Passive Backpanels, Assembled Component Content

Examination of Platform Specific Bus Architectures

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The following study will categorize a series of *passive* backpanel assemblies according to their respective bus architectures and identify the component content of those assembled panels. Typical structures included in this discussion are as follows: VME/VME64x (VERSAmodule Eurocard & Extensions), VME320 (high speed proprietary), VXI (VME Extension for Instrumentation), FB+ (FutureBus+), and cPCI (CompactPCI). Although the PWB physical layers, circuit patterns, and logic families employed differ significantly between these architectures, the electro-mechanical interconnects and electronic control components are quite similar and can be discussed in this essay. The former will not be discussed herein and should be reserved for a closer examination of a system's performance attributes and end application.

VME / VME64 / VME64x / VME320 / and VXI PWB ASSEMBLIES:

Using VME parlance, the most common PWB is referred to as a *Monolithic Backplane*. It is a 10 layer PWB and serves as the foundation for the others, chronologically and as the system packaging standard. VME64, VME64x, VME320, and VXI are extensions of the monolithic VME board architecture and were electrically enhanced to take advantage of higher speed applications by providing a wide address bus with increased bandwidth, additional ground planes to safeguard signal fidelity, multiple voltage planes (3.3, 5.0, & 12 volts), automatic daisy-chaining between slots, and additional user-defined input/output terminations. Regardless of these performance criteria, the board-to-board connector systems remain very much the same, except in the case of VME64x which uses a 160 position connector and a 95 position pin header centrally located between the JI & J2 DIN connectors in each slot. Because the VME320 and VXI interconnection systems mimic that of the VME64, they will be considered *equivalent* architectures for the purpose of this review.

- **Mechanical Hardware**

There are two primary mechanical form factors for VME bus modules and they are referred to as 3U and 6U boards. The 'U' is a unit of measure for the front panel, where each 'U' is equal to 1.75 inches. A specification for 9U (15.75 inch high) Eurocards has been completed by the VITA Standards Organization and is called the VITA 1.3-1999 standard.

- **VME bus Backplanes**

VME bus backplanes are available in lengths between 1 and 21 slots. Daughtercard slots are located on 0.8 inch centers. There are three types of backplanes available:

  - Standard, 3-row connector backplanes,
  - VME64x, 5-row connector backplanes with 160 pin enhanced connector, and
  - VME320 backplanes (proprietary architecture).

Each style is available in 3U, 6U and 9U form factors. The maximum size of all VME backplanes is 21 slots and is 16.65 inches wide.

- **Optional Backpanel Content**
  - Active termination resistor networks are used to balance all transmission lines. Decoupling capacitors are used to control capacitance between selected slots.
  - Automatic daisy chain is accomplished via mechanical contacts within the backplane connector, or via electronic switching methods.
  - A *single* 10 position polarized pin header is used for system surveillance and reset I/O port.
  - Rear I/O connector shrouds are not supplied on Standard 3-row connector backplanes unless user specified, but are required on VME64x to support the rear I/O transition modules.
  - A special cabling option on the J2 high speed backplane offers extra rows of ground pins that straddle the user defined I/O pins on the rear of the backplane.
- **Board-to-Board Connectors**
  - All VME type products use 3 row 96 position DIN 41612 connectors and are available from multiple sources. The VME64 and VME64x backpanels use *proprietary* 5x32, 160 position male connectors which have thirty-two additional pins located on both sides of a standard DIN 41612 connector, and are available from Harting or AMP. There are other non-licensed third parties that offer this connector. Hybrid VME64 & (x) may use 3 and 5 row connectors in combination. Depending on the connectors slot location, tail lengths will either be *stub* or *rear plug-up* (17 mm long).

VME, continued:

- **Board-to-Board Connectors, continued:**
  - VME64x uses 5x19, 95 position header modules which conform to the IEC 1076-4-101 (AMP Z-PACK HM) and are available from several manufacturers.
  - The VME64x optionally uses coaxial cable or fiber-optic modules between slots.
- **Power Connectors**
  - There is no standard way of connecting power supply leads to the backplane. Most use FASTON (spade terminal) connectors, M5 studs & bus bars, power cubes with screw terminals, or Mate-N-Lok type connectors.
- **I/O Terminations** can be routed from the rear of the backplane by:
  - plugging into shrouds using ribbon cable or discrete wire connectors, or
  - plugging into shrouds using a rear transition module, or
  - by being bussed internally across the backplane.
- **Mezzanine Modules**

Although they *are not* a backplane connector systems, Mezzanine modules are used to customize VME daughter cards allowing the user to 'mix-and-match' needed I/O functions. The VME bus mezzanine industry is fragmented because of all of the types of mezzanine cards and this discussion will not attempt to describe the vast number of cards available. However, the two most popular are the CMC/PMC (Common Mezzanine Card) and IP (IndustryPack) mezzanine modules.

Futurebus+ Assemblies:

Futurebus+ uses the same basic structure as VME but incorporates features which provide an upward migration path for users of VME and Multibus II that maximizes bus data throughput. The Futurebus+ committee created the ultimate bus. Unfortunately, the standard has not lived up to its promise. Futurebus+ is for the most part a dead bus. There are only three or four customers worldwide that still support the bus. PWB size was 300 mm x 300 mm as compared to 160 mm x 233 mm for VME. Expected data rates of 500-600 Mbytes/sec barely reached 125 Mbytes/sec. It was also more expensive then competing buses. While Futurebus+ may be dead, many of it features have been added to other bus designs creating *hybrid* PWB assemblies. The third generation VME bus incorporates the use of fast transceiver logic devices, electromagnetic compatibility, ESD protection, and a new keying scheme.

- **Futurebus+ Backplanes**

Futurebus+ backplanes consist of 14 layers, conform to IEEE 896.2 and are available in lengths between 5 and 14 slots. Daughtercard slots are located on 0.8 inch centers. However, there are some applications at 0.6 inch centers (applies to 4 row Metral type modules only). The maximum size of all FB+ backplanes is 14 slots and is 16.54 inches wide.

- **Optional Backpanel Content**
  - Active termination resistor networks are used to balance all transmission lines. Decoupling capacitors are used to control capacitance between selected slots.
  - Rear I/O connector shrouds are not supplied on Standard backplanes unless user specified.
- **Board-to-Board Connectors**
  - All FB+ products use 4 or 5 row connector modules which conform to IEEE 1301.1 (Metral) and are available from multiple sources. Specialty modules include high current, coax, fiber optic, guidance, grounding, and ESD protection. Modules are also available with tail lengths ranging from *stub* to *rear plug-up* (17 mm long).

Futurebus+, continued:

- **Power Connectors**
  - FB+ provides Power Modules to distribute power between PWB and daughtercards. However, there is no standard way of connecting power supply leads to the backplane. Typically M6 threaded studs with or without bus bars are utilized to meet the high current requirements.
- **I/O Terminations** can be routed from the rear of the backplane by:
  - plugging into shrouds using FB+ discrete wire cable connectors, or
  - plugging into shrouds using rear transition modules.

CompactPCI Assemblies:

CompactPCI utilizes the Eurocard form factor popularized by the VME bus and is defined for both 3U (100mm by 160 mm) and 6U (160mm by 233 mm) card sizes. Although, it is typical to find rather large PWB configurations, the PICMG specification actually defines PWB modules that are between 2 and 8 slots in length. To build larger panels (systems) in 8 slot increments, board manufacturers *link* multiple PWB modules together using Bridge Modules or Bridge Chips.

- **CompactPCI Backplanes**
  Standard cPCI PWBs are comprised of 8 layers, but an enhanced electrical version with special routing at 10 layers is also available. Daughtercard slots are located on 0.8 inch centers.
- **Optional Backpanel Content**
  - Active termination resistor networks are used to balance all transmission lines. Decoupling capacitors are used to control capacitance between selected slots.
- **Board-to-Board Connectors**
  - CompactPCI uses connectors which meet the IEC 1076-4-101 (AMP Z-PACK HM) and are available from several manufacturers. This 2 millimeter "Hard Metric" connector has 47 rows of 5 pins per row, with a total of 220 pins (15 pins are lost to the keying area). These connectors have Long 17 mm tails for I/O shroud compatibility. See I/O terminations below. An additional external metal shield is also used.
  - 3U CompactPCI processor boards use a single 220 pin connector for all power, ground, and PCI signals. This connector consists of two halves - the lower half (110 pins) is called J1 and the upper half (also 110 pins) is called J2..
  - 6U boards can have up to three additional connectors with a total of 315 pins. These are also 2mm style. These optional connectors can be used for a variety of purposes. They can be used as a bridge to other buses like VME or ISA in hybrid backplanes.
- **Power Connectors**
  - Each PWB has at least one male, 20 position ATX compliant power connectors.
  - Each PWB has one 0.156 inch MTA header for a power supply switch & power LED's.
  - The power supply panel uses either of two connector interfaces which are not compatible to each other and will not mate together. They are as follows:
    - ✓ IEC 603-2 Type M multipurpose DIN connector available from many suppliers, and
    - ✓ Positronics PCI 47F 300A1 CONNECTOR (recently adopted by PICMG Committee).
- **I/O Terminations** can be routed from the rear of the backplane by:
  - Each slot provides rear I/O through the use of 17 mm long tailed connectors shrouds which allow plugging into the shrouds using discrete wire cable connectors. See board-to-board connectors above.