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EXM-24
Intelligent Serial I/O
Hardware Reference

RadiSys® Corporation

15025 S.W. Koll Parkway

Beaverton OR 97006

(503) 646-1800

FAX: (503) 646-1850

07-0193-01 February 1994

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January 1994

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NOTES

Table of Contents

1. Product Description 1
- Port Performance 1
- On-board Processor Interface 2
- Specifications 2

2. Installation 3
- Insertion into an EXM Carrier 3
- Configuring the BIOS Setup 4
  - Enabling the EXM Module 4
  - Sizing the Memory 6
  - Setting the Base Memory Address 7
  - Software Support 8

3. Connector 9
- DB-78 Connector 9

4. Programming Interface 11
- Standard EXM Registers 11
  - I/O Space 12
  - Buffering 12
- On-Board Processor Interface 12
- Software Compatibility 12

5. Support and Service 15
- In North America 15
  - Technical Support 15
  - Bulletin Board 15
  - Repair Services 16
  - Warranty Repairs 16
  - Non-Warranty Repairs 16
  - Arranging Service 17
- Other Countries 18

Figures

Figure 1. EXM Setup Screen 4
Figure 2. EXM Slot Numbering 5
Figure 3. OB1 Register 5
Figure 4. OB2 Register 6
Figure 5. Standard EXM Registers 11

Tables

Table 1. EXM-24 Environmental and Electrical Specifications 2
Table 2. Sizing the Memory 7
Table 3. EXM-24 RS-232 DB-78 Pin-out 9

1. Product Description

This manual contains the information required to install the EXM-24 intelligent serial communications module.

The EXM-24 is an RS-232 eight-port intelligent serial communications board designed to be **100% compatible with DigiBoard PC/8i software and accessories**. The eight serial ports are accessed via a 78-pin connector off the front panel of the EXM-24, typically intended for mating with an 'octacable' which splits each port out into an individual connector.

An on-board 80C186 16MHz microprocessor off-loads much of the serial transmission management from the host CPU, hence the designation 'intelligent'. Communication between the host CPU and the on-board processor is via on-board dual-ported SRAM. The 80C186 also has access to private on-board SRAM. The private SRAM is 128 KBytes. The dual-ported SRAM is 256 KBytes.

The EXM-24 ships with an eight-port "octacable" adapter. The software interface to the EXM-24 is via drivers supplied by DigiBoard to RadiSys under a license agreement. These drivers are available for DOS and Windows. For drivers and software using a different operating system, contact DigiBoard directly at (612) 943-9020. Their DigiLine BBS phone number is (612) 943-0812 (up to 9600 baud, 8,N,1)

Multiple EXM-24 boards may operate within the same system, provided each board's I/O address and any IRQ used are unique. Memory addresses across boards need not be unique, as memory access to a board can be enabled/disabled via software.

Port Performance

The EXM-24 supports data transfer rates up to 115.2K baud. The number of ports operating at any given rate depends on multiple factors, i.e. the individual port baud rates, the synchronization of the data transfers among ports, etc. Typically, 1 to 2 ports may be run at 115.2K baud, or 1 to 3 at 57.6K baud, or all eight at 38.4K baud or less.

Serial communications are controlled by 85C30 SCCs and associated line drivers/receivers. Typical output voltage swings are -6.5 volts to +7.3 volts. Outputs are short-circuit protected from -30 volts to +30 volts, and RS-232 voltage levels (+/-30 volts) are accepted at the inputs.

On-board Processor Interface

The interface to the on-board 80C186 microprocessor is via on-board dual-ported memory, and through an I/O port address.

Specifications

Table 1 defines the environmental and electrical specifications of the EXM-24.

Characteristic		Value
Environmental		
Temperature	operating	0° to 60° C (* see below)
	storage	-40° to 85° C
Humidity	operating	5% - 95% (non-condensing)
	storage	5% - 95% (non-condensing)
Vibration	operating	.015"displacement with 2.5 Gs peak (max) acceleration over 5 to 2000 Hz
	storage	.030" displacement with 5 Gs peak (max) acceleration over 5 to 2000 Hz
Shock	operating	30g 11 msec duration, half-sine shock pulse
	storage	50g 11 msec duration, half-sine shock pulse
Electrical		
Current	maximum	5V @ 0.7A
	typical	5V @ 0.4A

Table 1. EXM-24 Environmental and Electrical Specifications.

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

2. Installation

2 2

Before installing the EXM-24, 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-24, 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.**

Insertion into an EXM Carrier

Insertion of the EXM-24 into an EXM carrier is straightforward. Remove a blank EXM panel from the carrier (by unscrewing the thumbscrews) and insert the EXM-24 into the card guides. Firmly press the EXM-24 front panel to ensure that the module is properly seated in the subplane and secure it with the thumbscrews. DO NOT OVERTIGHTEN.

- **MAKE SURE THAT POWER TO YOUR SYSTEM IS OFF. THIS EXM IS NOT DESIGNED TO BE INSERTED OR REMOVED FROM A LIVE SYSTEM.**

- **WHEN INSERTING THE EXM, AVOID TOUCHING THE CIRCUIT BOARD, AND MAKE SURE THE ENVIRONMENT IS STATIC-FREE.**

- **INSERT IT WITH ADEQUATE CONTINUOUS FORCE RATHER THAN TAPPING OR HAMMERING ON IT.**

2 2

Configuring the BIOS Setup

Once the EXM-24 is inserted into the carrier, turn the system on and boot it up. The EXM configuration data in the EPC to which the EXM-24 is connected now must be modified to recognize and enable the card and select from the available options. Invoke the BIOS setup function from the command line by pressing the CTRL-ALT-ESC keys simultaneously.

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    ED  01  00
     2    D7  0D  0D
     3    DE  01  00
     4    F5  05  00
     5    7D  05  00
```

Figure 1. EXM Setup Screen.

The EXM Setup Screen displays the EXM configuration data (in hexadecimal) stored in nonvolatile memory which the EPC uses at power-up to recognize and configure each installed EXM. An example of configuration data for the EXM-24 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-24 occupies. Note that dashed lines indicate EXM slots that may not be available on all systems.

EXM Slots

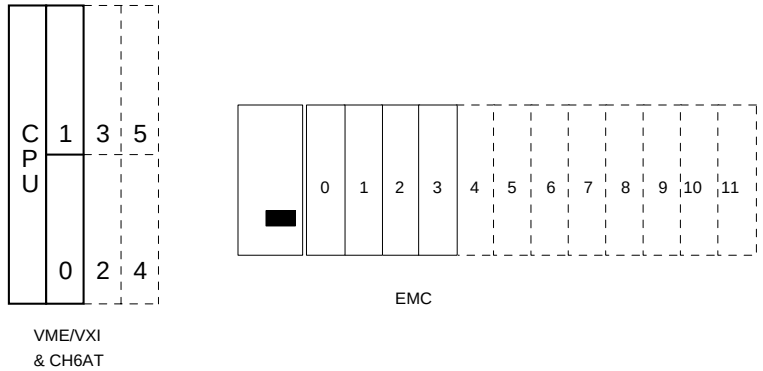


Figure 2. EXM Slot Numbering.

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

OB1/OB2 are two bytes of option information.

All slots **not** occupied by an EXM module should show an ID of FF and OB1/OB2 of 00 00 indicating that 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-24 should be set to **D7**h.

OB1 is a hexadecimal value derived by combining the following:

>64K (bit 7)	IRQ 2-0 (bits 6-4)	I/O 2-0 (bits 3-1)	Card Enable (bit 0)
0 - 64K 1 - >64K	000 - none 001 - IRQ11 010 - IRQ12 011 - IRQ3 100 - IRQ4 101 - IRQ5 110 - IRQ15 111 - IRQ7	000 - none 001 - 100h 010 - 110h 011 - 120h 100 - 200h 101 - 220h 110 - 300h 111 - 320h	0 - disable 1 - enable

Figure 3. OB1 Register.

OB1 contains the card enable bit, specifies the I/O port base address, sets the IRQ, and controls the dual port memory setting. For example, a typical OB1 value is **0D**h (00001101) indicating the card is enabled, uses I/O address 300h, uses no IRQ, and acts as if only 64K of dual port memory is available to conserve memory space.

OB2 is a hexadecimal value derived by combining the following:

A23 (bit 7)	A22 (bit 6)	A21 (bit 5)	A20 (bit 4)	A19 (bit 3)	A18 (bit 2)	A17/ >256K (bit 1)	A16/ >128K (bit 0)
x	x	x	x	x	x	0 - 256K 1 - reserved	0 - 128K 1 - >128K

Figure 4. OB2 Register.

OB2 holds two bits to size the memory and memory base address lines A16 through A23. There are 24 bits available for address matching. Note that boards cannot be mapped into high memory for host systems containing 16 Megabytes or more of memory.

There are several restrictions that apply when using DOS/Windows systems. Under DOS, if using memory address A000, you cannot utilize 256 color VGA display. A memory address of D000 conflicts with the EXM-17 PCMCIA adapter. In addition, the EXM-10A Ethernet controller, the EXM-25 Token Ring controller, and the EXM-28 Arcnet controller may also conflict with D000. EMC systems can safely use E000; VME/VXI systems cannot.

Address space memory must be placed above existing memory if it is to be placed above the 1 MByte boundary.

Note that under MS Windows, a memory size of 256K will work. Make sure you exclude this memory from Windows access using the EMMExclude= statement under the [386Enh] heading in your SYSTEM.INI file. For more information, refer to the *Microsoft Windows Operating System* manual.

Sizing the Memory

Use the chart below to determine the settings for your system. Note that once OB1 Bit 7 is set to zero, OB2 Bit 1 and OB2 Bit 0 are no longer used to size the memory, but are used instead to set the Base Memory Address. The same rule applies when OB2 Bit 0 is set to zero to set the system for 128K - OB2 Bit 1 is no longer used to size the memory, but is used instead to set the Base Memory Address.

OB1 Bit 7 (64K)	OB2 Bit 0 (A16/128K)	OB2 Bit 1 (A16/256K)	Resulting Memory Size
0	-	-	64K
1	0	-	128K
1	1	0	256K
1	1	1	Do not use

Table 2. Sizing the Memory.



Setting the Base Memory Address

Register OB2 corresponds to the eight upper address bits decoded in the 24-bit address space. Address bits A15 - A0 are implied zero by default, based on a 64K boundary.

For example, if using a 64K memory size based at 0xD000:0, use the following settings:

OB1 Bit 7 = 0; OB2 = 0D, or 00001101

For a 128K memory size based at 40000:0, use the following settings:

OB1 Bit 7 = 1; OB2 = 40h, or 01000000

For a 256K memory size based at 80000:0, use the following settings:

OB1 Bit 7 = 1; OB2 = 81h, or 10000001

For example, a typical OB2 value is **0D**h (00001101) indicating 64K memory size with the memory base address at 0D0000h.

2 2

Software Support

The EXM-24 ships with DigiBoard DOS/Windows software disks and manuals under an agreement with RadiSys. Follow the installation instructions for drivers and functions found in the DigiBoard manuals that refer to the PC/8i board specifically or the PC/Xi board generally. Note that the DigiBoard software includes a substantial text file which provides detailed information about the DigiBoard drivers and functions.

For software drivers and manuals supporting operating systems other than DOS/Windows, DigiBoard can be contacted directly at the address and phone number listed in Chapter 4, *Programming Interface*, on page 13.

3. Connector

DB-78 Connector

The EXM-24 has a single DB-78 connector on the faceplate. Grounding of the shell is performed by the jackscrews holding the face plate to the connector. The shell is grounded to chassis ground, not VSS.

Octacable (eight port) external interface cables are available from RadiSys, splitting the board connector into individual port connectors.

The pin-out is listed in Table 3.

Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal
1	DTR8	21	RTS5	40	TXD5	60	RTS8
2	TXD6	22	DTR5	41	RTS6	61	DTR7
3	DTR6	23	CD6	42	DSR6	62	RTS7
4	CTS6	24	RI6	43	CD5	63	TXD7
5	DSR5	25	CTS5	44	RI5	64	TXD8
6	CD8	26	DSR8	45	CTS8	65	
7	RI8	27	RXD8	46	RXD7	66	
8	RXD6	28	RXD5	47	RI7	67	
9	CTS7	29	DSR7	48	CD7	68	GND
10	TXD4	30	TXD1	49	DTR1	69	GND
11	TXD3	31	RTS2	50	TXD2	70	GND
12	RTS3	32	DTR2	51	RTS1	71	GND
13	DTR3	33	CD2	52	DTR4	72	GND
14	RTS4	34	DSR2	53	CTS2	73	GND
15	RI2	35	CD1	54	DSR1	74	GND
16	CTS1	36	RI1	55	RXD1	75	GND
17	RXD2	37	RXD3	56	RXD4	76	
18	CD4	38	DSR4	57	CTS4	77	
19	RI4	39	CD3	58	DSR3	78	
20	RI3			59	CTS3		

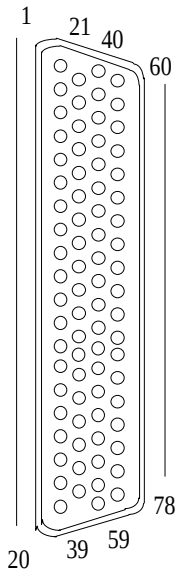


Table 3. EXM-24 RS-232 DB-78 Pin-out.

NOTES



4. Programming Interface

This chapter contains information about the EXM-24 registers. To write custom software for the EXM-24, you will also need the *FEPOS Developer's Kit for the 80186*, available from DigiBoard.

If you are using the EXM-24 software supplied on the distribution diskette, or some other applications that enable access to the serial ports, you can ignore this chapter.

Standard EXM Registers

The Device ID and Configuration Option Byte registers are described below:

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	I/O port
Device ID Reg	1	1	0	1	0	1	1	1	100
Config Option Byte 1 Reg	>64K	IRQ2	IRQ1	IRQ0	I/O2	I/O1	I/O0	Cden	102
Config Option Byte 2 Reg	A23	A22	A21	A20	A19	A18	A17	A16	103

Figure 5. Standard EXM Registers.

These are standard EXM registers for device identification and configuration. The EXM-24 responds to accesses to these ports only if EXM expansion interface line -EXMID is asserted (by writing the slot number to I/O address 96h). An 8-bit read from I/O address 100h returns the device ID value **D7**h. Read/write configuration registers appear at I/O address 102h and 103h.

I/O addresses below 100h should not be used, due to the potential for conflict with other devices.

OB2 controls the memory start address, lines A16 through A23, depending on memory size.

CDEN specifies whether the EXM is disabled or enabled. If disabled, the EXM does not respond to any I/O or memory addresses and does not assert an interrupt output; it only responds to reads from I/O port 100h and reads from and writes to I/O port 102h and 103h, and then only if EXM expansion interface line -EXMID is asserted.

I/O Space

The EXM-24 resides within the first 1024 bytes (1 Kbyte) of I/O space, specified by address lines A0 - A9.

Buffering

There is no DMA mode for the EXM-24.

On-board Processor Interface

Interface to the on-board 80C186 microprocessor is via on-board dual-ported memory, and through an I/O port address.

Software Compatibility

The EXM-24 is compatible with all DigiBoard drivers. Applicable drivers are provided with the hardware for installation on the host computer.

The core of the DigiBoard driver software is the FEPOS (Front End Processor Operating System). The EXM-24 has no BIOS of its own. The FEPOS performs this function.

Different limitations are placed on the FEPOS by different operating systems. Some of the major restrictions are listed below:

- ***Under the 1MB boundary:*** Under the 1MB boundary, only 128k may be used. Due to driver and other considerations, only one address range is possibly available for the full 128K, between C0000h and DFFFFh (depending on video mode used, if any), even though the EXM-24 can be configured for other addresses. If VGA video is present, only 64K can be used.

  For systems that cannot fit the entire 128K of memory into the address space, there is a configuration bit that directs the EXM-24 to act as if only 64k were installed. This also potentially opens the A0000h to AFFFFh region (again, depending on video usage).

  For applications with multiple boards, each may be configured in the same memory space. Individual boards may have their memory alternately enabled or disabled. Under DOS, the EXM-24 on-board dual-port memory must be addressed under the 1MB boundary, and FEPOS features are accessed via Interrupt 14.

- ***16 Bit Device:*** Because the EXM-24 is a 16-bit device, care must be taken when using it in the same 128K block as an 8-bit device. The EXM-24 dual port memory must be disabled (via the I/O port) before accessing the 8-bit device.

For a higher level of software support, third party software is available from at least one vendor, GreenLeaf Software, headquartered in Dallas, Texas. This is support software designed to run on the host CPU and interface with the DigiBoard FEPOS. Since the EXM-24 is DigiBoard compatible, GreenLeaf Software will work with the EXM-24.

DigiBoard also has separate products they provide at an additional charge to customers that wish to write their own drivers. These are the *Drivers Writer's Guide* and the *FEPOS Tool Kit*. DigiBoard can be contacted using the following information:

DigiBoard
6400 Flying Cloud Drive
Eden Prairie, MN 55344
(612) 943-9020
BBS: (612) 943-0812 (8,N,1; up to 9600 baud)

NOTES



5. Support and Service

In North America

Technical Support

RadiSys maintains a technical support phone line at (503) 646-1800 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 (503) 646-1850. The RadiSys E-mail address on the Internet is *support@radisys.com*. If you are sending E-mail or a FAX, please include information on both the hardware and software being used and a detailed description of the problem, specifically 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.

Bulletin Board

RadiSys operates an electronic bulletin board (BBS) 24 hours per day to provide access to the latest drivers, software updates and other information. The bulletin board is not monitored regularly, so if you need a fast response please use the telephone or FAX numbers listed above.

The BBS operates at up to 14400 baud. Connect using standard settings of eight data bits, no parity, and one stop bit (8, N, 1). The telephone number is (503) 646-8290.

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. 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 (503) 646-1800. 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 following address:

Product Service Center
RadiSys Corporation
15025 SW Koll Parkway
Beaverton, Oregon 97006-6902

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.

Other Countries

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

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