

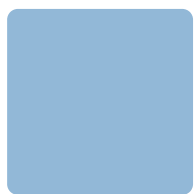
Hardware Documentation

NetDCUMX93

(PicoCoreMX93 Rev. 1.10 + ADP-NDCU2PCORE Rev. 1.10)

Version 003/07.2025

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About This Document

The NetDCUMX93 is a combination of two boards, the PicoCoreMX93 and the ADP-NDCU2PCORE Adapter. This document describes how to use the NetDCUMX93 (further named as module) with mechanical and electrical information. The latest version of this document can be found at: www.fseembedded.com.

ESD Requirements



All F&S hardware products are electrostatic discharge (ESD) sensitive. All products are handled and packaged according to ESD 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.

Review Service

F&S provide a schematic review service for your baseboard implementation. Please send your schematic as searchable PDF to support@fs-net.de.

History

Version	Date	Platform	Added (A) Removed (R) Modified (M)	Chapter	Description	Author
001/07.2025	02.07.2025 4.07.2025	-	-	All	Initial Version	SM
003/07.2025	11.07.2025	-	R	Title	Typo	SM

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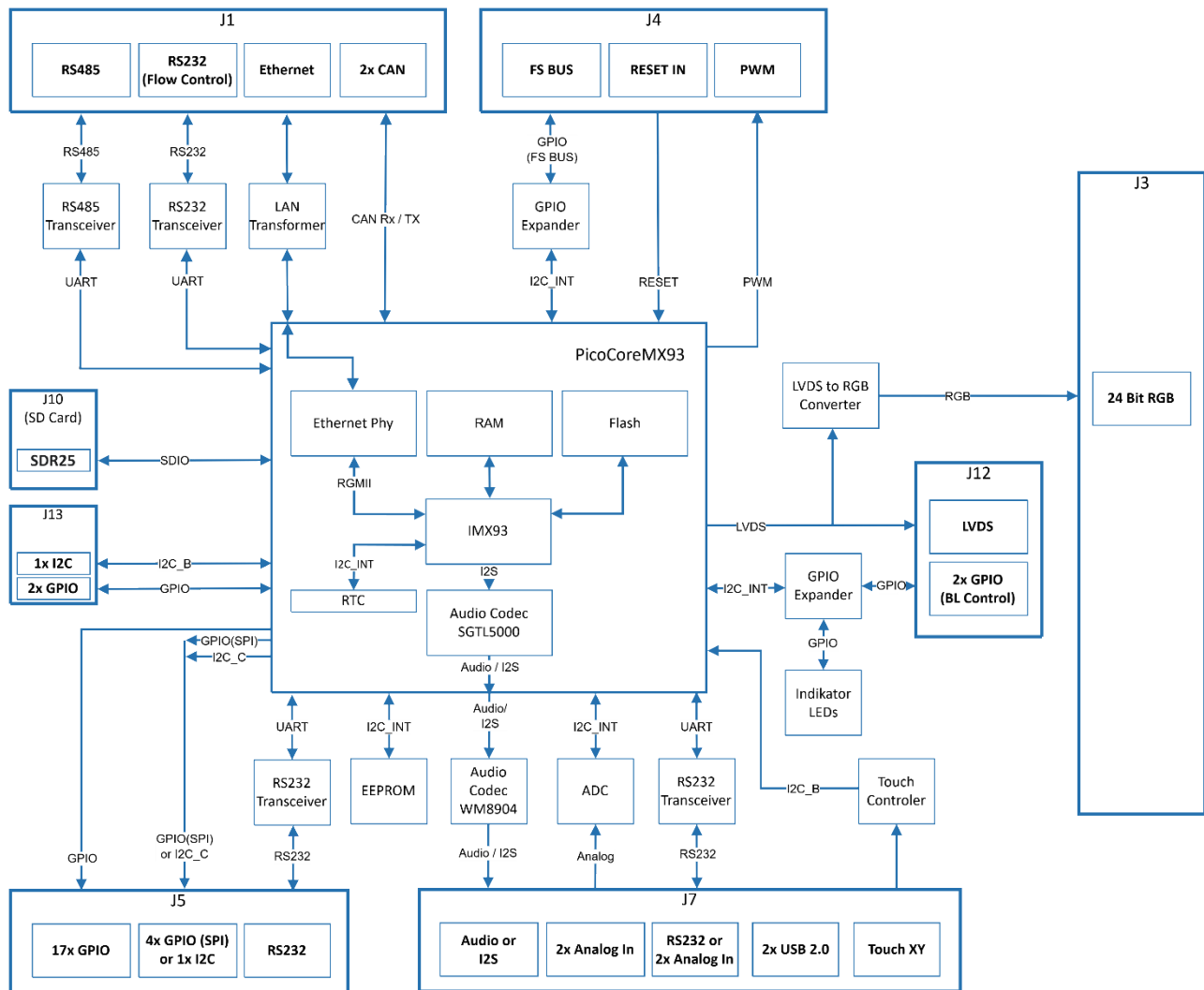
1 Overview

1.1 General Parameter

Parameter	Description
Dimension	100.0 mm x 80.0 mm x 19.5 mm
Weight	≈ 50.0 g
Operating Temperature	-25.0 °C ... +85.0 °C
Mounting Holes	4x Ø 3.2 mm

Table 1: General parameter

1.2 Block Diagram

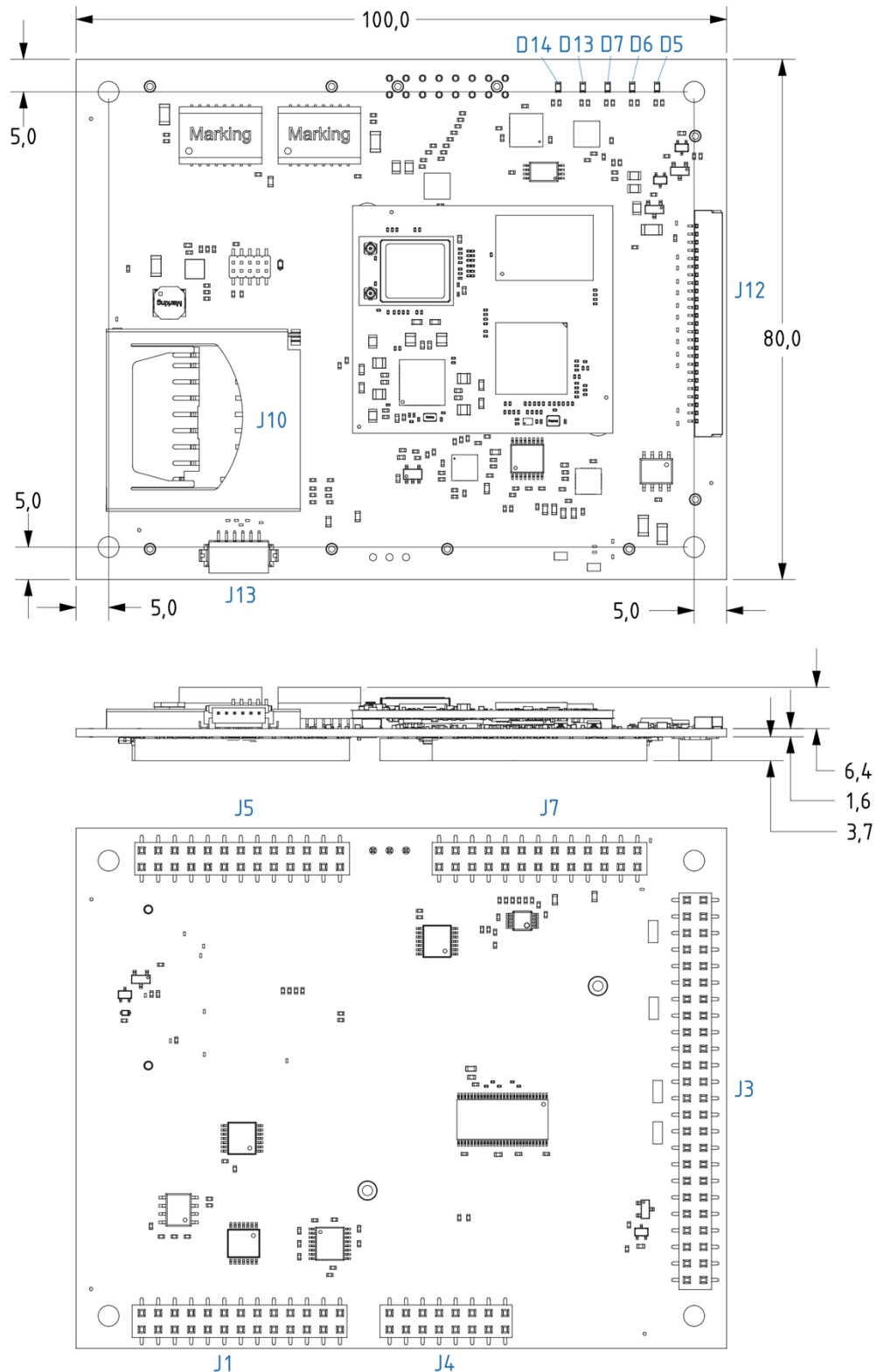


Note: This diagram shows the maximum available features. The availability depends on the configuration.

Figure 1: Block diagram

1.3 Dimensions and Connectors

1.3.1 Technical Drawing



Note: All dimensions are in mm.

Figure 2: Technical drawing

1.3.2 Connectors

Ref.	Description	Connector Type	Counter Part
J1	Power Input	2x 13 pol pin socket RM: 2.54 mm	
J3	Display	2x 24 pol pin socket RM: 2.54 mm	
J4	FS BUS	2x 8 pol pin socket RM: 2.54 mm	
J5	GPIOs	2x 13 pol pin socket RM: 2.54 mm	
J7	Audio / Touch / USB	2x 13 pol pin socket RM: 2.54 mm	
J10	SD Card	SD Card Slot	
J12	Display	JAE, FI-S25P-HFE	JAE, FI-S25S ¹
J13	I2C / GPIOs	Hirose, DF 13-06	Hirose, DF13-6S-1.25C ¹

¹Connectors and preassembled cables are available for purchase at www.fsembedded.com.

Table 2: Connector description

2 Connector Signal Description

The following shows the contact signal description of the board to board connectors.

2.1 Conventions

Contact Type	Description
I	input to the module
O	output from the module
I/O	bi-directional input / output signal
PWR	open drain output
n.c.	not connected

Table 3: Contact Types

2.2 J1 (Supply Input, Ethernet, CAN, RS232)

Pin	Signal	Voltage	Type	Internal Connection ¹	Description
1	ETH_A_RX_P		I		Ethernet receive
2	ETH_A_RX_N		I		Ethernet receive
3	UART_A_RTS		I		RS232 request to send
4	UART_A_RX		I		RS232 receive
5	UART_A_CTS		O		RS232 clear to send
6	UART_A_TX		O		RS232 transmit
7	ETH_A_TX_P		O		Ethernet transmit
8	ETH_A_TX_N		O		Ethernet transmit
9	V_5V0	5.0 V	PWR O		Reference voltage for external devices. (max. 100 mA)
10	GND				
11	CAN_A_TX	5.0 V	O	PDM_CLK (G17)	CAN transmit
12	CAN_A_RX	5.0 V	I	PDM_BIT_STREAM0 (J17)	CAN receive
13	CAN_B_TX	5.0 V	O	I2C1_SCL (C20)	CAN transmit
14	CAN_B_RX	5.0 V	I	I2C1_SDA (C21)	CAN receive
15	ETH_B_RX_P		I		Ethernet receive
16	ETH_A_RX_N		I		Ethernet receive
17	ETH_A_TX_P		O		Ethernet transmit
18	ETH_A_TX_N		O		Ethernet transmit
19	V_BL	max. 20 V	PWR I		Voltage input for a display backlight at J3.
20	RS485_P	3.3 V	I/O		RS485 positive
21	V_5V0	5.0 V	PWR I		Module supply input
22					
23	V_RTC	3.0 V	PWR I		Voltage input for real time clock
24	RS485_N	3.3 V	I/O		RS485 negative
25	GND				
26	GND				

Table 4: J1 (pin description)

2.3 J3 (RGB Display)

6	Signal	Voltage	Type	Internal Connection ¹	Description
1	RGB_R0	3.3 V	O		RGB data 0 red
2	RGB_R1	3.3 V	O		RGB data 1 red
3	RGB_G0	3.3 V	O		RGB data 0 green
4	RGB_G1	3.3 V	O		RGB data 1 green
5	RGB_B0	3.3 V	O		RGB data 0 blue
6	RGB_B1	3.3 V	O		RGB data 1 blue
7	GND				
8	RGB_R3	3.3 V	O		RGB data 3 red
9	RGB_R2	3.3 V	O		RGB data 2 red
10	RGB_G7	3.3 V	O		RGB data 7 green
11	RGB_G6	3.3 V	O		RGB data 6 green
12	RGB_G5	3.3 V	O		RGB data 5 green
13	RGB_G4	3.3 V	O		RGB data 4 green
14	GND				
15	RGB_B5	3.3 V	O		RGB data 5 blue
16	RGB_B4	3.3 V	O		RGB data 4 blue
17	RGB_B3	3.3 V	O		RGB data 3 blue
18	RGB_B2	3.3 V	O		RGB data 2 blue
19	RGB_G3	3.3 V	O		RGB data 3 green
20	RGB_G2	3.3 V	O		RGB data 2 green
21	RGB_B7	3.3 V	O		RGB data 7 blue
22	RGB_B6	3.3 V	O		RGB data 6 blue
23	GND				
24	RGB_VEEK	3.3 V	O		PWM signal for backlight dimming
25	RGB_CLK	3.3 V	O		RGB clock
26	RGB_VSYNC	3.3 V	O		RGB vertical synchronization
27	RGB_DE	3.3 V	O		RGB data enable
28	RGB_HSYNC	3.3 V	O		RGB horizontal synchronization
29	RGB_DEN	3.3 V	O		RGB display enable (display on)
30	GND				
31	V_DISP_RGB	3.3 V	PWR O		Switched via Port 0_2 from GPIO expander
34	GND				
36	V_RGB_VCFL	V_BL	PWR O		Switched via Port 0_0 from GPIO expander
37	RGB_R4	3.3 V	O		RGB data 4 red
38	RGB_R5	3.3 V	O		RGB data 5 red
39	RGB_R6	3.3 V	O		RGB data 6 red
40	RGB_R7	3.3 V	O		RGB data 7 red
41	GND				
42	GND				

Table 5: J3 (pin description)

2.4 J4 (FS Bus, PWM, Reset)

Pin	Signal	Voltage	Type	Internal Connection ¹	Description
1	PIF_D0	V_PIF	I/O	Exp.: I2C_A (0x20) P0_0	FS Bus data 0
2	PIF_D1	V_PIF	I/O	Exp.: I2C_A (0x20) P0_1	FS Bus data 1
3	PIF_D2	V_PIF	I/O	Exp.: I2C_A (0x20) P0_2	FS Bus data 2
4	PIF_D3	V_PIF	I/O	Exp.: I2C_A (0x20) P0_3	FS Bus data 3
5	PIF_D4	V_PIF	I/O	Exp.: I2C_A (0x20) P0_4	FS Bus data 4
6	PIF_D5	V_PIF	I/O	Exp.: I2C_A (0x20) P0_5	FS Bus data 5
7	PIF_D6	V_PIF	I/O	Exp.: I2C_A (0x20) P0_6	FS Bus data 6
8	PIF_D7	V_PIF	I/O	Exp.: I2C_A (0x20) P0_7	FS Bus data 7
9	V_PIF	3.3 V / 5.0 V	PWR O		Reference voltage for PIF signals (max. 100 mA)
10	PIF_RW#	V_PIF	O	Exp.: I2C_A (0x20) P1_2	FS Bus read / write, low active
11	PIF_CS#	V_PIF	O	Exp.: I2C_A (0x20) P1_1	FS Bus chip select, low active
12	PIF_ADE	V_PIF	O	Exp.: I2C_A (0x20) P1_3	FS Bus address enable
13	PIF_IRQ#	V_PIF	I	Exp.: I2C_A (0x20) P01_0	FS Bus interrupt, low active
14	RESET_IN#	3.3 V	I		PMIC reset input, low active
15	PWM	3.3 V	O	GPIO_IO24 (U21)	Generic PWM output
16	GND				

Table 6: J4 (pin description)

2.5 J5 (GPIO, SPI, RS232)

Pin	Signal	Voltage	Type	Internal Connection ¹	Description
1	KBINT	3.3 V	I/O	Exp.: I2C_INT (0x20) P1_4	Matrix keyboard interrupt (GPIO)
2	ROW7	3.3 V	I/O	Exp.: I2C_INT (0x20) P1_3	Matrix keyboard row 7 (GPIO)
3	ROW6	3.3 V	I/O	Exp.: I2C_INT (0x20) P1_2	Matrix keyboard row 6 (GPIO)
4	ROW5	3.3 V	I/O	Exp.: I2C_INT (0x20) P1_1	Matrix keyboard row 5 (GPIO)
5	ROW4	3.3 V	I/O	Exp.: I2C_INT (0x20) P1_6	Matrix keyboard row 4 (GPIO)
6	ROW3	3.3 V	I/O	Exp.: I2C_INT (0x20) P1_7	Matrix keyboard row 3 (GPIO)
7	ROW2	3.3 V	I/O	Exp.: I2C_INT (0x20) P0_6	Matrix keyboard row 2 (GPIO)
8	ROW1	3.3 V	I/O	Exp.: I2C_INT (0x20) P1_5	Matrix keyboard row 1 (GPIO)
9	ROW0	3.3 V	I/O	Exp.: I2C_INT (0x20) P0_5	Matrix keyboard row 0 (GPIO)
10	COL8 (SPI_MISO)	3.3 V	I	GPIO_IO01 (J20)	GPIO (SPI data in) (Optional: I2C_C_SDA)
11	COL9 (SPI_MOSI)		O	GPIO_IO02 (K20)	GPIO (SPI data out) (Optional: I2C_C_SCL)
12	UART_C_RX		I		RS232 receive
13	COL10 (SPI_CS)	3.3 V	O	GPIO_IO00 (J21)	GPIO (SPI chip select)
14	UART_C_TX		O		RS232 transmit
15	COL11 (SPI_CLK)	3.3 V	I/O	GPIO_IO03 (K21)	GPIO (SPI clock)
16	GND				
17	COL7	3.3 V	I/O	Exp.: I2C_INT (0x20) P0_	Matrix keyboard column 7 (GPIO)
18	COL6	3.3 V	I/O	Exp.: I2C_INT (0x20) P0_5	Matrix keyboard column 6 (GPIO)
19	COL5	3.3 V	I/O	SAI1_TXD0 (H21)	Matrix keyboard column 5 (GPIO)
20	COL4	3.3 V	I/O	SAI1_TXC (G20)	Matrix keyboard column 4 (GPIO)
21	COL3	3.3 V	I/O	SAI1_RXD0 (H20)	Matrix keyboard column 3 (GPIO)

Pin	Signal	Voltage	Type	Internal Connection ¹	Description
22	COL2	3.3 V	I/O	SAI1_TXFS (G21)	Matrix keyboard column 2 (GPIO)
23	COL1	3.3 V	I/O	Exp.: I2C_INT (0x20) P1_0	Matrix keyboard column 1 (GPIO)
24	COL0	3.3 V	I/O	Exp.: I2C_INT (0x20) P0_7	Matrix keyboard column 0 (GPIO)
25	V_5V0	5.0 V	PWR O		Reference voltage for 5.0 V signals. (max. 100 mA)
26	V_3V3	3.3 V	PWR O		Reference voltage for 3.3 V signals. (max. 100 mA)

Table 7: J5 (pin description)

2.6 J7 (Audio, Analog In, Touch Sensor, USB)

Pin	Signal	Voltage	Type	Internal Connection ¹	Description
1	AU_LOUT_L		O		Audio line out left
2	AU_LOUT_R		O		Audio line out right
3	GND				
4	AU_LIN_L		I		Audio line in left
5	AU_LIN_R		I		Audio line in right
6	GND				
7	AU_MIC		I		Microphone in
8	AU_MICBIAS		I		Microphone bias voltage
9	UART_D_RX		I		RS232 receive (optional: ANALOG_IN2)
10	UART_D_TX		O		RS232 transmit (optional: ANALOG_IN3)
11	ANLAOG_IN0	3.3 V	I		I2C Analog digital converter input
12	ANLAOG_IN2	3.3 V	I		I2C Analog digital converter input
13	V_5V0	5.0 V	PWR O		Reference voltage for 5.0 V signals. (max. 100mA)
14	GND				
15	TOUCH_X_P	3.3 V	I		Touch controller input
16	TOUCH_Y_P	3.3 V	I		Touch controller input
17	TOUCH_X_N	3.3 V	I		Touch controller input
18	TOUCH_Y_N	3.3 V	I		Touch controller input
19	V_3V3	3.3 V	PWR O		Reference voltage for 3.3 V signals. (max. 100mA)
20	GND				
21	USB_A_D_N		I/O		USB 2.0 data negative
22	USB_A_D_P		I/O		USB 2.0 data positive
23	USB_B_D_N		I/O		USB 2.0 data negative
24	USB_B_D_P		I/O		USB 2.0 data positive
25	V_USB_A	5.0 V	PWR O		Switchable supply for a USB connector (max. 500 mA)
26	V_USB_B	5.0 V	PWR O		Switchable supply for a USB connector (max. 500 mA)

Table 8: J7 (pin description)

2.7 J12 (LVDS) (optional)

Pin	Signal	Voltage	Type	Internal Connection ¹	Description				
1	V_DISP_LVDS	3.3 V / 5.0 V	PWR O		Display supply voltage				
2									
3	GND								
4									
5	DISP_A_D0_N		O		LVDS data 0 negative				
6	DISP_A_D0_P		O		LVDS data 0 positive				
7	GND								
8	DISP_A_D1_N		O		LVDS data 1 negative				
9	DISP_A_D1_P		O		LVDS data 1 positive				
10	GND								
11	DISP_A_D2_N		O		LVDS data 2 negative				
12	DISP_A_D2_P		O		LVDS data 2 positive				
13	GND								
14	DISP_A_CLK_N		O		LVDS clock negative				
15	DISP_A_CLK_P		O		LVDS clock positive				
16	GND								
17	DISP_A_D3_N		O		LVDS data 3 negative				
18	DISP_A_D3_P		O		LVDS data 3 positive				
19	GND								
20	GND								
21	GND								
22	GND								
23	V_DISP_LVDS	3.3 V / 5.0 V	PWR O		Display supply voltage				
24	DISP_BL_EN	3.3 V	I/O		Backlight enable signal				
25	DISP_BL_PWM	3.3 V	O		PWM signal for backlight dimming				

Table 9: J12 (pin description)

2.8 J13 (I2C, GPIO)

Pin	Signal	Voltage	Type	Internal Connection ¹	Description
1	V_3V3	3.3V	PWR O		Supply for external devices (max. 100mA)
2	I2C_B_SDA	3.3 V	I/O	GPIO_IO12 (N20)	I2C data
3	I2C_B_SCL	3.3 V	O	GPIO_IO13 (N21)	I2C signal clock
4	I2C_B_RST	3.3 V	I/O	GPIO_IO14 (P20)	GPIO for reset
5	I2C_B_IRQ	3.3 V	I/O	GPIO_IO15 (P21)	GPIO for I2C interrupts
6	GND				

Table 10: J13 (pin description)

¹ Mainly: the connected CPU pad (pin). Alternatively: I2C GPIO expander ("Exp.:")

3 Detailed Description

3.1 Display

3.1.1 Interface

The module has two possible display interfaces. One 24-bit RGB¹ on J3 or a single channel LVDS on J12. The voltage supplies on both connectors are switchable.

¹Generated over an LVDS to RGB converter, type: Ti, DS90CF386

3.1.2 Backlight

For backlight supply, the module provides a passthrough connection from J1 pin 19 (V_{BL}) to J3 pin 36 (V_{RGB_VCFL}) this voltage path is switchable.

3.1.3 Touch Controller

A 12 bit, four wire I2C touch controller¹ is applied. The controller is supplied with 3.3 V.

¹Type: TI, TSC2004

3.2 I2C

The module uses 4 different I2C interfaces.

3.2.1 Device Overview

Ref.	CPU	Component	Description	Address
I2C_INT	I2C2	EEPROM	Storage for board information	0x50
		ADS1015	Analog to digital converter	0x48
		WM8904	Audio Codec	0x34
		PCAL6416A	GPIO expander for display control signals and indicator LEDs	0x21
		SGTL5000	Audio Codec (optional)	0x0A
		PCF85263ATL	Real time clock	0x51
		PCA9451A	Power management IC	0x25
		PCAL6416A	GPIO expander (GPIOs on J5, display control signals)	0x20
		Reserved	Do not use	0x2E
I2C_A	I2C1	PCAL6416A	GPIO expander for FS Bus	0x20
		Reserved	Do not use	0x50
I2C_B	I2C8	TSC2004	12 bit four wire touch controller	0x49
		External	Available on connector J13	-
I2C_C	I2C5	External	Available on connector J5 (optional)	-

Table 11: I2C (address overview)

3.2.2 GPIO-Expander

To reach the required number of GPIOs, three I2C GPIO Expander¹ devices are used. The expander ports used for the board to board connector are described in the connector tables in chapter 2.

¹Type: NXP, PCAL6416A

3.3 Serial Buses

3.3.1 RS232

The module provides one RS232 interface with flow control (UART A) and two interfaces without (UART C & UART D).

3.3.2 RS485

The module provides one RS485 interface (UART B).

3.3.3 CAN FD

The module provides two CAN interfaces without transceiver.

3.3.4 SPI

The module supports one SPI interface.

3.3.5 USB 2.0

The module provides two USB 2.0 ports. There are also switchable 5.0 V supplies for each port with a max. current of 500 mA each.

3.4 Ethernet

The module provides two ethernet interfaces¹ with a data rate up to 100 Mbit/s. A transformer for each interface is applied on the module.

¹ Physical layer: Realtek, RTL8211FDI.

3.5 FS Bus

The FS Bus is a 8bit parallel Bus with control signals. All pins are pulled up to V_PIF¹.

¹ As a mounting option V_PIF can be 3.3 V or 5.0 V.

3.6 SD Card

The module provides one SD card slot. The slot is connected to the SD2 port of the CPU.

3.7 eMMC

An eMMC flash storage is connected to SD1 of the CPU.

3.8 Analog to Digital Converter

The module has a 12 bit, four channel I2C analog to digital converter¹ (ADC). The ADC is supplied by 3.3 V.

¹ Type: TI, ADS1015.

3.9 Audio

The module provides an audio codec¹ over an I2S interface².

¹ NXP, SGT15000 or Cirrus Logic, WM8904.

² As a mounting option, the I2S interface will be directly accessible.

3.10 Wifi and Bluetooth

The module contains a Wi-Fi 6 module (IEEE 802.11ax/ac/a/b/g/n) with a Bluetooth 5.2 interface. The Wi-Fi module is widely certified¹.

¹ Please contact support@fs-net.de for further information.

4 Characteristics

4.1 Absolute Maximum Ratings¹

Description	Min	Max	Unit
Supply voltage	-0.30	6.00	V
Real time clock supply voltage	-0.50	6.50	V
SPI (3.3V)	-0.30	3.60	V
GPIOs (3.3V)			
I2C (3.3V)			
CAN			
ADC IN			
LINE IN, MIC	-0.30	2.10	V
RS485	-9.00	14.00	V
RS232	-13.20	13.20	V

Table 12: Absolute maximum ratings

¹ Stresses beyond the listed values may affect reliability or cause permanent damage to the module.

4.2 Recommended Operating Conditions

Parameter	Description	Condition	Min	Typ	Max	Unit
General						
V_5V0	Module main supply voltage		4.40	5.00	5.50	V
V_USB	USB supply voltage		4.40	5.00	5.50	V
V_RTC	Real time clock voltage		0.90	3.00	5.50	V
V_BL	Backlight voltage				20.00	V
V_3V3	Internal voltage		3.15	3.30	3.45	V
V_DISP	Supply voltage for display at J3 and J12.	Default (3.3 V)	3.15	3.30	3.45	V
		Optional (5.0 V)	4.40	5.00	5.50	V
I _{V_3V3_OUT}	Output overall current for B2B connectors				0.50	A
I _{V_5V0_OUT}	Output overall current for B2B connectors				0.50	A
I _{V_USB}	Output current for each USB ports				0.50	A
I _{V_DISP}	Output current at connector J7 and J12	at 3.30V			0.10	A
		at 5.00V			0.10	A
I _{V_BL}	Current through backlight path				1.00	A
Analog Input / Output						
FSR _{ADC}	ADC full scale input voltage range	0dBFS	-2.00		2.00	V
FSR _{AU_LINE_IN}	Audio LINE IN full scale input level	0dBFS		0.500		VRMS
FSR _{AU_MIC_IN}	Audio MIC IN full scale input level	0dBFS		0.019		VRMS
FSR _{AU_LINE_OUT}	Audio LINE OUT full scale output level	0dBFS		1.00		VRMS
Storage						
T _{STORE}	Storage time	no environmental control		6		months
		t _{amb} = 25°C ± 5°C humidity max. 60%		12		months

Table 13: Recommended operating conditions

5 Packaging & Labels

5.1 ESD

All F&S electrostatic discharge sensitive (ESDS) products are marked and will be shipped in ESD protective packaging.

5.2 Serial Number

All shipped F&S products are labeled with a matrix code sticker that includes the serial number. For product information visit www.fseembedded.com/en/support/serial-number-info-and-rma/.

6 Appendix

6.1 Second source rules

The qualifications of products from a second source are done autonomously by F&S. 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.

6.2 RoHS and REACH statement

Please see the following webpage: www.fsembedded.com/en/support/certifications/

6.3 Important Notice

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