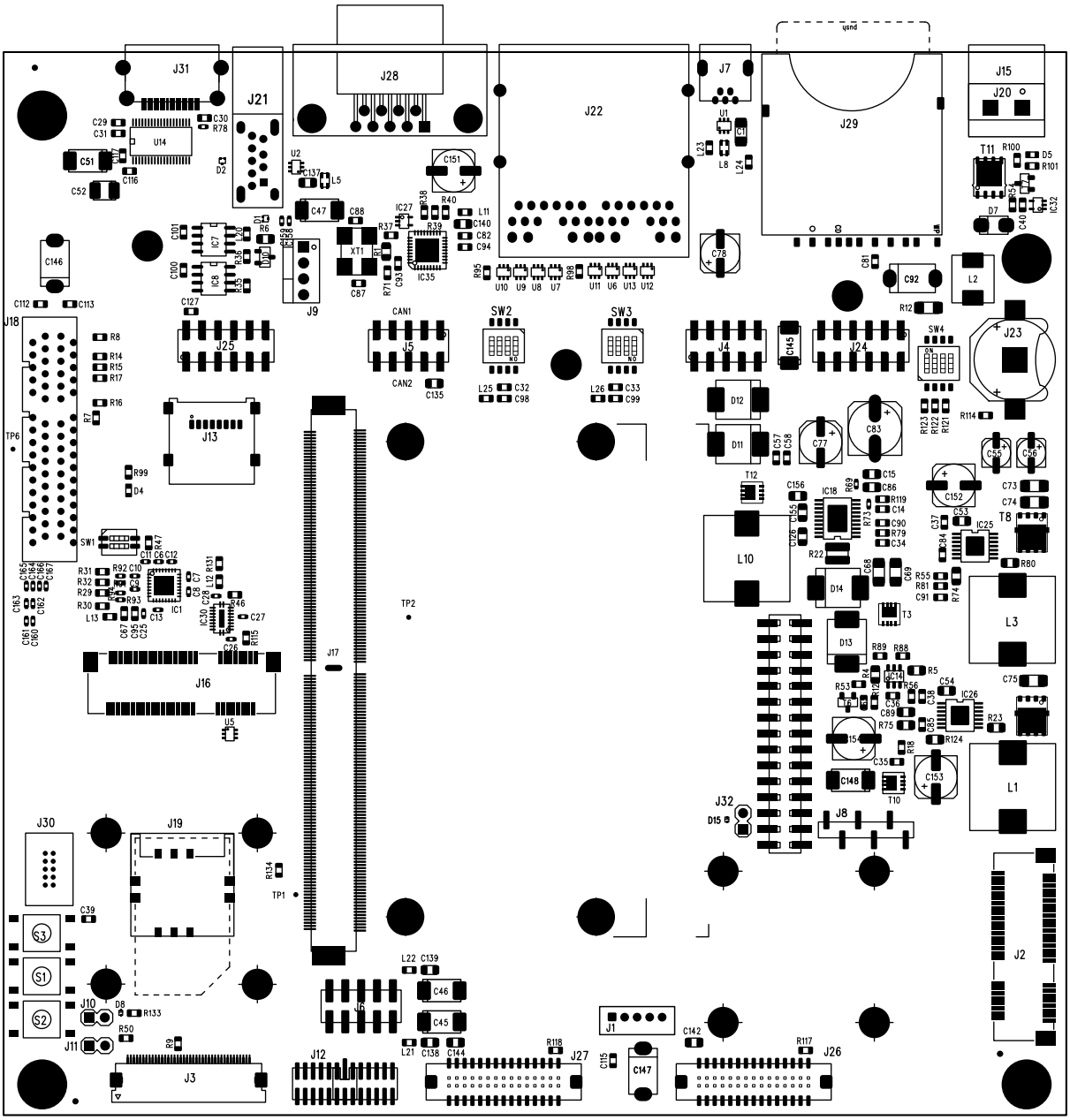
7.2 Environmental Specifications

Operating temperature	
Standard	-25°C ... +85°C
Storage temperature	
Storage temperature	-40 ... +125°C
Relative humidity	
Relative humidity	0 ... 95 %, non-condensing

7.3 Mechanical Specifications

Mechanical Specifications	
Weight	approx. 220 g
Board	glass-epoxy FR-4, UL-listed, 6 layers
Dimensions	170 mm x 170 mm x 32 mm

7.3.1 Assembly Drawing Top



7.3.2 Assembly Drawing Bottom