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A user's guide to selecting the right computer-on-module (COM)

Computer-on-modules (COMs) are time-saving and cost-effective embedded computer building blocks. Acal BFi have an extensive range of form factors, pin-outs and processors from several select manufacturers. This guide will help you select the right COM for your project or application.

What are COMs?

COMs are highly integrated, single-board computers in which all generic PC functions are readily available in a single off-the-shelf module. This provides the designer with the core functionality of a PC in an easily embedded form factor.

They are available with chipsets from leading manufacturers such as Intel, AMD, Freescale and ARM.

The designer creates their own carrier board which complements the COM with the additional functionality required for their specific application. The carrier board provides all the interface connectors for peripherals such as storage, Ethernet, keyboard/mouse, and display, as well as any application specific circuitry.

Typically these modules are used in applications such as programmable automation controllers, security gateways, civil aeronautics, renewable energy controllers, test and measurement, and telecoms, and are supported by a range of operating systems and development tools, including Windows and Linux.

COMs use processors designed for embedded applications, these processors have a significantly longer lifetime than those found in laptops or PCs. The typical lifetime for an embedded processor is seven years from release for Intel processors and ten for Freescale.

Why use a COM?

COMs allow designers to focus on their core competencies and on the unique functions of their systems, rather than having to design their own computer building block from scratch. The modular approach allows scalability, fast time to market and upgradability, while still maintaining low costs.

Figure 1 shows a typical implementation of a COM system. The COM (blue) is a QSeven module mounted on a customer's designed carrier board which contains the circuitry for the rest of the design.

Figure 1: Typical implementation using a COM
(Image courtesy of Hectronic AB)

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Types of COMs available

COM Express®

The COM Express® (COMe) was developed by PICMG (PCI Industrial Computer Manufacturers Group) and is the most widely used COM standard. The PICMG standard defines the physical size, interconnect, and the module's thermal interface. There are several pinout types with each one having a specific combination of peripherals, expansion interfaces and connector layout, the most common of which are Types 2 and 6 (the Type 6 pinout is based on the Type 2 layout, but with legacy functions replaced by DDI and additional PCIe lanes). Similarly Type 10 is based on the Type 1 pinout. The Type 10 pinout provides additional flexibility for developers by freeing up pins reserved for SATA and PCIe for future technologies and using the second LVDS channel, VGA and TV-out pins to support SDVO (via DDI).

The standard size of both Type 6 and Type 2 modules is 125mm x 95mm however a compact version exists which is 95mm x 95mm. Type 10 units are 84mm x 55mm.

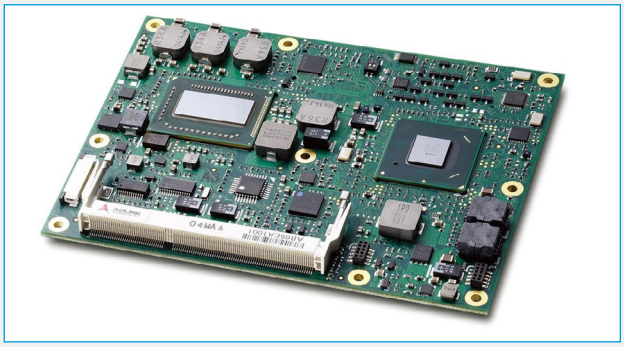

Figure 2: COM Express® Type 6 Module
(Image courtesy of Adlink Technology Inc)

Types	PCI Express Lanes	PEG/ SDVO	PCI	IDE Ports	SATA Ports	LAN Ports	USB 2.0 / USB 3.0	Display Interfaces	Pinout
Type 1 AB connector	Up to 6	-	-	-	4	1	8 / 0	VGA, LVDS	1
Type 2 AB/CD connector	Up to 22	1/2	32-bit	1	4	1	8 / 0	VGA, LVDS, PEG/SDVO	1
Type 3 AB/CD connector	Up to 22	1/2	32-bit	-	4	3	8 / 0	VGA, LVDS, PEG/SDVO	1
Type 6 AB/CDconnector	Up to 24	1/NA	-	-	4	1	8 / 4	VGA, LVDS PEG, 3x DDI	2
Type 10 AB connector	Up to 4	-/1	-	-	2	1	8 / 0	1x DDI	2

COM Express pinout types and supported features (courtesy of Adlink Technology Inc)

ETX®

The ETX® (Embedded Technology Extended) specification includes the standard functions required for almost any application, such as graphics, Ethernet, audio, IDE, floppy, keyboard/mouse, parallel, serial and USB ports, and PCI and ISA system busses. ETX® COMs are 95mm x 114mm.

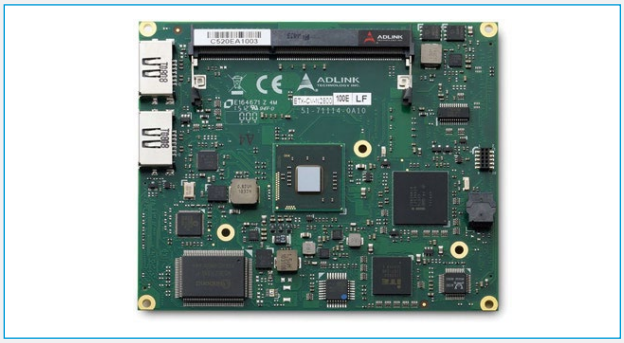

Figure 3: Typical ETX® module
(Image courtesy of Adlink Technology Inc)

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QSeven

The QSeven form factor is designed as a compact, low-cost, low-power module incorporating newer high-speed interfaces.

These devices are compact (70mm x 70mm), low profile and cost effective. Using high-speed interfaces such as PCI Express, SATA, Gigabit Ethernet and USB 2.0, they are available for a wide range of applications, including manned and unmanned transportation, industrial automation, vehicle computers and medical HMI systems.

Qseven modules are designed to have a maximum power of 12W, which allows fan-less operation. They also employ an MXM card slot as its main connector. This is a cost-effective and reliable connection method used in many laptops.

Qseven modules also support SMBus, I2C, SPI and CAN interfaces. CAN is not commonly supported on many other X86 platforms, but widely used in the automotive industry.

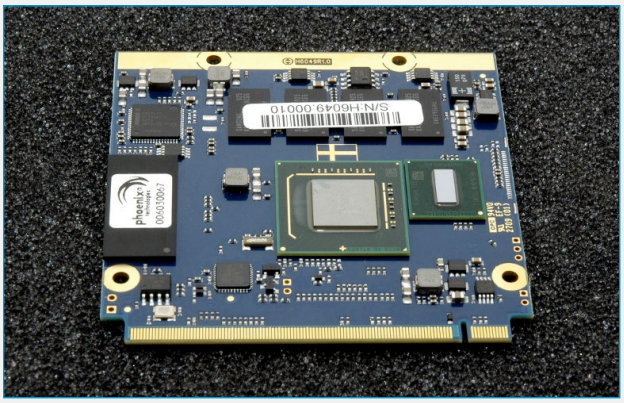

Figure 4: Typical Q7 module
(Image courtesy of Hectronic AB)

SMARC

SMARC® ("Smart Mobility ARChitecture") is a small form factor module design for applications that require very low power, such as battery powered designs, low cost, and high performance.

SMARC® devices include many of the features found in COM Express, such as a number of PCIe, SATA and USB ports, but also provides a combination of interfaces that allow many features of interest not supported by COM Express® to be made available for contemporary mobile applications.

The modules are available in either 82mm x 50mm or 82mm x 80mm sizes.

Figure 5: Typical SMARC module
(Image courtesy of Adlink Technology Inc)

PC104 / PC104+

The PC/104 and PC/104+ are stand-alone modules which don't need their own carrier card (although they are flexible enough to mount on your own designed carrier card if needed) and which stack on top of one another, supported by pillars in the corner. This topology is very rigid, making the modules very reliable in high-vibration applications such as military and transport applications. PC/104 units are based on the ISA bus, and PC/104+ units are based on the ISA and PCI buses.

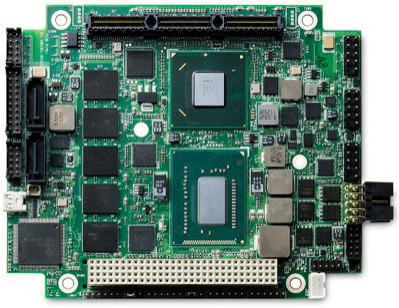

Figure 6: Typical PC/104 module
(Image courtesy of Adlink Technology Inc)

So which is the best COM to use?

COM Express® is the most widely used COM standard that is optimised for PC architecture-based embedded systems. The feature set exploits contemporary PC chipsets. There is support for numerous USB ports and PCI Express lanes, PCI Express graphics, LPC bus and PCI bus, as well as power pins supporting over 100 watts. So if you need a high power processor, then COMe is a good starting point.

ETX® is an excellent choice if interfacing to legacy PCI / ISA/ IDE based systems.

PC104/ PC104+ systems continue to be popular choices for rugged vehicle applications where ISA and PCI connectivity are needed. This form factor is also ideal for low volume applications which may not justify a custom carrier card or where a standard carrier card is too large.

Qseven is a good choice for compact, low-power, cost-efficient mobile applications where fast serial interfaces as well as CAN and I2C Buses are used. However, legacy connectivity such as ISA and PCI is not supported. It should also be noted that Qseven will only support processors running below 12W.

Smarc targets low-power, small-form-factor, mobile applications. The SMARC pin out is optimised for features common to ARM CPUs rather than those of the PC architecture. Some of these features include:

- parallel LCD display interfaces
- camera input
- multiple I2C, I2S, SPI and serial port options
- USB client/host mode and OTG (on the go) operation
- SD/eMMC card operation.

Other COM considerations

Remote monitoring of COM
One of the shortcomings of many COM-based embedded systems is that remote monitoring is not straightforward, and this function may need to be designed into the carrier card.

Recently developed, however, is a system known as SEMA (smart embedded management agent) which allows the designer to monitor many processor functions such as current and power consumption, up time, total operation hours, and temperature of CPU and board, as a standard function built into the COM.

This is especially useful for remote applications, where product life time and early possible system failure can be predicted by monitoring chip temperatures and power consumption.

For a full list of available control and monitoring functions, click here.

Rugged design

For outside and mobile applications, COMs are available with extended temperature ranges (typically -40°C to 85°C) and with HALT (highly accelerated life test) testing. This allows reliable performance in the harshest of conditions. These tests also include vibration and mechanical shock tests.

These tests are usually conducted on a sample basis, but optionally Extended Temperature tests can be carried out on all production units to verify that they will operate reliably over customer specified temperature ranges.

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How to get started?

For most COMs, starter kits and carrier cards are available to help designers. Support and help to define the most suitable module for your application is available from Acal BFi.

Figure 7 below shows a typical starter kit containing COM, CPU, memory, carrier board, cables, heat spreader and heatsink, as well as schematics, design guides, documentation, BSPs and drivers.

Figure 7: Typical COM starter kit
(Image courtesy of Adlink Technology Inc)

Still not sure which is the best COM for your application?

Give Acal BFi expert engineers a call and let them use their experience of helping customers deploy COMs in different applications to help you pick the most suitable device.

Our engineers have helped many customers from industries as diverse as remote operated vehicles and mobile communications systems to pick the most suitable COM for their application.

Acal BFi can also supply a semi-build service where the COM is supplied complete with memory modules attached and/or heat spreader mounted and/or your application installed and tested. This means that the user has a production-friendly unit, saving build and testing time during the manufacturing process.

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