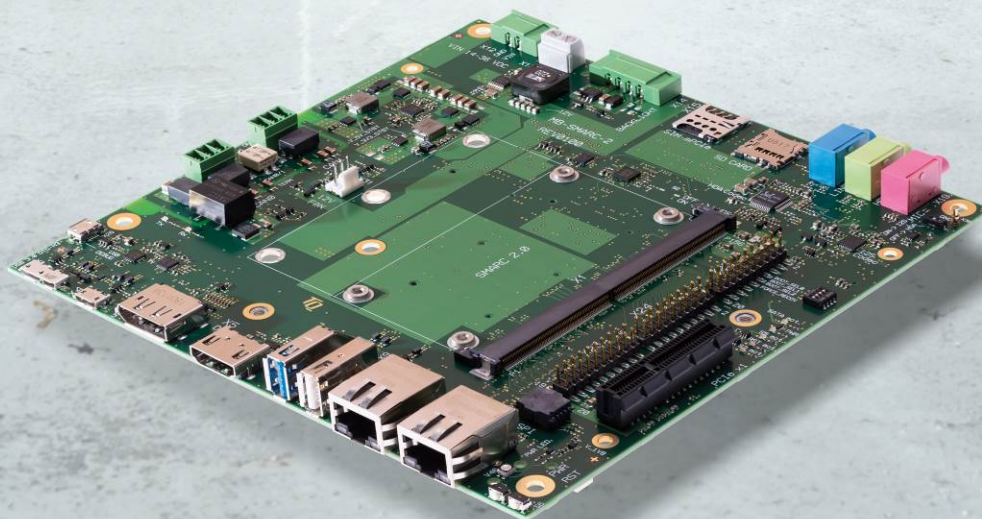




# MB-SMARC-2 User's Manual

MB-SMARC-2 UM 0104  
2021-06-21





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## REVISION HISTORY

Rev.	Date	Name	Pos.	Modification
0100	2019-01-14	SP		First edition
0101	2019-04-03	SP	Figure 1 3.5 Figure 3	Updated Added Interface and connector description corrected
0102	2020-06-04	FP	All Figure 3, Figure 4 Table 18	Non-functional changes, formatting Connectors numbers added Signal names corrected
0103	2020-12-22	SP	Chapter 3.6.4	Warning added for USB 3.0 OTG Interface
0104	2021-06-21	FP	All	Made document searchable Replaced "Illustration" with "Figure"



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### 1.5 Service and Support

Please visit our website [TQ-Group](http://TQ-Group) for latest product documentation, drivers, utilities and technical support.

You can register on our website [TQ-Group](http://TQ-Group) to have access to restricted information and automatic update services.

For direct technical support you can contact our FAE team by email: [TQ-Support](mailto:TQ-Support).

Our FAE team can also support you with additional information like 3D-STEP files and confidential information, which is not provided on our public website.





For service or RMA, please contact our service team by email ([TQ-Service](mailto:TQ-Service)) or your sales team at TQ.

## 1.6 Tips on Safety

Improper or incorrect handling of the product can substantially reduce its life span.


## 1.7 Symbols and Typographic Conventions

Table 1: Terms and Conventions


Symbol	Meaning
	This symbol represents the handling of electrostatic-sensitive modules and / or components. These components are often damaged / destroyed by the transmission of a voltage higher than about 50 V. A human body usually only experiences electrostatic discharges above approximately 3,000 V.
	This symbol indicates the possible use of voltages higher than 24 V. Please note the relevant statutory regulations in this regard. Non-compliance with these regulations can lead to serious damage to your health and also cause damage / destruction of the component.
	This symbol indicates a possible source of danger. Acting against the procedure described can lead to possible damage to your health and / or cause damage / destruction of the material used.
	This symbol represents important details or aspects for working with TQ-products.
<b>Command</b>	A font with fixed-width is used to denote commands, contents, file names, or menu items.

## 1.8 Handling and ESD Tips

General handling of your TQ-products

	<p>The TQ-product may only be used and serviced by certified personnel who have taken note of the information, the safety regulations in this document and all related rules and regulations.</p> <p>A general rule is: do not touch the TQ-product during operation. This is especially important when switching on, changing jumper settings or connecting other devices without ensuring beforehand that the power supply of the system has been switched off.</p> <p>Violation of this guideline may result in damage / destruction of the MB-SMARC-2 and be dangerous to your health.</p> <p>Improper handling of your TQ-product would render the guarantee invalid.</p>
---	--

Proper ESD handling

	<p>The electronic components of your TQ-product are sensitive to electrostatic discharge (ESD). Always wear antistatic clothing, use ESD-safe tools, packing materials etc., and operate your TQ-product in an ESD-safe environment. Especially when you switch modules on, change jumper settings, or connect other devices.</p>
---	---



## 1.9 Naming of Signals

A hash mark (#) at the end of the signal name indicates a low-active signal.

Example: RESET#

If a signal can switch between two functions and if this is noted in the name of the signal, the low-active function is marked with a hash mark and shown at the end.

Example: C / D#

If a signal has multiple functions, the individual functions are separated by slashes when they are important for the wiring.

The identification of the individual functions follows the above conventions.

Example: WE2# / OE#

## 1.10 Further Applicable Documents / Presumed Knowledge

- **Specifications and manual of the product used:**  
These documents describe the service, functionality and special characteristics of the product used.
- **Specifications of the components used:**  
The manufacturer's specifications of the components used, for example CompactFlash cards, are to be taken note of. They contain, if applicable, additional information that must be taken note of for safe and reliable operation. These documents are stored at TQ-Systems GmbH.
- **Chip errata:**  
It is the user's responsibility to make sure all errata published by the manufacturer of each component are taken note of. The manufacturer's advice should be followed.
- **Software behaviour:**  
No warranty can be given, nor responsibility taken for any unexpected software behaviour due to deficient components.
- **General expertise:**  
Expertise in electrical engineering / computer engineering is required for the installation and the use of the device.

Implementation information for the carrier board design is provided in the SMARC Design Guide (2) maintained by the SGET.

This Carrier Design Guide includes a good guideline to design a SMARC carrier board.

It includes detailed information with schematics and detailed layout guidelines.

Please refer to the official SGET documentation for additional information (1), (2).





## 2. INTRODUCTION

The SMARC mainboard MB-SMARC-2 is a carrier board for SMARC modules with a pinout based on the SMARC 2.0 specification. It can be used for panel PCs, embedded computers or as evaluation platform for SMARC modules.

In combination with a standard SMARC module it forms a very compact hardware kit that can be used for a freely scalable embedded PC platform thanks to its modular design. Because of this – with uniform interfaces and dimensions – the PC system can be easily adapted to suit the requirements of the application. The many extension options and storage media, which can be added, offer a high level of flexibility and allow functionalities and performance to be extended easily, quickly and inexpensively. Typical usage is in embedded server applications, PC systems, automation, visualisation and monitoring and all applications that place high demands on quality, durability and long-term availability.

### 2.1 Functional Overview

The following key functions are implemented on the MB-SMARC-2:

#### Supported Modules:

- SMARC Modules with pinout based on SMARC 2.0 specification

#### External Interfaces:

- 2 × Gigabit Ethernet
- USB Type A: 1 × USB 2.0; 1 × USB 3.0
- USB Type Micro B: 1 × USB 2.0; 1 × USB 3.0
- 1 × HDMI
- 1 × DisplayPort
- Audio (headphone out, microphone in and line in)
- Power Button / Reset

#### Internal Interfaces:

- LVDS or eDP
- Mini PCIe socket (with micro SIM Card support)
- M.2 socket with B-Keying (for SATA based SSDs)
- M.2 socket with E-Keying (e.g. for WLAN / Bluetooth cards)
- Socket for µSD cards
- Socket for PCIe cards (PCIe ×1)
- 2 × RS-232
- 2 × MIPI CSI (Camera Serial Interface)
- 2 × Isolated CAN
- USB Type Micro B (Debug Interface via FTDI chip)

#### Power supply:

- Voltage: 14 V to 36V DC

#### Environment:

- Extended temperature: –20 °C to +85 °C

#### Form factor / dimensions:

- 170 × 170 mm<sup>2</sup> (Mini ITX)

### 2.2 Compliance

The MB-SMARC-2 supports SMARC modules, which are compliant to SGET SMARC Hardware Specification (V2.0).

### 2.3 Accessories

- **DSUB-ADAPTER DK-RS-232-9POL-DSUB-PICOBLADE**  
Adapter cable from internal connector to a 9-pin D-Sub male connector, 150 mm long  
Order code: 278622.0100

Please contact [TQ-Support](#) for details about DisplayPort cables and DisplayPort to DVI/HDMI adapters.

### 3. ELECTRONICS

#### 3.1 Block Diagram

The following illustration shows the block diagram of the MB-SMARC-2:

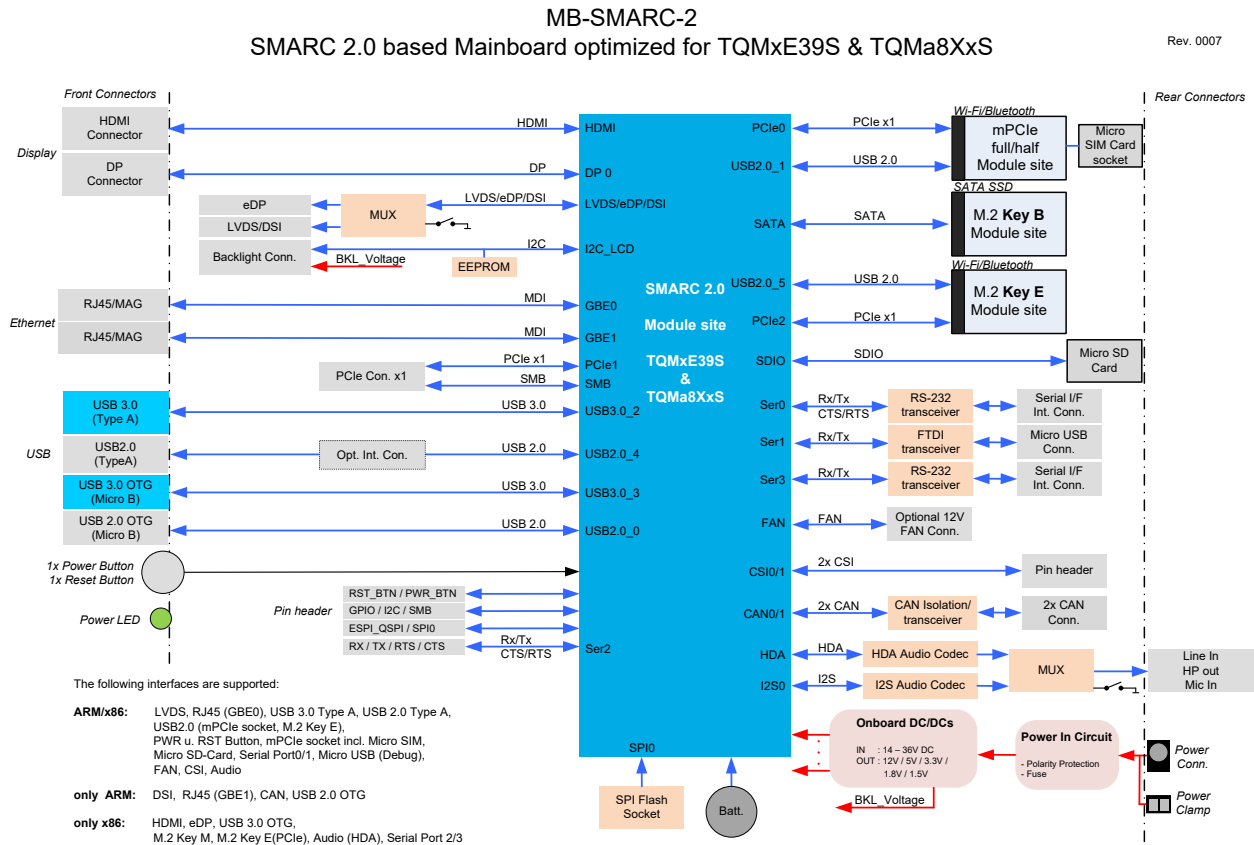


Figure 1: Block Diagram MB-SMARC-2


## 3.2 Power Supply

### 3.2.1 Supply Voltage Characteristics

The MB-SMARC-2 requires an input voltage of 14 V to 36 V DC. Nominal voltage is 24 V DC.

The input voltages shall rise from 10 % of nominal to 90 % of nominal within 0.1 msec to 20 msec.  
(0.1 msec ≤ Rise Time ≤ 20 msec).

There must be a smooth and continuous increase of each DC output voltage from 10 % to 90 % of its final set point within the regulation range.


Attention: High voltage	
	Take care with operating voltages above 24 V DC.

### 3.2.2 Power Consumption Specification

The power consumption of the system significantly depends on the connected devices (SMARC module, Mass storage devices, USB devices, display backlight etc.).

The power consumption of the MB-SMARC-2 itself is approximately 2 W (SMARC module supplied externally; UEFI-shell active; no keyboard, no mouse, no mass storage device etc. connected).

The maximum input current of the MB-SMARC-2 is limited to 7 A by a fuse. The load caused by devices connected to the carrier board should not exceed 50 W.

Note: Power requirement	
	The power supply for the MB-SMARC-2 must be configured with enough reserve. It should be calculated with the maximum power of all connected components.

## 3.3 Environmental Specification

- Operating temperature, extended: -20 °C to +85 °C
- Storage temperature: -20 °C to +85 °C
- Relative humidity (operating / storage): 10 % to 90 % (not condensing)

## 3.4 System Components

### 3.4.1 Audio

The MB-SMARC-2 provides a Realtek ALC262 High Definition Audio Codec and a Texas Instruments TLV320AIC3204 Stereo Audio Codec. The mainboard is equipped with a multiplexer to switch from either audio codec to the audio jacks line in, microphone and headphone. For more details see section 3.6.15.

### 3.5 DIP switches S1, S2, S3

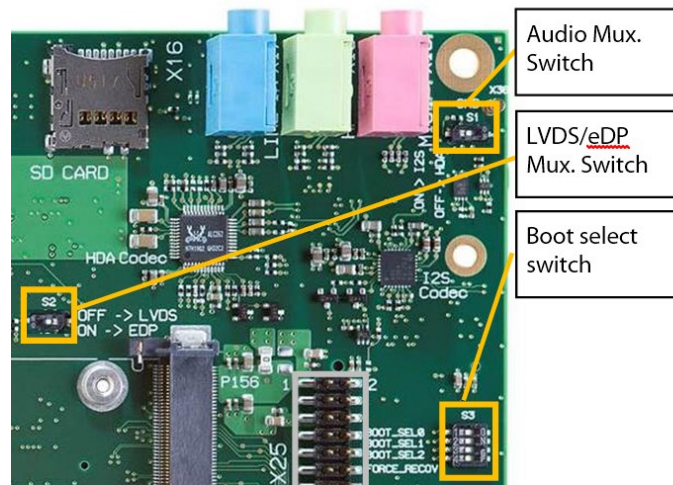


Figure 2: Position of DIP switches S1, S2, S3

DIP switches S1, S2, and S3 provide the following functionality:

- Audio (S1)
  - ON ⇒ I2S
  - OFF ⇒ HDA
- Display (S2)
  - ON ⇒ EDP
  - OFF ⇒ LVDS
- Boot Select (S3)

The options of DIP Switch S3 are predefined by the Module.  
See TQMxE39S and TQMa8XxS boot source options in the following table.

Table 2: Boot Select S3

S3-1	S3-2	S3-3	S3-4	Boot Source	TQMxE39S	TQMa8XxS
BOOT_SEL0	BOOT_SEL1	BOOT_SEL2	FORCE_RECOV			
ON	ON	ON	OFF	MB-SMARC-2 SATA	–	–
OFF	ON	ON	OFF	MB-SMARC-2 SD card	–	X
ON	OFF	ON	OFF	MB-SMARC-2 eSPI	–	–
OFF	OFF	ON	OFF	MB-SMARC-2 SPI	X	–
ON	ON	OFF	OFF	TQ-Module device (NAND, NOR)	–	NOR
OFF	ON	OFF	OFF	Remote boot (GBE, serial)	–	Internal Fuses
ON	OFF	OFF	OFF	TQ-Module eMMC flash	–	X
OFF	OFF	OFF	OFF	TQ-Module SPI	X	–
–	–	–	ON	Serial Downloader Mode	–	X

### 3.6 Connectors and Interfaces

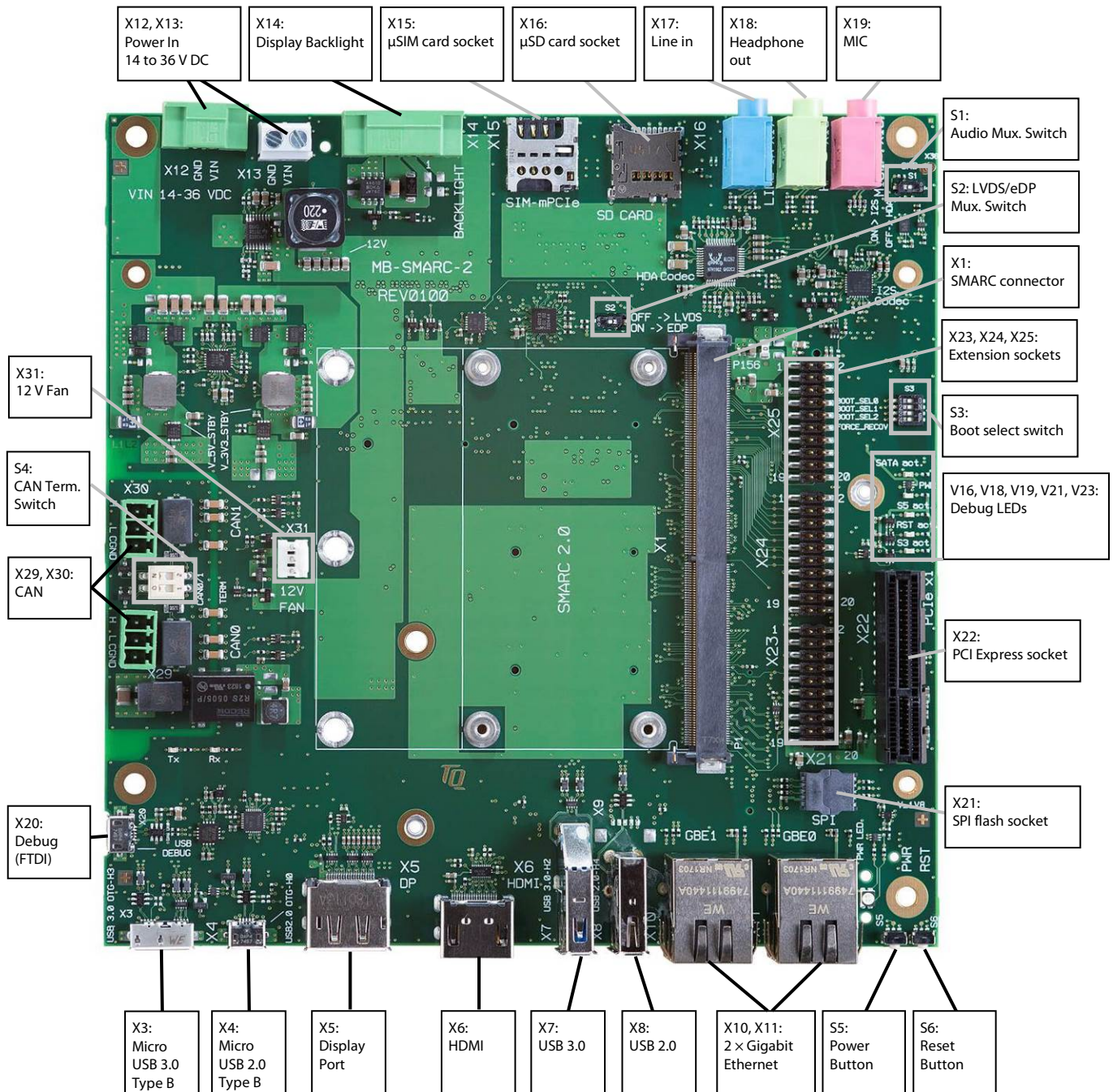


Figure 3: MB-SMARC-2, Top

### 3.6 Connectors and Interfaces (continued)

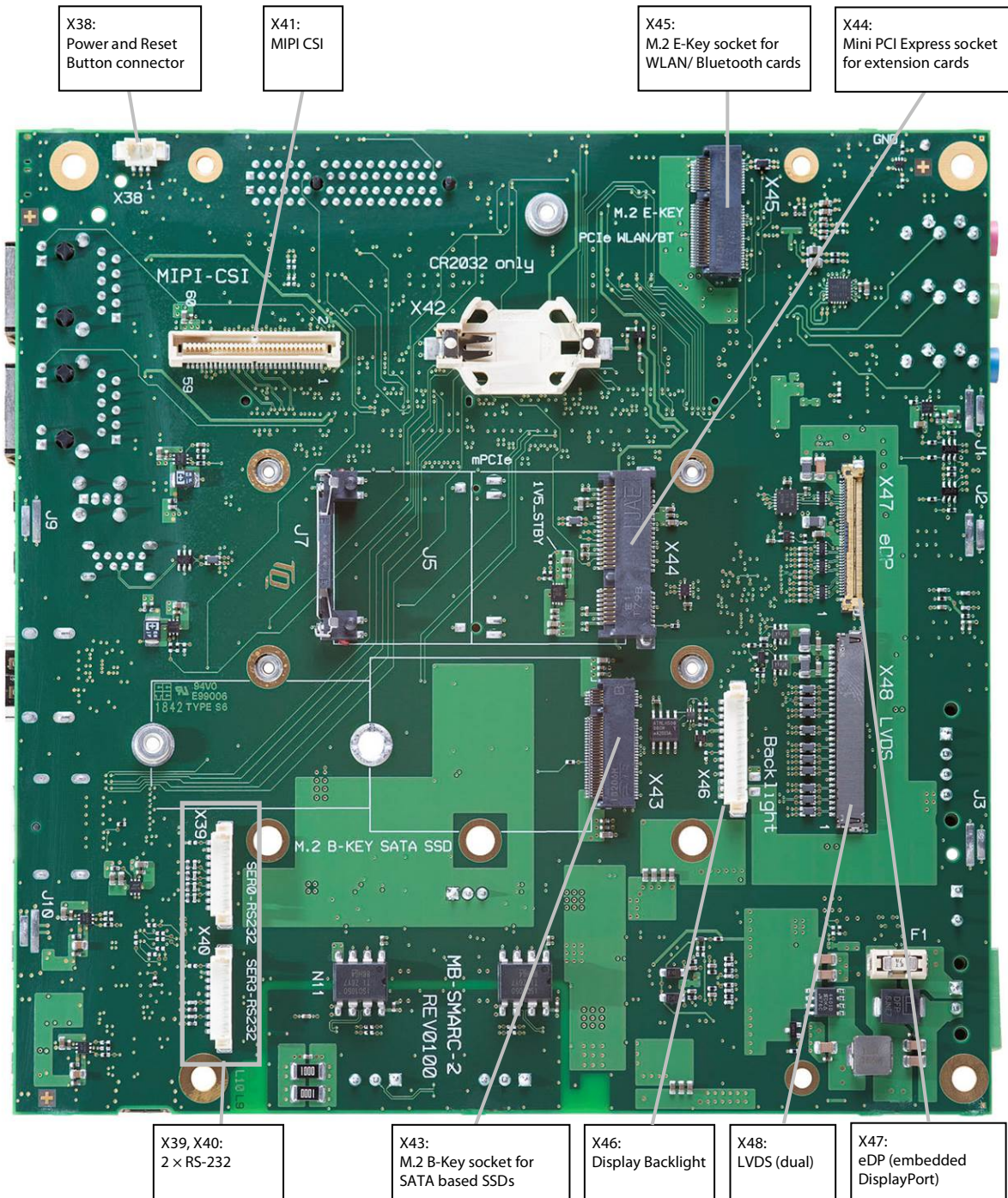


Figure 4: MB-SMARC-2, Bottom

### 3.6.1 Power Supply, X12 / X13

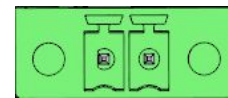
The MB-SMARC-2 requires a single 14 V to 36 V DC power supply. The nominal voltage is 24 V DC.

Power-In connector X12:

- Connector type: Phoenix MC 1,5/ 2-GF-3,5-LR (1817615)
- Mating connector: e.g. Phoenix FMC 1,5/ 2-STF-3,5 (1966091)

Table 3: Pinout Power-In connector, X12

Pin	Signal	Remark
1	24 V	Fused @ 7 A
2	GND	–



Pin1

Figure 5: DC Power Supply Connector, X12

Power-In connector X13:

- Connector type: Lumberg KRM02 (screw terminal)

Table 4: Pinout Power-In connector, X13

Pin	Signal	Remark
1	24 V	Fused @ 7 A
2	GND	–



Pin1

Figure 6: DC Power Supply Connector, X13

### 3.6.2 DisplayPort, X5

The MB-SMARC-2 provides one DisplayPort interface.

The support of the interface and adapters from DP to HDMI, DVI or VGA depends on the combination of the SMARC module and the adapter used. The combination of some modules with some adapters might not work.

### 3.6.3 HDMI, X6

The MB-SMARC-2 provides one HDMI interface.

The support of the interface and possible adapters depends on the combination of the SMARC module and the adapter used. The combination of some modules with some adapters might not work.

### 3.6.4 USB Interfaces, X7, X8, X3, X4

The MB-SMARC-2 provides several **USB Host** interfaces.

USB 3 Front connector X7: For direct usage of a USB 3.1 Gen1 host port (up to 0.9 A @ 5 V)

USB 2 Front connector X8: For direct usage of a USB 2.0 host port (up to 0.9 A @ 5 V)

The MB-SMARC-2 provides several **USB OTG** interfaces.

USB 3 Front connector X3: For direct usage of a USB 3.1 Gen1 host or device port (delivery up to 0.9 A @ 5 V)

USB 2 Front connector X4: For direct usage of a USB 2.0 host or device port (delivery up to 0.9 A @ 5 V)

The support of the OTG interface functionality depends on the implementation on the SMARC module.

#### Attention: Power requirement



It is not allowed to connect a Host to the USB OTG 3.0 Port in combination with the TQMa8XxS module. Otherwise hardware can be damaged.

### 3.6.5 Gigabit Ethernet, X10, X11

The MB-SMARC-2 provides two common 10/100/1000 Mbps speed Gigabit Ethernet ports.

Table 5: Function of Ethernet LEDs

LED Colour	Function
Green	Link is up (Link is connected)
Orange / Yellow	Act (Blinks at data transfer)



Figure 7: RJ45 Connectors, X10, X11

### 3.6.6 Serial Interfaces (RS-232), X39 / X40

The MB-SMARC-2 provides two serial ports:

- RS-232 port at on-board connectors X39 and X40

The SMARC specification does provide following signal definitions for the serial ports:

- X39: Rx / Tx / RTS / CTS
- X40: Rx / Tx

RS-232 connector: For usage of the RS-232 ports with an adapter cable (see chapter Accessories 2.3)

- Connector type: Molex 53398-1071
- Mating connector: Molex 51021-1000

Table 6: RS-232 D-Sub Connector

Pin	RS-232 Signal (all signals)	MB-SMARC-2	D-Sub connector (with DSUB-Adaptor)
1	DCD	NC	-
2	DSR	NC	RXD
3	RXD	RXD	TXD
4	RTS	RTS	-
5	TXD	TXD	GND
6	CTS	CTS	-
7	DTR	NC	RTS
8	RI	NC	CTS
9	GND	GND	-
10	-	NC	-

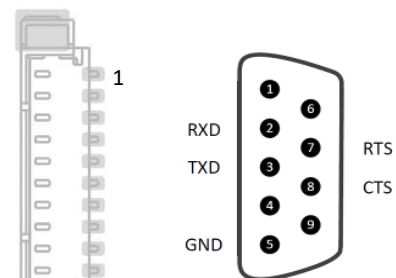


Figure 8: Molex Connector and RS-232 D-SUB Connector



### 3.6.7 Embedded Display Port, X47

The MB-SMARC-2 provides an embedded DisplayPort (eDP) interface where suitable displays can be connected directly. This functionality is only available when the connected SMARC module provides eDP and the multiplexer on the mainboard is switched to eDP interface (DIP switch S2 is "ON").

Please contact [TQ-Support](#) for further information about eDP or LVDS support.

eDP connector:

- Connector type: JAE HD1S040HA1
- Mating connector: JAE HD1P040MA1

Table 7: eDP Connector, X47

Pin	Signal	Remark
1	NC	–
2	GND	–
3	TX3–	Lane 3 differential pair
4	TX3+	
5	GND	–
6	TX2–	Lane 2 differential pair
7	TX2+	
8	GND	–
9	TX1–	Lane 1 differential pair
10	TX1+	
11	GND	–
12	TX0–	Lane 0 differential pair
13	TX0+	
14	GND	–
15	AUX+	AUX - channel
16	AUX–	
17	GND	–
18	3V3	3.3 V supply voltage
19	3V3	
20	3V3	
21	3V3	
22	NC	–
23	GND	–
24	GND	
25	GND	
26	GND	
27	HPD	Hot Plug Detect
28	GND	–
29	GND	
30	GND	
31	GND	
32	BKLT_EN	Backlight enable
33	BKLT_CTRL	Backlight (brightness) control
34	VDD_EN	Panel power enable
35	AUX_SEL	No function
36	V_BKLT	12 V Backlight supply voltage
37	V_BKLT	
38	V_BKLT	
39	V_BKLT	
40	NC	–

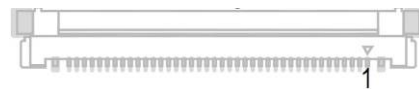


Figure 9: eDP Connector, X47

### 3.6.8 LVDS, X48

The MB-SMARC-2 provides an LVDS interface where suitable displays can be connected directly. This functionality is only available when the connected SMARC module provides LVDS and the multiplexer on the mainboard is switched to LVDS interface (DIP switch S2 is "OFF").

Please contact [TQ-Support](#) for further information about eDP or LVDS support.

There is also a connector on the carrier board to power the display backlight (for further information see next page).

The MB-SMARC-2 has an on-board EDID EEPROM to store display specific timing information.

This EEPROM can be programmed with an external I<sup>2</sup>C programmer.

If the programmer supports 3.3 V output voltage, the MB-SMARC-2 can be programmed without any additional power supply. In this case no SMARC module should be connected to the carrier board.

#### LVDS connector

- Connector type: Hirose DF19G-30P-1H
- Mating connector: Hirose DF19-30S-1C

Table 8: LVDS Connector, X48

Pin	Signal	Remark
1	A0-	Odd bus
2	A0+	Odd bus
3	A1-	Odd bus
4	A1+	Odd bus
5	A2-	Odd bus
6	A2+	Odd bus
7	GND	-
8	ACLK-	Odd bus
9	ACLK+	Odd bus
10	A3-	Odd bus
11	A3+	Odd bus
12	B0-	Even bus
13	B0+	Even bus
14	GND	-
15	B1-	Even bus
16	B1+	Even bus
17	GND	-
18	B2-	Even bus
19	B2+	Even bus
20	BCLK-	Even bus
21	BCLK+	Even bus
22	B3-	Even bus
23	B3+	Even bus
24	GND	-
25	5V_PANEL	5 V Panel supply voltage
26	5V_PANEL	
27	5V_PANEL	
28	3V3_PANEL	3.3 V Panel supply voltage
29	3V3_PANEL	
30	3V3_PANEL	



Figure 10: LVDS Connector, X48

### 3.6.8 LVDS, X48 (continued)

#### Backlight Power connector, X14

- Connector type: Phoenix MC 1,5/ 4-GF-3,5-LR (1817631)
- Mating connector: e.g. Phoenix FMC 1,5/ 4-STF-3,5 (1966114)

Table 9: Backlight Power Connector, X14

Pin	Signal	Remark
1	12V_BL	12 V always-on output
2	VCC_IN <sup>1</sup>	Backlight voltage input
3	GND	-
4	VCC_BKLT_OUT	Backlight voltage output

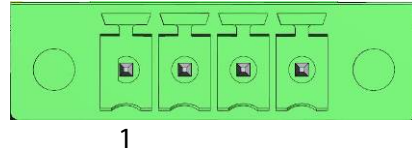


Figure 11: Backlight Power Connector, X14

Connect Pin 1 and 2 to use the 12 V of the MB-SMARC-2 for the backlight.

#### Backlight connector, X46

- Connector type: Molex 53398-1271
- Mating connector: Molex 51021-1200

Table 10: Backlight Connector, X46

Pin	Signal	Remark
1		
2	VCC_BKLT_OUT	Backlight voltage output
3		
4		
5	GND	-
6		
7	NC	-
8	LCD0_BKLT_EN	Display 0 Backlight Enable output
9	LCD0_BKLT_CTRL	Display 0 Backlight (brightness) control
10	3V3_PROG <sup>2</sup>	3.3 V input (programming)
11	EDID_CLK <sup>2</sup>	EDID I <sup>2</sup> C clock
12	EDID_DAT <sup>2</sup>	EDID I <sup>2</sup> C data
13	LCD1_BKLT_EN	Display 1 Backlight Enable output
14	LCD1_BKLT_CTRL	Display 1 Backlight (brightness) control

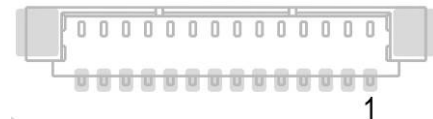


Figure 12: Backlight Connector, X46

1: An external voltage of up to 30 V can be supplied at this pin.

2: These pins can be used to program the on-board EDID EEPROM. The EEPROM can be powered by the 3V3\_PROG pin.

### 3.6.9 MIPI CSI (Camera serial interface), X41

The MB-SMARC-2 is equipped with two MIPI camera interfaces. It can be connected via a Board-to-Board connector.

MIPI CSI connectors X41

- Connector type: Tyco 5177986-2
- Mating connector: Tyco 5177985-2

Table 11: MIPI CSI Connectors, X41

Remark	Signal	Pin		Signal	Remark
-	GND	1	2	GND	-
1.8 V GPIO	CAM0_PWR#	3	4	CAM1_PWR#	1.8 V GPIO
1.8 V GPIO	CAM0_RST#	5	6	CAM1_RST#	1.8 V GPIO
-	NC	7	8	NC	-
-	NC	9	10	NC	-
-	NC	11	12	NC	-
-	GND	13	14	GND	-
-	NC	15	16	CSI1_RX3-	CSI 1 Lane 3 differential pair
-	NC	17	18	CSI1_RX3+	
-	GND	19	20	GND	-
-	NC	21	22	CSI1_RX2-	CSI 1 Lane 2 differential pair
-	NC	23	24	CSI1_RX2+	
-	GND	25	26	GND	-
CSI 0 Lane 1 differential pair	CSI0_RX1-	27	28	CSI1_RX1-	CSI 1 Lane 1 differential pair
	CSI0_RX1+	29	30	CSI1_RX1+	
-	GND	31	32	GND	-
CSI 0 Lane 0 differential pair	CSI0_RX0-	33	34	CSI1_RX0-	CSI 1 Lane 0 differential pair
	CSI0_RX0+	35	36	CSI1_RX0+	
-	GND	37	38	GND	-
CSI 0 clock differential pair	CSI0_CLK-	39	40	CSI1_CLK-	CSI 1 clock differential pair
	CSI0_CLK+	41	42	CSI1_CLK+	
-	GND	43	44	GND	-
CAM0 I2C Bus	I2C_CAM0_DAT_1V8	45	46	I2C_CAM1_DAT_1V8	CAM1 I2C Bus
	I2C_CAM0_CLK_1V8	47	48	I2C_CAM1_CLK_1V8	
-	GND	49	50	GND	-
-	CLK_CAM_MCLK_1V8	51	52	NC	-
-	GND	53	54	GND	-
-	NC	55	56	V_5V_STBY	5 V supply voltage
-	NC	57	58	V_5V_STBY	
-	NC	59	60	V_5V_STBY	

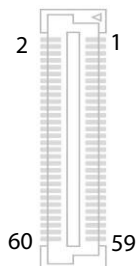


Figure 13: MIPI CSI Connector, X41

### 3.6.10 M.2 Socket with E-Keying (for I/O devices), X45

The MB-SMARC-2 provides a socket to support an M.2 module with 22 mm width and 30 mm length. USB and a PCIe ×1 interface signals are routed to this socket.

M.2 2230 single and double sided modules with E or A+E-Keying can be inserted.

The maximum transfer rate of this interface mainly depends on the SMARC module used and the connected device.

### 3.6.11 Mini PCI Express Socket (for WLAN/WWAN devices), X44

The MB-SMARC-2 provides a socket to support a full size Mini PCI Express module.

The usage of a half size mPCIe Module is also possible. This is an optional feature.

The signals of a USB 2.0 interface and a PCIe ×1 interface are routed to this socket.

The Micro SIM card socket X15 on the MB-SMARC-2 supports UMTS or LTE mPCIe cards.

The reachable transfer rate of this interface depends mainly on the SMARC module used and the connected device.

### 3.6.12 PCI Express Socket, X22

The MB-SMARC-2 provides a socket to support PCI Express extension cards.

The signals of a SM Bus interface and a PCIe ×1 interface are routed to this socket.

The reachable transfer rate of this interface depends mainly on the SMARC module used and the connected device.

### 3.6.13 M.2 Socket with B-Keying (for SATA SSD devices), X43

The MB-SMARC-2 provides a socket to support SATA based M.2 SSDs with 22 mm width and 80 mm length.

The usage of 2242 M.2 SSDs is also possible. This is an optional feature.

M.2 2280 single and double sided modules with B or B+M-Keying can be inserted.

The reachable transfer rate of this interface depends mainly on the SMARC module used and the connected device.

### 3.6.14 μSD Card, X16

The MB-SMARC-2 is equipped with a socket to support micro SD cards.

The corresponding signals of the SMARC module are routed to the SD card socket.

### 3.6.15 Audio, X17 / X18 / X19

The MB-SMARC-2 provides two audio codecs (I2S and HDA) with integrated amplifiers to support following audio features:

- X18: Headphone out
- X19: Microphone in
- X17: Line in

There is a multiplexer implemented to switch the Audio Signals from either I2S or HDA codec to the connectors.

When DIP switch S1 is "ON", the I2S path is active. When DIP switch S1 is "OFF", the HDA path is active.

### 3.6.16 CAN, X29 / X30

The MB-SMARC-2 provides two isolated CAN interfaces.

Table 12: CAN Connector, X29 / X30

Pin	Signal	Remark
1	CAN_H	CAN High
2	CAN_L	CAN Low
3	GND_CAN	Isolated CAN Ground

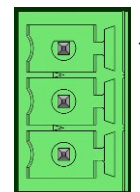


Figure 14: CAN Connector, X29 / X30

The CAN Ports can be terminated with 120 Ω.

Set switch S4 to "ON" to activate the termination (contact 1 refers to CAN0 and contact 2 to CAN1).

### 3.6.17 Fan Connector, X31

The MB-SMARC-2 provides a connector for 12 V fans with a standard 3-pin connector.

Table 13: 12 V Fan Connector, X31

Pin	Signal	Remark
1	GND	–
2	Fan Voltage	Output voltage (0 to 12 V PWM)
3	SENSE	Sense input for fan speed (for open drain outputs of fans)

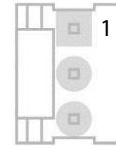


Figure 15: 12 V Fan Connector, X31

### 3.6.18 Power and Reset Button Connector, X38

A power and a reset button can be connected to the MB-SMARC-2.

- Connector type: Molex 53398-0371
- Mating connector: Molex 51021-0300

Table 14: Power and Reset Button Connector, X38

Pin	Signal
1	PWR_BTN#
2	GND
3	RST_BTN#

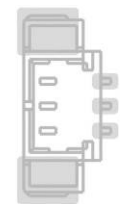


Figure 16: PWR and RST Button, X38

### 3.6.19 SPI Flash Socket, X21

The MB-SMARC-2 provides a socket for SPI flashes. This is useful if a BIOS update fails or for BIOS development purposes. SPI flashes with SO8W package can be inserted. It depends on the SMARC module used whether a certain flash device is supported.

### 3.6.20 SMARC Connector, X1

On the MB-SMARC-2 an MXM3 compatible connector is used to contact the gold contacts of the SMARC module. The stack height (board to board distance between carrier board and module) is 1.5 mm.

### 3.6.21 Power LED, V46

The MB-SMARC-2 provides a power LED. It is visible on the front if an appropriate light pipe is used.

Table 15: Power LED, V46

PCB Text	Function
PWR LED	Off: Carrier is not powered Green: Module in operation (S0 state) Blue: Module is turned off or in sleep state (S5 – soft off or S3/S4 – sleep)

### 3.6.22 Debug LEDs

The MB-SMARC-2 provides several LEDs for debug purposes.

Table 16: Debug LEDs

Function	PCB Text	Remark
Power	PWR	Green if input power is present
SUS S3	S3 act.	Green if module is in power-saving mode S3 (Suspend to RAM)
SUS S5	S3 act.	Green if module is in power-saving mode S5 (Soft off)
Reset active	RST act.	Green if Reset is asserted
SATA activity	SATA act.	SATA activity LED (green if active)

### 3.6.23 Extension Sockets

The MB-SMARC-2 provides several extension pin header with 100 mil pitch.

Table 17: Extension connector, X23

Signal	Pin	Signal
ESPI_IO_0_1V8	1	ESPI_IO_1_1V8
ESPI_CK_1V8	3	ESPI_CS1_1V8#
ESPI_CS0_1V8#	5	ESPI_RESET_1V8#
ESPI_IO_3_1V8	7	ESPI_IO_2_1V8
ESPI_ALERT1_1V8#	9	ESPI_ALERT0_1V8#
GND	11	GND
SMB_CLK_3V3	13	I2C_GP_CK_3V3
SMB_DAT_3V3	15	I2C_GP_DAT_3V3
SMB_ALERT_1V8#	17	V_1V8
12V	19	V_1V8

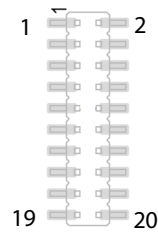


Figure 17: Extension Connector, X23

Table 18: Extension connector, X24

Signal	Pin	Signal
GPIO11_1V8	1	GPIO10_1V8
GPIO9_1V8	3	GPIO8_1V8
GPIO7_1V8	5	GPIO6_1V8
GPIO5_1V8	7	GPIO4_1V8
GPIO3_1V8	9	GPIO2_1V8
GPIO1_1V8	11	GPIO0_1V8
GND	13	GND
SPI0_MOSI_1V8	15	SPI0_MISO_1V8
SPI0_CLK_1V8	17	SPI0_CS1_1V8#
SPI0_CS0_1V8#	19	GND

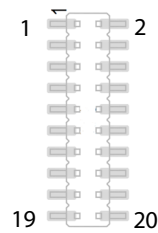


Figure 18: Extension Connector, X24

Table 19: Extension connector, X25

Signal	Pin	Signal
V_3V3_STBY	1	GND
V_3V3_STBY	3	GND
V_5V_STBY	5	GND
FORCE_RECOV_1V8#	7	BATLOW_1V8#
CHARGING_1V8#	9	CHARGER_PRSNT_1V8#
LID_1V8#	11	SLEEP_1V8#
WDT_1V8#	13	PCIE_WAKE_3V3#
GND	15	GND
SER2_CTS_1V8#	17	SER2_RTS_1V8#
SER2_RX_1V8	19	SER2_TX_1V8

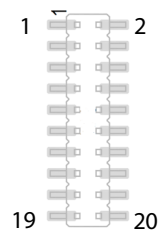


Figure 19: Extension Connector, X25

## 4. MECHANICS

### 4.1 Dimensions

The dimensions are according to the Mini-ITX form factor of  $170 \times 170 \text{ mm}^2$ .  
The following illustration shows the dimensions of the MB-SMARC-2.

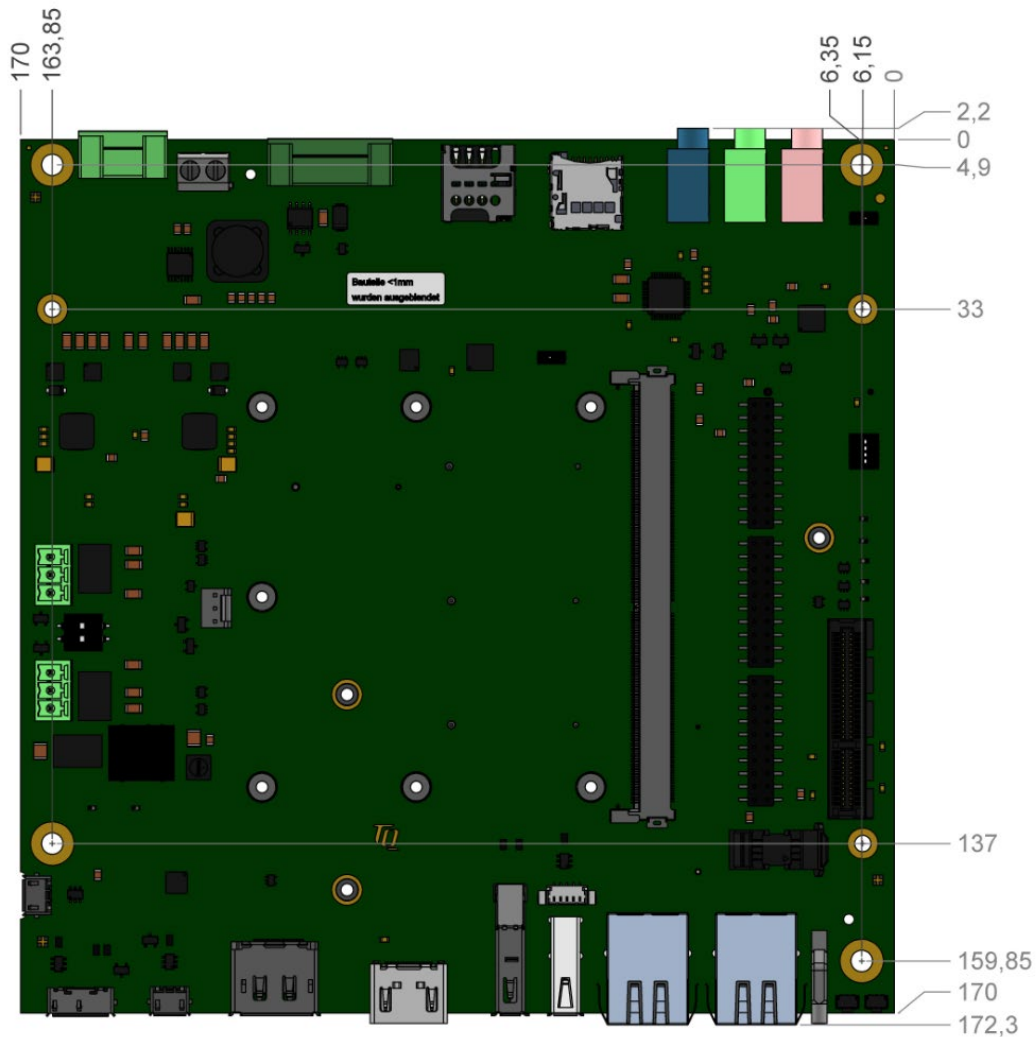


Figure 20: MB-SMARC-2, dimensions

Please contact [TQ-Support](#) for more details about 3D Step models.

### 4.2 Protection against External Effects

The MB-SMARC-2 is not protected against dust, external impact and contact (IP00).  
Adequate protection has to be guaranteed by the surrounding system.



## 5. SOFTWARE

### 5.1 System Resources

#### 5.1.1 General Purpose I<sup>2</sup>C Bus

The general purpose I<sup>2</sup>C bus (SMARC pin names I2C\_GP\_CK and I2C\_GP\_DAT) is routed to an EEPROM and the extension socket. The following table shows the I<sup>2</sup>C address mapping for the General Purpose I<sup>2</sup>C bus:

Table 20: I<sup>2</sup>C Address Mapping General Purpose I<sup>2</sup>C Bus

8-bit Address	Function	Device	Remark
0xAE	EEPROM	AT24C32E	EEPROM for software test purposes

#### 5.1.2 SMBus / Power Management I<sup>2</sup>C Bus

The SMBus (System Management Bus) (SMARC pin names I2C\_PM\_CK and I2C\_PM\_DAT) is accessible on an extension socket. There are no devices connected to this bus on the MB-SMARC-2.

## 5.2 Operating Systems

### 5.2.1 Supported Operating Systems

The MB-SMARC-2 supports various Operating Systems:

- Microsoft® Windows® 10
- Microsoft® Windows® 8.1 / Microsoft® Windows® Embedded Standard 8 (WES8)
- Microsoft® Windows® 7 / Microsoft® Windows® Embedded Standard 7 (WES7)
- Linux (i.e. Ubuntu 14.10 or later)

Other Operating Systems are supported on request.

Please contact [TQ-Support](#) for further information about supported Operating Systems.

### 5.2.2 Driver Download

The MB-SMARC-2 module is well supported by the Standard Operating Systems, which already include most of the drivers required. It is recommended to use the latest drivers for best performance and the full feature set of the module.

Please contact [TQ-Support](#) for further driver download assistance.

## 6. SAFETY REQUIREMENTS AND PROTECTIVE REGULATIONS

### 6.1 EMC

The MB-SMARC-2 was developed according to the requirements of electromagnetic compatibility (EMC). Depending on the target system, anti-interference measures may still be necessary to guarantee that the limits for the overall system including housing are met.

### 6.2 ESD

In order to avoid interspersions on the signal path from the input to the protection circuit in the system, the protection against electrostatic discharge should be arranged directly at the inputs of a system. Most external interfaces are protected using ESD protection diodes. Measurements for ESD protection have to be done with the electronic parts mounted in a housing. Since TQ-Systems GmbH does not offer a housing for the MB-SMARC-2, no special preventive measures are taken.

### 6.3 Operational Safety and Personal Security

Due to the occurring voltages ( $\leq 36$  V DC), tests with respect to the operational and personal safety have not been carried out.

### 6.4 Reliability and Service Life

The MTBF according to MIL-HDBK-217F N2 is 442,775 hours, Ground Benign, @ +40 °C.

### 6.5 Environment protection

#### 6.5.1 RoHS

The MB-SMARC-2 is manufactured RoHS compliant.

- All components and assemblies are RoHS compliant
- The soldering processes are RoHS compliant

#### 6.5.2 WEEE<sup>®</sup>

The final distributor is responsible for compliance with the WEEE<sup>®</sup> regulation.

Within the scope of the technical possibilities, the MB-SMARC-2 was designed to be recyclable and easy to repair.

#### 6.5.3 REACH<sup>®</sup>

The EU-chemical regulation 1907/2006 (REACH<sup>®</sup> regulation) stands for registration, evaluation, certification and restriction of substances SVHC (Substances of very high concern, e.g., carcinogen, mutagen and/or persistent, bio accumulative and toxic). Within the scope of this juridical liability, TQ-Systems GmbH meets the information duty within the supply chain with regard to the SVHC substances, insofar as suppliers inform TQ-Systems GmbH accordingly.

#### 6.5.4 EuP

The Ecodesign Directive, also Energy using Products (EuP), is applicable to products for the end user with an annual quantity >200,000. The MB-SMARC-2 must therefore always be seen in conjunction with the complete device.

The available standby and sleep modes of the components on the MB-SMARC-2 enable compliance with EuP requirements for the MB-SMARC-2.

#### 6.5.5 Packaging

The MB-SMARC-2 is delivered in reusable packaging.

## 6.6 Battery

### 6.6.1 General notes

Due to technical reasons a battery is required for the MB-SMARC-2. Batteries containing mercury (Hg), cadmium (Cd) or lead (Pb) are not used. If this is for technical reasons unavoidable, the device is marked with the corresponding hazard note. To allow a separate disposal, batteries are generally only mounted in sockets.

### 6.6.2 Lithium batteries

The requirements concerning special provision 188 of the ADR (section 3.3) are complied with for Lithium batteries. There is therefore no classification as dangerous goods:

- Basic lithium content per cell not more than 1 grams (except for lithium ion and lithium polymer cells for which a lithium content of not more than 1.5 g per cell applies (equals 5 Ah)).
- Basic lithium content per battery not more than 2grams (except for lithium ion batteries for which a lithium content of not more than 8 grams per cell applies (equals 26 Ah)).
- Lithium cells and batteries are examined according to UN document ST/SG/AC.10-1.

During transport a short circuit or discharging of the socketed lithium battery is prevented by extricable insulating foils or by other suitable insulating measures.

## 6.7 Other Entries

By environmentally friendly processes, production equipment and products, we contribute to the protection of our environment. To be able to reuse the MB-SMARC-2, it is produced in such a way (a modular construction) that it can be easily repaired and disassembled. The energy consumption of this subassembly is minimised by suitable measures.

The energy consumption of this subassembly is minimised by suitable measures

Due to the fact that at the moment there is still no technical equivalent alternative for printed circuit boards with bromine-containing flame protection (FR-4 material), such printed circuit boards are still used. No use of PCB containing capacitors and transformers (polychlorinated biphenyls). These points are an essential part of the following laws:

- The law to encourage the circular flow economy and assurance of the environmentally acceptable removal of waste as at 27.9.94 (Source of information: BGBl I 1994, 2705)
- Regulation with respect to the utilization and proof of removal as at 1.9.96 (Source of information: BGBl I 1996, 1382, (1997, 2860))
- Regulation with respect to the avoidance and utilization of packaging waste as at 21.8.98 (Source of information: BGBl I 1998, 2379)
- Regulation with respect to the European Waste Directory as at 1.12.01 (Source of information: BGBl I 2001, 3379)

This information is to be seen as notes. Tests or certifications were not carried out in this respect.

## 7. APPENDIX

### 7.1 Acronyms and Definitions

The following acronyms and abbreviations are used in this document.

Table 21: Acronyms

Acronym	Meaning
ATA	Advanced Technology Attachment
BIOS	Basic Input/Output System
CAN	Controller Area Network
CSI	Camera Serial Interface (MIPI)
DIP	Dual In-line Package
DP	Display Port
DVI	Digital Visual Interface
EDID	Extended Display Identification Data
eDP	embedded Display Port
EEPROM	Electrically Erasable Programmable Read-Only Memory
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
EuP	Energy using Products
FAE	Field Application Engineer
flexiCFG	Flexible Configuration
FR-4	Flame Retardant 4
FTDI	Future Technology Devices International
GPIO	General-Purpose Input/Output
HD	High Definition (Audio)
HDA	High-Definition Audio (Intel)
HDMI	High Definition Multimedia Interface
HPD	Hot Plug Detect
I/O	Input/Output
I2C	Inter-Integrated Circuit
I2S	Integrated Interchip Sound
IEEE®	Institute of Electrical and Electronics Engineers
IP	Ingress Protection
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LTE	Long Term Evolution
LVDS	Low Voltage Differential Signal
MIPI	Mobile Industry Processor Interface
mPCIe	Mini Peripheral Component Interconnect Express
MTBF	Mean (operating) Time Between Failures
NC	Not Connected
OTG	On-The-Go

## 7.1 Acronyms and Definitions (continued)

Table 21: Acronyms (continued)

Acronym	Meaning
PC	Personal Computer
PCB	Printed Circuit Board
PCI	Peripheral Component Interconnect
PCIe	Peripheral Component Interconnect express
PCMCIA	People Can't Memorize Computer Industry Acronyms
PICMG®	PCI Industrial Computer Manufacturers Group
PWM	Pulse-Width Modulation
PWR	Power
RAM	Random Access Memory
REACH®	Registration, Evaluation, Authorisation (and restriction of) Chemicals
RJ45	Registered Jack 45
RMA	Return Merchandise Authorization
RoHS	Restriction of (the use of certain) Hazardous Substances
RS-232	Recommended Standard (serial interface)
SATA	Serial ATA
SD	Secure Digital
SGET	Standardization Group for Embedded Technologies
SIM	Subscriber Identity Module
SM	System Management
SMARC	Smart Mobile ARChitecture
SMB	System Management Bus
SPI	Serial Peripheral Interface
SSD	Solid-State Drive
SVHC	Substances of Very High Concern
UEFI	Unified Extensible Firmware Interface
UMTS	Universal Mobile Telecommunications System
UN	United Nations
USB	Universal Serial Bus
VGA	Video Graphics Array (640 × 480)
WEEE®	Waste Electrical and Electronic Equipment
WES	(Microsoft®) Windows® Embedded Standard
WLAN	Wireless Local Area Network
WWAN	Wireless Wide Area Network



## 7.2 References

Table 22: Further Applicable Documents and Links

No.	Name	Rev. / Date	Company
(1)	SGET SMARC Hardware Specification (and Errata) <a href="https://www.sget.org/fileadmin/user_upload/SMARC_Hardware_Specification_V200_Errata.zip">https://www.sget.org/fileadmin/user_upload/SMARC_Hardware_Specification_V200_Errata.zip</a>	V2.0 / June 2016 V2_errata1.1/Feb 2017	<a href="#">SGET</a>
(2)	SGET SMARC Design Guide (available for public download) <a href="https://www.sget.org/fileadmin/user_upload/SMARC_DG_V2.pdf">https://www.sget.org/fileadmin/user_upload/SMARC_DG_V2.pdf</a>	V2.0 / June 2016	<a href="#">SGET</a>

