INDUSTRIAL COMPUTER SOURCE

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Model EXM-MX Series
Product Manual

MANUAL NUMBER : 41417-050-2A

FORWARD

This instruction manual provides the necessary user information for the referenced product(s) manufactured or distributed by Industrial Computer Source for the user to install, operate and/or program the product properly. Please refer to the following pages for information regarding the warranty and repair policies.

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Manual Errors, Omissions and Bugs: A Bug Sheet is included as the last page of this manual. Please use it if you find a problem with the manual you believe should be corrected.

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Chapter 1: Product Description

The EXM-MX is an EXM expansion module containing an IDE (integrated drive electronics) hard disk, a floppy disk controller and a connector for external floppy disk drives. It provides a fully functional hard disk in a single EXM slot form factor.

A front-panel connector is provided for addition of one or two 3.5" or a 5.25" external floppy disk drive(s). There are also two indicator LEDs; one indicates the presence of +5V power and the other indicates that an access to the hard disk is in process.

The EXM-MX expansion module is compatible with all PC operating systems because the IDE hard disk and the external floppy connector are fully PC-compatible at the hardware level.

The construction and definition of the EXM-MX prohibits its use in several logical and mechanical configurations. The contexts in which an EXM-MX may not be used are the following:

- In the same system with an EXM-9 disk controller unless the EXM-MX and EXM-9 are not enabled at the same time

- In the same system with an EXM-3 disk controller or EXP-MS40 unless at most one floppy controller is enabled at the same time

- In the same system with another EXM-MX, unless at most one hard disk and one floppy controller are enabled at the same time

- In the same system with an EXP-MX mass storage module

- In an EPC-2, EPC-6, or EPC-7

- In the upper EXM slot of an EPC-4 or EPC-5

In addition, the EXM-MX200 cannot be installed in any VXI or VME system.

Specifications

Table 1-1 defines the environmental and electrical specifications of the EXM-MX.

Charateristics		Value
Environmental Specifications		
Temperature	operating	0 to 60°C (see below)
	storage	-40 to 125°C
Humidity	operating	0% to 90% (non condensing)
	storage	0% to 95% (non condensing)
Vibration	operating	0.015" dislpacement with 2.5 g peak (max) acceleration over 5 to 2000 Hz
	storage	0.030" dislpacement with 5 g peak (max) acceleration over 5 to 2000 Hz
Shock	operating	30g 11ms duration, half-sine shock pulse
	storage	50g 11ms duration, half-sine shock pulse

Table 1-1. EXM-MX Environmental and Electrical Specifications.

* Upper temperature limit degrades 2° C per 1000 ft. elevation. Maximum elevation 10,000 ft.

Chapter 2: Installation

Before installing the EXM-MX, unpack and inspect it for shipping damage.

- Do not remove the module from its anti-static bag unless you are in a static-free environment. The EXM-MX, like most other electronic devices, is susceptible to ESD damage. ESD damage is not always immediately obvious, in that it can cause a partial breakdown in semiconductor devices that might not immediately result in a failure.

- Ensure that the installation process as described herein is also performed in a static-free environment.

Before Installation

Before inserting the EXM-MX into the system, check the drive type label on the side of the unit. Write down the appropriate drive type to use for this module. You will need this information later.

If you are not going to install an external floppy drive, you can skip the remainder of this section and proceed to Installing the EXM-MX on the next page.

The EXM-MX provides the option of supplying +5VDC to the floppy drive through the ribbon cable. Before connecting an external floppy drive, check the drive specifications to determine if your particular drive can take advantage of this feature. There is a three-pin header near the rear of the EXM-MX circuit board labeled "JP1 enable +5 Ý FDD" (see diagram, next page). There is a middle pin, a pin labeled OFF, and a pin labeled ON. If you plan to provide external power to the floppy drive, connect the middle pin to the OFF pin. If you plan to provide power through the ribbon cable, connect the middle pin to the ON pin. For more detailed information about this feature, see the section Connectors on page 13.

- Providing power through the ribbon cable to a drive that cannot correctly use that power may damage the drive and will probably damage the EXM-MX.

The only valid configuration when the jumper connects the **ON** pin is:

- Single floppy being used as A:
- Straight ribbon cable
- Floppy is configured to expect +5VDC through the ribbon cable

The external power jumper is found in either of the two locations below:
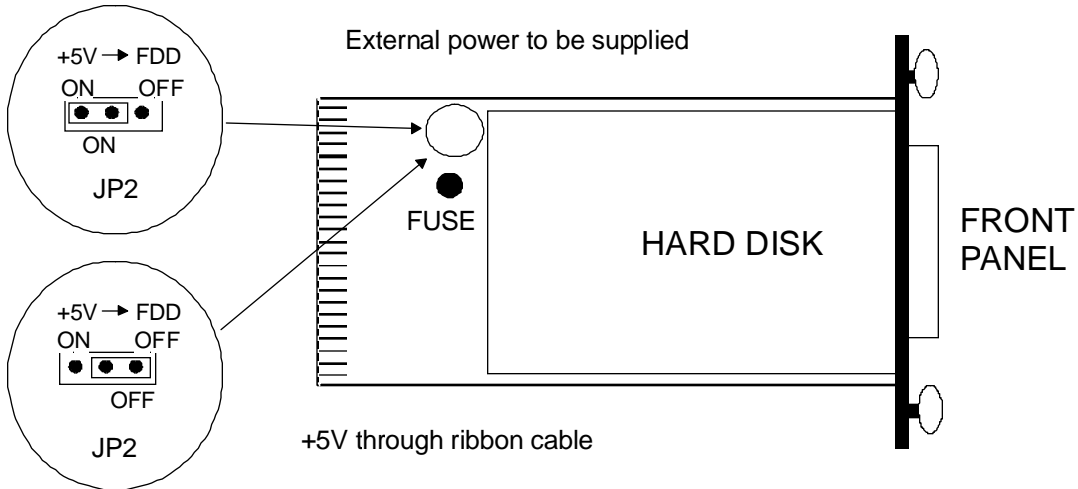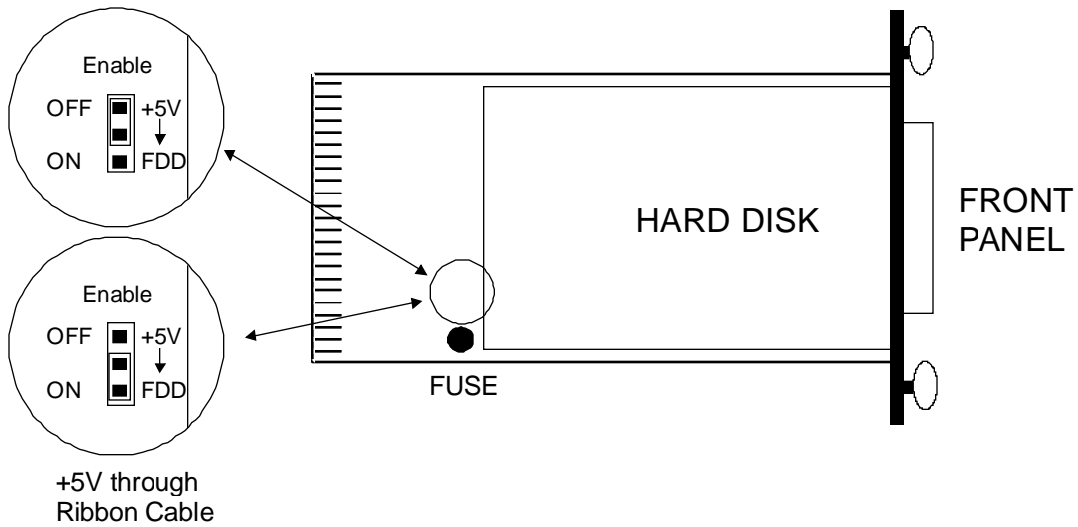

Figure 2-1. Floppy Power Jumper Locations.

Installing the EXM-MX

- Make sure that power to your system is off. The EXM is not designed to be inserted or removed from a live system.

- Handle the module with care, avoiding sudden drops and jolts. Insert it with adequate continuous force rather than tapping or hammering on it.

- When inserting the EXM, avoid touching the circuit board, and make sure the environment is static-free.

Installation of the EXM-MX into an EXM carrier is straightforward:

- If you intend to use the built-in EXM carrier on an EPC-4 or EPC-5, the EXM-MX can only be inserted in the lower EXM slot.

- If the EPC is not already installed, insert the EPC into the chassis and press firmly on the front panel until you feel the EPC seat into the rear connector(s).

- Remove a blank EXM panel from the carrier (by unscrewing the thumbscrews) and insert the EXM-MX into the EXM card guides. Firmly press the EXM-MX front panel to ensure that the module is properly seated in the rear connector and secure it with the thumbscrews.

Note the following restriction before you install the EXM-MX200:

- The EXM-MX200 cannot be installed in any VXI or VME system.

Adding an External Floppy Drive

One or two external floppy drives can be used with the EXM-MX by attaching a ribbon cable from the drive to the 34-pin front-panel connector. Most standard 3.5" and 5.25" drives can be used.

Floppy disk drives normally come configured as drive select 2. A single drive connected with a straight ribbon cable will be addressed as drive A:. A second drive (B:), configured with the same drive select, can be connected using a standard AT-type daisy-chain twisted ribbon cable (pins 10-16 are "twisted") that swaps the drive address lines for drive B:.

Some newer floppy drives can be powered through the ribbon cable. These drives connect +5VDC through pins 7, 9, and 11 of the ribbon cable. Other drives expect these pins to be Ground. The EXM-MX supports both types of drives. However, care must be taken such that +5VDC and Ground are not connected together. In particular, be careful with floppy drives that contain jumpers to configure whether +5VDC or Ground is connected to these pins. If you are unsure which type of drive you have, or if you don't know how the jumpers should be configured for a specific drive, consult the manual for your particular drive before connecting the drive to the EXM-MX.

The EXM-MX circuit board contains a field replaceable fuse protecting the power circuit to the floppy drive. If the fuse is blown, the floppy disk controller and the hard disk will continue to operate, but the +5VDC will not be available on the connector and both of the front-panel LEDs will not illuminate.

WARNING!

If the jumper is set to the **ON** position and the floppy requires **GROUND** on these pins, the fuse will blow.

If the jumper is set to the **ON** position, using a twisted cable will blow the fuse. Do not use a twisted cable if you are trying to power the drive through the cable.

If your floppy drive has jumpers or switches, follow these guidelines:

- If numbering on your drive starts at 1 and the drive has a DS (drive select) jumper or switch, set DS to 2. If numbering on your drive starts at 0 and the drive has a DS jumper or switch, set DS to 1.

- If the drive has an MM/MS (motor control) jumper or switch, set it to MS (motor control derived from drive-select signal).

- If the drive has a SR/DC (disk change) jumper or switch, set it to DC.

- If the drive is 1.2 MByte, set to dual speed. Check your drive manual for details.

Configuration

To use the EXM-MX, you will need to perform several steps to configure it logically into your system and prepare the hard disk for use:

- Enable it as an EXM module
- Specify the hard disk type in the CMOS setup
- If using an external floppy drive(s), specify its (their) type in the CMOS setup
- Partition and format the hard disk for your operating system

The EPC BIOS

The BIOS in the EPC to which the EXM-MX is connected needs to be configured to enable the hard disk and specify the hard disk and floppy disk drive type(s). For the hard disk, the type identifies the basic hard disk parameters: the number of cylinders, heads, and sectors in the hard disk assembly. Follow the instructions in the EPC reference manual for your specific EPC model to invoke the BIOS setup function. This is typically done by pressing the CTRL-ALT-ESC keys simultaneously. EPC system configuration procedures differ slightly depending on BIOS versions.

Enabling the EXM module

Once in the setup program, a menu displays specifying which function keys are available for further configuration. Press the F2 function key to invoke the EXM menu. The screen display resembles the figure below.

	ID	OB1	OB2
Slot 0	FF	00	00
1	DB	C1	00
2	**7D**	**05**	**00**
3	DE	01	00
4	F5	05	00
5	DC	F5	91

Figure 2-2. EXM Setup Screen.

The EXM Setup Screen displays the EXM configuration data (in hexadecimal) stored in non-volatile memory which the EPC uses at power-up to recognize and configure each installed EXM. An example of configuration data for the EXM-MX is shown in bold in slot 2. The displayed data shows SLOT, ID, OB1 and OB2. These are defined as follows:

SLOT   indicates the slot in which the EXM is installed. See the diagram below to determine which EXM slot the EXM-MX occupies. Note that dashed lines indicate EXM slots that may not be available on all systems.
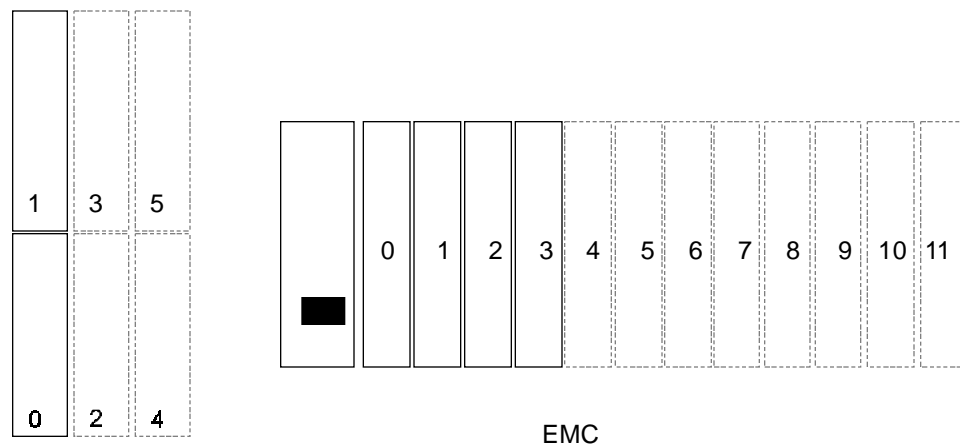
EXM Slots

Figure 2-3. EXM Slot Numbering.

ID   is a hard-wired ID value. Each EXM has a unique ID value.

OB1/OB2   are two bytes of option information.

Note that all slots are listed on the screen even if the actual system configuration does not have all the possible EXM slots. All slots **NOT** occupied by an EXM module show an ID of FF and OB1/OB2 of 00 00 indicating no EXM is present.

To add or change an EXM configuration, use the cursor keys (arrows) to move between the fields on the screen. Move the cursor to the appropriate slot entry and type in the correct value.

The **ID** for the EXM-MX should be set to **7D**h.

OB1 is a hexadecimal value derived by computing the following:

Bits	Description
00	EXM-MX disabled
03	Floppy controller enabled, IDE interface disabled
05	IDE interface enabled, floppy controller disabled
07	IDE interface and floppy controller enabled

Table 2-1. OB1 Bit Definition.

For example, a typical OB1 value is 05h (00000101) indicating the IDE interface is enabled and the floppy controller is disabled.

OB2 is not used and should be set to **00**.

Specify the Hard Disk Type

A separate screen exists for specifying the fixed (hard) disk type. Check the function key menu to determine the appropriate function key to bring up the Fixed disk menu. The screen is similar to the one below.

```
Fixed Disk Menu

Fixed Disk Drive C: None

Fixed Disk Drive D: None
```

Figure 2-4. Fixed Disk Menu Display.

If you are using the hard disk in the EXM-MX, you should first toggle to the AT option for drive C. Selection of this option causes a type line to appear. The type line allows you to select among a large variety of predefined drive types, or to specify the detailed parameters of a drive not defined by a predefined type. Toggle to the type number that matches the type number on the sticker on the side of your drive.

Fixed disk Drive D: should be set to NONE (or SCSI if you are using the EXP-MS40 or the EXM-3). If you are using both the EXM-MX and a SCSI hard disk with the EXM-3 or EXP-MS40, the EXM-MX hard disk must be drive C:. After selecting the appropriate values, press F10 to save this data and return to the main Setup screen.

Specify the Floppy Drive Type

Finally, the main setup menu provides selections for the diskette drives. If you have no external diskette drives, set both selections to NONE. If you have an A: drive or both floppy drives, toggle through the selections to specify the one matching your floppy drive(s).

When you are sure that the CMOS Setup data is correct, press F10 to save this data. Then press F5 to confirm the data and reboot.

Low-level Formatting

CAUTION!

If you are using a drive type that is larger than the actual drive capacity, do not attempt to low-level format the drive. You may permanently damage the drive.

No function is provided for low-level formatting IDE drives.

All disk drives used by RadiSys are pre-formatted by the manufacturer. Modern disks, with automatic bad-block mapping, don't need low-level formatting.

Previous generations of hard disks sometimes needed to be formatted at a low level to set the interleave, map out bad sectors, or to clear the disk of all data. Disks were typically delivered by the manufacturer in an unformatted state, so several commercial programs are available that perform a low-level format. RadiSys does not supply nor recommend any particular program for this purpose.

Disk Partitioning and Formatting

The EXM-MX is shipped from the factory with no partition or high-level formatting. The hard disk must be partitioned and formatted for your operating system before you can load any software.

Partitioning is the process of building the primary data structures on the hard disk that define the physical characteristics of the drive and divide the disk into one or more sections. Formatting (also called high-level formatting) is the process of actually building a file system on a disk drive partition - basically setting up each partition so that it "looks like" a file system.

Partitioning and Formatting for DOS

The following procedure requires a floppy drive be installed.

The process for MS-DOS 5.0 is described here. Other operating systems have similar procedures, with different details.

1) Boot the system using the operating system SETUP diskette.

2) You will be asked several questions. Follow the instructions on the screen until you see the following prompt:

Allocate all free hard disk space for MS-DOS
Allocate some free hard disk space for MS-DOS
Do not allocate free hard disk space for MS-DOS

   The first option will be highlighted. You can allocate ALL the hard disk space by pressing ENTER. The SETUP program will partition the disk and reboot the system. The SETUP program will be re-invoked and automatically start formatting the disk.

   Note that you may choose to "Allocate some free hard disk space for MS-DOS" to allow multiple partitions on the disk.   If you do, the process is slightly different.

3) The remainder of the installation process is automatic. Follow the instructions on the screen.

Replacing the Fuse

- Make sure that power to your system is off. The EXM is not designed to be inserted or removed from a live system.

- Handle the module with care, avoiding sudden drops and jolts. Insert it with adequate continuous force rather than tapping or hammering on it.

- When handling the EXM, avoid touching the circuit board, and make sure the environment is static-free.

The EXM-MX has a socketed fuse (field replaceable) located at the bottom of the circuit board immediately behind the hard disk (see Figure 2-1). Should the fuse blow, follow these instructions to replace it.

The replacement fuse is a Littlefuse 272-002 (or equivalent).

- To prevent ESD damage to the module, ensure that the replacement process described is performed in a static-free environment and you are properly grounded.

To replace the fuse,

- Ensure that power to the system is OFF.

- Remove the EXM-MX by unscrewing the thumbscrews and gently pulling forward.

- Place the EXM-MX on a static-free work surface, with the component side up and the front panel to your right.

- Remove the old fuse by pulling straight up with continuous pressure. Do not jerk on the fuse as this may damage the sockets or the circuit board.

- Insert the new fuse in the sockets. Visually inspect the fuse to verify that both pins are completely seated in the sockets.

- Replace the EXM-MX module in the original EXM slot and secure by tightening the thumbscrews.

Connectors

The EXM-MX front panel contains a latching 34-pin ribbon-cable connector for attachment of one or two external floppy drives.

Pin	Signal	Pin	Signal
1	Ground	2	-DENS
3	not used	4	not used
5	not used	6	not used
7	Ground or Vcc	8	-IDX
9	Ground or Vcc	10	-MO2
11	Ground or Vcc	12	-DS1
13	Ground	14	-DS2
15	Ground	16	-MO1
17	Ground	18	-DIRC
19	Ground	20	-STEP
21	Ground	22	-WD
23	Ground	24	-WE
25	Ground	26	-TRQ0
27	Ground	28	-WP
29	Ground	30	-RDD
31	Ground	32	-HS
33	Ground	34	-DCH
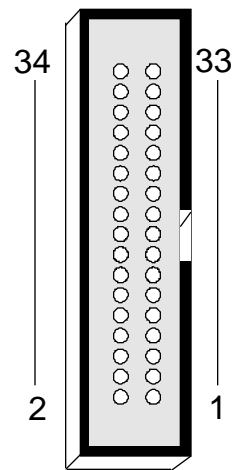
Table 2-2. 34-Pin Floppy Connector Pin-Out.

Note that pins 7, 9, and 11 have a dual definition. If the jumper labeled "JP1 enable +5 Ý FDD" is installed connecting the middle pin to the OFF pin, signals 7, 9, and 11 on the front panel floppy connector are Ground. If the jumper is installed connecting the middle pin to the ON pin, signals 7, 9, and 11 are +5VDC.

Mating cable connectors for the front-panel connector include the following (or equivalents):

    3M 3414-x634 (x meaning don't care)   T&B 622-3441
    T&B 636-3441   AMP 499485-8

Trouble Shooting

Symptom	Possible Cause	Solution
Cannot access hard drive and both front panel LEDs are off	Most likely cause is absence of power to the EXM-MX	Check seating of the module
Cannot access hard drive and +5V front panel LED is on	BIOS has not enabled the EXM-MX	Check the entry in the BIOS setup screen EXM menu
	The fixed-disk type assumed by the BIOS is incorrect	Check the drive type in the BIOS setup Fixed Disk menu
	There is another disk controller in the system interfering with the EXM-MX	Reread the configuration rules in Chapter 1
Cannot boot from hard disk	The hard disk may not have been formatted as a system disk	See your operating system manual for details on making a system disk
	Wrong drive type in the BIOS setup	Check the BIOS setup screen against the drive type sticker to verify the correct drive type entry
	The partition may not be set Active	Use the partitioning function for your operating system to activate the partition

Table 2-3. Troubleshooting Guidelines.

Symptom	Possible Cause	Solution
Cannot access external floppy drive(s)	A: or B: drive has not been correctly configured in the BIOS	Invoke your BIOS setup program and check the type defined for this drive
	Improper or faulty cable	Verify cable is good or replace with known good cable
	Incorrect jumper/switch settings in the drive	Consult your drive manual for correct settings
	Improperly formatted or unformatted disk	Re-format the diskette
Cannot boot from the floppy drive	The floppy disk may not have been formatted as a system disk	See your operating systems manual for details on making a system disk
	The BIOS definition of your floppy drive may be incorrect	Check the BIOS setup screen to verify the correct floppy drive entry
No power to external floppy drive	If you are powering the drive from the EXM-MX, the jumper in the EXM-MX may not be correct	Connect the middle pin to the ON pin (see Figure 2-1)
	If the floppy drive is powered from an external source, the power source may not be turned on or plugged in	Verify that the external power source is functioning correctly and the power connector to the floppy is fully seated
	Improper or faulty cable	Verify cable is good or replace with a good cable
	The +5VDC fuse has been blown (indicated by both LEDs being off)	Replace the fuse (see section REPLACING THE FUSE)

Table 2-3. Troubleshooting Guidelines, continued.

Chapter 3: Programming Interface

This chapter contains information needed to write custom software drivers for the EXM-MX. Anyone using the EXM-MX as a standard PC/AT compatible hard disk and floppy disk controller can ignore this chapter.

The EXM-MX defines the following registers in the I/O space.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	I/O Port
0	1	1	1	1	1	1	0	100

Device ID Register

					IDEN	FEDN	CDEN	102

Configuration Option Byte 1 Register

	1F0

Data Register

	1F1

Error/Write Precomp Register

	1F2

Sector Count Register

	1F3

Sector Number Register

	1F4

Cylinder Low Register

	1F5

Cylinder High Register

	1F6

SDH Register

	1F7

Status/Command Register

	3F2

Floppy Operations Register

	3F4

Floppy Command Register

	3F5

Floppy Data Register

	3F6

Alt Status/Digital Out Register

	3F7

Drive Adr/Floppy Ctl Register

The first two are standard EXM registers for device identification and configuration. The EXM-MX responds to accesses to these ports only if EXMbus line -EXMID is asserted. An 8-bit read from I/O address 100h returns the value 7D, the device ID of the EXM-MX. A read/write configuration register appears at I/O address 102h. The defined bits are

IDEN specifies whether the IDE interface and hard drive is enabled (1) or disabled (0). If IDEN and CDEN are set, the I/O addresses 1F0-1F7 and 3F6-3F7 are active.

FDEN specifies whether the floppy diskette controller is enabled (1) or disabled (0). If FDEN and CDEN are set, the I/O addresses 3F2-3F7 and the floppy diskette controller are active.

CDEN specifies whether the EXM-MX is enabled (1) or disabled (0). If disabled, the EXM-MX will not respond to the 1F0-1F7 and 3F2-3F7 I/O addresses; it will only respond to reads from I/O port 100h and reads and writes from I/O port 102h, and then only if EXMbus line -EXMID is asserted.

Because of the IBM PC/AT architecture, both the IDE interface and the floppy controller use address 3F7; the IDE interface defines bits 0-6 and the floppy controller defines bit 7. These individual bits are activated by the IDEN and FLEN enable bits. For instance, if FLEN=0, bit 7 of I/O address 3F7 is not driven by the EXM-MX, meaning that another floppy controller at address 3F7 can be active in the system.

For an explanation of the IDE and floppy drive registers, refer to documentation on any standard PC/AT fixed-disk and floppy drive interface.

BUG REPORT

While we have tried to assure this manual is error free, it is a fact of life that works of man have errors. We request you to detail any errors you find on this BUG REPORT and return it to us. We will correct the errors/problems and send you a new manual as soon as available. Please return to:

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Product: **EXM-MX Series**

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