

# User Manual

## BC50R – IP65 Box PC for In-Vehicle Applications



*Configuration example*



## **BC50R - IP65 Box PC for In-Vehicle Applications (AMD)**

The BC50R is a maintenance-free box computer that has been designed, e.g., for data acquisition applications in rugged environments in vehicles, e.g. in trains, commercial vehicles, mobile machines or ships.

All interfaces are implemented on rugged M12 connectors (USB, digital input and output, Gigabit Ethernet, CAN and legacy serial I/O). The housing is compliant to the IP65 protection class.

On the inside, the system offers two PCI Express® Mini card slots with two SIM card slots for WLAN, GNSS or 3G/4G functionality. The necessary antenna connectors can be made available at the front panel.

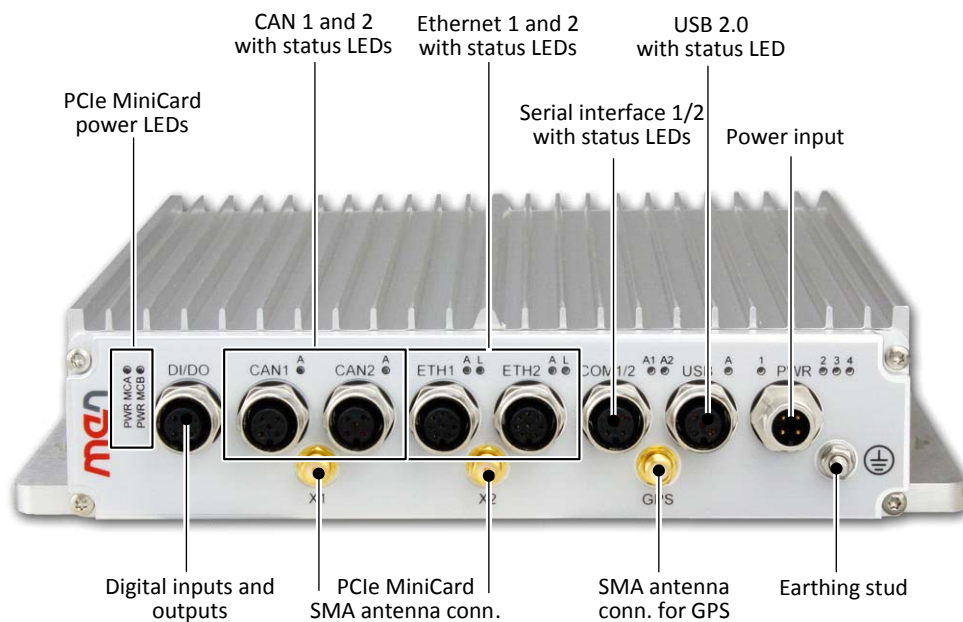
It is powered by an AMD Embedded G-Series APU (Accelerated Processing Unit), the T48N, running at 1.4 GHz. The use of the Embedded G-Series makes for high scalability in CPU (single/dual core) performance.

The BC50R is equipped with 2 GB of DDR3 SDRAM and offers SD card and mSATA slots. The system is designed for fanless operation at temperatures from -40 to +70°C (+85°C for up to 10 minutes), its special aluminum housing with cooling fins serves as a heat sink for the internal electronics and in this way provides conduction cooling.

The BC50R supports a 24 VDC and 36 VDC nom. (10 to 50.4 V) class S2 power supply in compliance with EN 50155 or power supplies which comply with ISO 7637-2 (E-mark for automotive) (nominal input voltage 24 V) or with EN 60945 (ship). The power can be switched on and off using an ignition signal on the power connector, and a shutdown-delay time after switching off the power can be adjusted by software.

The combination of the various CPU/GPU options with the available selection of external interfaces (realized via separate graphics and I/O interface boards within the system) makes for an extremely flexible system design that can quickly be tailored to a vast number of applications.

## Diagram



## Technical Data

### **CPU**

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- AMD Embedded G-Series T48N
  - Dual-Core
  - 1.4 GHz processor core frequency
  - Accelerated Processing Unit (APU), also includes GPU (see Graphics)

### **Controller Hub**

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- AMD A55E

### **Memory**

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- 64 KB L1 and 512 KB L2 cache
- 2 GB DDR3 SDRAM system memory
  - Soldered
  - 1066 MT/s

### **Mass Storage**

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- One SD card slot
  - Via USB
- One mSATA slot
  - SATA Revision 2.x support
  - Transfer rates up to 300 MB/s (3 Gbit/s)

### **Front I/O**

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- Positioning: GPS, GLONASS
  - Via one SMA antenna connector at the front
  - 1 status LED on front
- Ethernet
  - Two 10/100/1000Base-T Ethernet channels
  - Two M12 connectors at front panel
  - Four onboard LEDs to signal LAN link, activity status and connection speed
- USB
  - One USB 2.0 client port
  - M12 connector at front panel
  - EHCI implementation
  - One status LED at front panel
- CAN bus
  - Two CAN bus channels
  - Two M12 connectors at front panel
  - 1 LED at front panel for each CAN port

- Two RS232 UART (COM1/2)
  - One M12 connector at front panel
  - Data rates up to 115 200 bit/s
  - Handshake lines: none
  - 1 LED at front panel for each COM port
- GPIO
  - 2 digital inputs (GPI)
  - 2 digital outputs (GPO)
  - Optically isolated
  - One M12 connector at front panel
  - 1 status LED

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## **2 PCI Express® Mini Card slots**

- For functions such as
  - Mobile service standards: GSM (2G), UMTS (3G), LTE (4G) and derivatives
  - Wireless communication: WLAN / WiFi IEEE 802.11 and derivatives
- 2 SIM card slots
- PCI Express® and USB interface

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## **Real-Time Clock**

- Buffered by Gold Cap for up to 72 h

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## **Electrical Specifications**

- Supply voltage:
  - 24V and 36V nominal input voltage according to EN50155
  - 24V nominal input voltage according to ISO 7637-2 (E-mark) requirements
  - 10 to 50.4 V input voltage range
  - EN 50155 power interruption class S2
- Power consumption: up to 30 W

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## **Mechanical Specifications**

- Dimensions: approx. 250 mm x 220 mm x 48.1 mm
- Weight: 1.8 kg
- Front protected according to IP65

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## **Environmental Specifications**

- Temperature range (operation):
  - Depends on system configuration (CPU, PCIeMiniCards, Ethernet, USB, ...)
  - Maximum: +70°C (+85°C for 10 minutes) according to EN50155 Tx
  - Minimum: -40°C (all processors)
  - Conditions: typical power dissipation: 14.4 W (with 18W CPU T48N) with Windows® 7 operating system and 1 Gb Ethernet connection
  - Fanless operation
- Temperature range (storage): -40..+85°C
- Relative humidity (operation): max. 95% non-condensing
- Relative humidity (storage): max. 95% non-condensing

- Altitude: -300 m to +3,000 m
- Shock: 50 m/s<sup>2</sup>, 30 ms
- Vibration (function): 1 m/s<sup>2</sup>, 5 Hz – 150 Hz
- Vibration (lifetime): 7.9 m/s<sup>2</sup>, 5 Hz – 150 Hz
- Conformal coating of internal components

#### **MTBF**

- 262,804 h @ 40°C according to IEC/TR 62380 (RDF 2000)

#### **Safety**

- Flammability
  - UL 94V-0
- Fire Protection
  - EN 45545-2
- Electrical Safety
  - EN 50153
  - EN 50155

#### **EMC Compliance (Automotive)**

- ECE R10 (E-mark)

#### **EMC Compliance (Railway)**

- EN 50121-3-2

#### **EMC Compliance (Ship)**

- EN 60945

#### **BIOS**

- InsydeH2O™ UEFI Framework

#### **Software Support**

- Windows® 7
- Windows® Embedded Standard 7
- Linux



For more information on supported operating system versions and drivers, please see the [online data sheet](#).

## Configuration Options

### APU

- AMD T56N, 1.65 GHz Dual Core, 18W, AMD Radeon™ HD 6320
- AMD T56E, 1.65 GHz Dual Core, 18W, AMD Radeon™ HD 6250
- AMD T48N, 1.4 GHz Dual Core, 18W, AMD Radeon™ HD 6310
- AMD T48E, 1.4 GHz Dual Core, 18W, AMD Radeon™ HD 6250
- AMD T40N, 1.0 GHz Dual Core, 9W, AMD Radeon™ HD 6290
- AMD T40E, 1.0 GHz Dual Core, 6.4W, AMD Radeon™ HD 6250
- AMD T52R, 1.5 GHz Single Core, 18W, AMD Radeon™ HD 6310
- AMD T44R, 1.2 GHz Single Core, 9W, AMD Radeon™ HD 6250
- AMD T40R, 1.0 GHz Single Core, 5.5W, AMD Radeon™ HD 6250
- AMD T16R, 615 MHz Single Core, 4.5W, AMD Radeon™ HD 6250
- AMD T48L, 1.4 GHz Dual Core, 18W
- AMD T30L, 1.4 GHz Single Core, 18W
- AMD T24L, 1000 MHz Single Core, 5W

### Memory

- Up to 4 GB DDR3 SDRAM system memory

### Other Options

- The product concept is very flexible, there are many other configuration possibilities.
- Please contact our sales team if you do not find your required function in the options.
- Some of these options may only be available for large volumes.



For available standard configurations see the [online data sheet](#).

## Product Safety

### Electrostatic Discharge (ESD)



Computer boards and components contain electrostatic sensitive devices. Electrostatic discharge (ESD) can damage components. To protect the board and other components against damage from static electricity, you should follow some precautions whenever you work on your computer.

- Power down and unplug your computer system when working on the inside.
- Hold components by the edges and try not to touch the IC chips, leads, or circuitry.
- Use a grounded wrist strap before handling computer components.
- Place components on a grounded antistatic pad or on the bag that came with the component whenever the components are separated from the system.
- Only store the board in its original ESD-protected packaging. Retain the original packaging in case you need to return the board to MEN for repair.

## About this Document

This user manual is intended only for system developers and integrators, it is not intended for end users.

It describes the hardware functions of the system and connection of peripheral devices. It also provides additional information for special applications and configurations of the system.

The manual does not include detailed information on individual components (data sheets etc.). A list of literature is given in the appendix.

### History

Issue	Comments	Date
E1	First issue	2015-09-07

## Conventions



Indicates important information or warnings concerning the use of voltages that could lead to a hazardous situation which could result in personal injury, or damage or destruction of the component.



Indicates important information or warnings concerning proper functionality of the product described in this document.



The globe icon indicates a [hyperlink](#) that links directly to the Internet, where the latest updated information is available.  
When no globe icon is present, the [hyperlink](#) links to specific elements and information within this document.

<i>italics</i>	Folder, file and function names are printed in <i>italics</i> .
<b>bold</b>	<b>Bold</b> type is used for emphasis.
mono	A monospaced font type is used for hexadecimal numbers, listings, C function descriptions or wherever appropriate. Hexadecimal numbers are preceded by "0x".
comment	Comments embedded into coding examples are shown in <b>green text</b> .
IRQ# /IRQ	Signal names followed by a hashtag "#" or preceded by a forward slash "/" indicate that this signal is either active low or that it becomes active at a falling edge.
in/out	Signal directions in signal mnemonics tables generally refer to the corresponding board or component, "in" meaning "to the board or component", "out" meaning "from the board or component".

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# 1 Product Description

## 1.1 Overview

This chapter gives an overview of the box PC.

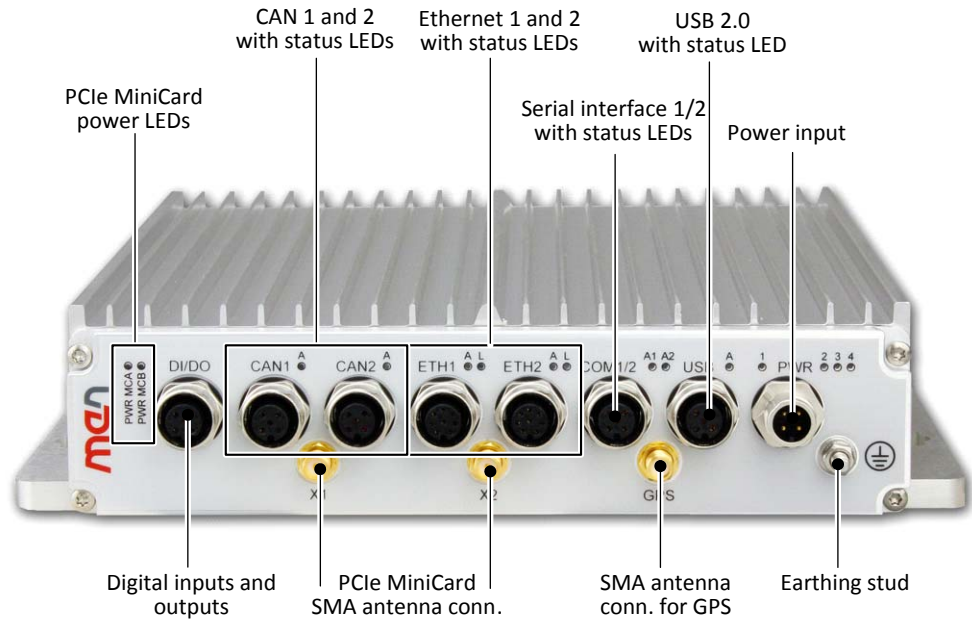
**Figure 1.** The BC50R - overview



### 1.1.1 External Interfaces

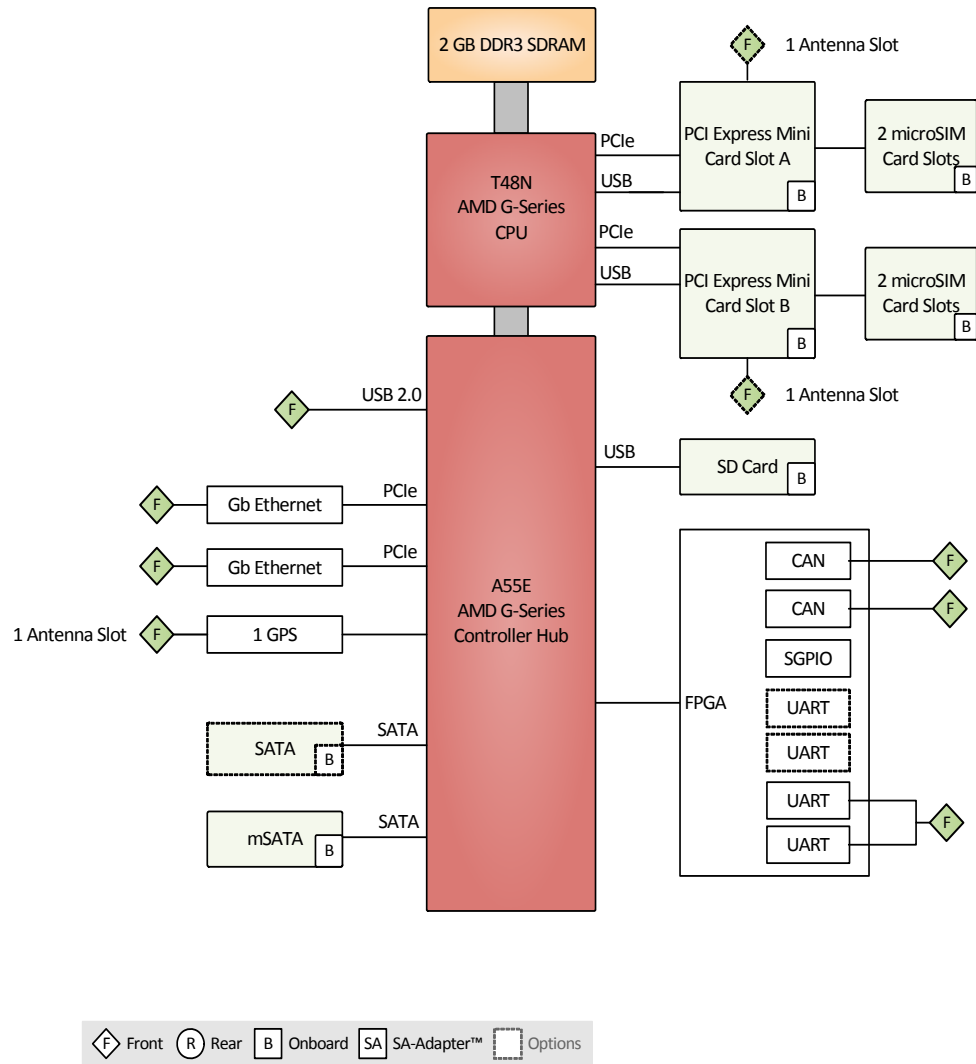
The following picture shows the BC50R front without antennas.

**Figure 2.** The BC50R - front interfaces



## 1.2 Block Diagram

Figure 3. Block diagram



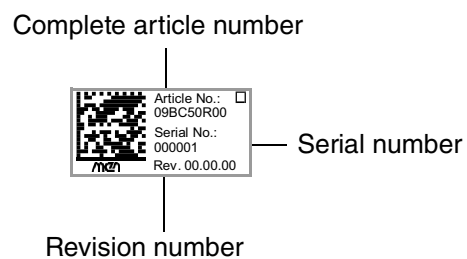
### 1.3 Product Identification

MEN user documentation may describe several different models and/or design revisions of the BC50R. You can find information on the article number, the design revision and the serial number on a label attached to the chassis.

- **Article number:** Gives the product's family and model. This is also MEN's ordering number. To be complete it must have 9 characters.
- **Revision number:** Gives the design revision of the product.
- **Serial number:** Unique identification assigned during production.

If you need support, you should communicate these numbers to MEN.

**Figure 4.** Label giving the product's article number, revision and serial number



## 2 Getting Started

### 2.1 Unpacking the System

After unpacking, check whether there are any transport or other damages on the system. If one of the following situations arises, get the equipment checked by service personnel:

- The power cable or plug is damaged.
- Liquid has penetrated into the equipment.
- The equipment has been exposed to moisture.
- The equipment does not work well, or you cannot get it to work according to the user manual.
- The equipment has been dropped and damaged.
- The equipment has obvious signs of breakage.



Damaged equipment may be under dangerous voltage and can cause fire. Damaged equipment has unpredictable behavior and characteristics.

Prevent that damaged equipment is installed and put into operation. Mark the damaged equipment and keep it under lock and key. Send the equipment to repair immediately.

When the equipment has been subjected to low temperatures or extreme temperature variations condensation can form on or inside the system. Humidity causes short circuits in electric circuits and damages the system. To avoid damages, do the following:

- Store the equipment in a dry environment
- Ensure that the equipment has the same temperature as the environment before starting it up.
- Do not subject the equipment to the direct radiation of a heating device.
- Wait until the equipment has dried completely or wait 12 hours before switching on the equipment.

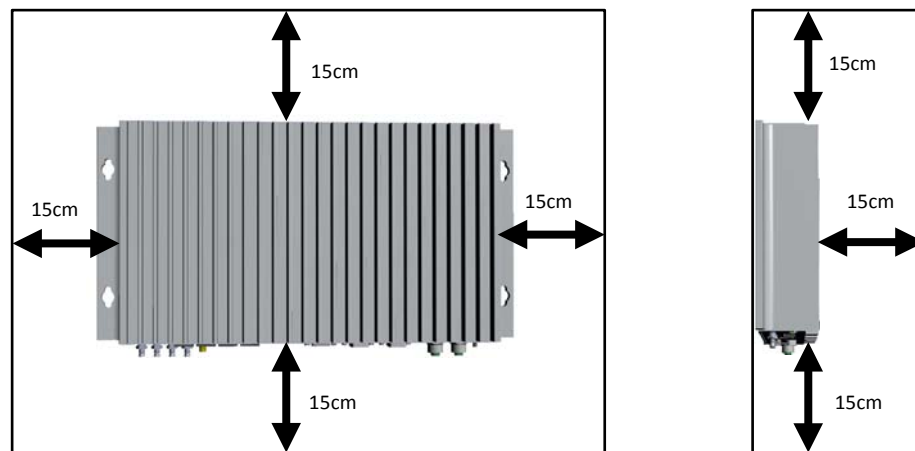
## 2.2 Mounting the BC50R

Please consider the following instructions when installing the BC50R:



- Do not install the system near any heat sources (e.g. radiators, heat registers).
- Keep the system away from liquids. Avoid exposure to dripping or splashing.
- Keep a free space of 15 cm around the housing to ensure cooling (except on the mounting side).

**Figure 5.** Mounting distances required for the box PC



- The connector side should face down.
- The BC50R provides four mounting holes for installation.
- Use M5 countersink head screws.

See [Chapter 5.4 Dimensions of the BC50R Box PC on page 48](#) for the exact dimensions of the box PC and the positions of the mounting holes and connectors.

## 2.3 Connecting an Earthing Cable

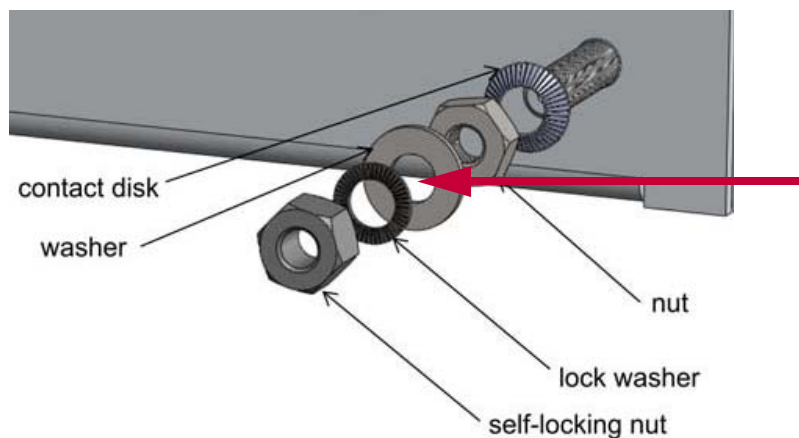
The BC50R features an earthing stud on the right side of the front panel (see [Figure 2, The BC50R - front interfaces on page 18](#)). A protective earth connection is essential for the system to meet its EMC specifications.



An earthing cable has to be connected to the earthing stud before any other connections! For disassembling the system, the earthing cable has to be detached last.

Carry out the following steps to connect an earthing cable:

- ☑ Take an earthing cable with a cross section of at least 0.75 mm<sup>2</sup>.
- ☑ Slide the cable onto the stud between the washer and the lock washer as indicated in the following picture:



- ☑ Fasten the cable by tightening the nut.

## 2.4 Electrical Connection



- Ensure that the box PC is completely configured and mounted before connecting and applying power to the system.
- Implement a readily accessible disconnect device external to the box PC for complying with the EN 60950-1 standard.
- Make sure that the voltage of the power supply conforms with the voltage on the type plate.
- Ensure that the power supply (power socket) is grounded correctly and that the power cable is intact and undamaged.
- Do not switch on the system if there are damages on the power cable or plug.
- Use power cables which are approved for the power supply in your country.
- Power supplies have to be grounded.
- Connect the PSU to the power supply via the power cable.

## 2.5 Starting up the System



Make sure that all peripheral devices are connected to the system before connecting an external power supply and switching on the system.

You can use the following check list when installing the unit for the first time and with minimum configuration.

- ☒ Connect a host PC to the COM1 interface of the BC50R.

See [Chapter 3.8 Serial Interfaces on page 36](#) for the pin assignment of the M12 COM connector.

- ☒ Power-up the system.
- ☒ Start up a terminal program on your host PC and open a terminal connection.
- ☒ Set your terminal connection to the following protocol:
  - 115 200 baud data transmission rate
  - 8 data bits
  - 1 stop bit
  - No parity
- ☒ You can access the BIOS of the BC50R via Console Redirection and start up the BIOS setup menu by hitting the <F2> key.
- ☒ Now you can make configurations in BIOS and install an operating system.



MEN provides an Application Note describing how to prepare a USB drive and install an operating system from this drive on the BC50R using the YUMI Multiboot USB Creator. See [MEN's website](#) for a list of all available documentation.

## 2.6 Installing Operating System Software

The board supports Windows 7 and Linux.

## 2.7 Installing Driver Software

For a detailed description on how to install driver software please refer to the respective documentation of the software package to be installed.



You can find any software available on the BC50R pages on the [MEN website](#).

### 3 Functional Description

The following describes the individual functions of the system and their configuration. There is no detailed description of the individual controller chips and the CPU. They can be obtained from the data sheets or data books of the semiconductor manufacturer concerned.

#### 3.1 Power Supply

The BC50R is supplied with a nominal input voltage of 24 VDC and 36 VDC (10 to 50.4 V input voltage range) via a 4-pin M12 connector. You can find pin 1 at the left (see [Figure 6, PSU connector at BC50R front](#)).

The onboard power supply generates all the necessary internal voltages.

Connector type:

- 4-pin M12 plug, male, A-coded 90° (Phoenix Contact SACC-CI-M12MS-4CON-L90 SCO - 1436660)

Mating connector:

- 4-pin M12 receptacle, female, A-coded

**Figure 6.** PSU connector at BC50R front



**Table 1.** Pin assignment of PSU connector

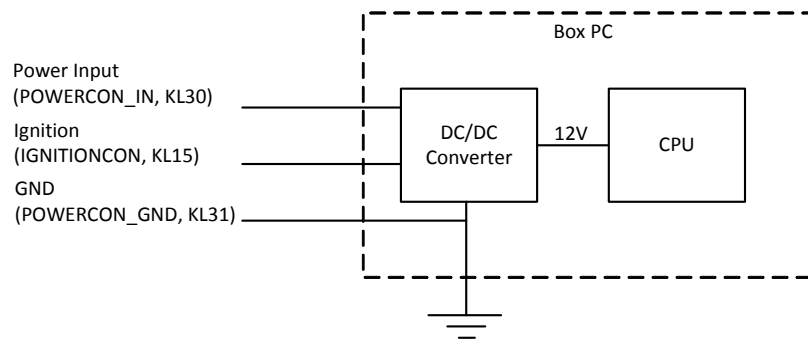
1	POWERCON_IN	Power input
2	POWERCON_GND	Power input ground
3	-	-
4	IGNITIONCON	Ignition

### 3.1.1 Ignition

Using the ignition pin, the start-up and shut-down of the BC50R can be controlled.

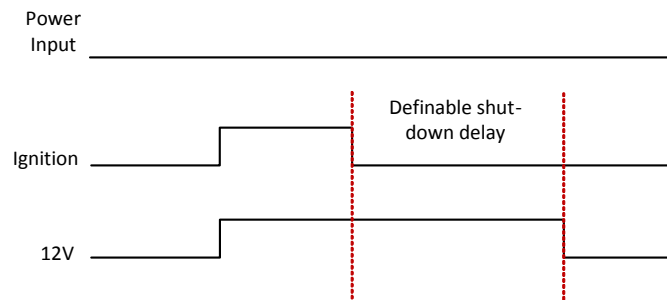
If the ignition pin (IGNITIONCON, KL15) is connected to the power input pin (POWERCON\_IN, KL30) via a switch or a controller, switching on and off of the BC50R can be controlled without having to disconnect the power supply.

**Figure 7.** Connection of power pins from PSU

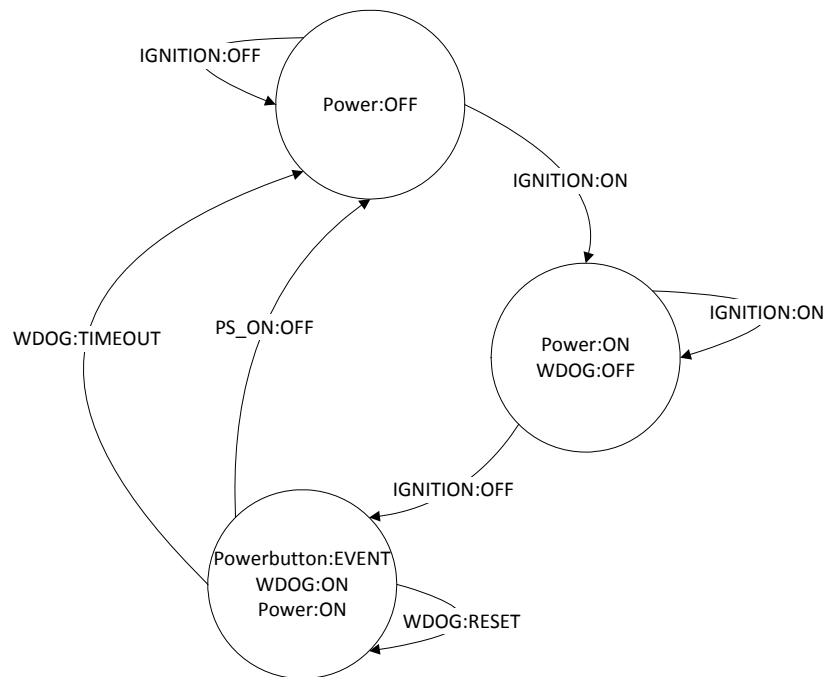


When the ignition is turned on, the 12 V supply voltage is also switched on (see [Figure 8, Ignition behavior](#)). When the ignition is turned off, the input voltage is not switched off at once but can be supplied for a user-defined time (shut-down delay) so that the operating system of the BC50R can shut down in a controlled way.

**Figure 8.** Ignition behavior



The shut-down delay can be set using a watchdog. If the ignition signal is disabled and the watchdog is running, it is possible to reset the watchdog timer by software using the WDOG\_EN signal to avoid a power shutdown. If the watchdog is running and the timer is not restarted, the box computer is forced into power down mode after approximately 5 minutes.

**Figure 9.** Ignition and watchdog state diagram

The ignition pin (pin 4) can also be permanently connected to the power input pin (pin 1). In this case the BC50R is starting up as soon as the supply voltage is connected and switched off as soon as the supply voltage is disconnected without a delay for shutting down the operating system.

### 3.2 Real-Time Clock

The board includes a real-time clock connected to the processor as a system RTC. The RTC has an accuracy of approximately 1.7 seconds/day (11 minutes/year) at 25°C.

For data retention during power off the RTC is backed up by a supercapacitor. The supercapacitor gives an autonomy of up to 72 hours when fully loaded.

The real-time clock device is connected to the CPU via SMBus. Due to its reduced current consumption, the life time of the battery or supercapacitor can be increased considerably compared to the RTC integrated in the CPU.



MEN provides a dedicated software driver for the RTC device in order to set date and time as usual in Windows. For a detailed description of the functionality of the driver and for downloading the software please refer to the drivers' documentation on MEN's [website](#).

### 3.3 Processor Core

The BC50R can be equipped with several dual-core AMD APUs (Accelerated Processing Units). The default APU is the T48N (marked in gray in the following table).

**Table 2.** Processor core options on BC50R

Model	Clock Speed, No. of Cores	Cache	Max. TDP	DDR3 Speed	Graphics
AMD T56N	1.65 GHz dual core	L1 cache 64 KB, L2 cache 512 kB x2	18 W	DDR3-1333	Radeon HD 6320
AMD T52R	1.5 GHz single core	L1 cache 64 KB, L2 cache 512 kB	18 W	DDR3-1333	Radeon HD 6310
AMD T48N	1.4 GHz dual core	L1 cache 64 KB, L2 cache 512 kB x2	18 W	DDR3-1066	Radeon HD 6310
AMD T40N	1.0 GHz dual core	L1 cache 64 KB, L2 cache 512 kB x2	9 W	LVDDR3-1066	Radeon HD 6310
AMD T44R	1.2 GHz single core	L1 cache 64 KB, L2 cache 512 kB	9 W	LVDDR3-1066	Radeon HD 6250
AMD T40E	1.0 GHz dual core	L1 cache 64 KB, L2 cache 512 kB x2	6.4 W	LVDDR3-1066	Radeon HD 6250
AMD T40R	1.0 GHz single core	L1 cache 64 KB, L2 cache 512 kB	5.5 W	LVDDR3-1066	Radeon HD 6250
AMD T16R	615 MHz single core	L1 cache 64 KB, L2 cache 512 kB	4.5 W	LVDDR3-1066	Radeon HD 6250
AMD T56E	1.65 GHz Dual Core	L1 cache 64KB, L2 cache 512kB x2	18W	DDR3-1333	Radeon HD 6250
AMD T48E	1.4 GHz Dual Core	L1 cache 64KB, L2 cache 512kB x2	18W	DDR3-1066	Radeon HD 6250

Model	Clock Speed, No. of Cores	Cache	Max. TDP	DDR3 Speed	Graphics
AMD T48L	1.4 GHz Dual Core	L1 cache 64KB, L2 cache 512kB x2	18W	DDR3-1066	N/A
AMD T30L	1.4 GHz Single Core	L1 cache 64KB, L2 cache 512kB	18W	DDR3-1066	N/A
AMD T24L	1000 MHz Single Core	L1 cache 64KB, L2 cache 512kB	5W	LVDDR3-1066	N/A

Note: T56N and T40N are models enabled by AMD Turbo Core technology, up to 10% clock speed increase is planned.

### 3.3.1 Thermal Considerations

The operating temperature range of the BC50R depends on the system configuration (CPU, PCIeMiniCards, Ethernet, USB, ...)

The power dissipation of the system also depends on the environmental conditions. It has a typical power dissipation of 14.4 W in a configuration with a T48N CPU with Windows 7 operating system and 1 Gb Ethernet connection.

The system is designed for a maximum operating temperature of +70°C(+85°C for 10 minutes). The minimum temperature is -40°C for all processors.

As an option, a wider housing with additional cooling fins is available, enabling permanent operation at +85°C.

## **3.4 Memory and Mass Storage**

### **3.4.1 DRAM System Memory**

The standard model of the BC50R is equipped with 2 GB of DDR3 SDRAM. Up to 4 GB are supported. The graphics controller of the BC50R has no own memory and so uses 256 MB of the system memory by default. Other values can be set using a BIOS item in the sub-menu Video Configuration (possible settings 64 MB, 128 MB, 256 MB or 512 MB).

### **3.4.2 Boot Flash**

The BC50R is equipped with a boot Flash containing its BIOS.

### **3.4.3 SD Card Slot**

Within its housing, the BC50R provides one SD card slot. The slot supports the Secure Digital 2.0 specification (SDHC) with a storage capacity of 2 up to 32 GB and a data transfer rate of 25 MB/s.

Please contact the [MEN sales team](#) for further information.

### **3.4.4 mSATA Slot**

Within its housing, the BC50R provides one mSATA slot.

Please contact the [MEN sales team](#) for further information.

### **3.4.5 SATA Hard Disk (Optional)**

The BC50R offers the possibility to install an additional SATA hard disk in the housing on a special mounting frame.

Please contact the [MEN sales team](#) for further information.

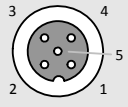
### 3.5 USB Interfaces

The BC50R provides one USB 2.0 interface at the front panel via one M12 USB connector. The activity of the USB interface can be signaled via an LED at the front panel. The LED (user LED B) can be controlled via the SMBus. See [Chapter 4.2 SMBus Overview on page 41](#).

Connector types:

- 5-pin M12 receptacle, female, A-coded 90° (Phoenix Contact SACC-CI-M12FS-5CON-L90 SCO - 1436644)
- Mating connector:  
5-pin M12 plug, male

**Table 3.** Pin assignment of USB front-panel connectors

	1	+5V
	2	USB_D-
	3	USB_D+
	4	GND
	5	-

**Table 4.** Signal mnemonics of USB front-panel connectors

Signal	Direction	Function
+5V	out	+5 V power supply
GND	-	Digital ground
USB_D+, USB_D-	in/out	USB lines, differential pair

### 3.6 Ethernet Interfaces

The BC50R provides two Gigabit Ethernet ports at the front.

Connector type:

- 8-pin M12 receptacle, female, A-coded 90° (Phoenix Contact 1436990 SACC-CI-M12FS-8CON-L90 SCO)

Mating connector:


- 8-pin M12 plug, male, A-coded

MEN offers a starter kit including an M12 to RJ45 adapter for making the Ethernet interfaces available on standard Ethernet connectors



See MEN's [website](#) for information on how to order the accessories.

**Table 5.** Pin assignment of Ethernet front-panel connectors

		1000Base-T	10/100Base-T
	1	BI_DC-	
	2	BI_DD+	
	3	BI_DD-	
	4	BI_DA-	TX-
	5	BI_DB+	RX+
	6	BI_DA+	TX+
	7	BI_DC+	-
	8	BI_DB-	RX-





**Table 6.** Signal mnemonics of Ethernet front-panel connectors

Signal	Direction	Function
BI_Dx+/-	in/out	Differential pairs of data lines for 1000Base-T
RX+/-	in	Differential pair of receive data lines for 10/100Base-T
TX+/-	out	Differential pair of transmit data lines for 10/100Base-T

### 3.6.1 Ethernet Status LEDs

The BC50R provides a total of four Ethernet status LEDs, two for each Ethernet channel. They signal the link and activity status (different LED behavior can be implemented on demand).

**Table 7.** Ethernet status LEDs

LED	Description	Color	Function
<b>L</b> 	Port 1 link	orange	on, when connection established
<b>A</b> 	Port 1 activity	yellow	on, when Ethernet communication on Rx or Tx
<b>L</b> 	Port 2 link	orange	on, when connection established
<b>A</b> 	Port 2 activity	yellow	on, when Ethernet communication on Rx or Tx

### 3.7 Status and User LEDs

The BC50R provides two status LED and two user LEDs. One of the status LEDs signals whether the onboard power generated by the BC50R's on-board DC/DC converter is within valid range (LED1), the other (LED2) signals the system status (see [Chapter 3.7.1 Status LED on page 35](#) for a detailed description of the LED's behavior).

The two user LEDs can be controlled via an I/O expander on the SMBus. The LEDs can be used freely depending on an application's requirements. See [Chapter 4.2 SMBus Overview](#) for information on how to access the LEDs.

The following table shows a list of all status and user LEDs with their functionality or default state.

**Table 8.** Status and user LEDs on the BC50R

Number	Description	Color	Function
1 	Power good	green	on, when internal 12V active
2 	Status LED (diagnostic)	yellow	see <a href="#">Chapter 3.7.1 Status LED on page 35</a>
3 	User LED C	blue	User LED, default: off
4 	User LED A	orange	User LED, default: off

### 3.7.1 Status LED

The status LED (LED2) is connected to the system's board controller.

It has the following behavior:

- off, if system is in S5 state
- blinking at less than 0.5 Hz if system is in S3 state
- on, if system is in S0 state and BIOS has sent live sign after power-up
- it flashes repeatedly n times according to an error code and pauses for one second until the system is restarted or completely powered-off, if system is in error condition and error code is n. See the following table for supported error codes.

**Table 9.** Error codes signaled by Status LED flashes

Error Code	Description	Solution
1	+V3.3A Voltage Failure	internal failure
2	Input Voltage Failure	internal failure
3	External Power Supply Failure	check power supply voltage range
4	CPU too hot	check thermal constraints
5	BIOS Live Sign Timeout	internal failure
6	System Reset Timeout	internal failure
7	Platform Reset Failure	internal failure
8	Chipset Handshake Failure	internal failure
9	System Power OK Failure	internal failure
255	Invalid PIC state	internal failure

## 3.8 Serial Interfaces

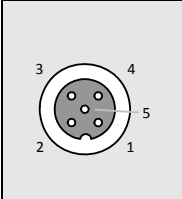
### 3.8.1 RS232 Interface

The BC50R provides two isolated RS232 interfaces with a baud rate of up to 115.2 kbaud. They have an isolation of 500VDC to power and shield, both COM1 and COM2 have the same isolation group. The activity of the COM interfaces is signaled via two LEDs at the front panel.

Connector types

- 5-pin M12 receptacle, female, A-coded 90° (Phoenix Contact SACC-CI-M12FS-5CON-L90 SCO - 1436644)
- Mating connector:  
5-pin M12 plug, male

**Table 10.** Pin assignment of RS232 front-panel connectors

	1	COM1_TXD
	2	COM2_TXD
	3	GND
	4	COM2_RXD
	5	COM1_RXD

**Table 11.** Signal mnemonics of RS232 connector

Signal	Direction	Function
GND	-	Ground
+5V	out	+5V supply voltage
RXD	in	Receive data
TXD	out	Transmit data

### 3.9 PCI Express Mini Card Interface

The BC50R supports the PCI Express Mini Card standard. Its two PCI Express Mini Card slots are located within the housing.

The PCIe MiniCard sockets on the BC50R support both a USB and a PCIe interface.

The power supply of the PCIe MiniCard can be reset via GPIO. This power reset is required when switching from one micro-SIM card to another.

See [Chapter 4.2 SMBus Overview on page 41](#) for more information on how to switch the micro-SIM cards.

The power of the PCI Express Mini Cards is signaled using two LEDs at the front panel. They are on when the PCI Express Mini Card is powered and can additionally be switched off via GPIO.

See [Chapter 4.2 SMBus Overview on page 41](#) for more information on how to switch PCI Express Mini Card LEDs.

#### Micro-SIM Cards

The BC50R provides four micro-SIM Card sockets. Two micro-SIM cards are attached to one PCIe MiniCard socket. Either micro-SIM card A or micro-SIM card B can be connected to the PCI Express Mini Card. By default the PCI Express Mini card is connected to micro-SIM card A.

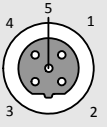
### 3.10 Binary Inputs and Outputs (DI/DO)

The binary inputs and outputs of the BC50R are optically isolated and accessible via a 5-pin M12 receptacle. The interfaces are controlled via SMBus. See [Chapter 4.2 SMBus Overview on page 41](#) for more information.

Connector types:

- 5-pin M12 receptacle, female, B-coded 90° (Phoenix Contact SACC-CI-M12FSB-5CON-L90 SCO - 1436657)
- Mating connector:  
5-pin M12 plug, male

**Table 12.** Pin assignment of DI/DO front-panel connectors

	1	GPI1
	2	GPI2
	3	GND
	4	GPO1
	5	GPO2

### 3.10.1 Binary Inputs

The BC50R supports two isolated digital inputs. These inputs work with an input voltage range from 0 V up to 154 V. This input voltage range is independent of the power supply input voltage. The GPI maximum voltage is the power input voltage. The BC50R works with a maximum input signal frequency of 10 Hz.

- GPI low level detection is  $< 6V$  @  $IGPI < 5mA$
- GPI high level detection is  $> 12V$  @  $IGPI > 5mA$

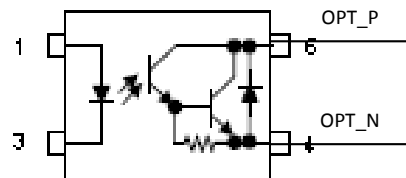
### 3.10.2 Photocouplers

The BC50R provides 2 photocouplers used as shutters (see [Figure 10, Photocouplers \(shutters\) - 2 lines](#)). The shutters are open by default. The outputs are overcurrent protected and support a maximum output current of 200mA.

**Table 13.** Photocoupler ratings

Description	Absolute maximum value	Recommended maximum value
Collector-emitter voltage	250V	200V
Emitter-collector voltage	5V	
Collector current	350mA	200mA
Current Limit	920mA	700mA
max. Switching frequency	250Hz	200Hz
$R_{ds\_on}$	15R	

**Figure 10.** Photocouplers (shutters) - 2 lines



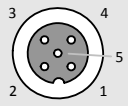
### 3.11 CAN Interfaces

Two High Speed CAN interfaces according to ISO11898-2 are supported on the BC50R. The interfaces are isolated with 500VDC to power, shield and other interfaces.

Connector types:

- 5-pin M12 receptacle, female, A-coded 90° (Phoenix Contact SACC-CI-M12FS-5CON-L90 SCO - 1436644)
- Mating connector:  
5-pin M12 plug, male

**Table 14.** Pin assignment of CAN front-panel connectors

	1	CAN_H
	2	CAN_L_R120
	3	I-GND
	4	CAN_H
	5	CAN_L

Note: If pin 1 and pin 2 are connected the termination resistance of 120Ohm is used.  
If pin 1 and pin 2 are not connected, the termination is high impedance.

### **3.12 GNSS**

The BC50R is equipped with the Telit Jupiter SL869 GNSS receiver module with 32 channels. The module supports GPS, Glonass and Galileo.

The GNSS signals are received via a U.FL antenna connector which has to be connected to an external antenna.

The BC50R itself has no antenna. You need to select and connect an antenna suitable for your application. The accuracy is mainly dependent on antenna quality.

Please note that MEN does not supply antennas with the BC50R, since the choice of a suitable antenna depends on your application. The BC50R supports active and passive antennas. An antenna supply voltage of 5V is provided.

The GNSS receiver converts the data received from the antenna to data packets. The time mark signal is readable by application software. The data transfer rate is configurable.

The GNSS module is accessed via a FTDI2UART chip. Under Linux the device port is probably ttyUSB0. The baudrate is 115200 8N1.

The GNSS's power supply can be reset via GPIO. See [Chapter 4.2 SMBus Overview](#).

As an option, the BC50R's GNSS supports dead reckoning.

## 4 Organization of the Board

### 4.1 SMBus Devices

The controller hub of the BC50R has two SMB controllers. The devices responsible for board supervision and hardware control (SPD, BC) are connected to SMB0. The devices related to information and board functions (e.g. EEPROMs, sensors, GPIO controllers) are connected to SMB1.

**Table 15.** SMBus address of EEPROM

Address	Function
0xAC	EEPROM, includes system information e.g. serial number and the date of production.

**Table 16.** SMBus devices

SMBus	8-Bit-Address	7-Bit-Address	Function
0	0xA0	0x50	SPD EEPROM
0	0xA2	0x51	SPD EEPROM for stacked memory
0	0x9A	0x4D	Board Controller (PIC)
0	0x64	0x32	External real-time clock ERTC
1	0xAE	0x57	Board information EEPROM with thermal sensor
1	0x3E	0x1F	Thermal sensor of the EEPROM
1	0xE0	0x70	FPGA for SATA SGPIO

### 4.2 SMBus Overview

The PCI Express Mini Cards, the microSIM cards, the photocouplers, the GNSS module and the binary inputs can all be controlled using the SMBus and two I/O expanders.



MEN offers a driver for accessing the SMBus. See [MEN's website](#).

Two I/O expanders and a system EEPROM are connected to the SMBus.

### 4.3 SMBus Register Description

The SMB address is compliant to the Windows nomenclature. This means that the last bit which is used as the read/write bit is added with the value '0' to the address.

Under Linux a 0 is added at the beginning of the address so that all consecutive address bits are moved one bit to the right.

#### Example

Binary address of the I/O-Expander with hard coded offset 0b 0100 and chosen address bits:

- 0b 0100 (A2)(A1)(A0)(R/W)

With address bits:

- 0b 0100 010 (R/W)

Windows address:

- (R/W) = 0 -> 0b 0100 0100 -> 0x44

Linux address:

- 0b 0010 0010 -> 0x22

**Table 17. SMB address space**

Address	Function
0xAC	EEPROM, includes system information e.g. serial number and the date of production.
0x40	I/O Expander, used to activate the ignition signal, the photocouplers and the binary inputs, reset the watchdog and control user LEDs A and B at the front panel.
0x42	I/O Expander, used to control user LED C at the front panel, power cycle the PCIe Mini Cards and to switch between the connected SIM cards.

### User LED Signals (0x40)

**Table 18. SMB 0x40**

Bit	Direction	Signal	Default Value	Description	Group
7	In	IGNITION_ISO	-	Bit to read back the ignition status.	System
			0 =	Setting this bit to '0' results in the same behavior as deactivating the external ignition signal (power button event, starting the watchdog timer)	
			1 =	If the bit is '1' the ignition signal is active.	

Bit	Direction	Signal	Default Value	Description	Group
6	In	WDOG_EN	1	Signal to reset the watchdog  0 = Setting this bit to '0' generates a falling edge. The falling edge results in a reset of the watchdog.  1 = For every watchdog reset the bit must be set in sequence '1' -> '0' to generate a falling edge.	System
5	Out	BIN_OUT[2]	1	Enable signal for the second (2) output photocoupler.  0 = By setting the bit to '0' the corresponding coupler is closed.  1 = The default value is '1' and the corresponding coupler is open.	Isolated output
4	Out	BIN_OUT[1]	1	Enable signal for the first (1) output photocoupler.  0 = By setting the bit to '0' the corresponding coupler is closed.  1 = The default value is '1' and the corresponding coupler is open.	Isolated output
3	Out	USR_LEDB (USB)	1	Enable bit for the corresponding user LED (activity LED for USB interface).  0 = The LED is enabled/on.  1 = The LED is disabled/off (default value).	USR_LED
2	Out	USR_LED A	1	Enable bit for the corresponding user LED.  0 = The LED is enabled/on.  1 = The LED is disabled/off (default value).	USR_LED
1	In	BIN_IN[2]	-	Value of the connected isolated input	Isolated input
0	In	BIN_IN[1]	-	Value of the connected isolated input	Isolated input

## SIM Card, PCIe Mini Card Power Signals (0x42)

Table 19. SMB 0x42

Bit	Direction	Signal	Default Value	Description	Group
7	Out	SIMA_SW	1	Signal to switch between the primary and secondary SIM card of the PCIe Mini Card A. 0 = The secondary SIM card is connected to the PCIe Mini Card 1 = The primary SIM card is connected to the PCIe Mini Card (default value).	PCIe Mini Card
6	Out	SIMB_SW	1	Signal to switch between the primary and secondary SIM card of the PCIe Mini Card B. 0 = The secondary SIM card is connected to the PCIe Mini Card 1 = The primary SIM card is connected to the PCIe Mini Card (default value).	PCIe Mini Card
5	Out	MCA_LED	1	The bit is used to control the PCIe Mini Card A's power LED 0 = The LED is disabled/off. 1 = The LED is enabled/on.	PCIe Mini Card
4	Out	MCB_LED	1	The bit is used to control the PCIe Mini Card B's power LED 0 = The LED is disabled/off. 1 = The LED is enabled/on.	PCIe Mini Card
3	Out	MINI_A_PWR_EN	1	The bit is used to control the PCIe Mini Card A's power supply. 0 = The power of the PCIe Mini Card is disabled. 1 = The power of the PCIe Mini Card is enabled (default value).	PCIe Mini Card
2	Out	MINI_B_PWR_EN	1	The bit is used to control the PCIe Mini Card B's power supply. 0 = The power of the PCIe Mini Card is disabled. 1 = The power of the PCIe Mini Card is enabled (default value).	PCIe Mini Card
1	Out	USR_LEDC	1	Enable bit for the corresponding user LED. 0 = The LED is enabled/on.	USR_LED

Bit	Direction	Signal	Default Value	Description	Group
				1 = The LED is disabled/off (default value).	
0	Out	GPS_PW R_ EN	1	Signal to control the GPS module power supply.	GPS
				0 = By setting the bit to '0' the power supply of the GPS module is switched off.	
				1 = The default value is '1' and the GPS module is powered.	

## 5 Maintenance

### 5.1 Cleaning the System

The system should be cleaned once a year. Clean the bottom and top plate, remove dirt and dust from air ventilation holes. Light dirt can be removed with a dry cloth. Persistent dirt should only be removed with a mild detergent and a soft cloth.

Take care that no liquid gets inside the system.

### 5.2 Fuse Protection



The DC/DC converter inside the Power Supply Unit is protected by a fuse. **This fuse is not intended to be exchanged by the customer. Your warranty for the Power Supply Unit will cease if you exchange the fuse on your own.** Please send your unit to MEN for repair if a fuse blows.

- Current rating: 5 A
- Voltage rating: 350 VDC
- Type: Time-Lag (T)
- MEN part number: 5675-0011

### 5.3 Literature and Web Resources



BC50R data sheet with up-to-date information and documentation:  
[www.men.de/products/09BC50R.htm](http://www.men.de/products/09BC50R.htm)

#### 5.3.1 GNSS



Jupiter SL869 EVK GNSS module  
[Jupiter SL869 EVK User Guide](#)

#### 5.3.2 CAN Bus



CAN in Automation e. V.  
[www.can-cia.de](http://www.can-cia.de)

#### 5.3.3 Ethernet



- ANSI/IEEE 802.3-1996, Information Technology - Telecommunications and Information Exchange between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications; 1996; IEEE  
[www.ieee.org](http://www.ieee.org)
- Charles Spurgeon's Ethernet Web Site  
Extensive information about Ethernet (IEEE 802.3) local area network (LAN) technology.  
[www.ethermanage.com/ethernet/](http://www.ethermanage.com/ethernet/)
- InterOperability Laboratory, University of New Hampshire  
This page covers general Ethernet technology.  
[www.iol.unh.edu/services/testing/ethernet/training/](http://www.iol.unh.edu/services/testing/ethernet/training/)

#### 5.3.4 PCI Express Mini Card



PCI Express Mini Card Electromechanical Specification  
Revision 1.2; October 26, 2007  
PCI Special Interest Group  
[www.pcisig.com](http://www.pcisig.com)

#### 5.3.5 USB



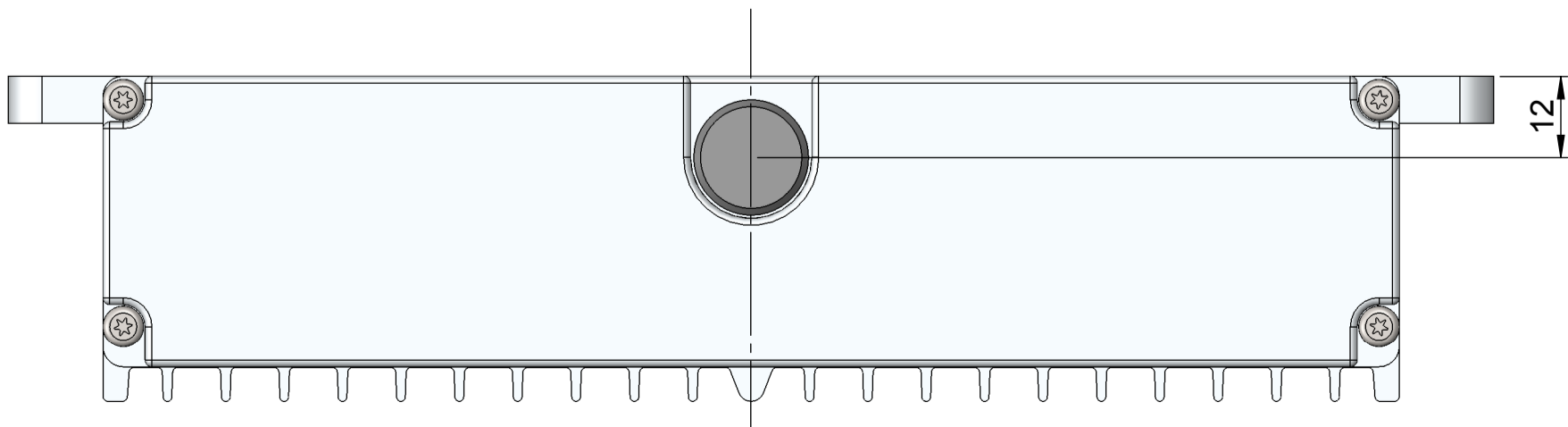
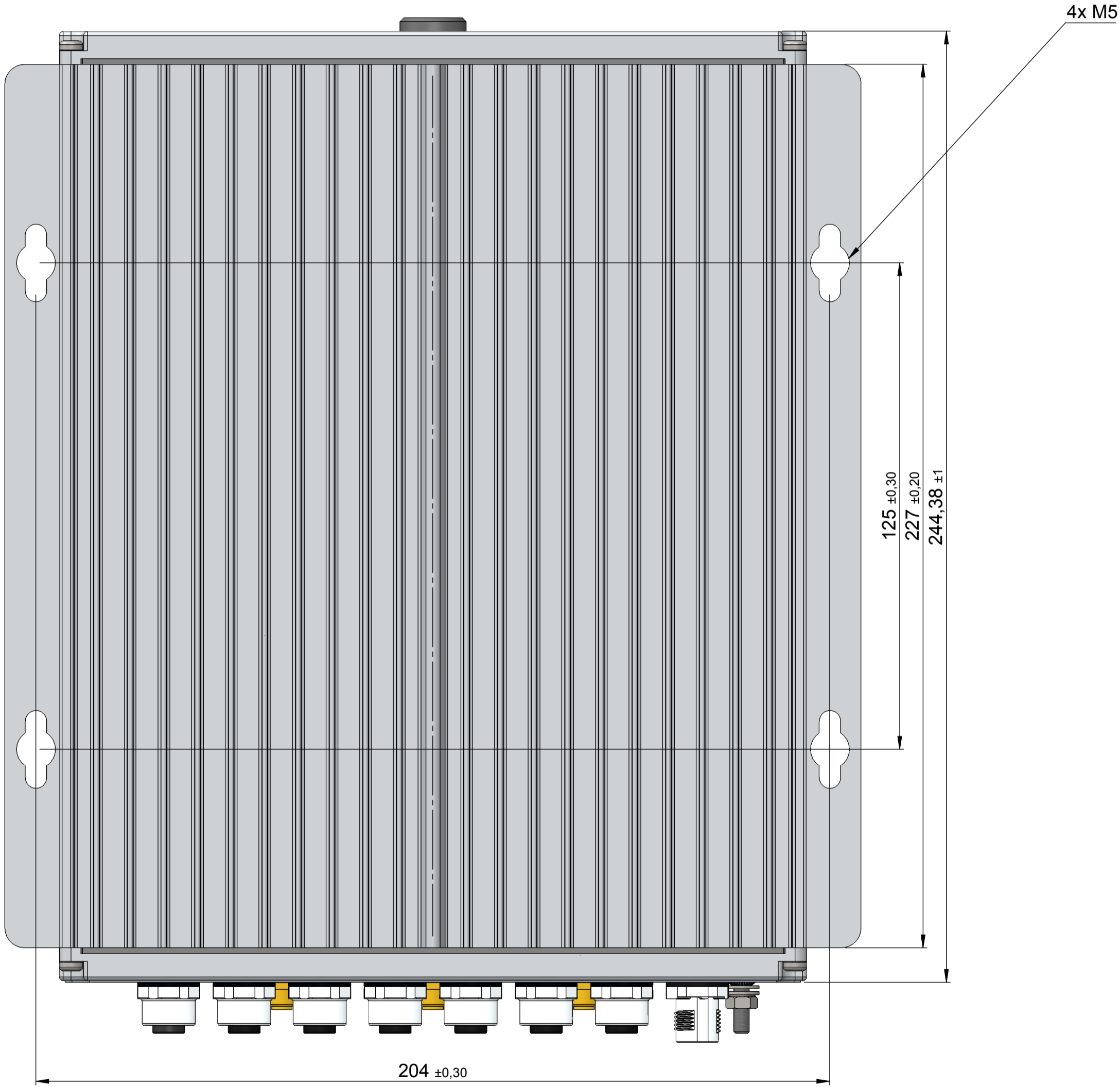
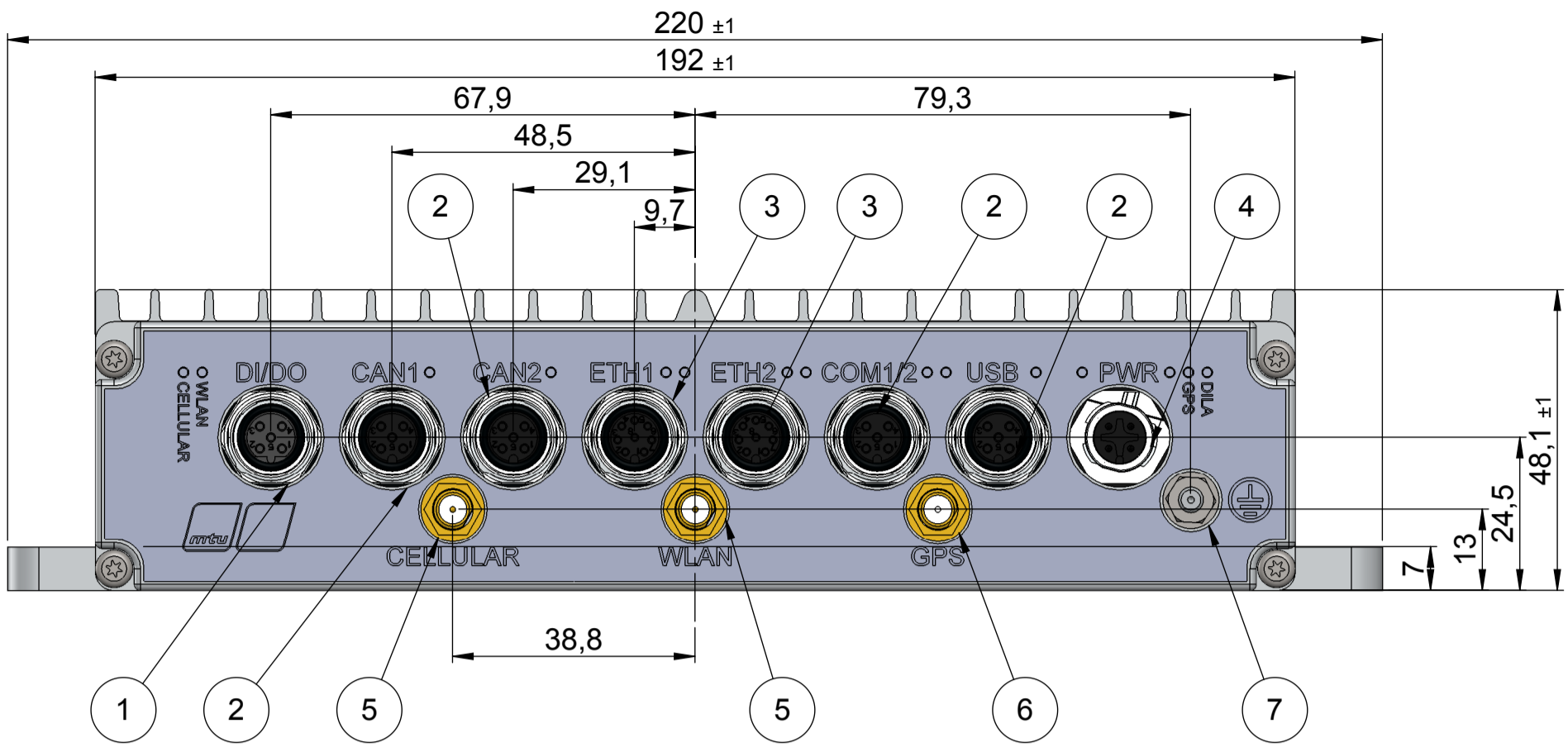
USB Implementers Forum, Inc.  
[www.usb.org](http://www.usb.org)

## 5.4 Dimensions of the BC50R Box PC

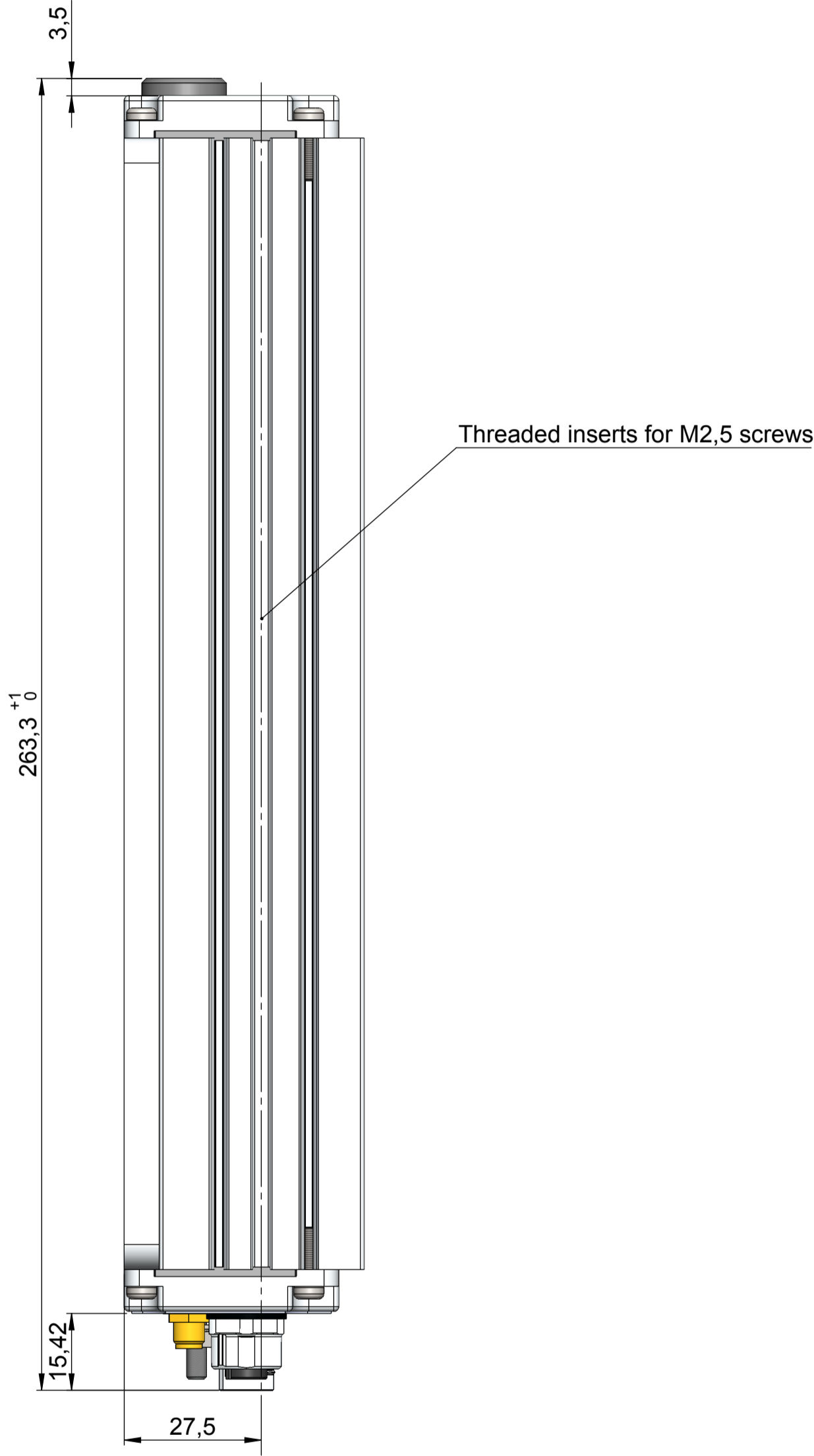
In the following you can find a drawing of the exact dimensions of the box PC.



You can find a detailed 3D drawing (PDF and STEP file) on the [BC50R pages](#) on the [MEN website](#).



POS.	QTY.	FUNCTION	DESCRIPTION	MATING CONNECTOR
1	1	DIDO	M12 jack 5-pin B-coded	M12 plug 5-pin B-coded e.g. Phoenix: 1517877
2	4	CAN/COM/USB	M12 jack 5-pin A-coded	M12 plug 5-pin A-coded e.g. Phoenix: 1518326
3	2	Ethernet	M12 jack 8-pin A-coded	M12 plug 8-pin A-coded e.g. Phoenix: 1407405
4	1	Power	M12 plug 4-pin A-coded	M12 jack 4-pin A-coded e.g. Phoenix: 1407782
5	2	Antenna	RP-SMA jack	RP-SMA plug
6	1	Antenna	SMA plug	SMA plug
7	1	Ground	M4x13 bolt	Cable eye



MEN Mikro Elektronik GmbH  
Manufacturer Number: 09BC50R01  
Weight: max. 3,5 kg  
Input voltage: 24 VDC  
Operating temperature: -40..70°C

1.0	J.Ultsch 2015-04-09	Initial version
Rev.: Prepared/Date:		Modification:
Responsible author: J.Ultsch		RoHS-compliant (2011/65/EU): yes
<small>Printed version FOR INFORMATION ONLY This is an electronic document. It has been digitally signed. Please see release form.</small>		
Scale: 1:1		Tolerance: ---
Material:		Surface: ---
Description: 09BC50R01_Space Allocation Drawing 09BC50R01_R00_ASSEMBLY		Document No. 09BC50R01_SAD
Prj.: ---		Sheet: 1 / 1