DIGITAL PCI32-VME64 Adapter

Hardware Owner's Guide

Part Number: EK-DWP64-UG. A01

April 1997

This guide describes the configuration and installation of the DIGITAL PCI32-VME64 adapter. Read this information before you begin the hardware installation procedure.

Digital Equipment Corporation
Maynard, Massachusetts

April 1997

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Table of Contents

1 Introduction to the PCI32-VME64 Adapter

2 Installing the PCI32-VME64 Adapter

Figures

Tables

Preface

Overview

This guide describes the configuration and installation procedures for the DIGITAL PCI32-VME64 adapter.

Intended Audience

This guide is intended for all users who need to know how to install and use the DIGITAL PCI32-VME64 adapter on their VME system.

Organization

This guide contains the following chapters:

Chapter 1, Introduction to the DIGITAL PCI32-VME64 Adapter — Provides an introduction and product overview. It also explains the functions and shows the locations of the jumpers on the DIGITAL PCI32-VME64 adapter.

Chapter 2, Installing the Adapter — Provides instructions on how to install the PCI32-VME64 adapter in a DIGITAL AlphaServer system.

Related Documents

Other documents related to the PCI32-VME64 adapter include the following:

Title	Part Number
DIGITAL PCI32-VME64 Adapter Driver User's Guide for OpenVMS	AA-R25UA-TE
DIGITAL PCI32-VME64 Adapter Driver Installation Guide for OpenVMS	AA-R25VA-TE
DIGITAL PCI32-VME64 Adapter Driver for OpenVMS SPD 60.78.00	AE-R2MTA-TE
DIGITAL PCI32-VME64 Adapter Driver User's Guide for DIGITAL UNIX	AA-R25RA-TE
DIGITAL PCI32-VME64 Adapter Driver Installation Guide for DIGITAL UNIX	AA-R25SA-TE
DIGITAL PCI32-VME64 Adapter Driver for DIGITAL UNIX SPD 60.79.00	AE-R2MSA-TE

Conventions

This guide uses the following conventions:

Convention	Meaning
Note	A note calls the reader's attention to any item of information that may be of special importance.
Caution	A caution contains information essential to avoid damage to the equipment.
Warning	A warning contains information essential to the safety of personnel.
❶	Circled numbers provide a link between figures or examples and text.

Reader's Comments

DIGITAL welcomes your comments on this or any other manual. You can send your comments to DIGITAL the following way:

- Mail:

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1
Introduction to the PCI32-VME64 Adapter

1.1 Overview of the DIGITAL PCI32-VME64 Adapter

The DIGITAL PCI32-VME64 adapter is a high-speed adapter used to interface DIGITAL systems to various VME applications. One module in this two-module set installs into a standard PCI bus interface; the other installs into a VME backplane.

1.2 Compatible Software

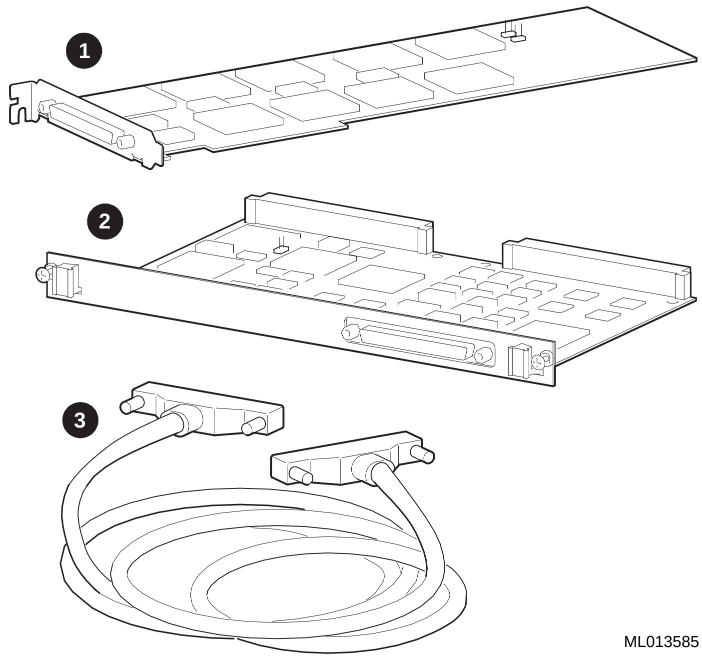
The DIGITAL PCI32-VME64 adapter is supported on the OpenVMS Alpha and DIGITAL UNIX operating systems via layered adapter driver software products. Refer to the appropriate Software Product Descriptions (SPD 60.78.xx for OpenVMS Alpha or SPD 60.79.xx for DIGITAL UNIX) for a list of product functionality and supported systems.

1.3 Components

The DIGITAL PCI32-VME64 adapter consists of the following components (see Figure 1-1):

- PCI Bus Bridge Module (PBM), containing Sparse Memory Address Space Jumpers
- VMEbus (6U) Bridge Module (VBM), containing VMEbus Interface Chip and System Controller Jumper
- 3-meter Interconnect Cable
- Extender brackets for PBM
- *DIGITAL PCI32-VME64 Adapter Hardware Owner's Guide*

Figure 1-1 PCI32-VME64 Adapter Components



❶ PCI Bus Bridge Module (PBM)

❷ VMEbus Bridge Module (VBM)

❸ Interconnect Cable

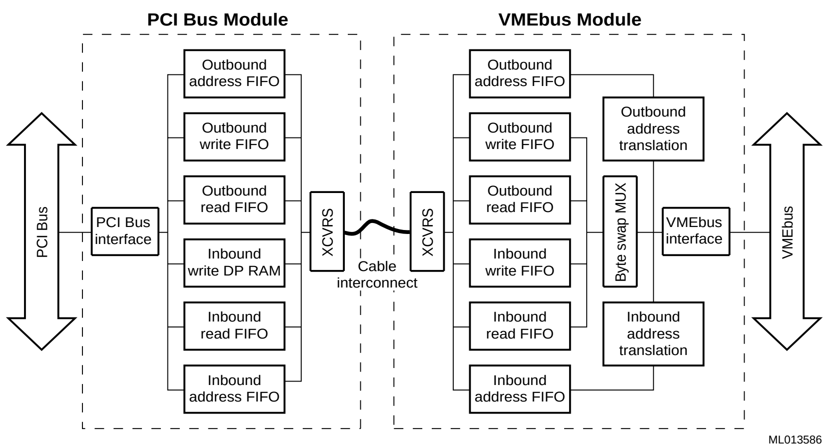
1.4 Features of the Adapter

The following sections provide an overview of the features of the PCI32-VME64 adapter modules and interconnect cable.

1.4.1 Major Components

Physically the PCI to VME adapter is a two board set with one board designed to install into a standard PCI32 interface (Edge card), and the other to install into a 6U VME backplane. A shielded 3-meter cable will connect the two boards together. The PCI Bus Bridge Module shall be referred to in this document as the PBM, and the VMEbus Bridge Module as the VBM. Figure 1-1 shows the physical components and Figure 1-2 shows the system block diagram.

Figure 1-2 System Block Diagram



1.4.2 Specifications

The PCI32-VME64 Adapter provides connectivity between VMEbus devices and supported PCI-based AlphaServer systems using a process called "memory mapping." With memory mapping, VME address space and memory cells are accessible to the host software, while host address space and cells are accessible to VME devices. In this way, memory mapping permits most required I/O transactions to occur as if the VMEbus were built into the host.

In particular, mapping registers provide a mechanism that allows non-contiguous host memory physical pages (demand-paged virtual memory) to be accessed from a contiguous VMEbus address window, or to appear contiguous for DMA operations. 32-bit wide memory mapping registers (Mapping RAM Registers) are used to steer accesses in 256K byte segments from PCI address space to VMEbus address space. The contents of the 512 PCI-to-VMEbus Mapping RAM Registers identify the VMEbus address, the address modifier code, and the option of byte, word or longword swapping. Likewise, 16,384 32-bit wide Mapping RAM Registers are available to map 8K byte segments from VMEbus bus onto the PCI bus.

Appropriate operating system device drivers are required for each VMEbus module installed in the VME chassis. These drivers are written by the user or purchased separately and are not included with the PCI32-VME64 adapter.

To illustrate the memory mapping approach, consider each type of transaction that might occur:

- **Direct Memory Access (DMA):**

  Generally used to achieve the fastest transfer of bulk data, DMA refers to the ability of a VME module to directly access host memory without involving the host CPU. Two types of DMA are supported by the PCI32-VME64 adapter:

  – **Slave-mode** – DMA is performed by a processor on a VME device under the direction of the host CPU.

  – **Controller (Master) –** DMA is performed by the PCI32-VME64 adapter under the direction of the host CPU.

- **Programmed I/O:**

  Programmed I/O refers to the ability of the CPU to control a data transfer by initiating a data transfer cycle. It is used for modules that do not support DMA, or when it is not desirable to permit access by an application program to the memory or registers of a VME module. Programmed I/0 is required for certain 8-bit and 16-bit data accesses.

- **Memory Mapped I/O:**

  Memory Mapped I/O is used to allow a user level task to access data stored on a VME module. (The Alpha architecture imposes some restrictions on transactions involving data transfers shorter than 32 bits.) Memory mapped I/O is supported subject to the technical limitations and restrictions of the DIGITAL UNIX or OpenVMS Operating Systems. Refer to the appropriate Software Product Description (SPD) for complete details on memory mapped I/O support.

Because the PCI32-VME64 adapter is treated like any other processor on the VMEbus, the PCI32-VME64 adapter can function either as a slave device or as the bus master on the VMEbus. Consequently, the Alpha host system can directly control and monitor a wide variety of VMEbus cards and high-performance processors, thus eliminating the need to purchase an additional VMEbus system controller. As system controller, the PCI32-VME64 adapter will provide 3 levels of arbitration, the VMEbus system clock and system reset, and the Bus Error global time-out. In addition, interrupts that are generated on the VMEbus by any VME module can be passed to the host via the PCI32-VME64 adapter. All seven interrupt levels defined in the VME specification (IEEE 1014C) are supported.

The PCI32-VME64 adapter allows each bus (PCI and VME) to operate independently. Integrity of the interface between adapter modules is maintained by parity checks on address, control and data lines.

Table 1-1 contains the specifications for the PCI32-VME64 adapter.

Table 1-1 PCI32-VME64 Adapter Specifications

General PCI32-VME64 Adapter Specifications		
Standards	IEEE 1014C (VMEbus) PCI Local Bus Version 2.1	
Data mode generated/accepted	D8, D16, D32, D64	
Address modes: PCI to VME VME to PCI	A16, A24, A32 A16, A24, A32	
Hardware swapping	Byte, word, longword	
PIO total size	128 MB (less 256K) available	
DMA total size	128 MB slave, 16MB (less 1 byte) master	
Interrupt levels	7	
Multiple adapters	Supported by software	
Concurrent I/O through adapter	Supported	
Mapping register size	256 KB, PCI to VME 8KB, VME to PCI	
Number of mapping registers	511 PIO 16K DMA	
VME board size	6U	
PCI board size	PCI long card	
Cable length	3 meter maximum	
Power requirements	VMEbus card: 2.0A @5V PCI card: 1.6A @5V	
Environment	Temperature: operating 5ºC to 50ºC storage -40ºC to 66ºC Humidity: operating 10% to 90% non-condensing	
High Speed Data Transfer*		
Operation	*Speed*	*Data Transfer Direction*
Programmed I/O Read - D32 Write - D32	0.9 MB/s 2.4 MB/s	VME to PCI PCI to VME
Master DMA BLT Read - D32 Write- D32	31.5 MB/s 18.0 MB/s	VME to PCI PCI to VME
Master DMA BLT Read - D64 Write- D64	50.2 MB/s 28.3 MB/s	VME to PCI PCI to VME

* Engineering estimates based upon console (non Operating System) measurements taken on a DIGITAL AlphaServer 8200 system.

1.4.3 PCI Bus Bridge Module

The PCI bus bridge module (PBM) is a single-slot PCI long card module that interfaces between the 32-bit PCI bus and the interconnect cable that links the bus to the VMEbus bridge module (VBM). The PBM, which adheres to PCI Local Bus Version 2.1 Specification, contains the control logic and data buffering to perform this data link.

1.4.4 VMEbus Bridge Module

The VMEbus bridge module (VBM) is a single 6U VME module that interfaces between the 64-bit VMEbus and the interconnect cable. This module contains the VIC64 VMEbus interface chip and its companion chips to form the VME 64 interface. The module also contains registers for memory mapping, hardware-assisted byte swapping, and address and data buffering to allow for asynchronous communication between the interconnect cable and the VMEbus. The VIC64 and the associated companion chips (CY7C964's) are the VME 64 interface.

1.4.5 Interconnect Cable

The interconnect cable is a high-speed, point-to-point interconnect that joins the PCI bus bridge module and the VMEbus bridge module. The cable contains multiplexed, parity-protected address and data lines as well as command lines. Two simplex 16-bit data paths with a positive acknowledge protocol provide a raw bandwidth of 80 MB/s in each direction. A four-bit command bus also connects the two modules. All data is transferred in 32-bit word entities using LVDS fully differential drivers and receivers through twisted-pair wires. The LVDS technology features a low-voltage differential signal and fast transition times. The low voltage minimizes power use while maximizing data rates.

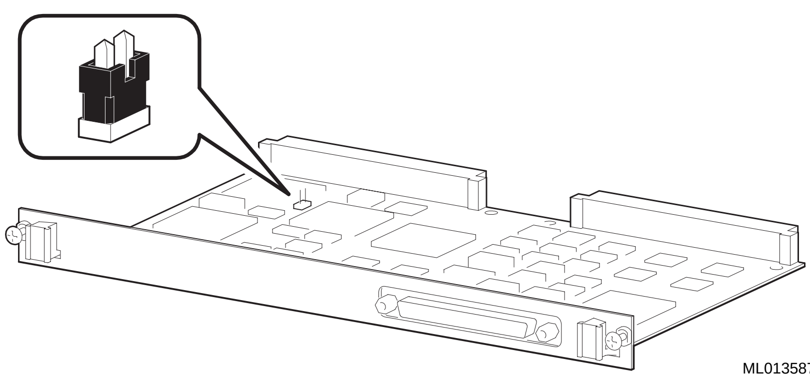
1.4.6 System Controller Jumper

The system controller jumper, labeled W1, is located on the VMEbus bridge module. When this jumper is installed, the module handles all the functions of a VMEbus system controller. When the jumper is not installed, the module handles daisy chains and bus grants, as would any other module in the system.

Table 1-2 VMEbus Bridge Module System Controller Jumper Setting

W1	Definition
In	System Controller
Out	Not System Controller

Figure 1-3 System Controller Jumper Location



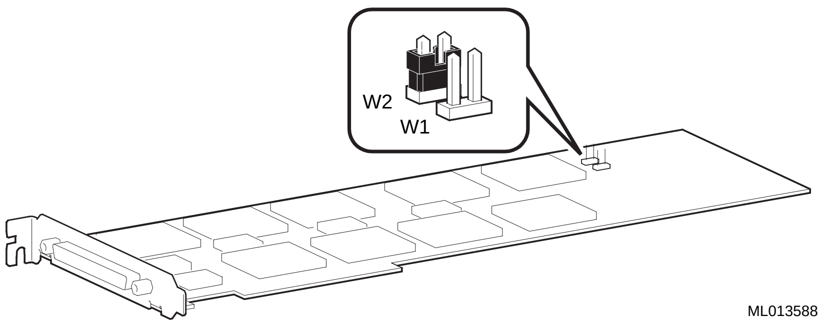
1.4.7 Sparse Memory Address Jumpers

Three sparse memory address jumpers on the PCI bus bridge module set the size of the sparse address space window. The jumpers, labeled W1 and W2, and corresponding settings are shown in Table 1-3 and Figure 1-4.

Table 1-3 PCI Bus Bridge Module Sparse Memory Address Jumper Settings

W1	W2	Window Size
Out	Out	16 MB
Out	In	32 MB
In	Out	64 MB

Figure 1-4 Sparse Memory Address Jumpers



2
Installing the PCI32-VME64 Adapter

2.1 Overview

This chapter describes the following installation steps:

- Verifying the Shipment
- Environmental Requirements
- Installation Restrictions
- Installing the PCI32-VME64 Adapter

2.2 Verifying the Shipment

The PCI32-VME64 adapter is provided in two configurations. A bill of materials is provided with each package and lists the contents of the package.

Table 2-1 lists the two configurations along with their part numbers and a description of each.

Table 2-1 Configuration Part Numbers and Descriptions

Configuration	Part Number	Description
OpenVMS	2T-DWP64-AA	PCI32-VME64 adapter hardware, BC12N-10 3-meter cable, OpenVMS adapter driver media kit, documentation, extender brackets
DIGITAL UNIX	2T-DWP64-BA	PCI32-VME64 adapter hardware, BC12N-10 3-meter cable, DIGITAL UNIX adapter driver media kit, documentation, extender brackets

If any component is missing or damaged, call the DIGITAL field representative, customer support division, shipping agent, or dealer.

2.3 Mechanical Requirements

2.3.1 Dimensions

VMEbus Bridge Module Dimensions:	160 mm x 233 mm (6.3 in. x 9.2 in.)
VMEbus Bridge Module weight	120 g (4.2 oz)
PCI Bus Bridge Module Dimensions	106.68 mm x 312 mm (4.2 in. x 12.28 in.)
PCI Bus Bridge Module weight	120 g (4.2 oz)

2.3.2 Installation Restrictions

The following restrictions apply to the PCI32-VME64 adapter hardware:

- Installation of the PCI32 module in a PCI slot, which supports shared interrupts, is not supported.
- Installation of the PCI32 module in a PCI slot, which is behind a PCI-PCI bridge chip (i.e. secondary PCI bus), is not supported.
- Due to the tightly integrated nature of the module set, power to the VME64 module must remain on while the host operating system is running. Powering off the VMEbus chassis while the host operating system is running **will** result in a system crash.

2.3.3 Installing the Adapter

This section provides the steps necessary to install the adapter modules.

Caution

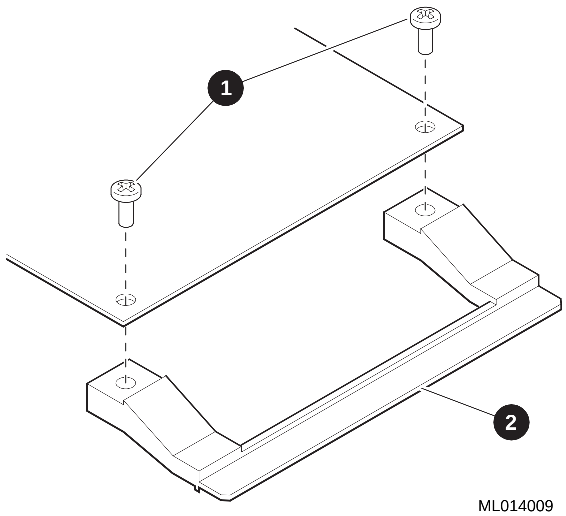
Electrostatic discharge may cause the PCI32-VME64 adapter to malfunction. When you handle adapters, wear an antistatic wriststrap with the wire clipped to the frame of the system.

1. Perform a power shutdown of both the VMEbus chassis and the AlphaServer system.
   a. Perform an orderly shutdown of the operating system.
   b. Set all power switches on the system and the VME chassis to the “off” position.
   c. Unplug all power cords from the wall socket, then disconnect the cord from the system unit and the VME chassis.
2. Set jumpers on the VME and PCI modules to the desired configuration settings, as outlined Section 1.4.6 and Section 1.4.7.
3. The PCI bus bridge adapter module is shipped with the straight extender bracket attached. The type of extender bracket required depends on the model of the AlphaServer host. Table 2-2 identifies the PCI extender bracket used in each AlphaServer model. If the AlphaServer system requires a slot-offset extender bracket, remove the straight extender bracket and refer to Figure 2-1 to install the PCI slot-offset extender bracket.

Table 2-2 PCI Extender Bracket Specification for AlphaServer Systems

AlphaServer Model	Straight Extender Bracket (P/N 74-49920-01)	Slot-Offset Extender Bracket (P/N 74-47802-01)
AlphaServer 4100		✓
AlphaServer 8200	✓	
AlphaServer 8400	✓	

Figure 2-1 PCI Module Slot-Offset Extender Bracket Installation

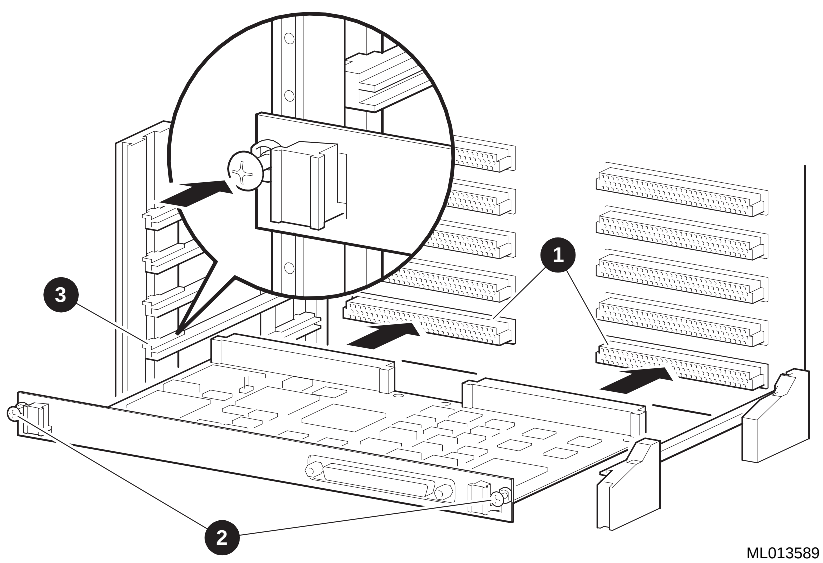


❶ Self-tapping Screws

❷ Offset extender bracket

4. Install the PCI adapter module as follows:
   a. Remove slot covers from PCI slots.
   b. Align the PCI bus bridge adapter module with the slot and push down to make a firm connection, then fasten the screw.
   c. Reinstall the slot covers for the PCI slots and fasten the screws.
   d. Attach the interconnect cable to the PCI bus bridge module, making sure the connection is firm, and tighten the thumbscrews on the connector.
   e. Close the system unit and reconnect the power cord.
5. Install the VMEbus bridge module (see Figure 2-2), following these steps:
   a. Remove the cover plate from the VME chassis by removing the screws.
   b. Align the VMEbus bridge adapter module with the slot ❸ and push down to make a firm connection with the slot connectors ❶. Tighten the two screws ❷ to fasten the module to the backplane.
   c. Attach the interconnect cable to the VMEbus bridge module, making sure the connection is firm, and tighten the thumbscrews on the connector.
6. Power on the VME chassis and the host system.

Figure 2-2 VMEbus Bridge Module Installation



2.4 Testing the Installation

After applying power to the adapter verify that the LED on the front panel of the VME module is on. This verifies that the proper voltages are applied to the module and that the clock circuitry is functioning properly

The PCI module and cable connections are verified by the adapter software at system boot time.