# CEM860 Technical Announcement

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# 1. User Information

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# 2. Introduction

The CEM860 is a Computer-On-Module 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. CEM860 is designed with type-6 definition to be future proof and to provide an advanced bus and signals interfaces with LVDS (Low Voltage Differential Signaling) interfaces as well as PCI Express and Serial ATA on the other hand.

Key features of CEM860 include:

· Rich complement of contemporary high bandwidth serial interfaces, including PCI Express, Serial ATA, USB, and Gigabit Ethernet
· 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, DP, DVI and HDMI terminal drivers plus x16 PEG port to Carrier Board graphics controller

The CEM860 with COM Express™ type-6 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.

## 2.1 COM Express$^{TM}$ Specification and COM Express Design Guide

This Design Guide for CEM860 COM Express type-6 Baseboards is one of three principal references for designing COM Express Baseboards, which carry COM Express Modules.

The three references include:

The PICMG COM Express™ Specification, which defines the three Module Form Factors (Compact, Basic and Extended), pin-outs, and signals. We suggest that you read this document first. You can find the COM Express™ Specification on the PICMG (PCI Industrial Computer Manufacturers Group) Web site: www.picmg.org. There is a fee for the document. All Axiomtek COM Express Modules follow the COM Express™ Specification.

The Axiomtek Design Guide for COM Express Baseboards serves as a general guide for Baseboard designs. The Design Guide focuses on maximum flexibility to accommodate a range of COM Express Modules. The Axiomtek COM Express Design Guide explores the requirements of the COM Express™ Specification and provides recommendations on how to design COM Express Baseboards to support features of Axiomtek COM Express Modules.

The COM Express Design Guide provides schematic examples and information on standard I/O interfaces, connections, and routing. The guide also offers ideas to maximize the design potential of COM Express Baseboards to accommodate all Axiomtek COM Express Modules.

COM Express Module User Guides document specifications and features of an individual COM Express Module. You can find all user guides for COM Express Modules on the Axiomtek Website.

Axiomtek Co., Ltd. website at http://www.axiomtek.com

## 2.2 Acronyms / Definitions

Acronyms and terms used in this document are defined in the table below.

**Table 2-1 Terms and Definitions**

| Term | Definition |
| --- | --- |
| **AC '97** | Audio CODEC (Coder-Decoder) |
| **ACPI** | Advanced Configuration Power Interface – standard to implement power saving modes in PC-AT systems |
| **Basic Module** | COM Express™ 125mm x 95mm Module form factor. |
| **BIOS** | Basic Input Output System – firmware in PC-AT system that is used to initialize system components before handing control over to the operating system. |
| **Carrier Board** | An application specific circuit board that accepts a COM Express™ Module. |
| **CCTV** | Closed Circuit Television |
| **CVBS** | Composite Video Baseband Signal |
| **Compact Module** | COM Express™ 95x95 Module form factor |
| **DDC** | Display Data Control – VESA (Video Electronics Standards Association) standard to allow identification of the capabilities of a VGA monitor |
| **DIMM** | Dual In-line Memory Module |
| **DisplayPort** | DisplayPort is a digital display interface standard put forth by the Video Electronics Standards Association (VESA). It defines a new license free, royalty free, digital audio/video interconnect, intended to be used primarily between a computer and its display monitor. |
| **DRAM** | Dynamic Random Access Memory |
| **DVI** | Digital Visual Interface - a Digital Display Working Group (DDWG) standard that defines a standard video interface supporting both digital and analog video signals. The digital signals use TMDS. |
| **EAPI** | Embedded Application Programming Interface<br>Software interface for COM Express specific industrial functions<br>• System information<br>• Watchdog timer<br>• I2C Bus<br>• Flat Panel brightness control<br>• User storage area<br>• GPIO |
| **EEPROM** | Electrically Erasable Programmable Read-Only Memory |
| **Extended Module** | COM Express™ 155mm x 110mm Module form factor. |
| **FR4** | A type of fiber-glass laminate commonly used for printed circuit boards. |
| **Gb** | Gigabit |
| **GBE** | Gigabit Ethernet |
| **GPI** | General Purpose Input |
| **GPIO** | General Purpose Input Output |
| **GPO** | General Purpose Output |
| **HDA** | Intel High Definition Audio (HD Audio) refers to the specification released by Intel in 2004 for delivering high definition audio that is capable of playing back more channels at higher quality than AC97. |
| **HDMI** | High Definition Multimedia Interface |
| **$I^2C$** | Inter Integrated Circuit – 2 wire (clock and data) signaling scheme allowing communication between integrated circuits, primarily used to read and load register values. |
| **IDE** | Integrated Device Electronics – parallel interface for hard disk drives – also known as PATA |
| **Legacy Device** | Relics from the PC-AT computer that are not in use in contemporary PC systems: primarily the ISA bus, UART-based serial ports, parallel printer ports, PS-2 keyboards, and mice. Definitions vary as to what constitutes a legacy device. Some definitions include IDE as a legacy device. |
| **LAN** | Local Area Network |

| Term | Definition |
| --- | --- |
| **LPC** | Low Pin-Count Interface: a low speed interface used for peripheral circuits such as Super I/O controllers, which typically combine legacy-device support into a single IC. |
| **LS** | Least Significant |
| **LVDS** | Low Voltage Differential Signaling – widely used as a physical interface for TFT flat panels. LVDS can be used for many high-speed signaling applications. In this document, it refers only to TFT flat-panel applications. |
| **MS** | Most Significant |
| **NA** | Not Available |
| **NC** | No Connect |
| **NTSC** | National Television Standards Committee – video broadcast standard used in North America |
| **OEM** | Original Equipment Manufacturer |
| **PAL** | Phase Alternating Line – video broadcast standard used in many European countries. |
| **PATA** | Parallel AT Attachment – parallel interface standard for hard-disk drives – also known as IDE, AT Attachment, and as ATA |
| **PC-AT** | "Personal Computer – Advanced Technology" – an IBM trademark term used to refer to Intel x86 based personal computers in the 1990s |
| **PCB** | Printed Circuit Board |
| **PCI** | Peripheral Component Interface |
| **PCI Express**<br>**PCIE** | Peripheral Component Interface Express – next-generation high speed Serialized I/O bus |
| **PEG** | PCI Express Graphics |
| **PHY** | Ethernet controller physical layer device |
| **Pin-out Type** | A reference to one of seven COM Express™ definitions for the signals that appear on the COM Express™ Module connector pins. |
| **PS2**<br>**PS2 Keyboard**<br>**PS2 Mouse** | "Personal System 2" - an IBM trademark term used to refer to Intel x86 based personal computers in the 1990s. The term survives as a reference to the style of mouse and keyboard interface that were introduced with the PS2 system. |
| **$R_a$** | Roughness Average – a measure of surface roughness, expressed in units of length. |
| **ROM** | Read Only Memory – a legacy term – often the device referred to as a ROM can actually be written to, in a special mode. Such writable ROMs are sometimes called Flash ROMs. BIOS is stored in ROM or Flash ROM. |
| **RTC** | Real Time Clock – battery backed circuit in PC-AT systems that keeps system time and date as well as certain system setup parameters |
| **SAS** | Serial Attached SCSI – high speed serial version of SCSI |
| **SCSI** | Small Computer System Interface – an interface standard for high end disk drives and other computer peripherals |
| **SPD** | Serial Presence Detect – refers to serial EEPROM on DRAMs that has DRAM Module configuration information |
| **SPI** | Serial Peripheral Interface |
| **SO-DIMM** | Small Outline Dual In-line Memory Module |
| **S0, S1, S2, S3, S4, S5** | System states describing the power and activity level<br><br>S0 Full power, all devices powered<br>S1<br>S2<br>S3 Suspend to RAM System context stored in RAM; RAM is in standby<br>S4 Suspend to Disk System context stored on disk<br>S5 Soft Off Main power rail off, only standby power rail present |
| **SATA** | Serial AT Attachment: serial-interface standard for hard disks |
| **SDVO** | Serialized Digital Video Output – Intel defined format for digital video output that can be used with Carrier Board conversion ICs to create parallel, TMDS, and LVDS flat-panel formats as well as NTSC and PAL TV outputs |
| **SM Bus** | System Management Bus |
| **Super I/O** | An integrated circuit, typically interfaced via the LPC bus that provides legacy PC I/O functions including PS2 keyboard and mouse ports, serial and parallel port(s) and a floppy interface. |
| **TFT** | Thin Film Transistor – refers to technology used in active matrix flat-panel displays, in which there is one thin film transistor per display pixel. |
| **TMDS** | Transition Minimized Differential Signaling - a digital signaling protocol between the graphics subsystem and display. TMDS is used for the DVI digital signals. |
| **TPM** | Trusted Platform Module, chip to enhance the security features of a computer system. |

| Term | Definition |
|---|---|
| USB | Universal Serial Bus |
| VGA | Video Graphics Adapter – PC-AT graphics adapter standard defined by IBM. |
| WDT | Watch Dog Timer. |
| XAUI | 10 Gigabit / sec Attachment Unit Interface. |

# 3. COM Express™ Specification

The COM Express™ type-6 Specification defines requirements for highly integrated compact modules with standard I/O interfaces and connections, which allows interoperability between multi-sourced modules.

Key capabilities defined in the COM Express™ Specification include support for:

- PCI Express Bus
- PCI Express Graphics (PEG)
- Serial ATA
- USB 2.0/3.0
- Gigabit Ethernet
- DDI interface

The CEM860 COM Express™ Specification defines form factor:

- Basic (125mm x 95mm) Module

The mechanical envelope for the Basic Module is defined for low-profile, space-constrained applications.

Basic Modules usually use a single (or two stacked) horizontal mount SO-DIMM.

Type-6 apply to Basic form factors:

- Module Types-6 supports two connectors with four rows of pins (440 pins total).

Connector placement and most mounting holes have transparency between Form Factors.

The differences among the Module Types are summarized in Table 3-1.

**Table 3-1 Module Type Summary Features**

| Types | Connector Rows | PCI Express Lanes | PEG/ SDVO | PCI | IDE Ports | SATA Ports | LAN Ports | USB 2.0 / SuperSpeed USB | Display Interfaces |
|---|---|---|---|---|---|---|---|---|---|
| Type 1 | A-B | Up to 6 | - | - | - | 4 | 1 | 8 / 0 | VGA, LVDS |
| Type 2 | A-B C-D | Up to 22 | 1/2 | 32 bit | 1 | 4 | 1 | 8 / 0 | VGA, LVDS, PEG/SDVO |
| Type 3 | A-B C-D | Up to 22 | 1/2 | 32 bit | - | 4 | 3 | 8 / 0 | VGA, LVDS, PEG/SDVO |
| Type 4 | A-B C-D | Up to 32 | 1/2 | - | 1 | 4 | 1 | 8 / 0 | VGA, LVDS, PEG/SDVO |
| Type 5 | A-B C-D | Up to 32 | 1/2 | - | - | 4 | 3 | 8 / 0 | VGA, LVDS, PEG/SDVO |
| Type 6 | A-B C-D | Up to 24 | 1/NA | - | - | 4 | 1 | 8 / 4 | 3xDDI , PEG, VGA, LVDS |
| Type 10 | A-B | Up to 4 | -/1 | - | - | 2 | 1 | 8 / 0 | 1xDDI |

## 3.1 Synopsis

Table 3-1 provides a quick overview of the key functionality of COM Express Modules as defined in the COM Express™ Specification.

All Module Types minimally support the following key interfaces:

- 1 PCI Express (PCIe) Lanes
- 1 LAN Port 10/100/1000 Base-T
- 1 SATA Port
- 4 USB Ports (0 thru 3)
- 1 LPC Bus

Module Types-6 optionally supports the following key interface:

- PCI Express Graphics (PEG), configured for one of the following:
  PCIe Graphics (x16), DDI or PCI Express (PCIe) Lanes (16 thru 31)

# 4. COM Express Baseboard Design

## 4.1 PCB Design Rules

The COM Express™ Specification provides a rich set of modern, high-speed differential serial interfaces.

Designing COM Express Baseboards is not difficult, but certain design rules must be followed.

The most important design rule is: route high-speed serial interfaces as differential pairs. The two lines in the pair must be length-matched and should have uniform edge-to-edge spacing. They should have a minimum of layer changes. If they do change layers, both lines in the pair should change. The preferred reference plane for the high-speed pairs is a single, continuous GND plane. If the differential pair is referenced to a power plane, avoid routing the pair across a power-plane split.

## 4.2 Trace-Impedance Considerations

Most high-speed interfaces used in a COM Express design for a Baseboard are differential pairs that need a well-defined and consistent differential and single-ended impedance. The differential pairs should be edge-coupled (i.e. the two lines in the pair are on the same PCB layer, at a consistent spacing to each other). Broadside coupling (in which the two lines in the pair track each other on different layers) is not recommended for mainstream commercial PCB fabrication.

There are two basic structures used for high-speed differential and single-ended signals. The first is known as a “microstrip”, in which a trace or trace pair is referenced to a single ground or power plane.

The outer layers of multi-layer PCBs are microstrips. A diagram of a microstrip cross section is shown in Figure 4-1 below.

The second structure is the “strip-line” in which a trace or pair of traces is sandwiched between two reference planes, as shown in Figure 4-2 below. If the traces are exactly halfway between the reference planes, then the strip-line is said to be symmetric or balanced. Usually the traces are a lot closer to one of the planes than the other (often because there is another, orthogonal, trace layer, which is not shown in Figure 4-2). In this case, the strip-lines are said to be asymmetric or un-balanced. Inner layer traces on multi-layer PCBs are usually asymmetric strip-lines.

Before proceeding with a Baseboard layout, designers should decide on a PCB stack-up and on trace parameters, primarily the trace-width and differential-pair spacing. It is quite a bit harder to change the differential impedance of a trace pair after layout work is done than it is to change the impedance of a single-ended signal. That is because (with reference to Figures 4-1, and Table 4-1 below) the geometric factors that have the biggest impact on the impedance of a single-ended trace are H1 and W1.Both H1 and W1 can be manipulated slightly by the PCB vendor. The differential impedance of a trace pair depends primarily on H1, W1 and the pair pitch. A PCB vendor can easily manipulate H1 and W1 but changing the pair pitch cannot generally be done at fabrication time. It is more important for the PCB designer and the Project Engineer to determine the routing parameters for differential pairs ahead of time.

Work with a PCB vendor on a suitable board stack-up and do your own homework using a PCB-impedance calculator. An easy to use and comprehensive calculator is available from Polar Instruments (www.polarinstruments.com). Many PCB vendors use software from Polar Instruments for their calculations. Polar Instruments offers an impedance calculator on a low-cost, per-use basis. To find this, search the Web for a “Polar Instruments subscription”. Alternatively, impedance calculators are included in many PCB layout packages, although these are often incomplete when it comes to differential-pair impedances. There also are quite a few free impedance calculators available on the Web. Most are very basic, but they can be useful.

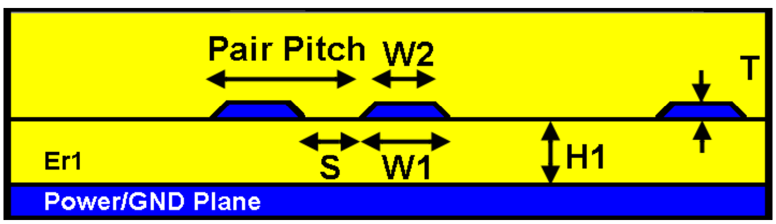


Figure 4-1 Microstrip Cross Section

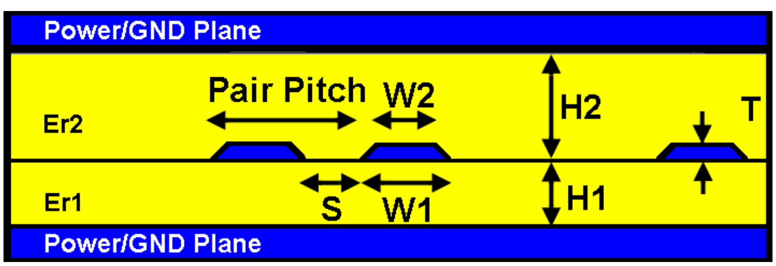


Figure 4-2 Asymmetric Strapline Cross Section

| Symbol | Definition |
|---|---|
| Er1 | Dielectric constant of material between the trace and the reference plane.<br>Increasing Er1 results in a lower trace impedance. |
| Er2<br>H1 | Dielectric constant of the material between the 2nd reference plane (strapline case only). Usually Er1 and Er2 are the same. Increasing Er2 results in a lower trace impedance. Distance between the trace lower surface and the closer reference plane. Increasing H1 raises the trace impedance (assuming that H1 is less than H2). |
| H2 | Distance between the trace lower surface and the more distant reference plane (strapline case only). Usually H2 is significantly greater than H1. When this is true, the lower plane shown in the figure is the primary reference plane. Increasing H2 raises the trace impedance. |
| Pair Pitch | The center-to-center spacing between two traces in a differential pair. Increasing the pair pitch raises the differential trace impedance. |
| S | The spacing or gap between two traces in a differential pair. The pair pitch is the sum of S and W1. Increasing S raises the differential trace impedance. |
| T | The thickness of the trace. The thickness of a ½ oz. inner layer trace is about 0.0007 inches. The thickness of a 1 oz. inner layer trace is about 0.0014 inches. Outer layer traces using a given copper weight are thicker, due to plating that is usually done on outer layers. Increasing the trace thickness lowers trace impedance. |
| W1、W2 | W1 is the base thickness of the trace. W2 is the thickness at the top of the trace. The relation between W1 and W2 is called the “etch factor” in the PCB trade. For rough calculations, it can be assumed that W1 = W2. The etch factor is process dependent. W2 is often about 0.001 inches less than W1 for ½ Oz inner layer traces For example, a 5 mil (0.005 inch) nominal trace will be 5-mil wide at the bottom and 4-mil wide at the top. Increasing the trace-width lowers trace impedance. |

***Table 4-1 Microstrip and strapline Definitions***

# 5. COM Express Module Connectors

## 5.1 Connector Descriptions

Descriptions, part numbers, and land patterns for COM Express Connectors are provided in the COM Express™ Specification. The discussion below augments the description given in the Specification.

COM Express Baseboards that implement Pin-out Types 2, 3, 4 ,5 or 6 use a pair of 220-pin, 0.5mm-pitch, surface-mount connectors for a total of 440 pins. Each connector has two rows of 110 pins. For the full 440-pin implementation, there are four rows of 110 pins each. The four rows are labeled A, B, C and D in the COM Express™ Specification. The two 220-pin connectors are referred to as the 'A-B' connector and the 'C-D' connector. Only Type 1/10 Modules use a single 220-pin connector, the 'A-B' connector.

The connectors are from the AMP / Tyco 0.5mm pitch 'Freeheight', or FH family. There may later be alternate suppliers, per the terms imposed on the primary connector vendor by the PICMG. COM Express Baseboard connectors are available in stacking heights of 8mm and 5mm.

The Baseboard connector is the 'Plug.' (It is a plug in the vendor's terminology; although to some users it looks more like a receptacle). The module connector is the 'Receptacle' in the vendor's terminology. The module is always built with the same connector, the 4mm receptacle ('4H' in the vendor's terminology). The system's stack height is determined by the choice of the Baseboard connector. The options available in this pin count are 8mm ("8H Plug") and 5mm ("5H Plug").

A pair of 220-pin COM Express Carrier-Board connectors is available from the vendor in a bridged configuration in which the two 220-pin connectors are held together during assembly by a disposable bridge. The bridge keeps the two connectors aligned, relative to each other, during assembly. The bridge also has a pad that can be used by pick and place equipment to pick up the connector pair.

The 8mm stack height 440 pin (bridged 220 pin pair) plug suitable for the Baseboard has the following part numbers:

| | |
|---|---|
| AMP / Tyco | 3-5353652-6 |
| FOXCONN | QT002206-4131-9F |

The 5mm stack height 440 pin (bridged 220 pin pair) plug suitable for the Baseboard has the following part numbers:

| | |
|---|---|
| AMP / Tyco | 3-1827233-6 |

## 5.2 Connector Land Patterns and Alignment

It is extremely important that the designers of Baseboards ensure that the COM Express connectors have the proper land patterns and that the connectors are aligned correctly. The land pattern is diagrammed in the COM Express™ Specification. Connector alignment is ensured if the peg location holes in the PCB connector pattern are in the correct positions (as shown in the land pattern of the COM Express™ Specification) and if the holes are drilled to the proper size and tolerance by the PCB fabricator.

## 5.3 Connector and Module CAD Symbol Recommendations

The 440-pin COM Express™ connector should be shown in the Baseboard CAD system as a single schematic symbol and a single PCB symbol, rather than as a pair of 220-pin symbols. This ensures that the relative position of the two 220-pin connectors' remains correct as PCB placement for the Baseboard is done.

It also is very advantageous to extend this concept to include the Express Module outline and the Module mounting holes in the same PCB land pattern. This allows PCB designers to easily move the entire module around to try placement options without losing the relative positions and orientations of the Module connectors, mounting holes, and Module outline.

## 5.4 Connector Schematics (Type 6 Pin-Out)

The following schematics show available signals for the COM Express connector pins for Connector Rows A, B, C and D as defined in the COM Express™ Specification for a Type 6 pin-out. The schematics show available and unused signals. COM Express connectors are treated in the schematic as a single, 440-pin connector, S1 (with pin Rows A, and B) and S2 (with pin Rows C and D).

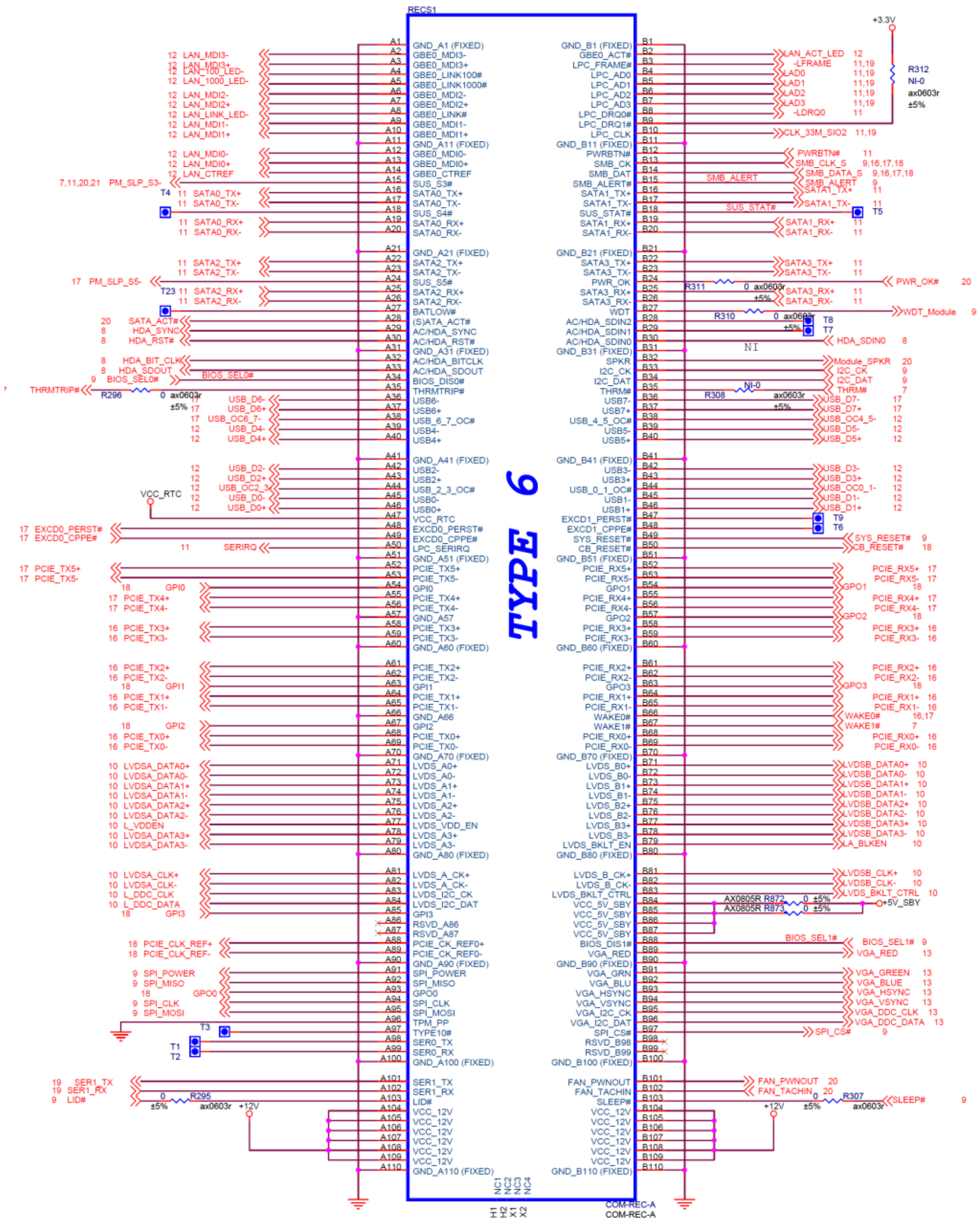



**Figure 5-1 COM Express™ Connector S1 Schematic(Type 6 Pin-Out)**

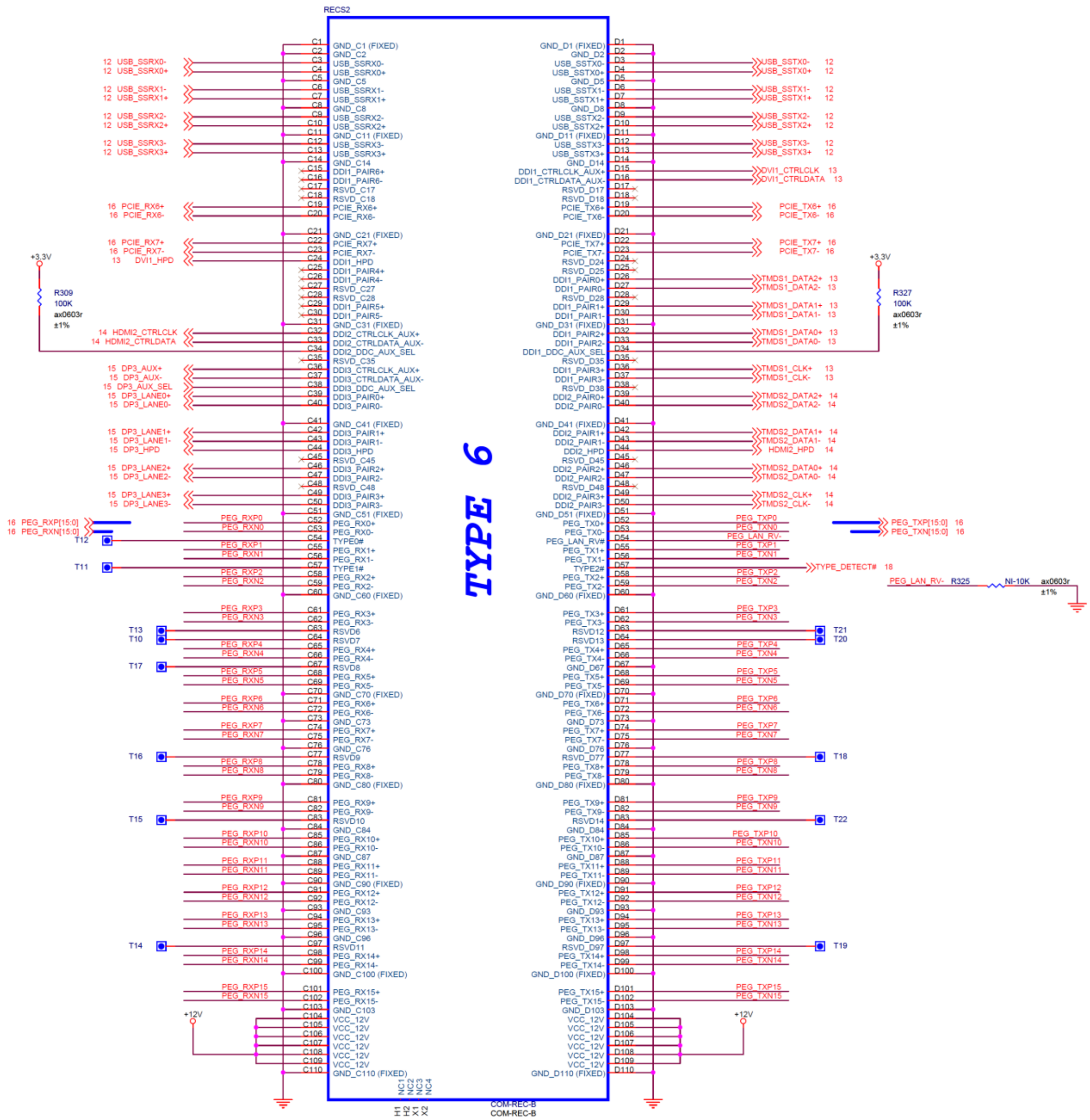



**Figure 5-2 COM Express™ Connector S2 Schematic(Type 6 Pin-Out)**

# 6. Electrical Specification

## 6.1 Input Power – General Considerations

The 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 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.

## 6.2 Input Power – Current Load

The Module connector pins limit the amount of power that can be brought into the COM Express™ Modules. The limits are different for Module Pin-out Types 1, and 10; and for Pinout Types 2 through 6 as Pin-out Type 1 and 10 have fewer pins available.

**Table 17-1 Input Power- Pin-out Type 1,10 Modules(Single Connector,220 pins)**

| Power Rail | Module Pin Current Capability (Amps) | Nominal Input (Volts) | Input Range (Volts) | Derated Input (Volts) | Max Input Ripple (mV) | Max Module Input Power (w. derated input) (Watts) | Assumed Conversion Efficiency | Max Load Power (Watts) |
|---|---|---|---|---|---|---|---|---|
| VCC_12V | 6 | 12 | 11.4 - 12.6 | 11.4 | +/- 100 | 68 | 85% | 58 |
| VCC_5V_SBY | 2 | 5 | 4.75 – 5.25 | 4.75 | +/- 50 | 9 | | |
| VCC_RTC | 0.5 | 3 | 2.0 - 3.3 | | +/- 20 | | | |

**Table 17-2 Input Power- Pin-out Type 2-6 Modules(Dual Connector,440 pins)**

| Power Rail | Module Pin Current Capability (Amps) | Nominal Input (Volts) | Input Range (Volts) | Derated Input (Volts) | Max Input Ripple (mV) | Max Module Input Power (w. derated input) (Watts) | Assumed Conversion Efficiency | Max Load Power (Watts) |
|---|---|---|---|---|---|---|---|---|
| VCC_12V | 12 | 12 | 11.4 - 12.6 | 11.4 | +/- 100 | 137 | 85% | 116 |
| VCC_5V_SBY | 2 | 5 | 4.75 – 5.25 | 4.75 | +/- 50 | 9 | | |
| VCC_RTC | 0.5 | 3 | 2.0 - 3.3 | | +/- 20 | | | |

## 6.3 Input Power – Sequencing

COM Express™ input power sequencing requirements are as follows:

VCC_RTC shall come up at the same time or before VCC_5V_SBY comes up.

VCC_5V_SBY shall come up at the same time or before VCC_12V comes up.

PWROK shall be active at the same time or after VCC_12V comes up.

PWROK shall be inactive at the same time or before VCC_12V goes down.

VCC_12V shall go down at the same time or before VCC_5V_SBY goes down.

VCC_5V_SBY shall go down at the same time or before VCC_RTC goes down.

**Figure 17-1 Power Sequencing**

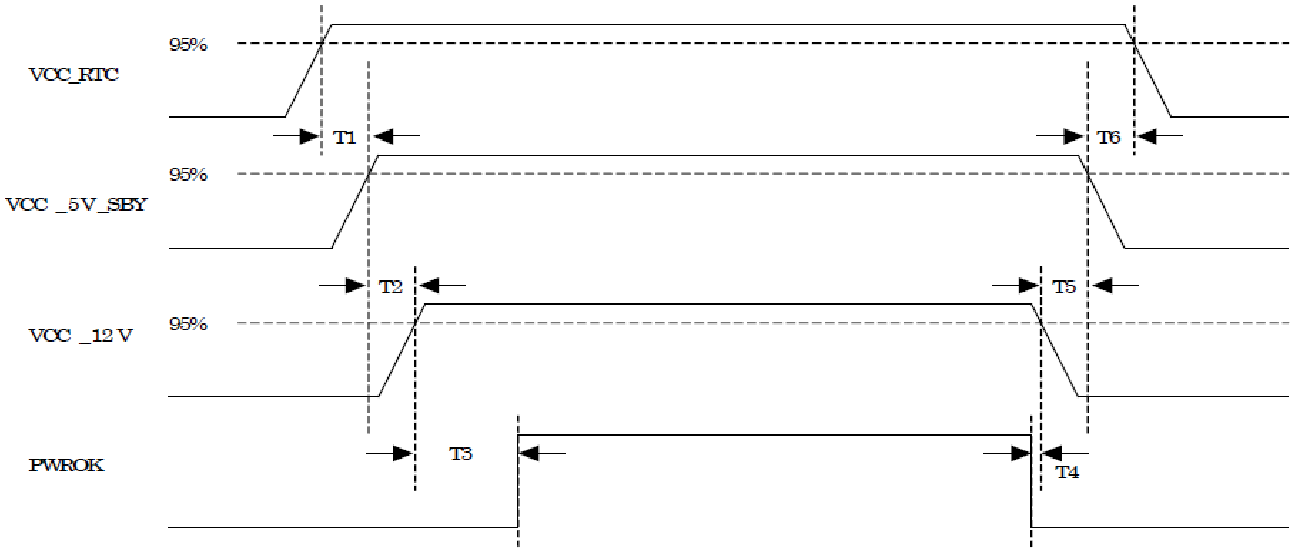


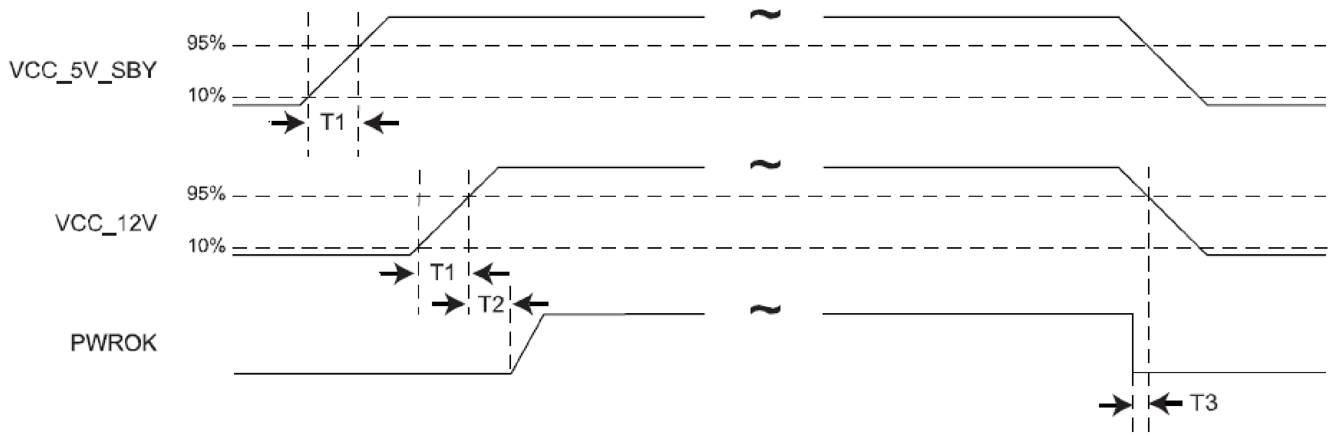

**Table 17-3 Power Sequencing**

| | | |
|---|---|---|
| T1 | VCC_RTC rise to VCC_5V_SBY rise | ≥ 0 ms |
| T2 | VCC_5V_SBY rise to VCC_12V rise | ≥ 0 ms |
| T3 | VCC_12V rise to PWROK rise | ≥ 0 ms |
| T4 | PWROK fall to VCC_12V fall | ≥ 0 ms |
| T5 | VCC_12V fall to VCC_5V_SBY fall | ≥ 0 ms |
| T6 | VCC_5V_SBY fall to VCC_RTC fall | ≥ 0 ms |

## 6.4 Input Power – Rise Time

The input voltages to the COM Express module VCC_12V and VCC_5V_SBY if used shall rise from ≤10% of nominal to within the regulation ranges within 0.1 ms to 20 ms (0.1 ms ≤ T2 ≤ 20 ms). There must be a smooth and continuous ramp of each DC output voltage from 10% to 90% of its final set point within the regulation band. The smooth turn-on requires that, during the 10% to 90% portion of the rise time, the slope of the turn-on waveform must be positive and have a value of between 0 V/ms and [Vout, nominal / 0.1] V/ms. Also, for any 5ms segment of the 10% to 90% rise time waveform, a straight line drawn between the end points of the waveform segment must have a slope ≥ [Vout, nominal / 20] V/ms.

**Figure 17-2 Input Power Rise Time**




T1,min = 0.1ms

T1,max = 20ms

T2 ≥ 0ms

T3 ≥ 0ms

The values chosen were selected to be compatible and enable use of ATX specification R2.2

# Appendix

## Technical References

This ETX Hardware Specification makes reference to, and is based on, the current versions of the following specifications:

- Axiomtek Co., Ltd. website at http://www.axiomtek.com
- PC/104 Specification, Version 2.3, PC/104 Consortium, visit http://www.PC104.org
- PC/104-Plus Specification, Version 1.1, PC/104 Consortium, visit http://www.PC104.org
- Intel Corporation at http://www.intel.com
- PCI Local Bus Specification, Revision 2.2, PCI Special Interest Group
- ISA Bus Specification, IEEE P996
- AT Attachment - 5 with Packet Interface (ATA/ATAPI-5), ANSI NCITS 340–2000
- Standard Test Access Port and Boundary Scan Architecture, IEEE 1149.1
- Display Data Channel Standard, Version 3, VESA
- Universal Serial Bus Specification, Revision 1.1, Compaq, Intel, Microsoft, NEC
- Standard Signaling Method for a Bi-directional Parallel Peripheral Interface for Personal Computers, IEEE 1284–1994
- VIA Technologies, Inc. at http://www.via.com.tw
- Realtek Semiconductor Corp. at http://www.realtek.com.tw
- Switchtech Enterprise Limited at http://www.mbmags.com/switchtech