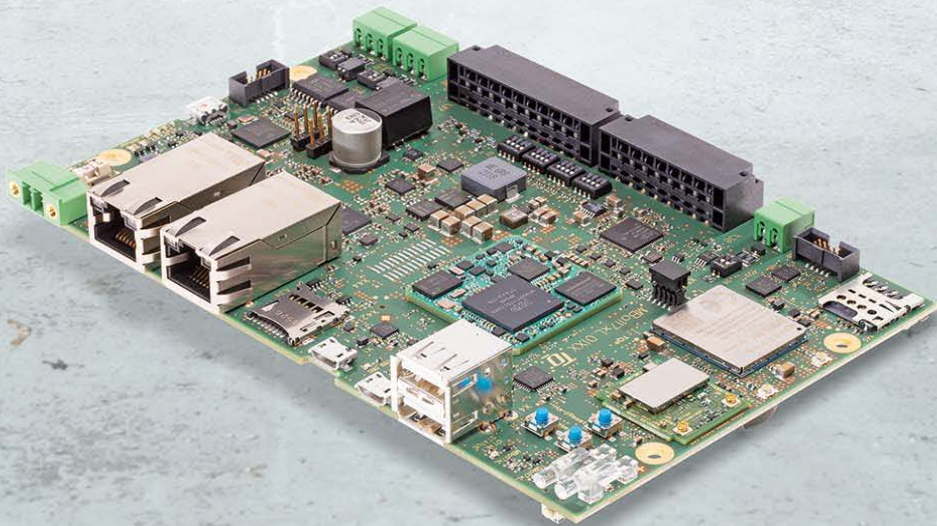




# MBa117xL User's Manual

MBa117xL UM 0101  
12.03.2025





## TABLE OF CONTENTS

1.	ABOUT THIS MANUAL.....	1
1.1	Copyright and license expenses .....	1
1.2	Registered trademarks .....	1
1.3	Disclaimer.....	1
1.4	Intended Use.....	1
1.5	Imprint.....	2
1.6	Tips on safety .....	2
1.7	Symbols and typographic conventions .....	2
1.8	Handling and ESD tips.....	2
1.9	Naming of signals.....	3
1.10	Further applicable documents / presumed knowledge .....	3
2.	BRIEF DESCRIPTION .....	4
2.1	MBa117xL block diagram.....	4
2.2	MBa117xL interfaces overview .....	5
3.	ELECTRONICS.....	7
3.1	MBa117xL functional groups.....	7
3.1.1	TQMa117xL overview .....	7
3.1.2	TQMa117xL pinout .....	7
3.1.3	I <sup>2</sup> C devices, address mapping.....	8
3.1.4	RTC backup.....	8
3.1.5	Control signals.....	8
3.2	Power supply .....	9
3.2.1	Power input.....	9
3.2.2	Protective circuitry.....	11
3.3	Communication interface .....	11
3.3.1	Ethernet .....	11
3.3.2	SD card interface .....	12
3.3.3	USB 2.0 hub .....	13
3.3.4	USB 2.0 OTG.....	13
3.3.5	UART.....	13
3.3.6	RS485 .....	14
3.3.7	MIPI DSI / LVDS.....	15
3.3.8	MIPI CSI.....	19
3.3.9	CAN .....	20
3.3.10	WiFi .....	20
3.3.11	IoT radio module .....	21
3.3.12	Analog inputs .....	22
3.3.13	Digital inputs and outputs.....	25
3.3.14	PIN header X44.....	27
3.3.15	SEC connection .....	28
3.4	Diagnostic and user interfaces.....	28
3.4.1	Boot Mode configuration.....	28
3.4.2	Module settings .....	29
3.4.3	Carrier settings .....	30
3.4.4	Push buttons .....	30
3.4.5	Reset Buttons.....	30
3.4.6	Status LEDs .....	31
3.4.7	JTAG® / Fremlink .....	33
4.	SOFTWARE.....	34
5.	MECHANICS.....	35
5.1	MBa117xL dimensions .....	35
5.2	Embedding in the overall system .....	35
5.3	Housing .....	35
5.4	Thermal management.....	35
5.5	Assembly / component placement / labeling .....	35



6.	SAFETY REQUIREMENTS AND PROTECTIVE REGULATIONS.....	37
6.1	EMC.....	37
6.2	ESD.....	37
6.3	Operational safety and personal security.....	37
6.4	Export Control and Sanctions Compliance.....	37
6.5	Warranty.....	37
7.	CLIMATIC AND OPERATIONAL CONDITIONS.....	38
7.1	Protection against external effects.....	38
7.2	Reliability and service life.....	38
8.	ENVIRONMENT PROTECTION.....	39
8.1	RoHS.....	39
8.2	WEEE®.....	39
8.3	REACH®.....	39
8.4	EuP.....	39
8.5	Statement on California Proposition 65.....	39
8.6	Packaging.....	39
8.7	Batteries.....	39
8.7.1	General notes.....	39
8.7.2	Lithium batteries.....	39
8.8	Other entries.....	40
9.	APPENDIX.....	41
9.1	Acronyms and definitions.....	41
9.2	References.....	43



## TABLE DIRECTORY

Table 1:	Terms and conventions.....	2
Table 2:	TQMa117xL control signals.....	8
Table 3:	Pinout MIPI DSI, X40, suitable for NXP Display RK055HDMIPI4M.....	16
Table 4:	Pinout LVDS, X43.....	17
Table 5:	Pinout LVDS, X7.....	17
Table 6:	MIPI CSI socket X57.....	19
Table 7:	Pinout connector X38.....	23
Table 8:	Pinout connector X37.....	25
Table 9:	X44 pinout.....	27
Table 10:	Pinning SEC connector X41.....	28
Table 11:	Boot_Mode.....	28
Table 12:	BOOT_CFG [7:4] for boot device selection.....	29
Table 13:	BOOT_CFG[11:0] for boot configuration.....	29
Table 14:	DIP switches S3 to S6.....	30
Table 15:	Status LEDs.....	31
Table 16:	Pinout JTAG® pin header, X48.....	34
Table 17:	Labels on MBa117xL.....	36
Table 18:	Climatic and operational conditions MBa117xL.....	38
Table 19:	Acronyms.....	41
Table 20:	Further applicable documents.....	43



## FIGURE DIRECTORY

Figure 1:	Block diagram MBa117xL.....	4
Figure 2:	Position interfaces (top) .....	5
Figure 3:	Position interfaces (bottom).....	6
Figure 4:	Block diagram TQMa117xL.....	7
Figure 5:	Block diagram I <sup>2</sup> C bus .....	8
Figure 6:	Block diagram input wiring / PoE.....	9
Figure 7:	Jumper setting and their position .....	9
Figure 8:	Block diagram power supply chain MBa117xL .....	10
Figure 9:	MBa117xL protective circuitry.....	11
Figure 10:	Block diagram Ethernet.....	11
Figure 11:	Position Ethernet.....	11
Figure 12:	Block diagram SD card interface.....	12
Figure 13:	Block diagram USB 2.0 Hub.....	13
Figure 14:	Block diagram UARTs.....	14
Figure 15:	Position X39 and DIP switch for RS485.....	14
Figure 16:	Block diagram DSI / LVDS Interface .....	15
Figure 17:	Position LVDS and DSI connectors.....	18
Figure 18:	Block diagram CAN interface.....	20
Figure 19:	Block diagram WiFi .....	20
Figure 20:	Block diagram IoT module.....	21
Figure 21:	Position of IoT module and of the antenna connectors.....	22
Figure 22:	Block diagram Analog Frontend.....	22
Figure 23:	Position X38 .....	23
Figure 24:	Analog interface voltage-current measurement.....	23
Figure 25:	Analog interface voltage.....	24
Figure 26:	Analog interface RTD measurement.....	24
Figure 27:	Analog interface TC measurement.....	25
Figure 28:	Block diagram Digital IO.....	26
Figure 29:	Position of X37 .....	26
Figure 30:	Position X44 .....	27
Figure 31:	Position X41 .....	28
Figure 32:	Position push buttons.....	31
Figure 33:	Position Status LEDs .....	32
Figure 34:	Block diagram JTAG / SWD switching.....	33
Figure 35:	Position JTAG and Fremlink interfaces.....	33
Figure 36:	MBa117xL component placement top.....	35
Figure 37:	MBa117xL component placement bottom and labeling .....	36



## REVISION HISTORY

Rev.	Date	Name	Pos.	Modification
0001	29.10.2021	Kreuzer		First edition
0100	20.11.2023	Kreuzer	All	Reworked the whole document to board revision 0200
0101	12.03.2025	Kreuzer	1.4 Table 18	Chapter moved Ambient temperature corrected



## 1. ABOUT THIS MANUAL

### 1.1 Copyright and license expenses

Copyright protected © 2025 by TQ-Systems GmbH.

This User's Manual may not be copied, reproduced, translated, changed or distributed, completely or partially in electronic, machine readable, or in any other form without the written consent of TQ-Systems GmbH.

The drivers and utilities for the components used as well as the BIOS are subject to the copyrights of the respective manufacturers. The licence conditions of the respective manufacturer are to be adhered to.

Bootloader-licence expenses are paid by TQ-Systems GmbH and are included in the price.

Licence expenses for the operating system and applications are not taken into consideration and must be calculated / declared separately.

### 1.2 Registered trademarks

TQ-Systems GmbH aims to adhere to copyrights of all graphics and texts used in all publications, and strives to use original or license-free graphics and texts.

All brand names and trademarks mentioned in this User's Manual, including those protected by a third party, unless specified otherwise in writing, are subjected to the specifications of the current copyright laws and the proprietary laws of the present registered proprietor without any limitation. One should conclude that brand and trademarks are rightly protected by a third party.

### 1.3 Disclaimer

TQ-Systems GmbH does not guarantee that the information in this User's Manual is up-to-date, correct, complete or of good quality. Nor does TQ-Systems GmbH assume guarantee for further usage of the information. Liability claims against TQ-Systems GmbH, referring to material or non-material related damages caused, due to usage or non-usage of the information given in this User's Manual, or due to usage of erroneous or incomplete information, are exempted, as long as there is no proven intentional or negligent fault of TQ-Systems GmbH.

TQ-Systems GmbH explicitly reserves the rights to change or add to the contents of this User's Manual or parts of it without special notification.

#### **Important Notice:**

Before using the MBa117xL or parts of the MBa117xL schematics, you must evaluate it and determine if it is suitable for your intended application. You assume all risks and liability associated with such use. TQ-Systems GmbH makes no other warranties including, but not limited to, any implied warranty of merchantability or fitness for a particular purpose. Except where prohibited by law, TQ-Systems GmbH will not be liable for any indirect, special, incidental or consequential loss or damage arising from the usage of the MBa117xL or schematics used, regardless of the legal theory asserted.

### 1.4 Intended Use

TQ DEVICES, PRODUCTS AND ASSOCIATED SOFTWARE ARE NOT DESIGNED, MANUFACTURED OR INTENDED FOR USE OR RESALE FOR THE OPERATION IN NUCLEAR FACILITIES, AIRCRAFT OR OTHER TRANSPORTATION NAVIGATION OR COMMUNICATION SYSTEMS, AIR TRAFFIC CONTROL SYSTEMS, LIFE SUPPORT MACHINES, WEAPONS SYSTEMS, OR ANY OTHER EQUIPMENT OR APPLICATION REQUIRING FAIL-SAFE PERFORMANCE OR IN WHICH THE FAILURE OF TQ PRODUCTS COULD LEAD TO DEATH, PERSONAL INJURY, OR SEVERE PHYSICAL OR ENVIRONMENTAL DAMAGE. (COLLECTIVELY, "HIGH RISK APPLICATIONS")

You understand and agree that your use of TQ products or devices as a component in your applications are solely at your own risk. To minimize the risks associated with your products, devices and applications, you should take appropriate operational and design related protective measures.

You are solely responsible for complying with all legal, regulatory, safety and security requirements relating to your products. You are responsible for ensuring that your systems (and any TQ hardware or software components incorporated into your systems or products) comply with all applicable requirements. Unless otherwise explicitly stated in our product related documentation, TQ devices are not designed with fault tolerance capabilities or features and therefore cannot be considered as being designed, manufactured or otherwise set up to be compliant for any implementation or resale as a device in high risk applications. All application and safety information in this document (including application descriptions, suggested safety precautions, recommended TQ products or any other materials) is for reference only. Only trained personnel in a suitable work area are permitted to handle and operate TQ products and devices. Please follow the general IT security guidelines applicable to the country or location in which you intend to use the equipment.

## 1.5 Imprint

TQ-Systems GmbH  
Gut Delling, Mühlstraße 2  
D-82229 Seefeld





Tel: +49 8153 9308-0  
Fax: +49 8153 9308-4223  
E-Mail: [Info@TQ-Group](mailto:Info@TQ-Group)  
Web: [TQ-Group](http://TQ-Group)

## 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 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, 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 not to 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 MBa117xL 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 modules used:**  
These documents describe the service, functionality and special characteristics of the module used (incl. BIOS).
- **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.

The following documents are required for full comprehension of this User's Manual:

- MBa117xL schematics
- [TQMa117xL User's Manual](#)
- [i.MX RT1170 Data Sheet](#)
- i.MX RT1170 Reference Manual
- U-Boot documentation: [www.denx.de/wiki/U-Boot/Documentation](http://www.denx.de/wiki/U-Boot/Documentation)
- FreeRTOS documentation: [www.freertos.org/Documentation/RTOS\\_book.html](http://www.freertos.org/Documentation/RTOS_book.html)
- TQ-Support Wiki: <https://support.tq-group.com/en/arm/tqma117x/>

## 2. BRIEF DESCRIPTION

This User's Manual describes the hardware of the MBa117xL as of revision REV.02xx.

The MBa117xL is designed as a carrier board for the TQMa117xL. The TQMa117xL is directly soldered on the MBa117xL.

Core of the MBa117xL is the TQMa117xL with an NXP i.MX RT1170 based on a Cortex-M7.

The TQMa117xL connects all peripheral components. In addition to the standard communication interfaces such as USB, Ethernet, SD card, etc., most other available TQMa117xL signals are routed on 50 mil pin headers on the MBa117xL.

CPU features and interface can be evaluated, software development for a TQMa117xL-based project can start immediately.

Currently nine i.MX RT1170 derivatives are supported:

- 1) i.MX RT1171
- 2) i.MX RT1172
- 3) i.MX RT1173
- 4) i.MX RT1175
- 5) i.MX RT1176
- 6) i.MX RT117T
- 7) i.MX RT117H
- 8) i.MX RT117F
- 9) i.MX RT117C

### 2.1 MBa117xL block diagram

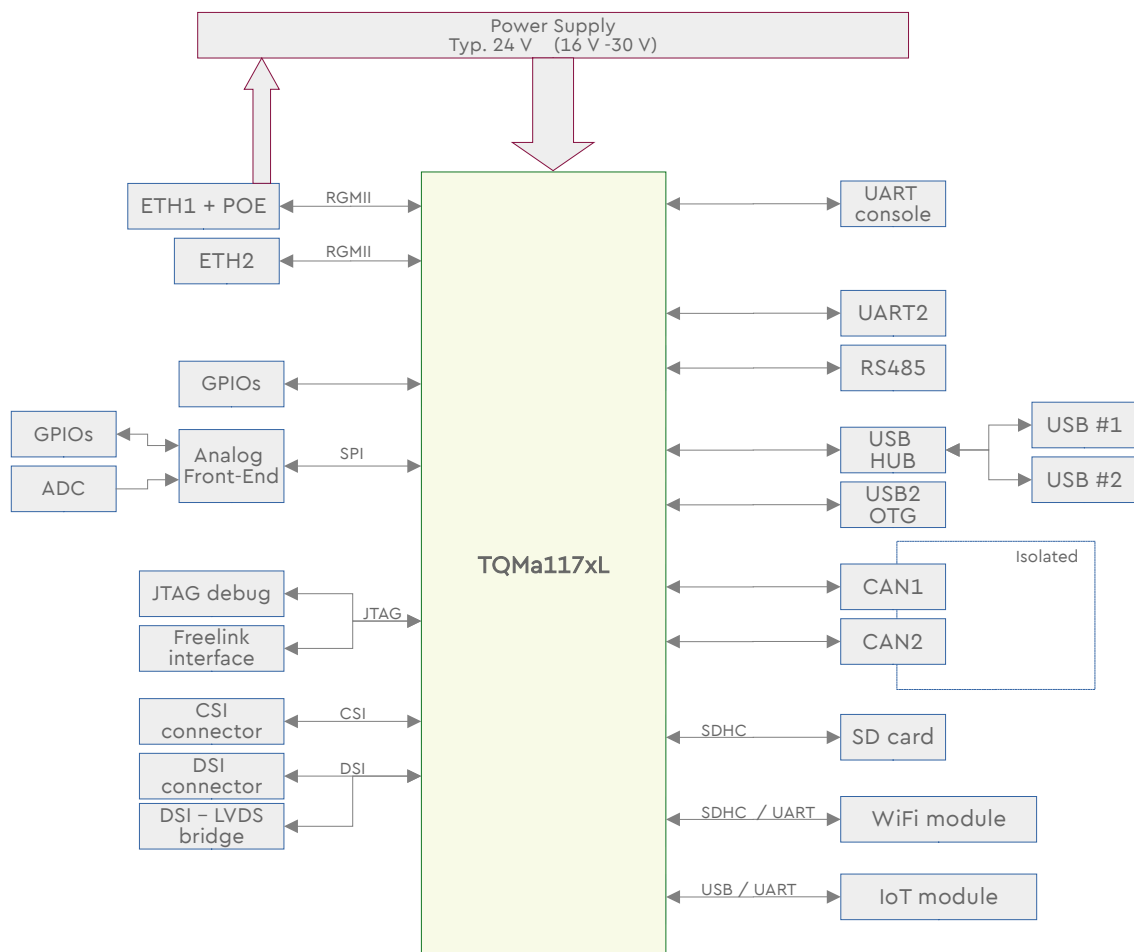


Figure 1: Block diagram MBa117xL

## 2.2 MBa117xL interfaces overview

The following interfaces/functions and user interfaces are available on the MBa117xL:

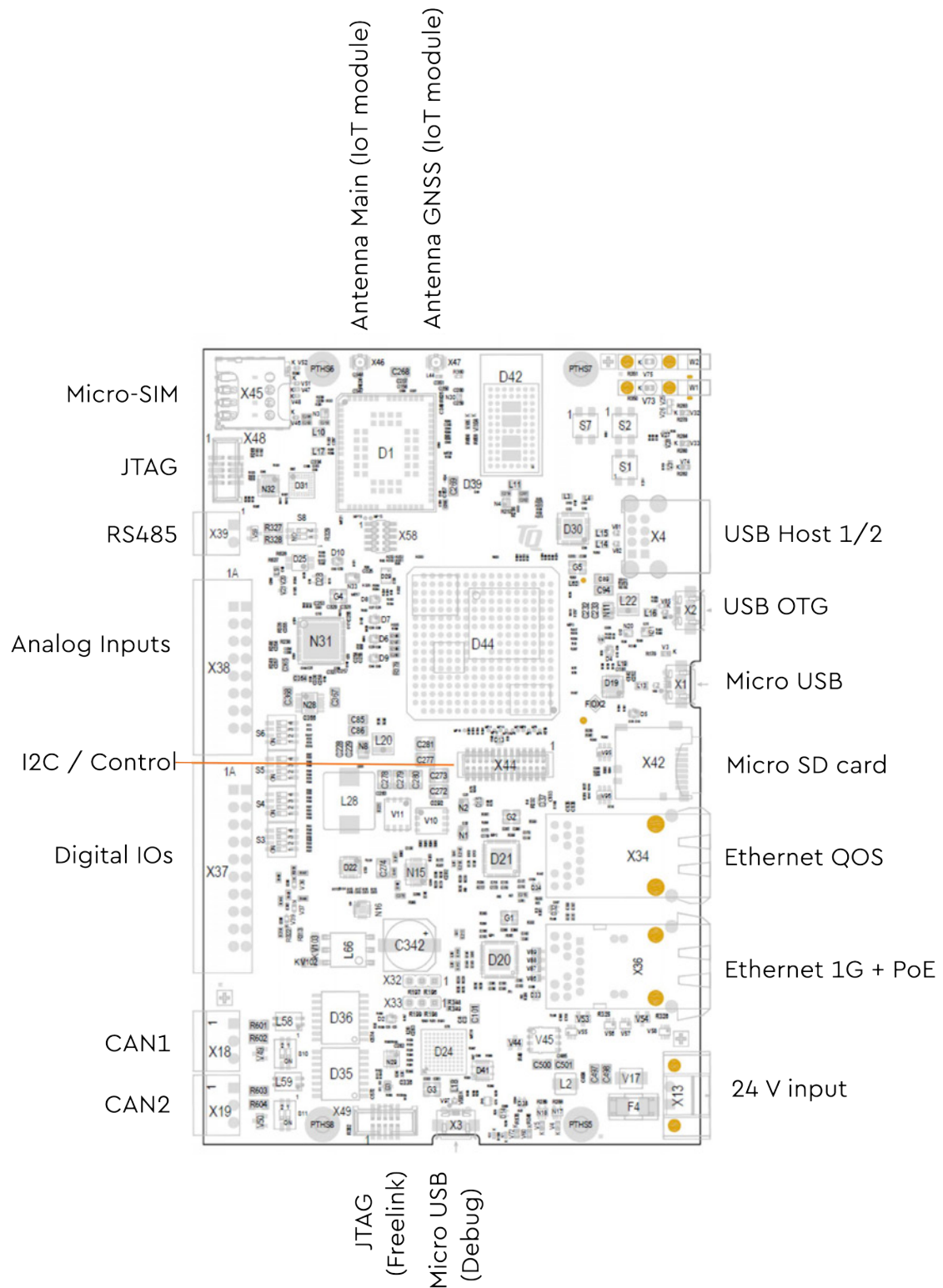


Figure 2: Position interfaces (top)

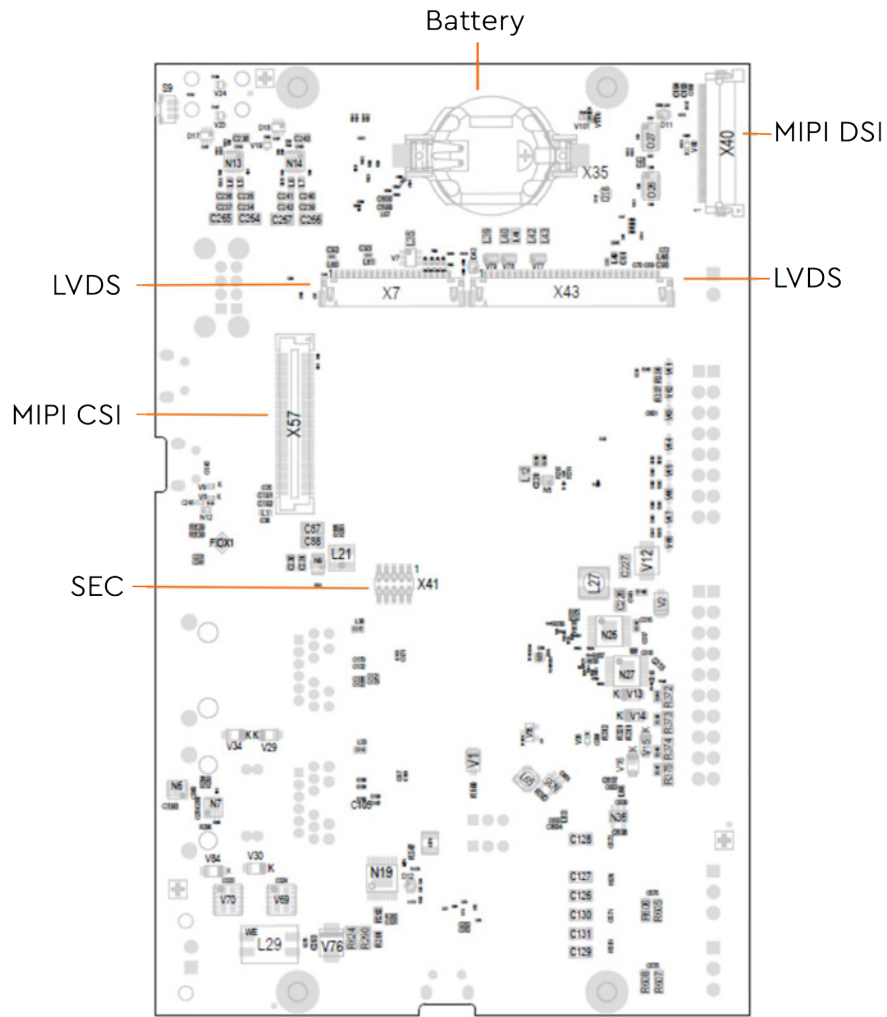


Figure 3: Position interfaces (bottom)

### 3. ELECTRONICS

#### 3.1 MBa117xL functional groups

The following chapters describe the interfaces of the MBa117xL in connection with a TQMa117xL.

##### 3.1.1 TQMa117xL overview

The MBa117xL provides all power supplies and configurations required for the operation of the TQMa117xL.

The TQMa117xL is the central system on the MBa117xL. All functionally relevant pins of the i.MX RT1170 are routed to the TQMa117xL LGA pads. This enables to use the TQMa117xL with all the freedom that comes with a customer-specific design-in solution. Further information can be found in the TQMa117xL User's Manual.

On the MBa117xL the standard interfaces like USB, Ethernet, etc., provided by the TQMa117xL are routed to industry standard connectors. All other relevant signals and buses provided by the TQMa117xL are routed to 50 mil pin headers on the MBa117xL. The boot behaviour of the TQMa117xL can be controlled and the boot mode configuration is set with a DIP switch on the MBa117xL.

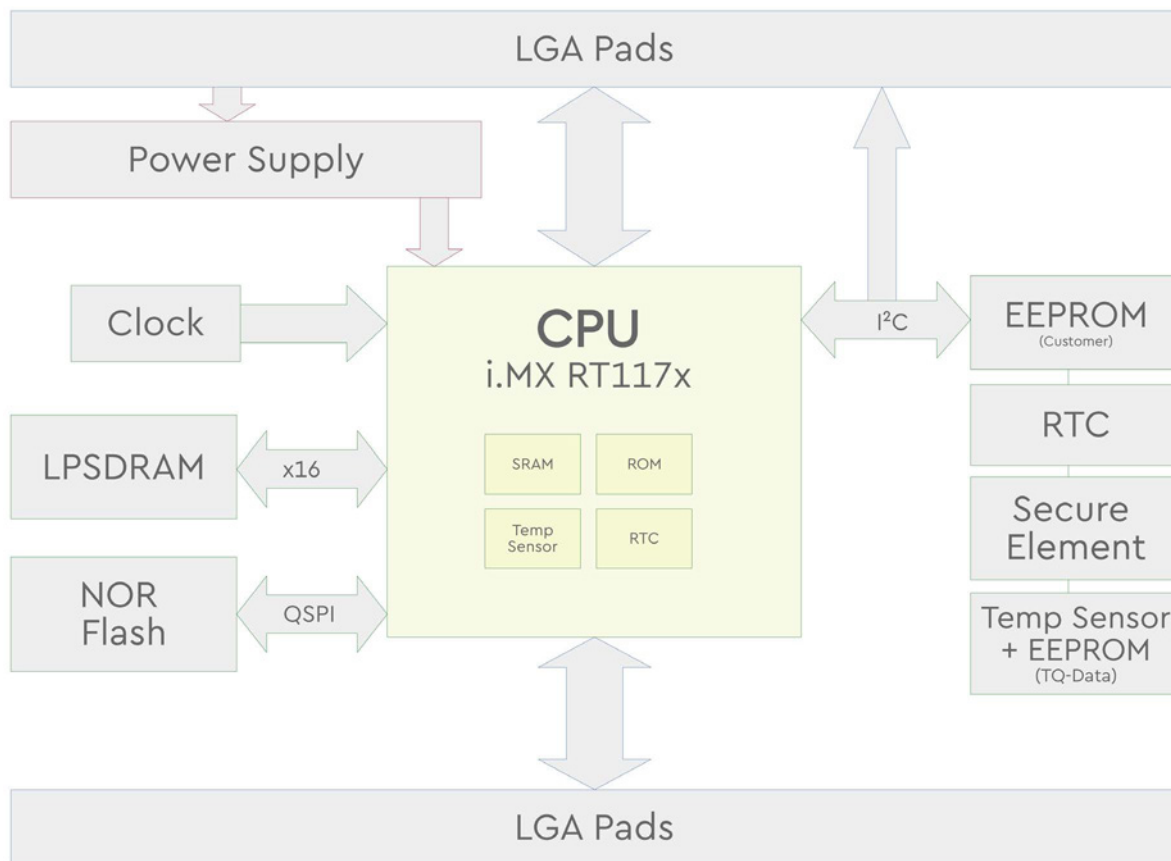



Figure 4: Block diagram TQMa117xL

##### 3.1.2 TQMa117xL pinout

All relevant TQMa117xL signals are routed to 50 mil pin headers on the MBa117xL.

Note: Available interfaces	
	<p>Depending on the TQMa117xL derivative, not all interfaces are available. More information about available interfaces can be found in the TQMa117xL User's Manual and pinout tables.</p>

### 3.1.3 I<sup>2</sup>C devices, address mapping

The TQMa117xL has three I<sup>2</sup>C buses:

- LPI2C3 with level conversion from 1.8V (PU 4K7) to 3.3V (PU 2K2).
- GPIO Port Expander (0x20)
- Pin Header X44
- DSI Display X40
- LPI2C5: 1.8V with PU 4K7
- LVDS Bridge (0x2C / 7-bit, 0x58 / 8-bit)
- CSI Interface X57
- LPI2C6: 1.8V with PU on TQMa117xL
- Pin header X44

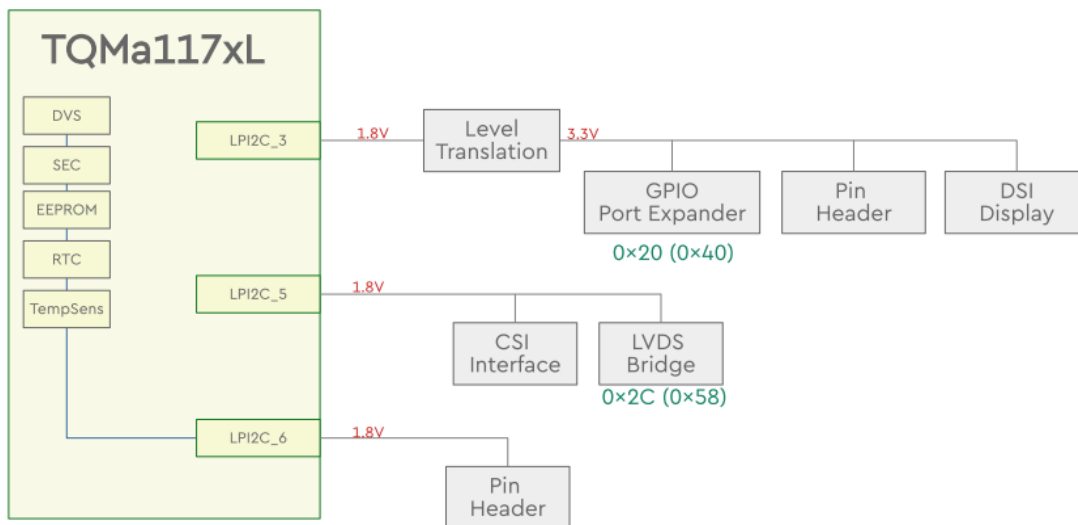


Figure 5: Block diagram I<sup>2</sup>C bus

### 3.1.4 RTC backup

In case of power failure or power down, a lithium battery type CR2032 on the MBa117xL supplies the RTC on the TQMa117xL, which can be supplied with 2.1 V to 3.7 V, typical 3.0 V.

### 3.1.5 Control signals

The TQMa117xL uses the following control signals:

Table 2: TQMa117xL control signals

Signal	Direction	Circuitry on TQMa117xL	Use MBa117xL
TQMa117xL_HARD_RESET#	Input	Pullup VIN	Push button or open drain circuit
TQMa117xL_SOFT_RESET#	Input	Pullup 1.8 V	Push button or Open drain circuit
TQMa117xL_PWR_BTN#	Input	Pullup SNVS (1.8 V)	Push button or Open drain circuit
TQMa117xL_PGOOD	Output	1.8 V	To activate the further power supply
TQMa117xL_RESET_OUT#	Output	1.8 V	TQMa117xL Reset Status
CTRL_NVCC_SD1	Input	47K Pulldown	To control the NVCC_SD1 voltage Low = 3.3 V, High = 1.8 V
CTRL_NVCC_SD2	Input	47K Pulldown	To control the NVCC_SD2 voltage Low = 3.3 V, High = 1.8 V
MCU_WAKEUP	Input	1.8 V	Wakeup from LP
PMIC_WDI	Input	1.8 V	Optional PMIC watchdog

## 3.2 Power supply

The power sequencing is designed in such a way that the VIN voltage (5.0 V) must be available for the TQMa117xL first and automatically. As soon as the module has activated all voltages on the module itself, a PGOOD signal is set to High. Based on this signal, the other voltages on the MBa117xL can then be activated.

The TQMa117xL provides the signal TQMa117xL\_PGOOD, which signals that all voltages have been activated on the module. 20 ms later, the CPU is fetched from the reset, i.e. the voltages on the MBa117xL should be valid within 20 ms. A total of 7 voltages are activated, each of which is started one after the other. To have some reserve, each supply voltage should have a soft start time of  $\leq 2\text{ms}$ .

### 3.2.1 Power input

The power supply VIN can be provided in two ways, classically via the supply socket X13 or alternatively via Power over Ethernet (PoE).

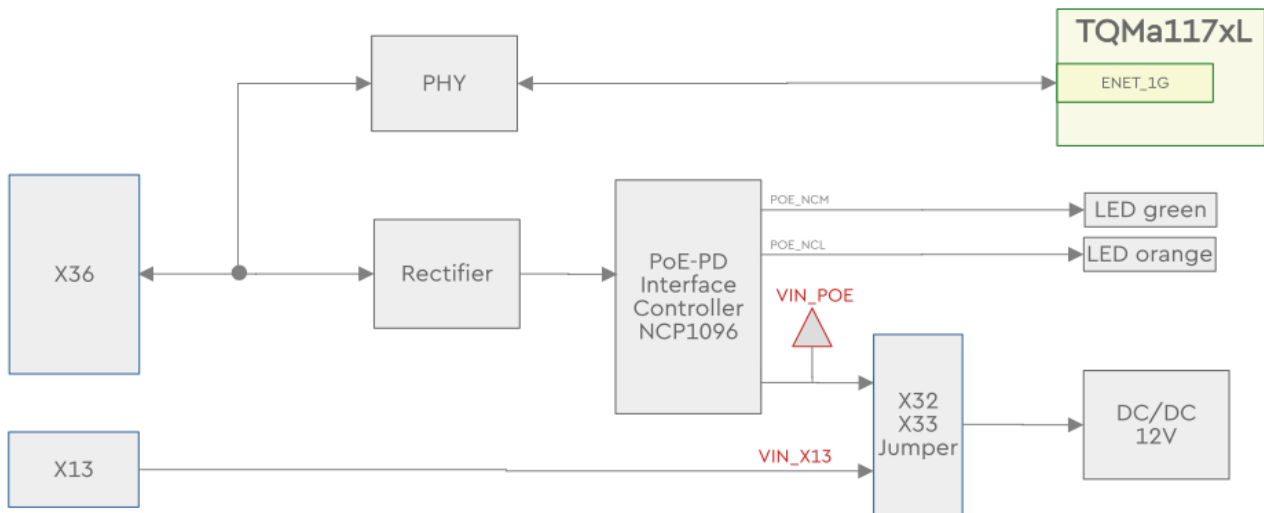


Figure 6: Block diagram input wiring / PoE

At X13 Pin 1, the MBa117xL has to be supplied with  $24\text{ V} + 25\% / -33\%$  (16 V to 30 V). X13 Pin 2 has to be DGND.

The second power supply option is PoE via the Ethernet socket X36. The respective supply must be configured via jumpers: There are two jumpers, both of which must always be set the same on pin headers X32 and X33: Jumpers on pins 1 and pins 2 select socket X13 as power source. Jumpers on pins 2 and pins 3 select PoE as power source.

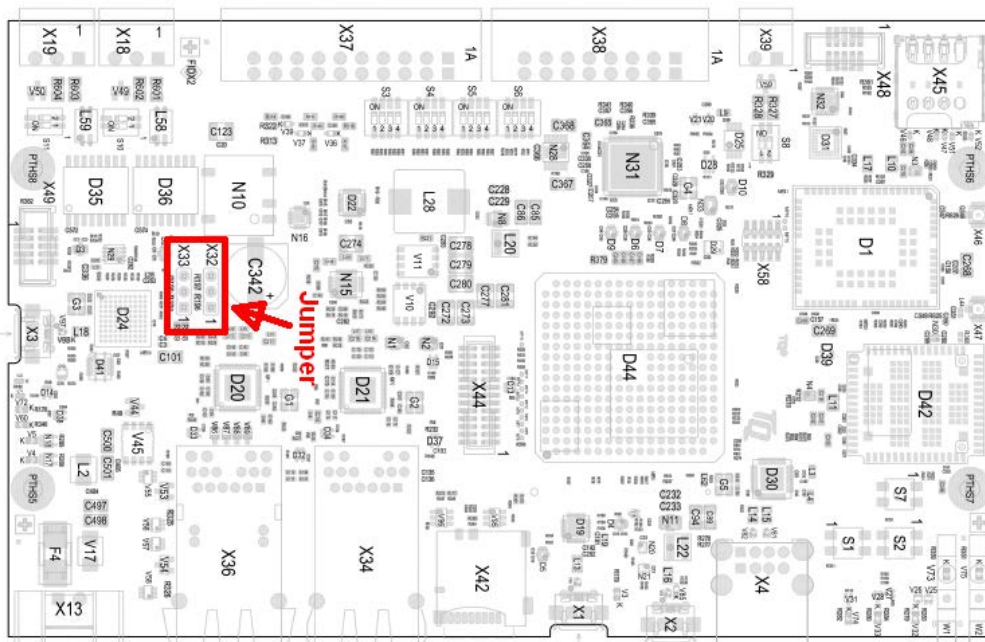


Figure 7: Jumper setting and their position

All other voltages required on the MBa117xL are derived from the supply voltage.

Under full load of the TQMa117xL and with full load at all pin headers and slots, the MBa117xL including TQMa117xL may consume significantly more power. The power supply for a carrier board must be dimensioned accordingly.

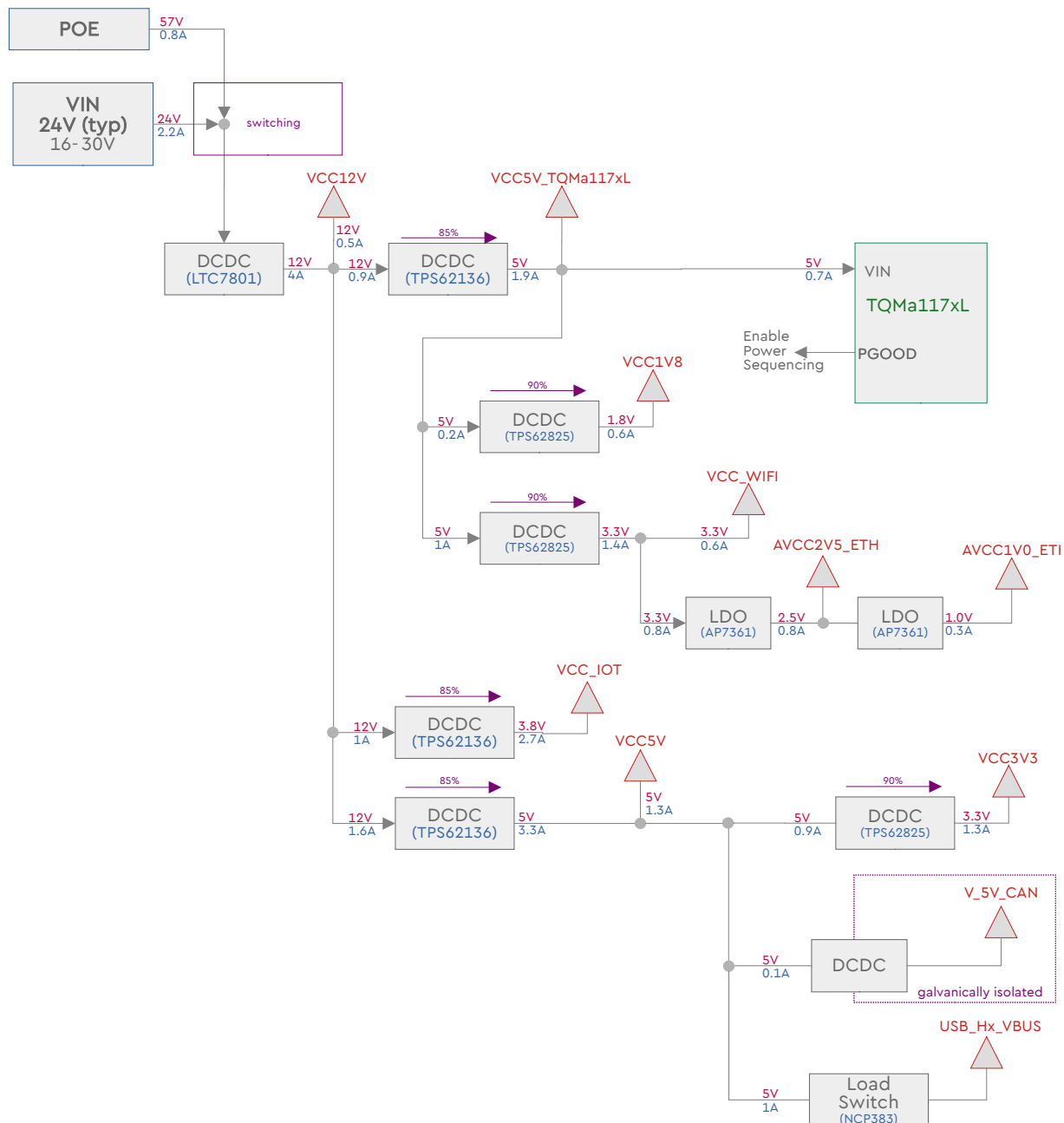


Figure 8: Block diagram power supply chain MBa117xL

Note:

- VCC5V\_TQMa117xL is activated immediately after VIN is applied to supply the module.
- For effective utilisation, VCC5V\_TQMa117xL also serves as a supply for other DCDCs.
- Separate DCDCs are provided for the WIFI module and the IoT module.
- A galvanically isolated voltage is implemented for CAN
- LDOs are sufficient for the Ethernet supply



### 3.2.2 Protective circuitry

The protective circuitry features the following characteristics:

- Overcurrent protection by fuse 5 A, Slow Blow
- Overvoltage protection
- PI filter
- Reverse polarity protection
- Capacitors for voltage smoothing



Figure 9: MBa117xL protective circuitry

### 3.3 Communication interface

#### 3.3.1 Ethernet

Two Ethernet interfaces are available on the MBa117xL. The PHY DP83867ISRGZ from TI is used for both interfaces and supports IEEE 802.3 10BASE-Te, 100BASE-TX, and 1000BASE-T.

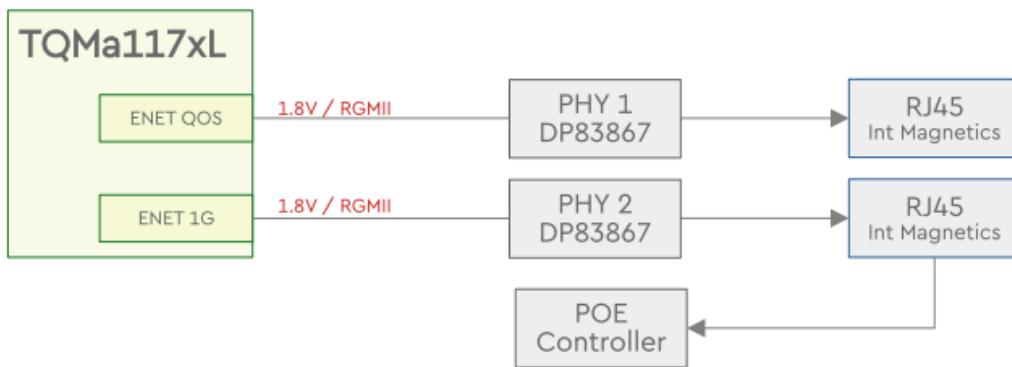


Figure 10: Block diagram Ethernet

Gigabit Ethernet is available at X36 with PoE. The Quality of Service (QoS) Ethernet is available at X34. Boot pinstrapping is partially on the RGMII lines. The IO voltage is 1.8V and the reference clock is generated in the CPU.

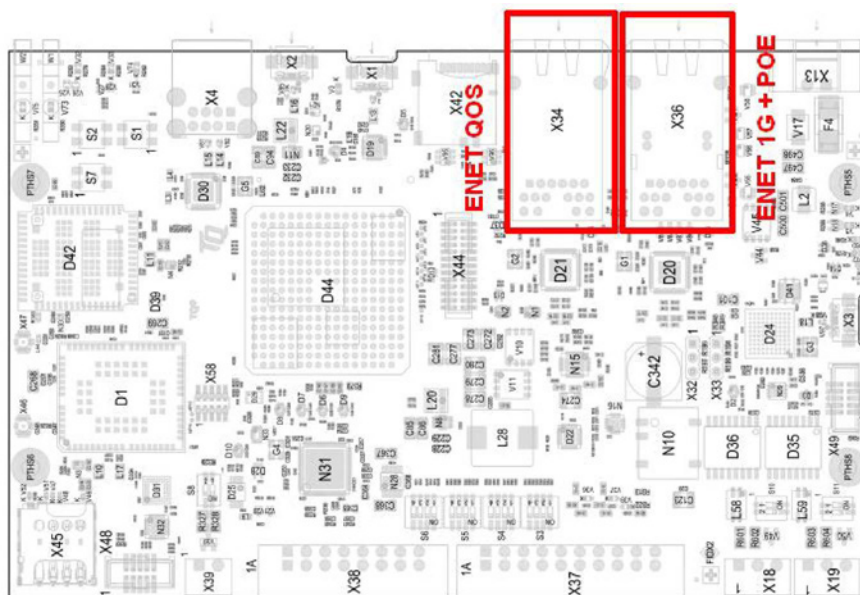


Figure 11: Position Ethernet

### 3.3.2 SD card interface

MBa117xL provides a Micro SD card slot. The SDHC1 interface from TQMa117xL is designed with a 4-bit bus width for an SD card. The module also provides an adapted supply voltage (1.8V and 3.3V depending on the mode) that can be used for the pull-up supply.

- The SD card supply should be operated with switched 3.3 V.
  - Software controlled via SDHC1\_RESET#
  - Power Cycle at TQMa117xL Reset
- IO voltage switching via SDHC1\_VSELECT
- Card Detect available

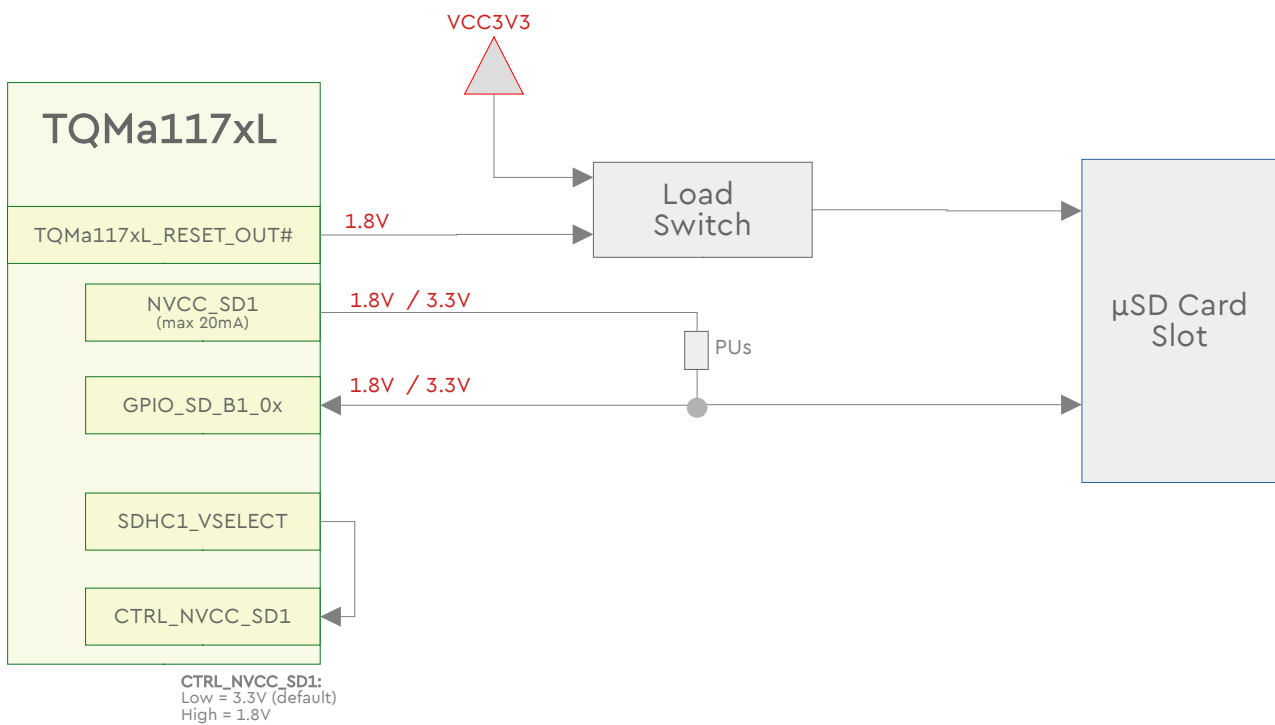


Figure 12: Block diagram SD card interface

### 3.3.3 USB 2.0 hub

A USB 2.0 hub is connected to the USB2 interface on the MBa117xL, which provides four USB 2.0 host interfaces. The USB connectors are supplied with 5 V via power switches. The current is monitored and can be switched off in case of an overload and/or overheating. USB Host 1 and USB Host 2 are connected to a Dual USB 2.0 Type A socket (Host) on the MBa117xL. USB Host 3 is routed to the IoT radio module, USB Host 4 is routed to the LVDS connector X7 on the MBa117xL.

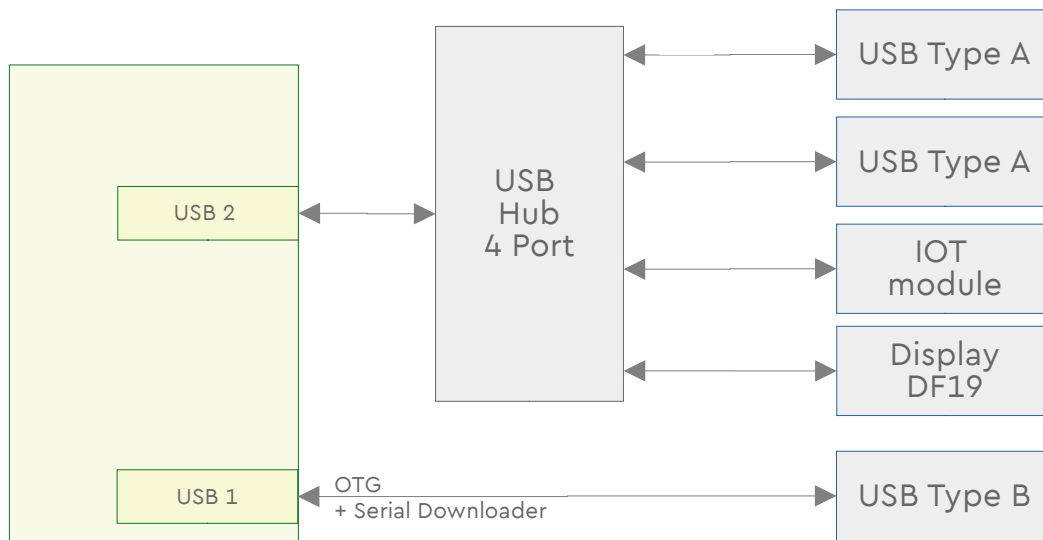


Figure 13: Block diagram USB 2.0 Hub

### 3.3.4 USB 2.0 OTG

The second TQMa117xL USB interface is configured as USB 2.0 OTG and routed to USB Micro-B connector X2 on the MBa117xL. This interface can be used for the CPUs Serial Downloader Mode. The USB connector is supplied with 5 V via a power switch. The current is monitored and can be switched off in case of an overload and/or overheating.

### 3.3.5 UART

A separate USB interface is primarily provided for debugging outputs.

The TQMa117xL provides 4 UART interfaces (LPUART1, 6, 8, 11). These are used by default as follows:

- 1 UART (LPUART1) for console outputs (USB conversion)
- 1 UART (LPUART6) freely usable via USB / Pin Header (X44) or IoT module
- 1 UART (LPUART8) for RS485 or wireless function
- 1 UART (LPUART11) for IoT module GNSS

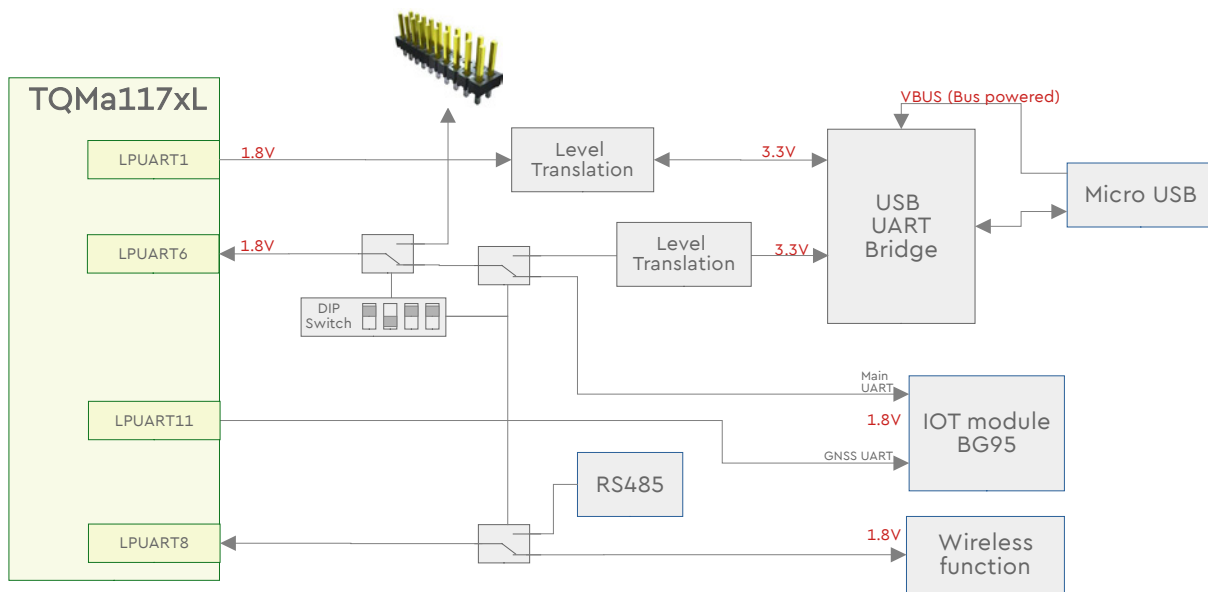


Figure 14: Block diagram UARTs

All UARTs of the TQMa117xL refer to 1.8V. Level changes are therefore provided individually.

### 3.3.6 RS485

An RS485 interface is implemented on the MBa117xL:

- Connect LPUART8 with RS485 transceiver via switch N33 (control signal LPUART8\_SWITCH)
- DIP switch for 120 Ohm termination resistor can be activated
- Interface available at X39
- RS485 and a wireless function cannot be used simultaneously. Switching the interface via LPUART8\_SWITCH: LOW for RS485 and HIGH for wireless.
- The transceiver used is the SN65HVD75DGK from TI.
- A level conversion of 1.8V <-> 3.3V is necessary to the TQMa117xL module.

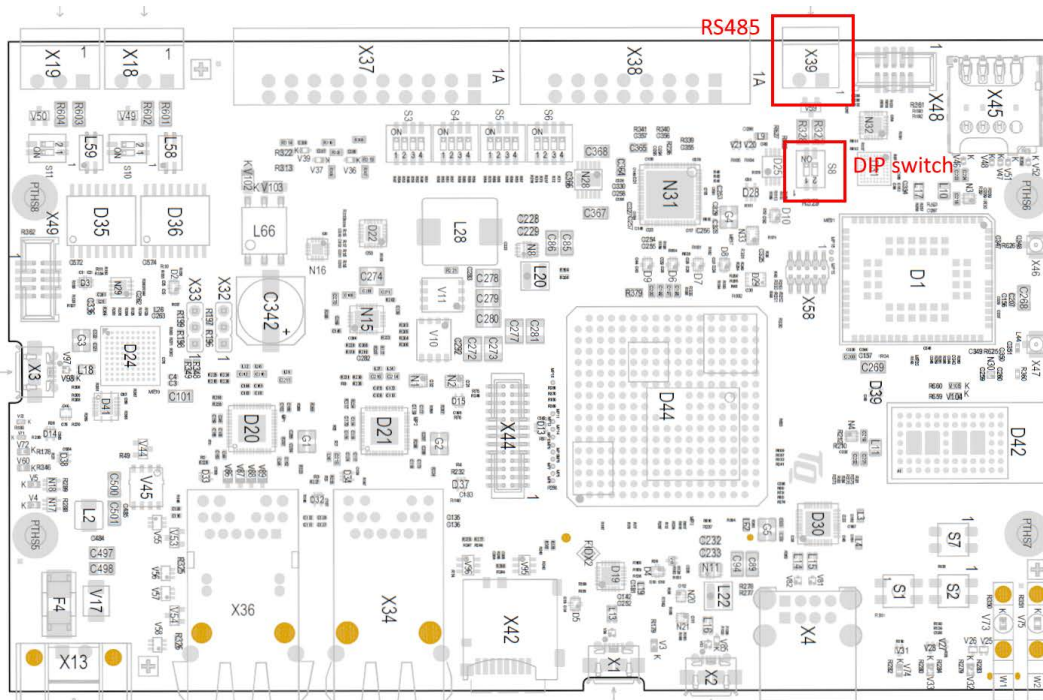


Figure 15: Position X39 and DIP switch for RS485

### 3.3.7 MIPI DSI / LVDS

The TQMa117xL provides a MIPI DSI interface with 2 lanes. This can be used on the MBa117xL in two ways:

- direct connection of a DSI display (FH12A-40S-0.5SH connector)
- indirect connection of an LVDS display via DSI-to-LVDS Bridge (connector with TQ standard pinout)

Info: MIPI DSI or LVDS – you have to decide



Both display interfaces cannot be used at the same time.  
Switching is done by GPIO signal MIPI\_DSI\_SELECT via port expander.

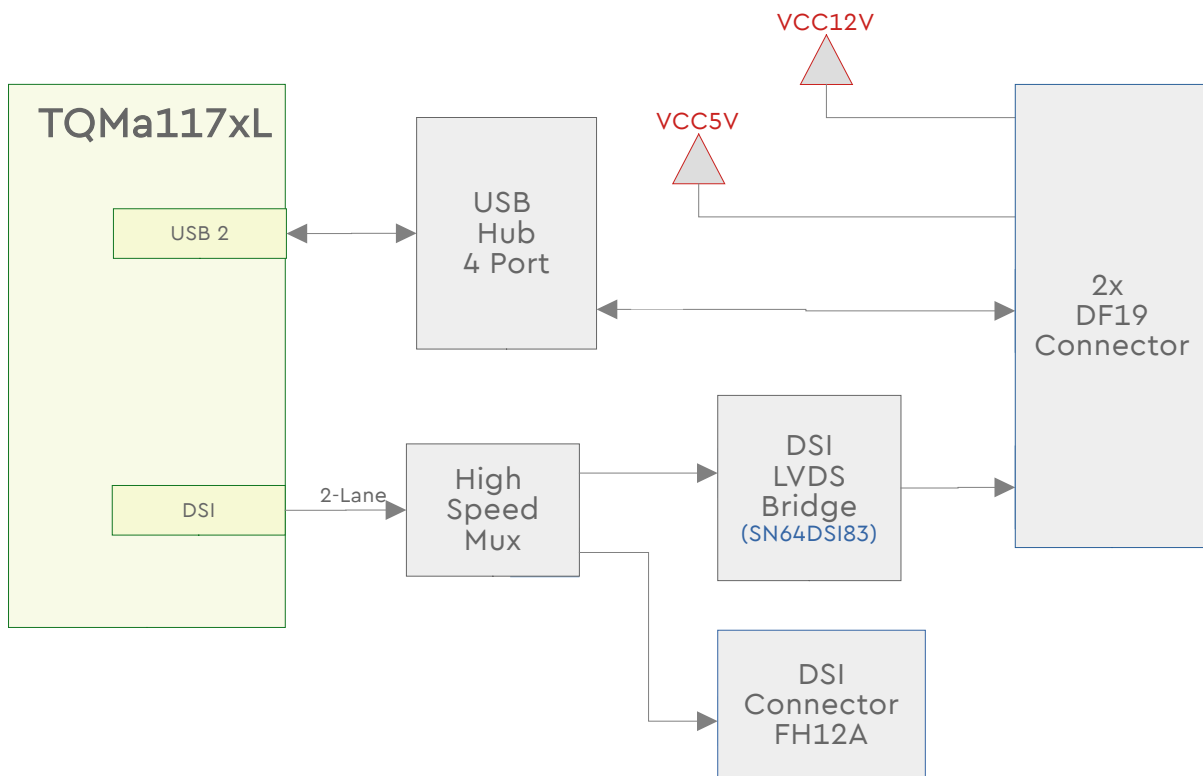


Figure 16: Block diagram DSI / LVDS Interface

Table 3: Pinout MIPI DSI, X40, suitable for NXP Display RK055HDMIPI4M

Pin	Signal	Pinout suitable for NXP RK055HDMIPI4M Display
1	NC	LEDK
2	NC	LEDA
3	NC	-
4	DGND	-
5	DSI_MUX_A_DN0	MIPI_TDN0
6	DSI_MUX_A_DP0	MIPI_TDP0
7	DGND	-
8	DSI_MUX_A_DN1	MIPI_TDN1
9	DSI_MUX_A_DP1	MIPI_TDP1
10	DGND	-
11	DSI_MUX_A_CKN	MIPI_TCN
12	DSI_MUX_A_CKP	MIPI_TCP
13	DGND	-
14	NC	MIPI_TDN2
15	NC	MIPI_TDP2
16	DGND	-
17	NC	MIPI_TDN3
18	NC	MIPI_TDP3
19	DGND	-
20	DGND	-
21	DSI_LCD_RST#	LCD_RST# 1.8V
22	DSI_LPTE	LCD_LPTE 1.8V
23	NC	VDD_2V8
24	NC	LCD_ID
25	NC	IOVCC_1V8
26	LPI2C3_SDA_3V3	CTP_SDA 3.3V
27	LPI2C3_SCL_3V3	CTP_SCL 3.3V
28	DSI_CTP_RST#	CTP_RST 3.3V
29	DSI_CTP_IRQ	CTP_INT 3.3V
30	NC	VDD_3V3
31	DGND	-
32	DSI_LCD_PWR_EN	POWER_EN 3.3V
33	DGND	-
34	PWM2_A1	PWM 3.3V
35	DGND	-
36	DGND	-
37	DGND	-
38	NC	-
39	VCC5V	VDD_5V
40	VCC5V	VDD_5V

Table 4: Pinout LVDS, X43

Pin	Signal	Note
1	LVDS_D0_N	
2	LVDS_D0_P	
3	LVDS_D1_N	
4	LVDS_D1_P	
5	LVDS_D2_N	
6	LVDS_D2_P	
7	DGND	
8	LVDS_CLK_N	
9	LVDS_CLK_P	
10	LVDS_D3_N	
11	LVDS_D3_P	
12	NC	
13	NC	
14	DGND	
15	NC	
16	NC	
17	DGND	
18	NC	
19	NC	
20	NC	
21	NC	
22	NC	
23	NC	
24	DGND	
25	VCC5V_LVDS	Iout = 1.0 A (max)
26		
27		
28	VCC3V3_LVDS	Iout = 1.0 A (max)
29		
30		
M1	DGND	
M2	DGND	

Table 5: Pinout LVDS, X7

Pin	Signal	Note
1	VCC12V	Iout = 1.0 A (max)
2		
3		
4	DGND	
5		
6		
7	VCC5V	Iout = 100 mA (max)
8		
9		
10	DGND	
11	USB_H4_VBUS	
12	DGND	
13	USB_H4_DN	
14	USB_H4_DP	
15	DGND	
16	DSI_LCD_RST#	
17	LVDS_DISP_BACKLIGH_EN	
18	DSI_LCD_PWR_EN	
19	PWM2_A2_3V3	
20	DGND	
M1	DGND	
M2	DGND	

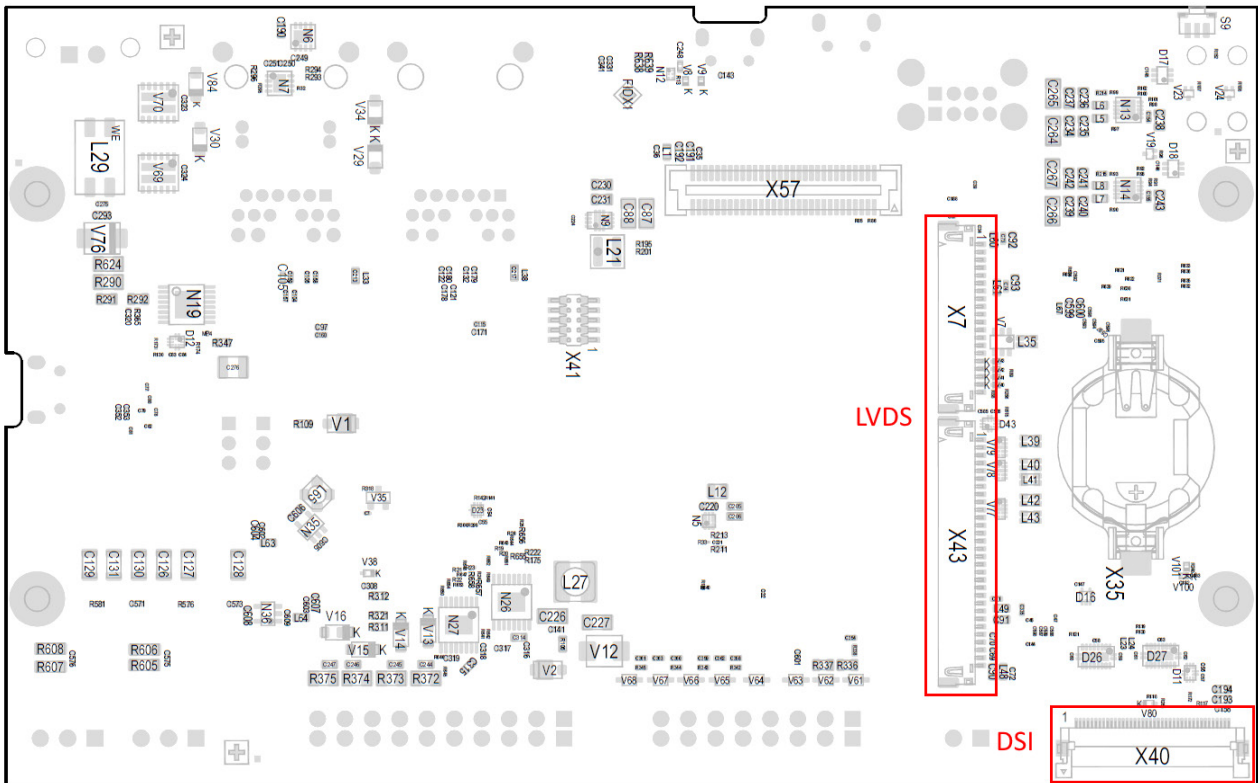


Figure 17: Position LVDS and DSI connectors



### 3.3.8 MIPI CSI

The TQMa117xL has a MIPI-CSI interface with two lanes. Here, the concept can be implemented as it has already been done on other TQ mainboards. This interface is intended for connecting an adapter board for embedded camera modules. This allows easy accessibility and flexibility in camera selection, but always requires an adapter board.

Table 6: MIPI CSI socket X57

Signal	Pin	Pin	Signal
DGND	1	2	DGND
MIPI_CSI_EN	3	4	NC
MIPI_CSI_RST#	5	6	NC
MIPI_CSI_TRIGGER	7	8	NC
MIPI_CSI_SYNC	9	10	NC
NC	11	12	NC
DGND	13	14	DGND
NC	15	16	NC
NC	17	18	NC
DGND	19	20	DGND
NC	21	22	NC
NC	23	24	NC
DGND	25	26	DGND
CSI_DN1	27	28	NC
CSI_DP1	29	30	NC
DGND	31	32	DGND
CSI_DN0	33	34	NC
CSI_DP0	35	36	NC
DGND	37	38	DGND
CSI_CKN	39	40	NC
CSI_CKP	41	42	NC
DGND	43	44	DGND
LPI2C5_SDA	45	46	NC
LPI2C5_SCL	47	48	NC
DGND	49	50	NC
PWM2_A2_1V8	51	52	NC
DGND	53	54	DGND
NC	55	56	VCC5V I <sub>max</sub> : 300 mA
NC	57	58	
NC	59	60	

### 3.3.9 CAN

Two CAN interfaces are implemented on the MBa117xL according to the ISO 11898 standard. The signals are each made available on a 3-pin socket (X18 and X19, Phoenix Contact MC1.5/3-G-3.5).

The interfaces are galvanically isolated with an isolation voltage of 1 kV. The two CAN interfaces are not isolated from each other.

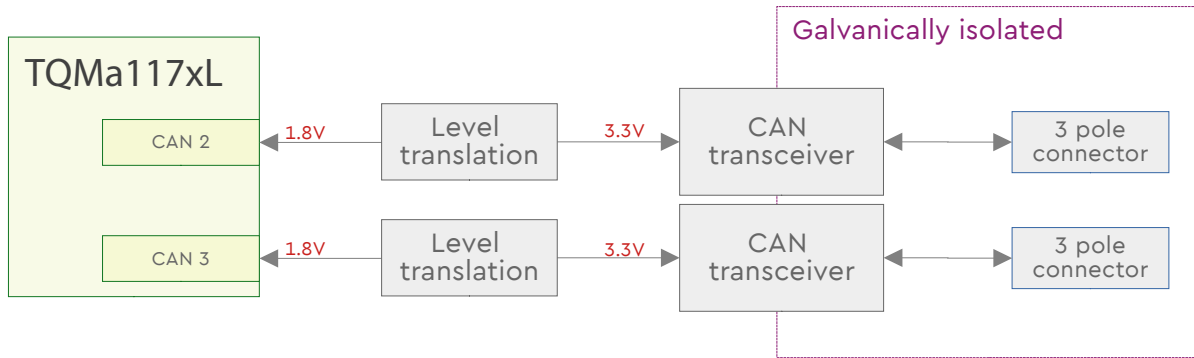


Figure 18: Block diagram CAN interface

### 3.3.10 WiFi

The WiFi module ENWF9408A1EF from Panasonic is integrated on the MBa117xL.

- IEEE802.11a/b/g/n/ac (2.4 GHz, 5 GHz)
  - 5 GHz: 20/40/80 MHz channel bandwidth
  - 2.4 GHz: 20/40 MHz channel bandwidth
- Interfaces
  - WiFi: SDIO3.0

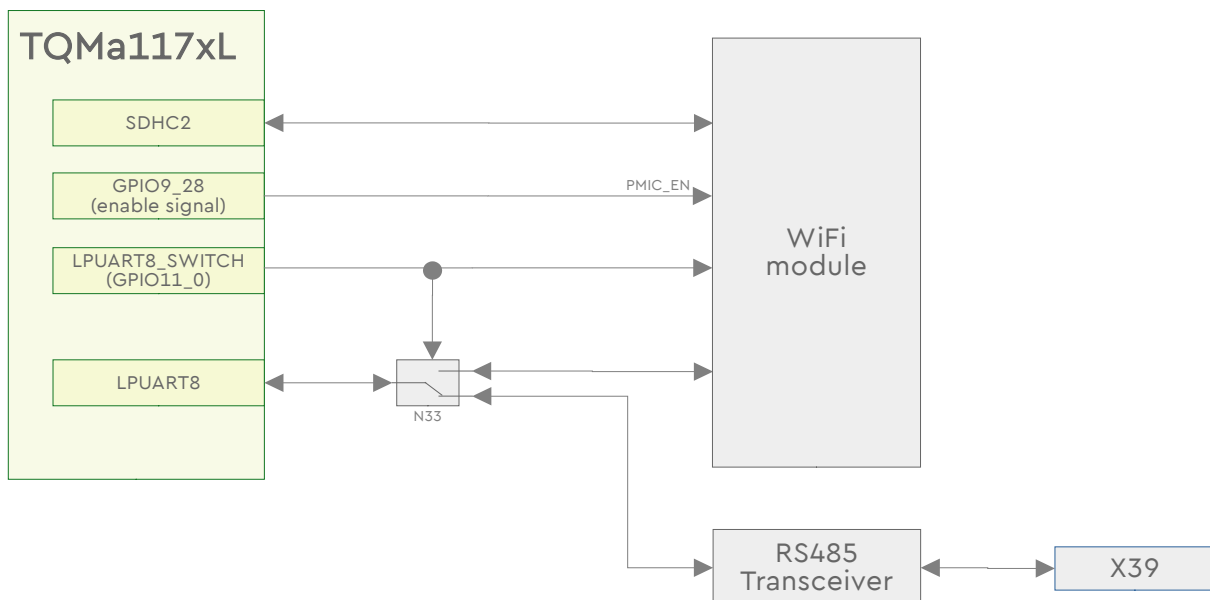


Figure 19: Block diagram WiFi

The WiFi module is enabled by GPIO9\_28: A minimum time of 100 ms is required after PMIC\_EN is de-asserted (Low) and before it is asserted (High).

The UART interface for a wireless function can be activated via the switch N33 with the control signal LPUART8\_SWITCH (High) to LPUART8 of the TQ module. Due to bootstrap options, the LPUART8 signals may only be used after reset. All connector sockets are ESD protected.

### 3.3.11 IoT radio module

The BG95 IoT radio module from Quectel provides NB-IoT and GNSS functionality on the MBa117xL. The module was developed for the global market.

- LTE: CAT M1 (max. 588 DL / 1119 UL), CAT NB2 (max. 127 DL / 158.5 UL)
- VoLTE for CAT M1 (planned by Quectel)
- GNSS: GPS, GLONASS, BeiDou, Galileo, QZSS
- 2 antenna connectors, 1 (U)SIM connector
- (U)SIM
  - Micro-SIM slot X45
  - 1.8V type
  - Card Detect available
- The IOT\_MAIN\_UART is connected to LPUART6 via the change-over switches N20 / N21.
- The control signals of the changeover switches can be operated via LPI2C3 and the port expander D22.
- The IoT module can be addressed via the USB hub, port 3.
- Due to boot options, LPUART11 may only be used after the module has been started up.
- NET\_STATUS\_LED:
  - Flicker slow (200 ms / 1800 ms): Network searching
  - Flicker slow (1800 ms / 200 ms): Idle
  - Flicker quick (125 ms / 125 ms): Data transfer
  - Always high: Voice Call
- BG95\_STATUS: HIGH when module is switched on

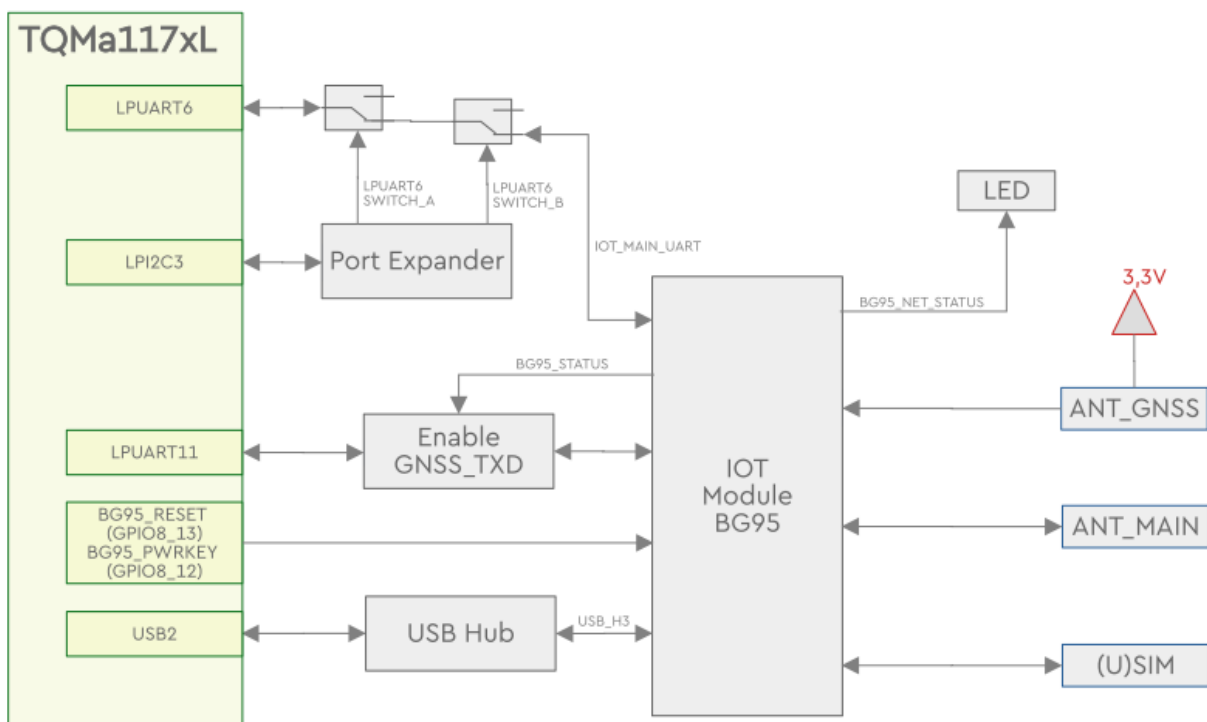


Figure 20: Block diagram IoT module

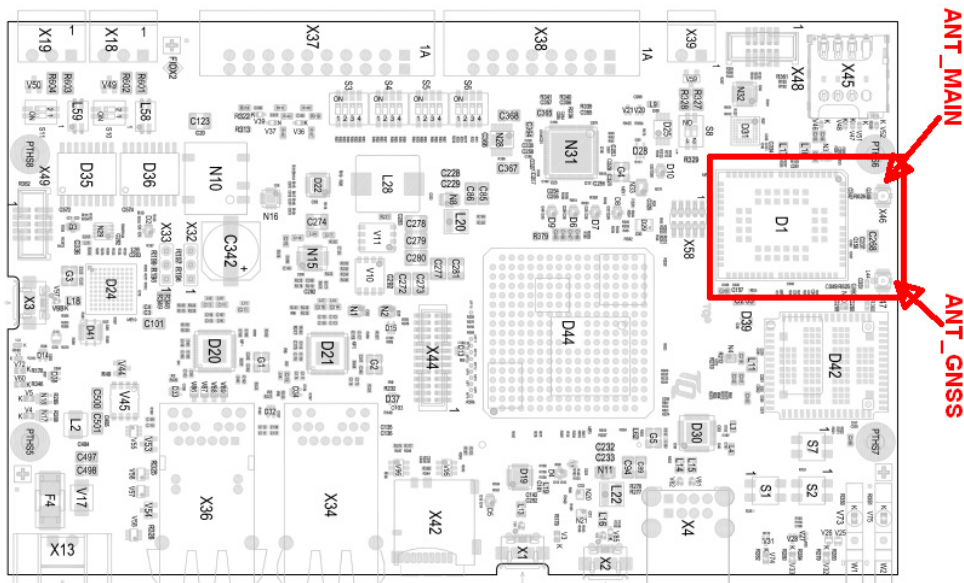


Figure 21: Position of IoT module and of the antenna connectors

### 3.3.12 Analog inputs

An 8-channel analog frontend IC (NAFE13388B40BS from NXP) is available on the MBa117xL. This offers great flexibility, as the user can make current or voltage measurements as required. The frontend is connected to the CPU via SPI:

- Data rates: 7.5 SPS - 288 kSPS, simultaneous 50 Hz / 60 Hz line rejection, ENOB: 17-bit at 72 kSPS
- High accuracy of data evaluation:  $\pm 0.01\%$  (at room temperature)
- Temperature sensor
- Up to 30 MHz SPI interface
- Calibration and diagnostic options
- Analog inputs
  - #1P/1N can be used for current measurement by changing the components (R336, R337)
  - #3P/N and #4P/N can be used as differential inputs through component change (C362, C363)
- GPIO0 and GPIO1 are used as analogue inputs
- Communication via LPSPI1
- Voltage converter for all signals from / to TQMa117xL
- Analog inputs available at X38

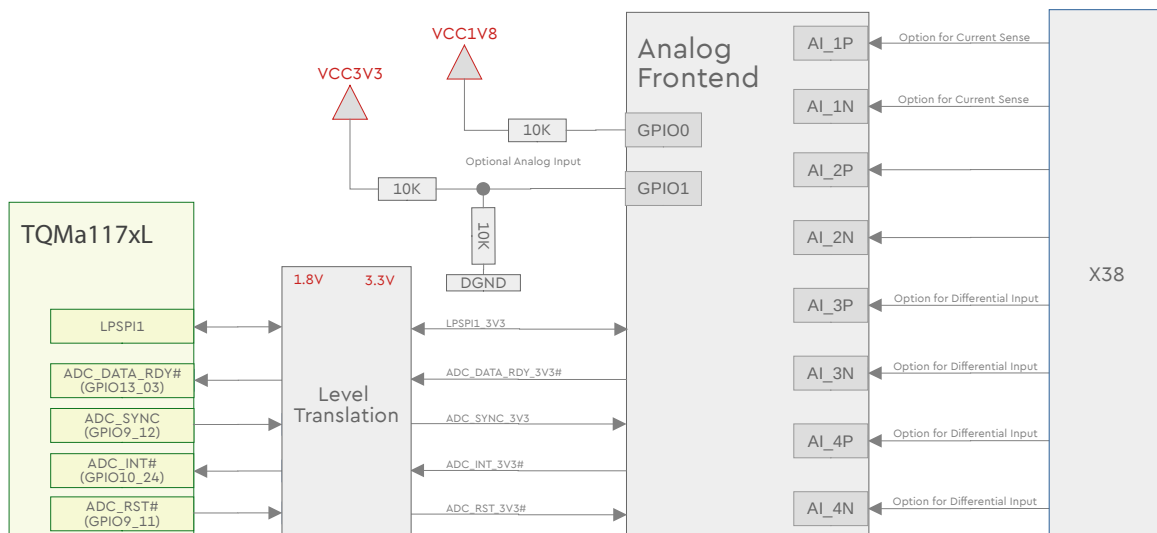


Figure 22: Block diagram Analog Frontend

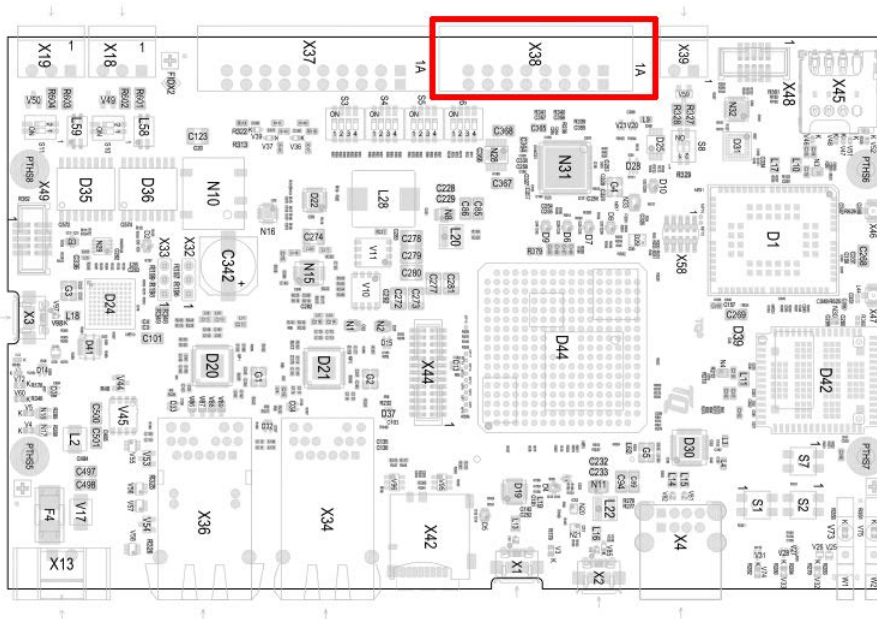


Figure 23: Position X38

Table 7: Pinout connector X38

Signal	Pin	Pin	Signal
A11P	1A	1B	DGND
A11N	2A	2B	DGND
A12P	3A	3B	DGND
A12N	4A	4B	DGND
A13P	5A	5B	DGND
A13N	6A	6B	DGND
A14P	7A	7B	DGND
A14N	8A	8B	DGND

Measurement options:

- Standard circuit for voltage and current measurement:

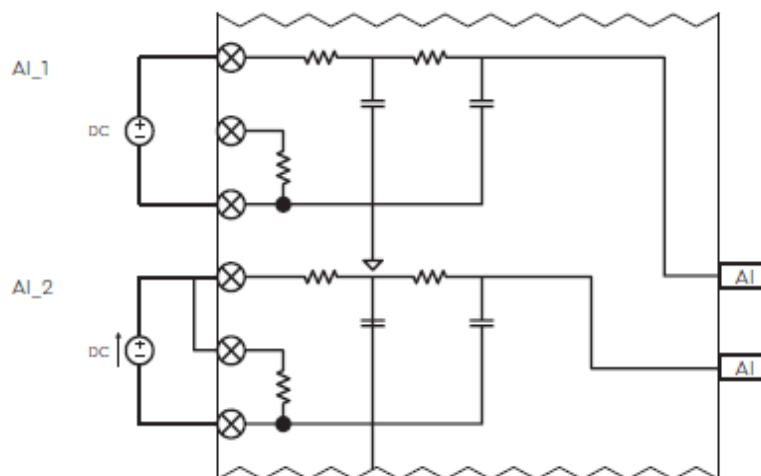


Figure 24: Analog interface voltage-current measurement

- Standard voltage measurement:

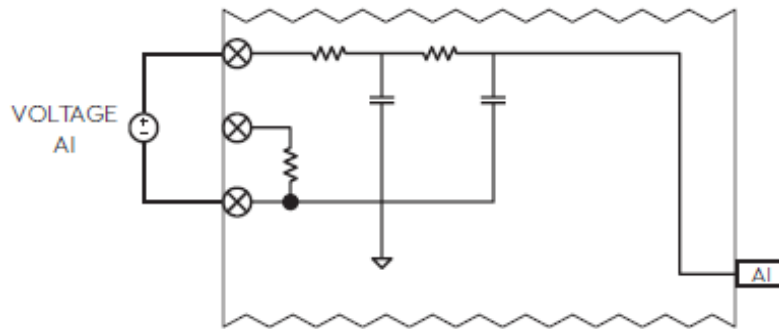


Figure 25: Analog interface voltage

- RTD measurement (resistance thermometer). AFE can provide current source:

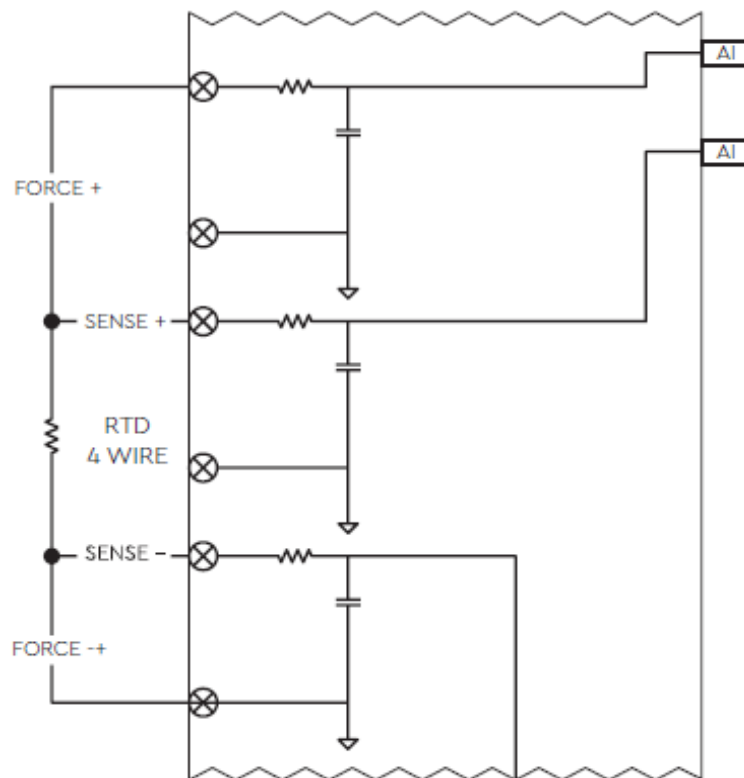


Figure 26: Analog interface RTD measurement

- TC measurement (thermocouple) via differential measurement:

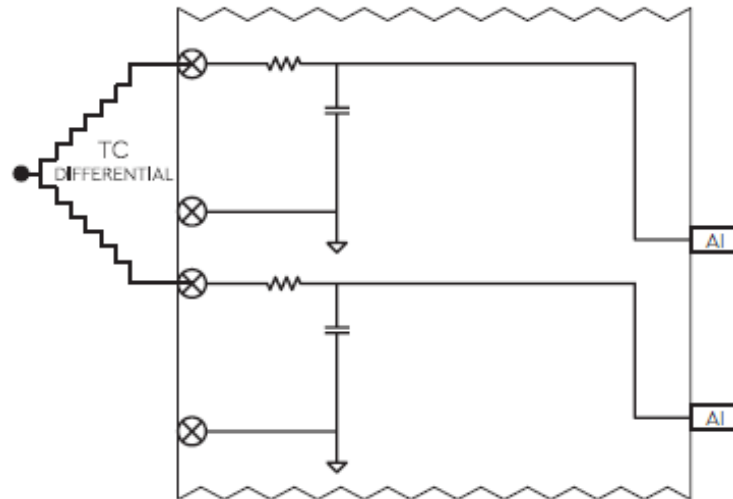


Figure 27: Analog interface TC measurement

### 3.3.13 Digital inputs and outputs

The MBa117xL provides four digital inputs and outputs each at connector X37:

- The digital outputs are switched via power switches. These switches can be powered from either V\_HSS\_IN on X37 (default) or VIN\_X13. The selected switch supply voltage defines the respective output voltage.
- The power switches are controlled by signals from the port expander. The port expander can be addressed via LPI2C3, and status signals can also be called up at the port expander.
- The digital inputs are connected to the TQMa117xL via protective circuitry and comparators.

Table 8: Pinout connector X37

Signal	Pin	Pin	Signal
V_HSS_IN	1A	1B	DGND
	2A	2B	DGND
DIG_OUT_1	3A	3B	DGND
DIG_OUT_2	4A	4B	DGND
DIG_OUT_3	5A	5B	DGND
DIG_OUT_4	6A	6B	DGND
DIG_IN_1	7A	7B	DGND
DIG_IN_2	8A	8B	DGND
DIG_IN_3	9A	9B	DGND
DIG_IN_4	10A	10B	DGND

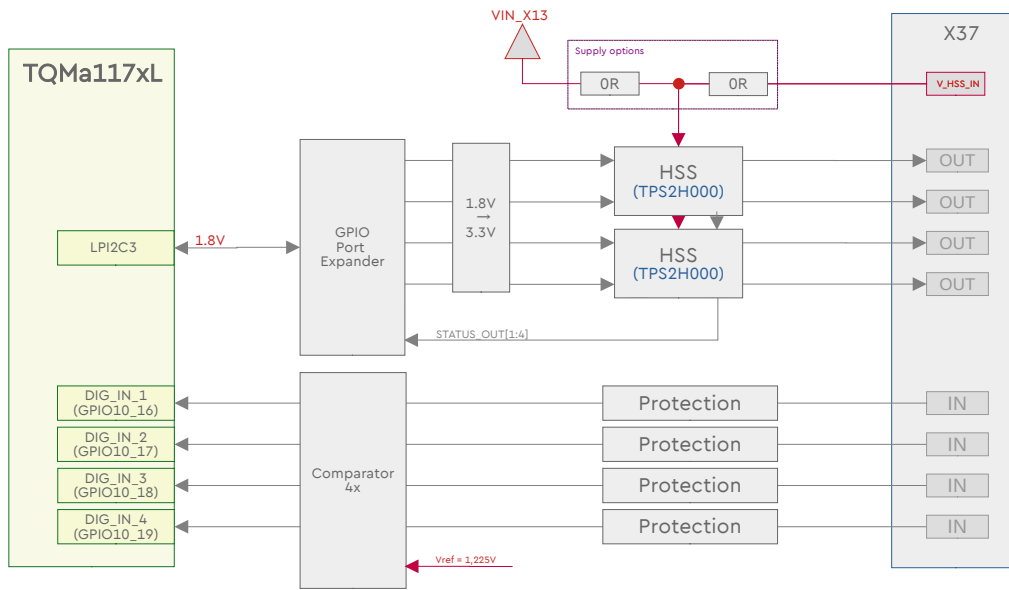


Figure 28: Block diagram Digital IO



Figure 29: Position of X37



### 3.3.14 PIN header X44

Pin header X44 provides various important signals:

Table 9: X44 pinout

Signal	Pin	Pin	Signal
VCC3V3	1	2	VCC1V8
LPI2C3_SCL_3V3	3	4	NC
LPI2C3_SDA_3V3	5	6	GPIO8_IO16
LPUART6_TXD_EXT	7	8	RTC_CLKOUT
LPUART6_RXD_EXT	9	10	RTC_INT#
LPI2C6_SCL	11	12	TEMP_ALERT
LPI2C6_SDA	13	14	CUST_EEPROM_WC#
TQMa117xL_PGood	15	16	MCU_WAKEUP
NC	17	18	PMIC_WDI
NC	19	20	TQMa117xL_RESET_OUT#
NC	21	22	ON_OFF_BUTTON
TQMa117xL_HARD_RESET#	23	24	TQMa117xL_SOFT_RESET#
DGND	25	26	DGND

#### Notes:

- LPI2C3\_3V3: 3.3 V level, Pullup 2K2 on MBa117xL
- LPI2C6: 1.8 V level, Pullup on TQMa117xL
- LPUART6\_EXT: 1.8 V level, switchable at pin header via switch N20 with signal LPUART6\_SWITCH\_A

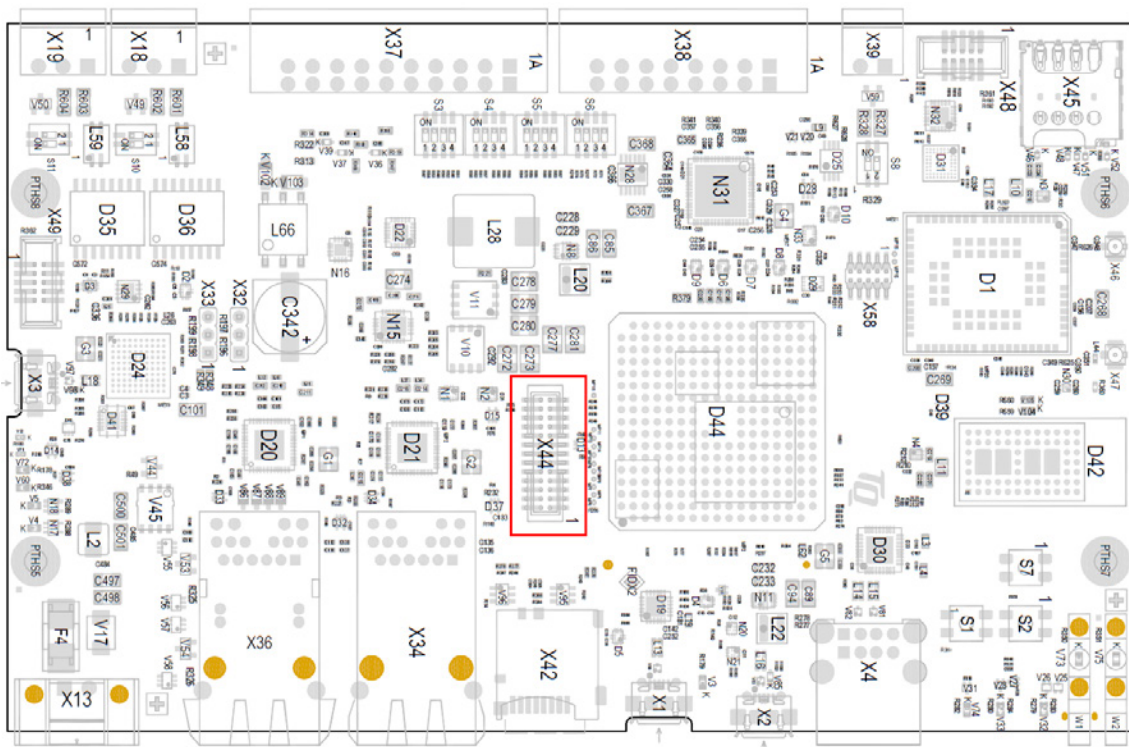


Figure 30: Position X44

#### Attention: Maximum current of 1.8 V and 3.3 V rails



The current load of the 1.8 V and 3.3 V rails add up to the current consumption of the MBa117xL. The additional power required must be provided by the power supply of the MBa117xL. The maximum load of the fuse must be observed.

### 3.3.15 SEC connection

For TQMa117xL variants with TSE chip, the corresponding circuitry is available for the pins used. The ISO 14443 interface is connected to the pin header X41 where an antenna can be connected. The ISO 7816 interface of the TSE chip is also routed to the pin header X41.

Table 10: Pinning SEC connector X41

Signal	Pin	Pin	Signal
VCC3V3	1	2	VCC1V8
SE_IOS7816_IO1	3	4	SE_ISO14443_LA
SE_IOS7816_IO2	5	6	SE_ISO14443_LB
SE_IOS7816_CLK	7	8	SE_ENA
SE_IOS7816_RST#	9	10	DGND

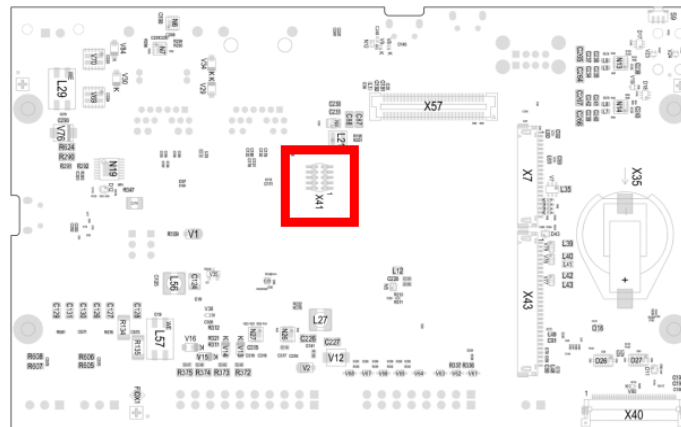


Figure 31: Position X41

## 3.4 Diagnostic and user interfaces

### 3.4.1 Boot Mode configuration

The i.MX RT117x boots in four different ways:

- In "Internal Boot" mode, the boot source / configuration is read in via the GPIOs BOOT\_CFG. This mode is preferred for development purposes.
- In "Serial Downloader" mode, a program image can be loaded into the on-chip RAM via UART or USB.
- The "Boot from Fuses" mode corresponds to the Internal Boot Mode, except that not the GPIOs are read in, but the blown fuses. The GPIO pin strapping is ignored. This mode is preferred for series production
- The fourth mode is reserved for NXP use.

The boot mode is selected based on the binary value stored in the internal BOOT\_MODE register. The BOOT\_MODE register is initialized by sampling the BOOT\_MODE0 and BOOT\_MODE1 inputs on the rising edge of POR\_B. After these inputs are sampled, their subsequent state does not affect the contents of the internal BOOT\_MODE register.

The state of the internal BOOT\_MODE register may be read from the BMOD[1:0] field of the SRC Boot Mode Register (SRC\_SBM2). See this table for settings:

Table 11: Boot\_Mode

Boot_Mode[1:0]	Boot Type
00	Boot from fuses
01	Serial downloader
10	Internal boot
11	Reserved

Boot Modes can be set on the MBa117xL via the DIP switch S6. (see Table 14)

More information about the boot flow can be found in the Reference Manual (2), and the Data Sheet (1) of the i.MX RT1170.

### 3.4.2 Module settings

The following boot sources are supported by MBa117xL:

- NOR Flash via FlexSPI
- SD Card via SDHC1
- eMMC via SDHC2 (no eMMC is installed on the MBa117xL)

In general, the boot source is set via pin strapping using the BOOT\_CFG signals:

Table 12: BOOT\_CFG [7:4] for boot device selection

BOOT_CFG[7:4]	Boot device
0000b	Serial NOR boot via FlexSPI
01xxb	SD Boot via uSDHC
10xxb	eMMC/MMC boot via uSDHC
001xb	SLC NAND boot via SEMC
11xxb	Serial NAND boot via FlexSPI

The BOOT\_CFG [7:4] bits only represent a rough preselection of the boot source. Overall, BOOT\_CFG [11:0] must be set correctly, which varies depending on the preselection via BOOT\_CFG [7:4]:

Table 13: BOOT\_CFG[11:0] for boot configuration

Boot_CFG[x]	FlexSPI1 – Serial NOR	SD Card via SDHC1	eMMC via SDHC2
11	FLEXSPI_INSTANCE 0 – FLEXSPI1 1 – FLEXSPI2	Reserved	Reserved
10	xSPI_FLASH_TYPE 000 – Boot with default 0x03 Read Enabled 001 – Reserved 010 – HyperFLASH 1V8 011 – HyperFLASH 3V0 100 – MXIC Octal Read 101 – Micron Octal Read	Reserved	Bus Width: 00 – 4-bit 01 – 8-bit 10 – 4-bit DDR (MMC 4.4) 11 – 8-bit DDR (MMC 4.4)
9		Bus Width: 0 – 1-bit 1 – 4-bit	
8		Reserved	SD2_VOLTAGE_SELECTION: 0 – 3.3V 1 – 1.8V
7	0	0	1
6	0	1	0
5	0	SD/SDXC Speed: 00 – Normal/SDR12 01 – High/SDR25	SD/MMC Speed: 0 – Normal 1 – High
4	0	10 – SDR50 11 – SDR104	Fast Boot Acknowledge enable: 0 – Boot Ack disabled 1 – Boot Ack enabled
3	FLASH_PROBE_TYPE 00 – QuadSPI NOR 01 – MXIC Octal 10 – Micron Octal 11 – Adesto Octal	SD Power Cycle Enable: 0 – No power cycle 1 – Enabled via USDHC_RST pad	SD Power Cycle Enable: 0 – No power cycle 1 – Enabled via USDHC_RST pad
2		SD Loopback Source Sel: (for SDR50 and SDR104 only) 0 – through SD 1 – direct	SD Loopback Source Sel: (for SDR50 and SDR104 only) 0 – through SD 1 – direct
1	ENCRYPT_XIP_EN 0 – Disabled 1 – Enabled	Port Select: 0 – eSDHC1	Port Select: 1 – eSDHC2
0	FLASH_AUTO_PROBE_EN 0 – Disabled 1 – Enabled	Reserved	Fast Boot: 0 – Regular 1 – Fast Boot

The boot mode eMMC via SDHC2 is not supported on the MBa117xL.

### 3.4.3 Carrier settings

The Boot\_CFG and BOOTMODE settings can be set on the MBa117xL via multiple 4-fold DIP switches (S3 to S6):

Table 14: DIP switches S3 to S6

Switch	Number	Signal
S3	1	BOOTCFG[0]
	2	BOOTCFG[1]
	3	BOOTCFG[2]
	4	BOOTCFG[3]
S4	1	BOOTCFG[4]
	2	BOOTCFG[5]
	3	BOOTCFG[6]
	4	BOOTCFG[7]
S5	1	BOOTCFG[8]
	2	BOOTCFG[9]
	3	BOOTCFG[10]
	4	BOOTCFG[11]
S6	1	BOOTMODE[0]
	2	BOOTMODE[1]
	3	LPUART1_SWITCH
	4	JTAG_SWITCH

### 3.4.4 Push buttons

On/Off button S9 at the MBa117xL is directly connected to the TQMa117xL. Additionally the signal is routed to pin header X44 where it can be connected with other signals. User button S2 is not routed to the pin header and instead directly connected with GPIO8\_IO28.

### 3.4.5 Reset Buttons

The MBa117xL has two reset buttons (Soft Reset S1 and Hard Reset S7). Both are directly connected to the TQMa117xL. In addition, both signals are available on pin header X44, where they can be switched by other signals. Hard Reset resets all module components via PMIC. Soft Reset resets only NOR Flash and CPU via POR#.

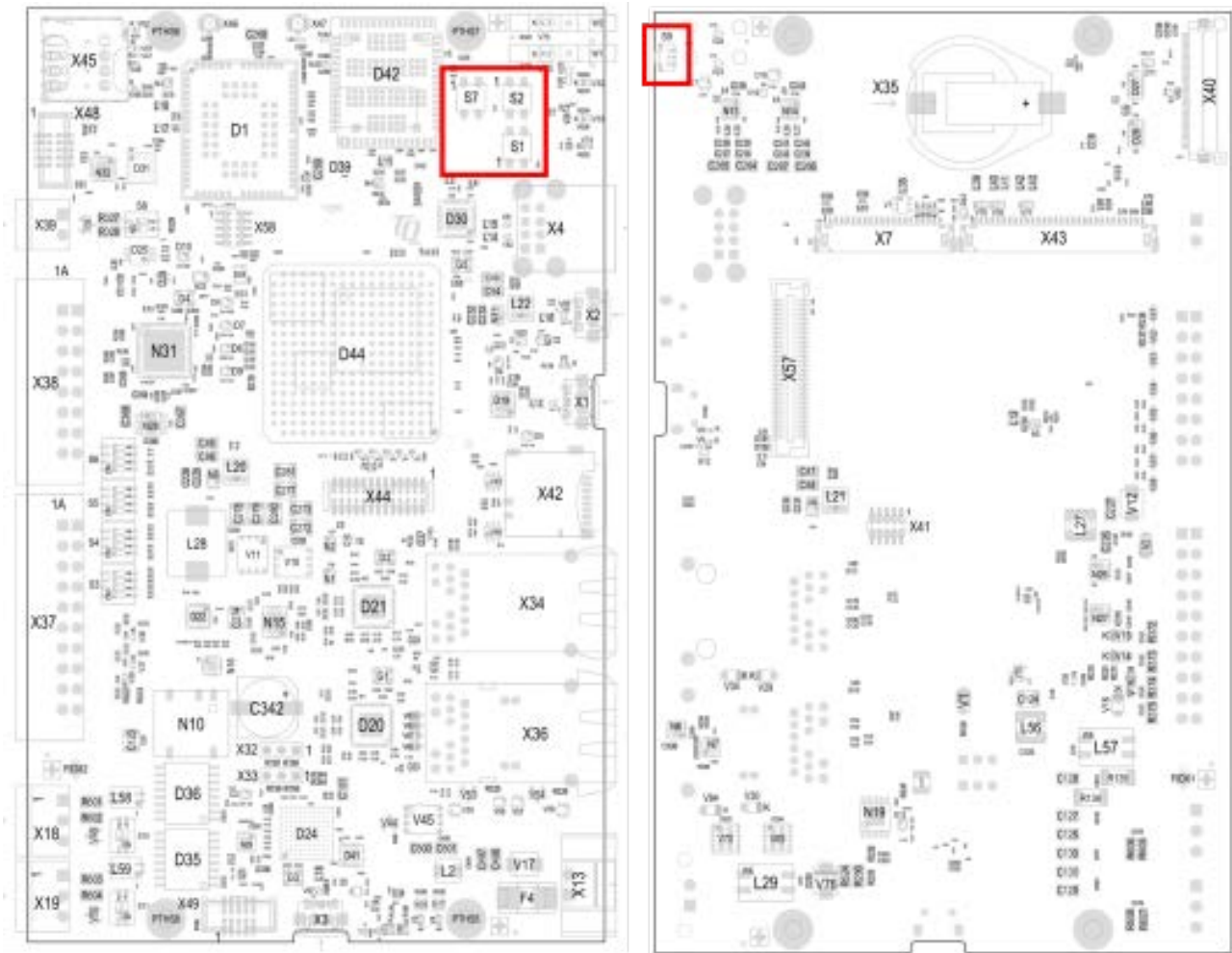


Figure 32: Position push buttons

### 3.4.6 Status LEDs

The MBa117xL provides the following status LEDs:

Table 15: Status LEDs

Control signal	Reference	Color	Indication
EN_MBa117xL_PWR	V32	green / red	TQMa117xL PGOOD
PGOOD_VCC_IOT	V33	green / red	MBa117xL PGOOD
VIN_POE	V4	blue	Power PoE
VIN_X13	V5	blue	Power X13
USER_LED_1 (GPIO8_19)	V73	green	User LED 1
USER_LED_2 (GPIO8_20)	V75	yellow	User LED 2
BG95_NET_STATUS	V74	green	IoT module net status

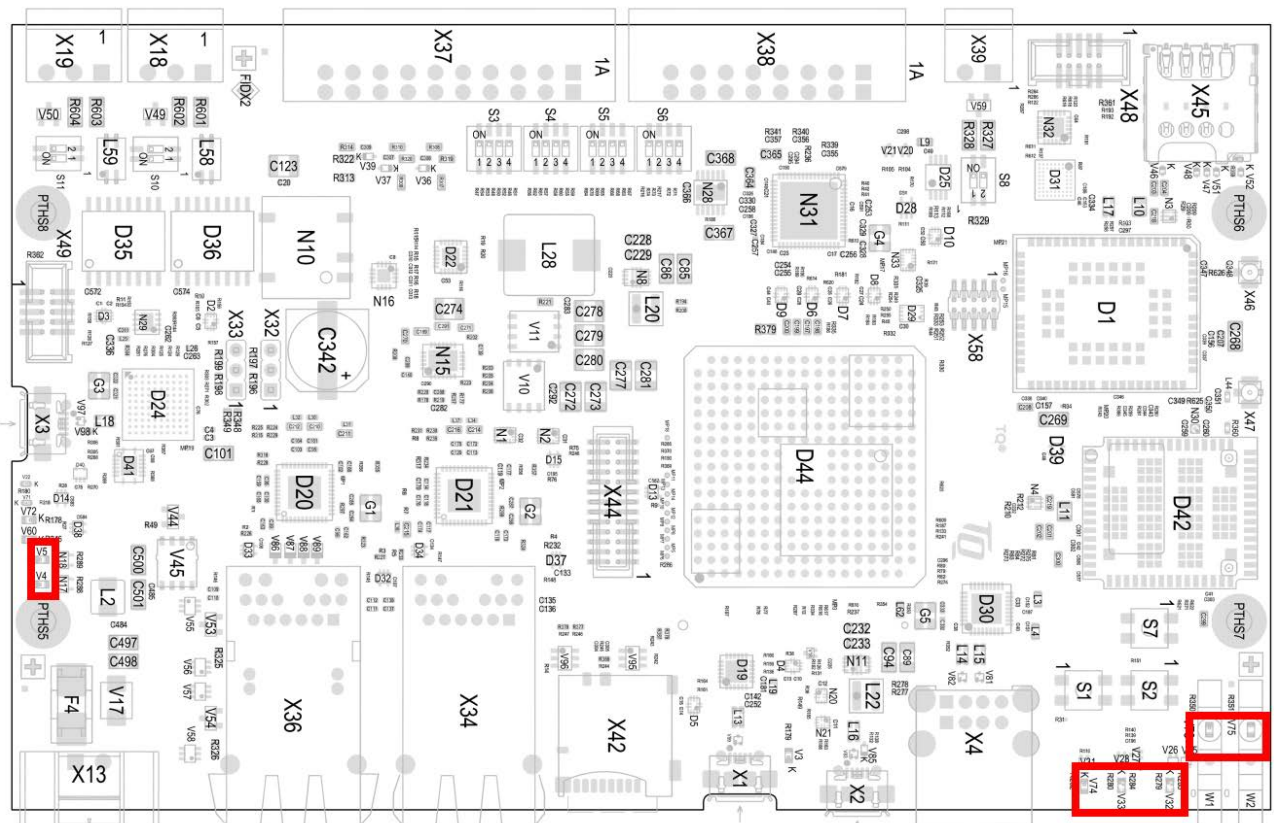


Figure 33: Position Status LEDs



### 3.4.7 JTAG® / Fremlink

The debug interface of the TQMa117xL can be accessed in two ways:

- JTAG pin header X48
- Via debug controller LPC4322JET100 (Fremlink Interface) to Micro USB X3

The following options can be selected via DIP switch S6:

LPUART1\_SWITCH

ON (High) = LPUART1 via USB debug interface

OFF (Low) = LPUART1 via Fremlink Interface

JTAG\_SWITCH

ON (High) = SWD via connector

OFF (Low) = SWD / JTAG via Fremlink Interface

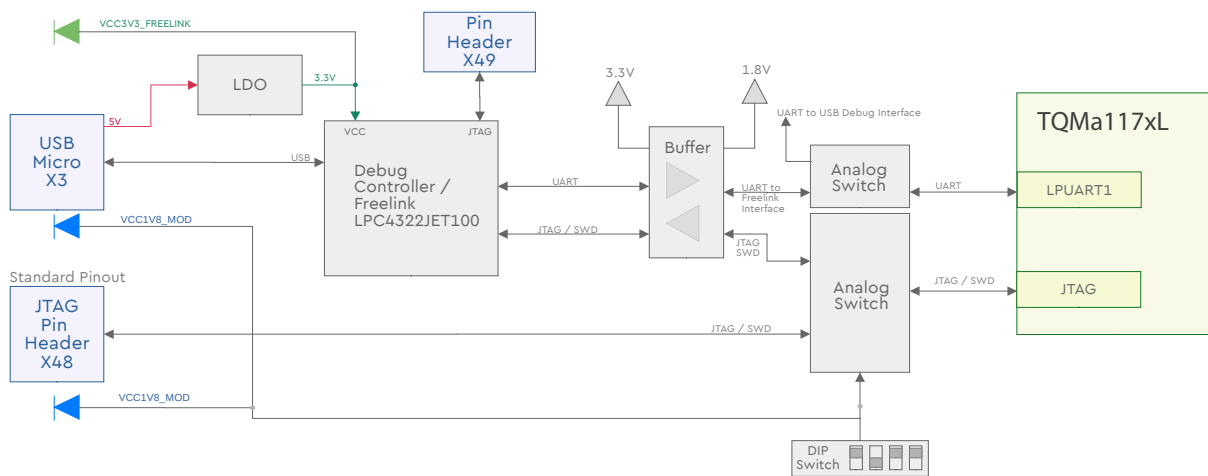


Figure 34: Block diagram JTAG / SWD switching

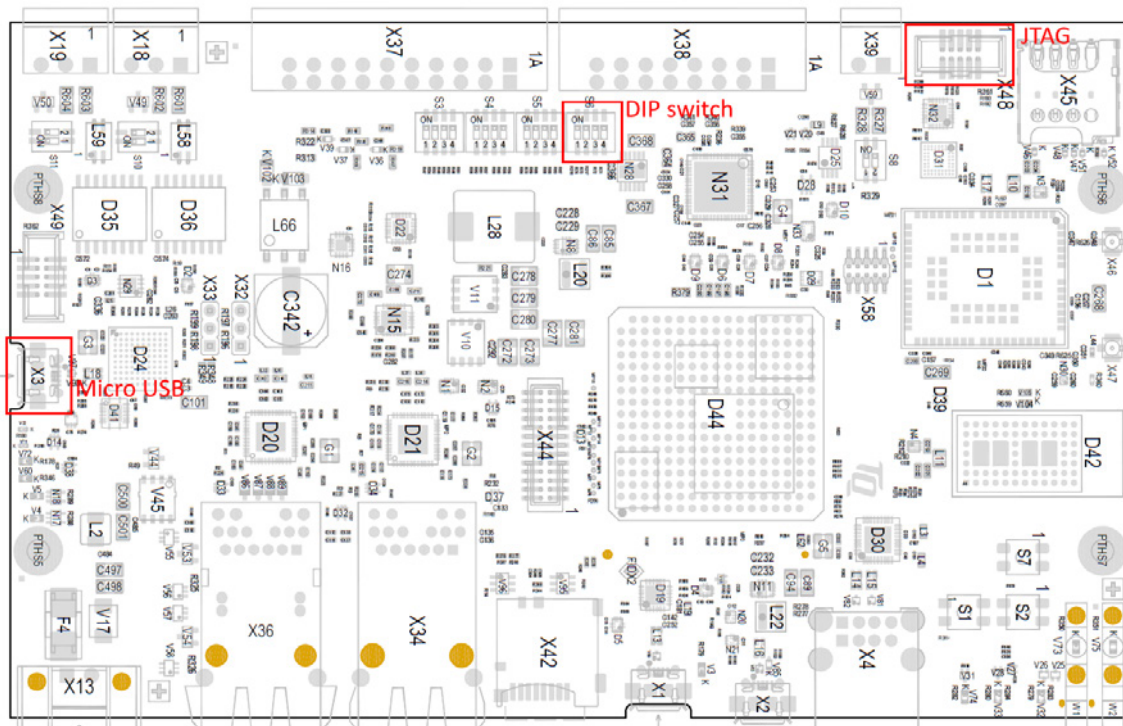


Figure 35: Position JTAG and Fremlink interfaces



The following table shows the JTAG® connector pinout:

Table 16: Pinout JTAG® pin header, X48

Pin	Signal	Remark
1	VCC1V8_MOD	–
2	JTAG_CONN_TMS	–
3	GND	–
4	JTAG_CONN_TCK	–
5	GND	–
6	JTAG_CONN_TDO	–
7	Key	NC
8	JTAG_CONN_TDI	–
9	GND	–
10	JTAG_CONN_TRST#	10 kΩ PU to 1.8 V

#### 4. SOFTWARE

No software is required for the MBa117xL. Suitable software is only required on the TQMa117xL and is not a part of this User's Manual.

More information can be found in the [TQ-Support Wiki for the TQMa117xL](#).



## 5. MECHANICS

### 5.1 MBa117xL dimensions

The MBa117xL has overall dimensions (length × width) of 160 mm × 100 mm.

### 5.2 Embedding in the overall system

The MBa117xL serves as a design base for customer products, as well as a platform to support during development. As a built-in module, the module is not protected against dust, external influences and contact (IP00). The corresponding protection must be provided by the surrounding system.


### 5.3 Housing

The form factor and the mounting holes of the MBa117xL are designed for installation in a standard EURO housing.

### 5.4 Thermal management

No further measures are required for cooling the TQMa117xL at room temperature. The customer is responsible for dissipating the power loss at higher temperatures in his application.

Further power consumption occurs mainly at externally connected devices.

Attention: TQMa117xL heat dissipation	
	<p>The i.MX RT1170 belongs to a performance category in which a cooling system is essential. It is the user's sole responsibility to define a suitable heat sink (weight and mounting position) depending on the specific mode of operation (e.g., dependence on clock frequency, stack height, airflow, and software).</p> <p>Particularly the tolerance chain (PCB thickness, board warpage, BGA balls, BGA package, thermal pad, heatsink) as well as the maximum pressure on the TQMa117xL must be taken into consideration when connecting the heat sink.</p> <p>The TQMa117xL is not the highest component. Inadequate cooling connections can lead to overheating of the TQMa117xL or the MBa117xL and thus malfunction, deterioration or destruction.</p>

### 5.5 Assembly / component placement / labeling

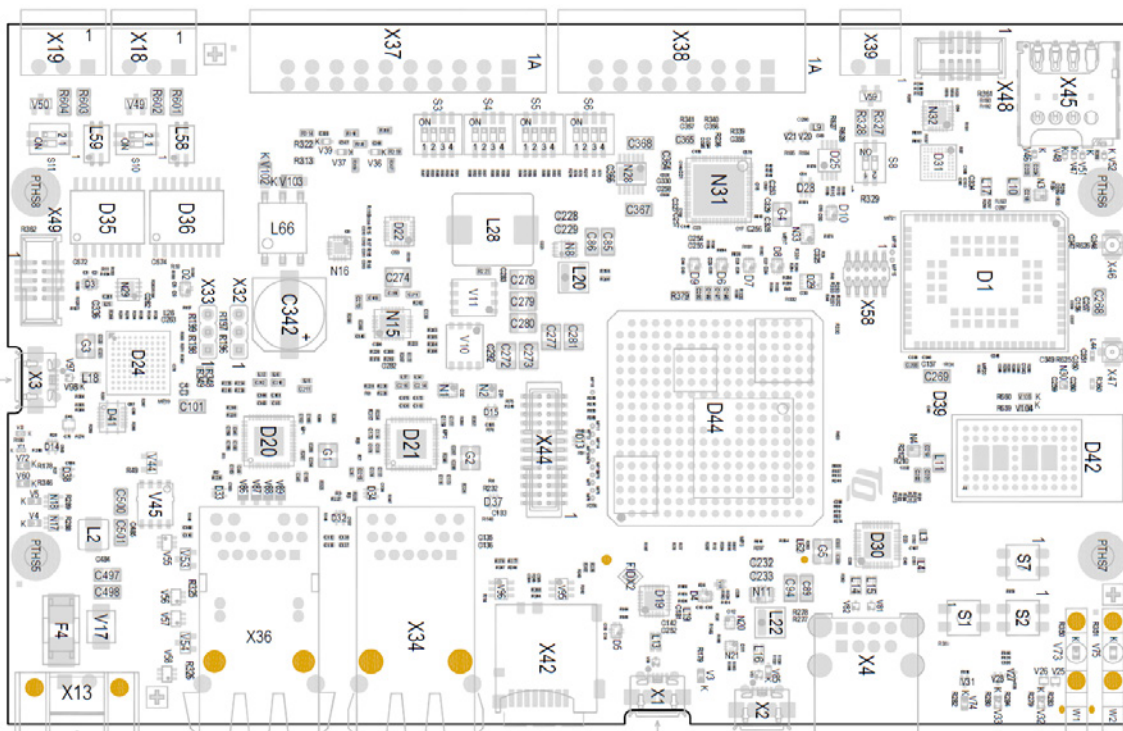


Figure 36: MBa117xL component placement top

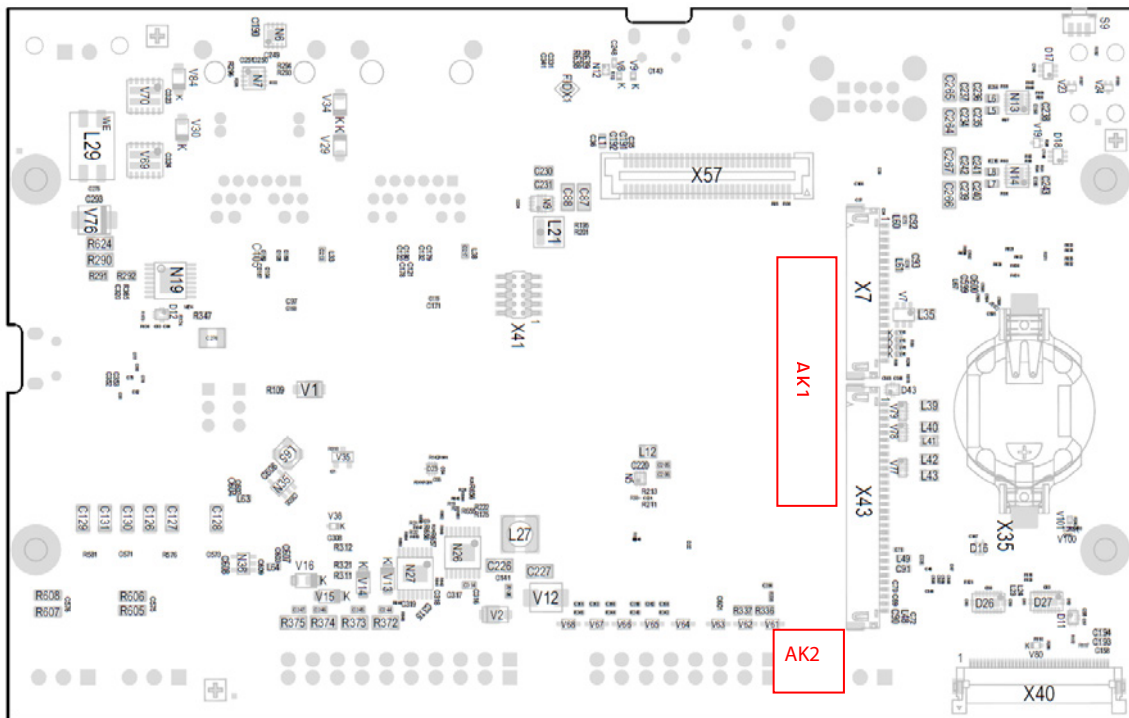


Figure 37: MBa117xL component placement bottom and labeling

The labels on the MBa117xL show the following information:

Table 17: Labels on MBa117xL

Label	Content
AK1	MBa117xL version and revision, tests performed
AK2	Serial number



## 6. SAFETY REQUIREMENTS AND PROTECTIVE REGULATIONS

### 6.1 EMC

The MBa117xL has been carefully developed according to the requirements of electromagnetic compatibility (EMC). Depending on the design of the complete system, interference suppression measures may nevertheless be necessary to ensure compliance with certain limit values for the overall system:

- Sufficient ground planes
- Sufficient block capacitors at all supply voltage connections
- Keep fast or constantly clocking lines short; avoid interference with other signals by spacing and/or shielding; pay attention not only to the frequency but also to the signal rise times.
- Filter all signals that are connected externally (even "slow" and DC voltage signals can indirectly radiate HF).

### 6.2 ESD

Good protection against electrostatic discharge must be placed directly at the inputs of a system. Common measures have been provided on the MBa117xL, but without considering special normative requirements.

- Generally applicable: Shielding of the supply lines (shielding on both sides solidly connected to ground / enclosure).
- For supply voltages: Protection by suppressor diodes
- Slow signal lines: RC filtering, possibly Z diode
- Fast signal lines: Integrated protection components (e.g. suppressor diode arrays)

### 6.3 Operational safety and personal security

Tests for operational safety and personal protection were not carried out due to the voltages  $\leq 60$  V DC.

### 6.4 Export Control and Sanctions Compliance

The customer is responsible for ensuring that the product purchased from TQ is not subject to any national or international export/import restrictions. If any part of the purchased product or the product itself is subject to said restrictions, the customer must procure the required export/import licenses at its own expense. In the case of breaches of export or import limitations, the customer indemnifies TQ against all liability and accountability in the external relationship, irrespective of the legal grounds. If there is a transgression or violation, the customer will also be held accountable for any losses, damages or fines sustained by TQ. TQ is not liable for any delivery delays due to national or international export restrictions or for the inability to make a delivery as a result of those restrictions. Any compensation or damages will not be provided by TQ in such instances.

The classification according to the European Foreign Trade Regulations (export list number of Reg. No. 2021/821 for dual-use-goods) as well as the classification according to the U.S. Export Administration Regulations in case of US products (ECCN according to the U.S. Commerce Control List) are stated on TQ's invoices or can be requested at any time. Also listed is the Commodity code (HS) in accordance with the current commodity classification for foreign trade statistics as well as the country of origin of the goods requested/ordered.

### 6.5 Warranty

TQ-Systems GmbH warrants that the product, when used in accordance with the contract, fulfills the respective contractually agreed specifications and functionalities and corresponds to the recognized state of the art.

The warranty is limited to material, manufacturing and processing defects. The manufacturer's liability is void in the following cases:

- Original parts have been replaced by non-original parts.
- Improper installation, commissioning or repairs.
- Improper installation, commissioning or repair due to lack of special equipment.
- Incorrect operation
- Improper handling
- Use of force
- Normal wear and tear

## 7. CLIMATIC AND OPERATIONAL CONDITIONS

The acceptable temperature range of the baseboard depends strongly on the installation situation (heat dissipation through heat conduction and convection) and the usage. Therefore, no fixed value can be given for the entire assembly. In general, reliable operation is given when the following conditions are met:

Table 18: Climatic and operational conditions MBa117xL

Parameter	Range	Remark
Ambient temperature	-25 °C to +85 °C	With suitable cooling
Storage temperature	-40 °C to +100 °C	
Relative humidity (operation / storing)	10 % to 90 %	Not condensing

### Attention: TQMa117xL heat dissipation



The i.MX RT1170 belongs to a performance category in which a cooling system is essential.

It is the user's sole responsibility to define a suitable heat sink (weight and mounting position) depending on the specific mode of operation (e.g., dependence on clock frequency, stack height, airflow, and software).

Particularly the tolerance chain (PCB thickness, board warpage, BGA balls, BGA package, thermal pad, heatsink) as well as the maximum pressure on the TQMa117xL must be taken into consideration when connecting the heat sink.

The TQMa117xL is not the highest component. Inadequate cooling connections can lead to overheating of the TQMa117xL or the MBa117xL and thus malfunction, deterioration or destruction.

### 7.1 Protection against external effects

Protection class IP00 was defined for the MBa117xL. There is no protection against foreign objects, touch or humidity.

### 7.2 Reliability and service life

No detailed MTBF calculation has been done for the MBa117xL.

Aluminium electrolytic capacitors are used, which can limit the service life depending on the requirements / temperature range.



## 8. ENVIRONMENT PROTECTION

### 8.1 RoHS

The MBa117xL is manufactured RoHS compliant. All components, assemblies and soldering processes are RoHS compliant.

### 8.2 WEEE®

The final distributor is responsible for compliance with the WEEE® regulation.

Within the scope of the technical possibilities, the MBa117xL was designed to be recyclable and easy to repair.

### 8.3 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.

### 8.4 EuP

The Ecodesign Directive, also Energy using Products (EuP), is applicable to products for the end user with an annual quantity >200,000. The MBa117xL must therefore always be seen in conjunction with the complete device. The available standby and sleep modes of the components on the MBa117xL enable compliance with EuP requirements for the MBa117xL.

### 8.5 Statement on California Proposition 65

California Proposition 65, formerly known as the Safe Drinking Water and Toxic Enforcement Act of 1986, was enacted as a ballot initiative in November 1986. The proposition helps protect the state's drinking water sources from contamination by approximately 1,000 chemicals known to cause cancer, birth defects, or other reproductive harm ("Proposition 65 Substances") and requires businesses to inform Californians about exposure to Proposition 65 Substances.

The TQ device or product is not designed or manufactured or distributed as consumer product or for any contact with end-consumers. Consumer products are defined as products intended for a consumer's personal use, consumption, or enjoyment. Therefore, our products or devices are not subject to this regulation and no warning label is required on the assembly. Individual components of the assembly may contain substances that may require a warning under California Proposition 65. However, it should be noted that the Intended Use of our products will not result in the release of these substances or direct human contact with these substances. Therefore you must take care through your product design that consumers cannot touch the product at all and specify that issue in your own product related documentation. TQ reserves the right to update and modify this notice as it deems necessary or appropriate.

### 8.6 Packaging

The MBa117xL is delivered in reusable packaging.

### 8.7 Batteries

#### 8.7.1 General notes

Due to technical reasons a battery is necessary for the MBa117xL. 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.

#### 8.7.2 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 grams per cell applies (equals 5 Ah)).
- Basic lithium content per battery not more than 2 grams (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.

## 8.8 Other entries

By environmentally friendly processes, production equipment and products, we contribute to the protection of our environment. To be able to reuse the MBa117xL, it is produced in such a way (a modular construction) that it can be easily repaired and disassembled. The energy consumption of the MBa117xL is minimised by suitable measures.

Because currently 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 polychlorinated biphenyls (PCB) containing capacitors and transformers.

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 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.

## 9. APPENDIX

### 9.1 Acronyms and definitions

The following acronyms and abbreviations are used in this document:

Table 19: Acronyms

Acronym	Meaning
ADC	Analog/Digital Converter
AI	Artificial Intelligence
ARM®	Advanced RISC Machine
BGA	Ball Grid Array
BIOS	Basic Input/Output System
CAN	Controller Area Network
CAN FD	Controller Area Network Flexible Data-Rate
CCM	Clock Control Module
CPU	Central Processing Unit
CSI	Camera Serial Interface
DIP	Dual In-line Package
DNC	Do Not Connect
DP	DisplayPort
DSI	Display Serial Interface
eCSPI	enhanced Capability Serial Peripheral Interface
eDP	embedded DisplayPort
EEPROM	Electrically Erasable Programmable Read-Only Memory
EMC	Electromagnetic Compatibility
eMMC	embedded Multimedia Card (Flash)
ESD	Electrostatic Discharge
EU	European Union
EuP	Energy using Products
FPS	Frames Per Second
FR-4	Flame Retardant 4
GP	General Purpose
GPIO	General Purpose Input/Output
GPT	General Purpose Timer
HD	High Density (graphics)
HDMI	High-Definition Multimedia Interface
HSS	High-Side Switch
I	Input
I/O	Input/Output
I <sup>2</sup> C	Inter-Integrated Circuit
IEEE®	Institute of Electrical and Electronics Engineers
IP00	Ingress Protection 00
JTAG®	Joint Test Action Group
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LGA	Land Grid Array
LPDDR4	Low-Power DDR4
LVDS	Low Voltage Differential Signal

## 9.1 Acronyms and definitions (continued)

Table 19: Acronyms (continued)

Acronym	Meaning
MAC	Media Access Controller
MIC	Microphone
MIPI	Mobile Industry Processor Interface
ML	Machine Learning
MTBF	Mean operating Time Between Failures
NAND	Not-And (flash memory)
NC	Not Connected
NMI	Non-Maskable Interrupt
NOR	Not-Or
NP	Not Placed
O	Output
OTG	On-The-Go
P	Power
PCB	Printed Circuit Board
PCIe	Peripheral Component Interconnect express
PCMCIA	People Can't Memorize Computer Industry Acronyms
PD	Pull-Down
PHY	Physical (layer of the OSI model)
PMIC	Power Management Integrated Circuit
PU	Pull-Up
PWM	Pulse-Width Modulation
QSPI	Quad Serial Peripheral Interface
REACH®	Registration, Evaluation, Authorisation (and restriction of) Chemicals
RGMII	Reduced Gigabit Media-Independent Interface
RJ45	Registered Jack 45
RoHS	Restriction of (the use of certain) Hazardous Substances
RPM	Revolutions Per Minute
RTC	Real-Time Clock
SAI	Serial Audio Interface
SD	Secure Digital
SDHC	Secure Digital High Capacity
SDRAM	Synchronous Dynamic Random Access Memory
SIM	Subscriber Identification Module
SPDIF	Sony-Philips Digital Interface Format
SVHC	Substances of Very High Concern
TSE	Trust Secure Element
UART	Universal Asynchronous Receiver/Transmitter
UHS	Ultra-High Speed
UM	User's Manual
UN	United Nations
USB	Universal Serial Bus
uSDHC	Ultra-Secured Digital Host Controller
WEEE®	Waste Electrical and Electronic Equipment
ZIF	Zero Insertion Force





## 9.2 References

Table 20: Further applicable documents

No.	Name	Rev. / Date	Company
(1)	i.MX RT1170 Processor Data Sheet	Rev. 4, Jun 2023	<a href="#">NXP</a>
(2)	i.MX RT1170 Processors Reference Manual	Rev. 2, Jul 2023	<a href="#">NXP</a>
(3)	Chip Errata i.MX RT1170	Rev. 1.4, Apr 2023	<a href="#">NXP</a>
(4)	TQMa117xL User's Manual	– current –	<a href="#">TQ-Systems</a>
(5)	TQMa117xL Support Wiki	– current –	<a href="#">TQ-Systems</a>

