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EXP-MX

Hardware Reference

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07-0370-00 June 1996

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RadiSys Corporation ("RadiSys") warrants the EPC system and component modules to the original purchaser for two years from the product's shipping date. If an EPC product fails to operate in compliance with its specification during this period, RadiSys will, at its option, repair or replace the product at no charge. The customer is, however, responsible for shipping the product; RadiSys assumes no responsibility for the product until it is received. This warranty does not cover repair of products that have been damaged by abuse, accident, disaster, misuse, or incorrect installation.

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1. Product Description

The EXP-MX mass storage modules are 6U (VMEbus-size) modules that plug into the EXM expansion interface of a RadiSys VMEbus embedded PC. The EXP-MX mass storage module contains a disk controller board, a hard disk, and a 1.44 MB floppy diskette drive. Depending on the capacity and physical size of the internal hard disk, an EXP-MX module occupies either two or three VMEbus slots.

Front-panel connectors are provided for adding either a 3.5″ or a 5.25″ external floppy drive. There are also three indicator LEDs. Two indicate that the VMEbus +5V and +12V supplies are available (the +12V supply is needed for the hard disk drive). The third LED is lit whenever a hard disk access is underway.

All EXP-MX models are fully MS-DOS compatible. The EXP-MX uses the IDE (Integrated Device Electronics) interface.

EXP-MX models are compatible with all PC operating systems, not just MS-DOS.

The EXP-MX mates to an EXM expansion subplane that has a special right-most connector for the EXP-MX, like the BP-3, -4, -5, and -6. Only one EXP-MX module may be used in a system, and an EXP-MX cannot be used with either EXM-3 or EXM-9 disk controllers, or with the EXM-MX series disk drives.

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Specifications

The following table defines the typical environmental and electrical specifications of the EXP-MX. Individual drive types may vary.

Characteristic		Value
Environmental		
Temperature	operating	5 to 50°C ambient
	storage	-40 to 65°C
Humidity	operating	8 to 85% non condensing
	storage	5 to 95% non condensing
Altitude	operating	0 to 10,000 ft (3,000 m)
	storage	0 to 40,000 ft (12,000 m)
Vibration *	operating	1 G (max) acceleration, 5-500 Hz (peak to peak) sine wave
	storage	2 G (max) acceleration, 5-500 Hz (peak to peak) sine wave
Shock *	operating	10 G, 11 ms duration, half-sine shock pulse
	storage	70 G, 11 ms duration, half-sine shock pulse
Electrical		
Power	maximum	20 W for 15 seconds at power-up
	typical	10 W
Current	maximum	+5V @ 1.5A, +12V @ 1A
	typical	+5V @ 1A, +12V @ 0.4A
Other		
Weight	maximum	35 oz (1000 g), over all models

Table 1. EXP-MX Specifications.

* **NOTE**: Shock and Vibration as measured on the hard disk itself. These values may not be equivalent to shock and vibration applied to the VMEbus chassis.

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2. Installation

Before installing the EXP-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 EXP-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.**

Installing the EXP-MX

Prior to insertion of the EXP-MX, the EXM expansion subplane must be installed; follow the instructions in the EPC manual to do so.

The EXP-MX is always inserted as the right-most module (assuming vertically oriented modules). Insert it so that its rear connector mates with the lower rightmost connector of the subplane. Tighten the top and bottom front-panel screws to hold it firmly in place.

- ☒ **HANDLE THE DISK MODULE WITH CARE, AVOIDING SUDDEN DROPS AND JOLTS. INSERT IT WITH ADEQUATE CONTINUOUS FORCE RATHER THAN TAPPING OR HAMMERING ON IT.**

- ☒ **MAKE SURE THAT POWER TO YOUR VME SYSTEM IS OFF. INSERTING OR REMOVING THE DISK MODULE IN A LIVE BACKPLANE WILL DAMAGE THE MODULE.**

- ☒ **WHEN INSERTING THE MODULE, AVOID TOUCHING THE CIRCUIT BOARD AND CONNECTOR PINS, AND MAKE SURE THE ENVIRONMENT IS STATIC-FREE.**

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Configuration

There are two aspects to configuring a hard disk in a PC/AT-compatible system. The first is setting up the correct parameters in the CPU BIOS. The second is actually partitioning and formatting the hard disk with the operating system. EPC systems shipped with software loaded have both the BIOS and the hard disks pre-configured at the factory. In these cases this configuration section can be skipped in its entirety, as the products can be plugged into the subplane and powered up with no user configuration required.

The EPC BIOS

The BIOS in the EPC to which the EXP-MX is attached needs to be configured for the number of floppy and hard disk drives, and for their *type*. For hard disks, the *type* identifies the basic hard disk parameters: the number of cylinders, heads, and sectors in the hard disk assembly. Invoke the BIOS setup function by pressing the CTRL-ALT-ESC keys simultaneously.

Floppy Disk Drive

Diskette drive A should be defined as 1.4 MB, 3.5 inch, unless the jumper is removed as described in the section *Adding an External Floppy Drive*, page 7 and an external drive is connected as the A: drive. In this case drive A: needs to be defined with the characteristics of the external drive. Drive B: should be set to NONE unless an external B: floppy drive is installed, in which case it needs to be defined with the characteristics of the external drive.

Fixed Disk Menu

Press F3 to bring up the fixed disk menu.

EXP-MX series

Set the BIOS definition of drive C: to **AT**. A line then displays which lets you select the drive *type*. Each EXP-MX drive is labeled with the drive type and/or parameters for use during this step.

Some of the newer, high-capacity drives may not appear in the BIOS list. In this case, most BIOS versions include user-editable drive types (type 48 and 49) that allow you to manually enter the drive's parameters.

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If a user-editable drive does not have a label or the label is no longer readable, but you know the model number, refer to the table below.

Drive	Cylinders	Heads	Sectors	Capacity
MX100	814	9	32	115 MB
MX200 & MX200A	723	13	51	235 MB
MX500	1017	16	63	501 MB
MX1000 (Award BIOS)	1024	16	63	528 MB
MX1000 (Phoenix BIOS)	2100	16	63	1084 MB

Table 2. User-Editable Parameters.

Drive D: should be defined as NONE.

Note that EXP-MX1000 drives will appear as 528 MB hard drives to a system using an older Award BIOS. Newer systems that use the Phoenix BIOS will recognize the entire drive.

Low-level Formatting

Only older-generation hard disks ever 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. All disk drives used by RadiSys are pre-formatted by the manufacturer. These modern disks, with automatic bad-block mapping, typically **NEVER** need low-level formatting.

No function is provided for low-level formatting IDE drives. Several commercial programs are available that perform a low-level format. However, RadiSys does not recommend any particular software for this purpose.

Disk Partitioning and Formatting

Configuring the BIOS for the hard disk is the first part of the configuration process. Next, the disk must be partitioned and formatted for the operating system.

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Partitioning is the process of building the primary data structures on the hard disk which 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 can store the files and directory structure required.

Depending on the context in which you ordered the EXP-MX, the hard disk could be one of the following:

1. A bootable disk with DOS and other software pre-installed in a ready-to-run fashion. In this case the system is ready to use, and no further action is required.

2. An empty disk, with no partitioning. In this case, partitioning and formatting must be done before the disk can be used.

Partitioning and Formatting for MS-DOS

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 are 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 is highlighted. Allocate ALL the hard disk space by pressing ENTER. MS-DOS automatically partitions and formats the drive and loads the operating system.

The remainder of the partitioning and formatting process is automatic. Follow the instructions on the screen.

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✉ **A DISK PARTITIONED, FORMATTED, AND LOADED AS ONE TYPE WILL PROBABLY NOT BE RECOGNIZED BY A CPU SET TO A DIFFERENT DRIVE TYPE. CHANGING THE DRIVE TYPE OF THE DISK LATER USUALLY REQUIRES COMPLETE RE-PARTITIONING AND RE-FORMATTING WITH LOSS OF ALL DATA ON THE DRIVE.**

Adding an External Floppy Drive

An external floppy drive can be used with the EXP-MX via cable attachment to the 34-pin connector. Most standard 5.25″ and 3.5″ drives can be used. The EXP-MX does not support drives that take their 5V power from the ribbon cable.

The 34-pin front-panel connector is defined in the following table. All odd-numbered pins are connected to Ground.

Pin	Signal	Pin	Signal
2	-DENS	18	-DIRC
4	not used	20	-STEP
6	not used	22	-WD
8	-IDX	24	-WE
10	-MO1	26	-TRQ0
12	-DS2	28	-WP
14	-DS1	30	-RDD
16	-MO2	32	-HS
		34	-DCH

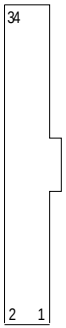


Table 3. Floppy Cable Pin-Out.

Assuming the drive is to be configured as the B: drive on a straight (pin-1 to pin-1, etc.) cable, configure the floppy drive as follows:

- Set the DS (drive-select) jumper or switch to 2. (If numbering on the drive starts at 0 instead of 1, set it to 1.)

- For 5.25″ drives, if the drive has an MM/MS (motor-control) jumper or switch, set it to MS (motor control derived from drive-select signal).

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- For 5.25″ drives, if the drive has a SR/DC (disk change) jumper or switch, set it to DC.

An application note is available from RadiSys Technical Support that describes the process of configuring an external floppy drive in more detail.

If the internal floppy drive is enabled, it is always configured as the A: drive. If you wish to add an external drive and it needs to be the A: drive, two actions must be taken:

1) Remove jumper JP2 (see diagram below) on the EXP-MX circuit board. This disables operation of the internal floppy drive.

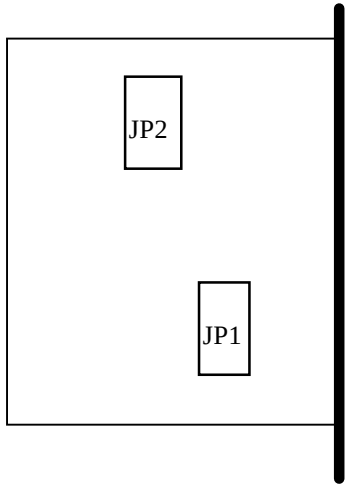


Figure 1. J1 & J2 Jumper Location.

2) Connect the drive through a ″twist cable″ (i.e., connect drive pin 10 to EXP-MX pin 16, and drive pin 12 to EXP-MX pin 14). If you are using a straight ribbon cable, configure the drive DS as 1 instead of 2 (or 0 instead of 1 if the numbering starts at 0).

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Additional Considerations

It is possible that data corruption can occur on a floppy diskette in the external floppy drive when the power is turned off, because the controller chip asserts the WRITE ENABLE bit. To prevent this, do one of the following:

1. **Remove the floppy diskette** from the external floppy drive before powering off the system.

2. **Turn off the power to the external floppy drive** before powering off the system.

Troubleshooting

Internal Floppy Drive Problems

If you cannot boot from or access the internal floppy disk drive, the problem could be any one of the following:

(1) the software configuration

(2) the drive configuration

(3) power to the EXP-MX

(4) the drive-enable jumper

(5) an improperly formatted diskette

(6) the EXP-MX.

To isolate the problem, perform the following operations:

A. Invoke the BIOS setup program

B. Ensure that drive A is specified as a 1.44 MB 3.5″ drive.

C. Ensure that the drive-enable jumper (JP2) on the circuit board in the EXP-MX is installed.

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D. Ensure that the LEDs indicating +5V and +12V power to the EXP-MX are lit.

E. Ensure that you don't have another module in the system (e.g., EXM or PC card) whose I/O ports or interrupt and DMA usage conflict with those of the EXP-MX. Refer to Chapter 3, *Programming Interface*, for the EXP-MX requirements.

F. Ensure that the trouble isn't with the diskette by attempting to read it or boot with it on another system.

Internal Hard Drive Problems

If you cannot boot from or access the hard disk, the solutions listed below may apply.

A. Invoke the BIOS setup program and ensure that you have the correct fixed-disk *type* selected (see table in previous section).

B. Check the voltage LEDs to see if the drive has power. Check the cable connections and the cable itself for damage, bent pins, etc.

C. Use Microsoft Diagnostics (MSD.EXE) to check for devices that may conflict with the EXP-MX IRQ (e.g., an EXM-3, EXM-9, or EXM-MX).

D. Ensure that the device has been formatted as a system disk and that the partition is active (which will require booting from a floppy).

External Floppy Drive Problems

If you have trouble with an external floppy drive, review the previous section on connecting an external floppy drive to ensure that the drive is configured correctly.

A. Ensure that you are supplying power to the drive. Check the cable connections and the cable itself.

B. If you want the external drive to be A:, make sure that you've twisted the cable as described earlier, that the drive enable jumper on the circuit board has been removed (to disable the internal drive), and that the selection for drive A: on the BIOS setup screen matches the characteristics of your external drive.

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C. If you want the external drive to be B:, ensure that the selection for drive B: on the BIOS setup screen matches the characteristics of your external drive.

D. Ensure that your diskette is readable or bootable on another system.

Common Error Messages

Some error messages that might appear and their interpretations are:

Disk boot failure. No boot disk could be found. Boot from a floppy and check to see that the hard disk is accessible, the partition is active, and the hidden system files are present.

Diskette drives or types mismatch error. The BIOS setup information is inconsistent with the floppy drives detected (or absent). Run the BIOS SETUP program and correct the inconsistencies.

Floppy disk controller error. The BIOS could not find the floppy disk controller in the EXP-MX (e.g., unit is not installed, another device is using conflicting I/O addresses).

General failure... Usually indicates an unformatted disk or diskette.

Non-system disk. Trying to boot from a disk or diskette that is not formatted as a bootable system disk.

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3. Programming Interface

The table in this chapter defines the I/O Port addresses used by the EXP-MX modules. Anyone just using the EXP-MX as a BIOS-controlled disk unit and interface can skip reading this chapter.

For an explanation of the floppy diskette controller registers, refer to documentation on the WD37C65 controller chip. For an explanation of the *EXP-MX only* hard drive registers, refer to documentation on any standard PC/AT fixed-disk interface.

The floppy disk controller in the EXP-MX uses interrupt IRQ6 and DMA channel 2. The IDE disk controller in the EXP-MX uses interrupt IRQ14.

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Address	Description	Notes:
1F0	Data Register (16 bits)	MX only
1F1	Error / Write Precompensation Register	MX only
1F2	Sector Count Register	MX only
1F3	Sector Number Register	MX only
1F4	Cylinder Low Register	MX only
1F5	Cylinder High Register	MX only
1F6	SDH Register	MX only
1F7	Status / Command Register	MX only
2B0	not available	
2B1	not available	
2B2	not available	
2B3	not available	
2B4	not available	
2B5	not available	
2B6	not available	
2B7	not available	
3F2	Floppy Operations Register	
3F4	Floppy Command Register	
3F5	Floppy Data Register	
3F6	Alternate Status / Digital Output Register	MX only
3F7	Drive Address Register / Floppy Control Register	MX only

Table 4. EXP-MX I/O Port Addresses.

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4. Support and Service

In North America

Technical Support

RadiSys maintains a technical support phone line at the telephone number listed on the cover of this manual that is staffed weekdays (except holidays) between 8 AM and 5 PM Pacific time. If you have a problem outside these hours, you can leave a message on voice-mail using the same phone number. You can also request help via electronic mail or by FAX addressed to RadiSys Technical Support. The RadiSys FAX number is also listed on the cover of this manaul. The RadiSys E-mail address on Internet is *support@radisys.com*. If you are sending E-mail or a FAX, please include information about both the hardware and software in use, and provide a detailed description of the problem (specifically, describe how the problem can be reproduced). We will respond by E-mail, phone or FAX by the next business day.

Technical Support Services are designed for customers who have purchased their products from RadiSys or a sales representative. If your RadiSys product is part of a piece of OEM equipment, or was integrated by someone else as part of a system, support will be better provided by the OEM or system vendor that did the integration and understands the final product and environment.

Web Site

RadiSys maintains an active site on the World Wide Web. The home page URL is *http://www.radisys.com*. The site contains current information about the company and locations of sales offices, new and existing products, contacts for sales, service, and technical support information. Fact sheets, manuals, and software can also be downloaded from the Web site, and you can also send e-mail to RadiSys Technical Support. Requests for sales, service, and technical support information receive prompt response.

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Repair Services

Factory Repair Service is provided for all RadiSys products. Standard service for all RadiSys products covers factory repair with customers paying shipping to the factory and RadiSys paying for return shipment. Overnight return shipment is available at customer expense. Normal turn-around time for repair and re-certification is five working days.

Quick Exchange services (immediate shipment of a loaner unit while the failed product is being repaired) or other extra-cost services can be arranged, but need to be negotiated in advance to allow RadiSys to pool the correct product configurations. RadiSys does not maintain a general "loaner" pool: units are available only for customers that have negotiated this service in advance.

RadiSys does not provide a fixed-price "swap-out" repair service, as customers have indicated that issues of serial number tracking and version control make it more convenient to receive their original products back after repair.

Warranty Repairs

Products under warranty (see warranty information in the front of this manual) will have manufacturing defects repaired at no charge. Products sent in for warranty repair that have no faults will be subject to a recertification charge. Extended Warranties are available and can be purchased at a standard price for any product still under warranty. RadiSys will gladly quote prices for Extended Warranties on products whose warranties have lapsed; contact the factory if this applies.

Customer induced damage (resulting from misuse, abuse, or exceeding the product specifications) is not covered by the standard product warranty.

Non-Warranty Services

There are several classes of non-warranty service. These include repair of customer induced problems, repairs of failures for products outside the warranty period, recertification (functional testing) of a product either in or out of warranty, and procurement of spare parts.

All non-warranty repairs are subject to service charges. RadiSys has determined that pricing repairs based on time and materials is more cost-effective for the customer than a flat-rate repair charge. When product is received, it will be analyzed and, if appropriate, a cost estimate will be communicated to the customer for authorization.

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After the customer authorizes the repair and billing arrangements have been made, the product will be repaired and returned to the customer.

A recertification service is provided for products either in or out of warranty. This service will verify correct operation of a product by inspection and testing of the product with standard manufacturing tests. There is a product-dependent charge for recertification.

There are only a few components that are generally considered field-repairable, but, because RadiSys understands that some customers want or need the option of repairing their own equipment, all components are available in a spares program. There is a minimum billing charge associated with this program.

Arranging Service

To schedule service for a product, please call RadiSys Technical Support directly at the telephone number listed on the cover of this manual. Have the product model and serial numbers available, along with a description of the problem. A Technical Support representative will issue a Returned Materials Authorization (RMA) number, a code number by which we track the product while it is being processed. Once you have received the RMA number, follow the instructions of the Technical Support representative and return the product to us, freight prepaid, with the RMA number clearly marked on the exterior of the package. If possible re-use the original shipping containers and packaging. In any case, be sure you follow good ESD-control practices when handling the product, and ensure that anti-static bags and packing materials with adequate padding and shock-absorbing properties are used.

Ship the product, freight prepaid, to the address listed on the cover of this manual

When shipping the product, include the following information: return address, contact names and phone numbers in purchasing and engineering, and a description of the suspected problem. Any ancillary information that might be helpful with the debugging process will be appreciated.

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Other Countries

Contact the sales organization from which you purchased your RadiSys product for service and support.

Spare Parts List

There are only two field replacable parts on the EXP-MX: the floppy drive and the hard disk. A list of the replacable drives is found in the table below:

Floppy Drive	For use with all EXP-MX modules	85-0017
40 MByte SCSI hard disk	For use with the EXP-MS40	85-0050
40 MByte IDE hard disk	For use with the EXP-MX40	85-0055
100 MByte IDE hard disk	For use with the EXP-MX100	85-0051
200 MByte IDE hard disk	For use with the EXP-MX200 & MX200A	85-0041
500 MByte IDE hard disk	For use with the EXP-MX500	85-0053

Table 5. Spare Parts List.

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