Hardware Documentation

FSSMBB
F&S SMARC V2.11 Carrier Board
for HW Revision 1.10

preliminary

Version 001
(2024-09-24)
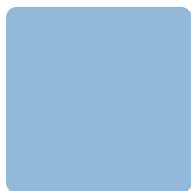
About This Document

This document describes how to use the F&S SMARC V2.11 Carrier Board (further named as carrier) with mechanical and electrical information. The latest version of this document can be found at: http://www.fs-net.de.

ESD Requirements

All F&S hardware products are electrostatic sensitive devices. All products are handled and packaged according to ESD (Electro Static Discharge) guidelines. Please do not handle or store ESD-sensitive material in ESD-unsafe environments. Negligent handling will harm the product and warranty claims become void.

History

Date	V	Platform	A,M,R	Chapter	Description	Au
25.09.24	001	-	-	All	Initial Version	SM

V	Version
A, M, R	Added, Modified, Removed
Au	Author

Table of Contents

1 Overview

The carrier follows the SMARC V2.1.1 specification and is designed to support F&S SMARC modules (further called module).

1.1 Additional Documentation

It is recommended to read the SMARC module documentation and the SMARC 2.1.1. specification additionally.
For detailed schematics of the carrier see "FSSMBB_REV110_Schaltplan.pdf", available on the F&S website

1.2 General Dimensions

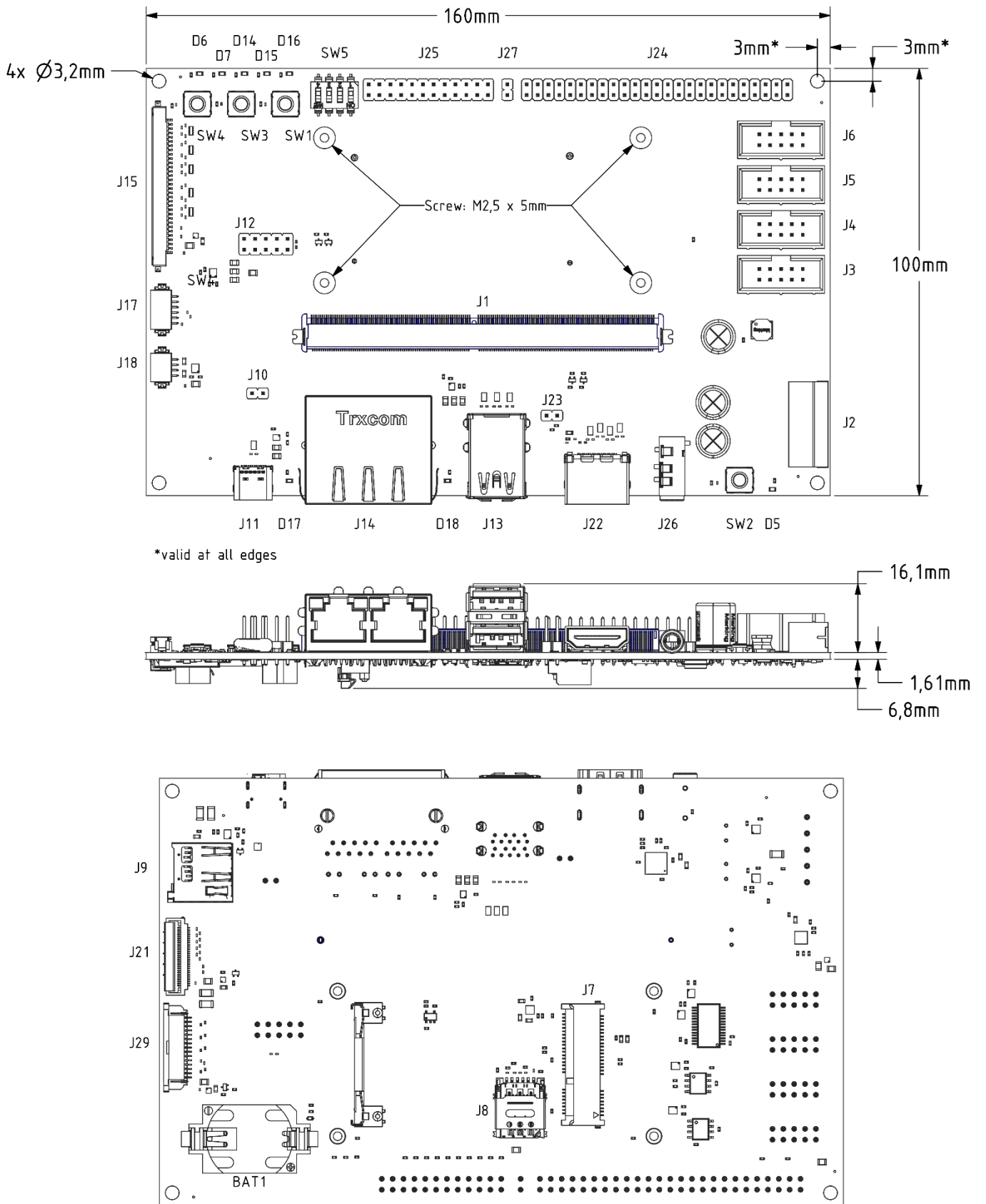| Dimensions	Description
Dimension	160.0 mm x 100.0 mm x 25.5 mm
Weight	≈ 115 g
Tolerance	±0.2 mm
Operating Temperature	-20.0 … +70.0°C
Mounting Holes Carrier	4x Ø 3.2 mm
Mounting Holes SMARC Module	4x M 2.5 (recommended screw length: 5mm)

Table 1: General dimensions

1.3 Mechanical Drawing

Figure 1: Dimensions and references

1.4 Parts Description

Ref.	Description	Connector Type
J1	Board-to-board connection	MXM3 314pos RM: 0,50mm
J2	Power Input	Phoenix Contact, MC 1,5/5-G-3,81
J3	UART A (RTS/CTS)	2x5 RM: 2.54 mm, shrouded
J4	UART B	2x5 RM: 2.54 mm, shrouded
J5	UART C	2x5 RM: 2.54 mm, shrouded
J6	CAN A	2x5 RM: 2.54 mm, shrouded
J7	Mini PCI Express	Full Size
J8	SIM Card	Nano SIM
J9	SD Card	Micro SD
J10	SDIO WP (write protect)	1x2 pin header, RM: 2.54 mm
J11	USB0 (USB 2.0, OTG)	Type C
J12	USB1 & USB5 (USB 2.0)	2x5 pin header, RM: 2.54 mm
J13	USB2 (top) & USB3 (bottom) (USB 3.0)	2x Typ A 3.0
J14	GBE0 (right) & GBE1 (left)	2x RJ45 Gigabit Ethernet Connector
J15	LVDS0&1 incl. I2C_LCD	Hirose, MDF76GW-30S-1H
J17	General Purpose Connector (I2C_LCD, GPIO, 3.3 V)	Hirose, DF13-06
J18	Backlight (5.0 V)	Hirose, DF13-04
J21	DSI CAM1	Hirose, FH41-28S-0.5SH(05)
J22	HDMI	Type A
J23	HDMI CEC & HEC	1x2 pin header, RM: 2.54 mm
J24	Feature Connector	2x25 pin header, RM: 2.54 mm
J25	SMARC Signal Connector	2x12 pin header, RM: 2.54 mm
J26	Audio Jack (Headphone & Microphone)	4 pin, 3.5 mm Audio Jack
J27	5.0 V external (cooling fan)	1x2 pin header, RM: 2.54 mm
J29	DSI CAM0	Amphenol, SFW15R-1
SW1	Force Recovery	Tactile button
SW2	Power	Tactile button
SW3	Sleep	Tactile button
SW4	Reset	Tactile button
SW5	Boot Select	DIP switch
D5	V_MOD Indicator	LED yellow
D6	V_5V0_PWON Indicator	LED yellow
D7	V_3V3_STBY Indicator	LED yellow
D14	mPCIe LED WWAN	LED yellow
D15	mPCIe LED WLAN	LED yellow
D16	mPCIe LED WPAN	LED yellow
D17	GBE0 L100	LED yellow
D18	GBE1 L100	LED yellow
BAT1	RTC Battery	CR2032 3.0V

Table 2: Reference description

2 Detailed Description

2.1 Power Supply & Management

2.1.1 Power Supply

Connector type: Phoenix Contact, MC 1,5/5-G-3,81

Counter connector: Phoenix Contact, MC 1,5/ 5-ST-3,81

Pin	Signal Name	Voltage	Description
1	n.c.		
2	V_3V0_RTC	3.0 V	Voltage input for the RTC, parallel to BAT1 see 2.15
3	V_IN	5.0 V	Voltage Input, max. 8A[1]
4	GND		
5	n.c.		

[1]Maximum possible power consumption of the carrier: 10 A. Please see "2.1.4 Power usage block diagram".

Table 3: J2 pin description

2.1.2 Management Control

Some management pins of the SMARC module are connected to buttons on the carrier.

Ref	Signal Name	Description
SW1	FORCE_RECOV#	Allows restoring from USB0 or invoke the native force recovery on the module
SW2	POWER_BTN#	Start standby voltage rails on module
SW3	SLEEP#	
SW4	RESET_IN#	Triggers a forced reset

Table 4: Button description

2.1.3 Voltage Indicator LEDs

The following LEDs indcate the presence of the main voltages.

Ref	Signal Name	Description
D5	V_MOD_IN	Main supply for the SMARC module
D6	V_5V0_PWON	Supply domain for USB, CAM, HDMI, Backlight, & 5V ext. (Fan)
D7	V_3V3_STBY	Supply domain for UART, CAN, mPCIe, Audio, LVDS, SDIO

Table 5: Supply LED description

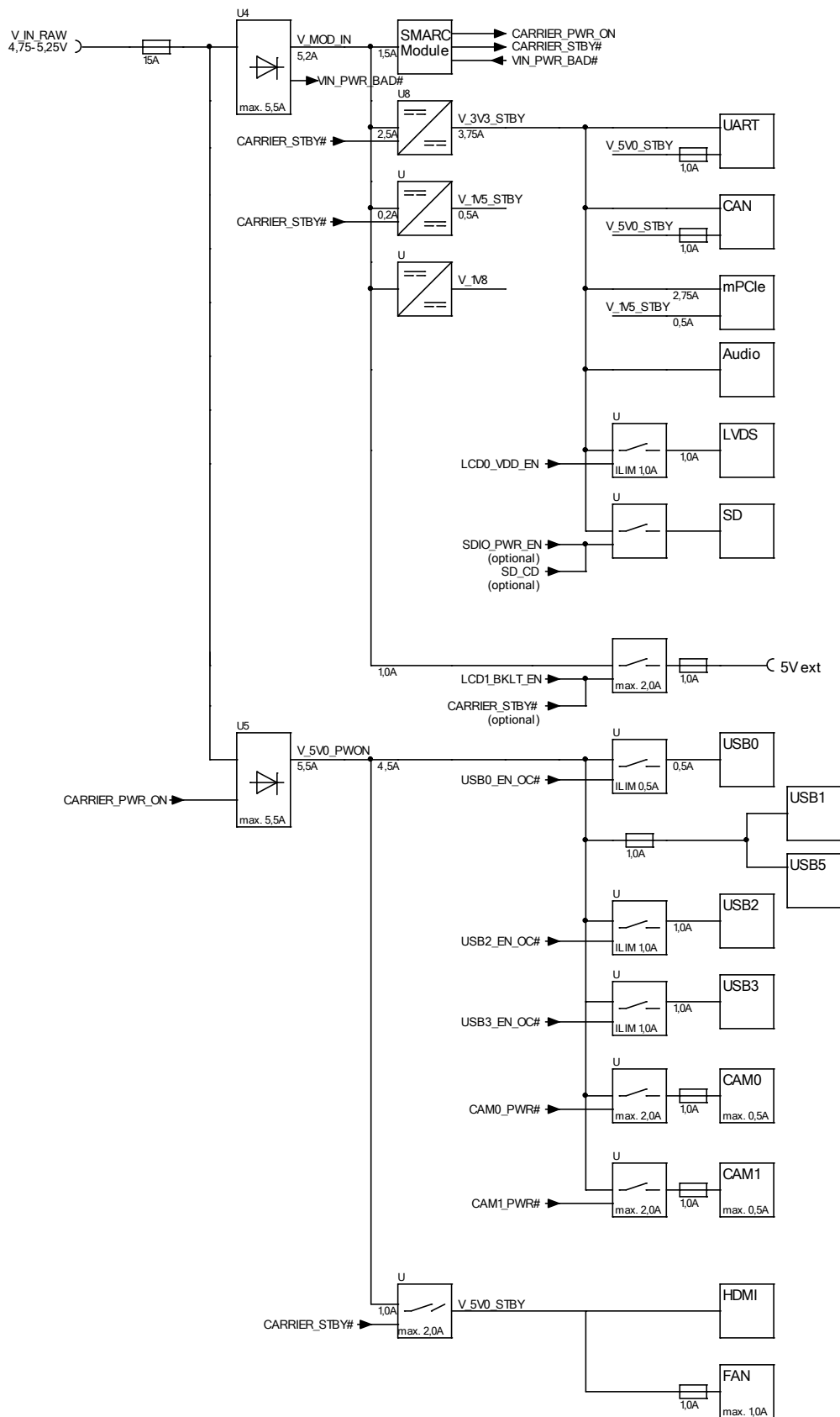## 2.1.4 Power usage block diagram

Figure 2: Power usage block diagram

2.2　Boot Select

The boot select signals are connected to dip switch SW5 (see chapter "1.3 Mechanical Drawing"). The selectable boot sources are listed in table 7 and depend on the moule.

Pos	Signal Name
1	BOOT_SEL2#
2	BOOT_SEL1#
3	BOOT_SEL0#
4	n.c.

Table 6: SW5 description

#	Boot select dip position			Boot source
	2	1	0	
0	ON	ON	ON	Not available on this carrier
1	ON	ON	OFF	Carrier SD Card
2	ON	OFF	ON	Not available on this carrier
3	ON	OFF	OFF	Carrier SPI (CS0#)
4	OFF	ON	ON	Module device (NAND, NOR) – vendor specific
5	OFF	ON	OFF	Remote boot (GBE, serial) – vendor specific
6	OFF	OFF	ON	Module eMMC Flash
7	OFF	OFF	OFF	Module SPI

Table 7: Truth table boot device

2.3　UART

The carrier supports four serial ports (SER0 to SER3).

2.3.1　SER0: RS232 RTS/CTS flow control (J3)

Connector type:　　　2x5 Pin Header, RM: 2,54mm, shrouded

Pin	Signal Name	Voltage	Comment
3	UART_A_RX	5.5 V	
4	UART_A_RTS	5.5 V	
5	UART_A_TX	5.5 V	
6	UART_A_CTS	5.5 V	
9	GND		
10	V_UART_5V0	5.0 V	Max. 1.0 A, fused

Table 8: J3 pin description

2.3.2 SER1: RS232 (J4)

Connector type: 2x5 Pin Header, RM: 2,54mm, shrouded

Pin	Signal Name	Voltage	Comment
3	UART_A_RX	5.5 V	
5	UART_A_RTS	5.5 V	
9	GND		
10	V_UART_5V0	5.0 V	Max. 1.0 A, fused

Table 9: J4 pin description

2.3.3 SER2: RS485 (J5)

Connector type: 2x5 Pin Header, RM: 2,54mm, shrouded

Pin	Signal Name	Voltage	Comment
3	UART_C_N		
4	UART_C_P		
9	GND		
10	V_UART_5V0	5.0 V	Max. 1.0 A, fused

Table 10: J5 pin description

2.3.4 SER3 (J24)

Directly connected to the feature connector, see chapter „2.13 Feature Connector (J24)"

2.4 CAN

The carrier supports two CAN ports of the module. CAN0 is connected to a transceiver, CAN1 is directly connected.

2.4.1 CAN0 (J6)

Connector type: 2x5 RM: 2,54mm Header shrouded

Pin	Signal Name	Voltage	Comment
1	V_CAN_5V0	5.0 V	Max. 1.0 A, fused
2	GND		
3	CAN_A_LOW		120 Ω terminated
4	CAN_A_HIGH		
5	GND		

Table 11: J3 pin description

2.4.2 CAN1 (J24)

Available on the feature connector J24. For the pining see chapter „2.13 Feature Connector (J24) ".

2.5 USB

The carrier supports five USB.

2.5.1 USB 0: 2.0 OTG(J11)

EN/OC- (Enable / Overcurrent) and OTG- (On the Go) functionalities are supported. The Current is limited to typ. 0.50 A. This port is used for recovery.

Connector type: USB Type C

2.5.2 USB1 & USB5: 2.0 (J12)

The carrier does not support the EN/OC functionality for these ports.

Connector type: 2x5 pin header, RM: 2.54mm.

Pin	Signal Name	Voltage	Comment
1	USB15_VBUS	5.0 V	Max. 1.0 A, fused
2			
3	USB5_D_N		
4	USB1_D_N		
5	USB5_P_N		
6	USB1_P_N		
7	GND		
8	GND		

Table 12: J12 pin description

2.5.3 USB2 & USB3: 3.0 (13)

EN/OC functionality is supported. The current is limited to 1.0 A.

Connector type: 2x USB Type A

2.5.4 USB4: 2.0, Mini PCI Express

USB4 is connected to the mini PCI Express port. EN/OC is not supported.

2.6 Display

The carrier supports HDMI and 8 bit LVDS display signals.

2.6.1 LVDS0 & LVDS1 (J15)

Connector type: Hirose, MDF76GW-30S-1H

Counter connector: Hirose, MDF76-30P-1C

Note: You will find supported displays and cables on the F&S online shop.

Pin	Signal Name	Voltage	Comment
1	LVDS0_D0_N		
2	LVDS0_D0_P		
3	LVDS0_D1_N		
4	LVDS0_D1_P		
5	LVDS0_D2_N		
6	LVDS0_D2_P		
7	GND		
8	LVDS0_CLK_N		
9	LVDS0_CLK_P		
10	LVDS0_D3_N		
11	LVDS0_D3_P		
12	LVDS1_D0_N		
13	LVDS1_D0_P		
14	GND		
15	LVDS1_D1_N		
16	LVDS1_D1_P		
17	GND		
18	LVDS1_D2_N		
19	LVDS1_D2_P		
20	LVDS1_CLK_N		
21	LVDS1_CLK_P		
22	LVDS1_D3_N		
23	LVDS1_D3_P		
24	GND		
25	I2C_LCD_SDA_3V3	3.3 V	
26	LCD0_IRQ_3V3	3.3 V	SMARC signal: LCD0_BKLT_EN
27	I2C_LCD_SCL_3V3	3.3 V	
28	LCD0_RST_3V3	3.3 V	SMARC signal: LCD0_BKLT_PWM
29	V_LCD_3V3_F1A	3.3 V	Max. 1.0 A, fused
30			Switched with Signal LCD0_VDD_EN

Table 13: J15 pin description

2.6.2 Backlight supply (J18)

J18 is meant to supply a backlight with 5.0 V, especially designed for F&S displays.

Connector type: Hirose, DF13-4P-1.25H

Counter connector: Hirose, DF13-4S-1.25C
Note: pre-assembled cable on F&S webstore: B.MKAB.35

Pin	Signal Name	Voltage	Comment
1	V_5V0_BKLT	5.0 V	Max. 1.0 A, fused
2	V_5V0_BKLT	5.0 V	Optional LCD1_BKLT_EN (3.3 V)
3	GND		Optional LCD1_BKLT_PWM (3.3 V)
4	GND		

Table 14: J18 pin description

2.6.3 HDMI (J22, J23)

Connector type (J22): HDMI Type A

The CEC and HEC signals are on J23 for development purposes.

Connector type (J23): 1x2 pin header, RM 2.54 mm

2.7　Camera

The carrier supports two CSI camera ports.

2.7.1　CSI0: 2 bit (J29)

Connector type:　　　Amphenol, SFW15R-1

Fitting cable:　　　FFC/FPC, 15pos, pitch: 1.0 mm, thickness: 0.3 mm

Pin	Signal Name	Voltage	Comment
1	GND		
2	CSI0_D0_N		
3	CSI0_D0_P		
4	GND		
5	CSI0_D1_N		
6	CSI0_D1_P		
7	GND		
8	CSI0_CLK_N		
9	CSI0_CLK_P		
10	GND		
11	CAM0_RST#		
12	CAM_MCK		
13	I2C_CAM0_SCL		
14	I2C_CAM0_SDA		
15	V_CAM0_3V3_F1A	3.3 V	Max. 0.5 A, fused. Switched with signal CAM0_PWR#

Table 15: J29 pin description

2.7.2 CSI1: 4 bit (J21)

The CSI1 connector pining fits Basler's BCON for MIPI interface. For more information see https://docs.baslerweb.com/bcon-for-mipi-interface-description .

Connector type: Hirose, FH41-28S-0.5SH(05)

Fitting cable: FFC, 28pos, pitch: 0.5 mm, thickness: 0.3 mm

Pin	Signal Name	Voltage	Comment
1	GND		
2	CSI0_D3_P		
3	CSI0_D3_N		
4	GND		
5	CSI0_D2_P		
6	CSI0_D2_N		
7	GND		
8	CSI0_CLK_P		
9	CSI0_CLK_N		
10	GND		
11	CSI0_D1_P		
12	CSI0_D1_N		
13	GND		
14	CSI0_D0_P		
15	CSI0_D0_N		
16	GND		
17	n.c.		
18	n.c.		
19	GND		
20	I2C_CAM1_SCL		
21	I2C_CAM1_SDA		
22	GND		
23	n.c.		
24	n.c.		
25	V_CAM1_5V0_F1A	5.0 V	Max. 1.0A, fused Switched with signal CAM1_PWR#
26			
27			
28	GND		
S	Shield		Connected through 1 nF (opt. 1 MΩ) to GND

Table 16: J29 pin description

2.8   Gigabit Ethernet (J14)

The carrier supports two gigabit ethernet ports. GBE0 on the right and GBE1 on the left connector of J14.

The LEDs on J14 are connected to GBE_LINK_ACT# (yellow) and GBE_LINK1000# (green). The two separate LEDs (D17, D18) are connected to GBE_LINK100#.

2.9   Audio (J26)

A SGTL5000 audio codec is mounted on the carrier. It is connected to I2S0 of the module. Headphone and microphone are connected to J26. Line in & out are connected to the feature connector (see chapter "2.14 Feature Connector"). J26 is a 3.5 mm audio jack connector with 4 pos.

2.10   Mini PCI Express (J7)

The carrier supports one Full-Mini PCI express (mPCIe) module on the PCIE_A port of the SMARC module.

2.10.1   LEDs

D14, D15 & D15 on the carrier are connected to the WWAN, WLAN and WPAN signals of the mPCIe connector.

2.10.2   SIM (J8)

A nano sim socket is connected to the mPCIe connector for GSM functionalitys.

2.11   Micro SD Card (J9)

The carrier has a micro SD card slot connected to the SDIO port of the module. With J10 (1x2 pin header, RM 2.54 mm) you can connect the signal SDIO_WP to GND.

2.12 General Purpose Connector (J17)

The general purpose connector is designed to connect a peripheral device like a touch sensor.

Connector type: Hirose, DF13-6P-1.25H

Counter connector: Hirose, DF13-6S-1.25C
Note: pre-assembled cable on F&S webstore: B.MKAB.47)

Pin	Signal Name	Voltage	Comment
1	V_3V3_STBY	3.3 V	
2	I2C_LCD_SDA		
3	I2C_LCD_SDA		
4	GPIO12		
5	GPIO13		
6	GND		

Table 17: J17 pin description

2.13 Feature Connector (J24)

The feature connector includes several signals and buses for an easy access.

Connector type: 2x25 pin header, RM 2.54 mm

Pin	Signal Name	Voltage	Comment
1	V_3V3_STBY	3.3 V	
2	V_5V0_STBY	5.0 V	
3	SPI0_CLK		
4	SPI0_CS0#		
5	SPI0_MOSI		
6	SPI0_MISO		
7	I2S2_SDIN		
8	GPIO4		
9	I2S2_SDOUT		
10	AU_MCLK		Audio master clock
11	GND		
12	I2S2_LRCLK		
13	SER3_TX		
14	I2S2_CLK		
15	SER3_RX		
16	I2C_GP_SCL		
17	I2C_GP_SDA		
18	SPI0_CS1#		
19	SPI1_CS0#		

20	SPI1_CS1#		
21	SPI1_CLK		
22	SPI1_MOSI		
23	SPI1_MISO		
24	CAN1_RX		No transceiver, no termination
25	V_1V8_STBY	1.8 V	
26	CAN1_TX		No transceiver, no termination
27	GND		
28	V_1V8_STBY	1.8 V	
29	I2C_PM_SDA		
30	I2C_PM_SCL		
31	GPIO5		
32	GPIO6		
33	GPIO7		
34	GPIO8		
35	GPIO9		
36	GPIO10		
37	GND		
38	GPIO11		
39	V_3V3_STBY	3.3 V	
40	V_5V0_STBY	5.0 V	
41	AU_MICIN		Microphone IN to audio codec, parallel to J26
42	GND		
43	n.c.		
44	FCON_A_LIN_R		LINE IN right to audio codec
45	FCON_A_LOUT_R		LINE OUT right from audio codec
46	GND		
47	GND		
48	FCON_A_LIN_L		LINE IN left to audio codec
49	FCON_A_LOUT_L		LINE OUT left from audio codec
50	GND		

Table 18: J24 pin description

2.14 SMARC Signal Connector (J25)

The SMARC signal connector includes some of the SMARC specific signals. They can be directly connected to a 1 kΩ pull down resistor.

Connector type: 2x12 pin header, RM 2.54 mm

Pin	Signal Name
1	GBE0_SDP
2	n.c.
3	GBE1_SDP
4	n.c.
5	USB3_ID
6	1 kΩ pull down
7	USB4_EN_OC#
8	1 kΩ pull down
9	RESET_OUT#
10	1 kΩ pull down
11	WDT_TIME_OUT#
12	1 kΩ pull down
13	SMB_ALERT#
14	1 kΩ pull down
15	LID#
16	1 kΩ pull down
17	CHARGER_PRSNT#
18	1 kΩ pull down
19	CHARGING#
20	1 kΩ pull down
21	TEST#
22	1 kΩ pull down
23	BATLOW#
24	1 kΩ pull down

Table 19: J25 pin description

2.15   RTC Battery (BAT1)

To supply the RTC on the module, there is a CR2032 battery socket for a 3V lithium cell on the carrier. The battery is in parallel to the input connector pin 2.

Note: The battery cell is not part of the carrier.

2.16   Fan supply connector (J27)

Connector type: 1x2 pin header, RM 2.54 mm

Pin	Signal Name	Voltage	Comment
1	GND		
2	V_5V0_FAN	5.0 V	Max. 1 A, fused

Table 20: J27 pin description

3   Electrical Characteristics

3.1   Absolute Maximum Ratings

Parameter.	Description	Min	Max	Unit
V_{IN_RAW}	Carrier supply voltage	0.0	6.0	V
V_{IN_UART}	UART input voltage (SER0 to SER2)	-0.3	5.7	V
$V_{IN\_SMARC\_IO}$	Signal input voltage from SMARC connector (SER, I2C, CAN, GPIO)	-0.5	4.6	V
V_{IN_I2S0}	I2S0 signal input voltage to Audio codec	-0.3	2.2	V
$V_{IN\_CAN\_A}$	Input voltage CAN A signals	-58.0	58.0	V
V_{BUS}	USB input voltage, all ports	-0.5	29.0	V
$V_{IN\_USB0\_CC}$	USB0 CC signal input voltage	-0.5	3.6	V
V_{LINE}	Audio Line IN input voltage	-0.3	3.6	V

Table 21: Absolute Maximum Ratings

3.2   Recommended Operating Conditions

Parameter.	Description	Min	Typ.	Max	Unit
V_IN_RAW	Carrier supply voltage	4.75	5.00	5.25	V
V_3V0_RTC	RTC supply voltage	2.20	3.00	3.45	V

Table 22: Recommended Operation Conditions

4 ESD and EMI Implementation

The connectors do not have any ESD protection. We highly recommend using the adapter board with wires as short as possible.

A helpful guide is available from TI; just search for slva680 at ti.com.

5 Second source rules

F&S qualifies their second sources for parts autonomously, if this does not touch the technical characteristics of the product. This is necessary to guarantee delivery times and product life. A setup of release samples with released second sources is not possible.

F&S does not use broker components without the consent of the customer.

6 Storage conditions

Maximum storage on room temperature with non-condensing humidity: 6 months
Maximum storage on controlled conditions 25 ±5 °C, max. 60% humidity: 12 months
For longer storage, we recommend vacuum dry packs.

7 ROHS and REACH statement

All F&S designs are created from lead-free components and are completely ROHS compliant.

The products we supply do not contain any substance on the latest candidate list published by the European Chemicals Agency according to Article 59(1,10) of Regulation (EC) 1907/2006 (REACH) in a concentration above 0.1 mass %.
Consequently, the obligations in No. 1 and 2 paragraphs in Annex are not relevant here.
Please understand that F&S is not performing any chemical analysis on its products to testify REACH compliance and is therefore not able to fill out any detailed inquiry forms.

8   Packaging

All F&S ESD-sensitive products will be shipped either in trays or in bags.

Matrix Code Sticker

All F&S hardware will ship with a matrix code sticker including the serial number. Enter your serial number here https://www.fs-net.de/en/support/serial-number-info-and-rma/ to get information on shipping date and type of board.

Figure 3: Matrix Code Sticker

9   Appendix

Important Notice

The information in this publication has been carefully checked and is believed to be entirely accurate at the time of publication. F&S Elektronik Systeme ("F&S") assumes no responsibility, however, for possible errors or omissions, or for any consequences resulting from the use of the information contained in this documentation.

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10 Content