



TQMxE40C2 User's Manual

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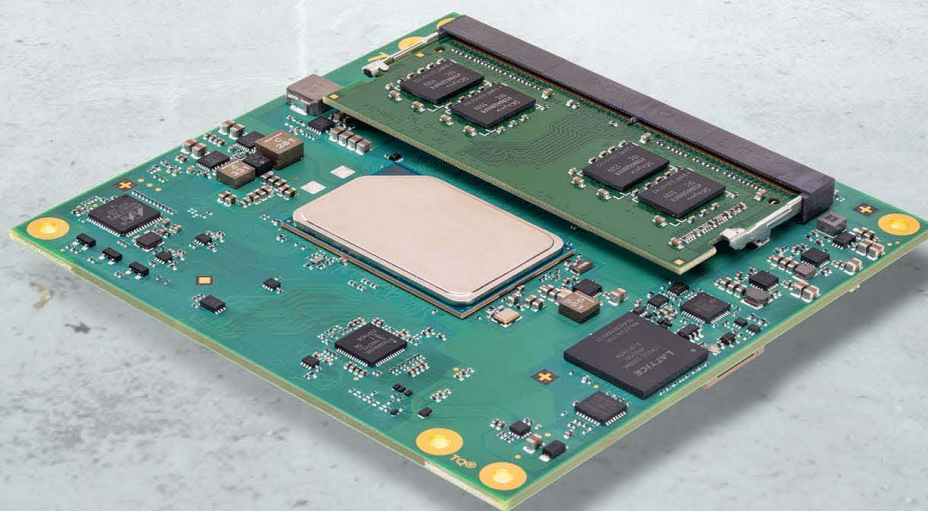




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1.7 Tips on Safety

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

1.8 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.

1.9 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 TQMxE40C2 and be dangerous to your health. Improper handling of your TQ-product would render the guarantee invalid.
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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.
---	--

1.10 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#

1.11 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 (2), 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 (1), (3).



2. INTRODUCTION

The TQ module TQMxE40C2 is based on the latest generation of Intel® Atom®, Pentium® and Celeron® CPUs (code name “Elkhart Lake”). It achieves a new level of computing performance, security and media processing performance in a very compact form factor to empower real-time computing, industrial automation, digital surveillance, aviation, medical, retail and more.

The TQMxE40C2 corresponds to the internationally established PICMG® standard COM Express™ Compact (COM.0 R3.0) with Type 6 pinout. 10 USB ports – including 2 USB 3.0 – and up to 8 PCIe lanes natively supported by the CPUs enable high bandwidth communication with peripherals and additional interfaces on the carrier board. With the latest Intel® graphics processor integrated, the TQMxE40C2 delivers 4K high resolution graphics output, immersive 3D processing and also greatly increased video encode and playback performance.

Time coordinated computing capabilities enable time synchronized processes within IoT networks and industrial control applications. On-board eMMC and the option for LVDS or native eDP enable flexibility and reduce overall BOM cost.

The integrated TQMx86 board controller enables high flexibility through “flexiCFG” and supports thermal management, watchdog, 16550 compatible UARTs, I²C controllers, GPIO handling and “Green ECO-Off” with a minimum of standby power. Combined with options like conformal coating and optimized cooling solutions the TQMxE40C2 also fits perfectly for mobile, low power, ruggedized and battery driven applications in multiple vertical markets like industrial automation, medical devices, transportation and others.



2.1 Overview

The following key functions are implemented on the TQMxE40C2:

Processor:

- Intel® Atom® X6000E Series: „Elkhart Lake“ with different SKUs
- optimized for Embedded, Industrial Functional Safety or PC Client applications

Memory:

- DDR4: 4 Gbyte, 8 Gbyte, 16 Gbyte
- eMMC 5.0 on-board-flash
- EEPROM: 32 kbit (24AA32AT)

Graphics:

- 2 × Digital Display Interface (DDI) (DP 1.2/1.3/1.4, HDMI 1.4b/2.0b)
- 1 × Embedded Digital Display Interface (eDDI) or dual LVDS interface (eDP 1.3 or dual LVDS)

Peripheral interfaces:

- 1 × Gigabit Ethernet (Marvell 88E1512)
- 2 × USB 3.1 Gen 2 (up to 10 Gb/s) with USB 3.0 and 2.0 backward compatibility
- 8 × USB 2.0
- 2 × SATA Gen 3 (up to 6 Gb/s)
- 8 × PCIe Gen 3 (up to 8 Gb/s) – 7 (×1), 4 (×2), or 1 (×4)
- 1 × PCIe Gen 3 PEG port (up to 8 Gb/s) – Lane 0, 1, 2, 8 and 9 (optionally multiplexed with PCIe)
- 1 × LPC or eSPI Interface
- 1 × Intel® HD audio (HDA)
- 1 × I²C, (optional 3 × I²C) (master/slave capable)
- 1 × SMBus
- 1 × SPI (for external uEFI BIOS flash)
- 2 × Serial port (Rx/Tx, legacy compatible), 4-wire (Rx/Tx/RTS/CTS) optionally through TQ-flexiCFG
- 1 × CAN interface (multiplexed with serial port 1)
- 1 × SD card interface / optional 8 × GPIO through TQ-flexiCFG (multiplexed, configurable in BIOS menu)

Security components:

- TPM (SLB9670 TPM 2.0 controller)

Others:

- TQMx86 board controller with Watchdog and TQ-flexiCFG

Power supply voltage:

- 4.75 V to 20 V
- 5 V Standby (optional)
- 3 V Battery for RTC

Environment:

- Standard temperature: 0 °C to +60 °C
- Extended 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 mm²



2.2 COM Express™ Specification Compliance

The TQMxE40C2 is compliant to the PICMG® COM Express™ Module Base Specification (COM.0 R3.0) Compact, Type 6, with dimensions of 84 mm × 55 mm.

2.3 Versions

The TQMxE40C2 is available in several standard configurations.

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

Other configurations are available on request.

Standard configuration features are:

- eDP or dual LVDS
- CPU version
- Memory configuration
- TPM
- Temperature range

Optional hardware and software configuration features:

- Conformal coating can be offered as custom specific add-on
- Custom specific GPIO configuration through TQ-flexiCFG
- Custom specific BIOS configuration

2.4 Accessories

- **TQMxE40C2-HSP**

Heat spreader for TQMxE40C2, according to COM Express™ specification.

- **Evaluation platform MB-COME6-3**

Mainboard for COM Express™ Compact, Type 6, 170 × 170 mm², with the following interfaces:

MB-COME6-3: 3 × DP, 1x LVDS, 1x eDP, 2 × Gbit Ethernet, 4 × USB 3.1 USB-A, 2 × COM, 1 × Audio, 2 × SATA, 1 × M.2 for I/O, 1x M.2 for SSD, 1x Mini PCIe, 1 x HDD / SSD Socket, PCIe PEG port, Fan, Debug

- **Debug module**

POST debug card for TQMxE40C2, see chapter 3.6.3.

3. FUNCTION

3.1 Block Diagram

The following illustration shows the TQMxE40C2 block diagram.

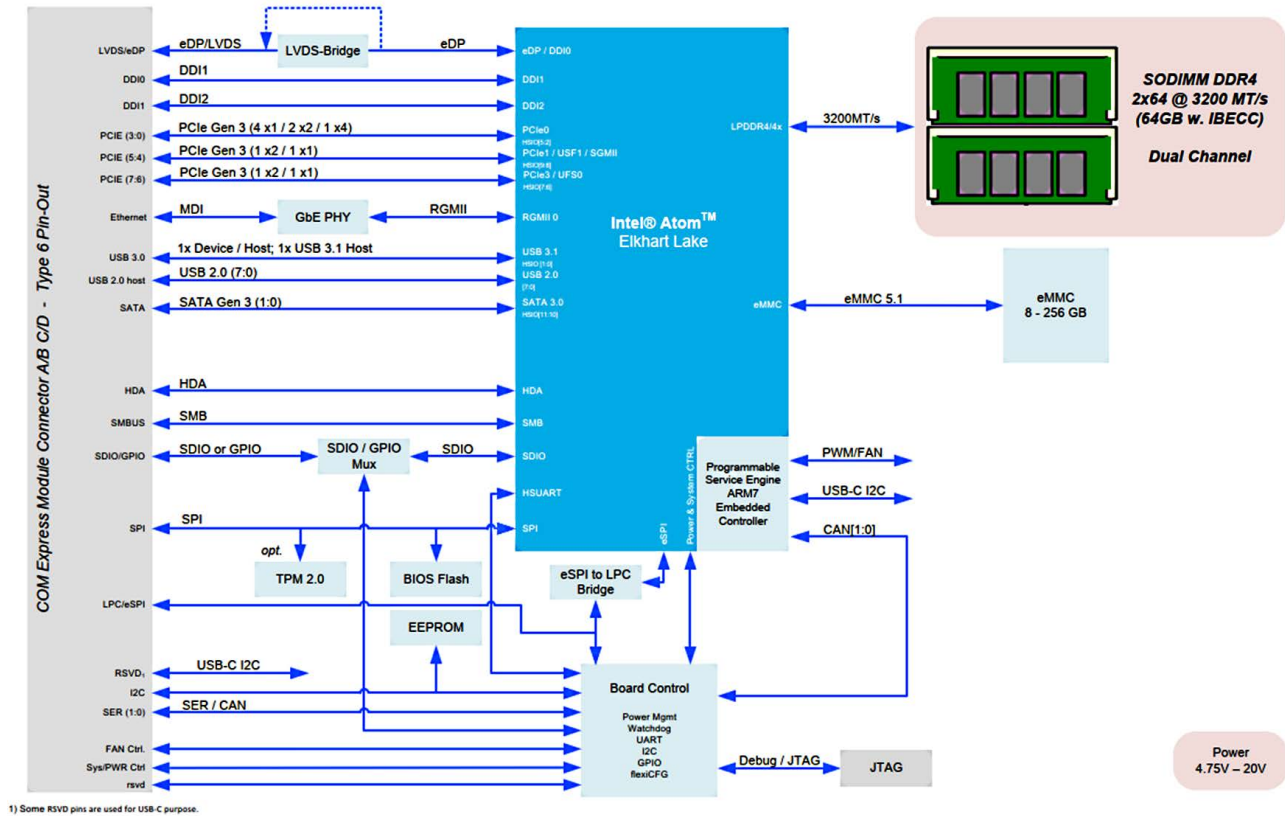


Illustration 1: TQMxE40C2 Block Diagram

3.2 Electrical Characteristics

3.2.1 Supply Voltage

The TQMxE40C2 supports a wide-range voltage input from 4.75 V to 20.0 V DC.

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

- Wide input: 4.75 V to 20.0 V max input ripple: ±100 mV
- VCC_5V_SBY: 4.75 V to 5.25 V max input ripple: ±50 mV
- VCC_RTC: 2.0 V to 3.3 V max input ripple: ±20 mV

The input voltages shall rise from 10 % to 90 % of nominal within 0.1 ms to 20 ms ($0.1 \text{ ms} \leq \text{Rise Time} \leq 20 \text{ ms}$).

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 values given below show the voltage and power consumption of the TQMxE40C2.

The values were measured using the TQMxE40C2 and the MB-COME6-3 COM Express™ carrier board.

The measurement was done with two power supplies, one for the TQMxE40C2 and the other one for the MB-COME6-3 COM Express™ carrier board.

The power consumption of each TQMxE40C2 was measured running Windows® 10, 64-bit and different dual channel DDR4 configurations. All measurements were done at a temperature of +25 °C and an input voltage of +12 V.

The power consumption of the TQMxE40C2 depends on the application, the mode of operation and the operating system.

The power consumption was measured under the following test modes:

- **Green ECO-Off state:**
The system is in Green ECO-Off state, all DC/DC power supplies on the TQMxE40C2 are switched off.
- **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 load:**
These values show the maximum worst case power consumption, , achieved by using the Intel® stress test tool to apply maximum load to the cores only, and cores plus graphics engine, Ethernet port is connected (1000 Mbps Speed)
- **Windows 10, 64 bit, Suspend Mode:**
The system is in S5/S4 state, Ethernet port is disconnected.

The following table shows the TQMxE40C2 power consumption with different CPUs.

Table 2: TQMxE40C2 Power Consumption

CPU on TQMxE40C2	Mode			
	Standby 5 V		Input 5.0 V	
	Green ECO-Off state	Suspend	Win10, 64 bit idle	Win10, 64 bit max. load
SKU6 Atom® x6413E	7.0 mW	1.04 W	5.6 W	12.4 W
SKU7 Atom® x6425E	7.0 mW	1.04 W	5.9 W	15.7 W
SKU8 Atom® x6212RE	7.0 mW	1.04 W	5.0 W	9.3 W
SKU9 Atom® x6425RE	7.0 mW	1.04 W	5.5 W	12.0 W
SKU10 Atom® x6425RE	7.0 mW	1.04 W	5.9 W	15.5 W

Note: Power requirement



The power supplies on the carrier board for the TQMxE40C2 have to be designed with enough reserve. The carrier board should be able to provide at least twice the maximum TQMxE40C2 workload power. The TQMxE40C2 supports several low-power states. The carrier board power supply has to be stable, even with no load.

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 3: RTC Current Consumption

Mode	Voltage	Current
Intel® X6000E Series "Elkhart Lake"	3.0 V	3 µA

The current consumption of the RTC in the Intel® X6000E Series "Elkhart Lake" is specified in the Product Family Datasheet (EDS) with quite high maximum current, but the values measured on several modules were lower than 3µA.

3.3 Environmental Conditions

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

Attention: Maximum operating temperature



Do not operate the TQMxE40C2 without properly attached heat spreader or without heat sink.
The heat spreader is not a sufficient heat sink.

3.4 System Components

3.4.1 Processor

The TQMxE40C2 supports the Intel® X6000E Series.

The following list illustrates some key features of these CPUs:

- Quad and dual CPU cores with up to 3GHz
- Intel® 64 Architecture
- Intel® Virtualization Technology (VT-x)
- In-Band ECC support
- Intel® Streaming SIMD Extensions 4.2 (Intel® SSE4.2)
- Intel® Enhanced Intel® SpeedStep® technology
- Intel® UHD Graphics
- High-bandwidth Digital Content Protection (HDCP) 2.3
- Triple independent displays

Table 4: Intel® X6000E Series: Comparison of the SKUs

Mode	Atom® x6211E	Atom® x6413E	Atom® x6425E	Atom® x6212RE	Atom® x6414RE	Atom® x6425RE	Atom® x6200FE	Atom® x6427FE
Use Condition	Embedded	Embedded	Embedded	Industrial	Industrial	Industrial	Industrial (FuSA)	Industrial (FuSA)
CPU Cores	2	4	4	2	4	4	2	4
CPU frequency	1.3 GHz	1.5 GHz	2 GHz	1.2 GHz	1.5 GHz	1.9 GHz	1.0 GHz	1.9 GHz
Burst frequency	3 GHz	3 GHz	3 GHz	--	--	--	--	--
UHD Graphics (Execution Units)	16 EUs	16 EUs	32 EUs	16 EUs	16 EUs	32 EUs	None	32 EUs
Temperature T _{junction}	-40 °C to +105 °C	-40 °C to +105 °C	-40 °C to +105 °C	-40 °C to +110 °C	-40 °C to +110 °C	-40 °C to +110 °C	-40 °C to +110 °C	-40 °C to +110 °C
Memory Speed	3200 MT/s	3200 MT/s	3733 MT/s	3200 MT/s	3200 MT/s	4267 MT/s	2400 MT/s	4267 MT/s
Functional Safety	No	No	No	No	No	No	Yes	Yes
Thermal Design Power (TDP)	6 W	9 W	12 W	6 W	9 W	12 W	4.5 W	12 W

3.4.2 Graphics

The Intel® X6000E Series CPUs includes an integrated Intel® UHD (Gen 11) graphics accelerator. It provides excellent 2D/3D graphics performance with triple simultaneous display support.

The following list shows some key features of

- Graphics Technology (Gen 11-LP) with up to 32 Execution Units
- Hardware accelerated video decoding/encoding for H.264, MPEG2, VC-1, H.265/HEVC, VP9, VP8, JPEG/MJPEG
- DirectX 12 support
- OpenGL 4.5, OpenCL 1.2 support

The TQMxE40C2 supports two external Digital Display Interfaces (DDI1 and DDI2) and one internal display, either eDP or dual channel LVDS interface at the COM Express™ connector, depending on module and carrier configuration.

Table 5: Maximum Resolution Display Configuration

Display	Maximum Display Resolution
LVDS	1920 × 1200 at 60 Hz (dual channel)
eDP 1.3	4096 × 2160 at 60 Hz
DP 1.4a	4096 × 2160 at 60 Hz
HDMI 2.0b	4096 × 2160 at 60 Hz

3.4.3 Memory

3.4.3.1 DDR4 SDRAM

The TQMxE40C2 supports a dual-channel DDR4 memory, running at up to 3200 MT/s and optional In Band ECC (IB ECC). The maximum memory size is 32 Gbyte. The available memory configuration can be either 4 Gbyte, 8 Gbyte or 16Gbyte

Note: DDR4 SO-DIMM modules



Only DDR4 SO-DIMM modules qualified by TQ-Systems are authorized for use with the TQMxE40C2. DDR4 SO-DIMM modules not released by TQ-Systems may cause functional issues.

On customer request a soldered memory configurations can be made available.

Please contact support@tq-group.com for further information about the soldered memory configurations.

3.4.3.2 eMMC

The TQMxE40C2 supports up to 512 Gbyte on-board eMMC 5.1 flash. The eMMC interface is not activated in BIOS default settings.

Attention: eMMC OS installation



The on-board eMMC Flash requires pre-configuration via EFI Shell before OS installation (e.g. diskpart utility)

3.4.3.3 SPI Boot Flash

The TQMxE40C2 provides a 256 Mbit SPI boot flash. It includes the uEFI BIOS and the Intel® Converged Security Engine (CSE) which is comparable to Trusted Execution Engine (TXE).

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 MX25L25645GMI-08G

3.4.3.4 EEPROM

The TQMxE40C2 supports a COM Express™ Module EEPROM. The 32 kbit EEPROM (24AA32AT) is connected to the general purpose I²C interface (COM Express™ pin names I2C_DAT and I2C_CK).

3.4.4 Real Time Clock

The TQMxE40C2 includes a standard RTC (Motorola MS146818B) integrated in the Intel® X6000E Series CPU.

3.4.5 Trusted Platform Module

The TQMxE40C2 supports the Trusted Platform Module (TPM) 2.0 (Infineon SLB9670 controller).

Intel® X6000E Series CPU supports also a Firmware Trusted Platform Module (FTPM); this is a Trusted Platform Module 2.0 implementation in firmware. This feature can be configured in the BIOS.

3.4.6 TQ flexible I/O configuration (TQ-flexiCFG)

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

Using the TQ-flexiCFG feature several COM Express™ I/O interfaces and functions can be configured via a programmable FPGA. This feature enables the user to integrate special embedded features and configuration options in the TQMxE40C2 to reduce the carrier board design effort. Here are some examples of the flexible I/O configuration:

- GPIO interrupt configuration
- Interrupt configuration via LPC Serial IRQ
- Serial Port handshake signals via GPIOs
- Integrate 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.

3.4.7 Ultra Deep Power State Green ECO-Off

The TQMxE40C2 supports the ultra-deep power state Green ECO-Off.

In this configuration all DC/DC power supplies on the TQMxE40C2 are switched off.

This results in lowest power consumption. The Green ECO-Off mode can be configured in the uEFI BIOS setup.

To wake up the system from the Green ECO-Off mode the power button signal has to be pulled low for at least 100 msec.

3.5 Interfaces

3.5.1 PCI Express

The TQMxE40C2 with Intel® X6000E Series CPU supports a very flexible PCI Express configuration with up eight PCI Express Gen3 ports. With a customized BIOS the PCI Express lane configuration can be set as follows:

Table 6: 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
(2) ×2 ports	Configuration via custom BIOS
(1) ×4 port	Configuration via custom BIOS
COM Express™ Port 4 – 7	Configuration
(2) ×1 ports	Configuration via custom BIOS
(2) ×2 ports	Standard BIOS

3.5.2 PCI Express for Graphics (PEG)

At the COM Express™ connector the TQMxE40C2 supports two x2 Gen3 PCI Express Graphics ports with 8 Gb/s speed.

The PCI Express PEG lanes 2 – 7 and 10 – 15 are not used. The PEG Interface is multiplexed with the PCI Express, therefore it depends on the configuration if the PEG Port is available.

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).

Attention: PCI Express Gen 4 carrier design



The COM Express™ specification Revision 3.0 only supports the PCI Express Gen 3 (8 Gb/s) data rate. If the COM Express™ carrier is not designed for the PCI Express Gen 4 (16 Gb/s) operation, the PCI Express port should be configured to operate in Gen 3 (8 Gb/s) mode.



3.5.3 Gigabit Ethernet

The TQMxE40C2 provides one Marvell 88E1512 Ethernet controller with 10/100/1000 Mbps speed.

The Ethernet LED functionality defined in the COM Express™ specification is currently not supported by the TQMxE40C2 module. Intel is working on this issue.

3.5.4 Serial ATA

The TQMxE40C2 supports two SATA Gen 3.0 (6 Gbit/s) interfaces.

The integrated SATA host controller supports AHCI mode, the SATA controller no longer supports legacy IDE mode using I/O space.

3.5.5 Digital Display Interface

The TQMxE40C2 supports three Digital Display Interfaces at the COM Express™ connector.

The DDI0 port supports LVDS (via an eDP to LVDS bridge) or eDP as an assembly option.

The DDI1 port supports DisplayPort or HDMI/DVI.

The DDI2 port supports DisplayPort or HDMI/DVI.

The TQMxE40C2 supports the following maximum display resolutions:

- DisplayPort 1.4 up to 4096 x 2160 @ 60 Hz
- HDMI 2.0b up to 4096 x 2160 @ 60 Hz
- DVI up to 4096 x 2160 @ 24 Hz (HDMI without Audio)
- eDP up to 4 lanes eDP 1.4a up to 4096 x 2160 @ 60 Hz
- LVDS up to 1920 x 1200 @ 60 Hz in dual channel LVDS mode

For an HDMI/DVI output, a level converter must be used on the carrier board.

3.5.6 LVDS Interface

The TQMxE40C2 supports an LVDS 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 x 1200 @ 60 Hz in dual channel LVDS mode.

The LVDS data 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 Interfaces

The TQMxE40C2 supports eight USB 2.0 and two USB 3.2 Gen 2 ports with data rate up to 10 Gb/s at the COM Express™ connector. The USB SuperSpeed ports are configured to USB 3.2 Gen 1 (5 Gb/s) per default.

Care must be taken in the COM Express™ carrier design, the carrier must support the USB 3.2 Gen 2 (10 Gb/s) high speed standard if this mode is needed.

Attention: USB 3.1 Gen 2 (10 Gb/s) carrier design



The COM Express™ specification Revision 3.0 only supports the USB 3.2 Gen 1 (5 Gb/s) data rate. 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.

Note: USB Port Mapping



The USB 2.0 port 0 must be paired with USB 3.1 SuperSpeedPlus port 0.
The USB 2.0 port 1 must be paired with USB 3.1 SuperSpeedPlus port 1.

To support more than two USB 3.1 ports the PCIe ports 0 and 1 can be configured to USB 3.2.

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

3.5.8 SD Card Interface

The TQMxE40C2 provides an SD card interface for 4-bit SD/MMC cards at the COM Express™ connector.

The SD card signals are shared with the GPIO signals and can be configured via the BIOS.

The default configuration at the COM Express™ connector is with GPIO signals.

The SD Card interface is not activated in BIOS default settings.

3.5.9 General Purpose Input / Output

The TQMxE40C2 provides eight GPIO signals at the COM Express™ connector.

The GPIO signals are shared with the SD card signals and can be configured via an uEFI BIOS setting.

The default configuration at the COM Express™ connector is GPIO.

The GPIO signals are integrated in the TQ-flexiCFG block and can be flexible configured.

The signals can also be used for special functions (see chapter 3.4.6).

3.5.10 High Definition Audio Interface

The TQMxE40C2 provides a High Definition Audio (HDA) interface, which supports two audio codecs at the COM Express™ connector. The HDA_SDIN2 signal at the COM Express™ is not connected. The Audio Codec is assembled on the carrier board.

3.5.11 LPC Bus / eSPI

The TQMxE40C2 supports a Low Pin Count (LPC) legacy bus and the Enhanced Serial Peripheral eSPI bus on the same COM Express™ connector pins.

The LPC bus is a 3.3 V bus and eSPI is a 1.8 V bus. There is the possibility of a mismatch an eSPI only module mated with a LPC only carrier, or an LPC only module on an eSPI carrier.

The TQMxE40C2 includes a multiplexer to switch between the LPC bus 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.

Note: LPC / eSPI bus



The legacy Low Pin Count (LPC) interface has been removed from the processor silicon. The TQMxE40C2 module includes an eSPI to LPC bridge to support the LPC legacy bus. For new carrier designs the Enhanced Serial Peripheral eSPI bus should be selected.

3.5.12 I²C Bus

The TQMxE40C2 supports a general purpose I²C port via a dedicated LPC to I²C controller integrated in the TQ-flexiCFG block. The I²C host controller supports a transfer rate of up to 400 kHz and can be configured independently.

3.5.13 SMBus

The TQMxE40C2 provides a System Management Bus (SMBus).

3.5.14 Serial Peripheral Interface

The TQMxE40C2 provides a Serial Peripheral Interface (SPI). The SPI interface can only be used for SPI boot Flash devices.

3.5.15 Serial Ports

The TQMxE40C2 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 7: Serial Port COM Express™ Port Mapping

COM Express™ Signal	COM Express™ Pin	TQMxE40C2	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



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 TQMxE40C2 the protection circuit is removed by default and the serial ports provide transfer rates of up to 115 kbaud. Therefore the TQMxE40C2 can only be used in a COM Express™ COM.0 2.0 and 3.0 Type 6 pin-out carrier board.

3.5.16 CAN interface

The TQMxE40C2 provides a CAN interface. The signals for the CAN interface are shared with the serial port (SER1) signals and can be configured via a register setting.

If CAN interface is required appropriate transceivers have to be realized on the carrier.

3.5.17 Watchdog Timer

The TQMxE40C2 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 ms to 1 h.

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 TQMxE40C2 on the carrier board. On the carrier board two 220-pin 0.5 mm pitch plug connectors have to be used. There are two versions available with 5 mm and 8 mm stacking height.

3.6.2 Debug Header

The TQMxE40C2 includes a 14-pin flat cable connector to connect an external debug module (TQ specific) to provide BIOS post code information, debug LEDs and a JTAG interface for on-board FPGA.

This header is intended for TQ internal use only.

Please contact support@tq-group.com for more details about the external debug module.

3.6.3 TQM Debug Card

The TQM debug card 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.



Illustration 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 TQMxE40C2 includes a dual colour LED providing boot and BIOS information. The following table illustrates some LED boot messages:

Table 8: 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

3.7 COM Express™ Connector Pinout

This section describes the TQMxE40C2 COM Express™ connector pin assignment, which is compliant with COM.0 R3.0 Type 6 pinout definitions.

Samples of mating connectors are available from: <https://www.ept.de/index.php?tq-colibri-lp>

3.7.1 Signal Assignment Abbreviations

The following table lists the abbreviations used within this chapter:

Table 9: 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
IO	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 TQMxE40C2.



3.7.2 COM Express™ Connector Pin Assignment

Table 10: 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 Mbit / sec link indicator	OD	
A5	GBE0_LINK1000#	Gigabit Ethernet Controller 0 1000 Mbit / sec 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	TQ-flexiCFG
A16	SATA0_TX+	SATA differential transmit pairs 0	O	
A17	SATA0_TX-	SATA differential transmit pairs 0	O	
A18	SUS_S4#	Indicates system is in Suspend to Disk state. Active low output.	O PD	TQ-flexiCFG
A19	SATA0_RX+	SATA differential receive pairs 0	I	
A20	SATA0_RX-	SATA differential receive pairs 0	I	
A21	GND(FIXED)	Ground	GND	
A22	SATA2_TX+	SATA differential transmit pairs 2	O	N/A
A23	SATA2_TX-	SATA differential transmit pairs 2	O	N/A
A24	SUS_S5#	Indicates system is in Soft Off state. Active low output.	O PD	TQ-flexiCFG
A25	SATA2_RX+	SATA differential receive pairs 2	I	N/A
A26	SATA2_RX-	SATA differential receive pairs 2	I	N/A
A27	BATLOW#	Indicates that external battery is low	I PU	
A28	(S)ATA_ACT#	SATA activity indicator	O	
A29	AC/HDA_SYNC	Sample-synchronization signal to the CODEC(s)	O	
A30	AC/HDA_RST#	Reset output to CODEC, active low.	O	
A31	GND(FIXED)	Ground	GND	
A32	AC/HDA_BITCLK	Serial data clock generated by the external CODEC(s)	IO	
A33	AC/HDA_SDOUT	Serial TDM data output to the CODEC	O	
A34	BIOS_DIS0#	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 6	IO	
A37	USB6+	USB differential pairs 6	IO	
A38	USB_6_7_OC#	USB over-current sense, USB channels 6 and 7	I PU	
A39	USB4-	USB differential pairs 4	IO	
A40	USB4+	USB differential pairs 4	IO	
A41	GND(FIXED)	Ground	GND	
A42	USB2-	USB differential pairs 2	IO	
A43	USB2+	USB differential pairs 2	IO	
A44	USB_2_3_OC#	USB over-current sense, USB channels 2 and 3	I PU	
A45	USB0-	USB differential pairs 0	IO	
A46	USB0+	USB differential pairs 0	IO	
A47	VCC_RTC	Real-time clock circuit-power input.	Power	
A48	RSVD	Reserved	O	N/A
A49	GBE0_SDP	Gigabit Ethernet Controller 0 Software-Definable Pin.	IO	TQ-flexiCFG
A50	LPC_SERIRQ/ESPI_CS1#	LPC serial interrupt / eSPI Master Chip Select	IO	
A51	GND(FIXED)	Ground	GND	
A52	PCIE_TX5+	PCI Express differential transmit pairs 5	O	
A53	PCIE_TX5-	PCI Express differential transmit pairs 5	O	
A54	GPIO/SD_DATA0	GPIO	I PU	TQ-flexiCFG
A55	PCIE_TX4+	PCI Express differential transmit pairs 4	O	

Table 12: COM Express™ Connector Pin Assignment (continued)

Pin	Pin-Signal	Description	Type	Remark
A56	PCIE_TX4-	PCI Express differential transmit pairs 4	O	
A57	GND	Ground	GND	
A58	PCIE_TX3+	PCI Express differential transmit pairs 3	O	
A59	PCIE_TX3-	PCI Express differential transmit pairs 3	O	
A60	GND(FIXED)	Ground	GND	
A61	PCIE_TX2+	PCI Express differential transmit pairs 2	O	
A62	PCIE_TX2-	PCI Express differential transmit pairs 2	O	
A63	GPI1/SD_DATA1	GPI1	I PU	TQ-flexiCFG
A64	PCIE_TX1+	PCI Express differential transmit pairs 1	O	
A65	PCIE_TX1-	PCI Express differential transmit pairs 1	O	
A66	GND	Ground	GND	
A67	GPI2/SD_DATA2	GPI2	I PU	TQ-flexiCFG
A68	PCIE_TX0+	PCI Express differential transmit pairs 0	O	
A69	PCIE_TX0-	PCI Express differential transmit pairs 0	O	
A70	GND(FIXED)	Ground	GND	
A71	LVDS_A0+ / eDP_TX2+	LVDS Channel A differential pairs 0 / eDP	O	
A72	LVDS_A0- / eDP_TX2-	LVDS Channel A differential pairs 0 / eDP	O	
A73	LVDS_A1+ / eDP_TX1+	LVDS Channel A differential pairs 1 / eDP	O	
A74	LVDS_A1- / eDP_TX1-	LVDS Channel A differential pairs 1 / eDP	O	
A75	LVDS_A2+ / eDP_TX0+	LVDS Channel A differential pairs 2 / eDP	O	
A76	LVDS_A2- / eDP_TX0-	LVDS Channel A differential pairs 2 / eDP	O	
A77	LVDS_VDD_EN / eDP_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	O	
A82	LVDS_A_CK- / eDP_TX3-	LVDS Channel A differential clock / eDP	O	
A83	LVDS_I2C_CK / eDP_AUX+	I2C clock output for LVDS display	IO	
A84	LVDS_I2C_DAT / eDP_AUX-	I2C data line for LVDS display	IO	
A85	GPI3/SD_DATA3	GPI3 / SD_DATA3	I PU	TQ-flexiCFG
A86	(RSVD18) EDP_AUX_DDC_SEL	(Reserved) Select between EDP I2C or LVDS DDC	I PD	TQ-flexiCFG
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	PWR	
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	TQ-flexiCFG
A97	TYPE10#	Type 10 Module indication (NC)	NC	
A98	SER0_TX	Serial port 0 transmitter	O 3V3	without protection
A99	SER0_RX	Serial port 0 receiver	I 3V3	without protection
A100	GND(FIXED)	Ground	GND	
A101	SER1_TX	Serial port 1 transmitter	O 3V3	without protection
A102	SER1_RX	Serial port 1 receiver	I 3V3	without protection
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 indicates the start of an LPC cycle / eSPI	IO	
B4	LPC_AD0/ESPI_IO_0	LPC multiplexed address, command and data bus / eSPI	IO	
B5	LPC_AD1/ESPI_IO_1	LPC multiplexed address, command and data bus / eSPI	IO	
B6	LPC_AD2/ESPI_IO_2	LPC multiplexed address, command and data bus / eSPI	IO	
B7	LPC_AD3/ESPI_IO_3	LPC multiplexed address, command and data bus / eSPI	IO	
B8	LPC_DRQ0#/ESPI_ALERT0#	LPC serial DMA request / eSPI	IO	
B9	LPC_DRQ1#/ESPI_ALERT1#	LPC serial DMA request / eSPI	IO	
B10	LPC_CLK/ESPI_CLK	LPC clock output / eSPI	O	
B11	GND(FIXED)	Ground	GND	
B12	PWRBTN#	Power button input	I PU	TQ-flexiCFG
B13	SMB_CLK	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 1	O	
B17	SATA1_TX-	SATA differential transmit pairs 1	O	
B18	SUS_STAT# / ESPI_RESET#	Indicates imminent suspend operation / eSPI Reset	O	
B19	SATA1_RX+	SATA differential receive pairs 1	I	
B20	SATA1_RX-	SATA differential receive pairs 1	I	
B21	GND(FIXED)	Ground	GND	
B22	SATA3_TX+	SATA differential transmit pairs 3	O	N/A
B23	SATA3_TX-	SATA differential transmit pairs 3	O	N/A
B24	PWR_OK	Power OK from main power supply	I PU	TQ-flexiCFG
B25	SATA3_RX+	SATA differential receive pairs 3	I	N/A
B26	SATA3_RX-	SATA differential receive pairs 3	I	N/A
B27	WDT	watchdog time-out	O	TQ-flexiCFG
B28	AC/HDA_SDIN2	Serial TDM data input 2	I PU	N/A
B29	AC/HDA_SDIN1	Serial TDM data input 1	I PU	
B30	AC/HDA_SDIN0	Serial TDM data input 0	I PU	
B31	GND(FIXED)	Ground	GND	
B32	SPKR	PC Audio Speaker output	O	
B33	I2C_CLK	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 7	IO	
B37	USB7+	USB differential pairs 7	IO	
B38	USB_4_5_OC#	USB over-current sense, USB channels 4 and 5	I PU	
B39	USB5-	USB differential pairs 5	IO	
B40	USB5+	USB differential pairs 5	IO	
B41	GND(FIXED)	Ground	GND	
B42	USB3-	USB differential pairs 3	IO	
B43	USB3+	USB differential pairs 3	IO	
B44	USB_0_1_OC#	USB over-current sense, USB channels 0 and 1	I PU	
B45	USB1-	USB differential pairs 1	IO	
B46	USB1+	USB differential pairs 1	IO	
B47	ESPI_EN#	The Carrier shall tie ESPI_EN# to GND for eSPI operation, LPC NC	I PU	TQ-flexiCFG
B48	USB0_HOST_PRESNT	Module USB client may detect the presence of a USB host on USB0	I PU	TQ-flexiCFG
B49	SYS_RESET#	Reset button input	I PU	TQ-flexiCFG
B50	CB_RESET#	Reset output from Module to Carrier Board	O	TQ-flexiCFG
B51	GND(FIXED)	Ground	GND	
B52	PCIE_RX5+	PCI Express differential receive pairs 5	I	
B53	PCIE_RX5-	PCI Express differential receive pairs 5	I	
B54	GPO1/SD_CMD	GPO1	O PD	TQ-flexiCFG
B55	PCIE_RX4+	PCI Express differential receive pairs 4	I	



Table 12: COM Express™ Connector Pin Assignment (continued)

Pin	Pin-Signal	Description	Type	Remark
B56	PCIE_RX4-	PCI Express differential receive pairs 4	I	
B57	GPO2 / SD_WP	GPO2	O PD	TQ-flexiCFG
B58	PCIE_RX3+	PCI Express differential receive pairs 3	I	
B59	PCIE_RX3-	PCI Express differential receive pairs 3	I	
B60	GND(FIXED)	Ground	GND	
B61	PCIE_RX2+	PCI Express differential receive pairs 2	I	
B62	PCIE_RX2-	PCI Express differential receive pairs 2	I	
B63	GPO3/SD_CD#	GPO3	O PD	TQ-flexiCFG
B64	PCIE_RX1+	PCI Express differential receive pairs 1	I	
B65	PCIE_RX1-	PCI Express differential receive pairs 1	I	
B66	WAKE0#	PCI Express wake up signal	I PU	TQ-flexiCFG
B67	WAKE1#	General purpose wake up signal	I PU	TQ-flexiCFG
B68	PCIE_RX0+	PCI Express differential receive pairs 0	I	
B69	PCIE_RX0-	PCI Express differential receive pairs 0	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 / eDP_BLKLT_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/eDP_BLKLT_EN	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	N/A
B90	GND(FIXED)	Ground	GND	
B91	VGA_GRN	Green for monitor	O	N/A
B92	VGA_BLU	Blue for monitor	O	N/A
B93	VGA_HSYNC	Horizontal sync output to VGA monitor	O	N/A
B94	VGA_VSYNC	Vertical sync output to VGA monitor	O	N/A
B95	VGA_I2C_CK	DDC clock line	O	N/A
B96	VGA_I2C_DAT	DDC data line	IO	N/A
B97	SPI_CS#	Chip select for Carrier Board SPI	O	
B98	(RSVD) SER0_RTS#	Serial port 0 Request To Send	O	TQ-flexiCFG
B99	(RSVD) SER0_CTS#	Serial port 0 Clear To Send	I PU	TQ-flexiCFG
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		



Table 12: 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 USB3.1 differential receive pairs 0	I	
C4	USB_SSRX0+	SuperSpeed USB3.1 differential receive pairs 0	I	
C5	GND	Ground	GND	
C6	USB_SSRX1-	SuperSpeed USB3.1 differential receive pairs 1	I	
C7	USB_SSRX1+	SuperSpeed USB3.1 differential receive pairs 1	I	
C8	GND	Ground	GND	
C9	USB_SSRX2-	SuperSpeed USB3.1 differential receive pairs 2	I	N/A
C10	USB_SSRX2+	SuperSpeed USB3.1 differential receive pairs 2	I	N/A
C11	GND(FIXED)	Ground	GND	
C12	USB_SSRX3-	SuperSpeed USB3.1 differential receive pairs 3	I	N/A
C13	USB_SSRX3+	SuperSpeed USB3.1 differential receive pairs 3	I	N/A
C14	GND	Ground	GND	
C15	DDI1_PAIR6+	DDI1 DP / HDMI / DVI differential pairs 6	O	N/A
C16	DDI1_PAIR6-	DDI1 DP / HDMI / DVI differential pairs 6	O	N/A
C17	(RSVD18) I2C_HDMI_SCL	(Reserved) Optional: I2C for HDMI redriver	IO	
C18	(RSVD18) I2C_HDMI_SDA	(Reserved) Optional: I2C for HDMI redriver	IO	
C19	PCIE_RX6+	PCI Express differential receive pairs 6	I	
C20	PCIE_RX6-	PCI Express differential receive pairs 6	I	
C21	GND(FIXED)	Ground	GND	
C22	PCIE_RX7+	PCI Express differential receive pairs 7	I	
C23	PCIE_RX7-	PCI Express differential receive pairs 7	I	
C24	DDI1_HPD	DDI1 Detection of Hot Plug	I PD	
C25	DDI1_PAIR4+	DDI1 DP / HDMI / DVI differential pairs 4	O	N/A
C26	DDI1_PAIR4-	DDI1 DP / HDMI / DVI differential pairs 4	O	N/A
C27	(RSVD18) I2C_USBC_PD_SCL	(Reserved) Optional: I2C for USB	IO	
C28	(RSVD18) I2C_USBC_PD_SDA	(Reserved) Optional: I2C for USB	IO	
C29	DDI1_PAIR5+	DDI1 DP / HDMI / DVI differential pairs 5	O	N/A
C30	DDI1_PAIR5-	DDI1 DP / HDMI / DVI differential pairs 5	O	N/A
C31	GND(FIXED)	Ground	GND	
C32	DDI2_CTRLCLK_AUX+	DDI2_CTRLCLK_AUX+ signal DP AUX, HDMI DVI CLK	IO	
C33	DDI2_CTRLDATA_AUX-	DDI2_CTRLDATA_AUX- signal DP AUX, HDMI DVI DATA	IO	
C34	DDI2_DDC_AUX_SEL	Selects the function of DDI2_CTRLx AUX+/- Signals	I PD	
C35	RSVD18	Reserved	NC	N/A
C36	DDI3_CTRLCLK_AUX+	DDI3_CTRLCLK_AUX+ signal DP AUX, HDMI DVI CLK	IO	N/A
C37	DDI3_CTRLDATA_AUX-	DDI3_CTRLDATA_AUX- signal DP AUX, HDMI DVI DATA	IO	N/A
C38	DDI3_DDC_AUX_SEL	Selects the function of DDI3_CTRLx AUX+/- Signals	I PU	N/A
C39	DDI3_PAIR0+	DDI3 DP / HDMI / DVI differential pairs 3	O	N/A
C40	DDI3_PAIR0-	DDI3 DP / HDMI / DVI differential pairs 3	O	N/A
C41	GND(FIXED)	Ground	GND	
C42	DDI3_PAIR1+	DDI3 DP / HDMI / DVI differential pairs 1	O	N/A
C43	DDI3_PAIR1-	DDI3 DP / HDMI / DVI differential pairs 1	O	N/A
C44	DDI3_HPD	DDI3 Detection of Hot Plug	I PD	N/A
C45	RSVD18	Reserved	NC	N/A
C46	DDI3_PAIR2+	DDI3 DP / HDMI / DVI differential pairs 2	O	N/A
C47	DDI3_PAIR2-	DDI3 DP / HDMI / DVI differential pairs 2	O	N/A
C48	RSVD18	Reserved	NC	N/A
C49	DDI3_PAIR3+	DDI3 DP / HDMI / DVI differential pairs 3	O	N/A
C50	DDI3_PAIR3-	DDI3 DP / HDMI / DVI differential pairs 3	O	N/A
C51	GND(FIXED)	Ground	GND	
C52	PEG_RX0+	PCI Express differential receive pairs 0	I	Optional (PCIe4)
C53	PEG_RX0-	PCI Express differential receive pairs 0	I	Optional (PCIe4)
C54	TYPE0#	Type 0 Module indication (NC)	NC	
C55	PEG_RX1+	PCI Express differential receive pairs 1	I	Optional (PCIe5)

Table 12: COM Express™ Connector Pin Assignment (continued)

Pin	Pin-Signal	Description	Type	Remark
C56	PEG_RX1-	PCI Express differential receive pairs 1	I	Optional (PCIe5)
C57	TYPE1#	Type 1 Module indication (NC)	NC	
C58	PEG_RX2+	PCI Express differential receive pairs 2	I	N/A
C59	PEG_RX2-	PCI Express differential receive pairs 2	I	N/A
C60	GND(FIXED)	Ground	GND	
C61	PEG_RX3+	PCI Express differential receive pairs 3	I	N/A
C62	PEG_RX3-	PCI Express differential receive pairs 3	I	N/A
C63	(RSVD18) I2C_USBC_PD_INT#	(Reserved) Optional: I2C for USB	I	
C64	RSVD18	Reserved	NC	N/A
C65	PEG_RX4+	PCI Express differential receive pairs 4	I	N/A
C66	PEG_RX4-	PCI Express differential receive pairs 4	I	N/A
C67	RAPID_SHUTDOWN	Trigger for Rapid Shutdown. Must be driven to 5V	I PD	
C68	PEG_RX5+	PCI Express differential receive pairs 5	I	N/A
C69	PEG_RX5-	PCI Express differential receive pairs 5	I	N/A
C70	GND(FIXED)	Ground	GND	
C71	PEG_RX6+	PCI Express differential receive pairs 6	I	N/A
C72	PEG_RX6-	PCI Express differential receive pairs 6	I	N/A
C73	GND	Ground	GND	
C74	PEG_RX7+	PCI Express differential receive pairs 7	I	N/A
C75	PEG_RX7-	PCI Express differential receive pairs 7	I	N/A
C76	GND	Ground		
C77	RSVD18	Reserved	NC	N/A
C78	PEG_RX8+	PCI Express differential receive pairs 8	I	Optional (PCIe6)
C79	PEG_RX8-	PCI Express differential receive pairs 8	I	Optional (PCIe6)
C80	GND(FIXED)	Ground	GND	
C81	PEG_RX9+	PCI Express differential receive pairs 9	I	Optional (PCIe7)
C82	PEG_RX9-	PCI Express differential receive pairs 9	I	Optional (PCIe7)
C83	RSVD18	Reserved	NC	N/A
C84	GND	Ground	GND	
C85	PEG_RX10+	PCI Express differential receive pairs 10	I	N/A
C86	PEG_RX10-	PCI Express differential receive pairs 10	I	N/A
C87	GND	Ground	GND	
C88	PEG_RX11+	PCI Express differential receive pairs 11	I	N/A
C89	PEG_RX11-	PCI Express differential receive pairs 11	I	N/A
C90	GND(FIXED)	Ground	GND	
C91	PEG_RX12+	PCI Express differential receive pairs 12	I	N/A
C92	PEG_RX12-	PCI Express differential receive pairs 12	I	N/A
C93	GND	Ground	GND	
C94	PEG_RX13+	PCI Express differential receive pairs 13	I	N/A
C95	PEG_RX13-	PCI Express differential receive pairs 13	I	N/A
C96	GND	Ground	GND	
C97	RSVD18	Reserved	I/O	TQ-flexiCFG
C98	PEG_RX14+	PCI Express differential receive pairs 14	I	N/A
C99	PEG_RX14-	PCI Express differential receive pairs 14	I	N/A
C100	GND(FIXED)	Ground	GND	
C101	PEG_RX15+	PCI Express differential receive pairs 15	I	N/A
C102	PEG_RX15-	PCI Express differential receive pairs 15	I	N/A
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	



Table 12: 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 USB3.1 differential transmit pairs 0	O	
D4	USB_SSTX0+	SuperSpeed USB3.1 differential transmit pairs 0	O	
D5	GND	Ground	GND	
D6	USB_SSTX1-	SuperSpeed USB3.1 differential transmit pairs 1	O	
D7	USB_SSTX1+	SuperSpeed USB3.1 differential transmit pairs 1	O	
D8	GND	Ground	GND	
D9	USB_SSTX2-	SuperSpeed USB3.1 differential transmit pairs 2	O	N/A
D10	USB_SSTX2+	SuperSpeed USB3.1 differential transmit pairs 2	O	N/A
D11	GND(FIXED)	Ground	GND	
D12	USB_SSTX3-	SuperSpeed USB3.1 differential transmit pairs 3	O	N/A
D13	USB_SSTX3+	SuperSpeed USB3.1 differential transmit pairs 3	O	N/A
D14	GND	Ground	GND	
D15	DDI1_CTRLCLK_AUX+	DDI1_CTRLCLK_AUX+ signal DP AUX, HDMI DVI CLK	IO	
D16	DDI1_CTRLDATA_AUX-	DDI1_CTRLDATA_AUX- signal DP AUX, HDMI DVI DATA	IO	
D17	RSVD18	Reserved	NC	N/A
D18	RSVD18	Reserved	NC	N/A
D19	PCIE_TX6+	PCI Express differential transmit pairs 6	O	
D20	PCIE_TX6-	PCI Express differential transmit pairs 6	O	
D21	GND(FIXED)	Ground	GND	
D22	PCIE_TX7+	PCI Express differential transmit pairs 7	O	
D23	PCIE_TX7-	PCI Express differential transmit pairs 7	O	
D24	(RSVD) SER1_RTS#	Serial port 1 Request To Send	O	TQ-flexiCFG
D25	(RSVD) SER1_CTS#	Serial port 1 Clear To Send	I / PU	TQ-flexiCFG
D26	DDI1_PAIR0+	DDI1 DP / HDMI / DVI differential pairs 0	O	
D27	DDI1_PAIR0-	DDI1 DP / HDMI / DVI differential pairs 0	O	
D28	RSVD18	Reserved	NC	N/A
D29	DDI1_PAIR1+	DDI1 DP / HDMI / DVI differential pairs 1	O	
D30	DDI1_PAIR1-	DDI1 DP / HDMI / DVI differential pairs 1	O	
D31	GND(FIXED)	Ground	GND	
D32	DDI1_PAIR2+	DDI1 DP / HDMI / DVI differential pairs 2	O	
D33	DDI1_PAIR2-	DDI1 DP / HDMI / DVI differential pairs 2	O	
D34	DDI1_DDC_AUX_SEL	Selects the function of DDI1_CTRLxAUX+/- Signals	I / PD	
D35	RSVD18	Reserved	NC	N/A
D36	DDI1_PAIR3+	DDI1 DP / HDMI / DVI differential pairs 3	O	
D37	DDI1_PAIR3-	DDI1 DP / HDMI / DVI differential pairs 3	O	
D38	RSVD18	Reserved	NC	N/A
D39	DDI2_PAIR0+	DDI2 DP / HDMI / DVI differential pairs 0	O	
D40	DDI2_PAIR0-	DDI2 DP / HDMI / DVI differential pairs 0	O	
D41	GND(FIXED)	Ground	GND	
D42	DDI2_PAIR1+	DDI2 DP / HDMI / DVI differential pairs 1	O	
D43	DDI2_PAIR1-	DDI2 DP / HDMI / DVI differential pairs 1	O	
D44	DDI2_HPD	DDI2 Detection of Hot Plug	I / PD	
D45	RSVD18	Reserved	NC	N/A
D46	DDI2_PAIR2+	DDI2 DP / HDMI / DVI differential pairs 2	O	
D47	DDI2_PAIR2-	DDI2 DP / HDMI / DVI differential pairs 2	O	
D48	RSVD18	Reserved	NC	N/A
D49	DDI2_PAIR3+	DDI2 DP / HDMI / DVI differential pairs 3	O	
D50	DDI2_PAIR3-	DDI2 DP / HDMI / DVI differential pairs 3	O	
D51	GND(FIXED)	Ground	GND	
D52	PEG_TX0+	PCI Express differential transmit pairs 0	O	Optional (PCIe4)
D53	PEG_TX0-	PCI Express differential transmit pairs 0	O	Optional (PCIe4)
D54	PEG_LANE_RV#	PCI Express Graphics lane reversal input strap	I	N/A
D55	PEG_TX1+	PCI Express differential transmit pairs 1	O	Optional (PCIe5)



Table 12: COM Express™ Connector Pin Assignment (continued)

Pin	Pin-Signal	Description	Type	Remark
D56	PEG_TX1-	PCI Express differential transmit pairs 1	O	Optional (PCIe5)
D57	TYPE2#	Type 2 Module indication (GND)	O	
D58	PEG_TX2+	PCI Express differential transmit pairs 2	O	N/A
D59	PEG_TX2-	PCI Express differential transmit pairs 2	O	N/A
D60	GND(FIXED)	Ground	GND	
D61	PEG_TX3+	PCI Express differential transmit pairs 3	O	N/A
D62	PEG_TX3-	PCI Express differential transmit pairs 3	O	N/A
D63	(RSVD18) I2C_USBC_PDC_SCL	(Reserved) Optional: I2C for USB	NC	
D64	(RSVD18) I2C_USB_PDC_SDA	(Reserved) Optional: I2C for USB	NC	
D65	PEG_TX4+	PCI Express differential transmit pairs 4	O	N/A
D66	PEG_TX4-	PCI Express differential transmit pairs 4	O	N/A
D67	GND	Ground	GND	
D68	PEG_TX5+	PCI Express differential transmit pairs 5	O	N/A
D69	PEG_TX5-	PCI Express differential transmit pairs 5	O	N/A
D70	GND(FIXED)	Ground	GND	
D71	PEG_TX6+	PCI Express differential transmit pairs 6	O	N/A
D72	PEG_TX6-	PCI Express differential transmit pairs 6	O	N/A
D73	GND	Ground	GND	
D74	PEG_TX7+	PCI Express differential transmit pairs 7	O	N/A
D75	PEG_TX7-	PCI Express differential transmit pairs 7	O	N/A
D76	GND	Ground	GND	
D77	(RSVD18) I2C_USBC_PDC_INT#	(Reserved) Optional: I2C for USB	NC	
D78	PEG_TX8+	PCI Express differential transmit pairs 8	O	Optional (PCIe6)
D79	PEG_TX8-	PCI Express differential transmit pairs 8	O	Optional (PCIe6)
D80	GND(FIXED)	Ground	GND	
D81	PEG_TX9+	PCI Express differential transmit pairs 9	O	Optional (PCIe7)
D82	PEG_TX9-	PCI Express differential transmit pairs 9	O	Optional (PCIe7)
D83	RSVD18	Reserved	NC	N/A
D84	GND	Ground	GND	
D85	PEG_TX10+	PCI Express differential transmit pairs 10	O	N/A
D86	PEG_TX10-	PCI Express differential transmit pairs 10	O	N/A
D87	GND	Ground	GND	
D88	PEG_TX11+	PCI Express differential transmit pairs 11	O	N/A
D89	PEG_TX11-	PCI Express differential transmit pairs 11	O	N/A
D90	GND(FIXED)	Ground	GND	
D91	PEG_TX12+	PCI Express differential transmit pairs 12	O	N/A
D92	PEG_TX12-	PCI Express differential transmit pairs 12	O	N/A
D93	GND	Ground	GND	
D94	PEG_TX13+	PCI Express differential transmit pairs 13	O	N/A
D95	PEG_TX13-	PCI Express differential transmit pairs 13	O	N/A
D96	GND	Ground	GND	
D97	RSVD18	Reserved	I/O	TQ-flexiCFG
D98	PEG_TX14+	PCI Express differential transmit pairs 14	O	N/A
D99	PEG_TX14-	PCI Express differential transmit pairs 14	O	N/A
D100	GND(FIXED)	Ground	GND	
D101	PEG_TX15+	PCI Express differential transmit pairs 15	O	N/A
D102	PEG_TX15-	PCI Express differential transmit pairs 15	O	N/A
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 TQMxE40C2 Dimensions

The TQMxE40C2 has dimensions of 95 mm × 95 mm (± 0.2 mm).
The following illustration shows the TQMxE40C2 Three View Drawing.

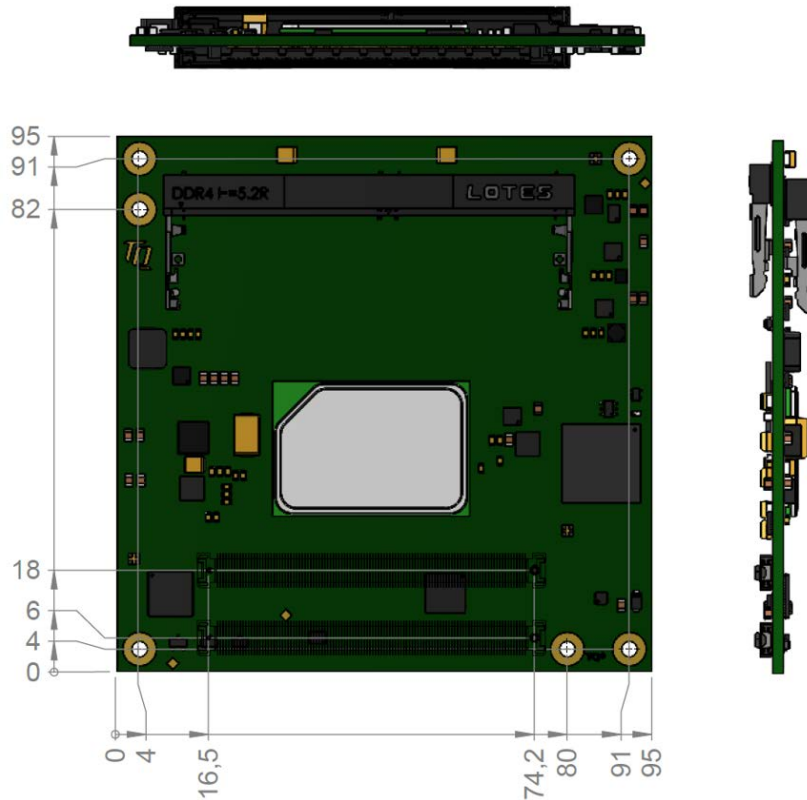


Illustration 3: TQMxE40C2 Three-View Drawing

The following illustration shows the TQMxE40C2 bottom view.

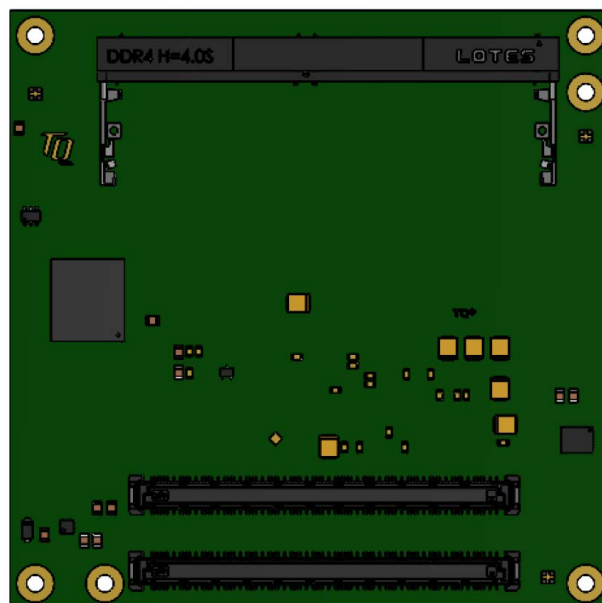


Illustration 4: TQMxE40C2 Bottom View Drawing

4.2 Heat Spreader

The TQMxE40C2 supports one heat spreader.

- TQMxE40C2-HSP-AA: Heat spreader for TQMxE40C2 according to the COM Express™ specification (13 mm $\pm$ 0.2 mm, including PCB).



Illustration 5: TQMxE40C2 Component Placement Top

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.

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.

4.3 Mechanical and Thermal Considerations

The TQMxE40C2 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 TQMxE40C2. The heat spreader is thermally coupled to the processor and provides optimal heat transfer from the TQMxE40C2 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 TQMxE40C2 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.

4.4 Protection against External Effects

The TQMxE40C2 itself is not protected against dust, external impact and contact (IP00).

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

To support applications in harsh environment, conformal coating can be offered as custom specific add-on.

Please contact support@tq-group.com for more information about the thermal configuration.

4.5 Label placement

Table 11: Labels on TQMxE40C2

Label	Content
AK1	MAC address
AK2	TQMxE40C2 version and revision
AK3	License label

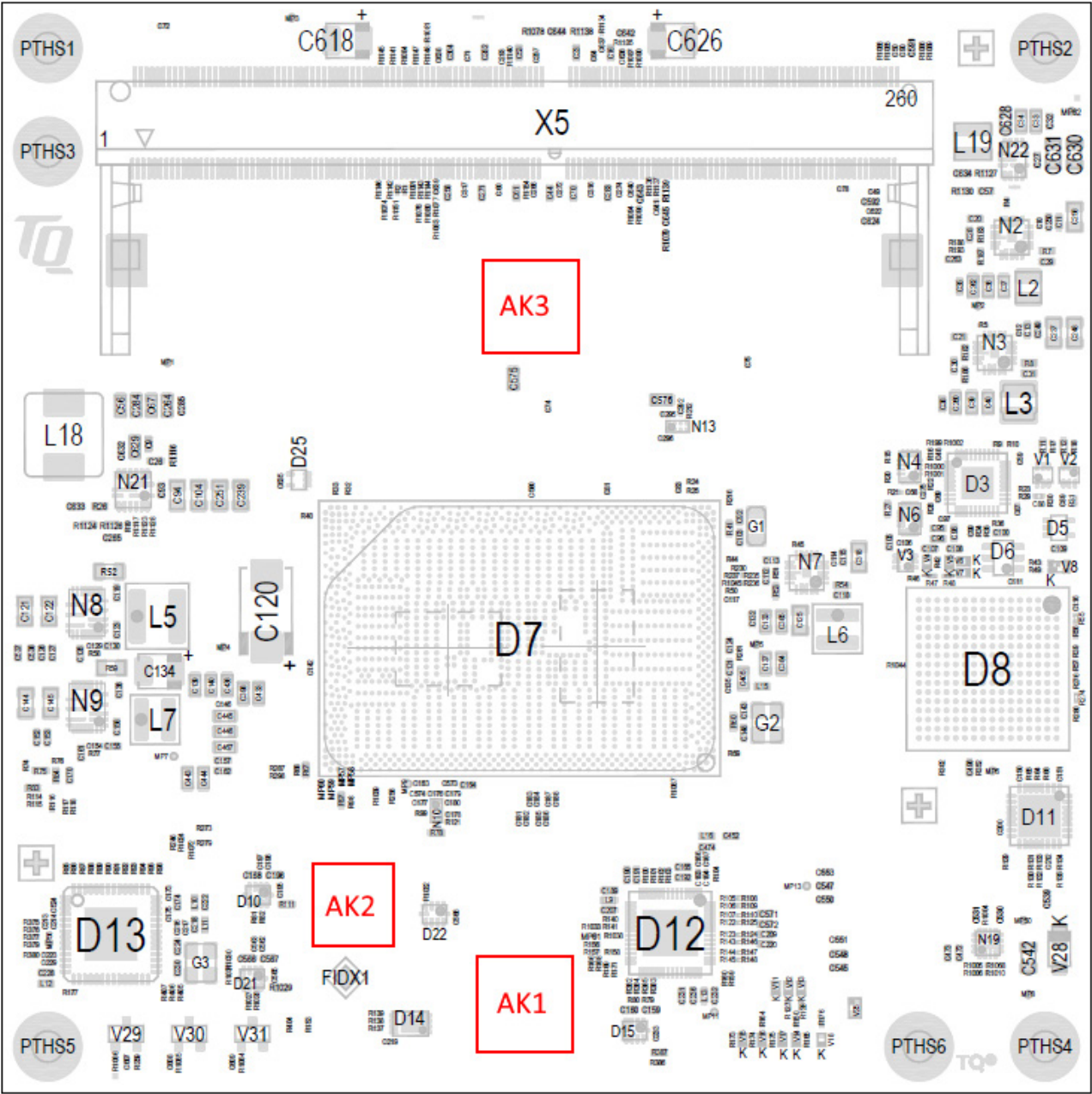


Illustration 6: Label Placement



5. SOFTWARE

5.1 System Resources

5.1.1 I²C Bus Devices

The TQMxE40C2 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 12: I²C Address Mapping COM Express™ I²C Port

8-bit Address	Function	Remark
0xA0	TQMxE40C2 Module EEPROM	–
0xAE	Carrier board EEPROM	Embedded EEPROM configuration not supported

5.1.2 SMBus Devices

The TQMxE40C2 provides a System Management Bus (SMBus). There are no SMBus devices on the TQMxE40C2.

5.1.3 Memory Mapping

The TQMxE40C2 supports the standard PC system memory and I/O memory map. Please contact support@tq-group.com for further information about the memory map.

5.1.4 Interrupt Mapping

The TQMxE40C2 supports the standard PC Interrupt routing. The integrated legacy devices (COM1, COM2) can be configured via the BIOS to different IRQs. Please contact support@tq-group.com for further information about the Interrupt configuration.



5.2 Operating Systems

5.2.1 Supported Operating Systems

The TQMxE40C2 supports several Operating Systems:

- Microsoft® Windows® 10 RS5 (64-bit) OS
- Linux (i.e. Yocto)

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 TQMxE40C2 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 TQMxE40C2 feature set.

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 TQMxE40C2 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>.

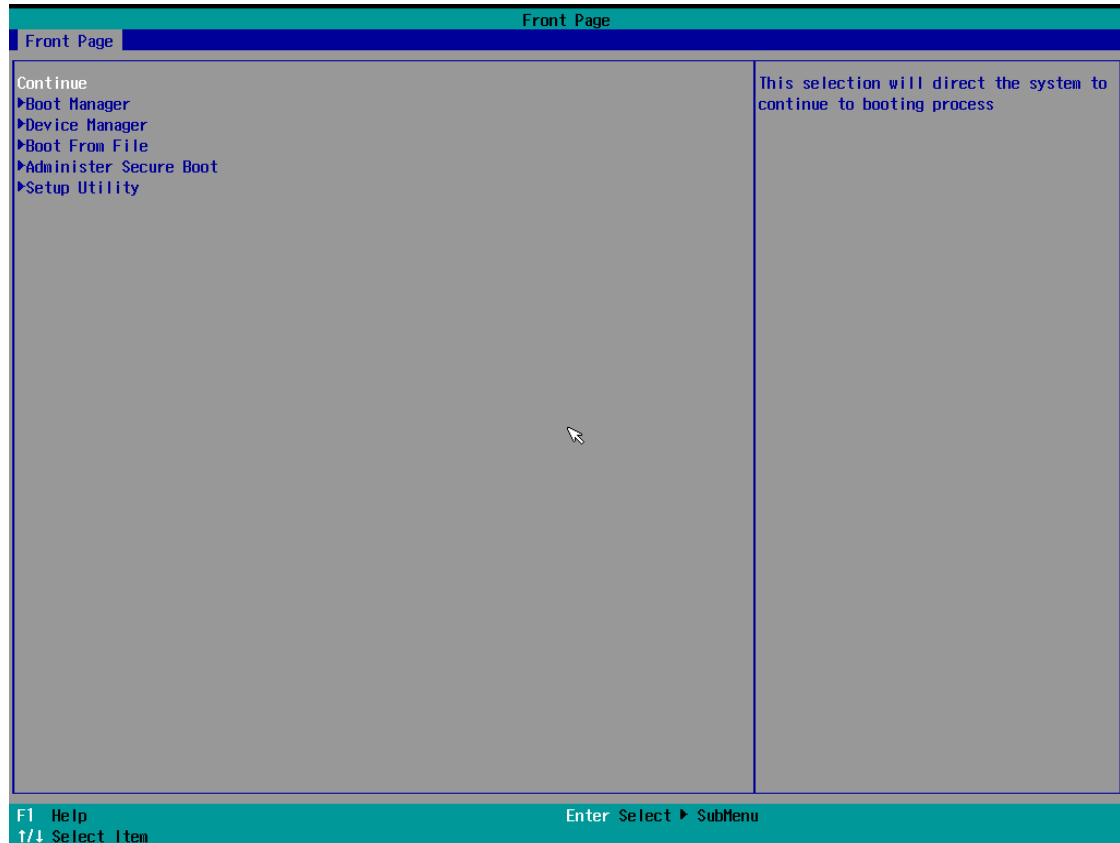


Illustration 7: InsydeH2O BIOS Front Page

6.1 Continue Boot Process

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

6.2 Boot Manager

Choose between possible boot options. If system is in UEFI Boot Mode one boot option will 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. If the button successfully pressed can be seen by sentence "ESC is pressed. Go to boot options" shown below the boot logo. On the splash screen that will appear, select "Setup Utility". The left frame of each menu page show the option, which can be configured whereas 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 screens 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
Platform Information	See submenu	Shows some platform information.
Language	English / Francais / 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
About this Software	See submenu	Shows Copyright © information of Insyde Software Corp.

6.6.2 Advanced

Use the right cursor to get from the main menu item to the advanced menu item.

Menu Item	Option	Description
Boot Configuration	See submenu	Configures settings for Boot Phase
USB Configuration	See submenu	Configure USB settings
Chipset Configuration	See submenu	Configure Platform Trust Technology
ACPI Table/Features Control	See submenu	Configure ACPI settings
RC Advanced Menu	See submenu	Configure Reference Code Features/Settings
SIO TQMx86	See submenu	Configure CPLD UARTs, TQ Board specific configuration and LVDS
Console Redirection	See submenu	Configure Console Redirection settings
H2OUve Configuration	See submenu	Configure H2OUVE support
SIO F81214E	See submenu	Configure UARTs of Fintek Super I/O F81214E
NVM Express Information	See submenu	Shows NVMe information



6.6.2.1.1 Boot Configuration

Setup Utility ⇒ Advanced ⇒ Boot Configuration

Menu Item	Option	Description
Numlock	On / Off	Allows to choose whether NumLock Key at system boot must be turned On or Off
Logo & SCU Resolution	Auto / 640 x 480 / 800 x 600 / 1024 x 768	Configuration Logo & Setup Utility Resolution
Rotate Screen	Disable / 90 degrees clockwise / 270 degrees clockwise	Enable/Disable Rotate Screen feature. Support 90 and 270 degrees clockwise.
H2O Setup – IGD display mode	Text Mode / Graphics Mode	Set the setup display mode for IGD.
H2O Setup – PEG display mode	Text Mode / Graphics Mode	Set the setup display mode for PEG.

6.6.2.1.2 USB Configuration

Setup Utility ⇒ Advanced ⇒ USB Configuration

Menu Item	Option	Description
USB BIOS Support	Enabled / Disabled	USB keyboard/mouse/storage support under UEFI environment.
Wake on USB from S5	Enabled / Disabled	Enable/Disable Wake on USB from S5 state.

6.6.2.1.3 Chipset Configuration

Setup Utility ⇒ Advanced ⇒ Chipset Configuration

Menu Item	Option	Description
Platform Trust Technology	Enabled / Disabled	Enable/Disable Platform Trust Technology.

6.6.2.1.4 ACPI Table/Features Control

Setup Utility ⇒ Advanced ⇒ ACPI Table/Features Control

Menu Item	Option	Description
FACP – RTC S4 Wakeup	Enabled / Disabled	Value only for ACPI. Enable/Disable for S4 Wakeup from RTC.
APIC – IO APIC Mode	Enabled / Disabled	This item is valid only for WIN2k and WINXP. Also, a fresh install of the OS must occur when APIC Mode is desired. Test the IO ACPI by setting item to Enable. The APIC table will then be pointed to by the RSDT, the Local APIC will be initialized, and the proper enable bits will be set in ICH4M.

6.6.2.1.5 RC Advanced Menu

Setup Utility ⇒ Advanced ⇒ RC Advanced Menu



Menu Item	Option	Description
ACPI Settings	See submenu	System ACPI parameters
CPU Configuration	See submenu	CPU Configuration parameters
Power & Performance	See submenu	Power & Performance parameters
Intel® Time Coordinated Computing	See submenu	Intel® Time Coordinated Computing (Intel® TCC) options. This menu shows options and links needed for real time systems.
Memory Configuration	See submenu	Memory Configuration parameters
System Agent (SA) Configuration	See submenu	System Agent (SA) parameters
PCH-IO Configuration	See submenu	PCH parameters
PCH-FW Configuration	See submenu	Configure Management Engine Technology parameters
Thermal Configuration	See submenu	Configure Fan Speed control under OS and while booting
Platform Settings	See submenu	Platform related settings

6.6.2.1.6 ACPI Settings

Setup Utility ⇒ Advanced ⇒ RC Advanced Menu ⇒ ACPI Settings

Menu Item	Option	Description
Enable ACPI Auto Configuration	[] / [X]	Enables or Disabled BIOS ACPI Auto Configuration
Enable Hibernation	[] / [X]	Enables or disables system ability to Hibernate (OS/S4 Sleep State). This option may not be effective with some OSs.
PTID Support	[] / [X]	PTID Support will be loaded if enabled.
PECI Access Method	Direct I/O / ACPI	PECI Access Method is Direct I/O or ACPI.
ACPI S3 support	Enabled / Disabled	Enable ACPI S3 support.
Native PCIE Enable	Enabled / Disabled	Enable Native PCIE.
Native ASPM	Auto / Enabled / Disabled	Enabled – OS controlled ASPM Disabled – BIOS controlled ASPM
BDAT ACPI Table Support	Enabled / Disabled	Enables support for the BDAT ACPI table
Low Power S0 Idle Capability	Enabled / Disabled	This variable determines if we enable ACPI Lower Power S0 Idle Capability (mutually exclusive with Smart connect). While this is enabled, it also disable 8254 timer for SLP_S0 support.
SSDT table from file	Enabled / Disabled	SSDT table from file.
PCI Delay Optimization	Enabled / Disabled	Experimental ACPI additions for FW latency optimizations.
MSI enabled	Enabled / Disabled	When disabled, MSI support is disabled in FADT.

6.6.2.1.7 CPU Configuration

Setup Utility ⇒ Advanced ⇒ RC Advanced Menu ⇒ CPU Configuration

Menu Item	Option	Description
CPU Flex Ratio Override	Enabled / Disabled	Enable/Disable CPU Flex Ratio programming.
CPU Flex Ratio Settings	[X]	This value must be between Max Efficiency Ratio (LFM) and maximum non-turbo ratio set by hardware (HFM). Note: Option just configurable when CPU Flex Ratio Override enabled.
Hardware Prefetcher	Enabled / Disabled	To turn on/off the MLC streamer prefetcher.
Adjacent Cache Line Prefetch	Enabled / Disabled	To turn on/off prefetching of adjacent cache lines.



Menu Item	Option	Description
Intel (VMX) Virtualization Technology	Enabled / Disabled	When enabled, a VMM can utilize the additional hardware capabilities provided by Vanderpool Technology.
Active Processor Cores	All / 1 / 2 / 3	Number of cores to enable in each processor package.
BIST	Enabled / Disabled	Enable/Disable BIST (Built-In Self Test) on reset.
AES	Enabled / Disabled	Enable/Disable AES (Advanced Encryption Standard).
Machine Check	Enabled / Disabled	Enable/Disable Machine Check.
MonitorMWait	Enabled / Disabled	Enable/Disable MonitorMWait.

6.6.2.1.8 Power & Performance

Setup Utility ⇒ Advanced ⇒ RC Advanced Menu ⇒ Power & Performance

Menu Item	Option	Description
CPU – Power Management Control	See submenu	CPU – Power Management Control options
GT – Power Management Control	See submenu	GT – Power Management Control options

Setup Utility ⇒ Advanced ⇒ RC Advanced Menu ⇒ Power & Performance ⇒ CPU – Power Management Control

Menu Item	Option	Description
Boot performance mode	Max Battery / Max Non-Turbo Performance/ Turbo Performance	Select the performance state that the BIOS will set starting from reset vector.
Intel® SpeedStep™	Enabled / Disabled	Allows more than two frequency ranges to be supported.
Race To Halt (RTH)	Enabled / Disabled	Enable/Disable Race To Halt feature. RTH will dynamically increase CPU frequency in order to enter pkg C-State faster to reduce overall power. RTH is controlled through MSR 1FC bit 20.
Intel® Speed Shift Technology	Enabled / Disabled	Enable/Disable Intel® Speed Shift Technology support. Enabling will expose the CPPC v3 interface to allow for hardware controlled P-states.
HDC Control	Enabled / Disabled	This option allows HDC configuration. Disabled: Disable HDC Enabled: Can be enabled by OS if OS native support is available.
Turbo Mode	Enabled / Disabled	Enable/Disable processor Turbo Mode (requires EMTM enabled too).
View/Configure Turbo Options	See submenu	View/Configure Turbo Options.
Platform PL1 Enable	Enabled / Disabled	Enable/Disable Platform Power Limit 1 programming. If this option is enabled, it activates the PL1 value to be used by the processor to limit the average power of given time window.
Platform PL2 Enable	Enabled / Disabled	Enable/Disable Platform Power Limit 2 programming. If this option is disabled, BIOS will program the default values for Platform Power Limit 2.
Power limit 4 Override	Enabled / Disabled	Enable/Disable Power Limit 4 override. If this option is disabled, BIOS will leave the default values for Power Limit 4.
C States	Enabled / Disabled	Enable/Disable CPU Power Management. Allows CPU to go to C states when it's not 100% utilized.
Enhanced C-states	Enabled / Disabled	Enable/Disable C1E. When enabled, CPU will switch to minimum speed when all cores enter C-State. Note: Only shown when C States enabled.



Menu Item	Option	Description
C-State Auto Demotion	C1 / Disabled	Configure C-State Auto Demotion. Note: Only shown when C States enabled.
C-State Un-demotion	C1 / Disabled	Configure C-State Un-demotion. Note: Only shown when C States enabled.
Package C-State Demotion	Enabled / Disabled	Package C-State Demotion. Note: Only shown when C States enabled.
Package C-State Un-demotion	Enabled / Disabled	Package C-State Un-demotion. Note: Only shown when C States enabled.
CState Pre-Wake	Enabled / Disabled	Disable – Sets bit 30 of POWER_CTL MSR(0x1FC) to 1 to disable the Cstate Pre-Wake. Note: Only shown when C States enabled.
IO MWAIT Redirection	Enabled / Disabled	When set, will map IO read instructions sent to IO registers PMG_IO_BASE_ADDRBASE+offset to MWAIT(offset). Note: Only shown when C States enabled.
Package C State Limit	C0/C1 / C2 / C3 / C6 / C7 / C7S / C8 / C9 / C10 / Cpu Default / Auto	Maximum Package C-State Limit Setting. Cpu Default: Leaves to Factory default value. Auto: Initializes to deepest available Package C-State Limit. Note: Only shown when C States enabled.
Time Unit	1 ns / 32 ns / 1024 ns / 32768 ns / 1048576 ns / 33554432 ns	Unit of measurement for IRTL value – bits [12:10] Note: Only shown when C States enabled.
Latency	0 – 1023	Interrupt Response Time Limit value-bits [9:0]
Thermal Monitor	Enabled Disabled	Enable/Disable Thermal Monitor.
CPU Lock Configuration	See submenu	CPU Lock Configuration

Setup Utility ⇒ Advanced ⇒ RC Advanced Menu ⇒ Power & Performance ⇒ CPU – Power Management Control ⇒ View/Configure Turbo Options

Menu Item	Option	Description
Energy Efficient P-state	Enabled / Disabled	Enable/Disable Energy Efficient P-state feature. When set to 0, will disable access to ENERGY_PERFORMANCE_BIAS MSR and CPUID Function 6 ECX[3] will read 0 indicating no support for Energy Efficient policy setting. When set to 1 will enable access to ENERGY_PERFORMANCE_BIAS MSR 1B0h and CPUID Function 6 ECX[3] will read 1 indicating Energy Efficient policy setting is supported.
Package Power Limit MSR Lock	Enabled / Disabled	Enable/Disable locking of Package Power Limit settings. When enabled, PACKAGE_POWER_LIMIT MSR will be locked and a reset will be required to unlock the register.
Power Limit 1 Override	Enabled / Disabled	Enable/Disable Power Limit 1 override. If this option is disabled, BIOS will program the default values for Power Limit 1 and Power Limit 1 Time Window.
Power Limit 1	[X]	Power Limit 1 in milliwatt. BIOS will round to the nearest 1/8W when programming. 0 = no custom override. For 12.50W, enter 12500.



Menu Item	Option	Description
		Overclocking SKU: Value must be between Max and Min Power Limits (specified by PACKAGE_POWER_SKU_MSR). Other SKUs: This value must be between Min Power Limit and TDP Limit. If value is 0, BIOS will program TDP value. Note: Option only shown when Power Limit 1 enabled.
Power Limit 1 Time Window	<X>	Power Limit 1 Time Window value in seconds. The value may vary from 0 to 128. 0 = default value (28 sec for Mobile and 8 sec for Desktop). Defines time window which TDP value should be maintained. Note: Option only shown when Power Limit 1 enabled.
Power Limit 2 Override	Enabled / Disabled	Enable/Disable Power limit 2 override. If this option is disabled, BIOS will program the default values for Power Limit 2.
Power Limit 2	[X]	Power Limit 2 in milliwatt. BIOS will round to the nearest 1/8W when programming. If the value is 0, BIOS will program this value as 1.25*TDP. For 12.5 W, enter 12500. Processor applies control policies such that the package power does not exceed this limit.
		Note: Option only shown when Power Limit 2 enabled.
1-Core Ratio Limit Override	[X]	1-Core Ratio Limit with range 0 to 83. The minimum range may vary between processors. This 1-Core Ratio Limit must be greater than or equal to 2-Core Ratio Limit, 3-Core Ratio Limit, 4-Core Ratio Limit
2-Core Ratio Limit Override	[X]	2-Core Ratio Limit with range 0 to 83. The minimum range may vary between processors. This 2-Core Ratio Limit must be greater than or equal to 1-Core Ratio Limit.
3-Core Ratio Limit Override	[X]	3-Core Ratio Limit with range 0 to 83. The minimum range may vary between processors. This 3-Core Ratio Limit must be greater than or equal to 1-Core Ratio Limit.
4-Core Ratio Limit Override	[X]	4-Core Ratio Limit with range 0 to 83. The minimum range may vary between processors. This 4-Core Ratio Limit must be greater than or equal to 1-Core Ratio Limit.
Energy Efficient Turbo	Enabled / Disabled	Enable/Disable Energy Efficient Turbo Feature. This feature will opportunistically lower the turbo frequency to increase efficiency. Recommended only to disable in overclocking situations where turbo frequency must remain constant. Otherwise, leave enabled.

Setup Utility ⇒ Advanced ⇒ RC Advanced Menu ⇒ Power & Performance ⇒ CPU – Power Management Control ⇒ CPU Lock Configuration

Menu Item	Option	Description
CFG Lock	Enabled / Disabled	Configure MSR 0xE2[15], CFG Lock bit
Overclocking Lock	Enabled / Disabled	Enable/Disable Overclocking Lock (Bit 20) in FLEX_RATIO(194) MSR

Setup Utility ⇒ Advanced ⇒ RC Advanced Menu ⇒ Power & Performance ⇒ GT – Power management Control

Menu Item	Option	Description
RC6(Render Standby)	Enabled / Disabled	Check to enable render standby support.
Maximum GT frequency	Default Max Frequency / X MHz	Maximum GT frequency limited by the user. Choose between 200 MHz (RPN) and 400 MHz (RP0). Value beyond the range will be clipped to min/max supported by SKU.
Disable Turbo GT frequency	Enabled / Disabled	Enabled: Disables Turbo GT frequency Disabled: GT frequency is not limited

6.6.2.1.9 Intel® Time Coordinated Computing

Setup Utility ⇒ Advanced ⇒ RC Advanced Menu ⇒ Intel® Time Coordinated Computing



Menu Item	Option	Description
Intel® TCC Mode	Enabled / Disabled	Enable or disable Intel® TCC mode. When enabled, this will modify system settings to improve real-time performance. The full list of settings and their current state are displayed below when Intel® TCC mode is enabled.
IO Fabric Low Latency	Enabled / Disabled	Enable or disable IO Fabric Low Latency. This will turn off some power management in the PCH IO fabrics. This option provides the most aggressive IO Fabric performance setting. S3 state is NOT supported.
GT CLOS	Enabled / Disabled	Enable or disable Graphics Technology (GT) Class of Service. Enable will reduce Gfx LLC allocation to minimize Impact of Gfx workload on LLC.

All other options are internal links to configurations which could impact to Time Coordinated Computing.

6.6.2.1.10 Memory Configuration

Setup Utility ⇒ Advanced ⇒ RC Advanced Menu ⇒ Memory Configuration

Menu Item	Option	Description
REFRESH_2X_MODE	Disabled / 1-Enabled for WARM or HOT 2- Enabled HOT only	0 – Disabled 1 – iMC enables 2xRef when Warm and Hot 2 – iMC enables 2xRef when Hot
In-Band ECC	Enabled / Disabled	Enable/Disable In-Band ECC

6.6.2.1.11 System Agent (SA) Configuration

Setup Utility ⇒ Advanced ⇒ RC Advanced Menu ⇒ System Agent (SA) Configuration

Menu Item	Option	Description
Graphics Configuration	See submenu	Graphics Configuration
VT-d	Enabled / Disabled	VT-d capability
X2APIC Opt Out	Enabled / Disabled	Enable/Disable X2APIC_OPT_OUT bit.
DMA Control Guarantee	Enabled / Disabled	Enable/Disable DMA_CONTROL_GUARANTEE bit.
IGD VTD Enable	Enabled / Disabled	Enable/Disable IGD VTD.
IOP VTD Enable	Enabled / Disabled	Enable/Disable IOP VTD.
GNA Device (B0:D8:F0)	Enabled / Disabled	Enable/Disable SA GNA Device.
CRID Support	Enabled / Disabled	Enable/Disable SA CRID and TCSS CRID control for Intel SIPP.
Above 4GB MMIO BIOS assignment	Enabled / Disabled	Enable/Disable above 4 GB MemoryMappedIO BIOS assignment. This is enabled automatically when Aperture Size is set to 2048 MB.

Setup Utility ⇒ Advanced ⇒ RC Advanced Menu ⇒ System Agent (SA) Configuration ⇒ Graphics Configuration

Menu Item	Option	Description
Skip Scanning of External Gfx Card	Enabled / Disabled	If Enable, it will not scan for External Gfx Card on PEG and PCH PCIE Ports.
Primary Display	Auto / IGD / PCIe	Select which of IGD or PCI Graphics device should be Primary Display. Or select HG for Hybrid Gfx.
Internal Graphics	Auto / Enabled / Disabled	Keep IGFX enabled based on the setup options.
GTT Size	2MB / 4MB / 8MB	Select the GTT Size.
Aperture Size	128MB / 256MB / 512MB / 1024MB / 2048MB	Select the Aperture Size. Note: Above 4 GB MMIO BIOS assignment is automatically enabled when selecting 2048 MB aperture. To use this feature, please disable CSM support.



Menu Item	Option	Description
PSMI SUPPORT	Enabled / Disabled	PSMI Enable/Disable
DVMT Pre-Allocated	64M / 96M / 128M / 160M / 192M / 224M / 256M / 288M / 320M / 352M / 384M / 416M / 448M / 480M / 512M	Select DVMT5.0 (Dynamic Video Memory Technology) Pre-Allocated (fixed) Graphics Memory size used by the Internal Graphic Device.
DVMT Total Gfx Mem	128M / 256M / MAX	Select the DVMT5.0 (Dynamic Video Memory Technology) Total Graphics Memory size used by the Internal Graphics Device.
DiSM Size	0GB / 1GB / 2GB / 3GB / 4GB / 5GB / 6GB / 7GB	DiSM Size for 2LM Sku.
Intel Graphics Pei Display Peim	Enabled / Disabled	Enable/Disable Pei (Early) Display.
VDD Enable	Enabled / Disabled	Enable/Disable forcing of VDD in the BIOS.
PM Support	Enabled / Disabled	Enable/Disable PM Support.
PAVP Enable	Enabled / Disabled	Enable/Disable PAVP.
Cdynmax Clamping Enable	Enabled / Disabled	Enable/Disable Cdynmax Clamping.
Cd Clock Frequency	307.2 MHz / 556.8 MHz / 652 MHz / Max CdClock freq basen on Reference Clk	Select the highest Cd Clock frequency supported by the platform.
Skip Full CD Clock Init	Enabled / Disabled	Enabled: Skip Full CD clock initialization. Disabled: Initialize the full CD clock if not initialized by Gfx PEIM.
LCD Control	See submenu	LCD Control options.

Setup Utility ⇒ Advanced ⇒ RC Advanced Menu ⇒ System Agent (SA) Configuration ⇒ Graphics Configuration ⇒ LCD Control

Menu Item	Option	Description
Primary IGFX Boot Display	VBIOS Default / EFP / LFP / EFP3 / EFP2 / EFP4	Select the Video Device which will be activated during POST. This has no effect if external graphics present. Secondary boot display selection will appear based on your selection. VGA modes will be supported only on primary display.
LCD Panel Type	VBIOS Default / 640 × 480 LVDS / 800 × 600 LVDS / 1024 × 768 LVDS / 1280 × 1024 LVDS / 1400 × 1050 LVDS1 / 1400 × 1050 LVDS2 / 1600 × 1200 LVDS / 1366 × 768 LVDS / 1680 × 1050 LVDS / 1920 × 1200 LVDS / 1440 × 900 LVDS / 1600 × 900 LVDS / 1024 × 768 LVDS / 1280 × 800 LVDS / 1920 × 1080 LVDS / 2048 × 1536 LVDS / 1366 × 768 LVDS	Select LCD panel used by internal graphics device by selecting the appropriate setup item.
Panel Scaling	Auto / Off / Force Scaling	Select the LCD panel scaling option used by the internal graphics device.
Backlight Control	PWM Inverted / PWM Normal	Backlight control setting.



6.6.2.1.12 PCH-IO Configuration

Setup Utility ⇒ Advanced ⇒ RC Advanced Menu ⇒ PCH-IO Configuration

Menu Item	Option	Description
PCI Express Configuration	See submenu	PCI Express Configuration settings
SATA configuration	See submenu	SATA Device Options settings
USB Configuration	See submenu	USB Configuration settings
Security Configuration	See submenu	Security Configuration settings
HD Audio Configuration	See submenu	HD Audio Subsystem Configuration settings
SCS Configuration	See submenu	Storage and Communication Subsystem (SCS) Configuration
PSE Configuration	See submenu	Programmable Service Engine (PSE) Configuration
TSN GBE Configuration	See submenu	Time Sensitive Network GBE Configuration
Wake on WLAN and BT Enable	Enabled / Disabled	Enable/Disable PCI Express Wireless LAN and Bluetooth to wake the system.
State After G3	S0 State / S5 State / Last State	Specify what state to go to when power is re-applied after a power failure (G3 state).
Pcie PII SSC	Auto / X% / Disable	Pcie PII SSC percentage. Auto – Keep HW default, no BIOS override Range is 0.0% - 2.0%
Flash Protection Range Registers (FPRR)	Enabled / Disabled	Enable Flash Protection Range Registers.
Global Reset Three Strike Counter	Enabled / Disabled	Enable/Disable Three Strike Counter (if enabled, PMC will keep platform in S5 after 3 rd consecutive type7 global reset occurs during boot flow).

Setup Utility ⇒ Advanced ⇒ RC Advanced Menu ⇒ PCH-IO Configuration ⇒ PCI Express Configuration

Menu Item	Option	Description
DMI Link ASPM Control	Disabled / L0s / L1 / L0xL1 / Auto	The control of Active State Power Management of the DMI Link.
Peer Memory Write Enable	Enabled / Disabled	Peer Memory Write Enable/Disable.
Compliance Test Mode	Enabled / Disabled	Enable when using Compliance Load Board.
PCIe function swap	Enabled / Disabled	When disabled, prevents PCIe rootport function swap. If any function other than 0 th is enabled, 0 th will become visible.
PCIe EQ settings	See submenu	This form contains options for controlling PCIe EQ process.
PCI Express Root Port X	See submenu	Configuration of the corresponding PCI Express Root Port X.

Setup Utility ⇒ Advanced ⇒ RC Advanced Menu ⇒ PCH-IO Configuration ⇒ PCI Express Configuration ⇒ PCIe EQ settings

Menu Item	Options	Description
PCIe EQ override	[] / [X]	Choose your own PCIe EQ settings, only for users who have a thorough understanding of equalization process.
PCIe EQ method	PCIe hardware EQ / PCIe fixed EQ	Choose PCIe EQ method
PCIe EQ mode	Use presets during EQ / Use coefficients during EQ	Choose EQ mode. Preset mode – root port will use presets during EQ process Coefficient mode – root port will use coefficients during EQ process
EQ PH1 downstream port transmitter preset	0 – 10	Choose the value of the preset that will be used during phase 1 of the equalization
EQ PH1 upstream port transmitter preset	0 – 10	Choose the value of the preset that will be used during phase 1 of the equalization



Menu Item	Options	Description
Enable EQ phase 2 local transmitter override	[] / [X]	EQ Phase 2 local transmitter override can be used to debug issues with PCI devices equalization
EQ Phase 2 local transmitter override preset	0 – 10	Select preset which will be used during phase 2 of the PCIe EQ process
Number of presets of coefficients used during phase 3	0 – 11	Select how many presets or coefficients will be used during phase 3 of EQ. Please note that you have to set all of the list entries to valid values. The interpretation of this field depends on PCIe EQ mode.
Prese X	0 – 63	Choose the target preset value.

Setup Utility ⇒ Advanced ⇒ RC Advanced Menu ⇒ PCH-IO Configuration ⇒ PCI Express Configuration ⇒ PCI Express Root Port X

Menu Item	Options	Description
PCI Express Root Port X	Enabled / Disabled	Control the PCI Express Root Port.
Connection Type	Built-in / Slot	Built-In: a built-in device is connected to this rootport. SlotImplemented bit will be clear. Slot: this rootport connects to user-accessible slot. SlotImplemented bit will be set.
ASPM	Disabled / L0s / L1 / L0sL1 / Auto	PCI Express Active State Power Management settings.
L1 Substates	Disabled / L1.1 / L1.1 & L1.2	PCI Express L1 Substates settings.
ACS	Enabled / Disabled	Enable or Disable Access Control Services extended capability.
PTM	Enabled / Disabled	Enable or Disable Precision Time Measurement.
DPC	Enabled / Disabled	Enable or Disable Downstream Port Containment.
EDPC	Enabled / Disabled	Enable or Disable Rootport extensions for Downstream Port Containment.
URR	Enabled / Disabled	PCI Express Unsupported Request Reporting enable/disable.
FER	Enabled / Disabled	PCI Express Device Fatal Error Reporting enable/disable.
NFER	Enabled / Disabled	PCI Express Device Non-Fatal Error Reporting enable/disable.
CER	Enabled / Disabled	PCI Express Device Correctable Error Reporting enable/disable.
SEFE	Enabled / Disabled	Root PCI Express System Error on Fatal Error enable/disable.
SENEFE	Enabled / Disabled	Root PCI Express System Error on Non-Fatal Error enable/disable.
SECE	Enabled / Disabled	Root PCI Express System Error on Correctable Error enable/disable.
PME SCI	Enabled / Disabled	PCI Express PME SCI enable/disable.
Hot Plug	Enabled / Disabled	PCI Express Hot Plug enable/disable.
Advanced Error Reporting	Enabled / Disabled	Advanced Error Reporting enable/disable.
PCIe Speed	Auto / Gen1 / Gen2 / Gen3	Configure PCIe Speed.
Transmitter Half Swing	Enabled / Disabled	Transmitter Half Swing enable/disable.
Detect Timeout	[X]	The number of milliseconds reference code will wait for link to exit Detect state for enabled ports before assuming there is no device and potentially disabling the port.
Extra Bus Reserved	[X]	Extra Bus Reserved (0-7) for bridges behind this Root Bridge.
Reserved Memory	[X]	Reserved Memory for this Root Bridge (1-20) MB.
Reserved IO	[X]	Reserved I/O (4K/8K/12K/16K/20K) Range for this Root Bridge.
LTR	Enabled / Disabled	PCH PCIE Latency Reporting Enable/Disable.
Snoop Latency Override	Auto / Manual / Disabled	Snoop Latency Override for PCH PCIE. Disabled: Disable override Manual: Manually enter override values. Auto (default): Maintain default BIOS flow.



Menu Item	Options	Description
Non Snoop Latency Override	Auto / Manual / Disabled	Non Snoop Latency Override for PCH PCIE. Disabled: Disable override Manual: Manually enter override values. Auto (default): Maintain default BIOS flow.
Force LTR Override	Enabled / Disabled	Force LTR Override for PCH PCIE. Disabled: LTR Override values will not be forced. Enabled: LTR override values will be forced and LTR messages from the device will be ignored.
LTR Lock	Enabled / Disable	PCIE LTR configuration lock.

Setup Utility ⇒ Advanced ⇒ RC Advanced Menu ⇒ PCH-IO Configuration ⇒ SATA Configuration

Menu Item	Options	Description
SATA Controller(s)	Enabled / Disabled	Enable or disable SATA Device.
SATA Mode Selection	AHCI / Intel RST Premium With Intel Optane System Acceleration	Determine how SATA controller(s) operate.
SATA Ports Multiplier	Enabled / Disabled	Ports Multiplier enable/disable.
SATA Test Mode	Enabled / Disabled	Test Mode enable/disable (loop back).
SATA Speed	Gen 1 / Gen 2 / Gen 3	SATA Speed.
Software Feature Mask Configuration	See submenu	RST Legacy OROM/RST UEFI driver will refer to the SWFM configuration to enable/disable the storage features.
Aggressive LPM Support	Enabled / Disabled	Enable PCH to aggressively enter link power state.
Serial ATA Port X	Enabled / Disabled	Enable or Disable SATA Port.
Hot Plug	Enabled / Disabled	Designates this port as Hot Pluggable.
External	Enabled / Disabled	Marks this port as external.
Spin Up Device	Enabled / Disabled	If enabled for any of ports Staggered Spin Up will be performed and only the drives which have this option enabled will spin up at boot. Otherwise all drives spin up at boot.
SATA Device Type	Hard Disk Drive / Solid State Drive	Identify the SATA port is connected to Solid State Drive or Hard Disk Drive.
Topology	Unknown / ISATA / Direct Connect / Flex / M2	Identify the SATA Topology if it is Default or ISATA or Flex or DirectConnect or M2.
SATA Port X DevSlp	Enabled / Disabled	Enable/Disable SATA Port 0 DevSlp. For DevSlp to work, both hard drive and SATA port need to support DevSlp function, otherwise an unexpected behaviour might happen. Please check board design before enabling it.
SATA Port X RxPolarity	Enabled / Disabled	Enable/Disable SATA Port X RxPolarity. Default should disable, please check board design before enable it.
DITO Configuration	Enabled / Disabled	Enable or disable DITO Configuration.
DITO Value	0 – 999	DITO Value. <u>Note:</u> This option is only configurable if "DITO Configuration" is enabled.
DM Value	0 – 15	DM Value. <u>Note:</u> This option is only configurable if "DITO Configuration" is enabled.

Setup Utility ⇒ Advanced ⇒ RC Advanced Menu ⇒ PCH-IO Configuration ⇒ USB Configuration

Menu Item	Options	Description
XHCI Compliance Mode	Enabled / Disabled	Option to enable Compliance Mode. Default is to disable Compliance Mode. Change to enabled for Compliance Mode testing.
xDCI Support	Enabled / Disabled	Enable/Disable xDCI (USB OTG Device)
USB Port Disable Override	Select per Pin / Disabled	Selectively enable/disable the corresponding USB port from reporting a device



Menu Item	Options	Description
		connection to the controller.
USB HS / SS Physical Connector #X	Enabled / Disabled	Enable/Disable USB Physical Connector #X (Physical port). Once disabled, any USB device plug into the connector will not be detected by BIOS or OS.
USB Device/HOST Mode Override	Select Per-Pin / Disabled	Selectively enable/disable the corresponding USB 2.0 and USB 3.0 device mode.
USB HS / SS X Operation Mode	Platform-POR / USB Host Mode / USB Device Mode	Select USB Operation Mode.

Setup Utility ⇒ Advanced ⇒ RC Advanced Menu ⇒ PCH-IO Configuration ⇒ Security Configuration

Menu Item	Options	Description
RTC Memory Lock	Enabled / Disabled	Enable will lock bytes 38h-3Fh in the lower/upper 128-byte bank of RTC RAM.
BIOS Lock	Enabled / Disabled	Enable/Disable the PCH BIOS Lock Enable feature. Required to be enabled to ensure SMM protection of flash.
Force unlock on all GPIO pads	Enabled / Disabled	If enabled BIOS will force all GPIO pads to be in unlocked state.

Setup Utility ⇒ Advanced ⇒ RC Advanced Menu ⇒ PCH-IO Configuration ⇒ HD Audio Configuration

Menu Item	Options	Description
HD Audio	Enabled / Disabled	Control Detection of the HD-Audio device. Disabled: HAD will be unconditionally disabled. Enabled: HAD will be unconditionally enabled.
Audio DSP	Enabled / Disabled	Enable or disable Audio DSP.
Audio DSP Compliance Mode	Non-UAA (IntelSST) / UAA (HAD Inbox/IntelSST)	Specifies DSP enabled system compliance. Non-UAA (IntelSST driver support only – CC_040100) UAA (HD Audio Inbox or IntelSST driver support – CC_040380)
Audio Link Mode	HD Audio Link / Advanced Link Config	Select Link mode
HDA-Link Codec Select	Platform Onboard / External Kit	Selects whether Platform Onboard Codec (single Verb Table Installed) or External Codec Kit (multiple Verb Tables installed) will be used.

Setup Utility ⇒ Advanced ⇒ RC Advanced Menu ⇒ PCH-IO Configuration ⇒ SCS Configuration

Menu Item	Options	Description
eMMC 5.0 Controller	Enabled / Disabled	Enable or disable SCS eMMC 5.0 Controller.
eMMC 5.1 HS400 Mode	Enabled / Disabled	Enable or disable SCS eMMC 5.1 HS400 Mode in BIOS and OS.
Driver Strength	33 Ohm / 40 Ohm / 50 Ohm	Sets I/O driver strength.
SD card 3.0 Controller	Enabled / Disabled	Enable or disable SCS SDMC 3.0 Controller.

Setup Utility ⇒ Advanced ⇒ RC Advanced Menu ⇒ PCH-IO Configuration ⇒ PSE Configuration

Menu Item	Options	Description
PSE Controller	Enabled / Disabled	Enables/Disables Programmable Service Engine (PSE) device
CAN0	None / PSE owned with pin muxed / Host owned with pinx muxed	Enables/Disables CAN interface. PSE owned – CAN used over PSE under Zephyr OS Host owned – CAN used under other OS (Linux) Note: Ensure CAN is also enabled in SioTqmx86 'COM Express Serial Port 1 Routing'



Menu Item	Options	Description
CAN1	None / PSE owned with pin muxed / Host owned with pinx muxed	Enables/Disables CAN interface. PSE owned – CAN used over PSE under Zephyr OS Host owned – CAN used under other OS (Linux) Note: Ensure CAN is also enabled in SioTqmx86 'COM Express Serial Port 1 Routing'

Setup Utility ⇒ Advanced ⇒ RC Advanced Menu ⇒ PCH-IO Configuration ⇒ TSN GBE Configuration

Menu Item	Options	Description
PCH TSN LAN Controller	Enabled / Disabled	Enable/Disable TSN LAN.
PCH TSN GBE Multi-Vc	Enabled / Disabled	Enable/Disable TSN Multi Virtual Channels.
PCH TSN GBE SGMII Support	Enabled / Disabled	Enable/Disable SGMII mode for PCH TSN GBE. Ports in SGMII mode with the same PLL common lane must use the same link speed. SATA or UFS may need to be disabled if TSN port is using the same PLL common lane. Please make sure IFWI has proper straps set for SGMII. Make sure Flex IO Lane Assignment is not None.
PCH TSN Link Speed	RefClk 24MHz 2.5Gbps / RefClk 24MHz 1Gbps / RefClk 38.4MHz 2.5Gbps / RefClk 38.4MHz 1Gbps /	PCH TSN Link Speed Configuration.
PSE TSN GBE X Multi-Vc	Enabled / Disabled	Enable/Disable TSN Multi Virtual Channels. TSN GBE must be host owned.
PSE TSN GBE X SGMII Support	Enabled / Disabled	Enable/Disable Modphy support for SGMII mode for PSE TSN GBE X. Ports in SGMII mode with the same PLL common lane must use the same link speed. UFS will need to be disabled as this TSN port uses the same PLL common lane. Please make sure IFWI has proper straps set for SGMII. Make sure Flex IO Lane Assignment is not NONE.
PSE TSN GBE X Link Speed	RefClk 38.4Mhz 2.5 Gbps / RefClk 38.4Mhz 1Gbps	PSE TSN GBE 0 Link Speed configuration.
Wake on LAN Enable	Enabled / Disabled	Enable/Disable integrated LAN to wake the system.
Skip TSN MAC region	Enabled / Disabled	Skip the TSN MAC region.
Skip TSN IP region	Enabled / Disabled	Skip the TSN IP region.
Skip TSN Config region	Enabled / Disabled	Skip the TSN config region.

6.6.2.1.13 PCH-FW Configuration

Setup Utility ⇒ Advanced ⇒ RC Advanced Menu ⇒ PCH-FW Configuration

Menu Item	Option	Description
ME State	Enabled / Disabled	When disabled ME will be put into ME Temporarily Disabled mode.
Firmware Update Configuration	See submenu	Configure Management Engine Technology parameters.

Setup Utility ⇒ Advanced ⇒ RC Advanced Menu ⇒ PCH-FW Configuration ⇒ Firmware Update Configuration

Menu Item	Option	Description
Me FW Image Re-Flash	Enabled / Disabled	Enable/Disable Me FW Image Re-Flash function. This option is only valid for next boot.
FW Update	Enabled / Disabled	Enable/Disable ME FW Update function.



6.6.2.1.14 Thermal Configuration

Setup Utility ⇒ Advanced ⇒ RC Advanced Menu ⇒ Thermal Configuration

Menu Item	Option	Description
Enable All Thermal Functions	Enabled / Disabled	Enables Fan Control under OS with different Trip Points.
Platform Thermal Configuration	See submenu	Platform Thermal Configuration options
Hardware Health Monitor	See submenu	Configure Fan speed while boot process.

Setup Utility ⇒ Advanced ⇒ RC Advanced Menu ⇒ Thermal Configuration ⇒ Platform Thermal Configuration

Menu Item	Option	Description
Critical Trip Point	15 C – 130 C	This value controls the temperature of the ACPI Critical Trip Point – the point in which the OS will shut the system off. Note: 110C is the Plan Of Record (POR) for all Intel mobile processors.
Active Trip Point 0	Disabled / 15 C – 119 C	This value control the temperature of the ACPI Active Trip Point 0 – the point in which the OS will turn the processor fan on Active Trip Point 0 Fan Speed.
Active Trip Point 0 Fan Speed	0 – 100	Active Trip Point 0 Fan Speed in percentage. Value must be between 0 (Fan off) – 100 (Max fan speed). This is the speed at which fan will run when Active Trip Point 0 is crossed.
Active Trip Point 1	Disabled / 15 C – 119 C	This value control the temperature of the ACPI Active Trip Point 1 – the point in which the OS will turn the processor fan on Active Trip Point 1 Fan Speed.
Active Trip Point 1 Fan Speed	0 – 100	Active Trip Point 1 Fan Speed in percentage. Value must be between 0 (Fan off) – 100 (Max fan speed). This is the speed at which fan will run when Active Trip Point 1 is crossed.
Passive Trip Point	Disabled / 15 C – 119 C	This value controls the temperature of the ACPI Passive Trip Point – the point in which the OS will begin throttling the processor.
Passive TC1 Value	1 – 16	This value sets the TC1 value for the ACPI Passive Cooling Formula.
Passive TC2 Value	1 – 16	This value sets the TC2 value for the ACPI Passive Cooling Formula.
Passive TSP Value	2 – 32	This item sets the TSP value for the ACPI Passive Cooling Formula. It represents in tenths of a second how often the OS will read the temperature when passive cooling is enabled.
Disable Active Trip Points	Enabled / Disabled	Disable Active Trip Points.
Disable Passive Trip Points	Enabled / Disabled	Disable Passive Trip Points.
Disable Critical Trip Points	Enabled / Disabled	Disable Critical Trip Points.

Setup Utility ⇒ Advanced ⇒ RC Advanced Menu ⇒ Thermal Configuration ⇒ Hardware Health Monitor

Menu Item	Option	Description
Boot Fan Speed	[0] – [100]	Set the Boot Fan Speed while boot process in percentage.

6.6.2.1.15 Platform Settings

Setup Utility ⇒ Advanced ⇒ RC Advanced Menu ⇒ Platform Settings

Menu Item	Option	Description
HID Event Filter Driver	Enabled / Disabled	Enables/Disables HID Event Filter Driver Interface to OS.
Enable PowerMeter	Enabled / Disabled	Enables/Disables PowerMeter.



6.6.2.1.16 SIO TQMx86

Setup Utility ⇒ Advanced ⇒ SIO TQMx86

Menu Item	Option	Description
Serial Port X	Enabled / Disabled / Auto	Disabled: No configuration Enabled: User Configuration Auto: EFI/OS chooses configuration
Base I/O Address	2E8 / 2F8 / 3E8 / 3F8	Configure Base I/O Address of corresponding Serial Port X.
Interrupt	IRQ3 / IRQ4 / IRQ5 / IRQ6 / IRQ7	Configure Interrupt of corresponding Serial Port X.
Handshake RTS/CTS	Connected / Disconnected	Connect or disconnect the COM Express Serial Port Handshake RTS/CTS for Serial Port X.
Power State S5	Normal / Low Power / Ultra Low Power	Configure Power State S5. Normal: Wakeup over LAN (WOL), timer, external Wake and Power Button possible. Ultra Low Power: Wakeup over Power Button possible.
GPI Interrupt Configuration	Interrupt disabled / IRQ7 / IRQ9 / IRQ12	Configure the GPI Interrupt number. Note: The interrupt is level high-triggered (ISA-style)
GPIO/SD-Card configuration	GPIO interface SD-Card interface	Configure the COM Express configuration as GPIO or SD-Card interface
Display Port B Aux Selection	DDC/AUX selection over RSVD9 pin (AUX is HW default) / DDC I2C is enabled	Choose if DDC I2C is enabled for DP_B or DDC/AUX selected over RSVD9 pin (A86). Note: For DDC/AUX selection AUX is HW default.
Gigabit Ethernet SDP	Output – generating time stamp / Input – receive time stamp	Choose if Gigabit Ethernet Software defined Pin (SDP) is used as input (receive time stamp) or output (generating time stamp).
COM Express Serial Port 1 Routing	CPLD UART 1 / CAN 1	Configure Multiplexer of Serial Port 1 either to CPLD UART 1 or CAN 1. Note: Ensure CAN is also enabled in 'PSE Configuration'.
Enable LVDS bridge	Enabled / Disabled	Enable or Disable the eDP-to-LVDS bridge.
LVDS Configuration	Enabled / Disabled	Enable or Disable the configuration of eDP-to-LVDS bridge.
LVDS Colour depth and data packing format	VESA 24 bpp / JEIDA 24 bpp / VESA and JEIDA 18 bpp	Configure the LVDS Colour depth in eDP-to-LVDS bridge.
LVDS dual/single mode	Single LVDS bus mode / Dual LVDS bus mode	Configure LVDS dual/single mode.
LVDS clock frequency center spreading depth	No Spreading / 0.5 % / 1.0 % / 1.5 % / 2.0 % / 2.5 %	Configure LVDS clock frequency center spreading depth.
LVDS EDID information	EDID Emulation off – read from DDC EDID Emulation on – read from internal Flash	Configure if the EDID information should be read from DDC or internal flash of eDP-to-LVDS bridge.
LVDS Resolution	1024 × 768 @ 60 Hz NXP Generic / 800 × 480 @ 60 Hz NXP Generic / 480 × 272 @ 60 Hz NXP Generic / 1600 × 900 @ 60 Hz Samsung LTM200 KT / 1920 × 1080 @ 60 Hz Samsung LTM230 HT / 1366 × 768 @ 60 Hz NXP Generic / 320 × 240 @ 60 Hz NXP Generic	Configure the resolution of eDP-to-LVDS bridge. Note: This option is only visible if 'LVDS EDID information' is set on 'EDID Emulation on – read from internal Flash'.



6.6.2.1.17 Console Redirection

Setup Utility ⇒ Advanced ⇒ Console Redirection

Menu Item	Option	Description
Console Serial Redirect	Enabled / Disabled	Enable or disable the Console Redirection. This options unhide CR parameters when enabled.

If enabled:

Menu Item	Option	Description
Terminal Type	VT_100 / VT_100+ / VT_UTF8 / PC_ANSI	Select the Console Redirection terminal type.
Baud Rate	115200 / 57600 / 38400 / 19200 / 9600 / 4800 / 2400 / 1200	Select the Console Redirection Baud Rate.
Data Bits	7 Bits / 8 Bits	Select the Console Redirection Data Bits.
Parity	None / Even / Odd	Select the Console Redirection Parity Bits.
Stop Bits	1 Bit / 2 Bits	Select the Console Redirection Stop Bits.
Flow Control	None / RTS/CTS / XON/XOFF	Select the Console Redirection Flow Control type.
Information Wait Time	0 Second / 2 Second / 5 Second / 10 Second / 30 Second	Select the Console Redirection Port information display time.
C.R. After Post	Yes / No	Console Redirection continue works after POST time.
Text Mode Resolution	AUTO / Force 80x25 / Force 80x24 (DEL FIRST ROW) / Force 80x24 (DEL LAST ROW)	Console Redirection Text Mode Resolution. Auto: Follow VGA text mode Force 80x25: Don't care about VGA and force text mode to be 80x25 Force 80x24 (DEL FIRST ROW): Don't care about VGA and force text mode to be 80x24 and Del first row Force 80x24 (DEL LAST ROW): Don't care about VGA and force text mode to be 80x24 and Del last row
AutoRefresh	Enabled / Disabled	When feature enable, screen will be auto refresh once after detect remote terminal was connected.
COM_X	See submenu	Set parameters of serial Port COMX.

Note: All COM / HSUART submenu are identical and, thus, they just will be listed once.

Menu Item	Option	Description
PortEnable	Enabled / Disabled	Enable or disable corresponding port.
UseGlobalSetting	Enabled / Disabled	If enabled use settings defined in superordinate CR menu. Disabling this option unhides corresponding settings.
Terminal Type	VT_100 / VT_100+ / VT_UTF8 / PC_ANSI	Select the Console Redirection terminal type.
Baud Rate	115200 / 57600 / 38400 / 19200 / 9600 / 4800 / 2400 / 1200	Select the Console Redirection Baud Rate.
Data Bits	7 Bits / 8 Bits	Select the Console Redirection Data Bits.
Parity	None / Even / Odd	Select the Console Redirection Parity Bits.
Stop Bits	1 Bit / 2 Bits	Select the Console Redirection Stop Bits.
Flow Control	None / RTS/CTS / XON/XOFF	Select the Console Redirection Flow Control type.

6.6.2.1.18 H2OUVE Configuration

Setup Utility ⇒ Advanced ⇒ H2OUVE Configuration

Menu Item	Option	Description
H2OUVE Support	Enabled / Disabled	Enable or disable support for Insyde Tool H2OUVE (UEFI Variable Editor). This tool is used to change i.e. default values of a BIOS image.



6.6.2.1.19 SIO F81214E

Setup Utility ⇒ Advanced ⇒ SIO F81214E

Menu Item	Option	Description
UART Port X Configuration	See submenu	UART Configuration

Setup Utility ⇒ Advanced ⇒ SIO F81214E ⇒ UART Port X Configuration

Menu Item	Option	Description
UART Port X	Enabled / Disabled	Configure UART Port using options: Disabled – Disable device Enabled – Enable device and use below settings
Base I/O Address	3F8h / 2F8h / 3E8h / 2E8h / 338h / 228h / 220h / 238h	System I/O base resources.
Interrupt	IRQ3 / IRQ4 / IRQ5 / IRQ6 / IRQ7 / IRQ10 / IRQ11	System interrupt resources.
Peripheral Type	RS232 / RS485	Choose Port Mode.

6.6.2.1.20 NVM Express Information

Setup Utility ⇒ Advanced ⇒ NVM Express Information

Information page for NVMe.

6.6.3 Security

Menu Item	Option	Description
Set Supervisor Password	123456	Install or change the BIOS password. The length of password must be greater than one and smaller or equal ten characters.

6.6.4 Power

Menu Item	Option	Description
Wake on PME	Enabled / Disabled	Determines the action taken when the system power is off and a PCI Power Management Enable (PME) wake up event occurs.
Auto Wake on S5	Disabled / By Every Day / By Day of Month	Auto wake on S5, by Day of Month or Fixed time of every day.
S5 Long Run Test	Enabled / Disabled	Enabled: Force to enable RTC S5 wake up, even if OS disables it. Support ipwrtest to do RTC S5 wakeup.

6.6.5 Boot

Menu Item	Option	Description
Boot Type	UEFI Boot Type	Select boot type to Dual type, Legacy type or UEFI type. Note: Operating systems installed in UEFI only will boot in UEFI or Dual boot type, not in Legacy. Also the other way around when an OS is installed in Legacy it will not boot in UEFI type. Note: Only UEFI Boot Type is supported on Elkhart Lake.
Quick Boot	Enabled / Disabled	Allow InsydeH2O to skip certain tests while booting. This will decrease the time needed to boot the system.



Menu Item	Option	Description
Quite Boot	Enabled / Disabled	Enable or disable booting in Text mode. No textual outputs are given while booting if this option is disabled.
Network Stack	Enabled / Disabled	Enable or disable Network stack Support: Windows 8 BitLocker Unlock UEFI IPv4/IPv6 PXE Legacy PXE OPRON Note: This option will grey-out the PXE Boot capability option.
PXE Boot capability	Disabled / UEFI: IPv4 / UEFI: IPv6 / UEFI: IPv4/IPv6	Disabled: Support Network Stack UEFI PXE: IPv4/IPv6 Legacy: Legacy PXE OPRON only
Power up In Standby Support	Enabled / Disabled	Enable or disable the Power Up in Standby Support (PUIS). The PUIS feature allows devices to be powered-up into the Standby power management state to minimize inrush current at power-up and to allow the host to sequence the spin-up of devices.
Add Boot Options	First / Last / Auto	Position in Boot Order for Shell, Network and Removables.
ACPI Selection	Acpi1.0B / Acpi3.0 / Acpi4.0 / Acpi5.0 / Acpi6.0 / Acpi6.1	Select booting to which ACPI version.
USB Boot	Enabled / Disabled	Enable or disable booting to USB boot device.
EFI Device First	Enabled / Disabled	Determine EFI device first or legacy device first. If enable, it is EFI device first. If disable, it is legacy device first.
UEFI OS Fast Boot	Enabled / Disabled	If enabled the system firmware does not initialize keyboard and check for firmware menu key. Note: If enabled it is not possible to change to BIOS menu by pressing <F10> when booting Windows.
USB Hot Key Support	Enabled / Disabled	Enable or disable to support USB hot key while booting. This will decrease the time needed to boot the system, however, it is not possible to get into BIOS menu by pressing <ESC> while booting. The change into BIOS has to be done over OS.
Timeout	0 – 10	The number of seconds that the firmware will wait before booting the original default boot selection.
Automatic Failover	Enabled / Disabled	Enable: If boot to default device fail, it will directly try to boot next device. Disable: If boot to default device fail, it will pop warning message then go into firmware UI.
EFI / Legacy	Submenu depends on bootable devices	Option to adapt boot order. Selection depends on boot devices connected. Note: Add Boot Options has to be configured as First or Last. The order can be changed by pressing <F5> or <F6>.

6.6.6 Exit

Menu Item	Option	Description
Exit Saving Changes		Save changes and reboot system afterwards. <F10> can be used for this operation.
Save Change Without Exit		Save changes without reboot system.
Exit Discarding Changes		Exit InsydeH2O Setup Utility without saving any changes. <ESC> can be used for this operation.
Load Optimal Defaults		Load optimal default values for all setup items. <F9> can be used for this operation.
Load Custom Defaults		Load custom default values for all setup items.
Save Custom Defaults		Save custom defaults for all setup items.
Discard Changes		Discard all changes without exiting InsydeH2O Setup Utility.

6.7 BIOS Update

The uEFI BIOS update instruction serves to guarantee a proper way to update the uEFI BIOS on the TQMxE40C2.

Please read the entire instructions before beginning the BIOS update. By disregarding the information you can destroy the uEFI BIOS on the TQMxE40C2!

This document will guide the customer to update the uEFI BIOS on the TQMxE40C2 by using the Insyde Flash Firmware Tools.

Please contact support@tq-group.com for more information to the latest uEFI BIOS version for the TQMxE40C2.

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!

6.7.1 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 200.00.00.13 or later
- InsydeH2OFF_x86_WIN folder (Flash Firmware Tool from Insyde for update via Windows 32-bit system)
- InsydeH2OFF_x86_WINx64 folder (Flash Firmware Tool from Insyde for update via Windows 64-bit system)
- BIOS.bin file e.g. xx.bin

6.7.2 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 ⇒ RC 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.



Illustration 8: RC Advanced Menu

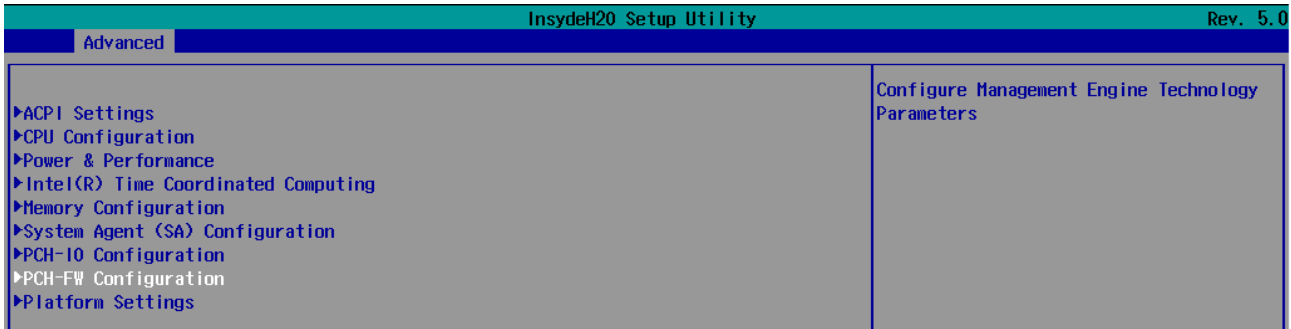


Illustration 9: PCH-FW Configuration menu

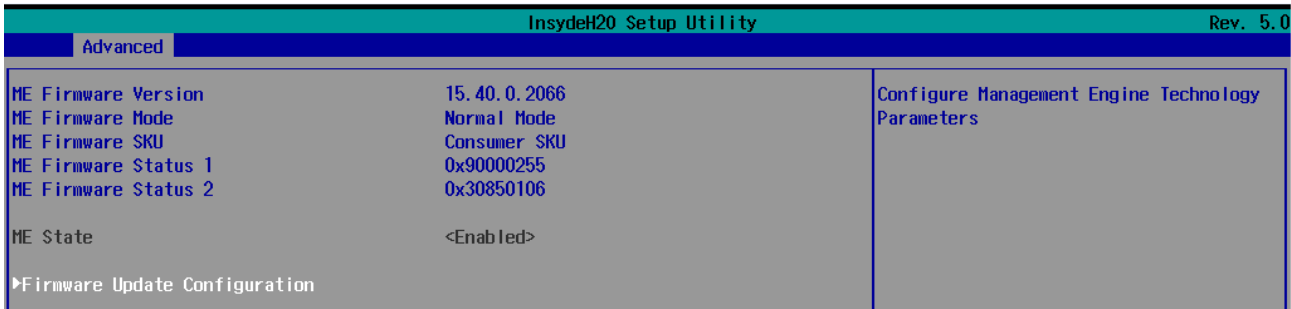


Illustration 10: Firmware Update configuration menu

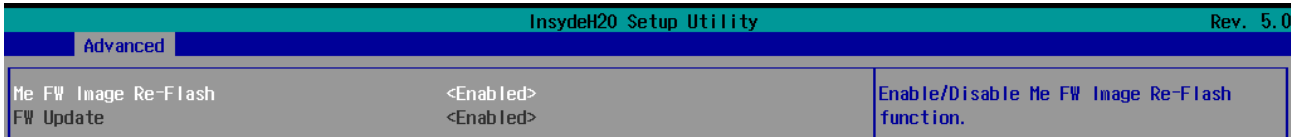


Illustration 11: ME FW Image Re-Flash option

6.7.3 Step 3a: Updating uEFI BIOS via EFI Shell

Plug the USB stick into the board you want to update the uEFI BIOS, and turn 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".

```
Mapping table
FS0: Alias(s):HD0d0b0b:;BLK1:
    PciRoot(0x0)/Pci(0x14,0x0)/USB(0x3,0x0)/USB(0x1,0x0)/HD(1,MBR,0x00000000,0x2000,0x1E1D800)
BLK0: Alias(s):
    PciRoot(0x0)/Pci(0x14,0x0)/USB(0x3,0x0)/USB(0x1,0x0)
Shell>
```

Illustration 12: 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 tqmxe40m") 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.

```
Mapping table
FS0: Alias(s):HD0d0b0b:;BLK1:
    PciRoot(0x0)/Pci(0x14,0x0)/USB(0x3,0x0)/USB(0x1,0x0)/HD(1,MBR,0x00000000,0x2000,0x1E1D800)
BLK0: Alias(s):
    PciRoot(0x0)/Pci(0x14,0x0)/USB(0x3,0x0)/USB(0x1,0x0)
Shell> fs0:
FS0:\> H2OFFT-Sx64.efi TQMxE40M_05.42.43.09.01.bin -all -ra
```

Illustration 13: EFI Shell uEFI BIOS Update

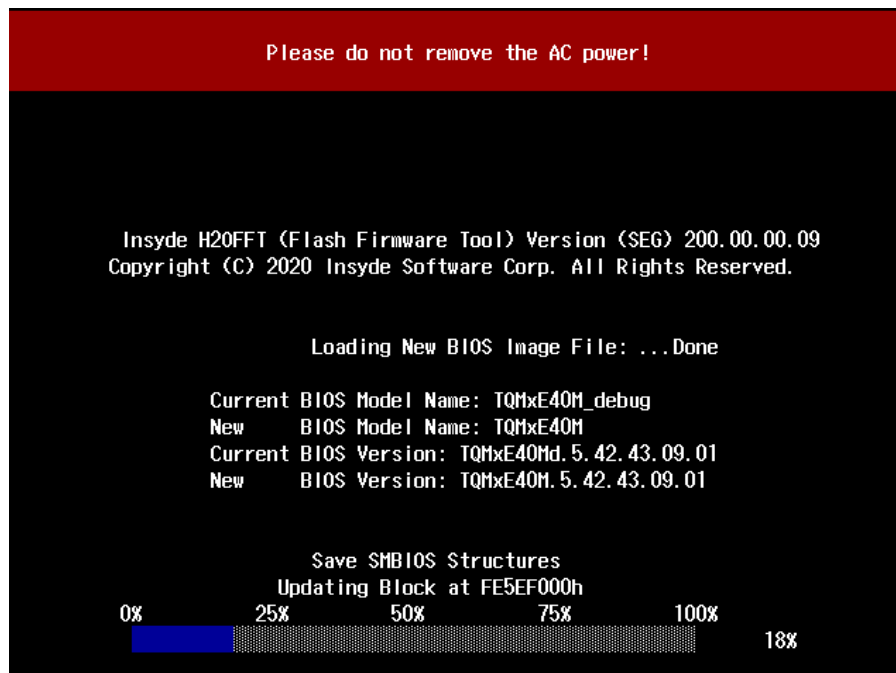


Illustration 14: Screen during BIOS Update

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

Boot the Windows operating system (64-bit) and plug the USB stick into the board you want to update the uEFI BIOS. Start the Command prompt (CMD) 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:\TQMXXXX_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.

6.7.5 Step 4: BIOS update check on the TQMxE40C2 Module

After the uEFI BIOS update the new uEFI BIOS configures the complete TQMxE40C2 hardware and this results in some reboots and the first boot time takes longer (up to 1 minute).

The TQMxE40C2 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 the uEFI BIOS boot is finished.

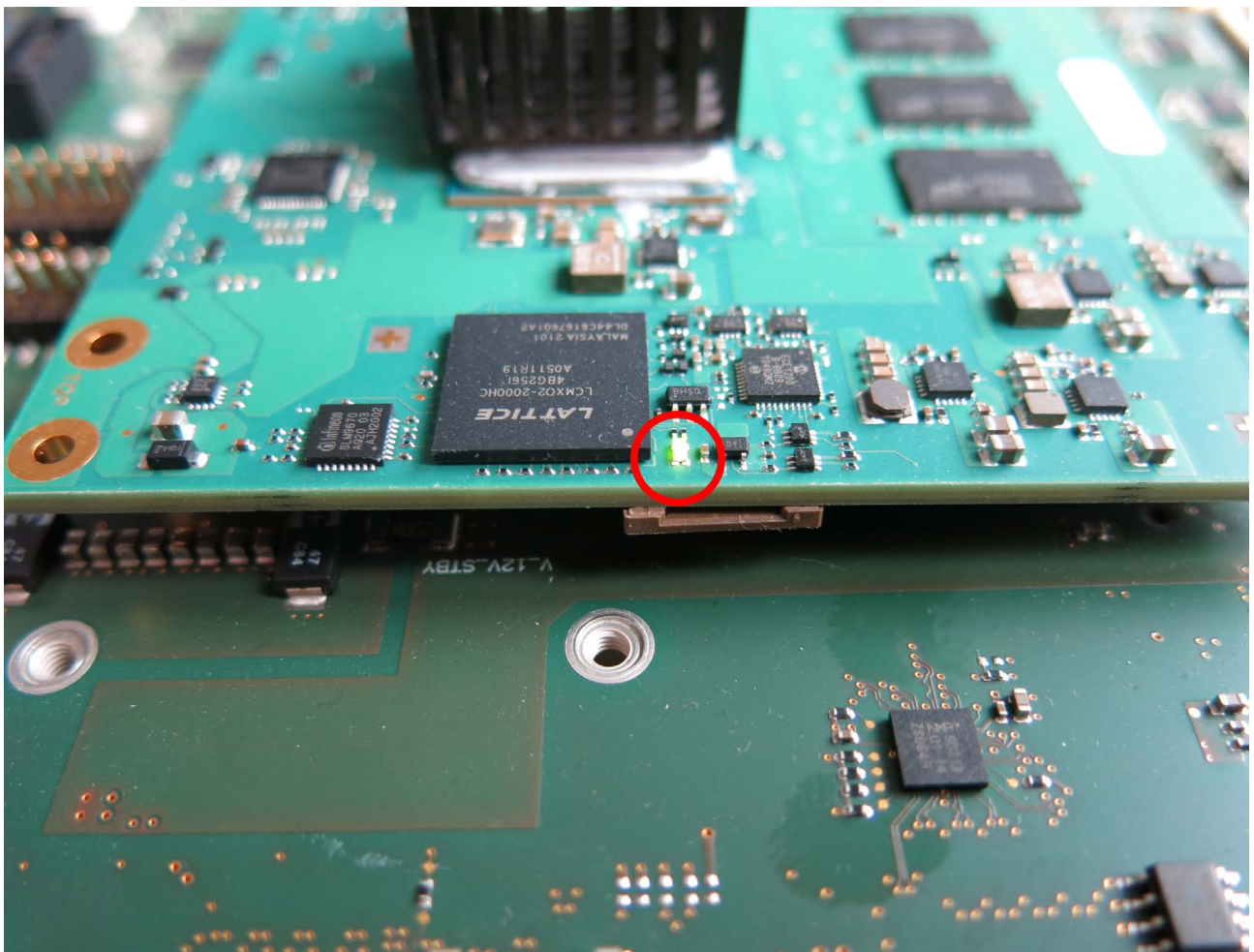


Illustration 15: TQMxE40C2 Debug LED



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.

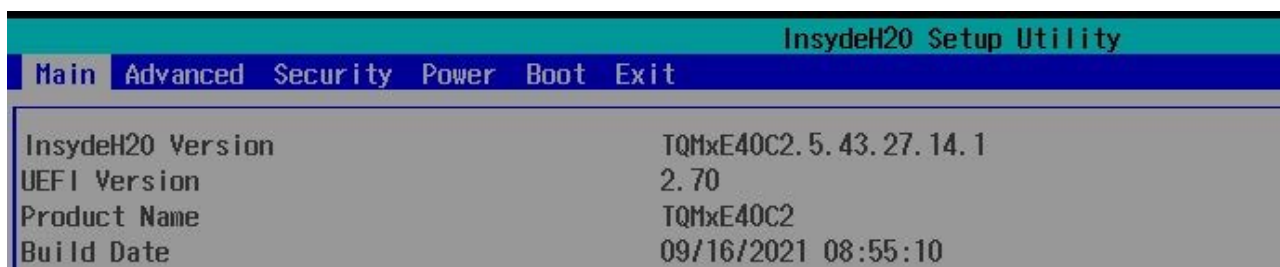


Illustration 16: EFI BIOS Main Menu



7. SAFETY REQUIREMENTS AND PROTECTIVE REGULATIONS

7.1 EMC

The TQMxE40C2 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.

7.2 ESD

In order to avoid interspersions on the signal path from the input to the protection circuit in the system, the protection against electrostatic discharge should be arranged directly at the inputs of a system. As these measures always have to be implemented on the carrier board, no special preventive measures were done on the TQMxE40C2.

7.3 Shock & Vibration

The TQMxE40C2 is designed to be insensitive to shock and vibration and impact.

7.4 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.

7.5 Cyber Security

A Threat Analysis and Risk Assessment (TARA) must always be performed by the customer for their individual end application, as the TQMxE40C2 is only a sub-component of an overall system.

7.6 Export Control and Sanctions Compliance

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

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

7.7 Warranty

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

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

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

7.8 Reliability and Service Life

The MTBF according to MIL-HDBK-217F N2 is approximately 344,858 h, Ground Benign, @ +40 °C.



8. ENVIRONMENT PROTECTION

8.1 RoHS

The TQMxE40C2 is manufactured RoHS compliant.

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

8.2 WEEE®

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

Within the scope of the technical possibilities, the TQMxE40C2 was designed to be recyclable and easy to repair.

8.3 REACH

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

8.4 Statement on California Proposition 65

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

The TQ device or product is not designed or manufactured or distributed as consumer product or for any contact with end-consumers. Consumer products are defined as products intended for a consumer's personal use, consumption, or enjoyment. Therefore, our products or devices are not subject to this regulation and no warning label is required on the assembly.

Individual components of the assembly may contain substances that may require a warning under California Proposition 65.

However, it should be noted that the Intended Use of our products will not result in the release of these substances or direct human contact with these substances. Therefore you must take care through your product design that consumers cannot touch the product at all and specify that issue in your own product related documentation.

TQ reserves the right to update and modify this notice as it deems necessary or appropriate.

8.5 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 TQMxE40C2 must therefore always be seen in conjunction with the complete device. The available standby and sleep modes of the components on the TQMxE40C2 enable compliance with EuP requirements for the TQMxE40C2.

8.6 Battery

No batteries are assembled on the TQMxE40C2.

8.7 Packaging

By environmentally friendly processes, production equipment and products, we contribute to the protection of our environment. To be able to reuse the TQMxE40C2, 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 TQMxE40C2 is delivered in reusable packaging.

8.8 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 13: 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 ² C	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 13: 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 14: Further Applicable Documents and Links

No.	Name	Rev., Date	Company
(1)	PICMG® COM Express™ Module Base Specification	Rev. 3.0, March 31, 2017	PICMG
(2)	PICMG® COM Express™ Carrier Design Guide	Rev. 2.0, Dec. 6, 2013	PICMG
(3)	PICMG® COM Express™ Embedded Application Programming Interface	Rev. 1.0, Aug. 8, 2010	PICMG

