TQMxE38C
User's Manual

TQMxE38C UM 0101
2019-03-14

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ILLUSTRATION DIRECTORY

REVISION HISTORY

Rev.	Date	Name	Pos.	Modification
0100	2016-07-15	FP		First edition
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1.5 Service and Support

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

You can register on our website TQ-Group to have access to restricted information and automatic update services.

For direct technical support you can contact our FAE team by email: TQ-Support.

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

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

1.6 Tips on Safety

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

1.7 Symbols and Typographic Conventions

Table 1: Terms and Conventions

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

1.8 Handling and ESD Tips

General handling of your TQ-products

	The TQ-product may only be used and serviced by certified personnel who have taken note of the information, the safety regulations in this document and all related rules and regulations. A general rule is: do not touch the TQ-product during operation. This is especially important when switching on, changing jumper settings or connecting other devices without ensuring beforehand that the power supply of the system has been switched off. Violation of this guideline may result in damage / destruction of the TQMxE38C module and be dangerous to your health. Improper handling of your TQ-product would render the guarantee invalid.

Proper ESD handling

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

1.9 Naming of Signals

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

Example: RESET#

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

Example: C / D#

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

The identification of the individual functions follows the above conventions.

Example: WE2# / OE#

1.10 Further Applicable Documents / Presumed Knowledge

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

Implementation information for the carrier board design is provided in the COM Express™ Design Guide (5) 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 (4).

2. INTRODUCTION

Based on the internationally established PICMG® standard COM Express™ (COM.0 R2.1), Compact, the TQ module TQMxE38C enables the design of not only powerful but also economical x86 based systems. The user has access to all essential interfaces of the CPU at the type 6 compliant pin out connector. Hence all features of the Intel® Atom™ processor can be used. The direct access to interfaces like digital display interface (DDI) and the USB device interface gives the user the freedom to use the features of the CPU in the most suitable way for his application.

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

2.1 Functional Overview

The following key functions are implemented on the TQMxE38C:

Processor:

- Intel® Atom™ E3800 („Bay Trail-I“)

Memory:

- DDR3L: 2 Gbyte, 4 Gbyte, 8 Gbyte with ECC support
- EEPROM: 32 kbit (24LC32)

Graphics:

- 2 × Digital Display Interface (DDI)
  for DP 1.1a, DVI, HDMI 1.4a or LVDS

System interfaces:

- 1 × Gigabit Ethernet (Intel® i210), external IEEE1588 sync optional through TQ-flexiCFG
- 1 × USB 3.0
- 8 × USB 2.0 (incl. USB 3.0 ports)

Peripheral interfaces:

- 2 × SATA 2.0 (up to 3 Gbit/s), eSATA capable
- 3 × PCIe 2.0 (up to 5 Gbit/s) (4^{th} lane optional, if no Ethernet)
- 1 × LPC bus
- 1 × Intel® HD audio (HDA)
- 1 × I^2C, (2^{nd} I^2C optional) (master/slave capable)
- 1 × SMBus
- 1 × SPI (for external uEFI BIOS flash)
- 2 × Serial port (Rx/Tx, legacy compatible), 4 wire optional through TQ-flexiCFG
- 1 × SD card interface / optional 8 × GPIO through TQ-flexiCFG (multiplexed)

Security components:

- TPM (SLB9660 TPM 1.2, alternatively SLB9665 TPM 2.0)

Others:

- TQMx86 board controller with Watchdog and TQ-flexiCFG
- Industrial real time clock (iRTC) (option)
- Hardware monitor

Power supply:

- Voltage: 4.75 V to 20 V
  5 V Standby (optional)
  3 V Battery for RTC (GoldCap® option with iRTC)

Environment:

- Standard temperature: 0 °C to +60 °C
- Extended temperature: –40 °C to +85 °C

Form factor / dimensions:

- COM Express™ Compact, type 6 95 × 95 mm^2

2.2 Specification Compliance

The TQMxE38C module is compliant to the PICMG® COM Express™ Module Base Specification (COM.0 R2.1) Compact, type6, 95 × 95 mm².

2.3 Versions

The TQMxE38C module is available in several standard configurations.

- **TQMxE38C-AA ("Premium I-Temp.")**
  E3845 (Quad Core, 1.91 GHz, 2 Mbyte L2-Cache, HD Gfx 542/792 MHz, 10 W),
  4 Gbyte DDR3L-1333 ECC, TPM 1.2, Extended-Temp. –40 °C to +85 °C

- **TQMxE38C-AB ("Mainstream Light")**
  E3827 (Dual Core, 1.75 GHz, 1 Mbyte L2-Cache, HD Gfx 542/792 MHz, 8 W),
  2 Gbyte DDR3L-1333 ECC, Standard-Temp. 0 °C to +60 °C

Please visit www.tq-group.com/TQMxE38C for a complete list of standard versions.
Other configurations are available on request.

Standard configuration features are:

- CPU version
- Memory configuration
- TPM
- Temperature range

Optional hardware and software configuration features:

- Conformal coating can be offered as a customer specific add-on
- GPIO instead of SD card
- Custom specific GPIO configuration through TQ-flexiCFG
- 4 (×1) PCIe lanes
- iRTC
- Custom specific BIOS configuration

For further information regarding other versions, please contact TQ-Support.

2.4 Accessories

- **TQMxE38C-HSP** (TQMxE38C-HSP-11-M-5083-BL)
  Heat spreader for TQMxE38C module according to the COM Express™ specification.

- **Evaluation platform MB-COME6-1**
  Mainboard for COM Express™ Compact modules, Type 6.
  Interfaces: 2 × DP, LVDS, 2 × Gbit Ethernet, 4 × USB, 3 × COM, audio, mini PCIe, mSATA, 2.5“ SSD, SD card, riser extension with PCIe and USB, fan, debug.
  Dimensions: 170 × 170 mm².

3. FUNCTIONAL SPECIFICATION

3.1 Block Diagram

The following illustration shows the block diagram of the TQMxE38C module.

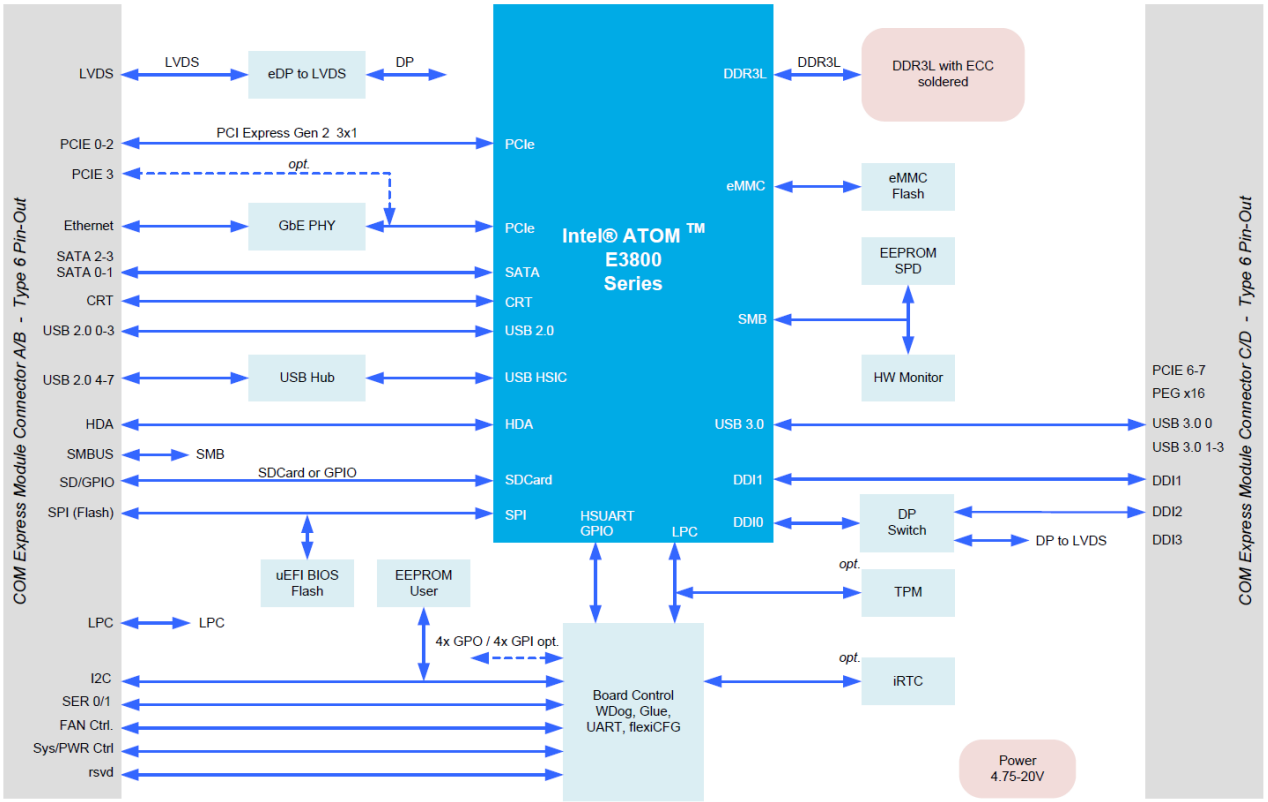

Illustration 1: Block Diagram TQMxE38C

3.2 Electrical Specification

3.2.1 Supply Voltage Characteristics

The TQMxE38C module supports a wide-range voltage input from 4.75 V to 20 V.

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

Wide input:	4.75 V to 20 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 % of nominal to 90 % of nominal within 0.1 ms to 20 ms (0.1 ms ≤ Rise Time ≤ 20 ms).
There must be a smooth and continuous increase of each DC output voltage from 10 % to 90 % of its final set point within the regulation range.

Note: Power source	
	The 5 V Standby voltage is not required for single supply operation. VCC_5V_SBY can be left unconnected.

3.2.2 Power Consumption Specification

The power consumption values below show the voltage and power specifications of the TQMxE38C module.

The values were measured with two power supplies; one for the TQMxE38C module and the other one for the MB-COME6-1 COM Express™ carrier board.

The power consumption of each module was measured running Windows® 7, 64-bit.
All measurements were done at a temperature of +25 °C.

The power consumption of the TQMxE38C module depends on the application, the mode of operation and the operating system.

The power consumption was measured under the following test modes:

- Windows® 7, 64-bit, idle state:
  Desktop idle state, Ethernet port is disconnected.
- Windows® 7, 64-bit, maximum workload:
  These values show the maximum worst case power consumption using the Intel® stress test tool to stress the processor and graphic engine. Ethernet port is connected (1,000 Mbps Speed).
- Suspend mode:
  The system is in S5/S4 state, Ethernet port is disconnected.
- Green ECO-Off state:
  The system is in Green ECO-Off state, all DC/DC power supplies on the module are switched off.

The following table shows the power consumption with different processor configurations.

Table 2: Module Power Consumption

Module	Mode			
	Standby 5 V		Wide input 12 V	
	Green ECO-Off state	Suspend (OS shut down)	Win7, 64 bit idle	Win7, 64 bit max. load
E3845 with 2 / 4 Gbyte DDR3L	4.9 mW	0.22 W	2.8 W	11.4 W
E3827 with 2 / 4 Gbyte DDR3L	4.9 mW	0.22 W	2.5 W	9.5 W
E3825 with 2 / 4 Gbyte DDR3L	4.9 mW	0.22 W	2.5 W	7.8 W
E3815 with 2 / 4 Gbyte DDR3L	4.9 mW	0.22 W	2.4 W	5.8 W
E3805 with 2 / 4 Gbyte DDR3L, no Gfx	4.9 mW	0.22 W	2.1 W	3.5 W

If 8 Gbyte DDR3L – RAM are installed, the power consumption is up to 1W higher.

Note: Power requirement	
	The power supplies on the carrier board for the TQMxE38C module must be configured with enough reserve. The carrier board should be able to provide at least twice maximum workload power of the TQMxE38C module. The TQMxE38C module supports several low power states. The power supply of the carrier board has to be stable even with no load.

3.2.2.1 Real Time Clock Current Specification

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® Atom™ E3800 integrated RTC	3.0 V	3 µA
With iRTC option	3.0 V	300 nA

The current consumption of the RTC in the Intel® Atom™ E3800 processor Product Family Datasheet is specified with 6 µA in average, but the values measured on several modules were lower.

3.3 Environmental Specification

- Temperature operating Standard: 0 °C to +60 °C
- Temperature operating Extended: –40 °C to +85 °C
- Temperature storage: –40 °C to +85 °C
- Relative humidity (operating / storage): 10 % to 90 % (not condensing)

Attention: Maximum operating temperature	
	Do not operate the TQMxE38C module if it is not attached properly to a heat spreader and a heat sink!

3.4 System Components

3.4.1 Processor

The TQMxE38C module supports the Intel® Atom™ E3800 Processor (BayTrail-I).
The following list illustrates some key features of the Intel® Atom™ E3800 processor:

- Single, dual or quad processor cores
- Up to 2 Mbyte Cache
- 64-bit Instruction Set
- Enhanced Intel® SpeedStep® technology
- Intel® HD Graphics
- Dual independent displays

Table 4: Processor Specifications

Mode	E3845	E3827	E3826	E3825	E3815	E3805
Processor Cores	4	2	2	2	1	2
Cache	2 Mbyte	1 Mbyte	1 Mbyte	1 Mbyte	512 Kbyte	1 Mbyte
Processor frequency	1.91 GHz	1.75 GHz	1.46 GHz	1.33 GHz	1.46 GHz	1.33 GHz
Temperature $T_{junction}$	–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	–40 °C to +110 °C
Memory Speed	1,333 MT/s	1,333 MT/s	1,067 MT/s	1,067 MT/s	1,067 MT/s	1,067 MT/s
Maximum memory	8 Gbyte	8 Gbyte	8 Gbyte	8 Gbyte	8 Gbyte	8 Gbyte
Memory configuration	Single, w ECC	Single, w ECC	Single, w ECC	Single, w ECC	Single, w ECC	Single, w ECC
Graphics	Intel® HD Graphics	Intel® HD Graphics	Intel® HD Graphics	Intel® HD Graphics	Intel® HD Graphics	None
GFX Base / Burst	542 / 792 MHz	542 / 792 MHz	533 / 667 MHz	533 / 533 MHz	400 / 400 MHz	–
Thermal Design Power (TDP)	10 W	8 W	7 W	6 W	5 W	3 W

3.4.2 Graphics

The E3800 processor includes an integrated Intel® HD (Gen 7) graphics accelerator. It provides excellent 2D / 3D graphics performance with dual simultaneous display support.

Table 5: Maximum Resolution in Dual Display Configuration

DDI1	DDI2
HDMI/DVI 1920×1200	HDMI/DVI 1920×1200
DP 2560×1600	DP 2560×1600

The TQMxE38C module supports two Digital Display Interfaces (DDI0 and DDI1) at the COM Express™ connector.

3.4.3 Memory

3.4.3.1 DDR3L SDRAM

The TQMxE38C module supports a memory-down single-channel DDR3L configuration with Error-Correcting Code (ECC) running up to 1,333 MT/s. The maximum memory size is 8 Gbyte. The available memory configuration can be either2 Gbyte, 4 Gbyte or 8 Gbyte.

3.4.3.2 SPI Boot Flash

The TQMxE38C module provides a 64 Mbit SPI boot flash. It includes the Intel® TXE Trusted Execution Engine and the uEFI BIOS.

An external SPI boot flash 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:

- Winbond W25Q64FV

3.4.3.3 EEPROM

The TQMxE38C module supports a COM Express™ Module EEPROM. The 2 kbit (AT24C32C) EEPROM device is connected to the general purpose I²C interface (COM Express™ pin names I2C_DAT and I2C_CK).

3.4.4 Real Time Clock

The TQMxE38C module includes a standard RTC (Motorola MC146818B) integrated in the Intel® Atom™ E3800 processor and a high accuracy, ultra-low power industrial RTC (iRTC) as an assembly option.

The following list illustrates some key features of the iRTC:

- Lowest current consumption (typ. 240 nA)
- Optimized for Gold Cap capacitor backup power
- Temperature compensation: –40 °C to +85 °C
- Time Deviation ±0.26 s/day / ±3.0 ppm
- Time keeping voltage down to 1.5 V

Please contact TQ-Support for further information about the iRTC.

3.4.5 Trusted Platform Module

The TQMxE38C module has been designed to support the Trusted Platform Module (TPM) 1.2 (Infineon SLB9660).

The TPM 2.0 configuration is available on request.

3.4.6 Hardware Monitor

The module includes an integrated Hardware Monitor to monitor the on-board temperature, board voltages and manage the fan control of the COM Express™ interface (FAN_PWMOUT and FAN_TACHOIN).

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

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

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

This feature enables the user to integrate special embedded features and configuration options in the module to reduce the carrier board design effort.

Here are some examples of the flexible I/O configuration:

- External IEEE1588 Ethernet synchronisation via GPIOs
- 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 TQ-Support for further information about the TQ-flexiCFG.

3.4.8 Ultra Deep Power State Green ECO-Off

The TQMxE38C module supports the ultra-deep power state Green ECO-Off. In this configuration all module DC/DC power supplies 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 must be pulled low for a minimum of 100 ms.

3.5 Interfaces

3.5.1 PCI Express

The TQMxE38C module supports 3 PCI Express Gen 2 ports (optional 4 PCIe ×1 or 1 PCIe ×4 with removed Ethernet). The default configuration for the PCI Express lanes is 3 ×1. With a customized BIOS the PCI Express lane configuration can be set to 1 ×1 / 1 ×2 or 1 ×4 (1 ×4 is only supported if Ethernet is removed on the module).

3.5.2 Gigabit Ethernet

The TQMxE38C module provides the Intel® i210IT Ethernet controller with 10/100/1000 Mbps speed and IEEE1588 support.
The Intel® i210IT Ethernet controller supports an external IEEE1588 synchronisation via GPIOs due to the TQ-flexiCFG feature.

3.5.3 Serial ATA

The TQMxE38C module supports two SATA Gen 2.0 (3 Gbit/s) interfaces.

3.5.4 Digital Display Interface

The TQMxE38C module supports two Digital Display Interfaces (DDI1 and DDI2) at the COM Express™ connector. If a monitor is connected to the DDI2 interface the LVDS interface will be disabled on the module. This has to be done, because the E3800 processor is only supporting 2 digital displays.

The Digital Display Interface supports Display Port (DP), High Definition Multimedia Interface (HDMI) and Digital Visual Interface (DVI). On both DDI ports the maximum display resolutions are:

- DisplayPort 1.1 resolution up to 2560 × 1600
- HDMI 1.4 up to 1920 × 1200
- DVI up to 1920 × 1200 (HDMI without Audio)

3.5.5 LVDS Interface

The TQMxE38C supports a LVDS interface at the COM Express™ connector. The LVDS interface is provided through an on-board eDP to LVDS bridge. If a monitor is connected to the DDI2 interface the LVDS interface will be disabled on the module. This has to be done, because the E3800 processor is only supporting 2 digital displays.

The eDP to LVDS bridge supports single or dual bus LVDS signalling with colour depths of 18 bits per pixel or 24 bits per pixel up to 112 MHz and a resolution up to 1920 × 1200 @ 60 Hz in dual 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 the system video BIOS.

Please contact TQ-Support for further information about the LVDS configuration.

3.5.6 VGA Interface

The TQMxE38C supports a VGA interface with a resolution up to 2560 × 1600.

3.5.7 USB 2.0 Interfaces

The TQMxE38C module supports four USB 2.0 ports at the COM Express™ connector.

Table 6: USB 2.0 COM Express™ Port Mapping

COM Express™	TQMxE38C
USB 0	Connected to E3800 USB port 0
USB 1	Connected to E3800 USB port 1
USB 2	Connected to E3800 USB port 2
USB 3	Connected to E3800 USB port 3
USB 4	Connected to HSIC USB Hub port 1
USB 5	Connected to HSIC USB Hub port 2
USB 6	Connected to HSIC USB Hub port 3
USB 7	Connected to HSIC USB Hub port 4

3.5.8 USB 3.0 Interfaces

The TQMxE38C module supports one USB 3.0 port at the COM Express™ connector.

Table 7: USB 3.0 COM Express™ Port Mapping

COM Express™	TQMxE38C
USB 0	USB 0
USB 1	Reserved

The E3800 processor is only supporting one USB 3.0 port. COM Express™ USB port 1 is not supported by the TQMxE38C module.

Note: USB Port Mapping	
	The USB 2.0 port 0 must be paired with USB 3.0 SuperSpeed port 0.

3.5.9 SD Card Interface

The TQMxE38C module provides an SD card interface for 4-bit SD, SDHC, SDXC and MMC cards at the COM Express™ connector. The SD card signals are shared with the GPIO signals and can be configured via an assembly option. The default configuration at the COM Express™ connector is with SD card signals.

3.5.10 General Purpose Input / Output

The TQMxE38C module 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 assembly option. The default configuration at the COM Express™ connector is with SD card signals.
The GPIO signals are integrated in the TQ-flexiCFG block and can be configured flexibly. The signals can also be used for special functions (see 3.4.7).

3.5.11 High Definition Audio Interface

The TQMxE38C module 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.

3.5.12 LPC Bus

The TQMxE38C module supports a Low Pin Count (LPC) legacy bus for I/O expansion.
The LPC bus Direct Memory Access (DMA) is not supported.

3.5.13 I²C Bus

The TQMxE38C module 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.

3.5.14 SMBus

The TQMxE38C module provides a System Management Bus (SMBus).

3.5.15 Serial Peripheral Interface

The TQMxE38C module provides a Serial Peripheral Interface (SPI) interface.
The SPI interface can only be used for SPI boot Flash devices.

3.5.16 Serial Ports

The TQMxE38C module 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 8: Serial Port COM Express™ Port Mapping

COM Express™ Signal	COM Express™ Pin	TQMxE38C	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 Revision 2.0 of the COM Express™ specification the signals A98, A99, A101 and A102 have been reclaimed from the VCC_12V pool. Therefore protection on the module and on the carrier board is necessary to avoid damage to those when accidentally exposed to 12V. The implementation of this circuitry causes lower transfer rates on the two serial ports. On the TQMxE38C module the protection circuit is removed by default and the serial ports provide transfer rates of up to 115 kbaud. Therefore the TQMxE38C module can only be used in a COM.0 Revision 2.0 Type 6 pin-out carrier board.

3.5.17 Watchdog Timer

The TQMxE38C module 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 TQMxE38C module on the carrier board.
On the carrier board two 220-pin 0.5 mm pitch plug connectors must be used. There are two versions with 5 mm and 8 mm stack height available.

3.6.2 Debug Header

The TQMxE38C module includes a 14-pin flat cable connector to connect an external debug module (TQ specific) providing BIOS post code information, debug LEDs and a JTAG interface for on-board FPGA.
This header is for TQ internal use only.
Please contact TQ-Support for more details about the external debug module.

3.6.3 On-board Debug LED

The TQMxE38C module includes a dual colour LED providing boot and BIOS information.
The following table illustrates some LED boot messages:

Table 9: 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 finished

3.7 COM Express™ Connector Pinout List

This section describes the TQMxE38C module COM Express™ connector pin assignment, which is compliant with COMR.0 R2.1 Type 6 pinout definitions.

3.7.1 Signal Assignment Abbreviations

The table lists the abbreviations used within this chapter:

Table 10: 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: not used signals on the carrier board	
	If the input signals at the COM Express™ connector are not used, these signals can be left open on the carrier board, since these signals have a termination on the TQMxE38C module.

3.7.2 COM Express™ Connector Pin Assignment

Table 11: 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	I/O	
A3	GBE0_MDI3+	Gigabit Ethernet Controller 0: Media Dependent Interface	I/O	
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	I/O	
A7	GBE0_MDI2+	Gigabit Ethernet Controller 0: Media Dependent Interface	I/O	
A8	GBE0_LINK#	Gigabit Ethernet Controller 0 link indicator	OD	
A9	GBE0_MDI1–	Gigabit Ethernet Controller 0: Media Dependent Interface	I/O	
A10	GBE0_MDI1+	Gigabit Ethernet Controller 0: Media Dependent Interface	I/O	
A11	GND(FIXED)	Ground	GND	
A12	GBE0_MDI0–	Gigabit Ethernet Controller 0: Media Dependent Interface	I/O	
A13	GBE0_MDI0+	Gigabit Ethernet Controller 0: Media Dependent Interface	I/O	
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	O	
A17	SATA0_TX–	SATA differential transmit pairs	O	
A18	SUS_S4#	Indicates system is in Suspend to Disk state. Active low output.	O PD	TQ-flexiCFG
A19	SATA0_RX+	SATA differential receive pairs	I	
A20	SATA0_RX–	SATA differential receive pairs	I	
A21	GND(FIXED)	Ground	GND	
A22	SATA2_TX+	SATA differential transmit pairs	O	N/A
A23	SATA2_TX–	SATA differential transmit pairs	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	I	N/A
A26	SATA2_RX–	SATA differential receive pairs	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)	I/O	
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	I/O	
A37	USB6+	USB differential pairs	I/O	
A38	USB_6_7_OC#	USB over-current sense, USB channels 6 and 7	I PU	
A39	USB4–	USB differential pairs	I/O	
A40	USB4+	USB differential pairs	I/O	
A41	GND(FIXED)	Ground	GND	
A42	USB2–	USB differential pairs	I/O	
A43	USB2+	USB differential pairs	I/O	
A44	USB_2_3_OC#	USB over-current sense, USB channels 2 and 3	I PU	
A45	USB0–	USB differential pairs	I/O	
A46	USB0+	USB differential pairs	I/O	
A47	VCC_RTC	Real-time clock circuit-power input. Nominal +3.0 V	Power	
A48	EXCD0_PERST#	PCI ExpressCard: reset, active low, one per card	O	TQ-flexiCFG
A49	EXCD0_CPPE#	PCI ExpressCard: PCI Express capable card request, active low	I PU	TQ-flexiCFG
A50	LPC_SERIRQ	LPC serial interrupt	I/O	TQ-flexiCFG
A51	GND(FIXED)	Ground	GND	
A52	PCIE_TX5+	PCI Express differential transmit pairs	O	N/A
A53	PCIE_TX5–	PCI Express differential transmit pairs	O	N/A
A54	GPI0/SD_DATA0	GPIO0 / SDIO Data lines	I/O	TQ-flexiCFG
A55	PCIE_TX4+	PCI Express differential transmit pairs	O	N/A

Table 11: COM Express™ Connector Pin Assignment (continued)

Pin	Pin-Signal	Description	Type	Remark
A56	PCIE_TX4–	PCI Express differential transmit pairs	O	N/A
A57	GND	Ground	GND	
A58	PCIE_TX3+	PCI Express differential transmit pairs	O	N/A PCIe on request
A59	PCIE_TX3–	PCI Express differential transmit pairs	O	N/A PCIe on request
A60	GND(FIXED)	Ground	GND	
A61	PCIE_TX2+	PCI Express differential transmit pairs	O	
A62	PCIE_TX2–	PCI Express differential transmit pairs	O	
A63	GPI1/SD_DATA1	GPI1 / SDIO Data lines	I/O	TQ-flexiCFG
A64	PCIE_TX1+	PCI Express differential transmit pairs	O	
A65	PCIE_TX1–	PCI Express differential transmit pairs	O	
A66	GND	Ground	GND	
A67	GPI2/SD_DATA2	GPI2 / SDIO Data lines	I/O	TQ-flexiCFG
A68	PCIE_TX0+	PCI Express differential transmit pairs	O	
A69	PCIE_TX0–	PCI Express differential transmit pairs	O	
A70	GND(FIXED)	Ground	GND	
A71	LVDS_A0+	LVDS Channel A differential pairs 0	O	
A72	LVDS_A0–	LVDS Channel A differential pairs 0	O	
A73	LVDS_A1+	LVDS Channel A differential pairs 1	O	
A74	LVDS_A1–	LVDS Channel A differential pairs 1	O	
A75	LVDS_A2+	LVDS Channel A differential pairs 2	O	
A76	LVDS_A2–	LVDS Channel A differential pairs 2	O	
A77	LVDS_VDD_EN	DDI1 eDP panel power enable	O	
A78	LVDS_A3+	LVDS Channel A differential pairs 3	O	
A79	LVDS_A3–	LVDS Channel A differential pairs 3	I PU	
A80	GND(FIXED)	Ground	GND	
A81	LVDS_A_CK+	LVDS Channel A differential clock	O	
A82	LVDS_A_CK–	LVDS Channel A differential clock	O	
A83	LVDS_I2C_CK	I^2C clock output for LVDS display	I/O	
A84	LVDS_I2C_DAT	I^2C data line for LVDS display	I/O	
A85	GPI3/SD_DATA3	GPI3 / SD_DATA3	I/O	TQ-flexiCFG
A86	RSVD18	Reserved	I PD	
A87	eDP_HPD	eDP Detection of Hot Plug	I PD	N/A
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 / SDIO Clock	O	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)		
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	

Table 11: 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#	LPC frame indicates the start of an LPC cycle	I/O	
B4	LPC_AD0	LPC multiplexed address, command and data bus	I/O	
B5	LPC_AD1	LPC multiplexed address, command and data bus	I/O	
B6	LPC_AD2	LPC multiplexed address, command and data bus	I/O	
B7	LPC_AD3	LPC multiplexed address, command and data bus	I/O	
B8	(LPC_DRQ0#) GPIO	LPC serial DMA request	I/O	N/A TQ-flexiCFG
B9	(LPC_DRQ1#) GPIO	LPC serial DMA request	I/O	N/A TQ-flexiCFG
B10	LPC_CLK	LPC clock output	O	
B11	GND(FIXED)	Ground	GND	
B12	PWRBTN#	Power button input	I PU	TQ-flexiCFG
B13	SMB_CK	System Management Bus bidirectional clock line	I/O	
B14	SMB_DAT	System Management Bus bidirectional data line	I/O	
B15	SMB_ALERT#	System Management Bus Alert	I PU	
B16	SATA1_TX+	SATA differential transmit pairs	O	
B17	SATA1_TX–	SATA differential transmit pairs	O	
B18	SUS_STAT#	Indicates imminent suspend operation	O	
B19	SATA1_RX+	SATA differential receive pairs	I	
B20	SATA1_RX–	SATA differential receive pairs	I	
B21	GND(FIXED)	Ground	GND	
B22	SATA3_TX+	SATA differential transmit pairs	O	N/A
B23	SATA3_TX–	SATA differential transmit pairs	O	N/A
B24	PWR_OK	Power OK from main power supply	I PU	TQ-flexiCFG
B25	SATA3_RX+	SATA differential receive pairs	I	N/A
B26	SATA3_RX–	SATA differential receive pairs	I	N/A
B27	WDT	watchdog time-out	O	TQ-flexiCFG
B28	AC/HDA_SDIN2	Serial TDM data input	I PU	N/A
B29	AC/HDA_SDIN1	Serial TDM data input	I PU	
B30	AC/HDA_SDIN0	Serial TDM data input	I PU	
B31	GND(FIXED)	Ground	GND	
B32	SPKR	PC Audio Speaker output	O	
B33	I2C_CK	General purpose I^2C port clock output	I/O	TQ-flexiCFG
B34	I2C_DAT	General purpose I^2C port data I/O line	I/O	TQ-flexiCFG
B35	THRM#	Input from carrier temperature sensor	I PU	
B36	USB7–	USB differential pairs	I/O	
B37	USB7+	USB differential pairs	I/O	
B38	USB_4_5_OC#	USB over-current sense, USB channels 4 and 5	I PU	
B39	USB5–	USB differential pairs	I/O	
B40	USB5+	USB differential pairs	I/O	
B41	GND(FIXED)	Ground	GND	
B42	USB3–	USB differential pairs	I/O	
B43	USB3+	USB differential pairs	I/O	
B44	USB_0_1_OC#	USB over-current sense, USB channels 0 and 1	I PU	
B45	USB1–	USB differential pairs	I/O	
B46	USB1+	USB differential pairs	I/O	
B47	EXCD1_PERST#	PCI ExpressCard: reset, active low, one per card	O	TQ-flexiCFG
B48	EXCD1_CPPE#	PCI ExpressCard: PCI Express capable card request, active low	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	O	N/A
B53	PCIE_RX5–	PCI Express differential receive pairs	O	N/A
B54	GPO1/SD_CMD	GPO1 / SDIO Command	O	TQ-flexiCFG
B55	PCIE_RX4+	PCI Express differential receive pairs	O	N/A

Table 11: COM Express™ Connector Pin Assignment (continued)

Pin	Pin-Signal	Description	Type	Remark
B56	PCIE_RX4–	PCI Express differential receive pairs	O	N/A
B57	GPO2 / SD_WP	GPO2 / SDIO Write Protect	I PU	TQ-flexiCFG
B58	PCIE_RX3+	PCI Express differential receive pairs	O	N/A PCIe on request
B59	PCIE_RX3–	PCI Express differential receive pairs	O	N/A PCIe on request
B60	GND(FIXED)	Ground	GND	
B61	PCIE_RX2+	PCI Express differential receive pairs	O	
B62	PCIE_RX2–	PCI Express differential receive pairs	O	
B63	GPO3/SD_CD#	GPO3 / SDIO Card Detect	I PU	TQ-flexiCFG
B64	PCIE_RX1+	PCI Express differential receive pairs	O	
B65	PCIE_RX1–	PCI Express differential receive pairs	O	
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	O	
B69	PCIE_RX0–	PCI Express differential receive pairs	O	
B70	GND(FIXED)	Ground	GND	
B71	LVDS_B0+	LVDS Channel B differential pairs 0	O	
B72	LVDS_B0–	LVDS Channel B differential pairs 0	O	
B73	LVDS_B1+	LVDS Channel B differential pairs 1	O	
B74	LVDS_B1–	LVDS Channel B differential pairs 1	O	
B75	LVDS_B2+	LVDS Channel B differential pairs 2	O	
B76	LVDS_B2–	LVDS Channel B differential pairs 2	O	
B77	LVDS_B3+	LVDS Channel B differential pairs 3	O	
B78	LVDS_B3–	LVDS Channel B differential pairs 3	O	
B79	LVDS_BKLT_EN	LVDS panel backlight enable	O	
B80	GND(FIXED)	Ground	GND	
B81	LVDS_B_CK+	LVDS Channel B differential clock	O	
B82	LVDS_B_CK-	LVDS Channel B differential clock	O	
B83	LVDS_BKLT_CTRL	LVDS panel backlight brightness control	O	
B84	VCC_5V_SBY	Standby power input: +5.0 V nominal	PWR	
B85	VCC_5V_SBY	Standby power input: +5.0 V nominal	PWR	
B86	VCC_5V_SBY	Standby power input: +5.0 V nominal	PWR	
B87	VCC_5V_SBY	Standby power input: +5.0 V nominal	PWR	
B88	BIOS_DIS1#	Selection straps to determine the BIOS boot device	I PU	
B89	VGA_RED	Red for monitor	O	
B90	GND(FIXED)	Ground	GND	
B91	VGA_GRN	Green for monitor	O	
B92	VGA_BLU	Blue for monitor	O	
B93	VGA_HSYNC	Horizontal sync output to VGA monitor	O	
B94	VGA_VSYNC	Vertical sync output to VGA monitor	O	
B95	VGA_I2C_CK	DDC clock line	O	
B96	VGA_I2C_DAT	DDC data line	I/O	
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	GND	

Table 11: 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 USB3.0 differential receive pairs	I	
C4	USB_SSRX0+	SuperSpeed USB3.0 differentia receive pairs	I	
C5	GND	Ground	GND	
C6	USB_SSRX1–	SuperSpeed USB3.0 differentia receive pairs	I	N/A
C7	USB_SSRX1+	SuperSpeed USB3.0 differentia receive pairs	I	N/A
C8	GND	Ground	GND	
C9	USB_SSRX2–	SuperSpeed USB3.0 differentia receive pairs	I	N/A
C10	USB_SSRX2+	SuperSpeed USB3.0 differentia receive pairs	I	N/A
C11	GND(FIXED)	Ground	GND	
C12	USB_SSRX3–	SuperSpeed USB3.0 differentia receive pairs	I	N/A
C13	USB_SSRX3+	SuperSpeed USB3.0 differentia receive pairs	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	Reserved		
C18	RSVD18	Reserved		
C19	PCIE_RX6+	PCI Express differential receive pairs	O	N/A
C20	PCIE_RX6–	PCI Express differential receive pairs	O	N/A
C21	GND(FIXED)	Ground	GND	
C22	PCIE_RX7+	PCI Express differential receive pairs	O	N/A
C23	PCIE_RX7–	PCI Express differential receive pairs	O	N/A
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	Reserved		
C28	RSVD18	Reserved		
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	I/O	
C33	DDI2_CTRLDATA_AUX–	DDI2_CTRLDATA_AUX– signal DP AUX, HDMI / DVI DATA	I/O	
C34	DDI2_DDC_AUX_SEL	Selects the function of DDI2_CTRLxAUX+/– Signals	I PD	
C35	RSVD18	Reserved		
C36	DDI3_CTRLCLK_AUX+	DDI3_CTRLCLK_AUX+ signal DP AUX, HDMI / DVI CLK	I/O	N/A
C37	DDI3_CTRLDATA_AUX–	DDI3_CTRLDATA_AUX– signal DP AUX, HDMI / DVI DATA	I/O	N/A
C38	DDI3_DDC_AUX_SEL	Selects the function of DDI3_CTRLxAUX+/– 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		
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		
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	I	N/A
C53	PEG_RX0–	PCI Express differential receive pairs	I	N/A
C54	TYPE0#	Type 0 Module indication (NC)		
C55	PEG_RX1+	PCI Express differential receive pairs	I	N/A

Table 11: COM Express™ Connector Pin Assignment (continued)

Pin	Pin-Signal	Description	Type	Remark
C56	PEG_RX1–	PCI Express differential receive pairs	I	N/A
C57	TYPE1#	Type 1 Module indication (NC)		
C58	PEG_RX2+	PCI Express differential receive pairs	I	N/A
C59	PEG_RX2–	PCI Express differential receive pairs	I	N/A
C60	GND(FIXED)	Ground	GND	
C61	PEG_RX3+	PCI Express differential receive pairs	I	N/A
C62	PEG_RX3–	PCI Express differential receive pairs	I	N/A
C63	RSVD18	Reserved		
C64	RSVD18	Reserved		
C65	PEG_RX4+	PCI Express differential receive pairs	I	N/A
C66	PEG_RX4–	PCI Express differential receive pairs	I	N/A
C67	RSVD18	Reserved		
C68	PEG_RX5+	PCI Express differential receive pairs	I	N/A
C69	PEG_RX5–	PCI Express differential receive pairs	I	N/A
C70	GND(FIXED)	Ground	GND	
C71	PEG_RX6+	PCI Express differential receive pairs	I	N/A
C72	PEG_RX6–	PCI Express differential receive pairs	I	N/A
C73	GND	Ground	GND	
C74	PEG_RX7+	PCI Express differential receive pairs	I	N/A
C75	PEG_RX7–	PCI Express differential receive pairs	I	N/A
C76	GND	Ground	GND	
C77	RSVD18	Reserved		
C78	PEG_RX8+	PCI Express differential receive pairs	I	N/A
C79	PEG_RX8–	PCI Express differential receive pairs	I	N/A
C80	GND(FIXED)	Ground	GND	
C81	PEG_RX9+	PCI Express differential receive pairs	I	N/A
C82	PEG_RX9–	PCI Express differential receive pairs	I	N/A
C83	RSVD18	Reserved		
C84	GND	Ground	GND	
C85	PEG_RX10+	PCI Express differential receive pairs	I	N/A
C86	PEG_RX10–	PCI Express differential receive pairs	I	N/A
C87	GND	Ground	GND	
C88	PEG_RX11+	PCI Express differential receive pairs	I	N/A
C89	PEG_RX11–	PCI Express differential receive pairs	I	N/A
C90	GND(FIXED)	Ground	GND	
C91	PEG_RX12+	PCI Express differential receive pairs	I	N/A
C92	PEG_RX12–	PCI Express differential receive pairs	I	N/A
C93	GND	Ground	GND	
C94	PEG_RX13+	PCI Express differential receive pairs	I	N/A
C95	PEG_RX13–	PCI Express differential receive pairs	I	N/A
C96	GND	Ground	GND	
C97	RSVD18	Reserved		TQ-flexiCFG
C98	PEG_RX14+	PCI Express differential receive pairs	I	N/A
C99	PEG_RX14–	PCI Express differential receive pairs	I	N/A
C100	GND(FIXED)	Ground	GND	
C101	PEG_RX15+	PCI Express differential receive pairs	I	N/A
C102	PEG_RX15–	PCI Express differential receive pairs	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 11: 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 USB3.0 differential transmit pairs	O	
D4	USB_SSTX0+	SuperSpeed USB3.0 differential transmit pairs	O	
D5	GND	Ground	GND	
D6	USB_SSTX1–	SuperSpeed USB3.0 differential transmit pairs	O	N/A
D7	USB_SSTX1+	SuperSpeed USB3.0 differential transmit pairs	O	N/A
D8	GND	Ground	GND	
D9	USB_SSTX2–	SuperSpeed USB3.0 differential transmit pairs	O	N/A
D10	USB_SSTX2+	SuperSpeed USB3.0 differential transmit pairs	O	N/A
D11	GND(FIXED)	Ground	GND	
D12	USB_SSTX3–	SuperSpeed USB3.0 differential transmit pairs	O	N/A
D13	USB_SSTX3+	SuperSpeed USB3.0 differential transmit pairs	O	N/A
D14	GND	Ground	GND	
D15	DDI1_CTRLCLK_AUX+	DDI1_CTRLCLK_AUX+ signal DP AUX, HDMI / DVI CLK	I/O	
D16	DDI1_CTRLDATA_AUX–	DDI1_CTRLDATA_AUX– signal DP AUX, HDMI / DVI DATA	I/O	
D17	RSVD18	Reserved		
D18	RSVD18	Reserved		
D19	PCIE_TX6+	PCI Express differential transmit pairs	O	N/A
D20	PCIE_TX6–	PCI Express differential transmit pairs	O	N/A
D21	GND(FIXED)	Ground	GND	
D22	PCIE_TX7+	PCI Express differential transmit pairs	O	N/A
D23	PCIE_TX7–	PCI Express differential transmit pairs	O	N/A
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		
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		
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		
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		
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		
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	O	N/A
D53	PEG_TX0–	PCI Express differential transmit pairs	O	N/A
D54	PEG_LANE_RV#	PCI Express Graphics lane reversal input strap	I	N/A
D55	PEG_TX1+	PCI Express differential transmit pairs	O	N/A

Table 11: COM Express™ Connector Pin Assignment (continued)

Pin	Pin-Signal	Description	Type	Remark
D56	PEG_TX1–	PCI Express differential transmit pairs	O	N/A
D57	TYPE2#	Type 2 Module indication (GND)	O	
D58	PEG_TX2+	PCI Express differential transmit pairs	O	N/A PCIe on request
D59	PEG_TX2–	PCI Express differential transmit pairs	O	N/A PCIe on request
D60	GND(FIXED)	Ground	GND	
D61	PEG_TX3+	PCI Express differential transmit pairs	O	N/A
D62	PEG_TX3–	PCI Express differential transmit pairs	O	N/A
D63	RSVD18	Reserved		
D64	RSVD18	Reserved		
D65	PEG_TX4+	PCI Express differential transmit pairs	O	N/A
D66	PEG_TX4–	PCI Express differential transmit pairs	O	N/A
D67	GND	Ground	GND	
D68	PEG_TX5+	PCI Express differential transmit pairs	O	N/A
D69	PEG_TX5–	PCI Express differential transmit pairs	O	N/A
D70	GND(FIXED)	Ground	GND	
D71	PEG_TX6+	PCI Express differential transmit pairs	O	N/A
D72	PEG_TX6–	PCI Express differential transmit pairs	O	N/A
D73	GND	Ground	GND	
D74	PEG_TX7+	PCI Express differential transmit pairs	O	N/A
D75	PEG_TX7–	PCI Express differential transmit pairs	O	N/A
D76	GND	Ground	GND	
D77	RSVD18	Reserved		
D78	PEG_TX8+	PCI Express differential transmit pairs	O	N/A
D79	PEG_TX8–	PCI Express differential transmit pairs	O	N/A
D80	GND(FIXED)	Ground	GND	
D81	PEG_TX9+	PCI Express differential transmit pairs	O	N/A
D82	PEG_TX9–	PCI Express differential transmit pairs	O	N/A
D83	RSVD18	Reserved		
D84	GND	Ground	GND	
D85	PEG_TX10+	PCI Express differential transmit pairs	O	N/A
D86	PEG_TX10–	PCI Express differential transmit pairs	O	N/A
D87	GND	Ground	GND	
D88	PEG_TX11+	PCI Express differential transmit pairs	O	N/A
D89	PEG_TX11–	PCI Express differential transmit pairs	O	N/A
D90	GND(FIXED)	Ground	GND	
D91	PEG_TX12+	PCI Express differential transmit pairs	O	N/A
D92	PEG_TX12–	PCI Express differential transmit pairs	O	N/A
D93	GND	Ground	GND	
D94	PEG_TX13+	PCI Express differential transmit pairs	O	N/A
D95	PEG_TX13–	PCI Express differential transmit pairs	O	N/A
D96	GND	Ground	GND	
D97	RSVD18	Reserved		TQ-flexiCFG
D98	PEG_TX14+	PCI Express differential transmit pairs	O	N/A
D99	PEG_TX14–	PCI Express differential transmit pairs	O	N/A
D100	GND(FIXED)	Ground	GND	
D101	PEG_TX15+	PCI Express differential transmit pairs	O	N/A
D102	PEG_TX15–	PCI Express differential transmit pairs	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 Module Dimensions

The module dimensions are 95 mm × 95 mm (±0.2 mm).

The following illustration shows the Three View Drawing of the TQMxE38C.

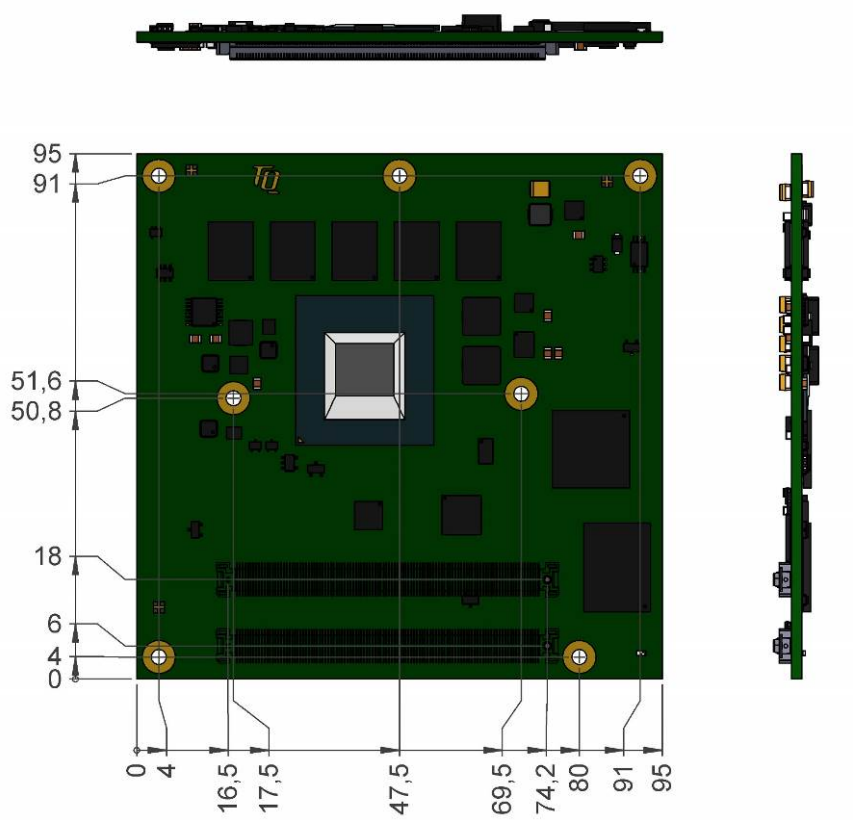

Illustration 2: Three-View Drawing TQMxE38C

The following illustration shows the bottom view of the TQMxE38C.

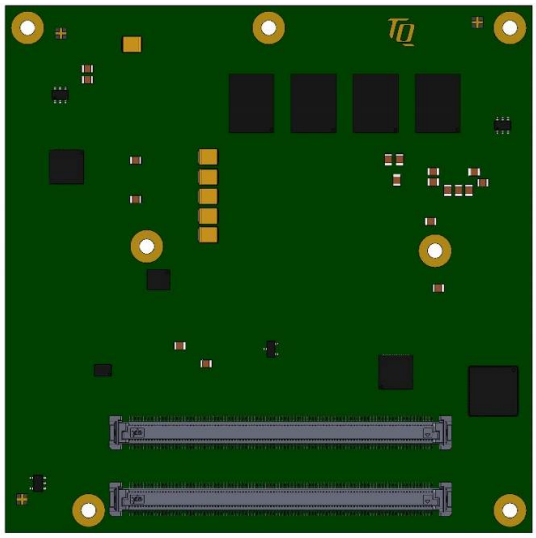

Illustration 3: Bottom-View Drawing TQMxE38C

4.2 Heat Spreader Dimensions

The TQMxE38C module supports two different heights of heat spreaders:

- Standard: TQMxE38C-HSP (TQMxE38C-HSP-11-M-5083-BL)
  The standard version is compliant to the COM Express™ specification with 13 mm (±0.2 mm) (including PCB).

The following illustration shows the standard heat spreader (TQMxE38C-HSP) for the TQMxE38C.

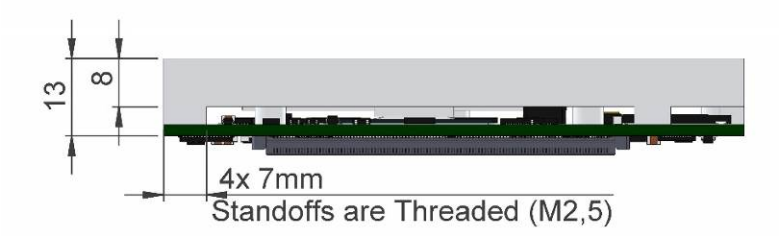

Illustration 4: Standard Heat Spreader "TQMxE38C-HSP"

Please contact TQ-Support for more details about 2D/3D Step models.

4.3 Mechanical and Thermal Considerations

The TQMxE38C module is designed to operate within a wide range of thermal environments.
An important issue during system integration is the thermal design. The heat spreader acts as a thermal coupling device to the module. The heat spreader is thermally coupled to the processor and provides optimal heat transfer from the module to the heat spreader. The heat spreader itself is not an appropriate heat sink.
System designers can implement different passive and active cooling systems through the thermal connection to the heat spreader.

Attention: Thermal Considerations	
	Do not operate the TQMxE38C without proper connection to a heat spreader and a heat sink!

If a special cooling solution must be implemented an extensive thermal design analysis and verification has to be performed. TQ-Systems GmbH offers thermal analysis and simulation as a service.

Please contact TQ-Support for more information about the thermal configuration.

4.4 Protection Against External Effects

The TQMxE38C module itself is not protected against dust, external impact and contact (IP00).
Adequate protection has to be guaranteed by the surrounding system and carrier board.
Conformal coating can be offered for applications in harsh environments.
Please contact TQ-Support for further details.

5. SOFTWARE

5.1 System Resources

5.1.1 I²C Bus

The TQMxE38C module 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	Module EEPROM	–
0xAE	Carrier board EEPROM	Embedded EEPROM configuration not supported

5.1.2 SMBus

The TQMxE38C module provides a System Management Bus (SMBus).
The following table shows the I²C address mapping for the COM Express™ SMBus port.

Table 13: I²C Address Mapping COM Express™ SMBus Port

8-bit Address	Function	Remark
0xA0	SPD EEPROM	Only used by BIOS
0x34	Thermal Sensor	–
0x58	Hardware Monitor	–
0x64	Reserved for iRTC	–

5.1.3 Memory Map

The TQMxE38C module supports the standard PC system memory and I/O memory map.

Please contact TQ-Support for further information about the memory map.

5.1.4 IRQ Map

The TQMxE38C module supports the standard PC Interrupt routing. The integrated legacy devices (COM1, COM2) can be configured via the BIOS to IRQ3 and IRQ4.

Please contact TQ-Support for further information about the Interrupt configuration.

5.2 Operating Systems

5.2.1 Supported Operating Systems

The TQMxE38C module supports various Operating Systems:

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

Other Operating Systems are supported on request.

Please contact TQ-Support for further information about supported Operating Systems.

5.2.2 Driver Download

The TQMxE38C module is well supported by the Standard Operating Systems, which already include most of the required drivers. The use of the latest Intel® drivers to optimize performance and the full feature set of the module is recommended.

Drivers for CPU / Graphics / Chipset can be downloaded at this Intel® page:

- Intel® Atom™ processor E3800 Product Family: Software and Drivers download
  http://www.intel.com/content/www/us/en/embedded/products/bay-trail/software-and-drivers.html

Drivers for the Intel® i201IT Gigabit Ethernet controller can be downloaded at this Intel® page:

- Intel® Download Center: Intel® Ethernet Controller i210 Series
  https://downloadcenter.intel.com/product/64399/Intel-Ethernet-Controller-I210-Series

Please contact TQ-Support for further driver download assistance.

5.3 BIOS

The TQMxE38C module uses a 64-bit uEFI BIOS with a legacy Compatibility Support Module (CSM).
This additional functionality enables the loading of a traditional OS or the use of a traditional OpROM.

5.3.1 Enter BIOS Setup

To enter the BIOS setup, turn on the computer, then press <ESC> and select the SCU menu.

5.4 Software Tools

Please contact TQ-Support for further information about available software tools.

6. SAFETY REQUIREMENTS AND PROTECTIVE REGULATIONS

6.1 EMC

The TQMxE38C module was developed according to the requirements of electromagnetic compatibility (EMC). Depending on the target system, anti-interference measures may still be necessary to guarantee the adherence to the limits for the overall system.

6.2 ESD

In order to avoid interspersion on the signal path from the input to the protection circuit in the system, the protection against electrostatic discharge should be arranged directly at the inputs of a system. As these measures always have to be implemented on the carrier board, no special preventive measures were done on the TQMxE38C.

6.3 Shock & Vibration

The TQMxE38C module is designed to be insensitive to shock and vibration and impact.
The design avoids additional connectors like SO-DIMM sockets to support applications also in harsh environments.

6.4 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.

6.5 Reliability and Service Life

The MTBF according to MIL-HDBK-217F N2 is approximately 335,880 h, Ground Benign, @ +40 °C.

6.5.1 RoHS

The TQMxE38C module is manufactured RoHS compliant.

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

6.5.2 WEEE®

The final distributor is responsible for compliance with the WEEE® regulation.
Within the scope of the technical possibilities, the TQMxE38C was designed to be recyclable and easy to repair.

6.6 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.

7. APPENDIX

7.1 Acronyms and Definitions

The following acronyms and abbreviations are used in this document.

Table 14: Acronyms

Acronym	Meaning
BIOS	Basic Input/Output System
CPU	Central Processing Unit
CSM	Compatibility Support Module
DC	Direct Current
DDC	Display Data Channel
DDI	Digital Display Interface
DDR3L	DDR3 Low Voltage
DMA	Direct Memory Access
DP	DisplayPort
DVI	Digital Visual Interface
ECC	Error-Correcting Code
eDP	embedded DisplayPort
EEPROM	Electrically Erasable Programmable Read-Only Memory
EMC	Electromagnetic Compatibility
eSATA	external Serial ATA
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
GND	Ground
GPIO	General Purpose Input/Output
HD	High Definition
HDA	High Definition Audio
HDMI	High Definition Multimedia Interface
HSP	Heat Spreader
I	Input
I PD	Input with internal Pull-Down resistor
I PU	Input with internal Pull-Up resistor
I/O	Input/Output
I^2C	Inter-Integrated Circuit
IEEE®	Institute of Electrical and Electronics Engineers
IP	Ingress Protection
IRQ	Interrupt Request
iRTC	Industrial Real Time Clock
JTAG®	Joint Test Action Group
LED	Light Emitting Diode
LP	Low-Profile
LPC	Low Pin Count
LVDS	Low Voltage Differential Signal

Table 14: Acronyms (continued)

Acronym	Meaning
MMC	Multimedia Card
mSATA	Mini-SATA
MTBF	Mean operating Time Between Failures
n.c.	Not Connected
O	Output
OD	Open drain output
OpROM	Option ROM
PC	Personal Computer
PCB	Printed Circuit Board
PCI	Peripheral Component Interconnect
PCIe	Peripheral Component Interconnect express
PCMCIA	People Can't Memorize Computer Industry Acronyms
PD	Pull-Down
PICMG®	PCI Industrial Computer Manufacturers Group
PU	Pull-Up
PWM	Pulse-Width Modulation
PWR	Power
RMA	Return Merchandise Authorization
RoHS	Restriction of (the use of certain) Hazardous Substances
RTC	Real-Time Clock
SATA	Serial ATA
SCU	System Control Unit
SD	Secure Digital
SD/MMC	Secure Digital Multimedia Card
SDRAM	Synchronous Dynamic Random Access Memory
SMB	System Management Bus
SO-DIMM	Small Outline Dual In-Line Memory Module
SPD	Serial Presence Detect
SPI	Serial Peripheral Interface
SSD	Solid-State Drive
TDP	Thermal Design Power
TPM	Trusted Platform Module
UART	Universal Asynchronous Receiver/Transmitter
uEFI	Unified Extensible Firmware Interface
USB	Universal Serial Bus
WEEE®	Waste Electrical and Electronic Equipment
WES	Microsoft® Windows® Embedded Standard

7.2 References

Table 15: Further Applicable Documents and Links

No.	Name	Rev. / Date	Company
(1)	Intel® Atom™ processor E3800 Product Family: Overview http://www.intel.de/content/www/us/en/embedded/products/bay-trail/overview.html		Intel®
(2)	Intel® Atom™ processor E3800 Product Family: Software and Drivers download http://www.intel.com/content/www/us/en/embedded/products/bay-trail/software-and-drivers.html		Intel®
(3)	Intel® Atom™ processor E3800 Product Family: Documentation http://www.intel.com/content/www/us/en/embedded/products/bay-trail/documentation.html Including Datasheets, Specification Updates and User Guides		Intel®
(4)	PICMG® COM0 COM Express™ Module Base Specification	Rev. 2.1 / May 14, 2014	PICMG®
(5)	PICMG® COM Express™ Carrier Design Guide (available for public download) https://www.picmg.org/wp-content/uploads/PICMG_COMDG_2.0-RELEASED-2013-12-061.pdf	Rev. 2.0 / Dec. 6, 2013	PICMG®
(6)	Intel® Download Center: Intel® Ethernet Controller i210 Series https://downloadcenter.intel.com/product/64399/Intel-Ethernet-Controller-I210-Series		Intel®

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