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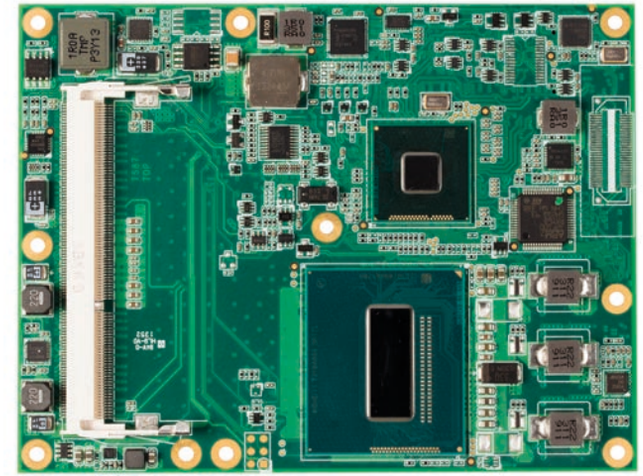
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COM Express™ conga-TS87

4th Generation Intel® Core™ i7, i5, i3 processor with QM87 or HM86 PCH

User's Guide

Revision 1.3

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Revision History

Revision	Date (yyyy.mm.dd)	Author	Changes
0.1	2013.06.03	AEM	• Preliminary release for Internal use
0.2	2013.09.30	AEM	• Updated section 2.5.1 • Updated section 5 "Onboard Temperature Sensors" • Updated section 10 "System Resources"
0.3	2013.11.05	AEM	• Updated section 2.1 "Feature List" • Updated section 4.1 with Flat pipe heatspreader. Deleted section 4.2 'Heatspreader thermal Imagery • Updated table 2 in section 6.2.3 "Digital Display Interface" • Added UART support for rev. B.0 and later in sections 2.1 "Feature List", 6.1.11 "General Purpose Serial Interface" and table 18
1.0	2014.03.26	AEM	• Updated COM Express concept in section 1 "Introduction" • Deleted the variant with PN:046809 from sections 1 "Introduction", 2 "Feature List" and 2.5 "Power Consumption". This variant is not on congatec's roadmap. Added additional two variants with part numbers 046810 and 046811 • Updated section 2.5 "Power Consumption" • Updated section 3 "Block Diagram" • Corrected pins D63 and D64 in section 9.4 "C-D Connector Pinout" • Added section 11 "BIOS Setup Description" • Official release
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1.2	2014.10.24	AEM	• Added note about the ULP mode in section 6.1.4 "Gigabit Ethernet" • Updated section 7.3 "Watchdog" • Updated section 8.2.5 "Intel Virtualization Technology" • Updated section 11 "BIOS Setup Description"
1.3	2016.15.07	AEM	• Corrected the BIOS Aptio UEFI version in section 2.1 "Feature List" • Added section 4 "Cooling Solution" • Added Windows 10 to section 2.2 "Supported Operating Systems" • Updated section 6.1.10 "LVDS/eDP" • Update section 7.7 "congatec Battery Management Interface" • Updated section 10.3 "PCI Interrupt Routing Map" • Deleted the comment "not supported" for SUS_S4# signal in table 17 "Power and System Management Signal Descriptions". Corrected also the description of PWRBTN# signal • Deleted sections 12.3 "BIOS Security Features" and 12.4 "Hard Disk Security Features" due to duplication

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Preface

This user's guide provides information about the components, features, connectors and BIOS Setup menus available on the conga-TS87. It is one of three documents that should be referred to when designing a COM Express™ application. The other reference documents that should be used include the following:

COM Express™ Design Guide
COM Express™ Specification

The links to these documents can be found on the congatec AG website at www.congatec.com

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Terminology

Term	Description
GB	Gigabyte (1,073,741,824 bytes)
GHz	Gigahertz (one billion hertz)
kB	Kilobyte (1024 bytes)
MB	Megabyte (1,048,576 bytes)
Mbit	Megabit (1,048,576 bits)
kHz	Kilohertz (one thousand hertz)
MHz	Megahertz (one million hertz)
TDP	Thermal Design Power
PCIe	PCI Express
SATA	Serial ATA
PEG	PCI Express Graphics
PCH	Platform Controller Hub
eDP	Embedded DisplayPort
T.O.M.	Top of memory = max. DRAM installed
HDA	High Definition Audio
I/F	Interface
N.C.	Not connected
N.A.	Not available
TBD	To be determined

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1 Introduction

1.1 COM Express™ Concept

COM Express™ is an open industry standard defined specifically for COMs (computer on modules). Its creation makes it possible to smoothly transition from legacy interfaces to the newest technologies available today. COM Express™ modules are available in following form factors:

- Mini 84mm x 55mm
- Compact 95mm x 95mm
- Basic 125mm x 95mm
- Extended 155mm x110mm

The COM Express™ specification 2.1 defines seven different pinout types.

Types	Connector Rows	PCIe Lanes	PCI	IDE	SATA Ports	LAN ports	USB 2.0/ USB 3.0	Display Interfaces
Type 1	A-B	Up to 6		-	4	1	8 / 0	VGA, LVDS
Type 2	A-B C-D	Up to 22	32 bit	1	4	1	8 / 0	VGA, LVDS, PEG/SDVO
Type 3	A-B C-D	Up to 22	32 bit	-	4	3	8 / 0	VGA,LVDS, PEG/SDVO
Type 4	A-B C-D	Up to 32		1	4	1	8 / 0	VGA,LVDS, PEG/SDVO
Type 5	A-B C-D	Up to 32		-	4	3	8 / 0	VGA,LVDS, PEG/SDVO
Type 6	A-B C-D	Up to 24		-	4	1	8 / 4*	VGA,LVDS/eDP, PEG, 3x DDI
Type 10	A-B	Up to 4		-	2	1	8 / 0	LVDS/eDP, 1xDDI

** The SuperSpeed USB ports (USB 3.0) are not in addition to the USB 2.0 ports. Up to 4 of the USB 2.0 ports can support SuperSpeed USB*

The conga-TS87 modules use the Type 6 pinout definition and comply with COM Express 2.1 specification. They are equipped with two high performance connectors that ensure stable data throughput.

The COM (computer on module) integrates all the core components and is mounted onto an application specific carrier board. COM modules are legacy-free design (no Super I/O, PS/2 keyboard and mouse) and provide most of the functional requirements for any application. These functions include, but are not limited to a rich complement of contemporary high bandwidth serial interfaces such as PCI Express, Serial ATA, USB 2.0, and Gigabit Ethernet. The Type 6 pinout provides the ability to offer PCI Express, Serial ATA, and LPC options thereby expanding the range of potential peripherals. The robust thermal and mechanical concept, combined with extended power-management capabilities, is perfectly suited for all applications.

Carrier board designers can use as little or as many of the I/O interfaces as deemed necessary. The carrier board can therefore provide all the interface connectors required to attach the system to the application specific peripherals. This versatility allows the designer to create a dense and optimized package, which results in a more reliable product while simplifying system integration. Most importantly, COM Express™

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modules are scalable, which means once an application has been created there is the ability to diversify the product range through the use of different performance class or form factor size modules. Simply unplug one module and replace it with another; no redesign is necessary.

1.2 Options Information

The conga-TS87 is currently available in seven 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-TS87 Variants

Part-No.	046804	046805	046806	046807	046808
Processor	Intel® Core™ i7-4700EQ 2.4 GHz Quad Core™	Intel® Core™ i5-4402E 1.6 GHz Dual Core™	Intel® Core™ i5-4400E 2.7 GHz Dual Core™	Intel® Core™ i3-4102E 1.6 GHz Dual Core™	Intel® Core™ i3-4100E 2.4 GHz Dual Core™
Intel® Smart Cache	6 MByte	3 MByte	3 MByte	3 MByte	3 MByte
Graphics	GT2	GT2	GT2	GT2	GT2
PEG	Yes	Yes	Yes	Yes	Yes
LVDS	Yes	Yes	Yes	Yes	Yes
DisplayPort (DP)	Yes	Yes	Yes	Yes	Yes
HDMI	Yes	Yes	Yes	Yes	Yes
Processor TDP	47 W	25 W	37 W	25 W	37 W

Part-No.	046810	046811
Processor	Intel® Celeron® 2000E 2.2 GHz Dual Core™	Intel® Celeron® 2002E 1.5 GHz Dual Core™
Intel® Smart Cache	2 MByte	2 MByte
Graphics	GT1	GT1
PEG	Yes	Yes
LVDS	Yes	Yes
DisplayPort (DP)	Yes	Yes
HDMI	Yes	Yes
Processor TDP	37 W	25 W

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2 Specifications

2.1 Feature List

Table 2 Feature Summary

Form Factor	Based on COM Express™ standard pinout Type 6 Rev. 2.1 (Basic size 95 x 125mm).	
Processor	Intel® 4th Generation Core i7,i5,i3 and Celeron mobile processors.	
Memory	Two memory sockets (located on the top and bottom side of the conga-TS87). Supports - SO-DIMM non-ECC DDR3L (low voltage @ 1.35V) modules - Data rates up to 1600 MT/s - Maximum 16 GB capacity	
congatec Board Controller	Multi-stage watchdog, manufacturing and board information, board statistics, hardware monitoring, fan control, I2C bus, Power loss control.	
Chipset	Intel® 8 Series Chipset: Intel® DH82QM87 and DH82HM86 PCH	
Audio	HDA (High Definition Audio)/digital audio interface with support for multiple codecs	
Ethernet	Gigabit Ethernet support via Intel® I218LM GbE LAN controller. Variants with Intel® QM87 support AMT 9.0.	
Graphics Options	Next Generation Intel® HD Graphics with support for Intel® Clear Video Technology (HD encode/transcode, Blu-ray playback), DirectX Video Acceleration (full AVC/VC1/MPEG2 hardware decode), OpenGL 4.0 and DirectX11.1. Up to 3 independent displays supported (DP, HDMI/DVI, VGA)	
	1x LVDS - Integrated flat panel interface with 25-112MHz single/dual-channel LVDS Transmitter - Single-channel LVDS interface: 1 x 18 bpp or 1 x 24 bpp. - Dual channel LVDS interface: 2 x 18 bpp or 2 x 24 bpp panel. - VESA LVDS and OpenLDI color mappings - Automatic Panel Detection via Embedded Panel Interface based on VESA EDID™ 1.3. - Resolution up to 1920x1200 in dual LVDS bus mode. 1x Optional eDP interface (**NOTE**: Either eDP or LVDS signals supported. Both not supported).	1x VGA - 180 MHz RAMDAC with resolution up to 1920 x 1200 and 24 bit color @ 60Hz refreshed rate with reduced blanking. 1x PEG Port (x16 Gen 3 (8GT/s)). 3x DisplayPorts (DP 1.1) on digital ports B, C and D. 3x HDMI 1.4 ports on digital ports B, C and D. 3x DVI ports on digital ports B, C and D. The DP and HDMI/DVI ports are multiplexed together. The interfaces support Hot-Plug detect.
Peripheral Interfaces	4x Serial ATA® with RAID support 0/1/5/10 7 PCI Express® Gen2 Lanes. 8x USB 2.0 (EHCI) 4x USB 3.0 (XHCI) 2x UART (Rev. B.0 and later)	LPC Bus I²C Bus, Fast Mode, multimaster SM Bus SPI GPIOs 2x ExpressCard
BIOS	AMI Aptio® UEFI 4.x firmware, 8/16 MByte serial SPI with congatec Embedded BIOS features.	
Power Management	ACPI 4.0 compliant with battery support. Also supports Suspend to RAM (S3) and Intel AMT 9.0. Configurable TDP	
Security	Optional discrete Trusted Platform Module "TPM 1.2".	

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Note

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 table in section 1.2 to determine what options are available on your particular module.

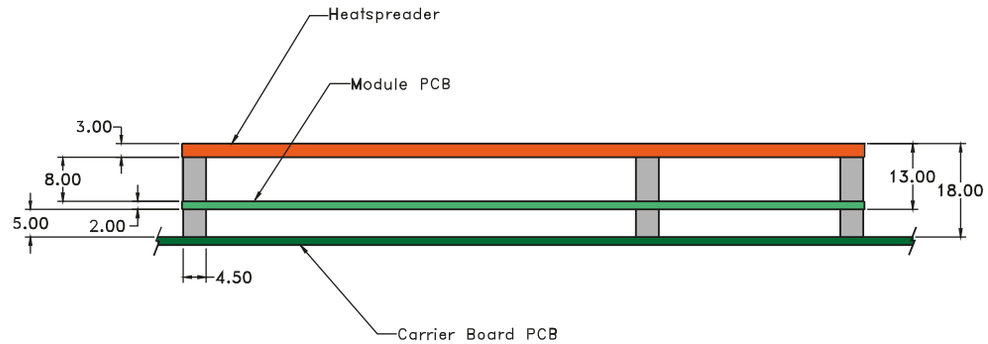
2.2 Supported Operating Systems

The conga-TS87 supports the following operating systems.

- Microsoft® Windows® 10
- Microsoft® Windows® 8
- Microsoft® Windows® 7
- Microsoft® Windows® Embedded Standard
- Linux

2.3 Mechanical Dimensions

- 95.0 mm x 125.0 mm (3.74" x 4.92")
- Height approximately 18 or 21mm (including heatspreader) depending on the carrier board connector that is used. If the 5mm (height) carrier board connector is used, then approximate overall height is 18mm. If the 8mm (height) carrier board connector is used, then approximate overall height is 21mm.

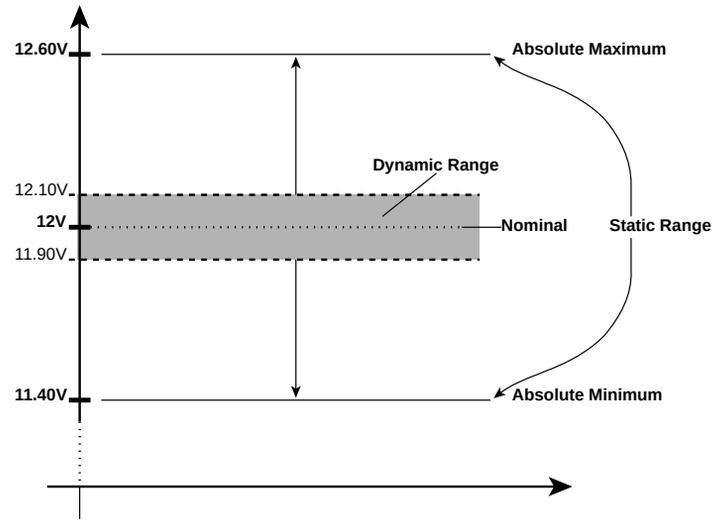


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2.4 Supply Voltage Standard Power

- 12V DC ± 5%

The dynamic range shall not exceed the static range.



2.4.1 Electrical Characteristics

Power supply pins on the module's connectors limit the amount of input power. The following table provides an overview of the limitations for pinout Type 6 (dual connector, 440 pins).

Power Rail	Module Pin Current Capability (Amps)	Nominal Input (Volts)	Input Range (Volts)	Derated Input (Volts)	Max. Input Ripple (10Hz to 20MHz) (mV)	Max. Module Input Power (w. derated input) (Watts)	Assumed Conversion Efficiency	Max. Load Power (Watts)
VCC_12V	12	12	11.4-12.6	11.4	+/- 100	137	85%	116
VCC_5V-SBY	2	5	4.75-5.25	4.75	+/- 50	9		
VCC_RTC	0.5	3	2.0-3.3		+/- 20			

2.4.2 Rise Time

The input voltages shall rise from 10% of nominal to 90% of nominal at a minimum slope of 250V/s. The smooth turn-on requires that, during the 10% to 90% portion of the rise time, the slope of the turn-on waveform must be positive.

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2.5 Power Consumption

The power consumption values listed in this document were measured under a controlled environment. The hardware used for testing includes a conga-TS87 module, conga-Cdebug carrier board, CRT monitor, SATA drive, and USB keyboard. The conga-Cdebug is modified so that the 12V input is only routed to the module and all other circuitry on the carrier itself is powered by the 5V input. The SATA drive was powered externally by an ATX power supply so that it does not influence the power consumption value that is measured for the module. The USB keyboard was detached once the module was configured within the OS. All recorded values were averaged over a 30 second time period. Cooling of the module was done by the module specific heatpipe heatspreader and a fan cooled heatsink to measure the power consumption under normal thermal conditions.

The conga-Cdebug originally does not provide 5V standby power. Therefore, an extra 5V_SB connection without any external loads was made. Using this setup, the power consumption of the module in S3 (Standby) mode was measured directly.

Each module was measured while running Windows 7 Professional 64Bit, Hyper Threading enabled, Speed Step enabled, CPU Turbo Mode enabled and Power Plan set to "Power Saver". This setting ensures that Core™ processors run in LFM (lowest frequency mode) with minimal core voltage during desktop idle. Each module was tested while using two 1GB memory modules. Using different sizes of RAM, as well as one or two memory modules, will cause slight variances in the measured results.

To measure the worst case power consumption the cooling solution was removed and the CPU core temperature was allowed to run up to between 95° and 100°C while running 100% workload with the Power Plan set to "Balanced". The peak current value was then recorded. This value should be taken into consideration when designing the system's power supply to ensure that the power supply is sufficient during worst case scenarios.

Power consumption values were recorded during the following stages:

Windows 7 (64 bit)

- Desktop Idle (power plan = Power Saver)
- 100% CPU workload (see note below, power plan = Power Saver)
- 100% CPU workload at approximately 100°C peak power consumption (power plan = Balanced)
- Suspend to RAM. Supply power for S3 mode is 5V.

Note

A software tool was used to stress the CPU to Max Turbo Frequency.

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Processor Information

The tables below provide additional information about the power consumption data for each of the conga-TS97 variants offered. The values are recorded at various operating mode.

2.5.1 Intel® Core™ i7-4700EQ 2.4 GHz Quad Core™ 6MB Cache

conga-TS87 Art. No. 046804	Intel® Core™ i7-4700EQ 2.4 GHz 4 Core™ 6MB Intel® Smart Cache (22nm) Layout Rev. TS87LA0 /BIOS Rev. TS87R005			
Max Turbo Frequency	3.4 GHz			
Memory Size	2 x 2GB			
Operating System	Windows 7 (64 bit)			
Power Consumption (Amps/Watts)	Desktop Idle	0.3 A/3.7 W (12V)	Suspend to Ram (S3) 5V Input Power	0.1 A/0.4 W (5V)
	100% workload without turbo mode	3.1 A/36.9 W (12V)	100% Workload with turbo mode	4.0 A/48.2 W (12V)
	100% CPU and GPU without turbo mode	4.5 A/53.4 W (12V)	100% CPU and GPU with turbo mode	5.0 A/60.4 W (12V)
Peak Power Consumption	5.6 A/67.3 W (12V)			

2.5.2 Intel® Core™ i5-4402E 1.6 GHz Dual Core™ 3MB Cache

conga-TS87 Art. No. 046805	Intel® Core™ i5-4402E 1.6 GHz 2 Core™ 3MB Intel® Smart Cache (22nm) Layout Rev. TS87LA0 /BIOS Rev. TS87R005			
Max Turbo Frequency	2.7 GHz			
Memory Size	2 x 2GB			
Operating System	Windows 7 (64 bit)			
Power Consumption (Amps/Watts)	Desktop Idle	0.3 A/3.5 W (12V)	Suspend to Ram (S3) 5V Input Power	0.1 A/0.4 W (5V)
	100% workload without turbo mode	1.3 A/16.0 W (12V)	100% Workload with turbo mode	2.3 A/28.0 W (12V)
	100% CPU and GPU without turbo mode	2.3 A/27.2 W (12V)	100% CPU and GPU with turbo mode	2.9 A/34.2 W (12V)
Peak Power Consumption	3.4 A/40.5 W (12V)			

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2.5.3 Intel® Core™ i5-4400E 2.7 GHz Dual Core™ 3MB Cache

conga-TS87 Art. No. 046806	Intel® Core™ i5-4400E 2.7 GHz 2 Core™ 3MB Intel® Smart Cache (22nm) Layout Rev. TS87LA0 /BIOS Rev. TS87R005			
Max Turbo Frequency	3.3 GHz			
Memory Size	2 x 2GB			
Operating System	Windows 7 (64 bit)			
Power Consumption (Amps/Watts)	Desktop Idle	0.3 A/3.5 W (12V)	Suspend to Ram (S3) 5V Input Power	0.1 A/0.4 W (5V)
	100% workload without turbo mode	1.6 A/18.6 W (12V)	100% Workload with turbo mode	3.4 A/40.3 W (12V)
	100% CPU and GPU without turbo mode	2.6 A/31.3 W (12V)	100% CPU and GPU with turbo mode	4.0 A/48.0 W (12V)
Peak Power Consumption	4.3 A/52.1 W (12V)			

2.5.4 Intel® Core™ i3-4102E 1.6 GHz Dual Core™ 3MB Cache

conga-TS87 Art. No. 046807	Intel® Core™ i3-4102E 1.6 GHz 2 Core™ 3MB Intel® Smart Cache (22nm) Layout Rev. TS87LA0 /BIOS Rev. TS87R005			
Max Turbo Frequency	N.A			
Memory Size	2 x 2GB			
Operating System	Windows 7 (64 bit)			
Power Consumption (Amps/Watts)	Desktop Idle	0.3 A/3.4 W (12V)	Suspend to Ram (S3) 5V Input Power	0.1 A/0.4 W (5V)
	100% workload without turbo mode	1.2 A/14.4 W (12V)	100% Workload with turbo mode	N.A
	100% CPU and GPU without turbo mode	2.0 A/24.2 W (12V)	100% CPU and GPU with turbo mode	N.A
Peak Power Consumption	2.1 A/25.1 W (12V)			

2.5.5 Intel® Core™ i3-4100E 2.4 GHz Dual Core™ 3MB Cache

conga-TS87 Art. No. 046808	Intel® Core™ i3-4100E 2.4 GHz 2 Core™ 3MB Intel® Smart Cache (22nm) Layout Rev. TS87LA0 /BIOS Rev. TS87R005			
Max Turbo Frequency	N.A			
Memory Size	2 x 2GB			
Operating System	Windows 7 (64 bit)			
Power Consumption (Amps/Watts)	Desktop Idle	0.3 A/3.4 W (12V)	Suspend to Ram (S3) 5V Input Power	0.1 A/0.4 W (5V)
	100% workload without turbo mode	2.1 A/25.3 W (12V)	100% Workload with turbo mode	N.A
	100% CPU and GPU without turbo mode	3.4 A/40.8 W (12V)	100% CPU and GPU with turbo mode	N.A
Peak Power Consumption	3.6 A/42.7 W (12V)			

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2.5.6 Intel® Celeron® 2000E 2.2 GHz Dual Core™ 2MB Cache

conga-TS87 Art. No. 046810	Intel® Celeron® 2000E 2.2 GHz 2 Core™ 2MB Intel® Smart Cache (22nm) Layout Rev. TS87LA0 /BIOS Rev. TS87R005			
Max Turbo Frequency	N.A			
Memory Size	2 x 2GB			
Operating System	Windows 7 (64 bit)			
Power Consumption (Amperes/Watts)	Desktop Idle	0.58 A/6.9 W (12V)	Suspend to Ram (S3) 5V Input Power	0.1 A/0.4 W (5V)
	100% workload without turbo mode	1.76 A/21.1 W (12V)	100% Workload with turbo mode	N.A
	100% CPU and GPU without turbo mode	2.08 A/25.0 W (12V)	100% CPU and GPU with turbo mode	N.A
Peak Power Consumption	N.A			

2.5.7 Intel® Celeron® 2002E 1.5 GHz Dual Core™ 2MB Cache

conga-TS87 Art. No. 046811	Intel® Celeron® 2002E 1.5 GHz 2 Core™ 2MB Intel® Smart Cache (22nm) Layout Rev. TS87LA0 /BIOS Rev. TS87R005			
Max Turbo Frequency	N.A			
Memory Size	2 x 2GB			
Operating System	Windows 7 (64 bit)			
Power Consumption (Amps/Watts)	Desktop Idle	0.56 A/6.7 W (12V)	Suspend to Ram (S3) 5V Input Power	0.1 A/0.4 W (5V)
	100% workload without turbo mode	1.12 A/13.4 W (12V)	100% Workload with turbo mode	N.A
	100% CPU and GPU without turbo mode	1.50 A/18.0 W (12V)	100% CPU and GPU with turbo mode	N.A
Peak Power Consumption	N.A			

2.6 Supply Voltage Battery Power

- 2.0V-3.5V DC
- Typical 3V DC

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2.6.1 CMOS Battery Power Consumption

RTC @ 20°C	Voltage	Current
Integrated in the Intel® DH82QM87 or DH82HM86 PCH	3V DC	2.27 µA

The CMOS battery power consumption value listed above should not be used to calculate CMOS battery lifetime. You should measure the CMOS battery power consumption in your customer specific application in worst case conditions, for example during high temperature and high battery voltage. The self-discharge of the battery must also be considered when determining CMOS battery lifetime. For more information about calculating CMOS battery lifetime refer to application note AN9_RTC_Battery_Lifetime.pdf on congatec AG website at www.congatec.com.

2.7 Environmental Specifications

Temperature	Operation: 0° to 60°C	Storage: -20° to +80°C
Humidity	Operation: 10% to 90%	Storage: 5% to 95%



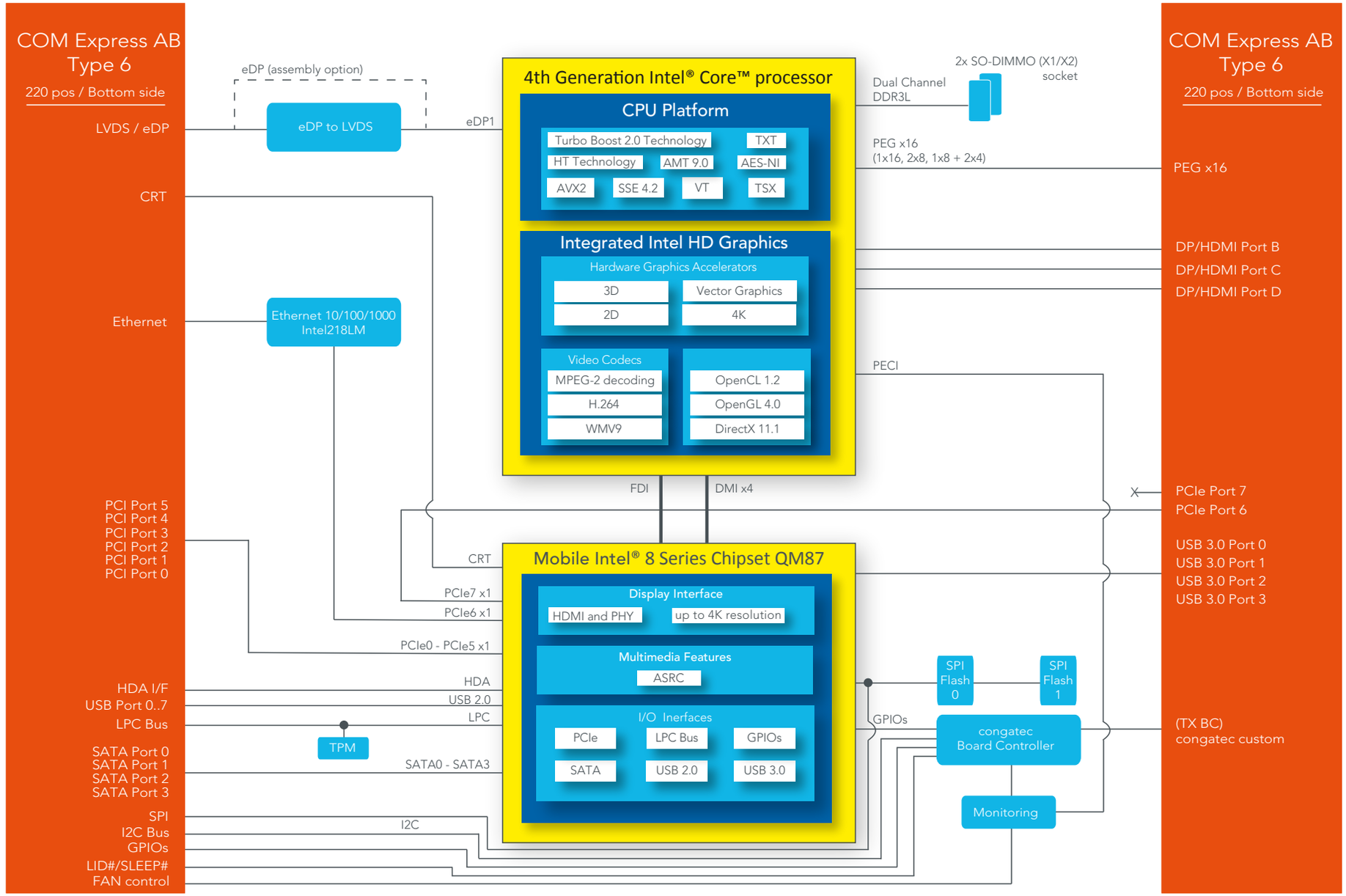
Caution

The above operating temperatures must be strictly adhered to at all times. When using a congatec heatspreader, the maximum operating temperature refers to any measurable spot on the heatspreader's surface.

Humidity specifications are for non-condensing conditions.

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3 Block Diagram



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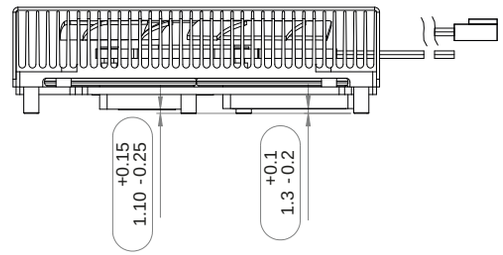
4 Cooling Solution

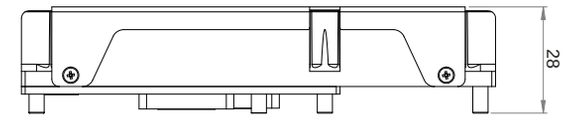
congatec AG offers three cooling solutions for the conga-TS87:

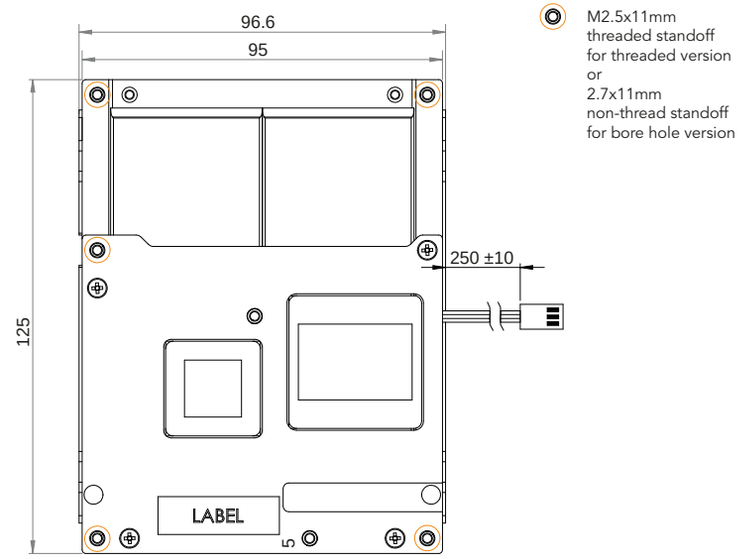
- Active cooling solution (CSA)
- Passive cooling solution (CSP)
- Heatspreader

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

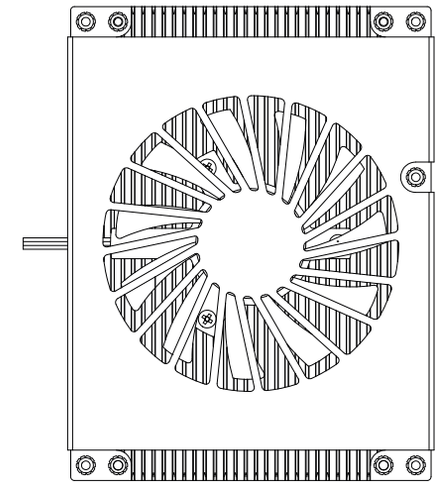
4.1 CSA Dimensions





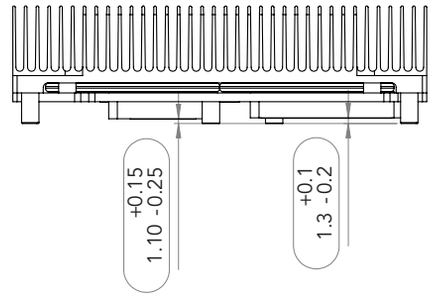


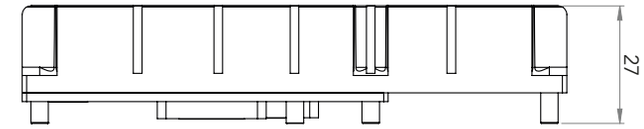
M2.5x11mm
threaded standoff
for threaded version
or
2.7x11mm
non-thread standoff
for bore hole version



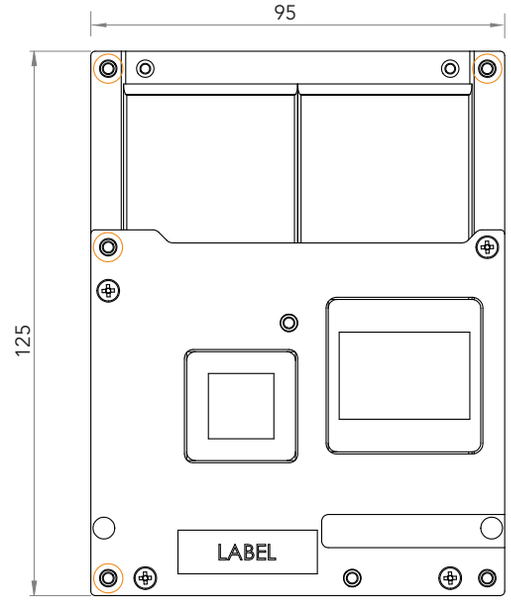
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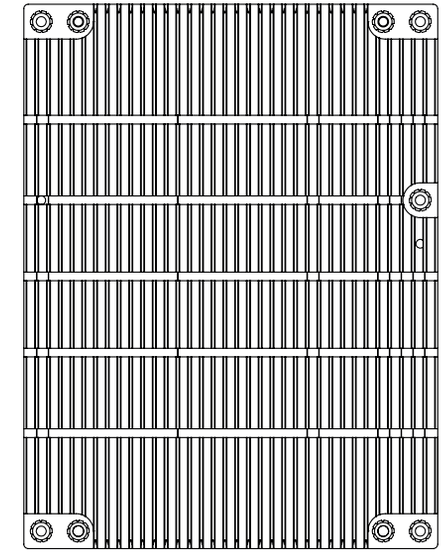
4.2 CSP Dimensions





M2.5x11mm
threaded standoff
for threaded version
or
2.7x11mm
non-thread standoff
for bore hole version



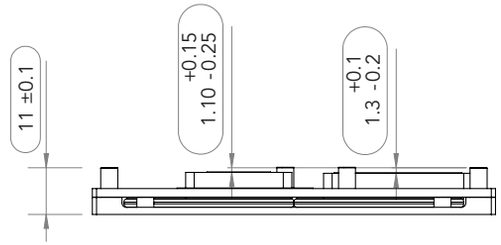


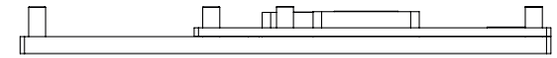
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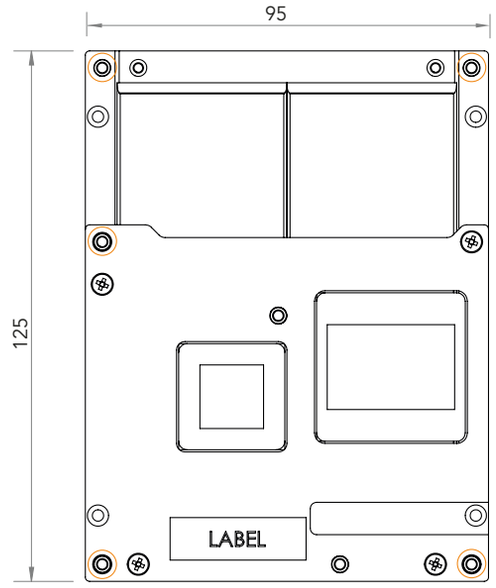
4.3 Heatspreader

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.

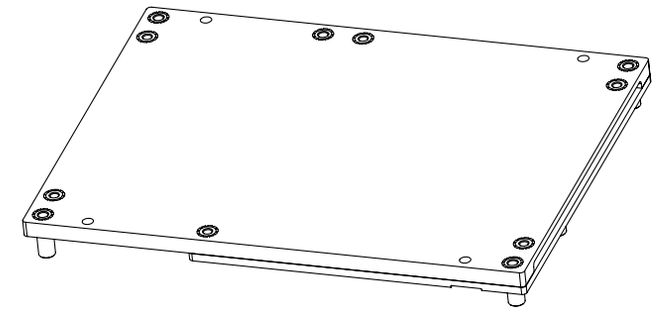
Although the heatspreader is the thermal interface where most of the heat generated by the module is dissipated, it is not to be considered as a heatsink. It has been designed as a thermal interface between the module and the application specific thermal solution. The application specific thermal solution 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.







M2.5x11mm
threaded standoff
for threaded version
or
2.7x11mm
non-thread standoff
for bore hole version



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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

congatec cooling solutions are designed for commercial temperature range only (0° to 60°C). Therefore, do not use the congatec cooling solutions in temperatures above 60°C or below 0°C. If an end user's system operates above 60°C or below 0°C, or is assembled with a non-congatec cooling solution, then the end user must use or design an optimized thermal solution that meets the needs of their application.

For adequate heat dissipation, use the mounting holes on the heatspreader to attach it to the module. Apply thread-locking fluid on the screws if the heatspreader 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 heatspreaders.

For applications that require vertically-mounted heatspreader, use only heatspreaders 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 specification for the heatspreader screws. Doing so may damage the module or/and the carrier board.

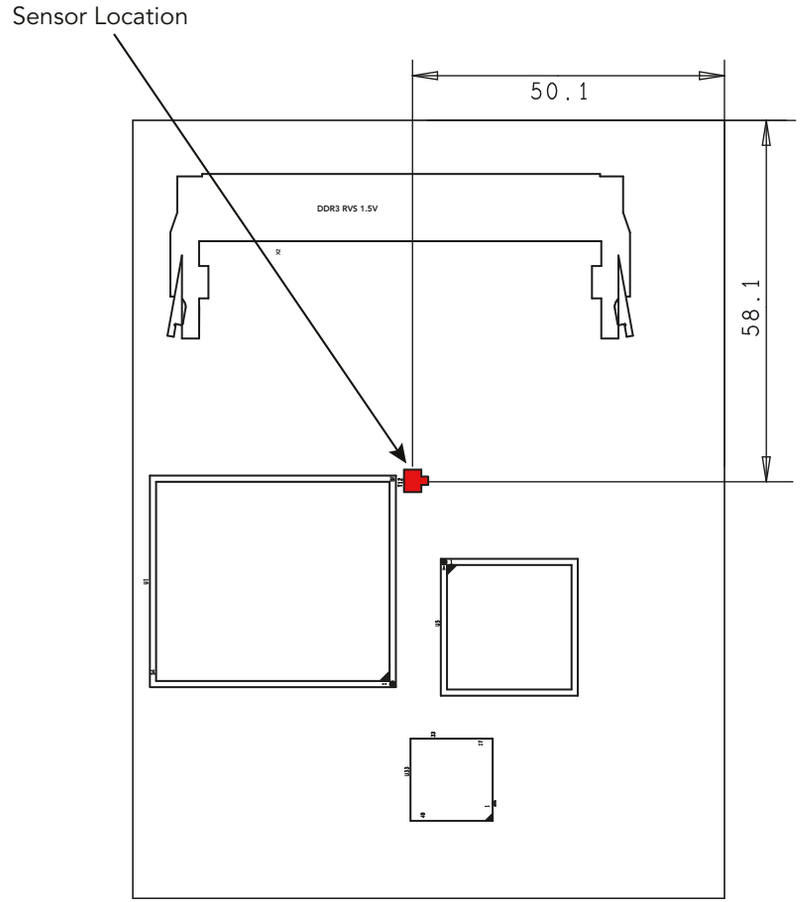
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5 Onboard Temperature Sensors

Onboard the conga-TS87 are two sensors - the board temperature sensor and the system environment temperature sensor. These sensors are defined in the CGOS API as CGOS_TEMP_BOARD and CGOS_TEMP_ENV.

Board Temperature Sensor:

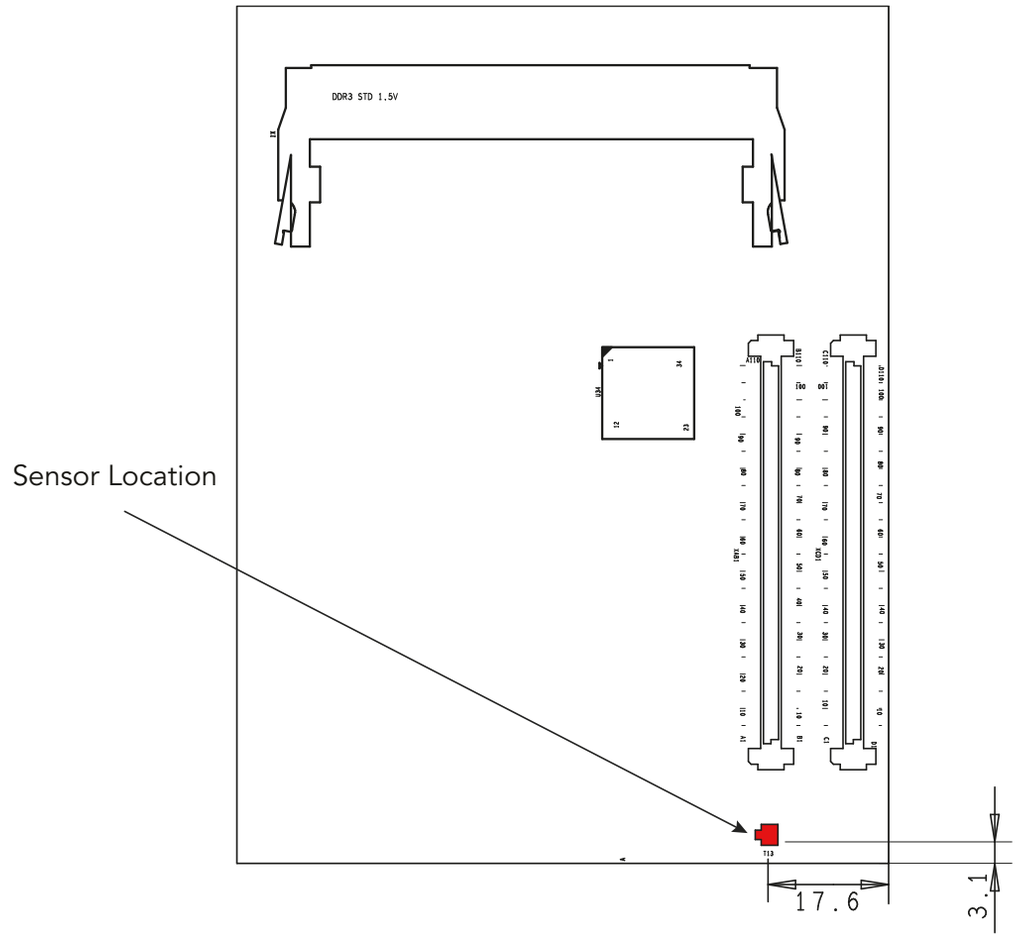
The board sensor (T12) is located at the top of the conga-TS87. This sensor measures the board temperature and is defined in CGOS API as CGOS_TEMP_BOARD. It is located on the module as shown below:



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System Environment Temperature Sensor:

The system environment sensor is located at the bottom of the conga-TS87. This sensor measures the system environment temperature and is defined in CGOS API as CGOS_TEMP_ENV. It is located on the module as shown below:

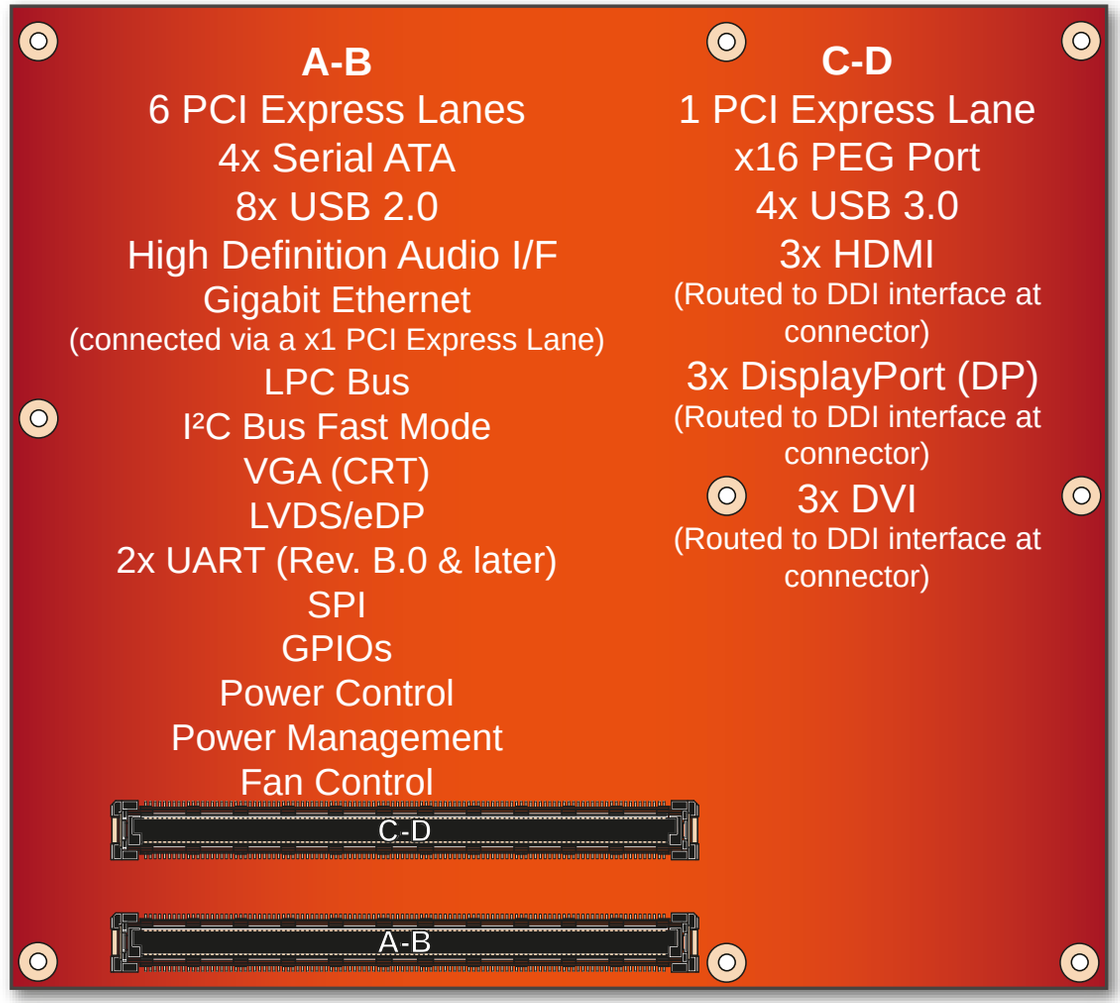


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6 Connector Subsystems Rows A, B, C, D

The conga-TS87 is connected to the carrier board via two 220-pin connectors (COM Express Type 6 pinout) for a total of 440 pins connectivity. These connectors are broken down into four rows. The primary connector consists of rows A and B while the secondary connector consists of rows C and D.

In this view the connectors are seen "through" the module.



top view

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6.1 Primary Connector Rows A and B

The following subsystems can be found on the primary connector rows A and B.

6.1.1 Serial ATA™ (SATA)

The conga-TS87 provides 4 SATA ports (SATA 0-3) externally via the Intel® QM87 PCH. The SATA ports are based on Serial ATA Specification, Revision 3.0 and support up to 6.0 Gb/s data transfer rates. Variants equipped with Intel® HM86 PCH support 6.0 Gb/s data rates only on SATA ports 0 and 1.

The SATA controller featured on the conga-TS87 operates in three modes in order to support different operating system conditions. The modes of operation are Native IDE, AHCI and RAID mode. Hot-plug is also supported when operating in non-native IDE mode. For more information, refer to section 11 "BIOS Setup Description".

Note

Only variants equipped with Intel® QM87 PCH support 6.0 Gb/s data rates on all SATA ports. The conga-TS87 variants equipped with Intel® HM86 PCH support 6.0 Gb/s data rates on only SATA ports 0 and 1.

6.1.2 USB 2.0

The conga-TS87 offers two EHCI USB host controllers that support USB high speed signalling via Intel® QM87 PCH. These controllers comply with USB standard 1.1 and 2.0 and offer a total of 8 USB ports via connector rows A and B. Each port is capable of supporting USB 1.1 and 2.0 compliant devices. For more information about how the USB host controllers are routed, see section 8.5.

6.1.3 High Definition Audio (HDA) Interface

The conga-TS87 provides an interface that supports the connection of HDA audio codecs.

6.1.4 Gigabit Ethernet

The conga-TS87 is equipped with a Gigabit Ethernet Controller that is integrated within the Intel® QM87 PCH. This integrated controller is routed to the Intel® I218-LM Phy through the use of the seventh PCI Express lane. The Ethernet interface consists of 4 pairs of low voltage differential pair signals designated from GBE0_MD0± to GBE0_MD3± plus control signals for link activity indicators. These signals can be used to connect to a 10/100/1000 BaseT RJ45 connector with integrated or external isolation magnetics on the carrier board.

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Note

The GBE0_LINK# output is only active during a 100Mbit or 1Gbit connection. It is not active during a 10Mbit connection. This is a limitation of Ethernet controller since it only has 3 LED outputs, ACT#, LINK100# and LINK1000#. The GBE0_LINK# signal is a logic AND of the GBE0_LINK100# and GBE0_LINK1000# signals on the conga-TS87 module.

The Intel i218 device driver offers a new feature called ULP (Ultra Low Power) mode. In this mode, the Intel i218 driver sets the LED outputs of the controller to tri-state mode. As a result, the ethernet link and activity LEDs may lit when no ethernet cable is connected. This issue is common with older driver versions because the ULP feature is enabled by default and cannot be disabled. In newer driver version, this feature can be disabled.

To have the correct LED status, congatec recommends that you use the latest i218 device driver provided on the website and additionally disable the ULP mode.

6.1.5 LPC Bus

conga-TS87 offers the LPC (Low Pin Count) bus through the Intel® QM87 PCH. There are many devices available for this Intel® defined bus. The LPC bus corresponds approximately to a serialized ISA bus yet with a significantly reduced number of signals. Due to the software compatibility to the ISA bus, I/O extensions such as additional serial ports can be easily implemented on an application specific baseboard using this bus. See section 10.2.1 for more information about the LPC Bus.

6.1.6 I²C Bus Fast Mode

The I²C bus is implemented through the congatec board controller (STMicroelectronics STM32) and accessed through the congatec CGOS driver and API. The controller provides a Fast Mode multi-master I²C Bus that has maximum I²C bandwidth.

6.1.7 PCI Express™

The conga-TS87 offers 8 PCI Express™ lanes via the Intel® QM87 PCH. Seven of these lanes are offered externally on the AB and CD connectors. The remaining lane is used by the onboard Gigabit Ethernet interface. The lanes are Gen 2 compliant and offer support for full 5 Gb/s bandwidth in each direction per x1 link.

The conga-TS87 offers 6 lanes on the AB connector and 1 lane on the CD connector. Default configuration for the lanes on the AB connector is 6x1 link. A 1x4 and 2x1 link configuration is also possible but requires a special/customized BIOS firmware. Contact congatec technical support for more information about this subject.

The PCI Express interface is based on the PCI Express Specification 2.0 with Gen 1 (2.5Gb/s) and Gen 2 (5 Gb/s) speed.

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6.1.8 ExpressCard™

The conga-TS87 supports the implementation of ExpressCards, which requires the dedication of one USB port or a x1 PCI Express link for each ExpressCard used.

6.1.9 Graphics Output (VGA/CRT)

The conga-TS87 provides an analog VGA display interface on the AB connector. The VGA display interface is supported on the PCH even though the main display engine is in the processor. The display engine sends display data over to the PCH via the Intel FDI - a bus connecting the processor and the PCH display components.

The analog VGA display interface has a RAM-based Digital-to-Analog Converter (RAMDAC) that transforms the digital data from the graphics engine to analog data for the VGA monitor. The 180 MHz RAMDAC supports up to 1920 x 1200 resolutions at 60 Hz refresh rate.

6.1.10 LVDS/eDP

The conga-TS87 offers an LVDS interface with optional eDP overlay on the AB connector. The LVDS/eDP interface is by default configured to provide LVDS signals. The interface can optionally support eDP (assembly option). For more information, contact congatec technical center.

The single/dual channel LVDS interface is provided through an integrated eDP to LVDS bridge device. The eDP to LVDS bridge processes incoming DisplayPort stream and converts the DP protocol to LVDS, before transmitting the processed stream in LVDS format. The bridge supports single and dual channel signalling with color depths of 18 bits or 24 bits per pixel and pixel clock frequency up to 112 MHz.

Note

The LVDS/eDP interface supports either LVDS or eDP signals. Both interfaces are not supported simultaneously.

6.1.11 General Purpose Serial Interface

Two TTL compatible two wire ports are available on Type 6 COM Express modules. These pins are designated SER0_TX, SER0_RX, SER1_TX and SER1_RX. Data out of the module is on the _TX pins. Hardware handshaking and hardware flow control are not supported. The module asynchronous serial ports are intended for general purpose use and for use with debugging software that make use of the "console redirect" features available in many operating systems.

Note

The conga-TS87 supports two UART interfaces on revision B.0 and later. These interfaces are provided on the AB connecter via single-chip USB to dual UART bridge. They do not support legacy COM port emulation and console redirection.

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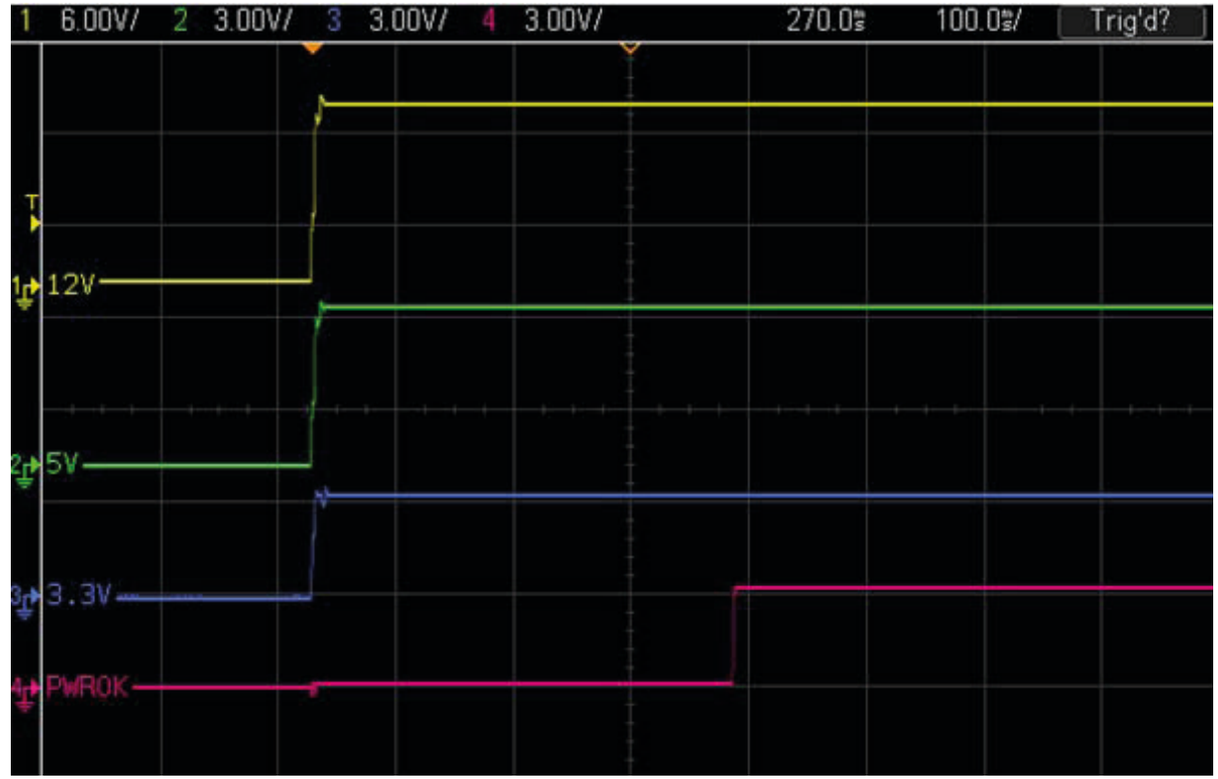
6.1.12 Power Control

PWR_OK

Power OK from main power supply or carrier board voltage regulator circuitry. A high value indicates that the power is good and the module can start its onboard power sequencing.

Carrier board hardware must drive this signal low until all power rails and clocks are stable. Releasing PWR_OK too early or not driving it low at all can cause numerous boot up problems. It is a good design practice to delay the PWR_OK signal a little (typically 100ms) after all carrier board power rails are up, to ensure a stable system.

A sample screenshot is shown below:

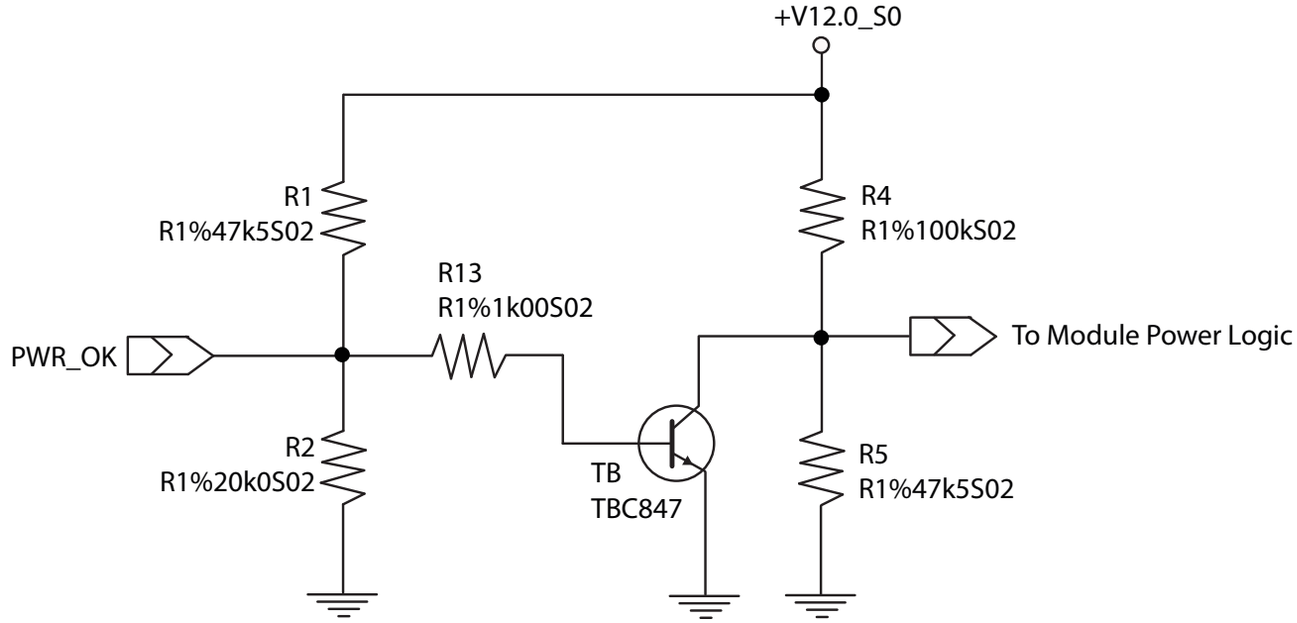


Note

The module is kept in reset as long as the PWR_OK is driven by carrier board hardware.

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The conga-TS87 PWR_OK input circuitry is implemented as shown below:



The voltage divider ensures that the input complies with 3.3V CMOS characteristic and also allows for carrier board designs that are not driving PWR_OK. Although the PWR_OK input is not mandatory for the onboard power-up sequencing, it is strongly recommended that the carrier board hardware drives the signal low until it is safe to let the module boot-up.

When considering the above shown voltage divider circuitry and the transistor stage, the voltage measured at the PWR_OK input pin may be only around 0.8V when the 12V is applied to the module. Actively driving PWR_OK high is compliant to the COM Express specification but this can cause back driving. Therefore, congatec recommends driving the PWR_OK low to keep the module in reset and tri-state PWR_OK when the carrier board hardware is ready to boot.

The three typical usage scenarios for a carrier board design are:

- Connect PWR_OK to the “power good” signal of an ATX type power supply.
- Connect PWR_OK to the last voltage regulator in the chain on the carrier board.
- Simply pull PWR_OK with a 1k resistor to the carrier board 3.3V power rail.

With this solution, it must be ensured that by the time the 3.3V is up, all carrier board hardware is fully powered and all clocks are stable.

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The conga-TS87 provides support for controlling ATX-style power supplies. When not using an ATX power supply then the conga-TS87's pins SUS_S3/PS_ON, 5V_SB, and PWRBTN# should be left unconnected.

SUS_S3#/PS_ON#

The SUS_S3#/PS_ON# (pin A15 on the A-B connector) signal is an active-low output that can be used to turn on the main outputs of an ATX-style power supply. In order to accomplish this the signal must be inverted with an inverter/transistor that is supplied by standby voltage and is located on the carrier board.

PWRBTN#

When using ATX-style power supplies PWRBTN# (pin B12 on the A-B connector) is used to connect to a momentary-contact, active-low debounced push-button input while the other terminal on the push-button must be connected to ground. This signal is internally pulled up to 3V_SB using a 10k resistor. When PWRBTN# is asserted it indicates that an operator wants to turn the power on or off. The response to this signal from the system may vary as a result of modifications made in BIOS settings or by system software.

Power Supply Implementation Guidelines

12 volt input power is the sole operational power source for the conga-TS87. The remaining necessary voltages are internally generated on the module using onboard voltage regulators. A carrier board designer should be aware of the following important information when designing a power supply for a conga-TS87 application:

- It has also been noticed that on some occasions, problems occur when using a 12V power supply that produces non monotonic voltage when powered up. The problem is that some internal circuits on the module (e.g. clock-generator chips) will generate their own reset signals when the supply voltage exceeds a certain voltage threshold. A voltage dip after passing this threshold may lead to these circuits becoming confused resulting in a malfunction. It must be mentioned that this problem is quite rare but has been observed in some mobile power supply applications. The best way to ensure that this problem is not encountered is to observe the power supply rise waveform through the use of an oscilloscope to determine if the rise is indeed monotonic and does not have any dips. This should be done during the power supply qualification phase therefore ensuring that the above mentioned problem doesn't arise in the application. For more information about this issue visit www.formfactors.org and view page 25 figure 7 of the document "ATX12V Power Supply Design Guide V2.2".

6.1.13 Power Management

ACPI 3.0 compliant with battery support. Also supports Suspend to RAM (S3).

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6.2 Secondary Connector Rows C and D

The following subsystems can be found on the secondary connector rows C and D.

6.2.1 PCI Express™

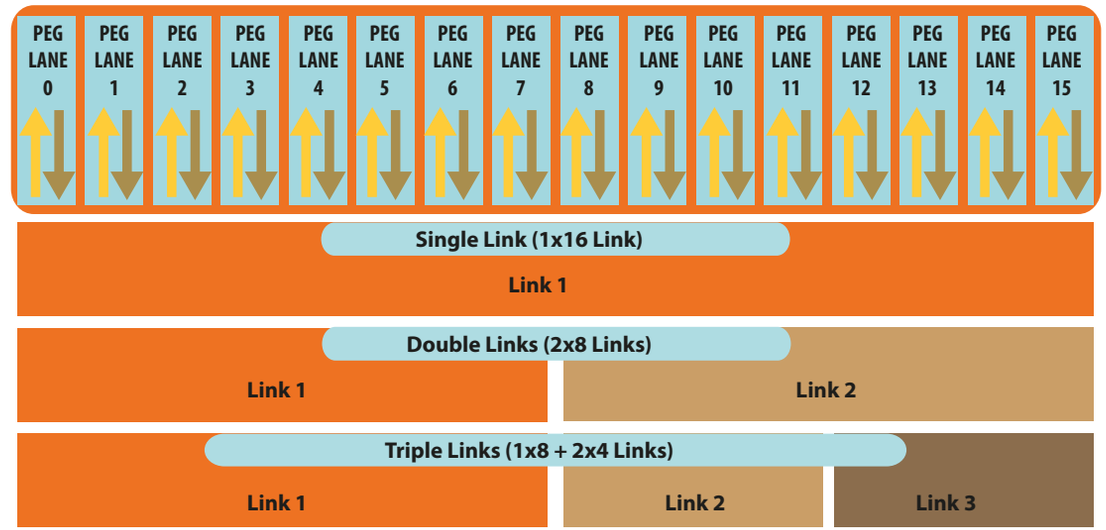
The conga-TS87 offers 8 PCI Express™ lanes via the Intel® QM87 PCH. Seven of these lanes are offered externally on the AB and CD connectors. The remaining lane is used by the onboard Gigabit Ethernet interface. The lanes are Gen 2 compliant and offer support for full 5 Gb/s bandwidth in each direction per x1 link.

The conga-TS87 offers 1 lane on the CD connector and 6 lanes on the AB connector. The PCI Express interface is based on the PCI Express Specification 2.0 with Gen 1 (2.5Gb/s) and Gen 2 (5 Gb/s) speed.

6.2.2 PCI Express Graphics (PEG)

PCI Express Graphics (PEG) is supported on conga-TS87 variants. The PEG lanes are same as PCI Express lanes 16-31 and are designed to be compliant with the PCI Express Specification 3.0, with support for 8.0 Gb/s speed.

The x16 PEG interface is by default configured as a 1x16 link. It is however possible to optionally configure the x16 PEG interface to support graphics and/or non-graphic PCI Express devices. This configuration increases the available PCI Express lanes on top of those explained in section 6.1.7 and section 6.2.1. It also enables the use of the PEG lanes for supporting x1, x2, x4 or x8 PCI Express devices. The possible configurations are 1x16 link (default), 2x8 links or 1x8 + 2x4 links as shown in the diagram below:



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The 16 PEG lanes can operate at 2.5 GT/s, 5 GT/s or 8 GT/s.

The sixteen PCIe lanes of the PEG interface are controlled by three controllers. Each controller can automatically operate on a lower link width allowing up to three simultaneous operating devices on the PEG interface. The PEG root port configuration can be selected in the BIOS setup.

Note

The PEG lanes can not be linked together with the PCI Express lanes discussed in sections 6.1.7 and 6.2.1.

6.2.3 Digital Display Interface

The Haswell processor onboard the conga-TS87 supports three Digital Display Interfaces. These interfaces can be configured as DisplayPort, HDMI or DVI. The processor also supports High-bandwidth Digital Content Protection (HDCP) for playing high definition content over digital interfaces.

Integrated in the processor is a dedicated Mini HD audio controller which drives audio on integrated digital display interfaces such as HDMI and DisplayPort. This controller supports two High Definition Audio streams simultaneously on any of the three digital ports.

For three independent displays, the processor supports the combination of DisplayPort, HDMI, DVI and VGA as shown below. This combination however does not include three simultaneous HDMI/DVI display.

Table 3 Display Combination

Display 1	Display 2	Display 3	Display 1 Max. Resolution	Display 2 Max. Resolution	Display 3 Max. Resolution
DP	DP	DP	3840x2160 @60Hz	3840x2160 @60Hz	3840x2160 @60Hz
HDMI	HDMI	DP	4096x2304 @24Hz 2560x1600 @60Hz	4096x2304 @24Hz 2560x1600 @60Hz	3840x2160 @60Hz
DVI	DVI	DP	1920x1200 @60Hz	1920x1200 @60Hz	3840x2160 @60Hz
VGA	DP	HDMI	1920x1200 @60Hz	3840x2160 @60Hz	4096x2304 @24Hz 2560x1600 @60Hz
LVDS/eDP	DP	HDMI	LVDS:1920x1200@60Hz eDP: 3840x2160 @60Hz	3840x2160 @60Hz	4096x2304 @24Hz 2560x1600 @60Hz
LVDS/eDP	DP	DP	LVDS:1920x1200@60Hz eDP: 3840x2160 @60Hz	3840x2160 @60Hz	3840x2160 @60Hz
LVDS/eDP	HDMI	HDMI	LVDS:1920x1200@60Hz eDP: 3840x2160 @60Hz	4096x2304 @24Hz 2560x1600 @60Hz	4096x2304 @24Hz 2560x1600 @60Hz

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Note

Two channel DDR3L memory configuration is required for driving three simultaneous 3840x2160 @ 60Hz display resolutions.

6.2.3.1 HDMI

The conga-TS87 offers three HDMI ports on the CD connector via the Digital Display Interfaces supported by the processor. The HDMI interfaces are based on HDMI 1.4 specification with support for 3D, 4K, Deep Color and x.v Color. These interfaces are multiplexed onto the Digital Display Interface of the COM Express connector.

Supported audio formats are AC-3 Dolby Digital, Dolby Digital Plus, DTS-HD, LPCM, 192 KHz/24 bit, 8 channel, Dolby TrueHD, DTS-HD Master Audio (Lossless Blu-Ray Disc Audio Format).

Note

The processor supports a maximum of 2 independent HDMI displays. See table 2 above for possible display combinations.

6.2.3.2 DVI

The conga-TS87 offers three DVI ports on the CD connector. The DVI interfaces are multiplexed onto the Digital Display Interface of the COM Express connector.

Note

The processor supports a maximum of 2 independent DVI displays. See table 2 above for possible display combinations.

6.2.3.3 DisplayPort (DP)

The conga-TS87 offers three DP ports, each capable of supporting data rate of 1.62 GT/s, 2.7 GT/s and 5.4 GT/s on 1, 2 or 4 data lanes. The DP is multiplexed onto the Digital Display Interface (DDI) of the COM Express connector and can support up to 3840x2160 resolutions at 60Hz.

The DisplayPort specification is a VESA standard aimed at consolidating internal and external connection methods to reduce device complexity, supporting key cross industry applications, and providing performance scalability to enable the next generation of displays. See section 9.5 of this document for more information about enabling DisplayPort peripherals.

Note

The DisplayPort supports 3 independent displays. See table 2 above for possible display combinations.

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6.2.4 USB 3.0

The conga-TS87 offers four SuperSpeed USB 3.0 ports on variants with Intel QM87 and two SuperSpeed USB 3.0 on variants with Intel HM86. These ports are controlled by an xHCI host controller provided by the Intel® QM87/HM86 PCH. The host controller allows data transfers of up to 5 Gb/s and supports SuperSpeed, high-speed, full-speed and low-speed traffic.



Note

The xHCI controller does not support USB debug port. If you desire USB debug port functionality, use the EHCI based debug port.

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7 Additional Features

7.1 congatec Board Controller (cBC)

The conga-TS87 is equipped with a STMicroelectronics STM32 microcontroller. This onboard microcontroller plays an important role for most of the congatec embedded/industrial PC features. It fully isolates some of the embedded features such as system monitoring or the I²C bus from the x86 core architecture, which results in higher embedded feature performance and more reliability, even when the x86 processor is in a low power mode. It also ensures that the congatec embedded feature set is fully compatible amongst all congatec modules.

7.2 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.

7.3 Watchdog

The conga-TS87 is equipped with a multi stage watchdog solution that is triggered by software. The COM Express™ Specification does not provide support for external hardware triggering of the Watchdog, which means the conga-TS87 does not support external hardware triggering. For more information about the Watchdog feature, see the BIOS setup description in section 11.4.2 of this document and application note AN3_Watchdog.pdf on the congatec AG website at www.congatec.com.

Note

The conga-TS87 module does not support the watchdog NMI mode.

7.4 I²C Bus

The conga-TS87 supports I²C bus. Thanks to the I²C host controller in the cBC, the I²C bus is multimaster capable and runs at fast mode.

7.5 Power Loss Control

The cBC has full control of the power-up of the module and therefore can be used to specify the behaviour of the system after a AC power loss condition. Supported modes are “Always On”, “Remain Off” and “Last State”.

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7.6 OEM BIOS Customization

The conga-TS87 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, which is called CGUTLm1x.pdf and can be found on the congatec website at www.congatec.com or contact technical support.

The customization features supported are described below:

7.6.1 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.

7.6.2 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.

7.6.3 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.

7.6.4 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.

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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.

7.6.5 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.

7.7 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.

The conga-TS87 BIOS fully supports this interface. 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-SBM^3 User's Guide

7.8 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 .

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7.9 Security Features

The conga-TS87 can be equipped optionally with a "Trusted Platform Module" (TPM 1.2). This TPM 1.2 includes coprocessors to calculate efficient hash and RSA algorithms with key lengths up to 2,048 bits as well as a real random number generator. Security sensitive applications like gaming and e-commerce will benefit also with improved authentication, integrity and confidence levels.

7.10 Suspend to Ram

The Suspend to RAM feature is available on the conga-TS87.

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8 conga Tech Notes

The conga-TS87 has some technological features that require additional explanation. The following section will give the reader a better understanding of some of these features. This information will also help to gain a better understanding of the information found in the System Resources section of this user's guide as well as some of the setup nodes found in the BIOS Setup Program description section.

8.1 Intel® PCH Features

8.1.1 Intel® Rapid Storage Technology

The Intel® QM87 provides support for Intel® Rapid Storage Technology, allowing AHCI functionality and RAID 0/1/5/10 support.

8.1.1.1 AHCI

The Intel® DH82QM87 or DH82HM86 provides hardware support for Advanced Host Controller Interface (AHCI), a new programming interface for SATA host controllers. Platforms supporting AHCI may take advantage of performance features such as no master/slave designation for SATA devices (each device is treated as a master) and hardware-assisted native command queuing. AHCI also provides usability enhancements such as Hot-Plug.

8.1.1.2 RAID

The industry-leading RAID capability provides high performance RAID 0, 1, 5, and 10 functionality on the 4 SATA ports of Intel® QM87 PCH. Software components include an Option ROM for pre-boot configuration and boot functionality, a Microsoft* Windows* compatible driver, and a user interface for configuration and management of the RAID capability of the Intel® QM87 PCH.

Note

The conga-TS87 variants that feature the Intel® HM86 chipset do not support RAID.

8.1.2 Intel® Smart Response Technology

Intel® Smart Response Technology is a disk caching solution that can provide improved computer system performance with improved power savings. It allows configuration of a computer systems with the advantage of having HDDs for maximum storage capacity with system performance at or near SSD performance levels.

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8.1.3 Intel® Rapid Start Technology

Intel® Rapid Start Technology enables systems to quickly resume from deep sleep. With this feature enabled, the system resumes smoothly and faster than with fresh Start Up or Resume from Hibernate, while maintaining the previous activity of the user.

Note

This feature requires an Intel® Core Processor

8.2 Intel® Processor Features

8.2.1 Intel® Turbo Boost Technology

Intel® Turbo Boost Technology allows processor cores to run faster than the base operating frequency if it's operating below power, current, and temperature specification limits. Intel® Turbo Boost Technology is activated when the Operating System (OS) requests the highest processor performance state. The maximum frequency of Intel® Turbo Boost Technology is dependent on the number of active cores. The amount of time the processor spends in the Intel Turbo Boost 2 Technology state depends on the workload and operating environment. Any of the following can set the upper limit of Intel® Turbo Boost Technology on a given workload:

- Number of active cores
- Estimated current consumption
- Estimated power consumption
- Processor temperature

When the processor is operating below these limits and the user's workload demands additional performance, the processor frequency will dynamically increase by 100 MHz on short and regular intervals until the upper limit is met or the maximum possible upside for the number of active cores is reached. For more information about Intel® Turbo Boost 2 Technology visit the Intel® website.

Note

Only conga-TS87 module variants that feature the Core™ i7 and i5 processors support Intel® Turbo Boost 2 Technology. Refer to the power consumption tables in section 2.5 of this document for information about the maximum turbo frequency available for each variant of the conga-TS87.

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8.2.2 Thermal Monitor and Catastrophic Thermal Protection

Intel® Core™ i7/i5/i3 and Celeron® processors have a thermal monitor feature that helps to control the processor temperature. The integrated TCC (Thermal Control Circuit) activates if the processor silicon reaches its maximum operating temperature. The activation temperature that the Intel® Thermal Monitor uses to activate the TCC, can be slightly modified via TCC Activation Offset in BIOS setup submenu "CPU submenu".

The Thermal Monitor can control the processor temperature through the use of two different methods defined as TM1 and TM2. TM1 method consists of the modulation (starting and stopping) of the processor clocks at a 50% duty cycle. The TM2 method initiates an Enhanced Intel Speedstep transition to the lowest performance state once the processor silicon reaches the maximum operating temperature.

Note

The maximum operating temperature for Intel® Core™ i7/i5/i3 and Celeron® processors is 100°C.

To ensure that the TCC is active for only short periods of time, thus reducing the impact on processor performance to a minimum, it is necessary to have a properly designed thermal solution. The Intel® Core™ i7/i5/i3 and Celeron® processor's respective datasheet can provide you with more information about this subject.

THERMTRIP# signal is used by Intel®'s Core™ i7/i5/i3 and Celeron® processors for catastrophic thermal protection. If the processor's silicon reaches a temperature of approximately 125°C then the processor signal THERMTRIP# will go active and the system will automatically shut down to prevent any damage to the processor as a result of overheating. The THERMTRIP# signal activation is completely independent from processor activity and therefore does not produce any bus cycles.

Note

In order for THERMTRIP# to be able to automatically switch off the system, it is necessary to use an ATX style power supply.

8.2.3 Processor Performance Control

Intel® Core™ i7/i5/i3 and Celeron® processors found on the conga-TS87 run at different voltage/frequency states (performance states), which is referred to as Enhanced Intel® SpeedStep® technology (EIST). Operating systems that support performance control take advantage of microprocessors that use several different performance states in order to efficiently operate the processor when it's not being fully used. The operating system will determine the necessary performance state that the processor should run at so that the optimal balance between performance and power consumption can be achieved during runtime.

The Windows family of operating systems links its processor performance control policy to the power scheme setting. You must ensure that the power scheme setting you choose has the ability to support Enhanced Intel® SpeedStep® technology.

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8.2.4 Intel® 64 Architecture

The formerly known Intel® Extended Memory 64 Technology is an enhancement to Intel®'s IA-32 architecture. Intel® 64 is only available on Intel® Core™ i7/i5/i3 and Celeron® processors and is designed to run with newly written 64-bit code and access more than 4GB of memory. Processors with Intel® 64 architecture support 64-bit-capable operating systems from Microsoft, Red Hat and SuSE. Processors running in legacy mode remain fully compatible with today's existing 32-bit applications and operating systems

Platforms with Intel® 64 can be run in three basic ways :

1. **Legacy Mode:** 32-bit operating system and 32-bit applications. In this mode no software changes are required, however the benefits of Intel® 64 are not utilized.

2. **Compatibility Mode:** 64-bit operating system and 32-bit applications. This mode requires all device drivers to be 64-bit. The operating system will see the 64-bit extensions but the 32-bit application will not. Existing 32-bit applications do not need to be recompiled and may or may not benefit from the 64-bit extensions. The application will likely need to be re-certified by the vendor to run on the new 64-bit extended operating system.

3. **64-bit Mode:** 64-bit operating system and 64-bit applications. This usage requires 64-bit device drivers. It also requires applications to be modified for 64-bit operation and then recompiled and validated.

Intel® 64 provides support for:

- 64-bit flat virtual address space
- 64-bit pointers
- 64-bit wide general purpose registers
- 64-bit integer support
- Up to one Terabyte (TB) of platform address space

You can find more information about Intel® 64 Technology at: http://developer.intel.com/technology/intel64/index.htm

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8.2.5 Intel® Virtualization Technology

Intel® Virtualization Technology (Intel® VT) makes a single system appear as multiple independent systems to software. This allows multiple, independent operating systems to run simultaneously on a single system. Intel® VT comprises technology components to support virtualization of platforms based on Intel architecture microprocessors and chipsets. Intel® Virtualization Technology for IA-32, Intel® 64 and Intel® Architecture Intel® VT-x) added hardware support in the processor to improve the virtualization performance and robustness.

Note

congatec does not offer virtual machine monitor (VMM) software. All VMM software support questions and queries should be directed to the VMM software vendor and not congatec technical support.

8.2.6 Thermal Management

ACPI is responsible for allowing the operating system to play an important part in the system's thermal management. This results in the operating system having the ability to take control of the operating environment by implementing cooling decisions according to the demands put on the CPU by the application.

The conga-TS87 supports Critical Trip Point. This cooling policy ensures that the operating system shuts down properly if the temperature in the thermal zone reaches a critical point, in order to prevent damage to the system as a result of high temperatures. Use the "critical trip point" setup node in the BIOS setup program to determine the temperature threshold that the operating system will use to shut down the system.

Note

The end user must determine the cooling preferences for the system by using the setup nodes in the BIOS setup program to establish the appropriate trip points.

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8.3 ACPI Suspend Modes and Resume Events

conga-TS87 supports S3 (STR= Suspend to RAM). For more information about S3 wake events, see section 11.4.5 "ACPI Configuration Submenu".

S4 (Suspend to Disk) is not supported by the BIOS (S4_BIOS) but it is supported by the following operating systems (S4_OS= Hibernate):

- Windows 8, Windows 7, Windows Vista, Linux.

This table lists the "Wake Events" that resume the system from S3 unless otherwise stated in the "Conditions/Remarks" column:

Wake Event	Conditions/Remarks
Power Button	Wakes unconditionally from S3-S5.
Onboard LAN Event	Device driver must be configured for Wake On LAN support.
SMBALERT#	Wakes unconditionally from S3-S5.
PCI Express WAKE#	Wakes unconditionally from S3-S5.
PME#	Activate the wake up capabilities of a PCI device using Windows Device Manager configuration options for this device OR set Resume On PME# to Enabled in the Power setup menu.
USB Mouse/Keyboard Event	When Standby mode is set to S3, USB hardware must be powered by standby power source. Set USB Device Wakeup from S3/S4 to ENABLED in the ACPI setup menu (if setup node is available in BIOS setup program). In Device Manager look for the keyboard/mouse devices. Go to the Power Management tab and check 'Allow this device to bring the computer out of standby'.
RTC Alarm	Activate and configure Resume On RTC Alarm in the Power setup menu. Only available in S5.
Watchdog Power Button Event	Wakes unconditionally from S3-S5.

8.4 Low Voltage Memory (DDR3L)

The Haswell processor featured on the conga-TS87 supports low voltage system memory interface. The memory interface I/O voltage is 1.35V and supports non-ECC, unbuffered DDR3L SO-DIMMs. With this low voltage system memory interface on the processor, the conga-TS87 offers a system optimized for lowest possible power consumption. The reduction in power consumption due to lower voltage subsequently reduces the heat generated.

Note

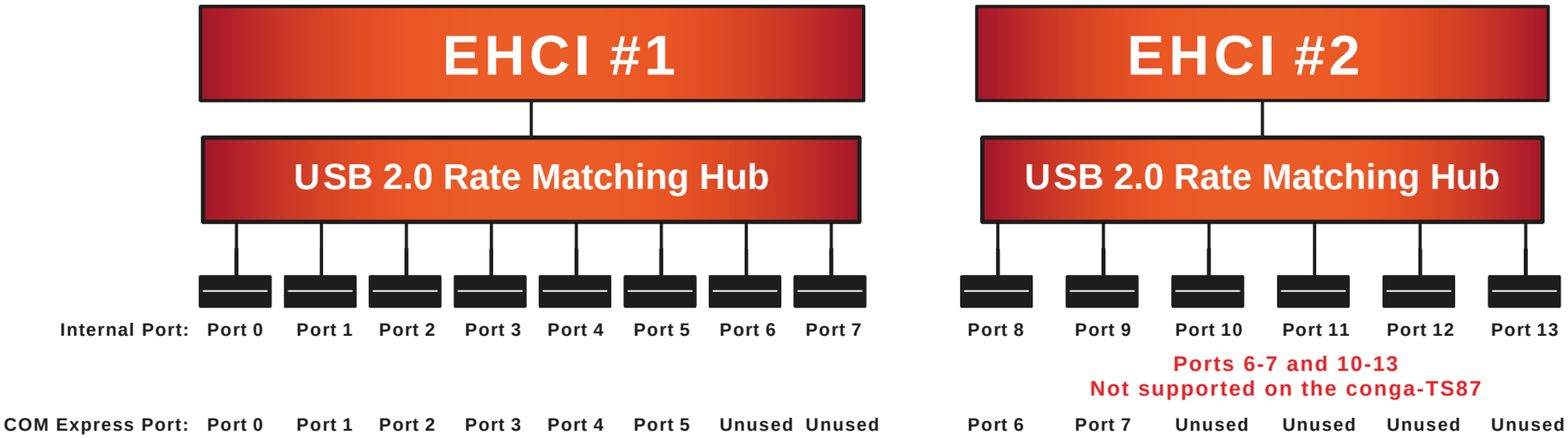
The usage of DDR3@1.5V SO-DIUM modules may affect the stability or boot-up of the conga-TS87. Therefore use only non-ECC, unbuffered DDR3L SO-DIMM memory modules up to 1600 MT/s on the conga-TS87.

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8.5 USB 2.0 EHCI Host Controller Support

The 8 available USB ports are provided by two USB 2.0 Rate Matching Hubs (RMH) integrated within the Intel® QM87 PCH . Each EHCI controller has one hub connected to it as shown below. The Hubs convert low and full-speed traffic into high-speed traffic. When the RMHs are enabled, they will appear to software like an external hub is connected to Port 0 of each EHCI controller. In addition, port 1 of each of the RMHs is muxed with Port 1 of the EHCI controllers and is able to bypass the RMH for use as the Debug Port. The hub operates like any USB 2.0 Discrete Hub and will consume one tier of hubs allowed by the USB 2.0 Spec. A maximum of four additional non-root hubs can be supported on any of the PCH USB Ports. The RMH will report the following Vendor ID = 8087h and Product ID = 0024h.

Routing Diagram



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9 Signal Descriptions and Pinout Tables

The following section describes the signals found on COM Express™ Type VI connectors used for congatec AG modules. The pinout of the modules complies with COM Express Type 6 Rev. 2.1.

Table 3 describes the terminology used in this section for the Signal Description tables. The PU/PD column indicates if a COM Express™ module pull-up or pull-down resistor has been used, if the field entry area in this column for the signal is empty, then no pull-up or pull-down resistor has been implemented by congatec.

The "#" symbol at the end of the signal name indicates that the active or asserted state occurs when the signal is at a low voltage level. When "#" is not present, the signal is asserted when at a high voltage level.

Note

The Signal Description tables do not list internal pull-ups or pull-downs implemented by the chip vendors, only pull-ups or pull-downs implemented by congatec are listed. For information about the internal pull-ups or pull-downs implemented by the chip vendors, refer to the respective chip's datasheet.

Table 4 Signal Tables Terminology Descriptions

Term	Description
PU	congatec implemented pull-up resistor
PD	congatec implemented pull-down resistor
I/O 3.3V	Bi-directional signal 3.3V tolerant
I/O 5V	Bi-directional signal 5V tolerant
I 3.3V	Input 3.3V tolerant
I 5V	Input 5V tolerant
I/O 3.3VSB	Input 3.3V tolerant active in standby state
O 3.3V	Output 3.3V signal level
O 5V	Output 5V signal level
OD	Open drain output
P	Power Input/Output
DDC	Display Data Channel
PCIE	In compliance with PCI Express Base Specification, Revision 2.0
PEG	PCI Express Graphics
SATA	In compliance with Serial ATA specification Revision 2.6 and 3.0.
REF	Reference voltage output. May be sourced from a module power plane.

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PDS	Pull-down strap. A module output pin that is either tied to GND or is not connected. Used to signal module capabilities (pinout type) to the Carrier Board.

9.1 A-B Connector Signal Descriptions

Table 5 Intel® High Definition Audio Link Signals Descriptions

Signal	Pin #	Description	I/O	PU/PD	Comment
AC/HDA_RST#	A30	Intel® High Definition Audio Reset: This signal is the master hardware reset to external codec(s).	O 3.3VSB		AC'97 codecs are not supported.
AC/HDA_SYNC	A29	Intel® High Definition Audio Sync: This signal is a 48 kHz fixed rate sample sync to the codec(s). It is also used to encode the stream number.	O 3.3VSB	PU 1K 3.3VSB	AC'97 codecs are not supported. AC/HDA_SYNC is a boot strap signal (see note below)
AC/HDA_BITCLK	A32	Intel® High Definition Audio Bit Clock Output: This signal is a 24.000MHz serial data clock generated by the Intel® High Definition Audio controller.	O 3.3VSB		AC'97 codecs are not supported.
AC/HDA_SDOUT	A33	Intel® High Definition Audio Serial Data Out: This signal is the serial TDM data output to the codec(s). This serial output is double-pumped for a bit rate of 48 Mb/s for Intel® High Definition Audio.	O 3.3VSB	PU 1K 3.3VSB	AC'97 codecs are not supported. AC/HDA_SDOUT is a boot strap signal (see note below)
AC/HDA_SDIN[2:0]	B28-B30	Intel® High Definition Audio Serial Data In [0]: These signals are serial TDM data inputs from the three codecs. The serial input is single-pumped for a bit rate of 24 Mb/s for Intel® High Definition Audio.	I 3.3VSB		AC'97 codecs are not supported.

Note

Some signals have special functionality during the reset process. They may bootstrap some basic important functions of the module.

For more information refer to section 9.5 of this user's guide.

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Table 6 Gigabit Ethernet Signal Descriptions

Gigabit Ethernet	Pin #	Description				I/O	PU/ PD	Comment
GBE0_MDI0+ GBE0_MDI0- GBE0_MDI1+ GBE0_MDI1- GBE0_MDI2+ GBE0_MDI2- GBE0_MDI3+ GBE0_MDI3-	A13 A12 A10 A9 A7 A6 A3 A2	Gigabit Ethernet Controller 0: Media Dependent Interface Differential Pairs 0, 1, 2, 3. The MDI can operate in 1000, 100, and 10Mbit/sec modes. Some pairs are unused in some modes according to the following:				I/O Analog		Twisted pair signals for external transformer.
			1000	100	10			
		MDI[0]+/-	B1_DA+/-	TX+/-	TX+/-			
		MDI[1]+/-	B1_DB+/-	RX+/-	RX+/-			
		MDI[2]+/-	B1_DC+/-					
		MDI[3]+/-	B1_DD+/-					
GBE0_ACT#	B2	Gigabit Ethernet Controller 0 activity indicator, active low.				O 3.3VSB		
GBE0_LINK#	A8	Gigabit Ethernet Controller 0 link indicator, active low.				O 3.3VSB		
GBE0_LINK100#	A4	Gigabit Ethernet Controller 0 100Mbit/sec link indicator, active low.				O 3.3VSB		
GBE0_LINK1000#	A5	Gigabit Ethernet Controller 0 1000Mbit/sec link indicator, active low.				O 3.3VSB		
GBE0_CTREF	A14	Reference voltage for Carrier Board Ethernet channel 0 magnetics center tap. The reference voltage is determined by the requirements of the module PHY and may be as low as 0V and as high as 3.3V. The reference voltage output shall be current limited on the module. In the case in which the reference is shorted to ground, the current shall be limited to 250mA or less.						Not connected

Note

The GBE0_LINK# output is only active during a 100Mbit or 1Gbit connection, it is not active during a 10Mbit connection. This is a limitation of Ethernet controller since it only has 3 LED outputs, ACT#, LINK100# and LINK1000#. The GBE0_LINK# signal is a logic AND of the GBE0_LINK100# and GBE0_LINK1000# signals on the conga-TS87 module.

Table 7 Serial ATA Signal Descriptions

Signal	Pin #	Description	I/O	PU/PD	Comment
SATA0_RX+ SATA0_RX-	A19 A20	Serial ATA channel 0, Receive Input differential pair.	I SATA		Supports Serial ATA specification, Revision 3.0
SATA0_TX+ SATA0_TX-	A16 A17	Serial ATA channel 0, Transmit Output differential pair.	O SATA		Supports Serial ATA specification, Revision 3.0
SATA1_RX+ SATA1_RX-	B19 B20	Serial ATA channel 1, Receive Input differential pair.	I SATA		Supports Serial ATA specification, Revision 3.0
SATA1_TX+ SATA1_TX-	B16 B17	Serial ATA channel 1, Transmit Output differential pair.	O SATA		Supports Serial ATA specification, Revision 3.0

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Signal	Pin #	Description	I/O	PU/PD	Comment
SATA2_RX+ SATA2_RX-	A25 A26	Serial ATA channel 2, Receive Input differential pair.	I SATA		Supports Serial ATA specification, Revision 3.0
SATA2_TX+ SATA2_TX-	A22 A23	Serial ATA channel 2, Transmit Output differential pair.	O SATA		Supports Serial ATA specification, Revision 3.0
SATA3_RX+ SATA3_RX-	B25 B26	Serial ATA channel 3, Receive Input differential pair.	I SATA		Supports Serial ATA specification, Revision 3.0
SATA3_TX+ SATA3_TX-	B22 B23	Serial ATA channel 3, Transmit Output differential pair.	O SATA		Supports Serial ATA specification, Revision 3.0
(S)ATA_ACT#	A28	ATA (parallel and serial) or SAS activity indicator, active low.	I/O 3.3v		

Table 8 PCI Express Signal Descriptions (general purpose)

Signal	Pin #	Description	I/O	PU/PD	Comment
PCIE_RX0+ PCIE_RX0-	B68 B69	PCI Express channel 0, Receive Input differential pair.	I PCIE		Supports PCI Express Base Specification, Revision 2.0
PCIE_TX0+ PCIE_TX0-	A68 A69	PCI Express channel 0, Transmit Output differential pair.	O PCIE		Supports PCI Express Base Specification, Revision 2.0
PCIE_RX1+ PCIE_RX1-	B64 B65	PCI Express channel 1, Receive Input differential pair.	I PCIE		Supports PCI Express Base Specification, Revision 2.0
PCIE_TX1+ PCIE_TX1-	A64 A65	PCI Express channel 1, Transmit Output differential pair.	O PCIE		Supports PCI Express Base Specification, Revision 2.0
PCIE_RX2+ PCIE_RX2-	B61 B62	PCI Express channel 2, Receive Input differential pair.	I PCIE		Supports PCI Express Base Specification, Revision 2.0
PCIE_TX2+ PCIE_TX2-	A61 A62	PCI Express channel 2, Transmit Output differential pair.	O PCIE		Supports PCI Express Base Specification, Revision 2.0
PCIE_RX3+ PCIE_RX3-	B58 B59	PCI Express channel 3, Receive Input differential pair.	I PCIE		Supports PCI Express Base Specification, Revision 2.0
PCIE_TX3+ PCIE_TX3-	A58 A59	PCI Express channel 3, Transmit Output differential pair.	O PCIE		Supports PCI Express Base Specification, Revision 2.0
PCIE_RX4+ PCIE_RX4-	B55 B56	PCI Express channel 4, Receive Input differential pair.	I PCIE		Supports PCI Express Base Specification, Revision 2.0
PCIE_TX4+ PCIE_TX4-	A55 A56	PCI Express channel 4, Transmit Output differential pair.	O PCIE		Supports PCI Express Base Specification, Revision 2.0
PCIE_RX5+ PCIE_RX5-	B52 B53	PCI Express channel 5, Receive Input differential pair.	I PCIE		Supports PCI Express Base Specification, Revision 2.0
PCIE_TX5+ PCIE_TX5-	A52 A53	PCI Express channel 5, Transmit Output differential pair.	O PCIE		Supports PCI Express Base Specification, Revision 2.0

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PCIE_CLK_REF+ PCIE_CLK_REF-	A88 A89	PCI Express Reference Clock output for all PCI Express and PCI Express Graphics Lanes.	O PCIE		A PCI Express Gen2/3 compliant clock buffer chip must be used on the carrier board if more than one PCI Express device is designed in.

Table 9 ExpressCard Support Pins Signal Descriptions

Signal	Pin #	Description	I/O	PU/PD	Comment
EXCD0_CPPE# EXCD1_CPPE#	A49 B48	ExpressCard capable card request.	I 3.3V	PU 10k 3.3V	
EXCD0_PERST# EXCD1_PERST#	A48 B47	ExpressCard Reset	O 3.3V	PU 10k 3.3V	

Table 10 LPC Signal Descriptions

Signal	Pin #	Description	I/O	PU/PD	Comment
LPC_AD[0:3]	B4-B7	LPC multiplexed address, command and data bus	I/O 3.3V		
LPC_FRAME#	B3	LPC frame indicates the start of an LPC cycle	O 3.3V		
LPC_DRQ[0:1]#	B8-B9	LPC serial DMA request	I 3.3V		
LPC_SERIRQ	A50	LPC serial interrupt	I/O OD 3.3V	PU 10k 3.3V	
LPC_CLK	B10	LPC clock output - 33MHz nominal	O 3.3V		

Table 11 USB Signal Descriptions

Signal	Pin #	Description	I/O	PU/PD	Comment
USB0+	A46	USB Port 0, data + or D+	I/O		USB 2.0 compliant. Backwards compatible to USB 1.1
USB0-	A45	USB Port 0, data - or D-	I/O		USB 2.0 compliant. Backwards compatible to USB 1.1
USB1+	B46	USB Port 1, data + or D+	I/O		USB 2.0 compliant. Backwards compatible to USB 1.1
USB1-	B45	USB Port 1, data - or D-	I/O		USB 2.0 compliant. Backwards compatible to USB 1.1
USB2+	A43	USB Port 2, data + or D+	I/O		USB 2.0 compliant. Backwards compatible to USB 1.1
USB2-	A42	USB Port 2, data - or D-	I/O		USB 2.0 compliant. Backwards compatible to USB 1.1
USB3+	B43	USB Port 3, data + or D+	I/O		USB 2.0 compliant. Backwards compatible to USB 1.1
USB3-	B42	USB Port 3, data - or D-	I/O		USB 2.0 compliant. Backwards compatible to USB 1.1
USB4+	A40	USB Port 4, data + or D+	I/O		USB 2.0 compliant. Backwards compatible to USB 1.1

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Signal	Pin #	Description	I/O	PU/PD	Comment
USB4-	A39	USB Port 4, data - or D-	I/O		USB 2.0 compliant. Backwards compatible to USB 1.1
USB5+	B40	USB Port 5, data + or D+	I/O		USB 2.0 compliant. Backwards compatible to USB 1.1
USB5-	B39	USB Port 5, data - or D-	I/O		USB 2.0 compliant. Backwards compatible to USB 1.1
USB6+	A37	USB Port 6, data + or D+	I/O		USB 2.0 compliant. Backwards compatible to USB 1.1
USB6-	A36	USB Port 6, data - or D-	I/O		USB 2.0 compliant. Backwards compatible to USB 1.1
USB7+	B37	USB Port 7, data + or D+	I/O		USB 2.0 compliant. Backwards compatible to USB 1.1
USB7-	B36	USB Port 7, data - or D-	I/O		USB 2.0 compliant. Backwards compatible to USB 1.1
USB_0_1_OC#	B44	USB over-current sense, USB ports 0 and 1. A pull-up for this line shall be present on the module. An open drain driver from a USB current monitor on the carrier board may drive this line low.	I 3.3VSB	PU 10k 3.3VSB	Do not pull this line high on the carrier board.
USB_2_3_OC#	A44	USB over-current sense, USB ports 2 and 3. A pull-up for this line shall be present on the module. An open drain driver from a USB current monitor on the carrier board may drive this line low. .	I 3.3VSB	PU 10k 3.3VSB	Do not pull this line high on the carrier board.
USB_4_5_OC#	B38	USB over-current sense, USB ports 4 and 5. A pull-up for this line shall be present on the module. An open drain driver from a USB current monitor on the carrier board may drive this line low.	I 3.3VSB	PU 10k 3.3VSB	Do not pull this line high on the carrier board.
USB_6_7_OC#	A38	USB over-current sense, USB ports 6 and 7. A pull-up for this line shall be present on the module. An open drain driver from a USB current monitor on the carrier board may drive this line low.	I 3.3VSB	PU 10k 3.3VSB	Do not pull this line high on the carrier board.

Table 12 CRT Signal Descriptions

Signal	Pin #	Description	I/O	PU/PD	Comment
VGA_RED	B89	Red for monitor. Analog DAC output, designed to drive a 37.5-Ohm equivalent load.	O Analog	PD 150R	Analog output
VGA_GRN	B91	Green for monitor. Analog DAC output, designed to drive a 37.5-Ohm equivalent load.	O Analog	PD 150R	Analog output
VGA_BLU	B92	Blue for monitor. Analog DAC output, designed to drive a 37.5-Ohm equivalent load.	O Analog	PD 150R	Analog output
VGA_HSYNC	B93	Horizontal sync output to VGA monitor	O 3.3V		
VGA_VSYNC	B94	Vertical sync output to VGA monitor	O 3.3V		
VGA_I2C_CK	B95	DDC clock line (I²C port dedicated to identify VGA monitor capabilities)	I/O OD 5V	PU 2k2 3.3V	
VGA_I2C_DAT	B96	DDC data line.	I/O OD 5V	PU 2k2 3.3V	

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Table 13 LVDS Signal Descriptions

Signal	Pin #	Description	I/O	PU/PD	Comment
LVDS_A0+ LVDS_A0- LVDS_A1+ LVDS_A1- LVDS_A2+ LVDS_A2- LVDS_A3+ LVDS_A3-	A71 A72 A73 A74 A75 A76 A78 A79	LVDS Channel A differential pairs	O LVDS		
LVDS_A_CK+ LVDS_A_CK-	A81 A82	LVDS Channel A differential clock	O LVDS		
LVDS_B0+ LVDS_B0- LVDS_B1+ LVDS_B1- LVDS_B2+ LVDS_B2- LVDS_B3+ LVDS_B3-	B71 B72 B73 B74 B75 B76 B77 B78	LVDS Channel B differential pairs	O LVDS		
LVDS_B_CK+ LVDS_B_CK-	B81 B82	LVDS Channel B differential clock	O LVDS		
LVDS_VDD_EN	A77	LVDS panel power enable	O 3.3V	PD 10k	
LVDS_BKLT_EN	B79	LVDS panel backlight enable	O 3.3V	PD 10k	
LVDS_BKLT_CTRL	B83	LVDS panel backlight brightness control	O 3.3V		
LVDS_I2C_CK	A83	DDC lines used for flat panel detection and control.	O 3.3V	PU 2k2 3.3V	
LVDS_I2C_DAT	A84	DDC lines used for flat panel detection and control.	I/O 3.3V	PU 2k2 3.3V	.

Table 14 Embedded DisplayPort Signal Descriptions

Signal	Pin #	Description	I/O	PU/PD	Comment
eDP_TX3+ eDP_TX3- eDP_TX2+ eDP_TX2- eDP_TX1+ eDP_TX1- eDP_TX0+ eDP_TX0-	A81 A82 A71 A72 A73 A74 A75 A76	eDP differential pairs.	AC coupled off module.		eDP_TX2 and eDP_TX3 pairs are not supported on conga-TS87.

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Signal	Pin #	Description	I/O	PU/PD	Comment
eDP_VDD_EN	A77	eDP power enable.	O 3.3V	PD 10k	
eDP_BKLT_EN	B79	eDP backlight enable.	O 3.3V	PD 10k	
eDP_BKLT_CTRL	B83	eDP backlight brightness control.	O 3.3V		
eDP_AUX+	A83	eDP AUX+.	AC coupled off module.		
eDP_AUX-	A84	eDP AUX-.	AC coupled off module.		
eDP_HPD	A87	Detection of Hot Plug / Unplug and notification of the link layer.	I 3.3V		

Table 15 SPI BIOS Flash Interface Signal Descriptions

Signal	Pin #	Description	I/O	PU/PD	Comment
SPI_CS#	B97	Chip select for Carrier Board SPI BIOS Flash.	O 3.3VSB		Carrier shall pull to SPI_POWER when external SPI provided but not used.
SPI_MISO	A92	Data in to module from carrier board SPI BIOS flash.	I 3.3VSB		
SPI_MOSI	A95	Data out from module to carrier board SPI BIOS flash.	O 3.3VSB		
SPI_CLK	A94	Clock from module to carrier board SPI BIOS flash.	O 3.3VSB		
SPI_POWER	A91	Power source for carrier board SPI BIOS flash. SPI_POWER shall be used to power SPI BIOS flash on the carrier only.	+ 3.3VSB		
BIOS_DIS0#	A34	Selection strap to determine the BIOS boot device.	I 3.3VSB	PU 10K 3.3VSB	Carrier shall be left as no-connect.
BIOS_DIS1#	B88	Selection strap to determine the BIOS boot device.	I 3.3VSB	PU 10K 3.3VSB	Carrier shall be left as no-connect

Table 16 Miscellaneous Signal Descriptions

Signal	Pin #	Description	I/O	PU/PD	Comment
I2C_CK	B33	General purpose I²C port clock output/input	I/O 3.3V	PU 2K2 3.3VSB	
I2C_DAT	B34	General purpose I²C port data I/O line	I/O 3.3V	PU 2K2 3.3VSB	
SPKR	B32	Output for audio enunciator, the “speaker” in PC-AT systems	O 3.3V		SPEAKER is a boot strap signal (see note below)
WDT	B27	Output indicating that a watchdog time-out event has occurred.	O 3.3V	PD 10K	

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Signal	Pin #	Description	I/O	PU/PD	Comment
FAN_PWNOUT	B101	Fan speed control. Uses the Pulse Width Modulation (PWM) technique to control the fan's RPM.	O OD 3.3V	PU 10K 3.3V	
FAN_TACHIN	B102	Fan tachometer input.	I OD	PU 10K 3.3V	Requires a fan with a two pulse output.
TPM_PP	A96	Physical Presence pin of Trusted Platform Module (TPM). Active high. TPM chip has an internal pull-down. This signal is used to indicate Physical Presence to the TPM.	I 3.3V		Trusted Platform Module chip is optional.

Note

Some signals have special functionality during the reset process. They may bootstrap some basic important functions of the module. For more information refer to section 9.5 of this user's guide.

Table 17 General Purpose I/O Signal Descriptions

Signal	Pin #	Description	I/O	PU/PD	Comment
GPO0	A93	General purpose output pins. Shared with SD_CLK. Output from COM Express, input to SD	O 3.3V		SDIO interface is not supported on the conga-TS87
GPO1	B54	General purpose output pins. Shared with SD_CMD. Output from COM Express, input to SD	O 3.3V		SDIO interface is not supported on the conga-TS87
GPO2	B57	General purpose output pins. Shared with SD_WP. Output from COM Express, input to SD	O 3.3V		SDIO interface is not supported on the conga-TS87
GPO3	B63	General purpose output pins. Shared with SD_CD. Output from COM Express, input to SD	O 3.3V		SDIO interface is not supported on the conga-TS87
GPI0	A54	General purpose input pins. Pulled high internally on the module. Shared with SD_DATA0. Bidirectional signal	I 3.3V	PU 10K 3.3V	SDIO interface is not supported on the conga-TS87
GPI1	A63	General purpose input pins. Pulled high internally on the module. Shared with SD_DATA1. Bidirectional signal	I 3.3V	PU 10K 3.3V	SDIO interface is not supported on the conga-TS87
GPI2	A67	General purpose input pins. Pulled high internally on the module. Shared with SD_DATA2. Bidirectional signal	I 3.3V	PU 10K 3.3V	SDIO interface is not supported on the conga-TS87
GPI3	A85	General purpose input pins. Pulled high internally on the module. Shared with SD_DATA3. Bidirectional signal.	I 3.3V	PU 10K 3.3V	SDIO interface is not supported on the conga-TS87

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Table 18 Power and System Management Signal Descriptions

Signal	Pin #	Description	I/O	PU/PD	Comment
PWRBTN#	B12	Power button to bring system out of S5 (soft off), active on falling edge.	I 3.3VSB	PU 10k 3.3VSB	
SYS_RESET#	B49	Reset button input. Active low input. Edge triggered. System will not be held in hardware reset while this input is kept low.	I 3.3VSB	PU 10k 3.3VSB	
CB_RESET#	B50	Reset output from module to Carrier Board. Active low. Issued by module chipset and may result from a low SYS_RESET# input, a low PWR_OK input, a VCC_12V power input that falls below the minimum specification, a watchdog timeout, or may be initiated by the module software.	O 3.3V	PD 100k	
PWR_OK	B24	Power OK from main power supply. A high value indicates that the power is good.	I 3.3V		Set by resistor divider to accept 3.3V.
SUS_STAT#	B18	Indicates imminent suspend operation; used to notify LPC devices.	O 3.3VSB	PU 10k 3.3VSB	
SUS_S3#	A15	Indicates system is in Suspend to RAM state. Active-low output. An inverted copy of SUS_S3# on the carrier board (also known as "PS_ON") may be used to enable the non-standby power on a typical ATX power supply.	O 3.3VSB		
SUS_S4#	A18	Indicates system is in Suspend to Disk state. Active low output.	O 3.3VSB		
SUS_S5#	A24	Indicates system is in Soft Off state.	O 3.3VSB		
WAKE0#	B66	PCI Express wake up signal.	I 3.3VSB	PU 1k 3.3VSB	
WAKE1#	B67	General purpose wake up signal. May be used to implement wake-up on PS/2 keyboard or mouse activity.	I 3.3VSB	PU 10k 3.3VSB	
BATLOW#	A27	Battery low input. This signal may be driven low by external circuitry to signal that the system battery is low, or may be used to signal some other external power-management event.	I 3.3VSB	PU 10k 3.3VSB	
THRM#	B35	Input from off-module temp sensor indicating an over-temp situation.	I 3.3V	PU 10k 3.3V	
THERMTRIP#	A35	Active low output indicating that the CPU has entered thermal shutdown.	O 3.3V	PU 10k 3.3V	
SMB_CK	B13	System Management Bus bidirectional clock line.	I/O 3.3VSB	PU 2k2 3.3VSB	
SMB_DAT#	B14	System Management Bus bidirectional data line.	I/O OD 3.3VSB	PU 2k2 3.3VSB	
SMB_ALERT#	B15	System Management Bus Alert – active low input can be used to generate an SMI# (System Management Interrupt) or to wake the system.	I 3.3VSB	PU 10k 3.3VSB	
LID#	A103	Lid button. Used by the ACPI operating system for a LID switch.	I OD 3.3V	PU 10k 3.3VSB	
SLEEP	B103	Sleep button. Used by the ACPI operating system to bring the system to sleep state or to wake it up again.	I OD 3.3V	PU 10k 3.3VSB	

Table 19 General Purpose Serial Interface Signal Descriptions

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Signal	Pin #	Description	I/O	PU/PD	Comment
SER0_TX	A98	General purpose serial port transmitter	O 3.3V		Supported on Rev. B.0 and later
SER1_TX	A101	General purpose serial port transmitter	O 3.3V		Supported on Rev. B.0 and later
SER0_RX	A99	General purpose serial port receiver	I 3.3V	PU 50k 3.3V	Supported on Rev. B.0 and later
SER1_RX	A102	General purpose serial port receiver	I 3.3V	PU 50k 3.3V	Supported on Rev. B.0 and later

Table 20 Power and GND Signal Descriptions

Signal	Pin #	Description	I/O	PU/PD	Comment
VCC_12V	A104-A109 B104-B109	Primary power input: +12V nominal. All available VCC_12V pins on the connector(s) shall be used.	P		
VCC_5V_SBY	B84-B87	Standby power input: +5.0V nominal. If VCC5_SBY is used, all available VCC_5V_SBY pins on the connector(s) shall be used. Only used for standby and suspend functions. May be left unconnected if these functions are not used in the system design.	P		
VCC_RTC	A47	Real-time clock circuit-power input. Nominally +3.0V.	P		
GND	A1, A11, A21, A31, A41, A51, A57, A60, A66, A70, A80, A90, A100, A110, B1, B11, B21, B31, B41, B51, B60, B70, B80, B90, B100, B110	Ground - DC power and signal and AC signal return path. All available GND connector pins shall be used and tied to Carrier Board GND plane.	P		

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9.2 A-B Connector Pinout

Table 21 Connector A-B Pinout

Pin	Row A	Pin	Row B	Pin	Row A	Pin	Row B
A1	GND (FIXED)	B1	GND (FIXED)	A56	PCIE_TX4-	B56	PCIE_RX4-
A2	GBE0_MDI3-	B2	GBE0_ACT#	A57	GND	B57	GPO2
A3	GBE0_MDI3+	B3	LPC_FRAME#	A58	PCIE_TX3+	B58	PCIE_RX3+
A4	GBE0_LINK100#	B4	LPC_AD0	A59	PCIE_TX3-	B59	PCIE_RX3-
A5	GBE0_LINK1000#	B5	LPC_AD1	A60	GND (FIXED)	B60	GND (FIXED)
A6	GBE0_MDI2-	B6	LPC_AD2	A61	PCIE_TX2+	B61	PCIE_RX2+
A7	GBE0_MDI2+	B7	LPC_AD3	A62	PCIE_TX2-	B62	PCIE_RX2-
A8	GBE0_LINK#	B8	LPC_DRQ0#	A63	GPI1	B63	GPO3
A9	GBE0_MDI1-	B9	LPC_DRQ1#	A64	PCIE_TX1+	B64	PCIE_RX1+
A10	GBE0_MDI1+	B10	LPC_CLK	A65	PCIE_TX1-	B65	PCIE_RX1-
A11	GND (FIXED)	B11	GND (FIXED)	A66	GND	B66	WAKE0#
A12	GBE0_MDI0-	B12	PWRBTN#	A67	GPI2	B67	WAKE1#
A13	GBE0_MDI0+	B13	SMB_CK	A68	PCIE_TX0+	B68	PCIE_RX0+
A14	GBE0_CTREF (*)	B14	SMB_DAT	A69	PCIE_TX0-	B69	PCIE_RX0-
A15	SUS_S3#	B15	SMB_ALERT#	A70	GND (FIXED)	B70	GND (FIXED)
A16	SATA0_TX+	B16	SATA1_TX+	A71	eDP_TX2+/LVDS_A0+	B71	LVDS_B0+
A17	SATA0_TX-	B17	SATA1_TX-	A72	eDP_TX2-/LVDS_A0-	B72	LVDS_B0-
A18	SUS_S4#	B18	SUS_STAT#	A73	eDP_TX1+/LVDS_A1+	B73	LVDS_B1+
A19	SATA0_RX+	B19	SATA1_RX+	A74	eDP_TX1-/LVDS_A1-	B74	LVDS_B1-
A20	SATA0_RX-	B20	SATA1_RX-	A75	eDP_TX0+/LVDS_A2+	B75	LVDS_B2+
A21	GND (FIXED)	B21	GND (FIXED)	A76	eDP_TX0-/LVDS_A2-	B76	LVDS_B2-
A22	SATA2_TX+	B22	SATA3_TX+	A77	eDP/LVDS_VDD_EN	B77	LVDS_B3+
A23	SATA2_TX-	B23	SATA3_TX-	A78	LVDS_A3+	B78	LVDS_B3-
A24	SUS_S5#	B24	PWR_OK	A79	LVDS_A3-	B79	eDP/LVDS_BKLT_EN
A25	SATA2_RX+	B25	SATA3_RX+	A80	GND (FIXED)	B80	GND (FIXED)
A26	SATA2_RX-	B26	SATA3_RX-	A81	eDP_TX3+/LVDS_A_CK+	B81	LVDS_B_CK+
A27	BATLOW#	B27	WDT	A82	eDP_TX3-/LVDS_A_CK-	B82	LVDS_B_CK-
A28	(S)ATA_ACT#	B28	AC/HDA_SDIN2	A83	eDP_AUX+/LVDS_I2C_CK	B83	eDP/LVDS_BKLT_CTRL
A29	AC/HDA_SYNC	B29	AC/HDA_SDIN1	A84	eDP_AUX-/LVDS_I2C_DAT	B84	VCC_5V_SBY
A30	AC/HDA_RST#	B30	AC/HDA_SDIN0	A85	GPI3	B85	VCC_5V_SBY

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Pin	Row A	Pin	Row B	Pin	Row A	Pin	Row B
A31	GND (FIXED)	B31	GND (FIXED)	A86	RSVD	B86	VCC_5V_SBY
A32	AC/HDA_BITCLK	B32	SPKR	A87	eDP_HPD	B87	VCC_5V_SBY
A33	AC/HDA_SDOUT	B33	I2C_CK	A88	PCIE0_CK_REF+	B88	BIOS_DIS1#
A34	BIOS_DIS0#	B34	I2C_DAT	A89	PCIE0_CK_REF-	B89	VGA_RED
A35	THRMTRIP#	B35	THRM#	A90	GND (FIXED)	B90	GND (FIXED)
A36	USB6-	B36	USB7-	A91	SPI_POWER	B91	VGA_GRN
A37	USB6+	B37	USB7+	A92	SPI_MISO	B92	VGA_BLU
A38	USB_6_7_OC#	B38	USB_4_5_OC#	A93	GPO0	B93	VGA_HSYNC
A39	USB4-	B39	USB5-	A94	SPI_CLK	B94	VGA_VSYNC
A40	USB4+	B40	USB5+	A95	SPI_MOSI	B95	VGA_I2C_CK
A41	GND (FIXED)	B41	GND (FIXED)	A96	TPM_PP	B96	VGA_I2C_DAT
A42	USB2-	B42	USB3-	A97	TYPE10#	B97	SPI_CS#
A43	USB2+	B43	USB3+	A98	SER0_TX	B98	RSVD
A44	USB_2_3_OC#	B44	USB_0_1_OC#	A99	SER0_RX	B99	RSVD
A45	USB0-	B45	USB1-	A100	GND (FIXED)	B100	GND (FIXED)
A46	USB0+	B46	USB1+	A101	SER1_TX	B101	FAN_PWMOUT
A47	VCC_RTC	B47	EXCD1_PERST#	A102	SER1_RX	B102	FAN_TACHIN
A48	EXCD0_PERST#	B48	EXCD1_CPPE#	A103	LID#	B103	SLEEP#
A49	EXCD0_CPPE#	B49	SYS_RESET#	A104	VCC_12V	B104	VCC_12V
A50	LPC_SERIRQ	B50	CB_RESET#	A105	VCC_12V	B105	VCC_12V
A51	GND (FIXED)	B51	GND (FIXED)	A106	VCC_12V	B106	VCC_12V
A52	PCIE_TX5+	B52	PCIE_RX5+	A107	VCC_12V	B107	VCC_12V
A53	PCIE_TX5-	B53	PCIE_RX5-	A108	VCC_12V	B108	VCC_12V
A54	GPI0	B54	GPO1	A109	VCC_12V	B109	VCC_12V
A55	PCIE_TX4+	B55	PCIE_RX4+	A110	GND (FIXED)	B110	GND (FIXED)

Note

The signals marked with asterisk symbol (*) are not supported on the conga TS87.

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9.3 C-D Connector Signal Descriptions

Table 22 PCI Express Signal Descriptions (general purpose)

Signal	Pin #	Description	I/O	PU/PD	Comment
PCIE_RX6+ PCIE_RX6-	C19 C20	PCI Express channel 6, Receive Input differential pair.	I PCIE		Supports PCI Express Base Specification, Revision 2.0
PCIE_TX6+ PCIE_TX6-	D19 D20	PCI Express channel 6, Transmit Output differential pair.	O PCIE		Supports PCI Express Base Specification, Revision 2.0
PCIE_RX7+ PCIE_RX7-	C22 C23	PCI Express channel 7, Receive Input differential pair.	I PCIE		Not supported
PCIE_TX7+ PCIE_TX7-	D22 D23	PCI Express channel 7, Transmit Output differential pair.	O PCIE		Not supported

Table 23 USB 3.0 Signal Descriptions

Signal	Pin #	Description	I/O	PU/PD	Comment
USB_SSRX0+	C4	Additional receive signal differential pairs for the Superspeed USB data path	I		
USB_SSRX0-	C3		I		
USB_SSTX0+	D4	Additional transmit signal differential pairs for the Superspeed USB data path	O		
USB_SSTX0-	D3		O		
USB_SSRX1+	C7	Additional receive signal differential pairs for the Superspeed USB data path	I		
USB_SSRX1-	C6		I		
USB_SSTX1+	D7	Additional transmit signal differential pairs for the Superspeed USB data path	O		
USB_SSTX1-	D6		O		
USB_SSRX2+	C10	Additional receive signal differential pairs for the Superspeed USB data path	I		
USB_SSRX2-	C9		I		
USB_SSTX2+	D10	Additional transmit signal differential pairs for the Superspeed USB data path	O		
USB_SSTX2-	D9		O		
USB_SSRX3+	C13	Additional receive signal differential pairs for the Superspeed USB data path	I		
USB_SSRX3-	C12		I		
USB_SSTX3+	D13	Additional transmit signal differential pairs for the Superspeed USB data path	O		
USB_SSTX3-	D12		O		

Table 24 PCI Express Signal Descriptions (x16 Graphics)

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Signal	Pin #	Description	I/O	PU/PD	Comment
PEG_RX0+	C52	PCI Express Graphics Receive Input differential pairs. Note: Can also be used as PCI Express Receive Input differential pairs 16 through 31 known as PCIE_RX[16-31] + and -.	I PCIE		
PEG_RX0-	C53				
PEG_RX1+	C55				
PEG_RX1-	C56				
PEG_RX2+	C58				
PEG_RX2-	C59				
PEG_RX3+	C61				
PEG_RX3-	C62				
PEG_RX4+	C65				
PEG_RX4-	C66				
PEG_RX5+	C68				
PEG_RX5-	C69				
PEG_RX6+	C71				
PEG_RX6-	C72				
PEG_RX7+	C74				
PEG_RX7-	C75				
PEG_RX8+	C78				
PEG_RX8-	C79				
PEG_RX9+	C81				
PEG_RX9-	C82				
PEG_RX10+	C85				
PEG_RX10-	C86				
PEG_RX11+	C88				
PEG_RX11-	C89				
PEG_RX12+	C91				
PEG_RX12-	C92				
PEG_RX13+	C94				
PEG_RX13-	C95				
PEG_RX14+	C98				
PEG_RX14-	C99				
PEG_RX15+	C101				
PEG_RX15-	C102				

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Signal	Pin #	Description	I/O	PU/PD	Comment
PEG_TX0+ PEG_TX0- PEG_TX1+ PEG_TX1- PEG_TX2+ PEG_TX2- PEG_TX3+ PEG_TX3- PEG_TX4+ PEG_TX4- PEG_TX5+ PEG_TX5- PEG_TX6+ PEG_TX6- PEG_TX7+ PEG_TX7- PEG_TX8+ PEG_TX8- PEG_TX9+ PEG_TX9- PEG_TX10+ PEG_TX10- PEG_TX11+ PEG_TX11- PEG_TX12+ PEG_TX12- PEG_TX13+ PEG_TX13- PEG_TX14+ PEG_TX14- PEG_TX15+ PEG_TX15-	D52 D53 D55 D56 D58 D59 D61 D62 D65 D66 D68 D69 D71 D72 D74 D75 D78 D79 D81 D82 D85 D86 D88 D89 D91 D92 D94 D95 D98 D99 D101 D102	PCI Express Graphics Transmit Output differential pairs. Note: Can also be used as PCI Express Transmit Output differential pairs 16 through 31 known as PCIE_TX[16-31] + and -.	O PCIE		
PEG_LANE_RV#	D54	PCI Express Graphics lane reversal input strap. Pull low on the carrier board to reverse lane order.	I	PU 10k 3.3V	PEG_LAN_RV# is a boot strap signal (see note below)

Note

Dedicated PEG Channels are provided in Type 6. SDVO is no longer multiplexed on the PEG port.

Some signals have special functionality during the reset process. They may bootstrap some basic important functions of the module. For more information refer to section 9.5 of this user's guide.

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Table 25 DDI Signal Description

Signal	Pin #	Description	I/O	PU/PD	Comment
DDI1_PAIR0+ DDI1_PAIR0-	D26 D27	Multiplexed with DP1_LANE0+ and TMDS1_DATA2+. Multiplexed with DP1_LANE0- and TMDS1_DATA2-.	O PCIE		
DDI1_PAIR1+ DDI1_PAIR1-	D29 D30	Multiplexed with DP1_LANE1+ and TMDS1_DATA1+. Multiplexed with DP1_LANE1- and TMDS1_DATA1-.	O PCIE		
DDI1_PAIR2+ DDI1_PAIR2-	D32 D33	Multiplexed with DP1_LANE2+ and TMDS1_DATA0+. Multiplexed with DP1_LANE2- and TMDS1_DATA0-.	O PCIE		
DDI1_PAIR3+ DDI1_PAIR3-	D36 D37	Multiplexed with DP1_LANE3+ and TMDS1_CLK+. Multiplexed with DP1_LANE3- and TMDS1_CLK-.	O PCIE		
DDI1_PAIR4+ DDI1_PAIR4-	C25 C26	Multiplexed with SDVO1_INT+. Multiplexed with SDVO1_INT-.			Not supported
DDI1_PAIR5+ DDI1_PAIR5-	C29 C30	Multiplexed with SDVO1_TVCLKIN+. Multiplexed with SDVO1_TVCLKIN-.			Not supported
DDI1_PAIR6+ DDI1_PAIR6-	C15 C16	Multiplexed with SDVO1_FLDSTALL+. Multiplexed with SDVO1_FLDSTALL-.			Not supported
DDI1_HPD	C24	Multiplexed with DP1_HPD and HDMI1_HPD.	I 3.3V	PD 1M	
DDI1_CTRLCLK_AUX+	D15	Multiplexed with DP1_AUX+ and HMDI1_CTRLCLK. DP AUX+ function if DDI1_DDC_AUX_SEL is no connect. HDMI/DVI I2C CTRLCLK if DDI1_DDC_AUX_SEL is pulled high	I/O PCIE I/O OD 3.3V	PD100k	
DDI1_CTRLDATA_AUX-	D16	Multiplexed with DP1_AUX- and HDMI1_CTRLDATA. DP AUX- function if DDI1_DDC_AUX_SEL is no connect. HDMI/DVI I2C CTRLDATA if DDI1_DDC_AUX_SEL is pulled high	I/O PCIE I/O OD 3.3V	PU 100k 3.3V	DDI1_CTRLDATA_AUX- is a boot strap signal (see not below). DDI enable strap already populated.
DDI1_DDC_AUX_SEL	D34	Selects the function of DDI1_CTRLCLK_AUX+ and DDI1_CTRLDATA_AUX- . This pin shall have a IM pull-down to logic ground on the module. If this input is floating, the AUX pair is used for the DP AUX+/- signals. If pulled-high, the AUX pair contains the CTRLCLK and CTRLDATA signals.	I 3.3V	PD 1M	
DDI2_PAIR0+ DDI2_PAIR0-	D39 D40	Multiplexed with DP2_LANE0+ and TMDS2_DATA2+. Multiplexed with DP2_LANE0- and TMDS2_DATA2-.	O PCIE		
DDI2_PAIR1+ DDI2_PAIR1-	D42 D43	Multiplexed with DP2_LANE1+ and TMDS2_DATA1+. Multiplexed with DP2_LANE1- and TMDS2_DATA1-.	O PCIE		
DDI2_PAIR2+ DDI2_PAIR2-	D46 D47	Multiplexed with DP2_LANE2+ and TMDS2_DATA0+. Multiplexed with DP2_LANE2- and TMDS2_DATA0-.	O PCIE		
DDI2_PAIR3+ DDI2_PAIR3-	D49 D50	Multiplexed with DP2_LANE3+ and TMDS2_CLK+. Multiplexed with DP2_LANE3- and TMDS2_CLK-.	O PCIE		
DDI2_HPD	D44	Multiplexed with DP2_HPD and HDMI2_HPD.	I 3.3V	PD 1M	

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Signal	Pin #	Description	I/O	PU/PD	Comment
DDI2_CTRLCLK_AUX+	C32	Multiplexed with DP2_AUX+ and HDMI2_CTRLCLK. DP AUX+ function if DDI2_DDC_AUX_SEL is no connect. HDMI/DVI I2C CTRLCLK if DDI2_DDC_AUX_SEL is pulled high	I/O PCIE I/O OD 3.3V	PD 100k	
DDI2_CTRLDATA_AUX-	C33	Multiplexed with DP2_AUX- and HDMI2_CTRLDATA. DP AUX- function if DDI2_DDC_AUX_SEL is no connect. HDMI/DVI I2C CTRLDATA if DDI2_DDC_AUX_SEL is pulled high.	I/O PCIE I/O OD 3.3V	PU 100k 3.3V	DDI2_CTRLCLK_AUX- is a boot strap signal (see note below). DDI enable strap already populated.
DDI2_DDC_AUX_SEL	C34	Selects the function of DDI2_CTRLCLK_AUX+ and DDI2_CTRLDATA_AUX- . This pin shall have a IM pull-down to logic ground on the module. If this input is floating, the AUX pair is used for the DP AUX+/- signals. If pulled-high, the AUX pair contains the CTRLCLK and CTRLDATA signals	I 3.3V		
DDI3_PAIR0+ DDI3_PAIR0-	C39 C40	Multiplexed with DP3_LANE0+ and TMDS3_DATA2+. Multiplexed with DP3_LANE0- and TMDS3_DATA2-.	O PCIE		
DDI3_PAIR1+ DDI3_PAIR1-	C42 C43	Multiplexed with DP3_LANE1+ and TMDS3_DATA1+. Multiplexed with DP3_LANE1- and TMDS3_DATA1-.	O PCIE		
DDI3_PAIR2+ DDI3_PAIR2-	C46 C47	Multiplexed with DP3_LANE2+ and TMDS3_DATA0+. Multiplexed with DP3_LANE2- and TMDS3_DATA0-.	O PCIE		
DDI3_PAIR3+ DDI3_PAIR3-	C49 C50	Multiplexed with DP3_LANE3+ and TMDS3_CLK+. Multiplexed with DP3_LANE3- and TMDS3_CLK-.	O PCIE		
DDI3_HPD	C44	Multiplexed with DP3_HPD and HDMI3_HPD.	I 3.3V	PD 1M	
DDI3_CTRLCLK_AUX+	C36	Multiplexed with DP3_AUX+ and HDMI3_CTRLCLK. DP AUX+ function if DDI3_DDC_AUX_SEL is no connect. HDMI/DVI I2C CTRLCLK if DDI3_DDC_AUX_SEL is pulled high	I/O PCIE I/O OD 3.3V	PD 100k	
DDI3_CTRLDATA_AUX-	C37	Multiplexed with DP3_AUX- and HDMI3_CTRLDATA. DP AUX- function if DDI3_DDC_AUX_SEL is no connect. HDMI/DVI I2C CTRLDATA if DDI3_DDC_AUX_SEL is pulled high.	I/O PCIE I/O OD 3.3V	PU 100k	DDI3_CTRLDATA_AUX- is a boot strap signal (see note below). DDI enable strap already populated.
DDI3_DDC_AUX_SEL	C38	Selects the function of DDI3_CTRLCLK_AUX+ and DDI3_CTRLDATA_AUX- . This pin shall have a IM pull-down to logic ground on the module. If this input is floating, the AUX pair is used for the DP AUX+/- signals. If pulled-high, the AUX pair contains the CTRLCLK and CTRLDATA signals	I 3.3V	PD 1M	

Note

Some signals have special functionality during the reset process. They may bootstrap some basic important functions of the module. For more information refer to section 9.5 of this user's guide.

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The Digital Display Interface (DDI) signals are multiplexed with HDMI and DisplayPort (DP). The signals for these interfaces are routed to the DDI interface of the COM Express connector. Refer to the HDMI and DisplayPort signal description tables in this section for information about the signals routed to the DDI interface of the COM Express connector.

Table 26 HDMI Signal Descriptions

Signal	Pin #	Description	I/O	PU/PD	Comment
TMDS1_CLK + TMDS1_CLK -	D36 D37	HDMI/DVI TMDS Clock output differential pair. Multiplexed with DDI1_PAIR3+ and DDI1_PAIR3-.	O PCIE		
TMDS1_DATA0+ TMDS1_DATA0-	D32 D33	HDMI/DVI TMDS differential pair. Multiplexed with DDI1_PAIR2+ and DDI1_PAIR2-.	O PCIE		
TMDS1_DATA1+ TMDS1_DATA1-	D29 D30	HDMI/DVI TMDS differential pair. Multiplexed with DDI1_PAIR1+ and DDI1_PAIR1-..	O PCIE		
TMDS1_DATA2+ TMDS1_DATA2-	D26 D27	HDMI/DVI TMDS differential pair. Multiplexed with DDI1_PAIR0+ and DDI1_PAIR0-.	O PCIE		
HDMI1_HPD	C24	HDMI/DVI Hot-plug detect. Multiplexed with DDI1_HPD.	I PCIE	PD 1M	
HDMI1_CTRLCLK	D15	HDMI/DVI I²C Control Clock Multiplexed with DDI1_CTRLCLK_AUX+	I/O OD 3.3V	PD 100k	
HDMI1_CTRLDATA	D16	HDMI/DVI I²C Control Data Multiplexed with DDI1_CTRLDATA_AUX-	I/O OD 3.3V	PU 100k 3.3V	HDMI1_CTRLDATA is a boot strap signal (see note below). HDMI enable strap already populated
TMDS2_CLK + TMDS2_CLK -	D49 D50	HDMI/DVI TMDS Clock output differential pair.. Multiplexed with DDI2_PAIR3+ and DDI2_PAIR3-.	O PCIE		
TMDS2_DATA0+ TMDS2_DATA0-	D46 D47	HDMI/DVI TMDS differential pair. Multiplexed with DDI2_PAIR2+ and DDI2_PAIR2-.	O PCIE		
TMDS2_DATA1+ TMDS2_DATA1-	D42 D43	HDMI/DVI TMDS differential pair. Multiplexed with DDI2_PAIR1+ and DDI2_PAIR1-.	O PCIE		
TMDS2_DATA2+ TMDS2_DATA2-	D39 D40	HDMI/DVI TMDS differential pair. Multiplexed with DDI2_PAIR0+ and DDI2_PAIR0-..	O PCIE		
HDMI2_HPD	D44	HDMI/DVI Hot-plug detect. Multiplexed with DDI2_HPD	I PCIE	PD 1M	
HDMI2_CTRLCLK	C32	HDMI/DVI I²C Control Clock Multiplexed with DDI2_CTRLCLK_AUX+	I/O OD 3.3V	PD 100k	
HDM12_CTRLDATA	C33	HDMI/DVI I²C Control Data Multiplexed with DDI2_CTRLDATA_AUX-	I/O OD 3.3V	PU 100k 3.3V	HDMI2_CTRLDATA is a boot strap signal (see note below). HDMI enable strap is already populated.
TMDS3_CLK + TMDS3_CLK -	C49 C50	HDMI/DVI TMDS Clock output differential pair.. Multiplexed with DDI3_PAIR3+ and DDI3_PAIR3-.	O PCIE		
TMDS3_DATA0+ TMDS3_DATA0-	C46 C47	HDMI/DVI TMDS differential pair. Multiplexed with DDI3_PAIR2+ and DDI3_PAIR2-.	O PCIE		

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Signal	Pin #	Description	I/O	PU/PD	Comment
TMDS3_DATA1+ TMDS3_DATA1-	C42 C43	HDMI/DVI TMDS differential pair. Multiplexed with DDI3_PAIR1+ and DDI3_PAIR1-..	O PCIE		
TMDS3_DATA2+ TMDS3_DATA2-	C39 C40	HDMI/DVI TMDS differential pair. Multiplexed with DDI3_PAIR0+ and DDI3_PAIR0-.	O PCIE		
HDMI3_HPD	C44	HDMI/DVI Hot-plug detect. Multiplexed with DDI3_HPD.	I PCIE	PD 1M	
HDMI3_CTRLCLK	C36	HDMI/DVI I²C Control Clock Multiplexed with DDI3_CTRLCLK_AUX+	I/O OD 3.3V	PD 100k	
HDMI3_CTRLDATA	C37	HDMI/DVI I²C Control Data Multiplexed with DDI3_CTRLDATA_AUX-	I/O OD 3.3V	PU 100k 3.3V	HDMI3_CTRLDATA is a boot strap signal (see note below). HDMI enable strap is already populated.

Note

Some signals have special functionality during the reset process. They may bootstrap some basic important functions of the module. For more information refer to section 9.5 of this user's guide.

Table 27 DisplayPort (DP) Signal Descriptions

Signal	Pin #	Description	I/O	PU/PD	Comment
DP1_LANE3+ DP1_LANE3-	D36 D37	Uni-directional main link for the transport of isochronous streams and secondary data. Multiplexed with DDI1_PAIR3+ and DDI1_PAIR3-.	O PCIE		
DP1_LANE2+ DP1_LANE2-	D32 D33	Uni-directional main link for the transport of isochronous streams and secondary data. Multiplexed with DDI1_PAIR2+ and DDI1_PAIR2-.	O PCIE		
DP1_LANE1+ DP1_LANE1-	D29 D30	Uni-directional main link for the transport of isochronous streams and secondary data. Multiplexed with DDI1_PAIR1+ and DDI1_PAIR1-.	O PCIE		
DP1_LANE0+ DP1_LANE0-	D26 D27	Uni-directional main link for the transport of isochronous streams and secondary data. Multiplexed with DDI1_PAIR0+ and DDI1_PAIR0-.	O PCIE		
DP1_HPD	C24	Detection of Hot Plug / Unplug and notification of the link layer. Multiplexed with DDI1_HPD.	I 3.3V	PD 1M	
DP1_AUX+	D15	Half-duplex bi-directional AUX channel for services such as link configuration or maintenance and EDID access.	I/O PCIE	PD 100k	
DP1_AUX-	D16	Half-duplex bi-directional AUX channel for services such as link configuration or maintenance and EDID access.	I/O PCIE	PU 100k 3.3V	DP1_AUX- is a boot strap signal (see note below). DP enable strap is already populated.

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Signal	Pin #	Description	I/O	PU/PD	Comment
DP2_LANE3+ DP2_LANE3-	D49 D50	Uni-directional main link for the transport of isochronous streams and secondary data. Multiplexed with DDI2_PAIR3+ and DDI2_PAIR3-	O PCIE		
DP2_LANE2+ DP2_LANE2-	D46 D47	Uni-directional main link for the transport of isochronous streams and secondary data. Multiplexed with DDI2_PAIR2+ and DDI2_PAIR2-	O PCIE		
DP2_LANE1+ DP2_LANE1-	D42 D43	Uni-directional main link for the transport of isochronous streams and secondary data. Multiplexed with DDI2_PAIR1+ and DDI2_PAIR1-	O PCIE		
DP2_LANE0+ DP2_LANE0-	D39 D40	Uni-directional main link for the transport of isochronous streams and secondary data. Multiplexed with DDI2_PAIR0+ and DDI1_PAIR0-	O PCIE		
DP2_HPD	D44	Detection of Hot Plug / Unplug and notification of the link layer. Multiplexed with DDI2_HPD.	I 3.3V	PD 1M	
DP2_AUX+	C32	Half-duplex bi-directional AUX channel for services such as link configuration or maintenance and EDID access.	I/O PCIE	PD 100k	
DP2_AUX-	C33	Half-duplex bi-directional AUX channel for services such as link configuration or maintenance and EDID access.	I/O PCIE	PU 100k 3.3V	DP2_AUX- is a boot strap signal (see note below). DP enable strap already populated.
DP3_LANE3+ DP3_LANE3-	C49 C50	Uni-directional main link for the transport of isochronous streams and secondary data. Multiplexed with DDI3_PAIR3+ and DDI3_PAIR3-.	O PCIE		
DP3_LANE2+ DP3_LANE2-	C46 C47	Uni-directional main link for the transport of isochronous streams and secondary data. Multiplexed with DDI3_PAIR2+ and DDI3_PAIR2-.	O PCIE		
DP3_LANE1+ DP3_LANE1-	C42 C43	Uni-directional main link for the transport of isochronous streams and secondary data. Multiplexed with DDI3_PAIR1+ and DDI3_PAIR1-.	O PCIE		
DP3_LANE0+ DP3_LANE0-	C39 C40	Uni-directional main link for the transport of isochronous streams and secondary data. Multiplexed with DDI3_PAIR0+ and DDI3_PAIR0-.	O PCIE		
DP3_HPD	C44	Detection of Hot Plug / Unplug and notification of the link layer. Multiplexed with DDI3_HPD.	I 3.3V	PD 1M	
DP3_AUX+	C36	Half-duplex bi-directional AUX channel for services such as link configuration or maintenance and EDID access.	I/O PCIE	PD 100k	
DP3_AUX-	C37	Half-duplex bi-directional AUX channel for services such as link configuration or maintenance and EDID access.	I/O PCIE	PU 100k 3.3V	DP3_AUX- is a boot strap signal (see note below). DP enable strap already populated.

Note

Some signals have special functionality during the reset process. They may bootstrap some basic important functions of the module. For more information refer to section 9.5 of this user's guide.

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Table 28 Module Type Definition Signal Description

Signal	Pin #	Description	I/O	Comment
TYPE0# TYPE1# TYPE2#	C54 C57 D57	The TYPE pins indicate to the Carrier Board the Pin-out Type that is implemented on the module. The pins are tied on the module to either ground (GND) or are no-connects (NC). For Pinout Type 1, these pins are don't care (X). TYPE2# / TYPE1# / TYPE0# / X / X / X / Pinout Type 1 NC / NC / NC / Pinout Type 2 NC / NC / GND / Pinout Type 3 (no IDE) NC / GND / NC / Pinout Type 4 (no PCI) NC / GND / GND / Pinout Type 5 (no IDE, no PCI) GND / NC / NC / Pinout Type 6 (no IDE, no PCI) The Carrier Board should implement combinatorial logic that monitors the module TYPE pins and keeps power off (e.g deactivates the ATX_ON signal for an ATX power supply) if an incompatible module pin-out type is detected. The Carrier Board logic may also implement a fault indicator such as an LED.	PDS	TYPE[0:2]# signals are available on all modules following the Type 2-6 Pinout standard. The conga-TS87 is based on the COM Express Type 6 pinout therefore the pins 0 and 1 are not connected and pin 2 is connected to GND.
TYPE10#	A97	Dual use pin. Indicates to the carrier board that a Type 10 module is installed. Indicates to the carrier that a Rev. 1.0/2.0 module is installed. TYPE10# NC – Pinout R2.0 PD – Pinout Type 10 pull down to ground with 4.7k resistor 12V – Pinout R1.0 This pin is reclaimed from VCC_12V pool. In R1.0 modules this pin will connect to other VCC_12V pins. In R2.0 this pin is defined as a no-connect for Types 1-6. A carrier can detect a R1.0 module by the presence of 12V on this pin. R2.0 module Types 1-6 will no-connect this pin. Type 10 modules shall pull this pin to ground through a 4.7k resistor.	PDS	Not connected to indicate "Pinout R2.0".

Table 29 Power and GND Signal Descriptions

Signal	Pin #	Description	I/O	PU/PD	Comment
VCC_12V	C104-C109 D104-D109	Primary power input: +12V nominal. All available VCC_12V pins on the connector(s) shall be used.	P		
GND	C1, C2, C5, C8, C11, C14, C21, C31, C41, C51, C60, C70,C73, C76, C80, C84, C87, C90, C93, C96, C100, C103, C110, D1, D2, D5, D8, D11, D14, D21, D31, D41, D51, D60, D67, D70, D73, D76, D80, D84, D87, D90, D93, D96, D100, D103, D110	Ground - DC power and signal and AC signal return path. All available GND connector pins shall be used and tied to carrier board GND plane.	P		

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9.4 C-D Connector Pinout

Table 30 Connector C-D Pinout

Pin	Row C	Pin	Row D	Pin	Row C	Pin	Row D
C1	GND (FIXED)	D1	GND (FIXED)	C56	PEG_RX1-	D56	PEG_TX1-
C2	GND	D2	GND	C57	TYPE1#	D57	TYPE2#
C3	USB_SSRX0-	D3	USB_SSTX0-	C58	PEG_RX2+	D58	PEG_TX2+
C4	USB_SSRX0+	D4	USB_SSTX0+	C59	PEG_RX2-	D59	PEG_TX2-
C5	GND	D5	GND	C60	GND (FIXED)	D60	GND (FIXED)
C6	USB_SSRX1-	D6	USB_SSTX1-	C61	PEG_RX3+	D61	PEG_TX3+
C7	USB_SSRX1+	D7	USB_SSTX1+	C62	PEG_RX3-	D62	PEG_TX3-
C8	GND	D8	GND	C63	RSVD	D63	RSVD
C9	USB_SSRX2-	D9	USB_SSTX2-	C64	RSVD	D64	RSVD
C10	USB_SSRX2+	D10	USB_SSTX2+	C65	PEG_RX4+	D65	PEG_TX4+
C11	GND (FIXED)	D11	GND (FIXED)	C66	PEG_RX4-	D66	PEG_TX4-
C12	USB_SSRX3-	D12	USB_SSTX3-	C67	RSVD	D67	GND
C13	USB_SSRX3+	D13	USB_SSTX3+	C68	PEG_RX5+	D68	PEG_TX5+
C14	GND	D14	GND	C69	PEG_RX5-	D69	PEG_TX5-
C15	DDI1_PAIR6+	D15	DDI1_CTRLCLK_AUX+	C70	GND (FIXED)	D70	GND (FIXED)
C16	DDI1_PAIR6-	D16	DDI1_CTRLDATA_AUX-	C71	PEG_RX6+	D71	PEG_TX6+
C17	RSVD	D17	RSVD	C72	PEG_RX6-	D72	PEG_TX6-
C18	RSVD	D18	RSVD	C73	GND	D73	GND
C19	PCIE_RX6+	D19	PCIE_TX6+	C74	PEG_RX7+	D74	PEG_TX7+
C20	PCIE_RX6-	D20	PCIE_TX6-	C75	PEG_RX7-	D75	PEG_TX7-
C21	GND (FIXED)	D21	GND (FIXED)	C76	GND	D76	GND
C22	PCIE_RX7+ (*)	D22	PCIE_TX7+ (*)	C77	RSVD	D77	RSVD
C23	PCIE_RX7- (*)	D23	PCIE_TX7- (*)	C78	PEG_RX8+	D78	PEG_TX8+
C24	DDI1_HPD	D24	RSVD	C79	PEG_RX8-	D79	PEG_TX8-
C25	DDI1_PAIR4+	D25	RSVD	C80	GND (FIXED)	D80	GND (FIXED)
C26	DDI1_PAIR4-	D26	DDI1_PAIR0+	C81	PEG_RX9+	D81	PEG_TX9+
C27	RSVD	D27	DDI1_PAIR0-	C82	PEG_RX9-	D82	PEG_TX9-
C28	RSVD	D28	RSVD	C83	RSVD	D83	RSVD
C29	DDI1_PAIR5+	D29	DDI1_PAIR1+	C84	GND	D84	GND
C30	DDI1_PAIR5-	D30	DDI1_PAIR1-	C85	PEG_RX10+	D85	PEG_TX10+

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Pin	Row C	Pin	Row D	Pin	Row C	Pin	Row D
C31	GND (FIXED)	D31	GND (FIXED)	C86	PEG_RX10-	D86	PEG_TX10-
C32	DDI2_CTRLCLK_AUX+	D32	DDI1_PAIR2+	C87	GND	D87	GND
C33	DDI2_CTRLDATA_AUX-	D33	DDI1_PAIR2-	C88	PEG_RX11+	D88	PEG_TX11+
C34	DDI2_DDC_AUX_SEL	D34	DDI1_DDC_AUX_SEL	C89	PEG_RX11-	D89	PEG_TX11-
C35	RSVD	D35	RSVD	C90	GND (FIXED)	D90	GND (FIXED)
C36	DDI3_CTRLCLK_AUX+	D36	DDI1_PAIR3+	C91	PEG_RX12+	D91	PEG_TX12+
C37	DDI3_CTRLDATA_AUX-	D37	DDI1_PAIR3-	C92	PEG_RX12-	D92	PEG_TX12-
C38	DDI3_DDC_AUX_SEL	D38	RSVD	C93	GND	D93	GND
C39	DDI3_PAIR0+	D39	DDI2_PAIR0+	C94	PEG_RX13+	D94	PEG_TX13+
C40	DDI3_PAIR0-	D40	DDI2_PAIR0-	C95	PEG_RX13-	D95	PEG_TX13-
C41	GND (FIXED)	D41	GND (FIXED)	C96	GND	D96	GND
C42	DDI3_PAIR1+	D42	DDI2_PAIR1+	C97	RVSD	D97	RSVD
C43	DDI3_PAIR1-	D43	DDI2_PAIR1-	C98	PEG_RX14+	D98	PEG_TX14+
C44	DDI3_HPD	D44	DDI2_HPD	C99	PEG_RX14-	D99	PEG_TX14-
C45	RSVD	D45	RSVD	C100	GND (FIXED)	D100	GND (FIXED)
C46	DDI3_PAIR2+	D46	DDI2_PAIR2+	C101	PEG_RX15+	D101	PEG_TX15+
C47	DDI3_PAIR2-	D47	DDI2_PAIR2-	C102	PEG_RX15-	D102	PEG_TX15-
C48	RSVD	D48	RSVD	C103	GND	D103	GND
C49	DDI3_PAIR3+	D49	DDI2_PAIR3+	C104	VCC_12V	D104	VCC_12V
C50	DDI3_PAIR3-	D50	DDI2_PAIR3-	C105	VCC_12V	D105	VCC_12V
C51	GND (FIXED)	D51	GND (FIXED)	C106	VCC_12V	D106	VCC_12V
C52	PEG_RX0+	D52	PEG_TX0+	C107	VCC_12V	D107	VCC_12V
C53	PEG_RX0-	D53	PEG_TX0-	C108	VCC_12V	D108	VCC_12V
C54	TYPE0#	D54	PEG_LANE_RV#	C109	VCC_12V	D109	VCC_12V
C55	PEG_RX1+	D55	PEG_TX1+	C110	GND (FIXED)	D110	GND (FIXED)

Note

The signals marked with asterisk symbol (*) are not supported.

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9.5 Boot Strap Signals

Table 31 Boot Strap Signal Descriptions

Signal	Pin #	Description of Boot Strap Signal	I/O	PU/PD	Comment
AC/HDA_SYNC	A29	High Definition Audio Sync: This signal is a 48 kHz fixed rate sample sync to the codec(s). It is also used to encode the stream number.	O 3.3VSB	PU 1K 3.3VSB	AC/HDA_SYNC is a boot strap signal (see caution statement below)
AC/HDA_SDOUT	A33	High Definition Audio Serial Data Out: .This signal is the serial TDM data output to the codec(s). This serial output is double-pumped for a bit rate of 48 Mb/s for High Definition Audio.	O 3.3VSB	PU 1K 3.3VSB	AC/HDA_SDOUT is a boot strap signal (see caution statement below)
SPKR	B32	Output for audio enunciator, the "speaker" in PC-AT systems	O 3.3V		SPKR is a boot strap signal (see caution statement below)
PEG_LAN_RV#	D54	PCI Express Graphics lane reversal input strap. Pull low on the carrier board to reverse lane order	I 3.3V	PU 10k 3.3V	PEG_LANE_RV# is a boot strap signal (see caution statement below).
DDI1_CTRLDATA_AUX- DP1_AUX- HDMI_CTRLDATA	D16	Multiplexed with DP1_AUX- and HDMI1_CTRLDATA. DP AUX- function if DDI1_DDC_AUX_SEL is no connect. HDMI/DVI I2C CTRLDATA if DDI1_DDC_AUX_SEL is pulled high.	I/O PCIE I/O OD 3.3V	PU100k 3.3V	DDI1_CTRLDATA_AUX- is a boot strap signal (see not below).
DDI2_CTRLDATA_AUX- DP2_AUX- HDM2_CTRLDATA	C33	Multiplexed with DP2_AUX- and HDMI2_CTRLDATA. DP AUX- function if DDI2_DDC_AUX_SEL is no connect. HDMI/DVI I2C CTRLDATA if DDI2_DDC_AUX_SEL is pulled high.	I/O PCIE I/O OD 3.3V	PU100k 3.3V	DDI2_CTRLDATA_AUX- is a boot strap signal (see not below).
DDI3_CTRLDATA_AUX- DP3_AUX- HDM3_CTRLDATA	C37	Multiplexed with DP3_AUX- and HDMI3_CTRLDATA. DP AUX- function if DDI3_DDC_AUX_SEL is no connect. HDMI/DVI I2C CTRLDATA if DDI3_DDC_AUX_SEL is pulled high	I/O PCIE I/O OD 3.3V	PU100k 3.3V	DDI3_CTRLDATA_AUX- is a boot strap signal (see not below).

Caution

The signals listed in the table above are used as chipset configuration straps during system reset. In this condition (during reset), they are inputs that are pulled to the correct state by either COM Express™ internally implemented resistors or chipset internally implemented resistors that are located on the module. No external DC loads or external pull-up or pull-down resistors should change the configuration of the signals listed in the above table. External resistors may override the internal strap states and cause the COM Express™ module to malfunction and/or cause irreparable damage to the module.

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10 System Resources

10.1 I/O Address Assignment

The I/O address assignment of the conga-TS87 module is functionally identical with a standard PC/AT.

Note

The BIOS assigns PCI and PCI Express I/O resources from FFF0h downwards. Non PnP/PCI/PCI Express compliant devices must not consume I/O resources in that area.

10.1.1 LPC Bus

On the conga-TS87, the PCI Express Bus acts as the subtractive decoding agent. All I/O cycles that are not positively decoded are forwarded to the PCI Bus not the LPC Bus. Only specified I/O ranges are forwarded to the LPC Bus. In the congatec Embedded BIOS, the following I/O address ranges are sent to the LPC Bus:

2Eh – 2Fh
4Eh – 4Fh
60h, 64h
A00 – BFFh

Parts of these ranges are not available if a Super I/O is used on the carrier board. If a Super I/O is not implemented on the carrier board, then this range is available for customer use. If you require additional LPC Bus resources other than those mentioned above, or more information about this subject, contact congatec technical support for assistance.

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10.2 PCI Configuration Space Map

Table 32 PCI Configuration Space Map

Bus Number (hex)	Device Number (hex)	Function Number (hex)	PCI Interrupt Routing	Description
00h	00h	00h	N.A.	Host Bridge
00h	01h	00h	Internal	PCI Express Graphic Root Port 0
00h	01h	01h	Internal	PCI Express Graphic Root Port 1
00h	01h	02h	Internal	PCI Express Graphic Root Port 2
00h	02h	00h	Internal	VGA Graphics
00h	03h	00h	Internal	Intel High Definition Audio controller
00h	14h	00h	Internal	XHCI Host Controller
00h(Note1)	16h	00h	Internal	Management Engine (ME) Interface 1
00h(Note1)	16h	01h	Internal	Intel ME Interface 2
00h(Note1)	16h	02h	Internal	ME IDE Redirection (IDE-R) Interface
00h(Note1)	16h	03h	Internal	ME KT (Remote Keyboard and Text)
00h	19h	00h	Internal	Onboard Gigabit LAN Controller
00h	1Ah	00h	Internal	EHCI Host Controller 2
00h (Note2)	1Ch	00h	Internal	PCI Express Root Port 0
00h (Note2)	1Ch	01h	Internal	PCI Express Root Port 1
00h (Note2)	1Ch	02h	Internal	PCI Express Root Port 2
00h (Note2)	1Ch	03h	Internal	PCI Express Root Port 3
00h (Note2)	1Ch	04h	Internal	PCI Express Root Port 4
00h (Note2)	1Ch	05h	Internal	PCI Express Root Port 5
00h (Note2)	1Ch	07h	Internal	PCI Express Root Port 7
00h	1Dh	00h	Internal	EHCI Host Controller 1
00h	1Fh	00h	N.A.	PCI to LPC Bridge
00h	1Fh	02h	Internal	Serial ATA Controller 1
00h	1Fh	03h	Internal	SMBus Host Controller
00h	1Fh	05h	Internal	Serial ATA Controller 2
00h	1Fh	06h	Internal	Thermal Subsystem
01h (Note3)	00h	00h	Internal	PEG Port 0
02h (Note3)	00h	00h	Internal	PEG Port 1
03h (Note3)	00h	00h	Internal	PEG Port 2
04h (Note3)	00h	00h	Internal	PCI Express Port 0

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05h (Note3)	00h	00h	Internal	PCI Express Port 1
06h (Note3)	00h	00h	Internal	PCI Express Port 2
07h (Note3)	00h	00h	Internal	PCI Express Port 3
08h (Note3)	00h	00h	Internal	PCI Express Port 4
09h (Note3)	00h	00h	Internal	PCI Express Port 5
0Ah (Note3)	00h	00h	Internal	PCI Express Port 6

Note

1. *In the standard configuration, the Intel Management Engine (ME) related devices are partly present or not present at all.*
2. *The PCI Express Ports are visible only if a device is attached behind them to the PCI Express Slot on the carrier board.*
3. *The table represents a case when a single function PCI/PCIe device is connected to all possible slots on the carrier board. The given bus numbers will change based on actual hardware configuration.*

10.3 PCI Interrupt Routing Map

Table 33 PCI Interrupt Routing Map

PIRQ	PCI BUS INT Line [1]	APIC Mode IRQ	VGA	HDA	XHCI	EHCI 1	EHCI 2	SM Bus + Thermal	LAN	SATA1	SATA2	PEG Root Port 1	PEG Root Port 2	PEG Root Port 3	PEG Port 0	PEG Port 1	PEG Port 2
A	INTA	16	x	x	x		x					x	x	x	x [2]	x [5]	x [4]
B	INTB	17													x [3]	x [2]	x [5]
C	INTC	18						x							x [4]	x [3]	x [2]
D	INTD	19								x	x				x [5]	x [4]	x [3]
E		20							x								
F		21															
G		22															
H		23				x											

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PIRQ	PCI-EX Root Port 0	PCI-EX Root Port 1	PCI-EX Root Port 2	PCI-EX Root Port 3	PCI-EX Root Port 4	PCI-EX Root Port 5	PCI-EX Root Port 7	PCI-EX Port 0	PCI-EX Port 1	PCI-EX Port 2	PCI-EX Port 3	PCI-EX Port 4	PCI-EX Port 5	PCI-EX Port 6 [6]
A	x				x			x [2]	x [5]	x [4]	x [3]	x [2]	x [5]	x [3]
B		x				x		x [3]	x [2]	x [5]	x [4]	x [3]	x [2]	x [4]
C			x					x [4]	x [3]	x [2]	x [5]	x [4]	x [3]	x [5]
D				x			x	x [5]	x [4]	x [3]	x [2]	x [5]	x [4]	x [2]
E														
F														
G														
H														

Note

[1] *These interrupt lines are virtual (message based).*

[2] *Interrupt used by single function PCI Express devices (INTA).*

[3] *Interrupt used by multifunction PCI Express devices (INTB).*

[4] *Interrupt used by multifunction PCI Express devices (INTC).*

[5] *Interrupt used by multifunction PCI Express devices (INTD).*

[6] *The COM Express PCIe Port 6 is routed to the PCIe Root Port 7 of the PCH.*

10.4 I²C Bus

There are no onboard resources connected to the I²C bus. Address 16h is reserved for congatec Battery Management solutions.

10.5 SM Bus

System Management (SM) bus signals are connected to the Intel® DH82QM87 or DH82HM86 PCH and the SM bus is not intended to be used by off-board non-system management devices. For more information about this subject, contact congatec technical support.

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11 BIOS Setup Description

The following section describes the BIOS setup program. The BIOS setup program can be used to view and change the BIOS settings for the module. Only experienced users should change the default BIOS settings.

11.1 Entering the BIOS Setup Program.

The BIOS setup program can be accessed by pressing the <DEL> or <F2> key during POST. The question is - how to – enter

11.1.1 Boot Selection Popup

Press the <F11> key during POST to access the Boot Selection Popup menu. A selection menu displays immediately after POST, allowing the operator to select either the boot device that should be used or an option to enter the BIOS setup program

11.2 Setup Menu and Navigation

The congatec BIOS setup screen is composed of the menu bar, left frame and right frame. The menu bar is shown below:

Main	Advanced	Chipset	Boot	Security	Save & Exit

The left frame displays all the options that can be configured in the selected menu. Grayed-out options cannot be configured. Only the blue options can be configured. When an option is selected, it is highlighted in white.

Note

Entries in the option column that are displayed in bold indicate BIOS default values.

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.

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The setup program uses a key-based navigation system. Most of the keys can be used at any time while in setup. The table below explains the supported keys:

Key	Description
← → Left/Right	Select a setup menu (e.g. Main, Boot, Exit).
↑ ↓ Up/Down	Select a setup item or sub menu.
+ - Plus/Minus	Change the field value of a particular setup item.
Tab	Select setup fields (e.g. in date and time).
F1	Display General Help screen.
F2	Load previous settings.
F9	Load optimal default settings.
F10	Save changes and exit setup.
ESC	Discard changes and exit setup.
ENTER	Display options of a particular setup item or enter submenu.

11.3 Main Setup Screen

When you first enter the BIOS setup, you will enter the main setup screen. The main setup screen reports BIOS, processor, memory and board information and is for configuring the system date and time. You can always return to the main setup screen by selecting the 'Main' tab.

The Main screen reports BIOS, processor, memory and board information and is for configuring the system date and time.

Feature	Options	Description
Main BIOS Version	No option	Displays the main BIOS version.
OEM BIOS Version	No option	Displays the additional OEM BIOS version.
Build Date	No option	Displays the date the BIOS was built.
Product Revision	No option	Displays the hardware revision of the board.
Serial Number	No option	Displays the serial number of the board firmware revision.
BC Firmware Revision	No option	Displays the controller firmare revision
MAC Address	No option	Displays the MAC address of the onboard ethernet controller.
Boot Counter	No option	Displays the number of boot-ups. (max. 16777215).
Running Time	No option	Displays the time the board is running [in hours max. 65535].
▶Platform Information	submenu	Opens the Platform Information submenu.
System Date	Day of week, month/ day/year	Specifies the current system date Note: The date is in month-day-year format.

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Feature	Options	Description
System Time	Hour:Minute:Second	Specifies the current system time. Note: The time is in 24 hour format.

11.3.1 Platform Information Submenu

The platform information submenu offers additional hardware and software information.

Feature	Options	Description
Processor Information	No option	Subtitle.
Processor Type	No option	Displays the processor ID string. The "Processor Type" text itself is not displayed just the ID string.
Codename	No option	Displays the processor codename
Processor Speed	No option	Displays the processor speed.
Processor Signature	No option	Displays the processor signature.
Stepping	No option	Displays the processor stepping.
Processor Cores	No option	Displays the number of processor cores.
Microcode Revision	No option	Displays the processor microcode revision.
IGD HW Version	No option	Displays the version of the graphics controller.
IGD VBIOS Version	No option	Displays the video BIOS version.
Total Memory	No option	Displays the total amount of installed memory.
PCH Information	No option	subtitle
Codename	No option	Displays the codename of the Platform Controller hub (PCH).
PCH SKU	No option	Displays the SKU name of the PCH.
Stepping	No option	Displays the PCH stepping.

11.4 Advanced Setup

Select the advanced tab from the setup menu to enter the advanced BIOS setup screen. The menu is used for setting advanced features and only features described within this user's guide are listed.

Main	Advanced	Chipset	Boot	Security	Save & Exit
	Graphics				
	Watchdog				
	Hardware Health Monitoring				

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PCI & PCI Express
ACPI
RTC Wake
Trusted Computing
CPU
SATA
Intel(R) Rapid Start Technology
Acoustic Management
USB
SMART Settings
Super IO
Serial Port Console Redirection
UEFI Network Stack
Intel(R) Ethernet Connection I218-LM

11.4.1 Graphics Submenu

Feature	Options	Description
Primary Graphics Device	Auto **IGD** PEG PCI/PCIe	Select primary graphics adapter to be used during boot up. Auto: BIOS will select it automatically. IGD: Internal Graphics Device (IGD) located in chipset. PEG: External PCI Express Graphics (PEG) card attached to the PEG port. PCI/PCIe: PCI/PCIe graphics card attached to some other (not PEG) PCI/PCIe port.
Internal Graphics Device	**Auto** Disabled Enabled	Enable or disable Internal Graphics Device (IGD).
IGD Pre-Allocated Graphics Memory	32M**, 64M**, 96M, 128M, 160M, 192M, 224M, 256M, 288M, 320M, 352M, 384M, 416M, 448M, 480M, 512M, 1024M	Select amount of pre-allocated (fixed) graphics memory used by the Internal Graphics Device.
IGD Total Graphics Memory	128MB **256MB** MAX	Select amount of total graphics memory that may be used by the Internal Graphics Device. Memory above the fixed graphics memory will be dynamically allocated by the graphics driver according to DVMT 5.0 specification. MAX = Use as much graphics memory as possible. Depends on total system memory installed and the operating system used (see DVMT 5.0 specification).

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Feature	Options	Description
Primary IGD Boot Display Device	**Auto** CRT LFP EFP EFP2 EFP3	Select the Primary IGD display device(s) used for boot up. CRT selects Analog VGA display port. LFP (Local Flat Panel) selects a LVDS panel connected to the integrated LVDS port. EFPx (External Flat Panel) selects a HDMI/DVI or DisplayPort device connected to the Digital Display Interfaces DDI1, DDI2 and DDI3. Examples for EFPx name assignment to DDI1, DDI2, DDI3: 1. If only DDI2 is enabled then the EFP name is assigned to DDI2. 2. If both port DDI1 and DDI2 are enabled then EFP is assigned to DDI1 and EFP2 is assigned to DDI2. EFP selections are valid only when DDI1, DDI2 and/or DDI3 are enabled.
Secondary IGD Boot Display Device	**Disabled** CRT LFP EFP EFP2 EFP3	Select the Secondary IGD display device(s) used for boot up. VGA modes will be supported only on Primary display. For other details see Primary IGD Boot Display Device.
Active LFP Configuration	No Local Flat Panel **Integrated LVDS** eDP	Select the active local flat panel configuration.
Always Try Auto Panel Detect	**No** Yes	If set to 'Yes' the BIOS will first look for an EDID data set in an external EEPROM to configure the Local Flat Panel. Only if no external EDID data set can be found, the data set selected under 'Local Flat Panel Type' will be used as a fallback data set.
Local Flat Panel Type	**Auto** VGA 640x480 1x18 (002h) VGA 640x480 1x18 (013h) WVGA 800x480 1x24 (01Bh) SVGA 800x600 1x18 (01Ah) XGA 1024x768 1x18 (006h) XGA 1024x768 2x18 (007h) XGA 1024x768 1x24 (008h) XGA 1024x768 2x24 (012h) WXGA 1280x800 1x18 (01Eh) WXGA 1280x768 1x24 (01Ch) SXGA 1280x1024 2x24 (00Ah) SXGA 1280x1024 2x24 (018h) UXGA 1600x1200 2x24 (00Ch) HD 1920x1080 2x24 (01Dh) WUXGA 1920x1200 2x18 (015h) WUXGA 1920x1200 2x24 (00Dh) Customized EDID™ 1 Customized EDID™ 2 Customized EDID™ 3	Select a predefined LFP type or choose Auto to let the BIOS automatically detect and configure the attached LVDS panel. Auto detection is performed by reading an EDID data set via the video I²C bus. The number in brackets specifies the congatec internal number of the respective panel data set. Note: Customized EDID™ utilizes an OEM defined EDID™ data set stored in the BIOS flash device.
Backlight Inverter Type	None **PWM** I2C	Select the type of backlight inverter used. PWM = Use IGD PWM signal. I2C = Use I2C backlight inverter device connected to the video I²C bus.

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Feature	Options	Description
PWM Inverter Polarity	**Normal** Inverted	Select PWM inverter polarity. Only visible if Backlight Inverter Type is set to PWM .
PWM Inverter Frequency (Hz)	**200** - 40000	Set the PWM inverter frequency in Hz. Only visible if Backlight Inverter Type is set to PWM.
Backlight Setting	0%, 10%, 25%, 40%, 50%, 60%, 75%, 90%, **100%**	Actual backlight value in percent of the maximum setting.
Inhibit Backlight	**No** Permanent Until End Of POST	Decide whether the backlight on signal should be activated when the panel is activated or whether it should remain inhibited until the end of BIOS POST or permanently.
Invert Backlight Setting	**No** Yes	Allow to invert backlight control values if required for the actual I2C type backlight hardware controller.
LVDS SSC	**Disabled**, 0.5%, 1.0%, 1.5%, 2.0%, 2.5%	Configure LVDS spread spectrum clock modulation depth with center spreading and fixed modulation frequency of 32.9kHz.
Digital Display Interface 1 (DDI1)	**Auto Selection** isabled HDMI/DVI	Select the output type of the digital display interface. **NOTE:** On conga-TS87 rev. A, the 'Auto Selection' option is not displayed and the default configuration is 'HDMI/DVI'.
Digital Display Interface 2 (DDI2)	**Auto Selection** Disabled Display Port HDMI/DVI	Select the output type of the digital display interface. **NOTE:** On conga-TS87 rev. A, the 'Auto Selection' option is not displayed and the default configuration is 'HDMI/DVI'.
Digital Display Interface 3 (DDI3)	**Auto Selection** Disabled Display Port HDMI/DVI	Select the output type of the digital display interface. **NOTE:** On conga-TS87 rev. A, the 'Auto Selection' option is not displayed and the default configuration is 'HDMI/DVI'.
►GOP Configuration	submenu	Configure graphics output when using the UEFI Graphics Output Protocol (GOP) driver instead of legacy video BIOS. Only visible if GOP driver is configured to be used in the 'Video Option ROM Launch Policy' setup node.

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11.4.1.1 GOP Configuration Submenu

Feature	Options	Description
Output Device	(options depend on detected display devices)	Select boot display device in GOP driver mode.
BIST Enable	**Disabled** Enabled	Starts or stops the BIST (built in self test) on the integrated display panel.

11.4.2 Watchdog Submenu

Feature	Options	Description
POST Watchdog	**Disabled** 30sec 1min 2min 5min 10min 30min	Select the timeout value for the POST watchdog. The watchdog is only active during the power-on-self-test of the system and provides a facility to prevent errors during boot up by performing a reset.
Stop Watchdog For User Interaction	No **Yes**	Select whether the POST watchdog should be stopped during the popup boot selection menu or while waiting for setup password insertion.
Runtime Watchdog	**Disabled** One-time Trigger Single Event Repeated Event	Selects the operating mode of the runtime watchdog. This watchdog will be initialized just before the operating system starts booting. If set to 'One-time Trigger' the watchdog will be disabled after the first trigger. If set to 'Single Event', every stage will be executed only once, then the watchdog will be disabled. If set to 'Repeated Event' the last stage will be executed repeatedly until a reset occurs.
Delay	**Disabled** 10sec 30sec 1min 2min 5min 10min 30min	Select the delay time before the runtime watchdog becomes active. This ensures that an operating system has enough time to load.
Event 1	ACPI Event **Reset** Power Button	Selects the type of event that will be generated when timeout 1 is reached. For more information about ACPI Event, see note below.
Event 2	**Disabled** ACPI Event Reset Power Button	Selects the type of event that will be generated when timeout 2 is reached.

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Feature	Options	Description
Event 3	**Disabled** ACPI Event Reset Power Button	Selects the type of event that will be generated when timeout 3 is reached.
Timeout 1	1sec 2sec 5sec 10sec **30sec** 1min 2min 5min 10min 30min	Selects the timeout value for the first stage watchdog event.
Timeout 2	see above	Selects the timeout value for the second stage watchdog event.
Timeout 3	see above	Selects the timeout value for the third stage watchdog event.
Watchdog ACPI Event	**Shutdown** Restart	Select the operating system event that is initiated by the watchdog ACPI event. These options perform a critical but orderly operating system shutdown or restart.

Note

In ACPI mode, it is not possible for a "Watchdog ACPI Event" handler to directly restart or shutdown the OS. For this reason the congatec BIOS will do one of the following:

For Shutdown: An over temperature notification is executed. This causes the OS to shut down in an orderly fashion.

For Restart: An ACPI fatal error is reported to the OS.

Additionally, the conga-TS87 module does not support the watchdog NMI mode.

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11.4.3 Hardware Health Monitoring Submenu

Feature	Options	Description
CPU Temperature	No option	Displays the actual CPU temperature in °C.
Board Temperature	No option	Displays the actual board temperature in °C.
Environment Temperature	No option	Displays the actual environment temperature in °C.
12V Standard	No option	Displays the actual voltage of the 12V standard power supply.
5V Standby	No option	Displays the actual voltage of the 5V standby power supply.
CPU Fan Speed	No option	Displays the actual CPU fan speed in RPM.
Fan PWM Frequency Mode	**Low Frequency** High Frequency	Select fan PWM base frequency mode. Low frequency: 35.3Hz High frequency: 22.5kHz
Continuous Tacho Reading	Disabled **Enabled**	If enabled, the fan tacho pulses are measured continuously instead of once per second. Helps to avoid audible pulsing of the fan as the speed would be set to 100% for a very short time during measurement.
Pulses Per Revolution	1, **2**, 3, 4	Select number of pulses per revolution generated by the attached fan.
Automatic Fan Speed Control	Disabled **Enabled**	Enable hardware fan speed control. Independent from any operating system the fan will be turned on once a certain start temperature is reached and linearly ramped up to the defined maximum speed within the given temperature range.
Fan Control Temperature	**CPU Temperature** Board Temperature Environ Temperature	Select which temperature input is used for the automatic fan speed control.
Start Temperature	30, 40, 50, **60**, 70, 80, 90, 100°C	At this temperature the fan will be turned on at the defined minimum fan speed.
Temperature Range	5, 10, 15, 20, 25, **30**, 40, 55, 80°C	Within this temperature range the fan will ramp up to the defined maximum fan speed.
Minimum Fan Speed	Fan Off, 10%, 15%, 20%, 25%, 30%, 35%, 40%, 45%, **50%**, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95% 100%	Select minimum/start fan speed to be set when the start temperature of the control slope is reached.
Maximum Fan Speed	Fan Off, 10%, 15%, 20%, 25%, 30%, 35%, 40%, 45%, 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95% **100%**	Select maximum/end fan speed to be ramped up to until the end temperature of the control slope is reached.
Fan Always On At Minimum Speed	**Disabled** Enabled	If enabled, the fan will always run at least at the selected minimum speed, even if the control temperature is below the fan control start temperature. This is to ensure a minimum air flow all the time.

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11.4.4 PCI & PCI Express Submenu

Feature	Options	Description
PCI Settings		
PCI Latency Timer	**32**, 64, 96, 128, 160, 192, 224, 248 PCI Bus Clocks	Select value to be programmed into PCI latency timer register.
VGA Palette Snoop	**Disabled** Enabled	Enable or disable VGA palette registers snooping.
PERR# Generation	**Disabled** Enabled	Enable or disable PCI device to generate PERR#.
SERR# Generation	**Disabled** Enabled	Enable or disable PCI device to generate SERR#.
Generate EXCD0/1_PERST#	Disabled 1ms 5ms **10ms** 50ms 100ms 150ms 200ms 250ms	Select whether the COM Express EXCD0_PERST# and EXCD1_PERST# pins should be driven low during POST and how long it will be, if enabled.
▶PCI Express Settings	submenu	PCI Express device and link settings.
▶PIRQ Routing & IRQ Reservation	submenu	Manual PIRQ routing and interrupt reservation for legacy devices.
▶PCI Express Graphics (PEG) Port	submenu	PCI Express Graphics (PEG) port settings. PEG port is not supported on low end CPUs.
PCIE Root Port Function Swapping	**Disabled** Enabled	Enable or disable PCI Express root port function swapping.
Subtractive Decode	**Disabled** Enabled	Enable or disable PCI Express subtractive decode.
▶PCI Express Port 0	submenu	Opens the PCI Express Port submenu
▶PCI Express Port 1	submenu	Opens the PCI Express Port submenu
▶PCI Express Port 2	submenu	Opens the PCI Express Port submenu
▶PCI Express Port 3	submenu	Opens the PCI Express Port submenu
▶PCI Express Port 4	submenu	Opens the PCI Express Port submenu
▶PCI Express Port 5	submenu	Opens the PCI Express Port submenu
▶PCI Express Port 6	submenu	Opens the PCI Express Port submenu

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11.4.4.1 PCI Express Settings Submenu

Feature	Options	Description
Relaxed Ordering	**Disabled** Enabled	Enable or disable PCI Express device relaxed ordering.
Extended Tag	**Disabled** Enabled	If enabled a device may use an 8-bit tag filed as a requester.
No Snoop	Disabled **Enabled**	Enable or disable PCI Express device 'No Snoop' option.
Maximum Payload	**Auto** 128 Bytes 256 Bytes 512 Bytes 1024 Bytes 2048 Bytes 4096 Bytes	Set maximum payload of PCI Express devices or allow system BIOS to select the value.
Maximum Read Request	**Auto** 128 Bytes 256 Bytes 512 Bytes 1024 Bytes 2048 Bytes 4096 Bytes	Set maximum read request size of PCI Express devices or allow system BIOS to select the value.
ASPM	**Disabled** Auto Force L0s	PCI Express Active State Power Management settings.
Extended Synch	**Disabled** Enabled	If enabled, the generation of extended PCI Express synchronization patterns is allowed.
Link Training Retry	Disabled, 2, 3, **5**	Defines number of retry attempts software will take to retrain the link if previous training attempt was unsuccessful.
Link Training Timeout (us)	10-10000 **Default : 100**	Defines number of microseconds software will wait before polling link training bit in the link status register. Value ranges from 10 to 10000 us.
Unpopulated Links	**Keep Link On** Disabled	In order to save power, software will disable unpopulated PCI Express links, if this option is set to disabled.
Restore PCIe Registers	Enabled **Disabled**	On non-PCI Express aware operating systems some devices may not be re-initialized correctly after S3. Setting this node to Enabled restores PCI Express configuration on S3 resume. Warning: Enabling this may cause issues with other hardware after S3 resume.

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11.4.4.2 PIRQ Routing & IRQ Reservation Submenu

Feature	Options	Description
PIRQA	**Auto**, IRQ3, IRQ4, IRQ5, IRQ6, IRQ10, IRQ11, IRQ14, IRQ15	Set interrupt for selected PIRQ. Please refer to the board's resource list for a detailed list of devices connected to the respective PIRQ. Note: These settings will only be effective while operating in PIC (non-IOAPIC) interrupt mode.
PIRQB	same as PIRQA	same as PIRQA
PIRQC	same as PIRQA	same as PIRQA
PIRQD	same as PIRQA	same as PIRQA
PIRQE	same as PIRQA	same as PIRQA
PIRQF	same as PIRQA	same as PIRQA
PIRQG	same as PIRQA	same as PIRQA
PIRQH	same as PIRQA	same as PIRQA
Reserve Legacy Interrupt 1	**None**, IRQ3, IRQ4, IRQ5, IRQ6, IRQ10, IRQ11, IRQ14, IRQ15	The interrupt reserved here will not be assigned to any PCI or PCI Express device and thus maybe available for some legacy bus device.
Reserve Legacy Interrupt 2	same as Reserve Legacy Interrupt 1	same as Reserve Legacy Interrupt 1

11.4.4.3 PCI Express Graphics (PEG) Port Submenu

Feature	Options	Description
PCI Express Graphics (PEG) Port	Disabled Enabled **Auto**	Disabled = Disable internal PEG interface devices and do not detect the devices connected to PEG port. Enabled = Enable internal PEG interface devices also if no device is detected on PEG port. Auto = Disable internal PEG interface devices if no device is detected on PEG port.
PEG Port Configuration	**1x16** 2x8 1x8+2x4	It determines how many ports with certain widths, will be formed from available 16 PCIe lanes.
PEG0	No option	Displays the width and the operation mode at which the attached device currently operates on PEG0 port (B0:D1:F0). Some Gen3, Gen2 devices start up in Gen1 mode and their OS driver just sets them to Gen3 or Gen2 mode.

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Feature	Options	Description
PEG0 Speed	**Auto** Gen1 Gen2 Gen3	PEG0 port (B0:D1:F0) max. speed Auto = Gen1, Gen2 or Gen3 Gen1 = 2.5GT/s Gen2 = 5.0GT/s Gen3 = 8.0GT/s Some older non-compliant PCI Express devices will function only if Gen1 is selected.
PEG0 ASPM	**Disabled** Auto ASPM L0s ASPM L1 ASPM L0sL1	Control ASPM support for the PEG device. This has no effect if PEG is not the currently active device.
ASPM L0s	Disabled Root Port Only Endpoint Port Only **Both Root and Endpoint Ports**	Enable PCIe ASPM L0s on PEG0 port (B0:D1:F0).
PEG0 De-emphasis Control	-6 dB **-3.5 dB**	Configure the de-emphasis control on PEG.
PEG1	No option	Displays the width and the operation mode at which the attached device currently operates on PEG1 port (B0:D1:F1). Some Gen3, Gen2 devices start up in Gen1 mode and their OS driver just sets them to Gen3 or Gen2 mode.
PEG1 Speed	**Auto** Gen1 Gen2 Gen3	PEG1 port (B0:D1:F1) max. speed Auto = Gen1, Gen2 or Gen3 Gen1 = 2.5GT/s Gen2 = 5.0GT/s Gen3 = 8.0GT/s Some older non-compliant PCI Express devices will function only if Gen1 is selected.
PEG1 ASPM	**Disabled** Auto ASPM L0s ASPM L1 ASPM L0sL1	Control ASPM support for the PEG device. This has no effect if PEG is not the currently active device.
ASPM L0s	Disabled Root Port Only Endpoint Port Only **Both Root and Endpoint Ports**	Enable PCIe ASPM L0s on PEG1 port (B0:D1:F1).
PEG1 De-emphasis Control	-6 dB **-3.5 dB**	Configure the de-emphasis control on PEG.
PEG2	No option	Displays the width and the operation mode at which the attached device currently operates on PEG2 port (B0:D1:F2). Some Gen3, Gen2 devices start up in Gen1 mode and their OS driver just sets them to Gen3 or Gen2 mode.

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Feature	Options	Description
PEG2 Speed	**Auto** Gen1 Gen2 Gen3	PEG2 port (B0:D1:F2) max. speed Auto = Gen1, Gen2 or Gen3 Gen1 = 2.5GT/s Gen2 = 5.0GT/s Gen3 = 8.0GT/s Some older non-compliant PCI Express devices will function only if Gen1 is selected.
PEG2 ASPM	**Disabled** Auto ASPM L0s ASPM L1 ASPM L0sL1	Control ASPM support for the PEG device. This has no effect if PEG is not the currently active device.
ASPM L0s	Disabled Root Port Only Endpoint Port Only **Both Root and Endpoint Ports**	Enable PCIe ASPM L0s on PEG2 port (B0:D1:F2).
PEG2 De-emphasis Control	-6 dB **-3.5 dB**	Configure the de-emphasis control on PEG.
Run-time C7 Allowed	**Disabled** Enabled	Enable or disable the entry to C7 state (run-time control). Don't enable this feature until you have all the appropriate Save/Restore Controller/Endpoint state.
Detect Non-compliant Device	**Disabled** Enabled	Try to detect also a non-compliant PCI Express device on the PEG port.
Program PCIe ASPM after OpROM	Enabled **Disabled**	Enabled = PCIe ASPM will be programmed after OpROM. Disabled = PCIe ASPM will be programmed before OpROM
PEG Sampler Calibrate	Auto Enabled **Disabled**	Enable or disable PEG sampler calibrate.
Swing Control	Half **Full**	Swing Control
PEG Gen3 Equalization	**Enabled** Disabled	Perform PEG Gen3 equalization steps.
Gen3 Eq Phase 2	Auto **Enabled** Disabled	Perform PEG Gen3 equalization phase 2.
► PEG Gen3 Root Port Preset Value for each Lane	**submenu**	In this submenu the Root Port Preset Value for PEG port lanes 0 -15 can be set individually.
► PEG Gen3 Endpoint Preset Value for each Lane	**submenu**	In this submenu, the Endpoint Preset Value for PEG port lanes 0 -15 can be set individually.
► PEG Gen3 Endpoint Hint Value for each Lane	**submenu**	In this submenu, the Endpoint Hint Value for PEG port lanes 0 -15 can be set individually.

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Feature	Options	Description
Gen3 Eq Preset Search	**Enabled** Disabled	Perform PEG Gen3 preset search algorithm.
Always Re-search Gen3 Eq Preset	Enabled **Disabled**	Always re-search Gen3 preset, even if it has been done once.
Preset Search Dwell Time	1-65535 Default : **1000**	PEG Gen3 preset search dwell time in [ms].
Error Target	1-65535 Default : **1**	Set the margin search error target value [1..65535].
PEG RxCEM Loopback Mode	Enabled **Disabled**	Enable or disable PEG RxCEM loopback mode.
PEG Lane Number for Test	1-15 Default : **0**	PEG lane number for RxCEM Loopback mode (0~15)
► PCIe Gen3 RxCTLEp Setting	submenu	In this submenu, the RxCTLEp Value for PEG lanes 0 -7 can be set individually.

Note

The items related to PEG 1 will only be displayed when you configure PEG Port as 2x8 or 1x8+2x4.

The items releated to PEG 2 will only be displayed when you configure PEG Port as 1x8+2x4.

11.4.4.4 PCI Express Port Submenu

Feature	Options	Description
PCI Express Port x	Disabled **Enabled**	Enable or disable the respective PCI Express port x. Note: Unless the Always Enable Port (see below) is enabled as well, an unpopulated port will still be disabled if no PCI Express device is connected.
ASPM	**Disabled** L0s L1 L0sL1 Auto	PCI Express Active State Power Management settings.
L1 Substates	**Disabled** L1.1 L1.2 L1.1 & L1.2	PCI Express L1 substates settings.
URR	**Disabled** Enabled	Enable or disable PCI Express Unsupported Request Reporting.

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Feature	Options	Description
FER	**Disabled** Enabled	Enable or disable PCI Express device Fatal Error Reporting.
NFER	**Disabled** Enabled	Enable or disable PCI Express device Non-Fatal Error Reporting.
CER	**Disabled** Enabled	Enable or disable PCI Express device Correctable Error Reporting.
CTO	**Disabled** Enabled	Enable or disable PCI Express Completion Timeout timer.
SEFE	**Disabled** Enabled	Enable or disable Root PCI Express System Error on Fatal Error.
SENFE	**Disabled** Enabled	Enable or disable Root PCI Express System Error on Non-Fatal Error.
SECE	**Disabled** Enabled	Enable or disable Root PCI Express System Error on Correctable Error.
PME SCI	Disabled **Enabled**	Enable or disable PCI Express PME (power management event) SCI.
Always Enable Port	**Disabled** Enabled	Disabled = Disable the internal PCI Express interface device if no device is detected on the port. Enabled = Enable the internal PCI Express interface device also if no device is detected on the port.
PCIe Speed	**Auto** Gen1	Maximum speed of the PCIe port. Auto = Gen1 or Gen2 Gen1 = 2.5GT/s Some older non-compliant PCI Express devices will function only if Gen1 is selected. Some Gen2 devices start up in Gen1 mode and then their OS driver sets them to Gen2 mode.
Detect Non-compliant Device	**Disabled** Enabled	Try to detect also a non-compliant PCI Express device. If enabled, POST time will be longer.
Extra Bus Reserved	0-7 Default : **0**	Extra bus reserved (0-7) for bridges behind this root bridge.
Reserved Memory	1-20 Default : **10**	Reserved memory range for this root bridge.
Prefetchable Memory	1-20 Default : **10**	Prefetchable memory range for this root bridge.
Reserved I/O	4-20 Default : **4**	Reserved I/O range for this root bridge.
PCIe LTR	Disabled **Enabled**	Enable or disable PCI Express Latency Tolerance Reporting (LTR).
PCIe LTR Lock	Disabled **Enabled**	PCIe LTR configuration lock.

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Feature	Options	Description
Snoop Latency Override	Disabled Manual **Auto**	Snoop latency override for PCH PCIe.
Snoop Latency Multiplier	1 ns, 32 ns, **1024 ns** 32768 ns, 1048576 ns 33554432 ns	Snoop latency multiplier for PCH PCIe.
Snoop Latency Value	0-252 Default : **60**	Snoop latency value for PCH PCIe.
No-Snoop Latency Override	Disabled Manual **Auto**	No-Snoop latency override for PCH PCIe.
No-Snoop Latency Multiplier	1 ns, 32 ns, 1024 **ns** 32768 ns, 1048576 ns 33554432 ns	No-Snoop latency multiplier for PCH PCIe.
No-Snoop Latency Value	0-252 Default : **60**	No-Snoop latency override for PCH PCIe.

11.4.5 ACPI Submenu

Feature	Options	Description
Hibernation Support	Disabled **Enabled**	Enable or disable system ability to hibernate (operating system S4 sleep state). This option may not be effective with some operating systems.
ACPI Sleep State	Suspend Disabled S1 only (CPU Stop Clock) **S3 (Suspend to RAM)** Both S1 and S3 available for OS to choose from	Select the state used for ACPI system sleep/suspend.
Lock Legacy Resources	**Disabled** Enabled	Enable or disable locking of legacy resources.
S3 Video Repost	**Disabled** Enabled	Enable or disable video BIOS re-post on S3 resume. Required by some operating systems.
Native PCI Express Support	Disabled **Enabled**	Enable or disable native OS PCI Express support.
Native ASPM	**Disabled** Enabled	Enabled = The OS will control the ASPM support of the PCI Express device. Disabled = The BIOS will control the ASPM support of the PCI Express device.
ACPI Debug	**Disabled** Enabled	Open a memory buffer for storing debug strings. Use method ADBG to write strings to buffer.

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Feature	Options	Description
ACPI 5.0 CPPC Support	**Disabled** Enabled	Enable ACPI 5.0 Collaborative Processor Performance Control (CPPC) support. When enabled, platform exposes CPPC interfaces to operating system. When disabled, platform exposes legacy (non-CPPC) processor interfaces to operating system.
ACPI 5.0 CPPC Platform SCI	**Disabled** Enabled	Enable ACPI 5.0 platform generation of SCI on CPPC command completion. When enabled, platform generates GPE/SCI. When disabled platform does not generate GPE/SCI and OS polls for command completion.
Automatic Critical Trip Point	**Disabled** Enabled	Enabled = Configure the critical trip point - the temperature threshold at which the ACPI aware OS performs a critical shutdown - automatically to recommended value. Disabled = Configure the critical trip point manually.
Critical Trip Point Value	71 C, 79 C, 87 C, 95 C, 103 C, **106 C**, 111 C, 119 C, 127 C	Specifies the temperature threshold at which the ACPI aware OS performs a critical shutdown.
Lid Support	**Disabled** Enabled	Configure COM Express LID# signal to act as ACPI lid.
Sleep Button Support	**Disabled** Enabled	Configure COM Express SLEEP# signal to act as ACPI sleep button.

11.4.6 RTC Wake Submenu

Feature	Options	Description
Wake System At Fixed Time	Disabled Enabled	Enable system to wake from S5 using RTC alarm.
Wake up hour		Specify wake up hour. For example, enter “3” for 3am and “15” for 3pm.
Wake up minute		Specify wake up minute.
Wake up second		Specify wake up second.

11.4.7 Trusted Computing Submenu

Feature	Options	Description
Security Device Support	**Disabled** Enabled	Enable or disable TPM support. System reset is required after change.
TPM State	**Disabled** Enabled	Enable or disable TPM chip. Note: System might restart several times during POST to acquire target state.

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Feature	Options	Description
Pending operation	**None,** Enable Take Ownership, Disable Take Ownership, TPM Clear	Perform selected TPM chip operation. Note: System might restart several times during POST to perform selected operation.

11.4.8 CPU Submenu

Feature	Options	Description
Processor Type	No option	Displays the processor ID string. The "Processor Type" is not displayed, just the ID string.
CPU Signature	No option	Displays the CPU Signature.
Microcode Patch	No option	Displays the revision of the Microcode Patch.
FSB Speed	No option	Displays the FSB Speed.
Max CPU Speed	No option	Displays the Max CPU Speed.
Min CPU Speed	No option	Displays the Min CPU Speed.
CPU Speed	No option	Displays the current CPU Speed.
Processor Cores	No option	Displays the number of the Processor Cores.
Intel HT Technology	No option	Displays whether Intel HT Technology is supported.
Intel VT-x Technology	No option	Displays whether Intel VT-x Technology is supported.
Intel SMX Technology	No option	Displays whether Intel SMX Technology is supported.
64-bit	No option	Displays whether 64-bit is supported.
EIST Technology	No option	Displays whether Enhanced Intel SpeedStep Technology (EIST) is supported.
CPU C3 State	No option	Displays whether CPU C3 State is supported.
CPU C6 State	No option	Displays whether CPU C6 State is supported.
CPU C7 State	No option	Displays whether CPU C7 State is supported.
L1 Data Cache	No option	Displays the size of the L1 Data Cache.
L1 Code Cache	No option	Displays the size of the L1 Code Cache.
L2 Cache	No option	Displays the size of the L2 Cache.
L3 Cache	No option	Displays the size of the L3 Cache.
Set Boot Freq Ratio	8-23 Default : 255	Range: 8 - 23. This sets the boot ratio. If ratio is out of range, maximum ratio is used. Non-ACPI OSes will use this ratio. The range 8-23 is just an example as the possible range depends on processor variant.
Hyper-Threading	Disabled **Enabled**	Enable or disable Hyper-Threading technology.

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Feature	Options	Description
Active Processor Cores	All 1 2 3	Set number of cores to be enabled.
Overclocking Lock	**Disabled** Enabled	FLEX_RATIO(194) MSR
Limit CPUID Maximum	**Disabled** Enabled	When enabled, the processor will limit the maximum CPUID input value to 03h when queried, even if the processor supports a higher CPUID input value. When disabled, the processor will return the actual maximum CPUID input value of the processor when queried. Limiting the CPUID input value may be required for older operating systems that cannot handle the extra CPUID information returned when using the full CPUID input value.
Execute Disable Bit	Disabled **Enabled**	Enable/Disable the Execute Disable Bit (XD) of the processor. With the XD bit set to enabled, certain classes of malicious buffer overflow attacks can be prevented when combined with a supporting OS.
Intel Virtualization Technology	Disabled **Enabled**	When enabled, a VMM can utilize the integrated hardware virtualization support.
Hardware Prefetcher	Disabled **Enabled**	Enable the Mid Level Cache (L2) streamer prefetcher.
Adjacent Cache Line Prefetch	Disabled **Enabled**	Enable the Mid Level Cache (L2) prefetching of adjacent cache lines.
CPU AES	Disabled **Enabled**	Enable/Disable CPU Advanced Encryption Standard (AES) instructions.
EIST	Disabled **Enabled**	Enable /Disable or disable Enhanced Intel SpeedStep Technology (EIST).
Energy Performance	**Performance** Balanced Perform. Balanced Energy Energy Efficient	Optimize between performance and power savings.
Turbo Mode	Disabled **Enabled**	Enable/Disable Turbo Mode.
Package Power Limit Lock	Disabled **Enabled**	When enabled, PACKAGE_POWER_LIMIT MSR will be locked and a reset will be required to unlock the register.
CPU Power Limit1	0-255 Default : 0	CPU Power Limit1 value
CPU Power Limit1 Time	0-255 Default : 0	Time window in which the Power Limit1 is maintained.
CPU Power Limit2	0-255 Default : 0	CPU Power Limit2 value
Platform Power Limit Lock	Disabled **Enabled**	When enabled, PLATFORM_POWER_LIMIT MSR will be locked and a reset will be required to unlock the register.

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Feature	Options	Description
CPU Power Limit3	0-255 Default : 0	CPU Power Limit3 value
CPU Power Limit3 Time	0-255 Default : 0	Time window in which the Power Limit3 is maintained.
CPU Power Limit3 Duty Cycle	0-100 Default : 0	Specify in percentage the duty cycle that the CPU is required to maintain over the configured Power Limit3 time windows.
DDR Power Limit1	0-255 Default : 0	DDR Power Limit1 value
DDR Power Limit1 Time	0-255 Default : 0	Time window in which the DDR Power Limit1 is maintained.
DDR Power Limit2	0-255 Default : 0	DDR Power Limit2 value
1-Core Ratio Limit	0-255 Default : 0	Limit for 1 active core. 0 means using the factory-configured value.
2-Core Ratio Limit	0-255 Default : 0	Limit for 2 active cores. 0 means using the factory-configured value
3-Core Ratio Limit	0-255 Default : 0	Limit for 3 active cores. 0 means using the factory-configured value.
4-Core Ratio Limit	0-255 Default : 0	Limit for 4 active cores. 0 means using the factory-configured value
VR Current Value Lock	Disabled **Enabled**	Locks VR current value from further writes until a reset.
VR Current Value	0-8191 Default : 0	Voltage regulator current limit. 0 means automatic.
CPU C States	**Disabled** Enabled	Enable or disable CPU C states.
Enhanced C1 State	**Disabled** Enabled	Enhanced C1 state
CPU C3 Report	Disabled **Enabled**	Enable or disable CPU C3 report to OS.
CPU C6 Report	Disabled **Enabled**	Enable or disable CPU C6 report to OS.
C6 Latency	**Short** Long	Configure Short/Long latency for C6.
CPU C7 Report	Disabled CPU C7 **CPU C7s**	Enable or disable CPU C7 report to OS.
C7 Latency	Short **Long**	Configure Short/Long latency for C7.

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Feature	Options	Description
CPU C8 Report	Disabled **Enabled**	Enablen or disable CPU C8 report to OS. Note: Not displayed/supported on all Processors types.
CPU C9 Report	Disabled **Enabled**	Enable or disable CPU C9 report to OS. Note: Not displayed/supported on all Processors types.
CPU C10 Report	Disabled **Enabled**	Enable or disable CPU C10 report to OS. Note: Not displayed/supported on all Processors types.
C1 State Auto Demotion	Disabled **Enabled**	Processor will conditionally demote C3/C6/C7 requests to C1 based on uncore auto-demote information.
C3 State Auto Demotion	Disabled **Enabled**	Processor will conditionally demote C6/C7 requests to C3 based on uncore auto-demote information.
Package C State Demotion	Disabled **Enabled**	Enable package C state demotion.
C1 State Auto Undemotion	Disabled **Enabled**	Un-demotion from demoted C1.
C3 State Auto Undemotion	Disabled **Enabled**	Enable or disable Un-demotion from demoted C3.
Package C State Undemotion	Disabled **Enabled**	Enable or disable package C state undemotion.
C State Pre-Wake	Disabled **Enabled**	Enable/Disable C state Pre-Wake feature.
CFG Lock	Disabled **Enabled**	Configure MSR 0xE2[15], CFG lock bit.
Package C State Limit	C0/C1, C2, C3, C6, C7, C7s, C8, C9, C10, **AUTO**	Set Package C state limit
Lake Tiny Feature	**Disabled** Enabled	Enable or disable Lake Tiny feature for C state configuration.
ACPI CTDP BIOS	**Disabled** Enabled	Enable or disable ACPI CTDP BIOS support.
Configurable TDP Level	**TDP NOMINAL** TDP DOWN TDP UP Disabled	Allow reconfiguration of TDP levels base on current power and thermal delivery capabilities of the system.
Config TDP Lock	**Disabled** Enabled	Lock the config TDP control register.
TCC Activation Offset	0-50 Default : **0**	Offset from the Intel factory Thermal Control Circuit (TCC) activation temperature. TCC activation will lower CPU core and graphics core frequency, voltage or both. The factory TCC activation temperature is normally 100C. By entering 10 for TCC offset, the TCC will be activated at 90C.

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Feature	Options	Description
Intel TXT(LT) Support	**Disabled** Enabled	Enable or disable Intel(R) TXT(LT) support.
Debug Interface	**Disabled** Enabled	Enable or disable CPU debug feature.
Debug Interface Lock	**Disabled** Enabled	Lock CPU debug feature setting.
IOUT Offset Sign	0-1 Default : **0**	0 means positive offset. 1 means negative offset.
IOUT Offset	0-625 Default : **0**	VR IOUT offset configuration The range is 0 - 625.
IOUT Slope	0-1023 Default : **512**	VR IOUT slope configuration The range is 0 - 1023.

11.4.9 SATA Submenu

Feature	Options	Description
SATA Controller(s)	**Enabled** Disabled	Enable or disable the onboard SATA controller(s).
SATA Mode Selection	Native IDE **AHCI** RAID	Select SATA controller mode. RAID option is not supported on all chipsets.
SATA Test Mode	Enabled **Disabled**	Should be set to disabled. Test Mode is used just for verification measurements.
Aggressive LPM Support	**Enabled** Disabled	Enable PCH to aggressively enter link power state.
SATA Controller Speed	**Default** Gen1 Gen2 Gen3	Indicates the maximum speed the SATA controller can support. Default = maximum speed supported by the chipset Gen1 = 1.5 Gbit/s Gen2 = 3 Gbit/s Gen3 = 6 Gbit/s The maximum speed for variants equipped with QM87 chipset is 6 Gbit/s. The maximum speed for variants equipped with HM86 chipset is: 6 Gbit/s on SATA port 0 and 1 3 Gbit/s on SATA port 2 and 3.
► Software Feature Mask Configuration	submenu	RAID option ROM and Intel Rapid Storage Technology driver will refer to the Software Feature Mask Configuration to enable or disable the storage features.

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Feature	Options	Description
Alternate ID	Enabled **Disabled**	Report alternate Device ID. Displayed just for RAID SATA mode.
Serial ATA Port 0, 1, 2, 3	No option	Displays the name of the connected Hard Disk or DVDROM when the port is enabled. Empty is displayed when the port is disabled or when the port is enabled but nothing is connected to it.
Software Preserve	No option	Displays whether the detected drive supports Software Settings Preservation.
SATA Port	Disabled **Enabled**	Enable or disable the relevant SATA port. Not possible in Native IDE mode.
Hot Plug	**Disabled** Enabled	Select hot plug support for relevant SATA port. Not possible in Native IDE mode.
External SATA	**Disabled** Enabled	Enable or disable external SATA support on relevant SATA port. Not possible in Native IDE mode.
SATA Device Type	**Hard Disk Drive** Solid State Drive	Identify if the relevant SATA port is connected to solid state drive or hard disk drive. Not possible in Native IDE mode.
Spin Up Device	**Disabled** Enabled	When enabled, the controller runs an initialization sequence for the connected device during startup at the relevant SATA port. Some hard disks and special Solid-state Drives (SSD) will function correctly only when this feature is enabled. Not possible in Native IDE mode.

11.4.9.1 Software Feature Mask Configuration

Feature	Options	Description
RAID0	Disabled **Enabled**	Enable or disable RAID0 feature.
RAID1	Disabled **Enabled**	Enable or disable RAID1 feature.
RAID10	Disabled **Enabled**	Enable or disable RAID10 feature.
RAID5	Disabled **Enabled**	Enable or disable RAID5 feature.
Intel Rapid Recovery Technology	Disabled **Enabled**	Enable or disable Intel Rapid Recovery Technology.
Option ROM UI and Banner	Disabled **Enabled**	If enabled, then the option ROM user interface is shown. Otherwise, no option ROM banner or information will be displayed if all disks and RAID volumes are normal.
HDD Unlock	Disabled **Enabled**	If enabled, indicates that the HDD password unlock in the OS is enabled.
LED Locate	Disabled **Enabled**	LED locate

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Feature	Options	Description
IRRT Only on eSATA	Disabled **Enabled**	If enabled, then only Intel Rapid Recovery Technology (IRRT) volumes can span internal and external SATA (eSATA) drives. If disabled, then any RAID volume can span internal and eSATA drives.
Intel Smart Response Technology	Disabled **Enabled**	Enable or disable Intel Smart Response Technology.
Option ROM UI Delay	**2 Seconds** 4 Seconds 6 Seconds 8 Seconds	If enabled, indicates the delay of the option ROM user interface splash screen in a normal status.

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11.4.10 Intel(R) Rapid Start Technology Submenu

Feature	Options	Description
Intel(R) Rapid Start Technology	**Disabled** Enabled	Enable or disable Intel(R) Rapid Start Technology.
No valid partition	No option	Warning message when the Intel(R) Rapid Start Technology is not completely set up.
Entry on S3 RTC Wake	Disabled **Enabled**	Rapid Start invocation upon S3 RTC wake.
Entry After	0-120 Default : **10**	Enable RTC wake timer at S3 entry. Value range is from 0 (immediately) to 120 minutes.
Active Page Threshold Support	**Disabled** Enabled	Support RST with small partition.
Active Memory Threshold	0-65535 Default : **0**	Try to support RST when partition size > Active Page Threshold size in MB. Value 0 means automatic mode.
Hybrid Hard Disk Support	**Disabled** Enabled	Hybrid Hard Disk Support
Rapid Start Display Save/ Restore	**Disabled** Enabled	Rapid Start Display Save/Restore
Rapid Start Display Type	**BIOS Save/Restore** Desktop Save/Restore	Rapid Start Display Type

11.4.11 Acoustic Management Submenu

Feature	Options	Description
Automatic Acoustic Management	**Disabled** Enabled	Enable or disable Automatic Acoustic Management (AAM) on optical or hard disk drives.
SATA Port 0 Disk drive name Acoustic Mode	**Bypass** Quiet Max Performance	Acoustic noise level and performance optimization of optical or hard disk drives Bypass: Use drive's preset value. Quiet: Drive is slower, but quieter. Max Performance: Drive is faster, but possibly noisier.
SATA Port 1 Disk drive name Acoustic Mode	**Bypass** Quiet Max Performance	Same as at SATA Port 0.
SATA Port 2 Disk drive name Acoustic Mode	**Bypass** Quiet Max Performance	Same as at SATA Port 0.
SATA Port 3 Disk drive name Acoustic Mode	**Bypass** Quiet Max Performance	Same as at SATA Port 0.

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Note

This menu displays only the SATA ports on which the optical or hard disk drive is detected.

11.4.12 USB Submenu

Feature	Options	Description
USB Devices	No option	Displays the detected USB devices.
xHCI Mode	Smart Auto **Auto** Enabled Disabled Manual	Select mode for ports: 'Enabled' - USB ports will function in USB 3.0 mode but require driver on the OS. USB ports will not function in pre-OS time if USB 3.0 Support in BIOS is disabled (see the USB 3.0 Support in BIOS item). 'Disabled' - USB ports will function in USB 2.0 mode only and routed to the EHCI1 controller. 'Auto' - USB ports will initially function in USB 2.0 mode but the operating system driver can switch to USB 3.0. 'Smart Auto' - Identical to 'Auto', except the BIOS will take over the operating system driver setting after each restart.
EHCI1 (Ports USB0-5)	Disabled **Enabled**	Enable or disable EHCI1 (USB 2.0) controller. **Note:** One EHCI controller must always be enabled.
EHCI2 (Ports USB6-7)	Disabled **Enabled**	Enable or disable EHCI2 (USB 2.0) controller. **Note:** One EHCI controller must always be enabled.
USB2.0 Pins Routing	Route Per-Pin **Route all Pins to EHCI** Route all Pins to xHCI	Route USB2.0 pins to EHCI or xHCI controller.
USB2.0 Port 0 Pins	**Route to EHCI** Route to xHCI	Route the respective USB2.0 port to EHCI or xHCI controller.
USB2.0 Port 1 Pins	**Route to EHCI** Route to xHCI	Route the respective USB2.0 port to EHCI or xHCI controller.
USB2.0 Port 2 Pins	**Route to EHCI** Route to xHCI	Route the respective USB2.0 port to EHCI or xHCI controller.
USB2.0 Port 3 Pins	**Route to EHCI** Route to xHCI	Route the respective USB2.0 port to EHCI or xHCI controller.
USB2.0 Port 4 Pins	**Route to EHCI** Route to xHCI	Route the respective USB2.0 port to EHCI or xHCI controller.
USB2.0 Port 5 Pins	**Route to EHCI** Route to xHCI	Route the respective USB2.0 port to EHCI or xHCI controller.
USB2.0 Port 6 Pins	**Route to EHCI** Route to xHCI	Route the respective USB2.0 port to EHCI or xHCI controller.
USB2.0 Port 7 Pins	**Route to EHCI** Route to xHCI	Route the respective USB2.0 port to EHCI or xHCI controller.

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Feature	Options	Description
USB-to-UART Controller	**Route to EHCI** Route to xHCI	Route the USB-to-UART controller to EHCI or xHCI controller.
USB3.0 Pins	Select Per-Pin **Disable all Pins** Enable all Pins	Enable or disable xHCI SuperSpeed support.
USB3.0 Port 0 Pins	**Disabled** Enabled	Enable or disable the xHCI SuperSpeed support on respective USB port.
USB3.0 Port 1 Pins	**Disabled** Enabled	Enable or disable the xHCI SuperSpeed support on respective USB port.
USB3.0 Port 2 Pins	**Disabled** Enabled	Enable or disable the xHCI SuperSpeed support on respective USB port.
USB3.0 Port 3 Pins	**Disabled** Enabled	Enable or disable the xHCI SuperSpeed support on respective USB port.
Overcurrent Protection	**Disabled** Enabled	Enable or disable overcurrent protection on all USB ports.
► USB Ports Per-Port Disable Control	Submenu	Opens submenu to individually disable USB ports
Legacy USB Support	**Enabled** Disabled Auto	Set legacy USB support: 'Enable' - Enables legacy USB support. 'Disable' - Keeps USB devices available only for EFI applications and BIOS setup. 'Auto' - Disables legacy support if no USB devices are connected.
External USB Controllers Support	Disabled **Enabled**	Enable or disable BIOS support for external USB controllers.
xHCI Hand-off	Disabled **Enabled**	This is a workaround for operating systems without xHCI hand-off support. The xHCI ownership change should be claimed by xHCI operating system driver.
EHCI Hand-off	**Disabled** Enabled	This is a workaround for operating systems without EHCI hand-off support. The EHCI ownership change should be claimed by EHCI operating system driver.
USB Mass Storage Driver Support	Disabled **Enabled**	Enable or disable USB mass storage driver support.
USB Transfer Timeout	1 sec 5 sec 10 sec **20 sec**	Select the timeout value for control, bulk, and interrupt transfers.
Device Reset Timeout	10 sec **20 sec** 30 sec 40 sec	USB mass storage device Start Unit command timeout.
Device Power -Up Delay Selection	**Auto** Manual	Select maximum time a USB device might need before it properly reports itself to the host controller. 'Auto' - Selects a default value which is 100ms for a root port or derived from the hub descriptor for a hub port.

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Feature	Options	Description
Device Power -Up Delay Value	1-40 **Default: 5**	Set power-up delay value in seconds.
USB Mass Storage Device Name (Auto detected USB mass storage devices are listed here dynamically)	**Auto** Floppy Forced FDD Hard Disk CD-ROM	Every USB mass storage device that is enumerated by the BIOS will have an emulation type setup option. This option specifies the type of emulation the BIOS has to provide for the device:[1] 'AUTO' - Lets the BIOS auto detect the current formatted media. 'Floppy' - Emulates the device as a floppy drive. 'Forced FDD' - Allows a HDD to be connected as a floppy image.[2] 'Hard Disk' - Allows the hard disk to be emulated as a HDD. 'CD-ROM' - Assumes the CD-ROM is formatted as a bootable media.[3] **Notes:** [1]The device's formatted type and the emulation type provided by the BIOS must match for the device to boot properly. [2]The drive must be formatted with FAT12, FAT16 or FAT32. [3]As specified by the 'El Torito' Format Specification

11.4.12.1 USB Ports Per-Port Disable Control Submenu

Feature	Options	Description
USB Ports Per-Port Disable Control	Disabled **Enabled**	Individual disabling of USB ports.
USB Port 0	Disabled **Enabled**	Enable or disable the respective USB2.0 port.
USB Port 1	Disabled **Enabled**	Enable or disable the respective USB2.0 port.
USB Port 2	Disabled **Enabled**	Enable or disable the respective USB2.0 port.
USB Port 3	Disabled **Enabled**	Enable or disable the respective USB2.0 port.
USB Port 4	Disabled **Enabled**	Enable or disable the respective USB2.0 port.
USB Port 5	Disabled **Enabled**	Enable or disable the respective USB2.0 port.
USB Port 6	Disabled **Enabled**	Enable or disable the respective USB2.0 port.
USB Port 7	Disabled **Enabled**	Enable or disable the respective USB2.0 port.

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Feature	Options	Description
USB-to-UART Controller	**Disabled** Enabled	Enable or disable the USB port to which the internal USB-to-UART Controller is not connected. Not displayed on conga-TS87 rev. A.
USB3.0 Port 0	Disabled **Enabled**	Enable or disable the respective USB3.0 port.
USB3.0 Port 1	Disabled **Enabled**	Enable or disable the respective USB3.0 port.
USB3.0 Port 2	Disabled **Enabled**	Enable or disable the respective USB3.0 port.
USB3.0 Port 3	Disabled **Enabled**	Enable or disable the respective USB3.0 port.

11.4.13 SMART Settings Submenu

Feature	Options	Description
SMART Self Test	**Disabled** Enabled	Run SMART self test on all hard disk drives during POST. Self-Monitoring, Analysis and Reporting Technology (SMART) predicts hard disk drives degradation and/or faults.

11.4.14 Super I/O Submenu

Feature	Options	Description
SIO Clock	**24MHz** 48MHz	Select Super I/O base clock
PS/2 Keyboard/Mouse Support	**Disabled** Enabled	Enable or disable PS/2 keyboard/mouse controller support.
Serial Port 0	Disabled **Enabled**	Enable or disable serial port 0.
Device Settings	IO=3F8h; IRQ=4;	Fixed configuration of serial port 0 if enabled.
Serial Port 1	Disabled **Enabled**	Enable or disable serial port 1.
Device Settings	IO=2F8h; IRQ=3;	Fixed configuration of serial port 1 if enabled.
Parallel Port	**Disabled** Enabled	Enable or disable parallel port.
Device Settings	IO=378h; IRQ=7;	Fixed configuration of the parallel port if enabled.
Device Mode	**Standard Parallel Mode** EPP Mode ECP Mode EPP Mode & ECP Mode	Set the parallel port mode.

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Note

This setup menu is only available if an external Winbond W83627 Super I/O has been implemented on the carrier board.

11.4.15 Serial Port Console Redirection Submenu

Feature	Options	Description
COM0 Console Redirection	**Disabled** Enabled	Enable or disable serial port 0 console redirection.
▶Console Redirection Settings	submenu	Opens console redirection configuration sub menu.
COM1 Console Redirection	**Disabled** Enabled	Enable or disable serial port 1 console redirection.
▶Console Redirection Settings	submenu	Opens console redirection configuration sub menu.

Note

The Serial Port Console Redirection can be enabled (is functional) only if an external Super I/O offering UARTs has been implemented on the carrier board

11.4.15.1 Console Redirection Settings Submenu

Feature	Options	Description
Terminal Type	VT100 VT100+ VT-UTF8 **ANSI**	Select terminal type.
Baudrate	9600, 19200, 38400, 57600, **115200**	Select baud rate.
Data Bits	7, **8**	Set number of data bits.
Parity	**None** Even Odd Mark Space	Select parity.
Stop Bits	**1** 2	Set number of stop bits.
Flow Control	**None** Hardware RTS/CTS	Select flow control.

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Feature	Options	Description
VT-UTF8 Combo Key Support	Disabled **Enabled**	Enable VT-UTF8 combination key support for ANSI/VT100 terminals
Recorder Mode	**Disabled** Enabled	With recorder mode enabled, only text output will be sent over the terminal. This is helpful to capture and record terminal data.
Resolution 100x31	**Disabled** Enabled	Enables or disables extended terminal resolution.
Legacy OS Redirection Resolution	**80x24** 80x25	Number of rows and columns supported for legacy OS redirection.
Putty KeyPad	**VT100** LINUX XTERMR6 SCO ESCN VT400	Select FunctionKey and KeyPad on Putty.
Redirection After BIOS POST	**Enabled** Disabled	Select whether serial redirection should be continued after POST.

11.4.16 UEFI Network Stack Submenu

Feature	Options	Description
UEFI Network Stack	**Disabled** Enabled	Enable or disable the UEFI network stack.
IPv4 PXE Support	Disabled **Enabled**	Enable IPv4 PXE boot support. If disabled IPv4 PXE boot option will not be created.
IPv6 PXE Support	Disabled **Enabled**	Enable IPv6 PXE boot support. If disabled IPv6 PXE boot option will not be created.

11.4.17 Intel (R) Ethernet Connection I218-LM Submenu

Feature	Options	Description
▶ NIC Configuration	submenu	Opens the NIC Configuration submen.
Blink LEDs	0-15 Default : **0**	The Ethernet LEDs will blink so many seconds long as entered.
UEFI Driver	No option	Displays the UEFI Driver version.
Adapter PBA	No option	Displays the Adapter PBA.
Chip Type	No option	Displays the type of the Chip in which the Ethernet controller is integrated.

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Feature	Options	Description
PCI Device ID	No option	Displays the PCI Device ID of the Ethernet controller.
Bus:Device:Function	No option	Displays the PCI Bus:Device:Function number of the Ethernet controller.
Link Status	No option	Displays the Link Status.
MAC Address	No option	Displays the MAC Address.

Note

The MAC address is also displayed in the submenu title.

11.4.18 NIC Configuration Submenu

Feature	Options	Description
Link Speed	**Auto Negotiated** 10 Mbps Half 10 Mbps Full 100 Mbps Half 100 Mbps Full	Specifies the port speed used for the selected boot protocol.
Wake On LAN	Disabled **Enabled**	Enables the server to be powered on using an in-band magic packet.

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11.5 Chipset Setup

Select the Chipset tab from the setup menu to enter the Chipset BIOS Setup screen. The menu is used for setting chipset features.

Main	Advanced	Chipset	Boot	Security	Save & Exit
		Platform Controller Hub (PCH)			
		Processor (Integrated Components)			

11.5.1 Platform Controller Hub (PCH) Submenu

Feature	Options	Description
Intel PCH SKU Name	No option	Displays the SKU Name of the PCH.
PCI Express Clock Gating	**Disabled** Enabled	Enable or disable PCI Express clock gating for each root port.
DMI Link ASPM PCH Side	**Disabled** Enabled	Active State Power Management (ASPM) of DMI link PCH side. DMI link is the main bus between the Processor and Platform Controller Hub (PCH).
DMI Link Extended Synch Control	**Disabled** Enabled	The control of extended synch on PCH side of the DMI link.
Isolate SMBus Segments	**Never** During POST Always	Allows to cut off the off-board SMBus segment. This can be a workaround for external SMBus devices that do not conform to specification.
PCIe-USB Glitch W/A	**Disabled** Enabled	PCIe-USB glitch W/A for bad USB device(s) connected behind PCIe/PEG port.
USB Precondition	**Disabled** Enabled	Precondition work on USB host controller and root ports for faster enumeration.
BTCG	**Enabled** Disabled	Enable or disable USB related trunk clock gating.
HDA Controller	Disabled Enabled **Auto**	Control activation of the HDA controller device. Disabled = HDA Controller will be unconditionally disabled. Enabled = HDA Controller will be unconditionally enabled. Auto = HDA Controller will be enabled if HDA codec present, disabled otherwise.
HDA PME	**Disabled** Enabled	Enable or disable the power management capability of the audio controller.
PCH LAN Controller	**Enabled** Disabled	Enable or disable the onboard, PCH integrated ethernet controller.
Wake on LAN	**Enabled** Disabled	Enable or disable the wake on LAN capability of the onboard, PCH integrated ethernet controller.

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Feature	Options	Description
SLP_LAN# Low on DC Power	Disabled **Enabled**	Enable or disable SLP_LAN# low on DC power.
Serial IRQ Mode	Quiet **Continuous**	Configure serial IRQ mode.
SB CRID	**Disabled** Enabled	Enable or disable southbridge compatible revision ID support.
SLP_S4 Assertion Width	Disabled 1-2 Seconds 2-3 Seconds 3-4 Seconds **4-5 Seconds**	Select a minimum assertion width of the SLP_S4# signal.
Port 80h Redirection	**LPC Bus** PCIe Bus	Control where the port 80h cycles are sent.

11.5.2 Processor (Integrated Components) Submenu

Feature	Options	Description
Processor Codename	No option	Displays the Processor codename.
VT-d Capability	No option	Displays whether the VT-d is supported by the Processor.
VT-d	Disabled **Enabled**	Enable or disable VT-d support. Displayed just if the VT-d capability is supported by the Processor.
Thermal Device (B0:D4:F0)	Enabled **Disabled**	Enable or disable thermal device.
Audio Device (B0:D3:F0)	**Enabled** Disabled	Enable or disable the integrated audio device in the Processor.
NB CRID	**Disabled** Enabled	Enable or disable northbridge compatible revision ID support.
BDAT ACPI Table Support	Enabled **Disabled**	Enables support for the BDAT ACPI table.
▶DMI Configuration	submenu	Control various DMI functions. DMI link is the main, but exclusively internal bus between the Processor and Platform Controller Hub (PCH).
▶Memory Configuration	submenu	Memory configuration parameters
▶GT - Power Management Control	submenu	Processor Graphics Controller (GT) power management control options

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11.5.2.1 DMI Configuration Submenu

Feature	Options	Description
DMI	No option	Displays the DMI bus characteristics.
DMI Vc1 Control	Enabled **Disabled**	Enable or disable DMI Vc1.
DMI Vcp Control	**Enabled** Disabled	Enable or disable DMI Vcp.
DMI Vcm Control	**Enabled** Disabled	Enable or disable DMI Vcm.
DMI Link ASPM Processor Side	**Disabled** L0s L1 L0sL1	Active State Power Management (ASPM) of the DMI link on the Processor side. DMI link is the main bus between the Processor and Platform Controller Hub (PCH).
DMI Extended Synch Control	Enabled **Disabled**	Enable or disable DMI extended synchronization.
DMI Gen 2	**Auto** Enabled Disabled	Enable or disable DMI Gen2.
DMI De-emphasis Control	**-6 dB** -3.5 dB	Configure the de-emphasis control on DMI.
DMI IOT	Enabled **Disabled**	Enable or disable DMI IOT.

11.5.2.2 Memory Configuration Submenu

Feature	Options	Description
Memory Frequency	No option	Displays the memory frequency.
Total Memory	No option	Displays the total amount of installed memory.
Memory Voltage	No option	Displays the memory voltage.
DIMM#0 (Bottom)	No option	Displays bottom memory socket DIMM information.
DIMM#2 (Top)	no option	Displays top memory socket DIMM information.
CAS Latency (tCL)	No option	Displays the CAS Latency (tCL).
CAS to RAS (tRCDmin)	No option	Displays the CAS to RAS (tRCDmin).
Row Precharge (tRPmin)	No option	Displays the Row Precharge (tRPmin).
Active to Precharge (tRASmin)	No option	Displays the Active to Precharge (tRASmin).

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Feature	Options	Description
DIMM Profile	**Default DIMM Profile** Custom profile XMP Profile 1 XMP Profile 2	Select DIMM timing profile that should be used. XMP profiles cannot work on current modules and MUSTnot be selected. **CAUTION:** For congatec internal debugging only. DO NOT CHANGE.
▶Custom Profile Control	Submenu	Configure the custom DIMM profile options. **CAUTION:** For congatec internal debugging only. DO NOT CHANGE.
Memory Frequency Limiter	**Auto**, 1067,1333, 1600, 1867, 2133, 2400, 2667	Maximum memory frequency selections in [MHz] (Hidden if DIMM profile set to 'Custom Profile').
DDR Reset Wait Time	0-3000000 Default : 0	The amount of time (in nano seconds) to wait for switch DDR voltage
Max TOLUD	**Dynamic**, 1 GB, 1.25 GB, 1.5 GB, 1.75 GB, 2 GB, 2.25 GB, 2.5 GB, 2.75 GB, 3 GB, 3.25 GB	Maximum value of TOLUD Dynamic assignment would adjust TOLUD automatically based on largest MMIO length of installed graphic controller.
Enh Interleave Support	Disabled **Enabled**	Enable or disable Enhanced Interleave support.
RI Support	Disabled **Enabled**	Enable or disable Rank Interleave support. Note: RI and HORI can not be enabled at the same time.
DLL Weak Lock Support	Disabled **Enabled**	Enable or disable DLL weak lock support.
Mc Lock	Disabled **Enabled**	Enable or disable capacity to lock or not MC registers.
Ch Hash Support	Disabled **Enabled**	Enable or disable channel hash support. Note: Only if memory interleaved mode.
Ch Hash Mask	1-0x3FFF Default : 0x30CE	Set the bit(s) to be included in the XOR function. Note: Bit mask corresponds to bits[19:6].
Ch Hash Interleaved Bit	BIT06, **BIT07**, BIT08, BIT09	Select the bit to be used for channel interleaved mode. Note: BIT07 will interleave the channels at a 2 cacheline granularity, BIT08 at 4 and BIT09 at 8.
NMode Support	**Auto** 1N Mode 2N Mode	NMode support option
Memory Scrambler	**Enabled** Disabled	Enable or disable memory scrambler support.
RMT Crosser Support	Enabled **Disabled**	Enable or disable RMT crosser support.
MRC Fast Boot	**Enabled** Disabled	Enable or disable MRC fast boot.
DIMM Exit Mode	**Auto** Slow Exit Fast Exit	DIMM Exit Mode control

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Feature	Options	Description
Power Down Mode	No Power Down APD PPD PPD-DLLoff APD-PPD Auto	Power Down Mode control Default is: Auto - when DIMM Exit Mode is set to Slow Exit and PPD - when DIMM Exit Mode is set to Fast Exit.
Memory Remap	**Enabled** Disabled	Enable or disable memory remap above 4G.
GDXC Support	Enabled **Disabled**	Enable or disable GDXC support.

11.5.2.3 GT - Power Management Control Submenu

Feature	Options	Description
Processor Graphics Controller Info	No option	Displays the Processor Graphics Controller Info.
RC6(Render Standby)	Disabled **Enabled**	Check to enable render standby support.
GT Overclocking Support	**Disabled** Enabled	Enable or disable GT overclocking support.
GT Overclocking Frequency	0-255 Default : 22	Overclocked RP0 frequency (MLCClk) in multiples of 50 MHz.
GT Overclocking Voltage	0-255 Default : 0	Extra voltage needed above the original RP0 voltage. The unit is 1/256 volt.

11.6 Boot Setup

Select the Boot tab from the setup menu to enter the Boot setup screen.

11.6.1 Boot Settings Configuration

Feature	Options	Description
Quiet Boot	**Disabled** Enabled	*Disabled* displays normal POST diagnostic messages. *Enabled* displays OEM logo instead of POST messages. *Note: The default OEM logo is a dark screen.*
Setup Prompt Timeout	1 0 - 65535	Number of seconds to wait for setup activation key. 0 means no wait for fastest boot (not recommended), 65535 means infinite wait.

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Feature	Options	Description
Bootup NumLock State	**On** Off	Select the keyboard numlock state.
System Off Mode	**G3/Mech Off** S5/Soft Off	Define system state after shutdown when a battery system is present.
Power Loss Control	**Remain Off** Turn On Last State	Specifies the mode of operation if an AC power loss occurs. *Remain Off* keeps the power off until the power button is pressed. *Turn On* restores power to the computer. *Last State* restores the previous power state before power loss occurred. *Note: Only works with an ATX type power supply.*
AT Shutdown Mode	System Reboot **Hot S5**	Determines the behavior of an AT-powered system after a shutdown.
Enter Setup If No Boot Device	No **Yes**	Select whether the setup menu should be started if no boot device is connected.
Enable Popup Boot Menu	No **Yes**	Select whether the popup boot menu can be started.
Boot Priority Selection	Device Based **Type Based**	Select between device and type based boot priority lists. The "Device Based" boot priority list allows you to select from a list of currently detected devices only. The "Type Based" boot priority list allows you to select device types, even if a respective device is not yet present. Moreover, the "Device Based" boot priority list might change dynamically in cases when devices are physically removed or added to the system. The "Type Based" boot menu is static and can only be changed by the user.
1st, 2nd, 3rd, ... Boot Device (Up to 12 boot devices can be prioritized if device based priority list control is selected. If "Type Based" priority list control is enabled only 8 boot devices can be prioritized.)	Disabled SATA 0 Drive SATA 1 Drive SATA 2 Drive SATA 3 Drive USB Floppy USB Harddisk USB CDROM Onboard LAN External LAN Other BEV Device	This view is only available when in the default "Type Based" mode. When in "Device Based" mode you will only see the devices that are currently connected to the system. SATA x Drive selection to a not existing SATA port will be ignored. The available SATA ports are listed in SATA submenu in dependency to the board variant (see SATA Submenu).
▶CSM & Option ROM Control	submenu	Opens submenu which controls the execution of UEFI and legacy option ROMs.
UEFI Fast Boot	**Disabled** Enabled	Enable or disable boot with initialization of a minimal set of devices required to launch active boot option. Has no effect for BBS / legacy boot options.

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Feature	Options	Description
SATA Support	Last Boot HDD Only, All SATA Devices **HDD Only**	
VGA Support	Auto **UEFI Driver**	If set to Auto, the legacy video option ROM will be installed for legacy OS boot; boot logo will NOT be shown during POST. For UEFI OS boot the UEFI GOP driver will be installed.
USB Support	Disabled Full Init **Partial Init**	If set to Disabled, no USB device will be available before OS boot. If set to Partial Init, specific USB ports/ devices will NOT be available before OS boot. If set to Enabled, all USB devices will be available during POST and after OS boot.
PS/2 Device Support	Disabled **Enabled**	If set to Disabled, PS/2 devices will be skipped.
Network Stack Driver Support	**Disabled** Enabled	If set to Disabled, the UEFI network stack driver installation will be skipped.

Note

1. The term 'AC power loss' stands for the state when the module looses the standby voltage on the 5V_SB pins. On congatec modules, the standby voltage is continuously monitored after the system is turned off. If within 30 seconds the standby voltage is no longer detected, then this is considered an AC power loss condition. If the standby voltage remains stable for 30 seconds, then it is assumed that the system was switched off properly.

2. Inexpensive ATX power supplies often have problems with short AC power sags. When using these ATX power supplies it is possible that the system turns off but does not switch back on, even when the PS_ON# signal is asserted correctly by the module. In this case, the internal circuitry of the ATX power supply has become confused. Usually another AC power off/on cycle is necessary to recover from this situation.

11.6.1.1 CSM & Option ROM Control Submenu

Feature	Options	Description
Launch CSM	**Enabled** Disabled	Controls the execution of the CSM module. Only disable for pure UEFI operating system support.
Boot Option Filter	**UEFI and Legacy** Legacy Only UEFI Only	Controls which devices / boot loaders the system should boot to.

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Feature	Options	Description
PXE Option ROM Launch Policy	**Do Not Launch** UEFI ROM Only Legacy ROM Only Legacy ROM First UEFI ROM First	Controls the execution of UEFI and legacy PXE option ROMs.
Storage Option ROM Launch Policy	Do Not Launch UEFI ROM Only **Legacy ROM Only** Legacy ROM First UEFI ROM First	Controls the execution of UEFI and legacy mass storage device option ROMs.
Video Option ROM Launch Policy	Do Not Launch UEFI ROM Only **Legacy ROM Only** Legacy ROM First UEFI ROM First	Controls the execution of UEFI and legacy video option ROMs.
Other Option ROM Launch Policy	**UEFI ROM Only** Legacy ROM Only	Controls the execution of option ROMs for PCI / PCI Express devices other than network, mass storage or video.
GateA20 Active	**Upon Request** Always	Gate A20 control. Upon Request: Gate A20 can be disabled using BIOS services. Always: Do not allow disabling Gate A20 This option is useful when any runtime code is executed above 1MB.
Option ROM Messages	**Force BIOS** Keep Current	Set display mode for option ROMs.
INT19 Trap Response	**Immediate** Postponed	BIOS reaction on INT19 trapping by Option ROM Immediate: Execute the trap right away. Postponed: Execute the trap during legacy boot.

11.7 Security Setup

Select the Security tab from the setup menu to enter the Security setup screen.

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11.7.1 Security Settings

Feature	Options	Description
Administrator Password	Enter password	Specifies the setup administrator password
HDD Security Configuration		
List of all detected hard disks supporting the security feature set	Select device to open device security configuration submenu	
▶Secure Boot Menu	Submenu	

11.7.1.1 BIOS Security Features

BIOS Password/ BIOS Write Protection

A BIOS password protects the BIOS setup program from unauthorized access. This ensures that end users cannot change the system configuration without authorization. With an assigned BIOS password, the BIOS prompts the user for a password on a setup entry. If the password entered is wrong, the BIOS setup program will not launch.

The congatec BIOS uses a SHA256 based encryption for the password, which is more secured than the original AMI encryption. The BIOS password is case sensitive with a minimum of 3 characters and a maximum of 20 characters. Once a BIOS password has been assigned, the BIOS activates the grayed out 'BIOS Update and Write Protection' option. If this option is set to 'enabled', only authorized users (users with the correct password) can update the BIOS. To update the BIOS, use the congatec system utility cgutlcmd.exe with the following syntax:

CGUTLCMD BFLASH <BIOS file> /BP: <password> where <password> is the assigned BIOS password.

For more information about "Updating the BIOS" refer to the congatec system utility user's guide, which is called CGUTLm1x.pdf and can be found on the congatec AG website at www.congatec.com.

With the BIOS password protection and the BIOS update and write protection, the system configuration is completely secured. If the BIOS is password protected, you cannot change the configuration of an end application without the correct password.

Note

Use cgutlcmd.exe version 1.5.3 or later.

Built in BIOS recovery is disabled in the congatec BIOS firmware to prevent the BIOS from updating itself due to the user pressing a special key combination or a corrupt BIOS being detected. congatec considers such a recovery update a security risk because the BIOS internal update process bypasses the implemented BIOS security explained above.

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Only the congatec utility interface to the SMI handler of the BIOS flash update is enabled. Other interfaces to the SMI handler are disabled to prevent non congatec tools from writing to the BIOS flash. As a result of this restriction, flash utilities supplied by AMI or Intel will not work .

UEFI Secure Boot

Secure Boot is a security standard defined in UEFI specification 2.3.1 that helps prevent malicious software applications and unauthorized operating systems from loading during system start up process. Without secure boot enabled (not supported or disabled), the computer simply hands over control to the bootloader without checking whether it is a trusted operating system or malware. With secure boot supported and enabled, the UEFI firmware starts the bootloader only if the bootloader's signature has maintained integrity and also if one of the following conditions is true:

- The bootloader was signed by a trusted authority that is registered in the UEFI database.
- The user has added the bootloader's digital signature to the UEFI database. The BIOS provides the key management setup sub-menu for this purpose.

Note

The congatec BIOS by default enables CSM (Compatibility Support Module) and disables secure boot because most of the industrial computers today boot in legacy (non-UEFI) mode. Since secure boot is only enabled when booting in native UEFI mode, you must therefore disable the CSM (compatibility support module) in the BIOS setup to enable Secure Boot.

A full description of secure boot is beyond the scope of this users guide. For more information about how secure boot leverages signature databases and keys, see the secure boot vverview in the windows deployment options section of the Microsoft TechNet Library at http://technet.microsoft.com.

11.7.1.2 Hard Disk Security Features

Hard Disk Security uses the Security Mode feature commands defined in the ATA specification. This functionality allows users to protect data using drive-level passwords. The passwords are kept within the drive, so data is protected even if the drive is moved to another computer system.

The BIOS provides the ability to 'lock' and 'unlock' drives using the security password. A 'locked' drive will be detected by the system, but no data can be accessed. Accessing data on a 'locked' drive requires the proper password to 'unlock' the disk.

The BIOS enables users to enable/disable hard disk security for each hard drive in setup. A master password is available if the user can not remember the user password. Both passwords can be set independently however the drive will only lock if a user password is installed. The max length of the passwords is 32 bytes.

During POST each hard drive is checked for security mode feature support. In case the drive supports the feature and it is locked, the BIOS prompts the user for the user password. If the user does not enter the correct user password within four attempts, the user is notified that the

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drive is locked and POST continues as normal. If the user enters the correct password, the drive is unlocked until the next reboot.

In order to ensure that the ATA security features are not compromised by viruses or malicious programs when the drive is typically unlocked, the BIOS disables the ATA security features at the end of POST to prevent their misuse. Without this protection it would be possible for viruses or malicious programs to set a password on a drive thereby blocking the user from accessing the data.

Note

If the user enables password support, a power cycle must occur for the hard drive to lock using the new password. Both user and master password can be set independently however the drive will only lock if a user password is installed.

11.8 Save & Exit Menu

Select the Save & Exit tab from the setup menu to enter the Save & Exit setup screen. You can display a 'Save & Exit' screen option by highlighting it using the <Arrow> keys.

Feature	Description
Save Changes and Exit	Exit setup menu after saving the changes. The system is only reset if settings have been changed.
Discard Changes and Exit	Exit setup menu without saving any changes.
Save Changes and Reset	Save changes and reset the system.
Discard Changes and Reset	Reset the system without saving any changes.
Save Options	
Save Changes	Save changes made so far to any of the setup options. Stay in setup menu.
Discard Changes	Discard changes made so far to any of the setup options. Stay in setup menu.
Restore Defaults	Restore default values of all the setup options.
Boot Override	
List of all boot devices currently detected.	Select device to leave setup menu and boot from the selected device. Only visible and active if Boot Priority Selection setup node is set to "Device Based".

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12 Additional BIOS Features

The conga-TS87 uses a congatec/AMI AptioEFI that is stored in an onboard Flash Rom chip and can be updated using the congatec System Utility (version 1.5.0 and later), which is available in a DOS based command line, Win32 command line, Win32 GUI, and Linux version.

The BIOS displays a message during POST and on the main setup screen identifying the BIOS project name and a revision code. The initial production BIOS is identified as BQ87R1xx or BH87R1xx where:

- BQ87 is the BIOS for modules with the QM87 chipset
- BH87 is the BIOS for modules with the HM86 chipset
- R is the identifier for a BIOS ROM file, 1 is the so called feature number and xx is the major and minor revision number.

The BQ87 BIOS binary size is 16MB and the BH87 BIOS binary size is 8MB.

12.1 Supported Flash Devices

The conga-TS87 supports the following flash devices:

- Spansion S25FL064K0SMFI01 (8MB)
- Winbond W25Q128FVSIG (16MB)
- Winbond W25Q64CVSSIG (8MB)

The flash devices listed above can be used on the carrier board for external BIOS support. For more information about external BIOS support, refer to the Application Note AN7_External_BIOS_Update.pdf on the congatec website at http://www.congatec.com.

12.2 Updating the BIOS

BIOS updates are often used by OEMs to correct platform issues discovered after the board has been shipped or when new features are added to the BIOS.

For more information about "Updating the BIOS" refer to the user's guide for the congatec System Utility, which is called CGUTLm1x.pdf and can be found on the congatec AG website at www.congatec.com.

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13 Industry Specifications

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

Specification	Link
Low Pin Count Interface Specification, Revision 1.0 (LPC)	http://developer.intel.com/design/chipsets/industry/lpc.htm
Universal Serial Bus (USB) Specification, Revision 2.0	http://www.usb.org/home
PCI Specification, Revision 2.3	http://www.pcisig.com/specifications
Serial ATA Specification, Revision 3.0	http://www.serialata.org
PICMG® COM Express Module™ Base Specification	http://www.picmg.org/
PCI Express Base Specification, Revision 2.0	http://www.pcisig.com/specifications

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