# MB-SMARC-3
# User's Manual

MB-SMARC-3 UM 0102
02.05.2022

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# TABLE DIRECTORY



# ILLUSTRATION DIRECTORY

# REVISION HISTORY

| Rev. | Date | Name | Pos. | Modification |
|---|---|---|---|---|
| 0100 | 31.01.2022 | Kreuzer | | First edition |
| 0101 | 22.03.2022 | Kreuzer | Table 20 | Device name corrected to TLV320AIC3204 |
| 0102 | 02.05.2022 | Kreuzer | 3.6.8 | Connector types corrected |

# 1. ABOUT THIS MANUAL

## 1.1 Copyright and Licence Expenses



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Please visit our website TQ-Group for latest product documentation, drivers, utilities and technical support.

You can register on our website 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.

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) 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.<br>Please note the relevant statutory regulations in this regard.<br>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. |
| **Command** | 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

| | |
|---|---|
|  | 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.<br>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.<br>Violation of this guideline may result in damage / destruction of the MB-SMARC-3 and be dangerous to your health.<br>Improper handling of your TQ-product would render the guarantee invalid. |

Proper ESD handling

| | |
|---|---|
|  | The electronic components of your TQ-product are sensitive to electrostatic discharge (ESD).<br>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. |

## 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-3 is a carrier board for SMARC modules with a pinout based on the SMARC 2.1 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-3:

**Supported Modules:**

- SMARC Modules with pinout based on SMARC 2.1 specification

**External Interfaces:**

- 2 × Gigabit Ethernet
- 3 × USB (1x Type C with 5Gb/s; 1x Type A with up to 10Gb/s, 1x Type A with 480Mb/s)
- 1 × DisplayPort (DP++)
- 1 × HDMI (2.0)
- Audio (headphone out, line in and microphone in)
- Power Button / Reset

**Internal Interfaces:**

- LVDS or eDP
- USB 2.0
- M.2 socket with B-Key (for SATA SSDs or WWAN modules, with micro SIM Card support)
- M.2 socket with E-Key (e.g. for WLAN / Bluetooth cards)
- M.2 socket with M-Key (for PCIe SSDs)
- µSD card socket
- up to 6 serial interfaces (e.g. with RS-232 transceivers)
- 2 x CAN interface (galvanically isolated)
- PCIe slot (for PCI add in cards)

**Power supply:**

- Voltage: 12 V DC ±5 %

**Environment:**

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

**Form factor / dimensions:**

- 170 mm × 170 mm (Mini ITX)

## 2.2 Specification Compliance

The MB-SMARC-3 supports SMARC modules, which are compliant to SGET SMARC Hardware Specification (V2.1).

## 2.3 Carrier Board Standard Configurations

- **MB-SMARC-3-AA**
  SMARC 2.1 Carrier for evaluation purposes

Other configurations are available on request.

## 2.4 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-3:

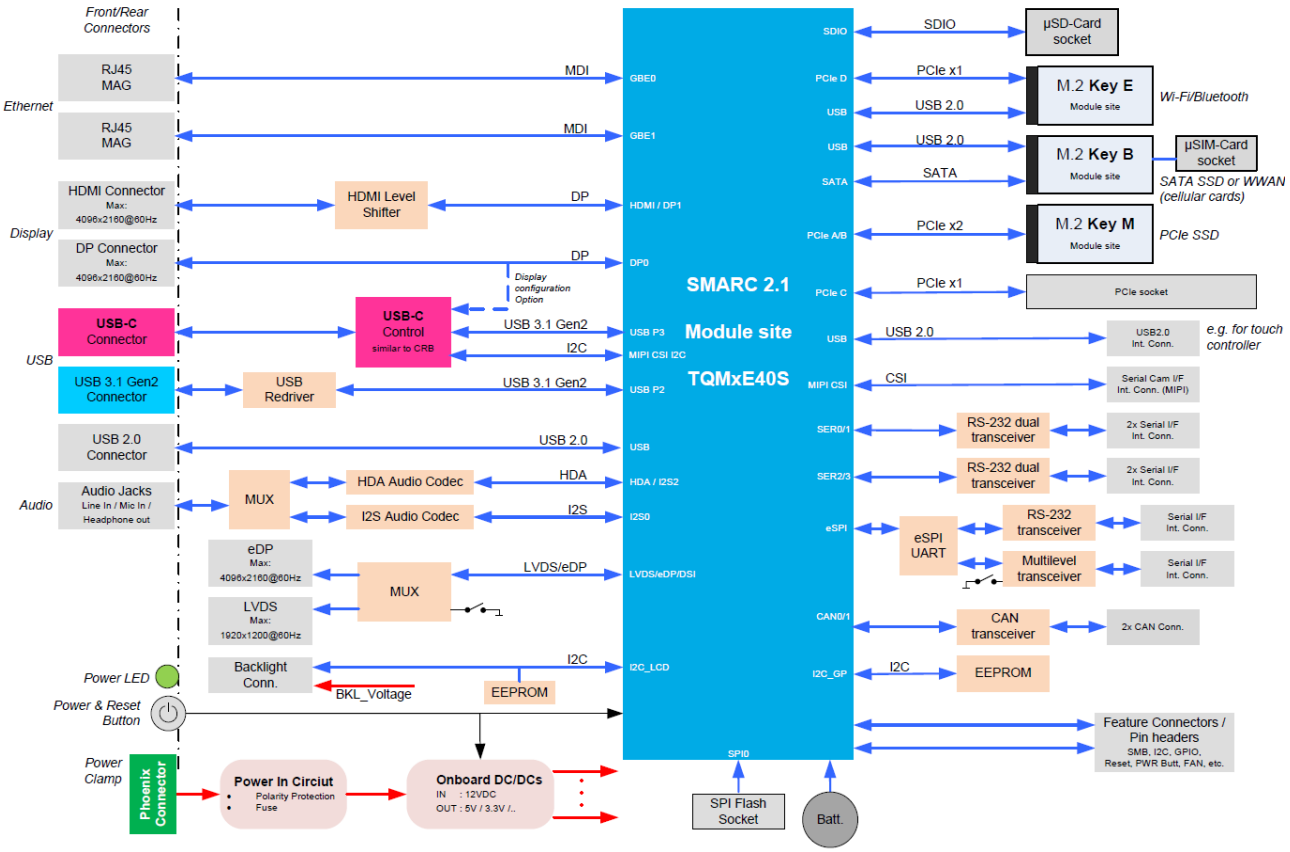


Illustration 1: Block Diagram MB-SMARC-3

## 3.2 Power Supply

### 3.2.1 Supply Voltage Characteristics

The MB-SMARC-3 requires an input voltage of 12 V DC ±5 %.

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

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.

### 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-3 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-3 is limited to 5 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-3 must be configured with enough reserve.<br>It should be calculated with the maximum power consumption 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-3 provides a Realtec 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.

### 3.4.2 Dual UART

The MB-SMARC-3 is equipped with a Fintek F81214 dual eSPI UART. The register set of the UART is based on the industry standard 16550 UART. The connected serial ports operate with standard serial port drivers.

## 3.5 DIP switches S1, S2, S3, S4

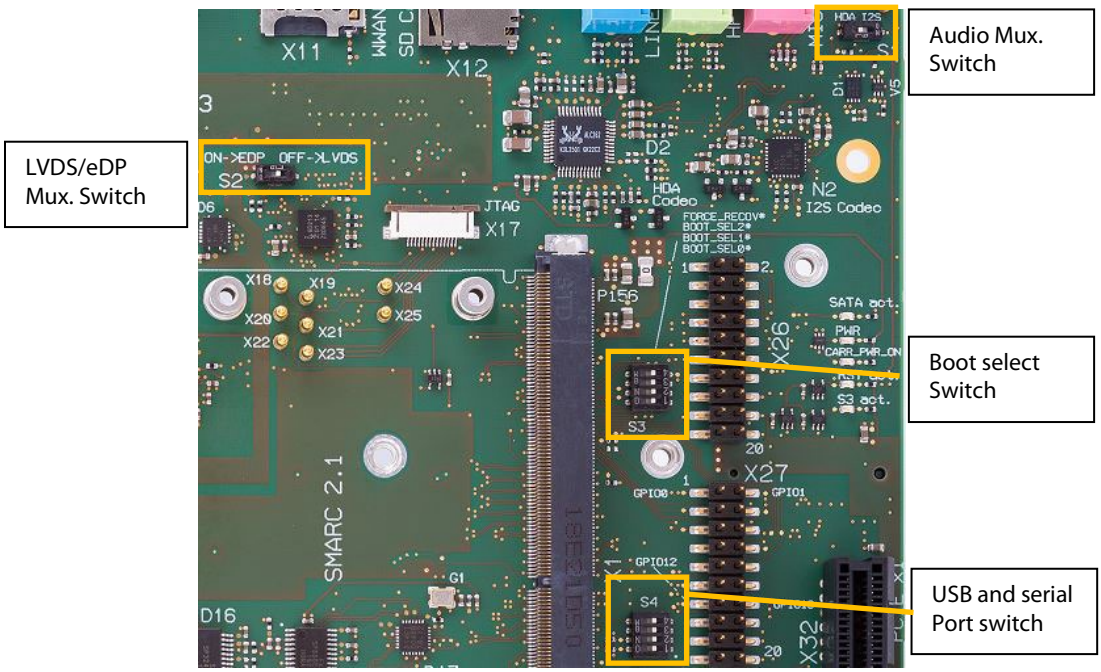


Illustration 2: Position of DIP switches

DIP switches S1, S2, S3 and S4 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 Table 2
- USB and serial Port (S4)
  - S4-1 ON -> RS-232 (SER5)
  - S4-1 OFF -> RS-485 (SER5)
  - S4-2 On -> Full Duplex (SER5)
  - S4-2 OFF -> Half Duplex (SER5)
  - S4-4 ON -> USB0 OTG_ID = 0

Table 2: Boot options

| S3-1 | S3-2 | S3-3 | S3-4 | Boot source |
|---|---|---|---|---|
| BOOT_SEL0# | BOOT_SEL1# | BOOT_SEL2# | FORCE_RECOV | |
| ON | ON | ON | OFF | MB-SMARC-3 SATA |
| OFF | ON | ON | OFF | MB-SMARC-3 SD Card |
| ON | OFF | ON | OFF | MB-SMARC-3 eSPI (CS0#) |
| OFF | OFF | ON | OFF | MB-SMARC-3 SPI (CS0#) |
| ON | ON | OFF | OFF | Module device (NAND, NOR) |
| OFF | ON | OFF | OFF | Remote boot (GbE, serial) |
| ON | OFF | OFF | OFF | Module eMMC Flash |
| OFF | OFF | OFF | OFF | Module SPI |
| – | – | – | – | ARM specific Serial Downloader Mode |

Most x86 modules only support the boot sources "Module SPI" and "MB-SMARC-3 SPI". For TQ's x86 SMARC modules only S3-3 (BOOT_SEL2#) is relevant. This toggles between the UEFI BIOS Flash on the module and the mainboard. Booting the operating system from mass storage devices is determined via the BIOS settings.

## 3.6 Connectors and Interfaces

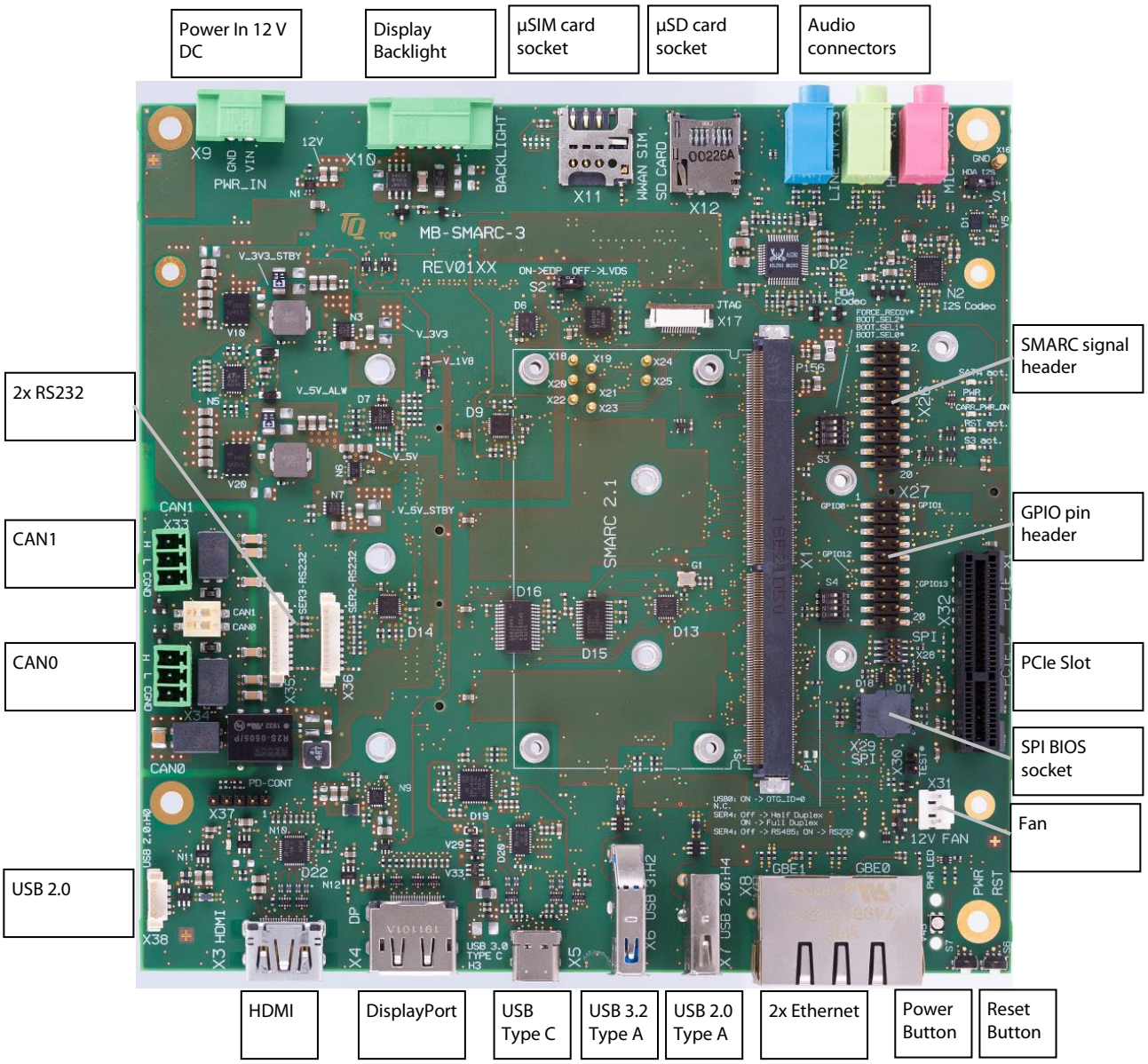


Illustration 3: MB-SMARC-3, Top

## 3.6 Connectors and Interfaces (continued)

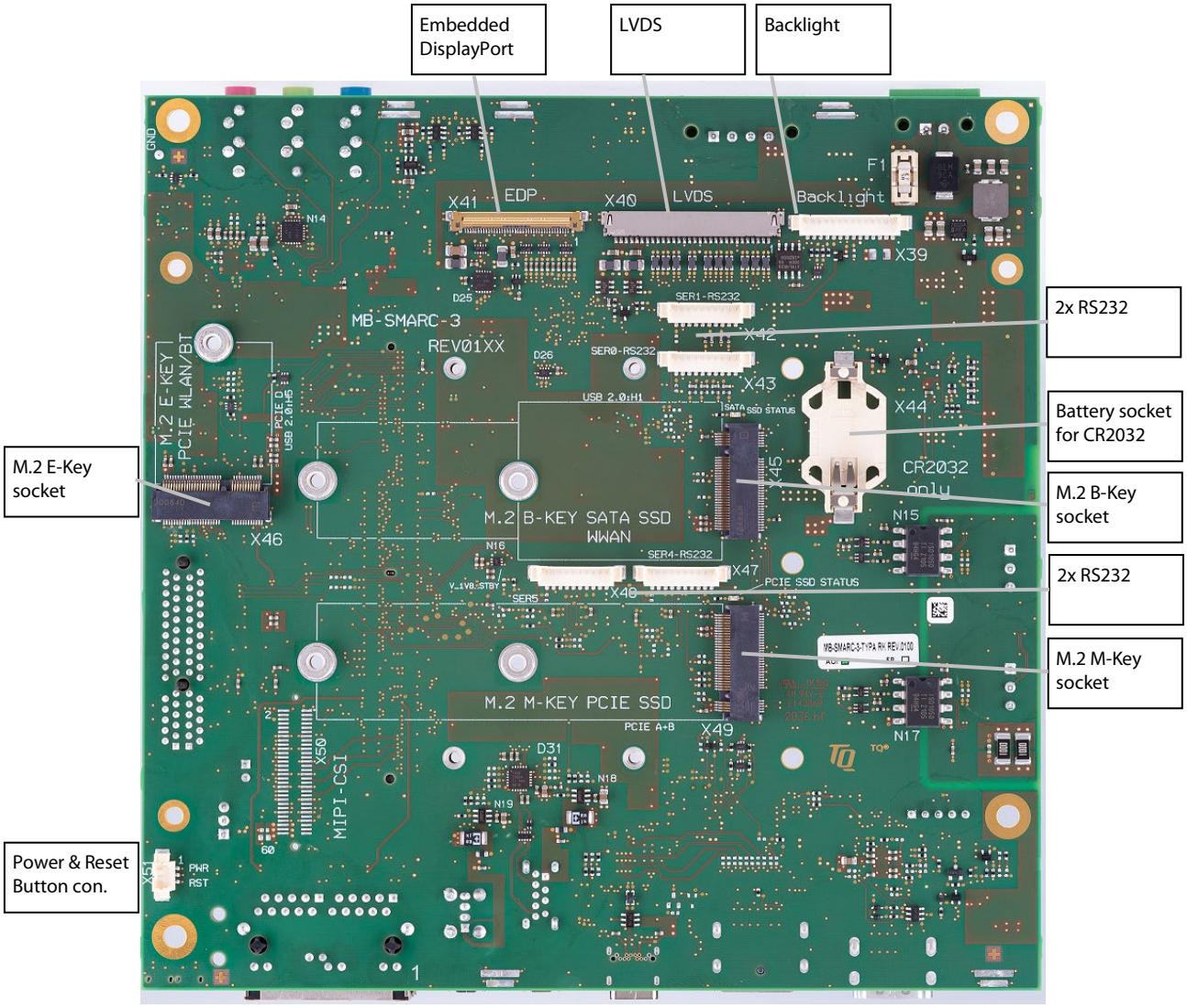


Illustration 4: MB-SMARC-3, Bottom

### 3.6.1 Power Supply

The MB-SMARC-3 requires a single 12 V DC power supply. The voltage should not vary more than ±5 %.

Power-In connector:

- 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, X9

| Pin | Signal | Remark |
|---|---|---|
| 1 | 12 V | Fused @ 5 A |
| 2 | GND | – |

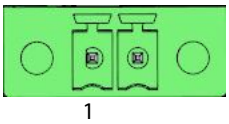


Illustration 5: DC Power Supply Connector

### 3.6.2 DisplayPort

The MB-SMARC-3 provides one DisplayPort interface with connector X4.
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

The MB-SMARC-3 provides one HDMI interface with connector X3. For good signal integrity and proper HDMI 2.0 support the MB-SMARC-3 is equipped with a retimer for this interface.
The support of the interface and possible adapters depends on the combination of the SMARC module and the adapter used. It is possible that not every combination of module and adapter works.

### 3.6.4 USB Interfaces

The MB-SMARC-3 provides several USB Host interfaces and connectors:

X5: C-Type connector connected to Host 3 of the SMARC module. This port supports data rates up to 5 Gb/s. The USB device and OTG capability is dependent on the connected SMARC module.

X6: A-Type connector connected to Host 2 of the SMARC module. This port is equipped with a 10 Gb/s redriver and is SuperSpeed+ (USB 3.2 Gen2) capable, if this is supported by the installed SMARC module.

X7: A-Type (USB2.0) connector for direct usage of USB host port

X38: USB host extension connector for usage of a USB host port with an adapter cable

- Connector type: Molex 53398-0571
- Mating connector: Molex 51021-0500 crimp housing

Table 4: Pinout USB Host Extension Connectors

| Pin | Signal | Cable Colour |
|---|---|---|
| 1 | +5 V | Red |
| 2 | D– | White |
| 3 | D+ | Green |
| 4 | GND | Black |
| 5 | GND | – |

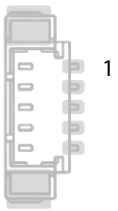


Illustration 6: USB host extension connector, X38

### 3.6.5 Gigabit Ethernet

The MB-SMARC-3 provides two common 10/100/1000 Mbps speed Gigabit Ethernet ports. For both ports the Ethernet signals of the SMARC module are used.

Table 5: Function of Ethernet LEDs

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

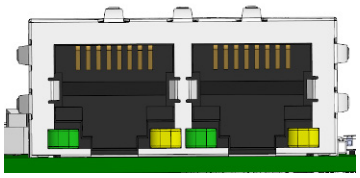

Illustration 7: RJ45 Connectors, X8

### 3.6.6 Serial Interfaces (RS-232)

The MB-SMARC-3 provides up to six serial ports:

- RS-232 port at on-board connectors X35, X36, X42, X43, X47, X48

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

- Rx / Tx / RTS / CTS for port 0 and 2
- Rx / Tx for port 1 and 3

RS-232 connector: For usage of the RS-232 ports with an adapter cable (see chapter Accessories 2.4)

- 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-3 | 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 | – |

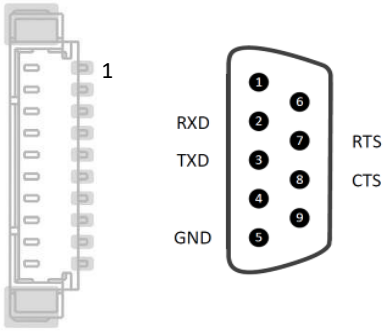


Illustration 8: Molex Connector and RS-232 D-SUB Connector

An ESPI UART is realized on the MB-SMARC-3 to support two more serial ports. SER5 is equipped with an RS232 / RS485 / RS422 multilevel transceiver.

Please contact TQ-Support for further information about available serial ports.

| Note: Typo on PCB | |
|---|---|
|  | The note on the PCB about the DIP switch S4 refers to SER4, which is unfortunately wrong. The switches influence SER5 ! |

### 3.6.7 Embedded Display Port

The MB-SMARC-3 has an embedded DisplayPort (eDP) interface for direct connection of suitable displays. 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, X41

| 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 | – |

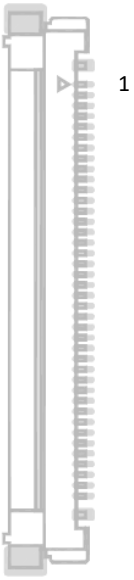


Illustration 9: eDP Connector


Illustration 10: Config. Switch S2: eDP/LVDS

### 3.6.8 LVDS

The MB-SMARC-3 provides an LVDS interface for direct connection of suitable displays. 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-3 has an on-board EDID EEPROM to store display specific timing information. This EEPROM can be programmed with an external I²C programmer. If the programmer supports 3.3 V output voltage, the MB-SMARC-3 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, X40

| 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 | |

1

Illustration 11: LVDS Connector


Illustration 12: Config. Switch S2: eDP/LVDS

Backlight Power connector

- 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, X10

| Pin | Signal | Remark |
|---|---|---|
| 1 | 12V_BL | 12 V always-on output |
| 2 | VCC_IN [1] | Backlight voltage input |
| 3 | GND | – |
| 4 | VCC_BKLT_OUT | Backlight voltage output |

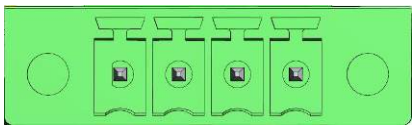


Illustration 13: Backlight Power Connector,

Connect pin 1 and 2 to use the 12 V of the MB-SMARC-3 for the backlight.

Backlight connector

- Connector type: Molex 53398-1471
- Mating connector: Molex 51021-1400

Table 10: Backlight Connector, X39

| Pin | Signal | Remark |
|---|---|---|
| 1 | VCC_BKLT_OUT | Backlight voltage output |
| 2 | | |
| 3 | | |
| 4 | GND | – |
| 5 | | |
| 6 | | |
| 7 | NC | – |
| 8 | LCD0_BKLT_EN | Display 0 Backlight Enable output |
| 9 | LCD0_BKLT_CTRL | Display 0 Backlight (brightness) control |
| 10 | 3V3_PROG [2] | 3.3 V input (programming) |
| 11 | EDID_CLK 2 | EDID I²C clock |
| 12 | EDID_DAT 2 | EDID I²C data |
| 13 | LCD1_BKLT_EN | Display 1 Backlight Enable output |
| 14 | LCD1_BKLT_CTRL | Display 1 Backlight (brightness) control |


Illustration 14: Backlight Connector

1: Connect pin 1 and 2 to use the 12 V of the MB-SMARC-3 for the backlight
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)

The MB-SMARC-3 is equipped with two MIPI camera interfaces. It can be connected via a Board-to-Board connector.

MIPI CSI connectors

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

Table 11: MIPI CSI Connectors, X50

| 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 | |

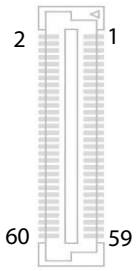


Illustration 15: MIPI CSI Connector, X50

The MIPI CSI connector is not placed on current MB-SMARC-3 variants. Please contact TQ-Support to request MIPI CSI support on the MB-SMARC-3.

### 3.6.10 M.2 Socket with E-Key

The MB-SMARC-3 provides the socket X46 to support an M.2 add-in card 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 add-in cards 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 M.2 Socket with B-Key

The MB-SMARC-3 provides the socket X45 to support SATA based M.2 SSDs or USB based WWAN add-in cards. SATA and USB 2.0 interface signals are routed to this socket. A Micro SIM card socket (X11) for native support of UMTS or LTE add-in cards is also available. M.2 2280, 2242 or 3042 single and double sided add-in cards with B or B+M-Keying can be inserted. Add-in cards with 42 mm length have to be mounted with an additional distance spacer.

The component height of add-in cards with 80 mm length shall not exceed 1.35 mm. Prevent contact between the add-in card and the steel spacer for mounting add-in cards with 42 mm length.

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

### 3.6.12 M.2 Socket with M-Key

The MB-SMARC-3 provides the socket X49 to support PCIe based M.2 SSDs. with 22 mm width and 80 mm or 42 mm length. PCIe x2 interface signals are routed to this socket. M.2 2280 or 2242 single and double sided add-in cards with M or B+M-Keying can be inserted. Add-in cards with 42 mm length have to be mounted with an additional distance spacer.

The component height of add-in cards with 80 mm length shall not exceed 1.35 mm. Prevent contact between the add-in card and the steel spacer for mounting add-in cards with 42 mm length.

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

### 3.6.13 PCI Express Socket

The MB-SMARC-3 provides the socket X32 to support PCI Express extension cards. PCIe x1 interface signals are routed to this socket. The transfer rate of this interface mainly depends on the SMARC module and the connected device.

### 3.6.14 µSD Card

The MB-SMARC-3 is equipped with the socket X12 to support micro SD cards. The corresponding signals of the SMARC module are routed to the SD card socket.

### 3.6.15 Audio

The MB-SMARC-3 provides two audio codecs (I2S and HDA) to support following audio features:

- Headphone out, X14 green
- Microphone in, X15 pink
- Line in, X13 blue

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

The MB-SMARC-3 provides two isolated CAN interfaces.

Table 12: CAN Connector

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

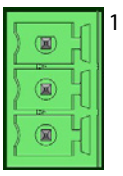


Illustration 16: CAN Connector, X34 / X33

The CAN ports can be terminated with 120 Ω. Set switch S5 (between CAN connectors) to “ON” to activate the termination (contact 1 refers to CAN0 and contact 2 to CAN1).

### 3.6.17 GPIO pin header

The MB-SMARC-3 provides a pin header for direct access to the SMARC module's GPIOs.

Table 13: GPIO pin header, X27

| Signal | Pin | | Signal |
|---|---|---|---|
| GPIO0_1V8 | 1 | 2 | GPIO1_1V8 |
| GPIO2_1V8 | 3 | 4 | GPIO3_1V8 |
| GPIO4_1V8 | 5 | 6 | GPIO5_1V8 |
| GPIO6_1V8 | 7 | 8 | GPIO7_1V8 |
| GPIO8_1V8 | 9 | 10 | GPIO9_1V8 |
| GPIO10_1V8 | 11 | 12 | GPIO11_1V8 |
| GPIO12_1V8 | 13 | 14 | GPIO13_1V8 |
| NC | 15 | 16 | NC |
| V_1V8 | 17 | 18 | GND |
| V_1V8 | 19 | 20 | GND |

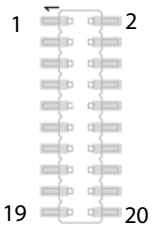


Illustration 17: GPIO pin header

### 3.6.18 Fan Connector

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

Table 14: 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<br>(for open drain outputs of fans) |

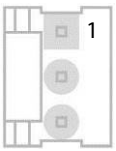


Illustration 18: 12 V Fan Connector

### 3.6.19 Power and Reset Button Connector

A power and a reset button can be connected to the MB-SMARC-3.

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

Table 15: Power and Reset Button Connector, X51

| Pin | Signal |
|---|---|
| 1 | PWR_BTN# |
| 2 | GND |
| 3 | RST_BTN# |

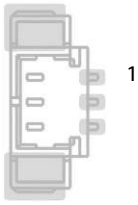


Illustration 19: PWR and RST Button

### 3.6.20 SPI Flash Socket

The MB-SMARC-3 provides the socket X29 for SPI flash memory. This is useful if a BIOS update fails or for BIOS development purposes. SPI flash memory with SO8W package can be inserted. It depends on the SMARC module used whether a certain flash device is supported.

If the "BOOT_SEL2#" switch is "ON", the BIOS from the SPI flash in the socket is active for TQ x86-modules.

### 3.6.21 (Front) Power LED

The MB-SMARC-3 provides a power LED. It is visible on the front if an appropriate light pipe is used.

Table 16: (Front) Power LED

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

### 3.6.22 Debug LEDs

The MB-SMARC-3 provides several LEDs for debug purposes.

Table 17: Debug LEDs

| Function | PCB Text | Remark |
|---|---|---|
| Power | PWR | Green if input power is present |
| Carrier Power on | CARRIER_PWR_ON | Green if module has turned carrier power on |
| SUS S3 | S3 act. | Green if module is in power-saving mode S3 (Suspend to RAM) |
| Reset active | RST act. | Green if Reset is asserted |
| SATA activity | SATA act. | SATA activity LED (green if active) |

### 3.6.23 SMARC signal extension connector, X26

The MB-SMARC-3 provides an extension connector (2.54 mm pitch), where some signals of the SMARC module are available.

Table 18: SMARC signal extension connector, X26

| Signal | Pin | | Signal |
|---|---|---|---|
| SMB_CLK_3V3 | 1 | 2 | I2C_GP_CK_3V3 |
| SMB_DAT_3V3 | 3 | 4 | I2C_GP_DAT_3V3 |
| SMB_ALERT_3V3 | 5 | 6 | NC |
| FORCE_RECOV_1V8# | 7 | 8 | BATLOW_1V8# |
| CHARGING_1V8# | 9 | 10 | CHARGER_PRSNT_1V8# |
| LID_1V8# | 11 | 12 | SLEEP_1V8# |
| WDT_1V8# | 13 | 14 | PCIE_WAKE_3V3# |
| V_3V3 | 15 | 16 | GND |
| V_3V3 | 17 | 18 | GND |
| V_5V | 19 | 20 | GND |

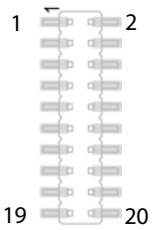


Illustration 20: SMARC signal extension connector

### 3.6.24 SMARC connector

On the MB-SMARC-3 an MXM3 compatible connector X1 is used to contact the gold contacts of the SMARC module.
The stack height (board to board distance between carrier board and module) is 5 mm.

# 4. MECHANICS

## 4.1 Dimensions

The dimensions are according to the Mini-ITX form factor of 170 mm × 170 mm.
The following illustration shows the dimensions of the MB-SMARC-3 in mm:

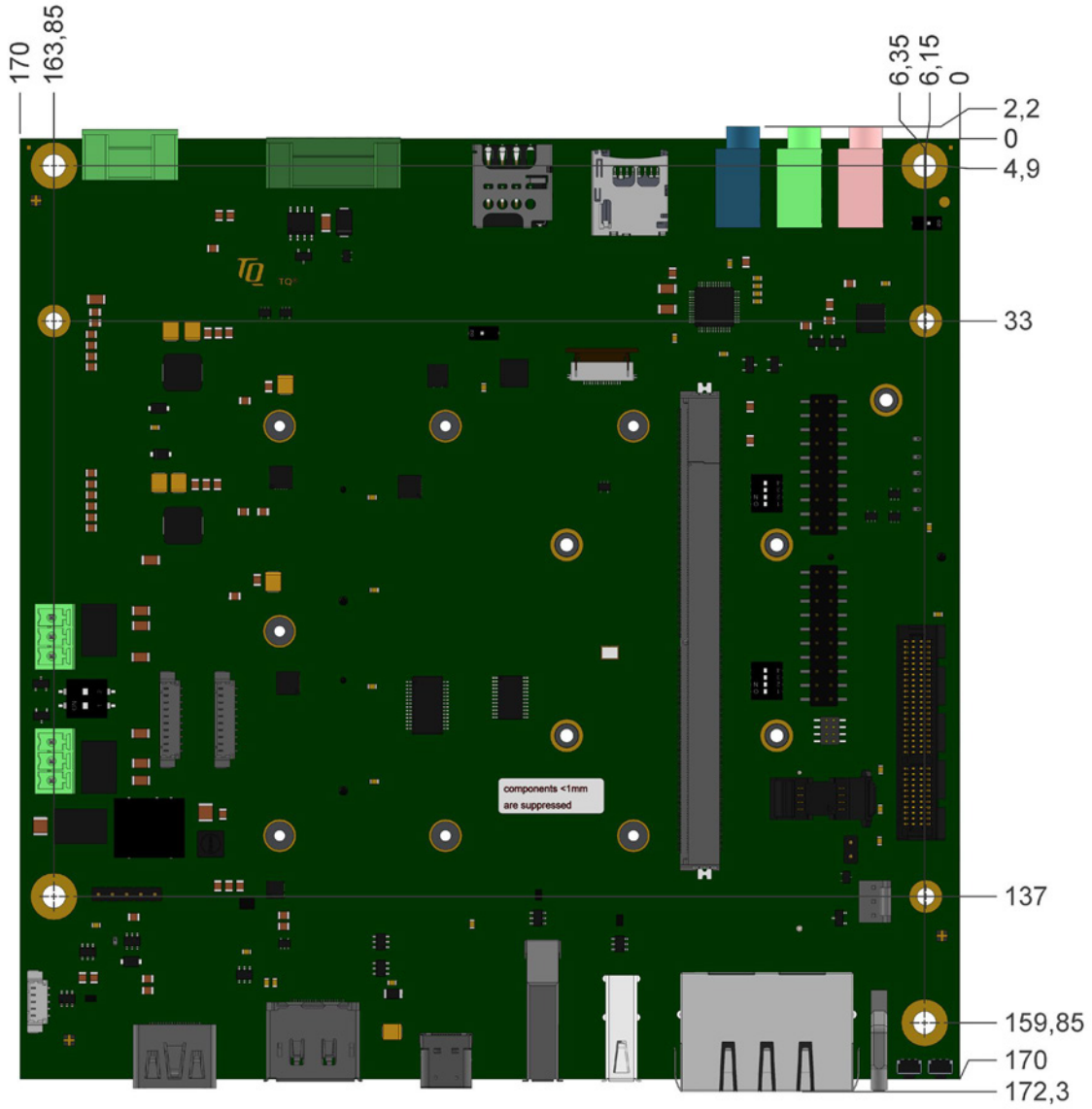


Illustration 21: MB-SMARC-3, dimensions

Please contact TQ-Support for more details about 3D Step models.

## 4.2 Labels

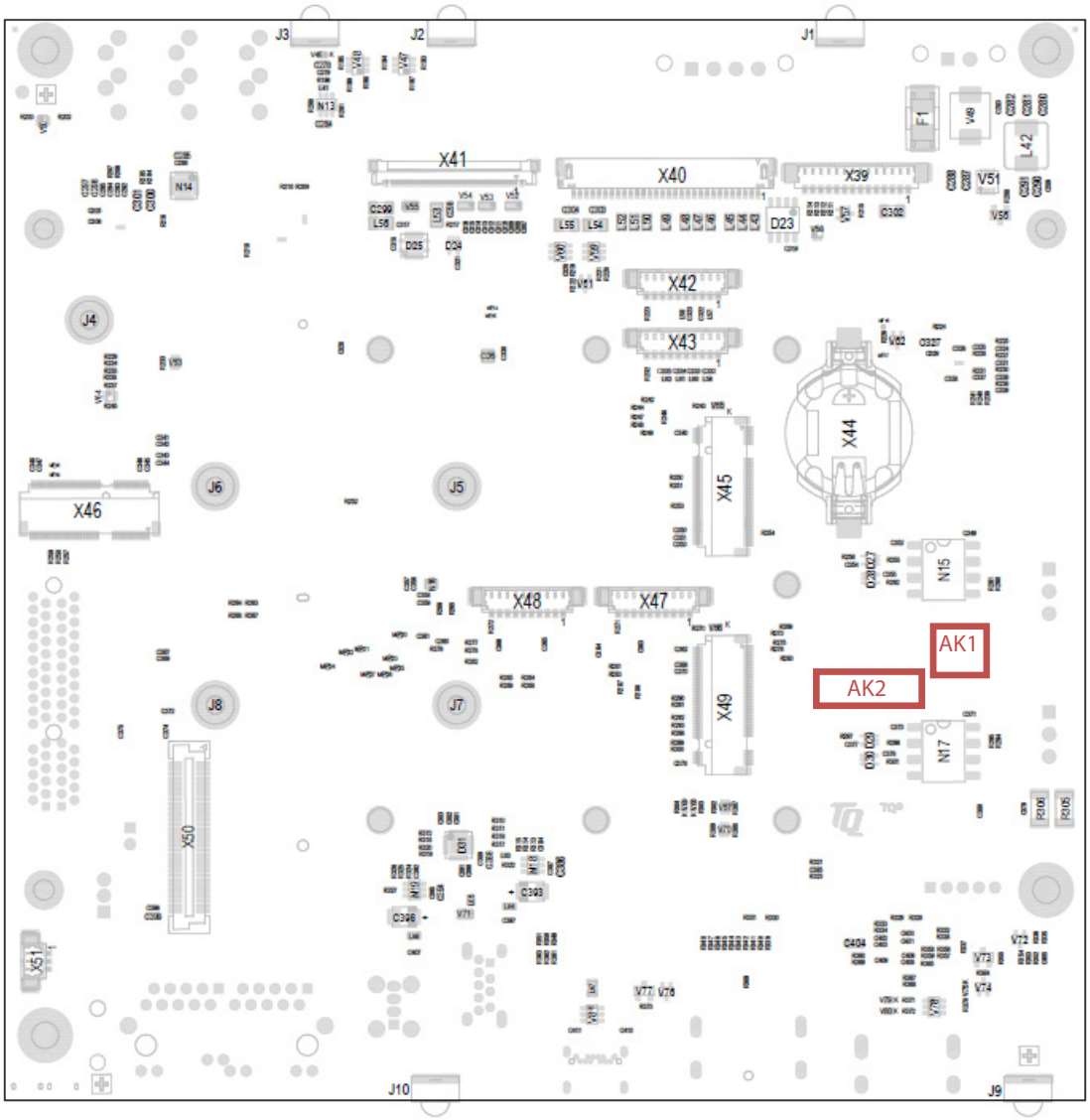


Illustration 22: Position Labels

Table 19: Labels on MB-SMARC-3

| Label | Content |
|---|---|
| AK1 | Serial number |
| AK2 | MB-SMARC-3 version and revision, tests performed |

## 4.3 Protection against External Effects

The MB-SMARC-3 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 I²C Bus

The general purpose I²C bus (SMARC pins I2C_GP_CK and I2C_GP_DAT) is routed to an EEPROM and the extension socket.
The following table shows the I²C address mapping for the General Purpose I²C bus:

Table 20: I²C Address Mapping General Purpose I²C Bus

| 8-bit Address | Function | Device | Remark |
|---|---|---|---|
| 0xAE | EEPROM | AT24C32E | EEPROM for software test purposes |
| 0x30 | I2S Audio Codec | TLV320AIC3204 | I2S Audio can be configured via this interface |

### 5.1.2 SMBus / Power Management I²C Bus

The SMBus (System Management Bus; SMARC pins 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-3.

## 5.2 Operating Systems

### 5.2.1 Supported Operating Systems

The MB-SMARC-3 supports various operating systems:

- Microsoft® Windows® 10
- Linux (i.e. Ubuntu 20.10 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-3 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-3 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 interspersion 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-3, no special preventive measures are taken.

## 6.3 Shock & Vibration

The MB-SMARC-3 is designed to be insensitive to shock and vibration and impact.

## 6.4 Operational Safety and Personal Security

Due to the occurring voltages (≤20 V DC), tests with respect to the operational and personal safety have not been carried out.

## 6.5 Reliability and Service Life

The MTBF according to MIL-HDBK-217F N2 is 394219 hours, ground benign, @ +40 °C.

# 7. ENVIRONMANT PROTECTION

## 7.1 RoHs

The MB-SMARC-3 is manufactured RoHS compliant.

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

## 7.2 WEEE®

The final distributor is responsible for compliance with the WEEE® regulation.
Within the scope of the technical possibilities, the MB-SMARC-3 was designed to be recyclable and easy to repair.

## 7.3 REACH®

The EU-chemical regulation 1907/2006 (REACH® 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.

## 7.4 EuP

The Eco Design Directive, also Energy using Products (EuP), is applicable to products for the end user with an annual quantity >200,000. The MB-SMARC-3 must therefore always be seen in conjunction with the complete device. The available standby and sleep modes of the components on the MB-SMARC-3 enable compliance with EuP requirements for the MB-SMARC-3.

## 7.5 Battery

No batteries are assembled on the MB-SMARC-3. The RTC battery socket X44 is designed for CR2032 coin cell.

## 7.6 Packaging

By environmentally friendly processes, production equipment and products, we contribute to the protection of our environment. To be able to reuse the MB-SMARC-3, 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 MB-SMARC-3 is delivered in reusable packaging.

## 7.7 Other Entries

By environmentally friendly processes, production equipment and products, we contribute to the protection of our environment.

The energy consumption of this subassembly is minimised by suitable measures.

Printed PC-boards are delivered in reusable packaging.

Modules and devices are delivered in an outer packaging of paper, cardboard or other recyclable material.

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.

# 8. APPENDIX

## 8.1 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 |

## 8.1 Acronyms and Definitions (continued)

Table 19: 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 |

## 8.2 References

Table 22: Further Applicable Documents and Links

| No. | Name | Rev. / Date | Company |
|---|---|---|---|
| (1) | SMARC (Smart Mobility ARChitecture) Hardware Specification | Version 2.1, March 23, 20 | SGET |
| (2) | SMARC (Smart Mobility ARChitecture) Design Guide | Rev. 2.1.1, April 29, 2021 | SGET |

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