

conga-PA5 Pico-ITX SBC

Detailed Description Of The congatec Pico-ITX Based On 5th Generation Intel® Atom™, Celeron® and Pentium®

User's Guide

Revision 1.1

Revision History

Revision	Date (yyyy.mm.dd)	Author	Changes
0.1	2017.03.17	BEU	<ul style="list-style-type: none">• Preliminary release
1.0	2017.09.11	BEU	<ul style="list-style-type: none">• Minor improvements throughout the document• Updated image of conga-PA5 on title page• Added LVDS, backlight, and new USB cable in section 1.2.3 "Optional Cables"• Changed SPI flash size to 8 MB in section 2 "Feature Summary"• Included power consumption measurements in section 2.5 "Power Consumption" and 2.6 "Supply Voltage Battery Power"• Added caution about correct orientation of the cooling solutions and updated images in section 4 "Cooling Solution"• Changed connectors in section 5.4.3 "USB 2.0 Header", 5.7.2 "LVDS Header", and 5.7.2.1 "Backlight Power Header"• Added note about maximum current draw in section 5.7.2 "LVDS Header"• Changed fuse limit to 500 mA in section 6.1.2 "I2C and Watchdog" and 6.1.3 "GPIOs"• Updated connectors in section 7 "Mechanical Drawing"• Included information in section 8 "BIOS Setup Description"
1.1	2018.01.08	BEU	<ul style="list-style-type: none">• Updated supported OS in section 2.2 "Supported Operating Systems"• Added caution about maximum cable length of USB 2.0 devices in section 5.3 "USB Connectors"• Updated security features in table 6 "Feature Summary" and section 6.9 "Security Features"

Preface

This user's guide provides information about the components, features and connectors available on the conga-PA5 Pico-ITX Single Board Computer.

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The following symbols are used in this user's guide:



Warning

Warnings indicate conditions that, if not observed, can cause personal injury.



Caution

Cautions warn the user about how to prevent damage to hardware or loss of data.



Note

Notes call attention to important information that should be observed.



Connector Type

Describes the connector used on the Single Board Computer.

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Terminology

Term	Description
PCIe	Peripheral Component Interface Express
cBC	congatec Board Controller
SDIO	Secure Digital Input Output
USB	Universal Serial Bus
SATA	Serial AT Attachment: serial-interface standard for hard disks
HDA	High Definition Audio
S/PDIF	Sony/Philips Digital Interconnect Format
HDMI	High Definition Multimedia Interface
TMDS	Transition Minimized Differential Signaling
DVI	Digital Visual Interface
LPC	Low Pin-Count
I ² C Bus	Inter-Integrated Circuit Bus
SM Bus	System Management Bus
SPI	Serial Peripheral Interface
GbE	Gigabit Ethernet
LVDS	Low-Voltage Differential Signaling
DDC	Display Data Channel is an I ² C bus interface between a display and a graphics adapter.
PN	Part Number - the part number for placing orders.
N.C	Not connected
N.A	Not available
TBD	To be determined

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1 Introduction

1.1 Pico-ITX Concept

The Pico-ITX form factor provides system designers and manufacturers with a standardized ultra compact platform for development. With a footprint of 100mm x 72mm, this scalable platform promotes the design of highly integrated, energy efficient systems. Due to its small size, the Pico-ITX form factor enables PC appliance designers not only to design attractive low cost devices but also allows them to explore a huge variety of product development options - from compact space-saving designs to fully functional Information Station and Value PC systems. This helps to reduce product design cycle and encourages rapid innovation in system design, to meet the ever-changing needs of the market.

Additionally, the boards can be passively cooled, presenting opportunities for fanless designs. The Pico-ITX boards are equipped with various interfaces such as PCI Express, SATA, USB 2.0/3.0, Ethernet, Displays and Audio.

1.2 conga-PA5

The conga-PA5 is a Single Board Computer design based on the Pico-ITX specification. The conga-PA5 SBC features the Intel 5th generation Atom, Celeron and Pentium processors. With maximum 12 W TDP processors, the SBC offers Ultra Low Power boards with high computing performance and outstanding graphics. Additionally, the SBC supports onboard LPDDR4 memory up to 2400 MT/s, maximum system memory capacity of 8 GB, multiple I/O interfaces, up to three independent displays and various congatec embedded features.

With smaller board size and lower height keep-out zones, the conga-PA5 SBC provides manufacturers and system designers with the opportunity to design compact systems for space restricted areas.

The various features and capabilities offered by the conga-PA5 makes it ideal for the design of compact, energy efficient, performance-oriented embedded systems.

1.2.1 Options Information

The conga-PA5 is currently available in nine variants. This user's guide describes all of these variants. The tables below show the different configurations available. Check for the Part-No. that applies to your product. This will tell you what options described in this user's guide are available on your particular module.

Table 1 conga-PA5 Commercial Variants

Part-No.	048100	048101	048102	048120	048121	048123
Intel Processor	Atom™ x7-E3950 Quad Core 1.6 GHz	Atom™ x5-E3940 Quad Core 1.6 GHz	Atom™ x5-E3930 Dual Core 1.3 GHz	Pentium® N4200 Quad Core 1.1 GHz	Celeron® N3350 Dual Core 1.1 GHz	Pentium® N4200 Quad Core 1.1 GHz
L2 Cache	2 MB	2 MB	2 MB	2 MB	1 MB	2 MB
Burst Frequency	2.0 GHz	1.8 GHz	1.8 GHz	2.5 GHz	2.4 GHz	2.5 GHz
Onboard Memory	8 GB 2400 MT/s	4 GB 2133 MT/s	4 GB 2133 MT/s	8 GB 2400 MT/s	4 GB 2400 MT/s	4 GB 2400 MT/s
Processor Graphics	Intel® HD Graphics 505	Intel® HD Graphics 500	Intel® HD Graphics 500	Intel® HD Graphics 505	Intel® HD Graphics 500	Intel® HD Graphics 505
Graphics Base / Burst	500/650 MHz	400/600 MHz	400/550 MHz	200/750 MHz	200/650 MHz	200/750 MHz
LVDS	Single/Dual 18/24-bit	Single/Dual 18/24-bit	Single/Dual 18/24-bit	Single/Dual 18/24-bit	Single/Dual 18/24-bit	Single/Dual 18/24-bit
DDI	DisplayPort++	DisplayPort++	DisplayPort++	DisplayPort++	DisplayPort++	DisplayPort++
Processor TDP (Max)	12 W	9.5 W	6.5 W	6 W	6 W	6 W

Table 2 conga-PA5 Industrial Variants

Part-No.	048110	048111	048112
Intel Processor	Atom™ x7-E3950 Quad Core 1.6 GHz	Atom™ x5-E3940 Quad Core 1.6 GHz	Atom™ x5-E3930 Dual Core 1.3 GHz
L2 Cache	2 MB	2 MB	2 MB
Burst Frequency	2.0 GHz	1.8 GHz	1.8 GHz
Onboard Memory	8 GB 2400 MT/s	4 GB 2133 MT/s	4 GB 2133 MT/s
Processor Graphics	Intel® HD Graphics 505	Intel® HD Graphics 500	Intel® HD Graphics 500
Graphics Base / Burst	500/650 MHz	400/600 MHz	400/550 MHz
LVDS	Single/Dual 18/24-bit	Single/Dual 18/24-bit	Single/Dual 18/24-bit
DDI	DisplayPort++	DisplayPort++	DisplayPort++
Processor TDP (Max)	12 W	9.5 W	6.5 W

1.2.2 Optional Accessories

Table 3 Accessories

Article	Part No.	Description
conga-PA5/HSP-T	048150	Heatspreader for Pico ITX board conga-PA5 (for boards with standard -non litted- CPUs)
conga-PA5/i-HSP-T	048151	Heatspreader for Pico ITX board conga-PA5 (for boards with litted CPUs -with integrated heat spreader)
conga-PA5/CSP-T	048152	Passive Cooling for Pico ITX board conga-PA5 (for boards with standard (non litted) CPUs)
conga-PA5/i-CSP-T	048153	Passive Cooling for Pico ITX board conga-PA5 (for boards with litted CPUs -with integrated heat spreader)

1.2.3 Optional Cables

Table 4 Cables

Article	Part No.	Description
cab-DP to HDMI Passive	14000128	22.5cm Displayport 20 pin male > HDMI-A 19 pin female up to 1920 x 1200 @ 60 Hz (1.1 and High Speed HDMI standard)
cab-Pico-ITX-LVDS (PA50)	14000211	Compatible with LCD panel AUO G170EG01 V.1.
cab-Pico-ITX-Backlight (PA50)	14000206	Compatible with LCD panel AUO G170EG01 V.1. PWM dimming not supported.
SATA III cable 30cm	48000030	30cm SATA III cable with data transfer rate of up to 6 Gbps suitable for conga-IGX; Connector: down / straight
conga-PA5 Cable Kit	14000203	For the contents of the cable kit, see table 5 "Cable Kit" below.

Table 5 Cable Kit

Article	Part No.	Description
cab-Pico-ITX-USB20-Twin	14000210	20cm from internal 2x5 pin, 2 mm pitch female header to 2x USB Type A receptacle
cab-Pico-ITX-Audio Cable Adapter	14000146	15cm audio Cable Adapter.
cab-Pico-ITX-Buttons-LED	14000147	30cm buttons and LED cable.
cab-Pico-ITX-GPIO	14000151	15cm GPIO cable with open end.
cab-Pico-ITX-RS232	14000152	15cm RS232 cable adapter, DSUB9 Male.
cab-Pico-ITX-RS422	14000153	15cm RS422 cable adapter, DSUB9 Male.
cab-Pico-ITX-RS485	14000154	15cm RS485 cable adapter, DSUB9 Male.
cab-Pico-ITX-External-Power	14000157	100cm external power cable with 4mm banana plugs (optimized to supply Pico-ITX from laboratory power source).
cab-Pico-ITX-Feature	14000161	15cm feature cable with open end.
cab-Pico-ITX-Power	14000172	15cm internal power cable for industrial versions.
cab-Pico-ITX-SATA-Power	14000205	15cm SATA power cable to supply HDD from Backlight power connector for 2.5" HDD only (+5V only)
SATA III cable 30cm	48000029	30cm SATA III cable with data transfer rate of up to 6 Gbps; Connector: straight / straight
miniPCIe metal baffle	56000071	miniPCIe metal baffle (extender) 1x Metal baffle + 4x Screws

2 Specification

2.1 Feature List

Table 6 Feature Summary

Form Factor	Based on Pico-ITX form factor (100 x 72 mm)	
Processor	Intel® 5 th Generation Intel® Atom™, Pentium® and Celeron® SoC.	
Memory	Up to 4 Channels onboard LPDDR4 with up to 2400 MT/s, maximum system capacity 8 GB	
cBC	Multi-stage watchdog, manufacturing and board information, board statistics, I2C bus, Power loss control	
Chipset	Integrated in the SoC	
Audio	High Definition Audio Interface, Cirrus Logic CS4207	
Ethernet	2x LAN Gbit / 100 Mbit / 10 Mbit, Intel® Gigabit Ethernet i211 controller (i210 for industrial variants)	
Graphics	Intel® Gen 9 HD Graphics with support for DirectX12, OpenGL 4.3, OpenCL 1.2, OpenGLES 3.0, MPEG2 full HW acceleration with H.264 with L5.2 decode and encode, HEVC (H.265), VP8, VP9, PAVP 2.0, HDCP 1.4/2.0, MVC and supports up to 3x independent displays	
Graphic Interfaces	1x DP++, 1x DP via USB Type-C™ and either 1x LVDS (default) or 1x eDP 1.3	
Back Panel I/O Connectors	1x DC Power Jack (optional for industrial variants) 2x USB 3.0 Ports 1x USB Type-C™ Port	1x DP++ Port 2x Gigabit Ethernet Ports
Onboard I/O Connectors	1x 2-Pin Power Connector 1x CR2032 / BR2330A Cell Battery Header 1x High Definition Audio Header 1x USB 2.0 Header (for two additional USB 2.0 ports) 1x SATA / SATADOM Port 1x 2-Pin SATA Power Connector 1x mSATA Card Slot	1x LVDS header 1x Backlight Power Header 2x UART Headers 1x mPCIe / mSATA Card Slot 1x Micro-SD Card Slot 1x CPU Fan Header 3x Feature Connectors
Other Features	Thermal and voltage monitoring, RTC Battery, congatec standard BIOS	
BIOS	AMI Aptio® UEFI 5.x firmware, 8 MB SPI flash with congatec embedded BIOS features.	
Power Management	ACPI 4.0 compliant with battery support. Also supports Suspend to RAM (S3). Ultra low standby power consumption.	
Security	Integrated Intel® PTT (TPM 2.0). Infineon SLB9665 (LPC TPM 2.0) or SLB9660 (LPC TPM 1.2) available by assembly option.	



Some of the features mentioned in the above feature summary are optional. Check the article number of your module and compare it to the options information list on page 11 of this user's guide to determine what options are available on your particular module.

2.2 Supported Operating Systems

The conga-PA5 supports the following operating systems.

- Calypso Island
- Microsoft® Windows® 10
- Microsoft® Windows® 10 IoT
- Linux 3.x/4.x
- Yocto 2.x

2.3 Mechanical Dimensions

- 100 mm x 72 mm
- 19 mm height

2.4 Supply Voltage Power

- 12 V DC \pm 10%



Caution

The absolute maximum rating of the input voltage is 13.2 volts. Do not exceed this rating or expose the conga-PA5 to the absolute maximum voltage for a prolonged time. The system may not function, may be damaged or may have reliability issues if you do not observe this warning information.

2.5 Power Consumption

The power consumption values were measured with the following setup:

- conga-PA5
- conga-PA5 cooling solution
- Microsoft® Windows® 10 (64-bit)



Note

The CPU was stressed to its maximum workload with the Intel® Thermal Analysis Tool

Table 7 Measurement Description

The power consumption values were recorded during the following system states:

System State	Description	Comment
S0: Minimum value	Lowest frequency mode (LFM) with minimum core voltage during desktop idle.	
S0: Maximum value	Highest frequency mode (HFM/Turbo Boost).	The CPU was stressed to its maximum frequency.
S0: Peak value	Highest current spike during the measurement of "S0: Maximum value". This state shows the peak value during runtime.	Consider this value when designing the system's power supply to ensure that sufficient power is supplied during worst case scenarios.

**Note**

1. The fan and SATA drives were powered externally.
2. All other peripherals except the LCD monitor were disconnected before measurement.

Table 8 Power Consumption Values

The tables below provide additional information about the power consumption data for each of the conga-PA5 variants offered. The values are recorded at various operating mode.

Part No.	Memory Size	H.W Rev.	BIOS Rev.	OS (64-bit)	CPU			Current (Amp.)		
					Variant	Cores	Base / Burst Freq. (GHz)	S0: Min	S0: Max	S0: Peak
048100	8 GB	A.0	PA50R019	Windows® 10	Atom™ x7-E3950	4	1.6/2.0	0.16	1.65	1.88
048101	4 GB	A.0	PA50R019	Windows® 10	Atom™ x5-E3940	4	1.6/1.8	0.28	1.38	1.46
048102	4 GB	A.0	PA50R019	Windows® 10	Atom™ x5-E3930	2	1.3/1.8	0.14	0.95	1.06
048120	8 GB	A.0	PA50R019	Windows® 10	Pentium® N4200	4	1.1/2.5	0.28	1.15	1.89
048121	4 GB	A.0	PA50R019	Windows® 10	Celeron® N3350	2	1.1/2.4	0.29	1.18	1.85
048123	4 GB	A.0	PA50R019	Windows® 10	Pentium® N4200	4	1.1/2.5	0.16	1.05	1.93
048110	8 GB	A.0	PA50R019	Windows® 10	Atom™ x7-E3950	4	1.6/2.0	0.16	1.65	1.88
048111	4 GB	A.0	PA50R019	Windows® 10	Atom™ x5-E3940	4	1.6/1.8	0.28	1.38	1.46
048112	4 GB	A.0	PA50R019	Windows® 10	Atom™ x5-E3930	2	1.3/1.8	0.14	0.95	1.06

**Note**

With fast input voltage rise time, the inrush current may exceed the measured peak current.

2.6 Supply Voltage Battery Power

Table 9 CMOS Battery Power Consumption

RTC @	Voltage	Current
-10°C	3 V DC	1.73 μ A
20°C	3 V DC	1.92 μ A
70°C	3 V DC	3.34 μ A



Note

1. Do not use the CMOS battery power consumption values listed above to calculate CMOS battery lifetime.
2. Measure the CMOS battery power consumption in your customer specific application in worst case conditions (for example, during high temperature and high battery voltage).
3. Consider also the self-discharge of the battery when calculating the lifetime of the CMOS battery. For more information, refer to application note AN9_RTC_Battery_Lifetime.pdf on congatec AG website at www.congatec.com/support/application-notes.
4. We recommend to always have a CMOS battery present when operating the conga-PA5.

2.7 Environmental Specifications

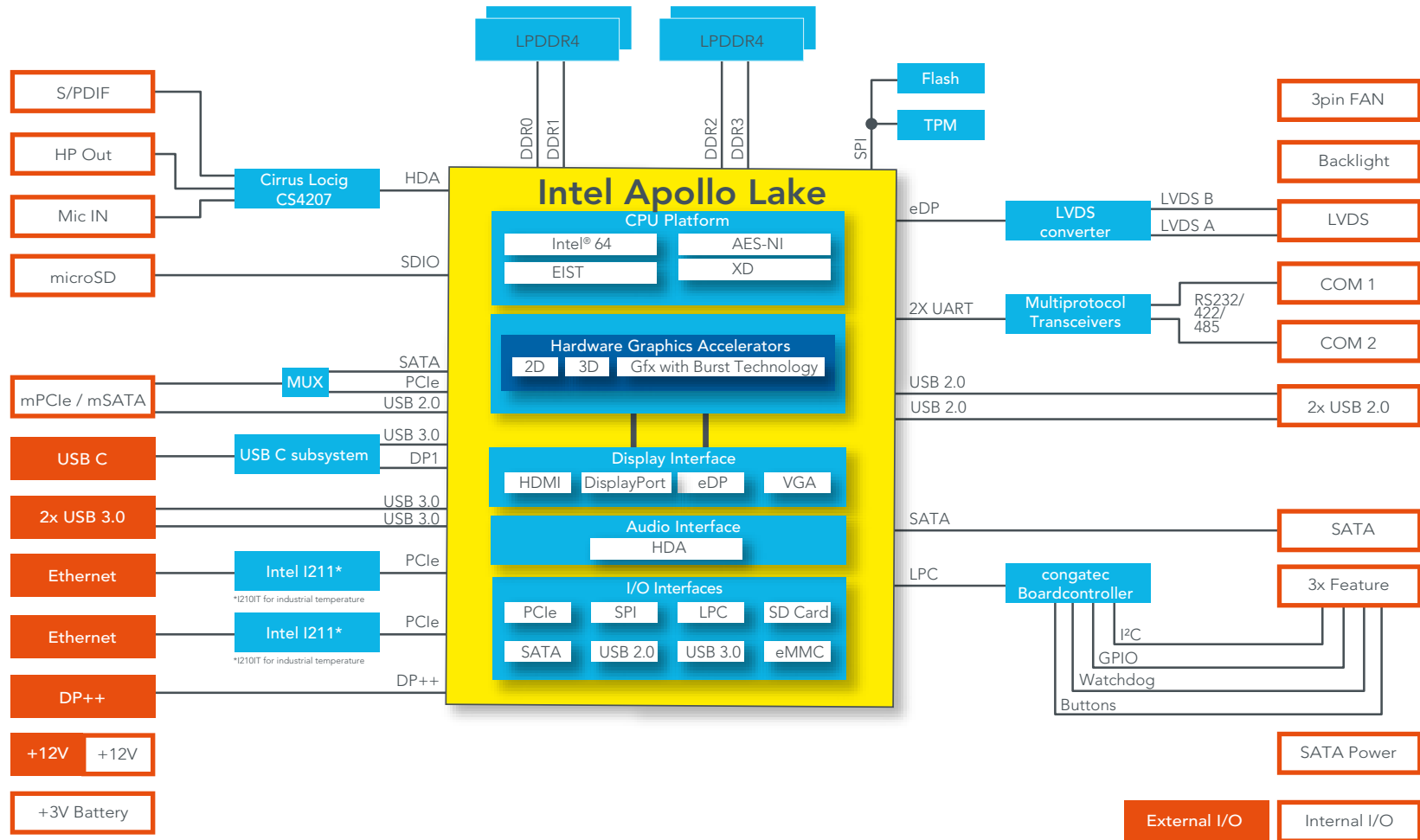
Temperature (commercial variants)	Operation: 0° to 60°C	Storage: -20° to +70°C
Temperature (industrial variants)	Operation: -40° to 85°C	Storage: -40° to +85°C
Humidity	Operation: 10% to 90%	Storage: 5% to 95%



Caution

The above operating temperatures must be strictly adhered to at all times. Humidity specifications are for non-condensing conditions.

3 Block Diagram



4 Cooling Solution

congatec AG offers cooling solutions for the lidded (industrial) and open silicon (commercial) conga-PA5 variants:

- Passive cooling solutions (CSP)
- Heatspreader (HSP)

The dimensions of the cooling solutions are shown below. All measurements are in millimeters. The maximum recommended torque for heatspreader screws is 0.3 Nm. Mechanical system assembly mounting shall follow the valid DIN/ISO specifications.

The heatspreader acts as a thermal coupling device to the module and is thermally coupled to the CPU via a thermal gap filler. On some modules, it may also be thermally coupled to other heat generating components with the use of additional thermal gap fillers.

Although the heatspreader is the thermal interface where most of the heat generated by the module is dissipated, it is not to be considered as a heatsink. It has been designed as a thermal interface between the module and the application specific thermal solution. The application specific thermal solution may use heatsinks with fans, and/or heat pipes, which can be attached to the heatspreader. Some thermal solutions may also require that the heatspreader is attached directly to the systems chassis thereby using the whole chassis as a heat dissipater.



Note

The gap pad material used on all heatspreaders contains silicon oil that can seep out over time depending on the environmental conditions it is subjected to. For more information about this subject, contact your local congatec sales representative and request the gap pad material manufacturer's specification.



Caution

The congatec heatspreaders/cooling solutions are tested only within the commercial temperature range of 0° to 60°C. Therefore, if your application that features a congatec heatspreader/cooling solution operates outside this temperature range, ensure the correct operating temperature of the board is maintained at all times. This may require additional cooling components for your final application's thermal solution.

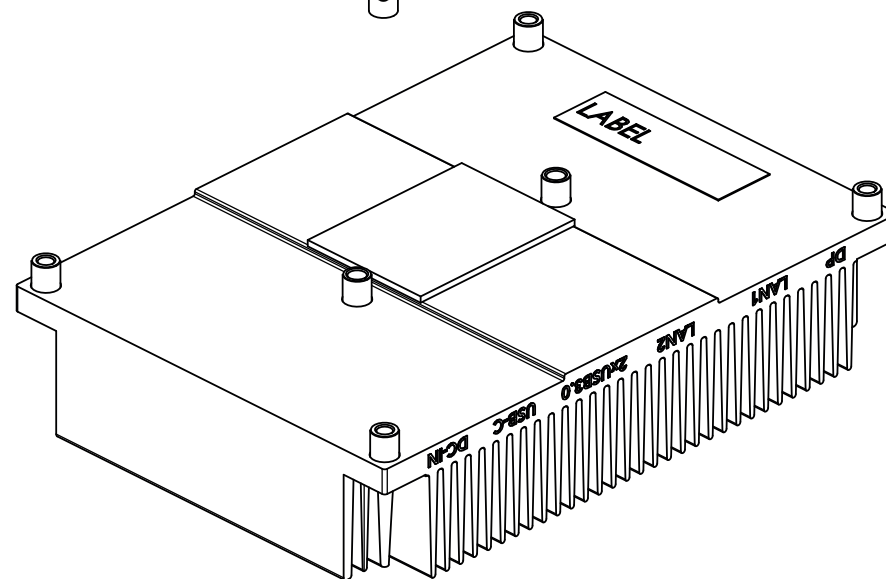
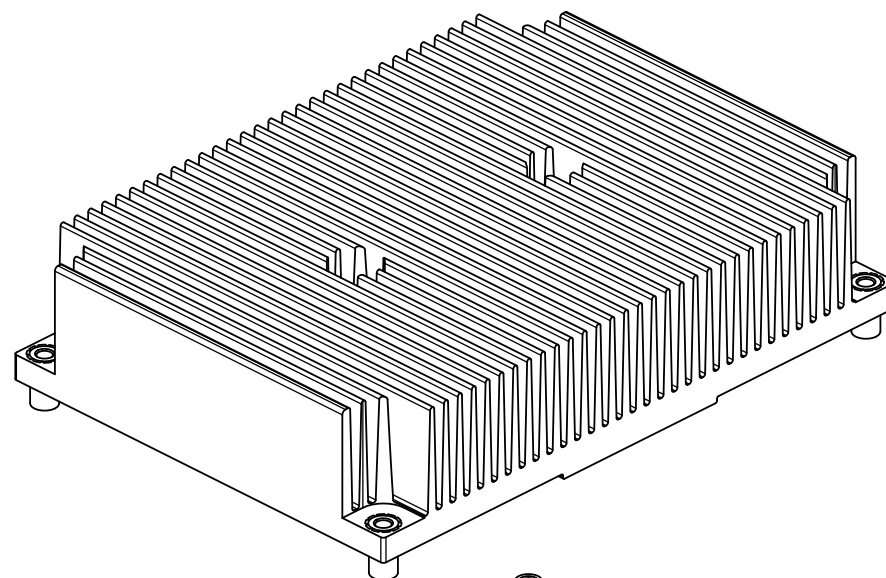
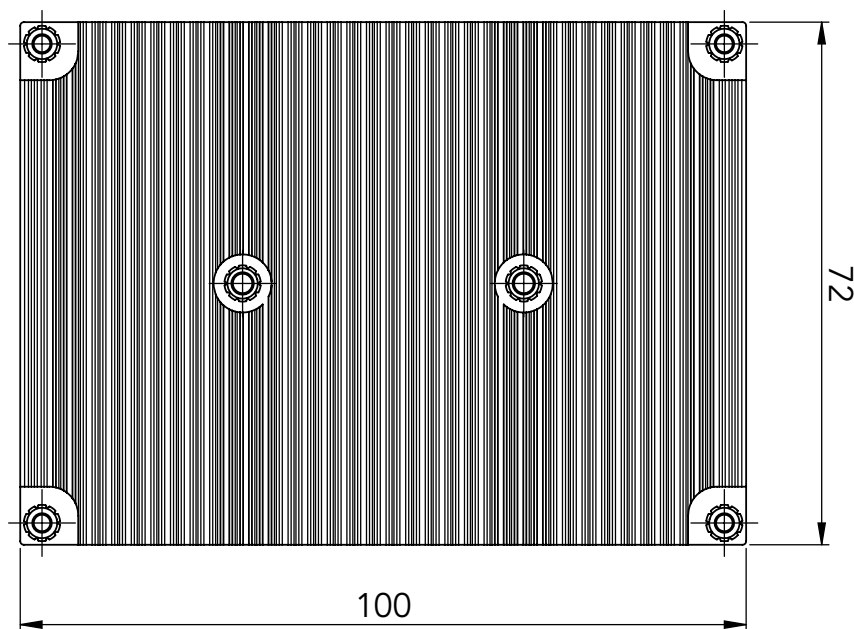
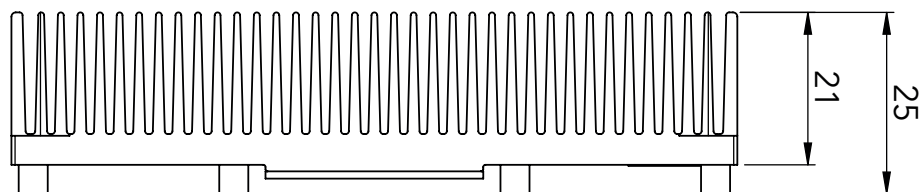
Mount the cooling solution in the correct orientation—the connectors of the conga-PA5 must match the connector names written on the side of the cooling solution.

For adequate heat dissipation, use the mounting holes on the cooling solution to attach it to the board. Apply thread-locking fluid on the screws if the cooling solution is used in a high shock and/or vibration environment. To prevent the standoff from stripping or cross-threading, use non-threaded carrier board standoffs to mount threaded cooling solutions.

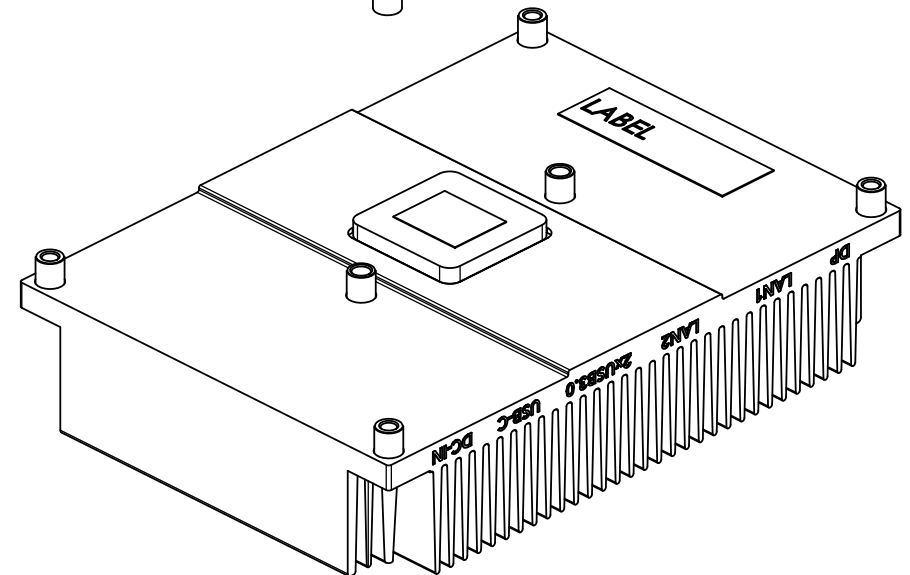
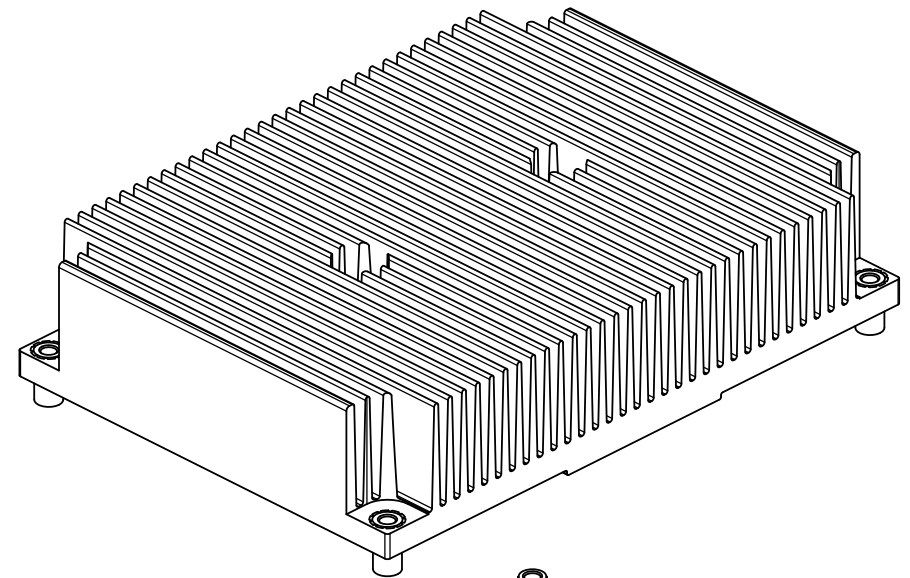
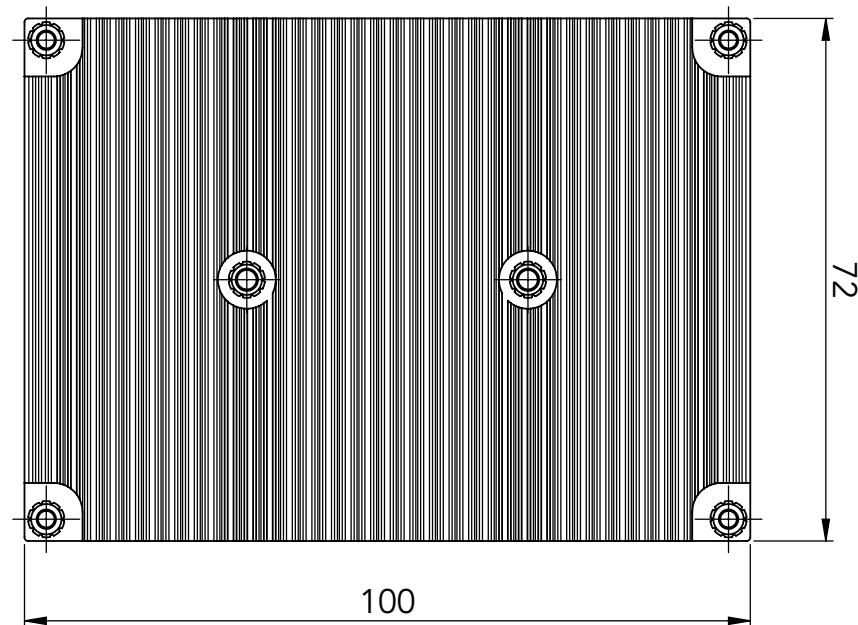
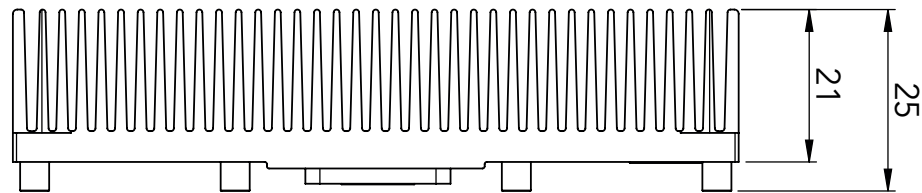
For applications that require vertically-mounted cooling solution, use only coolers that secure the thermal stacks with fixing post. Without the fixing post feature, the thermal stacks may move. Also, do not exceed the maximum torque specified for the screws. Doing so may damage the board.

4.1 CSP Dimensions

CSP Dimensions for Industrial Module Variants (PN: 048153)

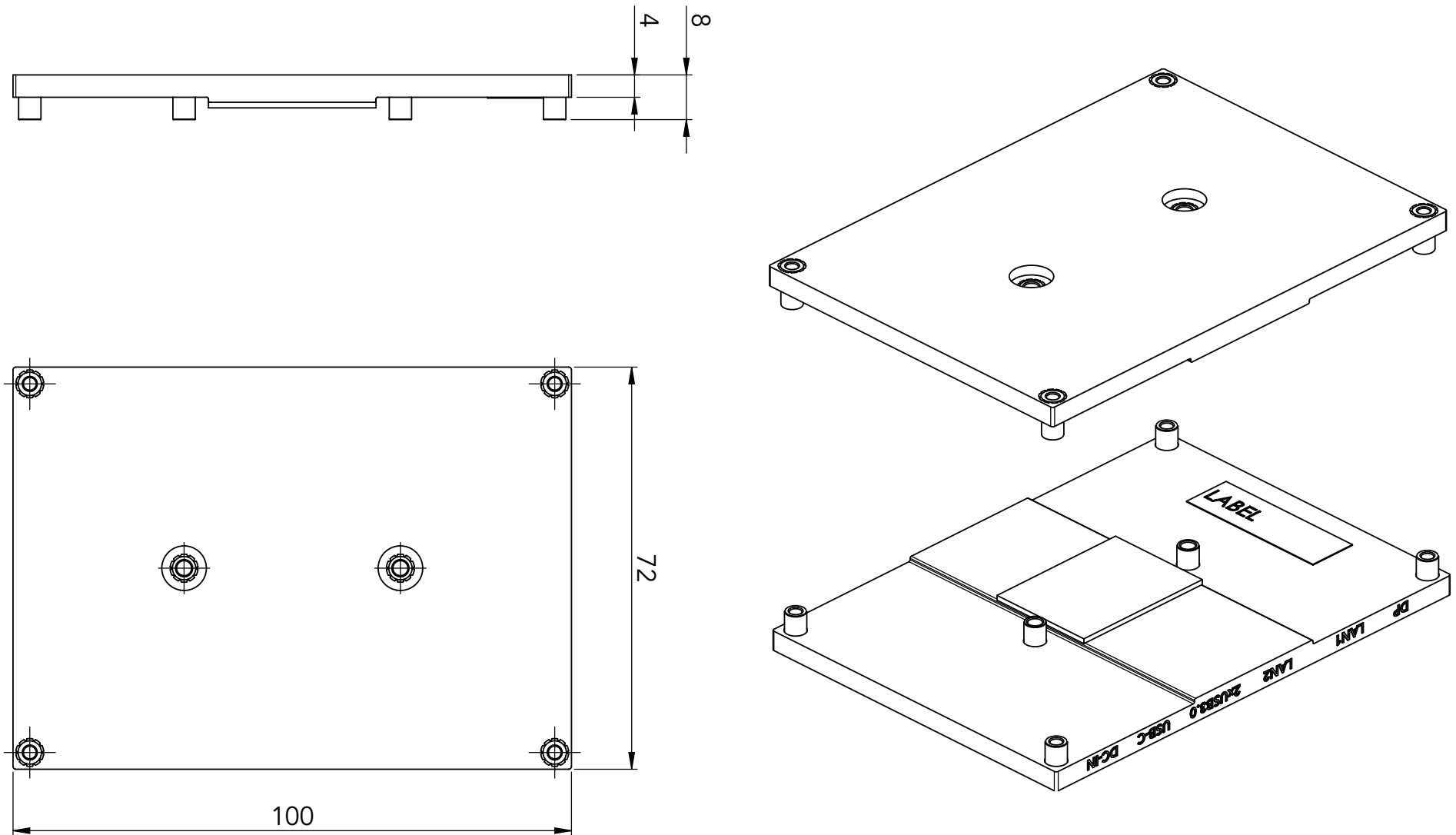


CSP Dimensions for Commercial Module Variants (PN: 048152)

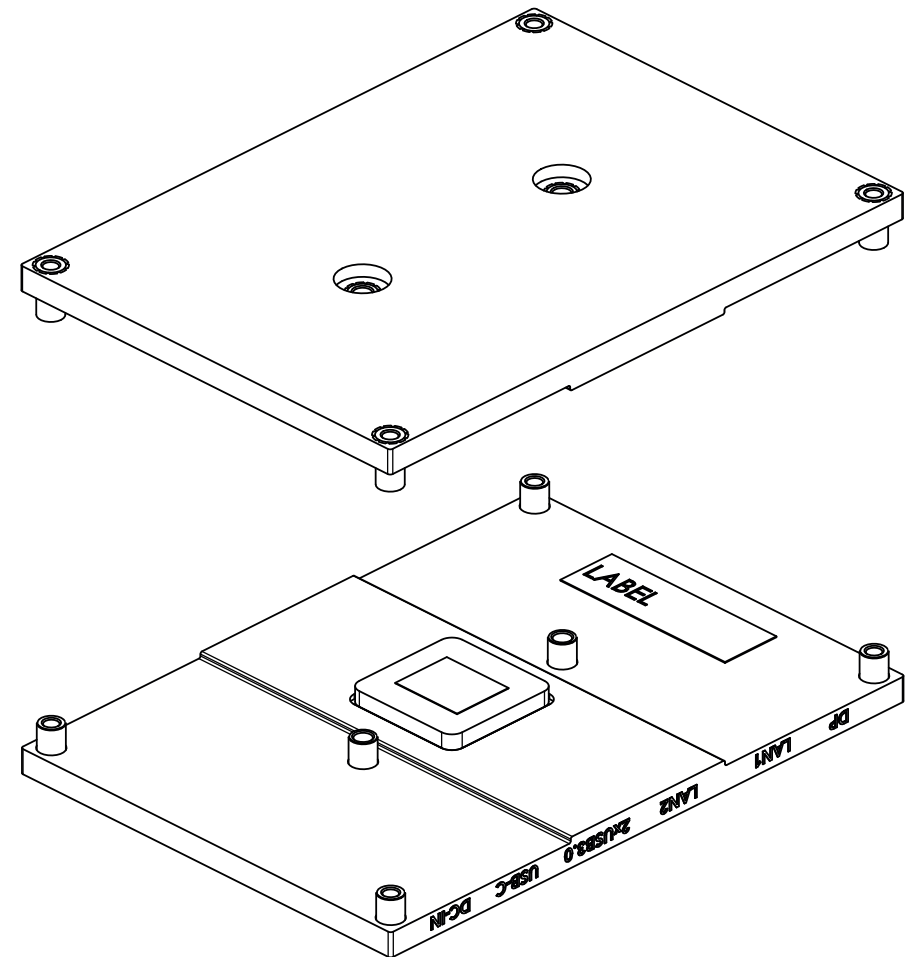
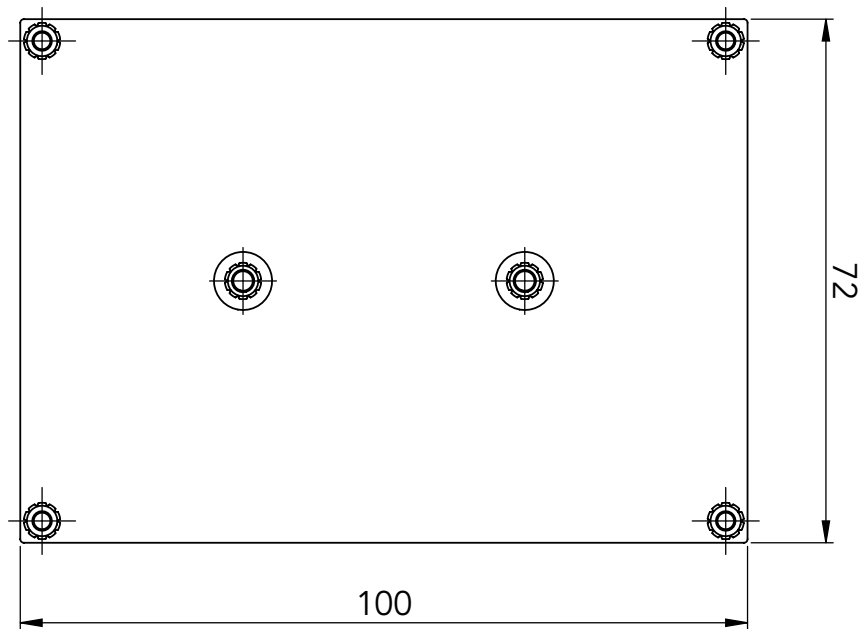
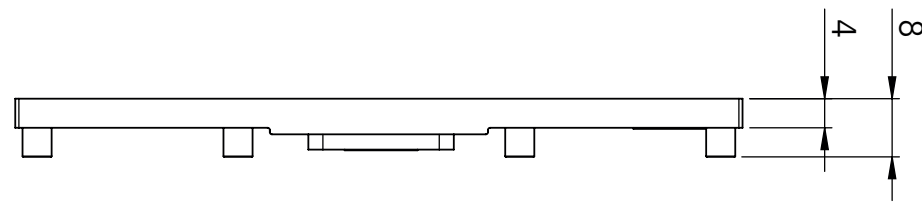


4.2 HSP Dimensions

HSP Dimensions for Industrial Module Variants (PN: 048151)



HSP Dimensions for Commercial Module Variants (PN: 048150)



5 Connector Description

5.1 Power Supply Connectors

The conga-PA5 provides a DC power jack (optional for industrial variants), a 2-pin power connector and a USB Type-C™ port for power supply.

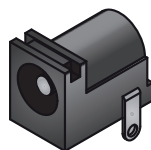
5.1.1 DC Power Jack

The commercial conga-PA5 variants provide a DC power jack (X21), protected against short transient overvoltage and ESD. Optionally, the industrial conga-PA5 variants can also provide a DC power jack. The supported power supply is defined in section 2.4 "Supply Voltage Power".

Table 10 X21 Pinout Description

Pin	Function
Center Pin	+12V
Sleeve/Barrel	GND

X21



Connector Type

X21: DC power jack, 5.5x2.5 mm diameter

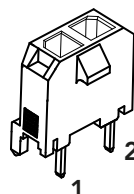
5.1.2 2-Pin Power Connector

The conga-PA5 provides a 2-pin power connector (X22), protected against short transient overvoltage. The supported power supply is defined in section 2.4 "Supply Voltage Power". Alternatively, you can use this connector as a +12V power output.

Table 11 X22 Pinout Description

Pin	Signal	Description
1	+12V	Power Supply +12V
2	GND	Ground

X22



Connector Type

X22: 2x1 pins, 3.00 mm pitch

5.1.3 USB Type-C™ Port

The USB Type-C™ port (X9) can be used to supply power to the conga-PA5. Refer to section 5.3.2 "USB Type-C™ Port" for more information.

5.1.4 Power Status LED

The conga-PA5 provides power status LED pins on the feature connector (X18). Refer to section 6.1 "Feature Connectors" for the pinout description.

Table 12 Power Status LED State Description

LED State	Description	ACPI State
Off	Sleeping or power-off (not running)	S3, S5
LED on	Running	S0

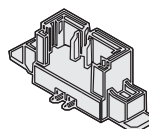
5.1.5 CR2032 / BR2330A Cell Battery Header

The conga-PA5 provides a CR2032 cell battery (BR2330A for industrial variants) connected to a header (X23).

Table 13 X23 Pinout Description

Pin	Description
1	+3V
2	GND

X23



Battery



Note

The battery has an adhesive tape on its shrinking tube. This tape enables the system integrator to adequately position the battery in the system case. The functionality of adhesive tape is time limited if exposed to higher temperatures and harsh or vibrant environment. The system integrator must ensure a stable position in this case.



Warning

Danger of explosion if battery is incorrectly replaced. Replace only with same or equivalent type recommended by the manufacturer. Dispose of used batteries according to the manufacturer's instructions.



Connector Type

X23: 2x1 pins, 1.25 mm pitch

5.2 High Definition Audio Header

The conga-PA5 provides an HD audio header (X6). The signals are routed from an HD audio codec (Cirrus Logic CS4207).

Table 14 X6 Pinout Description

Pin	Signal	Description
1	MIC_L	Analog Microphone Input - Left Channel
2	GND_HDA	Audio Ground
3	MIC_R	Analog Microphone Input - Right Channel
4	+5V_AMP	+5V Power Supply (for external speaker amplifier; max. 500mA)
5	MIC_JD	Microphone Jack Detection
6	LINE_R	Analog Line Out - Right Channel
7	GND_HDA	Audio Ground
8	LINE_L	Analog Line Out - Left Channel
9	LINE_JD	Line Out Jack Detection
10	+5V	+5V Power Supply (for S/PDIF optical transmitter)
11	GND	Digital Ground for S/PDIF
12	S/PDIF	S/PDIF Output (3.3V)



Connector Type

X5: 6x2 pins, 2.0 mm pitch

5.3 USB Connectors

The conga-PA5 provides two USB 3.0 ports, one USB Type-C™ port, and one USB 2.0 header for two additional USB 2.0 ports. USB 2.0 signals are also routed to the mSATA/mPCIe socket (X10).



Caution

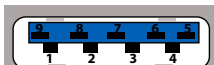
The maximum cable length of a USB 2.0 device connected to any port shall not exceed 3 meters in order to comply to EN 55024:2010.

5.3.1 USB 3.0 Ports

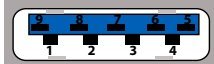
The conga-PA5 provides two USB 3.0 ports (X7).

X7

Upper



Lower



Connector Type

X7: Dual-stacked USB 3.0 Type-A ports



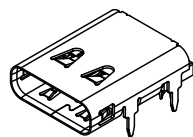
Caution

The maximum cable length of a USB 2.0 device connected to any port shall not exceed 3 meters in order to comply to EN 55024:2010.

5.3.2 USB Type-C™ Port

The conga-PA5 provides one USB Type-C™ port (X9). It supports Alternate Mode (USB 3.0, DisplayPort) and Power Delivery (3.0A @5V). It can also be used to supply power to the conga-PA5. The supported power supply is defined in section 2.4 "Supply Voltage Power".

X9



Connector Type

X9: USB Type-C™ port



Caution

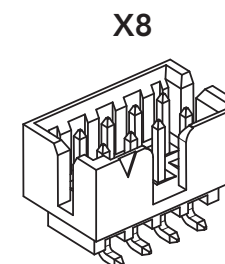
The maximum cable length of a USB 2.0 device connected to any port shall not exceed 3 meters in order to comply to EN 55024:2010.

5.3.3 USB 2.0 Header

The conga-PA5 provides an USB 2.0 header (X8) for two additional USB 2.0 ports.

Table 15 X8 Pinout Description

Port 1			Port 2		
Pin	Signal	Description	Pin	Signal	Description
1	+5V	+5V supply	2	+5V	+5V supply
3	Data1-	Hi-speed differential signal (negative)	4	Data2-	Hi-speed differential signal (negative)
5	Data1+	Hi-speed differential signal (positive)	6	Data2+	Hi-speed differential signal (positive)
7	GND	Ground	8	GND	Ground
9	NC	Not Connected	10	NC	Not Connected



Connector Type

X8: 5x2-pin, 2.00 mm pitch (Molex 87832-1014)



Caution

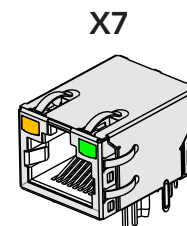
The maximum cable length of a USB 2.0 device connected to the header shall not exceed 3 meters in order to comply to EN 55024:2010.

5.4 Gigabit Ethernet Ports

The conga-PA5 provides two Gigabit Ethernet ports (X12 and X13). The signals are routed from the Intel® Gigabit Ethernet controller i211 (commercial variants) or i210 (industrial variants). The controller does not support the Intel® AMT feature.

Table 16 Gigabit Ethernet Port LEDs Description

LED Left Side	Description	LED Right Side	Description
Off	10 Mbps link speed	Off	No link
Green	100 Mbps link speed	Steady On	Link established, no activity detected
Orange	1000 Mbps link speed	Blinking	Link established, activity detected



Connector Type

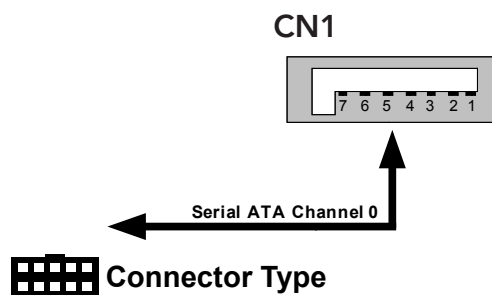
X12, X13: 8-pin RJ45 connector with Gigabit magnetic and LEDs

5.5 SATA Connectors

The conga-PA5 provides a SATA / SATADOM port, a 2-pin SATA power connector and an mSATA/mini PCIe card socket.

5.5.1 SATA / SATADOM Port

The conga-PA5 provides one SATA 6Gb/s port (CN1). To use SATADOM devices, enable SATADOM in the BIOS menu. You can connect a SATA activity LED to pin 11 (anode) and 12 (cathode) of the feature connector (X18).



CN1: SATA / SATADOM port

5.5.2 2-Pin SATA Power Connector

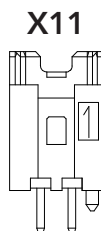
The conga-PA5 provides a 5V SATA power connector (X11). The maximum current is limited to 1 A by a fuse.

Table 17 X11 Pinout Description

Pin	Signal
1	+5V (max. 1.0 A)
2	+GND

Connector Type

X11: 2x1 pins, 2.50 mm pitch



5.5.3 mSATA Card Slot

The mSATA card slot is described in section 5.9 "mPCIe/mSATA Card Slot".

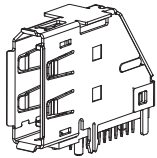
5.6 Display Interfaces

The conga-PA5 supports up to three displays via one DP++ port, one DP over USB Type-C™ port, and one LVDS header.

5.6.1 DP++ Port

The conga-PA5 provides one DP++ port (X5). The maximum supported resolution is 4096 x 2160 at 60 Hz for DP 1.2 and 3840 x 2160 @30 Hz for HDMI 1.4b.

X5



Connector Type

X5: 20 pins, DP++ port

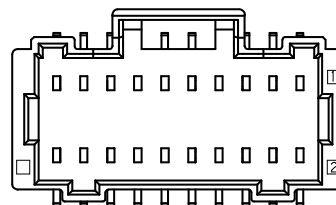
5.6.2 LVDS Header

The conga-PA5 provides an LVDS header (X3) via an eDP to LVDS bridge. It supports 18/24-bit single/dual channel, selectable backlight voltage, VESA color mappings, automatic panel detection and resolution up to 1920x1200 @60 Hz in dual LVDS mode.

Table 18 X3 Pinout Description

Pin	Signal	Pin	Signal
1	GND	2	GND
3	LVDS_EVEN_TX3P	4	LVDS_ODD_TX3P
5	LVDS_EVEN_TX3N	6	LVDS_ODD_TX3N
7	GND	8	GND
9	LVDS_EVEN_TX2P	10	LVDS_ODD_TX2P
11	LVDS_EVEN_TX2N	12	LVDS_ODD_TX2N
13	GND	14	GND
15	LVDS_EVEN_TX1P	16	LVDS_ODD_TX1P
17	LVDS_EVEN_TX1N	18	LVDS_ODD_TX1N
19	GND	20	GND
21	LVDS_EVEN_TX0P	22	LVDS_ODD_TX0P
23	LVDS_EVEN_TX0N	24	LVDS_ODD_TX0N
25	GND	26	GND
27	LVDS_EVEN_CLKP	28	LVDS_ODD_CLKP
29	LVDS_EVEN_CLKN	30	LVDS_ODD_CLKN
31	GND	32	GND
33	DDC_DAT (3.3V)	34	DDC_CLK (3.3V)
35	+VCC_LVDS	36	+VCC_LVDS
37	GND	38	+VCC_LVDS
39	LVDS_VDD_EN (3.3V)	40	N.C

X3



Connector Type

X3: 40 pins, 1.00 mm pitch (Molex 501190-4017)



Note

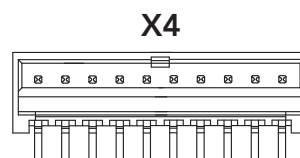
The maximum current of the LVDS power lane is limited to 1A. congatec offers an LVDS cable for 17" AUO Optonics G170EG01 V.1 panel only (see section 1.2.3 "Optional Cables"). For more information, contact congatec technical solution department.

5.6.2.1 Backlight Power Header

The conga-PA5 provides a backlight power header (X4). The hold current of the +12 V power is limited to 1.5 A by a fuse.

Table 19 X4 Pinout Description

Pin	Signal	Description
1	+12V	12V Backlight inverter power
2	+12V	12V Backlight inverter power
3	GND	Ground
4	GND	Ground
5	BKLTCTL_5V	Backlight PWM control (+5V)
6	BKLTEN_5V	Backlight Enable (+5V)
7	BKLTEN	Backlight Enable (+3.3V)
8	BKLTCTL	Backlight PWM control (+3.3V)
9	+V5	Optional power rail with +5V
10	+V5	Optional power rail with +5V



Connector Type

X4: 10x1 pins, 1.5 mm pitch (Molex 87437-1043)

5.6.2.2 Panel Power Jumper

The conga-PA5 supports 3.3 V and 5 V LVDS panels. Set the panel voltage (pins 35, 36, and 38) with jumper X24.

Table 20 X24 Pinout Description

Pin	Signal Name
1 - 2	3.3V
2 - 3	5V

X24



Connector Type

X24: 3x1-pin, 2.00 mm pitch

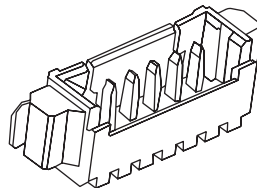
5.7 UART Headers

The conga-PA5 provides two UART headers (X15, X16) at the bottom of the board. Both headers support RS-232, RS-422, and RS-485. You can configure the ports in the BIOS menu.

Table 21 X15, X16 Pinout Description

Pin	RS232 Signal	RS422 / RS485 Signal
1	GND	GND
2	TXD	TX-
3	RTS#	TX+
4	CTS#	RX+
5	RXD	RX-

X15, X16



Connector Type

X15, X16: 5x1 pins, 1.25mm pitch

Possible Mating Connector: Molex 51021-0500



Note

congatec offers an adapter cable for the COM port (see section 1.2.3 "Optional Cables"). For more information, contact congatec technical solution department.

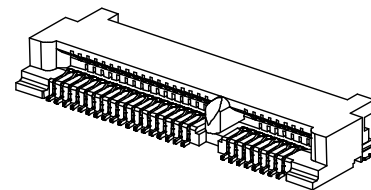
5.8 mPCIe / mSATA Card Slot

The conga-PA5 provides an mPCIe/mSATA card slot (X10). It supports mPCIe and mSATA cards. A multiplexer detects the type of the connected card via the signal detect pin 43 and sends the corresponding signals to the socket (X10).

Table 22 X10 Pinout Description

Pin	Signal	Pin	Signal
1	WAKE#	2	+3.3V
3	N.C.	4	GND
5	N.C.	6	+1.5V
7	CLKREQ#	8	N.C.
9	GND	10	N.C.
11	REFCLK-	12	N.C.
13	REFCLK+	14	N.C.
15	GND	16	N.C.
17	N.C.	18	GND
19	N.C.	20	W_DISABLE#
21	GND	22	PERST#
23	PERn0/SATA_RX1+	24	+3.3V
25	PERp0/SATA_RX1-	26	GND
27	GND	28	+1.5V
29	GND	30	SMB_CLK
31	PETn0/SATA_TX1-	32	SMB_DATA
33	PETp0/SATA_TX1+	34	GND
35	GND	36	USB_D-
37	GND	38	USB_D+
39	+3.3V	40	GND
41	+3.3V	42	N.C
43	mSATA_mPCIe_detect	44	LED_WLAN#
45	N.C	46	N.C
47	N.C	48	+1.5V
49	N.C	50	GND
51	N.C.	52	+3.3V
53	GND	54	GND

X10

**Connector Type**

X10: mPCIe/mSATA card slot

**Note**

For the conga-PA5 to detect the type of card inserted as described in the mPCIe/mSATA specification, pin 43 of the mPCIe card must be connected to ground. On mSATA card, this pin must not be connected. The mPCIe extender can be used for mPCIe half size cards.

6 Additional Features

6.1 Feature Connectors

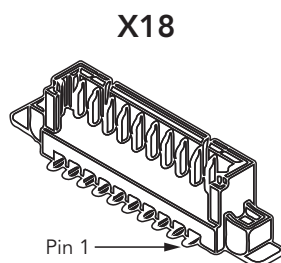
The conga-PA5 provides three feature connectors.

6.1.1 Buttons & LEDs

The conga-PA5 offers Lid, sleep, reset, power buttons as well as LED signals via the feature connector X18.

Table 23 X18 Pinout Description

Pin	Signal Name
1	LID_BTN#
2	GND
3	SLP_BTN#
4	GND
5	RST_BTN#
6	GND
7	PWR_BTN#
8	GND
9	PWR_LED (anode)
10	GND (cathode)
11	SATA_LED (anode)
12	SATA_ACT# (cathode)



Connector Type

X18: 12x1 pins, 1.25 mm pitch

Possible Mating Connector: Molex 51021-1200



Note

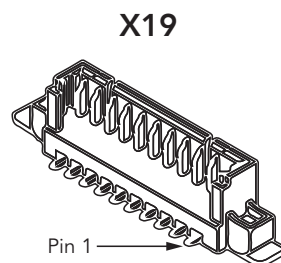
The LEDs on the conga-PA5 have series resistors. Therefore, you can connect X18 pins directly to the LED terminals.

6.1.2 I2C and Watchdog

The conga-PA5 provides I2C and watchdog signals via the feature connector X19.

Table 24 X19 Pinout Description

Pin	Signal Name
1	BATLOW#
2	+3.3V
3	LED_WLAN# (mPCIe)
4	I2C_CLK
5	I2C_DAT
6	GN D
7	WDTRIG#
8	WDOUT



Connector Type

X19: 8x1 pins, 1.25 mm pitch

Possible Mating Connector: Molex 51021-0800

Note

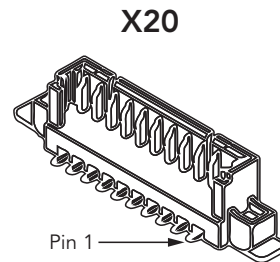
The signals are 3.3 V compatible. The fuse limits the power budget to 500 mA hold current. LED_WLAN# shall be connected to LED's cathode. A series resistor is present on conga-PA5.

6.1.3 GPIOs

The conga-PA5 provides GPIOs via the feature connector X20. It provides an optional connection to the integrated sensor hub (ISH), which is a feature of Intel® processor. A sensors can be connected via I2C and GPIO (voltage level is 1.8 V for ISH).

Table 25 X20 Pinout Description

Pin	Signal Name
1	GPI0
2	GPI1
3	GPI2
4	GPI3
5	GND
6	GPO0
7	GPO1
8	GPO2
9	GPO3
10	+3.3V



Connector Type

X20: 10x1 pin, 1.25 mm pitch

Possible Mating Connector: Molex 51021-1000

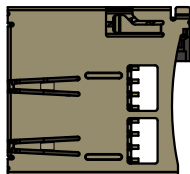
Note

Signals are 3.3V compatible. The fuse limits the power budget to 500 mA hold current.

6.1.4 Micro-SD Card Slot

The conga-PA5 provides a micro-SD card slot (X14). It complies with SDXC card specification 3.0 with support for up to 104 MB/s data rate.

X14



Connector Type

X14: Micro-SD card slot

6.2 congatec Board Controller (cBC)

The conga-PA5 is equipped with a Texas Instruments Tiva™ TM4E1231H6ZRBI microcontroller. This onboard microcontroller plays an important role for most of the congatec BIOS features. The cBC fully isolates some of the embedded features such as system monitoring, I²C bus from the x86 core architecture. This improves performance and reliability, even during low power mode.

6.2.1 Fan Control

The congatec Board Controller on the conga-PA5 controls the power supply to the fan with the PWM signal. Additionally, there is an input signal called FAN_TACHOIN that provides the ability to monitor the system's fan RPMs (revolutions per minute). This signal must receive two pulses per revolution in order to produce an accurate reading. For this reason, a two pulse per revolution fan is recommended.

6.2.2 Power Loss Control

The cBC has full control of the power-up of the SBC. Therefore, it can be used to specify the behavior of the system after an AC power loss condition. Supported modes are "Turn On", "Remain Off" and "Last State".

6.2.3 Board Information

The cBC provides a rich data-set of manufacturing and board information such as serial number, EAN number, hardware and firmware revisions, and so on. It also keeps track of dynamically changing data like runtime meter and boot counter.

6.2.4 CPU Fan Header

The conga-PA5 provides a 3-pin 12V CPU fan header (X17). The recommended maximum power of the fan is 3W.

Table 26 X17 Pinout Description

Pin	Signal
1	GND
2	+12VDC
3	FAN_TACHOIN

X17



Connector Type

X17: 3x1 pins, 2.54 mm pitch

6.3 OEM BIOS Customization

The conga-PA5 is equipped with congatec Embedded BIOS, which is based on American Megatrends Inc. Aptio UEFI firmware. The congatec Embedded BIOS allows system designers to modify the BIOS. For more information about customizing the congatec Embedded BIOS, refer to the congatec System Utility user's guide CGUTLm1x.pdf and can be found on the congatec website or contact technical support.

The customization features supported are described in the following sections.

6.3.1 OEM Default Settings

This feature allows system designers to create and store their own BIOS default configuration. Customized BIOS development by congatec for OEM default settings is no longer necessary because customers can easily perform this configuration by themselves using the congatec system utility CGUTIL. See congatec application note AN8_Create_OEM_Default_Map.pdf on the congatec website for details on how to add OEM default settings to the congatec Embedded BIOS.

6.3.2 OEM Boot Logo

This feature allows system designers to replace the standard text output displayed during POST with their own BIOS boot logo. Customized BIOS development by congatec for OEM Boot Logo is no longer necessary because customers can easily perform this configuration by themselves using the congatec system utility CGUTIL. See congatec application note AN8_Create_And_Add_Bootlogo.pdf on the congatec website for details on how to add OEM boot logo to the congatec Embedded BIOS.

6.3.3 OEM POST Logo

This feature allows system designers to replace the congatec POST logo displayed in the upper left corner of the screen during BIOS POST with their own BIOS POST logo. Use the congatec system utility CGUTIL 1.5.4 or later to replace/add the OEM POST logo.

6.3.4 OEM BIOS Code/Data

With the congatec embedded BIOS, it is possible for system designers to add their own code to the BIOS POST process. The congatec Embedded BIOS first calls the OEM code before handing over control to the OS loader.

Except for custom specific code, this feature can also be used to support Win XP SLP installation, Window 7 SLIC table (OA2.0), Windows 8 OEM activation (OA3.0), verb tables for HDA codecs, PCI/PCIe opROMs, bootloaders, rare graphic modes and Super I/O controller initialization.



Note

The OEM BIOS code of the new UEFI based firmware is only called when the CSM (Compatibility Support Module) is enabled in the BIOS setup menu. Contact congatec technical support for more information on how to add OEM code.

6.3.5 OEM DXE Driver

This feature allows designers to add their own UEFI DXE driver to the congatec embedded BIOS. Contact congatec technical support for more information on how to add an OEM DXE driver.

6.4 congatec Battery Management Interface

In order to facilitate the development of battery powered mobile systems based on embedded modules, congatec AG has defined an interface for the exchange of data between a CPU module (using an ACPI operating system) and a Smart Battery system. A system developed according to the congatec Battery Management Interface Specification can provide the battery management functions supported by an ACPI capable operating system (e.g. charge state of the battery, information about the battery, alarms/events for certain battery states, ...) without the need for any additional modifications to the system BIOS.

In addition to the ACPI-Compliant Control Method Battery mentioned above, the latest versions of the conga-PA5 BIOS and board controller firmware also support LTC1760 battery manager from Linear Technology and a battery only solution (no charger). All three battery solutions are supported on the I2C bus and the SMBus. This gives the system designer more flexibility when choosing the appropriate battery sub-system.

For more information about this subject visit the congatec website and view the following documents:

- congatec Battery Management Interface Specification
- Battery System Design Guide
- conga-SBM³ User's Guide

6.5 API Support (CGOS)

In order to benefit from the above mentioned non-industry standard feature set, congatec provides an API that allows application software developers to easily integrate all these features into their code. The CGOS API (congatec Operating System Application Programming Interface) is the congatec proprietary API that is available for all commonly used Operating Systems such as Win32, Win64, Win CE, Linux. The architecture of the CGOS API driver provides the ability to write application software that runs unmodified on all congatec CPU modules. All the hardware related code is contained within the congatec embedded BIOS on the module. See section 1.1 of the CGOS API software developers guide, which is available on the congatec website.

6.6 GPIOs

The conga-PA5 SBC provides four GPIs and four GPOs via the congatec board controller. The GPI/GPO signals are routed to the feature connector X20.

6.7 Thermal/Voltage Monitoring

The CPU onboard the conga-PA5 monitors the system temperature while the congatec Board Controller monitors the +12V input voltage and input current.

6.8 External System Wake Event

The conga-PA5 supports LAN, power/sleep/LID buttons and PCIe driven wake up events.

6.9 Security Features

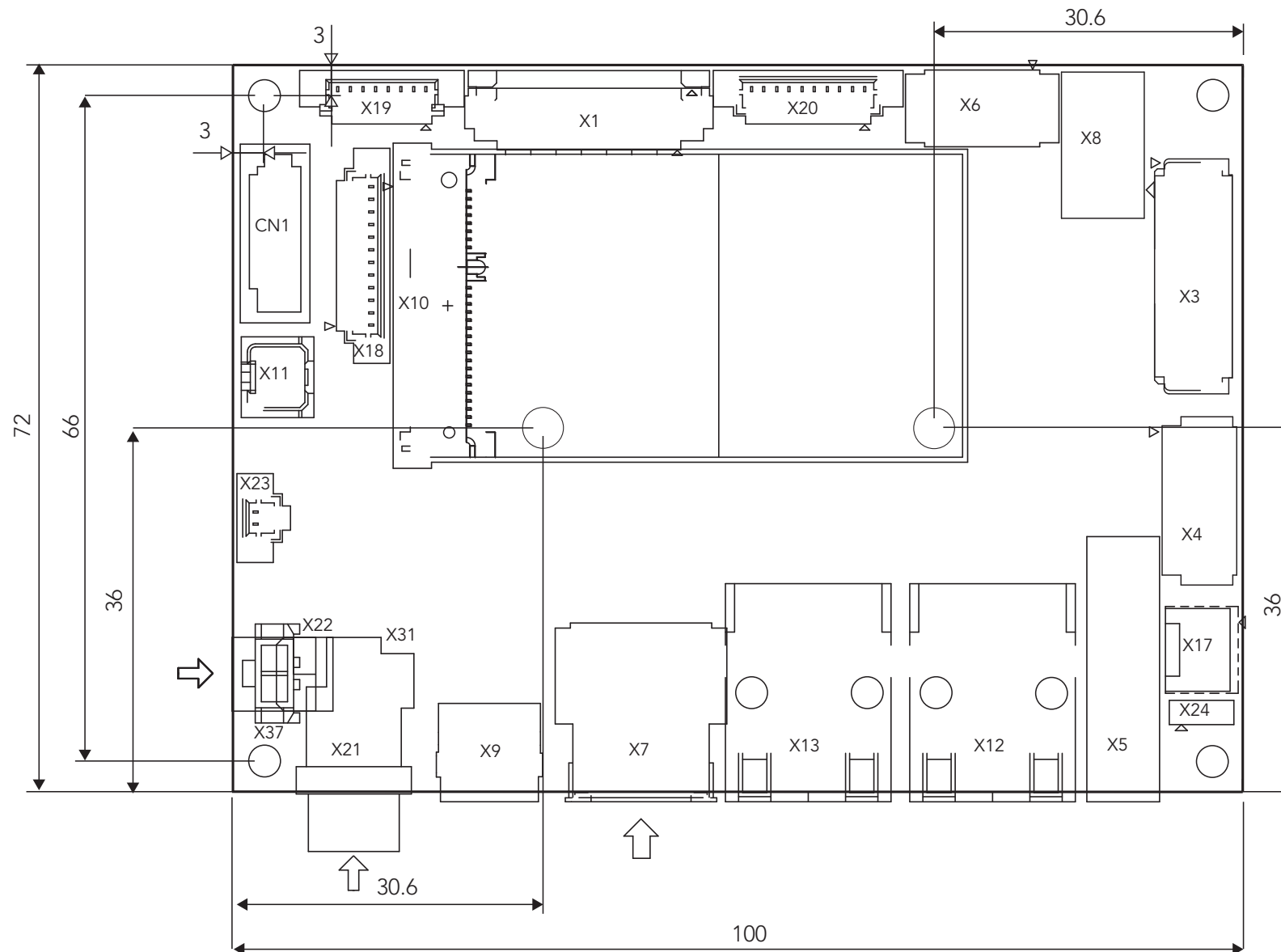
The conga-PA5 has an integrated Intel® PTT (TPM 2.0). Additionally, an Infineon SLB9665 (LPC TPM 2.0) or SLB9660 (LPC TPM 1.2) is available by assembly option.



Note

You can enable/disable the integrated Intel® PTT (TPM 2.0) in BIOS Setup: Enter BIOS Setup (see section 8.1 "Navigating the BIOS Setup Menu"), navigate to "Advanced Setup" and then "Platform Trust Technology". Always disable fTPM if you use an external TPM.

7 Mechanical Drawing



8 BIOS Setup Description

8.1 Navigating the BIOS Setup Menu

The BIOS setup menu shows the features and options supported in the congatec BIOS. To access and navigate the BIOS setup menu, press the or <F2> key during POST.

The right frame displays the key legend. Above the key legend is an area reserved for text messages. These text messages explain the options and the possible impacts when changing the selected option in the left frame.

8.2 BIOS Versions

The BIOS displays the BIOS project name and the revision code during POST, and on the main setup screen. The initial production BIOS for conga-PA5 is identified as PA50R1xx, where:

- PA5 is the project name
- R is the identifier for a BIOS ROM file
- 1 is the feature number
- xx is the major and minor revision number.

The binary size of conga-PA5 BIOS is 8MB.

8.3 Updating the BIOS

OEMs often use BIOS updates to correct platform issues discovered after the board has been shipped or when new features are added to the BIOS. The conga-PA5 uses a congatec/AMI AptioEFI firmware, which is stored in an onboard flash ROM chip and can be updated using the congatec System Utility. The utility has four versions—DOS based command line, Win32 command line, Win32 GUI, and Linux version.

For more information about “Updating the BIOS” refer to the user’s guide for the congatec System Utility “CGUTLm1x.pdf” on the congatec website at www.congatec.com.

8.4 Supported Flash Device

The conga-PA5 supports flash device Winbond W25Q64FW (8MB).

9 Industry Specifications

The list below provides links to industry specifications that apply to congatec AG products.

Specification	Link
Universal Serial Bus (USB) Specification, Revision 2.0	http://www.usb.org/home
Serial ATA Specification, Revision 3.0	http://www.serialata.org
PCI Express Base Specification, Revision 2.0	http://www.pcisig.com/specifications