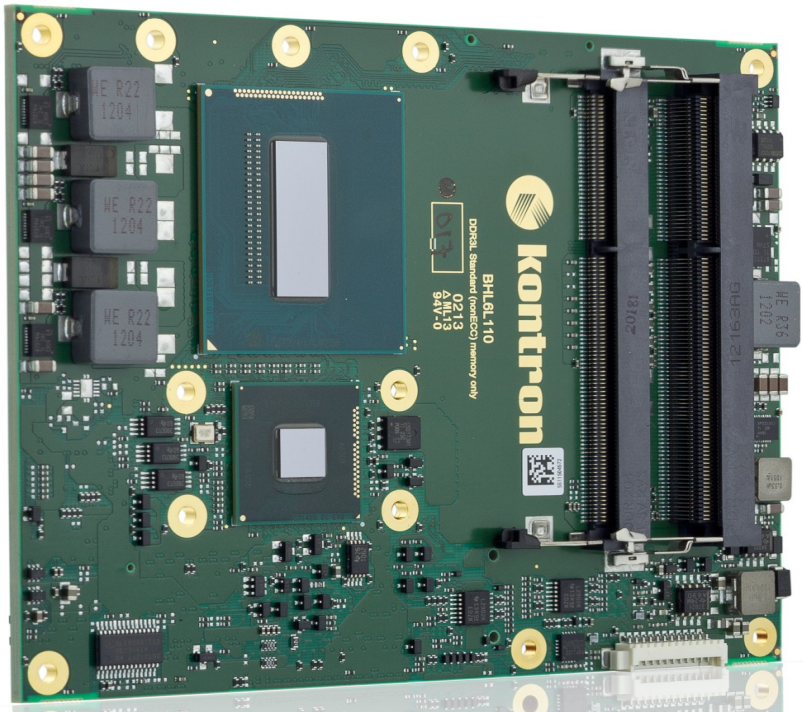
» Kontron User's Guide «



COMe-bHL6

Document Revision 010 - preliminary

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1 User Information

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Technicians and engineers from Kontron Europe GmbH and/or its subsidiaries are available for technical support. We are committed to make our product easy to use and will help you use our products in your systems.

Please consult our Website at http://www.kontron.com/support for the latest product documentation, utilities, drivers and support contacts. Consult our customer section http://emdcustomersection.kontron.com for the latest BIOS downloads, Product Change Notifications, Board Support Packages, DemoImages, 3D drawings and additional tools and software. In any case you can always contact your board supplier for technical support.

2 Introduction

2.1 Product Description

The brand new application-ready COMe-bHL6 offers increased performance density and up to twice the graphics performance compared to its predecessors. Up to three independent, daisy-chained displays with up to 4K resolution are supported to create stunning user experiences. Further to this, DirectX® 11.1 and OpenGL 4.0 support paves the way for compelling visuals when videos, graphics and interactive content are being displayed. By integrating the new Intel® AVX2 and OpenCL 1.2, Kontron's new Computer-on-Modules additionally not only provide an increase in floating-point performance they also possess improved parallel processing capacities. Typical application areas can be found in markets such as digital signage, professional gaming and entertainment, medical imaging and surveillance and security as well as industrial plant and machine line control on shop floor- and control room-level.

Engineers can immediately commence with evaluating these new benchmark Computer-on-Modules on all Kontron COM Express® pin-out type 6-compliant starter kits.

The Kontron COM Express® pin-out type 6 COMe-bHL6 module is available in several different variants ranging from the cost-optimized low-power processor versions up to quad-core Intel® Core™ i7 processors with up to 4x 2.4 GHz. The modules are designed with the Intel® Mobile QM87 Chipset, host up to 16 GB DDR3L RAM and support 7 PCI Express x1 lanes and 1 PEG x16 interface which is also compatible to standard PCI Express devices. Less complex peripherals can be connected via SPI and LPC. Additional dedicated features include 3x SATA 6Gb/s ports, 1 SATA 3Gb/s port, as well as Gigabit Ethernet, 4 USB 3.0 ports, 4 USB 2.0 and 2 serial ports. The Kontron COMe-bHL6 features comprehensive display support with 3x dual mode DisplayPort++ which can also output, HDMI, DVI and DisplayPort 1.2. Industrial applications benefit from the watchdog and real-time clock. The module supports an 8.5-20V wide-range power supply. The support of smart batteries via MARS and the standardized embedded application programming interface EAPI round off the feature set and provide engineers with a comprehensive service package that eases system development as well as system programming.

For customers wanting to instantly leverage the new graphics and computing power in their existing designs based on individual carrier boards, Kontron also offers standardized migration support services to accelerate the design-in phase and thus achieve fastest field deployment.

The Kontron COM Express® basic Computer-on-Module COMe-bHL6 supports the full Windows OS portfolio along with Linux and VxWorks.

2.2 Naming clarification

COM Express® defines a Computer-On-Module, or COM, with all components necessary for a bootable host computer, packaged as a super component.

» COMe-bXX# modules are Kontron's COM Express® modules in basic form factor (125mm x 95mm)

» COMe-cXX# modules are Kontron's COM Express® modules in compact form factor (95mm x 95mm)

» COMe-mXX# modules are Kontron's COM Express® modules in mini form factor (55mm x 84mm)

The product names for Kontron COM Express® Computer-on-Modules consist of a short form of the industry standard (**COMe-**), the form factor (**b**=basic, **c**=compact, **m**=mini), the capital letters for the CPU and Chipset Codenames (**XX**) and the pin-out type (**#**) followed by the CPU Name.

2.3 Understanding COM Express® Functionality

All Kontron COM Express® basic and compact modules contain two 220pin connectors; each of it has two rows called Row A & B on primary connector and Row C & D on secondary connector. COM Express® Computer-on-modules feature the following maximum amount of interfaces according to the PICMG module Pin-out type:

Feature	Pin-Out Type 1	Pin-Out Type 10	Pin-Out Type 2	Pin-Out Type 6
HD Audio	1x	1x	1x	1x
Gbit Ethernet	1x	1x	1x	1x
Serial ATA	4x	4x	4x	4x
Parallel ATA	-	-	1x	-
PCI	-	-	1x	-
PCI Express x1	6x	6x	6x	8x
PCI Express x16 (PEG)	-	-	1x	1x
USB Client	1x	1x	-	-
USB 2.0	8x	8x	8x	8x
USB 3.0	-	2x	-	4x
VGA	1x	-	1x	1x
LVDS	Dual Channel	Single Channel	Dual Channel	Dual Channel
DP++ (SDVO/DP/HDMI/DVI)	1x optional	1x	3x shared with PEG	3x
LPC	1x	1x	1x	1x
External SMB	1x	1x	1x	1x
External I2C	1x	1x	1x	1x
GPIO	8x	8x	8x	8x
SDIO	1x optional	1x optional	-	-
UART (2-wire COM)	-	2x	-	2x
FAN PWM out	-	1x	-	1x

2.4 COM Express® Documentation

This product manual serves as one of three principal references for a COM Express® design. It documents the specifications and features of COMe-bHL6. Additional references are available at your Kontron Support or at PICMG®:

» The COM Express® Specification defines the COM Express® module form factor, pin-out, and signals. This document is available at the PICMG® website by filling out the order form.

» The COM Express® Design Guide by PICMG® serves as a general guide for baseboard design, with a focus on maximum flexibility to accommodate a wide range of COM Express® modules.

Some of the information contained within this product manual applies only to certain product revisions (CE: xxx). If certain information applies to specific product revisions (CE: xxx) it will be stated. Please check the product revision of your module to see if this information is applicable.

2.5 COM Express® Benefits

COM Express® modules are very compact, highly integrated computers. All Kontron COM Express® modules feature a standardized form factor and a standardized connector layout which carry a specified set of signals. Each COM is based on the COM Express® specification. This standardization allows designers to create a single-system baseboard that can accept present and future COM Express® modules.

The baseboard designer can optimize exactly how each of these functions implements physically. Designers can place connectors precisely where needed for the application on a baseboard designed to optimally fit a system's packaging.

A single baseboard design can use a range of COM Express® modules with different sizes and pin-outs. This flexibility can differentiate products at various price/performance points, or when designing future proof systems that have a built-in upgrade path. The modularity of a COM Express® solution also ensures against obsolescence when computer technology evolves. A properly designed COM Express® baseboard can work with several successive generations of COM Express® modules.

A COM Express® baseboard design has many advantages of a customized computer-board design and, additionally, delivers better obsolescence protection, heavily reduced engineering effort, and faster time to market.

3 Product Specification

3.1 Modules & Accessories

The COM Express® basic sized Computer-on-Module COMe-bHL6 (BHL6) follows pin-out Type 6 and is compatible to PICMG specification COM.0 Rev 2.1. The COMe-bHL6 based on latest Shark Bay platform is available in different variants to cover the demand of different performance, price and power:

Commercial grade modules (0°C to 60°C operating)

Product Number	Product Name	Processor	Graphics	TDP	PCH	USB 3.0	SATA 6G	SATA 3G
38025-0000-24-7	COMe-bHL6 i7-4700EQ	Intel® Core™ i7-4700EQ	GT2	47W/37W	QM87	4	3	1
38025-0000-27-5	COMe-bHL6 i5-4400E	Intel® Core™ i5-4400E	GT2	37W	QM87	4	3	1
38025-0000-16-5	COMe-bHL6 i5-4402E	Intel® Core™ i5-4402E	GT2	25W	QM87	4	3	1

Accessories

Product Number	Baseboards
38114-0000-00-0	COM Express® Reference Carrier Type 6 (8mm COMe connector)
38106-0000-00-0	COM Express® Eval Carrier Type 6 (5mm COMe connector)
Product Number	**Memory**
97015-2048-16-1	DDR3L-1600 SODIMM 2GB
97015-4096-16-1	DDR3L-1600 SODIMM 4GB
97015-8192-16-1	DDR3L-1600 SODIMM 8GB
97015-2048-16-3	DDR3L-1600 SODIMM 2GB E2
97015-4096-16-3	DDR3L-1600 SODIMM 4GB E2
97015-8192-16-3	DDR3L-1600 SODIMM 8GB E2
Product Number	**Cooling & Mounting**
38025-0000-99-2	HSP COMe-bHL6 heatpipe thread
38025-0000-99-3	HSP COMe-bHL6 heatpipe through
38025-0000-99-4	HSP COMe-bHL6 low power thread (for low temperature usage only)
38013-0000-99-0C05	HSK COMe-bHL6 active (to be mounted on HSP)
38017-0000-00-5	COMe Mount KIT 5mm 1set
38017-0100-00-5	COMe Mount KIT 5mm 100sets
38017-0000-00-0	COMe Mount KIT 8mm 1set
38017-0100-00-0	COMe Mount Kit 8mm 100sets
Product Number	**Adapter & Cables**
9-5000-0352	ADA-LVDS-DVI 18bit (LVDS to DVI converter)
9-5000-0353	ADA-LVDS-DVI 24bit (LVDS to DVI converter)
96007-0000-00-7	ADA-Type6-DP3 (3x DP++ adapter between carrier and module)
96006-0000-00-8	ADA-DP-LVDS (DP++ to LVDS adapter)
96082-0000-00-0	KAB-ADAPT-DP-DVI (DP++ to DVI adapter cable)
96083-0000-00-0	KAB-ADAPT-DP-VGA (DP++ to VGA adapter cable)
96084-0000-00-0	KAB-ADAPT-DP-HDMI (DP++ to HDMI adapter cable)
96079-0000-00-0	KAB-HSP 200mm (Cable adapter to connect FAN to module)
96079-0000-00-2	KAB-HSP 40mm (Cable adapter to connect FAN to module)
96006-0000-00-2	COMe POST T6 (Debug Card)

3.2 Functional Specification

Processor

The 22nm Intel® 4th Gen Core™ i7/i5/i3/Celeron® embedded (Haswell / Crystal Well) CPU family with 37.5x32mm package size (BGA1364 socket) supports:

» Intel® Turbo Boost Technology 2.01

» Intel® 64

» Intel® Virtualization Technology (VT-x)

» Intel® Virtualization Technology for Directed I/O (VT-d)

» AES New Instructions (AES-NI)

» Intel® Hyper-Threading Technology

» Enhanced Intel SpeedStep® Technology

» Idle States (C-States)

» Intel® Smart Cache

» Thermal Monitoring Technologies

» Intel® Fast Memory Access

» Intel® Flex Memory Access

» Integrated Intel® HD Graphics with Dynamic Frequency

Optional available (with customized BIOS):

» Intel® vPRO™ Technology including:

» Intel® Active Management Technology (AMT)

» Intel® Trusted Execution Technology (TXT)

» Advanced Encryption Standard Instructions (AES-NI)

The integrated Intel® HD Graphics HD4600 supports:

» GraphicsTechnology GT2 with 20 Execution Units or GT3 with 40 Execution Units

» Intel® Quick Sync Video

» Intel® InTru™ 3D Technology

» Intel® Wireless Display

» Intel® Flexible Display Interface (Intel® FDI)

» Intel® Clear Video HD Technology

» Intel® Graphics Render C-State RC6

» Intel® Smart 2D Display Technology (S2DDT)

» 3 simultaneous displays (Win7/8 and Linux)

» Hybrid Multi Monitor with 2 internal and 2 external displays

» Video Decode for AVC/H.264/VC-1/MPEG-2

» Video Encode for AVC/H.264/MPEG-2

» Blu-ray Playback (incl. PAVP)

CPU Featureset

Intel®	Core™	Core™	Core™
-	i7-4700EQ	i5-4400E	i5-4402E
# of Cores	4	2	2
# of Threads	8	4	4
TDP Core frequency	**2400MHz**	**2700MHz**	**1600MHz**
Max Turbo Frequency 1 core	3400MHz	3300MHz	2700MHz
Max Turbo all cores	2800MHz	3200MHz	2600MHz
LFM/LPM Frequency	800MHz	800MHz	800MHz
Bus/Core Ratio	8 - 24	8 - 27	8 - 16
TjMax	100°C	100°C	100°C
Thermal Design Power (TDP)	47W	37W	25W
cTDP-Down	37W	-	-
cTDP-Down Core frequency	**1700MHz**	-	-
cTDP-Up	-	-	-
cTDP-Up Core frequency	-	-	-
Max Turbo Power (PL2 max)	58.75/46.25W	46.25W	46.25W
C-States	C0-C7	C0-C7	C0-C7
eDRAM	-	-	-
Smart Cache	6MB	3MB	3MB
Min Memory Type	DDR3L-1066	DDR3L-1066	DDR3L-1066
Max Memory Type	DDR3L-1600	DDR3L-1600	DDR3L-1600
Max Memory Size	2x8GB	2x8GB	2x8GB
# of Memory Channels	2	2	2
Graphics Model	HD4600	HD4600	HD4600
GFX LFM Frequency	200MHz	200MHz	200MHz
GFX Base Frequency	400MHz	400MHz	400MHz
GFX Turbo Frequency	1000MHz	1000MHz	900MHz
GFX Technology	GT2 20EU	GT2 20EU	GT2 20EU
GFX Func/Phys Cores	2/2	2/2	2/2
Quick Sync Video	Yes	Yes	Yes
InTru™ 3D	Yes	Yes	Yes
Wireless Display	Yes	Yes	Yes
Clear Video HD	Yes	Yes	Yes
vPRO™ (optional)	Yes	Yes	Yes
TXT (optional)	Yes	Yes	Yes
AES-NI (optional)	Yes	Yes	Yes
VT-x	Yes	Yes	Yes
VT-d	Yes	Yes	Yes
PCI Express Graphics x16	Gen 3.0	Gen 3.0	Gen 3.0

Memory

Sockets	2x DDR3 SO-DIMM
Memory Type	DDR3L-1333/1600
Maximum Size	2x8GB
Technology	Dual Channel

Chipset

The 32nm Intel® 8-Series Platform Controller Hub Lynx Point supports:

» PCI Express Revision 2.0

» PCI Express Configurations x1, x2, x4

» Intel® Virtualization Technology for Directed I/O (VT-d)

» Intel® Trusted Execution Technology (TXT)

» Intel® vPro Technology (optional)

» Intel® Active Management Technology 9.0 (optional)

» Intel® Anti-Theft Technology

» Intel® Rapid Storage Technology

» Intel® Smart Response Technology

PCH comparison

Feature	QM87	HM86
TDP	4.1W	4.1W
Rapid Storage	YES	YES
USB 3.0 (USB 2.0 compatible)	YES (4x on COMe)	YES (2x on COMe
USB 2.0	YES (4x on COMe)	YES (6x on COMe
Wireless Display	YES	YES
3 Displays simultaneously	YES	YES
VT-d	YES	NO
vPRO	YES	NO
AMT 9.0	YES	NO
TXT	YES	NO
SATA RAID	YES	NO
SATA 6Gb/s (Gen3)	YES (3x on COMe)	YES (2x on COMe)
SATA 3Gb/s (Gen2)	YES (1x on COMe)	YES (2x on COMe)

The Intel® vPro Technology including Trusted Execution Technology (TXT), Active Management Technology (AMT) and Encryption AES-NI is not supported by default on COMe-bHL6. Please contact your local sales or support for custom BIOS variants supporting vPro.

HighSpeed I/O Port Configuration

-	QM87 I/O	HM86 I/O	COMe with QM87	COMe with HM86
Port1	USB3 #1	USB3 #1	USB #0 = USB3.0	USB #0 = USB3.0
Port2	USB3 #2	USB3 #2	USB #1 = USB3.0	USB #1 = USB3.0
Port3	USB3 #5	-	USB #2 = USB3.0	-
Port4	USB3 #6	-	USB #3 = USB3.0	-
-	USB2	USB2	USB #4-7 = USB 2.0	USB #2-7 = USB 2.0
Port5	USB3 #3 or PCIe #1	USB3 #3 or PCIe #1	PCIe #0	PCIe #0
Port6	USB3 #4 or PCIe #2	USB3 #4 or PCIe #2	PCIe #1	PCIe #1
Port7	PCIe #3	PCIe #3	PCIe #2	PCIe #2
Port8	PCIe #4	PCIe #4	PCIe #3	PCIe #3
Port9	PCIe #5	PCIe #5	PCIe #4	PCIe #4
Port10	PCIe #6	PCIe #6	PCIe #5	PCIe #5
Port11	PCIe #7	PCIe #7	PCIe #6	PCIe #6
Port12	PCIe #8	PCIe #8	PCIe #7	PCIe #7
Port13	SATA3 #4 or PCIe #1	SATA3 #4	SATA #0 = SATA 6Gb/s	SATA #0 = SATA 6Gb/s
Port14	SATA3 #5 or PCIe #2	SATA3 #5	SATA #1 = SATA 6Gb/s	SATA #1 = SATA 6Gb/s
Port15	SATA3 #0	SATA2 #0	SATA #2 = SATA 6Gb/s	SATA #2 = SATA 3Gb/s
Port16	SATA3 #1	-	-	-
Port17	SATA2 #2	SATA2 #2	SATA #3 = SATA 3Gb/s	SATA #3 = SATA 3Gb/s
Port18	SATA2 #3	-	-	-

Graphics Core

The integrated Intel® GMA HD (Gen7.5) supports:

Graphics Core Render Clock	GT1/GT2/GT3 Base clock: 400/200 MHz GT Turbo: up to 1000 MHz
Execution Units / Pixel Pipelines	GT3: 40EU / GT2: 20EU / GT1: 10EU
Max Graphics Memory	1720MB
GFX Memory Bandwidth (GB/s)	25.6
GFX Memory Technology	DVMT
API (DirectX/OpenGL)	11.1 / 4.0 + OCL 1.2
Shader Model	5.0
Hardware accelerated Video	MPEG2, VC-1, AVC, Blu-ray (+3D)
Independent/Simultaneous Displays	3
Display Port	DP 1.2 / eDP 1.3
HDCP support	HDCP 1.4a

Monitor output

CRT max Resolution	1920x1200
TV out:	-

LVDS

LVDS Bits/Pixel	1x18/24, 2x18/24 with eDP2LVDS
LVDS Bits/Pixel with dithering	-
LVDS max Resolution:	1920x1200
PWM Backlight Control:	YES
Supported Panel Data:	JILI2/JILI3/EDID/DID

Display Interfaces

Discrete Graphics	1x PEG 3.0
Digital Display Interface DDI1	DP++
Digital Display Interface DDI2	DP++
Digital Display Interface DDI3	DP++
Maximum Resolution on DDI	HDMI: 4096x2304 DP: 3840x2160

PEG Configuration

The x16 PCI Express Graphics Port (PEG) is compatible to standard PCI Express devices like Ethernet or RAID controllers. The COMe-bHL6 supports following PEG Port configuration when used as PCI Express Interface:

» 1×16

» 1×8

» 1×4

» 1×2

» 1×1

The internal PCI Express controller can be re-configured to support up to 3 PCIe ports. The following port configurations are configurable via setup option:

» 2×8 (lanes #0-7 + #8-15)

» 1×8 + 2×4 (lanes #0-7 + #8-11 + #12-15)

Storage

onboard SSD	-
SD Card support	-
IDE Interface	-
Serial-ATA	up to 3x SATA 6Gb/s, 1x SATA 3Gb/s
SATA AHCI	NCQ, HotPlug, Staggered Spinup, eSATA, PortMultiplier
SATA RAID	0, 1, 5, 10

If SATA AHCI or RAID is disabled in setup, the SATA Interface only supports 3Gb/s transfer rate and Staggered Spin-Up. To configure a RAID enable RAID support in BIOS Chipset/SATA settings, connect at least two hard drives and enter the RAID Option ROM by pressing 'CTRL'+'I'

Connectivity

USB 2.0	8x USB 2.0
USB 3.0	up to 4x USB 3.0
USB Client	-
PCI	-
PCI External Masters	-
PCI Express	7x PCIe x1 Gen 2.0
Max PCI Express	8x PCIe without LAN
PCI Express x2/x4 configuration	YES (Softstrap option)
Ethernet	10/100/1000 Mbit
Ethernet controller	Intel® i218-LM (Clarkville)

PCI Express Configuration

By default, the COMe-bHL6 supports x1 PCIexpress lane configuration only (Configuration 0). Following x2/x4 configurations are available via Management Engine Softstrap Options with a customized Flash Descriptor.

PCIe	Port #0	Port #1	Port #2	Port #3	Port #4	Port #5*	Port #6*	Port #7*
Configuration0	x1	x1	x1	x1	x1	-	-	-
Configuration1	x2		x1	x1	x1	x1	x1	x1
Configuration2	x2		x2		x1	x1	x1	x1
Configuration3	x2		x2		x2		x1	x1
Configuration4	x2		x2		x2		x2	
Configuration5	x4				x1	x1	x1	x1
Configuration6	x4				x2		x1	x1
Configuration7	x4				x2		x2	
Configuration8	x4				x4			

- *PCIe Port #7 is available without Ethernet Controller only

Ethernet

The Intel® i218-LM (Clarkville) ethernet supports:

» Jumbo Frames - 9K

» MACsec IEEE 802.1 AE

» Time Sync Protocol Indicator

» WOL (Wake On LAN)

» PXE (Preboot eXecution Environment)

» IEEE1588

Misc Interfaces and Features

Audio	HD Audio + DisplayPort dual stream
Onboard Hardware Monitor	Nuvoton NCT7802Y
Trusted Platform Module	Atmel AT97SC3204-U2A1A-10
Miscellaneous	2x UART / PWM FAN

Kontron Features

External I2C Bus	Fast I2C, MultiMaster capable
Smart Battery (M.A.R.S.) support	YES
Embedded API	PICMG EAPI / JIDA32
Custom BIOS Settings / Flash Backup	YES
Watchdog support	Dual Staged

Additional features

» All solid capacitors (POSCAP). No tantalum capacitors used.

» Optimized RTC Battery monitoring to secure highest longevity

» Real fast I2C with transfer rates up to 40kB/s.

» Discharge logic on all onboard voltages for highest reliability

Power Features

Singly Supply Support	YES
Supply Voltage	8.5V - 20V
ACPI	ACPI 4.0
S-States	S0, S3, S4, S5
S5 Eco Mode	YES
Misc Power Management	tbd

Power Consumption and Performance

Full Load Power Consumption	tbd
Kontron Performance Index	tbd
Kontron Performance/Watt	tbd

*Measured Values. Please note the maximum Power Consumption with activated Turbo Mode in chapter Turbo 2.0

Detailed Power Consumption measurements in all states and benchmarks for CPU, Graphics and Memory performance are available in Application Note KEMAP054 at EMD Customer Section.

Supported Operating Systems

The COMe-bHL6 supports:

» Microsoft Windows 7 32bit/64bit

» Microsoft Windows Embedded Standard 7 (WES7) 32bit/64bit

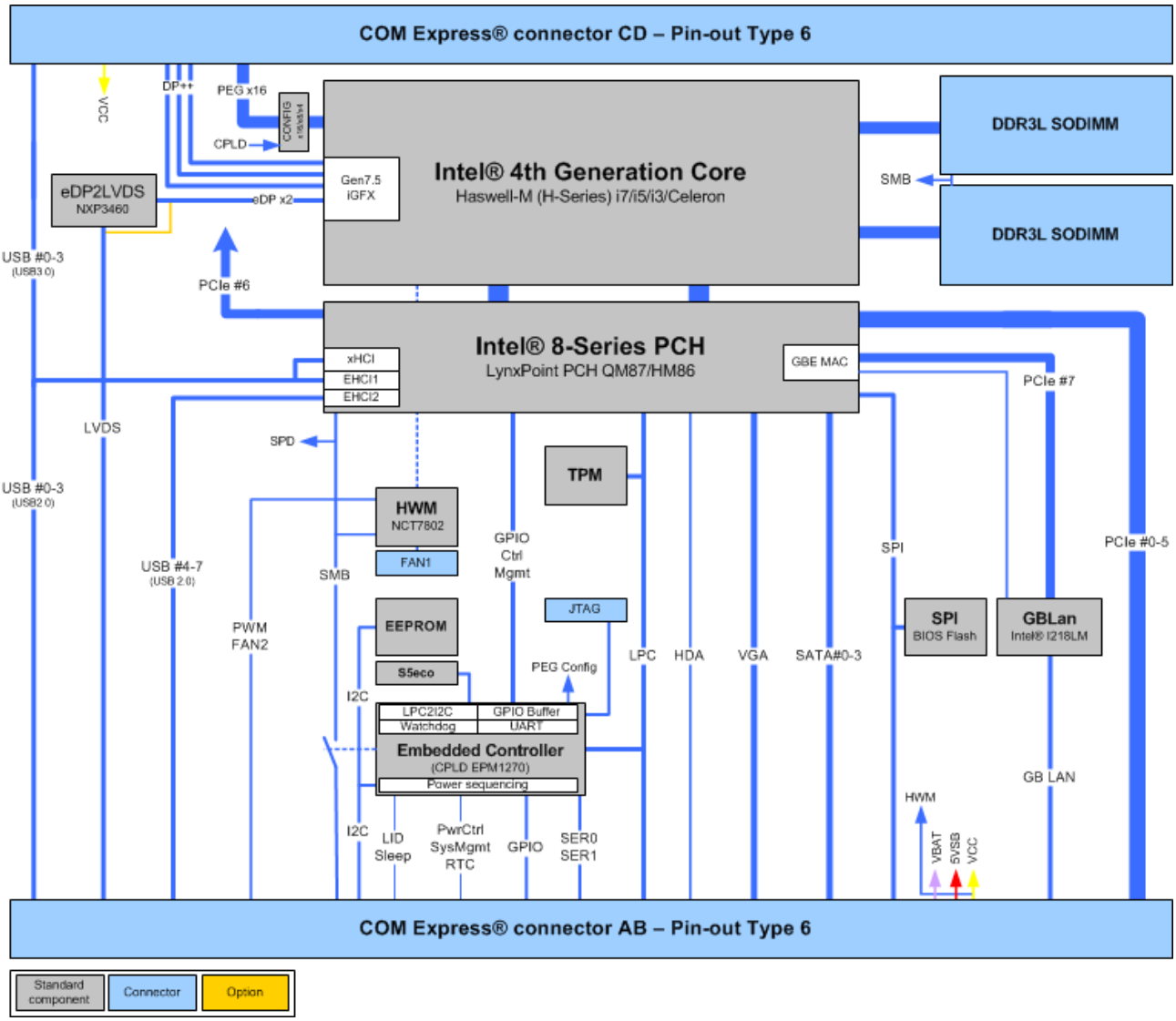
» Microsoft Windows 8 32bit/64bit

» Microsoft Windows Embedded Standard 8 (WES8) 32bit/64bit

» Linux

» VxWorks 6.9 32bit/64bit

3.3 Block Diagram



3.4 Electrical Specification

3.4.1 Supply Voltage

Following supply voltage is specified at the COM Express® connector:

VCC:	8.5V - 20V
Standby:	5V DC +/- 5%
RTC:	2.5V - 3.3V

- 5V Standby voltage is not mandatory for operation.
- Extended Temperature (E1) variants are validated for 12V supply only

3.4.2 Power Supply Rise Time

» The input voltages shall rise from ≤10% of nominal to within the regulation ranges within 0.1ms to 20ms.

» There must be a smooth and continuous ramp of each DC input voltage from 10% to 90% of its final set-point following the ATX specification

3.4.3 Supply Voltage Ripple

» Maximum 100 mV peak to peak 0 – 20 MHz

3.4.4 Power Consumption

The maximum Power Consumption of the different COMe-bHL6 variants is tbd (100% CPU load on all cores; 90°C CPU temperature). Further information with detailed measurements are available in Application Note KEMAP054 available on EMD Customer Section. Information there is available after registration.

3.4.5 ATX Mode

By connecting an ATX power supply with VCC and 5VSB, PWR_OK is set to low level and VCC is off. Press the Power Button to enable the ATX PSU setting PWR_OK to high level and powering on VCC. The ATX PSU is controlled by the PS_ON# signal which is generated by SUS_S3# via inversion. VCC can be 8.5V - 20V in ATX Mode. On Computer-on-Modules supporting a wide range input down to 4.75V the input voltage shall always be higher than 5V Standby (VCC > 5VSB).

State	PWRBTN#	PWR_OK	V5_StdBy	PS_ON#	VCC
G3	x	x	0V	x	0V
S5	high	low	5V	high	0V
S5 → S0	PWRBTN Event	low → high	5V	high → low	0 V→ VCC
S0	high	high	5V	low	VCC

3.4.6 Single Supply Mode

In single supply mode (or automatic power on after power loss) without 5V Standby the module will start automatically when VCC power is connected and Power Good input is open or at high level (internal PU to 3.3V). PS_ON# is not used in this mode and VCC can be 8.5V - 20V.

To power on the module from S5 state press the power button or reconnect VCC. Suspend/Standby States are not supported in Single Supply Mode.

State	PWRBTN#	PWR_OK	V5_StdBy	VCC
G3	x	x	x	0
G3 → S0	high	open / high	x	connecting VCC
S5	high	open / high	x	VCC
S5 → S0	PWRBTN Event	open / high	x	reconnecting VCC

Signals marked with “x” are not important for the specific power state. There is no difference if connected or open.

All ground pins have to be tied to the ground plane of the carrier board.

3.5 Power Control

Power Supply

The COMe-bHL6 supports a power input from 8.5V - 20V. The supply voltage is applied through the VCC pins (VCC) of the module connector.

Power Button (PWRBTN#)

The power button (Pin B12) is available through the module connector described in the pinout list. To start the module via Power Button the PWRBTN# signal must be at least 50ms (50ms ≤ t < 4s, typical 400ms) at low level (Power Button Event).

Pressing the power button for at least 4seconds will turn off power to the module (Power Button Override).

Power Good (PWR_OK)

The COMe-bHL6 provides an external input for a power-good signal (Pin B24). The implementation of this subsystem complies with the COM Express® Specification. PWR_OK is internally pulled up to 3.3V and must be high level to power on the module.

Reset Button (SYS_RESET#)

The reset button (Pin B49) is available through the module connector described in the pinout list. The module will stay in reset as long as SYS_RESET# is grounded. If available, the BIOS setting for “Reset Behavior” must be set to “Power Cycle”.

Modules with Intel® Chipset and active Management Engine do not allow to hold the module in Reset out of S0 for a long time. At about 10s holding the reset button the ME will reboot the module automatically

SM-Bus Alert (SMB_ALERT#)

With an external battery manager present and SMB_ALERT# (Pin B15) connected the module always powers on even if BIOS switch “After Power Fail” is set to “Stay Off”.

3.6 Environmental Specification

3.6.1 Temperature Specification

General Specification for COMs	Operating	Non-operating	Validated Input Voltage
Commercial grade	0°C to +60°C	-30°C to +85°C	VCC: 8.5V - 20V
Extended Temperature (E1)	-25°C to +75°C	-30°C to +85°C	VCC: 12V
Industrial grade by **Screening** (XT)	-40°C to +85°C	-40°C to +85°C	VCC: 12V
Industrial grade by **Design** (E2)	-40°C to +85°C	-40°C to +85°C	VCC: 8.5V - 20V

Please see chapter Product Specification for available variants

Operating with Kontron heatspreader plate assembly

The operating temperature defines two requirements:

» the maximum ambient temperature with ambient being the air surrounding the module.

» the maximum measurable temperature on any spot on the heatspreader's surface

Test specification:

Temperature Grade	Validation requirements
Commercial grade	at 60°C HSP temperature the CPU @ 100% load needs to run at nominal frequency
Extended Temperature (E1)	at 75°C HSP temperature the CPU @ 75% load is allowed to start speedstepping for thermal protection
Industrial grade by **Screening** (XT)	at 85°C HSP temperature the CPU @ 50% load is allowed to start throttling for thermal protection
Industrial grade by **Design** (E2)	at 85°C HSP temperature the CPU @ 50% load is allowed to start throttling for thermal protection

Operating without Kontron heatspreader plate assembly

The operating temperature is the maximum measurable temperature on any spot on the module's surface.

3.6.2 Humidity

» 93% relative Humidity at 40°C, non-condensing (according to IEC 60068-2-78)

3.7 Standards and Certifications

RoHS II

The **COMe-bHL6** is compliant to the directive 2011/65/EU on the Restriction of the use of certain Hazardous Substances (RoHS II) in electrical and electronic equipment

Component Recognition UL 60950-1

The **COM Express® basic** form factor Computer-on-Modules are Recognized by Underwriters Laboratories Inc. Representative samples of this component have been evaluated by UL and meet applicable UL requirements.

UL Listings:

» NWGQ2.E304278

» NWGQ8.E304278

WEEE Directive

WEEE Directive 2002/96/EC is not applicable for Computer-on-Modules.

Conformal Coating

Conformal Coating is available for Kontron Computer-on-Modules and for validated SO-DIMM memory modules. Please contact your local sales or support for further details.

Shock & Vibration

The **COM Express® basic** form factor Computer-on-Modules successfully passed shock and vibration tests according to

» IEC/EN 60068-2-6 (Non operating Vibration, sinusoidal, 10Hz-4000Hz, +/-0.15mm, 2g)

» IEC/EN 60068-2-27 (Non operating Shock Test, half-sinusoidal, 11ms, 15g)

EMC

Validated in Kontron reference housing for EMC the **COMe-bHL6** follows the requirements for electromagnetic compatibility standards

» EN55022

3.8 MTBF

The following MTBF (Mean Time Before Failure) values were calculated using a combination of manufacturer's test data, if the data was available, and the Telcordia (Bellcore) issue 2 calculation for the remaining parts.

The calculation methode used is "Telcordia Method 1 Case 3" in a ground benign, controlled environment (GB,GC). This particular method takes into account varying temperature and stress data and the system is assumed to have not been burned in.

Other environmental stresses (extreme altitude, vibration, salt water exposure, etc) lower MTBF values.

System MTBF (hours): tbd

Fans usually shipped with Kontron Europe GmbH products have 50,000-hour typical operating life. The above estimates assume no fan, but a passive heat sinking arrangement Estimated RTC battery life (as opposed to battery failures) is not accounted for in the above figures and need to be considered separately. Battery life depends on both temperature and operating conditions. When the Kontron unit has external power; the only battery drain is from leakage paths.

3.9 Mechanical Specification

Dimension

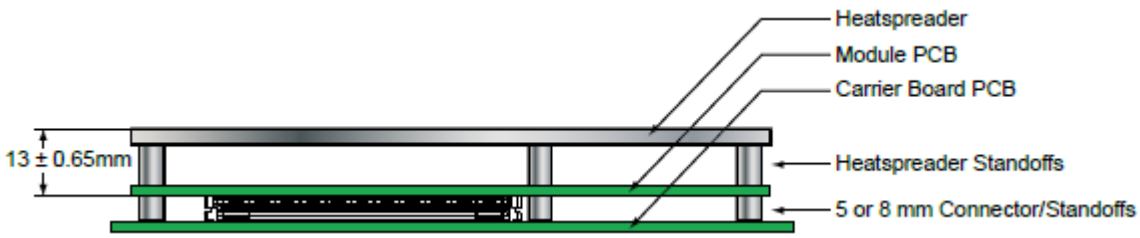
» 95.0 mm x 125.0 mm

» Height approx. 12mm (0.4”)

CAD drawings are available at EMD CustomerSection

Height

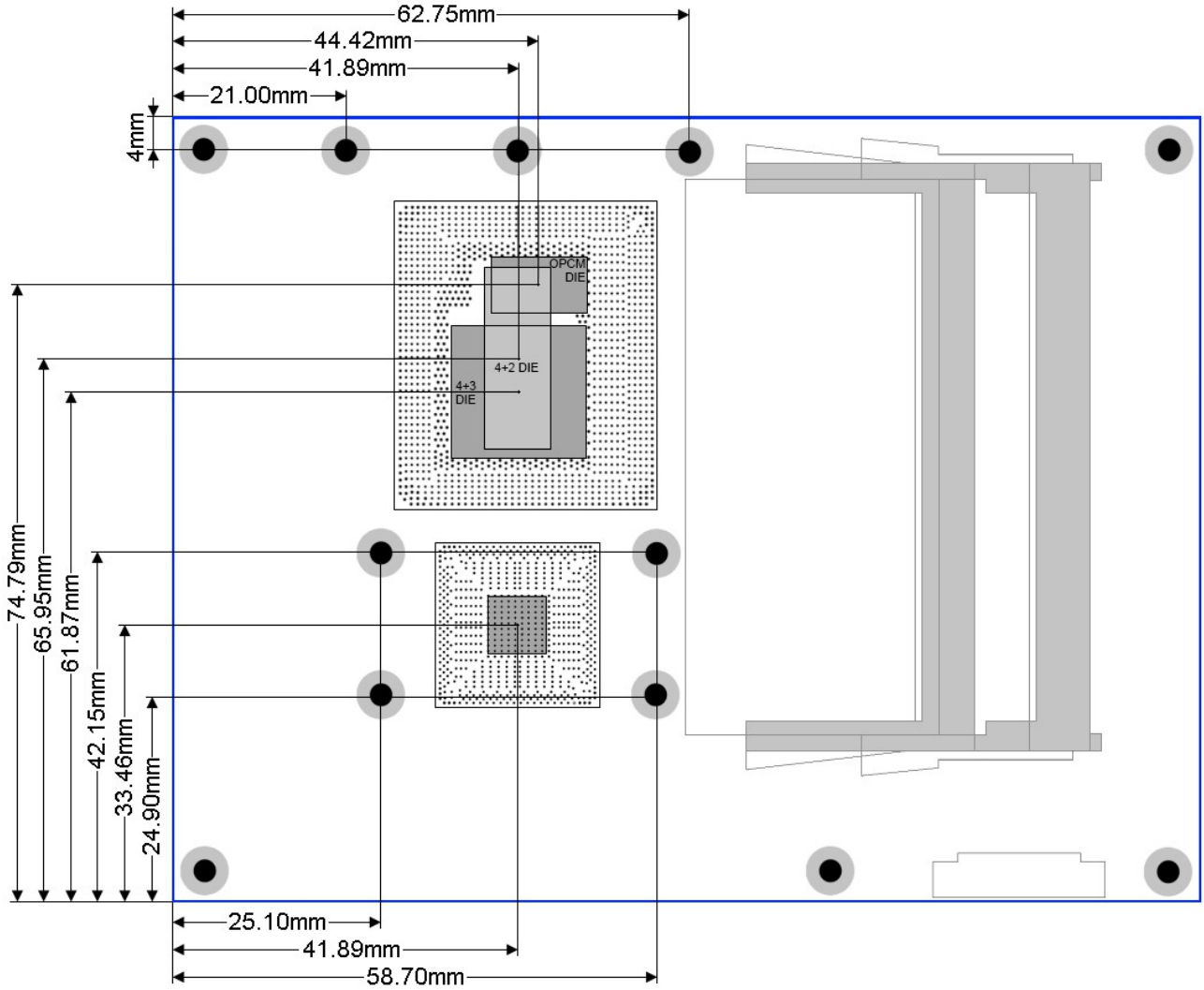
The COM Express® specification defines a module height of 13mm from bottom to heatspreader top:



Cooling solutions provided from Kontron Europe GmbH for basic sized Computer-on-Modules are 27mm in height from module bottom to Heatsink top.

Universal Cooling solutions to be mounted on the HSP (36099-0000-00-x) are 14.3mm in height for an overall height of 27.3mm from module bottom to Heatsink top.

3.10 Module Dimensions



3.11 Thermal Management, Heatspreader and Cooling Solutions

A heatspreader plate assembly is available from Kontron Europe GmbH for the COMe-bHL6. The heatspreader plate on top of this assembly is NOT a heat sink. It works as a COM Express®-standard thermal interface to use with a heat sink or external cooling devices.

External cooling must be provided to maintain the heatspreader plate at proper operating temperatures. Under worst-case conditions, the cooling mechanism must maintain an ambient air and heatspreader plate temperature on any spot of the heatspreaders surface according the module specifications:

» 60°C for commercial grade modules

» 75°C for extended temperature grade modules (E1)

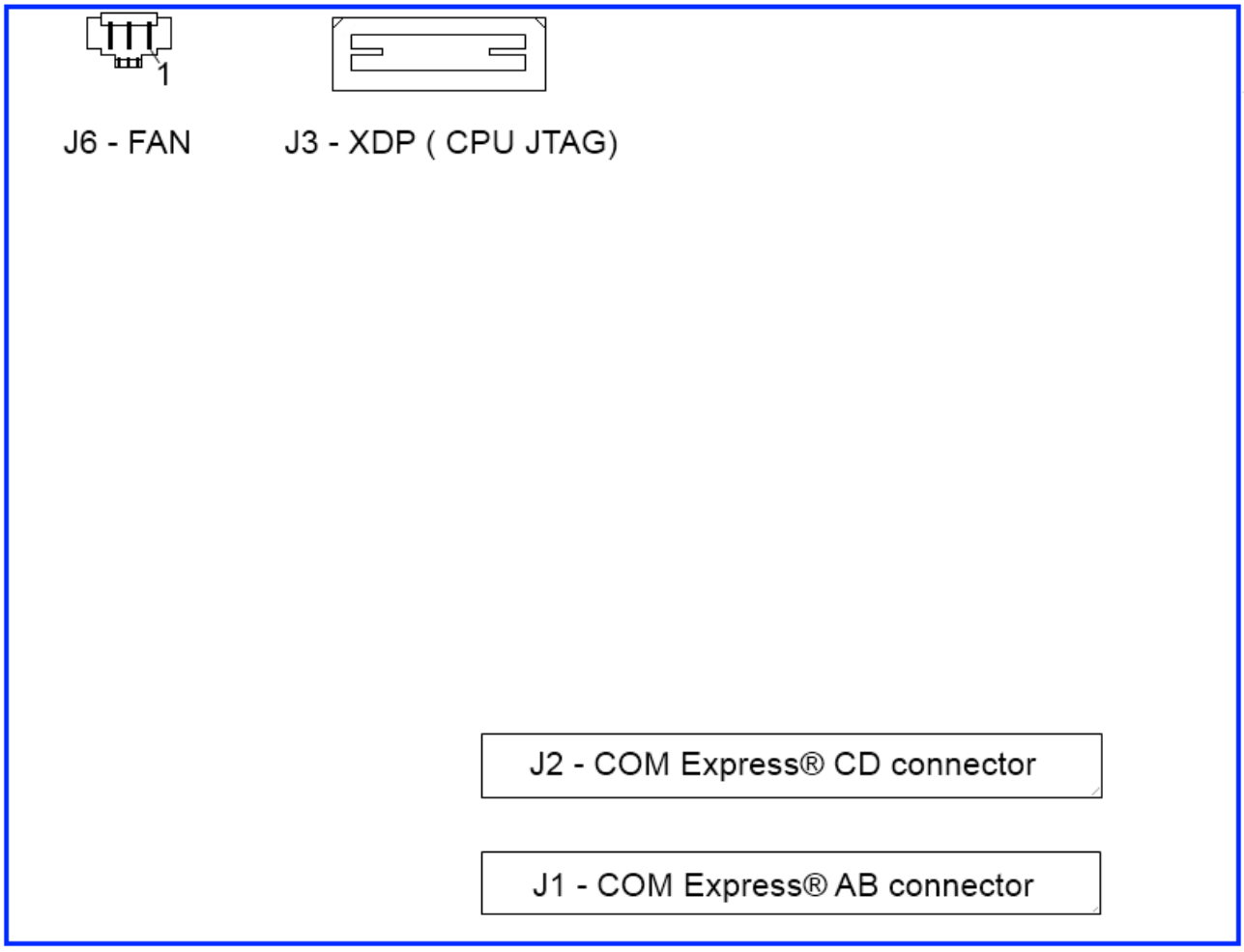
» 85°C for industrial temperature grade modules (E2/XT)

The aluminum slugs and thermal pads or the heat-pipe on the underside of the heatspreader assembly implement thermal interfaces between the heatspreader plate and the major heat-generating components on the COMe-bHL6. About 80 percent of the power dissipated within the module is conducted to the heatspreader plate and can be removed by the cooling solution.

You can use many thermal-management solutions with the heatspreader plates, including active and passive approaches. The optimum cooling solution varies, depending on the COM Express® application and environmental conditions. Active or passive cooling solutions provided from Kontron Europe GmbH for the COMe-bHL6 are usually designed to cover the power and thermal dissipation for a commercial grade temperature range used in a housing with proper air flow.

Documentation and CAD drawings of COMe-bHL6 heatspreader and cooling solutions are provided at http://emdcustomersection.kontron.com.

3.12 Onboard Connectors



3.12.1 FAN Connector J6 - PCB bottom

Specification

» Part number (Molex) J8: 53261-0390

» Mates with: 51021-0300

» Crimp terminals: 50079-8100

Pin assignment

» Pin1: Tacho, Pin2: VCC, Pin3: GND

Electrical characteristic

Module Input Voltage	8.5 - 13V	13 - 20V
FAN Output Voltage	8.5 - 13V	13V
Max. FAN Output Current	350mA	150mA

To connect a standard FAN with 3pin connector to the module please use adaptor cable KAB-HSP 200mm (96079-0000-00-0) or KAB-HSP 40mm (96079-0000-00-2)

3.12.2 CPU JTAG connector J3 - PCB bottom

The XDP connector is for internal use only. Do not use under any circumstances

3.12.3 CPLD Debug connector J7 - PCB top

The CPLD Debug and programming connector is for internal use only. Do not use under any circumstances

4 Features and Interfaces

4.1 S5 Eco Mode

Kontron's new high-efficient power-off state S5 Eco enables lowest power-consumption in soft-off state – less than 1 mA compared to the regular S5 state this means a reduction by at least factor 200!

In the "normal" S5 mode the board is supplied by 5V_Stb and needs usually up to 300mA just to stay off. This mode allows to be switched on by power button, RTC event and WakeOnLan, even when it is not necessary. The new S5 Eco mode reduces the current enormous.

The S5 Eco Mode can be enabled in BIOS Setup, when the BIOS supports this feature.

Following prerequisites and consequences occur when S5 Eco Mode is enabled

» The power button must be pressed at least for 200ms to switch on.

» Wake via Powerbutton only.

» "Power On After Power Fail"/"State after G3": only "stay off" is possible

4.2 LPC

The Low Pin Count (LPC) Interface signals are connected to the LPC Bus bridge located in the CPU or chipset. The LPC low speed interface can be used for peripheral circuits such as an external Super I/O Controller, which typically combines legacy-device support into a single IC. The implementation of this subsystem complies with the COM Express® Specification. Implementation information is provided in the COM Express® Design Guide maintained by PICMG. Please refer to the official PICMG documentation for additional information.

The LPC bus does not support DMA (Direct Memory Access) and a clock buffer is required when more than one device is used on LPC. This leads to limitations for ISA bus and SIO (standard I/O´s like Floppy or LPT interfaces) implementations.

All Kontron COM Express® Computer-on-Modules imply BIOS support for following external baseboard LPC Super I/O controller features for the **Winbond/Nuvoton 5V 83627HF/G and 3.3V 83627DHG-P**:

83627HF/G	Phoenix BIOS	AMI CORE8	AMI Aptio
PS/2	YES	YES	YES
COM1/COM2	YES	YES	YES
LPT	YES	YES	YES
HWM	YES	YES	NO
Floppy	NO	NO	NO
GPIO	NO	NO	NO
83627DHG-P	**Phoenix BIOS**	**AMI CORE8**	**AMI Aptio**
PS/2	YES	YES	YES
COM1/COM2	YES	YES	YES
LPT	YES	YES	YES
HWM	NO	NO	NO
Floppy	NO	NO	NO
GPIO	NO	NO	NO

Features marked as not supported do not exclude OS support (e.g. HWM can be accessed via SMB). For any other LPC Super I/O additional BIOS implementations are necessary. Please contact your local sales or support for further details.

4.3 Serial Peripheral Interface (SPI)

The Serial Peripheral Interface Bus or SPI bus is a synchronous serial data link standard named by Motorola that operates in full duplex mode. Devices communicate in master/slave mode where the master device initiates the data frame. Multiple slave devices are allowed with individual slave select (chip select) lines. Sometimes SPI is called a “four wire” serial bus, contrasting with three, two, and one wire serial buses.

The SPI interface can only be used with a SPI flash device to boot from external BIOS on the baseboard.

4.4 SPI boot

The COMe-bHL6 supports boot from an external SPI Flash. It can be configured by pin A34 (BIOS_DIS#0) and pin B88 (BIOS_DIS1#) in following configuration:

BIOS_DIS0#	BIOS_DIS1#	Function
open	open	Boot on-module BIOS
GND	open	Boot baseboard LPC FWH
open	GND	Baseboard SPI = Boot Device 1, on-module SPI = Boot Device 2
GND	GND	Baseboard SPI = Boot Device 2, on-module SPI = Boot Device 1

By default only SPI Boot Device 1 is used in configuration 3 & 4. Both SPI Boot Devices are used by splitting the BIOS with modified descriptor table in customized versions only

Using an external SPI flash

To programm an external SPI flash follow these steps:

» Connect a SPI flash with correct size (similar to BIOS ROM file size) to the module SPI interface

» Open pin A34 and B88 to boot from the module BIOS

» Boot the module to DOS with access to the BIOS image and Firmware Update Utility provided on EMD Customer Section

» Connect pin B88 (BIOS_DIS1#) to ground to enable the external SPI flash

» Execute Flash.bat to flash the complete BIOS image to the external SPI flash

» reboot

Your module will now boot from the external SPI flash when BIOS_DIS1# is grounded.

4.5 M.A.R.S.

The Smart Battery implementation for Kontron Computer-on-Modules called **M**obile **A**pplication for **R**echargeable **S**ystems is a BIOS extension for external Smart Battery Manager or Charger. It includes support for SMBus charger/selector (e.g. Linear Technology LTC1760 Dual Smart Battery System Manager) and provides ACPI compatibility to report battery information to the Operating System.

Reserved SM-Bus addresses for Smart Battery Solutions on the carrier:

8-bit Address	7-bit Address	Device
12h	0x09	SMART_CHARGER
14h	0x0A	SMART_SELECTOR
16h	0x0B	SMART_BATTERY

4.6 UART

The COMe-bHL6 supports up to two Serial RX/TX only Ports defined in COM Express® specification on Pins A98/A99 for UART0 and Pins A101/A102 for UART1. The implementation of the UART is compatible to 16450 and is supported by default from most operating systems. Resources are subordinated to other UARTS e.g. from external LPC Super I/O.

UART features:

» 450 to 115.2k Baud (except 56000)

» 5, 6, 7 or 8bit characters

» 1 or 2 Stop bit generation

» Even, odd or no-parity generation/detection

» Complete status reporting capabilities

» Line break generation and detection

» Full prioritized interrupt system control

» No FIFO

» One additional shift register for transmit and one for receive

» No Flow Control

» No FCR register due to unavailability of FIFO

» MCR and MSR registers only implemented in loopback mode for compatibility with existing drivers and APIs

» Initialized per default to COM3 3F8h/IRQ4 and COM4 2F8/IRQ3 without external SIO

» Initialized per default to COM3 3E8h/IRQ5 and COM4 2E8/IRQ10 with external SIO present

The UART clock is generated by the 33MHz LPC clock which results in an accuracy of 0.5% on all UART timings

- Due to the protection circuitry required according COM Express® specification the transfer speed can only be guaranteed for 9600 Baud. Please contact your local sales or support for customized versions without protection circuitry

- Legacy console redirection via onboard serial ports may be restricted in terms of serial input stream. Since they're only emulating a 16450 device (w/o FIFO) an input stream generated by a program may lose characters. Inputs from a keyboard via terminal program will be safe.

4.7 Fast I2C

The COMe-bHL6 supports a CPLD implemented LPC to I2C bridge using the WISHBONE I2C Master Core provided from opencores.org. The I2C Interface supports transfer rates up to 40kB/s and can be configured in Setup

Specification for external I2C:

» Speed up to 400kHz

» Compatible to Philips I2C bus standard

» Multi-Master capable

» Clock stretching support and wait state generation

» Interrupt or bit-polling driven byte-by-byte data-transfers

» Arbitration lost interrupt with automatic transfer cancellation

» Start/Stop signal generation/detection

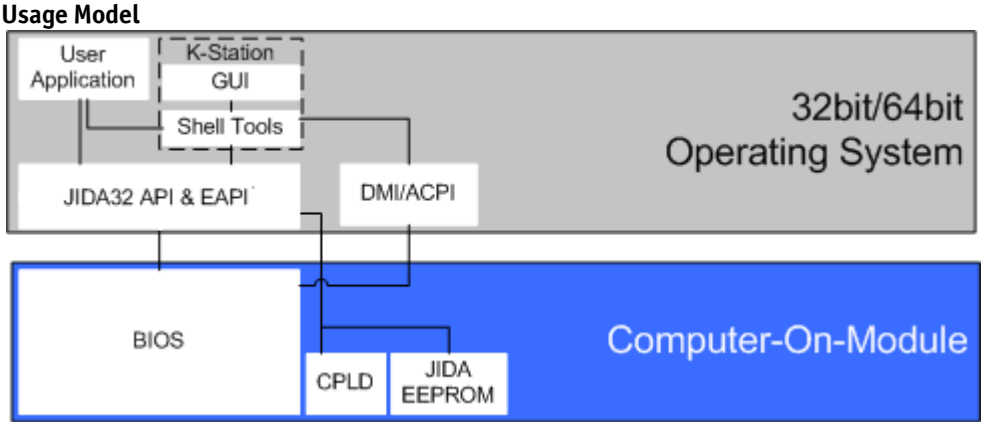
» Bus busy detection

» 7bit and 10bit addressing

4.8 EAPI, JIDA & PLD Driver

K-Station 2 including the Kontron PLD / Board Driver for new generation modules with UEFI is a replacement for former JIDA16/JIDA32 BIOS implementations. It consists of hardware drivers providing access to features like Watchdog, I2C Bus or GPIO implemented in the onboard Programmable Logic Device (CPLD). The Board Driver supports the official PICMG embedded API (EAPI) and for backwards compatibility the former used Kontron JIDA32 API. The driver (Cpld.sys) and API (Eapi.dll/Jida.dll) is available for Windows and for Linux.

Usage Model



4.9 K-Tools

For easy access to the API Kontron provides Windows Shell Utilities, the so called K-Tools, for direct access to the JIDA32 interface via the Windows command line.

Available K-Station 2 Shell Tools:

» KEthernet.exe (LAN Information)

» KGenInfo.exe (Module Information)

» KHWMon.exe (Hardware Monitoring)

» KI2CBus.exe (I2C and SMBus access)

» KIOPort.exe (GPIO control)

» KStorage.exe (JIDA EEPROM access to user bytes)

» KSystemSummary.exe (System Information)

» KVGATool.exe (LVDS Backlight control)

» KWDog.exe (Watchdog control)

K-Station 2 is available on EMD Customer Section. The Installer allows following installation methods:

» Light Target Installation for JIDA32 and EAPI driver only

» Medium Target Installation for JIDA32 and EAPI with K-Tools

» Host Installation with Sources and Documentation

For silent installation use command

» msiexec /quiet /i K-Station_2xxx_xxx.msi

4.10 K-Station 2 GUI

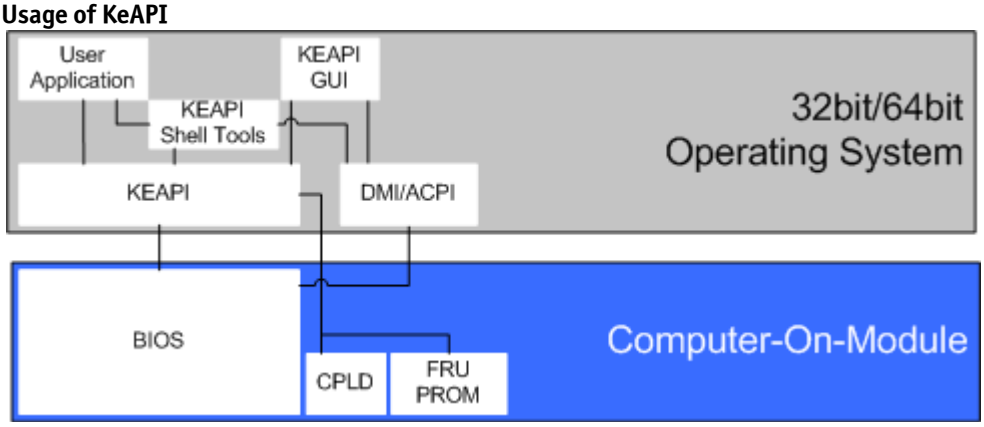
As an example utility Kontron provides the K-Station 2 GUI for 32 and 64bit Windows. K-Station 2 GUI is a JAVA based example Graphical User Interface using the K-Tools in Remote Mode. It allows easy and fast evaluation of board specific features supported by the API and PLD Driver.

4.11 KeAPI

The Kontron embedded API (KeAPI) is an extension of the PICMG EAPI mainly with additional remote functionality. It consists of hardware drivers providing access to features like Watchdog, I2C Bus or GPIO and a QT based user interface KEAPI GUI. KeAPI is part of standard BSPs for modules based on AMI APTIO (UEFI).

Please refer to EMD Customer Section for detailed documentation and downloads.

Usage of KeAPI



4.12 GPIO - General Purpose Input and Output

The COMe-bHL6 offers 4 General Purpose Input (GPI) pins and 4 General Purpose Output (GPO) pins. On a 3.3V level digital in- and outputs are available.

Signal	Pin	Description
GPI0	A54	General Purpose Input 0
GPI1	A63	General Purpose Input 1
GPI2	A67	General Purpose Input 2
GPI3	A85	General Purpose Input 3
GPO0	A93	General Purpose Output 0
GPO1	B54	General Purpose Output 1
GPO2	B57	General Purpose Output 2
GPO3	B63	General Purpose Output 3

Configuration

The GPI and GPO pins can be configured via JIDA32/K-Station. Please refer to the JIDA32/K-Station manual in the driver download packet on our customer section.

4.13 Dual Staged Watchdog Timer

Basics

A watchdog timer (or computer operating properly (COP) timer) is a computer hardware or software timer that triggers a system reset or other corrective action if the main program, due to some fault condition, such as a hang, neglects to regularly service the watchdog (writing a “service pulse” to it, also referred to as “kicking the dog”, “petting the dog”, “feeding the watchdog” or “triggering the watchdog”). The intention is to bring the system back from the nonresponsive state into normal operation.

The COMe-bHL6 offers a watchdog which works with two stages that can be programmed independently and used one by one.

Time-out events

Reset	A reset will restart the module and starts POST and operating system new.
NMI	A non-maskable interrupt (NMI) is a computer processor interrupt that cannot be ignored by standard interrupt masking techniques in the system. It is typically used to signal attention for non-recoverable hardware errors.
SCI	A system control interrupt (SCI) is a OS-visible interrupt to be handled by the OS using AML code
Delay	Might be necessary when an operating system must be started and the time for the first trigger pulse must extended. (Only available in the first stage)
WDT Signal only	This setting triggers the WDT Pin on baseboard connector (COM Express® Pin B27) only
Cascade:	Does nothing, but enables the 2nd stage after the entered time-out.

WDT Signal

B27 on COM Express® Connector offers a signal that can be asserted when a watchdog timer has not been triggered within time. It can be configured to any of the 2 stages. Deassertion of the signal is automatically done after reset. If deassertion during runtime is necessary please ask your Kontron technical support for further help.

4.14 Speedstep Technology

The Intel® processors offer the Intel® Enhanced SpeedStep™ technology that automatically switches between maximum performance mode and battery-optimized mode, depending on the needs of the application being run. It enables you to adapt high performance computing on your applications. When powered by a battery or running in idle mode, the processor drops to lower frequencies (by changing the CPU ratios) and voltage, conserving battery life while maintaining a high level of performance. The frequency is set back automatically to the high frequency, allowing you to customize performance.

In order to use the Intel® Enhanced SpeedStep™ technology the operating system must support SpeedStep™ technology.

By deactivating the SpeedStep feature in the BIOS, manual control/modification of CPU performance is possible. Setup the CPU Performance State in the BIOS Setup or use 3rd party software to control CPU Performance States.

4.15 C-States

New generation platforms include power saving features like SuperLFM, EIST (P-States) or C-States in O/S idle mode.

Activated C-States are able to dramatically decrease power consumption in idle mode by reducing the Core Voltage or switching of parts of the CPU Core, the Core Clocks or the CPU Cache.

Following C-States are defined:

C-State	Description	Function
C0	Operating	CPU fully turned on
C1	Halt State	Stops CPU main internal clocks via software
C1E	Enhanced Halt	Similar to C1, additionally reduces CPU voltage
C2	Stop Grant	Stops CPU internal and external clocks via hardware
C2E	Extended Stop Grant	Similar to C2, additionally reduces CPU voltage
C3	Deep Sleep	Stops all CPU internal and external clocks
C3E	Extended Stop Grant	Similar to C3, additionally reduces CPU voltage
C4	Deeper Sleep	Reduces CPU voltage
C4E	Enhanced Deeper Sleep	Reduces CPU voltage even more and turns off the memory cache
C6	Deep Power Down	Reduces the CPU internal voltage to any value, including 0V
C7	Deep Power Down	Similar to C6, additionally LLC (LastLevelCache) is switched off

C-States are usually enabled by default for low power consumption, but active C-States my influence performance sensitive applications or real-time systems.

» Active C6-State may influence data transfer on external Serial Ports

» Active C7-State may cause lower CPU and Graphics performance

It's recommended to disable C-States / Enhanced C-States in BIOS Setup if any problems occur.

4.16 Hyper Threading

Hyper Threading (officially termed Hyper Threading Technology or HTT) is an Intel®-proprietary technology used to improve parallelization of computations performed on PC´s. Hyper-Threading works by duplicating certain sections of the processor—those that store the architectural state but not duplicating the main execution resources. This allows a Hyper-Threading equipped processor to pretend to be two “logical” processors to the host operating system, allowing the operating system to schedule two threads or processes simultaneously. Hyper Threading Technology support always relies on the Operating System.

4.17 Dynamic FSB Frequency Switching

Dynamic FSB frequency switching effectively reduces the internal bus clock frequency by half to further decrease the minimum processor operating frequency from the Enhanced Intel SpeedStep Technology performance states and achieve the Super Low Frequency Mode (Super LFM). This feature is supported at FSB frequencies of 1066 MHz, 800 MHz and 667 MHz and does not entail a change in the external bus signal (BCLK) frequency. Instead, both the processor and GMCH internally lower their BCLK reference frequency to 50% of the externally visible frequency. Both the processor and GMCH maintain a virtual BCLK signal (VBCLK) that is aligned to the external BCLK but at half the frequency.

After a downward shift, it would appear externally as if the bus is running with a 133-MHz base clock in all aspects, except that the actual external BCLK remains at 266 MHz. See Figure 3 for details. The transition into Super LFM, a “down-shift,” is done following a handshake between the processor and GMCH. A similar handshake is used to indicate an “up-shift,” a change back to normal operating mode. Please ensure this feature is enabled and supported in the BIOS.

4.18 VID-x

The processor implements the VID-x feature for improved control of core voltage levels when the processor enters a reduced power consumption state. VID-x applies only when the processor is in the Intel Dynamic Acceleration Technology performance state and one or more cores are in low-power state (i.e., CC3/CC4/CC6). VID-x provides the ability for the processor to request core voltage level reductions greater than one VID tick. The amount of VID tick reduction is fixed and only occurs while the processor is in Intel Dynamic Acceleration Technology mode. This improved voltage regulator efficiency during periods of reduced power consumption allows for leakage current reduction which results in platform power savings and extended battery life.

When in Intel Dynamic Acceleration Technology mode, it is possible for both cores to be active under certain internal conditions. In such a scenario the processor may draw a Instantaneous current (ICC_CORE_INST) for a short duration of tINST; however, the average ICC current will be lesser than or equal to ICCDES current specification.

4.19 Intel® Turbo Boost Technology and AVX

For applications that are particularly power-hungry, the new processors provide enhanced Intel® Turbo Boost technology. This automatically shifts processor cores and processor graphics resources to accelerate performance, tailoring a workload to give users an immediate performance boost for their applications whenever needed. Another innovation is the enhancement to the 256-bit instruction set, known as Intel® Advanced Vector Extensions (AVX). AVX delivers improved performance, rich functionality and the ability to manage, rearrange and sort data in a better way. The new instruction set accelerates floating-point intensive applications such as “number crunchers” or digital processing of images, videos and audio data.

Intel® Turbo Boost Technology 2.0

Intel has optimized Intel® Turbo Boost Technology to provide even more performance when needed on the latest-generation Intel® microarchitecture. Intel® Turbo Boost Technology 2.0 automatically 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 2.0 is activated when the Operating System (OS) requests the highest processor performance state (P0).

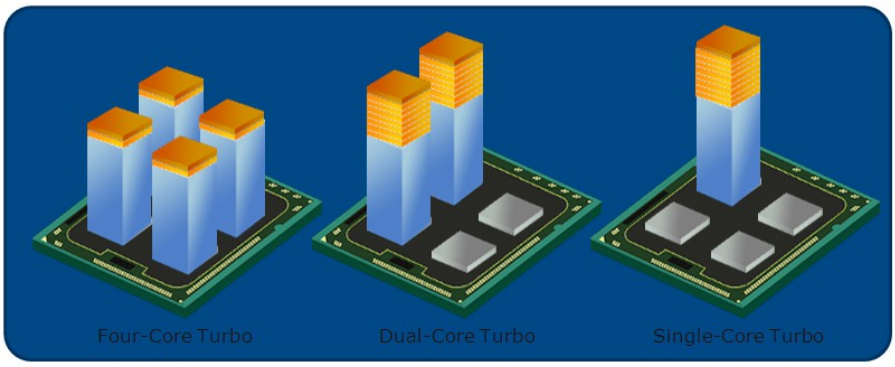
The maximum frequency of Intel Turbo Boost Technology 2.0 is dependent on the number of active cores. The amount of time the processor spends in the Intel Turbo Boost Technology 2.0 state depends on the workload and operating environment. Any of the following can set the upper limit of Intel Turbo Boost Technology 2.0 on a given workload:

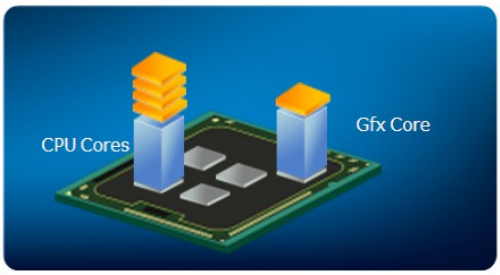
» Number of active cores

» 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 until the upper limit of frequency is reached. Intel Turbo Boost Technology 2.0 has multiple algorithms operating in parallel to manage current, power, and temperature to maximize performance and energy efficiency. Note: Intel Turbo Boost Technology 2.0 allows the processor to operate at a power level that is higher than its rated upper power limit (TDP) for short durations to maximize performance.

4.20 Display Configuration

DDI supported resolutions

Display1	Display2	Display3	Max.Res Display 1	Max.Res Display 2	Max.Res Display 3
HDMI	HDMI	DP	4096×2304@24Hz 2560×1600@60Hz	4096×2304@24Hz 2560×1600@60Hz	3840×2160@60Hz
DVI	DVI	DP	1920×1200@24Hz	1920×1200@24Hz	3840×2160@60Hz
DP	DP	DP	3840×2160@60Hz	3840×2160@60Hz	3840×2160@60Hz
VGA	DP	HDMI	1920×1200@60Hz	3840×2160@60Hz	4096×2304@24Hz 2560×1600@60Hz
LVDS	DP	DP	1920×1200@60Hz	3840×2160@60Hz	3840×2160@60Hz
LVDS	HDMI	HDMI	1920×1200@60Hz	4096×2304@24Hz 2560×1600@60Hz	4096×2304@24Hz 2560×1600@60Hz

Link Data Rate

The maximum supported Display Ports resolutions are dependent on the Link Data Rate and the used Lane Count:

Link Data Rate	1 Lane	2 Lanes	4 Lanes
RBR	1024×600	1400×1050	2240×1400
HBR	1280×960	1920×1200	2880×1800
HBR2	1920×1200	2880×1800	3840×2160

3 independent Display Support

The COMe-bHL6 supports up to 3 independent displays in Windows 7/8 and Linux by using the following rules:

» Max of 2 HDMIs

» Max of 2 DVIs

» Max of 1 HDMI and 1DVI

» Any 3 DisplayPort

» One VGA

Digital Display Interface Features

The integrated Intel® GMA HD (Gen7.5) graphics supports:

» High-bandwidth Digital Content Protection (HDCP) on HDMI and DisplayPort with up to 2 HDCP streams simultaneously

» One active Protected Audio and Video Path (PAVP) session on HDMI or DisplayPort

» Dual Stream DP/HDMI Audio

» DP/HDMI/DVI Hot-plug (low-active)

Supported Audio Formats on HDMI and DisplayPort

Audio Formats	HDMI	DisplayPort
AC-3 Dolby Digital	YES	YES
Dolby Digital Plus	YES	YES
DTS-HD	YES	YES
LPCM, 192kHz/24bit, 8 channel	YES	YES
Dolby True HD, DTS HD Master Audio	YES	YES

DDI Design Consideration

» For sufficient signal quality baseboard designs with long signal lanes or impedance leaps may require an Equalicer or Redriver for the digital display interfaces

» DDI hot-plug detection is high active

» SDVO can be used for external conversion to VGA, LVDS, TV-out and requires additional hardware on your baseboard

» DisplayPort can be used directly or with external adapters for HDMI, DVI or VGA

» HDMI or DVI usage on a baseboard requires a level shifter

Find more details for DDI usage as DisplayPort, HDMI or DVI with schematic examples available on http://emdcustomersection.kontron.com

DVI-I Design Topology

DVI-I is supported on PCH Digital Display Port B (COM DDI1) only. The implementation involves routing VGA and DVI-D signals to DVI-I connector:

» VGA port RGB signals should be routed to Analog RGB pins on the DVI-I connector

» DVI Data and Clock signals on PCH Digital Display Port B should be routed to TMDS Data 0, 1 and 2 pins and TMDS Clock pin of DVI-I connector respectively

» DVI HPD signals should be routed to the HPD pin of the DVI-I connector

» DVI DDC Clock and Data signals on PCH Digital Display Port B should be routed to the DDC Clock and Data pins of the DVI-I connector.

4.21 Hybrid Graphics / Multi-monitor

The COMe-bHL6 supports Hybrid Multi-monitor function which is one form of Intel's Hybrid Graphics where integrated graphics (in Chipset or CPU) is available to operate simultaneously with external PEG; PCIe or PCI graphics. This feature enables concurrent function of Intel's integrated Graphics Processing Unit (GPU/iGFX) along with a discrete GPU solution, allowing for operability of greater than two independently-driven displays. The O/S will handle control of the multiple GPU display adapters appropriately. For example, WindowsXP supports The Microsoft Windows XP Display Driver Model (XPDM) which allows loading and support of multiple graphics drivers. Windows 7 continues that legacy XPDM support but also adds WDDM v1.1 which, like XPDM, allows for simultaneous multiple graphics drivers (Windows Vista WDDM v1.0 did not allow this capability). Operating system applications will be adapter-unaware through use of the O/S GUI APIs and will utilize the adapter associated with the primary display, regardless of which display the image is located on.

Some applications may be adapter-aware, e.g., full-screen applications and system applications like the compositor. A number of software tools designed to assist multi-monitor use are available from third parties. One example is the UltraMon* utility for multi-monitor systems, which helps with the position of applications, assists desktop wallpapers and screen savers in multi-monitor configurations.

Hybrid Multi-monitor mode is recommended to be accomplished using a discrete third-party PCI Express graphics card either into the PEG slot of the platform or into an available PCI Express slot routed off of the I/O subsection of the chipset.

Requirements

» Baseboard supporting PEG (alternatively PCIe or PCI)

» Module BIOS which allows switching between iGFX and discrete GPU (iGFX must be set to primary boot display)

» O/S supporting heterogeneous display adapters (Linux / WindowsXP / Windows 7)

Setup a Multi-monitor system

» Start without the discrete GPU seated in the system

» Select IGD as Primary Boot Display in BIOS Setup

» Boot into O/S and install drivers requested for the integrated GPU

» Shut down the system and insert the discrete GPU

» Boot into O/S and install drivers requested for the discrete GPU (if necessary in Safe mode)

» Set the Windows Display properties as referenced below (example: WindowsXP)

In most cases the graphical user interfaces (e.g. ATI Catalyst Control Center) for both GPUs may not run properly. It's recommended to use O/S implemented Display Properties like in screenshot above

Detailed documentation is available in Intel Paper 323214

4.22 Intel® Wireless Display

Intel® Wireless Display, most commonly known as WiDi, is a wireless display standard developed by Intel, based on the existing Wi-Fi standard. It allows a portable device or computer to send up to 1080p HD video and 5.1 surround sound to a compatible display wirelessly.

The COMe-bHL6 supports WiDi in combination with following requirements:

CPU:

» Core(TM) i7

» Core(TM) i5

» Core(TM) i3

One of the following Wireless Devices:

» Intel® Centrino® Wireless-N 1000, 1030, 2200, or 2230

» Intel® Centrino® Wireless-N 2200 for Desktop

» Intel® Centrino® Advanced-N 6200, 6205, 6230, or 6235

» Intel® Centrino® Advanced-N 6205 for Desktop

» Intel® Centrino® Wireless-N + WiMAX 6150

» Intel® Centrino® Advanced-N + WiMAX 6250

» Intel® Centrino® Ultimate-N 6300

Operating System:

» Windows 7 64-bit, Home Premium, Ultimate or Professional

» Windows 7 32-bit, Home Premium, Ultimate, Professional or Basic

» Windows 8 32-bit and 64-bit editions

Software:

» Intel® My WiFi Technology (Intel® MWT)

» Intel® Wireless Display pre-installed and enabled

A Intel® WiDi compatible streaming target such as:

» WiDi Adapter (e.g. Belkin ScreenCast, D-Link DHD-131, NETGEAR Push2TV ...)

» HDTV's with built in WiDi Support (e.g. LG Smart TV ...)

» Any other WiDi compatible CE Devices (e.g. Netgear Media Player NTV200S ...)

4.23 Intel® vPro™ technology

Kontron and Intel® are addressing the security and manageability challenges facing embedded systems today with the implementation of Intel® vPro™ technology to enable: » System integrity » Secure isolation » Remote systems management

First, system integrity is the ability to identify whether the system hardware or system software has been modified without authorization. When a system's integrity is known, the system can be thought of as a trusted system. Second, secure isolation is the ability to use platform hardware to separate processes, resources, and data on the system such that they cannot interact with each other in unintended ways. By providing hardware-assisted isolation, there is limitless security, privacy, and cost savings that can be realized through consolidation and workload isolation. Finally, remote systems management is the ability to troubleshoot, perform power management or system verification through secure channels. Significant cost savings and efficiencies can be realized through remote management allowing for increased system up time and the ability to manage or diagnose a system, even when powered down.

Intel® vPro™ technology itself is special functionality designed into both, the processor and the chipset. The three technologies that comprise Intel® vPro™ technology are: Intel Virtualization Technology (Intel® VT), Intel Trusted Execution Technology (Intel® TXT) and Intel Active Management Technology (Intel® AMT).

Intel® VT provides hardware-based assists making secure isolation more efficient and decreases the virtualization footprint, lowering the effective attack surface of a solution. This hardware-based technology can help to protect applications and information by running multiple operating systems (OSs) in isolation on the same physical system. A virtual guest OS can be created in an entirely separate space on the physical system to run specialized or critical applications. Virtual environments leverage Intel® VT for memory, CPU, and Directed I/O virtualization. Intel® TXT provides the ability to use hardware-based mechanisms to verify system integrity during the boot process. It also provides system memory scrubbing that protects against soft reset attacks. Virtualized environments take advantage of Intel® TXT launch environment verification to establish a dynamic root of trust providing added security to hypervisor or virtual machine monitor (VMM).

Mechanisms employed by Intel® AMT include domain authentication, session keys, persistent data storage in the Intel® AMT hardware, and access control lists. Only firmware images that are digitally signed by Intel are permitted to load and execute. This set of hardware-based features is targeted for businesses and allows remote access to the system, whether wired or wireless, for management and security tasks. Because of the special hardware capabilities provided by Intel® AMT, out of band access is available even when the OS is not functional or system power is off.

Intel® TXT and Intel® AMT are disabled by default. Please contact your local sales or support for BIOS versions with full vPro™ support

4.24 ACPI Suspend Modes and Resume Events

The COMe-bHL6 supports the S3 state (=Save to Ram). S4 (=Save to Disk) is not supported by the BIOS (S4_BIOS) but S4_OS is supported by the following operating systems:

» Windows XP

» Windows Vista

» Windows 7

The following events resume the system from S3:

» USB Keyboard (1)

» USB Mouse (1)

» Power Button

» WakeOnLan (2)

The following events resume the system from S4:

» Power Button

» WakeOnLan (2)

The following events resume the system from S5:

» Power Button

» WakeOnLan (2)

(1) OS must support wake up via USB devices and baseboard must power the USB Port with StBy-Voltage

(2) WakeOnLan must be enabled in BIOS setup and driver options

5 System Resources

5.1 Interrupt Request (IRQ) Lines

IRQ #	Used For	Available	Comment
0	Timer0	No	-
1	Keyboard	No	-
2	Cascade	No	-
3	COM2	No	onboard UART2
4	COM1	No	onboard UART1
5	SIO LPT	Note(4)	external SIO LPT
6	COM3	Note(4)	external SIO COM1
7	COM4	Note(4)	external SIO COM1
8	RTC	No	-
9	ACPI	No	-
10	-	Yes	-
11	-	Yes	-
12	PS/2 Mouse	Note(4)	external SIO
13	FPU	No	-
14	-	Yes	-
15	-	Yes	-
16	LNK A	No	P.E.G + I.G.D + SA Audio + XHCI + Intel ME + USB EHCI2 + PCIe RP 0 + PCIe RP 4; Note(3)
17	LNK B	No	PCIe RP 1 + PCIe RP 5; Note(3)
18	LNK C	No	PCIe RP 2 + PCIe RP 6 + SMBus; Note(3)
19	LNK D	No	PCIe RP 3 + SATA; Note(3)
20	LNK E	No	Onboard LAN;Note(3)
21	LNK F	No	Note(3)
22	LNK G	No	PCH HDA;Note(3)
23	LNK H	No	USB EHCI#1

(1) If the “Used For” device is disabled in setup, the corresponding interrupt is available for other device.
(2) Not available if ACPI is used
(3) ACPI OS decides on particular IRQ usage
(4) Depends on system configuration (onboard COM Port support and external SIO presence)

5.2 Memory Area

The first 640 kB of DRAM are used as main memory. Using DOS, you can address 1 MB of memory directly. Memory area above 1 MB (high memory, extended memory) is accessed under DOS via special drivers such as HIMEM.SYS and EMM386.EXE, which are part of the operating system. Please refer to the operating system documentation or special textbooks for infor- mation about HIMEM.SYS and EMM386.EXE. Other operating systems (Linux or Windows versions) allow you to address the full memory area directly.

Upper Memory	Used for	Available	Comment
A0000h – BFFFFh	VGA Memory	No	Mainly used by graphic controller
C0000h – CFFFFh	VGA BIOS	No	Used by onboard VGA ROM
D0000h – DFFFFh	-	Yes	Free for shadow RAM in standard configurations.
E0000h – FFFFFh	System BIOS	No	Fixed
20000000h-201FFFFFh	IGFX	No	Fixed
40000000h-401FFFFFh	IGFX	No	Fixed
E0000000h–FEAFFFFFh	PCIe Config Space	No	Fixed
FEC00000 - FECFFFFF	Local APIC/IOAPIC(s)	No	Fixed
FED00000h-FED003FFh	HPET	No	Fixed
FED10000h-FED17FFFh	MCH	No	Fixed
FED18000h-FED18FFFh	DMI	No	Fixed
FED19000h-FED19FFFh	EPBA	No	Fixed
FED1C000h-FED1FFFFh	RCBA	No	Fixed
FED20000h FED3FFFFh	TXT	No	Fixed
FED40000h FED44FFFh	TPM	No	Fixed
FED45000h FED8FFFFh	TPM	No	Fixed
FED90000h-FED93FFFh	VT-d	No	Fixed
FEE00000h-FEEFFFFFh	MSI area	No	Fixed
FF000000h-FFFFFFFFh	BIOS Flash	No	Fixed

5.3 I/O Address Map

The I/O-port addresses of the are functionally identical to a standard PC/AT. All addresses not mentioned in this table should be available. We recommend that you do not use I/O addresses below 0100h with additional hardware for compatibility reasons, even if available.

I/O Address	Used for	Available	Comment
0000 - 001F	System Ressources	No	Fixed
0020 - 003F	Interrupt Controller 1	No	Fixed
002E - 002F	Ext. SIO	No	Fixed
0040 - 005F	Timer, Counter	No	Fixed
004E - 004F	TPM	No	Fixed
0060 - 006F	Keyboard controller	No	Fixed
0070 - 007F	RTC and CMOS Registers	No	Fixed
0080	BIOS Postcode	No	Fixed
0081 - 009F	DMA Controller	No	Fixed
00A0 - 00BF	Interrupt Controller	No	Fixed
00C0 - 00DF	DMA Controller	No	Fixed
00F0 - 00FF	Math Coprocessor	No	Fixed
03B0 - 03DF	VGA	No	Fixed
0400 - 047F	Chipset	No	Fixed
04D0 - 04D1	Chipset	No	Fixed
0800 - 087F	Chipset	No	Fixed
0A00 - 0A0F	LPC	Yes	Routed to LPC
0A80 - 0A8F	CPLD	No	Fixed
0A90 - 0AFF	LPC	Yes	Routed to LPC
0CF8 - 0CFF	Chipset	No	Fixed

5.4 Peripheral Component Interconnect (PCI) Devices

All devices follow the Peripheral Component Interconnect 2.3 (PCI 2.3) respectivily the PCI Express Base 1.0a specification. The BIOS and OS control memory and I/O resources. Please see the PCI 2.3 specification for details.

PCI Device	B:D:F	PCI IRQ	Interface	Comment
Host Bridge	0:0:0	None	internal	Chipset
P.E.G. Root Port	0:1:0	LNK A	internal	Chipset
Video Controller	0:2:0	LNK A	internal	Chipset
SA Audio	0:3:0	LNK A	internal	Chipset
XHCI	0:20:0	LNK A	internal	Chipset
ME	0:22:0	LNK A	internal	Chipset
GbE	0:25:0	LNK E	internal	Chipset
EHCI2	0:26:0	LNK A	internal	Chipset
PCH HDA	0:27:0	LNK G	PCIe	Chipset
PCIe Port 0	0:28:0	LNK A	internal	Chipset
PCIe Port 0 Slot	-	A/B/C/D	PCIe	Port 0
PCIe Port 1	0:28:1	LNK A	internal	Chipset
PCIe Port 1 Slot	-	B/C/D/A	PCIe	Port 1
PCIe Port 2	0:28:2	LNK A	internal	Chipset
PCIe Port 2 Slot	-	C/D/A/B	PCIe	Port 2
PCIe Port 3	0:28:3	LNK A	internal	Chipset
PCIe Port 3 Slot	-	D/A/B/A	PCIe	Port 3
PCIe Port 4	0:28:4	LNK A	internal	Chipset
PCIe Port 4 Slot	-	A/B/C/D	PCIe	Port 4
PCIe Port 5	0:28:5	LNK A	internal	Chipset
PCIe Port 5 Slot	-	B/C/D/A	PCIe	Port 5
PCIe Port 6	0:28:6	LNK A	internal	Chipset
PCIe Port 6 Slot	-	C/D/A/B	PCIe	Port 6
EHCI1	0:29:0	LNK H	internal	Chipset
LPC Bridge	0:31:0	-	internal	Chipset
SATA	0:31:2	LNK D	internal	Chipset
SMBus	0:31:3	LNK C	internal	Chipset

5.5 Internal I2C Bus

I2C Address	Used For	Available	Comment
58h	S5 Eco	No	S5 Eco Resistor
A0h	JILI-EEPROM	No	external LVDS EEPROM for JILI Data
C0h	LVDS bridge	No	DP to LVDS Bridge

5.6 External I2C Bus

I2C Address	Used For	Available	Comment
A0h	JIDA-EEPROM	No	Module EEPROM
AEh	FRU-EEPROM	No	Recommended for Baseboard EEPROM

5.7 System Management (SM) Bus

The 8-bit SMBus addresses uses the LSB (Bit 0) for the direction. Bit0 = 0 defines the write address, Bit0 = 1 defines the read address for the device. The 8-bit addresses listed below shows the write adress for all devices. 7-bit SMBus adresses shows the device address without Bit0.

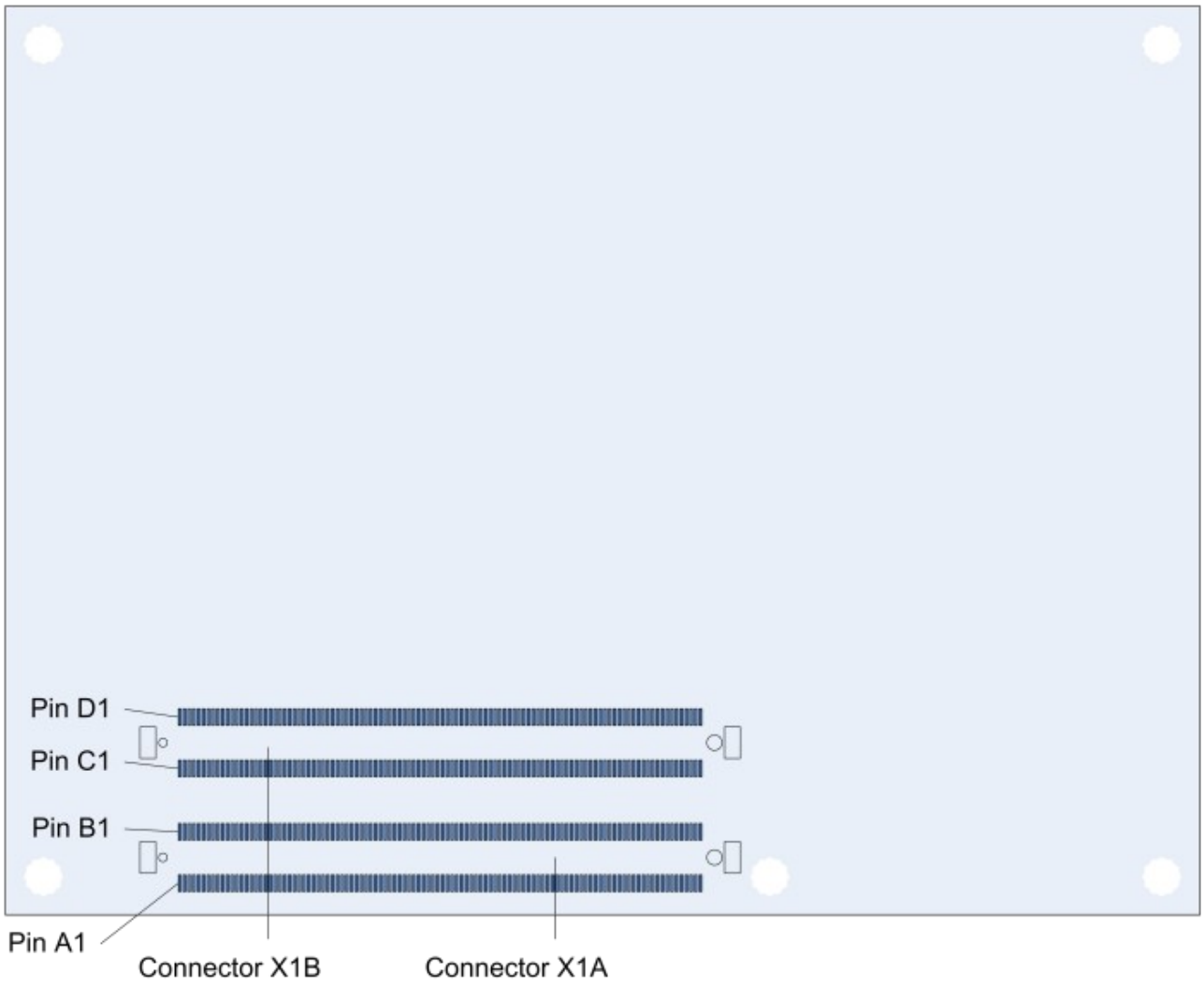
8-bit Address	7-bit Address	Device	Comment	SMBus
12h	0x09	SMART_CHARGER	Not to be used with any SM bus device except a charger	SMB
14h	0x0A	SMART_SELECTOR	Not to be used with any SM bus device except a selector or manager	SMB
16h	0x0B	SMART_BATTERY	Not to be used with any SM bus device except a battery	SMB
30h	0x18	DDR3 Thermal Sensor Chan. A	Do not use under any circumstances	SMB
34h	0x1A	DDR3 Thermal Sensor Chan. B	Do not use under any circumstances	SMB
5Ch	0x2C	Hardware Monitor	Do not use under any circumstances	SMB
A0h	0x50	DDR3 channel A SPD	Do not use under any circumstances	SMB
A4h	0x52	DDR3 channel B SPD	Do not use under any circumstances	SMB
C8h	0x64	Ethernet I218-LM	Do not use under any circumstances	SML0

A JIDA Bus No. like in former Modules cannot be provided because the EAPI driver implementation enumerates the I2C busses dynamically. Please follow the initialisation process like it is provided in the EAPI specification.

6 Connectors

The pinouts for Interface Connectors X1A and X1B are documented for convenient reference. Please see the COM Express® Specification and COM Express® Design Guide for detailed, design-level information.

6.1 Connector Location



7 Pinout List

7.1 General Signal Description

Type	Description
I/O-3,3	Bi-directional 3,3 V IO-Signal
I/O-5T	Bi-dir. 3,3V I/O (5V Tolerance)
I/O-5	Bi-directional 5V I/O-Signal
I-3,3	3,3V Input
I/OD	Bi-directional Input/Output Open Drain
I-5T	3,3V Input (5V Tolerance)
OA	Output Analog
OD	Output Open Drain
O-1,8	1,8V Output
O-3,3	3,3V Output
O-5	5V Output
DP-I/O	Differential Pair Input/Output
DP-I	Differential Pair Input
DP-O	Differential Pair Output
PU	Pull-Up Resistor
PD	Pull-Down Resistor
PWR	Power Connection

To protect external power lines of peripheral devices, make sure that: the wires have the right diameter to withstand the maximum available current the enclosure of the peripheral device fulfills the fire-protection requirements of IEC/EN60950

8 BIOS Operation

The module is equipped with Phoenix SecureCore, which is located in an onboard SPI serial flash memory.

8.1 Determining the BIOS Version

8.2 BIOS Update

Kontron provides continous BIOS updates for Computer-on-Modules. The updates are provided for download on http://emdcustomersection.kontron.com with a detailed change description within the according Product Change Notification (PCN). Please register for EMD Customer Section to get access to BIOS downloads and PCN service.

Modules with BIOS Region/Setup only inside the flash can be updated with AFU utilities (usually 1-3MB BIOS binary file size) directly. Modules with Intel® Management Engine, Ethernet, Flash Descriptor and other options additionally to the BIOS Region (usually 4-8MB BIOS binary file size) requires a different update process with Intel Flash Utility FPT and a wrapper to backup and restore configurations and the MAC address. Therefore it is strongly recommended to use the batch file inside the BIOS download package available on EMD Customer Section.

» Boot the module to DOS/EFI Shell with access to the BIOS image and Firmware Update Utility provided on EMD Customer Section

» Execute Flash.bat in DOS or Flash.nsh in EFI Shell

Any modification of the update process may damage your module!

Backup the BIOS / Create a BIOS with custom defaults:

8.3 POST Codes

Important POST codes during boot-up

8B	DOS
68	Setup / EFI Shell
00	Windows

8.4 Setup Guide

Menu Bar

The menu bar at the top of the window lists different menus. Use the left/right arrow keys to make a selection.

Legend Bar

Use the keys listed in the legend bar on the bottom to make your selections or exit the current menu. The table below describes the legend keys and their alternates.

Key	Function
← or → Arrow key	Select a menu.
↑ or ↓ Arrow key	Select fields in current menu.
<Home> or <End>	Move cursor to top or bottom of current window.
<PgUp> or <PgDn>	Move cursor to next or previous page.
+/-	Change Option
<Enter>	Execute command or select submenu.

Selecting an Item

Use the ↑ or ↓ key to move the cursor to the field you want. Then use the + and – keys to select a value for that field. The Save Value commands in the Exit menu save the values displayed in all the menus.

Displaying Submenus

Use the ← or → key to move the cursor to the submenu you want. Then press <Enter>. A pointer (►) marks all submenus.

Item Specific Help Window

The Help window on the right side of each menu displays the Help text for the selected item. It updates as you move the cursor to each field.

General Help Window

Pressing <F1> on a menu brings up the General Help window that describes the legend keys and their alternates. Press <Esc> to exit the General Help window.

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