PICMG® COM.0 Revision 2.0

COM Express® Module Base Specification
Short Form Specification

Revision 2.0, Ratified August 8, 2010

FOR INFORMATION ONLY: DO NOT ATTEMPT TO DESIGN FROM THIS DOCUMENT
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1 Introduction

NOTE: Section, Table and Figure numbers in this Short Form Specification are likely to be different from those in the full specification.

A Computer-On-Module, or COM, is a Module with all components necessary for a bootable host computer, packaged as a super component. A COM requires a Carrier Board to bring out I/O and to power up. COMs are used to build single board computer solutions and offer OEMs fast time-to-market with reduced development cost. Like integrated circuits, they provide OEMs with significant freedom in meeting form-fit-function requirements. For all these reasons the COM methodology has gained much popularity with OEMs in the embedded industry.

COM Express® is an open industry standard for Computer-On-Modules. It is designed to be future proof and to provide a smooth transition path from legacy parallel interfaces to LVDS (Low Voltage Differential Signaling) interfaces. These include the PCI bus and parallel ATA on the one hand and PCI Express and Serial ATA on the other hand.

Key features include:

- Rich complement of contemporary high bandwidth serial interfaces, including PCI Express, Serial ATA, USB, and Gigabit Ethernet
- 32-bit PCI, LPC and Parallel ATA options preserved for easy interface to a range of peripherals
- Extended power-management capabilities
- Robust thermal and mechanical concept
- Cost-effective design
- Legacy-free design (no Super I/O, PS2 keyboard or mouse)
- Small Module size with multiple footprint options to satisfy a range of performance requirements
- High-performance mezzanine connector with several pin-out types to satisfy a range of applications
- Extensive video port support, including VGA, LVDS, SDVO, DP, DVI and HDMI terminal drivers plus x16 PEG port to Carrier Board graphics controller

The COM Express® specification has been created to appeal to a range of vertical embedded markets. It has also been formulated to be applicable to a broad range of form factors, from floor-installed to bench-top to handheld.

Markets and applications include but are not limited to:

- Healthcare - clinical diagnostic imaging systems, patient bedside monitors, etc.
- Retail & advertising - electronic shopping carts, billboards, kiosks, POS systems, etc.
- Test & measurement - scientific and industrial test and measurement instruments
- Gaming & entertainment - simulators, slot machines, etc.
- Industrial automation - industrial robots, vision systems, etc.
- Security - digital CCTV, luggage scanners, intrusion detectors, etc.
- Defense & government - unmanned vehicles, rugged laptops, wearable computers, etc.
Systems based on the COM Express® Specification require the implementation of an application-specific Carrier Board that accepts the Module. User-specific features such as external connector choices and locations and peripheral circuits can be tailored to suit the application. The OEM can focus on application-specific features rather than CPU board design. The OEM also benefits from a wide choice of Modules providing a scalable range of price and performance upgrade options.

1.1 COM.0 R2.0 Changes from R1.0

Added definition of a Type 6 pin-out.

Added definition of a Type 10 pin-out.

(Some) Additional changes to all Module Types

- Added SPI using previously reserved pins on the A-B connector. SPI is the primary interface for Carrier mounted BIOS flash. External BIOS support over SPI is mandatory in R2.0 for all Module Types. In R1.0 the LPC interface was used for external BIOS support. R2.0 Modules must support SPI and might also support LPC external BIOS.
- Added PCI Express Gen2 signaling for all PCI Express lanes.
- AC97 pins are now used to support AC97 and HD audio.
- Added the definition for a 95 x 95 mm Module called a Compact Module.
- Added optional support for SDIO using the existing GPIO signals.
- Added multi-master support for the I2C bus.
- Added TYPE10# pin in reclaimed VCC_12V pool to allow detection of Rev 2.0 compliant Module types

1.2 COM.0 Revision 1.0 vs. 2.0 Compatibility Considerations

For designers wishing to build either modules compatible with both Revision 1.0 and 2.0 carriers, or carriers compatible with both Revision 1.0 and 2.0 modules, attention is called to the following COM Express® Revision 2.0 compatibility considerations. Even if new Revision 2.0 designs are not intended to support Revision 1.0 counterparts, the 12V pin reclamation consideration is important to protect against pairing with an incompatible Revision 1.0 counterpart.

2 Module Overview

2.1 Module Configuration

Three Module sizes are defined: the Compact Module, Basic Module and the Extended Module. The primary difference between the different size Modules is the over-all physical size and the performance envelope supported by each. The Extended Module is larger and can support larger processor and memory solutions. The Compact Module, Basic Module and Extended Module use the same connectors and pin-outs and utilize several common mounting hole positions. This level of compatibility allows that a Carrier Board can be designed to accommodate multiple Module sizes.

Up to 440 pins of connectivity are available between COM Express® Modules and the Carrier Board. Legacy buses such as PCI, parallel ATA, LPC, AC'97 can be supported as well as new high speed serial interconnects such as PCI.
Express, Serial ATA or SAS, USB 2.0 / 3.0 and Gigabit Ethernet. To enhance interoperability between COM Express® Modules and Carrier Boards, seven common signaling configurations (Pin-out Types) have been defined to ease system integration. Some Pin-out Types definitions require only a single 220-pin connector and others require both 220-pin connectors to supply all the defined signaling. All Pin-out Type definitions apply to either Compact Module, Basic Module or Extended Module sizes.

2.2 Feature Overview - Size

2.2.1 Compact Module

The Compact Module is intended for mobile systems and space-constrained stationary systems. Key features of the Compact Module include:

- Module size: 95mm x 95mm
- 5mm and 8mm stack height options (Module bottom to Carrier Board top)
- 18mm ‘z’ height with heat-spreader (using the 5mm stack option)
- Accommodates a single (or two stacked) horizontal mount SO-DIMM
- Single 220 pin or dual 220 pin connectors for up to 440 pins

2.2.2 Basic Module

The Basic Module is intended for mobile systems and space-constrained stationary systems. Key features of the Basic Module include:

- Module size: 125mm x 95mm
- 5mm and 8mm stack height options (Module bottom to Carrier Board top)
- 18mm ‘z’ height with heat-spreader (using the 5mm stack option)
- Accommodates a single (or two stacked) horizontal mount SO-DIMM
- Single 220 pin or dual 220 pin connectors for up to 440 pins

2.2.3 Extended Module

The Extended Module, which targets OEM applications that require larger amounts of system memory, features a larger Module size to accommodate full size DIMMs and larger chipset and CPU packages. The key features of the Extended Module include:

- Module size: 155mm x 110mm
- 5mm and 8mm stack height options (Module bottom to Carrier Board top)
- 18mm ‘z’ height with heat-spreader (using the 5mm stack option)
- Accommodates 2 full-size D1MM or mini D1MM memories or 2 horizontal mount or vertical mount SO-D1MMs
- Single 220 pin or dual 220 pin connectors for up to 440 pins
- Allows for the use of higher performance CPUs that can not be supported on the Compact Module or Basic Module

2.3 Feature Overview - Pin-out Types

2.3.1 Pin-out Type 1

- Single 220 pin connector (A-B connector)
- Up to 8 USB 2.0 ports; 4 shared over-current lines
• Up to 4 Serial ATA or SAS ports
• Up to 6 PCI Express Gen1/Gen2 signaling lanes
• Support pins for up to 2 ExpressCards
• Dual 24-bit LVDS channels
• Analog VGA
• AC '97 / HDA digital audio interface (external CODEC(s) required)
• Single Ethernet interface with integrated PHY – pinned for Gigabit Ethernet
• LPC interface
• SPI
• 8 GPIO pins
• 68W maximum input power over Module connector pins
• +12V primary power supply input
• +5V standby and 3.3V RTC power supply inputs

2.3.2 Pin-out Type 10
The type 10 Pin-out was introduced with COM Express® Rev. 2.0.
• Single 220 pin connector (A-B connector)
• Up to 8 USB 2.0 ports; 4 shared over-current lines
• Up to 2 Serial ATA or SAS ports
• Up to 4 PCI Express Gen1/Gen2 signaling lanes
• Support pins for up to 2 ExpressCards
• Single 24-bit LVDS channel
• One Digital Display Interface configurable as SDVO, DP, or TMDS
• AC '97 / HDA digital audio interface (external CODEC(s) required)
• Single Ethernet interface with integrated PHY – pinned for Gigabit Ethernet
• LPC interface
• Two TX/RX serial pairs
• SPI
• Fan control
• TPM support
• 8 GPIO pins
• 68W maximum input power over Module connector pins
• +12V primary power supply input
• +5V standby and 3.3V RTC power supply inputs

2.3.3 Pin-out Type 2
All Pin-out Type 1 features plus the following:
• Dual 220 pin connectors (A-B and C-D, 440 pins total)
• 32 bit PCI interface
• IDE port (to support legacy ATA devices such as CD-ROM drives and Compact Flash storage cards)

1 SPI support starts with COM.0 R2.0
2 Pin-out Type 10 is not compatible with Types 1-6
- Up to 22 PCI Express lanes (up to 6 on A-B and up to 16 on C-D)
- 16 of 22 PCI Express lanes commonly used for PCI Express Graphics
- SDVO option (pins shared with PCI Express Graphics)
- Maximum Module input power capability extended to 137W

2.3.4 **Pin-out Type 3**

All Pin-out Type 2 features with the exception of the following:
- IDE pins are reallocated to provide additional Gigabit Ethernet capability: no IDE
- Up to 3 Gigabit Ethernet channels

2.3.5 **Pin-out Type 4**

All Pin-out Type 2 features with the exception of the following:
- PCI pins are reallocated to provide additional PCI Express lanes: no PCI
- Up to 32 PCI Express lanes

2.3.6 **Pin-out Type 5**

All Pin-out Type 2 features with the exception of the following:
- Both IDE and PCI pins are reallocated: no IDE and no PCI
- Up to 32 PCI Express lanes
- Up to 3 Gigabit Ethernet channels

2.3.7 **Pin-out Type 6**

All Pin-out Type 2 features with the exception of the following:
- Both IDE and PCI pins are reallocated: no IDE and no PCI
- Up to 24 PCI Express lanes (16 on the PEG port)
- Reserved 16 pins to support the two extra differential pairs required for SuperSpeed USB 3.0. The 16 pins will allow SuperSpeed USB 3.0 support on up to four of the eight USB 2.0 ports. At this point in time, there is not enough information and silicon available for this subcommittee to determine the appropriate trace length and routing rules for SuperSpeed USB 3.0. The routing rules will be handled in a future version of this document
- Up to 3 Digital Display Interfaces

3 **Required and Optional Features**

3.1 **Module Pin-out Type Definitions**

Seven pin-out types are defined. Pin-out Type 1 and Type 10 Modules have a single 220-pin connector, the A-B connector. Module Pin-out Types 2 through 6 use a pair of 220 pin connectors, designated A-B and C-D, for a total of 440 pins. The variations in Pin-out Type definitions are summarized in the table below.

<table>
<thead>
<tr>
<th>Types</th>
<th>Connector Rows</th>
<th>PCI Express Lanes</th>
<th>PEG/SDVO</th>
<th>PCI</th>
<th>IDE Ports</th>
<th>SATA Ports</th>
<th>LAN Ports</th>
<th>USB 2.0 / SuperSpeed USB</th>
<th>Display Interfaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 1</td>
<td>A-B</td>
<td>Up to 6</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>4</td>
<td>1</td>
<td>8 / 0</td>
<td>VGA, LVDS</td>
</tr>
<tr>
<td>Type 2</td>
<td>A-B C-D</td>
<td>Up to 22</td>
<td>1/2</td>
<td>32 bit</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>8 / 0</td>
<td>VGA, LVDS, PEG/SDVO</td>
</tr>
<tr>
<td>Type 3</td>
<td>A-B C-D</td>
<td>Up to 22</td>
<td>1/2</td>
<td>32 bit</td>
<td>-</td>
<td>4</td>
<td>3</td>
<td>8 / 0</td>
<td>VGA, LVDS, PEG/SDVO</td>
</tr>
</tbody>
</table>
For Module Pin-out Types 2 through 6, a subset of the PCI Express lanes are commonly used as PCI Express Graphics (PEG) lanes.

**Type 1** Modules allow for a minimal possible feature set using two of the four available connector rows. Type 1 represents a basic feature set with the benefit of simplified routing of the Carrier Board to allow a lower layer count board.

**Type 10** Modules are similar but not compatible to Type 1 Modules. These Modules feature less PCI Express and SATA interfaces. Type 10 Modules support a single 24 bit LVDS panel interface and a single Digital Display Interface.

**Type 2** Modules include PCI and IDE interfaces. These Modules either use on board graphics capabilities or may use 16 PEG lanes to connect to an external video controller. In case of on board graphics, PEG pins may be alternatively used for two SDVO ports.

**Type 3** Modules trade IDE port pins for two additional LAN ports, allowing up to three GBE interfaces.

**Type 4** Modules drop the PCI interface, to allow up to 32 PCI Express lanes for applications with large I/O bandwidth requirements. IDE support is still available.

**Type 5** Modules trade IDE and PCI pins for up to 32 PCI Express lanes and up to three GBE interfaces. These Modules are intended for applications with large I/O bandwidth requirements.

**Type 6** Modules trade IDE and PCI pins for up to 8 PCI Express lanes, up to three Digital Display Interfaces and 4 of the 8 USB ports can be used as USB 3.0.

### 3.2 Module Pin-out Types 1-6 & 10 - Required and Optional Features

COM Express® Required and Optional features are summarized in the following table. The features identified as Minimum (Min.) **shall** be implemented by all Modules. Features identified up to Maximum (Max) **may** be additionally implemented by a Module.

<table>
<thead>
<tr>
<th>Type</th>
<th>A-B C-D</th>
<th>Up to</th>
<th>1/2</th>
<th>-</th>
<th>-</th>
<th>4</th>
<th>1</th>
<th>8 / 0</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 4</td>
<td>A-B C-D</td>
<td>Up to 32</td>
<td>1/2</td>
<td>-</td>
<td>-</td>
<td>4</td>
<td>1</td>
<td>8 / 0</td>
<td>VGA, LVDS, PEG/SDVO</td>
</tr>
<tr>
<td>Type 5</td>
<td>A-B C-D</td>
<td>Up to 32</td>
<td>1/2</td>
<td>-</td>
<td>-</td>
<td>4</td>
<td>3</td>
<td>8 / 0</td>
<td>VGA, LVDS, PEG/SDVO</td>
</tr>
<tr>
<td>Type 6</td>
<td>A-B C-D</td>
<td>Up to 24</td>
<td>1/NA</td>
<td>-</td>
<td>-</td>
<td>4</td>
<td>1</td>
<td>8 / 4³</td>
<td>VGA, LVDS, PEG, 3xDDI⁴</td>
</tr>
</tbody>
</table>

Change Key:
- **Green** = Generic R2.0
- **Blue** = Type 10 only
- **Violet** = Type 10 & Type 6 only
- **Red** = Type 6 only

³ The SuperSpeed USB ports are not in addition to the USB 2.0 ports. Up to 4 of the USB 2.0 ports can support SuperSpeed USB
⁴ Digital Display Interface

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**PICMG® COM.0 Revision 2.0 COM Express® Short Form Specification**
### Table 3.2: Module Pin-out - Required and Optional Features A-B Connector

<table>
<thead>
<tr>
<th>Connector</th>
<th>Feature</th>
<th>Type 10 (Single connector)</th>
<th>Type 1 (Single connector)</th>
<th>Type 2 (IDE + PCI)</th>
<th>Type 3 (No IDE)</th>
<th>Type 4 (No PCI)</th>
<th>Type 5 (No IDE, No PCI)</th>
<th>Type 6 (No IDE or PCI, add DDI + USB3)</th>
<th>Min / Max</th>
<th>Min / Max</th>
<th>Min / Max</th>
<th>Min / Max</th>
<th>Min / Max</th>
<th>Min / Max</th>
<th>Min / Max</th>
<th>Min / Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-B</td>
<td>System I/O</td>
<td></td>
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</tr>
<tr>
<td>A-B</td>
<td>PCI Express Lanes 0 - 5</td>
<td>1 / 4</td>
<td>1 / 6</td>
<td>1 / 6</td>
<td>1 / 6</td>
<td>1 / 6</td>
<td>1 / 6</td>
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<tr>
<td>A-B</td>
<td>LVDS Channel A</td>
<td>0 / 1</td>
<td>0 / 1</td>
<td>0 / 1</td>
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<tr>
<td>A-B</td>
<td>LVDS Channel B</td>
<td>NA</td>
<td>0 / 1</td>
<td>0 / 1</td>
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<tr>
<td>A-B</td>
<td>VGA Port</td>
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<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td>A-B</td>
<td>TV-Out</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td>A-B</td>
<td>Digital Display Interface 0</td>
<td>0 / 1</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td>A-B&lt;sup&gt;5&lt;/sup&gt;</td>
<td>Serial Ports 1 - 2</td>
<td>0 / 2</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>0 / 2</td>
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<tr>
<td>A-B</td>
<td>SATA / SAS Ports</td>
<td>1 / 2</td>
<td>1 / 4</td>
<td>1 / 4</td>
<td>1 / 4</td>
<td>1 / 4</td>
<td>1 / 4</td>
<td>1 / 4</td>
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<tr>
<td>A-B</td>
<td>AC’97 / HDA Digital Interface</td>
<td>0 / 1</td>
<td>0 / 1</td>
<td>0 / 1</td>
<td>0 / 1</td>
<td>0 / 1</td>
<td>0 / 1</td>
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<tr>
<td>A-B</td>
<td>USB Client</td>
<td>0 / 1</td>
<td>0 / 1</td>
<td>0 / 1</td>
<td>0 / 1</td>
<td>0 / 1</td>
<td>0 / 1</td>
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<tr>
<td>A-B</td>
<td>LAN Port 0</td>
<td>1 / 1</td>
<td>1 / 1</td>
<td>1 / 1</td>
<td>1 / 1</td>
<td>1 / 1</td>
<td>1 / 1</td>
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<tr>
<td>A-B</td>
<td>Express Card Support</td>
<td>0 / 2</td>
<td>1 / 2</td>
<td>1 / 2</td>
<td>1 / 2</td>
<td>1 / 2</td>
<td>1 / 2</td>
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<tr>
<td>A-B</td>
<td>LPC Bus</td>
<td>1 / 1</td>
<td>1 / 1</td>
<td>1 / 1</td>
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<td>1 / 1</td>
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<tr>
<td>A-B</td>
<td>SPI</td>
<td>1 / 2</td>
<td>1 / 2</td>
<td>1 / 2</td>
<td>1 / 2</td>
<td>1 / 2</td>
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<tr>
<td>A-B</td>
<td>System Management</td>
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<tr>
<td>A-B&lt;sup&gt;6&lt;/sup&gt;</td>
<td>SDIO (muxed on GPIO)</td>
<td>0 / 1</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>0 / 1</td>
<td></td>
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<tr>
<td>A-B</td>
<td>General Purpose I/O</td>
<td>8 / 8</td>
<td>8 / 8</td>
<td>8 / 8</td>
<td>8 / 8</td>
<td>8 / 8</td>
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<td></td>
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<tr>
<td>A-B</td>
<td>SMBus</td>
<td>1 / 1</td>
<td>1 / 1</td>
<td>1 / 1</td>
<td>1 / 1</td>
<td>1 / 1</td>
<td>1 / 1</td>
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<tr>
<td>A-B</td>
<td>I/F</td>
<td>1 / 1</td>
<td>1 / 1</td>
<td>1 / 1</td>
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<tr>
<td>A-B</td>
<td>Watchdog Timer</td>
<td>0 / 1</td>
<td>0 / 1</td>
<td>0 / 1</td>
<td>0 / 1</td>
<td>0 / 1</td>
<td>0 / 1</td>
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<td>A-B</td>
<td>External BIOS ROM Support</td>
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<td>0 / 2</td>
<td>0 / 2</td>
<td>0 / 2</td>
<td>0 / 2</td>
<td>0 / 2</td>
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<td>A-B</td>
<td>Reset Functions</td>
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<td>A-B</td>
<td>Power Management</td>
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<tr>
<td>A-B</td>
<td>Thermal Protection</td>
<td>0 / 1</td>
<td>0 / 1</td>
<td>0 / 1</td>
<td>0 / 1</td>
<td>0 / 1</td>
<td>0 / 1</td>
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<td>A-B</td>
<td>Battery Low Alarm</td>
<td>0 / 1</td>
<td>0 / 1</td>
<td>0 / 1</td>
<td>0 / 1</td>
<td>0 / 1</td>
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<tr>
<td>A-B</td>
<td>Suspend/Wake Signals</td>
<td>0 / 3</td>
<td>0 / 3</td>
<td>0 / 3</td>
<td>0 / 3</td>
<td>0 / 3</td>
<td>0 / 3</td>
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<tr>
<td>A-B</td>
<td>Power Button Support</td>
<td>1 / 1</td>
<td>1 / 1</td>
<td>1 / 1</td>
<td>1 / 1</td>
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<tr>
<td>A-B</td>
<td>Power Good</td>
<td>1 / 1</td>
<td>1 / 1</td>
<td>1 / 1</td>
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<tr>
<td>A-B&lt;sup&gt;5&lt;/sup&gt;</td>
<td>Sleep Input</td>
<td>0 / 1</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>0 / 1</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>A-B&lt;sup&gt;5&lt;/sup&gt;</td>
<td>Lid Input</td>
<td>0 / 1</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>0 / 1</td>
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</tbody>
</table>

<sup>5</sup> Indicates 12V-tolerant features on former VCC_12V signals.

<sup>6</sup> Cells in the connected columns spanning rows provide a rough approximation of features sharing connector pins.
### Table 3.3: Module Pin-out - Required and Optional Features C-D Connector

<table>
<thead>
<tr>
<th>Connector</th>
<th>Feature</th>
<th>Type 10 (Single connector)</th>
<th>Type 1 (Single connector)</th>
<th>Type 2 (IDE + PCI)</th>
<th>Type 3 (No IDE)</th>
<th>Type 4 (No PCI)</th>
<th>Type 5 (No IDE, No PCI)</th>
<th>Type 6 (No IDE or PCI, add DDI + USB3)</th>
<th>Min / Max</th>
<th>Max / Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-B</td>
<td>Fan Control Signals</td>
<td>0 / 2</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>0 / 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A-B</td>
<td>Trusted Platform Modules</td>
<td>0 / 1</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>0 / 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A-B</td>
<td>VCC_12V Contacts</td>
<td>12 / 12</td>
<td>12 / 12</td>
<td>12 / 12</td>
<td>12 / 12</td>
<td>12 / 12</td>
<td>12 / 12</td>
<td>12 / 12</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 3.3 EAPI - Embedded Application Programming Interface

All COM Express® modules **should** support the Revision 1.0 of the PICMG defined Software API EAPI. This API allows for an easier interoperability of COM Express® Modules.

Addressed functions are:

- System information
- Watchdog timer
- I2C Bus
- Flat Panel brightness control
- User storage area
- GPIO
4 Signal Descriptions

4.1 Signal List

COM Express® signal descriptions are described in the following table. The Pin Availability column in the table indicates in which Pin-out Types the signal is available. Module Pin-out Types 1 through 6 and 10 are designated T1, T2, T3, T4, T5, T6, T10 in the Pin Availability column. A notation of “All” indicates that the signal is available to all Module Pin-out Types.

4.1.1 AC97 Audio / High Definition Audio

The AC ’97 audio codec interface is limited to support a single AC ’97 link. High Definition Audio may be supported. The HDA signal level from some chipsets might be 1.5V. Module designers must add any necessary voltage translation circuitry to meet the COM Express® 3.3V signaling requirement for AC-97/HDA signals.

4.1.2 Ethernet

Up to 3 Gigabit Ethernet ports are defined, designated GBE0 through GBE2. The ports may operate in 10, 100, or 1000 Mbit/sec modes. Magnetics are assumed to be on the Carrier Board. All COM Express® Modules shall implement at least one 10/100 Ethernet port on the GBE0 pin slot.

4.1.3 IDE

Parallel ATA support for up to 2 devices in a master/slave configuration. This signaling interface is limited to ATA100 speeds. Higher (ATA133) speeds are not defined. PATA signal pins are reused in Pin-out Type 3 and 5 Modules for 2 additional GB Ethernet interfaces; and for USB3.0 interfaces in Type 6.

4.1.4 Serial ATA

Serial ATA links for support of existing SATA-150 and emerging SATA-300 devices. Alternatively, this interface may be used for Serial Attached SCSI (SAS).

4.1.5 General Purpose PCI Express Lanes

The number of available PCI Express lanes varies with the Module Pin-out Type. If the Module supports off-Module x16 PCI Express Graphics, then PCI Express Lanes 16-31 shall be used to implement this.

4.1.6 PEG PCI Express Lanes

These signals may be multiplexed with SDVO signals or defined as ordinary PCI Express signals on Module Types 2-5. Type 6 provides dedicated PEG and SDVO channels. The PEG lanes are the same lanes as PCI Express lanes 16-31.

4.1.7 ExpressCard

ExpressCard is a small form factor expansion card for mobile systems that uses PCI Express or USB as the interface. It is similar in concept and scope to
CardBus. COM Express® Modules shall provide support functions for at least one ExpressCard. This does not mean that a Module PCI Express lane or USB link are specifically allocated to ExpressCard use, but it does mean that the Module pins for ExpressCard detection and support are present.

4.1.8 PCI Bus

The PCI bus interface is specified to be a 32-bit PCI 2.3 compliant bus with speed options of 33MHz or 66MHz.

4.1.9 USB

All USB interfaces shall be USB 2.0 compliant. The minimum of 4 USB channels provides support for keyboard, mouse, CD/DVD drive, and one additional device. Up to four of the eight USB 2.0 ports can support the extended signaling for SuperSpeed USB 3.0. Note that this usage is not required and the actual Carrier Board usage of the USB port is not defined by this specification. USB7 may optionally be configured as a USB client.

4.1.10 LVDS Flat Panel

Low voltage differential signaling flat-panel interface. The Module pin-out allows one single channel display interface (1 pixel per clock) with up to 24 bit color. Alternatively, one dual channel display (2 pixels per clock) with up to 24 bit color, 48 bits per clock is allowed. Includes panel backlight control and EDID support.

4.1.11 LPC Interface

The LPC bus provides legacy I/O support on a Carrier Board via a Super I/O and system management devices.

4.1.12 SPI Interface

SPI. The SPI bus is used to support SPI-compatible flash devices. The SPI flash device can be up to 16 MB (128 Mb). The SPI bus is clocked at either 20 MHz, 25 MHz, 33 MHz or 50 MHz. SPI devices selected should support one of these frequencies. SPI support is introduced in COM.0 R2.0 for all Types. COM.0 R2.0 allows for Carrier Board LPC FWH operation that is backward compatible with COM.0 Rev.1 Carriers. It also allows two Carrier SPI options: SPI0 on Carrier and SPI1 on the Module, or SPI0 on the Module and SP1 on the Carrier.

SPI Power

Introducing a SPI POWER pin is desirable because some Module implementations will have the SPI power domain in power state S0 and others in S5. It is easier for Carrier board designers to take the Carrier SPI power from a pin on the Module.

4.1.13 Analog VGA

Analog RGB interface for CRT monitor and DDC support.
4.1.14 PEG Multiplexed SDVO
Serial Digital Video Output to LVDS or TMDS transmitters on the Carrier Board. These signals, if implemented, shall be multiplexed with PEG signals on Types 2-5.

4.1.15 Digital Display Interfaces - Module Type 6 and 10
Module Types 6 and 10 use Digital Display Interfaces (DDI) to provide DisplayPort, HDMI/DVI, and SDVO interfaces. Type 10 Modules can contain a single DDI (DDI[0]) that can support DisplayPort, HDMI/DVI, and SDVO. Type 6 Modules can contain up to 3 DDIs (DDI[1:3]) of which DDI[1:3] can support DisplayPort, HDMI/DVI and DDI[1] can support DisplayPort, HDMI/DVI, and SDVO. The main difference is that SDVO is only supported on DDI[0] for Type 10 Modules and DDI[1] for Type 6 Modules.

4.1.16 General Purpose Serial Interface
Two TTL compatible two wire ports are available on Module Types 6 and 10. 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 Module asynchronous serial ports should not be implemented as USB peripherals, as such implementations are generally not useful for low level debug purposes.
The serial ports, if implemented, shall support standard asynchronous serial port bit rates up to and including 115.2 kbits/second.

4.1.17 I2C Bus
The I2C port shall be available in addition to the SMBus. The I2C clock shall support 100kHz and should support 400kHz operation. The I2C interface should support multi-master operation. This capability will allow a carrier to read an optional Module EEPROM before powering up the module.

4.1.18 Power and System Management
Signals SYS_RESET#, and CB_RESET# shall be supported for all Module pin-out types. Signal PCI_RESET# shall be supported for pin-out types 2 and 3. Signal IDE_RESET# shall be supported for pin-out types 2 and 4. Additionally, signal PWR_OK indicates that all the power supplies to the Module are stable within specified ranges and can be used to enable Module internal power supplies.

4.1.19 Thermal Protection
This port provides thermal signaling to protect critical components on the Module and the Carrier Board.

4.1.20 SM Bus
The SMBus port is specified for system management functions. It is used on the Module to manage system functions such as reading the DRAM SPD EEPROM

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7 I2C multi-master support starts with COM Express® Rev. 2.0
and setting clock synthesizer parameters. Off Module, the SMBus should be used carefully. It may be useful for implementation on the Carrier Board of standards such as Smart Battery.

4.1.21 General Purpose Input Output

GPI and GPO pins may be implemented as GPIO (Module specific). GPI and GPO pins may be implemented as SDIO. If SDIO is supported the BIOS may be used to set the default state (SDIO or GPIO) of the GPIO.

4.1.22 SDIO

Support for an SDIO interface is optional and added in R2.0. The SDIO signals are piggy-backed on the existing COM.0 General Purpose IO (GPIO) signals. The signal mapping is such that SDIO card inputs connect to GPI and SDIO card outputs connect to GPO. With this mapping, any combination of Module and Carrier Board SDIO interface support will not result in damage. An EEPROM bit is added so that the Carrier Board can define if the GPIO are used as GPIO or SDIO.

4.1.23 Watchdog Timer

COM Express® Modules may implement a watchdog timer output to the Carrier Board.

5 Mechanical Specifications

5.1 Module Size - Compact Module

The PCB size for the Compact Module shall be 95mm x 95mm. The PCB thickness should be 2mm to allow high layer count stack-ups and facilitate a standard ‘z’ dimension between the Carrier Board and the top of the heat-spreader (See Section 21 “Heat-Spreader”). The holes shown in this drawing are intended for mounting the Module / heat-spreader combination to the Carrier Board. An independent, implementation specific set of holes and spacers shall be used to attach the heat-spreader to the Module.

Figure 5-1: Compact Module Form Factor

5.2 Module Size - Basic Module

The PCB size for the Basic Module shall be 125mm x 95mm. The PCB thickness should be 2mm to allow high layer count stack-ups and facilitate a standard ‘z’ dimension between the Carrier Board and the top of the heat-spreader. (See Section 21 “Heat-Spreader”). The holes shown in this drawing are intended for mounting the Module / heat-spreader combination to the Carrier Board. An independent, implementation specific set of holes and spacers shall be used to attach the heat-spreader to the Module.

Figure 5-2: Basic Module Form Factor
5.3 Module Size - Extended Module

The PCB size for the Extended Module shall be 155mm x 110mm. The PCB thickness should be 2mm to allow high layer count stack-ups and facilitate a standard ‘z’ dimension between the Carrier Board and the top of the heat-spreader. (See Section 21 “Heat-Spreader”).

The holes shown in this drawing are intended for mounting the Module / heat-spreader combination to the Carrier Board. An independent, implementation specific set of holes and spacers shall be used to attach the heat-spreader to the Module.

![Figure 5-3: Extended Module Form Factor](image)

5.4 Module Connector

The Module connector for Pin-out Types 2 through 6 shall be a 440-pin receptacle that is composed of 2 pieces of a 220-pin, 0.5 mm pitch receptacle. The pair of connectors may be held together by a plastic carrier during assembly to allow handling by automated assembly equipment. Module Pin-out Type 1 or 10 shall use a single 220-pin, 0.5 mm pitch receptacle. The connectors shall be qualified for LVDS operation up to 6.25GHz, to support PCI Express Generation 2 signaling speeds.
The Module connector is a receptacle by virtue of the vendor’s technical definition of a receptacle, and to some users it looks like a plug.

**Figure 5-4: Module Receptacle**

5.5 **Carrier Board Connector**

The Carrier Board connector for Module Pin-out Types 2 through 6 **shall** be a 440-pin plug that is composed of 2 pieces of a 220-pin, 0.5 mm pitch plug. The pair of connectors **may** be held together by a plastic carrier during assembly to allow handling by automated assembly equipment. Carrier Boards intended only for use with Pin-out Type 1 or 10 Modules **may** use a single 220-pin, 0.5 mm pitch plug. The connectors **shall** be qualified for LVDS operation up to 6.25GHz, to support PCI Express Generation 2 signaling speeds. The Carrier Board plugs are available in a variety of heights. The Carrier Board **shall** use either the 5mm or 8mm heights.

The Carrier Board connector is a plug by virtue of the vendor’s technical definition of a plug, and to some users it looks like a receptacle.

**Figure 5-5: Carrier Board Plug**
5.6 Heat-Spreader

Modules should be equipped with a heat-spreader. This heat-spreader by itself does not constitute the complete thermal solution for a Module but provides a common interface between Modules and implementation-specific thermal solutions.

If implemented, a heat-spreader shall use an implementation specific set of holes and spacers to attach the heat-spreader to the module. These implementation specific holes are in addition to the module mounting holes specified in Sections 5.1, 5.2 or 5.3.

A heat-spreader should not use the module mounting holes as the only attachment points to a module. The intent is to be able to provide a module and heat-spreader as an assembly that can then be mounted to a carrier without having to break the thermal interface between the module components and the heat-spreader.

Figure 5-6: Overall Height for Heat-Spreader in Compact, Basic and Extended Modules

All dimensions in mm.

Figure 5-7: Compact Module Heat-Spreader
All dimensions are in mm. X-Y tolerances shall be ± 0.3mm [±0.012"].
Figure 5-8: Basic Module Heat-Spreader

All dimensions are in mm. X-Y tolerances shall be ± 0.3mm [±0.012"].
6 Electrical Specifications

6.1 Input Power - General Considerations

The Compact, Basic and Extended Module Modules shall use a single main power rail with a nominal value of +12V.

Two additional rails are specified: a +5V standby power rail and a +3V battery input to power the Module Real-time Clock (RTC) circuit in the absence of other power sources. The +5V standby rail may be left unconnected on the Carrier Board if the standby functions are not required by the application. Likewise, the +3V battery input may be left open if the application does not require the RTC to keep time in the absence of the main and standby sources. There may be

All dimensions are in mm. X-Y tolerances shall be ± 0.3mm [±0.012”].
Module specific concerns regarding storage of system setup parameters that may be affected by the absence of the +5V standby and / or the +3V battery. The rationale for this power-delivery scheme is:

- Module pins are scarce. It is more pin-efficient to bring power in on a higher voltage rail.
- Single supply operation is attractive to many users.
- Lithium ion battery packs for mobile systems are most prevalent with a +14.4V output. This is well suited for the +12V main power rail.
- Contemporary chipsets have no power requirements for +5V other than to provide a reference voltage for +5V tolerant inputs. No COM Express® Module pins are allocated to accept +5V except for the +5V standby pins. In the case of an ATX supply, the switched (non standby) +5V line would not be used for the COM Express® Module, but it might be used elsewhere on the Carrier Board.

7 Appendix

7.1 Mounting positions and connector location for Carrier Boards

Figure 7-1: Carrier Board mounting positions

Common Mounting Positions for all Form Factors
Mounting Postions for Extended only
Mounting Postions for Basic only
Mounting Postions for Compact only
Common Mounting Postions for Compact and Basic

All dimensions are shown in millimeters.