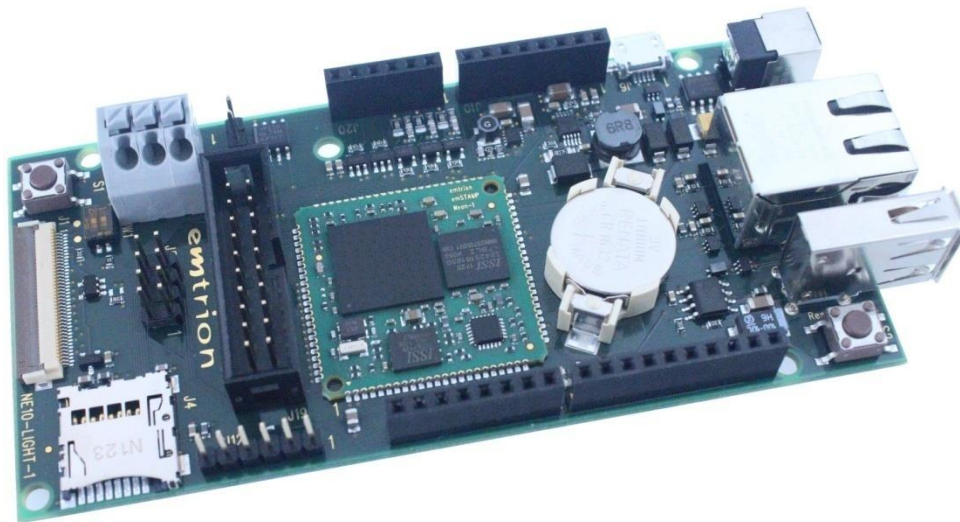


emSBC-Neon

Hardware Manual

Rev7 / 04.06.2020



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Rev	Date/Signature	Changes
1	15.06.2018/Sch	First revision
2	03.08.2018/Sch	Correct module name
3	14.08.2018/We	Changed module name to emSBC-Neon. Detailed description of FFC connector J1.
4	26.09.2018/Sch	Chapter (First Configuration) 4 removed
5	18.02.2020/We	Added chapter 5.3 for USB 2.0 Device with DFU mode. Updated chapter 6.2 with new pin assignment for USB2.0 Host. Updated chapter 6 "Pin Assignment" with STM32 port pins. Updated chapter 4 "Functional-Overview".
6	12.05.2020/We	Added dimensional drawing to chapter 7.
7	04.06.2020/We	Added chapter 6.14 with the pinout of the emSTAMP-Neon module. Added pin1 markings to drawings in chapter 4.1 and 8

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1 Introduction

The emSBC-Neon is a carrier board for the CPU module emSTAMP-Neon. For more details about the Neon processor module, read the emSTAMP-Neon hardware manual.

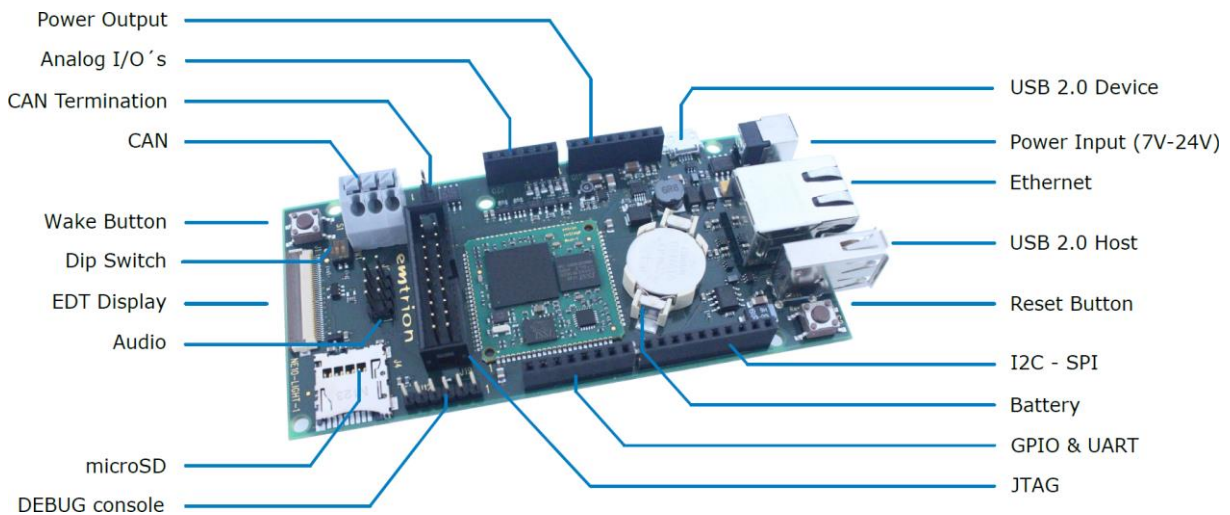
The board supports interfaces like 10/100 Mbit Ethernet, USB 2.0 full-speed Host and Device in full-speed, micro SDC and high speed CAN. In addition to the basic communication interfaces such as UART, JTAG, I²C and SPI, there are also 5 analog I/O's and 6 GPIO's available.

For multimedia applications, an 18 Bit RGB display port as well as an SAI audio interface is available on the board.

The processor and the board include a variety of functions required for industrial or multimedia applications. In addition, the board size and connector arrangement is designed according to the Arduino UNO form factor. So it can easily implement as a powerful replacement for existing Arduino projects.

This hardware manual describes the physical and electrical characteristics of the board. It covers the use of SBC-Neon with the supported core module 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.

2 Connector Overview



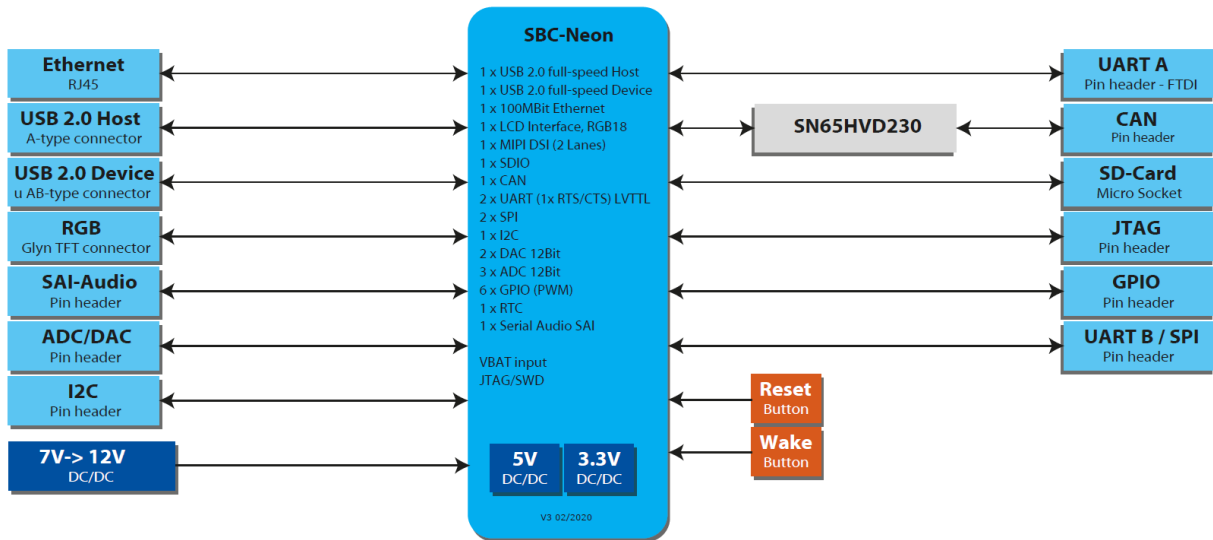
3 Handling Precautions

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

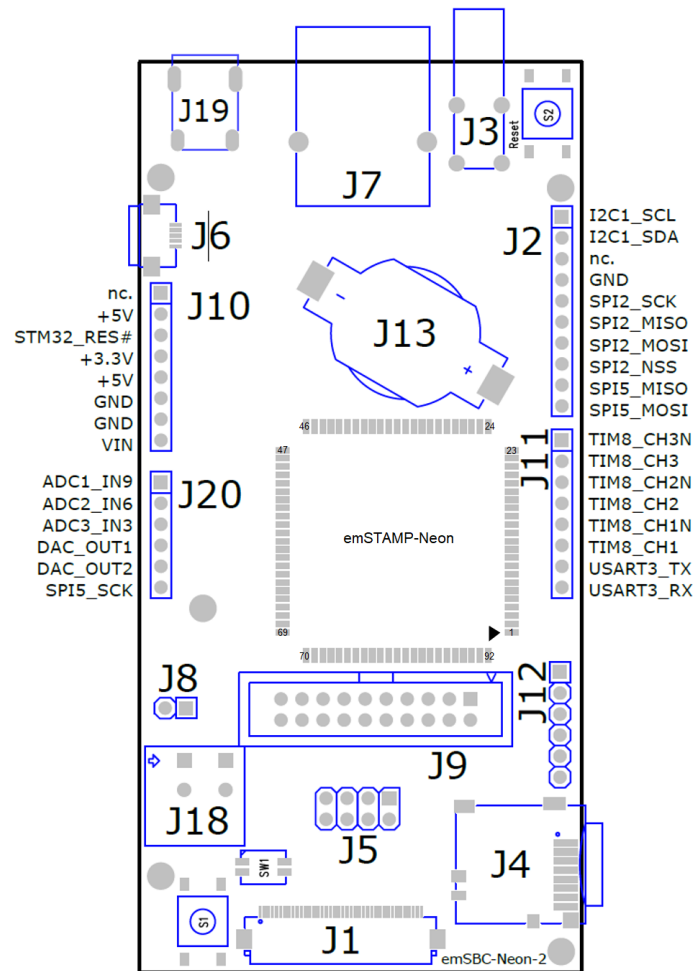
- Before installing a CPU module, the SBC-Neon base board needs to be configured depending on the used CPU module. Further information can be found later in this document.
- Before touching the base board, it is recommended that you discharge yourself by touching a grounded object.
- Be sure all tools 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

The Block Diagram of the available Interfaces and their connectivity:



4.1 Connector Assignment



5 List of features

The emSBC-Neon Baseboard provides the following interfaces and functions.

- 10/100 Base-T Ethernet interface at RJ45 connector
- USB 2.0 full-speed Host interface at USB-A connector
- USB 2.0 full-speed Device interface at microUSB-AB connector
- Micro SD Card socket
- 18 bit RGB interface for EDT TDT displays with integrated capacitive touch controller
- Serial Audio Interface (SAI)
- CAN controller
- 3 x ADC Analog Input
- 2 x DAC Analog Output
- 6 x GPIO
- Serial Interfaces
 - I²C
 - SPI
 - UART
- JTAG debug interface
- UART debug interface with flow control RTS/CTS
- WAKE, RESET button for power management
- Power Supply Input (7V – 24V)
- Power Supply Output (3,3V and 5V)
- 2-bit CPU boot mode control by DIP switches
- Battery holder for RTC backup, CR1632

5.1 Ethernet

A 10/100 Mbit ethernet interface is available via RJ45 connector (J7). The PHY on the CPU module uses the “current mode” for the 10/100 Mbit application. Therefore, the center taps of the magnetics are connected to a 3.3V DC voltage source. The traffic and speed LEDs on the RJ45 connector are not connected.

5.2 USB 2.0 Host

The USB 2.0 full-speed Host interface is available at the USB-A connector (J3) of the board.

As soon as the hardware configuration process is completed, the “USB_OTG_HS_VBUS_EN” signal from the CPU module enables the output of the power switch which supplies the VBUS to the USB-A connector. If the USB power switch detects an over current condition, the USB_OTG_HS_OC# signal will be pulled low to indicate the error state. The power switches can provide up to 5W.

5.3 USB 2.0 Device

The USB 2.0 full-speed Device interface is available at the microUSB-AB connector (J6) of the board.

This connector can be used as input voltage supply for the board. According to the USB 2.0 specification the maximum available current is limited to 500mA.

5.3.1 USB DFU mode

The microUSB connector J6 can also be used for the USB DFU mode to program the STM32Fxx9. To set the STM32Fxx9 to USB DFU mode follow this procedure:

- Set the DIP-Switch SW1 to switch-1=ON and switch-2=OFF
- Reset the board by pressing button S2 (or turn off and on the power supply)

Now the USB DFU mode of the STM32Fxx9 CPU is active and the internal flash can be programmed with an appropriate software tool (e.g. STM32CubeProgrammer). After successful programming the CPU has to be set back to normal boot mode (booting from flash):

- Set the DIP-Switch SW1 to switch-1=OFF and switch-2=OFF
- Reset the board by pressing button S2 (or turn off and on the power supply)

For more details concerning the available boot modes please refer to chapter 5.15 “Boot configuration DIP-Switch”.

5.4 Micro SD-Card

A micro SD-Card socket (J4) is available. All signals are directly connected to the CPU module without any further provisions. Thus the characteristic depends on the used CPU module. A write protect is not provided, so the micro SD-Card is always writeable. An active-low card detect signal is provided the socket.

5.5 EDT TFT

A TFT LCD display with 18 bpp color resolution can be connected to the connector (J1). 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 is designed only for displays with capacitive touch interface, which is located on the back side of the display. The touch controller is connected to the I²C interface. The touch controller's wake input is driven by the GPIO signal TIM8_CH1. The touch controller's interrupt output is connected to the GPIO signal TIM8_CH2. Further details about the touch controller can be found in the display's data sheet.

The backlight of the display is enabled by the GPIO signal TIM8_CH1N. Additionally the brightness can be controlled by the GPIO signal TIM8_CH2N. This signal should be driven by a PWM output. Since different displays use different pixel clock slopes to latch the data the active clock slope can be configured by the resistors R11 and R39. By default, the pixel clock signal is not inverted, therefore R39 is placed and R11 is unplaced. For an inverted clock signal, R39 has to be unplaced and R11 placed.

5.6 Audio

The Serial Audio Interface (SAI) is available at the pin header (J5). This Interface is configurable and supports the most digital audio standards like I²S, SPDIF, PCM, TDM and AC97.

Additional a 3.3 V and 5 V supply is available at the pin header.

5.7 CAN

The transmit and receive signals of the CPU module are routed to a 3-pole Push-in CAGE CLAMP (J18). A high-speed CAN transceiver is realized on the base, so that the CAN interface can directly connected to a CAN network. If the emSBC-Neon represents an end node in a CAN-Bus line topology, a 120 Ohm termination resistor can be activated by setting a jumper on pin header J8.

5.8 UARTs

USART-2 of the STM32-CPU is available on the 6-way single row pin header J12. TXD, RXD, RTS and CTS are available as LVTTTL signals on pin header J12.

USART-3 of the STM32-CPU is located on the I/O connector J11. The transmit and the receive lines are connected directly as LVTTTL signals to the CPU module.

5.9 JTAG

For debugging and programming of the emSTAMP-Neon CPU module, the standard 20-pin JTAG interface is provided at the connector J9.

5.10 I/O connector

The pin header J2, J10, J11 and J20 together form the I/O connector of the board. The placement of these connectors allows it to mount an Arduino shield. The connection compatibility should still be checked before use. The connector assignment can be found in chapter 4.1.

5.10.1 Power section

The pin header (J10) provides further power pins, which can be used to supply shields or other low power (< 500mA) components. It is not recommended to use this opportunity if the board is supplied by USB.

On the VIN pin, the supply voltage of the board (7V-24V) can be used as reference. Don't use this pin or the other pins on J10 to supply the board. Only the DC power jack J19 and microUSB-AB connector J6 is intended to supply the board.

A reset input (STM32_RS#) to reset the CPU module is also located on the pin header.

5.10.2 Analog I/O's

The Analog Inputs and Outputs are located on (J20).

There are three ADC connections for the input and two DAC connections for the output. For more details about the specification of the ADC/DAC use the manual of the emSTAMP Neon CPU module.

5.10.3 Digital I/O's

The digital inputs and outputs are located on the I/O connector (J11). There are 6 GPIO connections provided, each with PWM ability. The GPIO Signal TIM8_CH3 is connected to an activity LED (D1).

The GPIO's TIM8_CH2, TIM8_CH2N, TIM8_CH1, TIM8_CH1N are also used to control the EDT Display. Don't use this pin if a Display is connected on (J1)

Interface USART-3 of the STM32-CPU is also located on (J11). The transmit and the receive lines are connected directly as LVTTTL signals to the CPU module.

5.10.4 Serial Interfaces

The I²C Signals at the pin header (J2) are not ESD protected. The output high level of the I²C interface is 3.3V. The SPI Signals from the CPU module are also directly connected to (J2) and partially on (J20).

Before touching the connector, it is recommended that you discharge yourself by touching a grounded object.

5.11 Reset Button

A reset button (S2) is placed on the top right side of the board.

Pressing this button immediately pulls the signal STM32_RES# to GND and forces the CPU module to reset.

5.12 Wakeup Button

A Wakeup button (S1) is placed on the lower left side of the board.

Pressing this button immediately pulls the signal SYS_WKUP to GND and forces the CPU module to wake up.

5.13 LEDs

5.13.1 Power On LED

A green LED (D2) is active if the board is supplied by DC power jack (J19) or the microUSB connector (J6).

5.13.2 General purpose LED

A red LED (D1) is equipped on the board for testing and debugging. The red LED is controlled by the STM32 port pin PI7 configured as GPIO output. The LED has an active-low logic, i.e. a low output at port pin PI7 turns on the LED.

5.14 Backup Battery

A battery holder (J13) for lithium coin cell CR1632 is available to supply the RTC of the CPU boards.

5.15 Boot configuration DIP-Switch

The DIP-switch SW1 on the board is used to set the boot mode of the STM32Fxx9 CPU. The BOOT[1:0] configuration pins of the CPU are connected to SW1.

If a switch is in position "ON", the corresponding pin is read as "1".

If a switch is in position "OFF", the corresponding pin is read as "0".

SW1-1 BOOT0	SW1-2 BOOT1	Boot mode
OFF	OFF	Booting from flash memory
ON	OFF	Factory programmed Bootloader is executed (DFU)
OFF	ON	Booting from flash memory
ON	ON	Booting from SRAM

5.16 Power Supply

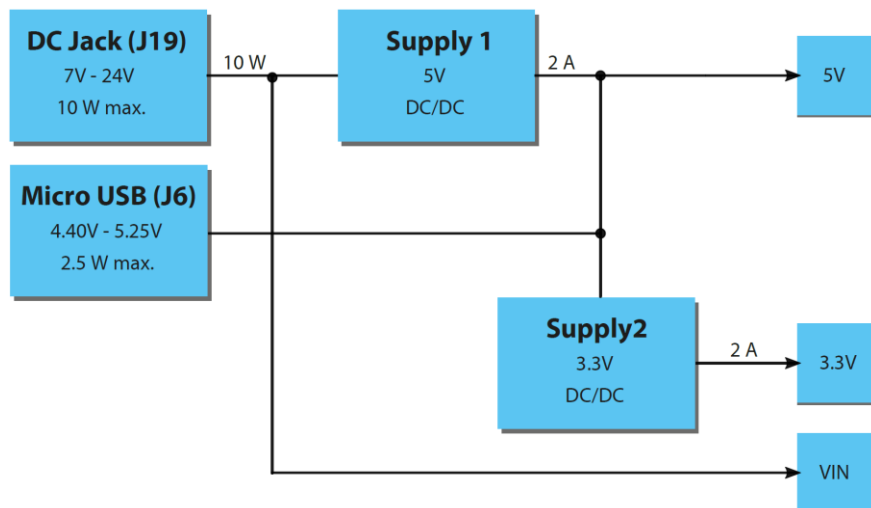
The SBC-NEON board has two possible power supply inputs.

- The DC Jack (J19)
- The microUSB connector J6.

The input voltage range at the DC Jack (J19) is +7V to +24 V $\pm 10\%$ with a maximum power consumption of 10 W.

The input voltage range of the microUSB connector J6 is 4.40V to 5.25 V with a maximum power consumption of 2.5 W.

It is not recommended to supply the board from other access points than the J6 and J19 connectors.



5.16.1 5 V Supply

The 5 Volt on the baseboard are generated from the main power supply-1 or supplied directly from VBUS at the microUBS connector J6.

5.16.2 3.3 V Supply

The 3.3 Volt on the baseboard are generated from the 5V by the buck converter supply-2.

6 Pin Assignments

6.1 Ethernet (J22)

Type: Rj45 Jack with magnetic

Pin	Signal	STM32 port pin
1	ETH_TDP	-
2	3.3V	-
3	ETH_TDM	-
4	ETH_RDP	-
5	3.3V	-
6	ETH_RDM	-
7	nc.	-
8	GND	-
9	nc.	-
10	nc.	-
11	nc.	-
12	nc.	-

6.2 USB 2.0 Host (J3)

Type: USB-A connector

Pin	Signal	STM32 port pin
1	VBUS	-
2	USB_OTG_HS_DM	PB14
3	USB_OTG_HS_DP	PB15
4	GND	-

6.3 USB 2.0 Device (J6)

Type: microUSB-AB connector

Pin	Signal	STM32 port pin
1	VBUS	-
2	USB_OTG_FS_DM	PA11
3	USB_OTG_FS_DM	PA12
4	GND	-
5	GND	-

6.4 EDT (J1)

Type: FFC-connector FH12-40S from Hirose (40pol, 0.5mm pitch, bottom contact type)

Pin	Signal	STM32 port pin
1	n/c	-
2	RESO#_DISP	-
3	LTDC_B7	PK6
4	LTDC_B6	PK5
5	LTDC_B5	PI5
6	LTDC_B4	PK3
7	LTDC_B3	PJ15
8	LTDC_B2	PJ14
9	GND	-
10	LTDC_G7	PB5
11	LTDC_G6	PI11
12	LTDC_G5	PH4
13	LTDC_G4	PJ13
14	LTDC_G3	PG10
15	LTDC_G2	PI15
16	GND	-
17	LTDC_R7	PG6
18	LTDC_R6	PJ5
19	LTDC_R5	PJ4
20	LTDC_R4	PJ3
21	LTDC_R3	PJ2
22	LTDC_R2	PJ1
23	GND	-
24	LCD_CLK	PI14
25	TIM8_CH1 (WAKE#)	PC6
26	LTDC_HSYNC	PI12
27	LTDC_VSYNC	PI13
28	LTDC_DE	PK7
29	TIM8_CH1N (BL_EN)	PH13
30	3.3V	-
31	GND	-
32	GND	-
33	3.3V	-
34	3.3V	-
35	TIM8_CH2 (IRQ#)	PC7
36	TIM8_CH2N (BL_CTRL)	PH14
37	I2C1_SCL	PB8
38	TP2	-
39	I2C1_SDA	PB7
40	TP1	-

6.5 JTAG (J9)

Type: dual row pin header 2x10 with 2.54mm pitch

Pin	Signal	Pin	Signal
1	3V3	2	3V3
3	JTAG_TRST#	4	GND
5	JTAG_TDI	6	GND
7	JTAG_TMS	8	GND
9	JTAG_TCLK	10	GND
11	nc.	12	GND
13	JTAG_TDO	14	GND
15	STM32_RES#	16	GND
17	nc.	18	GND
19	nc.	20	GND

6.6 Arduino I/O Connector (J10, J2 | J20, J11)

Type: single row pin header with 2.54mm pitch.

Pin header J10

Pin	Signal	STM32 port pin
1	nc.	-
2	5V	-
3	STM32_RES#	-
4	3V3	-
5	5V	-
6	GND	-
7	GND	-
8	VIN	-

Pin header J2

Pin	Signal	STM32 port pin
1	I2C1_SCL	PB8
2	I2C1_SDA	PB7
3	nc.	-
4	GND	-
5	SPI2_SCK	PI1
6	SPI2_MISO	PC2
7	SPI2_MOSI	PI3
8	SPI2_NSS	PI0
9	SPI5_MISO	PH7
10	SPI5_MOSI	PF9

Pin header J20

Pin	Signal	STM32 port pin
1	ADC1_IN9	PB1
2	ADC2_IN6	PA6
3	ADC_3_IN3	PA3
4	DAC_OUT1	PA4
5	DAC_OUT2	PA5
6	SPI5_SCK	PH6

Pin header J11

Pin	Signal	STM32 port pin
1	GPIO5/TIM8_CH3N	PH15
2	GPIO6/TIM8_CH3	PI7
3	GPIO3/TIM8_CH2N	PH14
4	GPIO4/TIM8_CH2	PC7
5	GPIO1/TIM8_CH1N	PH13
6	GPIO2/TIM8_CH1	PC6
7	USART3_TX	PB10
8	USART3_RX	PB11

6.7 micro SD Card (J4)

Type: microSDC Socket

Pin	Signal	STM32 port pin
1	SDIO_D2	PC10
2	SDIO_D3	PC11
3	SDIO_CMD	PD2
4	3V3	-
5	SDIO_CK	PC12
6	GND	-
7	SDIO_D0	PC8
8	SDIO_D1	PC9
9	SDIO_CD#	PA10
10	GND	-

6.8 Audio (J5)

Type: dual row pin header 2x4 with 2.54mm pitch

Pin	Signal	STM32 port pin	Pin	Signal	STM32 port pin
1	3.3V	-	2	GND	-
3	SAI1_FS_A	PE4	4	SAI1_SCK_A	PE5
5	SAI1_SD_A	PE6	6	SAI1_MCLK_A	PE2
7	GND	-	8	+5.0V	-

6.9 CAN (J18)

Type: 3 pin Cage Clamp

Pin	Signal
1	CAN_L
2	CAN_H
3	GND

6.10 CAN Termination (J8)

Type: single row 2 position pin header with 2.54mm pitch.

Pin	Signal
1	CAN_L (120Ω)
2	CAN_H

6.11 UART-A (J12)

Type: single row 6 position pin header with 2.54mm pitch.

Pin	Signal	STM32 port pin
1	GND	-
2	USART2_RTS	PD4
3	n.c.	-
4	USART2_RX	PD6
5	USART2_TX	PD5
6	USART2_CTS	PD3

6.12 General purpose LED

control of the red LED with low-active logic

Pin	Signal	STM32 port pin
-	GPIO6/TIM8_CH3	PI7

6.13 RTC Battery Holder (J13)

Type: Battery Holder for CR1632

Pin	Signal
1	GND
2	BAT +

6.14 emSTAMP-Neon module

I/O direction is from CPU's perspective, termination resistors are places on module. Further details can be found in the hardware manual of the emSTAMP-Neon, available on emtrions website.

Module Pin	Signal	CPU Pin	Direction	Termination
1	VDD	VDD	-	
2	VSS	VSS	-	
3	SAI1_FS_A	PE4	I/O	
4	SAI1_SCK_A	PE5	I/O	
5	SAI1_SD_A	PE6	I/O	
6	SAI1_MCLK_A	PE2	O	
7	CAN1_TX	PB9	O	
8	CAN1_RX	PI9	I	PU 10K
9	LTDC_DE	PK7	O	
10	LTDC_HSYNC	PI12	O	
11	LTDC_VSYNC	PI13	O	
12	LTDC_CLK	PI14	O	
13	VSS	VSS	-	
14	BOOT_0	BOOT0	I	PD 1K
15	BOOT_1	PB2/BOOT1	I	PD 1K
16	VBAT	VBAT	-	
17	STM32_RES#	NRST	I	PU 10K
18	SYS_WKUP	PA0/WKUP	I	
19	DAC_OUT1	PA4	AO	
20	DAC_OUT2	PA5	AO	
21	ADC2_IN6	PA6	AI	
22	ADC3_IN3	PA3	AI	

23	ADC1_IN9	PB1	AI	
24	ETH_TDM	PA7	-	
25	ETH_TDP	PC1	-	
26	VSS	VSS	-	
27	ETH_RDM	PA2	-	
28	ETH_RDP	PA1	-	
29	LTDC_R2	PJ1	O	
30	LTDC_R3	PJ2	O	
31	LTDC_R4	PJ3	O	
32	LTDC_R5	PJ4	O	
33	LTDC_R6	PJ5	O	
34	LTDC_R7	PG6	O	
35	VSS	VSS	-	
36	SPI5_MOSI	PF9	O	
37	SPI5_SCK	PH6	O	
38	SPI5_MISO	PH7	I	
39	USART3_RX	PB11	I	
40	USART3_TX	PB10	O	
41	USB_OTG_HS_OC#	PH8	I	
42	USB_OTG_HS_VBUS_EN	PH10	O	
43	USB_OTG_HS_DM	PB14	I/O	
44	USB_OTG_HS_DP	PB15	I/O	
45	VSS	VSS	-	
46	VDD	VDD	-	
47	SPI2_MOSI	PI3	O	
48	SPI2_MISO	PC2	I	
49	SPI2_SCK	PI1	O	
50	SPI2_NSS	PI0	O	
51	GPIO1/TIM8_CH1N	PH13	I/O	
52	GPIO2/TIM8_CH1	PC6	I/O	
53	GPIO3/TIM8_CH2N	PH14	I/O	
54	GPIO4/TIM8_CH2	PC7	I/O	
55	GPIO5/TIM8_CH3N	PH15	I/O	
56	GPIO6/TIM8_CH3	PI7	I/O	
57	VSS	VSS	-	
58	SDIO_CMD	PD2	O	PU 10K
59	SDIO_CD#	PA10	I/O	PU 10K
60	SDIO_D0	PC8	I/O	PU 47K
61	SDIO_D1	PC9	I/O	PU 47K
62	SDIO_D2	PC10	I/O	PU 47K
63	SDIO_D3	PC11	I/O	PU 47K
64	SDIO_CK	PC12	O	SR 33R
65	USB_OTG_FS_VBUS	PA9	AI	
66	VSS	VSS	-	
67	USB_OTG_FS_DM	PA11	I/O	
68	USB_OTG_FS_DP	PA12	I/O	
69	SYS_JTMS-SWDIO	PA13	I/O	PU 10K
70	SYS_JTCK-SWCLK	PA14	O	PD 10K
71	SYS_JTDI	PA15	I	PU 10K
72	SYS_JTDO-SWO	PB3	O	
73	SYS_JTRST	PB4	O	PU 10K
74	USART2_RX	PD6	I	
75	USART2_TX	PD5	O	
76	USART2_CTS	PD3	I	
77	USART2_RTS	PD4	O	
78	LTDC_G2	PI15	O	
79	LTDC_G3	PG10	O	
80	LTDC_G4	PJ13	O	
81	LTDC_G5	PH4	O	
82	LTDC_G6	PI11	O	
83	LTDC_G7	PB5	O	
84	VSS	VSS	-	
85	LTDC_B2	PJ14	O	
86	LTDC_B3	PJ15	O	
87	LTDC_B4	PK3	O	
88	LTDC_B5	PI5	O	
89	LTDC_B6	PK5	O	
90	LTDC_B7	PK6	O	
91	I2C1_SCL	PB8	O(OD)	PU 2K2
92	I2C1_SDA	PB7	I/O(OD)	PU 2K2

7 Technical Characteristics

7.1 Electrical Specifications

Electrical Specification	
Supply Voltage	+7 to +24V \pm 10%
Current consumption max.	max. 10W depending on core module and connected peripherals

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. 40 g
Board	glass-epoxy FR-4, UL-listed, 4 layers
Dimensions	118 mm x 54 mm x 18 mm

8 Dimensional Drawing

