Contents of the Lecture

4. Expansion Modules for Embedded Systems

- Requirements for Embedded Systems
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- COM Express Modules

Requirements for Embedded Systems (1)

- Embedded systems used in: industrial automation, transportation, defense
- Requirements: high reliability, simple maintenance
- Desktop systems use:
  - Connectors with blade contacts
  - Active backplanes or motherboards
- In an industrial or military environment, the backplane is exposed to mechanical stress

Requirements for Embedded Systems (2)

- High reliability:
  - Connectors with metallic pins and sockets
  - Front panels for fastening, guidance
  - Passive backplanes – only connectors
- Simple maintenance:
  - Short time required for repairs – failures of passive backplanes are rare
  - Simple module replacement
- Commonly, VME modules are used

4. Expansion Modules for Embedded Systems

- Requirements for Embedded Systems
- VME Modules
- CompactPCI Modules
- Mezzanine Modules
- COM Express Modules

VME Modules

- VME Modules
  - Parallel VME Bus Modules
  - VXS Modules
  - VPX Modules

Parallel VME Bus Modules (1)

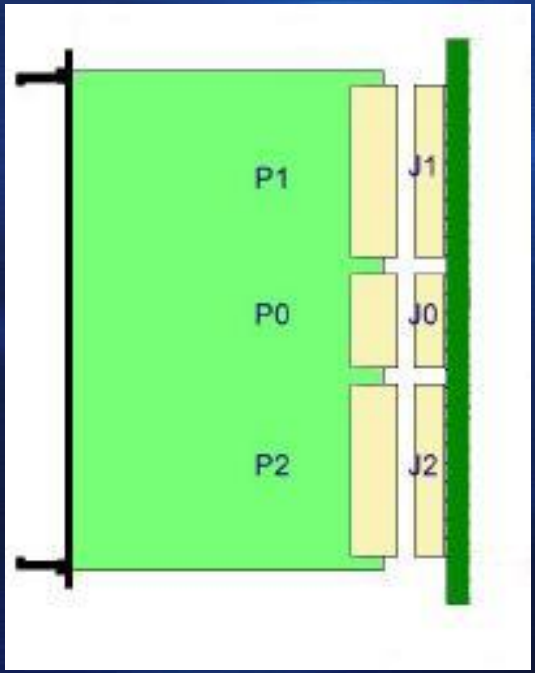
- Parallel VME module sizes
  - Single-height: 3U x 160 mm (U – unit of measure; 1U = 1.75 inch = 44.45 mm)
  - Double-height: 6U x 160 mm
  - Triple-height: 9U x 400 mm
- Conduction-cooled VME modules
  - Used in military and aerospace applications
  - Heat is conducted through the printed circuit board or through a conduction plate

Parallel VME Bus Modules (2)

- VME backplanes
  - Length of 19 inches; 1 .. 21 connectors
  - Standard: 3-row connectors
  - VME64x: 5-row connectors
  - VME320
- VME connector types
  - P (Plug): reside on the expansion modules
  - J (Jack): reside on the backplane
  - P1/J1, P2/J2: 96-pin or 160-pin connectors

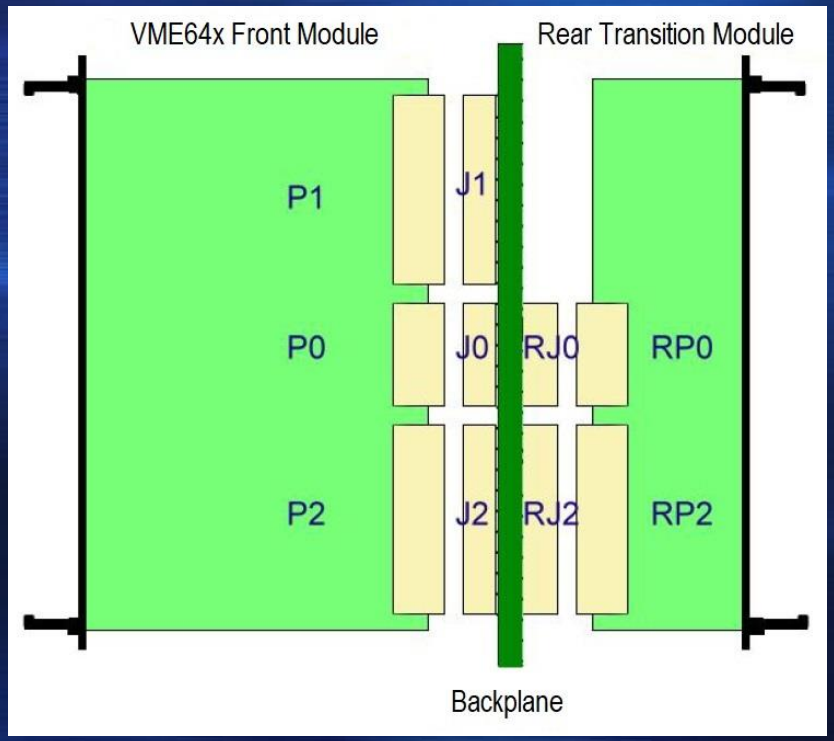
Parallel VME Bus Modules (3)

- P3/J3: may be included on 9U modules
- P0/J0: for VME64x modules
  - 95-pin connectors
  - May be used for high-speed signals
- Custom connectors can be placed between the P1/J1 and P2/J2 pairs, e.g., for:
  - Coaxial cable
  - Fiber-optic cable



Parallel VME Bus Modules (4)

- Rear I/O transition modules
  - Optional feature of VME64x and later backplanes
  - Size: 6U x 80 mm
  - Contain the RP0 and RP2 connectors
  - Connect to the front module via feed-through pins of J0 and J2

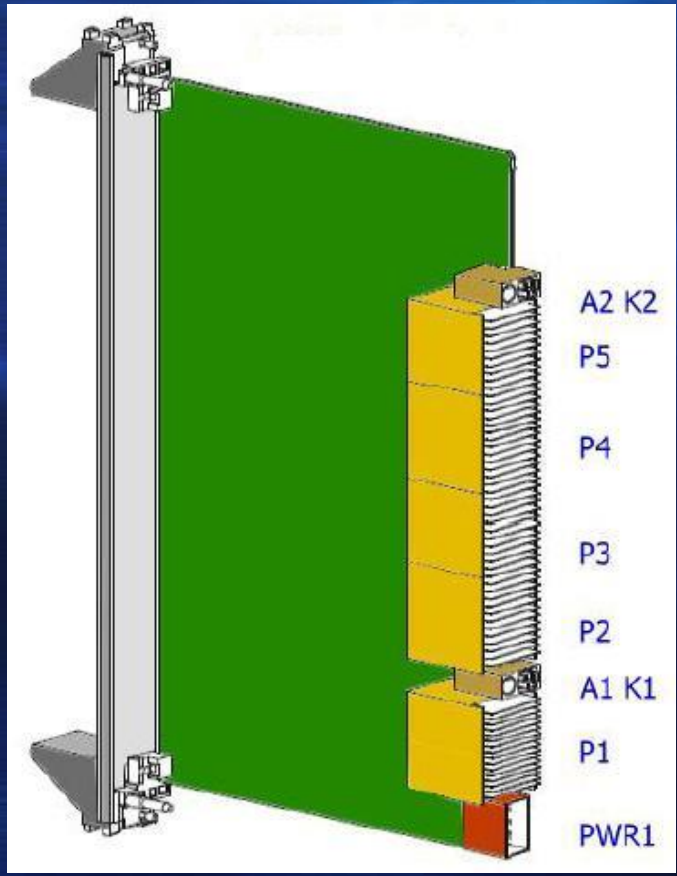


VME Modules

- VME Modules
  - Parallel VME Bus Modules
  - VXS Modules
  - VPX Modules

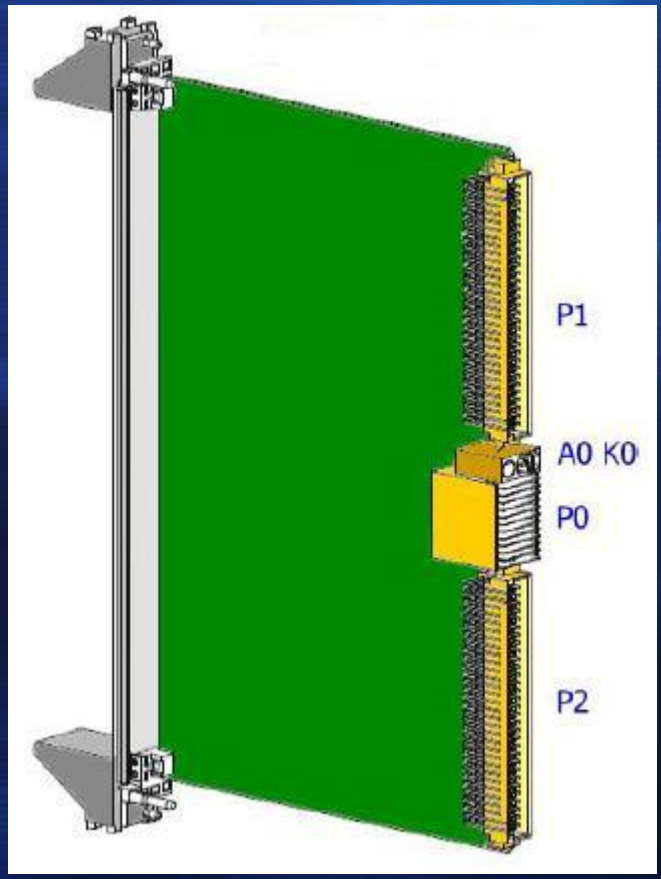
VXS Modules (1)

- VXS switch boards
  - Have point-to-point connections to other boards
  - 6U x 160 mm
  - Replace the parallel P1 and P2 connectors with 5 serial connectors (P1 .. P5)
  - MultiGig RT connectors
  - A1 K1, A2 K2: alignment and keying connectors
  - PWR1: power connector



VXS Modules (2)

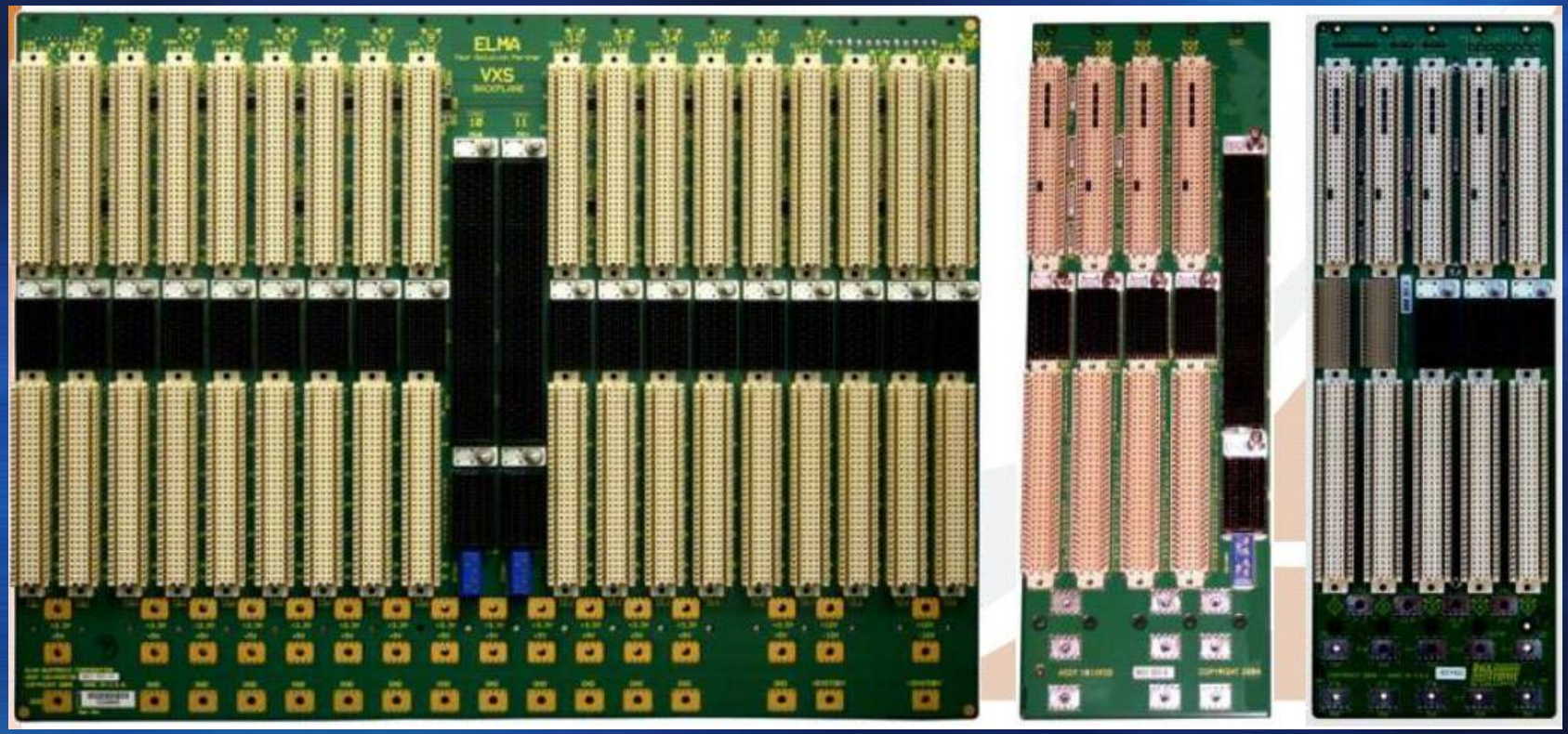
- VXS payload boards
  - P1, P2: VME64x parallel connectors; 5 rows
  - P0: high-speed serial connector; 7 rows
  - The P0 connector provides eight full-duplex serial links (up to 2.5 GB/s or 5 GB/s in each direction)
  - A0 K0: alignment and keying connector



VXS Modules (3)

- VXS Backplanes
  - Maximum configuration: 18 payload boards; 2 switch boards; 1 VME64x board
  - Single star topology: each payload board connects to a single switch board
  - Dual star topology: each payload board connects to both switch boards (redundancy)
  - Mesh topology: up to 3 payload boards directly connected without a switch board
  - Daisy-chain topology: each payload board connects to its nearest neighbors

VXS Modules (4)



VXS topologies: dual star; single star; mesh

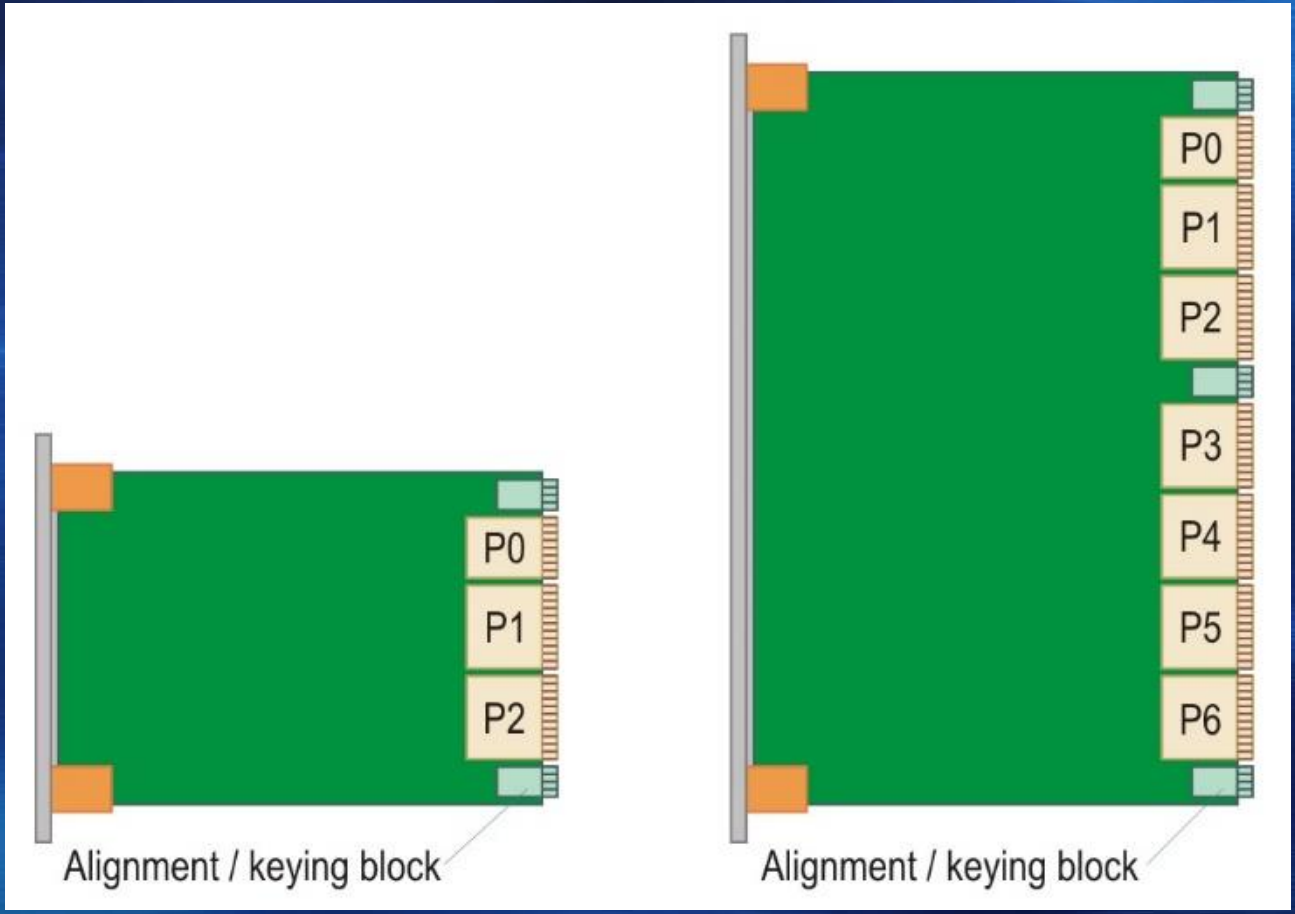
VME Modules

- VME Modules
  - Parallel VME Bus Modules
  - VXS Modules
  - VPX Modules

VPX Modules (1)

- The 3U and 6U Eurocard form factors of the VME specifications are maintained
  - 6U hybrid backplanes can also be used to accommodate VME64, VXS, and VPX modules
- Gen 4 VPX: MultiGig RT2 connectors
  - Data rates up to 16 Gbits/s
  - 3U modules: three connectors (P0 .. P2)
  - 6U modules: seven connectors (P0 .. P6)
  - Provided with robust alignment/keying blocks

VPX Modules (2)

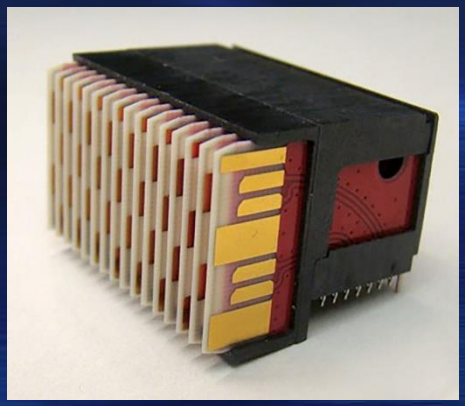


VPX Modules (3)

- P0 connector
  - 8 x 7 contacts
  - Power, system reset, reference clock, bus management, other utility signals
- P1 connector
  - 16 x 7 contacts
  - 32 differential pairs, 8 single-ended signals
- P2 .. P6 connectors
  - Physically identical with P1
  - A total of 128 differential pairs for user I/O

VPX Modules (4)

- Gen 5 VPX: MultiGig RT3 connectors
  - Data rates up to 25.8 Gbits/s
  - Compatible with MultiGig RT2 connectors
  - Contacts: small printed circuit boards with gold plates



Left: MultiGig RT2; right: MultiGig RT3 (© Tyco Electronics)

VPX Modules (5)

6U VPX Module (© Extreme Engineering Solutions)

Concepts, Knowledge

- Requirements for embedded systems
- Form factors for parallel VME modules
- Conduction-cooled VME modules
- VXS switch boards
- VXS payload boards
- VXS backplane topologies