WHITE PAPER

**Full COM Express product range based on
3rd generation Intel® Core™ processors
and Mobile Intel® QM77 Express Chipset**

Contents

The new chipsets of the 3rd generation Intel® Core™ processors provide maximum flexibility to congatec's new COM Express module families. conga-BS77 series support "classic" Type 2 pinout and conga-TS77 Type 6 pinout featuring High-End external graphics, multiple DisplayPorts and USB3.0.

1. Caption:

congatec Computer-On-Module concept with module based on 3rd generation Intel® Core™ processor and reference carrier board

1 Unlimited performance and flexibility

The 3rd generation Intel® Core™ processors set the standard today for embedded processors. Shrinking the manufacturing process from 32nm to 22nm and introducing a new technology with 3D Tri-Gate transistors results in smaller die sizes that reduce the cost of manufacturing and increase power efficiency as much as 25%. The new integrated Intel® HD Graphics 4000 graphics features now 16 instead of 12 parallel processing cores, boosting inbuilt graphics power about 40%, and supports up to three independent high-definition displays. To ensure maximum compatibility with existing projects and to support future trends and progress, congatec provides Type 2 and Type 6 pinout variants of their latest COM Express modules.

3

With its flagship quad-core model Intel® Core™ i7-3615QE, featuring a clock rate of 2.3 GHz in normal and up to 3.3 GHz in turbo mode with the same 45 W TDP as previous 2nd generation models, Intel demonstrates the ultimate in performance capable in today's embedded processors. The Intel® Core™ i7-3612QE processor is a milestone for embedded applications offering top performance in quad-core processors with an impressive clock rate of 2.1 GHz in normal operation and up to 3.1 GHz in turbo mode with a TDP as low as 35W. And this is exactly the maximum TDP today's passive cooling thermal interfaces can handle with reasonable cost and effort. This opens doors to many applications in medical, commercial and military technology, where fanless operation is a must to meet enhanced reliability, safety or shock resistance requirements. Many of these applications can make use of quad-core processors. Another improvement over previous models is the much larger turbo boost span, which now allows clock speed increases of up to 50%. Many applications which do not require the highest performance at all times can now

use processors with lower basic clock rates and lower power consumption.

Where turbo boost and graphics performance are not an issue and two independent displays with standard Intel® HD Graphics are sufficient the new Intel® Celeron® Processor 1020E Dual-Core (2M Cache, 2.20 GHz, TDP 35W), Intel® Celeron® Processor 1047UE Dual-Core (2M Cache, 1.40 GHz, TDP 17W) and Intel® Celeron® Processor 927UE Single-Core (1M Cache, 1.50 GHz, TDP 17W) are the perfect economy solution.

The COM Express module can be equipped with up to 16GB of fast dual-channel DDR3 memory (1600 MHz).
The modules provide greater security thanks to Intel® VT (Intel® Virtualization Technology) and optional Intel® AMT (Intel® Active Management Technology) 8.0 support.

With the Mobile Intel® QM77 Express Chipset supporting processors from Intel Celeron 800 to Core i7 processors, users of congatec's conga-TS77 and conga-BS77 COMs can enjoy

the luxury of a wide range of scalable performance without rerunning tedious verification and requalification processes.

With regards to power consumption and computing power, the 3rd generation Intel® Core™ processors provide even broader scalability than its predecessors. For the first time, quad-core processors are now a viable solution for fanless operation.

2   USB 3.0

The conga-TS77 with 3rd generation Intel® Core™ processors offers native USB 3.0 support, data transfer is considerably faster, energy consumption lower and now even simultaneous sending and receiving of data is possible. Eight USB ports are provided, three of those are capable of USB 3.0 Superspeed operation.

3   OpenCL 1.1

The conga-TS77 supports OpenCL 1.1 for a powerful programming environment with which computing tasks can be distributed and processed in a variety of processor systems involving a number of hardware units. The special feature of OpenCL is that multiple parallel execution is possible in a single step (SIMD=Single Instruction Multiple Data), so that it can support the classic parallel computer architecture as well. This is of crucial importance, because not only graphic representations but also many analytical problems are very well suited to parallel processing.

4   Multiple scalability with Hyperthreading

The 3rd generation of Intel® Core™ processors supports multiple physical (multi-core) and / or virtual cores. They expand the scalability enormously, because they offer the possibility of running several applications completely independently and safely on a single processor module - even with different operating systems. To fully exploit a dual or even multi-core application it is crucial to ensure operational

5

security, especially when it comes to hard real-time requirements. To build a system which is truly real-time capable but which is still manageable for system architects and software developers in most cases requires special software which controls the management of resources, including interrupts, caches and memory.

Currently, the 3rd generation of Intel® Core™ processors offers up to 4 cores. In addition the cores can be split into two encapsulated logical cores, making it possible to develop complex systems with up to eight logical processors. The logical or even better physical separation of the cores in a deterministic and highly reliable real time system on the one hand and a low-cost, universal system for user and graphical interfaces like Windows or Linux on the other hand, is a great reason for switching to a dual or quad core system. In this case, the industrial application continues to run uninterrupted even if, for example, a Windows graphics application crashes with a blue screen and the Windows system on this processor core has to be rebooted.

5   Module Variants based on Type 6 and Type 2

The conga-TS77 module variant is based on the Type 6 Pin-out for new designs and supports four native USB 3.0 ports. Three independent Digital Display Interfaces (DDI) in combination provide SDVO, HDMI or DisplayPort, while direct PCI Express x16 lanes (PEG 3.0), LVDS and VGA are available as separate graphic interfaces.
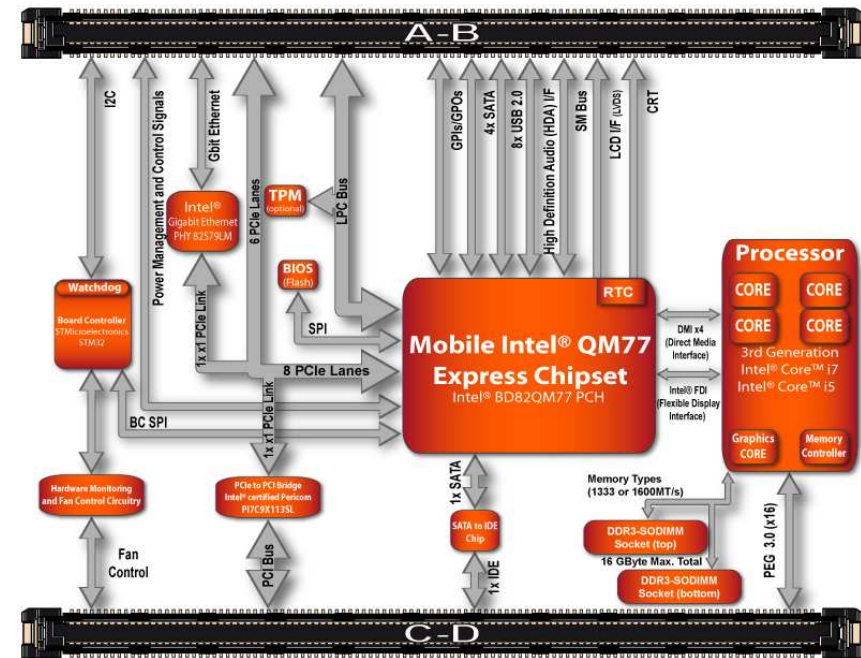
2. Caption:
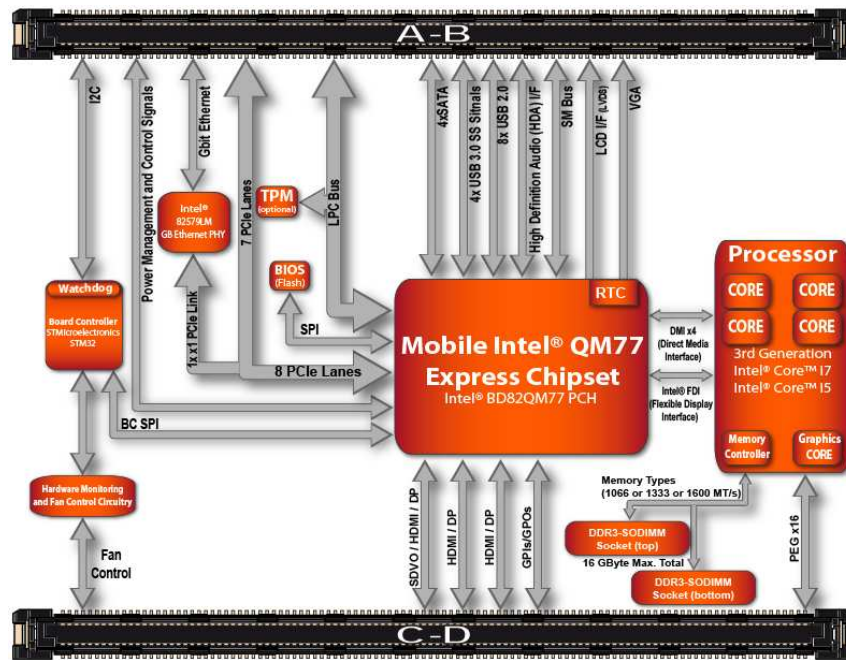
Block diagram of conga-TS77, Type 6 module

For existing project designs, congatec now offers two module variants for Type 2 Pin-out on COM Express for maximum graphics performance. In accordance with the COM Express specification, the conga-BP77 module features PCI Express x16 lanes (PEG 3.0), LVDS and VGA graphic interfaces. This module is suitable for applications that are based on PEG graphics and require an external high-end graphics

performance. PEG is implemented via a custom carrier board. The schematics of the evaluation carrier board conga-CEVAL, which are available for free download, provide the perfect template for the development of the application specific carrier board.
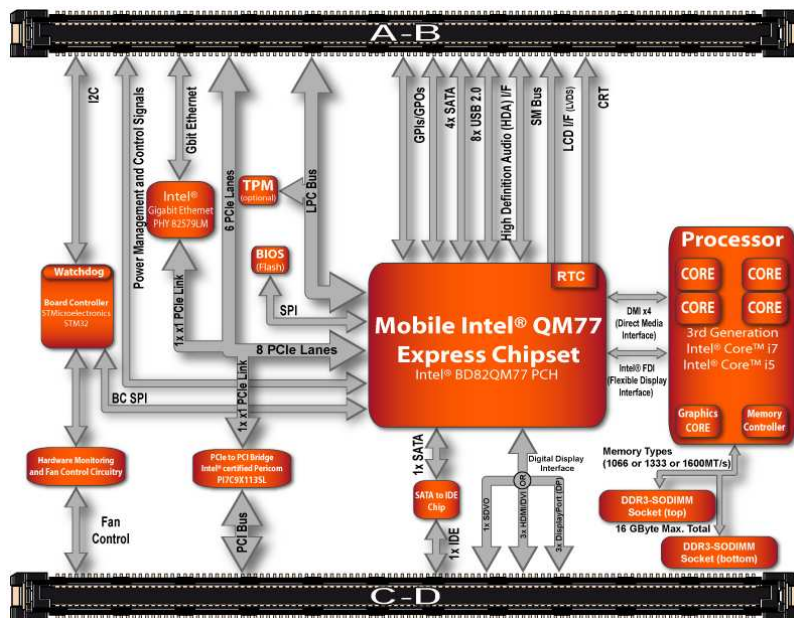

3. Caption:

Block diagram of conga-BP77, Type 2 module

For existing project designs on Type 2 Pin-out requiring a maximum of flexibility with regard to the graphics interfaces,

7

congatec offers the conga-BS77. It dispenses with the PEG interface in order to execute three independent Digital Display Interfaces (DDIs). Each can be configured as DisplayPort or TMDS (HDMI or DVI). In addition, one port can also be configured as SDVO output. LVDS and VGA are available too.

4. Caption:

Block diagram of conga-BS77, Type 2 module

6   New Connector Pinout Type 6

The newly defined Type 6 builds on the same success factors as Type 2 but also takes into consideration future interfaces. The A-B connector has almost the same pinout as Type 2 Rev. 2.0. Only some reserved pins are used for UART, FAN (PWM), Lid and Sleep signals. The UART pins (2x SER_Tx/Rx) were added for debugging purposes (e.g. console redirection) due to their simplicity. One of those can optionally be used as CAN interface. Additionally, a new pin has been defined to indicate physical presence to an optional TPM chip located on the module. The fact that these pins are used on Rev 1.0 systems for supplying the module with power requires that module and carrier board designers spend some additional time to ensure that these interfaces can withstand a connection to a 12 V rail. This provides the ability to connect a Rev. 1.0 module to a Rev 2.0 carrier board, or vice versa.

In contrast to the previously mentioned small signal changes on the A-B connector, the C-D connector covers most of the Type 6 features. It gets rid of parallel legacy interfaces such as

PCI and IDE and provides support for current and future interfaces.

Type 2:	Type 6:
IDE	-
PCI 32 Bit	-
PEG / SDVO (muxed)	PEG
6x PCIe	8x PCIe
GPIO	GPIO / SDIO (muxed)
LVDS	LVDS / eDP (muxed)
-	4x USB 3.0
-	3x DDI (TDMS / DP / SDVO 1x)
-	2x Serial, 1x muxed with CAN

5. Caption:

Table: COM Express main differences between Type 2 and Type 6

These changes can be summarized with 3 main categories:

• Up to four USB 3.0 Interfaces

• Up to three Digital Display Interfaces

• Up to 2 additional PCIe lanes
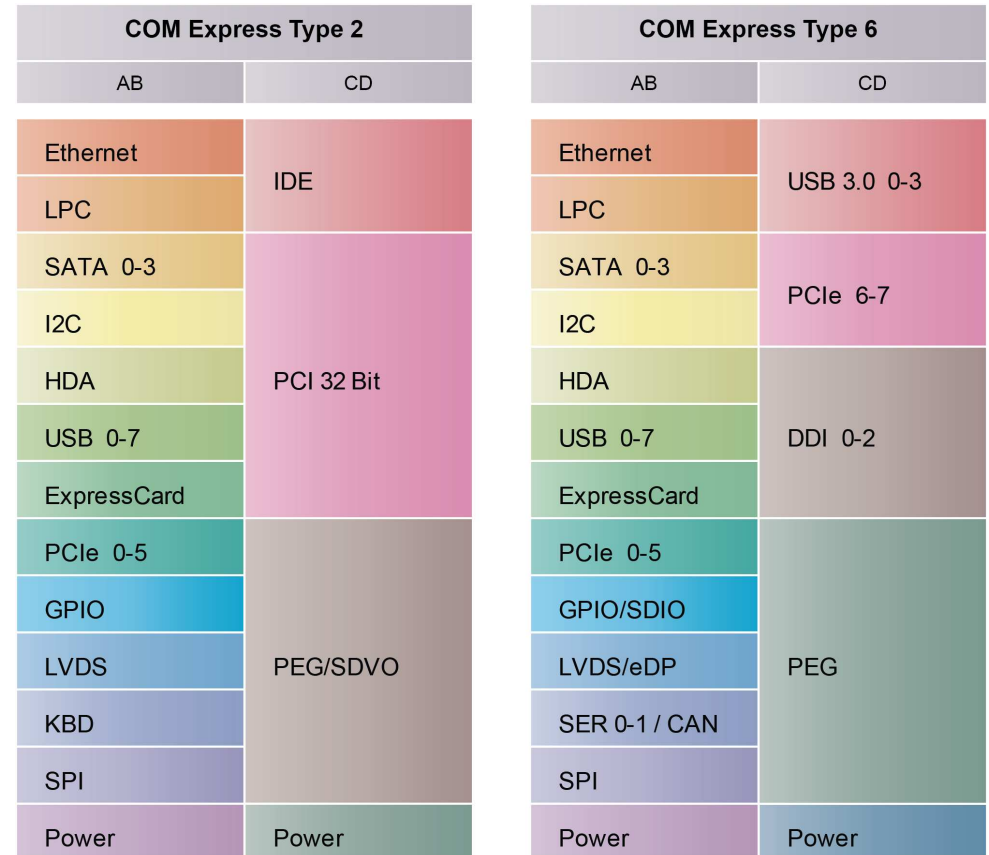
6. Caption:

Graphic: COM Express feature comparison for type 2 and type 6
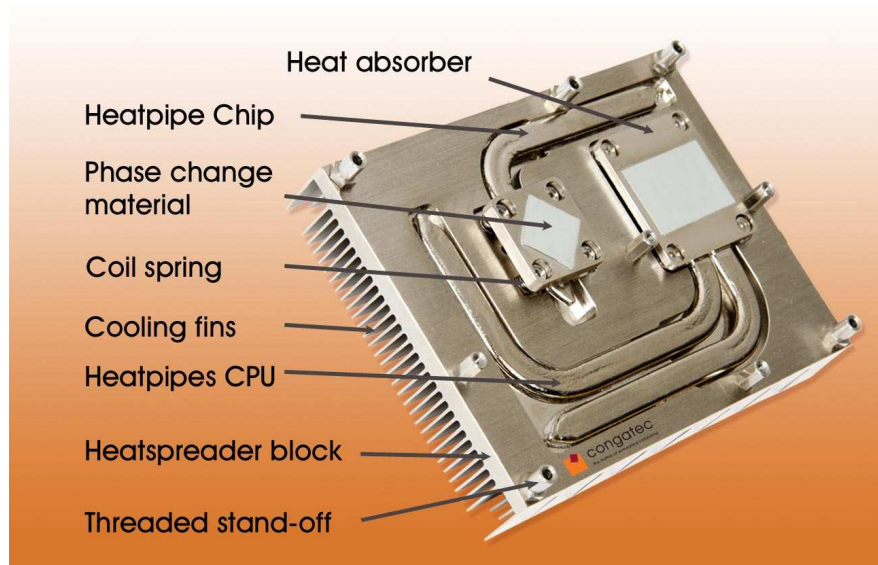
9

7 High Performance Cooling enables quad processor usage

One of the few downsides of Moore's law with processor structures getting smaller and smaller is the fact that even with decreasing total TDP (Thermal Design Power) the heat density on the die increases. So - simply spoken - the heat has to be transferred faster and more efficiently away from the processor package. With the significantly smaller geometries of the 3rd Generation Intel® Core™ processors this can be a serious issue. Special algorithms protect the processor by slowing down its clock frequency at higher temperatures. On the other hand, another mechanism allows for an aggressive overclocking of up to 50% using the Intel® Turbo Boost 2 Technology as long as the die temperature is not critical. So for the best performance and the highest reliability, a smart cooling technology is required to ensure that the Intel Turbo Boost 2 Technology feature is not lost through local overheating. An improved cooling system which is based on cooling pipes and integrated to the standardized heat spreader of the COM Express specification allows for an ultra fast transportation of the heat away from the CPU and enables top performance. Benefits are lower processing temperatures which are essential for a more frequent activation of the Intel Turbo Boost 2 Technology ensuring maximum COM performance and less thermal stress for the entire system. As a result, the processor can operate above the specified maximum permissible TDP. For the cooling of less power-hungry and low-end applications, the congatec modules offer a TDP management solution which can limit the power consumption in line with the existing cooling and power supply facilities. The advantages at a glance:

- Fast spot cooling for full performance
- Elimination of gap filler layer
- Elimination of mechanical stress, leading to better quality
- Improved cooling extends module life span
- Heat pipe principle enables innovative customer-specific cooling solutions

enhance fanless designs. In this way, designs can be optimized for the specific application.

Heat absorber
Heatpipe Chip
Phase change material
Coil spring
Cooling fins
Heatpipes CPU
Heatspreader block
Threaded stand-off

7. Caption
The individual components of congatec's cooling pipe solution

The revolutionary new heat pipe cooling design is available in several variants: active and passive cooling solution, heat spreader and customer-specific solution creating space for innovative ideas. As an option the heat pipe can be custom designed in such a way that it can be connected to a customer-specific heat sink or housing to enable or

About congatec

congatec has its head office in Deggendorf, Germany and is a leading supplier of industrial computer modules using the standard form factors Qseven, COM Express, XTX and ETX. congatec's products can be used in a variety of industries and applications, such as industrial automation, medical technology, automotive supplies, aerospace and transportation. Core knowledge and technical know-how includes unique extended BIOS features as well as comprehensive driver and board support packages. Following the design-in phase, customers are given support via extensive product lifecycle management. The company's products are manufactured by specialist service providers in accordance with modern quality standards. congatec currently has 135 employees and entities in Taiwan, Japan, USA, Australia and the Czech Republic. More information is available on our website at www.congatec.com or via Facebook, Twitter and YouTube.

© 2013 congatec

congatec is an Associate member of the Intel® Intelligent Systems Alliance. From modular components to market-ready systems, Intel and the 250+ member companies of the Alliance provide the processing performance, connectivity, manageability, and security developers need to speed smart, connected systems to market. Learn more at: Intel.com/go/intelligentsystems/alliance.

Headquarters

congatec AG
Auwiesenstr. 5
94469 Deggendorf, Germany
Phone +49 991 2700-0
Fax +49 991 2700-111

info@congatec.com