



# MBox-R/V User's Guide

MBox-R/V UG 0103  
2017-11-17







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## REVISION HISTORY

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## 1. IMPORTANT INFORMATION

### 1.1 General

Be sure to follow the tips given in this User's Guide to make best use of the MBox-R/V. Failure to do so might lead to discomfort or injury, or cause the MBox-R/V to fail.

### 1.2 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.

### 1.3 Before You Start

This User's Guide must be carefully read and completely understood before you start working with the MBox-R/V. This User's Guide provides information, which is essential for proper operation of the MBox-R/V. General safety instructions must be adhered to and only trained and authorized personnel is permitted to work with the MBox-R/V.

### 1.4 Duty Of Care

It must be ensured that the MBox-R/V is only used in environments, which meet the specification of the MBox-R/V. The User's Guide has to be completely read and understood and the personnel is authorized and trained regarding standards, regulations and instructions. It also has to be ensured, that the MBox-R/V is mounted, operated and maintained according to the instruction of this User's Guide. All applicable national and international regulations and standards have to be obeyed.

### 1.5 Limited Warranty

Parts which wear out naturally are excluded from the warranty beyond that provided by law. This applies to e.g., coin cell batteries.

### 1.6 Liability and Warranty Obligation

TQ-Systems GmbH shall be exempted from the statutory accident liability obligation in case the user does not observe the information provided in this User's Guide or the warnings on the device. In the event of damage caused by failure to observe the information provided in this User's Guide or the warnings on the device, TQ-Systems GmbH shall not be required to honour the warranty even during the warranty period and shall be exempted from the statutory accident liability obligation.



## 1.7 Safety Guidelines

Use the following safety guidelines to protect your MBox-R/V from potential damage and ensure your personal safety.

If the following safety guidelines are not observed, it could lead to injuries to the operator and/or damage of the MBox-R/V.

In cases of non-observance of the safety guidelines TQ-Systems GmbH is exempt from accident liability, even if the MBox-R/V is still under warranty. The MBox-R/V must be used as specified in this User's Guide, which describes the safety guidelines for the MBox-R/V as well as for the operator. The place where the MBox-R/V is installed has to meet the requirements of the country's standards and regulations. If power cables are delivered with the MBox-R/V only these may be used. Ensure that there is sufficient air circulation to cool the MBox-R/V. Do not cover the MBox-R/V or mount it close to heat sources or damp places.

To completely disconnect the MBox-R/V from mains, the power cord has to be disconnected. Make sure the power cord is always easy accessible. Only open the MBox-R/V after all cables are disconnected from the MBox-R/V to insert or remove add-on cards.

This may only be done by qualified personnel. If add-on cards are installed in the MBox-R/V, all effective legal regulations and all technical data has to be adhered to. It has to be ensured, that the power consumption of add-on cards does not exceed the limitations and the current consumption specified on the label of the MBox-R/V. Very important! A safe operation is not possible when the MBox-R/V is visibly damaged or is not functioning at all. In this case the MBox-R/V must be switched off and it must be ensured that the MBox-R/V cannot be put back into operation. It is very important to ensure that the wires of power cords are sufficiently dimensioned, according to the maximum electrical specifications of the MBox-R/V. Standards and regulations like EN62368-1, VDE0100, EN60204, or UL508 have to be adhered to. This information helps you to safely use the MBox-R/V.

Follow and keep all information included with the MBox-R/V. The information in this User's Guide does not alter the terms of your purchase agreement or the TQ-Systems GmbH Limited Warranty. Your safety is important to us. The MBox-R/V is developed to be safe and effective. Power cords, power adapters, and other features can create potential safety risks that may result in physical injury or property damage, especially if misused. To reduce these risks, follow the instructions in this User's Guide, and observe all warnings on the MBox-R/V and in this User's Guide. By carefully following the information contained in this User's Guide and provided with the MBox-R/V, you can help protect yourself from hazards and create a safer environment.

Do not attempt to service the MBox-R/V yourself unless instructed to do so by TQ-Systems GmbH or this User's Guide.

## 1.8 Grounding Considerations

Be aware, that the chassis of the MBox-R/V is internally connected to Digital Ground (Power Supply Connector GND).

Depending on the Power Supply Unit used, it also might be connected or not to protective earth (PE).

This has to be considered, when connecting other components to the MBox-R/V.

The grounding of the MBox-R/V might also influence the electromagnetic emission of the MBox-R/V.

TQ-Systems GmbH recommends using the CINCON TRG70A power supply unit or equivalent, where PE is connected to GND.

## 1.9 ESD Considerations

To avoid damaging the MBox-R/V caused by ESD make sure the following measures are adhered to:

Ground your workplace with e.g. anti-static mats and ground yourself with a wrist strap. Only use conductive tools when working on the MBox-R/V. Always handle electrostatic sensitive components at their edges, preferably wear conductive gloves.

Remove the power cord from the MBox-R/V before inserting or removing connectors or before inserting or removing add-on cards. Don't touch the contacts of connectors. Keep your work environment tidy and free of non-conductive materials.

## 1.10 Handling the MBox-R/V

### Note: Handling the MBox-R/V



Improper or incorrect handling of the MBox-R/V can substantially reduce its life span. TQ-Systems GmbH cannot be held responsible for unauthorized modifications made by the user and the consequences thereof, which may alter the conformity of the MBox-R/V.

## 1.11 Coin Cell Battery

### Note: Coin cell battery



Danger of explosion if the coin cell battery is incorrectly replaced. Replace the coin cell battery only with a coin cell battery of the same type and size. Check for correct polarity before inserting the coin cell battery in its socket. Do not immerse into water, heat to more than +100 °C, repair or disassemble the coin cell battery. Dispose the coin cell battery as required by local ordinances or regulations.





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For direct technical support you can contact our FAE team [support@tq-group.com](mailto:support@tq-group.com).

Our FAE team can also support you with additional information, which is not provided on our website.

For service/RMA, please contact our service team [service@tq-group.com](mailto:service@tq-group.com) or your TQ sales representative.



### 3. INTRODUCTION

The MBox-R/V is a very compact Embedded PC based on Intel® Atom™ processor series E3800 (Bay Trail-I) for embedded applications. The highly reliable hardware in combination with the rugged housing design enables the application in industrial and harsh environmental conditions.

The MBox-R/V focuses to meet individual configurations depending on customers demand. Functionality and interfaces can easily be added by internal Mini PCIe cards. Typical applications are embedded server and gateway applications, entry level PC systems for automation, visualisation and monitoring and all applications, which place high demands on quality, durability and long-term availability.

The name "MBox-R" refers to the MBox with a "robust" housing. The "MBox-R" comes in one height with or without serial ports. The name "MBox-V" refers to the MBox with a "variable" housing. The "MBox-V" is available in two different heights, with serial ports (higher housing) or without serial ports (lower housing).

#### 3.1 Functional Overview

The following key functions are implemented in the MBox-R/V:

##### External Interfaces (standard)

- 2 × Gigabit Ethernet
- 1 × USB 2.0
- 1 × USB 3.0
- 2 × Mini DisplayPort
- Power Button / Reset Button (rear)

##### Additional Interface according to the individual configuration

- 2 × D-Sub 9-pin (for i.e. RS-232 or other extension interfaces like fieldbus interfaces)
- 2 × SMA connector for antenna

##### Internal Interfaces and connection possibilities

- Mini PCIe socket (full size, with micro-SIM card support)
- Mini PCIe socket (half size)
- mSATA socket
- MicroSD card socket
- 2 × RS-232 (for internal use or available at the front)
- FAN connector
- Front panel connector

##### Power Supply

- Input voltage range: 9 to 36 V DC





### 3.2 MBox-R/V Versions

Currently the MBox-R/V is available in two different configurations. The following table shows the details:

Table 2: MBox-R/V Standard Versions

MBox	TQMxE38M	DDR3L SDRAM	Storage	Power Consumption	Temp. Range
MBox-R	TQMxE38M-AG	4 Gbyte, 1333, ECC	128 Gbyte mSATA	12 W	-40 °C to +60 °C
MBox-V	TQMxE38M-AE	2 Gbyte, 1066, ECC	16 Gbyte mSATA	8 W	-40 °C to +60 °C

The MBox-R/V focuses on individual / customer specific configurations and individual branding. For this reason several other TQMxE38M modules are available on request:

Table 3: TQMxE38M Module Versions

Module	CPU / Graphics	TPM	DDR3L SDRAM	Power consumption	Remark
TQMxE38M-AA "Premium I-Temp."	E3845 Quad Core, 1.91 GHz, 2 Mbyte L2 cache HD Gfx 542/792 MHz	1.2	4 Gbyte, 1333, ECC	10 W	-
TQMxE38M-AG "Premium"	E3845 Quad Core, 1.91 GHz, 2 Mbyte L2 cache HD Gfx 542/792 MHz	1.2	4 Gbyte, 1333, ECC	10 W	MBox-R
TQMxE38M-AB "Mainstream"	E3827 Dual Core, 1.75 GHz, 1 Mbyte L2 cache HD Gfx 542/792 MHz	-	4 Gbyte, 1333, ECC	8 W	-
TQMxE38M-AF "Mainstream Light"	E3827 Dual Core, 1.75 GHz, 1 Mbyte L2 cache HD Gfx 542/792 MHz	-	2 Gbyte, 1333, ECC	8 W	-
TQMxE38M-AE "Light"	E3825 Dual Core, 1.33 GHz, 1 Mbyte L2 cache HD Gfx 533/533 MHz	-	2 Gbyte, 1066, ECC	6 W	MBox-V
TQMxE38M-AC "Entry-Level"	E3815 Single Core, 1.46 GHz, 512 Kbyte L2 cache HD Gfx 400/400 MHz	-	2 Gbyte, 1066, ECC	5 W	-

More configuration options are possible:

#### Mass storage:

- 16 / 32 / 64 / 128 / 256 / 512 Gbyte mSATA (SATA III, MLC) (Standard-Temp. 0 °C to +70 °C)
- 32 / 64 Gbyte mSATA (SATA III, MLC) (Extended-Temp. -40 °C to +85 °C)
- Other mSATA flash drives on request

#### Add-ons:

- WiFi (Dual Band Wireless AC) with Bluetooth (Standard-Temp. 0 °C to +70 °C)
- WiFi (Single Band) with Bluetooth (Standard-Temp. 0 °C to +70 °C)
- Others on request, e.g.:
  - WiFi (Extended-Temp: -40 °C to +85 °C), ZigBee, EnOcean
  - Fieldbus interfaces like CAN, ProfiNet, ProfiBus, DeviceNet, ModBus
  - Cellular connectivity (2G / 3G / LTE)

## 4. FUNCTIONAL SPECIFICATION

### 4.1 Electrical Specification

#### 4.1.1 Supply Voltage Characteristics

The MBox-R/V supports a wide-range voltage input of 9 to 36 V DC.

#### 4.1.2 Power Consumption Specification

The power consumption of the system significantly depends on the configuration and the connected devices (COM Express™ module, mass storage devices, USB devices etc.). The maximum input current of the MBox-R/V 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 MBox-R/V must be configured with enough reserve. It should be calculated with the maximum power of all connected components.

### 4.2 Environmental Specification

- Temperature Operating / Extended:

The maximum operating temperature depends on the internal power dissipation which is mainly influenced by the CPU version. The following temperature parameters were determined by qualification tests (standard configurations without any add-on cards):

Table 4: CPU Overview

CPU	E3845	E3827	E3825	E3815	E3805
CPU Cores	4	2	2	1	2
Cache	2 Mbyte	1 Mbyte	1 Mbyte	512 Kbyte	1 Mbyte
CPU clock	1.91 GHz	1.75 GHz	1.33 GHz	1.46 GHz	1.33 GHz
Temp. T <sub>junction</sub>	-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
Max. memory	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
Graphics	Intel® HD Graphics	Intel® HD Graphics	Intel® HD Graphics	Intel® HD Graphics	None
GFX Base / Burst	542 / 792 MHz	542 / 792 MHz	533 / 533 MHz	400 / 400 MHz	-
TDP	10 W	8 W	6 W	5 W	3 W
MBox temp range	-40 °C to +60 °C		-40 °C to +70 °C		

The supported operating temperature range depends on the components and modules used, e.g. if the temperature of the COM Express™ module is in the range of 0 °C to +60 °C, the maximum operating temperature range is 0 °C to +60 °C.

- Storage temperature: -40 °C to +85 °C
- Relative humidity (operating / storage): 10 % to 90 % (not condensing)

#### Note: Environmental conditions



When powering the MBox-R/V, make sure the chassis is not covered by any objects. Otherwise the heat dissipation will be restricted by physical effects and the maximum operating temperature will be reduced.

### 4.3 Connectors and Interfaces

#### 4.3.1 External Connectors and Interfaces Arrangement

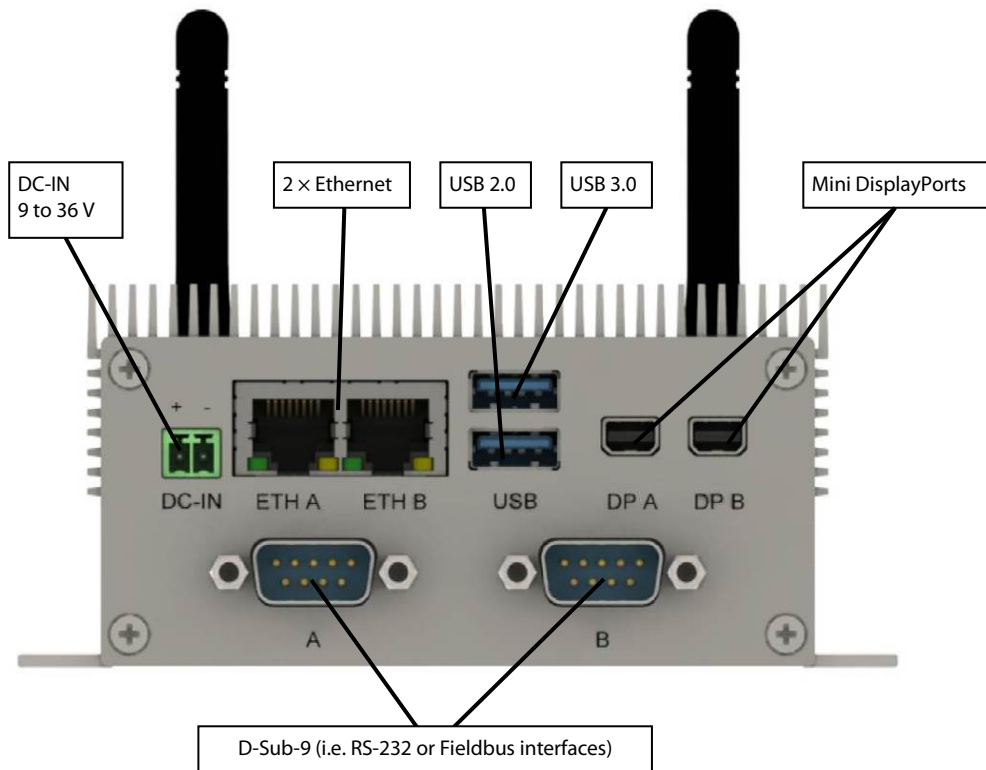


Illustration 1: MBox-R, Front with D-Sub-9 Connectors

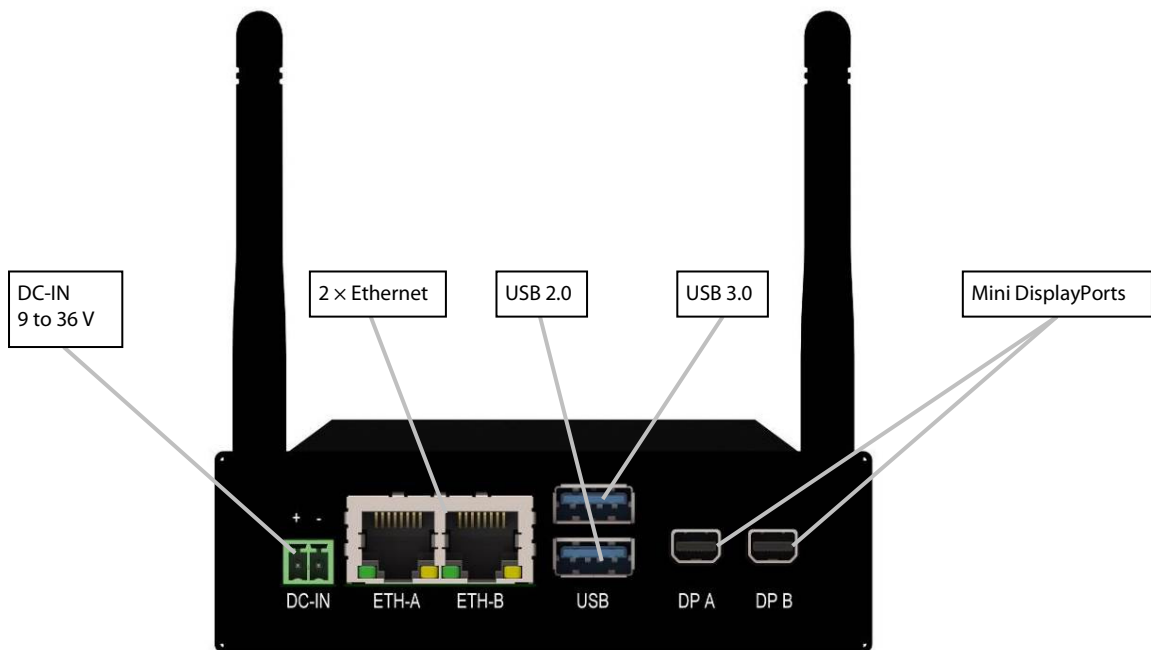


Illustration 2: MBox-V, Front without D-Sub-9 Connectors

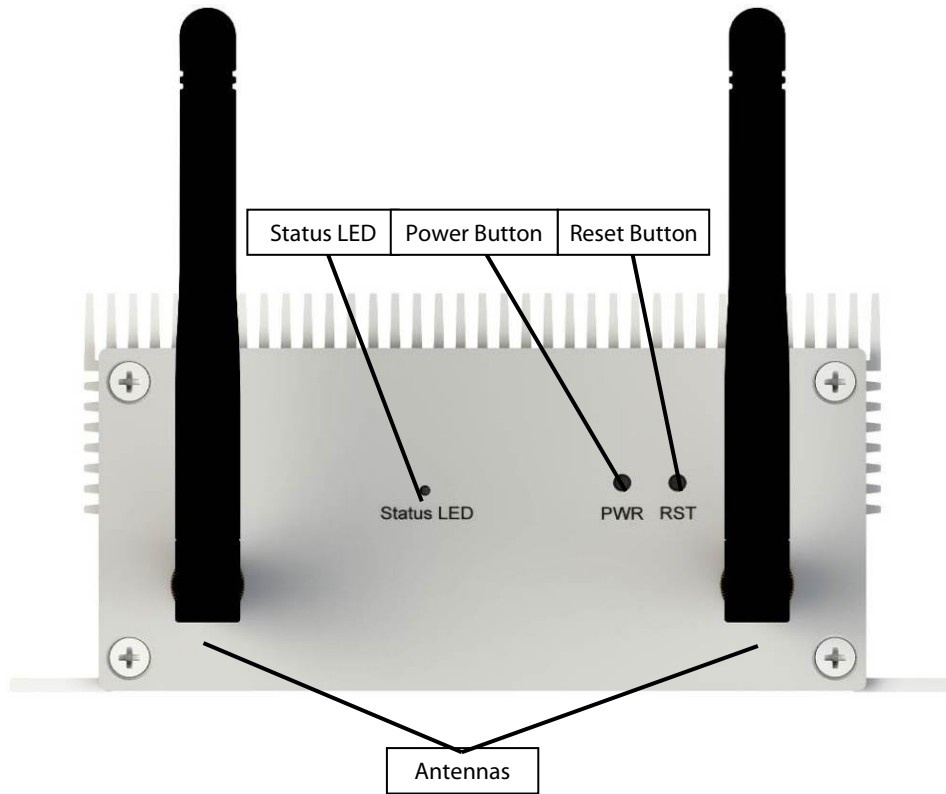


Illustration 3: MBox-R, Rear

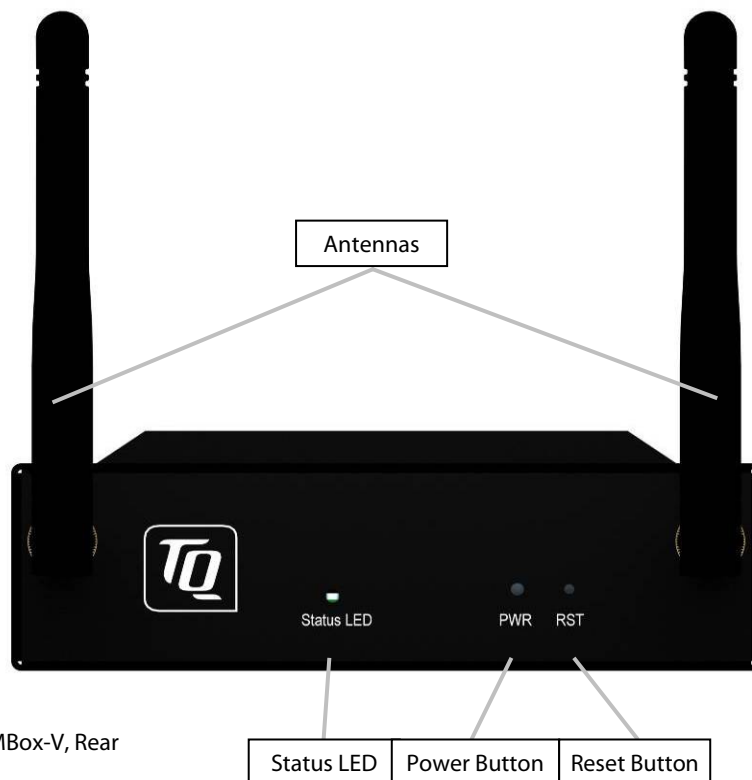


Illustration 4: MBox-V, Rear

#### 4.3.1.1 Power Supply Connector

The MBox-R/V supports a wide-range voltage input from 9 to 36 V DC.

Power-In connector:

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

Table 5: Pinout Power-In Connector

Pin	Signal	Remark
1 (+)	9 to 36 V	Fused @ 5 A
2 (-)	GND / chassis	-



Illustration 5: DC Power Supply Connector

#### Note: Power requirement



Do not connect or disconnect the Power Supply to the MBox-R/V under voltage.  
Switch off the voltage before plugging.

#### 4.3.1.2 Mini DisplayPort

The MBox-R/V supports two mini DisplayPort interfaces.

The interfaces support DP++ signalling. Therefore it is possible to connect monitors with DP, DVI, HDMI and VGA input by using dedicated cables and adapters.

The actual configuration with the Intel Atom E3800 series has extended monitor support with resolutions up to  $2 \times 2560 \times 1600$ .

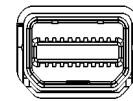


Illustration 6: Mini DP Connector

#### 4.3.1.3 USB Host Interfaces

The MBox-R/V supports two USB Host interfaces.

Double A-Type USB connector for direct usage of USB host ports

- Top USB Port (USB 3.0)
- Bottom USB Port (USB 2.0)

The maximum cable length of the USB interface is 3 m.

#### 4.3.1.4 Gigabit Ethernet

The MBox-R/V supports two common Gigabit Ethernet ports. An Intel® i210IT Ethernet controller with 10/100/1000 Mbps speed is implemented on both Ports.

Table 6: Ethernet LEDs

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



Illustration 7: RJ45 Connectors



#### 4.3.1.5 Status LED

The MBox-R/V is equipped with a Status LED (on rear side).

Table 7: Status LED Conditions

Status LED	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)

#### 4.3.1.6 Power Button and Reset Button

The Power Button and the Reset Button on the rear side of the MBox-R/V provide the following functions.

Table 8: Power Button and Reset Button Functions

Status	Event	System response
No power supply connected	Power is supplied	System starts automatically (BIOS default: S0)
System is shut down or in sleep mode (S3, S5)	Power button pushed <4 s	System starts (S0)
System running (S0)	Power button pushed <4 s	System shuts down or turns into sleep mode (S3, S5 depending on Windows settings)
System running (S0)	Power button pushed >4 s	System shuts down (S5)
System running (S0)	Reset button pushed	System restarts (S0)

### 4.3.2 Optional External Connectors and Interfaces Arrangement

#### 4.3.2.1 Serial Interfaces RS-232

The MBox-R/V provides up to two serial ports:

- 2 × D-Sub-9 RS-232 port (4-wire)
- Legacy compatible (IO addresses and IRQs)
- Up to 115 kbaud

To connect the internal RS-232 connectors to the front panel, the following adapters is used.

- Adapter cable 150 mm from internal connector to a 9-pin D-Sub connector, order code: 278622.0100



Illustration 8: D-Sub-9 Adapter Cable

Table 9: RS-232 D-Sub-9 Connector

Pin	D-Sub-9 Connector
1	–
2	RXD
3	TXD
4	–
5	GND
6	–
7	RTS
8	CTS
9	–
10	–

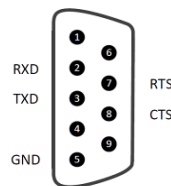


Illustration 9: RS-232 D-Sub-9 Connector

If the D-Sub-9 connectors at the front are used for other interfaces (like fieldbus), the RS-232 interfaces are not available.

#### 4.3.2.2 SMA Antenna Connectors

In combination with a Wireless or Bluetooth Mini PCI Express card, it is possible to add SMA antenna connectors for external antennas. For options and more information refer to chapter 3.2 and 4.3.2.5.

#### 4.3.2.3 Other Optional Connectors

For individual solutions more optional connectors are available.

#### 4.3.2.4 mSATA Interface for Mass Storage

An SSD is plugged in the mSATA socket on the carrier board of the MBox-R/V.

The size can be chosen according the requirements. See “mass storage” in chapter 3.2.

#### 4.3.2.5 Mini PCIe Extension Sockets

The MBox-R/V provides up to two Mini PCIe card slots to extend the IOs or other system functionality.

One Mini PCIe slot also provides a micro-SIM card socket. The socket is accessible when the back panel is removed.

- 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 carrier board in the MBox-R/V (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

#### 4.3.2.6 microSD Card Socket

The carrier board in the MBox-R/V provides a microSD card socket. The socket is accessible when the back panel is removed.



## 5. MECHANICS

### 5.1 Dimensions

The following illustrations show the MBox-R

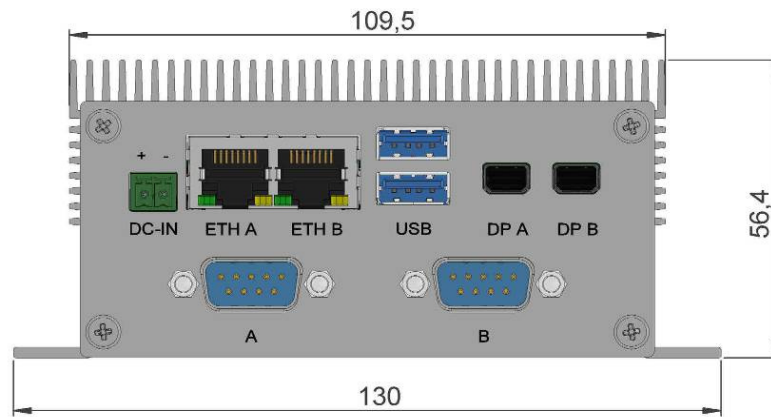


Illustration 10: MBox-R, Dimensions (mm), Front View

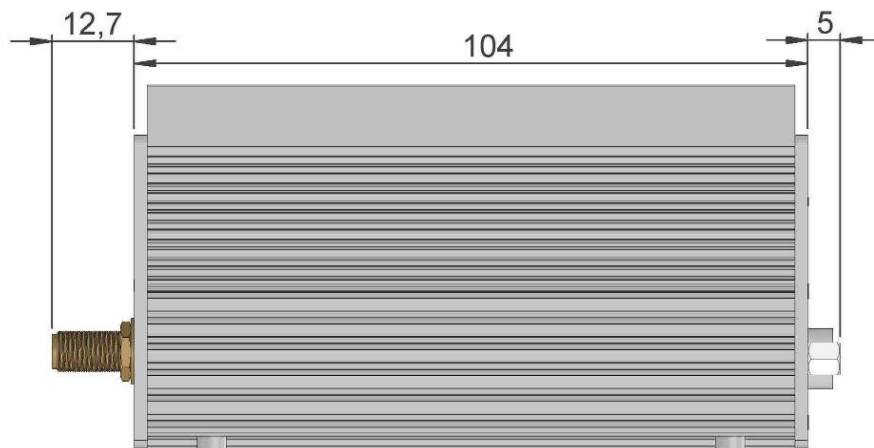


Illustration 11: MBox-R, Dimensions (mm), Side View

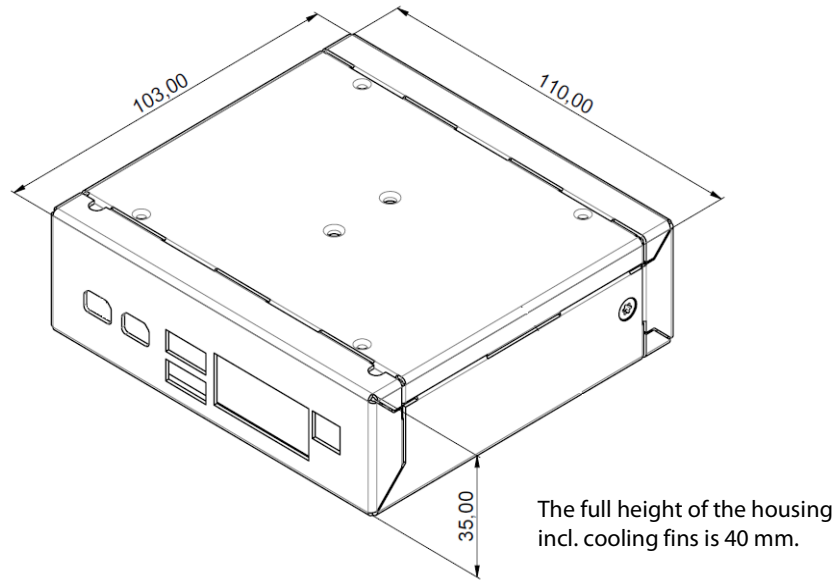


Illustration 12: MBox-V (without D-Sub-9 Connectors), Dimensions (mm), Bottom View

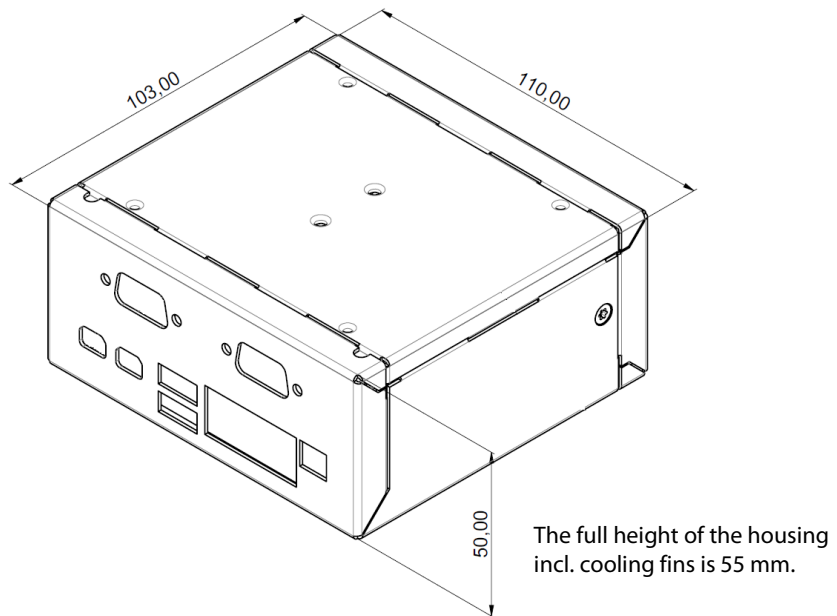


Illustration 13: MBox-V (with D-Sub-9 Connectors), Dimensions (mm), Bottom View

## 5.2 Mounting

There are several possibilities to mount the MBox-R/V:

- With an adapter plate
- To a cap rail with a clamp
- Directly with screws

Please contact [support@tq-group.com](mailto:support@tq-group.com) for more details or ideas suitable for your application.

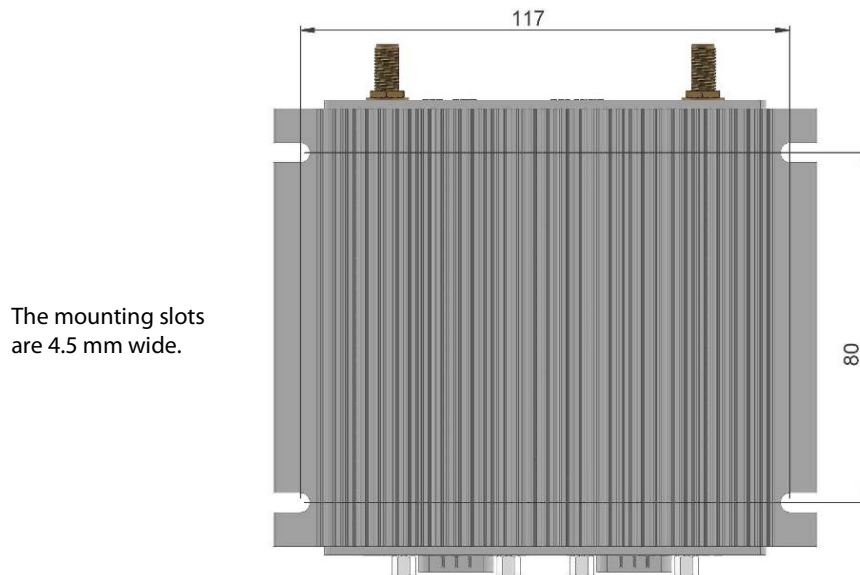


Illustration 14: MBox-R, Mounting Dimensions (mm), Top View

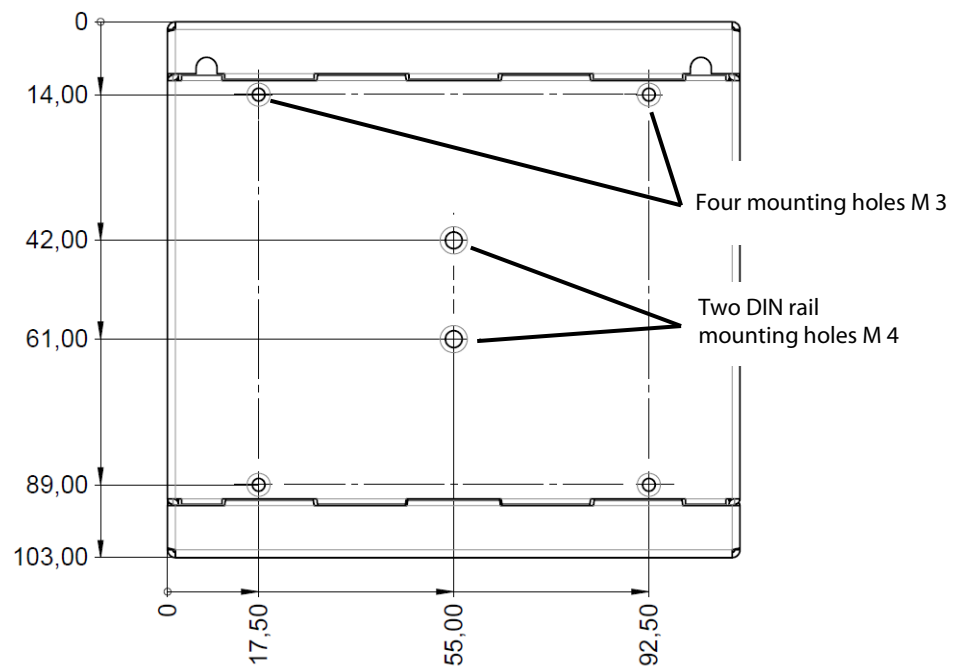


Illustration 15: MBox-V, Dimensions of Mounting Holes (mm), Bottom View

## 6. REGULATORY INFORMATION

### 6.1 EU Compliance with Electromagnetic Compatibility Directive

The MBox-R/V is in conformity with the protection requirements of EU Council Directive 2014/30/EU on the approximation of the laws of the Member States relating to electromagnetic compatibility. TQ-Systems GmbH cannot accept responsibility for any failure to satisfy the protection requirements resulting from a non-recommended modification of the MBox-R/V, including the installation of option cards from other manufacturers.

The MBox-R/V has been tested and found to comply with the limits for Class B Information Technology Equipment according to European Standard EN 55022, using the CINCON TRG70A power supply unit where PE is connected to GND. The limits for Class B equipment were derived for typical residential environments to provide reasonable protection against interference with licensed communication devices.

### 6.2 Declaration of Conformity

**We hereby declare under our sole responsibility that the**

**MBOX-V-E3825, Mat. No.: 292536**



**complies with the essential requirements, which are laid down in the referred harmonization directives below:**

- Directive 2011/65/EU of the European Parliament and of the council from June 8, 2011
- Directive 2014/30/EU of the European Parliament and of the council from February 26, 2014
- Directive 2012/19/EU of the European Parliament and of the council from July 4, 2012

**The MBOX-V-E3825, Mat. No.: 292536 also complies with the appropriate harmonised directives or specifications:**

- EN 50581, 2012-09
- EN 55022, 2010 / AC:2011
- EN 55024, 2010 + A1:2015

#### Additional information:

This declaration of Conformity is valid for all units, which are produced according to manufacturing drawings, which are a part of the technical documentation. Further information with respect to compliance with the standards and directives mentioned before, can be found in the accompanying documentation.

**Signed for / on behalf of:**

TQ-Systems GmbH

**Name, first name:**

i.V. Fromberger, Josef

**Function:**

Head of Embedded Division

Seefeld

19.10.2017

Ort und Datum / Place and date

*i.v. J. Fromberger*

Rechtsgültige Unterschrift / Signature

## 7. WEEE AND RECYCLING

### 7.1 WEEE

TQ-Systems GmbH encourages owners to recycle their MBox-R/V when it is not needed anymore.

The Waste Electrical and Electronic Equipment (WEEE) mark only applies to countries within the European Union (EU) and Norway. Appliances are labelled in accordance with European Directive 2012/19/EU concerning waste electrical and electronic equipment (WEEE). The Directive determines the framework for the return and recycling of used appliances as applicable throughout the European Union.

### 7.2 Recycling

Users of the MBox-R/V must not dispose the MBox-R/V as unsorted municipal waste, but use the collection framework available in their country for the return, recycle, or recovery of WEEE and minimize any potential effects on the environment and human health due to the presence of hazardous substances.



## 8. APPENDIX

Table 10: Further Applicable Software, Drivers and Documents

No.	Name	Rev. / Date	Company
(1)	Intel® Atom™ processor E3800 Product Family: Software and Drivers download <a href="http://www.intel.com/content/www/us/en/embedded/products/bay-trail/software-and-drivers.html">www.intel.com/content/www/us/en/embedded/products/bay-trail/software-and-drivers.html</a>	-	<a href="#">Intel®</a>
(2)	Intel® Download Center: Intel® Ethernet Controller i210 Series <a href="https://downloadcenter.intel.com/product/64399/Intel-Ethernet-Controller-i210-Series">https://downloadcenter.intel.com/product/64399/Intel-Ethernet-Controller-i210-Series</a>	-	<a href="#">Intel®</a>

