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CONVEX VIOP/VBCU
Service Guide

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Service Guide
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Revision Sheet
CONVEX VIOP/VBCU
Service Guide

Edition	Document No.	Date	Description
First	081-000030-200	April 1988	First release.
First, Rev. 1	081-000030-201	April 1989	New section added on guidelines for VMEbus controllers used with the CONVEX VMEbus. Release-On-Request (ROR) VMEbus master described (VBCU Revision "D"). New Preface and Reader's Forum added. Correct errors on Figures 4-5 and 4-6.

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Preface

Purpose and Intended Audience

This manual provides a general overview of the VMEbus Input/Output Processor (VIOP) and the VMEbus Control Unit (VBCU). It also explains how to:

- Install VMEbus subsystem components
- Integrate VMEbus devices with the CONVEX operating system
- Perform maintenance activities on the VMEbus subsystem

This manual is for CONVEX field engineers, manufacturing personnel, and customers who install and maintain this equipment. This manual is a subset of the VMEbus Service Kit.

Hardware and Software Requirements

- The VIOP/VBCU can be used with all CONVEX computers that have a VMEbus chassis installed.
- Diagnostic program *io5000* is used to verify the proper operation of the VIOP and VBCU.

Organization

The content of each chapter is outlined below:

- **Chapter 1. Description and Specifications**—Describes the VMEbus chassis, VMEbus Input/Output Processor (VIOP), VMEbus Control Unit (VBCU), and lists their electromechanical and environmental specifications.
- **Chapter 2. Unpacking and Installation**—Describes unpacking and reporting damage. Instructions on how to install the VMEbus chassis, VIOP, and VBCU are discussed.
- **Chapter 3. Integration and Test**—Explains how to integrate the VIOP modules with the CONVEX operating system. Information is also provided on diagnostic tests for the VIOP and VBCU.
- **Chapter 4. Maintenance Procedures and IPB**—Explains how to remove and replace all VMEbus subsystem Field Replaceable Units (FRUs). An Illustrated Parts Breakdown (IPB) is provided for all FRUs.
- **Appendix A. Problem Reporting**—Provides an example of the CONVEX *contact* utility for reporting minor software or hardware problems.

Notational Conventions

The following are examples of warnings, cautions, and notes and their typical content and locations as used in CONVEX documents:

> **WARNING**
>
> Warnings highlight procedures or information necessary to avoid injury to personnel. Warnings immediately precede the critical information and include a description of the hazard.

> **CAUTION**
>
> Cautions highlight procedures or information necessary to avoid damage to equipment, loss of data, or invalid test results. Cautions immediately precede the critical information and include a description of the possible damage.

> **NOTE**
>
> Notes highlight useful information that is supplemental in nature. Notes may immediately precede or follow the information that is being highlighted.

Associated Documentation

The following is a partial list of other manuals or books that provide more detailed information on the topics presented in this manual:

- *CONVEX VMEbus Reference Manual,* Order No. DHW-061
- *CONVEX VMEbus Service Kit,* Order No. DHW-050
- *The VMEbus SPECIFICATION C.1,* Motorola Inc.
- *CONVEX Processor Operation Guide,* Order No. DHW-015
- *CONVEX System Manager's Guide,* Order No. DSW-004
- *CONVEX PBUS I/O System Diagnostics Manual,* Order No. DHW-008
- *CONVEX Diagnostic Utility Manual,* Order No. DHW-082
- *Guide to Attaching Multibus Peripherals,* Order No. DHW-020
- *Multibus Configuration Guide,* Order No. DHW-022
- *Multibus Controller Configuration Guide,* Order No. DHW-122

- *CONVEX IOP Interface Reference Manual*, Order No. DSW-094

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Reader's Forum

If you wish to mail your comments to us, please use the form at the end of this manual and list the document page number with your questions and comments. Thank you.

Acknowledgments

I would like to thank the following people for their contributions to this manual:

- Technical contributors: Matt Barr, Dave Nobles, John Rachels, and Tom McClendon
- Document review team: Ron Elgelking, Al Haddix, John Rachels and Chip Stroup
- Hardware documentation staff: Larry Bonura, Art Fischman, Jimmy Holman, and Barbara Morris

Without the efforts of all the aforementioned, this document would not have been possible.

Bob Hopkins
CONVEX Hardware Documentation

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Chapter 1
Description and Specifications

1.1 Overview

This chapter describes the components that make up the CONVEX VersaModule European (VMEbus) subsystem, and lists their electromechanical and environmental specifications.

1.2 VMEbus Subsystem Overview

The CONVEX VMEbus subsystem functions as an intelligent, high-performance data and control path between peripheral devices residing in a VMEbus and main memory. Circuits within the VMEbus subsystem perform many tasks that would normally require intervention from the main CPU. Because the CPU is freed from these tasks, the effective processing speed of the system is increased. The CONVEX VMEbus subsystem consists of the following major components:

- VMEbus Input/Output Processor (VIOP)
- VMEbus Control Unit (VBCU)
- VMEbus expansion chassis and related hardware

1.2.1 C120 VMEbus Subsystem Data Path

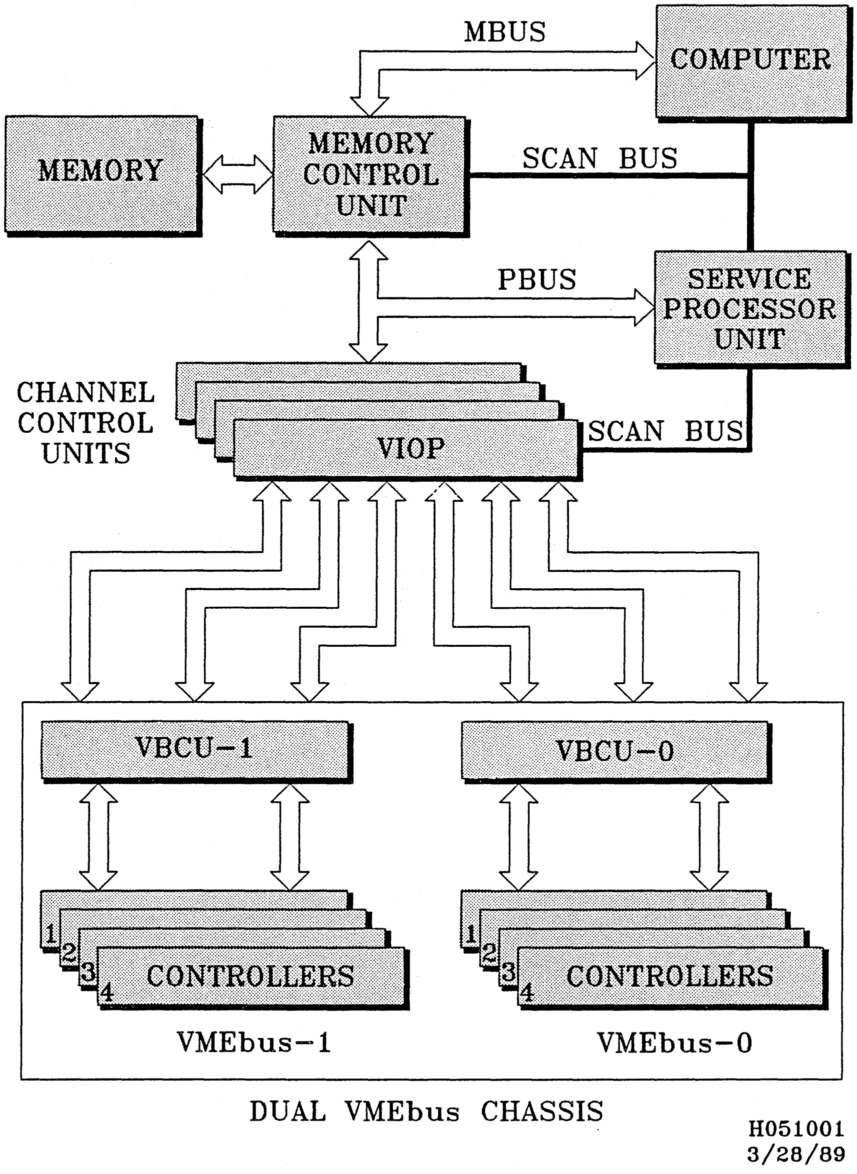
VMEbus peripheral controllers contained in a CONVEX expansion chassis are connected to a CONVEX C120 computer's main memory through a Channel Control Unit (CCU) and the VBCU. The VIOP, which is a VMEbus Input/Output Processor, controls all data transfers between main memory and the VBCU. The VBCU controls all data transfers on the VMEbus.

The intelligence for the subsystem is contained in the VIOP. Depending on the type of CONVEX computer, from one to five VIOPs can be installed in a C120 computer card cage.

One version of the CONVEX VMEbus subsystem contains dual VMEbuses and each VMEbus can contain a VBCU. Up to four VMEbus controllers can be installed in each of the dual VMEbuses. A single VIOP can be used for the dual bus, because the VIOP has two VBCU communication ports. The VIOP ports alternate between the two VBCUs as the need arises.

The VIOP's transfer bandwidth to and from main memory is many times greater than the VMEbus controller's bandwidth. Therefore, there is a minimum of controller waiting time to gain access to its VIOP port. The theoretical transfer speed of this configuration is approximately 12-Mbytes/VIOP or 6-Mbytes/VBCU. When only a single port is used, the theoretical transfer speed is 10 Mbytes for both the VIOP and VBCU. Figure 1–1, "C120 VMEbus Subsystem Block Diagram," illustrates the relationships between the major components in the CONVEX VMEbus subsystem and a C120 computer:

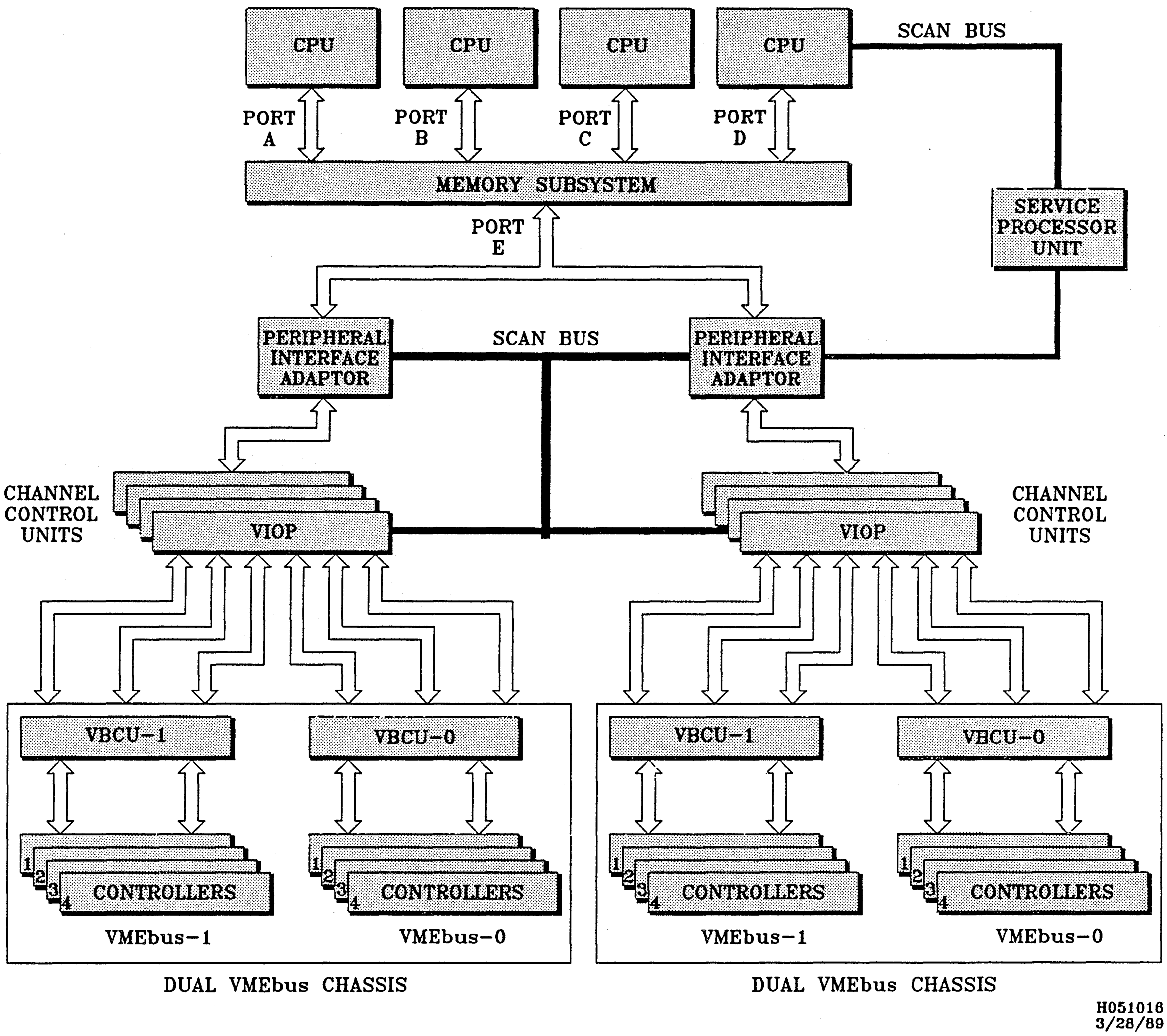
Figure 1–1, C120 VMEbus Subsystem Block Diagram



1.2.2 C230, C240 VMEbus Subsystem Data Path

In a multiprocessor system, such as a C220, C230 or C240, the data path to main memory is different from the C120. The VIOP connects to a Peripheral Interface Adapter (PIA). The PIA is the interface between the VIOP and main memory. The standard PIA configuration for a C220, C230, and C240 is a single PIA and up to four VIOPs. A second PIA and four additional VIOPs can be added as an option to the C230 and C240, but not to the C220. Figure 1–2,"C230, C240 VMEbus Subsystem Block Diagram," shows a C230, C240 with two PIAs and two dual VMEbus subsystem:

Figure 1–2, C230, C240 VMEbus Subsystem Block Diagram



1.2.3 VMEbus Subsystem Product Numbers

Each major component in the CONVEX VMEbus subsystem is identified by a product number. Table 1–1, "VMEbus System Product Numbers," lists the product numbers for each major VMEbus subsystem component along with a brief description:

Table 1–1, VMEbus System Product Numbers

Product Number	Product Description
VBS-003	VMEbus chassis, single (9-slot), VMEbus
VBS-004	VMEbus chassis, dual (two 5-slot), VMEbuses
VSB-005	VMEbus/Mbus Combo, 6-slot VMEbus and a 5-slot Multibus
VIOP-001	VMEbus Input/Output Processor (VIOP)
VMC-001	VMEbus Control Unit (VBCU)

1.3 VIOP Description

The VIOP provides a high-speed connection between the PBUS and the VBCU. The VIOP uses a 20-MHz 68020 microprocessor and a static no-wait state memory. The VIOP connects to the VBCU through three 60-pin I/O cables. The VIOP's VBCU interface architecture allows 8-, 16-, and 32-bit data transfers coupled with 22-bit addressing. Performance will approach 10 Mbytes per second on a single VIOP port and about 6 Mbytes per second when both VIOP ports are used.

Data is pipelined between the VIOP and VBCU in both directions. Data movement is controlled by an asynchronous protocol. The pipelining and asynchronous protocol compensate for propagation delays, introduced by long cable lengths. These features enable the maximum possible transfer bandwidth for a given peripheral device configuration.

The main features of the VIOP are detailed in the following list:

- Uses a 20-MHz 68020 microprocessor with 128K by 32-bit static RAM memory for zero-wait state access
- The 68020 microprocessor and its memory operate asynchronously from the rest of the VIOP
- Contains a 32K by 8-bit EPROM for firmware
- Has two VBCU interfaces that use asynchronous protocol and pipelining
- Contains a 128-Kbyte high-speed local memory (cache) for temporary storage of data between main memory and VMEbus controllers
- Has 32-bit data paths between the 68020 microprocessor, the cache, and the VMEbus chassis
- The type of CONVEX computer the VIOP is installed in is defined by a "machine type" register that is available to the 68020 microprocessor

- Contains a page memory mapper (4 Kbytes per page) in the 68020 microprocessor's local memory
- The VIOP maintains an encoded slot number of the current VMEbus master. This enables cache window access rights to be enforced on a specific VMEbus chassis and slot number
- Services equal interrupt priorities from two VMEbus chassis in a round-robin manner
- Has Page Map (PMAP) registers that contain a Test and Clear (TAC) bit for PBUS cycles, and an I/O bit that will start an I/O read/write PBUS cycle
- Each VMEbus slot number is contained in a VMEbus diagnostic register that is used during loopback testing to identify the device under test
- The 68020 microprocessor is able to write bad data parity on any combination of bytes of its 4-byte wide data path during the diagnostic mode of operation
- The 68020 microprocessor contains a parity/error address register to identify the address with bad parity, or the address that caused a bus error
- The 68020 microprocessor contains a bus error log to identify the cause of a bus error
- The SPU communicates with the 68020 microprocessor via a 16-bit scan-ring register
- The SPU can margin the 68020 microprocessor's clock via the scan-ring register

1.4 VBCU Description

The VBCU is the interface between the VIOP and the VMEbus. Arbitration circuits on the VBCU ensures that there is time for each VMEbus controller on its bus. VMEbus controllers that use the standard bus request protocol, typically release the VMEbus when their transfer operation is completed. For controllers with the same priority levels, these types of data transfers operations are handled by the VBCU in a round-robin, first come, first serve basis.

VBCUs with a revision level of "**D**", or later, support a Release-On-Request (ROR) type of VMEbus master as well as the standard VMEbus request. All VMEbus requests are logically ORed in the VBCU, and are used to generate a VMEbus Request **0** signal that is sent to all controllers on the VMEbus. If an ROR type of controller is VMEbus master, it will release the VMEbus when it detects the VMEbus Request **0** signal. ROR VMEbus requests are serviced by the VBCU in the same round-robin manner as a standard VMEbus request.

1.4.1 VBCU Features

Special features of the VBCU are:

- The VBCU is a triple-height (9U), single-width VMEbus board
- Provides a 16-MHz VMEbus system clock for the VMEbus
- Supports 8-, 16-, and 32-bit data fields on a 32-bit data path, generates and checks parity

- Supports a 22-bit address path with parity generation and checking on the VIOP cable side
- Address mapping of the 4-Mbyte cable address range into the 16-Mbyte VMEbus standard address space, is performed on 4-Mbyte boundaries
- Address mapping of the 4-Mbyte cable address range into the 4-Gbyte VMEbus extended address space is also performed on 4-Mbyte boundaries
- The VBCU generates VMEbus address modifiers 2D hex (short), 3D hex (standard), or 0D hex (extended) on VIOP transfers to the VMEbus chassis
- The VBCU responds to address modifiers 39 and 3D hex (standard), or to 09 and 0D hex (extended) on VMEbus controller transfers to the VIOP cache
- Contains a 768-μsec VMEbus Data Transfer Acknowledge (DTACK) timeout circuit
- The VBCU control register is used to margin the chassis power supply
- Low-airflow sensor and bus arbiter timeout error bits are available in the VBCU error log
- The VMEbus chassis is reset automatically when the VBCU is reset, and can also be reset through the VBCU control register
- Contains a low-airflow sensor for the VMEbus chassis

1.4.2 VBCU Registers

The VBCU has 16 internal registers that are used to control or record various activities. Certain registers are used to force a parity error, or to perform pattern testing on the address path during diagnostic testing. Two registers are used to extend the chassis address range to 32 bits. Other registers are used for the VBCU Control register, Error Log, and Address Map register. The Interrupt Status Register latches a hardware interrupt request until cleared by the 68020 microprocessor. Figure 1–3, "VBCU Register Map," identifies the locations of the various internal VBCU registers:

> **NOTE**
>
> The *[01]* notation in the register address means that the address bit is either a 1 or a 0. For VMEbus chassis 0, the address bit is a 0, and for VMEbus chassis 1, the address bit is a 1.

Figure 1–3, VBCU Register Map

Address						
C[01]FFFF	Reserved					
C[01]FFFE	VMEbus to VIOP Addr<31..24>					
C[01]FFFD	VIOP to VMEbus Addr<31..24>					
C[01]FFFC	0	0	Address<21..16>			
C[01]FFFB	Address<15..8>					
C[01]FFFA	Address<7..0>					
C[01]FFF9	A/D Conversion					
C[01]FFF8	A/D Conversion					
C[01]FFF7	Error Log					
C[01]FFF6	Force Parity Error					
C[01]FFF5	VIOP to VMEbus Addr<23..22>	x	x	VMEbus to VIOP Addr<23..22>	x	x
C[01]FFF4	VBCU Control					
C[01]FFF3	Force Interrupt					
C[01]FFF2	Interrupt Level					
C[01]FFF1	Interrupt Status					
C[01]FFF0	Interrupt Enable					

The 16 VBCU internal registers occupy the uppermost 16 bytes of the 6,5536-byte VMEbus short address space. Within the 68020 microprocessor address space, the short address space for VMEbus chassis 0 is located from C00000 through C0FFFF, and the short address space for VMEbus chassis 1 is located from C10000 through C1FFFF. The VBCU internal registers for chassis 0 and 1 are located from C0FFF0 through C0FFFF and from C1FFF0 through C1FFFF, respectively, in the 68020 microprocessor address space.

The 68020 microprocessor can also access VMEbus standard and extended address spaces. No portion of this address spaces is reserved; the entire range is available to the 68020 microprocessor.

The locations of VBCU registers and of VMEbus short, standard, and extended address spaces within the 68020 microprocessor memory map are summarized in Table 1–2, "Memory Map for VMEbus Addresses":

Table 1–2, Memory Map for VMEbus Addresses

VMEbus Address Space	Chassis 0	Chassis 1
VBCU	C0FFF0-C0FFFF	C1FFF0-C1FFFF
Short	C00000-C0FFEF	C10000-C1FFEF
Standard	1000000-13FFFFF	1400000-17FFFFF
Extended	1800000-1BFFFFF	1C00000-1FFFFFF

There are physically only 22 address bits used on the cable from the VIOP to the VMEbus chassis. VMEbus address bits A<22..31> are generated according to the contents of registers located on the VBCU. These registers are described in the following sections.

1.4.2.1 Interrupt Enable Register (C[01]FFF0)

The Interrupt Enable Register (IER) enables or disables the eight possible VMEbus interrupts; a "1" in a given bit position enables the associated interrupt, while a "0" masks the interrupt. VMEbus controllers generate interrupts **1** through **7** only. Interrupt **0** is asserted only through the Force Interrupt Register (FIR).

Masking an interrupt does not clear it. It simply prevents the interrupt from being sent to the interrupt controller on the VIOP and causing an interrupt to the 68020 microprocessor. An interrupt is cleared by performing the proper operation with the device that generated it. The IER is cleared automatically at powerup.

1.4.2.2 Interrupt Status Register (C[01]FFF1)

The Interrupt Status Register (ISR) provides a means for VIOP software to determine which VMEbus interrupts were asserted at the last interrupt acknowledge. Pending interrupts are indicated by a "1" in the associated bit position.

When a particular VMEbus interrupt request is asserted, it is latched in the ISR. This is done so that the interrupt remains active in the ISR if the VMEbus peripheral controller releases its interrupt request during an Interrupt Acknowledge (IACK) cycle. Because interrupts are latched, the software is able to distinguish forced interrupts from a Release On Acknowledge (ROAK) type of VMEbus interrupt.

Individual latched interrupts are cleared by encoding the interrupt number in DATA<2..0> and writing the number to the ISR. The complete ISR is cleared when the Local Reset signal is asserted in the VBCU Control Register.

1.4.2.3 Interrupt Level Register (C[01]FFF2)

Each of the eight interrupts are individually assigned to either 68020 microprocessor interrupt level **3** or level **1**. A "1" in a bit causes an interrupt to occur on level **3**, and a "0" causes an interrupt to occur on level **1**. This enables interrupting devices to be assigned to one of these two interrupt priority levels. Level **3** is the higher priority interrupt level.

The interrupt level should not be confused with the interrupt vector returned to the VIOP during an interrupt acknowledge cycle. The interrupt vector is determined by the VMEbus interrupt line (or forced interrupt) being acknowledged. The Interrupt Level register is not cleared by VMEbus reset.

1.4.2.4 Force Interrupt Register (C[01]FFF3)

Under the control of the 68020 microprocessor, any of the eight interrupts may be generated through the Force Interrupt Register (FIR). Setting an interrupt bit to a "1" causes the associated interrupt to be generated; clearing the bit, clears the interrupt. The interrupt bit must be enabled in the IER to force a specific interrupt. The FIR is cleared automatically at powerup.

1.4.2.5 VBCU Control Register (C[01]FFF4)

The format for VBCU control register is illustrated in Figure 1–4, "VBCU Control Register;" the register bits are described in the text after the figure:

Figure 1–4, VBCU Control Register

7	6	5	4	3	2	1	0
(unused)	AC FAIL	Pattern Test	VMEbus SYSFAIL	Local Reset	Margin High/Low	Margin Enable	Margin Capability

- **Bit 0, Power Supply Margin Capability**—This read-only status bit enables the 68020 microprocessor to determine whether software-controlled margining is possible through the VBCU. If this status bit is set to a "1," then the VBCU has the ability to enable margining in bit <1>.

> **NOTE**
>
> In a dual VMEbus chassis either VBCU has the ability to margin the VMEbus chassis power supply. In a VMEbus/Multibus combination chassis either the VBCU or MBCU should be selected to margin the power supply. Jumpers on the VMEbus backplane are provided for this selection.

- **Bit 1, Power Supply Margin Enable**—When set to "1," this bit enables margining of the +5 volt supply in the VMEbus chassis. In order for margin enable to function, the VMEbus backplane must be jumpered so that the VBCU has margin control capability. The jumper setting is visible in bit <0>. The margin enable bit is cleared when the RESET signal to the VBCU is asserted.
- **Bit 2, Power Supply Margin High/Low**—This bit controls the margin direction when the Power Supply Margin Enable bit is asserted. Setting bit <2> to a "1" selects high margin, and to a "0" selects low margin. Bit <2> is cleared when the RESET signal to the VBCU is asserted.

- **Bit 3, Local Reset**—This bit enables the 68020 microprocessor to assert the RESET signal to the VMEbus and to the VBCU bus arbiter. The RESET signal is true when this bit is set to "1," and it is automatically set when the IO-VB.RESET signal from the VIOP to the VBCU is asserted.
- **Bit 4, VMEbus SYSFAIL**—This read-only signal enables the 68020 microprocessor to monitor the status of the VMEbus SYSFAIL signal. This bit is set to a "1" if the SYSFAIL signal is asserted.
- **Bit 5, Address and Data Path Pattern Test Enable**—This bit is set to a "1" to enable diagnostic pattern testing of the address and data path. This feature is discussed in greater detail in the description of the Address Save registers.
- **Bit 6, AC FAIL**—This read-only signal enables the 68020 microprocessor to monitor the status of the power supply AC FAIL signal. This bit is set to a "1" if the AC FAIL signal is asserted.

1.4.2.6 Standard Address Space Map Register (C[01]FFF5)

This register controls the mapping between the 4-Mbyte cache and the 16-Mbyte VMEbus standard address space. When the 68020 microprocessor accesses VMEbus standard address space, bits <7> and <6> generate the high-order VMEbus address bits A23 and A22, respectively. Bits <5> and <4> are not used. Address modifier 3D hex is generated by the VBCU during a 68020 microprocessor access to VMEbus standard address space.

When a VMEbus controller is VMEbus master and wishes to access the VIOP cache through the VBCU, bits <3> and <2> must match VMEbus address bit <23> and <22>, respectively. This enables the 68020 microprocessor to map the VIOP cache into the desired portion of the VMEbus standard address space. Bits <1> and <0> are not used.

Address modifiers 3D and 39 hex are accepted by the VBCU. Either address modifier may be used to access the VIOP cache through VMEbus standard address space. The Standard Address Space Map register is cleared automatically at powerup.

1.4.2.7 Force Parity Error Register (C[01]FFF6)

The format for the Force Parity Error register is illustrated in Figure 1–5, "Force Parity Error Register;" the register bits are described in the text after the figure:

Figure 1–5, Force Parity Error Register

7	6	5	4	3	2	1	0
(unused)	(unused)	(unused)	Address Parity	Data Parity<3>	Data Parity<2>	Data Parity<1>	Data Parity<0>

- **Bit 0, Force Data_Parity<0> Error**—When set to a "1" this bit forces bad parity to be generated on DATA<31..24> from the VBCU to VIOP.
- **Bit 1, Force Data_Parity<1> Error**—When set to a "1" this bit forces bad parity to be generated on DATA<23..16> from the VBCU to VIOP.

- **Bit 2, Force Data_Parity<2> Error**—When set to a "1" this bit forces bad parity to be generated on DATA<15..8> from the VBCU to VIOP.
- **Bit 3, Force Data_Parity<3> Error**—When set to a "1" this bit forces bad parity to be generated on DATA<7..0> from the VBCU to VIOP.
- **Bit 4, Force Address Parity Error**—When set to a "1" this bit forces bad parity to be generated on ADDRESS<21..0> from the VBCU to VIOP.

> **NOTE**
>
> All force parity error control bits are cleared automatically on powerup. These bits control the generation of bad parity from VBCU to VIOP, however, the actual parity error is detected by the VIOP.

1.4.2.8 Error Log Register (C[01]FFF7)

The format for the Error Log register is illustrated in Figure 1–6, "Error Log Register;" the register bits are described in the text after the figure:

Figure 1–6, Error Log Register

7	6	5	4	3	2	1	0
Air Flow Sensor	Arbiter Timeout	Data Parity	Address Parity	Cable Master	Slot ID, Last VMEbus Master		

- **Bits <2..0>, Slot ID of Last VMEbus Master**—These three bits indicate the slot number of the VMEbus controller that was VMEbus master when the contents of the Error Log register were latched.
- **Bit 3, Last Cable Master**—When set to a "1" this bit indicates that a VMEbus peripheral controller was granted mastership of the cable interface when the Error Log register was latched. A "0" indicates that the VIOP controlled the cable interface.
- **Bit 4, Address Parity Error**—When set to a "1" this bit indicates that an address parity error was detected by the VBCU.
- **Bit 5, Data Parity Error**,—When set to a "1" this bit indicates that a data parity error was detected by the VBCU on at least one of the four data parity lines.
- **Bit 6, VMEbus Arbiter Timeout**—When set to a "1" this bit indicates that a controller has been granted mastership of the VMEbus, but it did not assert VMEbus BUSY within 768 μ. Bits <2..0> indicate the Slot ID of the errant controller.
- **Bit 7, Air Flow Sensor Error**—When set to a "1" this bit indicates that the VBCU air flow sensor detected a low air flow condition.

> **NOTE**
>
> All error log bits are cleared automatically on powerup. The Error Log register is latched whenever a particular error condition is detected. This also causes the ERROR signal to the VIOP to be asserted. The Error Log register remains latched until read by the VIOP; a VIOP read clears the register.

1.4.2.9 A/D Conversion Registers (C[01]FFF8 and C[01]FFF9)

These registers are used to measure power supply and temperature parameters on the VMEbus chassis. They are identical to the Multibus Control Unit (MBCU) A/D registers, except that the -5V conversion is not used. Refer to the *CONVEX IOP Interface Reference Manual* for a complete discussion of the contents and use of these registers.

1.4.2.10 Address Save Registers (C[01]FFFA through C[01]FFFC)

These registers are read-only registers. When the VBCU diagnostic pattern test is enabled, (bit 5 is set in the Control Register) data and address on writes to VMEbus standard address space are captured. The write data may be read from any address in the standard address space, and the write address may be read from the Address Save Registers.

When diagnostic pattern test is enabled, the VBCU intercepts all writes to VMEbus standard address space and saves the data in an internal register. Requests by VMEbus controllers for bus mastership are ignored, and no VMEbus cycles are granted. Similarly, reads to VMEbus standard address space returns the registered VBCU data (presumably from a previous diagnostic write) and does not generate a VMEbus data transfer cycle. The VMEbus address bits returned in the address save registers are detailed in Table 1–2, "Memory Map for VMEbus Addresses".

1.4.2.11 Extended Address Space Map Register, VIOP to VMEbus (C[01]FFFD)

This register controls the high-order address bits generated on the VMEbus when the 68020 microprocessor accesses VMEbus extended address space. The contents of this register generate VMEbus address bits A<31..24>. VMEbus address bits A23 and A22 are still generated by bits <7> and <6> of the standard address space map register. Address modifier 0D hex is generated by the VBCU during 68020 microprocessor accesses to VMEbus extended address space. This register is cleared automatically at powerup.

1.4.2.12 Extended Address Space Map Register, VMEbus to VIOP (C[01]FFFE)

This register controls extended address mapping between the 4-Mbyte VIOP cache and the 4-Gbyte VMEbus extended address space. When a VMEbus controller is bus master and wishes to access the VIOP cache through the VBCU, VMEbus address bits A<31..24> must match the contents of this register. VMEbus address bits <A23> and <A22> must still match bits <3> and <2> of the standard address space map register. Address modifiers 0D and 09 hex are accepted by the VBCU. Either address modifier may be used to access the VIOP cache through VMEbus extended address space. This register is cleared automatically at powerup.

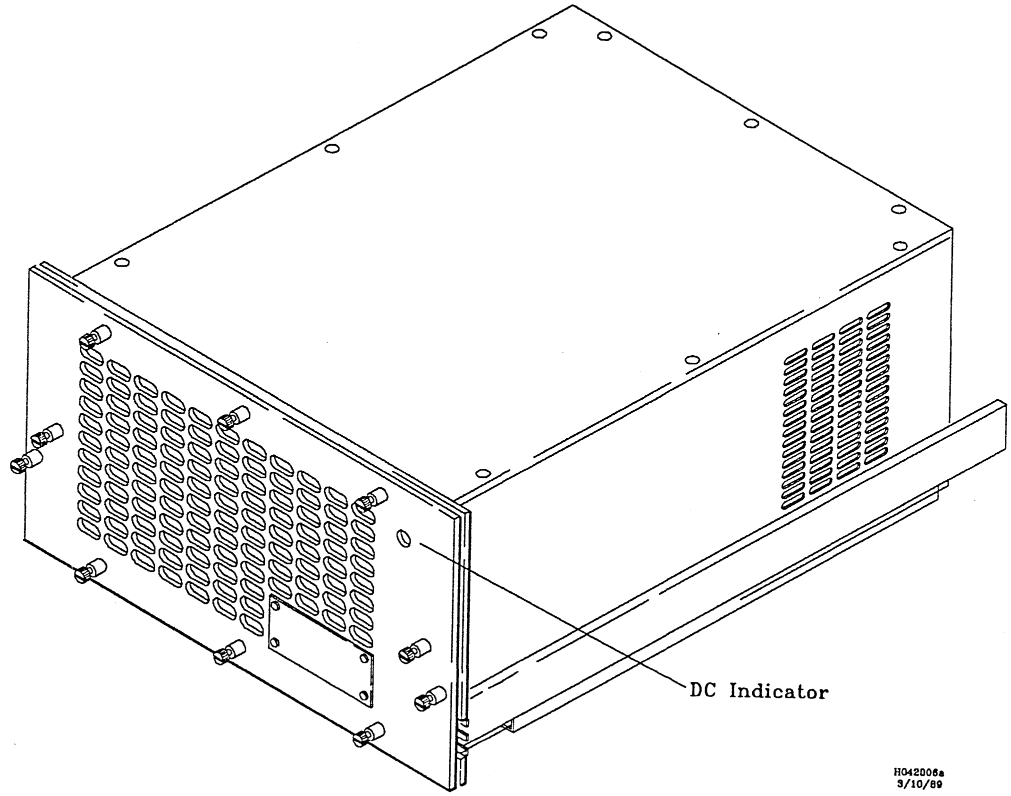
1.5 Chassis Descriptions

The CONVEX VMEbus expansion chassis is a self-contained unit that has its own:

- Power supply
- VMEbus backplane or VMEbus and Multibus backplanes
- Built-in bus terminator networks
- Chassis and power supply cooling fans
- Electromagnetic Interference (EMI) shielding
- Rear bulkhead cable entry points (12 each) with EMI shielding
- Power control switch with built-in circuit breaker and line filter
- Front panel DC indicator
- Low-airflow circuit breaker for automatic DC power shutdown
- Air filter

See Figure 1–7, "Typical VMEbus Chassis," for a VMEbus chassis:

Figure 1–7, Typical VMEbus Chassis



1.5.1 VMEbus and Backplane Description

CONVEX uses a proprietary VMEbus backplane. VMEbus **J1** and **J2** connectors are used, but the daisy chains for interrupt acknowledge and for level-**3** bus grant are not. Instead, each peripheral controller slot has its own dedicated bus request and bus grant lines that connect directly to the VBCU on its bus. All VMEbus controllers installed in a CONVEX VMEbus backplane must use bus request level **3**, and a unique interrupt level.

Because a VMEbus controller's priority level is not determined by its VMEbus position it can be located in any slot. These and other built-in features are transparent to all controllers that meet VMEbus standards.

The use of dedicated request and grant lines enables the current VMEbus master to be identified by slot. This is used by the program to assign cache window access rights on a chassis-and-slot basis. This provides the system manager with a useful tool for optimizing system performance. It has the additional benefit of identifying an errant controller during normal system operation or diagnostic testing.

1.5.2 VMEbus Controller Compatibility Guidelines

The following list is a set of compatibility guidelines CONVEX VMEbus chassis:

> **CAUTION**
>
> Failure to follow these compatibility guidelines may result in improper VMEbus controller or VMEbus operations.

- All VMEbus controllers must use VMEbus request level **3**.
- Each VMEbus controller must be assigned to a *unique* interrupt level.
- VMEbus controllers must comply with VMEbus power specifications; they must not use more than 6A from the +5V power supply.
- VMEbus controllers must to be able to be VMEbus master and use DMA transfer operations to achieve high data transfer rates. Also, the VMEbus controller should handle the VMEbus protocols as fast as possible to achieve maximum performance.
- The CONVEX VMEbus supports the standard VMEbus address modifiers, and when the 68020 microprocessor is VMEbus master, the following address modifiers are generated:
  - **16-bit Address, 2D**—Short Supervisory Access
  - **24-bit Address, 3D**—Standard Supervisory Data Access
  - **32-bit Address, 0D**—Extended Supervisory Data Access
- When a controller is VMEbus master and wants to access memory through the VIOP cache, the CONVEX VMEbus responds to the following address modifiers:
  - **24-bit Address, 3D**—Standard Supervisory Data Access
  - **24-bit Address, 39**—Standard Non-Privileged Data Access
  - **32-bit Address, 0D**—Extended Supervisory Data Access
  - **32-bit Address, 09**—Extended Non-Privileged Data Access
- VMEbus Block mode transfers, and address modifiers 3B, 3F, 0B, and 0F are *not* supported. Unaligned data transfers between the VIOP and a VMEbus controller are also *not* supported.
- The VMEbus address bits <A23..A22> must match the address map register in the VBCU for 24-bit addresses. Address bits <A31..A22> must match the address map in the VBCU for 32-bit addresses. The VMEbus DMA transfer address value must be consistent with the VBCU address map registers.

1.5.3 VMEbus Form Factor Boards

The VMEbus expansion chassis will accept both 6U and 9U VMEbus form factor cards (refer to Table 1–2, VMEbus Chassis Specifications, for exact dimensions). Each 6U form factor controller shipped by CONVEX comes with a 6U to 9U adapter that is installed in the chassis with the controller.

1.5.4 Airflow Circuits and Filter

If the airflow drops below a predetermined rate, a sensor on the VBCU causes the low-airflow circuit breaker to trip and a power-down signal to be sent the chassis power supply. All DC power is removed from the chassis and the green DC indicator on the front panel is extinguished. AC power is *still* applied to the power supply.

A low airflow condition is usually caused by a dirty air filter in the front of VMEbus chassis or by a defective chassis fan. If the air filter is dirty, it should be cleaned with a vacuum cleaner or replaced.

Once a clean filter is installed, the low-airflow circuit breaker must be reset before DC power can be restored to the chassis. If the circuit breaker still trips, contact the CONVEX Technical Assistance Center for assistance.

NOTE

To avoid low airflow conditions, the air filter should be cleaned with a vacuum cleaner every 30 days. Replace filter if it appears damaged.

1.5.5 Chassis Hardware

The expansion chassis is mounted on slides and is normally installed in a CONVEX expansion cabinet. The top and bottom panels are removable for servicing operations. The top panel is removed to install or remove Printed Circuit Boards (PCBs), power supply, or chassis fan. The bottom panel is removed to gain access to the backplane and power harness. The front air filter can be removed to gain access to the power supply voltage adjustment points. The average time to replace a failed device in the VMEbus chassis is less than one hour.

1.5.6 Types of CONVEX VMEbus Chassis

Three types of VMEbus expansion chassis are available. Each one contains a different backplane style, such as single, dual, or VMEbus/Multibus combination. All backplanes have built-in bus terminators; no plug-in terminators are required. The following sections discuss each chassis in greater detail.

1.5.6.1 Single VMEbus Chassis

The single (9-slot) VMEbus expansion chassis contains a single (9-slot) VMEbus backplane. Slot **1** is reserved for the VBCU and slots **2** through **8** are for standard VMEbus controllers. Slot **9** *cannot* be used for a single board VMEbus controller, because this slot has only power and ground connections. However, slot **9** can be used for the second board of a two board VMEbus controller set when the first board is located in slot **8**.

1.5.6.2 Dual VMEbus Chassis

The dual (two 5-slot) VMEbus chassis contains two VMEbus backplanes and two VBCUs. Slot **1** is reserved for VBCU-0 and slot **10** for VBCU-1. The dual VMEbus chassis can contain eight VMEbus controllers; four controllers may be installed in each VMEbus in the dual VMEbus chassis.

1.5.6.3 VMEbus/Mbus Combo Chassis

The VMEbus/Mbus combo chassis contains a 6-slot VMEbus and a 5-slot Multibus. Slot **1** is reserved for the VBCU and slot **7** is reserved for the Multibus Control Unit (MBCU). The VMEbus can contain five VMEbus controllers; the Multibus can contain four Multibus controllers.

> **NOTE**
>
> Information on the Multibus Control Unit (MBCU) and the Multibus Input/Output Processor (MIOP) is contained in other CONVEX documents (refer to the "Associated Documentation List" in the preface).

1.5.7 Chassis Specifications

The specifications and the recommended operating ranges for the VMEbus chassis are listed in Table 1–3, "VMEbus Chassis Specifications":

Table 1–3, VMEbus Chassis Specifications

Parameter	Value/Comment
Width	19 in (48.26 cm)
Height	10.5 in (26.67 cm)
Length[1]	22 in (55.88 cm)
Weight	75 lb (34.02 kg)
VMEbus Circuit Board Sizes[2] **6U (Double height)** **9U (Triple height)**	 6.299 in (160 mm) deep by 9.187 in (233.35 mm) high 6.299 in (160 mm) deep by 13.9 in (350.00 mm) high
VMEbus Backplane Connectors **J1** **J2**	 96-pin connector 96-pin connector
Bulkhead Cable Openings	12[3]
Chassis Fan	200 cu/ft/min
Low-Airflow Sensor Circuit Breaker	Removes DC power when activated
AC Circuit Breaker **Option 1** **Option 2**	 6 amps at 90 V to 132 V 4 amps at 180 V to 264 V
Power Dissipation, Maximum	≤ 700 W
Temperature Range,[4] **Maximum**	60 °F to 90 °F (15 °C to 32 °C)
Temperature Range,[4] **Recommended**	70 °F to 80 °F (21 °C to 26.6 °C)
Temperature Change, Maximum Rate	14.4 °F/hr (8 °C/hr)
Humidity Range, Maximum	10% to 90% with no condensation
Humidity Range, Recommended	40% to 60% with no condensation

[1] Chassis is mounted behind vertical rails and no cables are installed.
[2] Extended depth circuit boards, greater than 6.299 in (160 mm), will not fit in this chassis.
[3] The maximum number of cables per opening is four.
[4] At altitudes above 3,280 ft (1,000 m), lower air densities affect air conditioning. If the unit is located above this altitude, lower the recommended temperature value by 1 °F/1,000 ft (2 °C/1,000 m).

1.5.8 Chassis Power Supply Specifications

Table 1–4, "Chassis Power Supply," lists the specifications and the recommended operating ranges for the chassis power supply.

Table 1–4, Chassis Power Supply

Parameter	Value/Comment
Width	5.0 in (12.7 cm)
Height	5.75 in (14.6 cm)
Length	13.63 in (34.62 cm)
Weight	16.5 lb (7.48 kg)
AC Voltage Range **Option 1**[1] **Option 2**[1]	 90 V to 132 V[2] 184 V to 264 V[2]
AC Frequency Range	47 HZ to 63 HZ
Power Dissipation, Maximum	≤ 500 W
DC Voltages **V1 = +5V** **V2 = -5V**[3] **V3 = +12V** **V4 = -12V**	Line and Load Regulation = ± 0.4% 100 amps[4] 10 amps[4] 5 amps[4] 5 amps[4]
Ripple and Noise (PARD[5]**)**	1% p-p[6] or 50 mV, whichever is higher
Temperature Range,[7] **Maximum**	32 °F to 158 °F (0 °C to 70 °C)
Temperature Range,[7] **Recommended**	70 °F to 80 °F (21 °C to 26.6 °C)
Temperature Change, Maximum Rate	14.4 °F/hr (8 °C/hr)
Humidity Range, Maximum	10% to 90% with no condensation
Humidity Range, Recommended	40% to 60% with no condensation

1 The AC input voltage range is selected by front panel jumpers on the power supply.
2 Automatic shutdown occurs when input voltage exceeds 150/300 V. Recovery is automatic when the input voltage returns to a safe level.
3 Not a standard VMEbus voltage value, but is used in the Multibus backplane.
4 Foldback current limiting to less than 50% of full load rating under a short circuit condition.
5 PARD is the acronym for Periodic And Random Deviation.
6 p-p is the acronym for peak-to-peak value.
7 At altitudes above 3,280 ft (1,000 m), lower air densities affect air conditioning. If the unit is located above this altitude, lower the recommended temperature value by 1 °F/1,000 ft (2 °C/1,000 m).

1.6 VIOP Specifications

Table 1–5, "VIOP Specifications," lists the specifications and the recommended operating ranges for the VIOP:

Table 1–5, VIOP Specifications

Parameter	Value/Comment
Width	19.0 in (48.26 cm)
Height	20.3 in (51.56 cm)
Thickness	0.56 in (*approx*) (1.65 cm)
Weight	8 lb (*approx*) (3.62 kg)
Power Dissipation, Maximum	180 W
Temperature Range,[1] **Maximum**	60 °F to 90 °F (15 °C to 32 °C)
Temperature Range,[1] **Recommended**	70 °F to 80 °F (21 °C to 26.6 °C)
Temperature Change, Maximum Rate	14.4 °F/hr (8 °C/hr)
Humidity Range, Maximum	10% to 90% with no condensation
Humidity Range, Recommended	40% to 60% with no condensation

[1] At altitudes above 3,280 ft (1,000 m), lower air densities affect air conditioning. If the unit is located above this altitude, lower the recommended temperature value by 1 °F/1,000 ft (2 °C/1,000 m).

1.7 VBCU Specifications

Table 1–6, "VBCU Specifications," lists the specifications and the recommended operating ranges for the VBCU:

Table 1–6, VBCU Specifications

Parameter	Value/Comment
Width	14.43 in (36.65 cm)
Height	6.29 in (15.98 cm)
Thickness	0.65 in *(approx)* (1.65 cm)
Weight	3 lb *(approx)* (1.36 kg)
Low-Airflow Sensor	Trip point≤ 100 cu/ft./min.
Power Dissipation, Maximum	40 W
Temperature Range,[1] **Maximum**	60 °F to 90 °F (15 °C to 32 °C)
Temperature Range,[1] **Recommended**	70 °F to 80 °F (21 °C to 26.6 °C)
Temperature Change, Maximum Rate	14.4 °F/hr (8 °C/hr)
Humidity Range, Maximum	10% to 90% with no condensation
Humidity Range, Recommended	40% to 60% with no condensation

[1] At altitudes above 3,280 ft (1,000 m), lower air densities affect air conditioning. If the unit is located above this altitude, lower the recommended temperature value by 1 °F/1,000 ft (2 °C/1,000 m).

Chapter 2
Unpacking and Installation

2.1 Overview

Unpacking and inspection are discussed, major components of the CONVEX VME subsystem are identified, and installation procedures are provided.

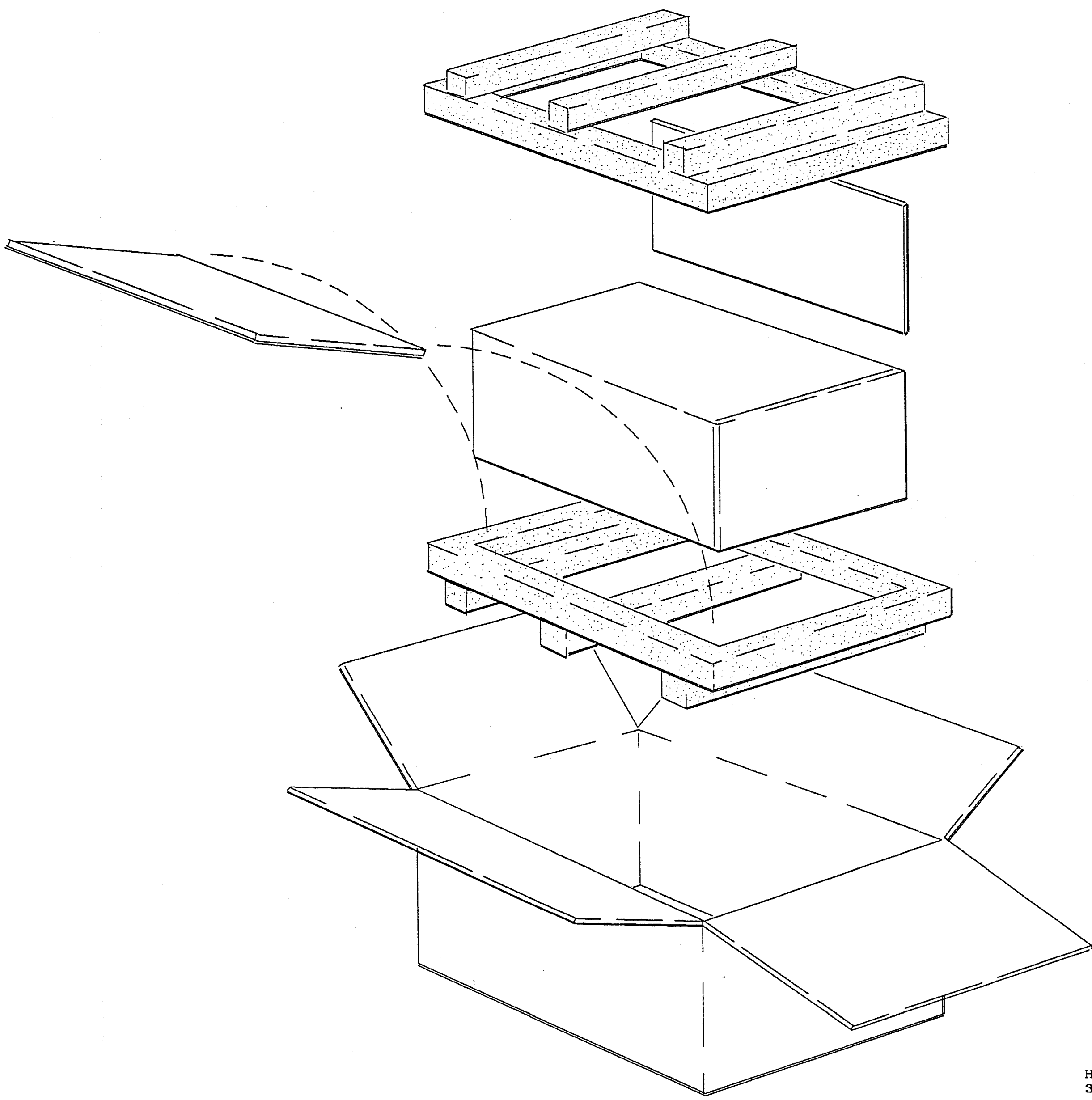
2.2 Unpacking and Inspection

General guidelines for unpacking the VMEbus subsystem are provided.

2.2.1 Shipping Configuration

A typical VMEbus subsystem shipping configuration consists of the items illustrated in Figure 2-1, "Shipping Carton":

Figure 2–1, Shipping Carton



2.2.2 Inspection for Damage

All shipping containers have been specially designed to protect their contents under normal shipping conditions. Carefully inspect each carton for signs of shipping damage as it is unpacked. If damage is found after visual inspection, document the damage with photographs and contact the transport carrier immediately. Unpack the equipment as described in the next section.

2.2.3 Unpacking

The customer's bill of material lists all VMEbus equipment shipped from CONVEX. It should be used as a checklist to ensure that all equipment has arrived. Refer to the following Table 2–1, "Typical VMEbus Bill of Material"," for a bill of material for the VMEbus subsystem:

Table 2–1, Typical VMEbus Bill of Material

Product Number	Description	Quantity
VSB-004	VMEbus chassis assy, dual	1
VIOP-001	VMEbus Input/Output Processor	1
VMC-001	VMEbus Control Unit and cables	2

1. Unpack each item of equipment from its shipping container.
2. Inspect each item of equipment for any sign of shipping damage as it is unpacked.
3. If equipment damage is found, document and proceed to the next section.

> **NOTE**
>
> Save all packing material until after operational checkout of the equipment. This enables equipment to be returned safely to CONVEX, if required.

2.2.4 Damage Claims

If the VMEbus equipment is damaged, a damage claim must be completed. Damage claims should be completed by the customer and given to the shipping representative. Claim forms are normally obtained from the shipping representative.

2.3 Chassis Installation Guidelines

The best location to install a VMEbus chassis can vary from machine to machine because of hardware installed in the system. The installed hardware, in some cases, limits available space for the VMEbus chassis. This in turn affects cabling distances from the VBCU, contained in the VMEbus chassis, to the VMEbus Input/Output Processor (VIOP), contained in the processor cabinet. Cabling distances between the VBCU and a VIOP are:

- **Maximum length** — 25 ft (7.62 m)
- **Recommended length** — 15 ft (4.57 m)

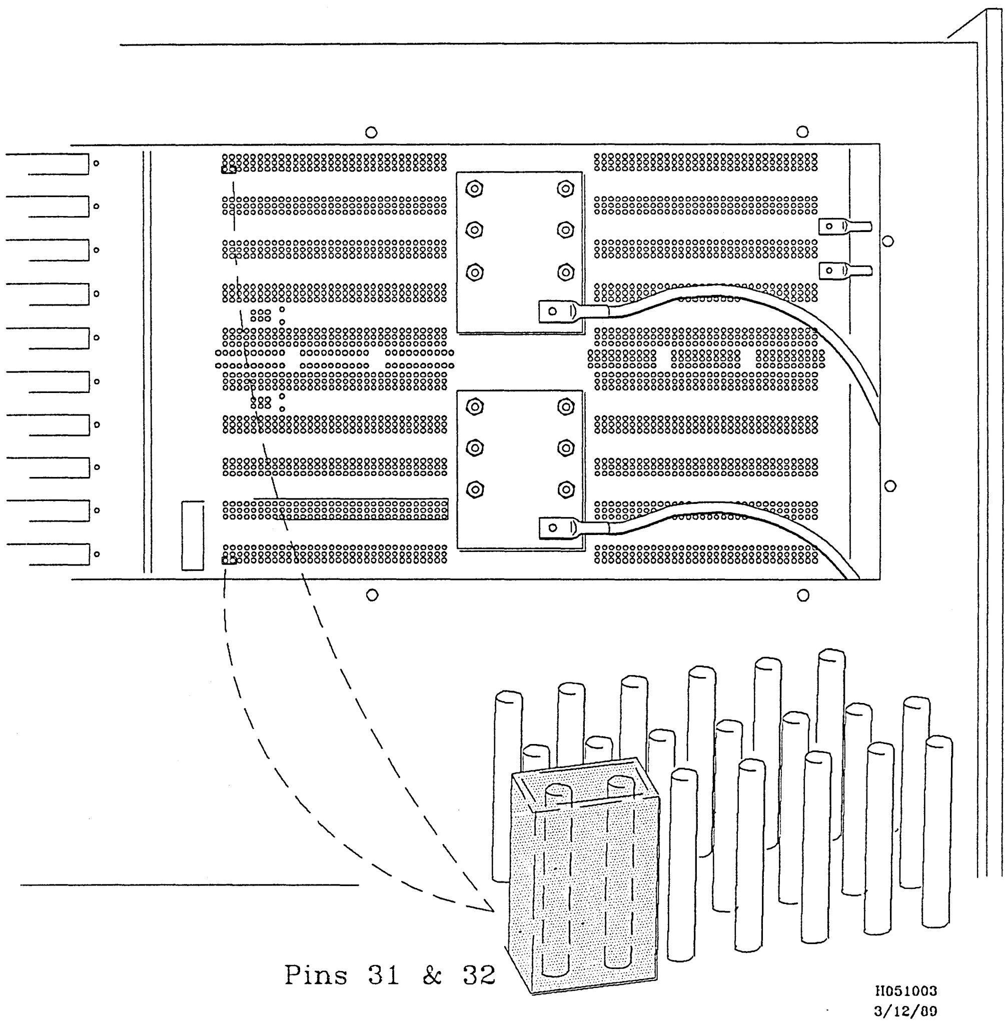
2.4 Dual VMEbus Backplane Jumpers

Two VBCUs can be installed in a dual VMEbus chassis and both VBCUs can margin the chassis power supply during diagnostic testing. When a jumper is *installed* between **J2C31** and **J2C32** (on the bottom of the VMEbus) power margining is *disabled*. When a jumper is *removed*, power margining is *enabled*.

If both VBCUs are connected to the same VIOP, then both jumpers are normally removed. If, however, the two VBCUs are connected to two *different* VIOPs, then only a *single* jumper should be installed. Usually the **VBCU0** jumper is removed and the **VBCU1** jumper is installed.

Jumper settings should be completed before the chassis is installed in an expansion cabinet, as it is difficult to see the backplane pins on the bottom of the VMEbus when the chassis is installed. See Figure2–2, "Dual VMEbus Backplane Jumpers," for the locations of **J2C31** and **J2C32**:

Figure 2–2, Dual VMEbus Backplane Jumpers



2.5 Chassis Installation Procedure

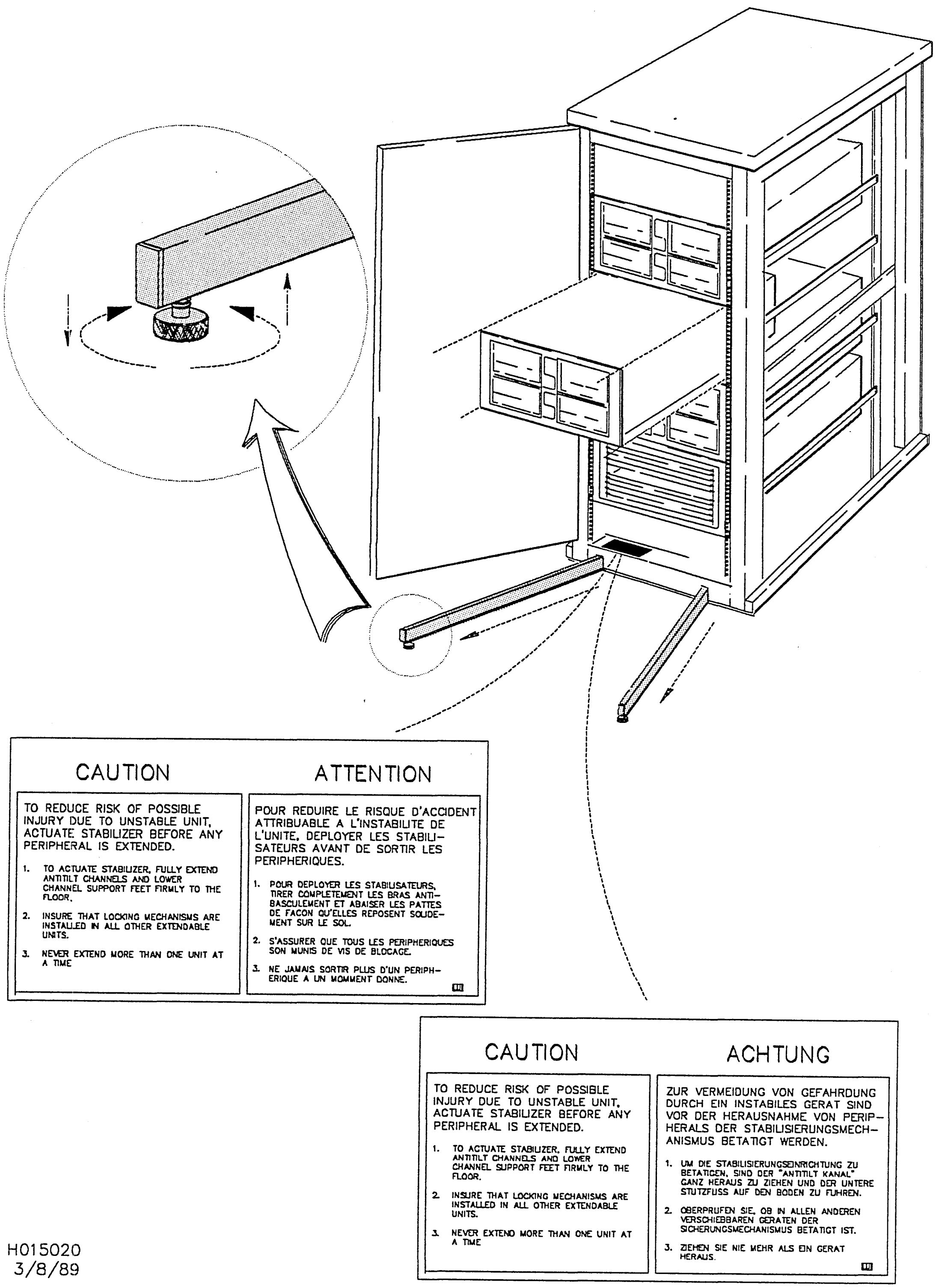
A CONVEX VMEbus chassis is supplied with mounting hardware and a VBCU (and MBCU for Combo chassis) interface circuit board and cables. The mounting hardware (screws, retaining plates, slides, and slide guides) is used to mount the VMEbus chassis in an expansion cabinet. Use the following procedures to install the VMEbus chassis in a CONVEX expansion cabinet.

2.5.1 VMEbus Chassis Slide Guides

> **WARNING**
>
> Expansion cabinet stabilizer bars must be extended prior to installing a VME chassis, or before extending this assembly forward on its slide rails for service. Failure to do so will make the expansion cabinet unstable, increasing the possibility of it falling forward. This can cause injury to personnel and will cause damage to equipment.

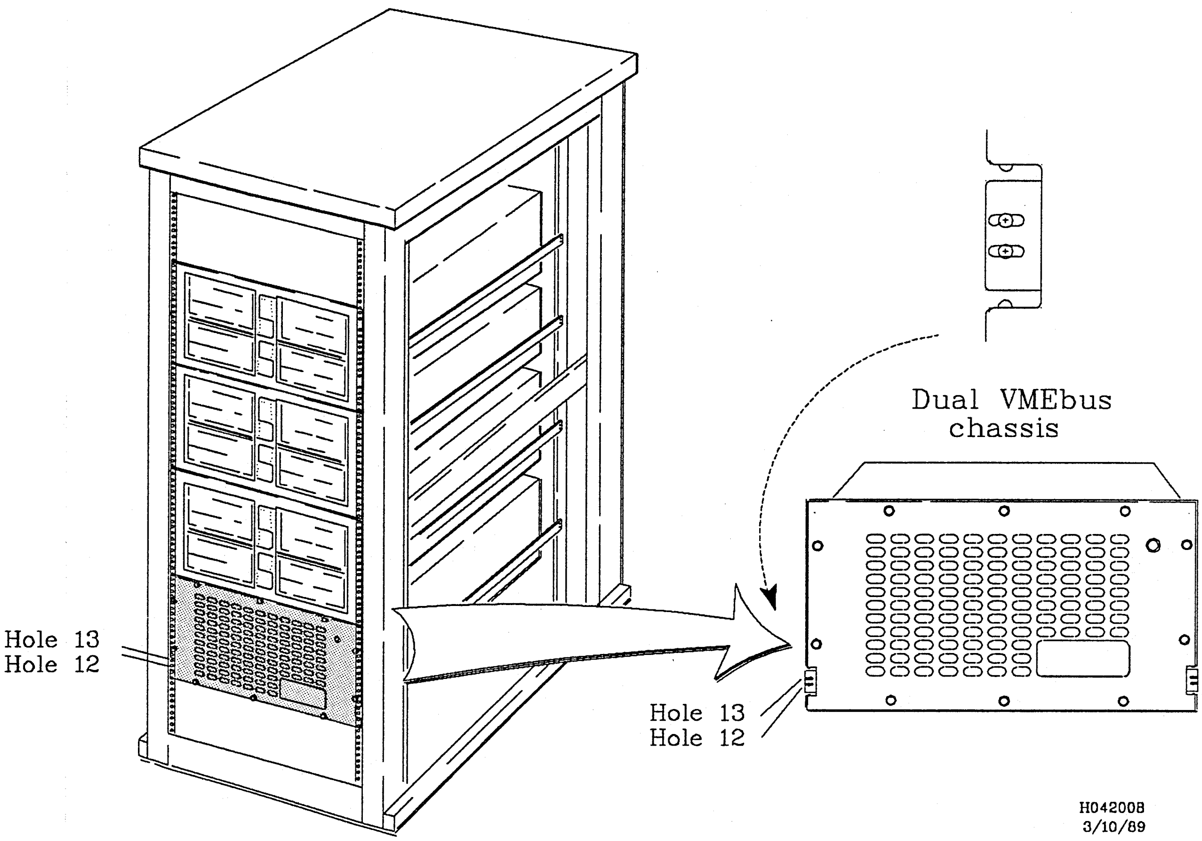
1. Extend the expansion cabinet stabilizer bars and adjust feet until they are in firm contact with the floor as shown in Figure 2–3, "Expansion Cabinet Stabilizer Bars":

Figure 2–3, Expansion Cabinet Stabilizer Bars



2. Place the retaining plates behind the expansion cabinet's vertical mounting rails at the positions shown in Figure 2–4, "VMEbus Chassis Slide Guide Retaining Plate Holes":

Figure 2–4, VMEbus Chassis Slide Guide Retaining Plate Holes



3. Start, but do not tighten, the 2 retaining plate screws on all 4 plates.
4. Slide the slotted ends of the 2 slide guides between the 4 retaining plate screws and the expansion cabinet's vertical rails.

> **NOTE**
>
> Do not tighten the retaining plate screws completely because the base unit will have to be aligned before the screws are tightened.

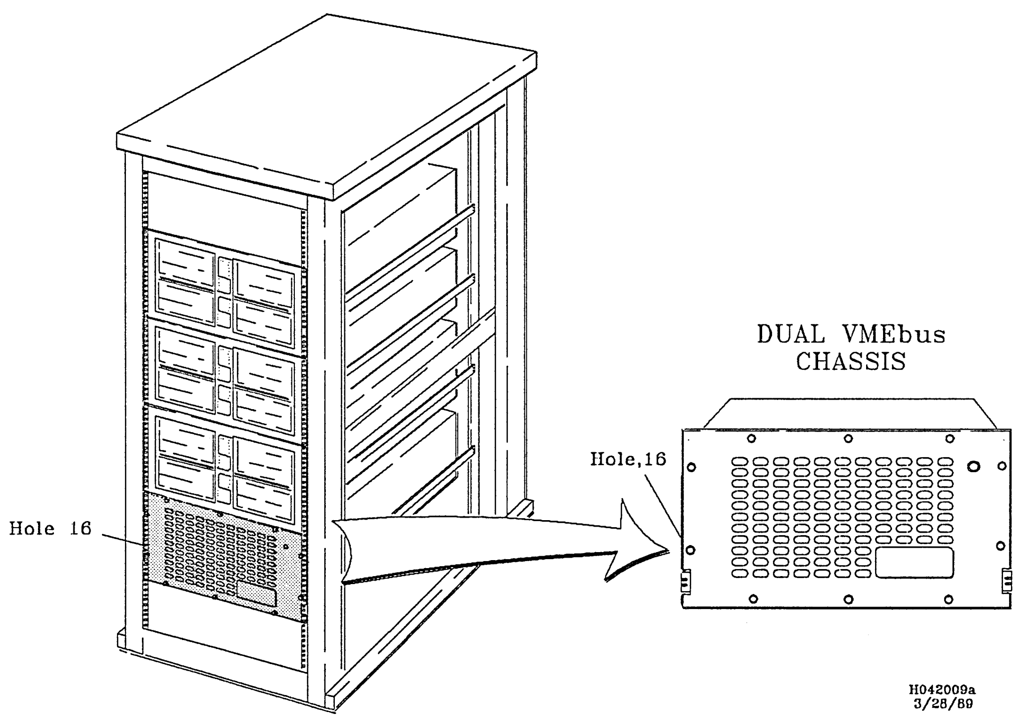
5. Tighten the retaining plate screws enough to prevent the slide guides from falling out when the base unit is installed.

WARNING

Because of the VMEbus chassis weight, and the slide guide mounting requirements, personnel injury or equipment damage may occur when the VME chassis is installed. Two people are required to install the VMEbus chassis.

6. Install the VMEbus chassis into its slide guides.
7. Move the VMEbus chassis to its retracted position, and secure it with the 2 front panel locking screws. See Figure 2–5, "VMEbus Chassis Lock Positions," for the locations of the screw holes:

Figure 2–5, VMEbus Chassis Lock Positions



NOTE

The VMEbus chassis alignment is first checked by ensuring that the front panel locking screws line up with the holes in the retaining plates. The VME chassis should then be moved in and out on its slides to ensure that it does not bind.

8. Adjust slide guides until the base unit is properly aligned, then tighten all mounting screws.

2.6 VMEbus Chassis Power Connection

> **WARNING**
>
> Failure to set VMEbus chassis power control switch to **OFF** before connecting the power cord may cause injury to personnel.

1. Ensure that the VMEbus chassis power control switch is set to the **OFF** position (see Figure 2–9, VMEbus Chassis Power Control Switch).
2. Connect the power cord to the power distribution panel inside the expansion cabinet.

2.7 Electrostatic Discharge (ESD) Damage

The VIOP/VBCU and VMEbus controllers can be damaged by Electrostatic Discharges (ESD) during maintenance procedures such as installation. A grounded wrist strap (or other grounding method) must be used when handling all PCBs to prevent ESD damage.

Static charges take place when various objects are separated or rubbed together, often creating a high voltage level. The main factors that determine a voltage level charge are:

- Types of materials
- Relative humidity
- Rate of change or separation

Table 2–2, "Static Charge Levels and Relative Humidity," is an approximation of electrostatic charge levels based on various personnel activities and humidity levels:

Table 2–2, Static Charge Levels and Relative Humidity

Personnel Activity[1]	Humidity[2] & Charge Levels (Volts[3])			
	26%	32%	40%	50%
Person walking across linoleum floor	6,150V	5,750V	4,625V	3,700V
Person walking across carpet	18,450V	17,250V	13,875V	11,100V
Person getting up from a plastic chair	24,600V	23,000V	18,500V	14,800V

1 Source: B. A. Unger, *Electrostatic Discharge Failures of Semiconductor Devices* (Bell Laboratories, 1981).
2 A high rate of air flow produces higher static charges than a low air flow rate, for the same relative humidity level.
3 Some data in this table has been extrapolated.

Table 2–3, "Components Susceptibility to ESD Damage," contains a list of various components and their susceptibility to static damage:

Table 2–3, Components Susceptibility to ESD Damage

Susceptibility Ranges of Various Devices Exposed to Electrostatic Discharge (Human Body Model[1])	
Device Type	**Level of ESD Susceptibility (Volts)**
MOSFET	>10
JFET	> 140
CMOS	> 250
Schottky Diodes, TTL	> 300
Bipolar Transistors	> 380
ECL (For Hybrid use, PCB level)	> 500
SCR	> 680

[1] Source: B. A. Unger, *Electrostatic Discharge Failures of Semiconductor Devices* (Bell Laboratories, 1981).

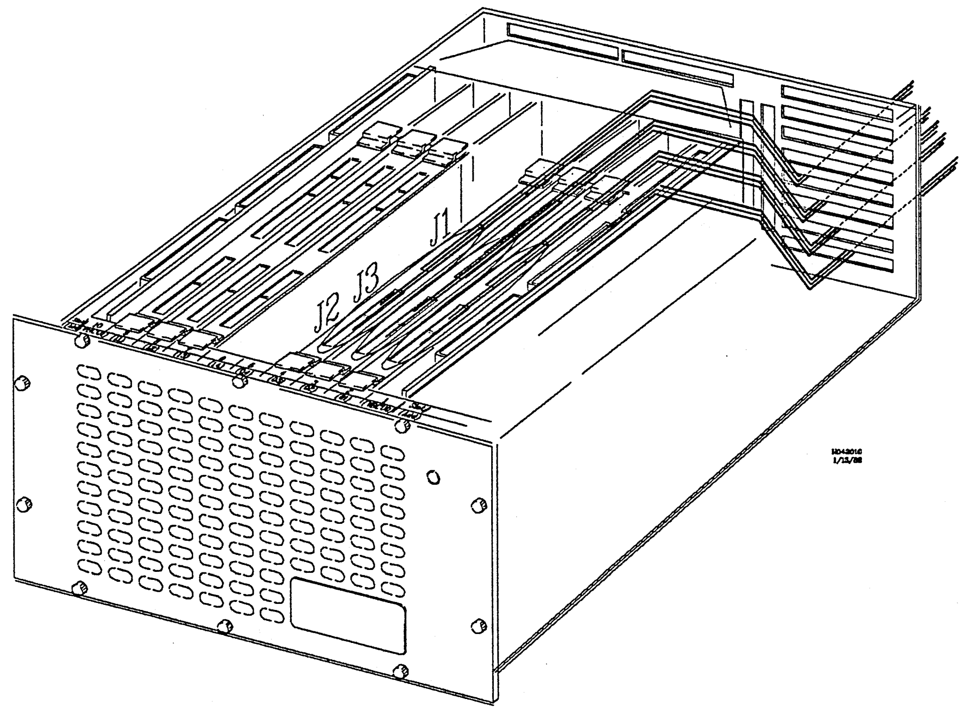
2.8 VIOP and VBCU Installation Procedures

The VBCU comes with three cables for connecting it to the VIOP. The three VBCU cables are connected between the VBCU and port #0 or #1 on the VIOP backplane connector. Exactly which port, depends on the equipment already connected to the VIOP. The VIOP plugs into the Channel Control Unit (CCU) slots in computer's card cage. The following sections describe the installation of the VIOP and the VBCU.

The locations for the VBCUs in a *dual* VMEbus chassis are illustrated in the following two figures:

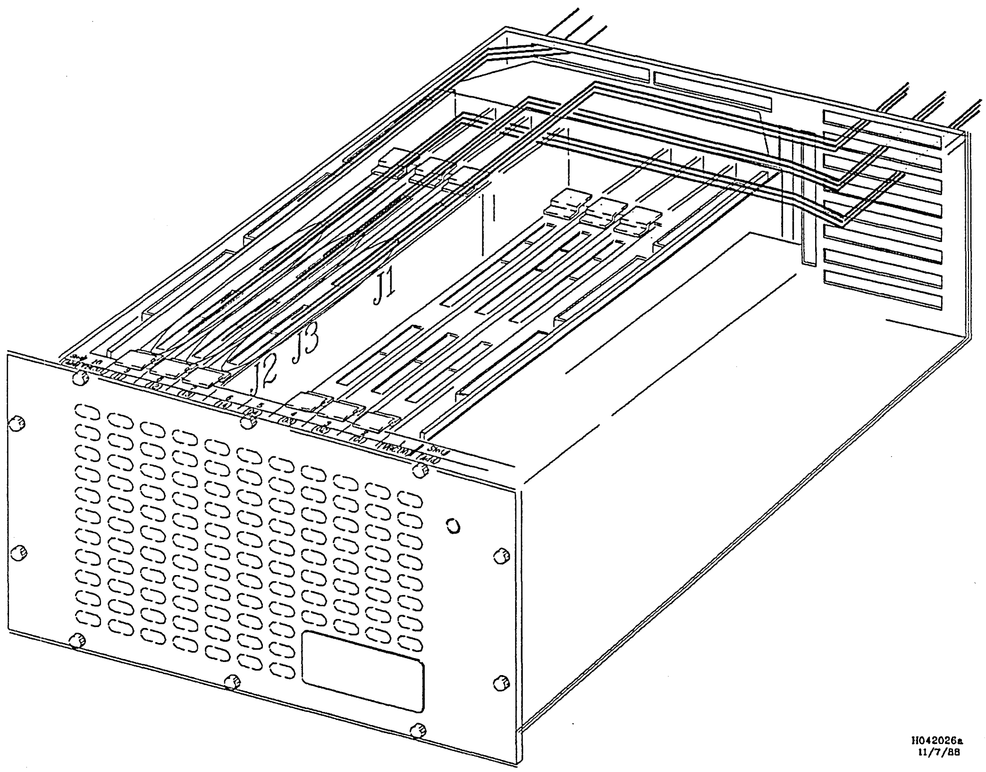
See page 2-21

Figure 2–6, VME-0 Positions and Cable Routing



Cable to controller not to VBCU

Figure 2–7, VME-1 Positions and Cable Routing



> **NOTE**
>
> The VMEbus backplane slot positions are labeled on the front of each chassis. Cable opening numbers are stamped on the outside rear panel on all CONVEX VMEbus chassis. VMEbus controller cables exit the chassis at the rear through cable openings. Cables from a given controller should always exit the VME chassis at the same hole position.

Table 2–4, "Cable Opening Numbers for VMEbus Chassis," defines cable opening numbers and device types for the three types of CONVEX VMEbus chassis:

Table 2–4, Cable Opening Numbers for VMEbus Chassis

Cable Opening Number	Dual (10-slot) VMEbus	Single (9-slot) VMEbus	Combo VMEbus/Mbus
J1	VBCU0	VBCU	VBCU
J2	VME0 Ctlr 1	VMEbus Ctlr 1	VMEbus Ctlr 1
J3	VME0 Ctlr 2	VMEbus Ctlr 2	VMEbus Ctlr 2
J4	VME0 Ctlr 3	VMEbus Ctlr 3	VMEbus Ctlr 3
J5	VME0 Ctlr 4	VMEbus Ctlr 4	VMEbus Ctlr 4
J6	VME1 Ctlr 4	VMEbus Ctlr 5	VMEbus Ctlr 5
J7	VME1 Ctlr 3	VMEbus Ctlr 6	Mbus Ctlr 3
J8	VME1 Ctlr 2	VMEbus Ctlr 7	Mbus Ctlr 2
J9	VME1 Ctlr 1	VMEbus Ctlr 7[1]	Mbus Ctlr 1
J10	unassigned	unassigned	Mbus Ctlr 0
J11	unassigned	unassigned	unassigned
J12	VBCU1	unassigned	MBCU

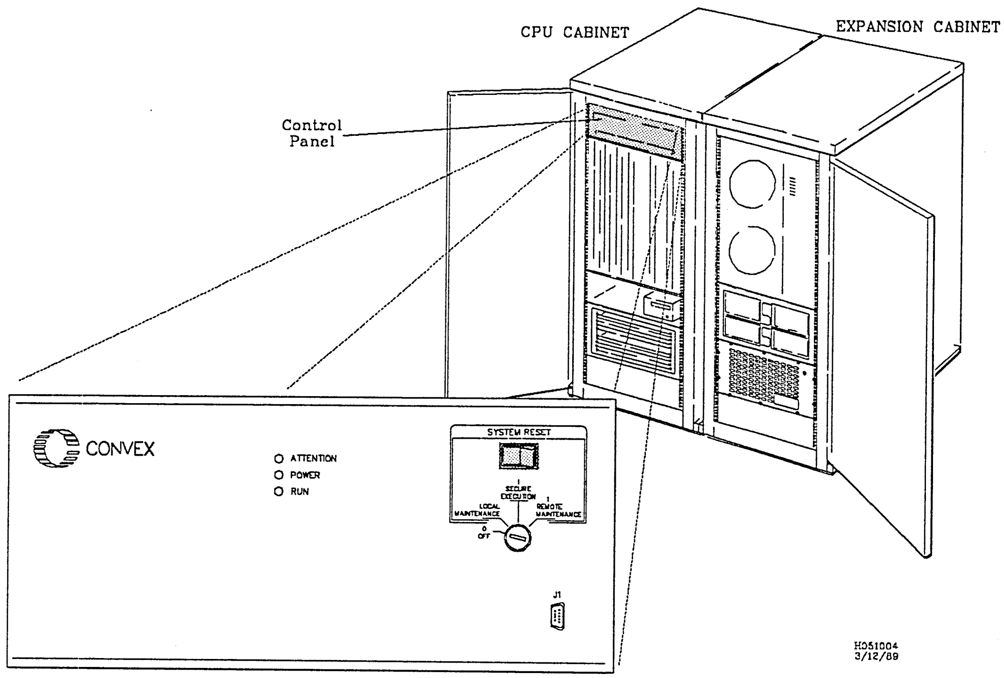
[1] This controller can be the second board of a two-board controller set when the first board is located in the previous VMEbus slot.

CAUTION

Failure to remove power before installing the VIOP will damage electronic components on the VIOP. Refer to the *CONVEX Processor Operation Guide (C1, C120, C210, C220)* for the shutdown procedures for a CONVEX computer.

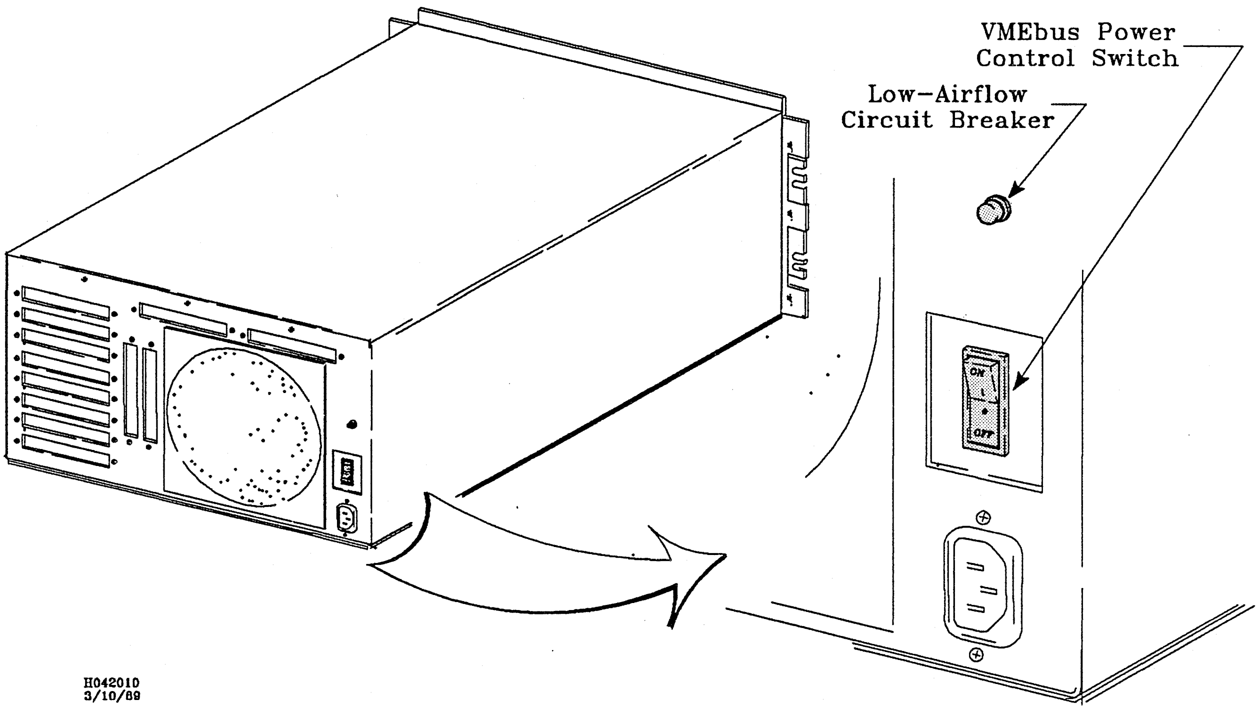
1. Turn the processor's front control panel key switch to the **OFF** position as shown in Figure 2–8, "Typical Front Panel Power Control Switch":

Figure 2–8, Typical Front Panel Power Control Switch



2. Set the VMEbus chassis power control switch to the **OFF** position as shown in Figure 2–9, "VMEbus Chassis Power Control Switch" :

Figure 2–9, VMEbus Chassis Power Control Switch

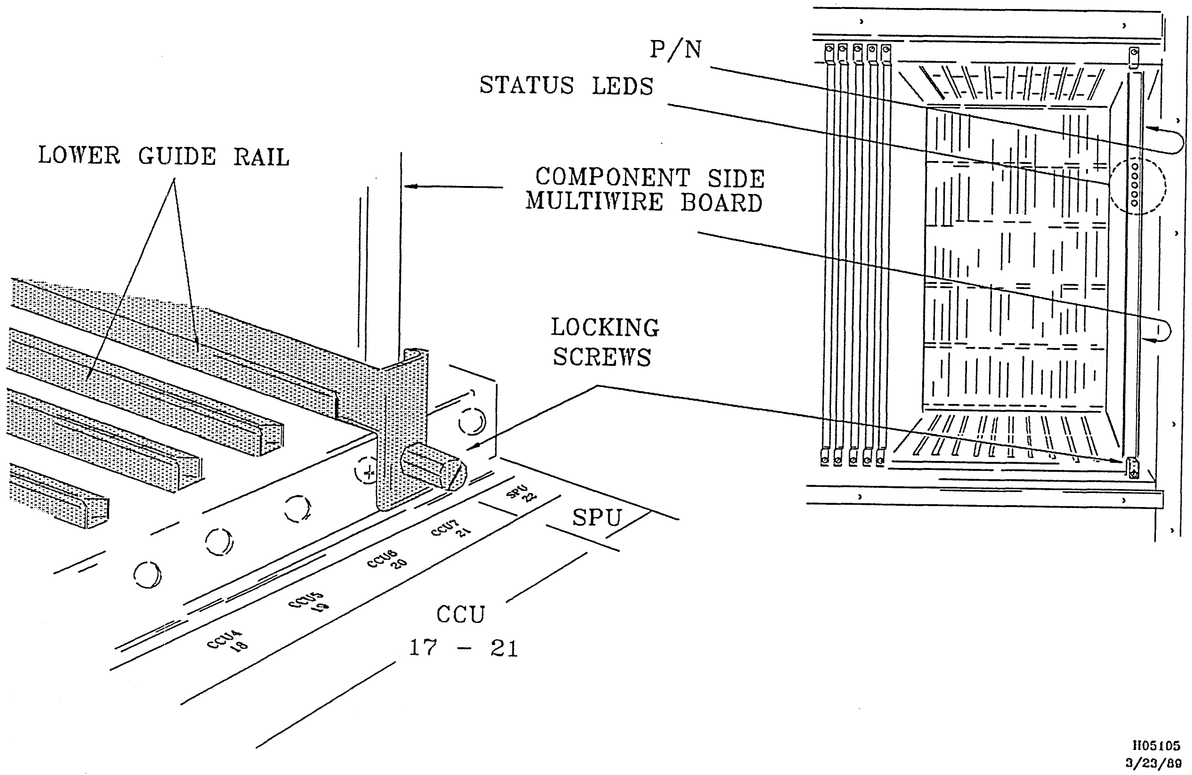


CAUTION

The VIOP can be damaged by Electrostatic Discharge (ESD). A grounded wrist strap (or other grounding method) must be used when handling the VIOP to prevent ESD damage.

3. Install the VIOP module in one of the available **CCU** slots in the processor cabinet's logic rack as shown in Figure 2–10, "CCU Slots and Mounting Hardware":

Figure 2–10, CCU Slots and Mounting Hardware



> **CAUTION**
>
> Failure to tighten the two VIOP captive mounting screws simultaneously may damage the connector or result in a faulty connection.

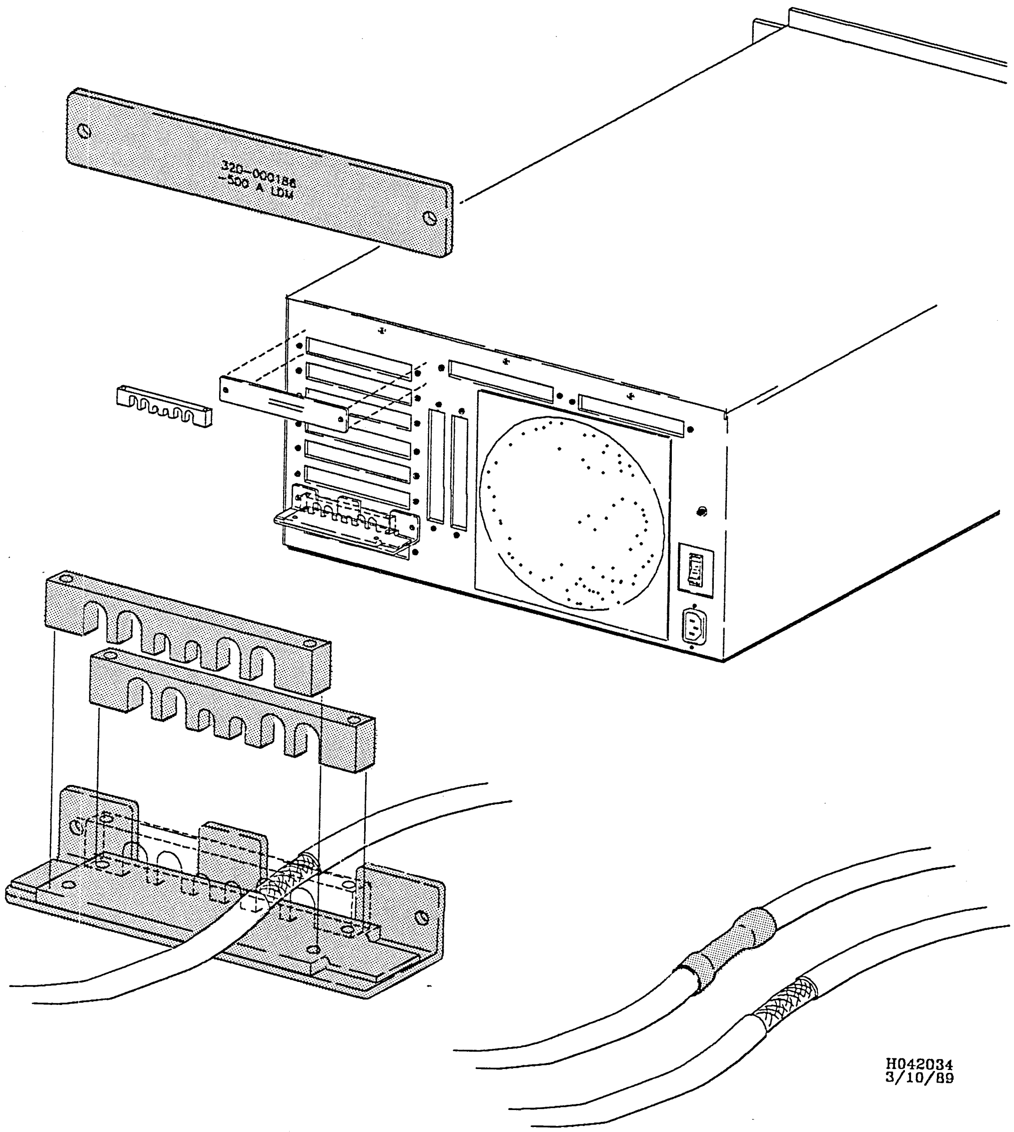
4. Using 2 nut drivers, simultaneously tighten the 2 captive mounting screws on each end of the VIOP as shown in the previous figure:

WARNING

Expansion cabinet stabilizer bars must be extended prior to installing a VME chassis, or before extending this assembly forward on its slide rails for service. Failure to do so will make the expansion cabinet unstable, increasing the possibility of it falling forward. This can cause injury to personnel and will cause damage to equipment.

5. Extend the expansion cabinet stabilizer bars and adjust feet until they are in firm contact with the floor (see Figure 2–3, Expansion Cabinet Stabilizer Bars).
6. Refer to Table 2–4, and remove the appropriate cable cover plate(s) on the rear of the VMEbus chassis as shown in Figure 2–11, "Cover Plate, Cable Clamp, and Shielded Cables":

Figure 2–11, Cover Plate, Cable Clamp, and Shielded Cables

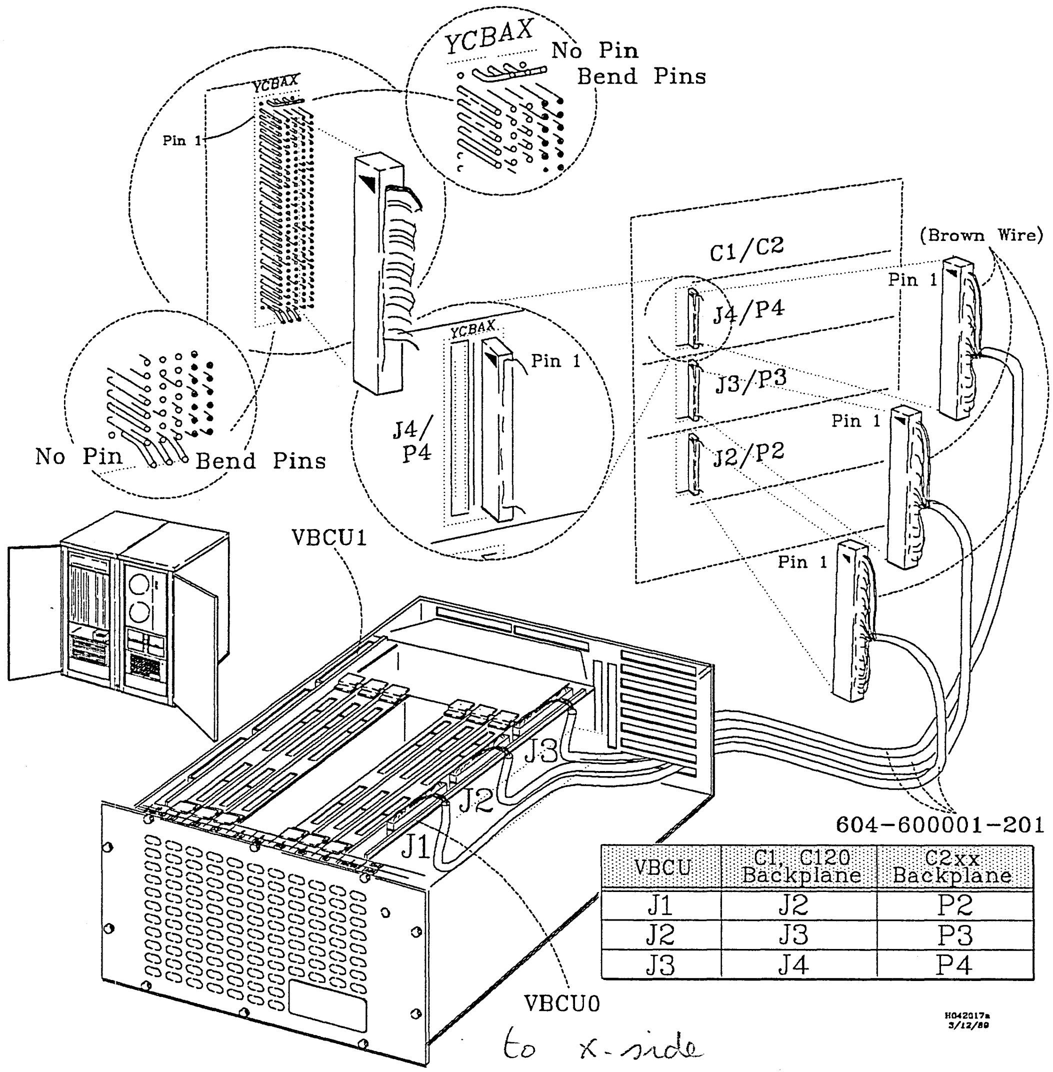


7. Unlock the 2 VMEbus chassis lock screws and pull the VMEbus chassis to its extended position.
8. Unlock the 12 locking screws on the VMEbus chassis top panel and remove top panel.

> **CAUTION**
>
> The VBCU can be damaged by Electrostatic Discharge (ESD). A grounded wrist strap (or other grounding method) must be used when handling the VBCU to prevent ESD damage.
>
> The low-airflow sensor on the VBCU may be damaged if the PCB is not aligned properly during installation.

9. Install the first VBCU (**VBCU0**) into slot **1** in the dual VMEbus chassis backplane.
10. Connect the **P1** end of cable 604-600001-201 to **J1** on **VBCU0**, then route the **P2** end through cable opening (**J1**) on the rear of the VMEbus chassis as shown in Figure 2–12, "VBCU0 to VIOP Cabling Connections":

Figure 2–12, VBCU0 to VIOP Cabling Connections



VBCU	C1, C120 Backplane	C2xx Backplane
J1	J2	P2
J2	J3	P3
J3	J4	P4

NOTE

A flashlight may be required to locate the proper connection points on the VIOP backplane when attaching cables.

NOTE

The VIOP backplane connectors are identified as **J4, J3,** and **J2** on the C1 and C120 computers. The same points are identified as **P4, P4,** and **P2** on the C210, C220, C230 and C240 computers.

CAUTION

The CCU backplane connectors are *not* keyed; ensure that pin 1 on the cable (brown wire) aligns with pin 1 on the VIOP backplane connector.

There are 3 rows of pin at the top and bottom of the connector that must be bent out of the way before the cable is attached.

11. Connect the **P2** end of cable 604-600001-201 from **J1** to **J2** (or **P2**) on the VIOP backplane connector.
12. Connect the **P1** end of cable 604-600001-201 to **J2** on **VBCU0**, then route the **P2** end through cable opening **J1** on the rear of the VMEbus chassis.

CAUTION

The CCU backplane connectors are *not* keyed; ensure that pin 1 on the cable (brown wire) aligns with pin 1 on the VIOP backplane connector.

There are 3 rows of pin at the top and bottom of the connector that must be bent out of the way before the cable is attached.

13. Connect the **P2** end of cable 604-600001-201 from **J2** to **J3** (or **P3**) on the VIOP backplane connector.
14. Connect the **P1** end of cable 604-600001-201 to **J3** on **VBCU0**, then route the **P2** end through cable opening **J1** on the rear of the VME chassis.

CAUTION

The CCU backplane connectors are *not* keyed; ensure that pin 1 on the cable (brown wire) aligns with pin 1 on the VIOP backplane connector.

There are 3 rows of pin at the top and bottom of the connector that must be bent out of the way before the cable is attached.

15. Connect the **P2** end of cable 604-600001-201 from **J3** to **J4** (or **P4**) on the VIOP backplane connector.
16. Select a point on each (VMEbus end) cable, as close as possible to the outside of the VMEbus chassis, and remove the heat shrink sleeve as shown in Figure 2–11, Cover Plate, Cable Clamp, and Shielded Cables.

CAUTION

Failure to contact the exposed cable shield with the cable clamp will result in the loss of the EMI shielding.

17. Install cable(s) (with exposed shields) in the inner cable clamp 72851232, then install the clamp on the mounting bracket. Install the outer clamp 72851233 over the insulated cable area, then mount the complete assembly to the rear of the VMEbus chassis with the screws provided.

CAUTION

The VBCU can be damaged by Electrostatic Discharge (ESD). A grounded wrist strap (or other grounding method) must be used when handling the VBCU to prevent ESD damage.

The low-airflow sensor on the VBCU may be damaged if the PCB is not aligned properly during installation.

18. Install the second VBCU (**VBCU1**), if required, into slot **10** in the dual VMEbus chassis backplane.

NOTE

A flashlight may be required to locate the proper connection points on the VIOP backplane when attaching cables.

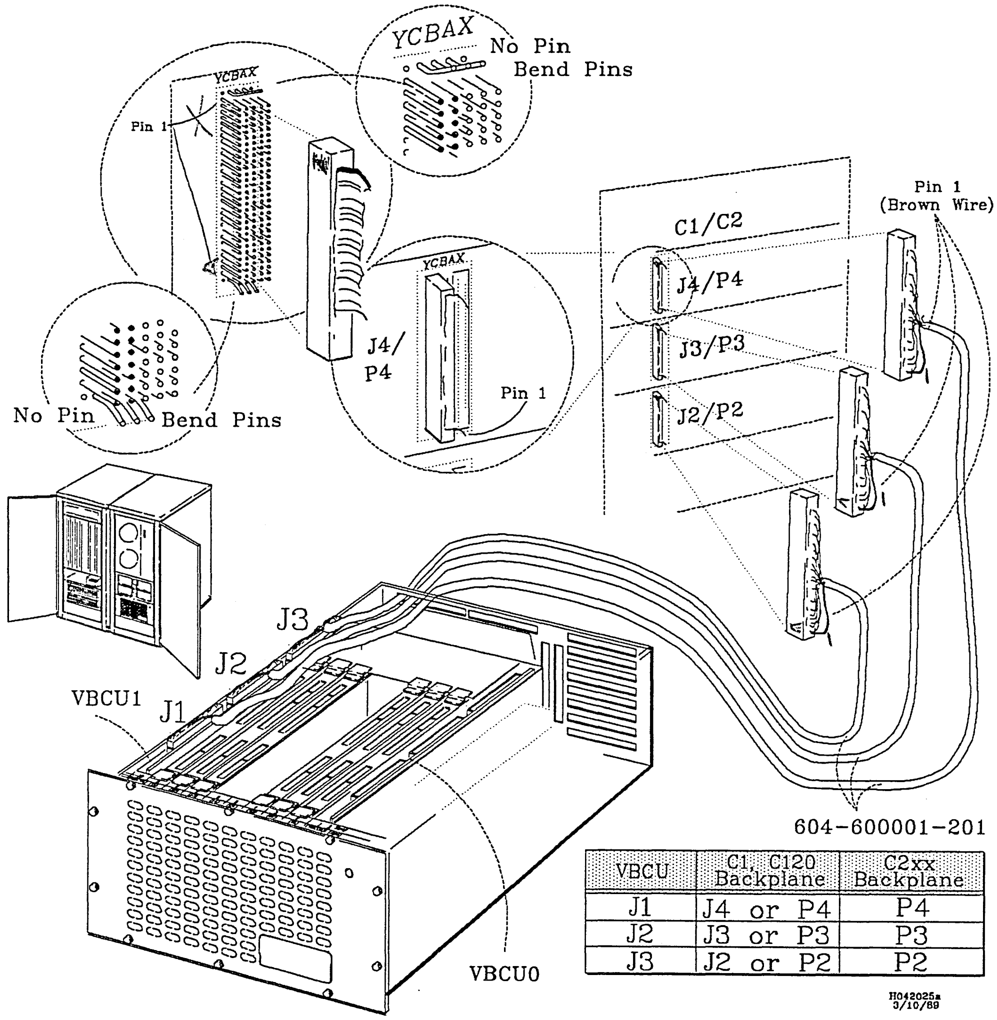
NOTE

The VIOP backplane connectors are identified as **J2, J3,** and **J4** on the C1 and C120 computers. The same points are identified as **P2, P3,** and **P4** on the C210, C220, C230, and C240 computers.

NOTE

The cable connections between VIOP connectors **J4** (or **P4**), **J3** (or **P3**) and **J2** (or **P2**) and **VBCU1** connectors **J1**, **J2**, and **J3** are *not* the same as **VBCU0**. Ensure that they are connected as illustrated in Figure 2–13, "VBCU-1 to VIOP Cabling Connections":

Figure 2–13, VBCU-1 to VIOP Cabling Connections



VBCU	C1, C120 Backplane	C2xx Backplane
J1	J4 or P4	P4
J2	J3 or P3	P3
J3	J2 or P2	P2

19. Connect the **P1** end of cable 604-600001-201 to **J1** on **VBCU1**, then route the **P2** end through cable opening **J12** on the rear of the VMEbus chassis.

> **CAUTION**
>
> The CCU backplane connectors are *not* keyed; ensure that pin 1 on the cable (brown wire) aligns with pin 1 on the VIOP backplane connector.
>
> There are 3 rows of pin at the top and bottom of the connector that must be bent out of the way before the cable is attached.

20. Connect the **P2** end of cable 604-600001-201 from **J1** to **J4** (or **P4**) on the VIOP backplane connector.
21. Connect **P1** end of cable 604-600001-201 to **J2** on **VBCU1**, then route the **P2** end through cable opening **J12** on the rear of the VMEbus chassis.

> **CAUTION**
>
> The CCU backplane connectors are *not* keyed; ensure that pin 1 on the cable (brown wire) aligns with pin 1 on the VIOP backplane connector.
>
> There are 3 rows of pin at the top and bottom of the connector that must be bent out of the way before the cable is attached.

22. Connect the **P2** end of cable 604-600001-201 from **J2** to **J3** (or **P3**) on the VIOP backplane connector.
23. Connect the **P1** end of cable 604-600001-201 to **J3** on **VBCU1**, then route the **P2** end through cable opening (**J12**) on the rear of the VMEbus chassis.

> **CAUTION**
>
> The CCU backplane connectors are *not* keyed; ensure that pin 1 on the cable (brown wire) aligns with pin 1 on the VIOP backplane connector.
>
> There are 3 rows of pin at the top and bottom of the connector that must be bent out of the way before the cable is attached.

24. Connect the **P2** end of cable 604-600001-201 from **J3** to **J2** (or **P2**) on the VIOP backplane connector.

> **CAUTION**
>
> Do not operate the VMEbus chassis with its cover removed. The cover must be installed to obtain proper airflow inside the VMEbus chassis.

25. Replace the VMEbus top panel and secure it with the 12 locking screws.
26. Return the VMEbus chassis to its retracted position.
27. Select a point on each (VMEbus end) cable, as close as possible to the outside of the chassis, and remove the heat shrink sleeve (see Figure 2–11, Cover Plate, Cable Clamp, and Shielded Cables).

> **CAUTION**
>
> Failure to contact the exposed cable shield with the cable clamp will result in the loss of the EMI shielding.

28. Install cable(s) (with exposed shields) in the inner cable clamp 72851232, then install the clamp on the mounting bracket. Install the outer clamp 72851233 over the insulated cable area, then mount the complete assembly to the rear of the VMEbus chassis with the screws provided.
29. Turn the processor's front panel power control switch to the **ON** position.
30. Set the VMEbus chassis power control switch to the **ON** position.
31. Return the expansion cabinet stabilizer bars to their retracted positions.

> **NOTE**
>
> Refer to Chapter 3 for diagnostic test information and procedures on the VIOP and VBCU.

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Chapter 3
Integration and Test

3.1 Overview

Guidelines for integrating VMEbus modules into the CONVEX Operating System (OS), and information for the VIOP diagnostic test are contained in this chapter.

VIOP modules, VMEbus controllers, and peripheral devices must be integrated into the CONVEX computer's OS before they can be used. How they are integrated depends on the type of performance or features required.

3.1.1 Software Integration

The CONVEX operating system contains all software drivers for the hardware supported by CONVEX. This means that a system generation is not required when the VMEbus subsystem is installed on a CONVEX computer.

System-level hardware is identified to the CONVEX OS via a configuration file (*/ioconfig*) located on the Service Processor Unit (SPU) disk. The */ioconfig* file describes, in hierarchical fashion, the connections between VIOPs, VMEbus controllers, and peripheral devices. The OS uses this information to assign a physical device number to a device of a given type.

Each type of VMEbus device is identified to the operating system by a mnemonic device code. These codes, and other information, are entered into the */ioconfig* file on the SPU disk. This file contains entries, such as VIOP number, VMEbus chassis number, controller type, control and status register (csr) address, interrupt number, and peripheral device type. A typical */ioconfig* file is shown in Figure 3–1, "Example */ioconfig* File":

Figure 3–1, Example */ioconfig* File

```
iop 3
    mbus 0
      ctrl DKC-001 csr 0x3f0 int 2
        unit 0 type DKD-005
      ctrl MTC-001 csr 0x0c0 int 4
        unit 0 type MTC-001
      ctrl ACM-001 csr 0x3c0 int 7
        unit 0 type TTY
        unit 1 type TTY
        unit 2 type TTY
        unit 3 type TTY
        unit 4 type TTY
viop 4
    vme 0
      ctrl DKC-203 csr 0x800 int 3
        unit 0 DKD-214
      ctrl DKC-203 csr 0xa00 int 4
        unit 0 DKD-214
      ctrl DKC-203 csr 0xc00 int 5
        unit 0 DKD-214
    vme 1
      ctrl DKC-203 csr 0x800 int 3
        unit 0 DKD-214
        unit 1 DKD-214
      ctrl DKC-203 csr 0xa00 int 4
        unit 0 DKD-214
        unit 1 DKD-214
```

Whenever a VMEbus controller is added or removed, the information in the hardware section of the configuration file (*/ioconfig)* must be changed, otherwise system operation problems will occur. The *CONVEX System Manager's Guide* should be consulted when making these changes.

3.2 Testing the VIOP and VBCU

The VIOP and VBCU are tested by the *io5000* diagnostic program. This program verifies the operation of the VIOPs and the VBCUs. The *io5000* diagnostic program verifies that:

- 68020 on the VIOP can correctly execute instructions
- VIOP local memory is functional
- Memory protection and mapping registers are operational
- Cache memory can be written to and read from, and the associated cache control bits are functional
- Two VMEbus cable interfaces operate in the loopback mode
- VIOP can boot a program from memory
- Voltages on the VMEbus chassis are within tolerance
- VBCU responds to forced interrupts
- VBCU data and address lines are operational

3.2.1 Using the *io5000* Diagnostic Program

The *io5000* diagnostic program is an offline program that must be executed on the SPU while the CPU is halted. The procedures for executing this test are beyond the scope of this manual. However, this information is contained in the *CONVEX PBUS I/O System Diagnostics Manual*. This manual should be consulted before running this test.

3.2.2 Fault Isolation Techniques

In some situations, a fault may be isolated by examining the internal VBCU registers. Chapter 1, "Description and Specifications," identifies the locations and functions of these registers. The *vioputil* I/O utility progam has to be used if no error print out is available. The *CONVEX Diagnostic Utility Manual* contains instructions on how to use the *vioputil* utility program.

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Chapter 4
Maintenance Procedures and IPB

4.1 Overview

Guidelines for obtaining technical assistance, and maintenance procedures for the VMEbus subsystem are contained in this chapter. Also, an Illustrated Parts Breakdown (IPB) for all Field Replaceable Units (FRUs) on the VME subsystem is included.

4.2 CONVEX Technical Assistance

CONVEX offers two sources of help if problems arise:

- CONVEX Technical Assistance Center (TAC)
- CONVEX *contact* utility

4.2.1 CONVEX Technical Assistance Center

Contact the CONVEX Technical Assistance Center (TAC) for real time support on urgent hardware and software problems. The TAC can be reached in Texas by calling (214)952-0379, or by calling 1(800)952-0379 from other locations in the continental United States. Customers outside the United States should contact their local CONVEX office.

4.2.2 CONVEX *contact* Utility

Use the CONVEX *contact* utility for reporting minor hardware and software problems. Refer to Appendix A for an example of the CONVEX *contact* utility.

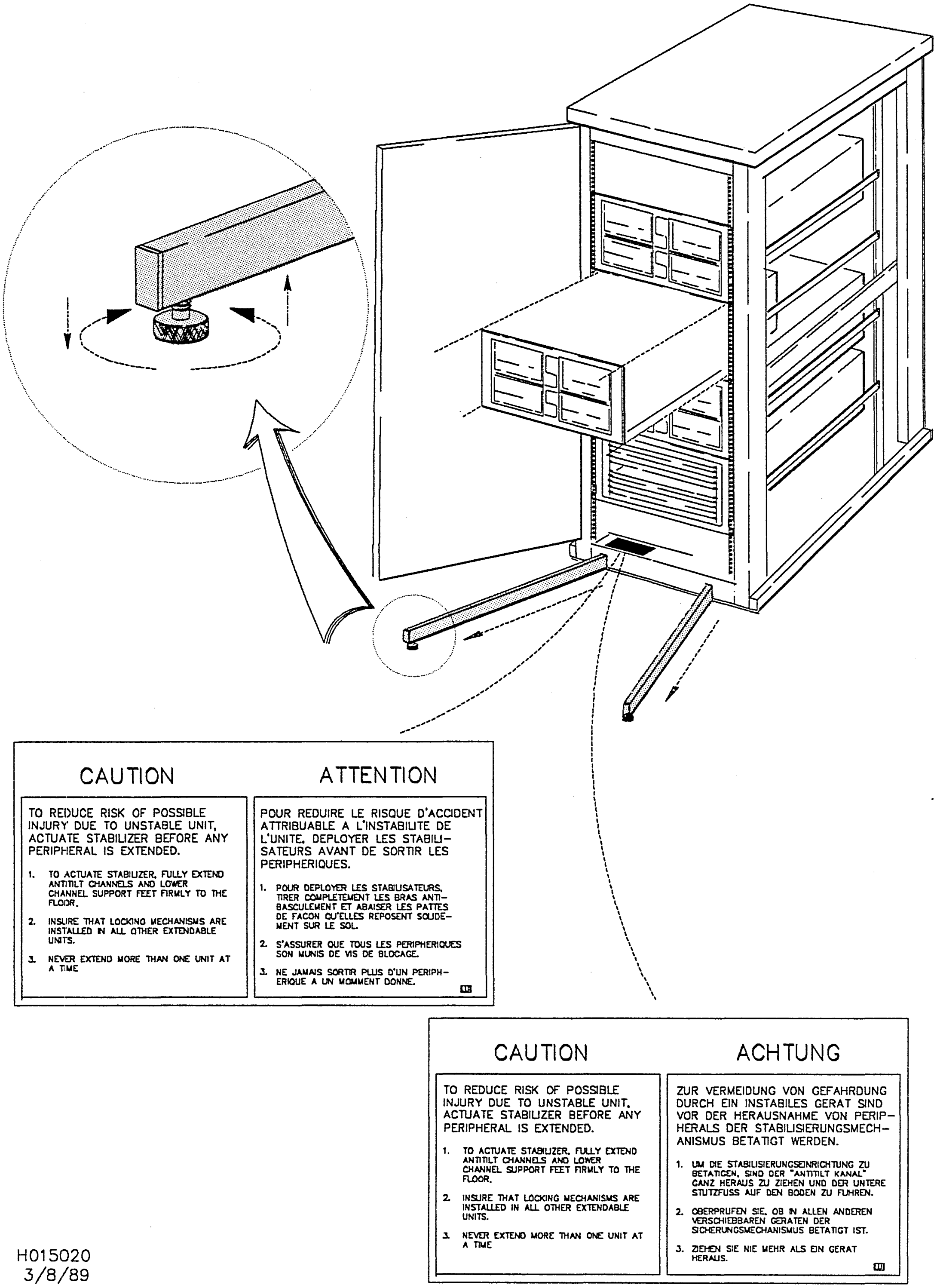
4.3 Maintenance Safety Procedures

Maintenance safety procedures for the VMEbus subsystem apply to most servicing operations. For example, the cabinet stabilizer bars must always be extended during servicing operations. These safety procedures must be used in the maintenance procedures described in Section 4.4.

> **WARNING**
>
> Expansion cabinet stabilizer bars must be extended prior to installing a VME chassis, or before extending this assembly forward on its slide rails for service. Failure to do so will make the expansion cabinet unstable, increasing the possibility of it falling forward. This can cause injury to personnel and will cause damage to equipment.

1. Extend the expansion cabinet stabilizer bars, and adjust the adjustable feet until they are in firm contact with the floor as shown in Figure 4–1, "Expansion Cabinet Stabilizer Bars":

Figure 4–1, Expansion Cabinet Stabilizer Bars

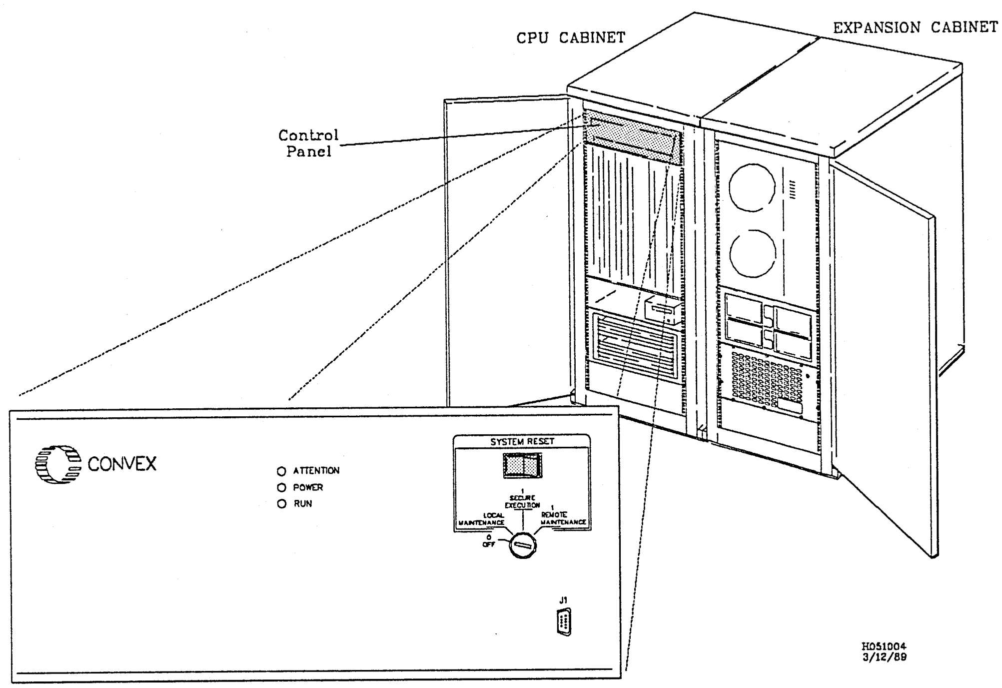


CAUTION

Failure to remove power before installing or removing equipment from the computer cardcage will damage electronic components. Refer to the *CONVEX Processor Operation Guide (C1, C120, C210, C220)* for power down procedures on a CONVEX computer.

2. Turn the power control switch on the computer's front control panel to the **OFF** position as shown in Figure 4–2, "Typical Front Panel Power Control Switch":

Figure 4–2, Typical Front Panel Power Control Switch

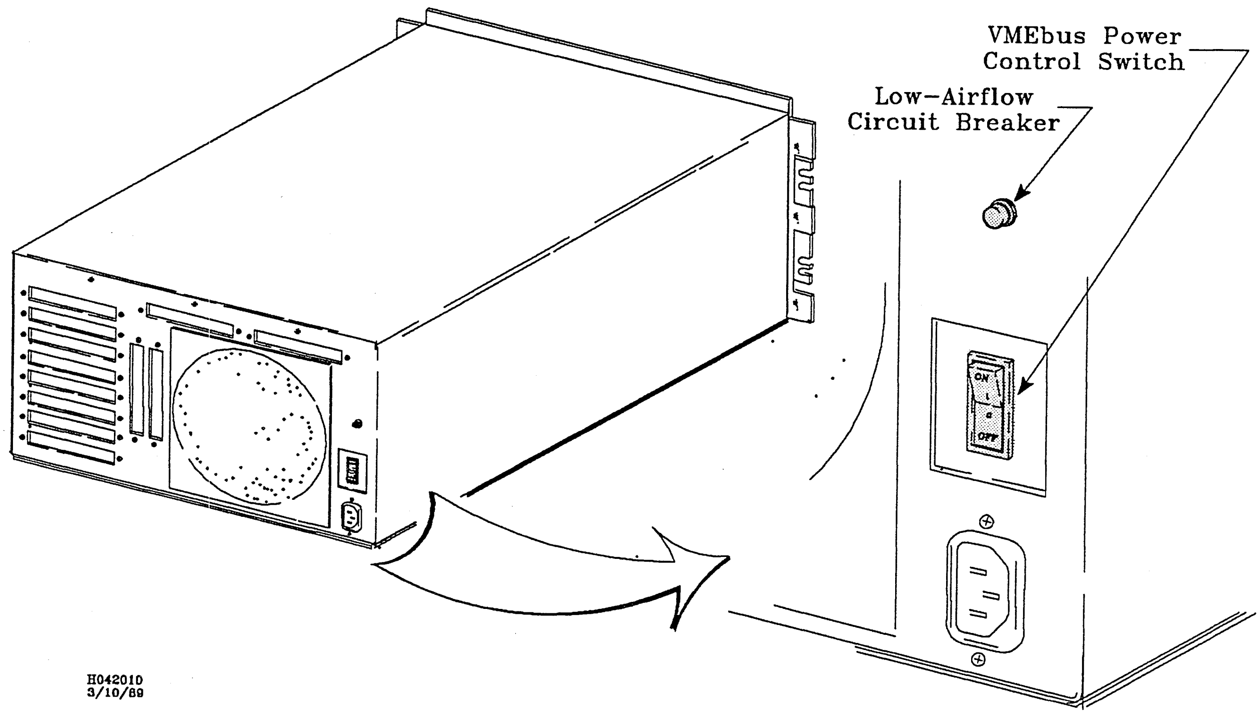


CAUTION

Failure to remove power to the VMEbus chassis before installing or removing equipment will damage electronic components.

3. Set the VMEbus chassis power control switch to the **OFF** position as shown in Figure 4–3, "VMEbus Chassis Power Control Switch":

Figure 4–3, VMEbus Chassis Power Control Switch



4.4 Maintenance Procedures

This section defines the maintenance procedures for the VMEbus subsystem.

4.4.1 VMEbus Chassis Assembly

Follow these procedures to remove and replace the VMEbus chassis assembly.

4.4.1.1 Removal

1. Complete steps 1, 2, and 3 in Section 4.3, "Maintenance Safety Procedures."
2. Release the 2 front chassis captive-lock screws and extend the chassis on its slides.
3. Release the 12 top panel captive-lock screws and remove the top panel.
4. Label and disconnect all internal controller cables.
5. Remove all controller cable clamps from the rear of the VMEbus chassis.
6. Remove all controller cables from the rear of VMEbus chassis cable openings.

> **CAUTION**
>
> VMEbus controllers can be damaged by Electrostatic Discharge (ESD). A grounded wrist strap (or other grounding method) must be used when handling VME controllers.

7. Remove all controllers from the VMEbus chassis backplane.
8. Disconnect the VMEbus chassis power cord from the chassis AC-input jack.

> **WARNING**
>
> Because the VMEbus chassis weighs 75 lbs, personnel injury or equipment damage can occur when the VMEbus chassis is installed or removed. Two people are required to install or remove the VMEbus chassis.

9. Release both slide guide locks, then lift the chassis free of the expansion cabinet slide guides.

4.4.1.2 Replacement

1. Ensure that steps 1, 2, and 3 in Section 4.3, "Maintenance Safety Procedures," are completed.

> **NOTE**
>
> If the chassis to be installed is a dual VMEbus, then refer to "Dual VMEbus Backplane Jumpers" section in Chapter 2.

2. Install power-margining jumper on backplane (see previous note).

> **WARNING**
>
> The VMEbus chassis weighs 75 lbs, personnel injury or equipment damage can occur when the VMEbus chassis is removed or replaced. Two people are required to remove or replace the VMEbus chassis.

3. Lift chassis and install its slides into the slide guide rails mounted in the expansion cabinet.

4. Route all controller cables through the appropriate rear openings of the VMEbus chassis (refer to Table 2–4, Cable Opening Numbers for VMEbus Chassis).

> **CAUTION**
>
> VMEbus controllers can be damaged by Electrostatic Discharge (ESD). A grounded wrist strap (or other grounding method) must be used when handling VME controllers.

5. Install all controllers into the chassis backplane(s).
6. Connect all controller cables to their appropriate VMEbus controller.

> **CAUTION**
>
> Failure to contact the exposed cable shield with the cable clamp will result in the loss of the EMI shielding.

7. Mount the controller cables to rear chassis bulkhead with cable clamps.

> **CAUTION**
>
> Do not operate the VMEbus chassis with its cover removed. The cover must be installed to obtain proper airflow inside the VMEbus chassis.

8. Install the top panel and secure it with the 12 captive-lock screws.
9. Ensure that the VMEbus chassis power control switch is set to the **OFF** position (see Figure 4–3, "VMEbus Chassis Power Control Switch").
10. Connect the chassis power cord to the expansion chassis AC-input jack.
11. Set the VMEbus chassis power control switch to the **ON** position (see Figure 4–3, "VMEbus Chassis Power Control Switch").
12. Turn the computer front panel power control switch to the **ON** position (see Figure 4–2, "Typical Front Panel Power Control Switch").
13. Return the VMEbus expansion chassis to its retracted position and secure it with the 2 front panel captive-lock screws.
14. Return the expansion cabinet stabilizer bars to their retracted positions.

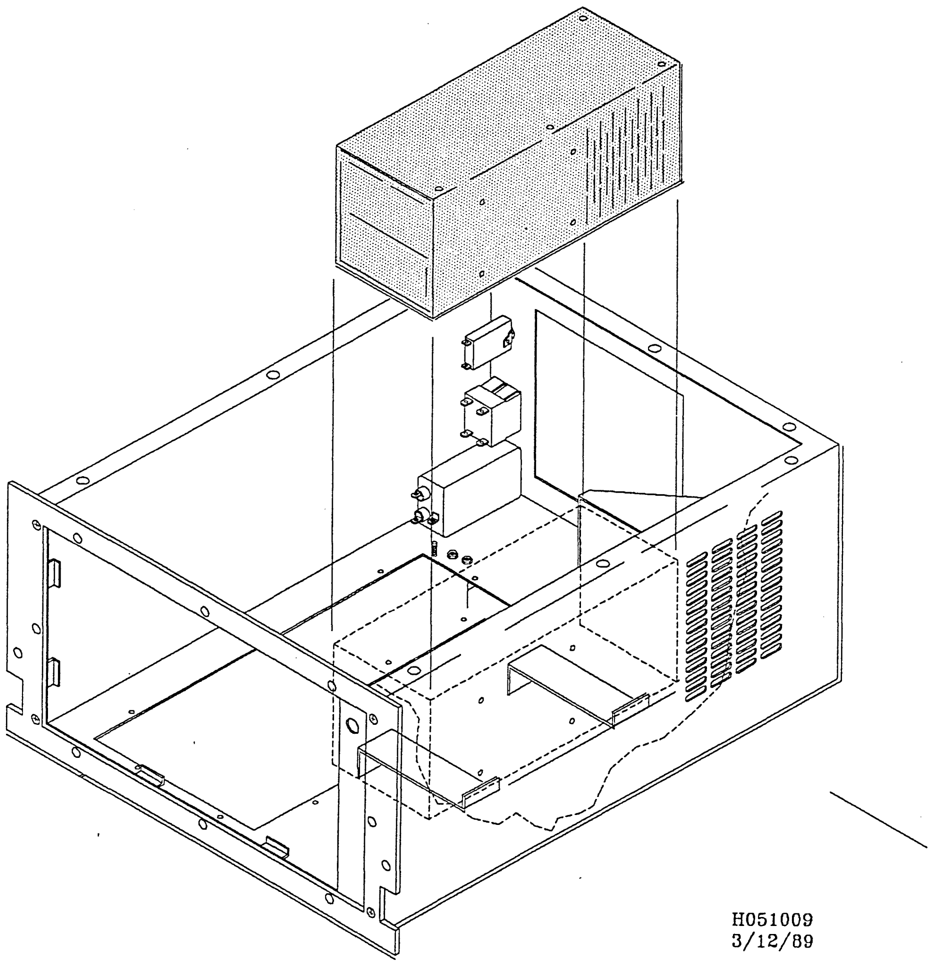
4.4.2 Power supply

Follow these procedures to remove, replace, and adjust the VMEbus chassis power.

4.4.2.1 Removal

1. Complete steps 1, 2, and 3 in Section 4.3, "Maintenance Safety Procedures."
2. Ensure that the VMEbus chassis power control switch is set to the **OFF** position (see Figure 4–3, "VMEbus Chassis Power Control Switch").
3. Disconnect the chassis power cord from the chassis AC-input jack.
4. Release the 2 front chassis captive-lock screws and extend the chassis on its slides.
5. Release the 12 top panel captive-lock screws and remove the top panel.
6. Release the 8 front panel captive-lock screws and remove the front panel.
7. Remove the chassis air filter.
8. Remove the 4 power supply mounting screws on the (right outside) chassis panel as shown in Figure 4–4, "Power Supply":

Figure 4–4, Power Supply



9. Slide the power supply to the left and toward the front, then disconnect all wiring from the power supply terminals.

CAUTION

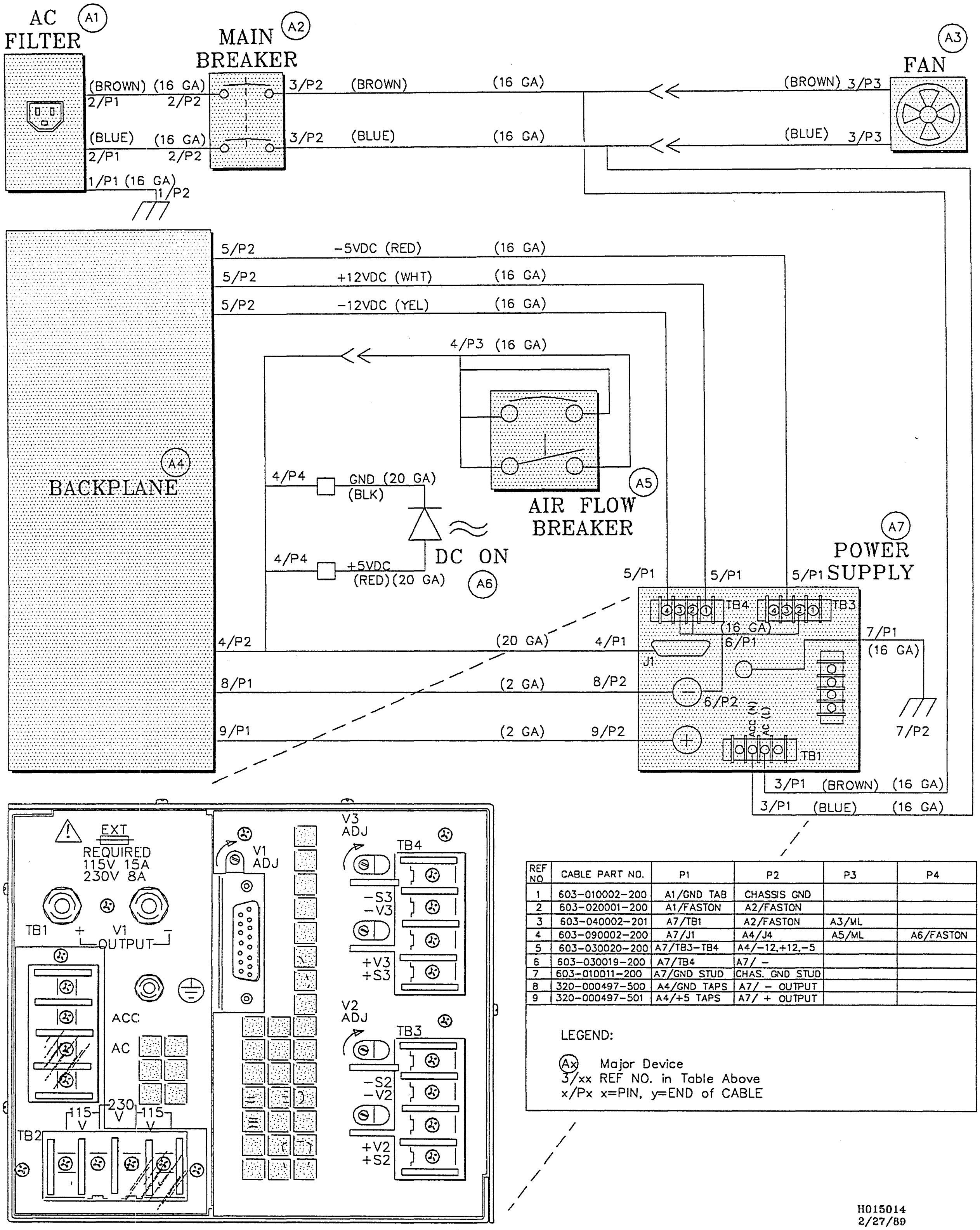
Exercise care when removing the power supply to avoid damaging the DC indicator.

10. Remove the power supply from the chassis.

4.4.2.2 Replacement

1. Ensure that steps 1, 2, and 3 in Section 4.3, "Maintenance Safety Procedures," are completed.
2. Refer to Figure 4–5, "Single and Dual Schematic Diagram," or Figure 4–6, "VMEbus/Mbus Combo Schematic Diagram," and ensure that the AC-power jumpers, on the AC-terminal block, are set for the appropriate AC-input voltage range.

Figure 4–5, Single and Dual Schematic Diagram



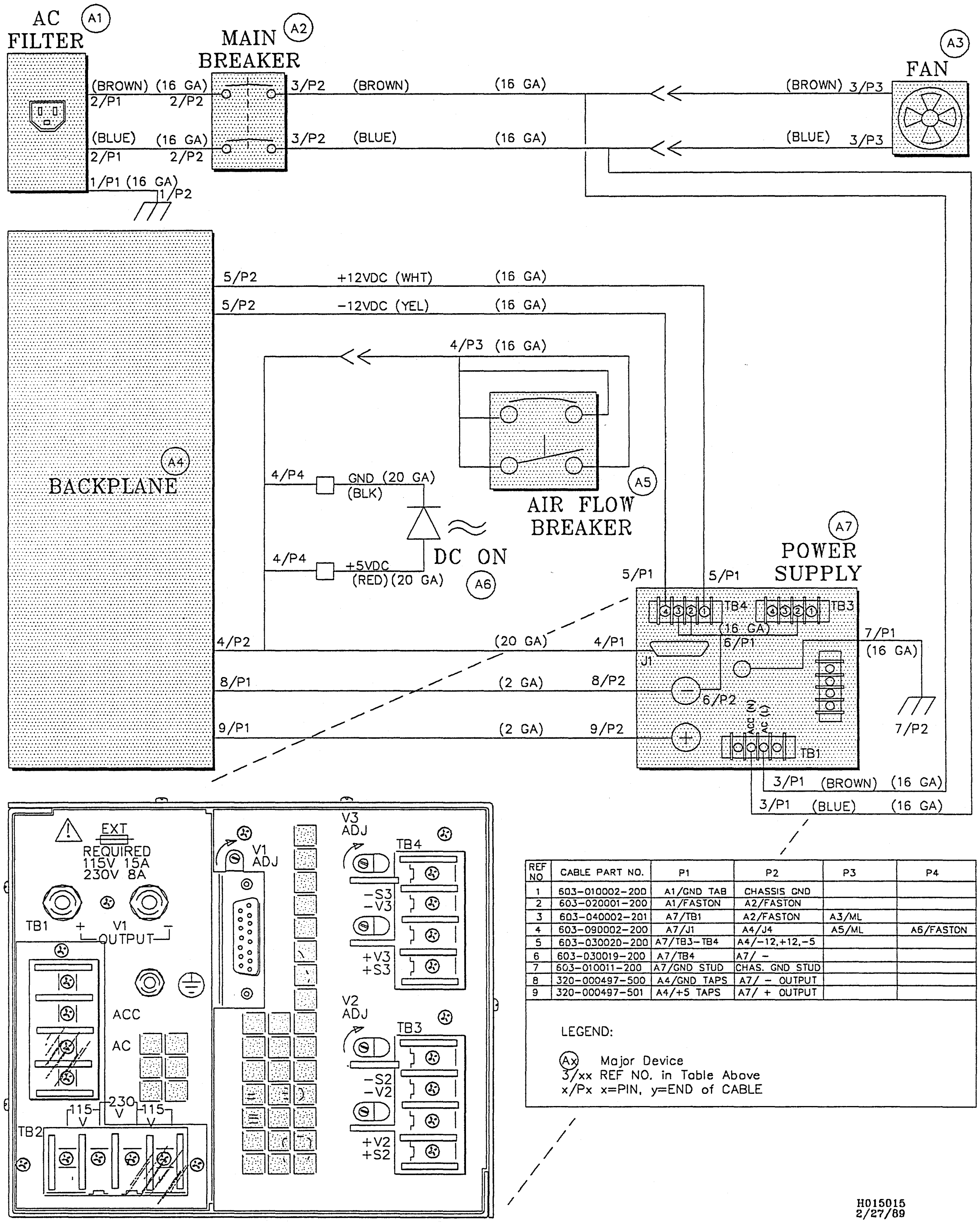
REF NO	CABLE PART NO.	P1	P2	P3	P4
1	603-010002-200	A1/GND TAB	CHASSIS GND		
2	603-020001-200	A1/FASTON	A2/FASTON		
3	603-040002-201	A7/TB1	A2/FASTON	A3/ML	
4	603-090002-200	A7/J1	A4/J4	A5/ML	A6/FASTON
5	603-030020-200	A7/TB3-TB4	A4/-12,+12,-5		
6	603-030019-200	A7/TB4	A7/ -		
7	603-010011-200	A7/GND STUD	CHAS. GND STUD		
8	320-000497-500	A4/GND TAPS	A7/ - OUTPUT		
9	320-000497-501	A4/+5 TAPS	A7/ + OUTPUT		

LEGEND:

(Ax) Major Device
3/xx REF NO. in Table Above
x/Px x=PIN, y=END of CABLE

H015014
2/27/89

Figure 4–6, VMEbus/Mbus Combo Schematic Diagram



REF NO	CABLE PART NO.	P1	P2	P3	P4
1	603-010002-200	A1/GND TAB	CHASSIS GND		
2	603-020001-200	A1/FASTON	A2/FASTON		
3	603-040002-201	A7/TB1	A2/FASTON	A3/ML	
4	603-090002-200	A7/J1	A4/J4	A5/ML	A6/FASTON
5	603-030020-200	A7/TB3-TB4	A4/-12,+12,-5		
6	603-030019-200	A7/TB4	A7/ -		
7	603-010011-200	A7/GND STUD	CHAS. GND STUD		
8	320-000497-500	A4/GND TAPS	A7/ - OUTPUT		
9	320-000497-501	A4/+5 TAPS	A7/ + OUTPUT		

LEGEND:

- (Ax) Major Device
- 3/xx REF NO. in Table Above
- x/Px x=PIN, y=END of CABLE

CAUTION

Exercise care when installing the power supply to avoid damaging the DC indicator.

3. Place the power supply on the power supply support fixture in the chassis.

CAUTION

Power-wiring lugs, such as the +5V, that come in contact with chassis ground points or other power connections, can damage the power supply or cause improper operation.

Applying incorrect voltage levels to the controllers in the VMEbus chassis can damage electronic components.

4. Refer to Figure 4–5, "Single and Dual Schematic Diagram," or Figure 4–6, "VMEbus/Mbus Combo Schematic Diagram," and connect all wiring to the power-supply terminals.

NOTE

The DC power indicator will not work unless the wiring connections are done properly. The black wire, from the power supply, must go to the side of the indicator with the dash (-) mark.

5. Release *all* controllers from the chassis backplane power connectors.
6. Connect the AC-power cord to the VMEbus chassis AC-input jack.

4.4.2.3 Adjustments

1. Set the VMEbus chassis power control switch to the **ON** position (see Figure 4–3, VMEbus Chassis Power Control Switch).

NOTE

Use a DC voltmeter with an input impedance ≥ 10 Mohm/V when measuring DC voltages on the chassis power-supply terminals.

CAUTION

Component damage can occur unless the voltage potentials are within 5% of rated value before installing circuit boards into the VMEbus backplane.

2. Measure **V1** (+5V), **V2** (-5V), **V3** (+12V), and **V4** (-12V) on the power-supply terminal blocks.

NOTE

Refer to Figure 4–5, Single and Dual Schematic Diagram, or Figure 4–6, "VMEbus/Mbus Combo Schematic Diagram," for the locations of the voltage test and adjustment points.

3. Adjust appropriate voltage control if voltage reading is not within 5% of its rated value:
   - **V1** — +4.75 V to +5.25 V
   - **V2** — -5.25 V to -4.75 V
   - **V3** — +11.4 V to +12.6 V
   - **V4** — -12.6 V to -11.4 V

4. Set the VMEbus chassis power control switch to the **OFF** position (see Figure 4–3, VMEbus Chassis Power Control Switch).

CAUTION

Failure to remove power to the VMEbus chassis before installing printed circuit boards will damage electronic components.

5. Re-install all VMEbus controllers into their backplane slots.
6. Set the VMEbus chassis power control switch to the **ON** position (see Figure 4–3, VMEbus Chassis Power Control Switch).
7. Measure, and adjust all DC voltages until they are within 0.4% of their rated value:
   - **V1** — +4.98 V to +5.02 V
   - **V2** — -5.02 V to -4.98 V
   - **V3** — +11.052 V to +12.048 V
   - **V4** — -12.048 V to -11.052 V

8. Set the VMEbus chassis power control switch to the **OFF** position (see Figure 4–3, VMEbus Chassis Power Control Switch).
9. Slide power supply to the right and rear, and install the 4 mounting screws on the (right outside) chassis panel.

> **NOTE**
>
> The next two steps provide a general check of the wiring connections that were completed in the previous steps. Also, these steps verify the proper operation of the low-airflow sensor and related circuits.

10. Disconnect the AC-inline connector going to the fan in the rear of the VME chassis.
11. Set the VMEbus chassis power control switch to the **ON** position (see Figure 4–3, VMEbus Chassis Power Control Switch). The low-airflow circuit breaker should trip in less than 1 min.
12. Set the VMEbus chassis power control switch to the **OFF** position (see Figure 4–3, VMEbus Chassis Power Control Switch).
13. Reset the low-airflow circuit breaker (see Figure 4–3, VMEbus Chassis Power Control Switch).
14. Connect the AC-inline connector going to the chassis fan.
15. Install the chassis air filter.
16. Install front panel and secure it with the 8 captive screws.

> **CAUTION**
>
> Do not operate the VMEbus chassis with its top panel removed. The panel must be installed to obtain proper airflow inside the VMEbus chassis.

17. Install top panel and secure it with the 12 captive screws.
18. Return the expansion chassis to its retracted position and secure it with the 2 captive screws.
19. Return the expansion cabinet stabilizer bars to their retracted positions.
20. Set the VMEbus chassis power control switch to the **ON** position (see Figure 4–3, VMEbus Chassis Power Control Switch).
21. Set the computer front panel power control switch to the **ON** position (see Figure 4–2, Typical Front Panel Power Control Switch).

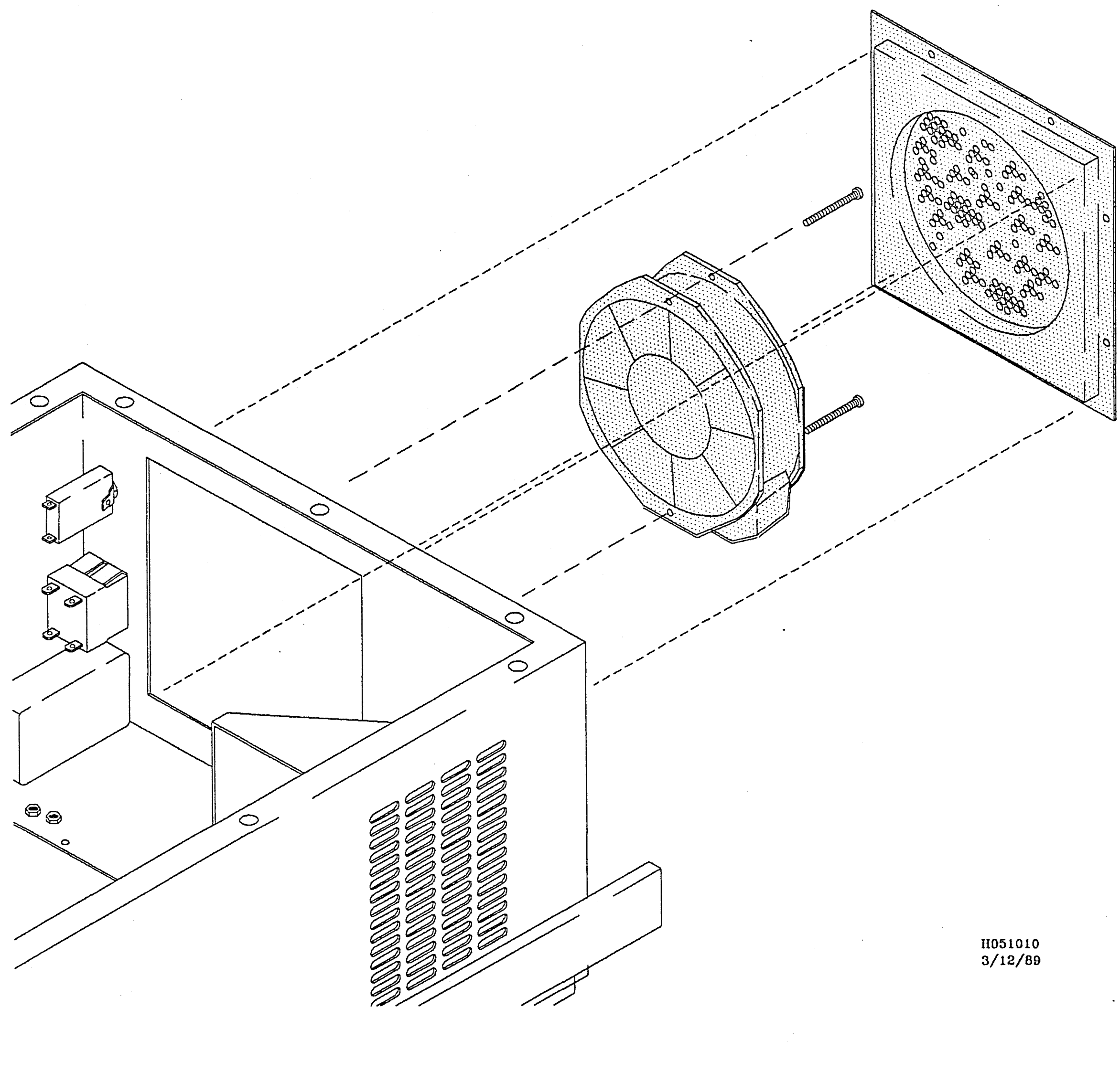
4.4.3 Chassis Fan

Follow these procedures to remove and replace the to remove and replace the VMEbus chassis fan.

4.4.3.1 Removal

1. Complete steps 1 and 3 in Section 4.3, "Maintenance Safety Procedures."
2. Open the rear door of the expansion cabinet containing the VMEbus chassis, and remove the 8 fan-baffle screws and the fan baffle as shown in Figure 4–7, "Fan Assembly":

Figure 4–7, Fan Assembly



3. Remove the 2 fan retaining screws from the chassis.
4. Release the expansion chassis and extend it on its slides.

5. Release the 12 top panel captive screws and remove the top panel.
6. Disconnect the AC-inline connector from the fan power harness.
7. Remove the chassis fan from the rear of the chassis.

4.4.3.2 Replacement

1. Ensure that steps 1 and 3 in Section 4.3, "Maintenance Safety Procedures," are completed.
2. Install the chassis fan into the rear of the chassis and secure it with 2 screws.
3. Install the fan baffle onto the rear of the chassis and secure it with 8 screws.
4. Connect the AC-inline connector to the fan power harness.

> **CAUTION**
>
> Do not operate the VMEbus chassis with its top panel removed. The panel must be installed to obtain proper airflow inside the VMEbus chassis.

5. Install the top panel and secure it with the 12 captive screws.
6. Return the expansion chassis to its retracted position and secure it with the 2 front chassis captive-lock screws.
7. Return the expansion cabinet stabilizer bars to their retracted positions.
8. Set the VMEbus chassis power control switch to the **ON** position (see Figure 4–3, VMEbus Chassis Power Control Switch).
9. Set the computer front panel power control switch to the **ON** position (see Figure 4–2, Typical Front Panel Power Control Switch).

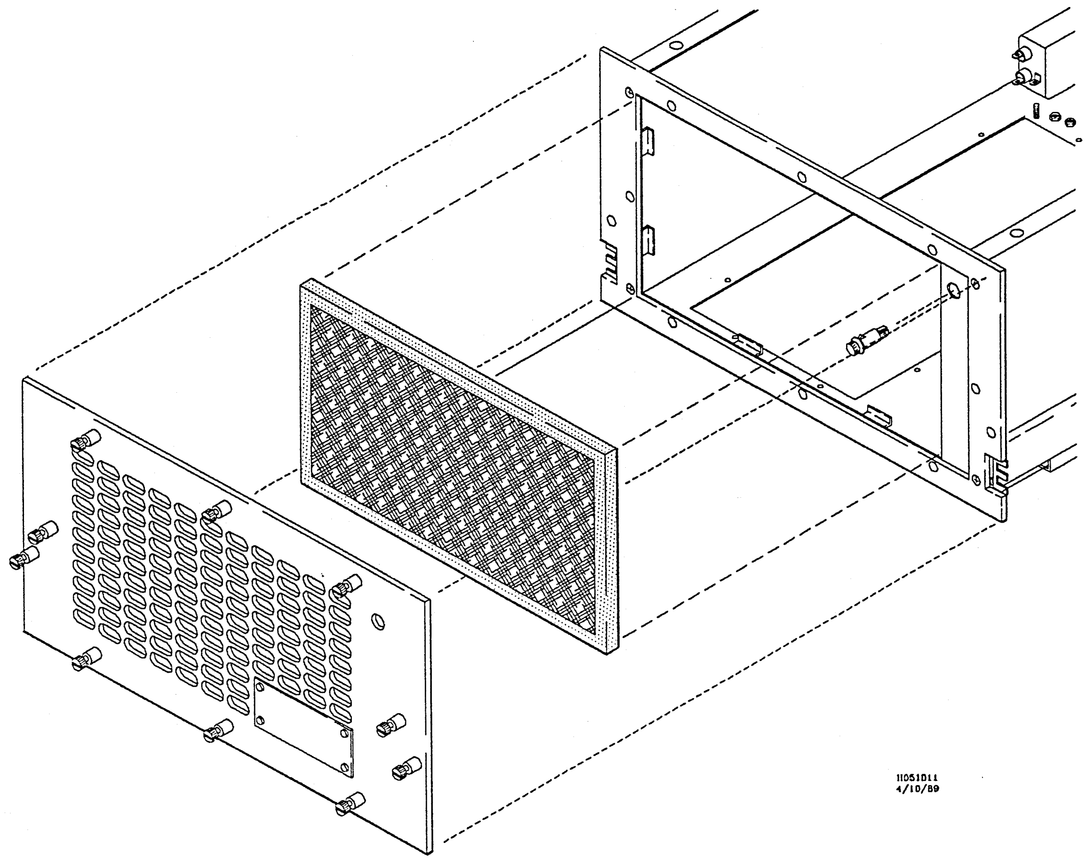
4.4.4 Air Filter

Follow these procedures to remove and replace the VMEbus chassis filter.

4.4.4.1 Removal

1. Set the VMEbus chassis power-control switch to the **OFF** position.
2. Release the 8 captive-lock screws of the front panel and remove panel as shown in Figure 4–8, "Air Filter":

Figure 4–8, Air Filter



3. Remove the chassis air filter.

4.4.4.2 Replacement

1. Install chassis air filter into the front of the chassis.
2. Replace front panel and secure with the 8 captive-lock screws.
3. Set the VMEbus chassis power-control switch to the **ON** position (see Figure 4–3, VMEbus Chassis Power Control Switch).

4.4.5 VIOP

Follow these procedures to remove and replace the VIOP.

4.4.5.1 Removal

1. Complete steps 1 and 2 in Section 4.3, "Maintenance Safety Procedures."

> **CAUTION**
>
> Failure to simultaneously tighten or loosen the 2 captive mounting screws can damage the bus connector.

2. Open the front door on the computer cabinet, and simultaneously loosen the captive hardware on each end of the VIOP.

> **CAUTION**
>
> The VIOP can be damaged by Electrostatic Discharge (ESD). A grounded wrist strap (or other grounding method) must be used when handling the VIOP.

3. Remove the VIOP from its Channel Control Unit (CCU) slot.

4.4.5.2 Replacement

> **CAUTION**
>
> The VIOP can be damaged by Electrostatic Discharge (ESD). A grounded wrist strap (or other grounding method) must be used when handling the VIOP.

1. Ensure that steps 1 and 2 in Section 4.3, "Maintenance Safety Procedures," are completed.
2. Install the VIOP into its CCU slot.

> **CAUTION**
>
> Failure to simultaneously tighten or loosen the 2 captive mounting screws can damage the bus connector.

3. Simultaneously tighten the captive hardware on each end of the VIOP.
4. Close the front door on the computer cabinet.
5. Set the front panel power-control switch on the computer to the **ON** position (see Figure 4–2, Typical Front Panel Power Control Switch).

4.4.6 VBCU

Follow these procedures to remove and replace the VBCU.

4.4.6.1 Removal

1. Complete steps 1, 2, and 3 in Section 4.3, "Maintenance Safety Procedures."
2. Release the 2 front chassis captive-lock screws and extend the chassis on its slides.
3. Release the 12 top panel captive-lock screws and remove the top panel.
4. Label and disconnect all cables attached to the VBCU.

CAUTION

The VBCU can be damaged by Electrostatic Discharge (ESD). A grounded wrist strap (or other grounding method) must be used when handling the VBCU.

The low-airflow sensor on the VBCU can be damaged if the PCB is misaligned during removal.

5. Remove the VBCU from its VMEbus chassis slot.

4.4.6.2 Replacement

1. Ensure that steps 1, 2, and 3 in Section 4.3, "Maintenance Safety Procedures" are completed.

CAUTION

The VBCU can be damaged by Electrostatic Discharge (ESD). A grounded wrist strap (or other grounding method) must be used when handling the VBCU.

The low-airflow sensor on the VBCU can be damaged if the PCB is misaligned during installation.

2. Install the VBCU into its VMEbus chassis slot.

NOTE

The next three steps verify the proper operation of the low-airflow sensor and related circuits on the VBCU just installed.

If another VBCU or MBCU is installed in the chassis, it must be released from from the backplane before this test is performed.

3. Release second VBCU or MBCU from the backplane if installed.
4. Disconnect the AC-inline connector going to the fan in the rear of the VME chassis.
5. Set the VMEbus chassis power control switch to the **ON** position (see Figure 4–3, VMEbus Chassis Power Control Switch). The low-airflow circuit breaker should trip in less than 1 min.
6. Set the VMEbus chassis power control switch to the **OFF** position (see Figure 4–3, VMEbus Chassis Power Control Switch).

7. Reset the low-airflow circuit breaker (see Figure 4–3, VMEbus Chassis Power Control Switch).
8. Connect the AC-inline connector going to the chassis fan.
9. Install the second VBCU or MBCU into its proper position if applicable.
10. Connect all cables to the VBCU.

> **CAUTION**
>
> Do not operate the VMEbus chassis with its top panel removed. The panel must be installed to obtain proper airflow inside the VMEbus chassis.

11. Install the top panel and secure it with the 12 captive screws.
12. Return the expansion chassis to its retracted position and secure it with the 2 front chassis captive-lock screws.
13. Return the expansion cabinet stabilizer bars to their retracted positions.
14. Set the VMEbus chassis power control switch to the **ON** position (see Figure 4–3, VMEbus Chassis Power Control Switch).
15. Set the computer front panel power control switch to the **ON** position (see Figure 4–2, Typical Front Panel Power Control Switch).

4.5 Illustrated Parts List

This section is the Illustrated Parts Breakdown (IPB) for the VMEbus subsystem. Table 4–1, "VMEbus Subsystem Parts List," lists the CONVEX part numbers for all FRUs. The table also contains a figure number reference for the FRU:

Table 4–1, VMEbus Subsystem Parts List

Description	Part Number	Quantity	Figure No.
VMEbus chassis, dual[1], 110 V	500-000223-210	1	4–9
VMEbus chassis, dual[1], 220 V	500-000223-211	1	4–9
VMEbus chassis, single[2], 110 V	500-000223-200	1	4–10
VMEbus chassis, single[2], 220 V	500-000223-201	1	4–10
VMEbus/Mbus chassis, combo, 110 V	500-000223-213	1	4–11
VMEbus/Mbus chassis, combo, 220 V	500-000223-214	1	4–11
Power supply	200-001005-200	1	4–4
Indicator, DC	150-000011-001	1	4–11
Fan, 6 in, Turboaxi, 110 V	230-000004-003	1	4–7
Fan, 6 in, Turboaxi, 220 V	230-000004-001	1	4–7
Filter, air	312-000240-001	1	4–8
VBCU	410-001150-200	note[3]	4–13
VIOP	410-001149-200	note[4]	4–12
Cables, interconnect	604-600001-201	3	2–11,12

[1] This is a dual (two 5-slot) VMEbus chassis.
[2] This is a single (9-slot) VMEbus chassis.
[3] The dual VMEbus chassis can contain two VBCUs. The single and VMEbus/Mbus combo each contain one VBCU.
[4] The number of VIOPs is determined by the number and types of VMEbus chassis installed.

Figure 4–9, Dual VMEbus Chassis Assembly

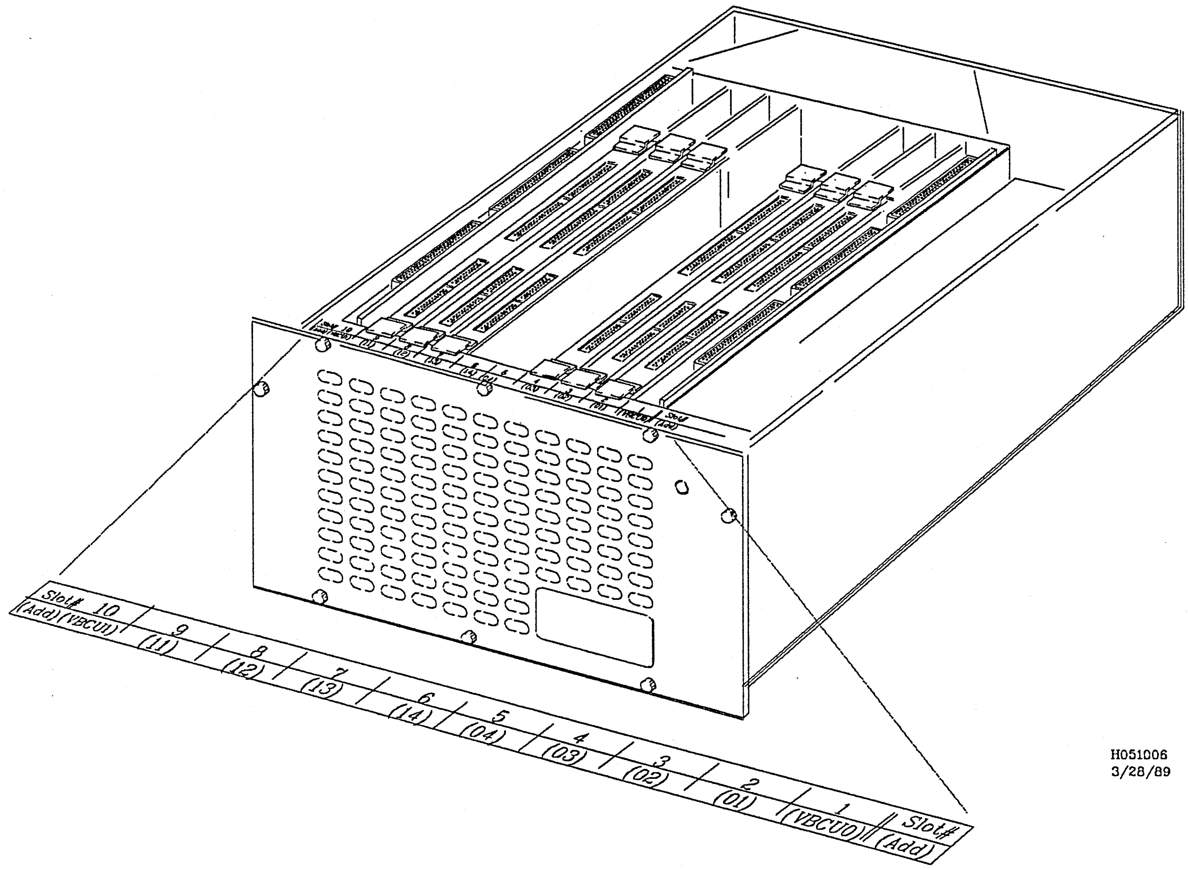


Figure 4–10, Single VMEbus Chassis Assembly

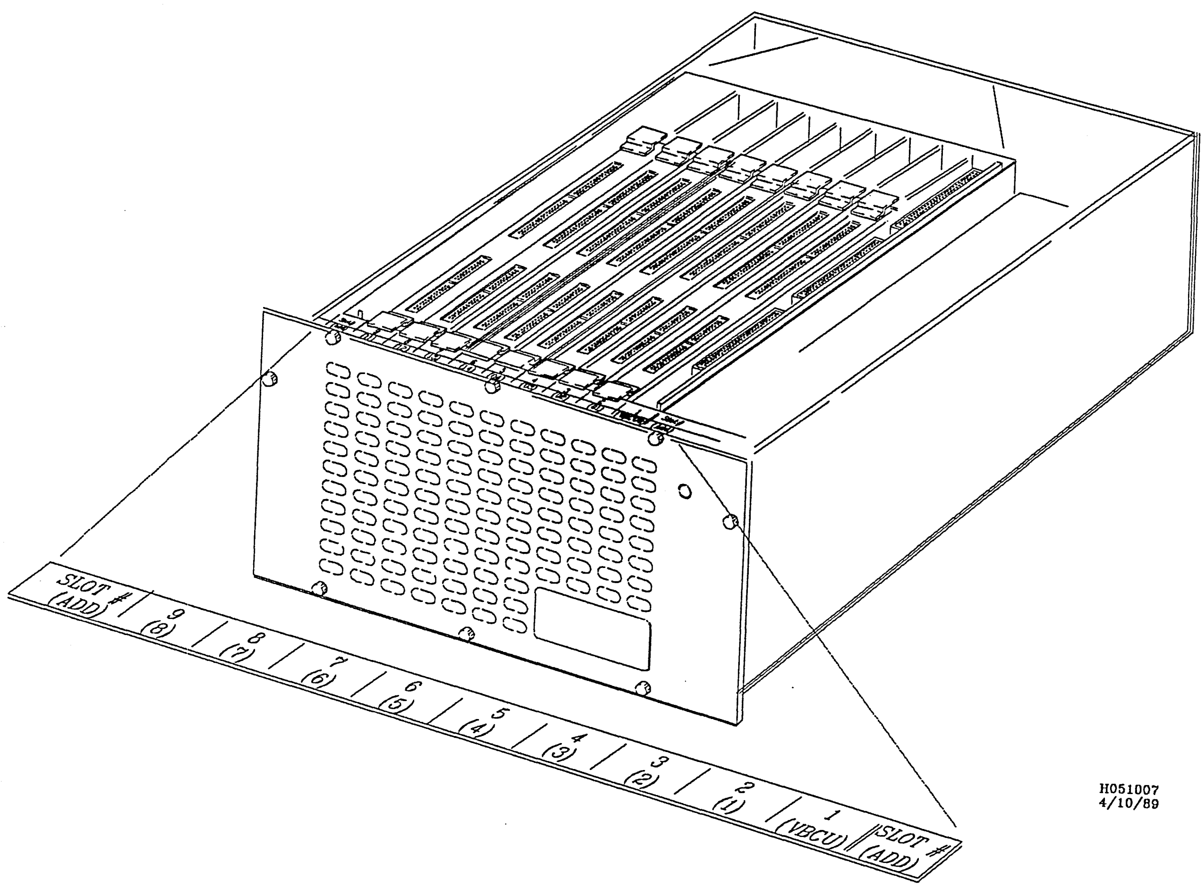


Figure 4–11, VMEbus/Mbus Combo Chassis Assembly

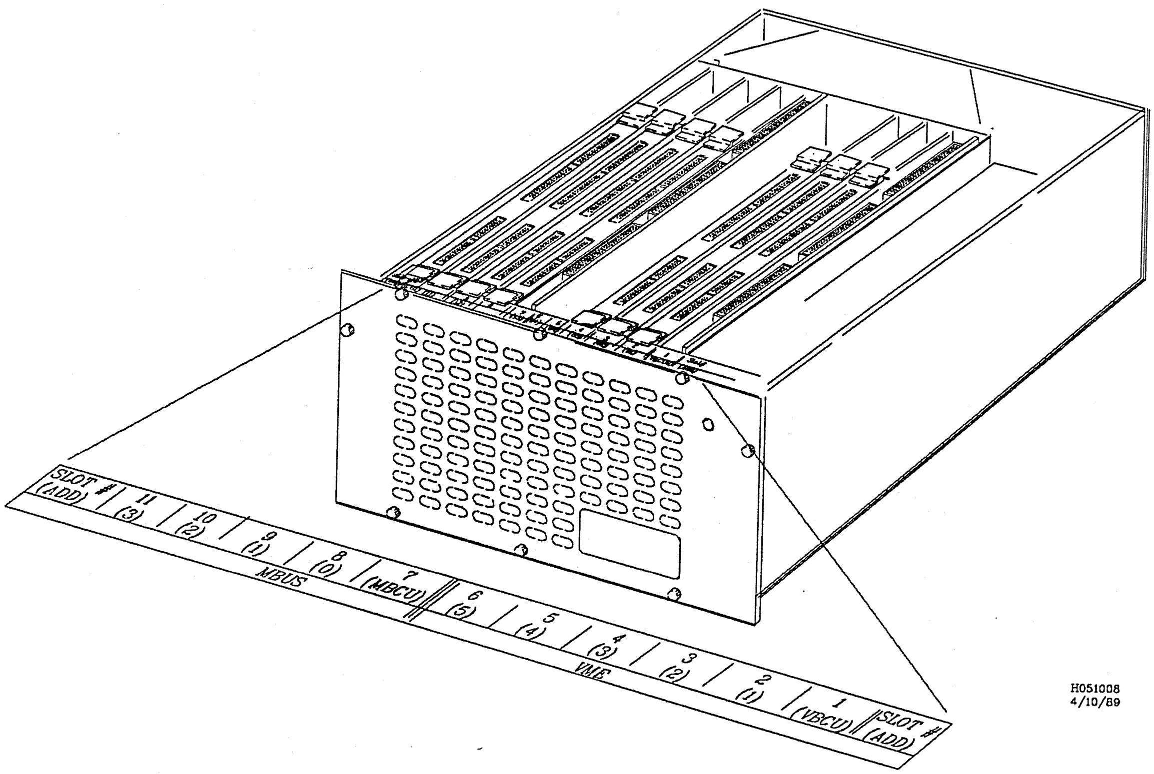


Figure 4–12, VIOP

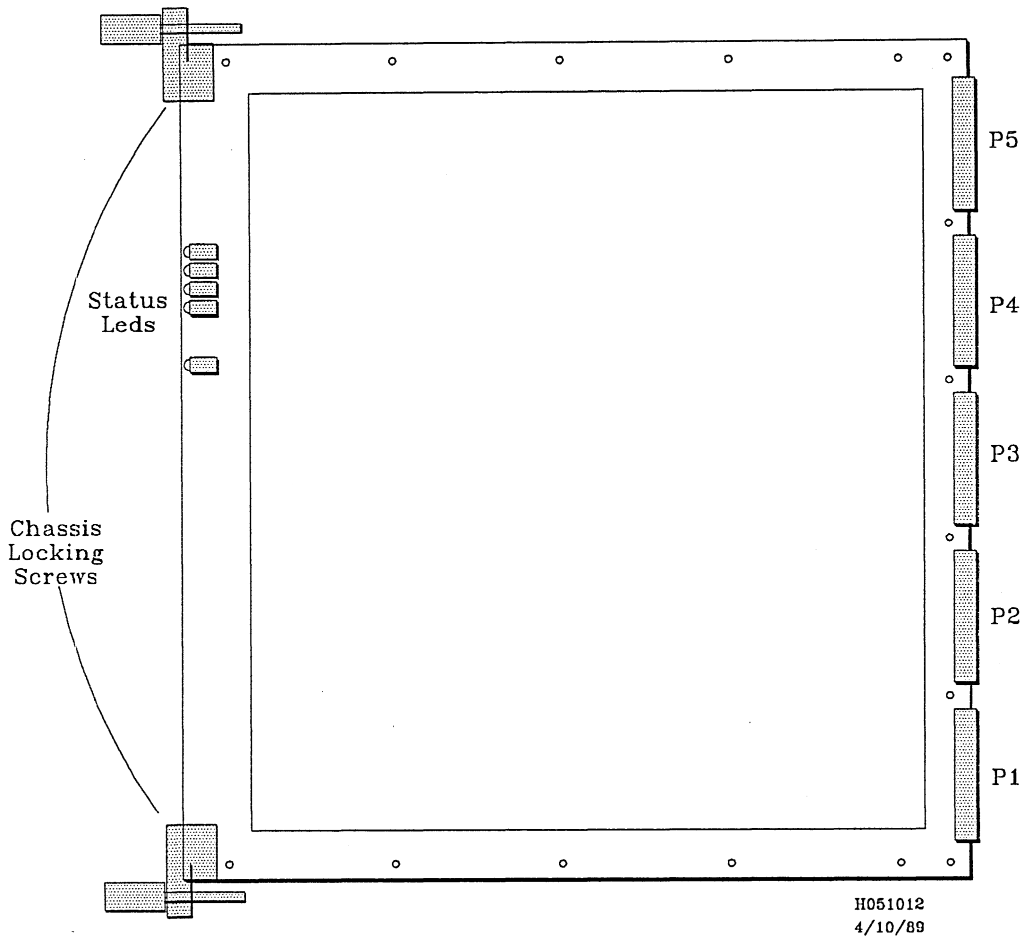
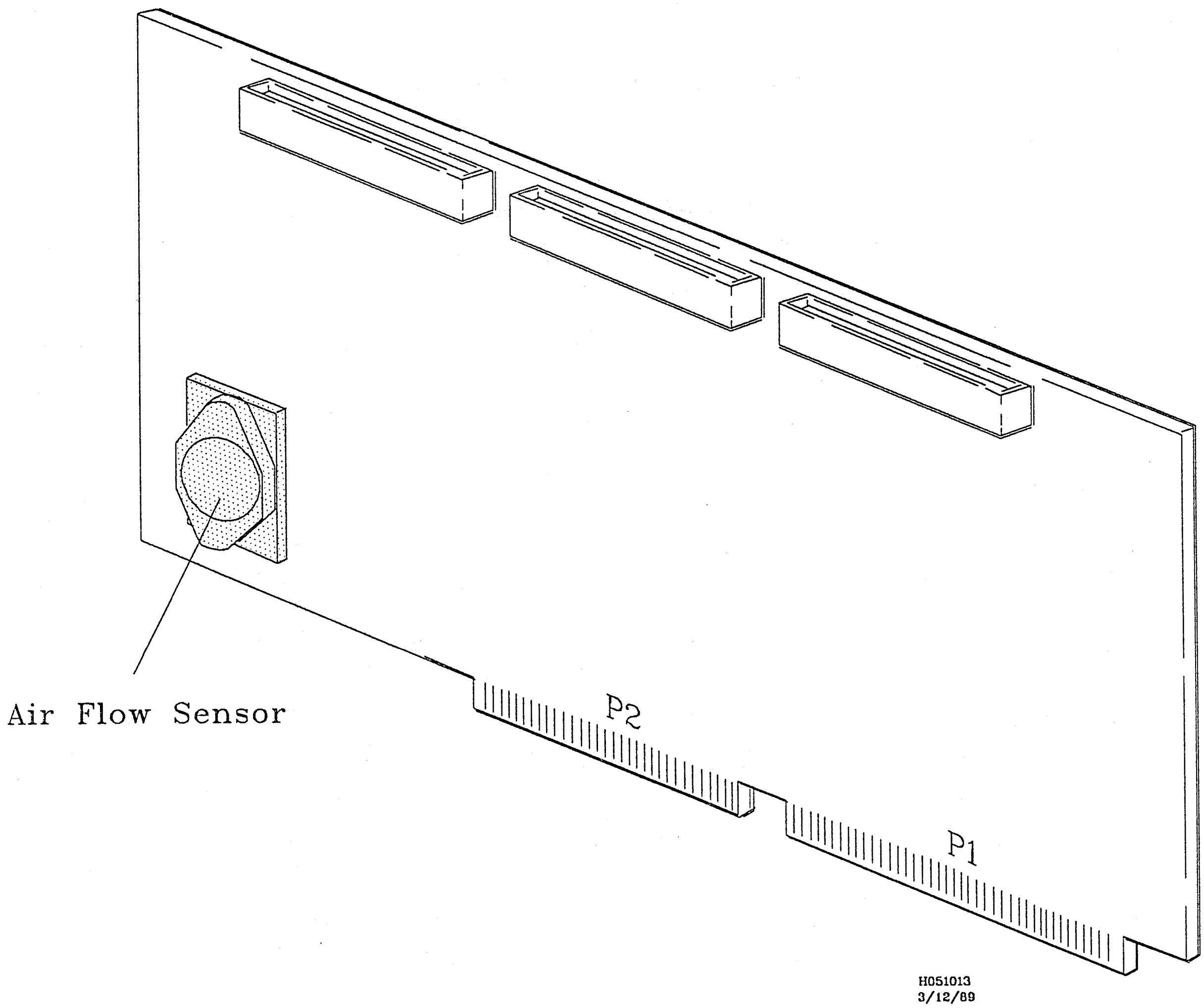


Figure 4–13, VBCU



Appendix A
Reporting Problems

A.1 Overview

This appendix introduces the CONVEX Technical Assistance Center (TAC) and the *contact* utility. The *contact* utility is an online system for reporting problems to the TAC. To learn *contact* by using it, enter **contact** at the system prompt and then answer the questions as they appear on the screen. To find out more about using *contact*, read through this appendix. It describes prerequisites and tips for using *contact* and the step-by-step process *contact* takes you through.

A.2 Technical Assistance Center

The CONVEX Technical Assistance Center (TAC) is staffed by technical specialists who can address the diverse questions and problems that arise in a supercomputing environment. If you have a hardware, software, or documentation problem, contact the TAC. This group stands ready to solve such problems.

A.3 The *contact* Utility

The TAC recommends using the *contact* utility to report a hardware, software, or documentation problem. The *contact* utility is an interactive utility that helps the TAC track reports and route them to the the CONVEX personnel most qualified to fix them.

After invoking *contact*, it prompts for information about the problem. When you finish your report, *contact* electronically mails it to the TAC. You are notified within 48 hours that the TAC has received your report.

A.4 Prerequisites

To use *contact* requires

- a UNIX-to-UNIX Communication Protocol (UUCP) connection to the TAC
- the full path name of the program or utility in question
- the version number of the program or utility in question

A.4.1 UUCP Connection

Before using *contact*, check with your system administrator to be sure there is a UUCP connection to the TAC. A UUCP connection allows files to be copied from one UNIX system to another. The *uucp* (UNIX-to-UNIX copy) command relies on either a dial-up or hard-wired UUCP communication line.

A.4.2 Finding the Program Path Name

To determine the full path name of the program or utility in question, use the *which* command. The following screen illustrates using the *which* command to find the full path name of the loader (*ld*) utility:

```
>which ld
/bin/ld
>
```

In this example, the full path name of the loader is */bin/ld*.

For more information on the *which* command, refer to the *which*(1) man page. You can also use the *info* online information system. Enter **info which** at the system prompt. If you use the C shell (*csh*), you can also use the *whence* command to find the program path name. The *whence* command works like *which*, only faster.

A.4.3 Finding the Program Version Number

To determine the version number of the program or utility in question, use the *vers* command. The following screen illustrates using the *vers* command (enter **vers**, then the path name of the program or utility) to find the version number of the loader (*ld*) utility.

```
>vers /bin/ld
/bin/ld: 7.0
>
```

In this example, the loader utility version number is 7.0.

For more information on the *vers* command, refer to the *vers*(1) man page. You can also use the *info* online information system. To do so, enter **info vers** at the system prompt.

A.5 Tips on Using the *contact* Utility

The *contact* utility is interactive and easy to use. This section lists tips to help use it efficiently. In particular, this section tells how to

- use a *.contact* file
- abort a contact session
- resubmit an aborted report
- suspend a contact session
- move from one prompt to another
- use tilde-escape sequences in the *contact* utility

A.5.1 Using a *.contact* File

When invoked, *contact* prompts for information regarding the problem. The first prompt is for your name, title, phone number, and company name. You can, however, create a *.contact* file to skip this first prompt. Follow these steps:

1. Create a *.contact* file in your home directory.
2. Enter your name, job title, phone number, and company name, each on a new line.

When you invoke *contact*, it automatically includes the *.contact* file as input for the first prompt and proceeds to the next prompt.

A.5.2 Aborting the Report

To abort a contact report, either enter the interrupt key (usually CTRL-C) or choose the abort option when prompted by the *contact* utility. Using CTRL-C to abort does not save the contents of the report. Using the abort option saves the contents of the report in a file named *dead.report* in your home directory.

A.5.3 Submitting the *dead.report* File

When aborting a contact session, the *contact* utility saves the report in a file named *dead.report* in your home directory. Using the *contact* command with the *-r* option automatically merges the contents of the *dead.report* file into the new contact session. Enter

contact -r

and *contact* finds the *dead.report* file in your home directory and merges it into the contact report. You can then edit the report. When you end the editing session, *contact* returns to the final prompt, which asks you to review, edit, submit, or abort the report.

A.5.4 Suspending a Report

Sometimes it is necessary to stop in the middle of a contact report and return to the shell (for instance, to suspend the contact session to find the program path name or version number). To suspend the contact session, press CTRL-Z. To return to the contact session, enter **fg**. Using CTRL-Z and the *fg* (foreground) command lets you switch back and forth between the *contact* utility and the shell. You cannot, however, use CTRL-Z and *fg* to switch back and forth if you are using a Bourne shell (*sh*).

A.5.5 Ending a Response

The *contact* utility prompts for information pertinent to your hardware, software, or documentation question. Some prompts require one-line responses; to move to the next prompt, press RETURN. Other prompts require more than a one-line response; to move to the next prompt, press CTRL-D.

A.5.6 Tilde-Escape Sequences

The *contact* utility treats input beginning with a tilde (~) as a special sequence. The character following the tilde is considered a request for a special function. The following tilde sequences are recognized by *contact*:

~e	Start the text editor (defined in your EDITOR environment variable).
~h	Display a list of available tilde-escape sequences.
~p	Print the contact report to the terminal screen.
~r *filename*	Read the contents of *filename* as a response to the current prompt. Some prompts require only a one-line response. This tilde-escape sequence only works for prompts that allow more a than one-line response.
~~	Insert a single tilde as the first character in the line.

A.6 Using the *contact* Utility

The *contact* utility prompts for the following information:

- your name, title, phone number, and corporate name
- the name and version of the product involved
- a one-line summary of the problem
- a detailed description of the problem
- the priority of the problem
- instructions on how to reproduce the problem
- comments about the problem
- comments about the documentation supporting the problem
- files to include in the contact report

The following is a step-by-step discussion of these prompts:

1a. To invoke the *contact* utility, enter **contact** at the system prompt. The system responds with a welcome message and a series of questions regarding your hardware, software, or documentation question. The following screen illustrates the *contact* command and the system response:

```
>contact
Welcome to contact version 0.11 ()

Enter your name, title, phone number, and corporate name (^D to terminate)
>
```

1b. If there is a *.contact* file in your home directory, *contact* skips the first prompt. The following screen illustrates the *contact* command and the system response when a *.contact* file is in your home directory:

```
>contact
Welcome to contact version 0.11 ()

Enter the name of the product involved
>
```

2. The *contact* utility prompts for the version number of the product. If you do not know the version number, use CTRL-Z to suspend the session. Use the *which* (or *whence* if using *csh*) and *vers* commands to find the version number of the product. Use the *fg* command to return to the session and enter the version number in the form X.X or X.X.X.X.
3. The *contact* utility prompts for a one-line summary of the problem. This summary is the subject header in any further correspondence regarding the problem. Make this summary as descriptive as possible in one line.
4. The *contact* utility prompts for a detailed description of the problem. Make this description as complete as possible. Include source code and a stack backtrace whenever possible. (Refer to the *adb*(1) or *csd*(1) man page for information on obtaining a stack backtrace.) The more information provided, the quicker the TAC can isolate and solve the problem.
5. The *contact* utility prompts for the priority of the problem. The following screen illustrates this prompt and the priority levels from which to choose; you must enter a priority number.

```
Enter a problem priority, based on the following:
1) Critical    - work cannot proceed until the problem is resolved.
2) Serious     - work can proceed around the problem, with difficulty.
3) Necessary   - problem has to be fixed.
4) Annoying    - problem is bothersome.
5) Enhancement - requested enhancement.
6) Informative - for informational purposes only.
>
```

6. The *contact* utility prompts for an explanation of how to reproduce the problem. Include the command syntax and options you used and anything else you did to make your program run.
7. The *contact* utility prompts for any other pertinent comments. Include any relevant information.
8. The *contact* utility prompts for suggestions regarding the documentation supporting the product. Indicate if the documentation could be revised to address the question.
9. The *contact* utility asks for the names of files necessary to reproduce the problem. The following screen illustrates the *contact* prompt and sample user response:

```
Are there any files that should be included in this report (yes | no)?
>yes
Please enter the names of the files, one to a line (^D to terminate)
>test.f
>~/subroutines/sub.f
>
```

> **NOTE**
>
> Tilde-escape sequences are not recognized in responses to this prompt. Instead, *contact* treats a tilde in this section to mean your home directory. This convention is based on use of the tilde for expanding file names in *csh*.

If the files specified are small text files, they are automatically included in the contact report. If the files are too big to be included in this report, *contact* gives further instructions on how to submit these files.

To specify a directory, combine the directory files into a single file using the *tar* command (refer to the *tar*(1) man page for further information) or enter each file name in the directory on a single line in the contact report.

10. The *contact* utility prompts you to review, edit, submit, or abort the contact report. The following screen illustrates this prompt:

```
Please select one of the following options:
1) Review the problem report.
2) Edit the problem report.
3) Submit the problem report.
4) Abort the problem report.
>
```

Choose the number of the option you want to select. These options let you do the following:

Review — Review the text of your contact report. You are then prompted again to select an option.

Edit — Edit the text of the contact report. If you choose to edit the report, *contact* puts you in your default text editor.

Submit — Send the report to the CONVEX TAC. You are notified within 48 hours that the TAC has received the report. This option exits the *contact* utility and returns you to the shell environment.

Abort — Save the text of your report in a file named *dead.report* in your home directory. This option exits the *contact* utility and returns you to the shell environment.

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