Chapter 1: Adaptor Functions

1.0 Executive Overview

The Bit 3 Model 413-1 Adaptor is an easy-to-use, cost-effective way to share memory and special purpose cards between two VMEbus systems. The Model 413-1 Adaptor provides high-speed data transfers between the two systems, and requires minimal software support.

Model 413-1 interconnects two VMEbus systems at the physical layer. Working at the lowest level, the bus, the Adaptor allows the two systems to share memory and I/O; memory appears to and is treated by each system as if it were its own. In addition, a card installed on one bus may be directly controlled by a device on another bus. For example, an Array Processor board on one VMEbus can be directly controlled by a remote VMEbus processor.

The Model 413-1 Adaptor supports bi-directional A32/D32 random access bus mastering from either system and also supports 32-bit data transfers using a built-in DMA Controller. This controller enables the Adaptor to transfer data from one system's memory to the other system's memory at sustained data rates of up to 25 Megabytes per second (M Bytes/sec).

Model 413-1 supports two methods of inter-system communications: Memory Mapping and Direct Memory Access (DMA). Memory Mapping controls random access (PIO transfers) to VMEbus RAM, dual-port memory, and VMEbus I/O, and provides an easy-to-use, flexible interface with low overhead. A VMEbus bus master can access memory in the remote VMEbus system through a window in its local address space.

With Memory Mapping there is no need to pass data through intermediate software drivers. Also, one VMEbus processor can execute code from the other system's memory.

Two Memory Mapping techniques are supported: Direct Mode (with address biasing) and Page Mode. Either technique can be used to control access to remote bus memory and dual-port memory. Access to remote bus I/O is not affected by the mapping mode.

Direct Mode has a one-to-one relationship between address windows. Data are transferred through one window directly into an equal size window on the other bus. The addressing range can be as large as 4 Gigabytes (G bytes). The high-speed interconnect permits random access 32-bit writes to the remote VMEbus at speeds comparable to read/write speeds to local global memory. Up to 4G bytes of remote memory can appear as local memory. Window size is configured via configuration jumper settings on the Adaptor cards.

Page Mode bus-to-bus mapping allows the transmitting system's bus master processor to access all 4G bytes of the receiving system's address space through a smaller window (64K bytes to 1M byte) on the transmitter. The window in the transmitting bus address space is coupled with a 16-bit programmable register. The address within the window provides the lower 16 - 20 address bits and the I/O register provides the upper 16 - 12 bits of the 32-bit receiving bus address.

Memory Mapping also controls access to dual-port memory. Dual Port RAM is an optional card that provides a memory buffer; saves the cost of additional memory cards; and requires no additional VMEbus card slots.

Bit 3's Dual Port RAM is a printed circuit card that plugs into either VMEbus Adaptor card as a daughter card. The following memory sizes are currently available: 32K, 128K, 1M, 2M, 4M, and 8M bytes.

Optional Dual Port RAM provides shared memory space that is accessible from either system. Dual Port RAM access uses only the bandwidth of the accessing bus. Consequently, data can be exchanged with minimal impact on the performance of the other system's bus. Both systems can access Dual Port RAM simultaneously; the Adaptor arbitrates accesses.

DMA, the other method of communication, is the automatic transfer of data from one memory address to another. The Model 413-1 Adaptor supports two DMA techniques: DMA Controller Mode and Slave Mode DMA.

DMA Controller Mode uses the Adaptor's DMA Controller to enable high-speed data transfers from one system's memory directly into the other system's memory. Data transfer in either direction can be initiated by either system's processor. Each DMA cycle supports transfer lengths from 4 bytes to 16M bytes. DMA participants must be 16/32-bit data devices and have 16-, 24-, or 32-bit address size.

To initiate a DMA Controller transfer, a processor sets the transmitting and receiving systems' target addresses, and a word count. Bits in the command registers specify parameters, such as word width, destination address space (A32, A24 or A16), the address modifier, and Block or Non-Block transfer mode. Interrupts are prevented from being passed between the buses during the DMA transfer. Also, random access across the I/O cable must not occur during a DMA transfer.

The DMA Controller also allows transfers between the optional Dual Port RAM and system memory.

In Slave Mode DMA, the Adaptor card appears as a slave memory card. This type of DMA transfer is performed when a DMA device transfers data through the Adaptor directly into the VMEbus.

The Model 413-1 Adaptor is not a repeater-type connection linking the timing of both buses (so that activity on one bus slows down the other). Instead, the Adaptor permits each bus to operate *independently*. The buses are linked only when a memory or I/O reference is made to an address on one system that translates to a reference on the other.

The Model 413-1 Adaptor consists of two 6U size VMEbus cards. The two cards are connected by a round EMI-shielded cable, purchased separately from Bit 3.

Cable is available in standard 8- or 25-foot lengths. Custom lengths may be ordered. Fiber-Optic Interface cards and modules are also available from Bit 3.