COM Express™ conga-TC87

4th Generation Intel® Core™ i7, i5, i3 and Mobile Intel® Celeron Single Chip Ultra Low TDP Processors

User's Guide

Revision 0.1 (Preliminary)

Revision History

Revision	Date (yyyy.mm.dd)	Author	Changes
0.1	2013.11.14	AEM	• Preliminary release

Preface

This user's guide provides information about the components, features, connectors and BIOS Setup menus available on the conga-TC87. 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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Intended Audience

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Symbols

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

Warning

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

Caution

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

Note

Notes call attention to important information that should be observed.

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
N.C.	Not connected
N.A.	Not available
MCP	MCP
TBD	To be determined

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1 INTRODUCTION

COM Express™ Concept

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

- Compact 95mm x 95mm
- Basic 125mm x 95mm
- Extended 155mm x 110mm

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

Types	Connector Rows	PCI Express Lanes	PCI	IDE Channels	LAN ports
Type 1	A-B	Up to 6			1
Type 2	A-B C-D	Up to 22	32 bit	1	1
Type 3	A-B C-D	Up to 22	32 bit		3
Type 4	A-B C-D	Up to 32		1	1
Type 5	A-B C-D	Up to 32			3
Type 6	A-B C-D	Up to 24			1
Type 10	A-B	Up to 4			1

The conga-TC87 modules use the Type 6 pinout definition. 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™ 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.

conga-TC87 Options Information

The conga-TC87 is currently available in four variants. This user's guide describes all of these variants. The table 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.

conga-TC87

Part-No.	046901	046902	046903	046904
Processor	Intel® Core™ i7-4650U 1.7 GHz Dual Core™	Intel® Core™ i5-4300U 1.9 GHz Dual Core™	Intel® Core™ i3-4010U 1.7 GHz Dual Core™	Intel® Celeron® 2980U 1.6 GHz Dual Core™
Intel® Smart Cache	4 MByte	3 MByte	3 MByte	2 MByte
Max. Turbo Frequency	3.3 GHz	2.9 GHz	n/a	n/a
Processor Graphics	Intel® HD graphics 5000 (GT3)	Intel® HD graphics 4400 (GT2)	Intel® HD graphics 4400 (GT2)	Intel® HD graphics (GT2)
Graphics Max. Dynamic Freq	1.1 GHz	1.1 GHz	1.0 GHz	1.0 GHz
PEG	No	No	No	No
LVDS	Yes	Yes	Yes	Yes
DisplayPort (DP)	Yes	Yes	Yes	Yes
HDMI	Yes	Yes	Yes	Yes
Processor TDP (Max)	15 W	15 W	15 W	15 W

2 Specifications

2.1 Feature List

Table 1 Feature Summary

Form Factor	Based on COM Express™ standard pinout Type 6 Rev. 2.1 (Compact size 95 x 95 mm).
Processor	Intel® Core™ i7-4650U 1.7 GHz Dual Core™ with 4-MByte Intel® Smart Cache Intel® Core™ i5-4300U 1.9 GHz Dual Core™ with 3-MByte Intel® Smart Cache Intel® Core™ i3-4010U 1.7 GHz Dual Core™ with 3-MByte Intel® Smart Cache Intel® Celeron® 2980U 1.6 GHz Dual Core™ with 2-MByte Intel® Smart Cache
Memory	2 sockets: SO-DIMM DDR3L (Low voltage @ 1.35V) up to 1600MT/s, with 16GB maximum capacity. Sockets located top and bottom side of module.
congatec Board Controller	Multi-stage watchdog, non-volatile user data storage, manufacturing and board information, board statistics, BIOS setup data backup, I2C bus, Power loss control.
Chipset	Intel® 8 Series PCH-LP integrated in the Multi-Chip Package (MCP).
Audio	High Definition Audio (HDA)/digital audio interface with support for multiple codecs
Ethernet	Gigabit Ethernet support via the onboard Intel® I218LM GbE Phy. Also offers AMT 9.5 support.

Graphics Options	Next Generation Intel® HD Graphics (4400/5000) 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 (Must be two DDI's (DP, HDMI/DVI) plus one eDP/LVDS)
	• LVDS (Integrated flat panel interface with 25-112MHz single/dual-channel LVDS Transmitter). Supports:
	  • 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 color mappings
	  • Automatic Panel Detection via Embedded Panel Interface based on VESA EDID™ 1.3.
	  • Resolution up to 1920x1200 in dual LVDS bus mode.
	• Optional eDP interface
	(**NOTE**: Either eDP or LVDS signals supported. Both not supported).
	• DisplayPort 1.1 (DP): 2x DisplayPorts ports on digital ports B, C. Multiplexed with HDMI/DVI ports. Hot-Plug detect support.
	• HDMI 1.4: 2x HDMI ports on digital ports B, C. Multiplexed with DisplayPort (DP)/DVI. Hot-plug detect support.
	• DVI: 2x DVI ports on digital ports B, C. Multiplexed with HDMI/DP ports. Hot-Plug detect support.
	• Optional VGA interface
	(**NOTE**: This option is offered on digital port C and supported only on rev. C.x. and later. The display combination for revisions with VGA support is 1x DDI, 1x VGA and 1x eDP).

Peripheral Interfaces	• 4x Serial ATA® 6Gb/s with RAID support 0/1/5/10 (Celeron variant supports only 2x SATA 6Gb/s) • 4 PCI Express® Lanes. Support for full 5 Gb/s bandwidth in each direction per x1 links. (can be configured via special/customized BIOS firmware to support four x1 and one x4 links. • 8x USB 2.0 (EHCI) • 2x USB 3.0 (XHCI) • 2x Serial Interface (UART0/1) • LPC Bus • I²C Bus, Fast Mode, multi-master • SM Bus • SPI • GPIOs
BIOS	AMI Aptio® UEFI 2.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 9.5. • Configurable TDP • Ultra low standby power consumption, Deep Sx.
Security	Optional discrete Trusted Platform Module "TPM", new AES Instructions for faster and better encryption.

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 option information list on page 11 of this user's guide to determine what options are available on your particular module.

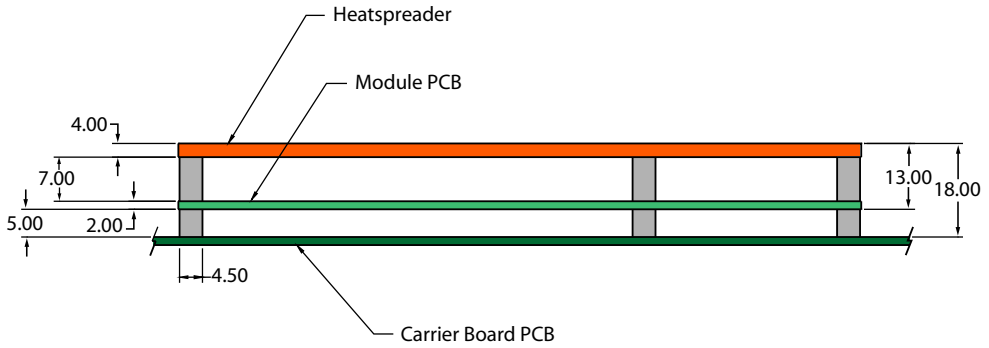
2.2 Supported Operating Systems

The conga-TC87 supports the following operating systems.

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

2.3 Mechanical Dimensions

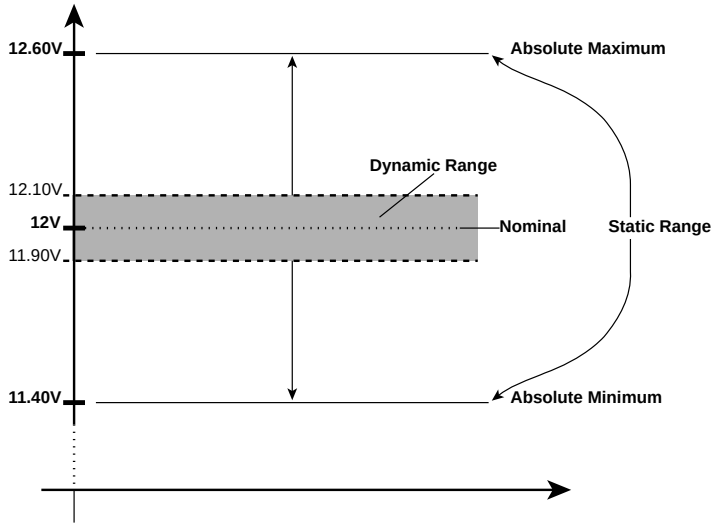
- 95.0 mm x 95.0 mm (3.74" x 3.74")
- Height approximately 18 or 21mm (including heatspreader) depending on the carrier board connector that is used. If the 5mm (height) carrier board connector is used, then approximate overall height is 18mm. If the 8mm (height) carrier board connector is used, then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



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.

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-TC87 module, conga-TEVAL carrier board, hdmi-equipped LCD monitor, SATA SSD drive, and USB keyboard/mouse. 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. To ensure that only the power consumption of the CPU module is measured, the conga-TEVAL power consumption was determined before the measurement and subtracted from the overall power consumption value measured.

The USB keyboard/mouse were 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 heatspreader and a fan cooled heatsink to measure the power consumption under normal thermal conditions.

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 2GB 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 90° and 95°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.

Processor Information

The tables below provide additional information about the power consumption data for each of the conga-TC87 variants offered. The values are recorded at various operating mode.

2.5.1 Intel® Core™ i7-4650U 1.7 GHz Dual Core™ 4MB Cache

conga-TC87 Art. No. 046901 (GT3 Graphics)	Intel® Core™ i7-4650U 1.7 GHz 2 Core™ 4MB Intel® Smart Cache 22nm Layout Rev. TU87LB1 /BIOS Rev. TU87R005			
Max Turbo Frequency	3.3 GHz			
Memory Size	4GB			
Operating System	**Windows 7 (64 bit)**			
Power State	**Desktop Idle**	**100% workload**	**100% workload in Turbo mode (peak)**	**Suspend to Ram (S3) 5V Input Power**
Power consumption (measured in Amperes/Watts)	**0.23 A/2.8 W (12V)**	**1.38 A/16.6 W (12V)**	**2.41 A/28.9 W (12V)**	**0.06 A/0.3 W (5V)**

2.5.2 Intel® Core™ i5-4300U 1.9 GHz Dual Core™ 3MB Cache

conga-TC87 Art. No. 046902 (GT2 Graphics)	Intel® Core™ i5-4300U 1.9 GHz 2 Core™ 3MB Intel® Smart Cache 22nm Layout Rev. TU87LB1 /BIOS Rev. TU87R005			
Max Turbo Frequency	2.9 GHz			
Memory Size	4GB			
Operating System	**Windows 7 (64 bit)**			
Power State	**Desktop Idle**	**100% workload**	**100% workload in Turbo mode (peak)**	**Suspend to Ram (S3) 5V Input Power**
Power consumption (measured in Amperes/Watts)	**0.28 A/3.4 W (12V)**	**1.38 A/16.6 W (12V)**	**1.95 A/23.4 W (12V)**	**0.06 A/0.3 W (5V)**

2.5.3 Intel® Core™ i3-4010U 1.7 GHz Dual Core™ 3MB Cache

conga-TC87 Art. No. 046903 (GT2 Graphics)	Intel® Core™ i3-4010U 1.7 GHz 2 Core™ 3MB Intel® Smart Cache 22nm Layout Rev. TU87LB1 /BIOS Rev. TU87R005			
Max Turbo Frequency	N/A			
Memory Size	4GB			
Operating System	**Windows 7 (64 bit)**			
Power State	**Desktop Idle**	**100% workload**	**100% workload approx. 100% CPU temp (peak)**	**Suspend to Ram (S3) 5V Input Power**
Power consumption (measured in Amperes/Watts)	**0.23 A/2.8 W (12V)**	**0.99 A/11.9 W (12V)**	**1.67 A/20.0 W (12V)**	**0.06 A/0.3 W (5V)**

2.5.4 Intel® Celeron® 2980U 1.6 GHz Dual Core™ 2MB Cache

conga-TC87 Art. No. 046904 (GT2 Graphics)	Intel® Celeron® 2980U 1.6 GHz 2 Core™ 2MB Intel® Smart Cache 22nm Layout Rev. TU87LB1 /BIOS Rev. TU87R005			
Max Turbo Frequency	N/A			
Memory Size	4GB			
Operating System	**Windows 7 (64 bit)**			
Power State	**Desktop Idle**	**100% workload**	**100% workload approx. 100% CPU temp (peak)**	**Suspend to Ram (S3) 5V Input Power**
Power consumption (measured in Amperes/Watts)	**TBD**	**TBD**	**TBD**	**TBD**

2.6 Supply Voltage Battery Power

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

2.6.1 CMOS Battery Power Consumption

RTC @ 20°C	Voltage	Current
Integrated in the Intel® 8 Series PCH-LP	3V DC	9 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 heatspreader, the maximum operating temperature refers to any measurable spot on the heatspreader's surface.

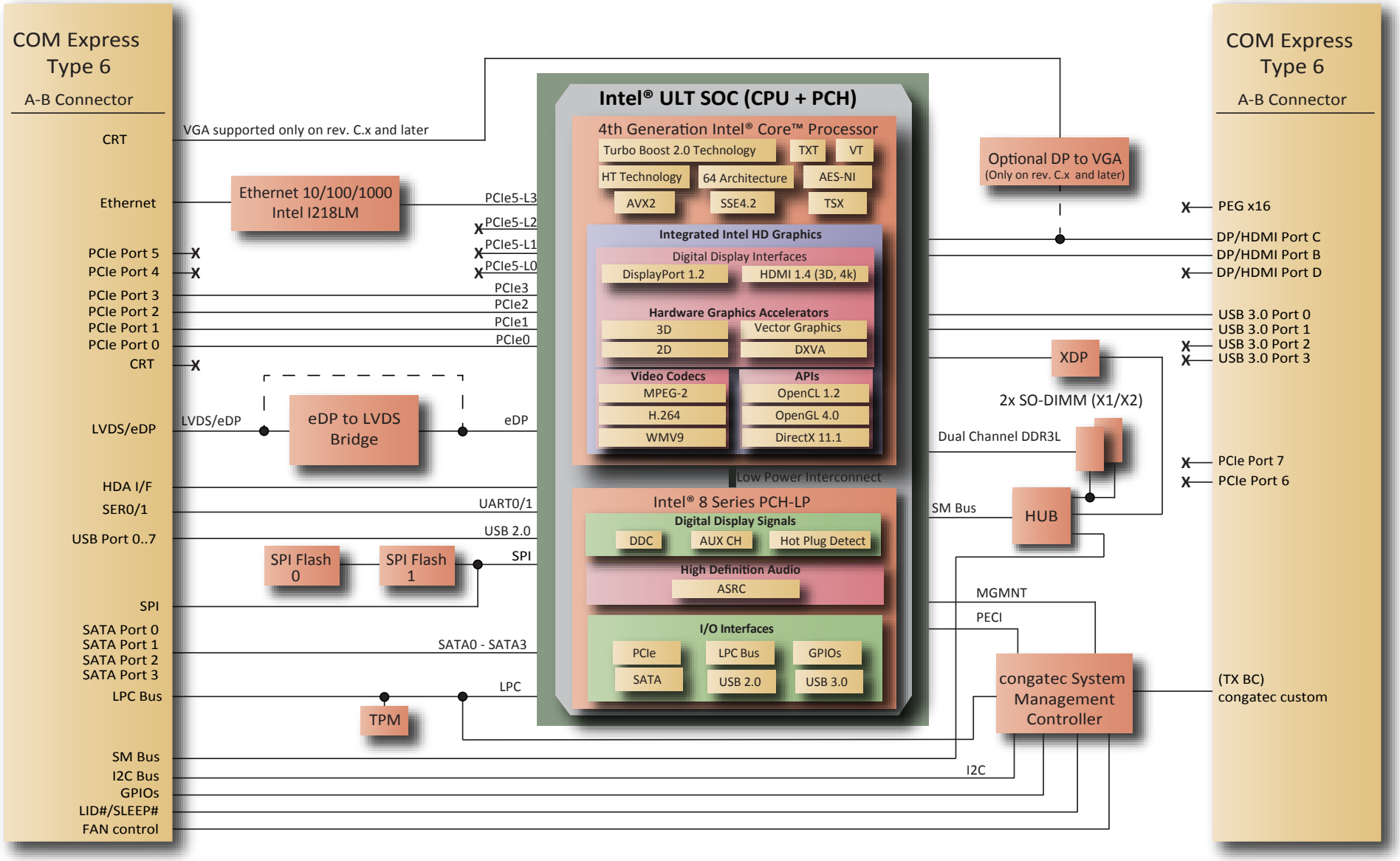
congatec AG strongly recommends that you use the appropriate congatec module heatspreader as a thermal interface between the module and your application specific cooling solution.

If for some reason it is not possible to use the appropriate congatec module heatspreader, then it is the responsibility of the operator to ensure that all components found on the module operate within the component manufacturer's specified temperature range.

For more information about operating a congatec module without heatspreader, contact congatec technical support.

Humidity specifications are for non-condensing conditions.

3 Block Diagram



4 Heatspreader

An important factor for each system integration is the thermal design. The heatspreader acts as a thermal coupling device to the module and its aluminum plate is 4mm thick. The heatspreader is thermally coupled to the CPU and other heat generating components via a heat pipe.

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 to be used 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.

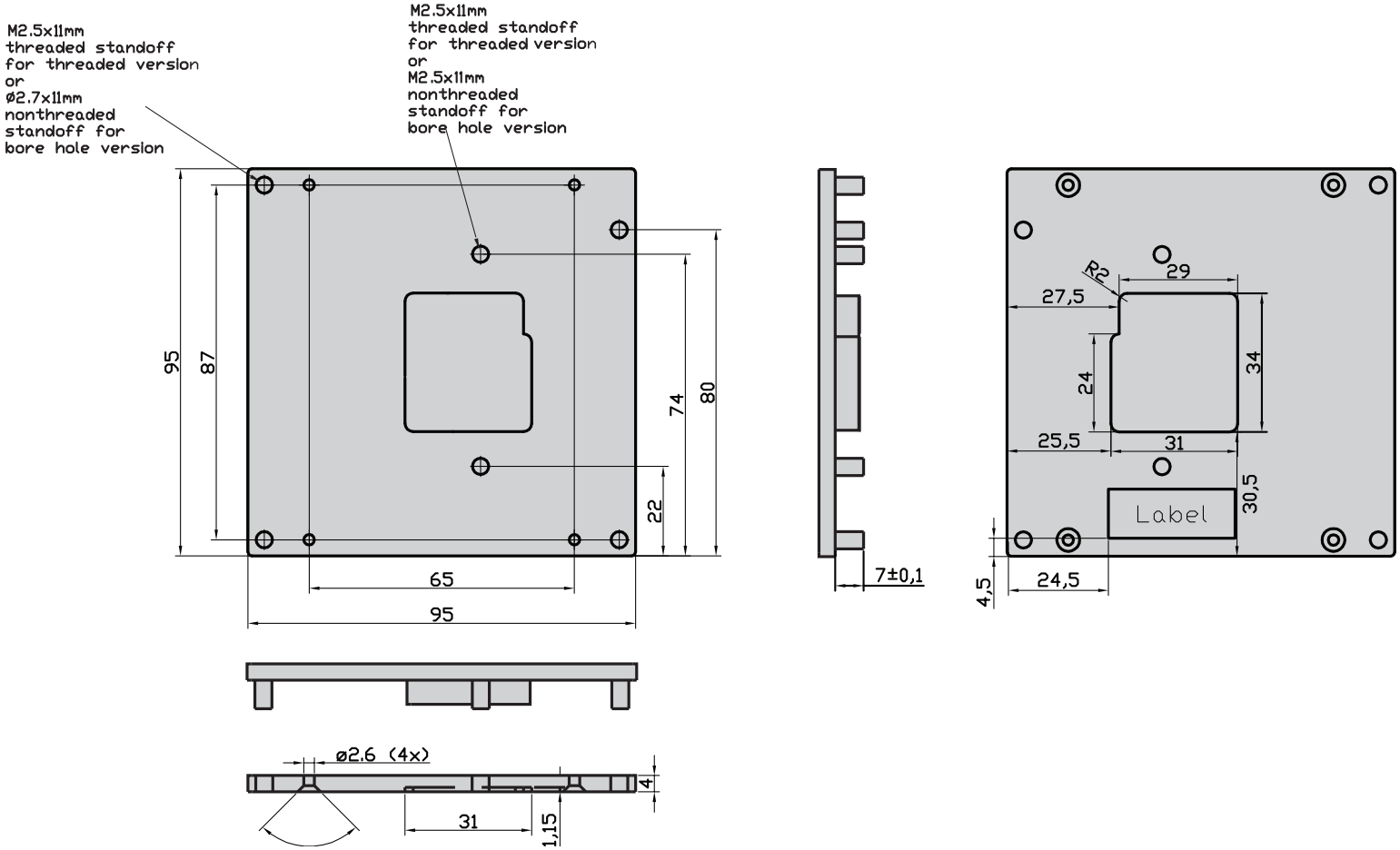
For additional information about the conga-TC87 heatspreader, refer to section 4.1 of this document.

Caution

There are mounting holes on the heatspreader designed to attach the heatspreader to the module. These mounting holes must be used to ensure that all components that are required to make contact with heatspreader do so. Failure to use these mounting holes will result in improper contact between these components and heatspreader thereby reducing heat dissipation efficiency.

Attention must be given to the mounting solution used to mount the heatspreader and module into the system chassis. Do not use a threaded heatspreader together with threaded carrier board standoffs. The combination of the two threads may be staggered, which could lead to stripping or cross-threading of the threads in either the standoffs of the heatspreader or carrier board.

4.1 Heatspreader Dimensions



Note

All measurements are in millimeters. Torque specification for heatspreader screws is 0.3 Nm. Mechanical system assembly mounting shall follow the valid DIN/IS0 specifications.

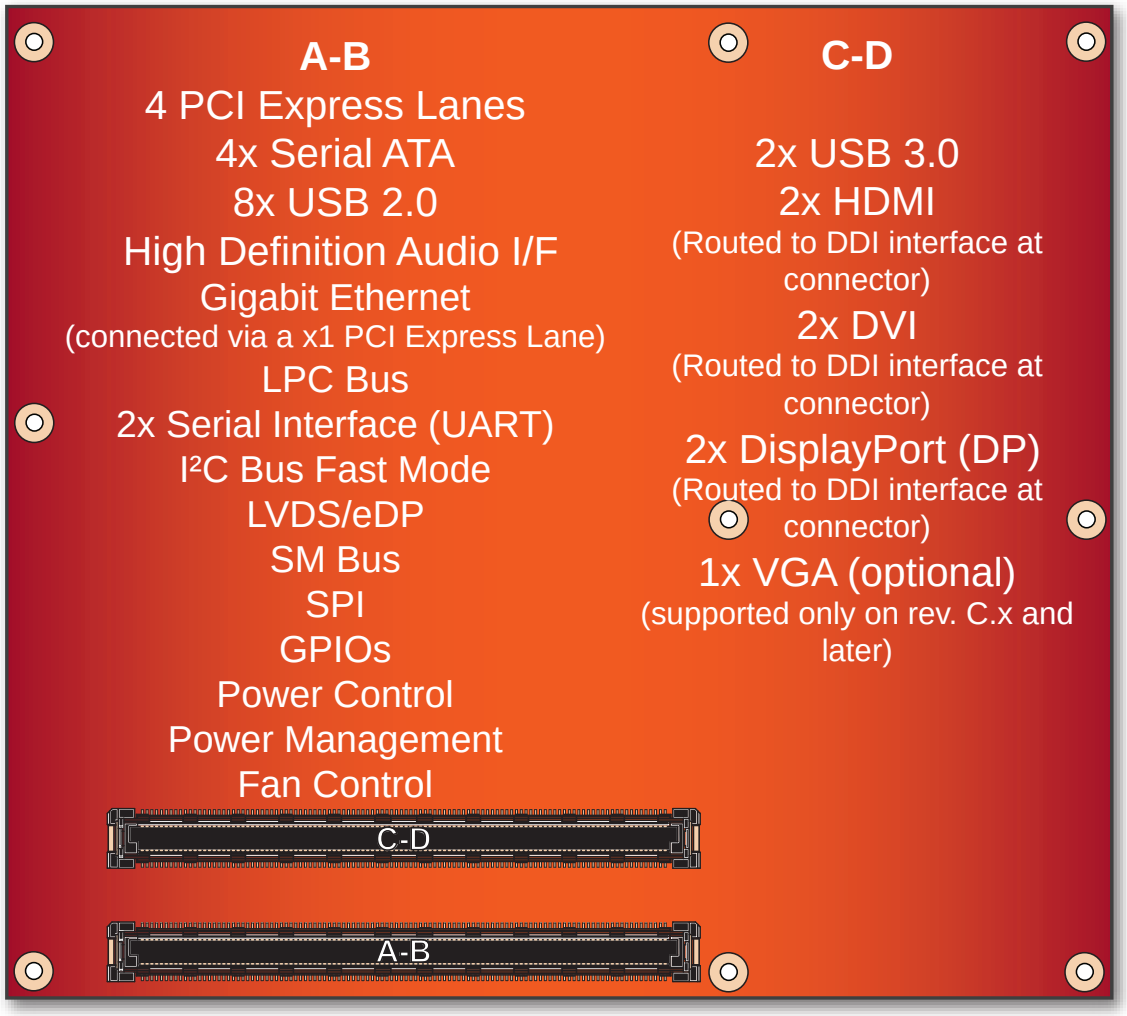
Caution

When using the heatspreader in a high shock and/or vibration environment, congatec recommends the use of a thread-locking fluid on the heatspreader screws to ensure the above mentioned torque specification is maintained.

5 Connector Subsystems Rows A, B, C, D

The conga-TC87 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

5.1 Primary Connector Rows A and B

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

5.1.1 Serial ATA™ (SATA)

The conga-TC87 provides 4 SATA interfaces (SATA 0-3) externally via the Intel® 8 Series PCH-LP integrated in the MCP. The SATA ports are based on Serial ATA Specification, Revision 3.0 and support up to 6.0 Gb/s data transfer rates.

The Intel® 8 Series PCH-LP featured on the conga-TC87 has one integrated SATA host controller. This controller does not support legacy mode using I/O space, rather it supports only one mode of operation - AHCI mode using memory space. Hot-plug is also supported when operating in non-native IDE mode. For more information, refer to section 10 “BIOS Setup Description”.

Note

The conga-TC87 Celeron variants support up to 2 SATA interfaces only.

5.1.2 USB 2.0

The conga-TC87 offers 8 USB 2.0 interfaces on the A-B connector. The EHCI host controller in the PCH supports these interfaces with high-speed, full-speed and low-speed USB signalling. The controller complies with USB standard 1.1 and 2.0. For more information about how the USB host controllers are routed, see section 7.5.

5.1.3 High Definition Audio (HDA) Interface

The conga-TC87 provides an interface that supports the connection of HDA audio codecs.

5.1.4 Gigabit Ethernet

The conga-TC87 is equipped with a Gigabit Ethernet Controller that is integrated within the Intel® 8 Series PCH-LP. This controller is routed to the onboard Intel® I218-LM Phy through the use of the fifth 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.

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-TC87 module.

5.1.5 LPC Bus

conga-TC87 offers the LPC (Low Pin Count) bus through the Intel® 8 Series PCH-LP. 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 9.1.1 for more information about the LPC Bus.

5.1.6 I²C Bus Fast Mode

The I²C bus is implemented through the congatec board controller (TI Stellaris® LM4FS11H5BB) and accessed through the congatec CGOS driver and API. The controller provides a Fast Mode multi-master I²C Bus that has maximum I²C bandwidth.

5.1.7 PCI Express™

The conga-TC87 offers 5 PCI Express™ lanes via the Intel® 8 Series PCH-LP. Four of these lanes are offered externally on the A-B connector. 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.

Default configuration for the lanes on the AB connector is 4x1 link. A 1x4 and 2x2 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.

5.1.8 ExpressCard™

The conga-TC87 supports the implementation of ExpressCards, which requires the dedication of one USB 2.0 port or a x1 PCI Express link for each ExpressCard used.

5.1.9 Graphics Output (VGA/CRT)

The Intel® ULT SoC does not support VGA interface. However on the conga-TC87 rev C.x and later, an optional VGA interface is supported on the DDI digital port C via NXP PTN3392BS Displayport to VGA controller.

5.1.10 LCD (LVDS/eDP)

The conga-TC87 offers an LVDS/eDP interface on the AB connector. The LVDS/eDP interface is by default configured to provide LVDS signals. The interface can optionally be switched via the BIOS setup menu to support eDP signals.

The single/dual channel LVDS interface is provided through an onboard 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 signals are not supported simultaneously.

5.1.11 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.

The conga-TC87 offers two UART interfaces via two UART controllers integrated in the congatec Board Controller. These controllers support up to 1MBit/s and can operate in low-speed, full-speed and high-speed modes. The UART interfaces are routed to the AB connector and require congatec driver to function..

Note

The UART interfaces do not support legacy COM port emulation.

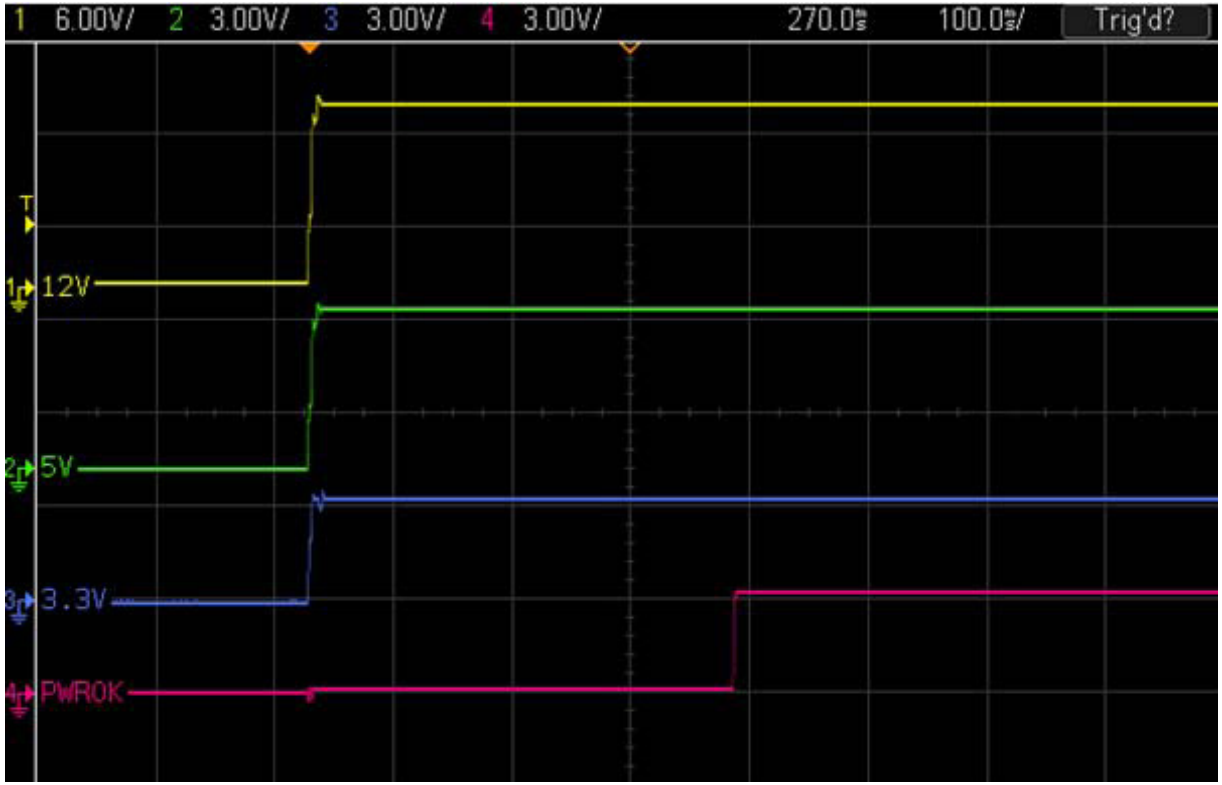
5.1.12 Power Control

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.

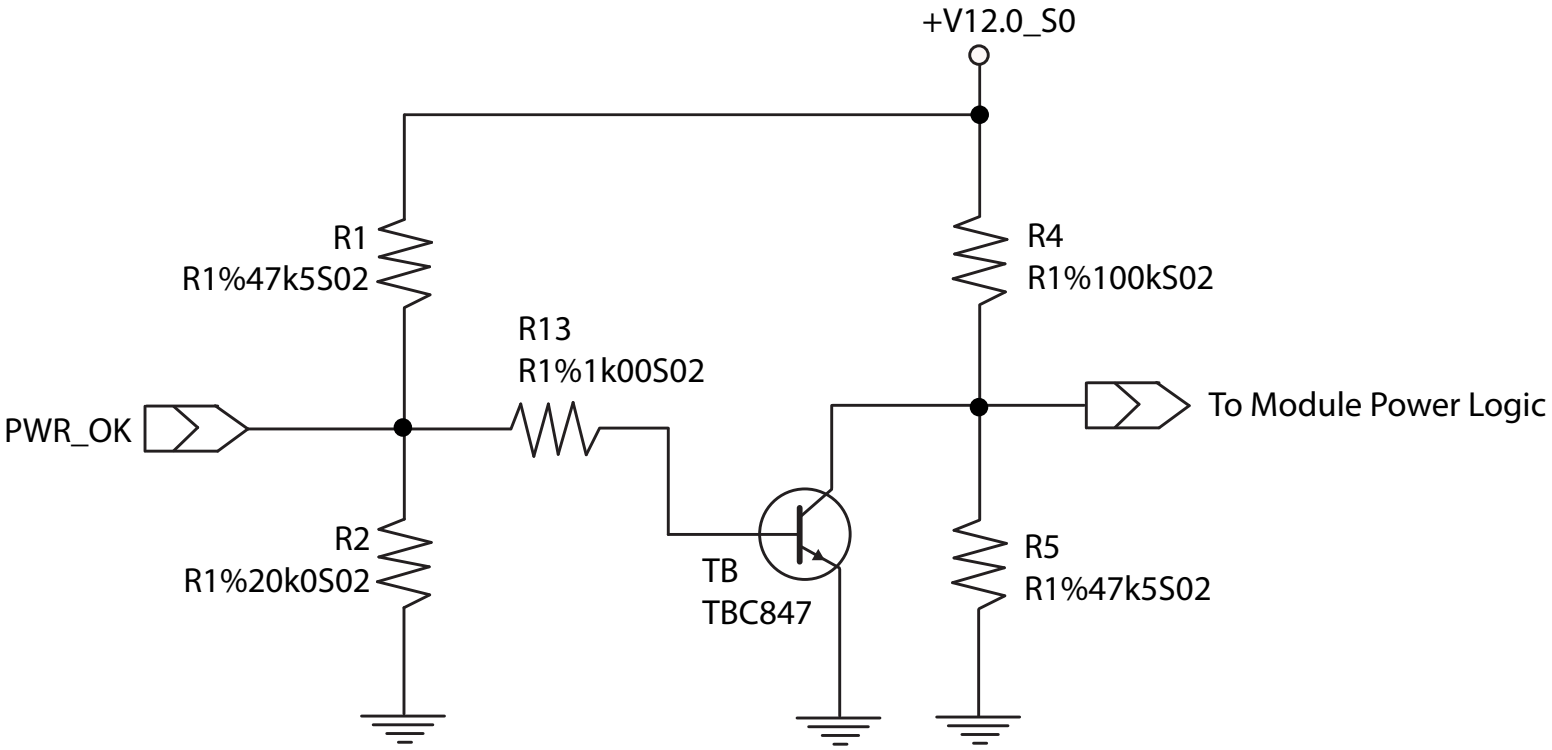
A sample screenshot is shown below:



Note

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

The conga-TC87 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.

The conga-TC87 provides support for controlling ATX-style power supplies. When not using an ATX power supply then the conga-TC87'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-TC87. 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-TC87 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".

5.1.13 Power Management

ACPI

The conga-TC87 supports Advanced Configuration and Power Interface (ACPI) specification, revision 4.0a. It also supports Suspend to RAM (S3). For more information, see section 7.3 “ACPI Suspend Modes and Resume Events”.

DEEP Sx

The Deep Sx is a lower power state employed to minimize the power consumption while in S3/S4/S5. In the Deep Sx state, the system entry condition determines if the system context is maintained or not. All power is shut off except for minimal logic which supports limited set of wake events for Deep Sx. The Deep Sx on resumption, puts system back into the state it is entered from. In other words, if Deep Sx state was entered from S3 state, then the resume path will place system back into S3.

5.2 Secondary Connector Rows C and D

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

5.2.1 PCI Express™

The conga-TC87 does not offer PCI Express lanes on the CD connector. For more information on supported PCI Express lanes, see section 5.1.7.

5.2.2 PCI Express Graphics (PEG)

The Intel® ULT SoC does not support PEG interface.

5.2.3 Digital Display Interface

The conga-TC87 supports two Digital Display Interfaces. These interfaces can be configured as DisplayPort, HDMI/DVI. On conga-TC87 rev C.x and later, the DDI digital port C is used for optional VGA support.

The processor on the conga-TC87 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.

The conga-TC87 offers the Digital Display Interface on the CD connector and supports up to three independent displays. The display combination must be 2 DDI and 1 eDP. For revisions equipped with optional VGA, the combination must be 1x DDI (Port B), 1x VGA (via Port C) and 1x eDP. The table below shows the conga-TC87 display combination and is not applicable to revisions equipped with optional VGA interface.

Table 2 Display Combination (U-processor line)

Display 1 (DDI Port B)	Display 2 (DDI Port C)	Display 3	Display 1 Max. Resolution	Display 2 Max. Resolution	Display 3 Max. Resolution
HDMI	HDMI	eDP	4096x2304 @24Hz	4096x2304 @24Hz	3200x2000 @60Hz
DP	DP	eDP	3200x2000 @60Hz	3200x2000 @60Hz	3200x2000 @60Hz
HDMI	DP	eDP	4096x2304 @24Hz	3200x2000 @60Hz	3200x2000 @60Hz

Note

The DP and eDP resolutions in the table above are supported for 4 lanes with link data rate HBR2 at 24 bits per pixel and single stream mode of operation. The DisplayPort Aux CH, DDC channel, panel power sequencing and HPD are supported through the PCH.

5.2.3.1 HDMI

The conga-TC87 offers two 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 conga-TC87 supports a maximum of 2 independent HDMI displays. Revisions equipped with optional VGA interface support only 1 HDMI interface. See table 2 above for possible display combinations. Consumer electronics control (CEC) is not supported.

5.2.3.2 DVI

The conga-TC87 offers two DVI ports on the CD connector. The DVI interfaces are multiplexed onto the Digital Display Interface of the COM Express connector.

Note

The conga-TC87 supports a maximum of 2 independent DVI displays. Revisions equipped with optional VGA interface support only 1 DVI interface. See table 2 above for possible display combinations.

5.2.3.3 DisplayPort (DP)

The conga-TC87 offers two DP ports, each capable of supporting data rate of 1.62 GT/s, 2.97 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 3200x2000 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 8.5 of this document for more information about enabling DisplayPort peripherals.

Note

The conga-TC87 supports a maximum of 2 independent DisplayPort displays. Revisions equipped with optional VGA interface support only 1 DP interface. See table 2 above for possible display combinations.

5.2.4 USB 3.0

The conga-TC87 offers two SuperSpeed USB 3.0 ports on the CD connector. These ports are controlled by an xHCI host controller provided by the Intel® 8 Series PCH-LP integrated in the MCP. 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 supports USB 3.0 debugging.

6 Additional Features

6.1 congatec Board Controller (cBC)

The conga-TC87 is equipped with Texas Instruments Tiva™ TM4E1231H6ZRB 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.

6.2 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.

6.3 Watchdog

The conga-TC87 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-TC87 does not support external hardware triggering. For more information about the Watchdog feature, see the BIOS setup description in section 10.4.2 of this document and application note AN3_Watchdog.pdf on the congatec AG website at www.congatec.com.

Note

The conga-TC87 module does not support the watchdog NMI mode. COM Express type 6 modules do not support the PCI bus, therefore the PCI_SERR# signal is not available. There is no way to drive an NMI to the processor without the presence of the PCI_SERR# PCI bus signal.

6.4 I²C Bus

The conga-TC87 supports I²C bus. Thanks to the I²C host controller in the cBC, the I²C bus is multi-master capable and runs at fast mode.

6.5 Power Loss Control

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

6.6 Embedded BIOS

The conga-TC87 is equipped with congatec Embedded BIOS, which is based on American Megatrends Inc. Aptio UEFI firmware. These are the most important embedded PC features:

6.6.1 CMOS Backup in Non Volatile Memory

A copy of the CMOS memory (SRAM) is stored in the BIOS flash device. This prevents the system from booting up with the wrong system configuration if the backup battery (RTC battery) fails. Additionally, it provides the ability to create systems that do not require a CMOS backup battery.

6.6.2 OEM CMOS Default Settings and OEM BIOS Logo

This feature allows system designers to create and store their own CMOS default configuration and BIOS logo (splash screen) within the BIOS flash device. Customized BIOS development by congatec for these changes is no longer necessary because customers can easily do these changes by themselves using the congatec system utility CGUITL.

6.6.3 OEM BIOS Code

With the congatec embedded BIOS it is even possible for system designers to add their own code to the BIOS POST process. Except for custom specific code, this feature can also be used to support Win XP SLP installation, Window 7 SLIC table, verb tables for HDA codecs, rare graphic modes and Super I/O controllers.

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 AG website at www.congatec.com or contact congatec technical support.

6.6.4 congatec Battery Management Interface

In order to facilitate the development of battery powered mobile systems based on embedded modules, congatec AG 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 additional modifications to the system BIOS.

The conga-TC87 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

6.6.5 API Support (CGOS/EAPI)

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 .

Other COM (Computer on Modules) vendors offer similar driver solutions for these kind of embedded PC features, which are by nature proprietary. All the API solutions that can be found on the market are not compatible to each other. As a result, writing application software that can run on more than one vendor's COM is not so easy. Customers have to change their application software when switching to another COM vendor. EAPI (Embedded Application Programming Interface) is a programming interface defined by the PICMG that addresses this problem. With this unified API it is now possible to run the same application on all vendor's COMs that offer EAPI driver support. Contact congatec technical support for more information about EAPI.

6.7 Security Features

The conga-TC87 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.

6.8 Suspend to Ram

The Suspend to RAM feature is available on the conga-TC87.

7 conga Tech Notes

The conga-TC87 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.

7.1 Intel® PCH-LP Features

7.1.1 Intel® Rapid Storage Technology

The Intel® 8 Series PCH-LP provides support for Intel® Rapid Storage Technology, allowing AHCI functionality and RAID 0/1/5/10 support.

7.1.1.1 AHCI

The Intel® 8 Series PCH-LP provides hardware support for Advanced Host Controller Interface (AHCI), a standardized programming interface for SATA host controllers. Platforms supporting AHCI may take advantage of performance features such as port independent DMA engines (each device is treated as a master) and hardware-assisted native command queuing. AHCI also provides usability enhancements such as Hot-Plug and advanced power management.

7.1.1.2 RAID

The industry-leading RAID capability provides high performance RAID 0, 1, 5, and 10 functionality on the 4 SATA ports of Intel® 8 Series PCH-LP. 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® 8 Series PCH-LP.

7.1.1.3 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.

Note

This feature requires an Intel® Core Processor

7.1.2 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

7.2 Intel® Processor Features

7.2.1 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-TC87 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-TC87.

7.2.2 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.

7.2.3 Processor Performance Control

Intel® Core™ i7/i5/i3 and Celeron® processors found on the conga-TC87 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.

7.2.4 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 supports:

- 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

7.2.5 Intel® Virtualization Technology

Virtualization solutions enhanced by Intel® VT will allow a Core™ i7/i5/i3 platform to run multiple operating systems and applications in independent partitions. When using virtualization capabilities, one computer system can function as multiple “virtual” systems. With processor and I/O enhancements to Intel®’s various platforms, Intel® Virtualization Technology can improve the performance and robustness of today’s software-only virtual machine solutions.

Intel® VT is a multi-generational series of extensions to Intel® processor and platform architecture that provides a new hardware foundation for virtualization, establishing a common infrastructure for all classes of Intel® based systems. The broad availability of Intel® VT makes it possible to create entirely new applications for virtualization in servers, clients as well as embedded systems thus providing new ways to improve system reliability, manageability, security, and real-time quality of service.

The success of any new hardware architecture is highly dependent on the system software that puts its new features to use. In the case of virtualization technology, that support comes from the virtual machine monitor (VMM), a layer of software that controls the underlying physical platform resources sharing them between multiple “guest” operating systems. Intel® VT is already incorporated into most commercial and open-source VMMs including those from VMware, Microsoft, XenSource, Parallels, Virtual Iron, Jaluna and TenAsys.

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

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.

7.2.6 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-TC87 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.

7.3 ACPI Suspend Modes and Resume Events

conga-TC87 supports S3 (STR= Suspend to RAM). For more information about S3 wake events, see section 10.4.5 “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.

7.4 Low Voltage Memory (DDR3L)

The Haswell ULT processor featured on the conga-TC87 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-TC87 offers a system optimized for lowest possible power consumption. The reduction in power consumption due to lower voltage subsequently reduces the heat generated.

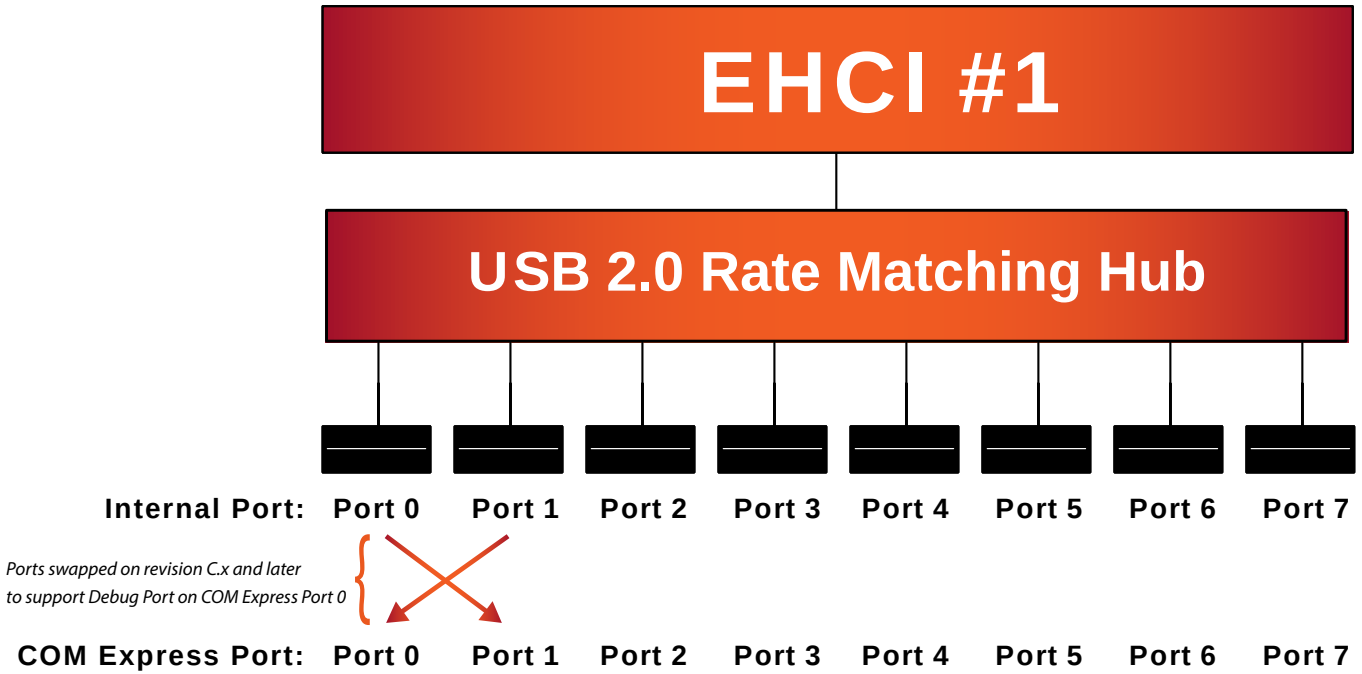
Caution

The usage of DDR3@1.5V SO-DIMM modules may affect the stability or boot-up of the conga-TC87. Therefore use only non-ECC, unbuffered DDR3L SO-DIMM memory modules up to 1600 MT/s on the conga-TC87.

7.5 USB 2.0 EHCI Host Controller Support

The 8 available USB ports are provided by a USB 2.0 Rate Matching Hub (RMH) integrated within the Intel® 8 Series PCH-LP . The EHCI controller is connected to the hub as shown below. The Hub 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 the EHCI controller. In addition, port 1 of the RMH is multiplexed with Port 1 of the EHCI controller 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 = 8000h.

Routing Diagram



8 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 3 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.
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.

8.1 A-B Connector Signal Descriptions

Table 4 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		AC'97 codecs are not supported.
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 8.5 of this user's guide.

Table 5 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		

Gigabit Ethernet	Pin #	Description	I/O	PU/PD	Comment
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-TC87 module.

Table 6 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
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 7 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		Not supported
PCIE_TX4+ PCIE_TX4-	A55 A56	PCI Express channel 4, Transmit Output differential pair.	O PCIE		Not supported
PCIE_RX5+ PCIE_RX5-	B52 B53	PCI Express channel 5, Receive Input differential pair.	I PCIE		Not supported
PCIE_TX5+ PCIE_TX5-	A52 A53	PCI Express channel 5, Transmit Output differential pair.	O PCIE		Not supported
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 8 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 9 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	PU 10k 3.3V	
LPC_SERIRQ	A50	LPC serial interrupt	I/O OD 3.3V	PU 10k 3.3V	
LPC_CLK	B10	LPC clock output - 24 MHz nominal	O 3.3V		

Table 10 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
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 11 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	Optional on rev. C.x and later
VGA_GRN	B91	Green for monitor. Analog DAC output, designed to drive a 37.5-Ohm equivalent load.	O Analog	PD 150R	Optional on rev. C.x and later
VGA_BLU	B92	Blue for monitor. Analog DAC output, designed to drive a 37.5-Ohm equivalent load.	O Analog	PD 150R	Optional on rev. C.x and later
VGA_HSYNC	B93	Horizontal sync output to VGA monitor	O 3.3V		Optional on rev. C.x and later
VGA_VSYNC	B94	Vertical sync output to VGA monitor	O 3.3V		Optional on rev. C.x and later
VGA_I2C_CK	B95	DDC clock line (I²C port dedicated to identify VGA monitor capabilities)	I/O OD 5V	PU 1k2 3.3V	Optional on rev. C.x and later
VGA_I2C_DAT	B96	DDC data line.	I/O OD 5V	PU 1k2 3.3V	Optional on rev. C.x and later

Table 12 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 13 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-TC87.
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 14 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 15 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	
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 8.5 of this user’s guide.

Table 16 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-TC87
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-TC87
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-TC87
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-TC87
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-TC87
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-TC87
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-TC87
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-TC87

Table 17 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 rising 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		Not supported
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 18 General Purpose Serial Interface Signal Descriptions

Signal	Pin #	Description	I/O	PU/PD	Comment
SER0_TX	A98	General purpose serial port transmitter	O 3.3V		
SER1_TX	A101	General purpose serial port transmitter	O 3.3V		
SER0_RX	A99	General purpose serial port receiver	I 3.3V	PU 50k 3.3V	
SER1_RX	A102	General purpose serial port receiver	I 3.3V	PU 50k 3.3V	

Table 19 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		

8.2 A-B Connector Pinout

Table 20 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
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 (*)

Pin	Row A	Pin	Row B	Pin	Row A	Pin	Row B
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 TC87.

8.3 C-D Connector Signal Descriptions

Table 21 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		Not supported
PCIE_TX6+ PCIE_TX6-	D19 D20	PCI Express channel 6, Transmit Output differential pair.	O PCIE		Not supported
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 22 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		Not supported.
USB_SSRX2-	C9		I		Not supported.
USB_SSTX2+	D10	Additional transmit signal differential pairs for the Superspeed USB data path	O		Not supported.
USB_SSTX2-	D9		O		Not supported.
USB_SSRX3+	C13	Additional receive signal differential pairs for the Superspeed USB data path	I		Not supported.
USB_SSRX3-	C12		I		Not supported.
USB_SSTX3+	D13	Additional transmit signal differential pairs for the Superspeed USB data path	O		Not supported.
USB_SSTX3-	D12		O		Not supported.

Table 23 PCI Express Signal Descriptions (x16 Graphics)

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		Not supported.
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				

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		Not supported.
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	Not supported.

Note

The PCI Express Graphics interface is not supported on the conga-TC87.

Table 24 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	
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.

Signal	Pin #	Description	I/O	PU/PD	Comment
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		Not supported
DDI3_PAIR1+ DDI3_PAIR1-	C42 C43	Multiplexed with DP3_LANE1+ and TMDS3_DATA1+. Multiplexed with DP3_LANE1- and TMDS3_DATA1-.	O PCIE		Not supported
DDI3_PAIR2+ DDI3_PAIR2-	C46 C47	Multiplexed with DP3_LANE2+ and TMDS3_DATA0+. Multiplexed with DP3_LANE2- and TMDS3_DATA0-.	O PCIE		Not supported
DDI3_PAIR3+ DDI3_PAIR3-	C49 C50	Multiplexed with DP3_LANE3+ and TMDS3_CLK+. Multiplexed with DP3_LANE3- and TMDS3_CLK-.	O PCIE		Not supported
DDI3_HPD	C44	Multiplexed with DP3_HPD and HDMI3_HPD.	I 3.3V		Not supported
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		Not supported
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		Not supported
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		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 8.5 of this user's guide.

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 25 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		Not supported
TMDS3_DATA0+ TMDS3_DATA0-	C46 C47	HDMI/DVI TMDS differential pair. Multiplexed with DDI3_PAIR2+ and DDI3_PAIR2-.	O PCIE		Not supported
TMDS3_DATA1+ TMDS3_DATA1-	C42 C43	HDMI/DVI TMDS differential pair. Multiplexed with DDI3_PAIR1+ and DDI3_PAIR1-..	O PCIE		Not supported
TMDS3_DATA2+ TMDS3_DATA2-	C39 C40	HDMI/DVI TMDS differential pair. Multiplexed with DDI3_PAIR0+ and DDI3_PAIR0-.	O PCIE		Not supported
HDMI3_HPD	C44	HDMI/DVI Hot-plug detect. Multiplexed with DDI3_HPD.	I PCIE		Not supported
HDMI3_CTRLCLK	C36	HDMI/DVI I²C Control Clock Multiplexed with DDI3_CTRLCLK_AUX+	I/O OD 3.3V		Not supported

Signal	Pin #	Description	I/O	PU/PD	Comment
HDMI3_CTRLDATA	C37	HDMI/DVI I²C Control Data Multiplexed with DDI3_CTRLDATA_AUX-	I/O OD 3.3V		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 8.5 of this user's guide.

Table 26 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.
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		

Signal	Pin #	Description	I/O	PU/PD	Comment
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		Not supported
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		Not supported
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		Not supported
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		Not supported
DP3_HPD	C44	Detection of Hot Plug / Unplug and notification of the link layer. Multiplexed with DDI3_HPD.	I 3.3V		Not supported
DP3_AUX+	C36	Half-duplex bi-directional AUX channel for services such as link configuration or maintenance and EDID access.	I/O PCIE		Not supported
DP3_AUX-	C37	Half-duplex bi-directional AUX channel for services such as link configuration or maintenance and EDID access.	I/O PCIE		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 8.5 of this user's guide.

Table 27 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-TC87 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 28 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		

8.4 C-D Connector Pinout

Table 29 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	DDPC_CTRLCLK
C9	USB_SSRX2- (*)	D9	USB_SSTX2- (*)	C64	RSVD	D64	DDPC_CTRLDATA
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+ (*)
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- (*)

Pin	Row C	Pin	Row D	Pin	Row C	Pin	Row D
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 an asterisk symbol (*) are not supported on the conga-TC87.

8.5 Boot Strap Signals

Table 30 Boot Strap Signal Descriptions

Signal	Pin #	Description of Boot Strap Signal	I/O	PU/PD	Comment
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)
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).

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.

9 System Resources

9.1 I/O Address Assignment

The I/O address assignment of the conga-TC87 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.

9.1.1 LPC Bus

On the conga-TC87, the PCI Express Bus acts as the subtractive decoding agent. All I/O cycles that are not positively decoded are forwarded to the internal 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

A00h – BFFh

C00h – CFFh (always used internally)

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 these ranges are 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.

9.2 PCI Configuration Space Map

Table 31 PCI Configuration Space Map

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

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.*

9.3 PCI Interrupt Routing Map

Table 32 PCI Interrupt Routing Map

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

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).*

9.4 I²C Bus

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

9.5 SM Bus

System Management (SM) bus signals are connected to the Intel® 8 Series PCH-LP 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.

10 BIOS Setup Description

TBD

11 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