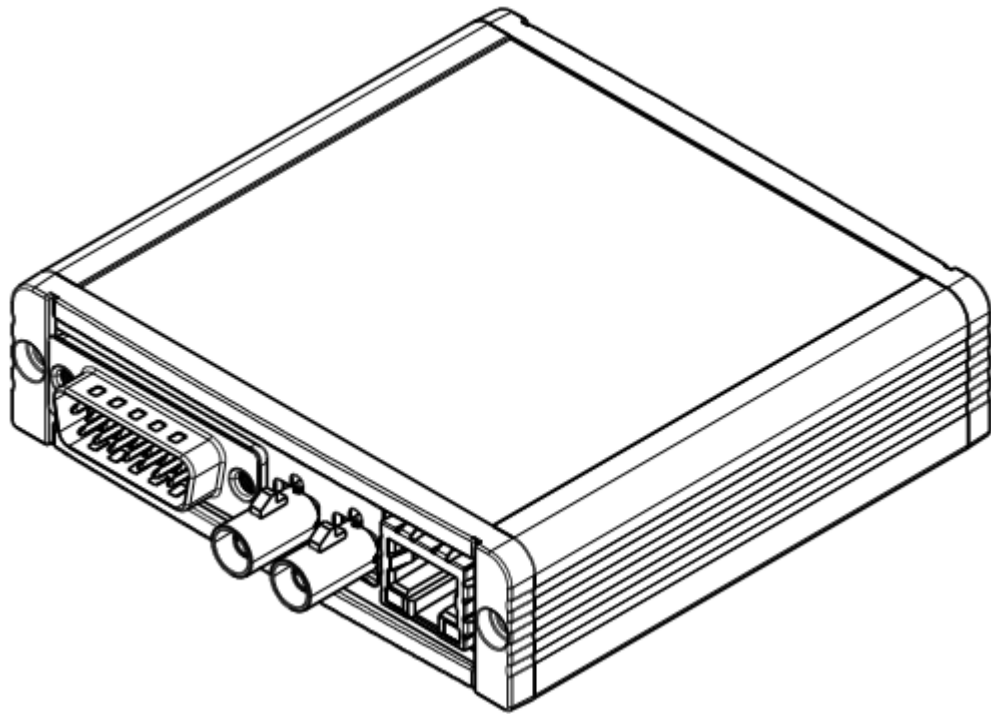


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### Technical description MX-4 C61



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Rev	Date	Reason
1	2021-01-15	Created for Greenstar Marine (C61 R1D)
2	2021-04-19	Corrected I/O, RS232 pins in DSub-connector (see paragraph Connector – PWR & CAN)

Revision history

# 1 General Description

## 1.1 Features

- ARM Cortex-A5 CPU, 500 MHz single core
- ARM Cortex-M4 CPU, 167 MHz single core
- 512 MB flash, 256 MB RAM
- Linux operating system
- Global 4G module
- 1x 3pol aux for Linux Headphone L and R with mic
- 1 x 10/100 Mbit/s Ethernet
- 1 x USB 2.0 high-speed host/device (auto detect)
- 3 x CAN 2.0 B
- 1 x Rs-485 (or 1x J1708)
- 1 x Rs-232
- 2 x Digital IO with analog in
  - 2 x Analog inputs
  - 2 x Digital inputs
  - 2 x Digital outputs sink and source
- 1 x Start signal input (to boot the system using external signal)
- µSD-card interface
- Super Capacitor
- Wide operating temperature: -40 to +85°C
- Wide input voltage range, 8-36 V
- Low power sleep mode

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## 1.2 *Intended Use*

Intended as a “black box” vehicle computer. Includes several different interfaces for communication with the vehicle, and several interfaces for communication with other equipment/systems. Can carry customer specific applications to suit specific needs.

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## 2 Soft Deliverables

When you buy a MX-4 hardware from Host Mobility AB the following is included.

### 2.1 Platform

Host Mobility AB provides a complete Linux platform with driver support for all hardware interfaces and with a customizable distribution.

All hardware interfaces are accessible via well defined API's. We try to reuse the standard Linux way of doing things as much as we can. This way the platform environment is familiar to developers who has worked with embedded Linux in their past.

Main software components:

- Linux (4.4)
- U-boot (2015.04)
- Ångstrom distribution built with yocto (<https://www.yoctoproject.org/>)
- Co-processor firmware

### 2.2 Firmware Update

Host Mobility AB provides a simple method to update the firmware in the MX-4 hardware.

This method is based on a `vf_hmupdate.img` which is able to update all software components (Linux kernel, u-boot, distribution, co-processor firmware).

This is easily done by placing an `vf_hmupdate.img` in the root of a USB flash drive and simply restarting the MX-4 system with the USB flash drive plugged in.

The `vf_hmupdate.img` can also be placed in the internal nand flash in `/boot` directory which will trigger an update as well. This method could be integrated in a customer application for over the air updates.

### 2.3 Source Code

Host Mobility's provides read-only access to our software repositories hosted at <https://github.com/hostmobility>

### 2.4 Support

Host Mobility AB provides first class support.

We will help you get started with MX-4 development and once the initial steps are done we also provide tips and tricks to optimize your application to our platform.

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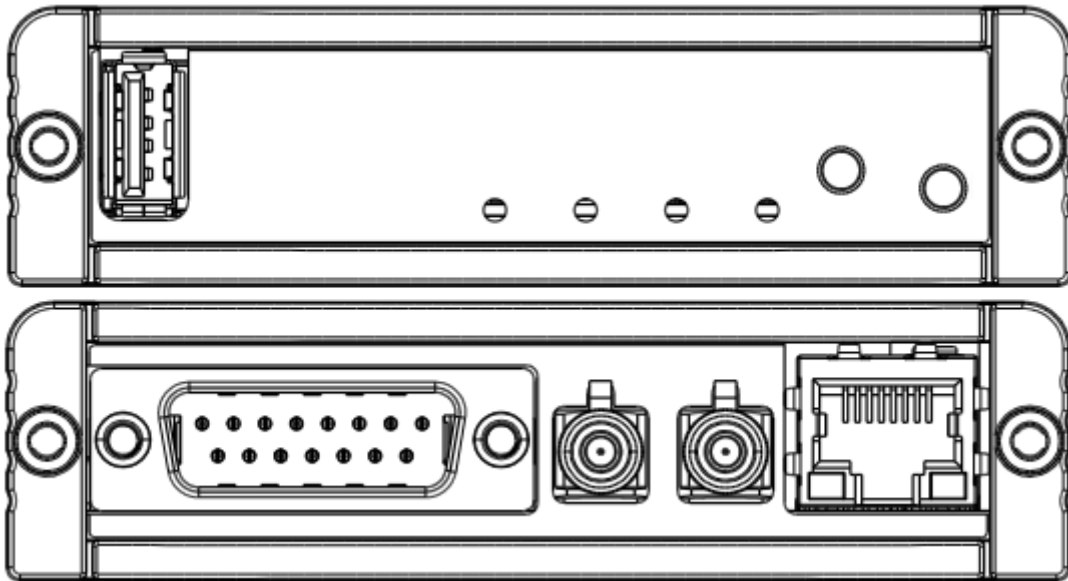
Beside the documentation and wiki you can also contact Host Mobility developers directly with your questions. See <http://hostmobility.com> for contact information.

**2.5 Wiki**

**2.6** <https://github.com/hostmobility/mx4-docs>

**3 Connectors**

**3.1 Connection Layout**



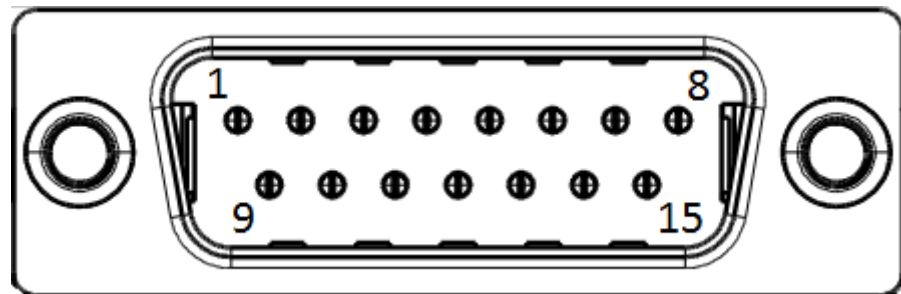
**3.2 Connector – PWR & CAN**

Pin	Function	Comment
1	CAN-1-H	
2	CAN-1-L	
3	CAN-2-H	
4	CAN-2-L	

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5	CAN-3-H	
6	CAN-3-L	
7	INPUT-POWER	
8	GND	Reference for INPUT-POWER
9	DIG-IO-1	Output with source and sink and/or analog in and/or digital in
10	RS-485 or J1708	RS-485 TX or J1708A (default variant is RS-485 not J1708)
11	DIG-IO-2	Output with source and sink and/or analog in and/or digital in
12	RS-485 or J1708	RS-485 RX or J1708B (default variant is RS-485 not J1708)
13	START-SIGNAL	Must be tied to INPUT-POWER for the unit to start
14	RS-232_RXD	Rs-232 receive from pc (default debug)
15	RS-232_TXD	Rs-232 transmit from device to pc (default debug)
S	GND	The shield acts as a general purpose GND

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Mating connector: D-Sub 15-pin female

Connector on MX-4: D-Sub 15-pin male

## 4 Features

### 4.1 *Digital Inputs and outputs*

There are two digital outputs available, both of which can source current and can sink current. And on the same two connector pins there is one analog in channel and one digital in.

#### 4.1.1 **Digital inputs level Definitions**

Negative going threshold: Min 1.8 V

Positive going threshold: Max 7.1 V

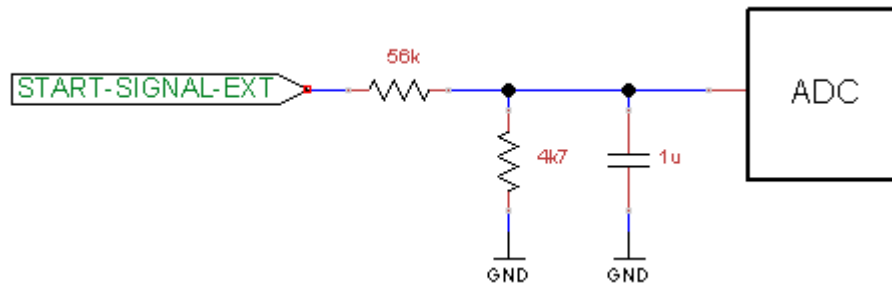
Hysteresis: Min 0.9 V

#### 4.1.2 **Analog In level Definitions**

This analog input is connected to the 12 bit ADC through a voltage divider which translates to ~8 mV per bit.

The tolerance in resistors used for the voltage divider can be compensated for by calibration in software(split of factor ~11.9 from source).

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### 4.1.3 Digital Outputs source

Operation voltage from 8 to 32V.

Source from INPUT-POWER.

Short-circuit trigger at INPUT-POWER min 3.5A to 7.5 (typical 5A) when INPUT-POWER is 13V.

Detection of short circuit can be made from either Digital in or analog in if needed.

### 4.1.4 Digital Outputs sink

Operation to sink voltage up to 32V.

Short-circuit trigger at INPUT-POWER min 2A to 3.8A (typical 2.8A) when INPUT-POWER is 13V.

Detection of short circuit can be made from either Digital in or analog in if needed.

## 4.2 Start Signal

This input can be read from software.

If START-SIGNAL is low, a software shutdown will put the unit in CUT OFF mode (see "Power Modes"). When START-SIGNAL goes low, the system will operate as before until your application decides to initiate a software shutdown into CUT OFF mode.

## 4.3 Ethernet

Standard Ethernet connector with two LEDs to indicate communication, see "LED indicators" for more information.

10/100 Mbit/s Full-duplex Ethernet controller.

## 4.4 CAN

CAN 2.0B, ISO11898, capable of running 1 Mbit/s.



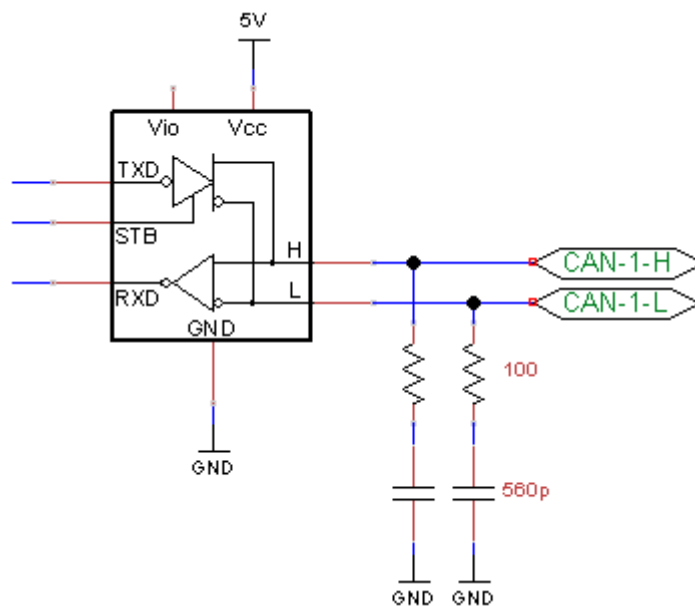
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The CAN controllers are exposed via the standard Linux SocketCAN API.

CAN bus terminated according to SS-ISO15765-4:2011(E) part 12.4.2.3.3. This is a termination method called AC termination, used for diagnostic tools which are connected to a stub on the CAN bus. Since the CAN bus already has two endpoints with resistor terminations, it's not allowed to terminate the CAN bus in MX-4 with a resistor.

The three CAN channels can be configured individually as wake-up sources from sleep or deep sleep. If a CAN channel is configured for wake-up, the unit will wake up as soon as any communication takes place on the CAN channel. See "Power Modes".

Please note that the first two CAN channels are high performance, but the third CAN channel is somewhat limited in performance and might miss frames on a CAN bus with heavy load.



#### 4.4.1 Frame timestamps

Every CAN frame received is timestamped in the lowest possible level.

A can frame has the following flow up to the application:

CAN BUS → CAN controller → Linux kernel driver → Network stack → User application.

Linux kernel driver is where the frame will get a time-stamp. The delay from CAN controller to Linux kernel driver is 15-30 μs, which means that one will get a CAN frame time-stamp that has a 15-30 μs offset.

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#### 4.5 **Accelerometer**

Freescall MMA8452Q connected to main CPU. Can be used as a wake-up source in sleep mode.

#### 4.6 **µSD-Card**

Optionally an SD card can be installed at delivery, which is not externally accessible. The SD card can then be mounted in LINUX through normal commands

The µSD card is only accessible internally and the PCB must be removed from the aluminum profile for the µSD and nano-SIM card to be accessible.

#### 4.7 **Rs-232**

One RS-232 (/dev/ttyLP0) is possible to use as console instead of internal connector header.

Or use UART with TTL levels available internally. Used for development only. Cable can be supplied by Host Mobility. Also, a HM007 adapter is needed to be able to use this TTL to usb cable.

Rs-232 can be used for other purpose than debug console if software (BSP) is changed to disable console output on that port but only through ethernet, modem or usb(rndis) with ssh is then possible to access the debug console.

#### 4.8 **Console**

UART\_B which is /dev/ttyLP2 is debug port. Can Be changed to UART\_A (RS232).

#### 4.9 **USB**

The unit has one selectable USB host/device port.

The connector is a standard type A connector, but with high retention for a secure connection in automotive environment.

The port supports USB 2.0 High Speed (480 Mbit/s).

When the system is booted, the host/device port will enter device mode if a cable is connected between this port and a powered USB port of a computer or similar.

When the system has booted, the port can be reconfigured to host or device by software.

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#### 4.10 **GSM/GPRS/3G/4G**

Quectel EG25-G Global Cat4 Module

External antenna.

Antenna requirements:

Frequency range: 1559MHz~1609MHz

Polarization: RHCP or linear

VSWR: <2 (Typ.)

Passive antenna gain: >0dBi

(Antenna must be mounted at least 20 cm from WiFi antenna.)

Antenna connectors: FAKRA Code D (Bordeaux)

LTE-FDD: B1/B2/B3/B4/B5/B7/B8/B12/B13/B18/B19/B20/B25/B26/B28

LTE-TDD: B38/B39/B40/B41

WCDMA: B1/B2/B4/B5/B6/B8/B19

GSM: B2/B3/B5/B8

##### 4.10.1 **SIM card**

Nano-SIM card is only accessible internally and the PCB must be removed from the aluminum profile for the the  $\mu$ SD and nano-SIM card to be accessible

#### 4.11 **GPS/GLONASS**

Quectel EG25-G integrated receiver that supports GPS, GLONASS, BeiDou, Galileo and QZSS.

External antenna.

Antenna connector: FAKRA Code C (Blue)

Tracking Sensitivity (Open sky): -147 dBm

Acquisition Sensitivity (Open sky): -146 dBm

Cold Start sensitivity: -146 dBm

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#### 4.12 **Super Capacitor**

A super-cap is used for short term power loss protection. A capacitor of 2.5 F is connected to the 4V power rail. The super-cap is slow charged through a current limiter so that the current consumption of the unit is limited to a reasonable level during boot. Once an appropriate charge level has been reached, it is brought online on the 4V power rail and the protection is active. This is designed to give at least 500 ms power interrupt protection.

The super-cap must be charged for 30-35 s before it can be connected to the 4V power rail, which means that it won't help during a power loss if the power loss takes place within 30-35 s after the unit has been powered.

#### 4.13 **RTC/GPS Backup Battery**

Default delivery is using a 12x2.5 mm re-chargable coin cell or an Standard CR1225 Battery 3V 48 mAh 12x2.5 mm, can be equipped on request from production.

#### 4.14 **RS-485/J1708**

Default variant has one 2-wire interface of rs-485. On request an J1708 (2-wire) bus can be mounted instead of Rs-485. RS-485 is direct connected to Linux and if use of J1708 it uses the same port(/dev/ttyLP1) from Linux but converts to j1708 message in co-CPU.

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## 5 Power

### 5.1 Input Voltage

Input voltage range: 8 – 36 V DC

8-30 V is the recommended input voltage, but MX-4 can withstand up to 40 V continuously without breaking. MX-4 can also withstand transients of much higher voltage.

### 5.2 Reset

The unit has a reset button which can be reached from outside of the enclosure through a small hole using a pen or similar can be used to reset the unit.

### 5.3 Power Modes

There are six power modes:

- RUNNING – CPU resources and communication interfaces are being used.
- IDLE – CPU resources are not being used (CPU in idle) and no communication interfaces are being used.
- SLEEP – Main CPU is suspended to RAM, micro-controller runs on 32 kHz and is in cyclic sleep, some internal power rails are turned off. Fast resume of operation.
- DEEP SLEEP – Most internal power rails are turned off, including power rail to the main CPU. Cold boot on wake-up.
- CUT OFF – Everything is turned off on the board. The unit can only wake-up (boot) using the START-SIGNAL and/or “Start Signal Slide Switch”.

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## 5.4 **Wake-Up Sources**

The different operating modes are controlled by software. The following wake-up events are supported (these apply to SLEEP and DEEP SLEEP modes).

- Digital inputs
- Accelerometer interrupt (motion, orientation, transient or tap event). (\*)
- RTC
- GSM/GPRS/3G Ring or SMS
- Low input voltage
- Analog input
- CAN traffic

(\*) – Accelerometer can not be used to wake-up from DEEP SLEEP mode.

## 5.5 **Power consumption**

Power consumption is depending on operating mode. Exactly what consumption you will get with your application is impossible to say, but you can get an idea from the numbers below.

Mode	Consumption
RUNNING (*)	Avg = 88 mA @ 24 V Avg = 95 mA @ 12 V
IDLE	79mA @ 24 V 84 mA @ 12 V
SLEEP/Suspend	36 mA @ 24 V 50 mA @ 12 V
DEEP SLEEP	3mA @ 24 V 12 mA @ 12 V
CUT OFF	0.3 mA @ 24 V 0.2 mA @ 12 V

(\*): In running mode with 100 % CPU load

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## 6 LED Indicators

Three green/orange biLEDs.

- **PWR.** Indicates the current operating mode.
- **GSM.** General purpose, intended to show connectivity of 4G-modem.
- **GPS.** General purpose, intended to show status of the GPS.

And one green/red biLED.

- **FUNC.** General purpose, intended to show status of the unit.

There is also two LEDs on each of the two RJ45 Ethernet connectors.

- **RJ45-Left.** On when a connection is established on the Ethernet interface. Blinking when communication takes place.
- **RJ45-Right.** On when the Ethernet controller is connected to a 100Base-TX network. Off if connected to a 10Base-T network, or not connected at all. If this LED is off, but the left LED is on or blinking, the network is a 10Base-T network.

## 7 Enclosure

Material: Alumina body with plastic sides.

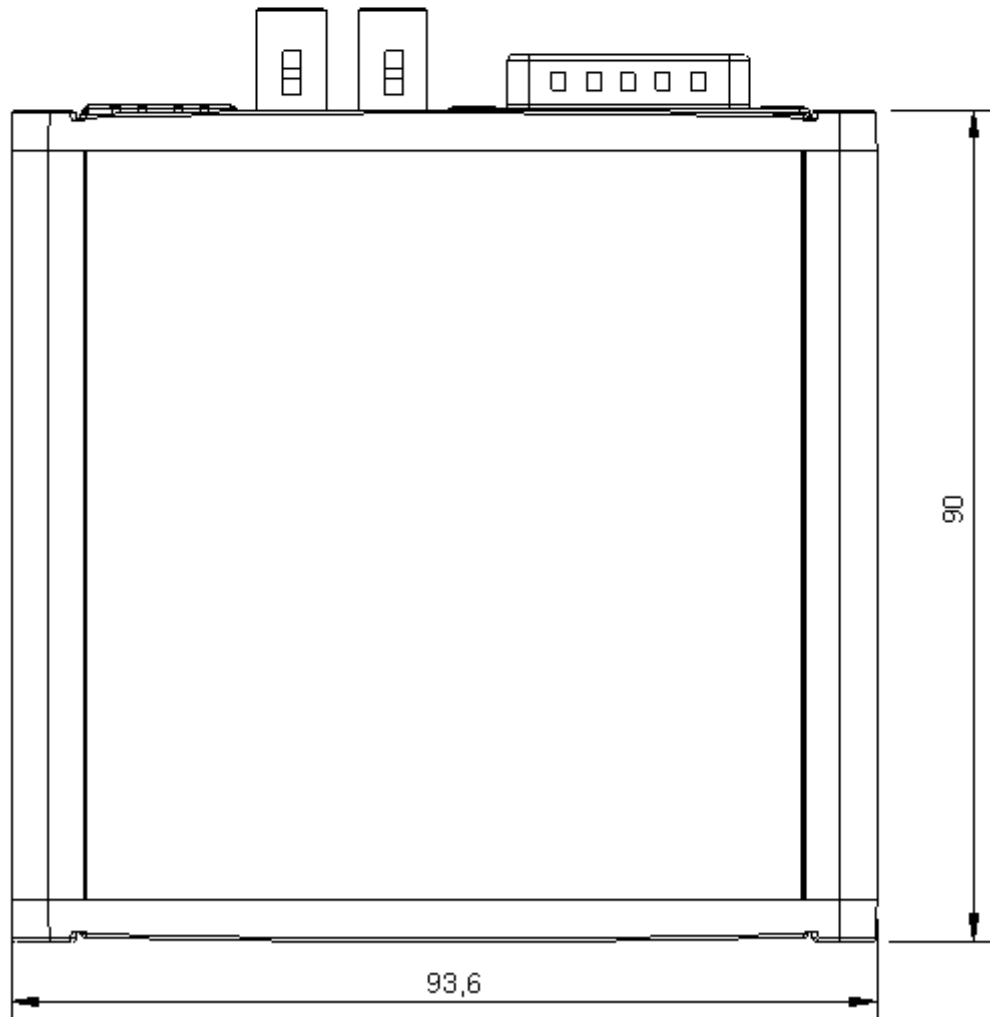
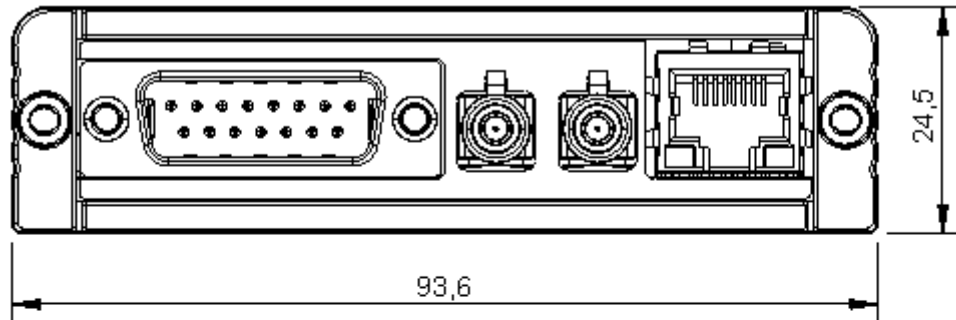
Coating: Black powder coating

Dimensions: 93.6x90x24.5 mm

Weight: ~200 g

IP-class: IP30

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## 8 Mounting

The unit is designed to withstand vibrations and shocks in a vehicle environment. A mounting shackle supplied by Host Mobility should be used for a secure mounting.

## 9 Environment

### 9.1 *Operating Temperature*

Parameter	Min	Max	Unit
Operating temperature range (*)	-40	+85	° C

(\*) Note: The modem will only function at -40 °C for a short while. It will eventually shut down if temperature is below -30 °C or above +85 °C.