Transforming the world of COM Express - Specification 2.0

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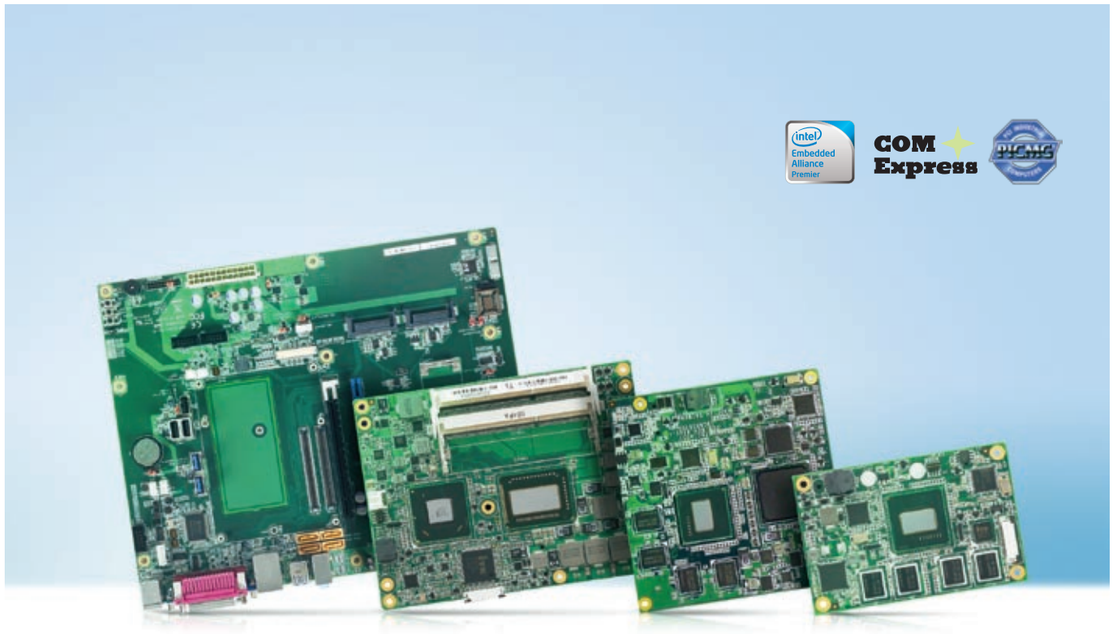


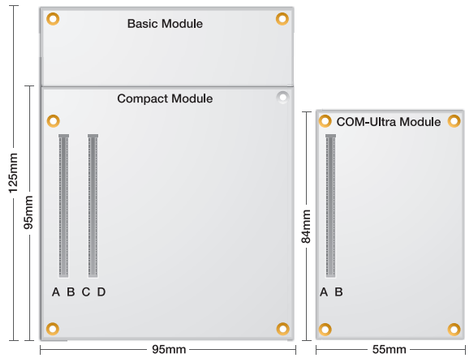
The PICMG consortium released the COM.0 Rev.2.0 specification on August 30th 2010 to the public. With the release of this new version of the specification, the world of Computer On Module based solutions is changing and adapting to new technologies again. This article will introduce the major changes and the resulting effects to carrier board design.

The COM Express standard is the only COM standard maintained from an independent committee (PICMG) in the market. With the new specification, the standard is adapting to new technologies and markets. But this also means that a deeper knowledge of the specification is necessary to choose the correct COM solution in the future and to avoid mistakes. The major changes are sorted into: mechanical, interface, and software features.

Mechanical Add-ons

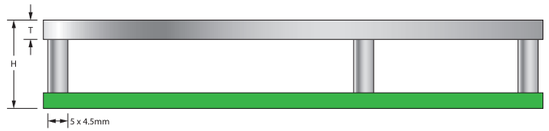
COM.0 Rev 2.0 includes one additional board form factor of 95mm x 95mm. This size is referred to as “Compact” size. In total three board form factors are now officially supported for the COM Express module design.

- COM Express Extended Module: 155mm x 110mm
- COM Express Basic Module: 125mm x 95mm
- COM Express Compact Module: 95mm x 95mm
- COM-Ultra Module: 84mm x 55mm



Even though the Compact Module size is already known in the market it is now also officially supported in the standard specification. The Compact Module form factor allows designs with up to 2 B2B connectors thus all existing pin out definitions can be realized on the module.

The module height including the heat spreader is on all three versions defined with 18mm for the 5mm B2B headers. With 8mm headers the total height reaches 21mm.



- Standoffs are threaded (M2.5) or clear (2.7mm)
- Thickness ‘T’ is implementation specific and may be 5mm.
- Height ‘H’ (which includes PCB thickness) shall be 18.00 mm

Despite the existence of modules with the size of 84mm x 55mm (COM ultra), this module dimension is not yet included into the official standard and therefore different solutions with similar board dimensions are available in the market. Thus the credit card sized 84mm x 55mm is supported from the majority of vendors that produce modules smaller than the Compact Module form factor allows.

Interface Changes

The world of existing defined pin out versions was already complex with the first release of the COM.0 spec. The maze of choices and possibilities is now even more diverse and this has led to increased time and effort spent consulting in order to successfully complete projects for customers.

Existing Pin-out Definitions

A total of 5 pin out definitions had been defined in the COM.0 specification version 1.0. These 5 pin out versions are redefined on some portions now, so that it is important to know for which specification the COM module and the carrier board was designed for. It is possible to make sure that the COM modules and carrier boards are able to work with both types of the specification. However, additional effort is needed to compensate for this compatibility issue. Since most modules in the market follow type 2 pin outs we will highlight the changes between the COM.0 specification versions in this example:

Row	I/O Function	COM.0 R1.0 Type2	COM.0 R2.0 Type2
A-B	Audio	AC97	AC97 or HDA
	TV-out	1	N/A
	USB Client	N/A	1
	SPI	N/A	1
	Power pins	21	12

Changes in Detail:

- Audio:
  In addition to the already supported AC97 audio interface COM module vendors can chose to support HDA instead. The pins for it are shared so that either AC97 or HDA is supported. This change is related to all pin out types.

- TV-out:
  The TV out function is removed from the pin out definitions. Customers that need the function have to include additional circuitry on their carrier board designs.

- USB-Client:
  Since many x86 platforms (especially Intel ATOM) support a USB client natively, the new pin out definition supports the possibility to utilize this feature in the future without proprietary vendor solutions or additional effort for customers on the carrier board.

- SPI interface:
  The SPI interface is now transferred to the board headers for customer usage. This allows the customer to add their own BIOS chip to the carrier board and to flash their own specific BIOS to it during the manufacturing process. Thus allowing the use of standard part number COM modules from vendors. In addition, customer settings in the BIOS will stay on the carrier board even when the COM module is exchanged. However the customer needs to know which COM board will be used on the carrier board. Plugging in a wrong module will result in bootup failures.

- Power pins:
  The new features mentioned above utilize pins that had been originally used for power pins. Therefore the pin count for power connections has now been reduced. This results in a lower maximum power consumption from the original 188W to 137W (Type 2,3,4,5,6 Modules).

Since all the changes for the type 2 pin outs are on rows A/B these changes also apply to the type 1 pin out definitions that are used for modules in the not yet standardized size of 84mm x 55mm (COM ultra). The maximum power consumption of modules of this form factor is now also reduced from the original 120W to 68W (Type 1, 10 Modules) from the standard. But this limitation will not affect any design since the board space allows only the low power ATOM platforms that don´t exceed power consumption of about 10W maximum.

New Pin-out Definitions

In addition to the already existing pin out definitions (Type 1, 2, 3, 4 and 5), two new pin outs (Type 6 and 10) are defined in COM.0 version 2.

Type 6

The type 6 pin out is based on two B2B connectors (rows A/B and C/D). In comparison to the type 2 pin out that represent the most common pin out of the past, the type 6 pin out removes legacy interfaces such as PCI, and IDE in order to provide new and future interface trends such as additional PCIe lanes and USB 3.0 links. The following table provides a comparison of the changes between the type 2 and the type 6 pin out definitions both from the COM.0 specification version 2.0.

Row	I/O Function	R2.0 Type 2	R2.0 Type 6
A-B	TV-out	N/A (Only in R1.0)	N/A
	Serial Port	N/A	2
	USB Client	1 (N/A in R1.0)	1
	SPI	1	1
	SDIO	N/A	1
	Fan Control	N/A	1
	Power pin	12 (21 in R1.0)	12
C-D	DDI	N/A	3
	USB3.0	N/A	4
	PCIex1 Port	N/A	2
	PCI	1	N/A
	IDE	1	N/A

Changes in Detail:

- Serial port:
  Up to two asynchronous serial ports (TTL compatible) can be provided from the module.

- SDIO interface:
  In case the processor platform provides an SDIO interface, the type 6 pin out allows the customer to utilize this interface in the future without additional cost overheads.

- Fan control:
  A PWM signal together with a tachometer input pin is defined in the new specification.

- Power pins
  The new pin count for the power allows modules with a maximum power consumption of 137W.

- DDI interface:
  Up to three DDI (Digital Display Interface) can be present on the type 6 pin out. This provides the flexibility for future multi display capabilities of modern x86 platforms. The DDI interface can be utilized with DisplayPort, HDMI/DVI and SDVO (DDI link 1 only). It will depend on the platform and the vendor which link will provide what standard. Therefore some attention should be spent during the definition of a carrier board design in order to find the right setup.

- USB 3.0 interface:
  The new pin out defines up to four USB 3.0 interfaces for future platforms. The new USB interface allows communications with up to 5Gbit/s. Allowing faster transfer rates for modern SSD drives and other communication intensive devices in the future. Also the carrier board design needs to address the new interface type since it allows devices to utilize up to 900mA / 5V from the port.

- PCIe x1 ports:
  Two additional PCIexpress x1 ports can be supported from the COM Express module compared to the type 2 standard.

- Removed features:
  In order to provide the connections for the above mentioned interfaces, the PCI and the IDE interfaces are removed.

Type 10

The type 10 pin out is defined with only one B2B connector (rows A/B) and is therefore only interesting for COM modules based on the not yet standardized COM ultra form factor. The table below provides an overview of the changes between the type 1 and the type 10 pin out specification:

Row	I/O Function	R2.0 Type 1	R2.0 Type 10
A-B	VGA	1	N/A
	TV-out	N/A (Only in R1.0)	N/A
	PCIex1 Port	6	4
	LVDS Channel	2	1
	DDI	N/A	1
	SATA	4	2
	Serial Port	N/A	2
	USB Client	1 (N/A in R1.0)	1
	SPI	1 (N/A in R1.0)	1
	SDIO	N/A	1
	Sleep/LID Input	N/A	1
	Fan Control	N/A	1
	Power pin	12 (21 in R1.0)	12

New: Software Standardization – EAPI

All COM solutions in the past suffered from the same problems on the software side. The hardware is standardized and ideally exchangeable but embedded solutions also need special features such as temperature monitoring, fan controls or many other features. Therefore, COM product vendors not only supported the customers with hardware, most also included software library functions. A customer had either the choice to limit themselves to a single vendor or they develop mechanisms to detect which vendor is present and enable the software to decide which API library to use. This meant doubling the effort on software development.

By including the EAPI (Embedded API) specification to the new release of COM.0 Rev2.0 specification a major new step has been taken. For the first time also some software parts are unified so that customers can setup their applications independent from the vendor they chose.

At present the following functions are defined in the EAPI specification release 1.0:

- System Information
  The current supported system information are:
  - Vendor ID
  - HW ID & SW versions
  - Boot counter and board uptime
  - HW temperatures, voltages and fan status.

- Watchdog timer
  A normal watchdog function is present. In addition vendors can program a staged watchdog timer function. In this case an initial event is triggered first from the watchdog. Only if there is no reaction within a predefined time after the first trigger event a reset will be issued from the watchdog. This allows to program recovery mechanisms to prevent a failing system from rebooting. An end user might only see a dead system and after a short period it acts normal again. Instead of seeing the reboot directly.

- I2C bus
  The current specification defines 3 I2C busses for COM Express modules. One is defined for the baseboard interface. The other two are used for display interfaces. Since additional vendor or platform specific interface might exist, customers need to take special care about this feature.

- Flat Panel brightness controls
  The backlight status (On/Off) and additional parameters for the backlights like the backlight brightness can be influenced.

- User storage area
  The EAPI defines a user storage area with at least 32 Bytes in order to store additional customer specific IDs.

- GPIO
  By default the EAPI supports 4 general purpose inputs and 4 general purpose outputs. Depending on the vendor implementation and the platform different configurations might be present.

Summary:

The new specification COM.0 release 2.0 provides multiple new features and opportunities. With the EAPI implementation the COM market really evolves one step further. On the other hand, the COM express standard is getting even more complex and additional care needs to be taken for the design specification and implementation to profit from the added functionality without running into compatibility issues. A strong COM module partner with design assistant services can help to bridge this gap and help to optimize better carrier board solutions.

COM-Ultra	COM-Express Compact	COM-Express Compact	COM-Express Basic	Development Board
SOM-7564	SOM-6764	SOM-6763 B1	SOM-5890	SOM-DB5800
COM 2.0 Type 10	COM 2.0 Type 2	COM 2.0 Type 2	COM 2.0 Type 6	COM 2.0
• Intel® Atom™ E6xx series up to 1.6 GHz • 1 GB DDR2 on-board memory • 1-ch. 24-bit LVDS, SDVO • PCIe x1, GbE	• Intel® Atom™ E6xx series up to 1.6GHz • 1 GB DDR2 on-board memory • PCIe x1, PCI, SATA, EIDE, 6 USB • Operating temperature: -40 ~ 85° C	• Intel® Atom™ N455/D525 processor + ICH8M • 24-bit LVDS, VGA • 2-ch. DDR3-667/800 SODIMM sockets up to 2 GB • 5 PCIe x1, 4 PCI masters, 3 SATA II, 8 USB 2.0, EIDE, GbE	• Intel® Core™ i7/i5/i3 processor + QM67 • 2-ch. 18/24-bit LVDS, HDMI, DisplayPort, VGA • 2-ch. DDR3-1333 SODIMM sockets up to 16 GB • 7 PCIe x1, 2 SATA III, 2 SATA II, 8 USB 2.0, GbE	• ATX form factor development board • Supports COM 2.0 type 6 & 10 pin-out • LVDS, HDMI, DVI, DisplayPort, SDVO, VGA • PEG, PCIe x1, SATA, GbE, SPI, LPC, SDIO

Backlight | GPIO | Hardware Monitor | SMBus | I2C | Watchdog

Built-in iManager utility and APIs improve hardware and software integration
Advantech iManager compliant with EAPI 1.0 standard