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Heptagon Systems Pty Ltd.
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HQ-Box User Manual

Rev 1.06 20190807

Table of Contents

1. Introduction

The HQ-Box is a family of highly flexible embedded servers. The HQ-Box comes in two types of enclosures "Compact" and "Extended". This manual refers to both types.
The Compact version has a single extension slot which can accommodate either a PCIe add-on card, or two U.2 2.5" drives (either PCIe or SATA).
The Extended version has three extension slots allowing up to 3c PCIe Add-on cards, 4x U.2 2.5 drive slots, and many combinations of PCIe slots and U2. Drives.
The manual is divided into the following sections
- Safety and standards – please read carefully
- Product description – technical details and the architecture of the product
- Assembly instructions for adding and removing optional parts
- Mechanical drawing

Heptagon systems is constantly improving it's products and adding new features. The user is advised to check the company web site for the latest revision of this document.

Please refer to our Quick Selection Guide (QSG) document available for download from our web site.

2. Safety instructions

There are not enough words to describe the importance of safety. Please invest the time to read the chapter below, compiled for your own safety.

Disclaimer: Failure to follow the safety instructions can lead to injuries and/or damage of property. Heptagon Systems is not liable should safety instructions not be followed. Please refer to the Heptagon Systems Sales and Warranty terms and conditions for further information.

This product was designed and built in accordance with the safety requirements of low voltage equipment.
This product was built and tested prior to shipment for operational and safe use.
In order to preserve this product as operational and safe, the following guidelines must be kept:
- The product must always operate within the operation and storage conditions described in this manual. Conditions include:
  - Supply voltage
  - Temperature
  - Humidity
  - Shock and vibration
- Installation and mounting instruction must be followed to ensure appropriate air circulation.
- Power supply to the product must meet local safety regulations for electrical installation. Electricity infrastructure connection should be prepared by people who are qualified for the task by the local authority. Proper grounding for an AC power supply is a must. Use only safety approved PS according to IEC/EN 60950-1 with rated voltage of 13.6 to 24VDC and a rated power of 200W max
- As the product weight is above 2Kg, exercise caution when moving and installing. Failure to properly mount can cause incidental falls and subsequent injuries.
- Before servicing the product, ensure it is has been disconnected from all power sources. Power it off safely then disconnect the power cable.
- Use anti-static equipment before opening and while servicing the product. Electro static discharge can destroy or damage electronic equipment. Take extra caution when using add-on cards to prevent damage.
- All add-on cards should comply with add-on card specifications. The total amount of add-on cards and disks used should not pass the power budget prescribed for them or exceed the maximum supply current of the product.
- Extensions or add-ons which require a service such as a filter or fan, should be maintained in accordance with their maintenance requirements.
- Stop using the product and disconnect it from its power source if it is malfunctioning or showing signs of damage. The product should be marked as faulty to prevent others from using it.
- Service to the product should be made by a Heptagon Systems qualified service. Opening of the product should be restricted for the purpose of replacing an add-on card, a storage device or a backup battery.

2.1. Caution – Hot surface

The left side (as seen from the panel) of the HQ-Box is a hot surface

2.2. Recycling and battery replacement

If the product contains a battery:
- Replace only with the correct type of battery as advised in the product manual. Failure to do so may result in a fire and/or explosion.
- Please recycle the battery as instructed by local authorities. Do not dispose in an ordinary rubbish bin.

Recycling:
All Heptagon Systems packaging materials are made from recyclable products.
Please consult your local Heptagon Systems representative for recycling of the product.

2.3. Electrostatic Sensitive device

The internals of this product may contain static sensitive devices. Appropriate anti-static handling procedures should be used when transporting and maintaining this product. The following should be noted:
- Make sure to be in an electrostatic safe environment when opening the product for service.
- Use a personal electrostatic strap before starting the service procedure.
- All electronic boards should be stored in ESD protective shields.

3. Electromagnetic Compatibility

This product is made for industrial use as classified by EMC directive (Type B device).
Europe (EU): It was tested and complies with
        EN 55032: 2012 + AC(13), Class B
        EN 61000-3-2: 2014
        EN 61000-3-3: 2013
        EN 55024: 2010
USA: It was tested and complies with FCC 47CFR part 15: 2015, subpart B.
Australia and New Zealand (AU and NZ): It was tested and complies with AS/NZS CISPR 32: 2015, Class B

The HQ-Box EMC compliance was done with cables of 3 meter maximum length. HQ-Box is not intended to connect to cables longer than 3 m.

4. Safety compliance

The device was tested and passed the following EU and AS/NZS directive safety tests:
EN 60950-1:2006+A11:2009+A1:2010+A12:2011+A2:2013
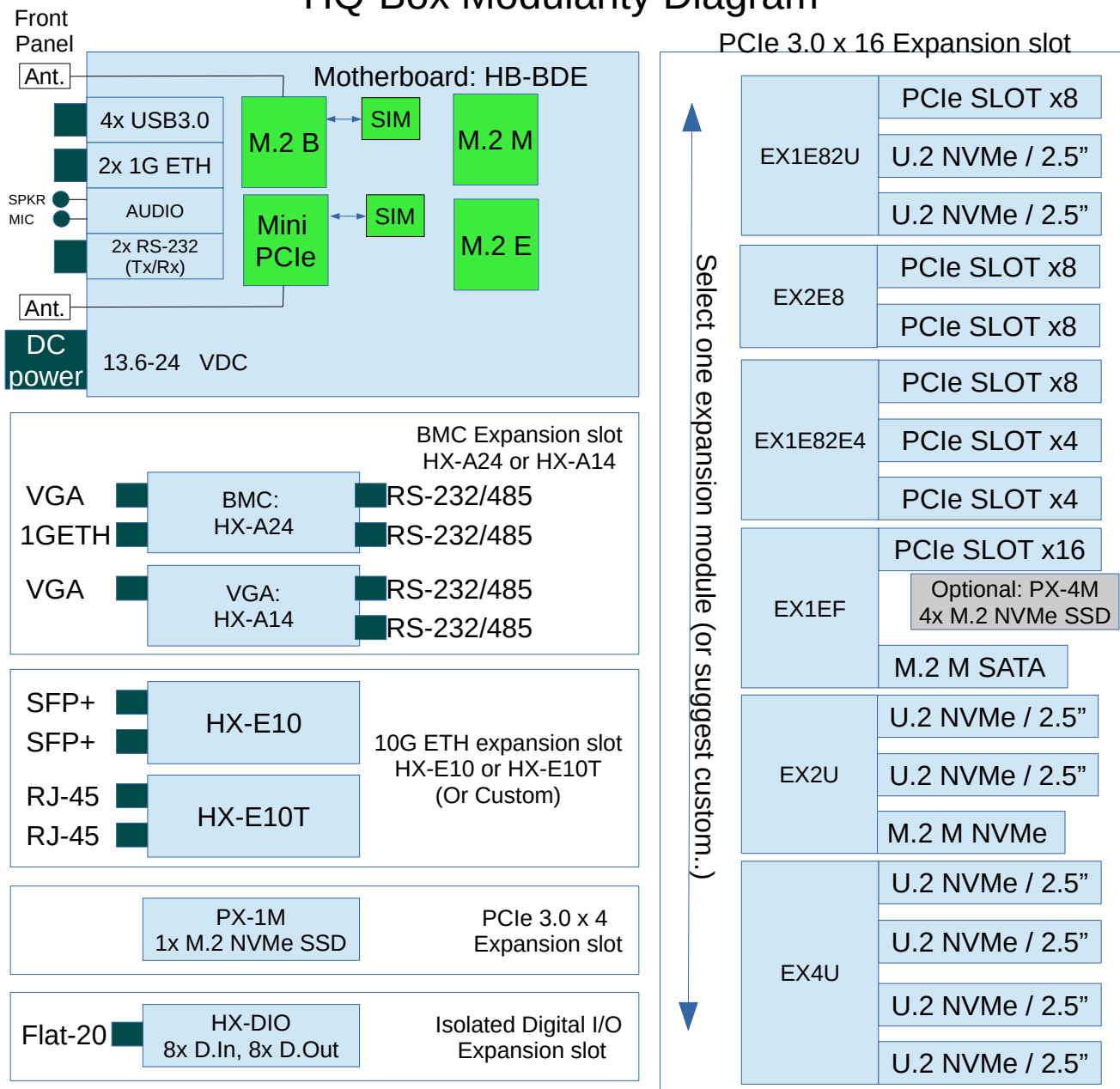IEC 60950-1:2005 (Second Edition)+Am1:2009+Am2:2013
AS/NZS 60950.1: 2015

5. Package contents

- HQ-Box, in accordance to the ordered configuration
- Packing list
- Optional accessories

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6. Product description

HQ-Box Modularity Diagram

Front Panel

Ant.

| 4x USB3.0 |
| 2x 1G ETH |
SPKR
MIC
| AUDIO |
| 2x RS-232 (Tx/Rx) |

Motherboard: HB-BDE

M.2 B — SIM
Mini PCIe — SIM
M.2 M
M.2 E

Ant.

DC power   13.6-24 VDC

BMC Expansion slot HX-A24 or HX-A14

VGA
1GETH
BMC: HX-A24
RS-232/485
RS-232/485

VGA
VGA: HX-A14
RS-232/485
RS-232/485

SFP+
SFP+
HX-E10

RJ-45
RJ-45
HX-E10T

10G ETH expansion slot HX-E10 or HX-E10T (Or Custom)

PX-1M 1x M.2 NVMe SSD — PCIe 3.0 x 4 Expansion slot

Flat-20
HX-DIO 8x D.In, 8x D.Out — Isolated Digital I/O Expansion slot

PCIe 3.0 x 16 Expansion slot

Select one expansion module (or suggest custom..)

EX1E82U
PCIe SLOT x8
U.2 NVMe / 2.5"
U.2 NVMe / 2.5"

EX2E8
PCIe SLOT x8
PCIe SLOT x8

EX1E82E4
PCIe SLOT x8
PCIe SLOT x4
PCIe SLOT x4

EX1EF
PCIe SLOT x16
Optional: PX-4M 4x M.2 NVMe SSD
M.2 M SATA

EX2U
U.2 NVMe / 2.5"
U.2 NVMe / 2.5"
M.2 M NVMe

EX4U
U.2 NVMe / 2.5"
U.2 NVMe / 2.5"
U.2 NVMe / 2.5"
U.2 NVMe / 2.5"

The HQ-Box server series offers a flexible and modular architecture, enabling full utilization of the Xeon-D SOC. The HQ-Box modularity enables flexibility in all major implementation junctions, accurately tailoring the HQ-Box to the exact needs of the client.
The HQ-Box was designed for many years of flawless service. For example, it uses only ceramic capacitors (100% ceramic) to eliminate MTBF issues of tantalum and organic capacitors.
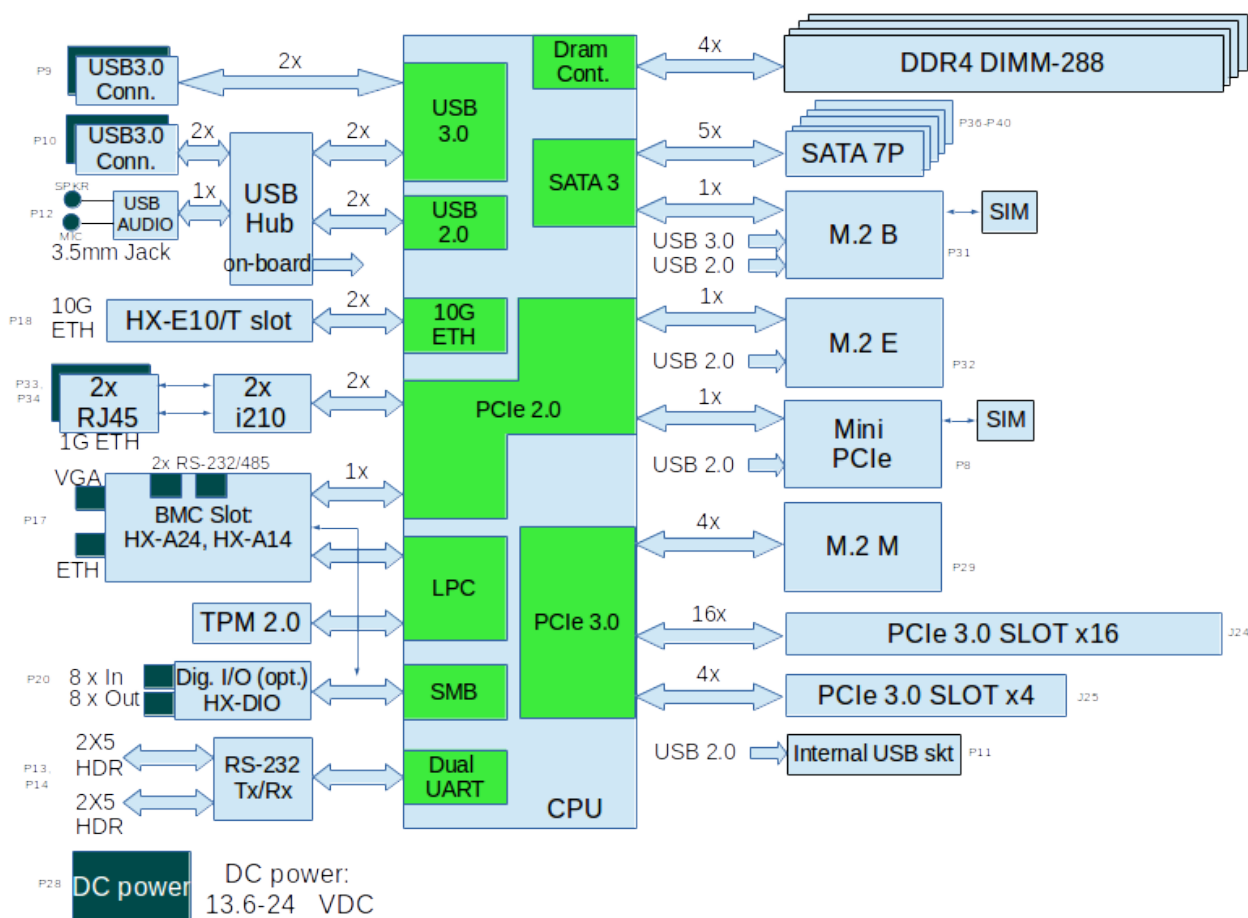
6.1. Front panel
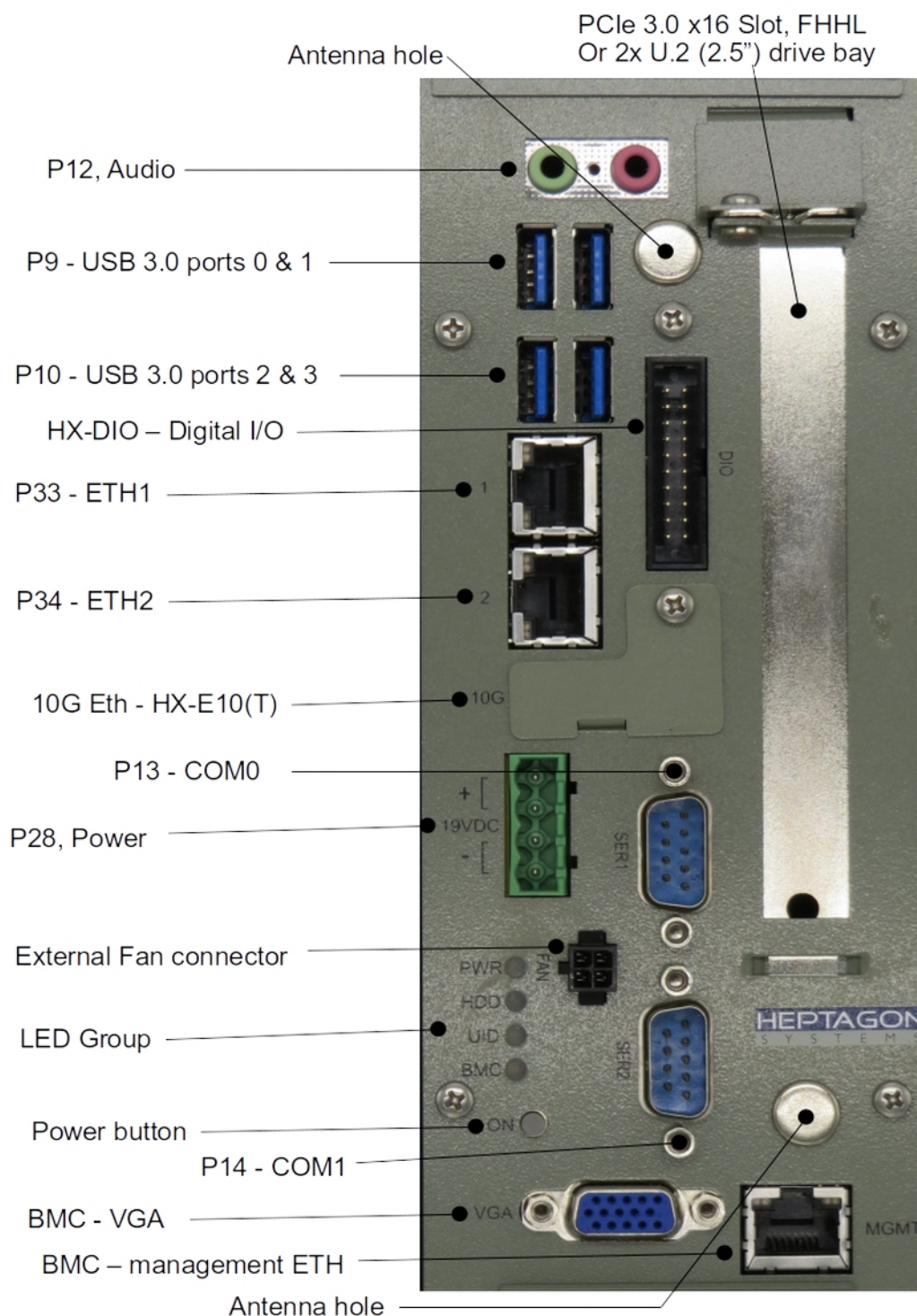
The Extended version is identical albeit the larger slot area which offers 3 slots for various combinations of PCIe 3.0 add-on card slots and U.2 drive bays.

6.2. The HQ-Box motherboard (HB-BDE)

HB-BDE Block Diagram

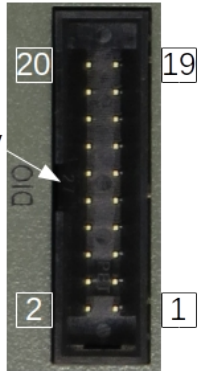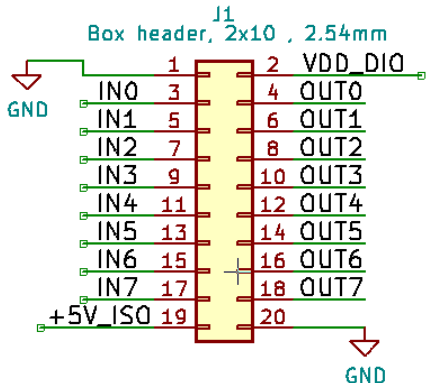The HQ-Box motherboard, HB-BDE, features the following:
- Xeon-D 1500 SOC. All series members are supported, from 25W to 65W.
- 128GB DDR4 total memory, 4x DIMM288 with ECC for improved reliability.
- 4x ports of USB3.0
- 2x port of 1Gb Ethernet
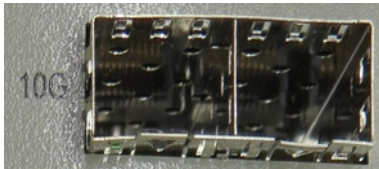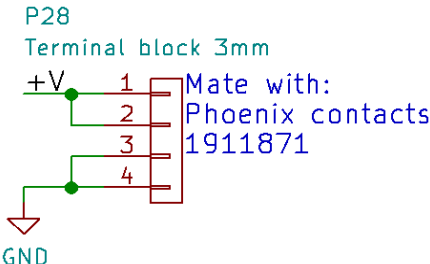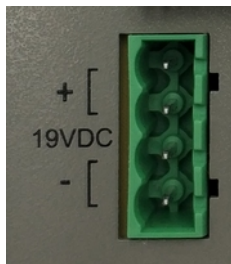- 3x M.2 expansion sockets + Mini PCIe socket

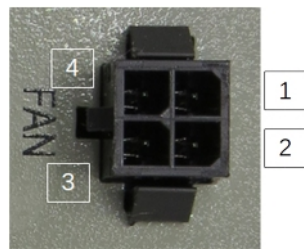The HB-BDE motherboard carries 4 expansion sockets with various functionality:
- PCIe 3.0 x16 slot which accepts expansion modules. Heptagon Systems currently offers 6 expansion modules. All Add-on cards can be of Full-Height Half-Length (FHHL) form factor.
- 10G Ethernet slot default is dual SFP+. Dual RJ45[1] (10G Base-T) option also exists.
- Board management Controller (BMC) slot to host an Aspeed AST2400 management controller, HX-A24. Projects which do not require the remote management capabilities of the HX-A24 can replace it with the VGA-only HX-A14 module.
- Digital I/O slot. The current HX-DIO supports HV isolated 8in+8Out. The I/O slot uses LPC and SMBUS, enabling future client specific custom modules.
- PCIe 3.0 x4 slot for internal HHHL add-on cards. This card has no I/O panel.

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1 - 10G Base-T is available for applications with temperature controller environment.

6.3. Connectors and sockets

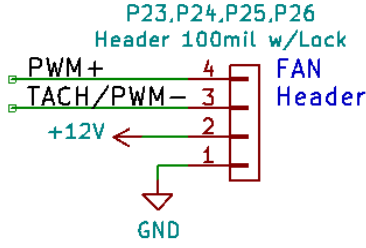| Panel connectors		
Function	**Connector**	**Description**
Audio	P12	Dual 3.5mm Audio Jack. Stereo out Mono microphone
USB	P9, P10	P9 - USB 3.0 ports 0 & 1 (directly from the SOC), Standard A-type P10 - USB 3.0 ports 2 & 3 (through a hub), Standard A-type
1GbE ETH	P33,P34	P33 - ETH1 P34 - ETH2 Dual 1Gbe RJ45 with Green/Yellow leds. Green – Link, Yellow - Activity
Digital I/O	J1 / HX-DIO	2x10, 2.54mm connector for flat cable. Pinout: • IN[0:7], Digital inputs, signal between 4.9..24V is logic high, 0..0.5V is logic low. 2KV isolation. • OUT[0:7], open drain up to 24VDC. 2KV isolation. • +5V_ISO 50mA, +5VDC isolated supply. 2KV isolation. • GND. Ground reference point to signal level. Note: Digital I/O (HX-DIO) is an optional function.

Panel connectors		
Function	**Connector**	**Description**
10G Ethernet	HX-E10 or HX-E10T	HX-E10 module has dual 10Gbe with dual SFP+ connector. HX-E10T, is a copper 10Gbe. Note: 10G Ethernet is an optional function.
Power connector	P28	DC 13.6V-24V, Mate with Phoenix Contact 1911871 Supply cable should be at least 20AWG stranded wire for 1m supply cable. Note that two wires are required on each side.
RS-232/485	SER1, SER2	By default, the serial DB9 cable assembly is connected to the CPU RS-232 channels (P13, P14 on the motherboard). These connectors supply RX/TX connectivity. Pinout is RX – 2, TX – 3, GND – 5. Full RS-232/485 UART functionality can be obtained by connecting the internal cable to the BMC (HX-A24). See HX-A24 BMC documentation for further details.

Panel connectors

Function	Connector	Description

External Fan		The external fan is internally connected to P24 on motherboard. Pinout:
		1: GND
		2: +12V DC
		3: TACH (input 3.3V signal)
		4: PWM (output 3.3V signal)
		It mates with:
		   Molex 43025-0400 (Rec housing 4P)
		   Molex 43030-0010 (crimp terminal)

Power button	SW6	Push button. Press for 5 seconds to turn off
VGA	HX-A24 or HX-A14	Standard VGA display over DB15 connector. Maximum Display resolution: 1920x1200 32bpp@60Hz • Supported widescreen resolutions: – WXGA: 1280x800 32/16bpp @60Hz – WXGA+ : 1440x900 32/16bpp @60Hz – WSXGA+ : 1680x1050 32/16bpp @60Hz – FullHD : 1920x1080p 32/16bpp @60Hz
Management port	HX-A24 only	Management port of the BMC. 1Gb Ethernet. Management port is available with the HX-A24 (BMC). The HX-A14 module, lacks the management port and has only VGA and serial ports functionality. View the HX-A24 BMC documentation for further details.
Antenna holes		Two antenna holes are provided for SMA or RP-SMA connector. It made to serve internal communication modules.

| Motherboard connectors and sockets		
Function	**Connector**	**Description**
DRAM	P3,P4,P5,P6	DIM288 sockets for DDR4, ECC.
PCIe 3.0 expansion slots	J24	PCIe 3.0 x16 Lane slot
	J25	PCIe 3.0 x4 Lane slot. Provided for PX-1M M.2 Adapter card
SATA III ports	P36	SATA-0, 7-pin SATA connector
	P37	SATA-1, 7-pin SATA connector (Not assembled)
	P38	SATA-2, 7-pin SATA connector
	P39	SATA-3, 7-pin SATA connector
	P40	SATA-4, 7-pin SATA connector
	P31	M.2 B-Key
Mini PCIe socket	P8	Half Card with uSIM (U29). **Note:** If M.2, P29 is mounted, you have to temporary remove it in order to access the Mini PCIe card and it's related uSim.
M.2 Socket	P29	M-Key, PCIe 3.0 x4, for NVME. 2280/22110.
	P31	B-Key, SATA, USB3.0, uSim (U62), up to 2280. **Note:** If M.2, P29 is mounted, you have to remove it temporarily in order to access the P31 M.2 card.
	P32	E-Key, USB2.0, PCIe2,0x1 for wireless lan and BT. 3042/3030.
10Gb ETH	P18	10Gb Ethernet expansion slot (HX-E10 or HX-E10T)
BMC expansion	P17	Socket for HX-A24 BMC or HX-A14 VGA
DIO	P20	Digital In/Out expansion slot
Serial ports	P13,14	COM-0,COM-1 2x5 header Tx/Rx only Note: 2x Full RS-232/485 port headers are found on the HX-A24 BMC. See HX-A24 BMC documentation for further details.

Motherboard connectors and sockets

Function	Connector	Description
Fan	P23, P24, P25, P26	Mating connector: * Molex 22-01-2047 (housing) * Molex 08-50-0114 or 08-50-0113 (crimp terminals) P23,P24,P25,P26 Header 100mil w/Lock PWM+ 4 FAN Header TACH/PWM− 3 +12V 2 1 GND Fan Connectors +12VDC PWM. Logic levels of PWM is 3.3V. **P24 is designated for the external fan as it has a built in fuse**. The other fan connectors have no fuse and should not be used for an external fan without adding a fuse in series.
CMOS Battery	BAT1	2032 or battery holder
USB	P11	Internal USB 2.0 port (for security device etc..), Standard A-type, Vertical (See Drawing 11, Page 24)

6.4. LED display.

The HQ-Box front panel utilizes 4 RED/Green LEDs:

LED (top to bottom)	Color	Function
PWR (DS2)	Red/Green	Red when off, Green when on. Blinks R/G when the memory sub system is initializing.
HDD (DS1)	Green	Green for SATA activity (form all ports).
UID (DS8)	Red/Green	When Red – BMC UID for remote identification. Green color is connected to a GPIO.
BMC (DS7)	Red/Green	When constant Green – BMC is initializing. Blinking green – BMC is working. When Red – BMC UID for remote identification.
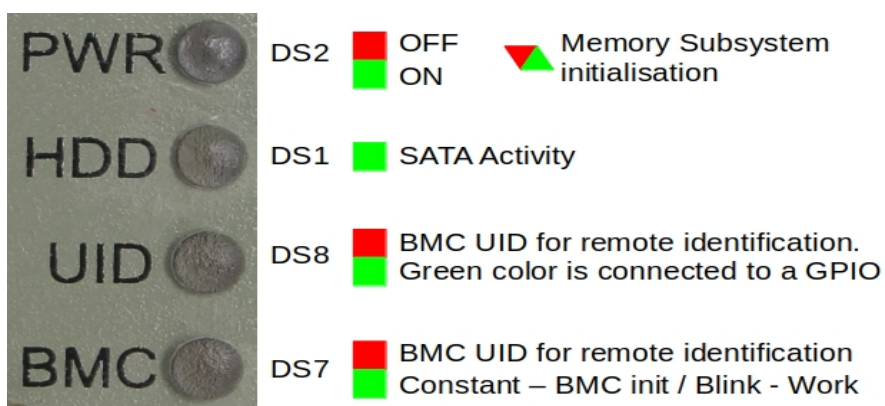
Drawing 1: Panel LED's function

6.5. DRAM Memory

The HQ-Box has four DIMM-288 sockets for DDR4 2400 (or 2100) with ECC. Maximum memory capacity is 128GB.

6.5.1. DRAM insertion order is P5,P4,P6,P3 (where P5 is first). See drawing 2 below:
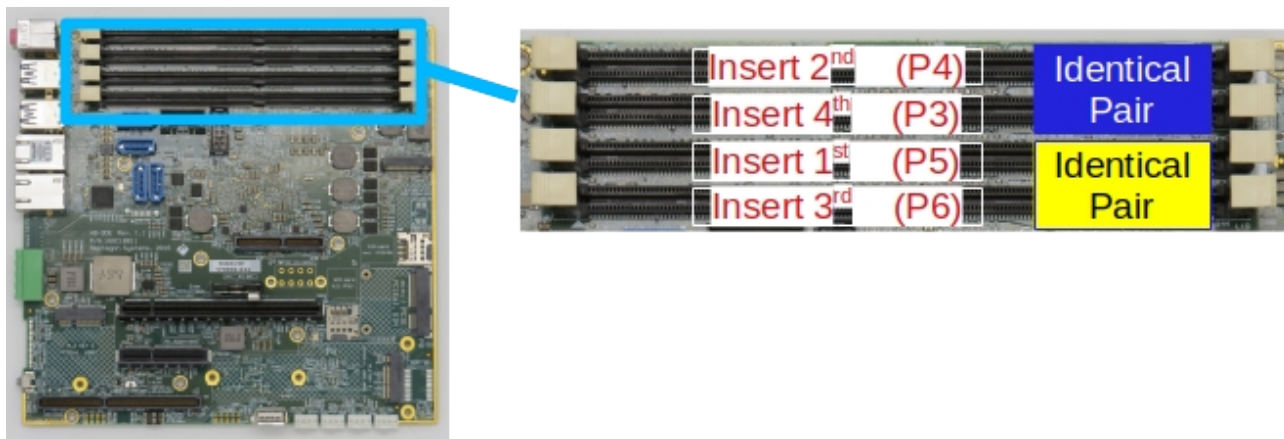
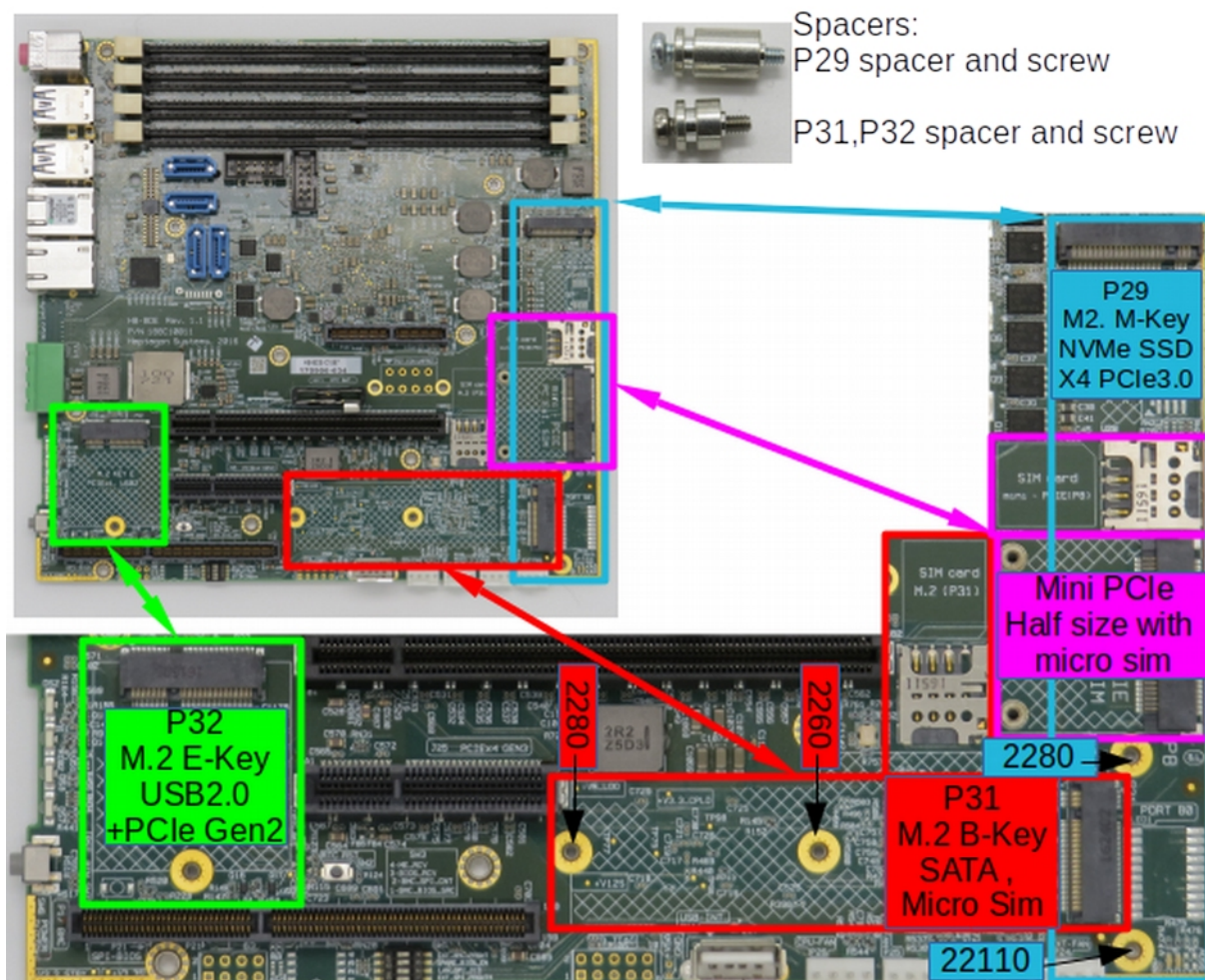*Drawing 2: Motherboard DRAM location and insertion order*

6.5.2. Pair matching. The DRAM is organized as two pairs (P3,P4) and (P5,P6). Each pair must be identical (manufacturer/model/size) in both slots. See Blue pair and Yellow pair in drawing 2. Note: Dram Size of the blue pair can be different of the yellow pair.

6.5.3. Supported DRAM sizes: 8GB, 16GB,32GB.

6.5.4. Qualified DRAM modules: Please consult our support as the list is dynamic and constantly updated.

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6.6. On board storage and I/O expansion

Drawing 3: M.2 and mPCIe slot location

6.6.1. Insertion order:

6.6.1.1. P29 is assembled above the Mini PCIe. Assemble the Mini PCIe (and the related uSim card when applicable) before mounting P29.

6.6.1.2. If P29 is a 22110 SSD, assemble P31 M.2 before the assembly of P29.
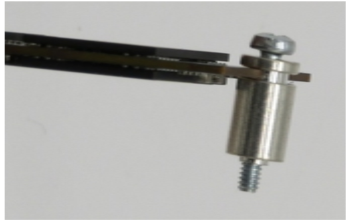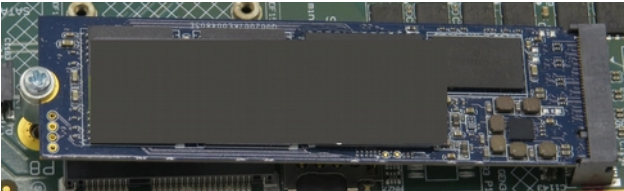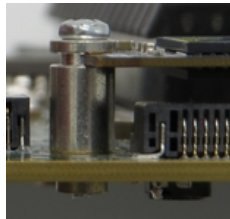
6.6.2. Spacer (a.k.a standoff) and screw:

6.6.3. Spacers come pre-assembled for all slots.

6.6.4. In case a spacer is lost, the following part numbers should be ordered:

Mate with	P/N	Description
P29	383A52560	Standoff for 8.5mm M2, 6.6mmH, M2 not threaded
	380J52090	Screw, M2x0.4, 12mmL, Din 7985, Stainless Steel
P31, P32	383A52510	Standoff for 4.2mm M2, 2.45mmH, M2 not threaded
	380J52070	Screw, M2x0.4, 8mmL, Din 7985, Stainless Steel

6.6.5. The standoff are custom parts and can be purchased as kits of 10 units.

6.6.6. M.2 Assembly instructions:

Step	Instructions
1	Remove from the motherboard and lightly attach the spacer with a screw to the M.2 card:
2	Gently insert the M.2 card to the slot, without dropping the spacer
3	Tighten the screw – but not too tight. Vibration sensitive application should add one small drop of Loctite 222 or similar glue to the nut hole on the PCB.

6.6.7. mPCIe assembly: Standoffs for the mini PCIe card are per-soldered to the motherboard. Use two 4mm length M2x0.4 pan head DIN7985 screws to secure the mPCIe to it's socket. Add a small drop of Loctite 222 or similar glue to the nut hole for vibration sensitive applications.

7. Assembly instructions

The following sections describe the procedures of inserting and removing add-on cards and disk drives.

7.1.   2.5" Hard disk and SSD mounting

7.1.1. Assemble the 2.5" HDD/SSD into drawer. Use the supplied plastic discs.

7.1.2. Open the top cover. The procedure depends on the type of top cover you have:
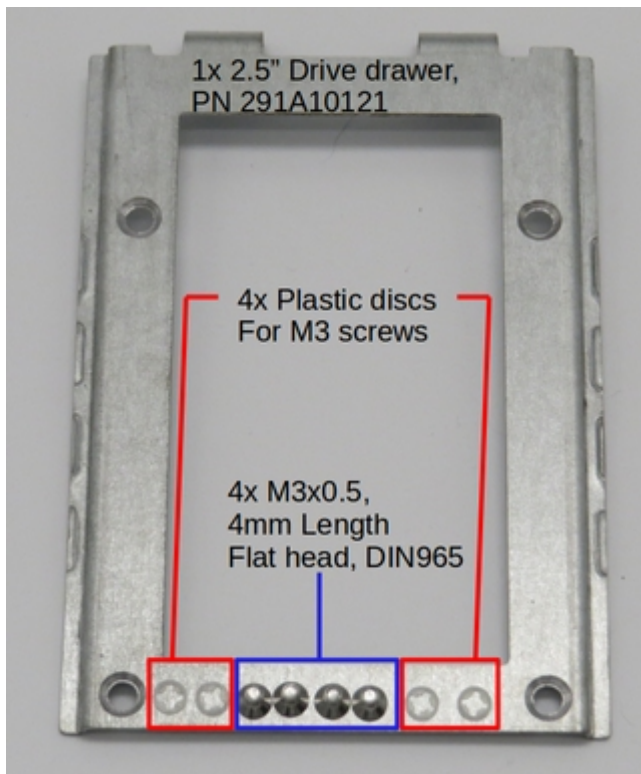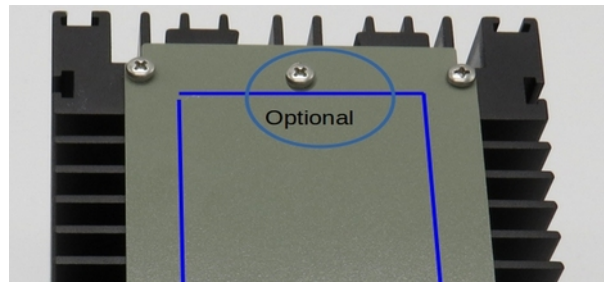
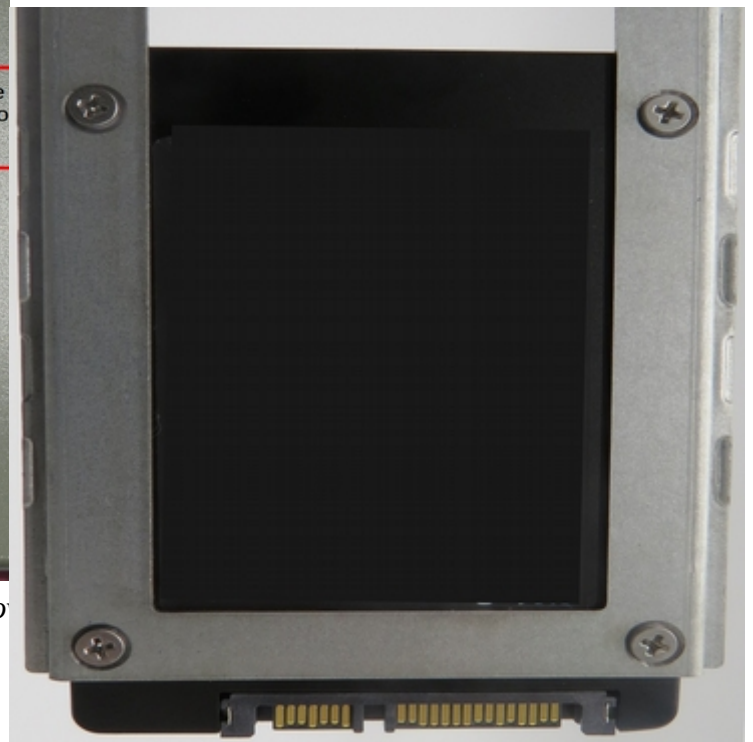7.1.2.1. With Quick Disk Access (QDA) top cover:

Drawing 4: Drive insertion

7.1.2.2. Standard cover opening:

Drawing 6: 2.5" Drive Drawer kit

Drawing 7: Drive assembled into drawer

7.1.2.3. Open the six perimeter screws (optionally 7).

7.1.2.4. For configuration with an internal drive only: open the drive reinforcement screw. (this is a dummy screw

Drawing 8: Screw location

for configuration without drive).

7.1.2.5. Slide the drive(s) into slots.

7.1.2.6. Mount the top cover

7.1.3. Standard cover closing:

7.1.3.1. Begin assembly with the drive reinforcement screw (if it was open)

7.1.3.2. Align the top cover opening

7.1.3.3. Loosely mount all screws without tightening.

7.1.3.4. Tighten all screws.

7.2. Add-On card insertion

7.2.1. Follow the procedure of the Top Cover opening in section 7.1.2. QDA top should also remove Drive reinforcement screw (see Drawing 4 when the door is open).

7.2.2. Remove the Add on cover (different types for Compact and Extended enclosures):

Drawing 9: Add-on cover

7.2.3. Remove the slot bracket and install the add-on card.

7.2.4. Mount the Add-on card support. For half height cards add the appropriate extension. The Add-on card support is supplied with the HQ-Box. Additional parts can be ordered from the below table:

PN	Description
291E10040	Add on card support for single slot
291E10050	Add on card support for dual slot
291E10060	Add on card support for tripe slot
291E10070	Add on card support, half height extension
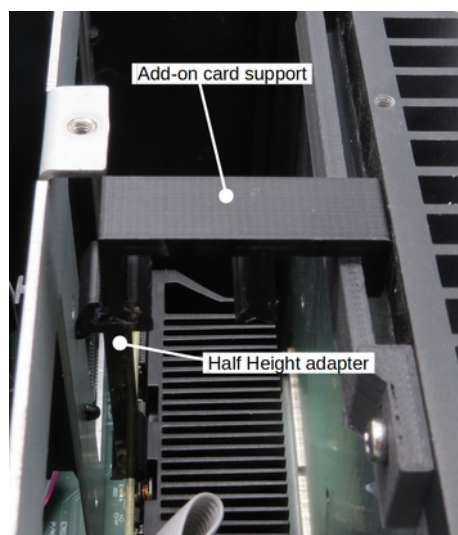
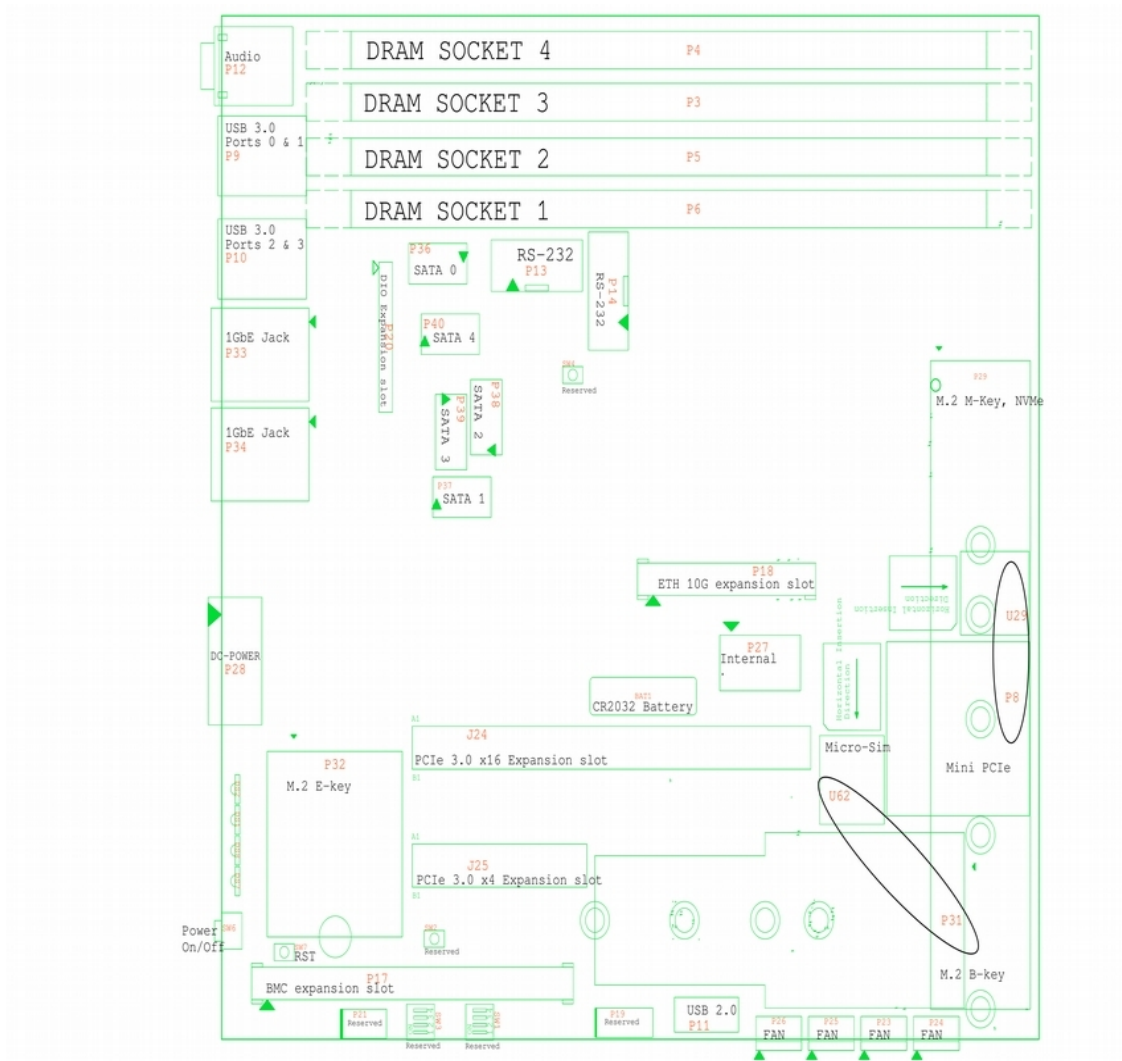*Drawing 10: Add-on card support*

7.2.5. Assemble the top cover.
7.2.6. Assemble the add-on cover.

8. CMOS Reset

CMOS reset is used to restore the BIOS to its default parameters.

1. Power-off the HQ-Box and disconnect the DC power connector.
2. Remove the top cover and the right side panel screws and open the HQ-Box.
3. Press the RST push button for 3 seconds.
   1. The RST push button (SW7) is found in the bottom left corner of the motherboard, above the BMC expansion slot (see the "Motherboard connector drawing", chapter 9).
4. Assemble the HQ-Box, connect the DC connector and power-on the HQ-Box.
5. Enter the BIOS menu and set PCIe Bifurcation (see BIOS manual for instructions), and any other settings specific to your HQ-Box.
6. Save BIOS settings and reboot.

9. Motherboard connector drawing

Drawing 11: HB-BDE motherboard connectors

10. External dimensions

Drawing 12: HQ-Box external dimensions

11. Copyright Notice