TQMx120
User's Manual

TQMx120 UM 0100
21.03.2023

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REVISION HISTORY

Rev.	Date	Name	Pos.	Modification
0100	21.03.2023	KG		First release

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You can register on our website www.tq-group.com to have access to restricted information and automatic update services.

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For service/RMA, please contact our service team by email (service@tq-group.com) or your sales team at TQ-Systems GmbH.

1.6　　　Tips on Safety

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

1.7　　　Symbols and Typographic Conventions

Table 1:　　　Terms and Conventions

Symbol	Meaning
	This symbol represents the handling of electrostatic-sensitive modules and / or components. These components are often damaged / destroyed by the transmission of a voltage higher than about 50 V. A human body usually only experiences electrostatic discharges above approximately 3,000 V.
	This symbol indicates the possible use of voltages higher than 24 V. Please note the relevant statutory regulations in this regard. Non-compliance with these regulations can lead to serious damage to your health and also cause damage / destruction of the component.
	This symbol indicates a possible source of danger. Acting against the procedure described can lead to possible damage to your health and / or cause damage / destruction of the material used.
	This symbol represents important details or aspects for working with TQ-products.
`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. 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. Violation of this guideline may result in damage / destruction of the TQMx120 and be dangerous to your health. 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). 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 modules used:**
  These documents describe the service, functionality and special characteristics of the module 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 has to 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 COM Express™ Design Guide (3), maintained by the PICMG®. This Carrier Design Guide includes a very good guideline to design a COM Express™ carrier board.

It includes detailed information with schematics and detailed layout guidelines.

Please refer to the official PICMG® documentation for additional information (2), (4).

2. INTRODUCTION

Based on the internationally established PICMG® standard COM Express™ (COM.0 Rev. 3.1), the TQMx120 enables the design of not only powerful but also economical x86 based systems. The user has access to all essential interfaces of the CPU at the Type 6 compliant pin out connector. Hence all features of the 12th Generation Intel® Core™ can be used. The direct access to all interfaces gives the user the freedom to use the features of the CPU in the most suitable way for his application.

The compact and robust design as well as the option of conformal coating extends the use cases to applications within rugged industry, transportation and aviation environments. Based on the very low-power consumption and the extended temperature support it is also possible to realize outdoor applications in an easy and reliable way.

2.1　Overview

The following key functions are implemented on the TQMx120:

Processor:

12th Generation Intel® Core™ embedded H-series (Alder Lake-P / H45) with up to 14 processor cores
- Intel® Core™　　i7-12800HE　6P+8E / 96EU,　24 MB Cache, up to 4.6 GHz , 45 W (cTDP 35 W), 0 ℃ – 100 ℃
- Intel® Core™　　i5-12600HE　4P+8E / 80EU,　18 MB Cache, up to 4.5 GHz , 45 W (cTDP 35 W), 0 ℃ – 100 ℃
- Intel® Core™　　i3-12300HE　4P+4E / 48EU,　12 MB Cache, up to 4.3 GHz , 45 W (cTDP 35 W), 0 ℃ – 100 ℃

12th Generation Intel® Core™ embedded P-series (Alder Lake-P / P28) with up to 12 processor cores
- Intel® Core™　　i7-1270PE　4P+8E / 96EU,　18 MB Cache, up to 4.5 GHz , 28 W (cTDP 35 W / 20 W), 0 ℃ – 100 ℃
- Intel® Core™　　i5-1250PE　4P+8E / 80EU,　12 MB Cache, up to 4.4 GHz , 28 W (cTDP 35 W / 20 W), 0 ℃ – 100 ℃
- Intel® Core™　　i3-1220PE　4P+4E / 48EU,　12 MB Cache, up to 4.2 GHz , 28 W (cTDP 35 W / 20 W), 0 ℃ – 100 ℃

12th Generation Intel® Core™ embedded U-series (Alder Lake-P / U15) with up to 10 processor cores
- Intel® Core™　　i7-1265UE　2P+8E / 96EU,　12 MB Cache, up to 4.7GHz , 15 W (cTDP 28 W / 12 W), 0 ℃ – 100 ℃
- Intel® Core™　　i5-1245UE　2P+8E / 80EU,　12 MB Cache, up to 4.4 GHz , 15 W (cTDP 28 W / 12 W), 0 ℃ – 100 ℃
- Intel® Core™　　i3-1215UE　2P+4E / 64EU,　10 MB Cache, up to 4.4 GHz , 15 W (cTDP 28 W / 12 W), 0 ℃ – 100 ℃
- Intel® Celeron™　7305E　　　1P+4E / 48EU,　8 MB Cache, up to 0.9 GHz ,　15 W (cTDP 12 W), 0 ℃ – 100 ℃

Memory:
- 2 × DDR5 SO-DIMM socket with max. 64 Gbyte, dual channel DDR5 up to 4800 MT/s SO-DIMM modules
- EEPROM: 32 kbit (24AA32) (optional)

Graphics:
- 3 × Digital Display Interface / DP++ with up to 8K; DisplayPort 1.4a with support for Multi-Stream Transport (MST)
- 1 × Embedded Digital Display Interface (eDP) or dual channel LVDS interface (eDP 1.4b or dual LVDS)

Peripheral interfaces:
- 1 × 2.5 Gigabit Ethernet (Intel® i226)
- 4 × USB 3.2 Gen 2 (up to 10 Gb/s) with USB 3.0 compatibility
- 2 × USB4 Support, pins shared with Digital Display Interface (optional)
- 8 × USB 2.0
- 2 × SATA Gen 3 (up to 6 Gb/s) or 2x PCIe Gen 3 (up to 8 Gb/s)
- 4 × PCIe Gen 3 (up to 8 Gb/s) (4 (×1), 2 (×2), or 1 (×4))
- 4 × PCIe Gen 4 (up to 16 Gb/s) (1 (×1), 1 (×2), or 1 (×4))
- 1 × PCIe PEG port Gen 4 (up to 16 Gb/s) (1 (×4) and 1 (x8) H series only)
- 1 × LPC or eSPI bus
- 1 × Intel® HD audio (HDA)
- 1 × I²C (2nd I²C optional) (master/slave capable)
- 1 × SMBus
- 1 × SPI for external uEFI BIOS flash
- 1 × SPI general purpose interface (optional)
- 2 × Serial port (Rx/Tx, legacy compatible), 4-wire (Rx/Tx/RTS/CTS) optionally through TQ-flexiCFG
- 8 × GPIO through TQ-flexiCFG
- 1 × MIPI-CSI Camera input interface connector (option)

Security components:
- TPM discrete SLB9670 TPM 2.0 controller or internal firmware TPM (FTPM)

Others:
- TQMx86 board controller with Watchdog and TQ-flexiCFG
- Hardware monitor

Power supply voltage:
- Wide input: 8.5 V to 20 V maximum input ripple: ±100 mV (U and P processor series)
- Standard input: nominal voltage 12 V (11.4 V to 12.6 V) (H processor series)
- 5 V Standby (optional) 5 V (4.75 V to 5.25 V)
- 3 V Battery for RTC

Environment:
- Operating Standard temperature: 0 °C to +60 °C
- Operating Extended temperature: 0 °C to +75 °C
- Storage temperature: –40 °C to +85 °C
- Relative humidity (operation):   10 % to 90 % (non-condensing)
- Relative humidity (storage):   5 % to 95 % (non-condensing, with conformal coating)

Form factor / dimensions:
- COMExpress™ Compact, Type 6, 95 × 95 mm^2

2.2 Compliance

The TQMx120 complies with PICMG® COM Express™ Module Base Specification (COM.0 Rev. 3.1).

2.3   Versions

The TQMx120 is available in several standard configurations.

Table 2:   TQMx120HC 12th Generation Intel® Core™ Embedded Series configurations and features

Feature	TQMx120HC-AA	TQMx120HC-AB	TQMx120HC-AC
Intel	Core™ i7-12800HE	Core™ i5-12600HE	Core™ i3-12300HE
CPU	6P + 8E	4P + 8E	4P + 4E
CPU TDP	45 / 35 W	45 / 35 W	45 / 35 W
CPU Clock (Base)	2.4 GHz	2.5 GHz	1.9 GHz
GfX	96 EU	80 EU	48 EU
L2 Cache	24 MB	18 MB	12 MB
Heat spreader	TQMx120-HSP-AA	TQMx120-HSP-AA	TQMx120-HSP-AA
Heatsink incl. fan	TQMx120-KK-AA	TQMx120-KK-AA	TQMx120-KK-AA
DRAM / SO-DIMM	16 / 32 / 64 GB	16 / 32 / 64 GB	16 / 32 / 64 GB
Use Condition	Embedded	Embedded	Embedded
Operating Temperature	0 °C to +60 °C (Turbo ON) 0 °C to +75 °C (35 W Turbo OFF)	0 °C to +60 °C (Turbo ON) 0 °C to +75 °C (35 W Turbo OFF)	0 °C to +60 °C (Turbo ON) 0 °C to +75 °C (35 W Turbo OFF)
TPM 2.0	1	1	1
Independent displays	4	4	4
LVDS or eDP	1	1	1
DP or HDMI	3	3	3
2.5 GbE	1	1	1
USB 2.0 host	8	8	8
USB 3.2 host	4	4	4
SATA Gen 3	2	2	2
PCIe Gen 3 ×1	8	8	8
PEG Gen 4 x4 / x8	1 / 1	1 / 1	1 / 1
I2C / SPI	1 / 1	1 / 1	1 / 1
HDA	1	1	1
LPC or eSPI	1	1	1
UART / GPIO	2 / 8	2 / 8	2 / 8

Table 3:   TQMx120PC 12th Generation Intel® Core™ Embedded Series configurations and features

Feature	TQMx120PC-AA	TQMx120PC-AB	TQMx120PC-AC
Intel	Core™ i7-1270PE	Core™ i5-1250PE	Core™ i3-1220PE
CPU	4P + 8E	4P + 8E	4P + 4E
CPU TDP	28 / 35 / 20 W	28 / 35 / 20 W	28 / 35 / 20 W
CPU Clock (Base)	1.8 GHz	1.7 GHz	1.5 GHz
GfX	96 EU	80 EU	48 EU
L2 Cache	18 MB	12 MB	12 MB
Heat spreader	TQMx120-HSP-AA	TQMx120-HSP-AA	TQMx120-HSP-AA
Heatsink incl. fan	TQMx120-KK-AA	TQMx120-KK-AA	TQMx120-KK-AA
DRAM / SO-DIMM	16 / 32 / 64 GB	16 / 32 / 64 GB	16 / 32 / 64 GB
Use Condition	Embedded	Embedded	Embedded
Operating Temperature	0 ℃ to +60 ℃ (Turbo ON) 0 ℃ to +75 ℃ (Turbo OFF)	0 ℃ to +60 ℃ (Turbo ON) 0 ℃ to +75 ℃ (Turbo OFF)	0 ℃ to +60 ℃ (Turbo ON) 0 ℃ to +75 ℃ (Turbo OFF)
TPM 2.0	1	1	1
Independent displays	4	4	4
LVDS or eDP	1	1	1
DP or HDMI	3	3	3
2.5 GbE	1	1	1
USB 2.0 host	8	8	8
USB 3.2 host	4	4	4
SATA Gen 3	2	2	2
PCIe Gen 3 ×1	8	8	8
PEG Gen 4 x4 / x8	1 / --	1 / --	1 / --
I2C / SPI	1 / 1	1 / 1	1 / 1
HDA	1	1	1
LPC or eSPI	1	1	1
UART / GPIO	2 / 8	2 / 8	2 / 8

Table 4:   TQMx120UC 12th Generation Intel® Core™ Embedded Series configurations and features

Feature	TQMx120UC-AA	TQMx120UC-AB	TQMx120UC-AC	TQMx120UC-AD
Intel	Core™ i7-1265UE	Core™ i5-1245UE	Core™ i3-1215UE	Celeron™ 7305E
CPU	2P + 8E	2P + 8E	2P + 4E	1P + 4E
CPU TDP	15 / 28 / 12 W	15 / 28 / 12 W	15 / 28 / 12 W	15 / 12 W
CPU Clock (Base)	1.7 GHz	1.5 GHz	1.2 GHz	1.0 GHz
GfX	96 EU	80 EU	64 EU	48 EU
L2 Cache	12 MB	12 MB	10 MB	8 MB
Heat spreader	TQMx120-HSP-AA	TQMx120-HSP-AA	TQMx120-HSP-AA	TQMx120-HSP-AA
Heatsink incl. fan	TQMx120-KK-AA	TQMx120-KK-AA	TQMx120-KK-AA	TQMx120-KK-AA
DRAM / SO-DIMM	16 / 32 / 64 GB	16 / 32 / 64 GB	16 / 32 / 64 GB	16 / 32 / 64 GB
Use Condition	Embedded	Embedded	Embedded	Embedded
Operating Temperature	0 ℃ to +60 ℃ (Turbo ON) 0 ℃ to +75 ℃ (Turbo OFF)	0 ℃ to +60 ℃ (Turbo ON) 0 ℃ to +75 ℃ (Turbo OFF)	0 ℃ to +60 ℃ (Turbo ON) 0 ℃ to +75 ℃ (Turbo OFF)	0 ℃ to +60 ℃ (Turbo ON) 0 ℃ to +75 ℃ (Turbo OFF)
TPM 2.0	1	1	1	--
Independent displays	3	3	3	3
LVDS or eDP	1	1	1	1
DP or HDMI	2	2	2	2
2.5 GbE	1	1	1	1
USB 2.0 host	8	8	8	8
USB 3.2 host	4	4	4	4
SATA Gen 3	2	2	2	2
PCIe Gen 3 ×1	8	8	8	8
PEG Gen 4 x4 / x8	1 / --	1 / --	1 / --	1 / --
I2C / SPI	1 / 1	1 / 1	1 / 1	1 / 1
HDA	1	1	1	1
LPC or eSPI	1	1	1	1
UART / GPIO	2 / 8	2 / 8	2 / 8	2 / 8

Please refer to www.tq-group.com/ for a full list of standard versions.

Other configurations are available on request.

Hardware and software configuration features on request:
- Conformal coating
- Customized BIOS
- USB4 support
- SPI general purpose support

2.4   Accessories

- **TQMx120-HSP**

  ALU Heat spreader with copper inlay for TQMx120, according to COM Express™ specification.

- **Evaluation platform MB-COME6-4**

  Mainboard for COM Express™ Basic and Compact, Type 6, 170 × 170 mm^2, with the following interfaces:
    - 3 × DP (2x up to 8k HBR3, 1x up to 4k HBR2)
    - 1 x dual LVDS
    - 1 x eDP (up to 4k HBR2)
    - 2 × 2.5 Gbit Ethernet
    - 2 x USB 3.2 USB-A
    - 1 x USB 3.2 USB-C
    - 3 x USB 2.0 internal
    - 2 × Serial Port RS232
    - 1x High Definition Audio (Line In, MIC In, HP Out)
    - 1x M.2 Socket Key E (Wi-Fi/BT),
    - 1x M.2 Socket Key B with µSIM (WWAN or SATA SSD)
    - 1x M.2 Socket Key M PCIe x4 (SSD)
    - 1x M.2 Socket Key M PCIe x2 (SSD)
    - 1x PCIExpress x16 PEG port
    - 1x SATA connector
    - Fan header
    - Debug header

- **Debug module**

  POST debug card for TQMx120, see 3.6.3. It is no standard accessory.

3.   FUNCTION

3.1   Block Diagram

The following figure shows the TQMx120 block diagram.
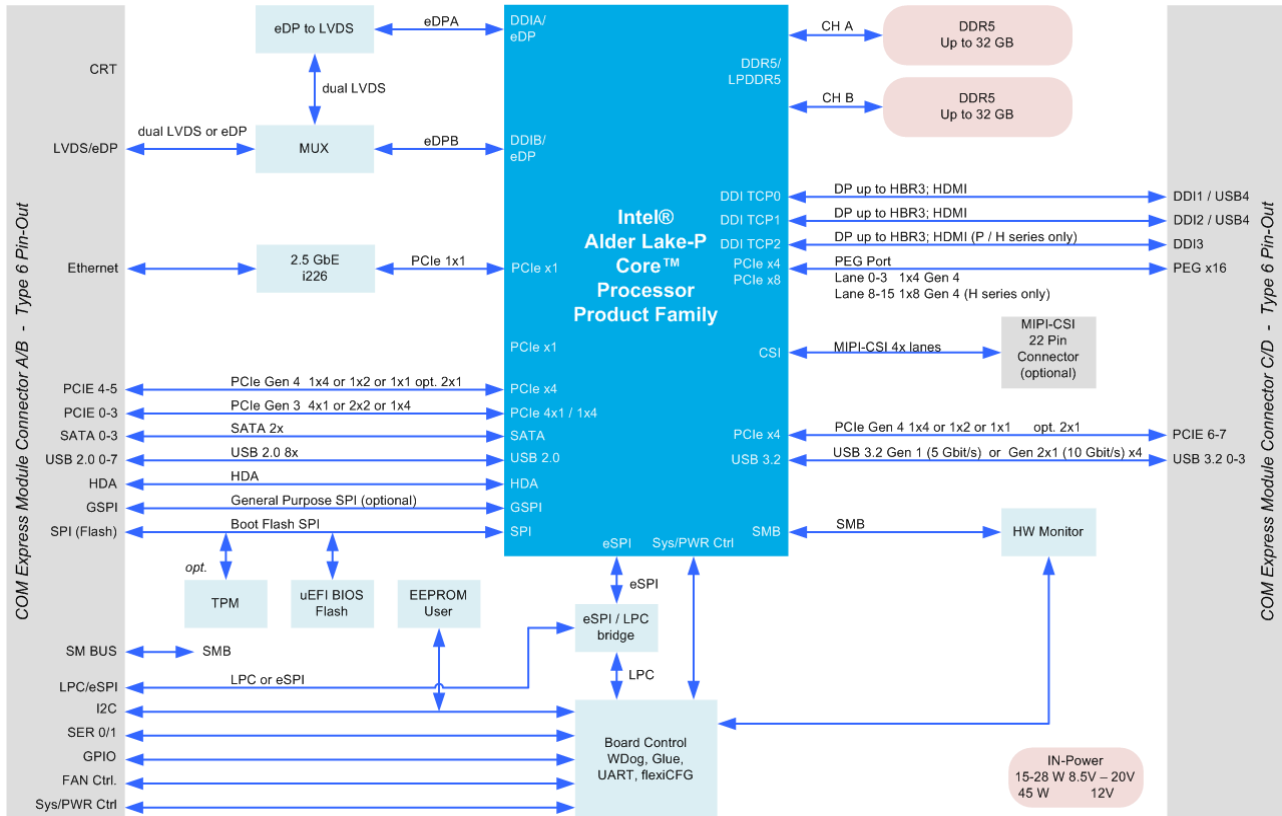
Figure 1: TQMx120 block diagram

3.2   Electrical Characteristics

3.2.1   Supply Voltage

The TQMx120 supports a wide-range voltage input from 8.5 V to 20 V.

The following supply voltages are specified at the COM Express™ connector:

Wide input:	8.5 V to 20 V	maximum input ripple: ±100 mV (U and P processor series)
Standard input:	11.4 V to 12.6 V	maximum input ripple: ±100 mV (H processor series)
VCC_5V_SBY:	4.75 V to 5.25 V	maximum input ripple: ±50 mV
VCC_RTC:	2.0 V to 3.3 V	maximum input ripple: ±20 mV

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

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

Note: Power source
For single supply operations, the 5 V Standby voltage is not required. VCC_5V_SBY can be left unconnected.

3.2.2   Power Consumption

The power consumption values below show the TQMx120 voltage and power specifications.

The values were measured with two power supplies; one for the TQMx120 and the other one for the MB-COME6-4 COM Express™ carrier board.

The power consumption of each TQMx120 version was measured running Windows® 10, 64-bit and a dual DDR5 SO-DIMM configuration (2 × 16 Gbyte). All measurements were done at a temperature of +25 °C and an input voltage of +12 V.

The power consumption of the TQMx120 depends on the application, the mode of operation and the operating system.

The power consumption was measured under the following test modes:

- **Suspend mode:**
  The system is in S5/S4 state, Ethernet port is disconnected.

- **Windows® 10, 64-bit, idle state:**
  Desktop idle state, Ethernet port is disconnected.

- **Windows® 10, 64-bit, maximum workload (cTDP down mode enabled):**
  These values show the maximum cTDP down power consumption using the Intel® stress test tool to stress the processor and graphic engine. Ethernet port is connected (1000Base-T Speed).

- **Windows® 10, 64-bit, maximum workload (nominal configuration):**
  These values show the maximum worst case power consumption using the Intel® stress test tool to stress the processor and graphic engine. Ethernet port is connected (1000Base-T Speed).

- **Windows® 10, 64-bit, maximum workload (turbo mode first 28 seconds)**
  These values show the maximum worst case power consumption using the Intel® stress test tool to stress the processor and graphic engine. This value was measured only for a short time (28 s) when the processor is in the turbo mode. This value should be used for designing the power supply for the TQMx120. Ethernet port is connected (1000Base-T Speed).

The following table shows the TQMx120 power consumption with different CPUs.

Table 5:   TQMx120 Power Consumption **Turbo Mode ON**

CPU	Mode				
	Standby 5 V	Input 12 V			
	Suspend	Win10, 64-bit idle	Win10, 64-bit cTDP down max. load	Win10, 64-bit nominal max. load	Win10, 64-bit Max load (Turbo mode)
TBD					

Table 6:   TQMx120 Power Consumption **Turbo Mode OFF**

CPU	Mode				
	Standby 5 V	Input 12 V			
	Suspend	Win10, 64-bit idle	Win10, 64-bit cTDP down max. load	Win10, 64-bit nominal max. load	Win10, 64-bit Max load (Turbo mode)
TBD					

Note: Power requirement	
	The power supplies on the carrier board for the TQMx120 have to be designed with enough reserve. The carrier board should be able to provide at least twice the maximum TQMx120 workload power. The TQMx120 supports several low-power states. The carrier board power supply has to be stable, even with no load.
	Carrier power supply example:
	Processor i7-12800HE max. load Turbo ON Power Consumption = 130 W: carrier power design 200 W
	Processor i7-12800HE max. load Turbo OFF Power Consumption = 55 W: carrier power design 110 W
	Processor i7-1270PE max. load Turbo ON Power Consumption = 90 W: carrier power design 150 W
	Processor i7-1270PE max. load Turbo OFF Power Consumption = 35 W: carrier power design 70 W
	Processor i7-1265UE max. load Turbo ON Power Consumption = 80 W: carrier power design 120 W
	Processor i7-1265UE max. load Turbo OFF Power Consumption = 29 W: carrier power design 60 W

3.2.3   Real Time Clock Power Consumption

The RTC (VCC_RTC) current consumption is shown below.

The values were measured at +25 °C under battery operating conditions.

Table 7:   RTC Current Consumption

Mode	Voltage	Current
12th Generation Intel® Core™ series integrated RTC	3.0 V	3 µA

The current consumption of the RTC in the 12th Generation Intel® Core™ series Product Family Datasheet is specified with 6 µA in average, but the measured values on several TQMx120 are lower.

3.3   Environmental Conditions

- Operating Standard temperature: 0 °C to +60 °C
- Operating Extended temperature: 0 °C to +75 °C
- Storage temperature: −40 °C to +85 °C
- Relative humidity (operating):   10 % to 90 % (non-condensing)
- Relative humidity (storage):   5 % to 95 % (non-condensing)

Attention: Maximum operating temperature	
⚠	Do not operate the TQMx120 without properly attached heat spreader and heat sink. The heat spreader is not a sufficient heat sink.

3.4   System Components

3.4.1   Processor

The TQMx120 supports the 12th Generation Intel® Core™ processor series (Alder Lake-P).

The following list illustrates some key features of the 12th Generation Intel® Core™ U, P, H processor series:
- First Intel® hybrid processor design combines Performance-cores with Efficient–cores, together up to 14 cores
- 10nm SuperFin technology
- DDR5 up to 4800 MT/s
- Intel® Hyper-Threading Technology (Intel® HT Technology)
- Intel® Advanced Vector Extensions 2 (Intel® AVX2)
- Intel® AVX2 Vector Neural Network Instructions (Intel® AVX2 VNNI)
- Intel® 64 Architecture
- Intel® Turbo Boost Max Technology 3.0
- Intel® Configurable Thermal Design Power (Intel® cTDP up and down)
- Intel® Enhanced Intel® SpeedStep® technology
- 12th generation Intel® UHD Graphics / Iris® Xe Graphics with up to 96 Execution Units (EUs)
- High Definition Content Protection (HDCP) 2.3
- Up to four independent displays

Table 8:   12th Generation Intel® Core™ i7, i5, i3 Embedded H-Series

Mode	Core™ i7-12800HE	Core™ i5-12600HE	Core™ i3-12300HE
Processor Cores	6P + 8E	4P + 8E	4P + 4E
Cache	24 Mbyte	18 Mbyte	12 Mbyte
P-Core Base frequency	2.4 GHz	2.5 GHz	1.9 GHz
P-Core Base frequency (cTDP down)	1.6 GHz	1.7 GHz	1.1 GHz
P-Core Max. Turbo frequency	4.6 GHz	4.5 GHz	4.3 GHz
E-Core Base frequency	1.8 GHz	1.8 GHz	1.5 GHz
P-Core Max. Turbo frequency	3.5 GHz	3.3 GHz	3.3 GHz
T$_{junction}$	0 °C to +100 °C	0 °C to +100 °C	0 °C to +100 °C
Memory speed DDR5	4800 MT/s	4800 MT/s	4800 MT/s
Max. memory	64 Gbyte	64 Gbyte	64 Gbyte
Graphics	Intel® Iris® Xe Graphics	Intel® Iris® Xe Graphics	Intel® UHD Graphics
Graphics Execution Units	96	80	48
Graphics Turbo frequency	1.35 GHz	1.3 GHz	1.15 GHz
Thermal Design Power (TDP nominal)	45 W	45 W	45 W
Configurable Thermal Design Power (cTDP down)	35 W	35 W	35 W
Processor Power Limit 2 (PL2)	115 W	115 W	90 W
Intel® Hyper-Threading Technology	Yes	Yes	Yes
Chipset	600 Series	600 Series	600 Series

Table 9:   12th Generation Intel® Core™ i7, i5, i3 Embedded P-Series

Mode	Core™ i7-1270PE	Core™ i5-1250PE	Core™ i3-1220PE
Processor Cores	4P + 8E	4P + 8E	4P + 4E
Cache	18 Mbyte	12 Mbyte	12 Mbyte
P-Core Base frequency	1.8 GHz	1.7 GHz	1.5 GHz
P-Core Base frequency (cTDP up)	1.9 GHz	1.8 GHz	1.7 GHz
P-Core Base frequency (cTDP down)	1.2 GHz	1.1 GHz	1.0 GHz
P-Core Max. Turbo frequency	4.5 GHz	4.4 GHz	4.2 GHz
E-Core Base frequency	1.2 GHz	1.2 GHz	1.1 GHz
P-Core Max. Turbo frequency	3.3 GHz	3.2 GHz	3.1 GHz
$T_{junction}$	0 ℃ to +100 ℃	0 ℃ to +100 ℃	0 ℃ to +100 ℃
Memory speed DDR5	4800 MT/s	4800 MT/s	4800 MT/s
Max. memory	64 Gbyte	64 Gbyte	64 Gbyte
Graphics	Intel® Iris® Xe Graphics	Intel® Iris® Xe Graphics	Intel® UHD Graphics
Graphics Execution Units	96	80	48
Graphics Turbo frequency	1.35 GHz	1.3 GHz	1.25 GHz
Thermal Design Power (TDP nominal)	28 W	28 W	28 W
Configurable Thermal Design Power (cTDP up)	35 W	35 W	35 W
Configurable Thermal Design Power (cTDP down)	20 W	20 W	20 W
Processor Power Limit 2 (PL2)	64 W	64 W	64 W
Intel® Hyper-Threading Technology	Yes	Yes	Yes
Chipset	600 Series	600 Series	600 Series

Table 10:   12th Generation Intel® Core™ i7, i5, i3 Embedded U-Series

Mode	Core™ i7-1265UE	Core™ i5-1245UE	Core™ i3-1215UE	Celeron™ 7305E
Processor Cores	2P + 8E	2P + 8E	2P + 4E	1P + 4E
Cache	12 Mbyte	12 Mbyte	10 Mbyte	8 Mbyte
P-Core Base frequency	1.7 GHz	1.5 GHz	1.2 GHz	1.0 GHz
P-Core Base frequency (cTDP up)	2.6 GHz	2.5 GHz	2.5 GHz	--
P-Core Base frequency (cTDP down)	1.1 GHz	1.1 GHz	0.8 GHz	0.8 GHz
P-Core Max. Turbo frequency	4.7 GHz	4.4 GHz	4.4 GHz	--
E-Core Base frequency	1.2 GHz	1.1 GHz	0.9 GHz	0.9 GHz
P-Core Max. Turbo frequency	3.5 GHz	3.3 GHz	3.3 GHz	--
$T_{junction}$	0 ℃ to +100 ℃	0 ℃ to +100 ℃	0 ℃ to +100 ℃	0 ℃ to +100 ℃
Memory speed DDR5	4800 MT/s	4800 MT/s	4800 MT/s	4800 MT/s
Max. memory	64 Gbyte	64 Gbyte	64 Gbyte	64 Gbyte
Graphics	Intel® Iris® Xe Graphics	Intel® Iris® Xe Graphics	Intel® UHD Graphics	Intel® UHD Graphics
Graphics Execution Units	96	80	64	48
Graphics Turbo frequency	1.25 GHz	1.2 GHz	1.1 GHz	1.1 GHz
Thermal Design Power (TDP nominal)	15 W	15 W	15 W	15 W
Configurable Thermal Design Power (cTDP up)	28 W	28 W	28 W	--
Configurable Thermal Design Power (cTDP down)	12 W	12 W	12 W	12 W
Processor Power Limit 2 (PL2)	55 W	55 W	55 W	55 W
Intel® Hyper-Threading Technology	Yes	Yes	Yes	Yes
Chipset	600 Series	600 Series	600 Series	600 Series

3.4.1.1   Intel® Turbo Boost Technology

Intel® Turbo Boost Technology accelerates processor and graphics performance for peak loads, automatically allowing processor cores to run faster than the rated operating frequency if they are operating below power, current, and temperature specification limits. Whether the processor enters into Intel® Turbo Boost Technology and the amount of time the processor spends in that state depends on the workload and operating environment.

The Intel® Turbo Boost Technology allows the processor to operate at a power level that is higher than its Thermal Design Power (TDP) configuration for short durations to maximize performance.

The Intel® Turbo Boost Technology can be configured in the uEFI BIOS, the default setting is "enabled".

Only the Intel® Core™ i7, i5, i3 processors support Intel® Turbo Boost Technology.

3.4.1.2   Intel® Configurable Thermal Design Power

The Intel® Configurable Thermal Design Power (cTDP) feature allows adjustment of the processor power consumption.

The cTDP consists of three modes:

1.   The cTDP nominal mode specifies the processor rated frequency and maximum power consumption.
2.   The cTDP down mode specifies a lower maximum processor power consumption and lower guaranteed frequency versus the nominal mode. This mode can be selected for ultra low-power applications, e.g. systems with reduced cooling solutions.
3.   The cTDP up mode specifies a higher maximum processor power consumption and a higher guaranteed frequency versus the nominal mode. This mode can be selected for high performance applications with optimized cooling solutions.

3.4.2   Graphics

The 12th Generation Intel® Core™ series includes an integrated Intel® HD graphics accelerator.

It provides excellent 2D / 3D graphics performance with support of up to four simultaneous displays.

The following list illustrates some key features of the 12th Generation Intel® Core™ processor:

- Intel® Iris® Xe Graphics with up to 96 Execution Units
- Hardware accelerated video decoding/encoding for AVC/VC-1/MPEG2/HEVC/VP8/JPEG
- Direct3D* 2015, Direct3D 12, Direct3D 11.2, Direct3D 11.1, Direct3D 9, Direct3D 10, Direct2D Video API support
- OpenGL 4.5
- Open CL 2.1, Open CL 2.0, Open CL 1.2
- Single 8K60Hz (HBR3) panel support

The TQMx120 supports three external Digital Display Interfaces (DDI1, DDI2 and DDI3) and one internal display, either dual channel LVDS or eDP interface at the COM Express™ connector, depending on TQMx120 and carrier configuration.

The 12th Generation Intel® Core™ series supports up to four displays (P and H series) at the same time.

Table 11:   Maximum Resolution Display Configuration

Display	Maximum Display Resolution
LVDS	1920 × 1200 @ 60 Hz
eDP 1.4b	4096 × 2304 @ 60 Hz
DP 1.4a	7680 × 4320 @ 60 Hz
HDMI 2.0b	4096 × 2160 @ 60 Hz

3.4.3   Chipset

The 12th Generation Intel® Core™ processor series includes the embedded 600 series platform controller hub (PCH).

3.4.4   Memory

3.4.4.1   DDR5 SDRAM SO-DIMM

The TQMx120 supports a dual-channel DDR5 memory, running at up to 4800 MT/s.

It provides two 260-pin DDR5 SO-DIMM sockets for two DDR5 SO-DIMM modules that support system memory configurations of 16 Gbyte, 32 Gbyte or 64 Gbyte.

Note: DDR5 SO-DIMM modules
Only DDR5 SO-DIMM modules qualified by TQ-Systems are authorized for use with the TQMx120. DDR5 SO-DIMM modules not released by TQ-Systems may cause functional issues.

3.4.4.2   SPI Boot Flash

The TQMx120 provides a 256 Mbit SPI boot flash. It includes the Intel® Management Engine (Intel® ME) and the uEFI BIOS.
An external SPI boot flash on the carrier can be used instead of the on-board SPI boot flash.
The uEFI BIOS supports the following 3.3 V SPI flash devices on the carrier board:

- Macronix MX25L25645GM2I

3.4.4.3   SPI General Purpose

The TQMx120 supports a general purpose SPI interface. The SPI Master is on the module. The interface may be used with general purpose SPI devices such as DACs, A/D converters on the carrier.

Attention: General Purpose SPI carrier design
SPI General Purpose support is introduced in COM.0 Rev. 3.1. To support the SPI General Purpose interface the COM Express™ carrier must be designed for the SPI standard! Please contact support@tq-group.com for further information about the SPI design requirements.

3.4.4.4   EEPROM

The TQMx120 supports a COM Express™ Module EEPROM. The 2 kbit EEPROM AT24AA32 is connected to the general purpose I²C interface (COM Express™ pin names I2C_DAT and I2C_CK).

3.4.5   Real Time Clock

The TQMx120 includes a standard RTC (Motorola MC146818B) integrated in the Intel PCH.

3.4.6   Trusted Platform Module

The TQMx120 supports the Trusted Platform Module (TPM) 2.0 (Infineon SLB9670 controller).
The 12th Generation Intel® Core™ series also support a Firmware Trusted Platform Module (FTPM), which is a Trusted Platform Module 2.0 implementation in firmware. This feature can be configured in the BIOS.

3.4.7   Hardware Monitor

The TQMx120 includes an integrated Hardware Monitor to monitor the on-board and processor die temperature, board voltages and manage the fan control of the COM Express™ interface.

3.4.8   TQ Flexible I/O Configuration (TQ-flexiCFG)

The TQ-Systems COM Express™ module TQMx120 includes a flexible I/O configuration feature, TQ-flexiCFG.

Using the TQ-flexiCFG feature several COM Express™ I/O interfaces and functions can be configured via a programmable FPGA.

This option allows TQ-Systems to integrate special embedded features and configuration options in the TQMx120 to reduce the carrier board design effort. Some examples of flexible I/O configuration are:

- GPIO interrupt configuration
- Interrupt configuration via LPC Serial IRQ
- Serial Port handshake signals via GPIOs
- Integration of additional I/O functions,
  (e.g. additional Serial, CAN, I²C, PWM controller or special power management configurations)

Please contact support@tq-group.com for further information about the TQ-flexiCFG.

3.5   Interfaces

3.5.1   PCI Express

The TQMx120 supports up to four PCI Express Gen 3 ports with 8 Gbit/s speed at the COM Express™ connector port 0 – 3 and up to four PCI Express Gen 4 ports with 16 Gbit/s speed at the COM Express™ connector 4 – 7.

With a customized BIOS the PCI Express lane configuration can be set as follows:

Table 12:   PCI Express port 0 – 7 Configuration Options

COM Express™ Port 0 – 3	Configuration
(4) ×1 ports	Standard BIOS
(1) ×2 and (2) ×1 ports	Configuration via custom BIOS
(1) ×4 port	Configuration via custom BIOS
COM Express™ Port 4 – 7	**Configuration**
(1) ×1 port	Standard BIOS
(1) ×2 port	Standard BIOS
(1) ×4 port	Standard BIOS

The PCI Express COM Express™ connector port 4 to 7 supports a flexible I/O configuration to directly connect an M.2 SSD module with PCI Express 1 (×4) interface.

3.5.2   PCI Express Graphics (PEG-Port)

At the COM Express™ connector PEG interface the TQMx120 supports up to two Gen 4 PCI Express Graphics ports with up to 16.0 Gbit/s speed per lane. The PCI Express Graphic port can be used for PCI Express graphics devices or high speed non-graphic PCI Express devices (e.g. quad Gigabit Ethernet or 10 Gigabit Ethernet controller).

Table 13:   PCI Express Graphics port Configuration Options

COM Express™ PEG Port 0 – 3	Configuration
(1) ×4 port	Standard BIOS
COM Express™ PEG Port 4 – 7	**Configuration**
--	Not used
COM Express™ PEG Port 8 – 15	**Configuration (H Series only)**
(1) ×8 port	Standard BIOS

The TQMx120 version with the Intel® Core™ embedded H-series supports the PCI Express x8 port. This port is not supported by U-series and P-series processors.

3.5.3   2.5 Gigabit Ethernet

The TQMx120 provides an Intel® i226 Ethernet controller with 10/100/1000/2500 Mbps speed.

Features of the Intel® i226 Ethernet controller:

- Automatic speed configuration 10 BASE-T / 100 BASE-TX / 1000 BASE-T / 1000 BASE-T / 2500 BASE-T
- Automatic MDI/MDIX crossover at all speeds
- Jumbo frames (up to 9 kB)
- 802.1as/1588 conformance
- Reduced power consumption during normal operation
- Energy Efficient Ethernet (EEE)
- Ethernet TSN support

Attention: 2500 BASE-T Ethernet carrier design	
⚠	If the COM Express™ carrier is not designed for the Gigabit Ethernet 2500 BASE-T operation, the Gigabit Ethernet ports should be configured to operate in 1000 BASE-T mode.

3.5.4   Serial ATA

The TQMx120 supports two SATA Gen 3.0 (6 Gbit/s) interfaces. The integrated SATA host controller supports AHCI mode and it also supports RAID mode.
The SATA controller no longer supports legacy IDE mode using I/O space.

The RAID capability provides high-performance RAID 0, 1, 5, and 10 functionality on up to two SATA ports of the SATA host controller. Matrix RAID support is provided to allow multiple RAID levels to be combined on a single set of hard drives, such as RAID 0 and RAID 1 on two disks. Other RAID features include hot spare support, SMART alerting, and RAID 0 auto replace.

To support more PCI Express ports the two SATA ports can be configured to two PCI Express ports with Gen 3 (8 Gbit/s) data rate (customized BIOS needed).
Please contact support@tq-group.com for further information about the SATA / PCI Express port configuration.

3.5.5   Digital Display Interface

The TQMx120 supports up to four Digital Display Interfaces at the COM Express™ connector DDI1, DDI2, DDI3 and eDP / LVDS port.
The external Digital Display Interface supports Display Port (DP), High Definition Multimedia Interface (HDMI) and Digital Visual Interface (DVI). Any display combination is supported.
The internal eDP / LVDS port supports LVDS (via an eDP to LVDS Bridge)
Maximum display resolutions:

- DisplayPort 1.4a resolution up to 7680 × 4320 @ 60 Hz
- HDMI 2.0b up to 4096 × 2160 @ 60 Hz with external level shifter on baseboard
- DVI up to 4096 × 2160 @ 24 Hz (HDMI without Audio)
- eDP up to 4 lanes eDP 1.4b up to 4096 × 2304 @ 60 Hz
- LVDS up to 1920 × 1200 @ 60 Hz in dual channel LVDS mode

The TQMx120 version with the Intel® Core™ embedded U-series supports only two DDI ports (DDI1 and DDI2). The DDI3 is not connected for this versions.

3.5.6   LVDS / eDP Interface

The TQMx120 supports a LVDS / eDP interface at the COM Express™ connector. The LVDS interface is provided through an on-board eDP to LVDS Bridge. The eDP to LVDS Bridge supports single or dual bus LVDS signalling with colour depths of 18 bits per pixel or 24 bits per pixel up to 112 MHz and a resolution up to 1920 × 1200 @ 60 Hz in dual channel LVDS mode.
The TQMx120 includes a multiplexer to switch between the LVDS and the eDP interface on the COM Express™ connector pins. In the BIOS the LVDS or eDP interface can be configured.
The LVDS data output packing can be configured either in VESA or JEIDA format.
To support panels without EDID ROM, the eDP to LVDS bridge can emulate EDID ROM behaviour avoiding specific changes in system video BIOS.
Please contact support@tq-group.com for further information about the LVDS configuration.

3.5.7   USB 2.0 and USB 3.2 Interfaces

The TQMx120 supports eight USB 2.0 and four USB 3.2 Gen 2 ports with data rate up to 10 Gbit/s at the COM Express™ connector. All USB 3.2 Gen 2 ports are configurable to USB 3.2 Gen 1 (5 Gbit/s).
Care must be taken in the COM Express™ carrier design, the carrier must support the USB 3.2 Gen 2 (10 Gbit/s) high speed standard.

Attention: USB 3.1 Gen 2 (10 Gb/s) carrier design	
⚠	If the COM Express™ carrier is not designed for the USB 3.2 Gen 2 (10 Gb/s) operation, the USB 3.2 ports should be configured to operate in Gen 1 mode.

Please contact support@tq-group.com for further information about USB 3.1 high-speed Design Guidelines.

Note: USB Port Mapping	
⚠	The USB 2.0 port 0 must be paired with USB 3.2 SuperSpeedPlus port 0. The USB 2.0 port 1 must be paired with USB 3.2 SuperSpeedPlus port 1. The USB 2.0 port 2 must be paired with USB 3.2 SuperSpeedPlus port 2. The USB 2.0 port 3 must be paired with USB 3.2 SuperSpeedPlus port 3.

3.5.8   USB4 interface

The TQMx120 module supports on the existing display DDI1 and DDI2 interface the USB4 high speed function. For this feature special hardware and BIOS configuration are necessary.

Attention: USB4 carrier design	
⚠	USB4 support is introduced in COM.0 Rev. 3.1. To support the USB4 feature on the DDI1 and DDI2 ports the COM Express™ carrier must be designed for the new USB4 standard! Please contact support@tq-group.com for further information about the new USB4 design requirements.

3.5.9   General Purpose Input / Output

The TQMx120 provides eight GPIO signals at the COM Express™ connector.
The signals can also be used for special functions (see 3.4.8).

3.5.10   High Definition Audio Interface

The TQMx120 provides a High Definition Audio (HDA) interface, which supports one audio codes at the COM Express™ connector. The HDA_SDIN1 and 2 signals at the COM Express™ connector are not connected. The Audio Codec is assembled on the carrier board.

3.5.11　LPC / eSPI Bus

The TQMx120 supports a Low Pin Count (LPC) legacy bus and the Enhanced Serial Peripheral (eSPI) bus on the same COM Express™ connector pins.

The TQMx120 includes a multiplexer to switch between the LPC and the eSPI bus on the COM Express™ connector pins. With the ESPI_EN# signal the carrier indicate the operating mode of the LPC / eSPI bus. If left unconnected on the carrier, LPC mode (default) is selected. If pulled to GND on the carrier, eSPI mode is selected.

The default COM Express™ interface configuration is LPC bus. For the eSPI option a customized BIOS configuration is necessary.

Please contact support@tq-group.com for further information about the Serial Peripheral eSPI BIOS and Carrier integration.

3.5.12　I²C Bus

The TQMx120 supports a general purpose I^{2}C port via a dedicated LPC to I^{2}C controller integrated in the TQ-flexiCFG block. The I^{2}C host controller supports a transfer rate of up to 400 kHz and can be configured independently.

3.5.13　SMBus

The TQMx120 provides a System Management Bus (SMBus).

3.5.14　MIPI-CSI Camera Serial Interface

The TQMx120 supports a MIPI-CSI Camera Serial Interface using a 22-pin SMT connector (X9) on the COM Express™ module. The MIPI-CSI pin-out is compliant with the COM.0 Rev. 3.1 MIPI-CSI implementation.

Please contact support@tq-group.com for further information about the MIPI-CSI support because of limited software / device support. For each device a special implementation in BIOS is necessary.

3.5.15   Serial Ports

The TQMx120 offers a dual Universal Asynchronous Receiver and Transmitter (UART) controller. The register set is based on the industry standard 16550 UART. The UART operates with standard serial port drivers without requiring a custom driver to be installed. The 16 byte transmit and receive FIFOs reduce CPU overhead and minimize the risk of buffer overflow and data loss.

With the TQ-flexiCFG feature the serial ports can be configured to route the handshake signals to free pins at the COM Express™ connector.

Table 14:   Serial Port COM Express™ Port Mapping

COM Express™ Signal	COM Express™ Pin	TQMx120	Remark
SER0_TX	A98	SER0_TX	3.3 V output (without protection)
SER0_RX	A99	SER0_RX	3.3 V input (without protection)
SER1_TX	A101	SER1_TX	3.3 V output (without protection)
SER1_RX	A102	SER1_RX	3.3 V input (without protection)
SER0_RTS#	B98	SER0_RTS#	3.3 V output
SER0_CTS#	B99	SER0_CTS#	3.3 V input
SER1_RTS#	D24	SER1_RTS#	3.3 V output
SER1_CTS#	D25	SER1_CTS#	3.3 V input

Note: Protection circuits	
⚠️ (i)	In COM Express™ specification Revision 3.0 the signals A98, A99, A101 and A102 have been reclaimed from the VCC_12V pool. Therefore protection on the carrier board is necessary to avoid damage to those when accidentally exposed to 12 V. The implementation of this circuitry causes lower transfer rates on the two serial ports.
	On the TQMx120 the protection circuit is removed by default and the serial ports provide transfer rates of up to 115 kbaud. Therefore the TQMx120 can only be used in a COM Express™ COM.0 2.0 and 3.0 Type 6 pin-out carrier board.

3.5.16   Watchdog Timer

The TQMx120 supports an independently programmable two-stage Watchdog timer integrated in the TQ-flexiCFG block.

There are four operation modes available for the Watchdog timer:

- Dual-stage mode
- Interrupt mode
- Reset mode
- Timer mode

The Watchdog timer timeout ranges from 125 msec to 1 h.

Note: Once the watchdog is enabled, the application cannot disable it. Only a system reset can disable the watchdog.

The COM Express™ Specification does not support external hardware triggering of the Watchdog. An external Watchdog Trigger can be configured to GPIO pins at the COM Express™ connector with the TQ-flexiCFG feature.

3.6　Connectors

3.6.1　COM Express™ Connector

Two 220-pin 0.5 mm pitch receptacle connectors are used to interface the TQMx120 on the carrier board.

On the carrier board two 220-pin 0.5 mm pitch plug connectors have to be used.

Two versions with 5 mm and 8 mm stack height are available.

Attention: USB 3.1 Gen 2 (10 Gb/s), PCI Express Gen 4 (16 Gb/s) and DisplayPort HBR3 (8.1 GB/s) carrier design	
⚠	To support on the COM Express™ carrier the new high speed interfaces, USB 3.2 Gen 2 (10 Gb/s), PCI Express Gen 4 (16 Gb/s) and DisplayPort HBR3 (8.1 Gb/s) data rate, a COM Express™ optimized high speed connector must be used. The company EPT offers an optimized COM Express™ connector (Colibri) for applications up to 16 Gb/s, this connector is compatible with all popular COM Express™ connectors. The Carrier design also needs to be optimized to support the new high speed interfaces. Please contact support@tq-group.com for further information about the new high speed design requirements

3.6.2　Debug Header

The TQMx120 includes a 14-pin flat cable connector to connect an external debug module (TQ specific) providing uEFI BIOS POST code information, debug LEDs and a JTAG interface for on-board FPGA.

The TQM debug card can be connected at this header.

3.6.3   TQM Debug Card

The TQM debug card is only on special request (no standard accessory). It is designed to provide access to several processor and chipset control signals.
When the COM Express module is powered up, the uEFI BIOS POST codes are shown.
If the COM Express module does not boot, the uEFI BIOS POST has detected a fatal error and stopped.
The number displayed on the TQM debug card is the number of the test, where the uEFI BIOS boot failed.

Figure 2: TQM Debug Card

Please contact support@tq-group.com for more details and ordering information about the TQM debug card.

3.6.4   Debug Module LED

The TQMx120 includes a dual colour LED providing boot and BIOS information.
The following table illustrates some LED boot messages:

Table 15:   LED Boot Messages

Red LED	Green LED	Remark
ON	OFF	Power supply error
ON	ON	S4/S5 state
BLINKING	BLINKING	S3 state
OFF	BLINKING	uEFI BIOS is booting
OFF	ON	uEFI BIOS boot is completed

Figure 3: Debug Module LED

3.7   COM Express™ Connector Pinout

This section describes the TQMx120 COM Express™ connector pin assignment, which is compliant with COM.0 R3.0 Type 6 pin-out definitions.

3.7.1   Signal Assignment Abbreviations

The following table lists the abbreviations used within this chapter:

Table 16:   Signal Assignment Abbreviations

Abbreviation	Description
GND	Ground
PWR	Power
I	Input
I PU	Input with pull-up resistor
I PD	Input with pull-down resistor
O	Output
OD	Open drain output
I/O	Bi-directional

Note: Unused signals on the carrier board
Unused inputs at the COM Express™ connector can be left open on the carrier board, since these signals are terminated on the TQMx120.

Note: COM Express™ Module Pinout configuration
The TQMx120 complies with the PICMG® COM Express™ Module Base Specification (COM.0 Rev. 3.0 and the new COM.0 Rev 3.1).
The default COM Express™ Module pinout configuration of the TQMx120 module is the COM.0 Rev. 3.0.
To support the new COM.0 Rev. 3.1 features (e.g. GP SPI and USB4) special hardware and BIOS configuration are necessary.
Please contact support@tq-group.com for further information about the COM.0 Rev. 3.1 requirements.

3.7.2 COM Express™ Connector Pin Assignment

Table 17: COM Express™ Connector Pin Assignment

Pin	Pin-Signal	Description	Type	Remark
A1	GND(FIXED)	Ground	GND	
A2	GBE0_MDI3-	Gigabit Ethernet Controller 0: Media Dependent Interface	IO	
A3	GBE0_MDI3+	Gigabit Ethernet Controller 0: Media Dependent Interface	IO	
A4	GBE0_LINK100#	Gigabit Ethernet Controller 0 100 / 2500 Mbit/s link indicator	OD	
A5	GBE0_LINK1000#	Gigabit Ethernet Controller 0 1000 Mbit/s link indicator	OD	
A6	GBE0_MDI2-	Gigabit Ethernet Controller 0: Media Dependent Interface	IO	
A7	GBE0_MDI2+	Gigabit Ethernet Controller 0: Media Dependent Interface	IO	
A8	GBE0_LINK#	Gigabit Ethernet Controller 0 link indicator	OD	
A9	GBE0_MDI1-	Gigabit Ethernet Controller 0: Media Dependent Interface	IO	
A10	GBE0_MDI1+	Gigabit Ethernet Controller 0: Media Dependent Interface	IO	
A11	GND(FIXED)	Ground	GND	
A12	GBE0_MDI0-	Gigabit Ethernet Controller 0: Media Dependent Interface	IO	
A13	GBE0_MDI0+	Gigabit Ethernet Controller 0: Media Dependent Interface	IO	
A14	GBE0_CTREF	Reference voltage for Carrier Board Ethernet channel 0	Power	
A15	SUS_S3#	Indicates system is in Suspend to RAM state. Active low output.	O PD	
A16	SATA0_TX+	SATA differential transmit pairs	O	
A17	SATA0_TX-	SATA differential transmit pairs	O	
A18	SUS_S4#	Indicates system is in Suspend to Disk state. Active low output.	O PD	
A19	SATA0_RX+	SATA differential receive pairs	I	
A20	SATA0_RX-	SATA differential receive pairs	I	
A21	GND(FIXED)	Ground	GND	
A22	SATA2_TX+	SATA differential transmit pairs	O	NC
A23	SATA2_TX-	SATA differential transmit pairs	O	NC
A24	SUS_S5#	Indicates system is in Soft Off state. Active low output.	O PD	
A25	SATA2_RX+	SATA differential receive pairs	I	NC
A26	SATA2_RX-	SATA differential receive pairs	I	NC
A27	BATLOW#	Indicates that external battery is low	I PU	
A28	(S)ATA_ACT#	SATA activity indicator	O	NC
A29	HDA_SYNC	Sample-synchronization signal to the CODEC(s)	O	
A30	HDA_RST#	Reset output to CODEC, active low.	O	
A31	GND(FIXED)	Ground	GND	
A32	HDA_BITCLK	Serial data clock generated by the external CODEC(s)	IO	
A33	HDA_SDOUT	Serial TDM data output to the CODEC	O	
A34	BIOS_DIS0#/ESPI_SAFS	Selection straps to determine the BIOS boot device	I PU	
A35	THRMTRIP#	indicating that the CPU has entered thermal shutdown	O	
A36	USB6-	USB differential pairs	IO	
A37	USB6+	USB differential pairs	IO	
A38	USB_6_7_OC#	USB over-current sense, USB channels 6 and 7	I PU	
A39	USB4-	USB differential pairs	IO	
A40	USB4+	USB differential pairs	IO	
A41	GND(FIXED)	Ground	GND	
A42	USB2-	USB differential pairs	IO	
A43	USB2+	USB differential pairs	IO	
A44	USB_2_3_OC#	USB over-current sense, USB channels 2 and 3	I PU	
A45	USB0-	USB differential pairs	IO	
A46	USB0+	USB differential pairs	IO	
A47	VCC_RTC	Real-time clock circuit-power input.	Power	
A48	RSMRST_OUT#	RSMReset (Resume Reset, active low) signal	O	Rev 3.1
A49	GBE0_SDP	Gigabit Ethernet Controller 0 Software-Definable Pin.	IO	TQ-flexiCFG
A50	LPC_SERIRQ/ESPI_CS1#	LPC serial interrupt / eSPI CS1#	IO	3.3V / 1.8V
A51	GND(FIXED)	Ground	GND	
A52	PCIE_TX5+	PCI Express differential transmit pairs	O	
A53	PCIE_TX5-	PCI Express differential transmit pairs	O	
A54	GPI0/SD_DATA0	GPI0	I PU	TQ-flexiCFG
A55	PCIE_TX4+	PCI Express differential transmit pairs	O	

COM Express™ Connector Pin Assignment (continued)

Pin	Pin-Signal	Description	Type	Remark
A56	PCIE_TX4-	PCI Express differential transmit pairs	O	
A57	GND	Ground	GND	
A58	PCIE_TX3+	PCI Express differential transmit pairs	O	
A59	PCIE_TX3-	PCI Express differential transmit pairs	O	
A60	GND(FIXED)	Ground	GND	
A61	PCIE_TX2+	PCI Express differential transmit pairs	O	
A62	PCIE_TX2-	PCI Express differential transmit pairs	O	
A63	GPI1/SD_DATA1	GPI1	I PU	TQ-flexiCFG
A64	PCIE_TX1+	PCI Express differential transmit pairs	O	
A65	PCIE_TX1-	PCI Express differential transmit pairs	O	
A66	GND	Ground	GND	
A67	GPI2/SD_DATA2	GPI2	I PU	TQ-flexiCFG
A68	PCIE_TX0+	PCI Express differential transmit pairs	O	
A69	PCIE_TX0-	PCI Express differential transmit pairs	O	
A70	GND(FIXED)	Ground	GND	
A71	LVDS_A0+ / eDP_TX2+	LVDS Channel A differential pairs 0 / eDP_TX2+	O	
A72	LVDS_A0- / eDP_TX2-	LVDS Channel A differential pairs 0 / eDP_TX2-	O	
A73	LVDS_A1+ / eDP_TX1+	LVDS Channel A differential pairs 1 / eDP_TX1+	O	
A74	LVDS_A1- / eDP_TX1-	LVDS Channel A differential pairs 1 / eDP_TX1-	O	
A75	LVDS_A2+ / eDP_TX0+	LVDS Channel A differential pairs 2 / eDP_TX0+	O	
A76	LVDS_A2- / eDP_TX0-	LVDS Channel A differential pairs 2 / eDP_TX0-	O	
A77	LVDS_VDD_EN	LVDS / eDP panel power enable	O PD	
A78	LVDS_A3+	LVDS Channel A differential pairs 3	O	
A79	LVDS_A3-	LVDS Channel A differential pairs 3	O	
A80	GND(FIXED)	Ground	GND	
A81	LVDS_A_CK+ / eDP_TX3+	LVDS Channel A differential clock / eDP_TX3+	O	
A82	LVDS_A_CK- / eDP_TX3-	LVDS Channel A differential clock / eDP_TX3-	O	
A83	LVDS_I2C_CK / eDP_AUX+	I2C clock output for LVDS display / eDP_AUX+	IO	
A84	LVDS_I2C_DAT / eDP_AUX-	I2C data line for LVDS display / eDP_AUX-	IO	
A85	GPI3/SD_DATA3	GPI3 / SD_DATA3	I PU	TQ-flexiCFG
A86	GP_SPI_MOSI	General Purpose SPI MOSI	O	NC / Rev 3.1 (opt.)
A87	eDP_HPD	eDP Detection of Hot Plug	I PD	
A88	PCIE_CLK_REF+	Reference clock output for all PCI Express lanes	O	
A89	PCIE_CLK_REF-	Reference clock output for all PCI Express lanes	O	
A90	GND(FIXED)	Ground	GND	
A91	SPI_POWER	Power supply for Carrier Board SPI Flash	PWR	3.3V
A92	SPI_MISO	Data in to Module from Carrier SPI	I PU	
A93	GPO0/SD_CLK	GPO0	O PD	TQ-flexiCFG
A94	SPI_CLK	Clock from Module to Carrier SPI	O	
A95	SPI_MOSI	Data out from Module to Carrier SPI	O	
A96	TPM_PP	Trusted Platform Module (TPM) Physical Presence pin	I PD	
A97	TYPE10#	Type 10 Module indication (NC)	NC	
A98	SER0_TX	Serial port 0 transmitter	O	w/o protection 3.3V
A99	SER0_RX	Serial port 0 receiver	I PU	w/o protection 3.3V
A100	GND(FIXED)	Ground	GND	
A101	SER1_TX	Serial port 1 transmitter	O	w/o protection 3.3V
A102	SER1_RX	Serial port 1 receiver	I PU	w/o protection 3.3V
A103	LID#	LID switch	I PU	
A104	VCC_12V	Primary wide power input	PWR	
A105	VCC_12V	Primary wide power input	PWR	
A106	VCC_12V	Primary wide power input	PWR	
A107	VCC_12V	Primary wide power input	PWR	
A108	VCC_12V	Primary wide power input	PWR	
A109	VCC_12V	Primary wide power input	PWR	
A110	GND(FIXED)	Ground	GND	

COM Express™ Connector Pin Assignment (continued)

Pin	Pin-Signal	Description	Type	Remark
B1	GND(FIXED)	Ground	GND	
B2	GBE0_ACT#	Gigabit Ethernet Controller 0 active indicator	OD	
B3	LPC_FRAME#/ESPI_CS0#	LPC frame / eSPI CS0#[1]	IO	3.3V / 1.8V
B4	LPC_AD0/ESPI_IO_0	LPC multiplexed address, command and data bus / eSPI IO0[1]	IO	3.3V / 1.8V
B5	LPC_AD1/ESPI_IO_1	LPC multiplexed address, command and data bus / eSPI IO1[1]	IO	3.3V / 1.8V
B6	LPC_AD2/ESPI_IO_2	LPC multiplexed address, command and data bus / eSPI IO2[1]	IO	3.3V / 1.8V
B7	LPC_AD3/ESPI_IO_3	LPC multiplexed address, command and data bus / eSPI IO3[1]	IO	3.3V / 1.8V
B8	LPC_DRQ0#/ESPI_ALERT0#	LPC serial DMA request / eSPI ALERT0#[1]	IO	3.3V / 1.8V
B9	LPC_DRQ1#/ESPI_ALERT1#	LPC serial DMA request / eSPI ALERT1#[1]	IO	NC
B10	LPC_CLK/ESPI_CK	LPC clock output / eSPI Clock[1]	O	3.3V / 1.8V
B11	GND(FIXED)	Ground	GND	
B12	PWRBTN#	Power button input	I PU	
B13	SMB_CK	System Management Bus bidirectional clock line	IO	
B14	SMB_DAT	System Management Bus bidirectional data line	IO	
B15	SMB_ALERT#	System Management Bus Alert	I PU	
B16	SATA1_TX+	SATA differential transmit pairs	O	
B17	SATA1_TX-	SATA differential transmit pairs	O	
B18	SUS_STAT#/ESPi_RST#	LPC indicates suspend operation / eSPI RST#	O	
B19	SATA1_RX+	SATA differential receive pairs	I	
B20	SATA1_RX-	SATA differential receive pairs	I	
B21	GND(FIXED)	Ground	GND	
B22	SATA3_TX+	SATA differential transmit pairs	O	NC
B23	SATA3_TX-	SATA differential transmit pairs	O	NC
B24	PWR_OK	Power OK from main power supply	I PU	
B25	SATA3_RX+	SATA differential receive pairs	I	NC
B26	SATA3_RX-	SATA differential receive pairs	I	NC
B27	WDT	watchdog time-out	O	
B28	HDA_SDIN2 / SNDW0_CLK	Serial TDM data input / SNDW0_CLK	IO	NC / Rev 3.1 (opt.)
B29	HDA_SDIN1 / SNDW0_DAT	Serial TDM data input / SNDW0_DAT	IO	NC / Rev 3.1 (opt.)
B30	HDA_SDIN0	Serial TDM data input	I PU	
B31	GND(FIXED)	Ground	GND	
B32	SPKR	PC Audio Speaker output	O	
B33	I2C_CK	General purpose I2C port clock output	IO	TQ-flexiCFG
B34	I2C_DAT	General purpose I2C port data I/O line	IO	TQ-flexiCFG
B35	THRM#	Input from carrier temperature sensor	I PU	
B36	USB7-	USB differential pairs	IO	
B37	USB7+	USB differential pairs	IO	
B38	USB_4_5_OC#	USB over-current sense, USB channels 4 and 5	I PU	
B39	USB5-	USB differential pairs	IO	
B40	USB5+	USB differential pairs	IO	
B41	GND(FIXED)	Ground	GND	
B42	USB3-	USB differential pairs	IO	
B43	USB3+	USB differential pairs	IO	
B44	USB_0_1_OC#	USB over-current sense, USB channels 0 and 1	I PU	
B45	USB1-	USB differential pairs	IO	
B46	USB1+	USB differential pairs	IO	
B47	ESPI_EN#	The Carrier shall tie ESPI_EN# to GND for eSPI operation, LPC NC[1]	I PU	
B48	USB0_HOST_PRSNT	Module USB client may detect the presence of a USB host on USB0	I PD	
B49	SYS_RESET#	Reset button input	I PU	
B50	CB_RESET#	Reset output from Module to Carrier Board	O	
B51	GND(FIXED)	Ground	GND	
B52	PCIE_RX5+	PCI Express differential receive pairs	I	
B53	PCIE_RX5-	PCI Express differential receive pairs	I	
B54	GPO1/SD_CMD	GPO1	O PD	TQ-flexiCFG
B55	PCIE_RX4+	PCI Express differential receive pairs	I	

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[1] See chapter 3.5.11

COM Express™ Connector Pin Assignment (continued)

Pin	Pin-Signal	Description	Type	Remark
B56	PCIE_RX4-	PCI Express differential receive pairs	I	
B57	GPO2 / SD_WP	GPO2	O PD	TQ-flexiCFG
B58	PCIE_RX3+	PCI Express differential receive pairs	I	
B59	PCIE_RX3-	PCI Express differential receive pairs	I	
B60	GND(FIXED)	Ground	GND	
B61	PCIE_RX2+	PCI Express differential receive pairs	I	
B62	PCIE_RX2-	PCI Express differential receive pairs	I	
B63	GPO3/SD_CD#	GPO3	O PD	TQ-flexiCFG
B64	PCIE_RX1+	PCI Express differential receive pairs	I	
B65	PCIE_RX1-	PCI Express differential receive pairs	I	
B66	WAKE0#	PCI Express wake up signal	I PU	
B67	WAKE1#	General purpose wake up signal	I PU	
B68	PCIE_RX0+	PCI Express differential receive pairs	I	
B69	PCIE_RX0-	PCI Express differential receive pairs	I	
B70	GND(FIXED)	Ground	GND	
B71	LVDS_B0+	LVDS Channel B differential pairs 0	O	
B72	LVDS_B0-	LVDS Channel B differential pairs 0	O	
B73	LVDS_B1+	LVDS Channel B differential pairs 1	O	
B74	LVDS_B1-	LVDS Channel B differential pairs 1	O	
B75	LVDS_B2+	LVDS Channel B differential pairs 2	O	
B76	LVDS_B2-	LVDS Channel B differential pairs 2	O	
B77	LVDS_B3+	LVDS Channel B differential pairs 3	O	
B78	LVDS_B3-	LVDS Channel B differential pairs 3	O	
B79	LVDS_BKLT_EN	LVDS / eDP panel backlight enable	O PD	
B80	GND(FIXED)	Ground	GND	
B81	LVDS_B_CK+	LVDS Channel B differential clock	O	
B82	LVDS_B_CK-	LVDS Channel B differential clock	O	
B83	LVDS_BKLT_CTRL	LVDS / eDP panel backlight brightness control	O PD	
B84	VCC_5V_SBY	Standby power input: +5.0V nominal	PWR	
B85	VCC_5V_SBY	Standby power input: +5.0V nominal	PWR	
B86	VCC_5V_SBY	Standby power input: +5.0V nominal	PWR	
B87	VCC_5V_SBY	Standby power input: +5.0V nominal	PWR	
B88	BIOS_DIS1#	Selection straps to determine the BIOS boot device	I PU	
B89	VGA_RED	Red for monitor	O	NC
B90	GND(FIXED)	Ground	GND	
B91	VGA_GRN	Green for monitor	O	NC
B92	VGA_BLU	Blue for monitor	O	NC
B93	VGA_HSYNC	Horizontal sync output to VGA monitor	O	NC
B94	VGA_VSYNC	Vertical sync output to VGA monitor	O	NC
B95	VGA_I2C_CK	DDC clock line	O	NC
B96	VGA_I2C_DAT	DDC data line	IO	NC
B97	SPI_CS#	Chip select for Carrier Board SPI	O	
B98	GP_SPI_MISO	General Purpose SPI MISO or SER0_RTS# (output)	I	SER0_RTS# / Rev 3.1
B99	GP_SPI_CK	General Purpose SPI CLK or SER0_CTS# (input)	O	SER0_CTS# / Rev 3.1
B100	GND(FIXED)	Ground	GND	
B101	FAN_PWMOUT	Fan Pulse Width Modulation speed control output	O	
B102	FAN_TACHIN	Fan tachometer input	I PU	
B103	SLEEP#	Sleep button	I PU	
B104	VCC_12V	Primary wide power input	PWR	
B105	VCC_12V	Primary wide power input	PWR	
B106	VCC_12V	Primary wide power input	PWR	
B107	VCC_12V	Primary wide power input	PWR	
B108	VCC_12V	Primary wide power input	PWR	
B109	VCC_12V	Primary wide power input	PWR	
B110	GND(FIXED)	Ground	GND	

COM Express™ Connector Pin Assignment (continued)

Pin	Pin-Signal	Description	Type	Remark
C1	GND(FIXED)	Ground	GND	
C2	GND	Ground	GND	
C3	USB_SSRX0-	SuperSpeed USB3.2 differential receive pairs	I	
C4	USB_SSRX0+	SuperSpeed USB3.2 differentia receive pairs	I	
C5	GND	Ground	GND	
C6	USB_SSRX1-	SuperSpeed USB3.2 differential receive pairs	I	
C7	USB_SSRX1+	SuperSpeed USB3.2 differential receive pairs	I	
C8	GND	Ground	GND	
C9	USB_SSRX2-	SuperSpeed USB3.2 differential receive pairs	I	
C10	USB_SSRX2+	SuperSpeed USB3.2 differential receive pairs	I	
C11	GND(FIXED)	Ground	GND	
C12	USB_SSRX3-	SuperSpeed USB3.2 differential receive pairs	I	
C13	USB_SSRX3+	SuperSpeed USB3.2 differential receive pairs	I	
C14	GND	Ground	GND	
C15	USB4_1_LSTX	Sideband TX interface for USB4 Alternate modes	IO	NC / Rev 3.1 (opt.)
C16	USB4_1_LSRX	Sideband RX interface for USB4 Alternate modes	IO	NC / Rev 3.1 (opt.)
C17	USB4_RT_ENA	Power Enable for Carrier based USB Retimers.	O	TQ-flexiCFG / Rev 3.1
C18	GND	Ground	GND	Rev 3.1
C19	PCIE_RX6+	PCI Express differential receive pairs	I	
C20	PCIE_RX6-	PCI Express differential receive pairs	I	
C21	GND(FIXED)	Ground	GND	
C22	PCIE_RX7+	PCI Express differential receive pairs	I	
C23	PCIE_RX7-	PCI Express differential receive pairs	I	
C24	DDI1_HPD	DDI1 Detection of Hot Plug	I PD	
C25	SML0_CLK	Clock lines for System Management Links 0	IO	NC / Rev 3.1 (opt.)
C26	SML0_DAT	Data line for I2C data based System Management Links 0	IO	NC / Rev 3.1 (opt.)
C27	SML1_CLK	Clock lines for System Management Links 1	IO	NC / Rev 3.1 (opt.)
C28	SML1_DAT	Data line for I2C data based System Management Links 1	IO	NC / Rev 3.1 (opt.)
C29	USB4_PD_I2C_CLK	I2C clock line between Module based Embedded Controller master and Carrier based USB Power Delivery Controller slave.	IO	NC / Rev 3.1 (opt.)
C30	USB4_PD_I2C_DAT	I2C clock line between Module based Embedded Controller master and Carrier basedUSB Power Delivery Controller slave.	IO	NC / Rev 3.1 (opt.)
C31	GND(FIXED)	Ground	GND	
C32	DDI2_CTRLCLK_AUX+/ USB4_2_AUX+	DDI2_CTRLCLK_AUX+ signal DP AUX, HDMI DVI CLK	IO	Rev 3.1
C33	DDI2_CTRLDATA_AUX-/ USB4_2_AUX-	DDI2_CTRLDATA_AUX- signal DP AUX, HDMI DVI DATA	IO	Rev 3.1
C34	DDI2_DDC_AUX_SEL	Selects the function of DDI2_CTRLxAUX+/- Signals	I PD	
C35	USB4_2_LSTX	Sideband TX interface for USB4 Alternate modes	IO	NC / Rev 3.1 (opt.)
C36	DDI3_CTRLCLK_AUX+	DDI3_CTRLCLK_AUX+ signal DP AUX, HDMI DVI CLK	IO	
C37	DDI3_CTRLDATA_AUX-	DDI3_CTRLDATA_AUX- signal DP AUX, HDMI DVI DATA	IO	
C38	DDI3_DDC_AUX_SEL	Selects the function of DDI3_CTRLxAUX+/- Signals	I PU	
C39	DDI3_PAIR0+	DDI3 DP / HDMI / DVI differential pairs 0	O	
C40	DDI3_PAIR0-	DDI3 DP / HDMI / DVI differential pairs 0	O	
C41	GND(FIXED)	Ground	GND	
C42	DDI3_PAIR1+	DDI3 DP / HDMI / DVI differential pairs 1	O	
C43	DDI3_PAIR1-	DDI3 DP / HDMI / DVI differential pairs 1	O	
C44	DDI3_HPD	DDI3 Detection of Hot Plug	I PD	
C45	GP_SPI_CS#	General Purpose SPI CS#	O	NC / Rev 3.1 (opt.)
C46	DDI3_PAIR2+	DDI3 DP / HDMI / DVI differential pairs 2	O	
C47	DDI3_PAIR2-	DDI3 DP / HDMI / DVI differential pairs 2	O	
C48	RSVD18	Reserved	NC	
C49	DDI3_PAIR3+	DDI3 DP / HDMI / DVI differential pairs 3	O	
C50	DDI3_PAIR3-	DDI3 DP / HDMI / DVI differential pairs 3	O	
C51	GND(FIXED)	Ground	GND	
C52	PEG_RX0+	PCI Express differential receive pairs	I	
C53	PEG_RX0-	PCI Express differential receive pairs	I	
C54	TYPE0#	Type 0 Module indication (NC)	NC	
C55	PEG_RX1+	PCI Express differential receive pairs	I	

COM Express™ Connector Pin Assignment (continued)

Pin	Pin-Signal	Description	Type	Remark
C56	PEG_RX1-	PCI Express differential receive pairs	I	
C57	TYPE1#	Type 1 Module indication (NC)	NC	
C58	PEG_RX2+	PCI Express differential receive pairs	I	
C59	PEG_RX2-	PCI Express differential receive pairs	I	
C60	GND(FIXED)	Ground	GND	
C61	PEG_RX3+	PCI Express differential receive pairs	I	
C62	PEG_RX3-	PCI Express differential receive pairs	I	
C63	GND	Ground	GND	Rev 3.1
C64	GND	Ground	GND	Rev 3.1
C65	PEG_RX4+	PCI Express differential receive pairs	I	NC
C66	PEG_RX4-	PCI Express differential receive pairs	I	NC
C67	RAPID_SHUTDOWN	Trigger for Rapid Shutdown. Must be driven to 5V	I PD	
C68	PEG_RX5+	PCI Express differential receive pairs	I	NC
C69	PEG_RX5-	PCI Express differential receive pairs	I	NC
C70	GND(FIXED)	Ground	GND	
C71	PEG_RX6+	PCI Express differential receive pairs	I	NC
C72	PEG_RX6-	PCI Express differential receive pairs	I	NC
C73	GND	Ground	GND	
C74	PEG_RX7+	PCI Express differential receive pairs	I	NC
C75	PEG_RX7-	PCI Express differential receive pairs	I	NC
C76	GND	Ground	GND	
C77	GND	Ground	GND	Rev 3.1
C78	PEG_RX8+	PCI Express differential receive pairs	I	
C79	PEG_RX8-	PCI Express differential receive pairs	I	
C80	GND(FIXED)	Ground	GND	
C81	PEG_RX9+	PCI Express differential receive pairs	I	
C82	PEG_RX9-	PCI Express differential receive pairs	I	
C83	GND	Ground	GND	Rev 3.1
C84	GND	Ground	GND	
C85	PEG_RX10+	PCI Express differential receive pairs	I	
C86	PEG_RX10-	PCI Express differential receive pairs	I	
C87	GND	Ground	GND	
C88	PEG_RX11+	PCI Express differential receive pairs	I	
C89	PEG_RX11-	PCI Express differential receive pairs	I	
C90	GND(FIXED)	Ground	GND	
C91	PEG_RX12+	PCI Express differential receive pairs	I	
C92	PEG_RX12-	PCI Express differential receive pairs	I	
C93	GND	Ground	GND	
C94	PEG_RX13+	PCI Express differential receive pairs	I	
C95	PEG_RX13-	PCI Express differential receive pairs	I	
C96	GND	Ground	GND	
C97	GND	Ground	GND	Rev 3.1
C98	PEG_RX14+	PCI Express differential receive pairs	I	
C99	PEG_RX14-	PCI Express differential receive pairs	I	
C100	GND(FIXED)	Ground	GND	
C101	PEG_RX15+	PCI Express differential receive pairs	I	
C102	PEG_RX15-	PCI Express differential receive pairs	I	
C103	GND	Ground	GND	
C104	VCC_12V	Primary wide power input	PWR	
C105	VCC_12V	Primary wide power input	PWR	
C106	VCC_12V	Primary wide power input	PWR	
C107	VCC_12V	Primary wide power input	PWR	
C108	VCC_12V	Primary wide power input	PWR	
C109	VCC_12V	Primary wide power input	PWR	
C110	GND(FIXED)	Ground	GND	

COM Express™ Connector Pin Assignment (continued)

Pin	Pin-Signal	Description	Type	Remark
D1	GND(FIXED)	Ground	GND	
D2	GND	Ground	GND	
D3	USB_SSTX0-	SuperSpeed USB3.2 differential transmit pairs	O	
D4	USB_SSTX0+	SuperSpeed USB3.2 differential transmit pairs	O	
D5	GND	Ground	GND	
D6	USB_SSTX1-	SuperSpeed USB3.2 differential transmit pairs	O	
D7	USB_SSTX1+	SuperSpeed USB3.2 differential transmit pairs	O	
D8	GND	Ground	GND	
D9	USB_SSTX2-	SuperSpeed USB3.2 differential transmit pairs	O	
D10	USB_SSTX2+	SuperSpeed USB3.2 differential transmit pairs	O	
D11	GND(FIXED)	Ground	GND	
D12	USB_SSTX3-	SuperSpeed USB3.2 differential transmit pairs	O	
D13	USB_SSTX3+	SuperSpeed USB3.2 differential transmit pairs	O	
D14	GND	Ground	GND	
D15	DDI1_CTRLCLK_AUX+/USB4_1_AUX+	DDI1_CTRLCLK_AUX+ signal DP AUX, HDMI DVI CLK	IO	Rev 3.1
D16	DDI1_CTRLDATA_AUX-/USB4_1_AUX-	DDI1_CTRLDATA_AUX- signal DP AUX, HDMI DVI DATA	IO	Rev 3.1
D17	USB4_PD_I2C_ALERT#	Alert signal associated with the System Management link	I	NC / Rev 3.1 (opt.)
D18	PMCALERT#	Alert signal associated with the System Management link	I	NC / Rev 3.1 (opt.)
D19	PCIE_TX6+	PCI Express differential transmit pairs	O	
D20	PCIE_TX6-	PCI Express differential transmit pairs	O	
D21	GND(FIXED)	Ground	GND	
D22	PCIE_TX7+	PCI Express differential transmit pairs	O	
D23	PCIE_TX7-	PCI Express differential transmit pairs	O	
D24	GND	Ground or SER1_RTS# (output)	GND	SER1_RTS# / Rev 3.1
D25	GND	Ground or SER1_CTS# (input)	GND	SER1_CTS# / Rev 3.1
D26	DDI1_PAIR0+/USB4_1_SSTX0+	DDI1 DP / HDMI / DVI differential pairs 0	O	Rev 3.1
D27	DDI1_PAIR0-/USB4_1_SSTX0-	DDI1 DP / HDMI / DVI differential pairs 0	O	Rev 3.1
D28	GND	Ground	GND	Rev 3.1
D29	DDI1_PAIR1+/USB4_1_SSRX0+	DDI1 DP / HDMI / DVI differential pairs 1	O	Rev 3.1
D30	DDI1_PAIR1-/USB4_1_SSRX0-	DDI1 DP / HDMI / DVI differential pairs 1	O	Rev 3.1
D31	GND(FIXED)	Ground	GND	
D32	DDI1_PAIR2+/USB4_1_SSTX1+	DDI1 DP / HDMI / DVI differential pairs 2	O	Rev 3.1
D33	DDI1_PAIR2-/USB4_1_SSTX1-	DDI1 DP / HDMI / DVI differential pairs 2	O	Rev 3.1
D34	DDI1_DDC_AUX_SEL	Selects the function of DDI1_CTRLxAUX+/- Signals	I PD	
D35	USB4_2_LSRX	Sideband RX interface for USB4 Alternate modes	IO	NC / Rev 3.1 (opt.)
D36	DDI1_PAIR3+/USB4_1_SSRX1+	DDI1 DP / HDMI / DVI differential pairs 3	O	Rev 3.1
D37	DDI1_PAIR3-/USB4_1_SSRX1-	DDI1 DP / HDMI / DVI differential pairs 3	O	Rev 3.1
D38	GND	Ground	GND	Rev 3.1
D39	DDI2_PAIR0+/USB4_2_SSTX0+	DDI2 DP / HDMI / DVI differential pairs 0	O	Rev 3.1
D40	DDI2_PAIR0-/USB4_2_SSTX0-	DDI2 DP / HDMI / DVI differential pairs 0	O	Rev 3.1
D41	GND(FIXED)	Ground	GND	
D42	DDI2_PAIR1+/USB4_2_SSRX0+	DDI2 DP / HDMI / DVI differential pairs 1	O	Rev 3.1
D43	DDI2_PAIR1-/USB4_2_SSRX0-	DDI2 DP / HDMI / DVI differential pairs 1	O	Rev 3.1
D44	DDI2_HPD	DDI2 Detection of Hot Plug	I PD	
D45	GND	Ground	GND	Rev 3.1
D46	DDI2_PAIR2+/USB4_2_SSTX1+	DDI2 DP / HDMI / DVI differential pairs 2	O	Rev 3.1
D47	DDI2_PAIR2-/USB4_2_SSTX1-	DDI2 DP / HDMI / DVI differential pairs 2	O	Rev 3.1
D48	GND	Ground	GND	Rev 3.1
D49	DDI2_PAIR3+/USB4_2_SSRX1+	DDI2 DP / HDMI / DVI differential pairs 3	O	Rev 3.1
D50	DDI2_PAIR3-/USB4_2_SSRX1-	DDI2 DP / HDMI / DVI differential pairs 3	O	Rev 3.1
D51	GND(FIXED)	Ground	GND	
D52	PEG_TX0+	PCI Express differential transmit pairs	O	
D53	PEG_TX0-	PCI Express differential transmit pairs	O	
D54	PEG_LANE_RV#	PCI Express Graphics lane reversal input strap	I PU	
D55	PEG_TX1+	PCI Express differential transmit pairs	O	

COM Express™ Connector Pin Assignment (continued)

Pin	Pin-Signal	Description	Type	Remark
D56	PEG_TX1-	PCI Express differential transmit pairs	O	
D57	TYPE2#	Type 2 Module indication (GND)	O	
D58	PEG_TX2+	PCI Express differential transmit pairs	O	
D59	PEG_TX2-	PCI Express differential transmit pairs	O	
D60	GND(FIXED)	Ground	GND	
D61	PEG_TX3+	PCI Express differential transmit pairs	O	
D62	PEG_TX3-	PCI Express differential transmit pairs	O	
D63	GND	Ground	GND	Rev 3.1
D64	GND	Ground	GND	Rev 3.1
D65	PEG_TX4+	PCI Express differential transmit pairs	O	NC
D66	PEG_TX4-	PCI Express differential transmit pairs	O	NC
D67	GND	Ground	GND	
D68	PEG_TX5+	PCI Express differential transmit pairs	O	NC
D69	PEG_TX5-	PCI Express differential transmit pairs	O	NC
D70	GND(FIXED)	Ground	GND	
D71	PEG_TX6+	PCI Express differential transmit pairs	O	NC
D72	PEG_TX6-	PCI Express differential transmit pairs	O	NC
D73	GND	Ground	GND	
D74	PEG_TX7+	PCI Express differential transmit pairs	O	NC
D75	PEG_TX7-	PCI Express differential transmit pairs	O	NC
D76	GND	Ground	GND	
D77	GND	Ground	GND	Rev 3.1
D78	PEG_TX8+	PCI Express differential transmit pairs	O	
D79	PEG_TX8-	PCI Express differential transmit pairs	O	
D80	GND(FIXED)	Ground	GND	
D81	PEG_TX9+	PCI Express differential transmit pairs	O	
D82	PEG_TX9-	PCI Express differential transmit pairs	O	
D83	GND	Ground	GND	Rev 3.1
D84	GND	Ground	GND	
D85	PEG_TX10+	PCI Express differential transmit pairs	O	
D86	PEG_TX10-	PCI Express differential transmit pairs	O	
D87	GND	Ground	GND	
D88	PEG_TX11+	PCI Express differential transmit pairs	O	
D89	PEG_TX11-	PCI Express differential transmit pairs	O	
D90	GND(FIXED)	Ground	GND	
D91	PEG_TX12+	PCI Express differential transmit pairs	O	
D92	PEG_TX12-	PCI Express differential transmit pairs	O	
D93	GND	Ground	GND	
D94	PEG_TX13+	PCI Express differential transmit pairs	O	
D95	PEG_TX13-	PCI Express differential transmit pairs	O	
D96	GND	Ground	GND	
D97	GND	Ground	GND	Rev 3.1
D98	PEG_TX14+	PCI Express differential transmit pairs	O	
D99	PEG_TX14-	PCI Express differential transmit pairs	O	
D100	GND(FIXED)	Ground	GND	
D101	PEG_TX15+	PCI Express differential transmit pairs	O	
D102	PEG_TX15-	PCI Express differential transmit pairs	O	
D103	GND	Ground	GND	
D104	VCC_12V	Primary wide power input	PWR	
D105	VCC_12V	Primary wide power input	PWR	
D106	VCC_12V	Primary wide power input	PWR	
D107	VCC_12V	Primary wide power input	PWR	
D108	VCC_12V	Primary wide power input	PWR	
D109	VCC_12V	Primary wide power input	PWR	
D110	GND(FIXED)	Ground	GND	

4.   MECHANICS

4.1   Dimensions

The TQMx120 has a dimensions of 125 mm × 95 mm (±0.2 mm).
The following figure shows the TQMx120 three view drawing.
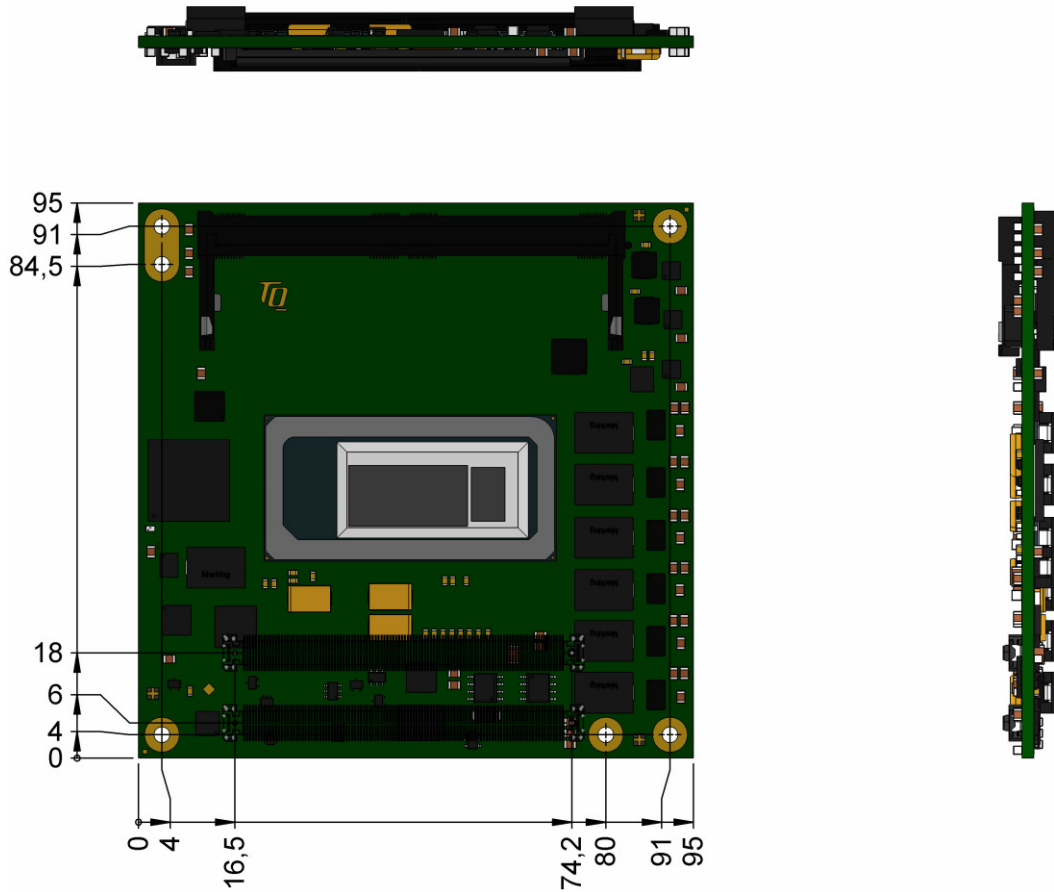
Figure 4: TQMx120 three view drawing

The following illustration shows the TQMx120 bottom view.
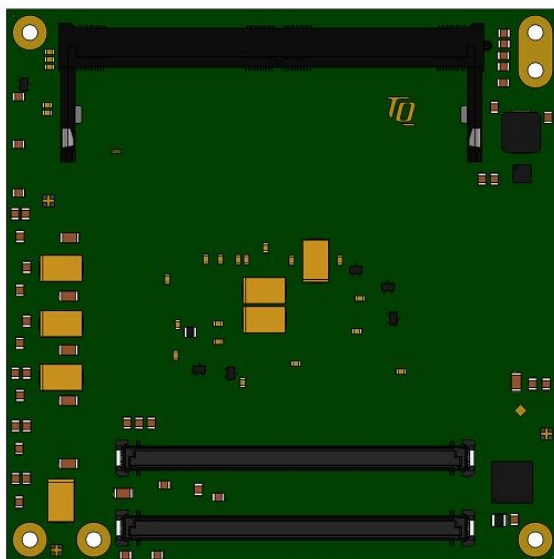
Figure 5: TQMx120 Bottom View Drawing

4.2 Component Placement and Labels

The following illustration shows the TQMx120 component placement.
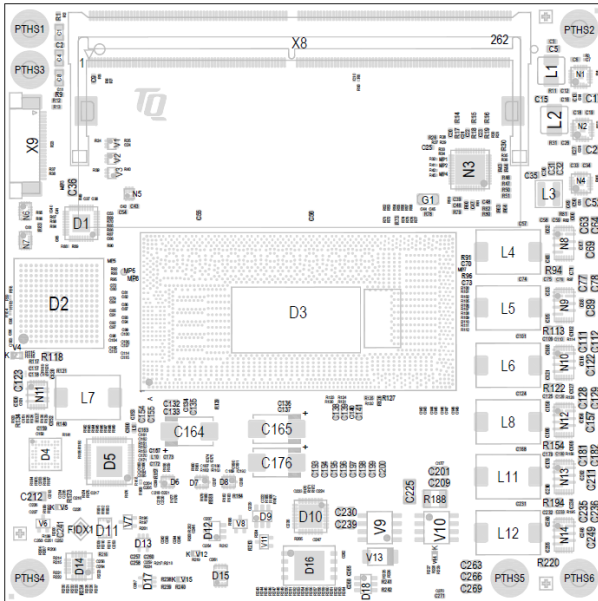
Figure 6: TQMx120 Component Placement Top
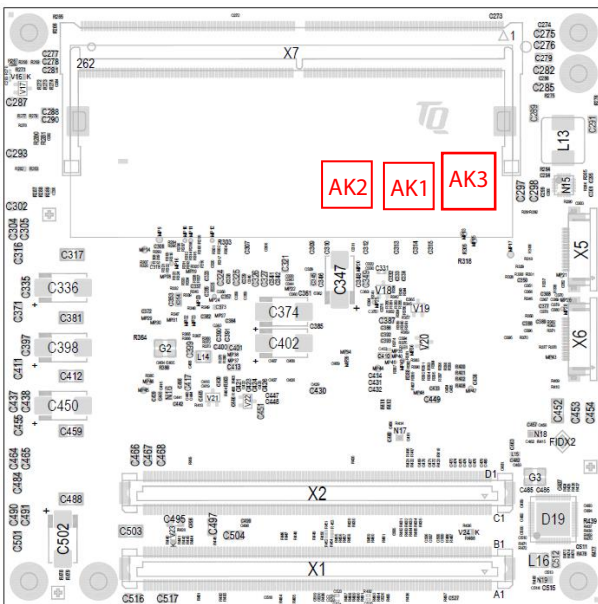
Figure 7: TQMx120 Component Placement Bottom

Table 18: Labels on TQMx120

Label	Content
AK1	MAC address, tests performed
AK2	TQMx120 version and revision
AK3	Bios label

4.3   Heat Spreader

A aluminium heat spreader with copper inlay "TQMx120-HSP" is available for the TQMx120.

The TQMx120 is available with or without mounted heat spreader.

The provided heat spreader complies with the latest COM Express™ specification (13 mm ±0.2 mm, including PCB).

The following illustration shows the heat spreader (TQMx120-HSP) for the TQMx120.

Figure 8: TQMx120-HSP Heat Spreader

The White Paper "Heat Spreader Mounting Instruction" provides information how to mount the heat spreader.

Please contact support@tq-group.com for more details about 2D/3D STEP models.

4.4   Mechanical and Thermal Considerations

The TQMx120 is designed to operate within a wide range of thermal environments.

An important factor for each system integration is the thermal design. The heat spreader provides the thermal coupling to the TQMx120. The heat spreader is thermally coupled to the processor and provides optimal heat transfer from the TQMx120 to the heat sink. The heat spreader itself is not an appropriate heat sink.

System designers can implement passive and active cooling systems using the thermal connection to the heat spreader.

Attention: Thermal Considerations
⚠️ Do not operate the TQMx120 without properly attached heat spreader and heat sink!

If a special cooling solution has to be implemented an extensive thermal design analysis and verification has to be performed.

TQ-Systems GmbH offers thermal analysis and simulation as a service.

4.5   Protection against External Effects

The TQMx120 itself is not protected against dust, external impact and contact (IP00).

Adequate protection has to be guaranteed by the surrounding system and carrier board.

Conformal coating can be offered for harsh environment applications.

5.   SOFTWARE

5.1   System Resources

5.1.1   I²C Bus Devices

The TQMx120 provides a general purpose I²C port via a dedicated LPC to I²C controller in the TQ-flexiCFG block.
The following table shows the I²C address mapping for the COM Express™ I²C port.

Table 19:   I²C Address Mapping COM Express™ I²C Port

8-bit Address	Function	Remark
0xA0	Module EEPROM	–
0xAE	Carrier board EEPROM	Embedded EEPROM configuration not supported

5.1.2   SMBus Devices

The TQMx120 provides a System Management Bus (SMBus).
The following table shows the I²C address mapping for the COM Express™ SMBus port.

Table 20:   I²C Address Mapping COM Express™ SMBus Port

8-bit Address	Function	Remark
0xA0, 0xA4	DDR5 SO-DIMM SPD EEPROMs	Only accessed by the BIOS
0x90, 0x94	DDR5 SO-DIMM PMIC Devices	Only accessed by the BIOS
0x58	Hardware Monitor	–

5.1.3   Memory Mapping

The TQMx120 supports the standard PC system memory and I/O memory map.

5.1.4   Interrupt Mapping

The TQMx120 supports the standard PC Interrupt routing.
The integrated legacy devices (COM1, COM2) can be configured via the BIOS to IRQ3 and IRQ4.

5.2   Operating Systems

5.2.1   Supported Operating Systems

The TQMx120 supports several Operating Systems:

- Microsoft® Windows® 10 (IoT) Enterprise (64-bit) LTSC 2021 or later
- Linux (i.e. Ubuntu 22.04, 23.04 or later)

Other Operating Systems are supported on request.
Please contact support@tq-group.com for further information about supported Operating Systems.

5.2.2   Driver Download

The TQMx120 is well supported by the Standard Operating Systems, which already include most of the drivers required.
It is recommended to use the latest Intel® drivers to optimize performance and make use of the full TQMx120 feature set.

The White Paper "Windows Driver Installation Instructions" provides information how to install the Windows driver.
Please contact support@tq-group.com for further driver download assistance.

5.3   TQ-Systems Embedded Application Programming Interface (EAPI)

The TQ-Systems Embedded Application Programming Interface (EAPI) is a driver package to access and control hardware resources on all TQ-Systems COM Express™ modules. The TQ-Systems EAPI is compatible with the PICMG® specification.

5.4   Software Tools

Please contact support@tq-group.com for further information about available software tools.

6. BIOS – MENU

The TQMx120 uses a 64-bit uEFI BIOS.

To access the InsydeH2O BIOS Front Page, the button <ESC> has to be pressed after System Power-Up during POST phase.

If the button is successfully pressed, you will get to the BIOS front page, which shows the main menu items.

For Help Dialog please press <F1>.

```
                                    Front Page
 Front Page
  Continue                                        This selection will direct the system to
  ▶Boot Manager                                   continue to booting process
  ▶Device Manager
  ▶Boot From File
  ▶Administer Secure Boot
  ▶Setup Utility

 F1  Help                         Enter Select ▶ SubMenu
 ↑/↓ Select Item
```
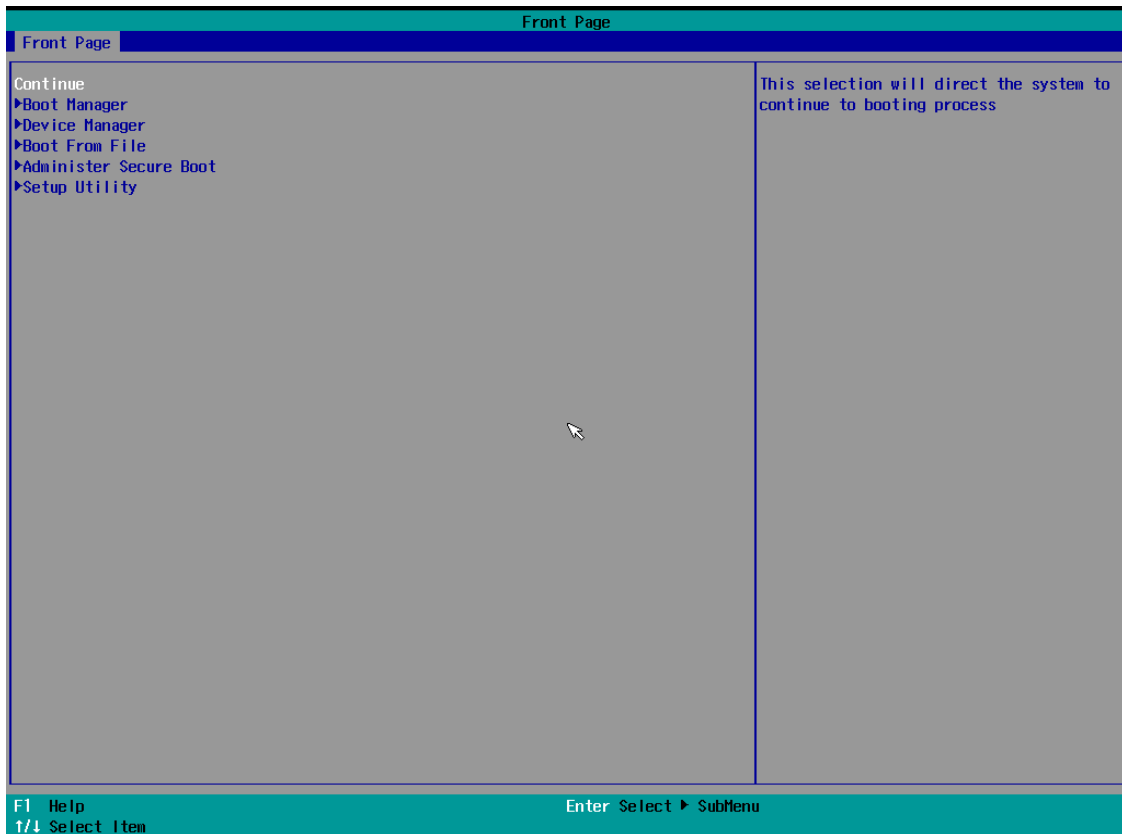
Figure 9: InsydeH2O BIOS Front Page

6.1 Continue

Continue boot process the same way if <ESC> was not pressed.

6.2 Boot Manager

Choose between possible boot options. One boot option will always be "Internal EFI Shell".

You can go back to "Boot Manager" by entering command "exit" and press <ENTER>.

6.3   Device Manager

6.3.1   Driver Health Manager

List all the driver health instances to manage.

6.3.2   Network Device List

Select the network device according the MAC address.

6.4   Boot from File

Boot from a specific mass storage device where a boot file is stored.

6.5   Administer Secure Boot

Enable and configure Secure Boot mode. This option can be also used to integrate PK, KEK, DB and DBx.

Note: Secure Boot	
⚠	This option should only be used by advanced users.

6.6 Setup Utility

A basic setup of the board can be done by Insyde Software Corp. "Insyde Setup Utility" stored inside an on-board SPI flash.
To get access to InsydeH2O Setup Utility the button <ESC> has to be pressed after System Power Up during POST phase.
After that, the sentence "ESC is pressed. Go to boot options" is displayed below the boot logo. Select "Setup Utility" on the splash screen that appears. The left frame of each menu page shows the option that can be configured, while the right frame shows the corresponding help.

Key:

↑ / ↓	Navigate between setup items.
← / →	Navigate between setup screens (Main, Advanced, Security, Power, Boot and Exit).
<F1>	Show general help screen (Key Legend).
<F5> / <F6>	In the main screen this buttons allow to change between different languages. Otherwise it allows to change the value of highlighted menu item.
<ENTER>	Press to display or change setup option listed for a certain menu or to display setup sub-screens.
<F9>	Press to load the setup default configuration of the board which cannot be changed by the user. This option has to be confirmed and saved by <F10> afterwards. Leaving the InsydeH2O Setup Utility will discard the changes.
<F10>	Press to save any changes made and exit setup utility by executing a restart.
<ESC>	Press to leave the current screen or sub-screen and discard all changes.

6.6.1 Main

The Main screen shows details regarding the BIOS version, processor type, bus speed, memory configuration and further information. There are three options which can be configured.

Menu Item	Option	Description
Language	English / French / Korean / Chinese	Configures the language of the InsydeH2O Setup Utility
System Time	HH:MM:SS	Use to change the system time to the 24-hour format
System Date	MM:DD:YYYY	Use to change the system date

7.   BIOS – UPDATE

The uEFI BIOS update instruction serves to guarantee a proper way to update the uEFI BIOS on the TQMx120.

Please read the entire instructions before beginning the BIOS update.

By disregarding the information you can destroy the uEFI BIOS on the TQMx120!

This document will guide the customer to update the uEFI BIOS on the TQMx120 by using the Insyde Flash Firmware Tools.

The InsydeH2O Tools are only available on request.

Please contact support@tq-group.com for more information about the BIOS Tools and the latest uEFI BIOS version for the TQMx120.

Note: Installation procedures and screen shots	
⚠	Installation procedures and screen shots in this section are for your reference and may not be exactly the same as shown on your screen.

7.1.1   Step 1: Preparing USB Stick

A USB stick with FAT32 format can be used. Copy the following files to the USB stick.
(See: https://www.tq-group.com/de/support/downloads/tq-embedded/software-treiber/x86-architektur/)
- H2OFFT-Sx64.efi (Flash Firmware Tool from Insyde for update via UEFI Shell)
  - Be sure to have H2OFFT Version 200.02.00.06 or later
- InsydeH2OFF_x86_WINx64 folder (Flash Firmware Tool from Insyde for update via Windows 64-bit system)
- BIOS.bin file e.g. xx.bin

7.1.2   Step 2: Preparing Management Engine (ME) FW for update

Enter the BIOS menu by pressing <ESC> while booting (POST phase) and change to the following page:

Setup Utility ⇨ Advanced ⇨ PCH-FW Configuration ⇨ Firmware Update Configuration

Then, set option "Me FW Image Re-Flash" to "enabled", save and exit by pressing <F10> and <Enter>.

Note: Option availability	
⚠	This option will only be valid for the next boot.

```
                              InsydeH20 Setup Utility                              Rev. 5.0
   Main  Advanced  Security  Power  Boot  Exit

                                                          Configure Management Engine Technology
    ▶Boot Configuration                                   Parameters
    ▶USB Configuration
    ▶Chipset Configuration
    ▶ACPI Table/Features Control
    ▶CPU Configuration
    ▶Power & Performance
    ▶Memory Configuration
    ▶System Agent (SA) Configuration
    ▶PCH-IO Configuration
    ▶PCH-FW Configuration
    ▶ACPI D3Cold settings
    ▶SIO TQMx86
    ▶SIO Hardware Monitor Nuvoton NCT7802Y
    ▶Console Redirection
    ▶SIO F81214E
```

Figure 10:   PCH-FW Configuration menu

```
                              InsydeH20 Setup Utility                              Rev. 5.0
      Advanced

    ME Firmware Version          16.1.25.2020              Configure Management Engine Technology
    ME Firmware Mode             Normal Mode               Parameters
    ME Firmware SKU              Consumer SKU
    ME Firmware Status 1         0x90000255
    ME Firmware Status 2         0x30850106
    ME Firmware Status 3         0x00000020
    ME Firmware Status 4         0x00004000
    ME Firmware Status 5         0x00000000
    ME Firmware Status 6         0x00000002

    ME State                     <Enabled>
    ME Unconfig on RTC Clear     <Enabled>

    ▶Firmware Update Configuration
    Extend CSME Measurement to TPM-PCR   <Disabled>
```

Figure 11:   Firmware Update Configuration menu

```
                              InsydeH20 Setup Utility                              Rev. 5.0
      Advanced

    Me FW Image Re-Flash         <Enabled>                 Enable/Disable Me FW Image Re-Flash
    FW Update                    <Enabled>                 function.
```
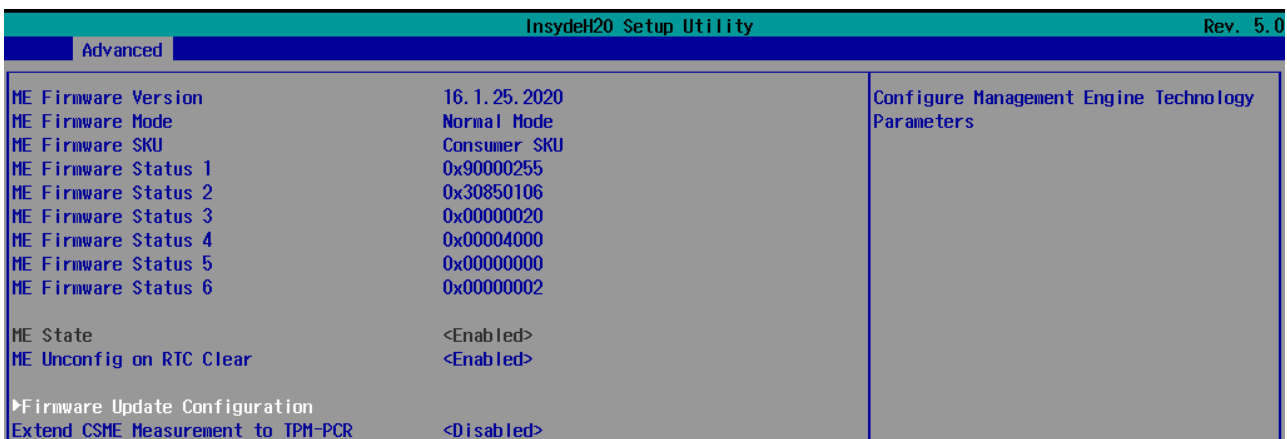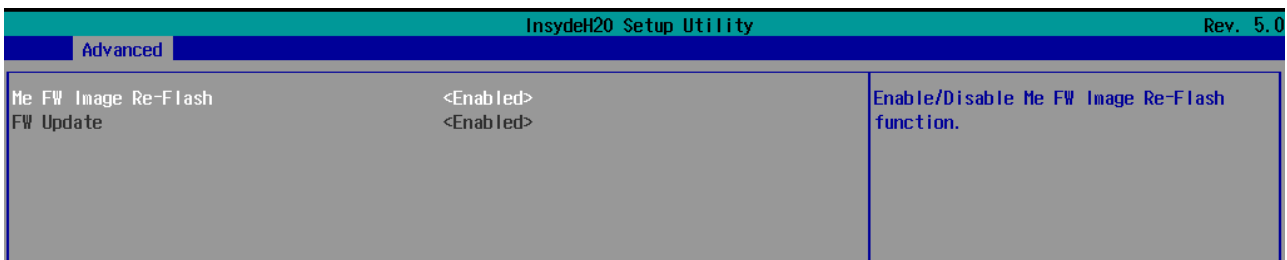
Figure 12:   ME FW Image Re-Flash option

7.1.3 Step 3a: Updating uEFI BIOS via EFI Shell

Insert the USB stick into the board on which you want to update the uEFI BIOS and switch on the board. The board will boot and go to the internal EFI shell. Note: If a boot device is plugged change to "Boot Manager" over Front Page and select "Internal EFI Shell".

```
UEFI Interactive Shell v2.2
EDK II
UEFI v2.80 (INSYDE Corp., 0x71234050)
Mapping table
     FS0: Alias(s):HD0c0b:;BLK1:
          PciRoot(0x0)/Pci(0x14,0x0)/USB(0x2,0x0)/HD(1,MBR,0x304F1DE1,0x80,0x7A6800)
     BLK0: Alias(s):
          PciRoot(0x0)/Pci(0x14,0x0)/USB(0x2,0x0)
Press ESC in 1 seconds to skip startup.nsh or any other key to continue.
Shell>
```

Figure 13:   EFI Shell

Please see device mapping table on the screen and select the removable hard disk file system "fsX" (X = 0, 1, 2, …).
Move operating directory to USB drive with e.g. "`fs0:`"
Then, enter into the BIOS folder (e.g. "`cd tqmx120uc`") to execute the Insyde BIOS update tool:

`H2OFFT-Sx64.efi <BIOS file> -ALL -RA`

If the argument "`-RA`" is set the SMBIOS data will not be overwritten and the UUID included in SMBIOS data will be preserved. However, this argument is not mandatory.

```
Shell> fs0:
FS0:\> cd TQMx120UC
FS0:\TQMx120UC\> H2OFFT-Sx64.efi TQMx120UC_5.44.23.50.02.bin -all -ra
```

Figure 14:   EFI Shell uEFI BIOS Update

```
Please do not remove the power!


     Insyde H2OFFT (Flash Firmware Tool) Version (SEG) 200.02.00.06
     Copyright (C) 2022 Insyde Software Corp. All Rights Reserved.


          Loading New BIOS Image File: ...Done

     Current BIOS Model Name: TQMx120UC
     New     BIOS Model Name: TQMx120UC
     Current BIOS Version: TQMx120UC.5.44.23.50.02
     New     BIOS Version: TQMx120UC.5.44.23.50.02
          Save SMBIOS Structures


          Updating Block at FE4F6000h
     0%      25%      50%      75%      100%
     [████                                  ]   14%
```
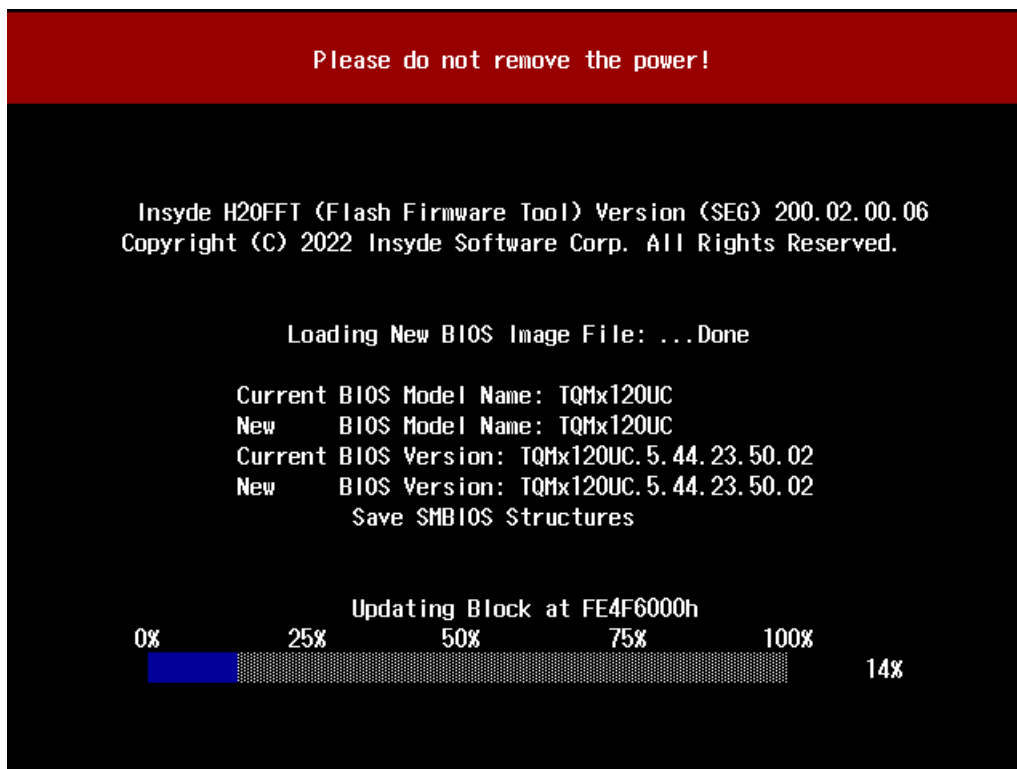
Figure 15:   Screen during BIOS Update

7.1.4 Step 3b: Updating uEFI BIOS via Windows Operating System

Boot the Windows operating system (64-bit) and insert the USB stick into the board on which you want to update the uEFI BIOS. Start the Command Prompt (CMD). It is important to note that the Command Prompt must be started in the administrator mode!

Select the BIOS update folder with the Insyde Windows 64-bit update tool and execute the Insyde BIOS update tool.

```
H2OFFT-Wx64.exe <BIOS file>.bin –all –ra
```

For the <BIOS file> argument, please specify the .bin file with the full path (e. g.: D:\TQMxXXXX_X.xx.xx.xx.xx.bin).

If the argument "–RA" is set the SMBIOS data will not be overwritten and the UUID included in SMBIOS data will be preserved. However, this argument is not mandatory.

Start the BIOS update with the Insyde Windows 64-bit update tool.

7.1.5 Step 4: BIOS update check on the TQMx120 Module

After the uEFI BIOS update, the new uEFI BIOS configures the complete TQMx120 hardware and this results in some reboots and the first boot time takes longer (up to 1-2 minutes).
The TQMx120 includes a dual colour Debug LED providing boot and uEFI BIOS information.
If the green LED is blinking the uEFI BIOS is booting. If the green LED is lit permanently the uEFI BIOS boot is finished.

Figure 16:   TQMx120 Debug LED

After the uEFI BIOS has been flashed completely, please check whether the uEFI BIOS has been flashed successfully. The BIOS Main menu includes the board and hardware information and it shows the installed BIOS version.
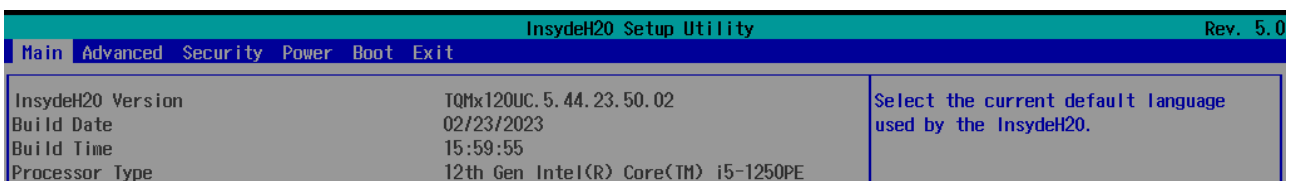

Figure 17:   EFI BIOS Main Menu

8.   SAFETY REQUIREMENTS AND PROTECTIVE REGULATIONS

8.1   EMC

The TQMx120 was developed according to electromagnetic compatibility requirements (EMC). Depending on the target system, anti-interference measures may still be necessary to guarantee the adherence to the limits for the overall system.

8.2   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. As these measures always have to be implemented on the carrier board, no special preventive measures were done on the TQMx120.

8.3   Shock & Vibration

The TQMx120 is designed to be insensitive to shock and vibration and impact.

8.4   Operational Safety and Personal Security

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

8.5   Reliability and Service Life

The MTBF according to MIL-HDBK-217F N2 is approximately 362546 h, Ground Benign, @ +40 °C.

8.5.1   RoHS

The TQMx120 is manufactured RoHS compliant.
- All components and assemblies are RoHS compliant
- The soldering processes are RoHS compliant

8.5.2   WEEE®

The company placing the product on the market is responsible for the observance of the WEEE® regulation.
To be able to reuse the product, it is produced in such a way (a modular construction) that it can be easily repaired and disassembled.

8.6   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.

8.7   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 TQMx120 must therefore always be seen in conjunction with the complete device. The available standby and sleep modes of the components on the TQMx120 enable compliance with EuP requirements for the TQMx120.

8.8   Battery

No batteries are assembled on the TQMx120.

8.9   Packaging

By environmentally friendly processes, production equipment and products, we contribute to the protection of our environment. To be able to reuse the TQMx120, 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 TQMx120 is delivered in reusable packaging.

8.10   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.

9. APPENDIX

9.1 Acronyms and Definitions

The following acronyms and abbreviations are used in this document.

Table 21: Acronyms

Acronym	Meaning
AHCI	Advanced Host Controller Interface
AMI	American Megatrends, Inc.
ATA	Advanced Technology Attachment
AVC	Advanced Video Coding
BIOS	Basic Input/Output System
CAN	Controller Area Network
CMOS	Complementary Metal Oxide Semiconductor
CODEC	Code/Decode
COM	Computer-On-Module
CPU	Central Processing Unit
CSM	Compatibility Support Module
cTDP	Configurable Thermal Design Power
DC	Direct Current
DDC	Display Data Channel
DDI	Digital Display Interface
DDR	Double Data Rate
DMA	Direct Memory Access
DP	DisplayPort
DVI	Digital Visual Interface
DXVA	DirectX Video Acceleration
EAPI	Embedded Application Programming Interface
ECC	Error-Correcting Code
EDID	Extended Display Identification Data
eDP	embedded DisplayPort
eDRAM	Embedded DRAM
EEPROM	Electrically Erasable Programmable Read-Only Memory
EFI	Extensible Firmware Interface
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
FAE	Field Application Engineer
FIFO	First In First Out
flexiCFG	Flexible Configuration
FPGA	Field Programmable Gate-Array
FR-4	Flame Retardant 4
GPIO	General Purpose Input/Output
HD	High Definition
HDA	High Definition Audio
HDMI	High Definition Multimedia Interface
HEVC	High Efficiency Video Coding
HSP	Heat Spreader
HT	Hyper-Threading
I	Input
I PD	Input with internal Pull-Down resistor
I PU	Input with internal Pull-Up resistor
I/O	Input/Output
I^2C	Inter-Integrated Circuit
IDE	Integrated Drive Electronics
IEC	International Electrotechnical Commission
IoT	Internet of Things
IP00	Ingress Protection 00
IRQ	Interrupt Request
JEIDA	Japanese Electronics Industry Development Association
JPEG	Joint Photographic Experts Group
JTAG®	Joint Test Action Group
LED	Light Emitting Diode
LPC	Low Pin Count
LVDS	Low Voltage Differential Signal

9.1   Acronyms and Definitions (continued)

Table 21:   Acronyms (continued)

Acronym	Meaning
ME	Management Engine
MMC	Multimedia Card
MPEG	Moving Picture Experts Group
MST	Multi-Stream Transport
MT/s	Mega Transfers per second
MTBF	Mean operating Time Between Failures
N/A	Not Available
NC	Not Connected
O	Output
OD	Open Drain
OpROM	Option ROM
OS	Operating System
PC	Personal Computer
PCB	Printed Circuit Board
PCH	Platform Controller Hub
PCI	Peripheral Component Interconnect
PCIe	Peripheral Component Interconnect express
PCMCIA	People Can't Memorize Computer Industry Acronyms
PD	Pull-Down
PEG	PCI-Express for Graphics
PICMG®	PCI Industrial Computer Manufacturers Group
POST	Power-On Self-Test
PU	Pull-Up
PWM	Pulse-Width Modulation
RAID	Redundant Array of Independent/Inexpensive Disks/Drives
RAM	Random Access Memory
RMA	Return Merchandise Authorization
RoHS	Restriction of (the use of certain) Hazardous Substances
RSVD	Reserved
RTC	Real-Time Clock
SATA	Serial ATA
SCU	System Control Unit
SD	Secure Digital
SD/MMC	Secure Digital Multimedia Card
SDIO	Secure Digital Input/Output
SDRAM	Synchronous Dynamic Random Access Memory
SIMD	Single Instruction, Multiple Data
SMART	Self-Monitoring, Analysis and Reporting Technology
SMBus	System Management Bus
SO-DIMM	Small Outline Dual In-Line Memory Module
SPD	Serial Presence Detect
SPI	Serial Peripheral Interface
SPKR	Speaker
SSD	Solid-State Drive
STEP	Standard for Exchange of Products
TDM	Time-Division Multiplexing
TDP	Thermal Design Power
TPM	Trusted Platform Module
UART	Universal Asynchronous Receiver/Transmitter
uEFI	Unified Extensible Firmware Interface
USB	Universal Serial Bus
VC-1	Video Coding (format) 1
VESA	Video Electronics Standards Association
VGA	Video Graphics Array
VP8	Video Progressive (compression format) 8
WDT	Watchdog Timer
WEEE®	Waste Electrical and Electronic Equipment
WES	Windows® Embedded Standard
XPDM	Windows XP Display Driver Model

9.2   References

Table 22:   Further Applicable Documents and Links

No.	Name	Rev., Date	Company
(1)	12th Generation Intel® Core™ series Product Brief	–	Intel
(2)	PICMG® COM Express™ Module Base Specification	Rev. 3.1, Oct 12, 2022	PICMG
(3)	PICMG® COM Express™ Carrier Design Guide	Rev. 2.0, Dec. 6, 2013	PICMG
(4)	PICMG® COM Express™ Embedded Application Programming Interface	Rev. 1.0, Aug. 8, 2010	PICMG

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