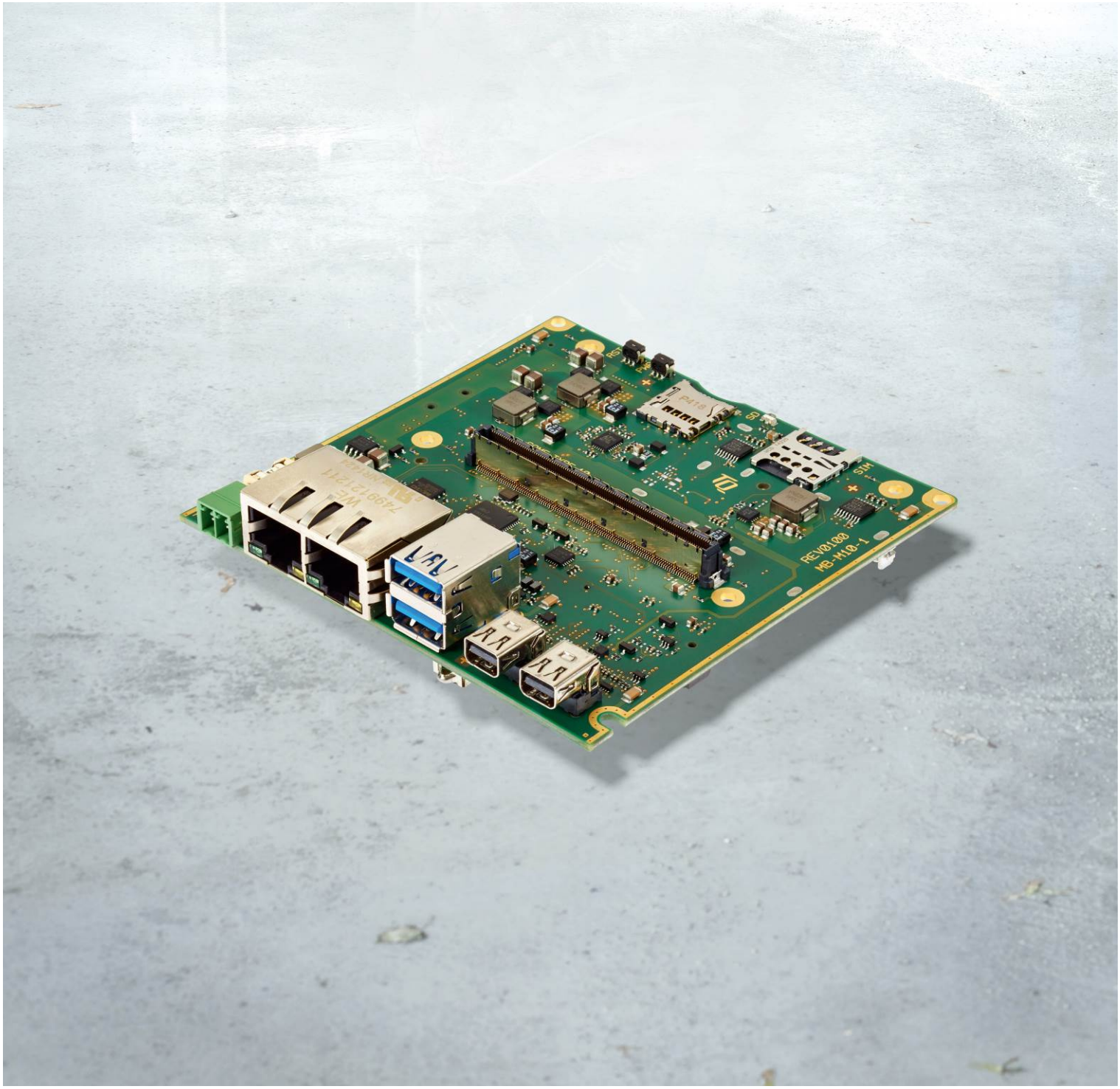
MB-M10-1
User's Manual

MB-M10-1 UM 0100
2016-04-01



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REVISION HISTORY

Rev.	Date	Name	Pos.	Modification
0100	2016-04-01	FP		First edition

1. ABOUT THIS MANUAL

1.1 Copyright and Licence Expenses

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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 MB-M10-1 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 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 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 (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), (2).

2. INTRODUCTION

The mainboard MB-M10-1 in combination with a CPU module based on PICMG standard COM Express™ Mini Type 10 (COM.0 R2.1) forms an extremely compact and powerful embedded PC platform.
The modularity enables future-proof designs with latest Intel® Atom™ embedded CPUs.

High speed communication interfaces and powerful graphics capabilities with up to dual 2560 × 1600 resolution enables smart gateway, BoxPC and digital signage applications.

The compact (100 × 100 mm^2) and robust design, the optional extended temperature range as well as the option of conformal coating extends the use cases to applications within rugged industry, railway and outdoor / harsh environment.

Based on the very low power consumption and smart power management the applications can be realized with passive cooling (fanless).

2.1 Functional Overview

The following key functions are implemented on the MB-M10-1:

Supported Modules:

- COM Express™ Mini Modules with Type 10 pinout

External Interfaces:

- 2 × Gigabit Ethernet
- 2 × USB3.0
- 2 × mini DisplayPort
- Power Button / Reset

Internal Interfaces:

- Mini PCIe socket (with micro-SIM card support)
- Mini PCIe socket (half size)
- mSATA socket
- micro SD card socket
- 2 × RS232
- FAN connector
- Front panel connector

Power supply:

- Input Voltage Range: 9 V to 36 V DC

Environment:

- Extended Temperature: –40 °C to +85 °C [1]

Form factor / dimensions:

- 100 mm × 100 mm
- Suitable for 100 mm standard chassis
- Also suitable for embedded NUC standard chassis (eNUC compatible mounting points and IO shield)

2.2 Specification Compliance

The MB-M10-1 supports modules compliant to the PICMG™ COM Express™ Module Base Specification (COM.0 R2.1) with Type 10 pinout.

2.3 Versions

The MB-M10-1 carrier is available in the following configurations:

- MB-M10-1-AA (“Standard”)
- Customer-specific configurations on request

1: Exclusive battery (Standard CR2032 battery is specified for –20 °C to +60 °C).

2.4 Accessories

The D-Sub-9 adapter cable “DK-RS232-9POL-DSUB-PICOBLADE REV.0100” has the order code 278622.0100.
It is 130 mm long and connects the internal connector X11 with a 9-pin D-Sub connector.

Illustration 1: D-Sub-9 Adapter Cable

Please contact support@tq-group.com for more details about mini Display Port cables and mini Display Port to DVI/HDMI adapters.

3. FUNCTIONAL SPECIFICATION

3.1 Block Diagram

The following illustration shows the block diagram of the MB-M10-1:

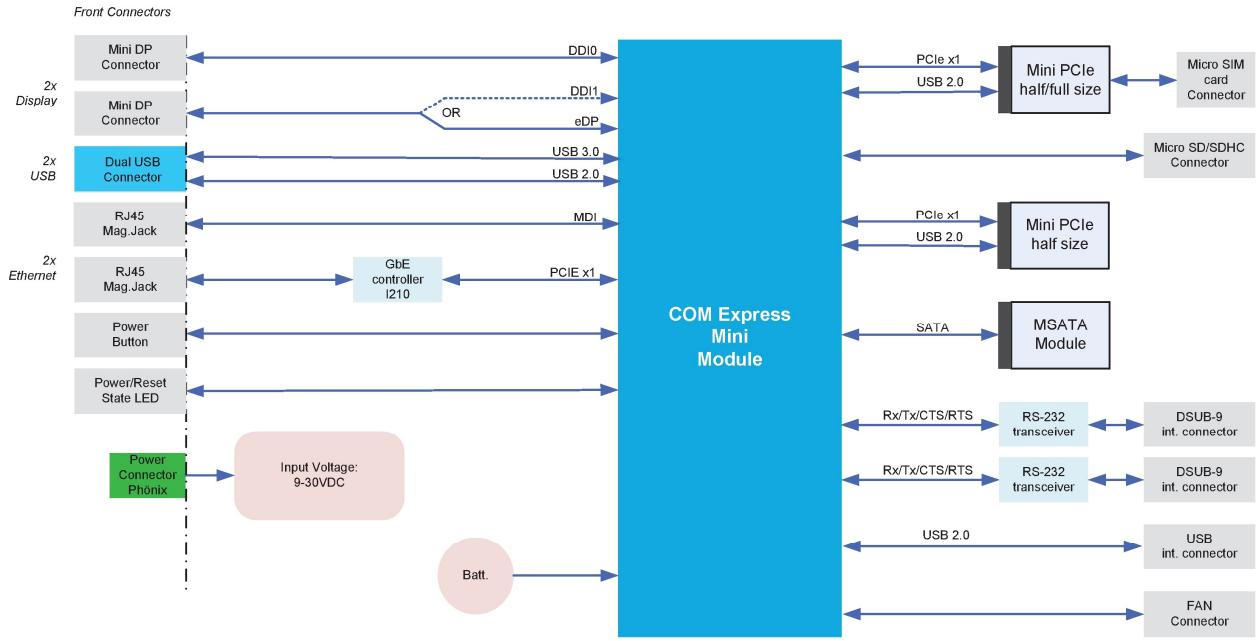

Illustration 2: Block Diagram MB-M10-1

3.2 Electrical Specification

3.2.1 Supply Voltage Characteristics

The MB-M10-1 supports a wide-range voltage input from 9 to 36 V DC.

3.2.2 Power Consumption Specification

The power consumption of the system significantly depends on the connected devices (COM Express™ module, Mass storage devices, USB devices etc.).

The power consumption of the MB-M10-1 itself is approximately 50 mA @ 12 V (COM Express™ module supplied externally; UEFI-shell active; no keyboard, no mouse, no mass storage device, no Ethernet cable etc. connected).

The maximum input current of the MB-M10-1 is limited to 5 A by a fuse.

The devices connected to the carrier should not exceed 30 W.

Note: Power requirement	
	The power supply for the MB-M10-1 must be configured with enough reserve. It should be calculated with the maximum power of all connected components.

3.3 Environmental Specification

- Temperature operating, Extended: –40 °C to +85 °C [2]
- Temperature storage: –40 °C to +85 °C [2]
- Relative humidity (operating / storage): 10 % to 90 % (not condensing)

2: Exclusive battery (Standard CR2032 battery is specified for –20 °C to +60 °C).

3.4 System Components

3.4.1 Gigabit Ethernet Controller

The MB-M10-1 is equipped with an Intel® i210IT Ethernet controller with 10/100/1000 Mbps speed and IEEE1588 support. Please contact support@tq-group.com for further information about the IEEE1588 support.

3.5 Connectors and Interfaces

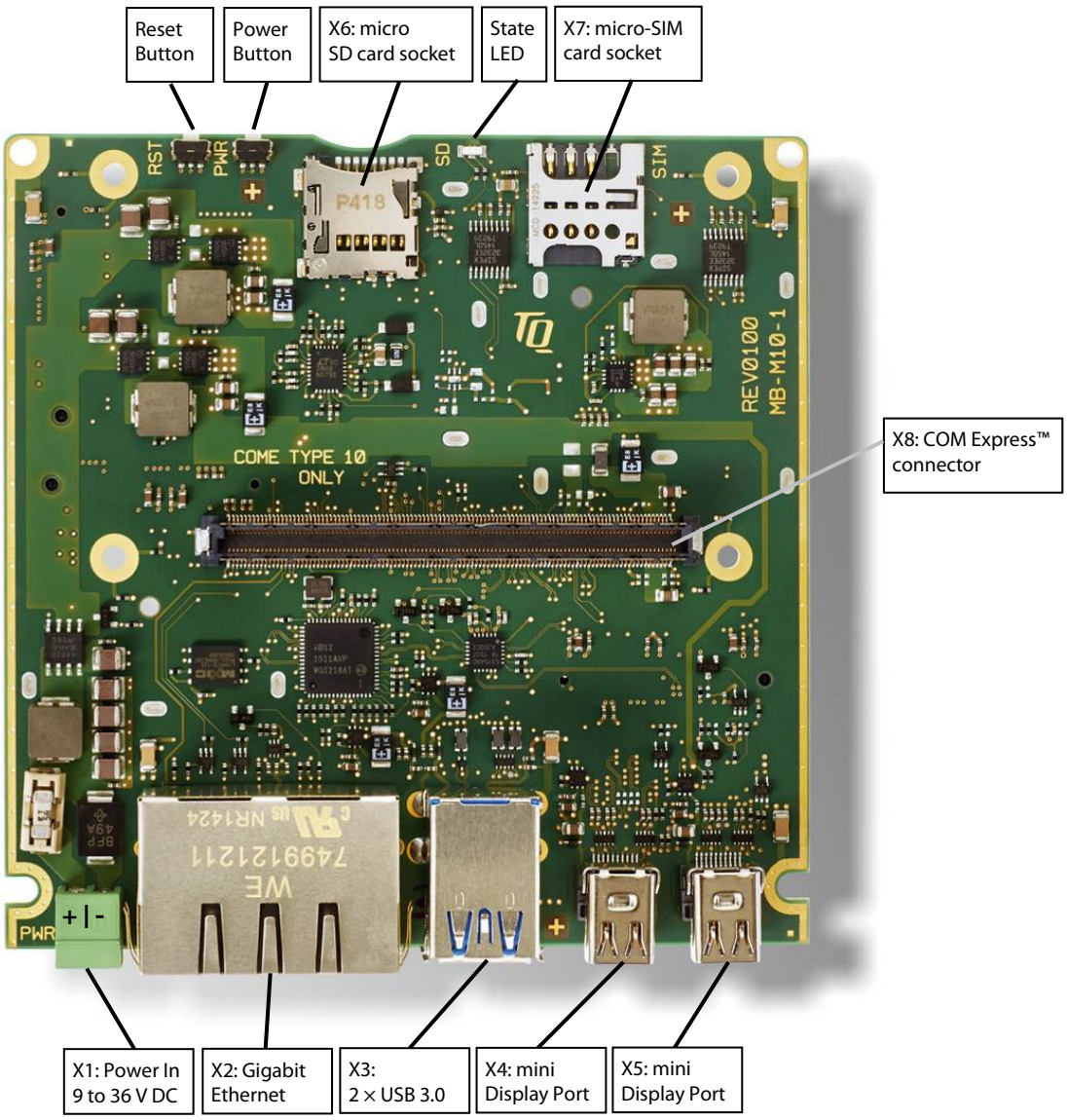

Illustration 3: MB-M10-1, Top

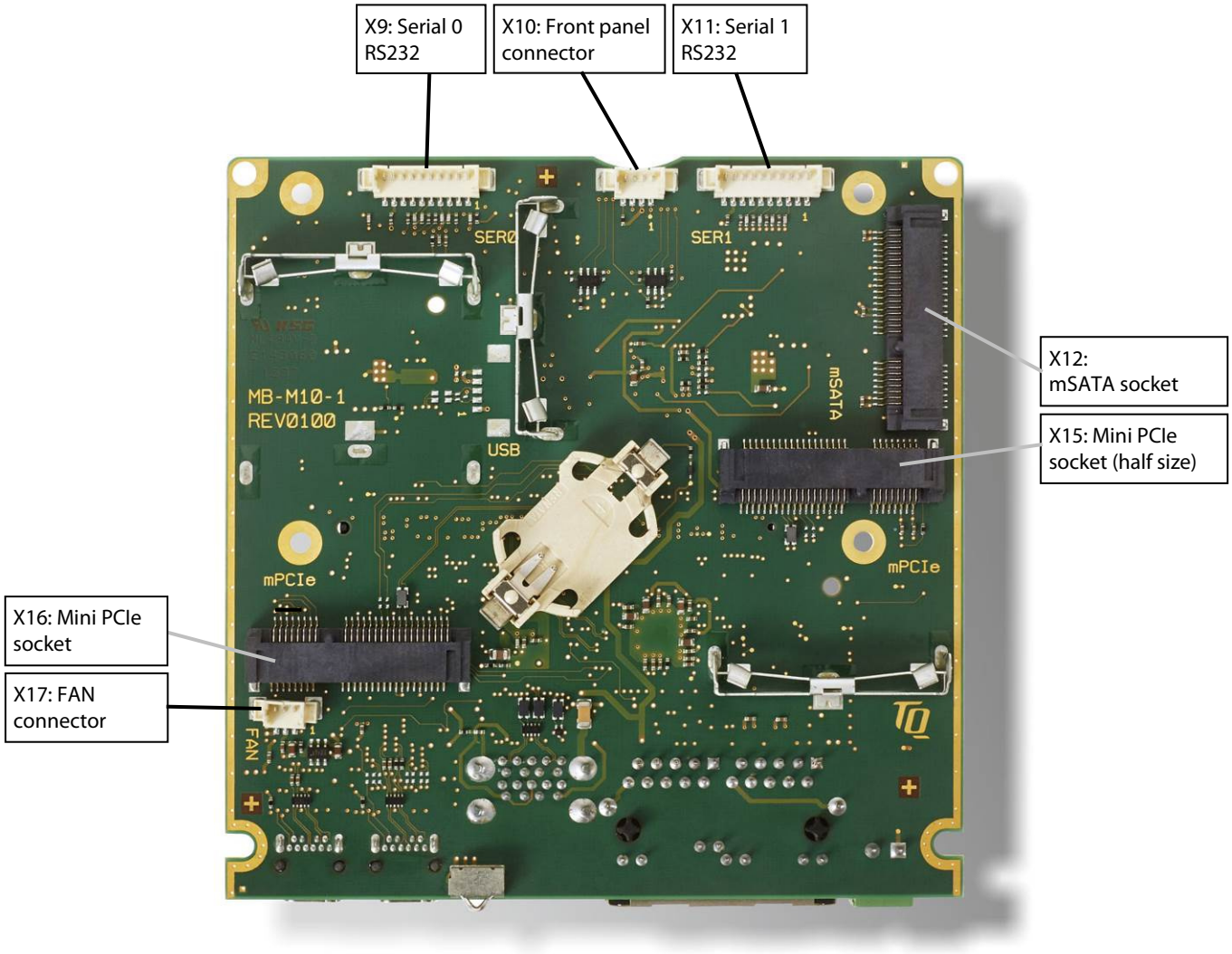

Illustration 4: MB-M10-1, Bottom

3.5.1 Power Supply

The MB-M10-1 supports a wide-range voltage input from 9 to 36 V DC.

X1: Power-In Connector

- Connector type: Phoenix MC1,5/2-G-3,5
- Mating connector: e.g. Phoenix FMC1,5/2-ST-3,5

Table 2: Pinout Power-In Connector X1

Pin	Signal	Remark
1	9 to 36 V	Fused @ 5 A
2	GND	

3.5.2 Mini DisplayPort

The MB-M10-1 supports two mini DisplayPort interfaces. The support of adapters from mini DP to HDMI, DVI or VGA depends on the combination of the COM Express™ module and the adapter used. The combination of some modules with some adapters might not work.

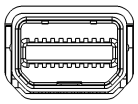

Illustration 5: mini DP Connectors X4, X5

Table 3: Pinout mini DP Connectors X4, X5

Pin	Signal	Remark
1	GND	
2	HPD	Hot plug detect
3	Lane 0+	
4	CONFIG1	
5	Lane 0–	
6	CONFIG2	
7	GND	
8	GND	
9	Lane 1+	
10	Lane 3+	
11	Lane 1–	
12	Lane 3–	
13	GND	
14	GND	
15	Lane 2+	
16	AUX_CH+	
17	Lane 2–	
18	AUX_CH–	
19	GND	
20	DP_PWR	

3.5.3 USB Host / Device Interfaces

The MB-M10-1 provides two USB Hosts interfaces at X3, a double A-Type (USB3.0) connector for direct usage of USB host ports.

3.5.4 Gigabit Ethernet

The MB-M10-1 supports two Gigabit Ethernet ports. The Ethernet signals of the COM Express™ connector are routed to X2.
The right port of X2 on the MB-M10-1 is connected to an Intel® i210IT Ethernet controller with 10/100/1000 Mbps speed.

Table 4: Ethernet LEDs

LED	Colour/ State	Description
Left (Link)	Off	No link
Left (Link)	Green	Link connected
Right (ACT)	Off	No activity
Right (ACT)	Yellow	Activity

Illustration 6: Double RJ45 Connector X2

3.5.5 Serial Interfaces (RS232/RS422)

The MB-M10-1 provides two RS232 ports at on-board headers.
The COM Express™ Specification only supports RX and TX lines of the serial interface. Due to the TQ-flexiCFG feature the serial ports can be configured to route the handshake signals to free pins on the COM Express™ connector.

Table 5: Serial Port COM Express™ Port Mapping

COM Express™ Signal	COM Express™ Pin	MB-M10-1	Remark
SER0_TX	A98	SER0_TX	3.3 V input
SER0_RX	A99	SER0_RX	3.3 V output
SER1_TX	A101	SER1_TX	3.3 V input
SER1_RX	A102	SER1_RX	3.3 V output
SER0_RTS# [3]	B77	SER0_RTS#	3.3 V input
SER0_CTS# [3]	B78	SER0_CTS#	3.3 V output
SER1_RTS# [3]	A78	SER1_RTS#	3.3 V input
SER1_CTS# [3]	A79	SER1_CTS#	3.3 V output

The four COM Express™ serial signals (RX/TX) are specified to provide protection and level shifter circuitry.
To implement this circuitry would lead to lower transfer speeds of the two serial ports on the COM Express™ module.
There is no protective circuitry on the MB-M10-1 and therefore the serial ports provide transfer rates of up to 115 kbaud.
The MB-M10-1 can only be used in combination with COM Express™ modules Type 10 pinout.

Table 6: RS232 Connector X11

Pin	RS232 Signals	MB-M10-1	D-Sub connector (with D-Sub adapter, see page 5)
1	DCD	NC [4]	–
2	DSR	NC [4]	RXD
3	RXD	RXD	TXD
4	RTS	RTS [5]	–
5	TXD	TXD	GND
6	CTS	CTS [5]	–
7	DTR	NC [4]	RTS
8	RI	NC [4]	CTS
9	GND	GND	–
10	–	NC	–

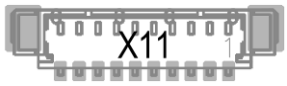

Illustration 7: RS232 Connector X11

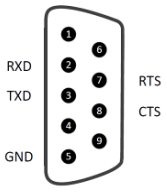

Illustration 8: D-Sub-9 Connector

3: These signals are not specified in COM Express™ specification.
These signals are only available when the TQ flexiCFG feature is available on the COM Express™ module. TQMxE38M modules support this feature.
4: Not available since signal is not defined in COM Express™ specification.
5: Only available when the TQ flexiCFG feature is available on the COM Express™ module.

3.5.6 Mini PCIe Socket

The MB-M10-1 supports up to two Mini PCIe cards to extend the functionality of the system.

- One full-size socket (for 50.95 mm × 30 mm Mini PCIe cards)
  - Supports PCIe ×1 and USB 2.0
  - Micro-SIM card socket on MB-M10-1 for SIM/USIM card for 2G/3G/LTE modem support
- One half-size socket (for 26.8 mm × 30 mm Mini PCIe cards)
  - Supports PCIe ×1 and USB 2.0

The maximum transfer rates of these interfaces mainly depend on the COM Express™ module used and the connected devices.

3.5.7 mSATA Interfaces

The MB-M10-1 supports an mSATA interface:

- One mSATA socket for mSATA-SSD

The maximum transfer rate of this interface mainly depends on the COM Express™ module used and the connected device.

3.5.8 Micro SD Card Socket

The MB-M10-1 provides a socket for micro SD cards.
The SDIO signals on COM Express™ modules can also be used as GPIO signals.
Please ensure that the module is configured for SDIO-usage of these pins.

3.5.9 Fan Connector

The MB-M10-1 provides a fan connector.

X17: 5 V fan connector

- Connector type: Molex 53398-0371
- Mating connector: e.g. Molex 51021-0300 crimp housing

Table 7: 5 V Fan Connector X17

Pin	Signal	Remark
1	SENSE	Sense input for fan speed
2	PWM_OUT	Speed control/power output
3	GND	–

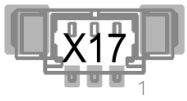

Illustration 9: 5 V Fan Connector X17

3.5.10 Front Panel Connector

The MB-M10-1 provides a front panel connector to connect an additional Power-Button and a Power-LED.

- A LED and a 130 Ω series resistor @ 3.3 V is required
- Connect Anode to Pin 3 and Cathode to Pin 4
- The LED lights up in S0 State (System is running)
- The LED is off in S5 State (System is shut down or not powered)

Table 8: Front Panel Connector X10

Pin	Signal	Remark
1	PWR_BTN#	PWR_BTN
2	GND	PWR_BTN
3	SUS_S5#	PWRD_ON_LED+ (3.3 V Level)
4	LED–	PWRD_ON_LED– (130 Ω to GND)

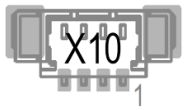

Illustration 10: Front Panel Connector X10

3.5.11 State LED

The MB-M10-1 provides a State LED.

Table 9: State LED Conditions

LED State	LED Colour	Description
Off	–	S5 State (System is shut down or not powered)
On	Green	S0 State (System is running)
On	Orange	S3 State (System is in Sleep mode)

3.5.12 COM Express™ Connector

The EPT 401-55101-51 or equivalent is used as COM Express™ connector.
The stack height (board-to-board distance between carrier board and module) is 8 mm.

4. MECHANICS

4.1 Dimensions

The board dimensions are designed for standard 100 mm chassis.
The mounting holes are positioned to support eNUC compatible chassis as well.

The following illustration shows the MB-M10-1.

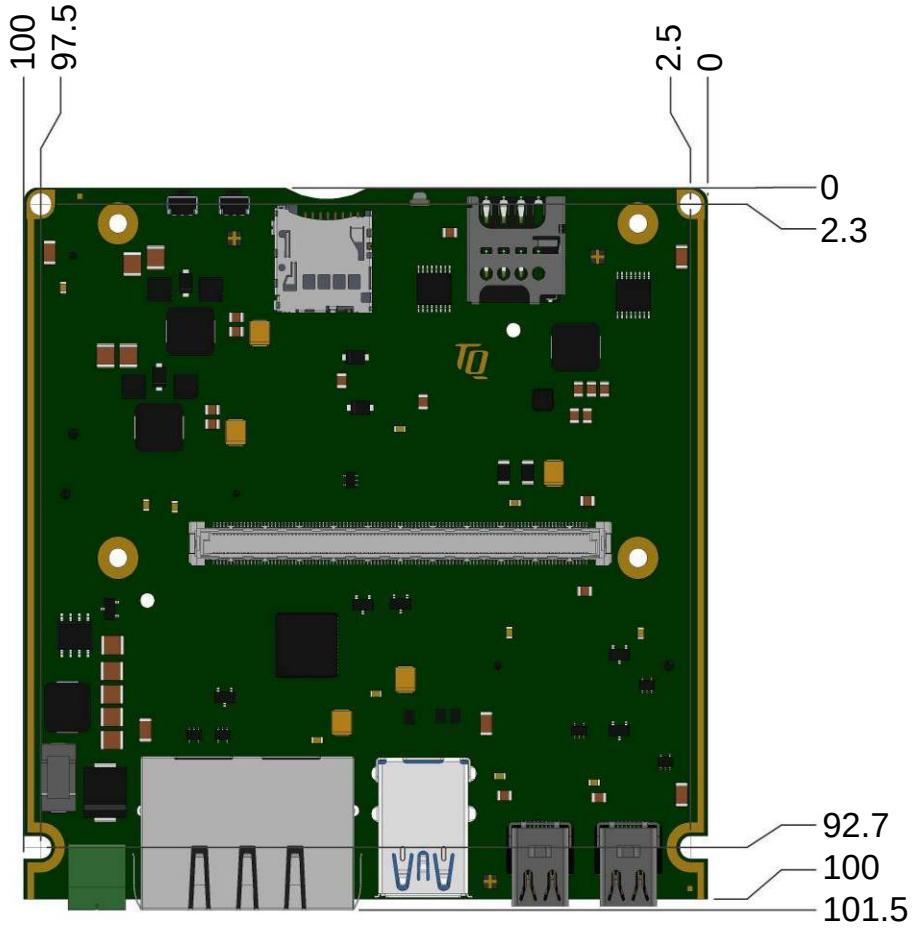

Illustration 11: MB-M10-1, Dimensions

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

4.2 Hardware Kit Assembly

The following illustration shows how to assemble the COM Express™ CPU module on the mainboard:

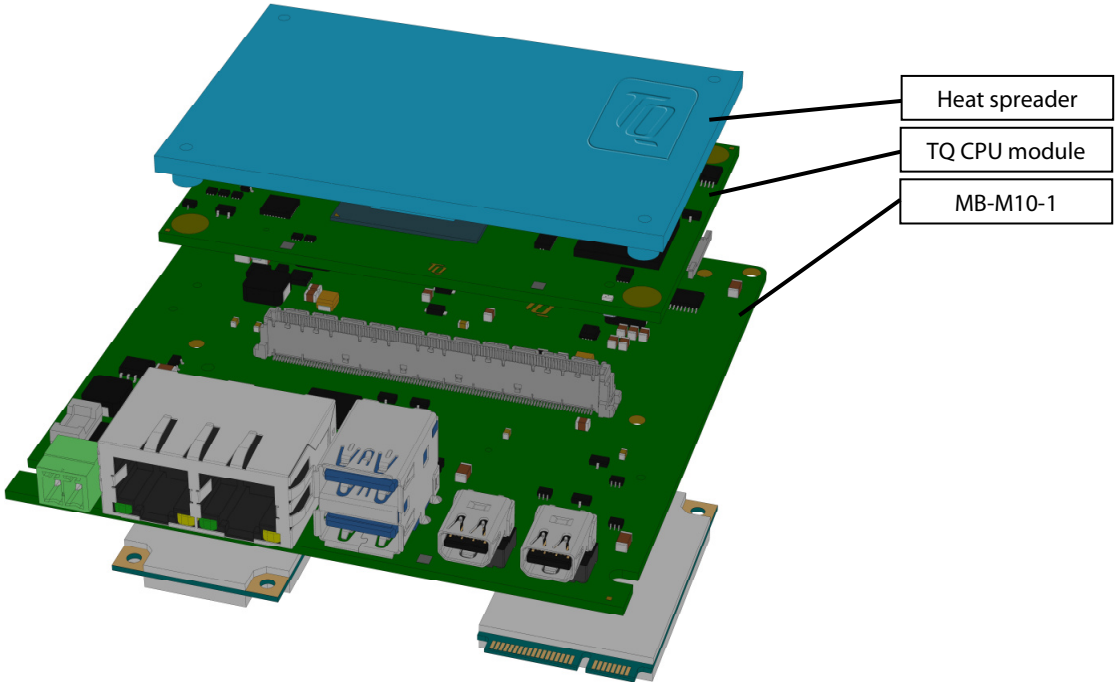

Illustration 12: MB-M10-1, 3D View, Assembly

- The CPU module is mounted to the heat spreader with distance bolts.
- The CPU module/heat spreader unit is mounted with screws from bottom side to the mainboard.

4.3 Protection Against External Effects

The MB-M10-1 is not protected against dust, external impact and contact (IP00).
Adequate protection has to be guaranteed by the surrounding system.

5. SOFTWARE

5.1 Operating Systems

5.1.1 Supported Operating Systems

The MB-M10-1 supports various Operating Systems:

- Microsoft® Windows™ 10
- 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 support@tq-group.com for further information about supported Operating Systems.

5.1.2 Driver Download

The MB-M10-1 module is well supported by the Standard Operating Systems, which already include most of the required drivers. It is recommended to use the latest drivers for optimal performance and the full feature set of the module.

Drivers for the Intel® i210IT 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 support@tq-group.com for further driver download assistance.

6. SAFETY REQUIREMENTS AND PROTECTIVE REGULATIONS

6.1 EMC

The MB-M10-1 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. (Incl. housing)

6.2 ESD

In order to avoid interspersion on the signal path from the input to the protection circuit in the system, the protection against electrostatic discharge should be arranged directly at the inputs of a system. Most external interfaces are protected using ESD protection diodes. Measurements for ESD protection have to be done with the electronic parts mounted in a housing. Since TQ-Systems GmbH does not offer a housing for the MB-M10-1 so far, no special preventive measures were done up to now.

6.3 Operational Safety and Personal Security

Due to the occurring voltages (36 V), tests with respect to the operational and personal safety haven't been carried out.

6.4 Reliability and Service Life

6.4.1 RoHS Compliance

The MB-M10-1 is manufactured RoHS compliant.

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

6.4.2 WEEE Regulation

The company placing the product on the market is responsible for the observance of the WEEE regulation.

To be able to reuse the product, it is produced in such a way (a modular construction) that it can be easily repaired and disassembled.

6.5 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 10: Acronyms

Acronym	Meaning
ATA	AT Attachment
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
IEEE®	Institute of Electrical and Electronics Engineers
IP	Ingress Protection
IRQ	Interrupt Request
iRTC	Industrial Real Time Clock
I^2C	Inter-Integrated Circuit
JTAG	Joint Test Action Group
LED	Light Emitting Diode
LP	Low-Profile
LPC	Low Pin Count
LVDS	Low Voltage Differential Signal

Table 10: Acronyms (continued)

Acronym	Meaning
MMC	Multimedia Card
mSATA	Mini-SATA
MTBF	Mean operating Time Between Failures
NC	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 11: Further Applicable Documents and Links

No.	Name	Rev. / Date	Company
(1)	PICMG® COM0 COM Express™ Module Base Specification	Rev. 2.1 / May 14, 2014	PICMG®
(2)	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®
(3)	Intel® Download Center: Intel® Ethernet Controller i210 Series https://downloadcenter.intel.com/product/64399/Intel-Ethernet-Controller-I210-Series		Intel®

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