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MIX TUTORIAL

For VMEBus Systems

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Pentek MIX Tutorial – Revision History

Date	Rev	Applicable Serial #'s	Comments
06/01/98	A	N/A	Created from MIX Appendices, previously contained in each MIX product manual as part of the actual document.
10/20/99	A.1	N/A	Replaced all occurances of "appendix" with "manual". A few other minor formatting changes.

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Chapter 1: MIX Assembly and Installation Instructions

1.1 Introduction

The connection between Pentek's family of expansion modules and the VMEbus resources is provided by the Modular Interface eXtension (MIX) interface, originally developed by Intel Corporation for Multibus II. The MIX standard defines an electrical and mechanical protocol for a private high−speed 32−bit bus, fully supported with inter−rupt and control functions. The elements of the MIX system, as implemented by Pentek for VMEbus, are described in this manual.

1.2 A Glossary of MIX Terms

MIX Baseboard — The primary VME−to−MIX interface board designed for supporting one, two, or three MIX expansion modules. A MIX Stack must contain one, and only one, baseboard.

MIX Expansion Module — A printed circuit board that mounts onto the MIX Baseboard. Expansion modules may provide I/O, Memory or processing resources for the baseboard. An expansion module may have a Slave−only or a Master/Slave MIX interface, and may or may not possess its own VMEbus interface. The terms MIX module and expansion module are used interchangably in this manual.

VME Board — A self−contained, stand−alone assembly suitable for plugging into a VME card cage.

MIX Board — The primary Printed Circuit (PC) board within the expansion module (i. e., the board containing the MIX surface mount connector pattern). In some expansion modules, (such as the Pentek Models 4241 and 4244), this is the only PC board.

Mezzanine Board — A secondary PC board attached to the MIX board containing additional circuitry. For example, in the Model 4242, the mezzanine board contains the analog circuitry, including amplifiers, filters, and the A/D and D/A converters.

MIX bus Master — A device that initiates and controls data transfer cycles over the MIX bus. When this device is the MIX Baseboard, it is referred to as a Lower MIX Bus Master (LMBM). When an expansion module masters a MIX transaction, it is called an Upper MIX Bus Master (UMBM).

MIX bus Slave — A device that participates in, but neither initiates nor controls, a data transaction over the MIX bus.

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1.3 Pentek MIX Baseboards

Pentek offers a variety of MIX baseboards, all of which are full size VMEbus boards in standard 6U format (160 mm x 233 mm) and occupy one standard slot position (0.8" of horizontal space) in a VMEbus card cage. Each baseboard has two 96−pin male DIN connectors (P1 and P2) that mate with the corresponding female connectors on the VME−bus backplane. All power for the baseboard, and any expansion modules it may hold, is drawn from the VMEbus through these connectors.

The MIX baseboard features a surface mount contact pattern near the center of the board that supports the MIX interface. This pattern consists of 130 gold−plated pads on the upper and lower surfaces of the baseboard and mounting holes for the MIX connectors.

Pentek's line of MIX baseboards for the VMEbus includes the following devices:

- ❑ Model 4200: 68030−based; 16 MHz processor; VMEbus A32/D32 Master/Slave and VSB Master interfaces; up to 4 MB RAM
- ❑ Model 4200A: 68030−based; 40 MHz processor; VMEbus A32/D32 Master/Slave and VSB Master interfaces; up to 4 MB RAM
- ❑ Model 4201: 68030−based; 16 MHz processor; VMEbus A32/D32 Master/Slave interface; up to 4 MB RAM
- ❑ Model 4201A: 68030−based; 40 MHz processor; VMEbus A32/D32 Master/Slave interface; up to 4 MB RAM
- ❑ Model 4202: VMEbus A32/D32 Slave−only Interface; maps MIX bus addresses to VMEbus addresses
- ❑ Model 4283: DSP−based (TMS320C30); VMEbus A32/D32 Master/Slave interface; up to 8 MB RAM
- ❑ Model 4284: DSP−based (TMS320C40); VMEbus A32/D32 Master/Slave interface; up to 16 MB RAM
- ❑ Model 4285: DSP−based (Multiple TMS320C40s); VME64 Master/Slave and Auxiliary A32/D32 VMEbus Master interfaces; up to 22 MB RAM

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1.4 Pentek MIX Expansion Modules

Pentek currently offers MIX expansion modules for the VME bus with the following features:

- ❑ Floating Point Digital Signal Processors:
  - Single and Dual Texas Instruments TMS320C30 Processors
  - Single, Dual, and Quad Texas Instruments TMS320C40 Processors
  - Triple AT&T DSP32C Processors
- ❑ A/D Converters
  - 32 Channel, 16–bit, 12.5 kHz sample rate
  - 32 Channel, 12– or 14–bit, 125 kHz sample rate
  - 32 Channel, 16–bit, 100 kHz sample rate with digital filter
  - Single Channel, 12–bit, 1 MHz sample rate with LC filter
  - Single Channel, 12–bit, 10 MHz sample rate
  - Single Channel, 14–bit, 10 MHz sample rate with 'C40 Comm Port output
- ❑ A/D – D/A Converters
  - 16 Channel, 16–bit, 48 kHz sample rate
  - 8 Channel, 16–bit, 200 kHz sample rate, with 'C40 Comm Port I/O
  - Single and Dual Channel, 18–bit, 200 kHz sample rate
  - Single Channel, 12–bit, 1 MHz sample rate
- ❑ D/A Converter: 32 Channel, 12–bit, 100 kHz sample rate
- ❑ Digital I/O devices
  - 32–bit Parallel Digital I/O
  - SCSI–1 Interface
  - Wide/Fast SCSI–2 Interface
  - RS–232C Serial Interface
- ❑ Digital Receivers
  - Four Channel, 12–bit, 70 MHz Digital Drop Receiver
  - Multiband Digital Drop Receiver
- ❑ Single and Dual Channel T1/CEPT Interface
- ❑ Time Code Reader
- ❑ Prototyping Module

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1.5 MIX Module General Description

Standard MIX modules are 10.3" long x 4.0" deep x 0.8" wide. No electrical or mechanical connection is made between the VMEbus back plane and a standard MIX module, since all power and signal lines are provided through the MIX interface connectors. Each module has its own front panel secured to the card cage with captive hardware. The back ends of standard expansion modules are mechanically secured to the baseboard by means of the MIX connectors.

Some of Pentek's MIX modules differ from the above standards. The Model 4240 MIX prototyping module is somewhat deeper (6.0"), to allow more flexibility for custom circuit construction.

The Model 4270, with four TMS320C40 DSPs, can function as either a stand−alone VME Slave board, a MIX Master/Slave module, or both. This unit is, therefore, a full−size 6U VME board and draws power from the VME backplane, rather than from the MIX bus. The Model 6102 Octal A/D−D/A Converter has a full VMEbus slave interface as well as a MIX bus slave interface. This, too, is a full−depth MIX card, which engages the P1 and P2 VME connectors and can participate in VMEbus data cycles. On these full−depth MIX modules, the MIX connector pattern is located near the center of the card, rather than at the rear.

The Emitter−Coupled Logic (ECL) input versions of the Digital Receiver modules (Models 4271 and 4272) are also full depth MIX cards. These also draw power from the VMEbus, but cannot participate in any VME data transactions (although they do pass along the daisy−chained signals).

Each MIX module is accessed by the MIX baseboard as a unique memory region, determined by the module's stack position. Separate interrupt and control lines are provided for each stack position.

1.6 MIX Module Stack Assembly Techniques

Two methods are available for installing the first MIX module on the MIX baseboard. The first expansion module may be mounted in the Nested position or in the Non−Nested position. These terms will be defined below.

When the first expansion module is mounted in the Nested position, this module and the MIX baseboard occupy the same VME card cage slot, and share the expansion module's front panel. When the nested assembly technique is used, a full MIX stack (consisting of a baseboard and three expansion modules) occupies only three slots in the VME card cage. This technique leaves an additional slot in the card cage available, so that another VME device may be installed.

When the first expansion module is mounted in the Non−Nested position, the baseboard occupies its own slot in the VMEbus card cage, and has its own front panel. The first expansion module will occupy the slot to the right of the baseboard in the card cage. When the Non−Nested assembly technique is used, a full MIX stack (consisting of a baseboard and three expansion modules) occupies four slots in the VMEbus card cage.

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1.6 MIX Module Stack Assembly Techniques (continued)

The front panels of the Models 4200, 4200A, 4201 and 4201A are very useful for the initial configuration of these baseboards, but in normal use the panel is generally removed. These baseboards will normally utilize the Nested assembly technique to share a com–mon card cage slot with the first MIX expansion module.

MIX Baseboard Model 4202 is most often used without the VME front panel, and with the first expansion module mounted in the Nested position. The Model 4283 can sometimes be used in this manner as well. The Models 4284 and 4285 Baseboards do not support the Nested module installation, and each of these devices will always occupy its own card cage slot.

Full–depth MIX modules can not be Nested on any baseboard, because they must engage the VME backplane and therefore require a card cage slot of their own.

Table 1–1 (below) describes which combinations of MIX Baseboards and expansion modules allow for Nested installation.

Table 1–1: Expansion Module/Baseboard Nesting Compatibility

A 'Yes' Indicates that for the given MIX Baseboard/Module combination, nest installation in stack position 1 is possible

MIX Modules	Pentek VME/MIX Baseboards					MIX Modules	Pentek VME/MIX Baseboards				
	4200(A)	4201(A)	4202	4283	4284/5*		4200(A)	4201(A)	4202	4283	4284/5*
4240	No	No	No	No	No	**4254**	Yes	Yes	Yes	No	No
4241	Yes	Yes	Yes	Yes	No	**4255**	Yes	Yes	Yes	Yes**	No
4242	Yes	Yes	Yes	No	No	**4256**	Yes	Yes	Yes	Yes	No
4243	Yes	Yes	Yes	No	No	**4257**	Yes	Yes	Yes	No	No
4244	Yes	Yes	Yes	Yes	No	**4258**	Yes	Yes	Yes	No	No
4245	Yes	Yes	Yes	No	No	**4259**	Yes	Yes	Yes	No	No
4246	Yes	Yes	Yes	No	No	**4260**	Yes	Yes	Yes	No	No
4247	Yes	Yes	Yes	No	No	**4270**	No	No	No	No	No
4248	Yes	Yes	Yes	No	No	**4271**	Yes†	Yes†	Yes†	No	No
4249	Yes	Yes	Yes	No	No	**4272**	Yes†	Yes†	Yes†	No	No
4250	Yes	Yes	Yes	No	No	**4273**	Yes	Yes	Yes	No	No
4251	Yes	Yes	Yes	No	No	**4274**	Yes	Yes	Yes	No	No
4252	Yes	Yes	Yes	No	No	**4275**	Yes	Yes	Yes	No	No
4253	Yes	Yes	Yes	No	No	**6102**	No	No	No	No	No

* – MIX Baseboard Models 4284 and 4285 do not support nested installation

** – Model 4255, Option 001, which features shrouded, latching connectors, will not nest on a Model 4283 baseboard

† – The ECL Input versions of these devices connect to VME, and cannot be nested on any baseboard

Regardless of the assembly technique selected, any MIX stack may consist of a baseboard with one, two, or three expansion modules installed upon it. The expansion modules are designed such that, when installed, the component side of the module faces the compo–nent side of the Baseboard.

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1.7 MIX Module Stack Assembly Components

The following subsections describe the mechanical components used to build a MIX stack. Figures 1–1, 1–2, and 1–3, on this page and the next, present pictures of these components. Figure 1–4, on the page after next, shows how these components are used in the assembly of a MIX stack.

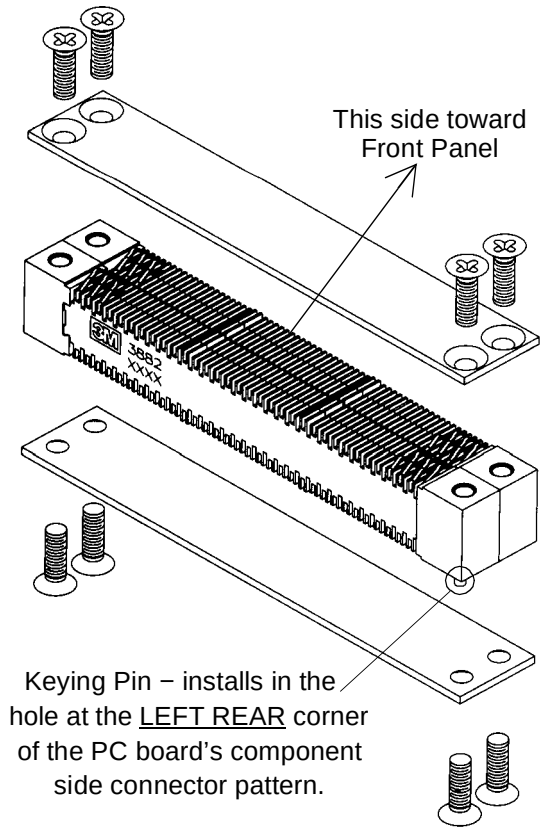


Figure 1–1: MIX Baseboard Connector with Stiffeners and Flathead Screws
Viewed from rear of Baseboard

Manufactured by 3M Electronic Products Division as Part Number X3882–1000, which includes one baseboard connector, two stiffeners and eight screws. This kit is shipped with each Pentek MIX baseboard
Reproduced with permission of 3M.

1.7.1 MIX Baseboard Connector

The MIX baseboard connector attaches a MIX expansion module to a MIX baseboard. The MIX base–board connector (see Figure 1–1, left) is a surface mount bridge between the MIX contact pattern on the base–board and the matching contact pat–tern on an expansion module. The baseboard connector is 0.476" tall and has 130 gold–plated spring con–tacts on both top and bottom sur–faces. It also features a keying pin, that fits into a keying hole on the baseboard. Pentek applies bright, orange labels to all MIX connectors, showing the "UP" side of the con–nector (i. e., toward the next module position) and the side of the connec–tor that faces the front panels.

1.7.2 MIX Stiffener

The MIX stiffener maintains contact pressure between the MIX baseboard connector and the MIX baseboard. Uninstalled, the MIX stiffener is slightly curved and features an insu–lating polyester film on the surface that touches the MIX contact pattern. The MIX stiffener attaches to the MIX baseboard connector via four flathead screws which pass through the MIX baseboard and into threaded inserts in the MIX baseboard con–nector. Figure 1–1, left, also shows the top and bottom stiffeners and the flathead screws.

When tightening these flathead screws, the torque should not exceed 2 in–lbs or there is a possibility of damaging the threads in the MIX baseboard connector. Pentek offers a special torque driver specifically for tightening these flathead screws (Pentek Model # 2030).

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1.7 MIX Module Stack Assembly Components (continued)

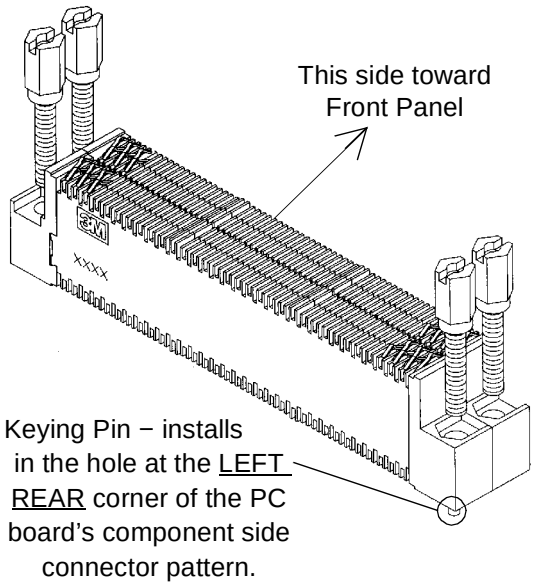


Figure 1−2: MIX Stacking Connector with Jackscrews
Viewed from rear of PC Board
Manufactured by 3M Electronic Products Division as Part Number X3884−1000, which includes one stacking connector and four jack screws. This kit is shipped with each expansion module.
Reproduced with permission of 3M.

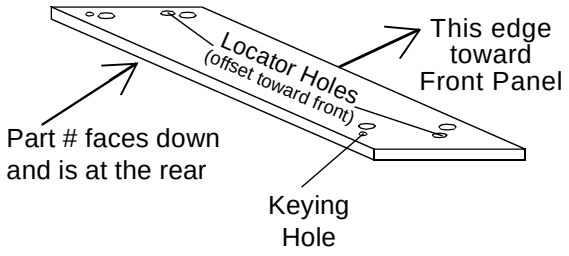


Figure 1−3: MIX Spacer Board
Viewed from rear of PC Board
Manufactured by Tektronix. The 'MIX' spacer board is shipped with every Pentek MIX baseboard.

1.7.3 MIX Stacking Connector

The MIX stacking connector is used when adding expansion modules to the MIX stack. The stacking connector is similar to the MIX baseboard connector described in Section 1.7.1, except that its height is 0.738" instead of 0.476" and the stacking connector features a step at each end to accommodate the jackscrews (described in Section 1.7.5. below). The stacking connector is shown in Figure 1−2, left.

1.7.4 MIX Spacer Board

In situations where the first MIX expansion module cannot (or will not) be nested on the baseboard (see Table 1−1, page before last), a MIX spacer board (see Figure 1−3, below left) must be installed between the MIX baseboard connector and the MIX stacking connector. A MIX spacer board is supplied with every Model 4283 and Model 4284 baseboard, and with the non−nestable MIX modules.

1.7.5 MIX Jackscrews

Each stacking connector attaches to the MIX connector below it via MIX jackscrews (see Figure 1−2, above left). The jackscrews pass through the MIX stacking connector, through the MIX expansion board, and into the threaded inserts (or other jackscrews) in the MIX connector below. Each jackscrew has a threaded opening in the head to accept jackscrews from additional MIX components above it. Pentek offers a special torque driver specifically for tightening the MIX jackscrews (Pentek Model # 2031).

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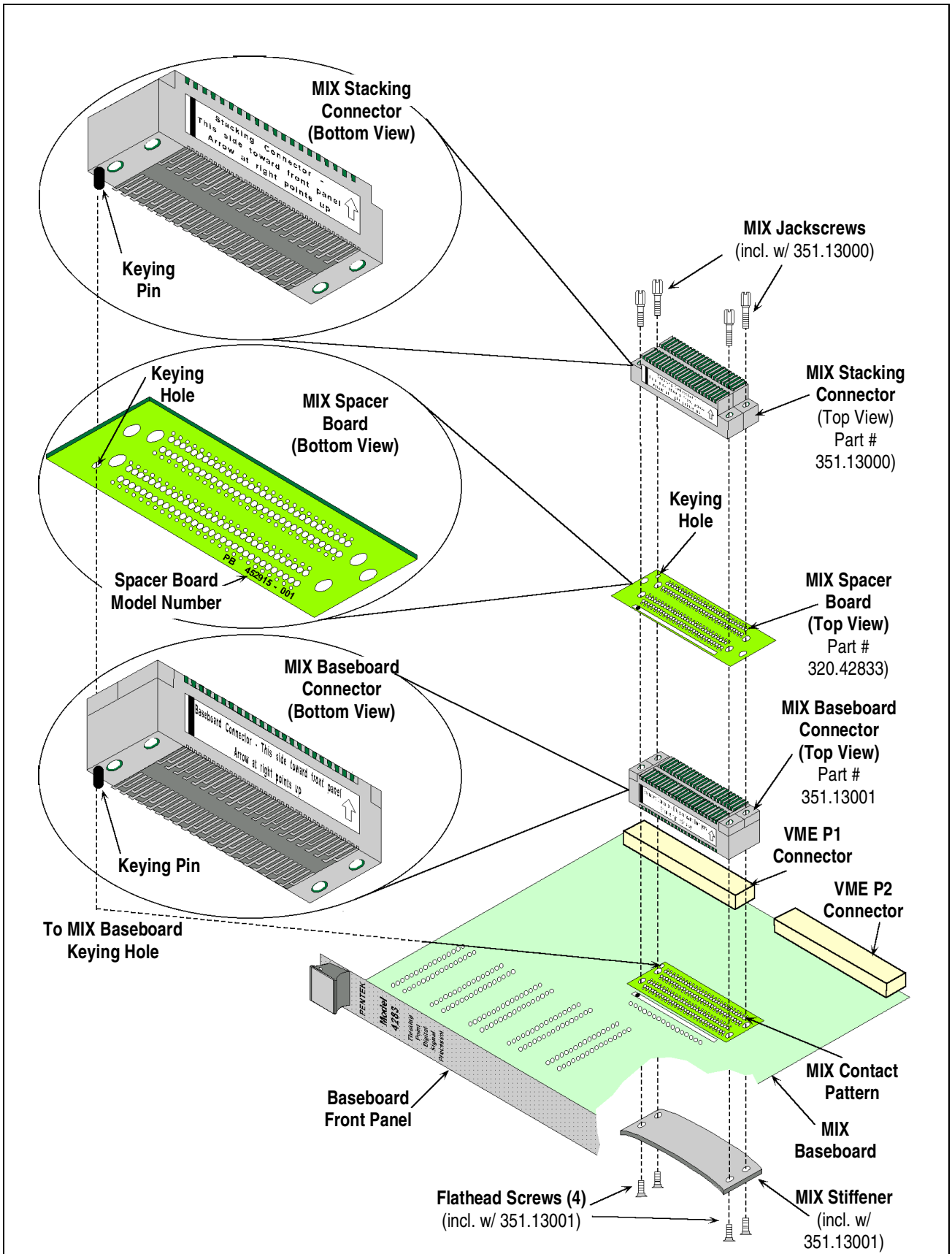


Figure 1–4: MIX Module Stack Component Assembly

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1.8 Non–Nested MIX Stack Assembly

While performing these assembly procedures, refer to Figures 1–4, 1–5, and 1–6, on pages 12, 15, and 17, respectively. Expansion module positions are referred to as "stack position 0" for the first module (the module mounted ***closest to the baseboard***), "stack position 1" for the second module, and "stack position 2" for the third module.



Assemble all MIX components in a static controlled environment!

Improper alignment of the MIX components WILL cause failure of the MIX interface and very likely damage the boards!

Turn off all power to the card cage before inserting or removing any board(s)!

1) Place a MIX baseboard connector on top of the baseboard's MIX contact pattern. Verify that the black stripes on both orange labels are aligned, and that the baseboard connector's keying pin is seated in the keying hole of the baseboard's contact pattern.

2) Place the insulated (shiny) side of a MIX stiffener against the **BOTTOM** of the baseboard's MIX contact pattern.

3) Insert, but ***do not fully tighten***, four flathead screws through the MIX stiffener, through the baseboard, and begin threading them into the baseboard connector.

4) Tighten the flathead screws ***slowly*** and ***evenly***, one turn at a time for each screw in sequence, following the pattern shown in Figure 1–5A, to draw the baseboard connector against the baseboard's MIX contact pattern.

   NOTE: Do not torque the flathead screws over 2 in–lbs (Pentek Model #2030 Torque Driver may be used).

5) Place a MIX spacer board on top of the MIX baseboard connector such that the black stripes on all three orange labels are aligned.

6) Place a MIX stacking connector over the MIX spacer board such that the black stripes on all four orange labels are aligned. Verify that the stacking connector's keying pin seats properly in the spacer board's keying hole.

7) Insert, but ***do not fully tighten***, four jackscrews through the stacking connector, through the spacer board, and begin threading them into the baseboard connector.

8) Tighten the jackscrews ***slowly*** and ***evenly***, one turn at a time for each screw in sequence, following the pattern shown in Figure 1–5A, to draw the stacking connector against the spacer board's MIX contact pattern.

   NOTE: Do not torque the jackscrews over 5 in–lbs (Pentek Model #2031 Torque Driver may be used).

9) Place the ***first*** expansion module over the stacking connector, with the component side facing ***DOWN***. ***If this installation requires only one expansion module, proceed to*** Step 18 (see page after next).

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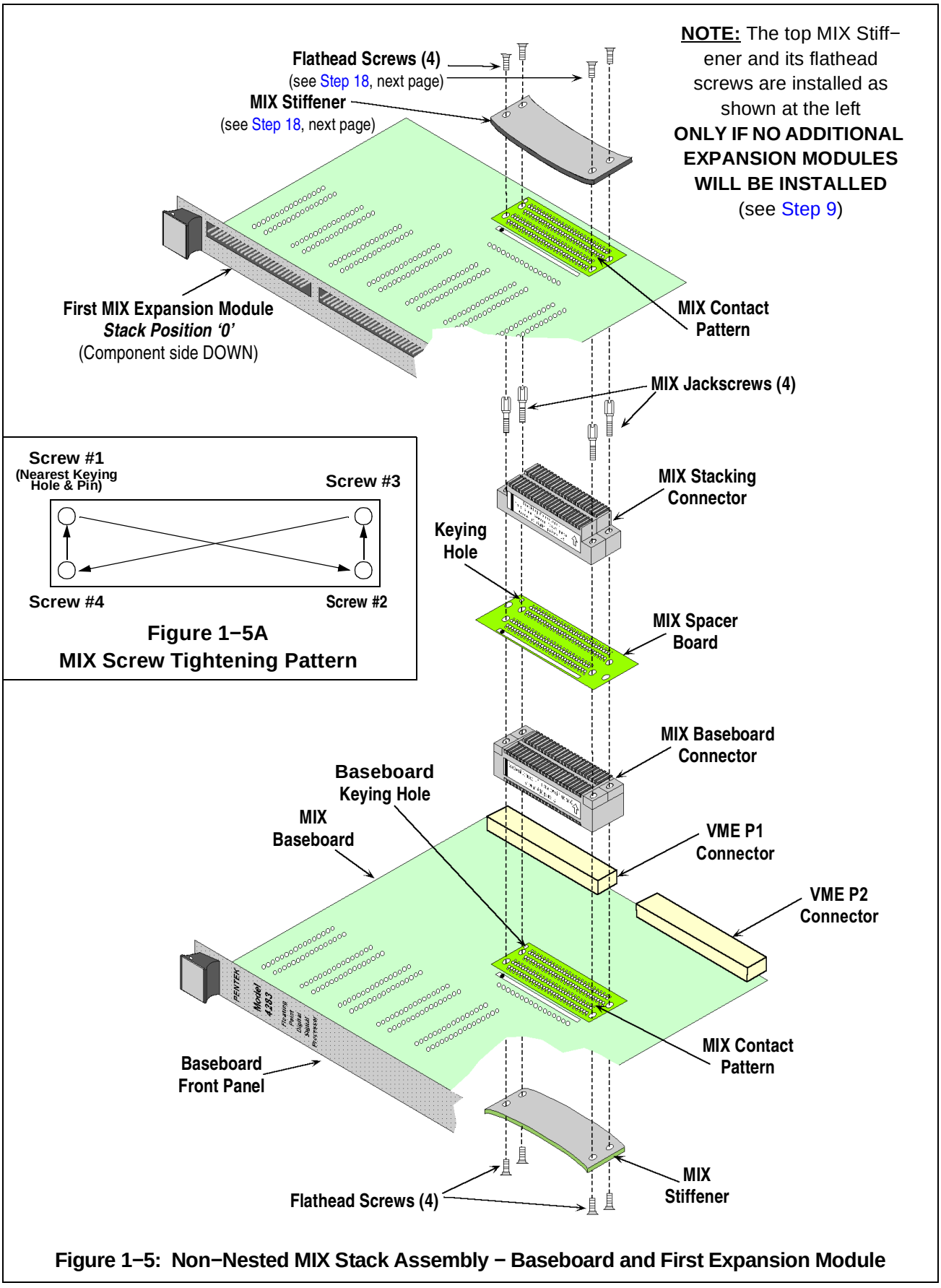


Figure 1−5A
MIX Screw Tightening Pattern

Figure 1−5: Non−Nested MIX Stack Assembly − Baseboard and First Expansion Module

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1.8 Non–Nested MIX Stack Assembly (continued)

10) Place another stacking connector over the MIX contact pattern on the TOP of the first expansion module (see Figure 1–6, on the next page). Verify that the black stripes on all orange labels are aligned, and that the stacking connector's keying pin seats properly in the expansion module's keying hole.

11) Insert, but ***do not fully tighten***, four jackscrews through the stacking connector, through the first expansion module, and begin threading them into the stacking connector below the expansion module.

12) Tighten the jackscrews ***slowly*** and ***evenly***, one turn at a time for each screw in sequence, following the pattern shown in Figure 1–5A (on the previous page), to draw the stacking connector against the expansion module.

    NOTE: Do not torque the jackscrews over 5 in–lbs (Pentek Model #2031 Torque Driver may be used).

13) Place the ***second*** expansion module over the stacking connector with the component side facing ***DOWN***. ***If this installation requires only two expansion modules, proceed to*** Step 18, below.

14) Place another stacking connector over the MIX contact pattern on the TOP of the ***second*** expansion module (see Figure 1–6, on the next page). Verify that the black stripes on all orange labels are aligned, and that the stacking connector's keying pin seats properly in the ***second*** expansion module's keying hole.

15) Insert, but ***do not fully tighten***, four jackscrews through the ***third*** stacking connector, through the ***second*** MIX expansion module, and begin threading them into the ***second*** stacking connector.

16) Tighten the jackscrews ***slowly*** and ***evenly***, one turn at a time for each screw in sequence, following the pattern shown in Figure 1–5A (on the previous page), to draw the stacking connector against the expansion module.

    NOTE: Do not torque the jackscrews over 5 in–lbs (Pentek Model #2031 Torque Driver may be used).

17) Place the ***third*** expansion module over the stacking connector, with the component side facing ***DOWN***.

18) Place the insulated (shiny) side of the MIX stiffener against the MIX contact pattern on the TOP of the ***last*** expansion module.

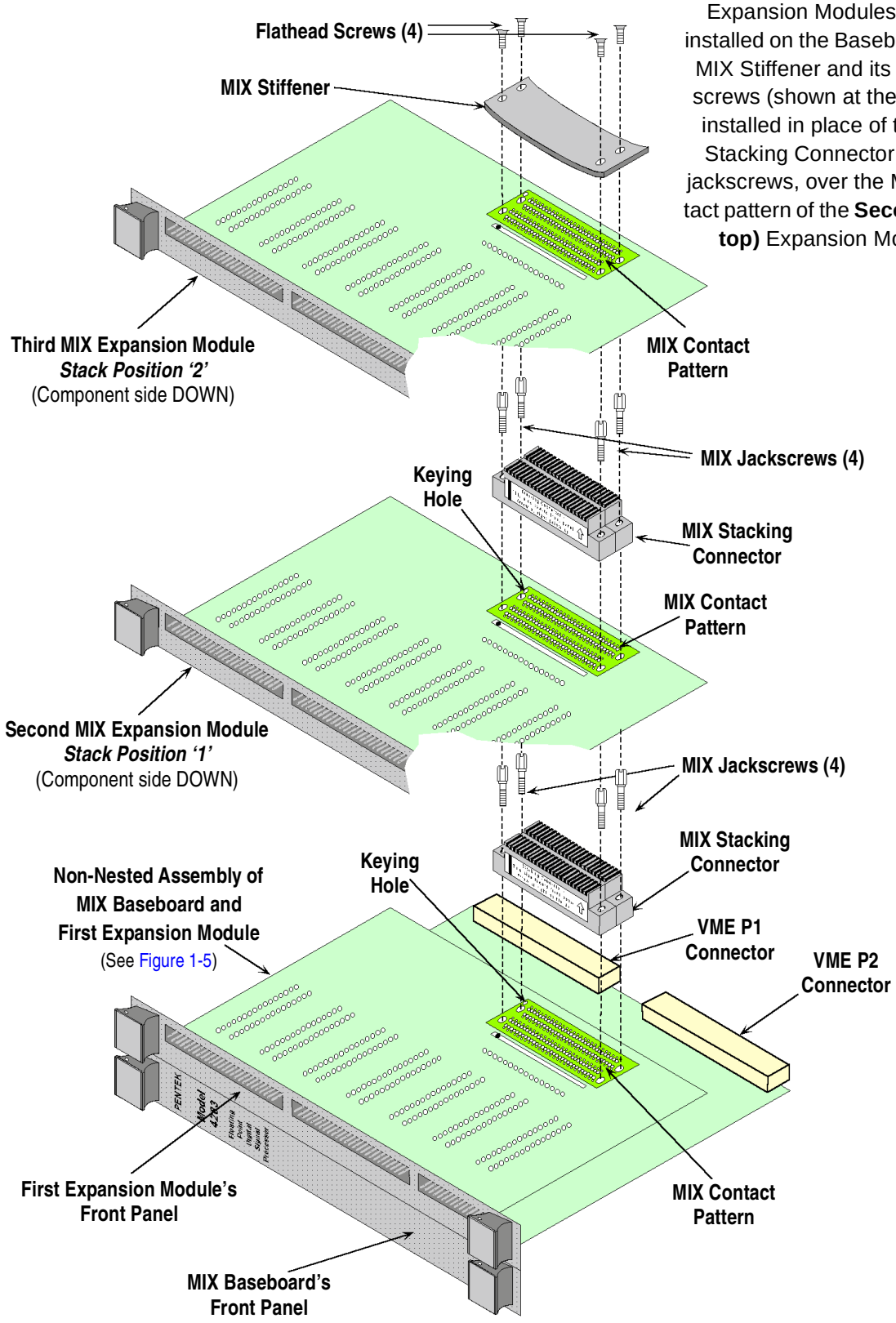
19) Insert, but ***do not fully tighten***, four flathead screws through the MIX stiffener, through the ***last*** expansion module, and begin threading them into the stacking connector below.

20) Tighten the flathead screws ***slowly*** and ***evenly***, one turn at a time for each screw in sequence, following the pattern shown in Figure 1–5A (on the previous page) to draw the stacking connector against the ***last*** expansion module's MIX contact pattern.

    NOTE: Do not torque the flathead screws over 2 in–lbs (Pentek Model #2030 Torque Driver may be used).

This completes the assembly procedure for a non–nested MIX stack.

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NOTE: If ONLY TWO MIX Expansion Modules will be installed on the Baseboard, the MIX Stiffener and its flathead screws (shown at the left) are installed in place of the MIX Stacking Connector and its jackscrews, over the MIX contact pattern of the **Second (i.e., top)** Expansion Module.

Figure 1−6: Non−Nested MIX Stack Assembly − Adding Expansion Modules

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1.9 Nested MIX Stack Assembly

In Nested configurations, the MIX baseboard and the first MIX expansion module occupy the same VMEbus card cage slot. Expansion module positions are still referred to as "stack position 0" for the first module (the module mounted ***closest to the baseboard***), "stack position 1" for the second module, and "stack position 2" for the third module. While performing these assembly procedures, please refer to Figures 1–4, 1–7, and 1–8, on pages 12, 19 and 21, respectively.

Assemble all MIX components in a static controlled environment!

Improper alignment of the MIX components *WILL* cause failure of the MIX interface and very likely damage the boards!

Turn off all power to the card cage before inserting or removing any

1) Place a MIX baseboard connector on top of the baseboard's MIX contact pattern. Verify that the black stripes on both orange labels are aligned, and that the baseboard connector's keying pin is seated in the keying hole of the baseboard's contact pattern.

2) Place the insulated (shiny) side of a MIX stiffener against the **BOTTOM** of the baseboard's MIX contact pattern.

3) Insert, but ***do not fully tighten***, four flathead screws through the MIX stiffener, through the baseboard, and begin threading them into the baseboard connector.

4) Tighten the flathead screws ***slowly*** and ***evenly***, one turn at a time for each screw in sequence, following the pattern shown in Figure 1–7A (at the bottom of this page), to draw the baseboard connector against the baseboard's MIX contact pattern.

   NOTE: Do not torque the flathead screws over 2 in–lbs (Pentek Model #2030 Torque Driver may be used).

5) Place the first expansion module on the stacking connector, with the component side facing ***DOWN***. ***If this installation requires only one expansion module, proceed to*** Step 14, on the next page.

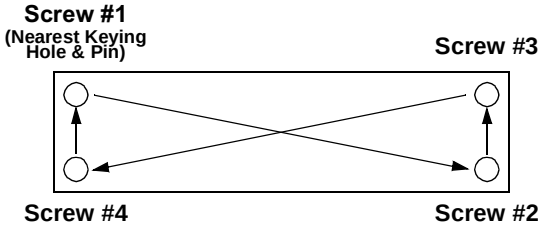


Figure 1–7A
MIX Screw Tightening Pattern

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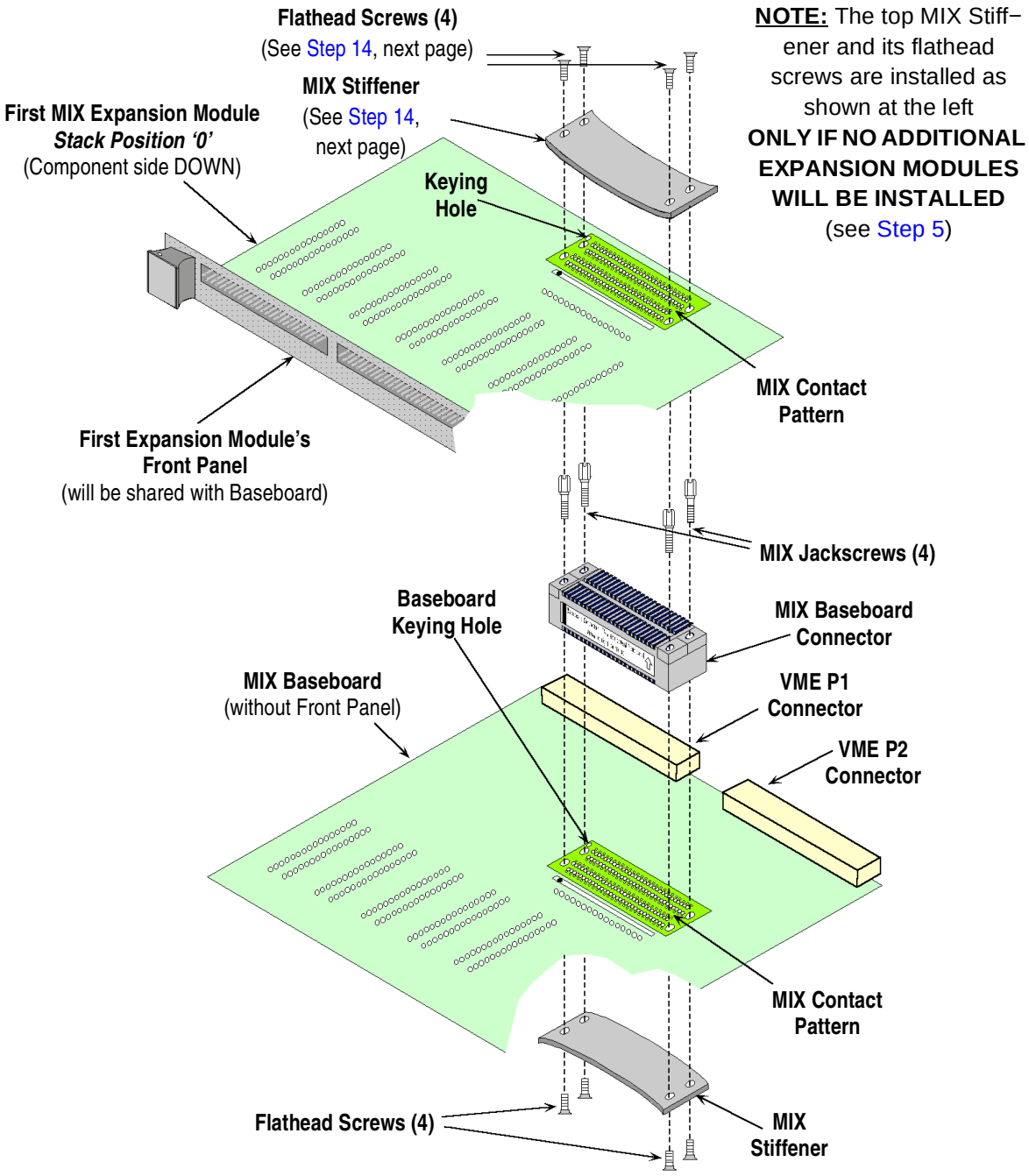


Figure 1−7: Nested MIX Stack Assembly − Baseboard and One Expansion Module

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1.9 Nested MIX Stack Assembly (continued)

6) Place a stacking connector over the MIX contact pattern on the TOP of the ***first*** expansion module (see Figure 1–8, on the next page). Verify that the black stripes on all orange labels are aligned, and that the stacking connector's keying pin seats properly in the expansion module's keying hole.

7) Insert, but ***do not fully tighten***, four jackscrews through the stacking connector, through the ***first*** expansion module, and begin threading them into the baseboard connector below the expansion module.

8) Tighten the jackscrews ***slowly*** and ***evenly***, one turn at a time for each screw in sequence, following the pattern shown in Figure 1–7A (at the bottom of the page before last), to draw the stacking connector against the expansion module.

   NOTE: Do not torque the jackscrews over 5 in–lbs (Pentek Model #2031 Torque Driver may be used).

9) Place the second expansion module over the stacking connector with the component side facing DOWN. ***If this installation requires only two expansion modules, proceed to*** Step 14, below.

10) Place another stacking connector over the MIX contact pattern on the TOP of the ***second*** expansion module (see Figure 1–8, on the next page). Verify that the black stripes on all orange labels are aligned, and that the stacking connector's keying pin seats properly in the ***second*** expansion module's keying hole.

11) Insert, but ***do not fully tighten***, four jackscrews through the ***second*** stacking connector, through the ***second*** MIX expansion module, and begin threading them into the ***second*** stacking connector.

12) Tighten the jackscrews ***slowly*** and ***evenly***, one turn at a time for each screw in sequence, following the pattern shown in Figure 1–7A (at the bottom of the page before last), to draw the stacking connector against the expansion module.

    NOTE: Do not torque the jackscrews over 5 in–lbs (Pentek Model #2031 Torque Driver may be used).

13) Place the ***third*** expansion module over the stacking connector, with the component side facing ***DOWN***.

14) Place the insulated (shiny) side of the MIX stiffener against the MIX contact pattern on the TOP of the ***last*** expansion module.

15) Insert, but ***do not fully tighten***, four flathead screws through the MIX stiffener, through the ***last*** expansion module, and begin threading them into the stacking connector below.

16) Tighten the flathead screws ***slowly*** and ***evenly***, one turn at a time for each screw in sequence, following the pattern shown in Figure 1–7A (on the page before last), to draw the stacking connector against the ***last*** expansion module's MIX contact pattern.

    NOTE: Do not torque the flathead screws over 2 in–lbs (Pentek Model #2030 Torque Driver can be used).

This completes the assembly procedure for a nested MIX stack.

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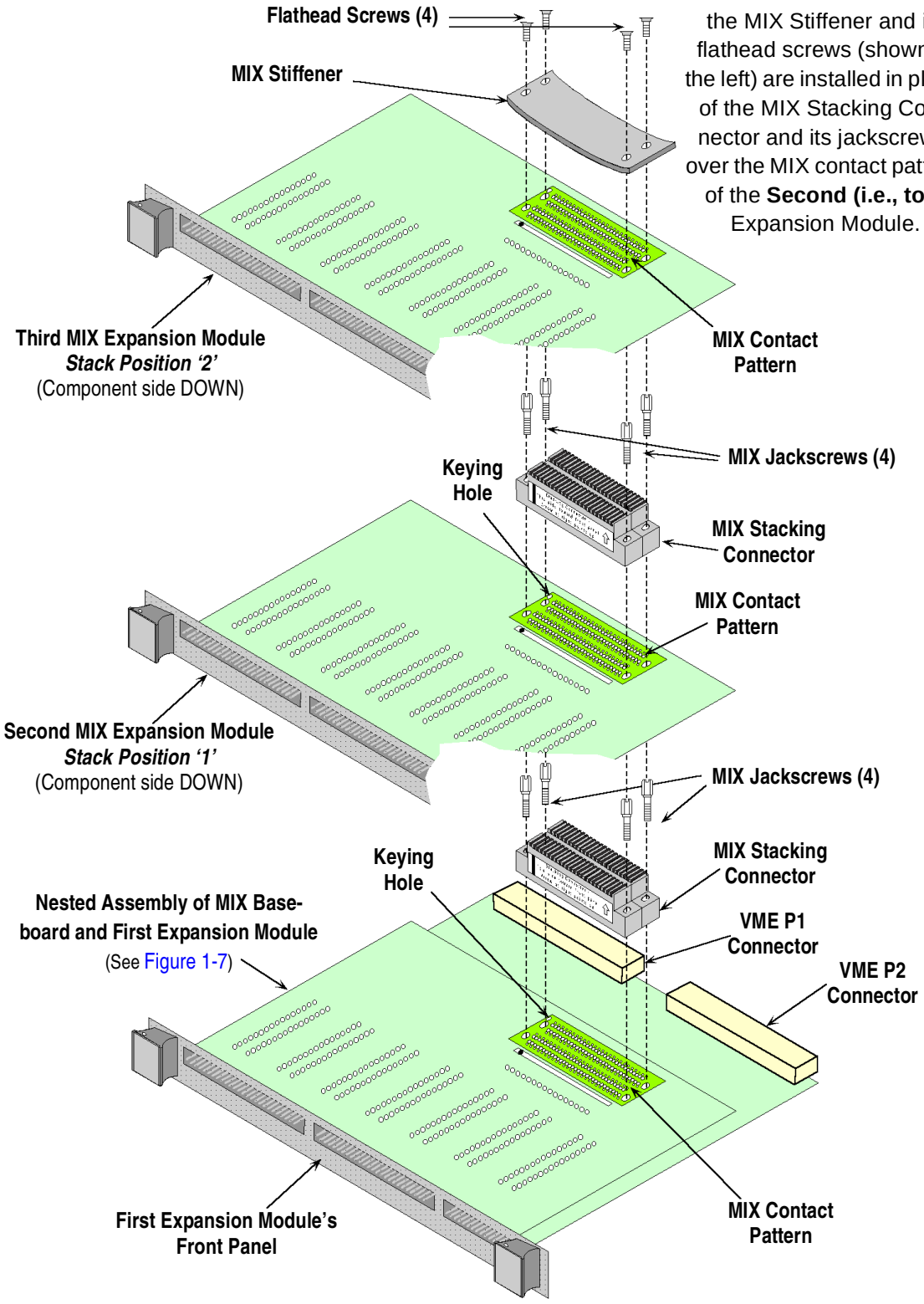


Figure 1−8: Nested MIX Stack Assembly − Adding Expansion Modules

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1.10 MIX Stack Disassembly

When disassembling a MIX stack, loosen all screws in the same manner in which they were tightened (***slowly*** and ***evenly***, one turn at a time for each screw in sequence, following the pattern shown in Figure 1–7A, at the bottom of page 18). **This is of particular importance when loosening the flathead screws,** which are stressed by the spring tension of the MIX stiffener. **Failure to observe this precaution may result in property damage or personal injury, caused by flying screws.**

1.11 Installing Ejector Handles on the MIX Module Front Panel

VME card cage ejector handles should be installed on the front panel of any assembly that engages the VMEbus backplane. For nested installations, where the baseboard's front panel is removed, ejector handles must be installed on the front panel of the nested MIX Module. The installation procedure is described below.

Each Ejector Handle and Panel Mounting Bracket assembly mounts to the front panel with one Philips–head screw and nut per handle. The Philips–head screws thread into hex nuts that are secured in recessed holes within both the top and bottom Ejector Handle and Panel Mounting Brackets. The assembly is illustrated in Figure 1–9, on the next page.

1) The Ejector Handles will be mounted on posts on the Panel Mounting Brackets at the top and bottom of the circuit board. These brackets are attached to the front panel with Philips–head screws at the top (and bottom) of the panel, located directly below (and above) the captive card–cage retraining screws. These Philips–head screws are threaded into hex nuts which are recessed within the body of the Panel Mounting Brackets. Locate and remove these two Philips screws. Be sure to retain the nuts, as they will be required to re–attach the mounting brackets.

2) Locate the Ejector Mounting Post on the panel bracket (see Figure 1–9, Detail B), which is found on the component side of the MIX module. A slotted–head screw is installed in each post. These screws need not be removed.

3) The top and bottom ejector handles differ from one another in the offset of the arm which will pass through the front panel. Holding the handle with the Cover Plate facing you (i. e., with the arm away from you) the top handle will have this arm offset to the left of center when the arm points *down*. The bottom handle will have the arm offset to the left of center when the arm points *up* (see Figure 1–9A, at the top of the next page). Identify each handle and mount it in its proper position. It may be necessary to gently flex the circuit board to allow the hole in the handle's mounting arm to engage the bracket's mounting post.

4) Slide the Cover Plates out of the Ejector Handles. This will reveal holes in the backs of the handles (again, see Figure 1–9A), through which you can replace the top and bottom front panel retaining screws that were removed in Step 1.

5) Slide the Cover Plates back into the Ejector Handles (see Figure 1–9, Detail A)

This completes the Ejector Handle mounting procedure.

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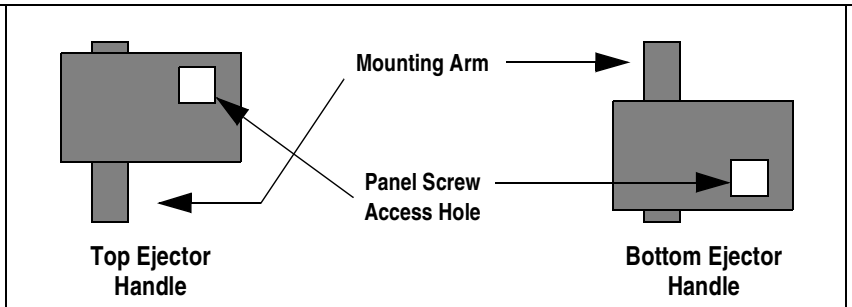


Figure 1–9A
VME Card Cage Ejector Handles
(front view, shown with Cover Plates Removed)

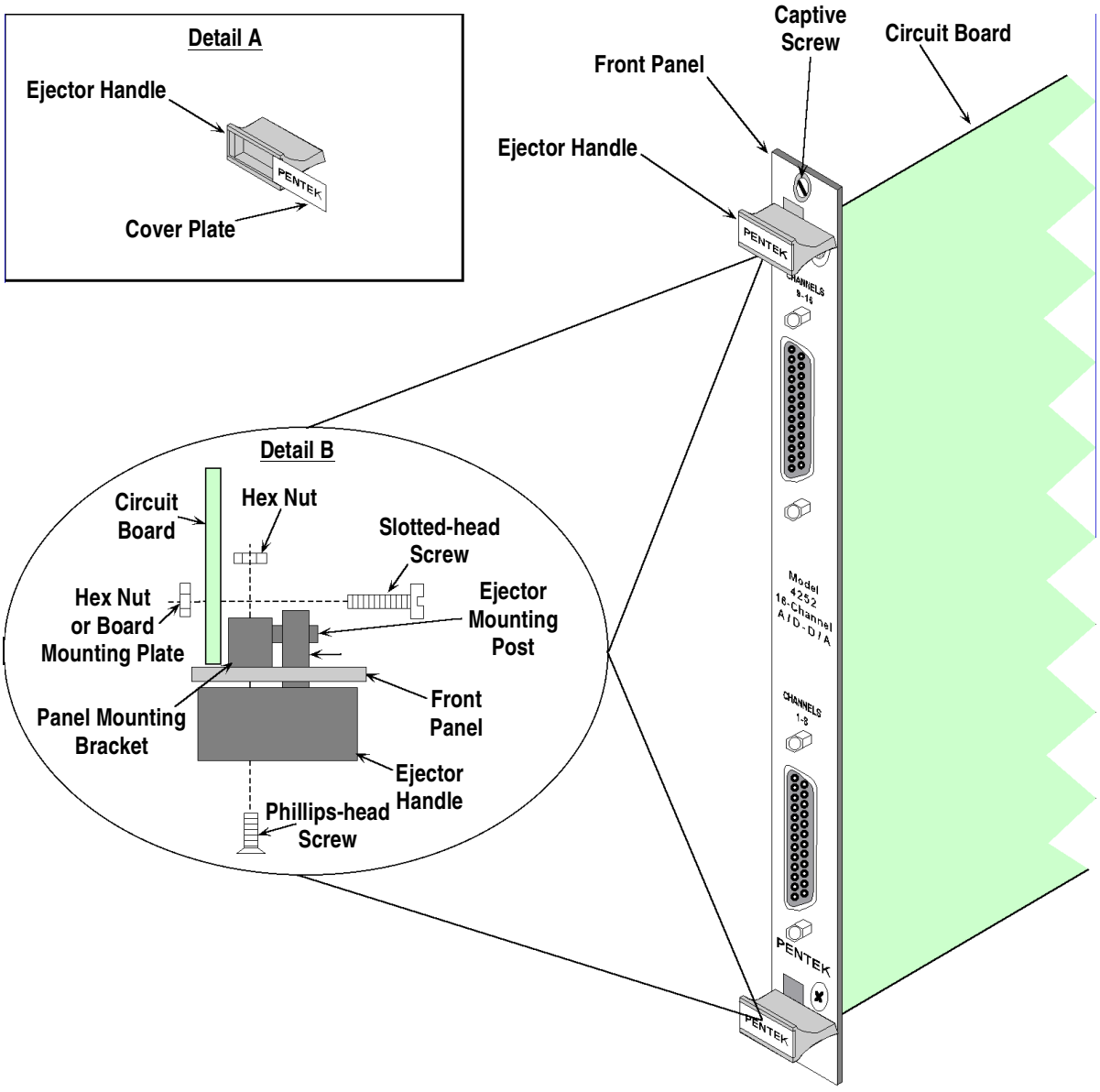


Figure 1–9: Installing Ejector Handles on MIX Module Front Panels

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1.12 Linking MIX Module Front Panels and Ejector Handles

After your MIX stack has been assembled according to the instructions above, the front panels of the modules 'float' until they are secured by their captive screws to the VMEbus card cage. Also, the ejector handle on the Baseboard (or the module nested on the Base–board) is the only mechanism for removing the MIX stack from the card cage.

In order to provide a more secure mechanical assembly when the stack is removed from the card cage, a pair of 'panel links' is provided with your Baseboard. These links may be used to tie all front panels in the stack together. Use of these links is optional, but strongly recommended if the stack will be removed from the card cage frequently.

Additionally, card cage ejector handles may be installed on all MIX module front panels. These ejectors must be physically secured to the ejectors on the Baseboard front panel, to assure equal pressure is applied along the card cage ejector plate during the ejection pro–cess. Installation of ejectors on the module panels is especially recommended if your stack includes any full–depth modules that engage the VME backplane, such as the Model 4270, the Model 6102, or the Models 4271 or 4272, with Option 012.

For the sturdiest configuration possible, the panel links and module ejector handles can be used together. This assembly method provides for both physical links between all module panels and improved ease of system ejection from the card cage. Procedures for the installation of the panel links and module ejector handle links are provided below. Note that, as a general rule, Pentek does not ship MIX modules with ejector handles installed, but the handles are included with the module. The installation procedure for the ejector handles can be found in Section 1.11, on page 22 of this manual. If you wish to use both panel and ejector handle links, the ejector handles should be installed on the MIX modules **BEFORE** the panel links.

1.12.1 Panel Links

The panel links are machined aluminum bars that may be snapped off to accommodate 2, 3 or 4 front panels in the MIX stack. Two links are required for each stack assembly: one for the top of the panels and one for the bottom. The top and bottom links are symmetrical, but not identical. The silver link bracket is used at the top of the panel, and the gold link bracket is used at the bottom. The links are installed behind the front panels, using the screws that hold the plastic Panel Mounting Brackets to the front panel.

Configuring the links for the number of modules in the stack is achieved by snapping the links at the molded indentations, as shown in Figure 1–10, on the next page. Grasp the link on either side of the indentation with two pliers and bend the link to snap it to length.

To use the links to join the front panels of the MIX modules, first assemble the MIX stack, using the MIX connectors as described in the assembly instructions in the preceding sections of this manual. If ejector handles will be used on the modules, install them next, as described in Section 1.11 of this manual. Then, follow the steps listed on the next page.

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1.12 Linking MIX Module Front Panels and Ejector Handles (continued)

1.12.1 Panel Links (continued)

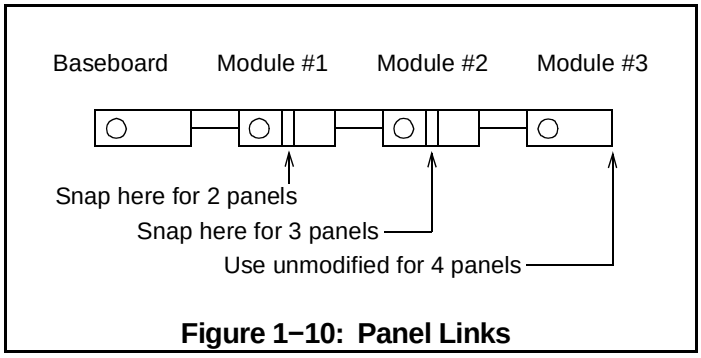


Figure 1−10: Panel Links

1) Remove the two cover plates from the ejector handles of the MIX baseboard by sliding them sideways. Lay the MIX stack flat on a work surface with the baseboard on the bottom.

2) Insert a #0 Philips screwdriver through the hollow center of the baseboard ejectors and loosen the 10 mm long, raised flat−head Philips screws (2.5 mm diam. x 0.45 pitch), located directly behind the two ejectors. Remove the nuts from the plastic brackets behind the front panel. Save these nuts for possible future use. (We suggest that you use the zip lock bag that the links came in.)

3) Loosen these same screws on each of the MIX modules and remove the nuts from their brackets.

4) Place the links behind the top and bottom plastic brackets such that the holes in the links are aligned with the screw holes on the appropriate panels, as indicated by the caption above the link drawing in Figure 1−10, above. Again, use the silver bracket at the tops of the panels, and the gold bracket at the bottoms.

5) Gradually tighten all screws in rotation, a few turns at a time, making sure that the panels are aligned at the top and bottom.

6) If you will **NOT** be using module ejectors, replace the two cover plates in the baseboard ejectors. The MIX stack may now be installed in the card cage, without the module ejectors.

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1.12 Linking MIX Module Front Panels and Ejector Handles (continued)

1.12.2 Linked Module Ejector Handles

As mentioned in the introductory remarks of this section, ejector handles installed on MIX module front panels must be physically coupled to the ejector handles on the MIX Baseboard. Beginning around October 1994, all VMEbus ejector handles shipped by Pentek have had small holes drilled in their sides. Ejectors on each unit may be coupled to those on adjacent units by passing rods through these holes. If you have an older MIX Baseboard or module and wish to use linked ejectors, contact the factory at the phone number shown on this manual's title page, and a set of modified ejector handles will be sent to you.

The parts listed below are supplied with each Pentek VMEbus MIX Baseboard to support this feature. Figure 1–11, at the top of the next page, will help you identify each part.

Quantity	Items	Pentek Part Number
2	ID Plate: VME 2 Slots w/ Logo	305.00031
2	ID Plate: VME 3 Slots w/ Logo	305.00033
2	ID Plate: VME 4 Slots w/ Logo	305.00035
2	Metal Bar Shaft: VME Ejector 2 Slots	384.00020
2	Metal Bar Shaft: VME Ejector 3 Slots	384.00030
2	Metal Bar Shaft: VME Ejector 4 Slots	384.00040
6	Retaining Ring: (E) 0.093 Shaft	388.20000
1	Full Size Bottom Panel Link (Gold)	303.00145
1	Full Size Top Panel Link (Silver)	303.00143

The assembly procedures beginning below assume that you have already installed a pair of handles on each module, the MIX module stack is fully assembled, and the ID (or blank aluminum) face plates are NOT inserted in the ejector handles.

1) Select a pair of shafts, based on the number of VME card cage slots your MIX stack will occupy.

2) Align the top and bottom rows of Ejector Handles and insert a shaft through each row. Shafts should be inserted such that the ends with two inscribed slots rest inside the Ejector Handles of the Baseboard (or the module nested on the Baseboard).

3) Install two pairs of retaining 'E' rings on the Shafts inside the Baseboard Ejector Handles. One ring is inserted in each of the two slots on the shafts in the top and bottom Ejector Handles. These rings prevent the shafts from sliding by anchoring the shafts inside the Ejector Handles of the Baseboard (or nested module). Figure 1–12, page after next, shows an installed shaft with the retaining rings properly positioned.

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1.12 Linking MIX Module Front Panels and Ejector Handles (continued)

1.12.2 Linked Module Ejector Handles (continued)

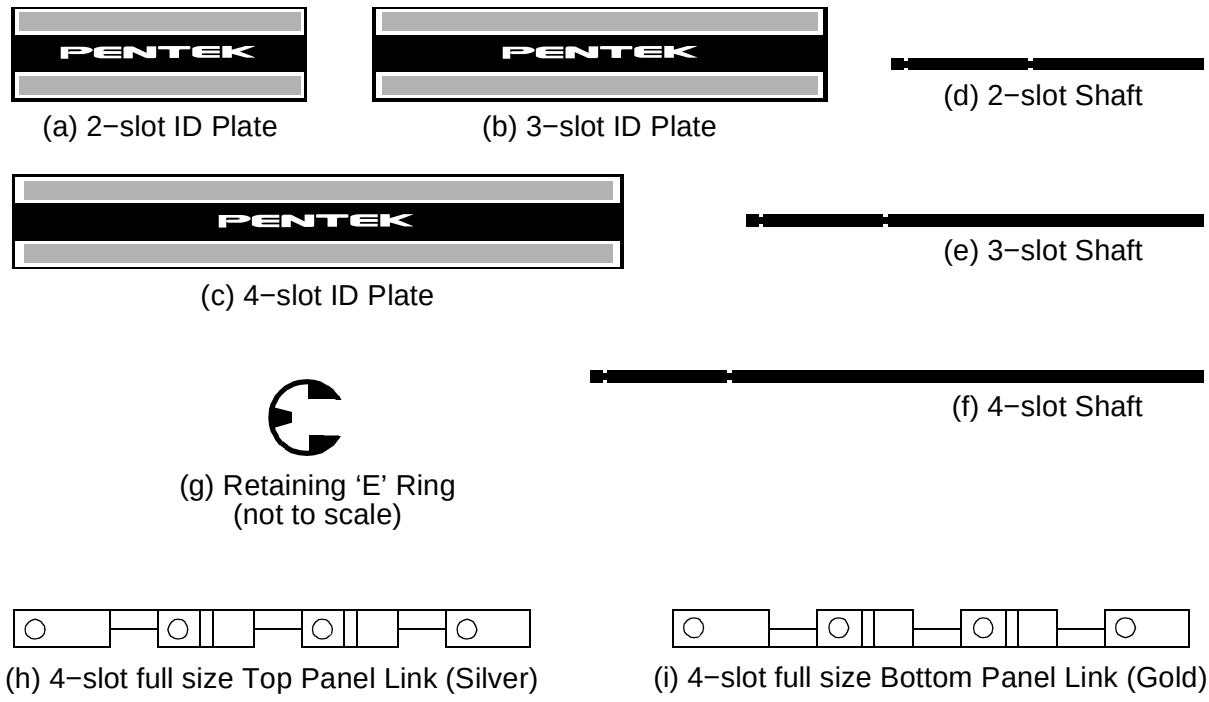


Figure 1−11: Linked Module Ejector Parts

4) Select a pair of ID plates (again, based on the number of VME card cage slots your MIX stack will occupy), and install one plate in each row of ejector handles. To install the plates, you may either slide them sideways through all the handles in the row, or position them over the handles and snap them in.

5) The MIX stack may now be installed in the card cage.

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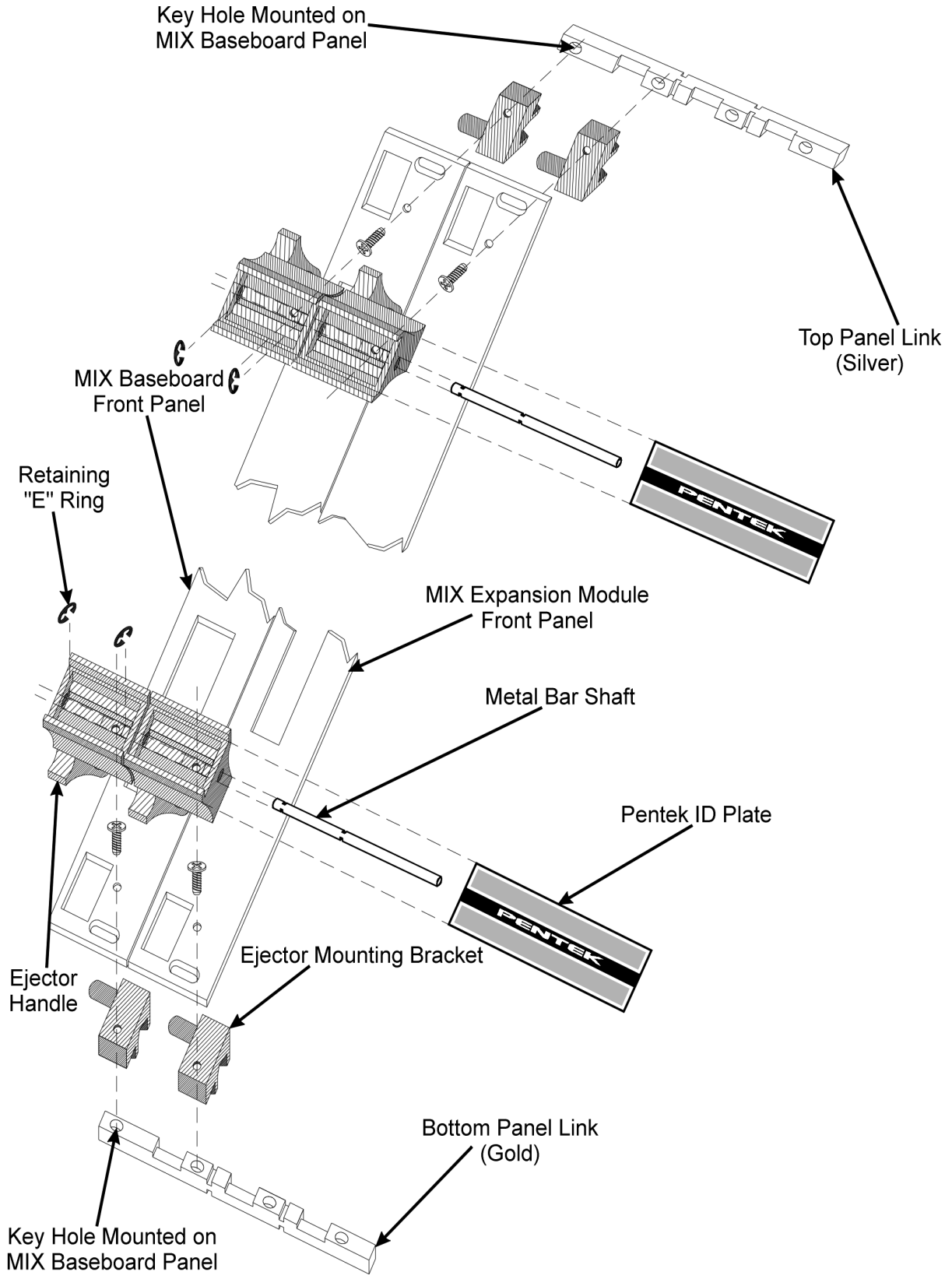


Figure 1−12: MIX Panels with Linked Module Ejectors

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1.13 Installing the Assembly into the VMEbus Card Cage

Once the assembly of the MIX baseboard and expansion module(s) has been completed, the assembly can be installed in the card cage.

If linked module ejector handles have not been installed, and the MIX baseboard will be the only portion of the assembly which actually engages in the back plane, then **use only the front panel ejector/handles of the MIX baseboard** (or nested MIX module) – not those of the expansion modules, when inserting and removing the assembly. After inserting the assembly, push in on the top and bottom ejector/handles of the MIX base–board or nested module ***only*** to fully seat the connectors in the back plane.

If linked ejectors were installed, and if there is more than one unit in the assembly that engages the backplane, apply equal pressure along the length of the linked ejector han–dles to seat all units in the VMEbus backplane connectors.

Once the assembly is seated, the captive panels screws at the top and bottom of each front panel should be screwed into the top and bottom rails of the card cage.

When removing the assembly, first loosen **ALL** captive screws on the top and bottom of each front panel. **Attempting to remove the MIX stack while any module is still secured to the cage will cause damage to the MIX connectors.** Then, push the ejector handles of the assembly away from the center of the panel to eject the assembly from the cage. Once disengaged, pull outward on the ejector handles to remove the assembly.

CAUTION!!

TURN OFF ALL POWER TO THE CARD CAGE
BEFORE INSERTING OR REMOVING ANY BOARD

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Chapter 2: MIX Baseboard Tutorial

2.1 Introduction

Since any of Pentek's VMEbus MIX modules can be used with any of Pentek's VMEbus MIX baseboards, the module is addressed and controlled in different ways, depending upon the characteristics of the MIX baseboard. Below are some characteristics of each of Pentek's currently–offered MIX baseboards. Understanding how each baseboard functions will lead to a better understanding of how to program the MIX module for maximum performance.

Table 2–1, below, shows which interfaces each of Pentek's MIX baseboards supports:

Table 2–1: Pentek MIX Baseboard Features

Pentek Model Number	VME Master Interface	VME Mapped Slave Resources		VSB Master Interface	Supports MIX Masters	On Board Processor(s)
		MIXbus	RAM			
4200(A)	Yes	Yes	4 MB SRAM	Yes	Yes	68030
4201(A)	Yes	Yes	4 MB SRAM	No	Yes	68030
4202	No	Yes	None	No	Yes	none
4283	Yes	No	8 MB DRAM	No	No	'C30
4284	Yes	No	16 MB DRAM	No	Yes	'C40
*4285	Yes	Yes	3 MB SRAM	Option 032**	Yes	8 x C'40

* - The Model 4285 becomes a MIX Baseboard when equipped with Option 031
** - Options 031 and 032 for the Model 4285 are mutually exclusive (i. e., VSB and MIX interfaces cannot be combined on the Model 4285).

The table summarizes many of the important features which are analyzed below:

VME Master Interface: Note that all MIX baseboards except for the 4202 have VME master interfaces. On the 4283, 4284 and 4285, this VME master interface is mapped into the address space of a DSP processor chip. The Model 4285 features a VME64 master/slave interface, as well as A32/D32 VMEbus master capabilities. On the 4200 and 4201, the VME master interface is mapped into the address space of the 68030 processor and is also mapped into the MIX bus address space for access by any MIX bus master. See Section 2.2.

VME Mapped Slave Resources – MIXbus: This column shows whether or not the MIX–bus is addressable from the VMEbus as a slave memory region. Note that this is possible for the 4200, 4201, 4202 and 4285, baseboards but not for the 4283 and 4284 baseboards. In these products, the MIX bus is addressable only from the DSP processor.

VME Mapped Slave Resources – RAM: This column shows the size and type of RAM addressable from the VMEbus as a slave memory region. The 4283 and 4284 present DRAM to the VMEbus while the 4200, 4201 and 4285 present SRAM to the VMEbus. The 4202 contains no RAM.

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2.1 Introduction (continued)

VSB Master Interface: The Model 4200 has a VSB master interface which is mapped into the address space of the 68030 processor and is also mapped into the MIX bus address space for access by any MIX bus master. See Section 2.3. The Model 4285 can also support an optional VSB master interface, but it cannot simultaneously support VSB and MIX interface cards.

Supports MIX Masters: Some MIX modules, such as the 'C40 processor products, have the ability to master the MIX bus. This means that they can read or write to other MIX modules and possibly access some features on the baseboard. All of the MIX baseboards except for the Model 4283 support Upper MIX Bus Master (UMBM) transfers. See Section 2.4.

2.2 VMEbus Slave and Master Interfaces

There are two major categories of VMEbus interfaces: 'master' and 'slave'. A 'VMEbus master interface' allows a VME board to initiate read or write cycles with another VMEbus board. The important issue here is that the master device actively drives the control lines (data strobes, address strobes, etc.) on the bus during the memory cycle.

The board that responds to reads or writes by the master is called the 'slave'. The slave presents its memory or registers to the VMEbus as part of the VMEbus address space. Each slave should be assigned a separate region of address space, usually determined by on−board jumpers, so that each slave is separately addressable by any master device. This is done by the system integrator when he sets up the VME system.

A board can have both master and slave interfaces. A single board may have the ability to initiate memory cycles on the VMEbus (master capability), and also present memory or registers which are mapped into VMEbus address space (slave capability). It is actually quite common that a board with a master interface will also have a slave interface.

For example, the Model 4283 has a dual−port RAM addressable from the VMEbus as a slave memory resource. It also has a master interface which allows it to read any VMEbus slave device. These two features are quite separate and distinct sub−systems on the board.

On the other hand, the Model 4202 has only a slave interface, which maps the MIXbus onto the VMEbus. All of the memory resources and registers in every MIX module attached to the Model 4202 are thus directly addressable as slave memory on the VMEbus.

2.3 VSBus Slave and Master Interfaces

The VSBus is a sub−system bus which uses 64 lines on the VMEbus backplane which are 'reserved' in the VMEbus specification for other applications. It provides a secondary 32−bit data path for transfers between boards supporting this specification, and involves both 'master' and 'slave' interfaces similar to the VMEbus. VSB address and data are multiplexed over the same 32 lines: the address is sent out first and then multiple data transfers are performed to sequential addresses, making block transfers quite efficient.

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2.3 VSBus Slave and Master Interfaces (continued)

The Pentek Model 4200 includes a VSBbus master interface. This makes it ideal for applications such as delivering data from an A/D converter MIX module to a VSB slave destination such as a general purpose memory board. The Model 4285 can support either a MIX interface or a VSB interface, but cannot be configured to support both at once.

2.4 MIXbus Master Interface and MIXbus Slave Interfaces

Extending the discussion of VMEbus and VSBbus 'master' and 'slave' interfaces leads to a similar definition of those interfaces on the MIXbus. MIXbus master modules can initiate reads and write to other slave resources of the MIXbus. This can include other MIX modules, like A/D converters, and the shared memory of co−processor modules. The MIX baseboard is always capable of mastering the MIXbus.

Pentek's 'C40 co−processor MIX modules (the Models 4254, 4257 and 4270) can read input data by mastering data transfers from an A/D converter, for example. It can also read or write directly into the global SRAM of a neighboring 4254/57/70. Reading and writing to MIXbus resources is as simple as using the correct address since all MIX modules are mapped into a well−defined address space determined by the stacking position.

All but one of Pentek's MIX baseboards support the operation of master MIX modules − the Model 4283. It only permits the 'C30 on the baseboard to master the MIXbus. This means that all data transfers to and from MIX modules are mastered by the baseboard 'C30 and not by a MIX module. Nevertheless, the Model 4283, Pentek's first baseboard product, has supported thousands of powerful applications.

For all of Pentek's other MIX baseboards, a master MIX module like the Model 4257 can obtain mastership of the MIXbus. When a MIX master module is attached to the Model 4200 or Model 4201, the MIX mastering capability makes the module capable of performing its own VMEbus and (with the 4200) VSBus cycles. See Section 2.7 for more discussion.

2.5 Turning a MIX Module into a Slave VMEbus Board with the Model 4202

If your application needs the function of a MIX module in the form of a standard 6U VMEbus card with a simple slave interface, the Model 4202 is the answer. For example, a 32−channel A/D Converter MIX module like the 4248 can be made into a 32−channel A/D Converter single−slot VMEbus board by attaching it to a Model 4202. All of the modules control and status registers and the output FIFO are mapped directly onto the VMEbus. The VMEbus address space occupied by the board is easily set with address switches and jumpers.

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2.6 Using the Model 4202 Baseboard for MIX Master Sub–Systems

Suppose someone needs a 16–channel voice–band A/D converter plus quad 'C40 DSP horsepower to drive a T1 telecom line. In this case, the activity over the VMEbus is min–imal, and certainly does not require a VMEbus master interface.

Configuring a system with a Model 4252 A/D, a Model 4270 Quad C40, and a Model 4258 T1 Interface all on a Model 4202 baseboard does the trick! In this 3–slot sub–system, the Quad 'C40, acting as a MIXbus master, moves the input data from the A/D module, processes the data, and sends output data to the T1 module.

2.7 Turning a MIX Module Into a VMEbus Master

Two of Pentek's baseboards allow a master MIX module to become a VMEbus master – the Models 4200 and 4201. In operation, a master MIX module like the Model 4270 issues a read or write to the MIX address space reserved for the VMEbus master interface. In this case, the read or write is transported through to the VMEbus.

Since all four 'C40's in the 4270 can be MIXbus masters, any one of the 'C40 processors on the Model 4270 can freely access any VMEbus slave memory resource.

There are currently three MIX modules with MIXbus master interfaces: Models 4254, 4257, and 4270, with one, two and four 'C40's, respectively. All MIX modules have slave interfaces, even those with master interfaces. These slave interfaces make available to the MIXbus the shared memory, control registers, status registers, and FIFO memories within the modules.

2.8 DMA Controller Functions with the Model 4200/01(A)

Suppose a 32–channel A/D converter board needs to send data to various VMEbus des–tinations. In this case, the ideal solution is a 32–channel A/D MIX module coupled to a Model 4200, 4200A, 4201 or 4201A baseboard. This family of baseboards, with its VME–bus master interface, contains a powerful DMA controller which is easily configurable from the VMEbus.

First, the A/D converter is initialized for the number of channels, sampling rate, and interrupt conditions (such as FIFO half–full), etc.

Secondly, the DMA controller on the Model 4200/01(A) is initialized for the data source (MIX bus address of the A/D FIFO), the data destination (some VMEbus slave resource address), the number of points to be transferred per block (typically one half the FIFO size), and the initiating event for the DMA transfer (like the FIFO half–full interrupt from the A/D).

Now, when the A/D is released for collecting data, every time the FIFO fills up with 512 points (half–full), those 512 points are automatically delivered to the VMEbus destina–tion without any further intervention.

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2.8 DMA Controller Functions with the Model 4200/01(A) (continued)

This self−contained data mover is simple to use and extremely flexible. Notice that even though there is a 68030 on board, the basic operation of the Model 4200/01(A) does not require the user to perform any CPU or DSP programming. All standard data move schemes are implemented in on−board firmware, and require only the setting of the basic parameters of the data move.

2.9 Programming the 68030 on the 4200/01(A) MIX Baseboards

Many system designers want to program the 68030 processor inside the Model 4200/01(A). No matter how many canned DMA routines exist in the firmware, many applications demand a special software routine executed by the 68030 not easily handled by the firm−ware. While stressing simplicity of use, this baseboard family was designed to accom−modate many such custom applications.

There are three basic memory resources on the Model 4200/01(A):

- The Boot Flash ROM contains the factory supplied firmware for initializing the VMEbus and MIXbus interfaces and standard DMA firmware routines. Normally, this ROM is used as a read−only resource. However, provisions have been made to allow firmware upgrades in the field by sending customers a disk containing the new firmware. Special jumpers on the board permit the Boot Flash ROM to be rewritten from the disk file.
- The general purpose static RAM, ranging from 1 to 4 MB, is addressable from the VMEbus, the MIXbus, and the 68030. Programs developed for the 68030 using a generic C cross−compiler on a host computer can be downloaded easily through the VMEbus interface.
- The User Flash ROM permits the user to store a nonvolatile program which can be executed upon power up. This obviates the need to download a program to RAM from a host, a significant benefit in dedicated or embedded stand−alone applications.

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Chapter 3: Using the Pentek Model 4283 MIX Baseboard

3.1 Introduction

This section describes the addressing of MIX modules when they are attached to the Model 4283 MIX baseboard. All data and commands to the MIX modules are controlled by the TMS320C30 processor on the Model 4283 baseboard. For more detailed information about the Model 4283, refer to the Model 4283 Operating Manual.

The MIX bus interface on the Model 4283 is implemented by using the expansion bus of the 'C30 processor. This bus has 32 bits of data and 13 bits of address. Therefore, the 'C30 expansion bus can directly access 2^{13} = 8,192 locations of 32−bit words.

This capability of the 'C30 expansion bus is utilized in the MIX bus interface as follows: The least significant address bit of the 'C30 expansion bus drives the A2 bit of the MIX bus, which corresponds to MIX bus address boundary resolution of 32−bit words.

Therefore, the two least significant MIX bus address bits are not driven by the Model 4283 MIX bus interface. Another way of expressing this relationship is that the 'C30 can only access 32−bit MIX bus words on MIX addresses ending with hex digits of 0, 4, 8 and C. Note that consecutive 'C30 expansion bus addresses are spaced at 4−byte increments on the MIX bus. All resources of the MIX module are arranged to match this scheme.

The most significant address bit of the 'C30 expansion bus drives the MIX address line A14. MIX address lines A15 and above are supplied from the Model 4283 Page Register. This is a special register which is written to by the 'C30 prior to MIX bus accesses in order to set up these higher order address bits. The result is that the Model 4283 sees the MIX bus as a set of 'pages' of memory, each containing 32 kbytes, or 8k 32−bit words.

In addition to the upper MIXbus address bits, the Page Register also supplies the Module Select bits. These two bits select which one of the three MIX modules is being accessed.

Most data acquisition MIX modules are not memory−intensive devices and for these units all accesses to the unit occur within the address range of base page (8k x 32 bits). Therefore, the 4283 Page Register need only be changed to select the MIX module.

All accesses to the 8k x 32−bit MIXbus page from the Model 4283's 'C30 expansion bus are mapped into a 'C30 CPU address range which starts at location 0x80 4000 and ends at 0x80 5FFF. The MIX bus address references used in the body of the manual have a correspondence to 'C30 addresses in the Model 4283 as shown in the charts on the next pages.

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3.1 Introduction (continued)

Notation used in this section uses conventions followed in the 'C' language where a '0x' prefix designates a hex number. The number of hex digits reflects the range of the number. The MIX address is expressed as an 8−digit number (32 bit range) while the 'C30 addresses are expressed as a 6−digit number (24 bit range). A space inserted before the last four digits improves readability.

3.2 Model 4283 MIX Module Selection

Each module is accessed by the TMS320C30 by using a two bit field in the Model 4283's Page Register. The Model 4283's Page Register is a write−only device mapped into 'C30 address 0x80 0002.

There are a total of 32 bits in the Page Register, only two of which are used for module selection. When changing these bits, it is recommended that a memory image of the current value of the Page Register be maintained so that only these two bits can be altered. This can be conveniently done by first reading the Page Register, masking bits 15 and 16 to zero, and then 'OR'−ing in the new bits values for bit 15 and 16 as shown in the last column of the chart below.

Bits 15 and 16 select one of three possible MIX stack positions according to Table 3−1, below.

Table 3−1: Module Selection − Model 4283 Page Register Bits − 'C30 Address 0x80 0002

MIX Stack Position	Z	MIX_base Address (0xZnnn nnnn)	Page Register Bits				'OR'−ed Value for Page Register
			Bits 31 thru 17	Bit 16	Bit 15	Bits 14 thru 0	
Position 1	C	0xCnnn nnnn	x	1	1	x	0x0001 8000
Position 2	D	0xDnnn nnnn	x	1	0	x	0x0001 0000
Position 3	E	0xEnnn nnnn	x	0	1	x	0x0000 8000

The following information describes the entries in the table above:

Stack Position: Stack position 1 is closest to the Model 4283 baseboard (first position)

Stack position 2 is the second or middle stack position

Stack position 3 is the third or last position, farthest away from the Model 4283

Z digit: The Z digit is the module select digit and is the most significant MIX address digit. This is the first digit of the MIX_base Address, referenced in the MIX Address Map shown in Chapter 3 of the MIX module's manual.

x: These bits are involved with other operations of the Model 4283. See the note in the paragraph above and refer to the Model 4283 manual for complete details.

n: MIX module−specific MIX address hex digits independent of stack position.

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3.3 Model 4283 Register Selection within the Module

Once the module has been selected, all registers of the MIX module appear in the 'C30's address map according to Table 3–2, below right. Accessing these registers is accomplished by simply reading and writing to these locations.

This addressing corresponds to 32–bit word addresses for the TMS320C30 even though many of the elements may correspond to 8–bit or 16–bit devices.

Although the MIX bus uses byte addressing, the MIX module must be addressed with 32–bit data words as shown in the map. The Model 4283 baseboard conducts only 32–bit accesses, and all addresses are located on four–byte MIX bus address boundaries (least significant address digits of 0, 4, 8, or C).

Notation used in the table at the right uses conventions followed in the 'C' language, where a '0x' prefix designates a hex number. The number of hex digits reflects the range of the number. The MIX address is expressed as an 8–digit number (32–bit value) while the 'C30 addresses are expressed as 6–digit numbers (24–bit values). The space in front of the last four digits improves readability.

Table 3–2, at the right, shows the correspondence between several 'C30 addresses for the Model 4283 and the equivalent MIX addresses. Note that the MIX address space for the Model 4283 MIX baseboard begins at 'C30 address 0x80 4000. Each successive 'C30 address represents an increment of 4 in the MIX address.

Table 3–2: Address Translation between Model 4283 'C30 and MIX Addresses

MIX Address	'C30 Address
0xZ000 0048	0x80 4012
0xZ000 0044	0x80 4011
0xZ000 0040	0x80 4010
0xZ000 003C	0x80 400F
0xZ000 0038	0x80 400E
0xZ000 0034	0x80 400D
0xZ000 0030	0x80 400C
0xZ000 002C	0x80 400B
0xZ000 0028	0x80 400A
0xZ000 0024	0x80 4009
0xZ000 0020	0x80 4008
0xZ000 001C	0x80 4007
0xZ000 0018	0x80 4006
0xZ000 0014	0x80 4005
0xZ000 0010	0x80 4004
0xZ000 000C	0x80 4003
0xZ000 0008	0x80 4002
0xZ000 0004	0x80 4001
0xZ000 0000	0x80 4000

Z = 'C' for first or bottom MIX stack position
'D' for second or middle MIX stack position
'E' for third or top MIX stack position

In general, the formulas for hex conversion between a MIX address and an equivalent 'C30 address are given by:

'C30 Address = (MIX Address − 0xZ000 0000) / 4

MIX Address = 0xZ000 0000 + 4 x ('C30 Address − 0x80 4000)

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