EECE494:
Computer Bus and SoC Interfacing

IC PACKAGES & COMPUTER BUS

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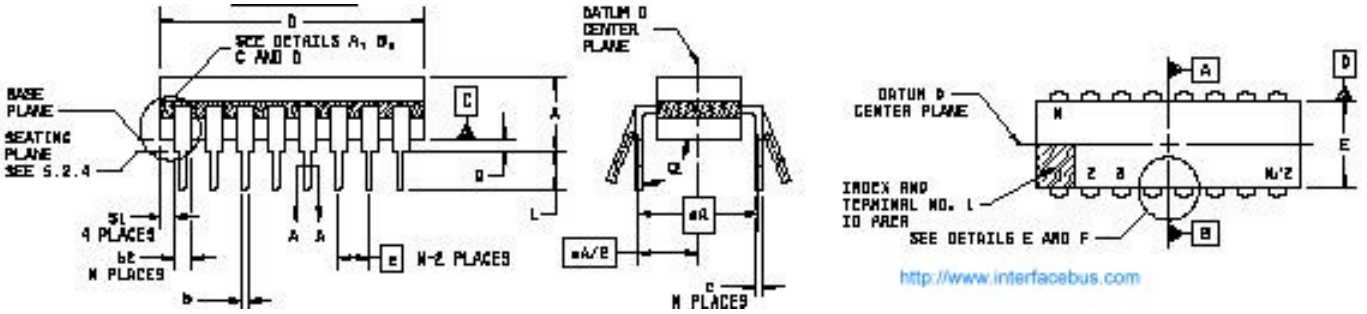
Bus? SoC? Interfacing?

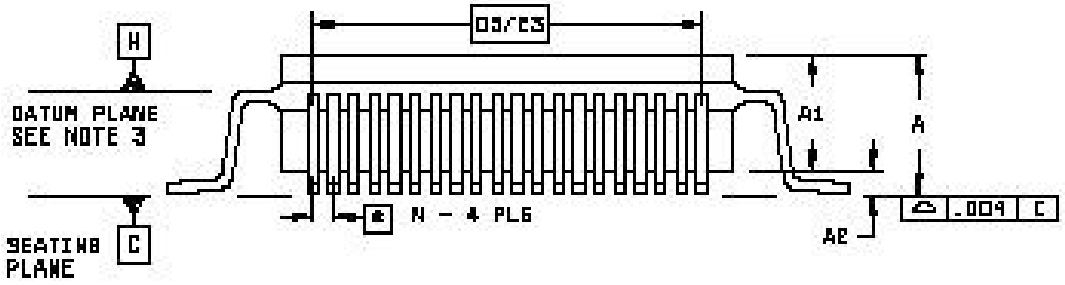
- **Bus**:
  - A common and standardized electrical pathway between multiple devices in a computer
  - Method of transmitting data from one part of the computer to another part of the computer.
- **SoC**:
  - "System On a Chip": All components of a computer in to a single chip
  - SoC vs. (Microcontroller): "degree of integration": more (less) powerful processors; capable(incapable) of running OS (Windows or Linux); inclusion (exclusion) of timing sources; available (unavailable)industry standard **interfaces** such as USB, Ethernet, USART, SPI, etc.
- Chip (package) types:

IC Package Types

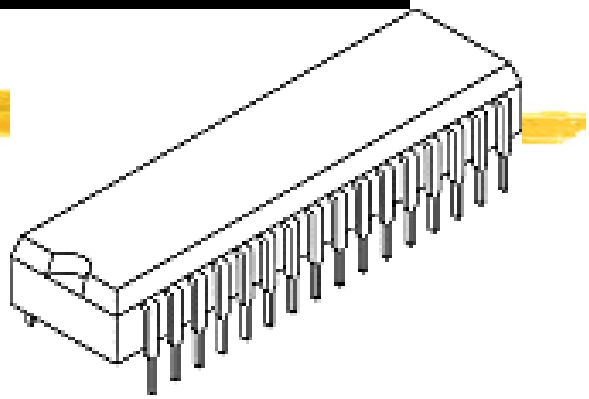
- Thru-Hole Device Type



- Surface-Mount Device Type



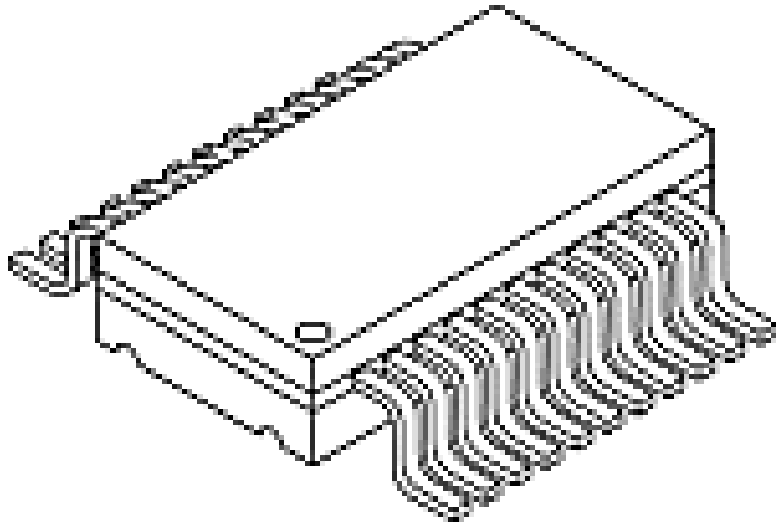
IC PACKAGE TYPES



- DIP (Dual-In-Line Package)
  - Most Popular 1st Generation IC package type
  - Thru-hole device with 0.1” spacing two sides
  - Body width: 0.3”, 0.4”, 0.6”, or 0.9”
- SDIP (Shrink DIP)
  - Higher pin counts
  - Body width: 0.6” or 0.75”

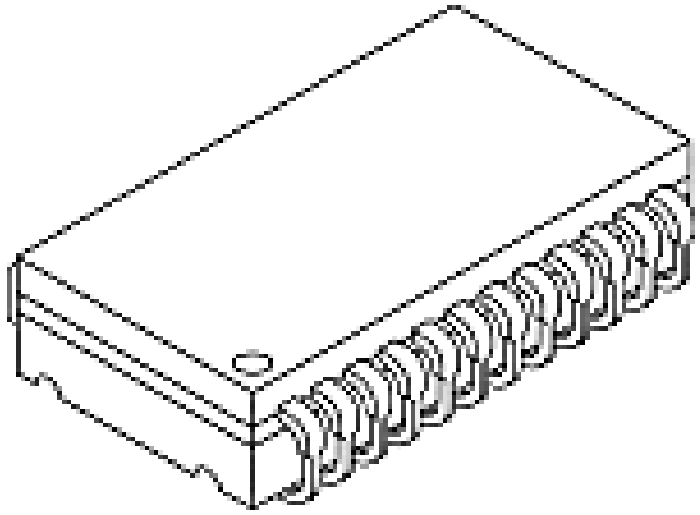
IC Package Type

- SOIC (Small Outline IC)
  - The first surface-mount package to replace small pin count (i.e. 8-16) DIP packages.
  - "Gull Wing" package
  - Pitch: 1.27mm

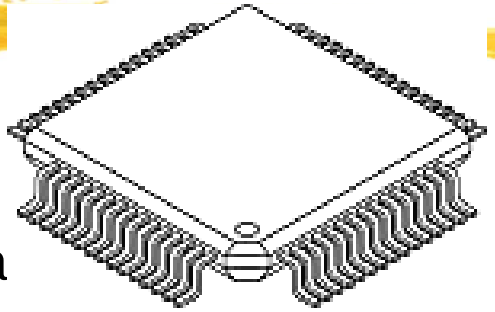


IC Package Type

- SOJ (Small Outline J-Leaded)
  - a surface-mount equivalent to a thru-hole DIP.
  - lead pitch is reduced to 50 mil (1.27mm).
  - Pins protrude on two sides of the plastic package body and curl under it.
  - The lead looks like the letter "J“.



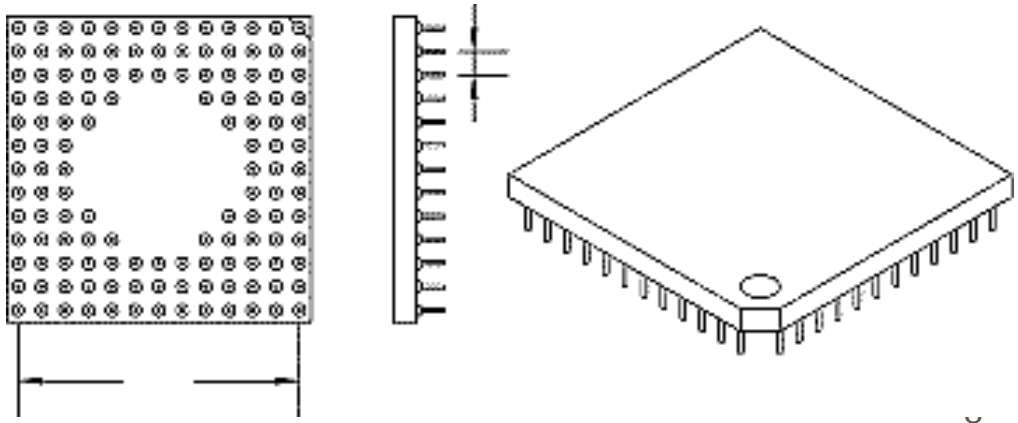
IC Package Type



- **QFP (Quad Flat Pack)**
  - high-density, surface-mount packages
  - leads protruding on all four sides of the packa
- **Package Variations**
  - Ceramic Quad Flat Pack (CQFP): similar to PQFP, but the body size can differ substantially.
  - Metal Quad Flat Pack (MQFP): Package material is metal.
  - Thin Quad Flat Pack (TQFP): body thickness of 2mm or less.
  - Very (small) Quad Flat Pack (VQFP): Same as TQFP.

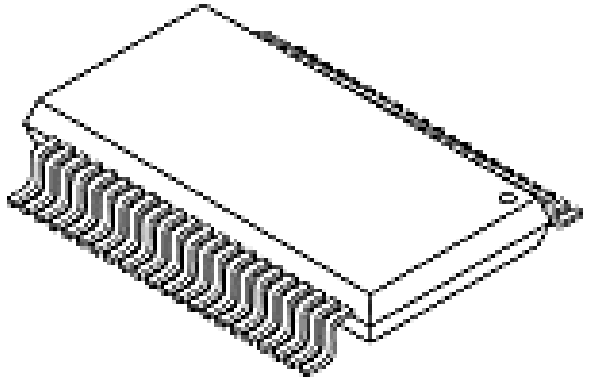
IC Package Type

- **PGA (Pin Grid Array)**
  - Second generation package.
  - thru-hole, but reduced size
  - pins are located on a 0.1" grid in various patterns.
- **Package Variations**
  - Interstitial package(IPGA): carries additional pins on a 0.5" offset pattern in between the pins of a regular PGA pattern.
  - doubles the available pins on the same package size as a standard PGA.



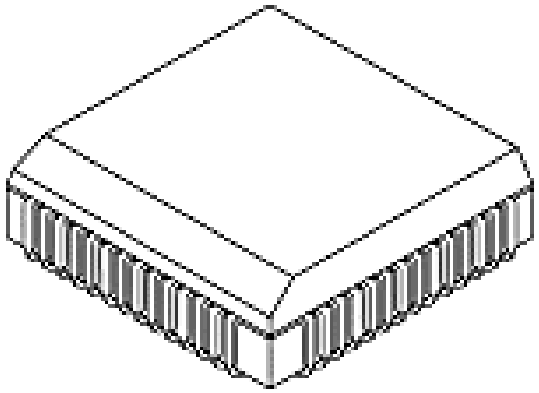
IC Package Type

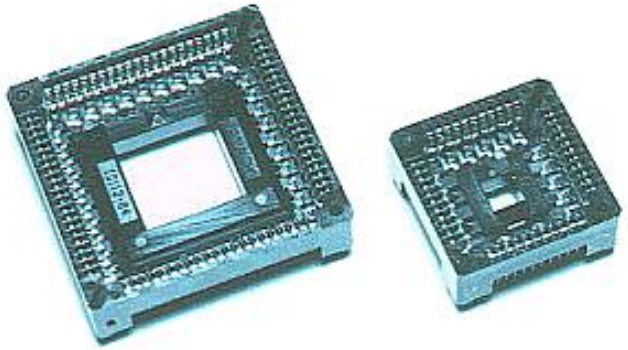
- **TSOP (Thin Small Outline Package)**
  - **a special variation of the SOIC**
  - **TSOP I has the pins on the WIDE edge.**
  - **TSOP II has leads on NARROW side and looks more like a DIP package that was shrunk and turned into a surface mount package.**
  - **Package Variations**
    TSOP I -- Pitch 0.5 or 0.55mm
    TSOP II -- Pitch: 0.65, 0.8 or 1.25mm
    TSSOP -- Pitch: 0.4, 0.5 or 0.65mm



IC Package Type

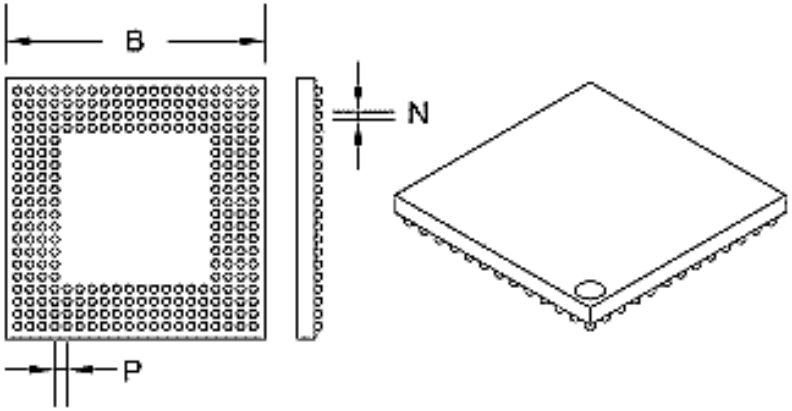
- **PLCC (Plastic Leaded Chip Carrier)**
  - Third generation packaging.
  - a more popular version of the SOJ.
  - leads on all four sides.
- **Package Variations**
  - LCC (Leadless Chip Carrier): Ceramic body material with no physical lead. There are only pads on the bottom of the IC around the edges.
  - JLCC (J Leaded Chip Carrier): Ceramic body material with leads similar to PLCC package.





IC Package Type

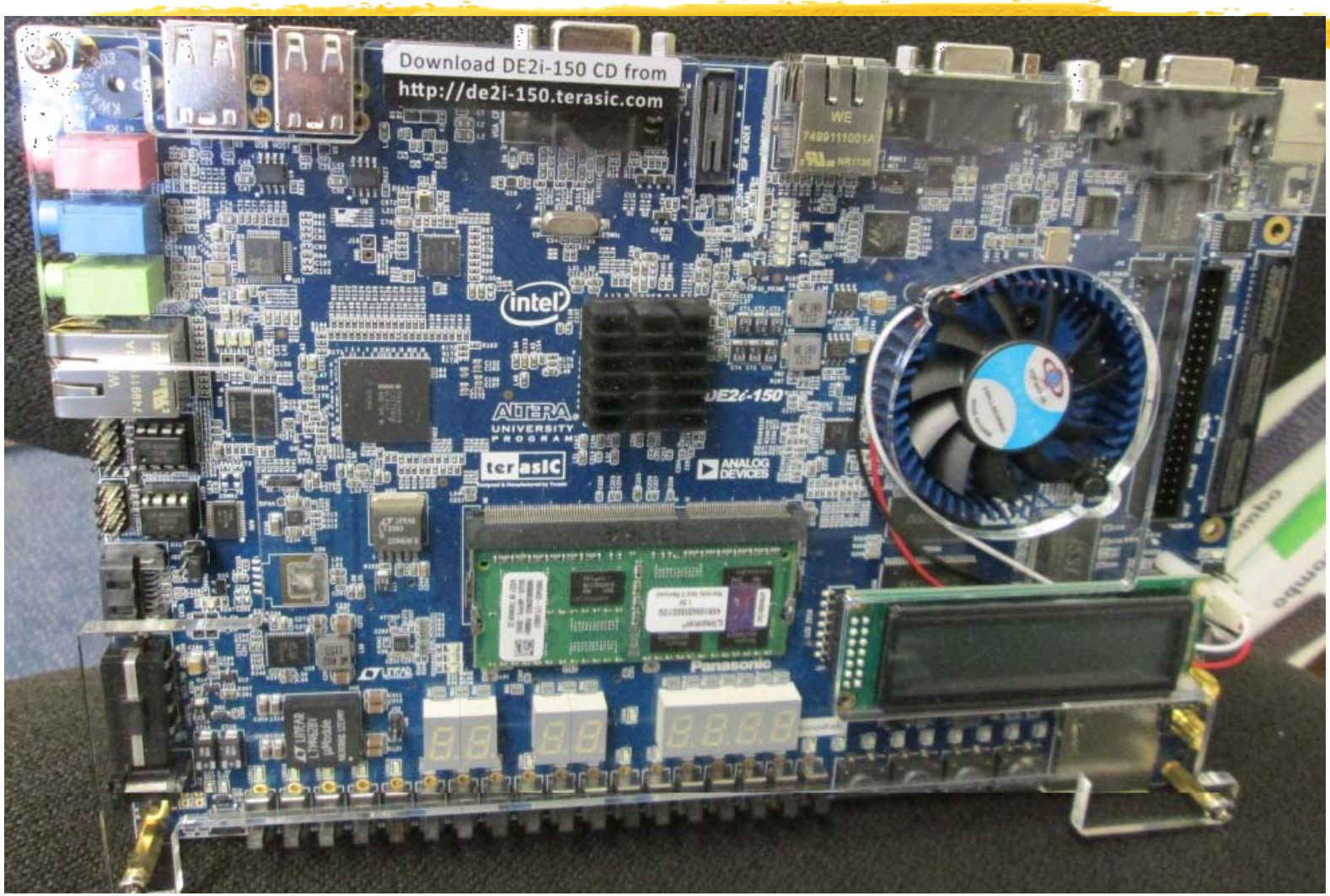
- **BGA (Ball Grid Array)**
  - **One of the latest in high-density, surface-mount packages.**
  - **pin connections are solder balls in a grid pattern, in the package bottom.**
- **Package Variations**
  - **MicroBGA: finer grids. There are three prevalent Micro BGA pitches: 0.65, 0.75 and 0.8mm.**
  - **Interstitial BGA (IBGA) :carries additional pins, in an offset pattern, in between the balls of a regular BGA pattern. It almost doubles the available connections on the same package size as a regular BGA.**



IC Type Activity

- Find as many IC types as your team can from the DE2i-150 Kit
  - IC Type: IC Name (Face)

IC Package Activity – Identify and Mark



BUS and Computer Bus

- **Concept of Computer Bus**
  - **A common and standardized electrical pathway between multiple devices in a computer**
  - **Method of transmitting data from one part of the computer to another part of the computer.**
  - 80% of signals (lines) are common for all connections between functional units
  - the connections lines include:
    - **address lines**
    - **data lines**
    - **control lines (RD, WR, IOR, IOW, etc.)**

Computer Bus

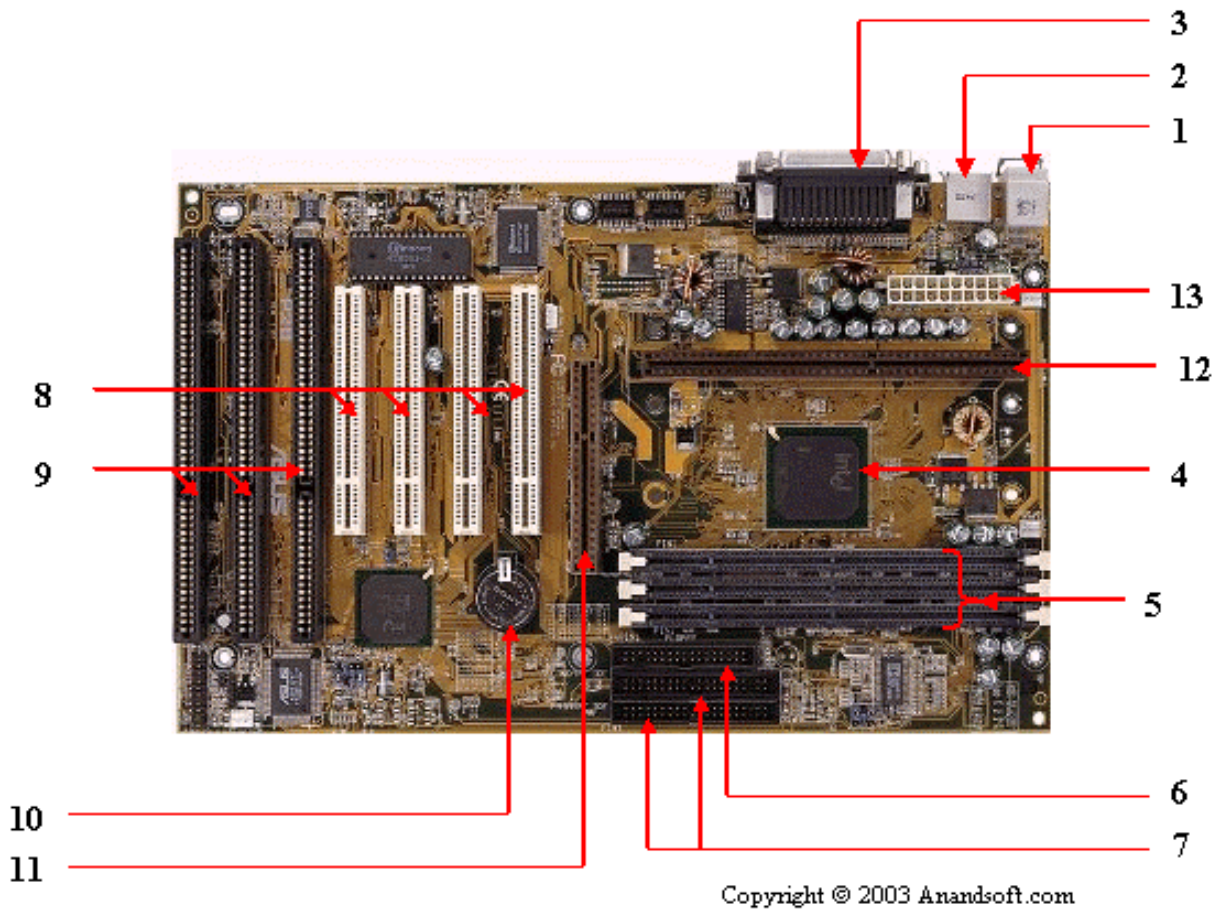
Types of Computer Buses

- **System bus**: 50 to 100 parallel wires, with connectors spaced at regular intervals and with standardized signals;
- **Special purpose buses**: buses connecting special functional parts of a computer, such as co-processors, etc;
- **Internal buses**: buses used within a CPU.
- **Expansion bus (ISA, MCA, EISA, PCI, etc)**
- **Disk Bus (IDE, EIDE, SCSI)**

Mother Board and Computer Bus

- 1. Mouse & keyboard
  2. USB
  3. Parallel port
  4. CPU Chip
  5. RAM slots
  6. Floppy controller
  7. IDE controller
  8. PCI slot
  9. ISA slot
  10. CMOS Battery
  11. AGP slot
  12. CPU slot

- 13. Power supply plug in



Bus

- **ISA (Industry Standard Architecture Bus)**
  - IBM introduced ISA
  - originally an 8-bit bus, later expanded to 16-bit bus
  - Fading out
- **MCA (Micro Channel Bus)**
  - IBM introduced MCA in 1987
  - never became widely used
  - phased out of the desktop computers.
- **EISA (Extended Industry Standard Architecture Bus)**
  - Introduced by 9 competitors to compete with IBM's MCA BUS.
  - AST Research, Compaq, Epson, Hewlett Packard, NEC, Olivetti, Tandy, WYSE and Zenith Data Systems.
  - 32-bit slots at an 8.33 MHz cycle rate for use with 386DX or higher processors
  - never became widely used and is no longer found in Desktop computers.
- **AGP** (Advanced Graphic Port)
  - Intel introduced in 1997
  - a 32-bit Bus designed for the high demands of 3-D graphics.
  - a direct line to the computers memory which allows 3-D elements to be stored in the system memory instead of the video memory.
  - comes with most Pentium II and Pentium III machines.
  - needs to be running Windows 95, Windows 98, or Windows 2000

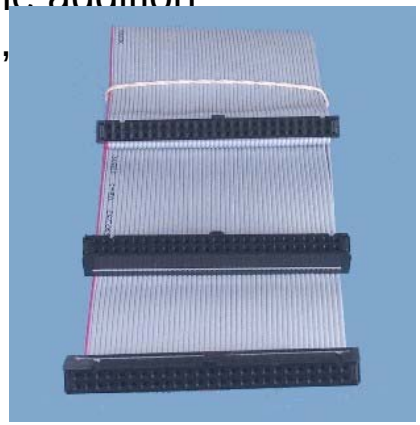
Bus

- **PCI (Peripheral Component Interconnect Bus)**
  - Intel introduced in 1992
  - Today the PCI Bus is one of the most commonly used computer
  - originally released as a 32-bit bus
  - 64-bit bus available
  - on all motherboards manufactured today.
- **USB (Universal Serial Bus)**
  - a new external Bus
  - Developed by Intel, Microsoft, and Compaq
  - transfer rates of 12 Mbps
  - can support 127 devices
  - supports hot plugging.
  - geared towards replacing the serial ports, parallel ports and other I/O devices.

- **PCMCIA** (Personal Computer Memory Card International Association)
  - **PC Card**
    - **Type I : For external Memory (RAM)**
    - **Type II: For Modem**
    - **Type III: For Disk**

Bus

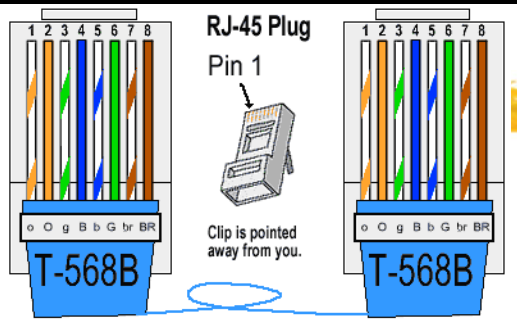
- **SCSI (Small Computer Systems Interface)**
  - SCSI (pronounced "scuzzy")
  - a smart bus (it is controlled with a microprocessor) and it allows the addition of up to seven devices (not necessarily just hard drives; scanners, and other devices often use SCSI) to the computer.
  - requires the addition of a SCSI adapter.



- **IEEE-1394** high-performance serial bus
  - promoted by the 1394 Trade Association
  - multimedia interface standard,
    - replacing IDE for internal peripherals
    - Replacing SCSI for external peripherals, such as digital VCRs and DVD players.
  - allows for connecting as many as 63 devices and operates at a 400 Mbps (800 Mbps is in the works, followed by 1 Gbps)—compared to 12 Mbps with USB.

Bus/Connector on DE2i-150

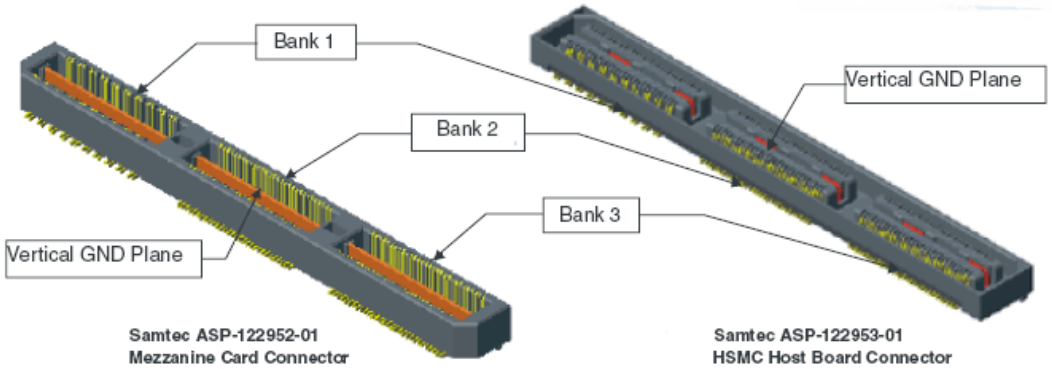
- RJ45 Ethernet
- SD (Secure Digital)



- GPIO (General Purpose Input/Output)

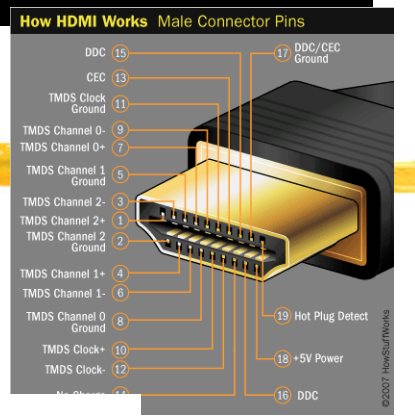
- HSMC (High Speed Mezzanine Card)

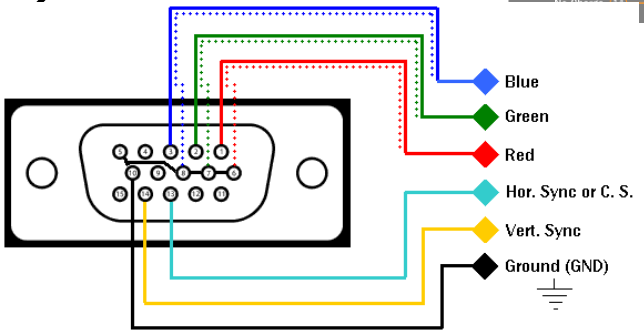
Figure 2–1. HSMC Connectors

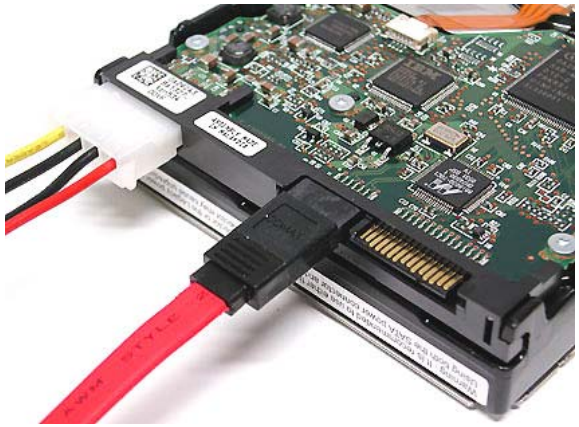


Bus/Connector on DE2i-150

- HDMI (High-Definition Multimedia Interface)
- VGA (Video Graphics Array)
- SATA: Serial Advanced Technology Attachment (Host ←→ Mass Storage Device
- mSATA(mini- SATA)
- SMA (Sub-miniature version A) connector

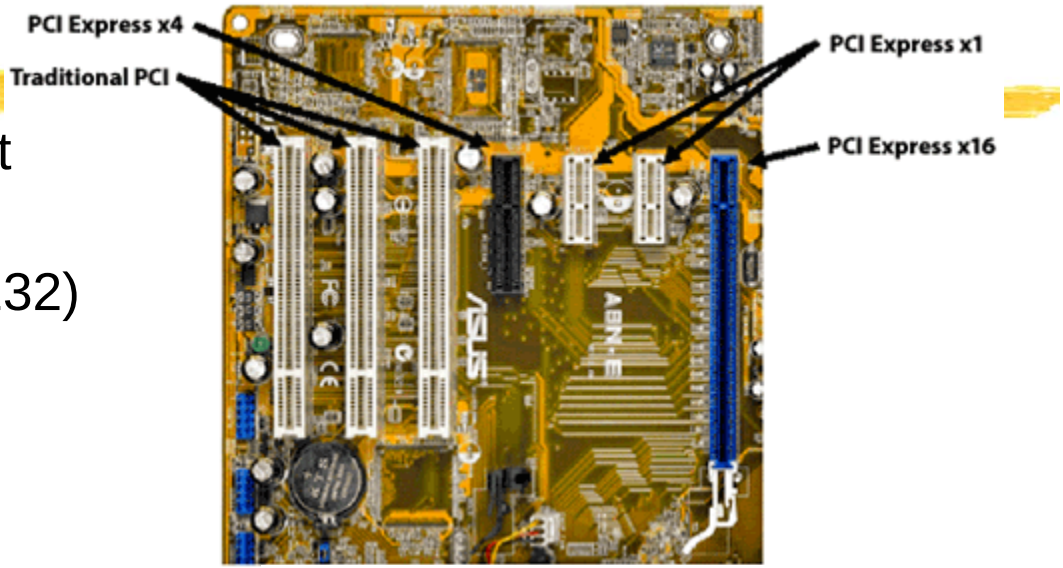


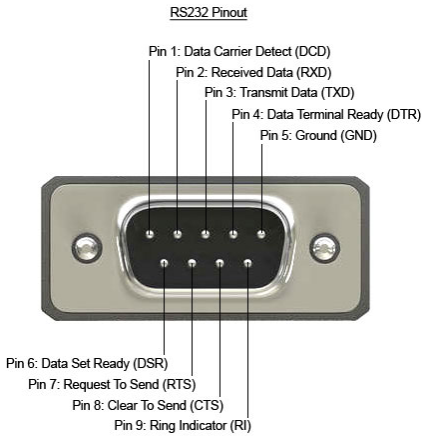


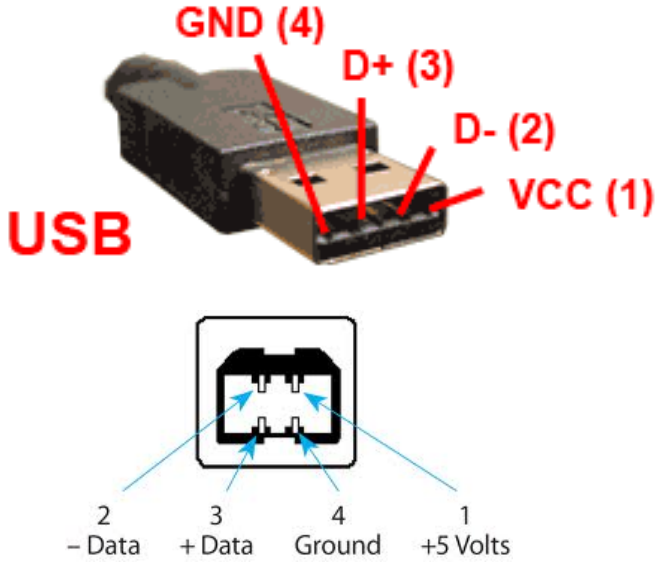


Bus/Connector on DE2i-150

- PCIe (Peripheral Component Interconnect Express)
- Serial Communication (RS-232)
- USB (Universal Serial Bus)
- RCA A/V Jack
- Audio (Line In – Out)







BUS/connector activity

- Find and list ALL types of computer bus/connector from DE2i-150 kit
  - Bus/connector Name: Location in the BE2i-150 Board

Bus/connector Activity – Find and Mark