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Technical description MX-4 CT WiFi 3G

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1 General description

1.1 Features

– ARM Cortex-A9 CPU, 1GHz dual core

– 1 GB flash, 512 MB RAM

– Linux 3.1.10 operating system

– HDMI interface, 1920x1080

– VGA interface, 1400x1050

– CPU analog stereo audio interface

– Modem analog differential mono audio interface

– 14.4 / 5.7 Mbps Five band 3G module

– 802.11 b/g/n WiFi

– 2 x 10/100 Mbit Ethernet

– 2 x USB 2.0 high-speed host

– 1 x USB 2.0 high-speed device

– 3 x CAN 2.0 B

– 2 x RS-232

– 1 x RS-485

– 1 x J1708

– 6 x Digital inputs

– 5 x Digital outputs

– 1 x Tachometer input

– 1 x Analogue inputs (4-20 mA)

– 3 x Analogue inputs (0-32 V)

– Internal Lithium battery

– 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.

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 an 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:

- Tool-chain

    ‣ Tegra2: Linaro GCC 4.7-2013.09
      (http://releases.linaro.org/13.09/components/toolchain/gcc-linaro/4.7)

- Linux (Tegra2: 3.1.10)

- U-boot (Tegra2: 2011.06)

- 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 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 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 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.

With this access you can fork the repository, create pull-requests, create issues and clone the repository and build the whole platform from scratch.

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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.

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

http://hostmobility.github.io/mx4/

2.6 Build Server

Host Mobility AB provides access to our build server which is based on Jenkins software. Here you can download the latest and greatest software for your MX-4 platform.

It is also possible to setup a customer specific build job on request where one could integrate the customer application in the MX-4 platform build system or build a branch of the MX-4 platform repository.
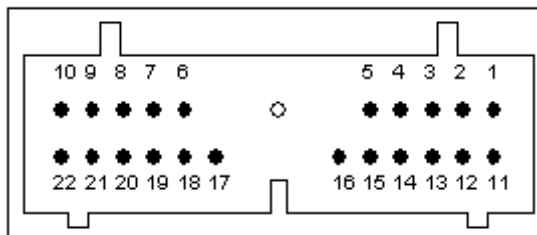
3 Connectors

3.1 Connection layout
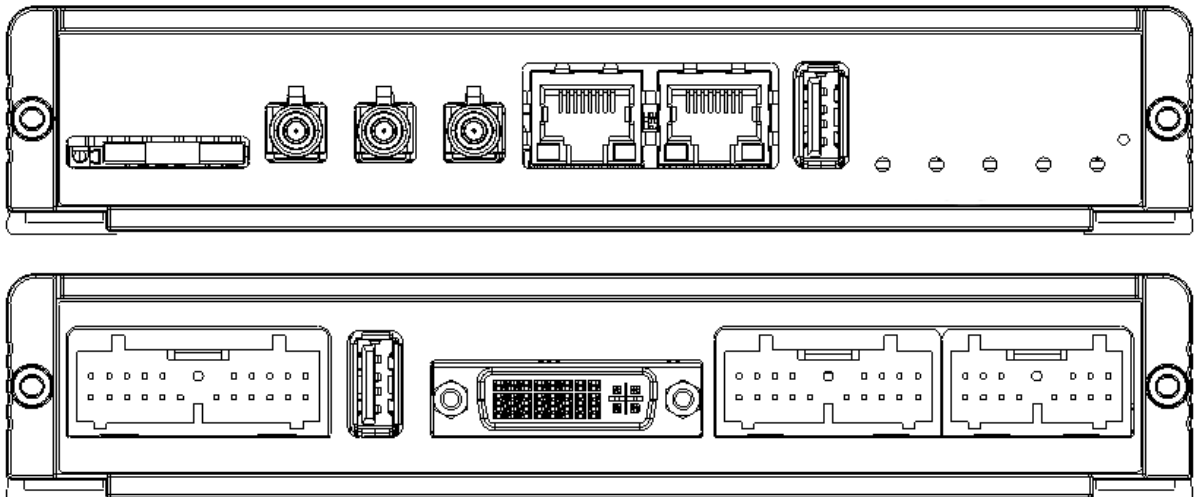
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3.2 Connector – Digital and Analog I/O

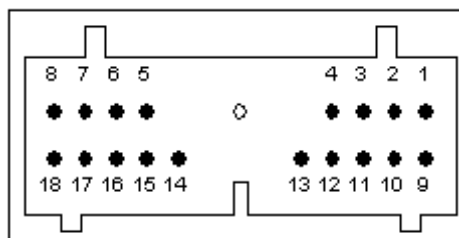| Pin	Function	Comment
1	CAN-1-H	
2	CAN-1-L	
3	CAN-2-H	
4	CAN-2-L	
5	GND	Reference for all I/O and communication buses
6	4-20mA-PWR	Digital output for powering 4-20 mA sensors
7	DIG-OUTPUT-1	
8	DIG-OUTPUT-2	
9	DIG-OUTPUT-3	
10	DIG-OUTPUT-4	
11	DIG-INPUT-1	
12	DIG-INPUT-2	
13	DIG-INPUT-3	
14	DIG-INPUT-4	
15	DIG-INPUT-5	
16	DIG-INPUT-6	
17	GND	Reference for all I/O and communication buses
18	ANALOG-IN-1	0-32 V input, must be high for the unit to start
19	ANALOG-IN-2	4-20 mA input
20	ANALOG-IN-3	0-32 V input
21	ANALOG-IN-4	0-32 V input
22	PULSE-COUNTER	Input for tachometer

Mating connector: JAE IL-AG5-22S-D3C1

Connector on MX-4:   JAE IL-AG5-22P-D3L2

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3.3 Connector – Power & Communication

| Pin	Function	Comment
1	RS485-A	
2	RS485-B	
3	J1708-A	
4	J1708-B	
5	DIG-OUTPUT-5V	Digital 5V output, for peripherals
6	GND	Reference for all communication buses
7	GND	Reference for all communication buses
8	INPUT-POWER	
9	GND	Reference for INPUT-POWER
10	N/A	
11	N/A	
12	RS232-2-RXD	RS-232 no. 2 - Data input
13	RS232-2-TXD	RS-232 no. 2 - Data output
14	GND	Reference for all communication buses
15	RS232-1-TXD	RS-232 no. 1 - Data output
16	RS232-1-RTS	RS-232 no. 1 - RTS output
17	RS232-1-CTS	RS-232 no. 1 - CTS input
18	RS232-1-RXD	RS-232 no. 1 - Data input

Mating connector: JAE IL-AG5-18S-D3C1

Connector on MX-4: JAE IL-AG5-18P-D3L2

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3.4 Connector – Audio & CAN

Pin	Function	Comment
1	3G-AUDIO-IN-P	Modem audio input, positive (referenced to negative input)
2	CAN-3-H	
3	CAN-3-L	
4	N/A	
5	GND	Reference for all communication buses
6	GND-A	Reference for Linux platform audio interface
7	3G-AUDIO-IN-N	Modem audio input, negative (referenced to positive input)
8	3G-AUDIO-OUT-P	Modem audio output, positive (referenced to negative output)
9	3G-AUDIO-OUT-N	Modem audio output, negative (referenced to positive output)
10	GND-A	Reference for Linux platform audio interface
11	AUDIO-IN-MIC	Linux platform audio input, with biasing voltage for microphone
12	AUDIO-IN-LINE	Linux platform audio input, without biasing voltage
13	AUDIO-OUT-R	Linux platform audio output, right
14	AUDIO-OUT-L	Linux platform audio output, left
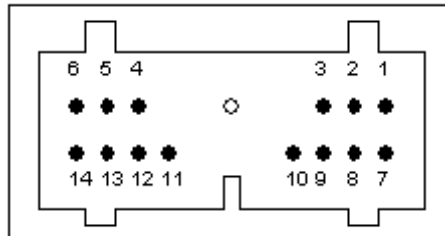
Mating connector: JAE IL-AG5-14S-D3C1-A

Connector on MX-4:   JAE IL-AG5-14P-D3L2

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4 Features

4.1 Digital Inputs

4.1.1 Level Definitions

Negative going threshold = Min 1.73 V

Positive going threshold = Max 6.69 V

Hysteresis = Min 0.85V

4.2 Pulse counter input

This input is intended to be used with a tachometer output. The number of pulses registered on this input is counted by the microcontroller and is made available to the system.

4.3 Digital Outputs

There are five digital outputs available. The "4-20mA-PWR" is electrically identical to the other four digital outputs, but it's set to normal high in software.

4.3.1 Level Definitions

Output low: Max 1V

Output high: Min input power – 1.5V

Output current: Max 500 mA each

Short circuit detection is available individually on all outputs.

4.3.2 Short circuit detection level definitions

Negative going threshold = Min 4.81 V

Positive going threshold = Max 5.74 V

Hysteresis = Min 0.93V

4.4 Digital 5V Output

This digital output can supply 5V to peripherals so that they don't need to include an advanced power supply.

This output voltage is ~4.6 V and up to 500 mA can be supplied.

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4.5 ANALOG-IN-1 – Start signal

For the unit to boot, this input must be high. After unit has booted, the signal can go low without the unit shutting down.

This input can be read from software, just like ANALOG-IN-3 and ANALOG-IN-4 (see Analog Inputs 0-32V).

If ANALOG-IN-1 is low, a software shutdown can put the unit in the same state as before ANALOG-IN-1 went high.

4.6 Analog in 0-32V

The analog inputs 1, 3 and 4 can be connected to various voltage sources and can by software be read in the interval 0 – 32 V.

4.7 Analog in 4-20 mA

The analog input, ANALOG-IN-2, can be connected to a current source which then can be read by the software in the interval 0 – 24 mA. Typically this input is used for temperature or pressure sensors.

The current to voltage, and analog to digital conversion is made on the low side. This means that the sensor should be powered by a digital output, or a voltage source in the vehicle. It can then be grounded on the ANALOG-IN-2 if it only uses two pins. If the sensor has a current output pin, this pin shall be connected to ANALOG-IN-2.

4.8 CAN

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

4.9 Accelerometer

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

4.10 SD Card Holder

It's possible to extend the flash memory using SD memory. The SD card can be accessed without opening the enclosure.

4.11 System Battery

Lithium battery 3.7 V 1050 mAh.

This battery is always being charged if the unit is powered and ANALOG-IN-1 is high or the system has booted.

4.12 GPS Backup Battery

Standard BR1225 Battery 3V 48 mAh 12x2.5 mm

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4.13 Console

UART with TTL levels available internally. Used for development only. Cable can be supplied by Host Mobility.
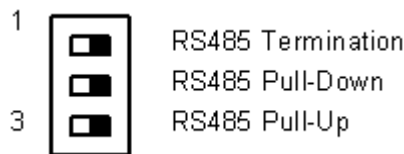
4.14 RS-232

One 4-wire interface is supported (TX/RX/CTS/RTS).

One 2-wire interface is supported (TX/RX).

4.15 RS-485

Termination, pull-up and pull-down resistors is connected individually using three DIP-switches.

Termination resistor: 120 ohm

Pull-up and Pull-down resistors: 680 ohm

4.16 Ethernet

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

10/100 Mbit Full-duplex Ethernet controller.

4.17 USB

The unit has one dedicated USB Host port and one selectable USB host/device port.

Both connectors are standard type A connectors, but with high retention for a secure connection in automotive environment.

Both ports support USB 2.0 High Speed (480 Mbit/s).

The host/device port is placed by the system connectors, and the dedicated host port is placed next to the Ethernet connectors.

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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4.18 Dual display interface

Dual independent display interfaces.

Integrated Ultra-low power NVIDIA GeForce GPU

H.264, WMV9 VC-1, MPEG-4, MPEG-2, H.263, DiVX, XviD

Both display interfaces are available in the DVI-I connector. These can be used simultaneously if a Y-split cable is used.

4.19 HDMI

Located in the DVI-I connector.

HDMI V1.3 1080p (1920 x 1080)

4.20 VGA

Located in the DVI-I connector.

Up to 140 MHz pixel clock

For VGA Signal Timing see: http://tinyvga.com/vga-timing

4.21 Platform Audio

The main CPU has an audio interface available in one of the connectors. Analogue stereo out and analogue mono in is referenced to GND-A in the same connector.

The analog mono in has 3.3V biasing voltage for driving microphones.

4.22 Modem Audio

The internal modem has an audio interface available in one of the connectors. Analogue differential mono output and analogue differential mono input.

4.23 GSM/GPRS/3G

Cinterion PHS8-P. Only external antenna.

Antenna connector: FAKRA Code D (Bordeaux)

Five Bands UMTS/HSPA+: 850/800, 900, 1900 and 2100 MHz

Quad-Band GSM: 850/900/1800 and 1900 MHz

HSDPA Cat. 10 / HSUPA Cat.6

Data rates: max. 14.4 Mbps DL, max. 5.76 Mbps UL

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4.24 GPS/GLONASS

Cinterion PHS8-P. Only external antenna.

Antenna connector: FAKRA Code C (Blue)

Frequency GPS: 1575.42 MHz

Frequency GLONASS: 1601.72 MHz

Tracking Sensitivity (Open sky): -159 dBm

Acquisition Sensitivity (Open sky): -149 dBm

Cold Start sensitivity: -145 dBm

Channels: 40

4.25 WLAN

Zcomax Technologies ZCN-722M. Only external antenna.

Antenna connector: FAKRA Code I (Beige)

WiFi modes: Station (STA) and AccessPoint (AP) infrastructure mode

Standard: IEEE 802.11b/g/n (draft 5.0) Compliant

Chipset: Atheros AR9271

Transmit Power: 23 dBm

Receive Sensitivity: -94dBm @ 11Mbps

Radio Mode: 2.4GHz

Encryption: 64/128 WEP, TKIP/AES

Authentication: WPS, WEP, WPA, WPA2

4.26 Battery powered

The unit is fully functional when the input power is disconnected if the internal lithium battery is charged, with a few exceptions. The digital outputs and LIN communication will not be functional. Also, note that there is a fifth output used for 4-20mA sensors which won't be functional.

4.27 Reset

When MX-4 is equipped with an internal lithium battery, a reset button which can be reached from outside the enclosure through a small hole using a paper-clip or similar can be used to reset the unit.

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5 Power

5.1 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.

5.1.1 CPU idle

Fully running, but no application and not all interfaces are put in use

150 mA @ 24 V
290 mA @ 12 V

5.1.2 CPU load 100%

As high current consumption as we can manage to get. CPU load 100%, modem, WiFi and Ethernet transmitting. Digital outputs and USB ports not supplying any current.

Avg = 315 mA @ 24 V
Max = 400 mA @ 24 V

Avg = 545 mA @ 12 V
Max = 750 mA @ 12 V

5.1.3 Sleep

12mA @ 24 V
20mA @ 12 V

5.1.4 Off mode (ANALOG-IN-1 low, system in shutdown)

0.2 mA @ 24 V
0.1 mA @ 12 V

5.2 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.

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5.3 Power Management

Entering sleep mode is done through software. The following wake-up events is supported.

- Digital inputs (not all digital inputs can be used for wake-up)
- Accelerometer interrupt
- RTC
- GSM/GPRS/3G Ring or SMS
- Low input voltage
- Analog input

6 LED indicators

Four green/orange biLEDs and one green LED indicate the status for the MX-4 VCC.

- **PWR**. Indicates the current operating mode.
- **GSM**. General purpose, intended to show connectivity of 3G-modem.
- **WiFi**. Indicates communication of the WiFi interface.
- **GPS**. General purpose, intended to show status of the GPS.
- **FUNC**. General purpose.

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.

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7   Enclosure

Material: Alumina body with plastic sides.

Coating: Black powder coating

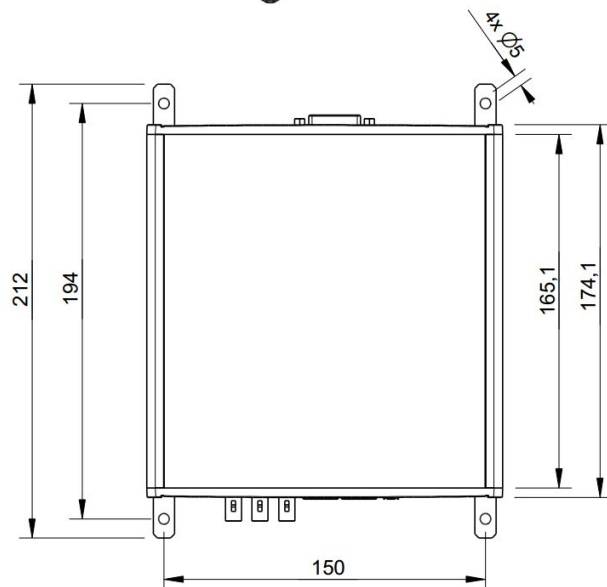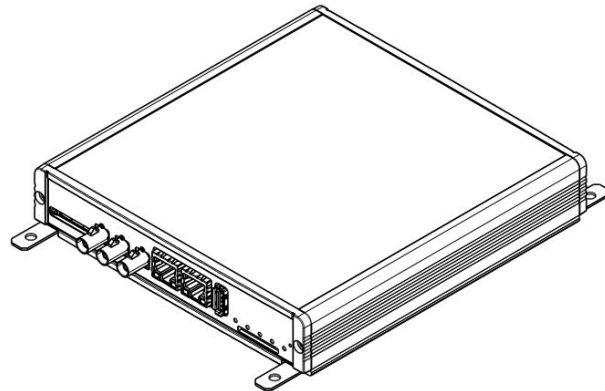Dimensions: 175x167x32 mm

Weight: 830 g

IP-class: IP30

8   Mounting

The MX-4 is designed to withstand vibrations and shocks in a vehicle environment. Two mounting shackles supplied by Host Mobility should be used for a secure mounting.

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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. The WiFi module is only specified to +80 °C.

The main CPU will shut down in a controlled manner at +115 °C. There are three different temperature sensors available internally which the software has access to. A configurable thermal throttling mode can be used to lower the units self heating.