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EXM-29

RS422/RS485

Hardware Reference

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07-0187-01 December 1993

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October 1993

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NOTES

1. Product Description

This manual contains the information you need to install and use the EXM-29 RS422/RS485 serial-port interface.

The EXM-29 provides two RS-422/RS-485 serial ports. It is software compatible with the ICS FASTCOMM/422 dual port board, save for two exceptions. First, the EXM-29 is configured via programmable registers on the board, instead of via dip switches. Second, the EXM-29 does not have the capability of sharing interrupts across multiple boards. However, interrupt sharing between ports on the same board is available. Thus, once configured, the EXM-29 is capable of running any software developed for FASTCOMM/422 control, provided different boards use different interrupts.

Two DB-9 connectors on the front panel provide the port interfaces. In addition, LEDs on each port's transmit and receive lines provide a visual display of port activity.

Port input signals (RXD, CTS) can be terminated with on-board 100Ω resistors connected through a dip switch. Therefore, termination resistors can be switched in or out as needed.

Port outputs can be configured to be gated by the port RTS signal. CTS handshaking may be enabled or ignored for each port independently. Each port may be independently set for half-duplex mode (TXD and RXD signals connected together on the board).

Each port is controlled by a separate 82510 asynchronous serial controller, capable of running at baud rates up to 288K. Other features include 5-9 bit character formats, 4 byte independent transmit and receive FIFOs, and 16450 compatibility.

1 1

Specifications

The following table defines the environmental and electrical specifications of the EXM-29.

Characteristic		Value
Environmental Specifications		
Temperature	operating	0 to 60°C ambient
	storage	-40 to 85°C
Humidity	operating	5% to 90% non condensing
	storage	5% to 95% non condensing
Altitude	operating	10,000 ft (3,000 m)
	storage	50,000 ft (15,000 m)
Vibration	operating	0.015 inch (0.38 mm) Peak to Peak displacement with 2.5 g peak (max) acceleration over 5 to 2000 Hz
	storage	0.030 inch (0.76 mm) P-P displacement with 5.0 g peak (max) acceleration over 5-2000 Hz
Shock	operating	30 g, 11 ms duration, half-sine shock pulse
	storage	50 g, 11 ms duration, half-sine shock pulse
Electrical Specifications		
Current	typical	+5V @ 0.370A
	maximum	+5V @ 0.53A

Table 1. EXM-29 Environmental and Electrical Specifications.

2. Installation

Before installing your EXM-29, you should 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-29, 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 in an EXM Carrier

Insertion of the EXM-29 into an EXM carrier is straightforward. In the case of the EXP-MC, first ensure that the subplane has been inserted into the backplane and that the EXP-MC has been inserted into the subplane and attached to the chassis. Then remove any blank EXM panel from the carrier (by unscrewing the thumbscrews) and insert the EXM-29 into the card guides. Firmly press the EXM-29 front panel to ensure that it has mated with the rear connector, and secure it with the thumbscrews.

✉ **MAKE SURE THAT POWER TO YOUR SYSTEM IS OFF. THE 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.**

Configuration Using BIOS Setup Screen

2 2

The EXM configuration data in the EPC to which the EXM-29 is connected needs to be modified to recognize and enable the card and select from the available options. Invoke the BIOS setup function 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 Figure 1 below.

```
          ID OB1 OB2
Slot 0    FF  00  00
     1    DB  C1  00
     2    D2  AB  FF
     3    DE  01  00
     4    ED  01  00
     5    DC  F5  91
```

Figure 1. EXM Setup Screen.

The 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. The displayed data shows SLOT, ID, OB1 and OB2 for each installed EXM.

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 should show an ID of FF and OB1/OB2 of 00 00 indicating that no EXM is present. A typical value for the EXM-29 is shown in bold letters in slot 2.

Slot, OB1 and OB2 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-29 occupies. Note that dashed lines indicate EXM slots that may not be available on all systems.

EXM Slots

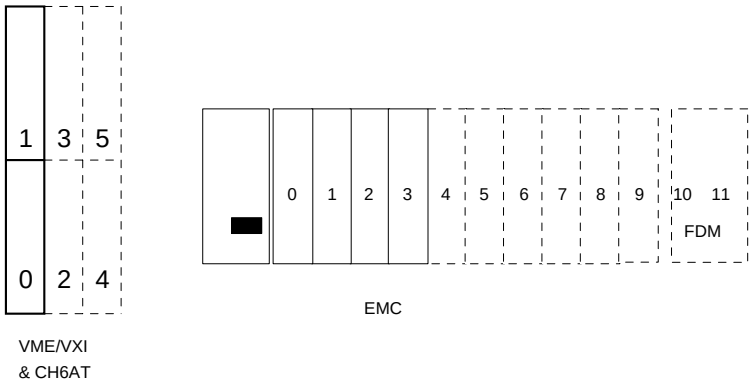


Figure 2. EXM Slot Numbering.

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

OB1/OB2 are two bytes of option information.

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-29 is **D2**h.

OB1 and OB2 are two bytes of option information.

OB1 is a hexadecimal value derived by combining the following:

Resrvd (bit 7)	Port 2 IRQH (bit 6)	Port 2 IRQM (bit 5)	Port 2 IRQL (bit 4)	Port 1 IRQH (bit 3)	Port 1 IRQM (bit 2)	Port 1 IRQL (bit 1)	Card Enable (bit 0)
Set to 1	See below	See below	See below	See below	See below	See below	0 - disable 1 - enable

Table 2. OB1 Configuration Bit Definition.

IRQ settings are displayed in the following table:

Setting	IRQ
000	none
001	none
010	IRQ9(2)
011	IRQ3
100	IRQ4
101	IRQ5
110	IRQ6
111	IRQ7

Table 3. IRQ Settings for OB1.

For instance, a typical OB1 value is **AB**h (10101011), representing Port 2 set to IRQ9(2), Port 1 set to IRQ5, and card enabled.

OB2 is a hexadecimal value derived by combining the following:

Resrvd (bit 7)	Port 2 RTS (bit 6)	Port 2 CTS (bit 5)	Port 2 RS485 (bit 4)	Resrvd (bit 3)	Port 1 RTS (bit 2)	Port 1 CTS (bit 1)	Port 1 RS485 (bit 0)
Set to 1	See below	See below	0 - RS422 1 - RS485	Set to 1	See below	See below	0 - RS422 1 - RS485

Table 4. OB2 Configuration Bit Definition.

The OB2 register holds the RS-422/RS-485 select bits (bits 0 and 4) for each port; the CTS handshaking enable bit for each port (bits 1 and 5); and the RTS gate enable bits for each port (bits 2 and 6). When configured for RS-485, the board is set up in half-duplex mode (i.e., the TX+ and TX- lines are connected to the RX+ and RX- lines, respectively).

The CTS handshaking bits (bits 1 and 5) enable or disable CTS handshaking. The default setting of 0 represents CTS enabled, and 1 represents CTS disabled.

The RTS gate enable bits (bits 2 and 6) disable or enable the RTS signal control of the port line drivers. The default setting of 0 disables the RTS gate enable bits, while a 1 enables the RTS gate enable bits. When enabled, the line drivers are enabled/disabled by the state of the RTS signal.

For instance, a typical OB2 value is **FF**h (11111111), representing RTS gate enable mode is enabled, CTS is disabled and RS-485 is enabled for Port 2 and Port 1.



OB3

This register is located at 104h and holds the base I/O address select bits for the 8 bytes of I/O space needed by port 1 of the EXM-29.

104h

A10	A9	A8	A7	A6	A5	A4	A3

These bits directly correspond to address lines SA3-SA10 on the system bus. SA15 is decoded as well ('0' expected), to prevent conflict with certain RadiSys VXI bus I/O registers.

Note that this register is not configurable from the BIOS setup screen, thus must be programmed after the system boots, if the default address of 3E8 (OB3 = 7Dh) is not acceptable. See the section on *I/O Base Address Configuration* for information both on the default address and programming considerations.

CAUTION The contents of the OB3 register are NOT battery-backed. This register returns to the default value on power-up.

OB4

This register is located at 105h and holds the base I/O address select bits for the 8 bytes of I/O space needed by port 2 of the EXM-29.

105h

A10	A9	A8	A7	A6	A5	A4	A3

These bits directly correspond to address lines SA3-SA10 on the system bus. SA15 is decoded as well ('0' expected), to prevent conflict with certain RadiSys VXI bus I/O registers.

Note that this register is not configurable from the BIOS setup screen, but must be programmed after the system boots, if the default address of 2E8 (OB4 = 5Dh) is not acceptable. See the section on *I/O Base Address Configuration* for information both on the default address and programming considerations.

CAUTION The contents of the OB4 register are NOT battery-backed. This register returns to the default value on power-up.

If you change the configuration of the ports, make sure they do not conflict with other used I/O addresses. In case of conflict, a hardware reset returns the port base address to the default.

I/O Base Address Configuration

The EXM-29 port base addresses are set in Option Byte Registers 3 and 4. These bytes are not configurable from the BIOS setup screen, but must be set via software, unless the default values are acceptable.

The default values are **7D**h for Option Byte Register 3 (corresponding to an I/O base address of **3E8**h for port 1), and **5D**h for Option Byte Register 4 (corresponding to an I/O base address of **2E8**h for port 2).

Because these registers are part of the EXM configuration space, changes must be preceded by a write to the register at address 96h. This register must be written with the slot number in which the EXM-29 to be configured resides.

Therefore, changing the base address for a port is a two step process. First, address 96h is written with the appropriate slot number. Then, the appropriate Option Byte Register is written with the correct value. Refer to Figure 2 for slot numbering.

To facilitate this process, software is provided with the EXM-29 for easy configuration under DOS. The executable file EXM29CFG.EXE accepts up to four parameters (optional "quiet" mode for no message display, the slot number, the port 1 base address to set, and the port 2 base address to set). Invoking this executable from within the AUTOEXEC.BAT file on boot up essentially provides the same effect as if the I/O base addresses were configured from the BIOS setup screen.



Invocation of the EXM29CFG.EXE program is as follows:

exm29cfg [/q] [/slot:<val>] [/ob3:<val>] [/ob4:<val>]

Options may be preceded by either a forward slash, '/', or a hyphen, '-'. Options may be added in any order. Values are always separated from the option by the colon, ':'.

Integer or hexadecimal values must not be preceded or trailed by additional characters or padding. For example, the value **3E8**h must be entered as '3E8', not '0x03E8' or '3E8h'. Zero must be entered as '0', not '00'. Options and values are case-insensitive.

On encountering this, the program exits and displays a summary of options without fully invoking the program.

Options are not required. All have default values. One special option is pre-defined. This is the '?' option. A quick review of the default values can be obtained by invoking the program with the summary option, '/?'. Any option not explicitly set will be treated as though it were set with the default value.

Default values are:

OB3	3F8h
OB4	2F8h
slot	slot 0

Options:

/q - This option directs the program not to display any messages while running or upon completion, except in the case of error. This is useful when the program is invoked from AUTOEXEC.BAT.

/slot - This is the slot in which the EXM-29 to be configured resides. This should be an integer value.



/ob3 - This guides the value for the Option Byte 3 register. The value associated with this option should be the I/O address, in hexadecimal, at which EXM-29 port 1 will be based. The program will take care of adjusting this address such that the appropriate value is loaded into the Option Byte 3 register.

/ob4 - This guides the value for the Option Byte 4 register. The value associated with this option should be the I/O address, in hexadecimal, at which EXM-29 port 2 will be based. The program will take care of adjusting this address such that the appropriate value is loaded into the Option Byte 4 register.

Example:

Assuming an EXM-29 in slot 3, to configure the port 1 base address at 2A0h, and the port 2 base address at 2B8h, the program would be invoked as follows:

```
exm29cfg /slot:3 /ob3:2a0 /ob4:2b8
```

3. Connectors

3 3

DB-9 Connectors

The EXM-29 has two standard female DB-9 connectors. The signals are shown below.

Pin	Signal
1	Ground
2	RTS+
3	RTS-
4	TX+
5	TX-
6	CTS-
7	CTS+
8	RX+
9	RX-

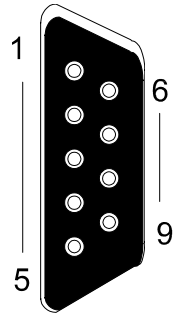


Table 5. DB-9 Pin-out.

LEDs

Two diagnostic LEDs for each port monitor transmit (red) and receive (green) activity, respectively.

NOTES



4. Operation

RS-422/RS-485 Operation

While the RS-232 interface is a widely-known standard that most engineers have worked with, RS-422 and RS-485 are less common. This section will detail some of the differences and similarities between the three standards.



The RS-422 standard was developed to improve several aspects of the RS-232 standard. One of the chief problems with RS-232 is that cable lengths are restricted to less than 50 feet at speeds of 9600 baud or more. Second, RS-232 cables in an industrial setting tend to pick up errors due to electromagnetic interference and other line noise. Fluorescent lights, transformers, electric motors, and other sources of static and interference can induce significant errors into the system. Third, RS-232 data rates are functionally limited to 19,200 baud.

Using RS-422 devices, cable lengths can reach 5,000 feet, and line noise is significantly reduced. RS-422 cables tend to be immune to background interference. Data rates are greatly improved due to changes in the way data is driven and received. RS-422 uses a differential scheme that vastly improves on the single-ended method used in the RS-232 standard.

Under RS-232, the transmit signal was simply TX; in RS-422 transmitting is a differential signal consisting of TX+ and TX-. Similarly, receiving is transformed from simple RX to RX+ and RX-.

Under both RS-232 and RS-422 two devices cannot share a single cable. Thus the RS-485 standard is yet another improvement. RS-485 offers all the benefits of RS-422 and also allows up to 32 units to share the same twisted pair cable.

Termination Resistance

In both RS-422 and RS-485 mode, the receiver end of the cable between two stations must be terminated with a resistor equal to the characteristic impedance of the wire. This is to prevent signal reflections in the wire and to improve noise rejection. However, you do not need to add a terminating resistor to your cables when using the EXM-29, because termination resistance is built in between RX+ and RX- and between CTS+ and CTS-.

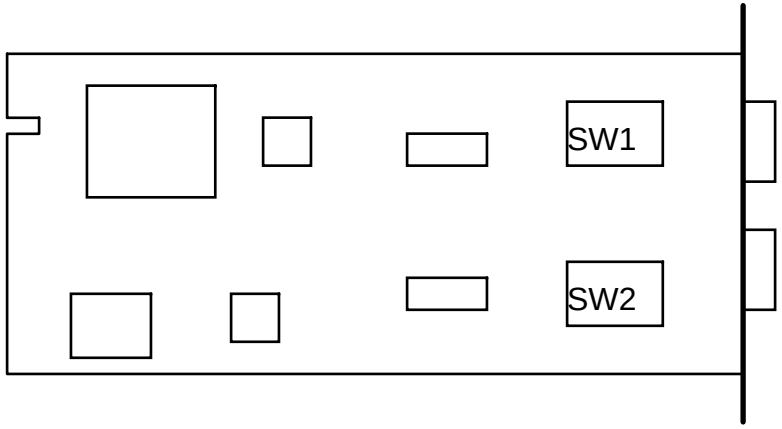


Figure 3. Location of SW1 and SW2 Terminating Resistors.

Serial port A is terminated via SW1, and serial port B is terminated via SW2. The switch consists of two white dip switches, as shown in the figure below.

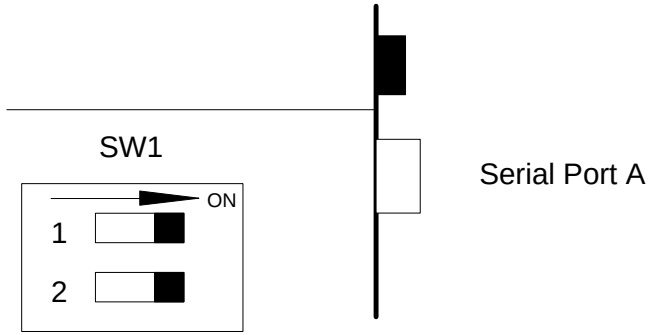


Figure 4. Switch 1 Settings.

When the dip switches are pushed on (toward the front panel), the signals are terminated. Refer to the figure below.

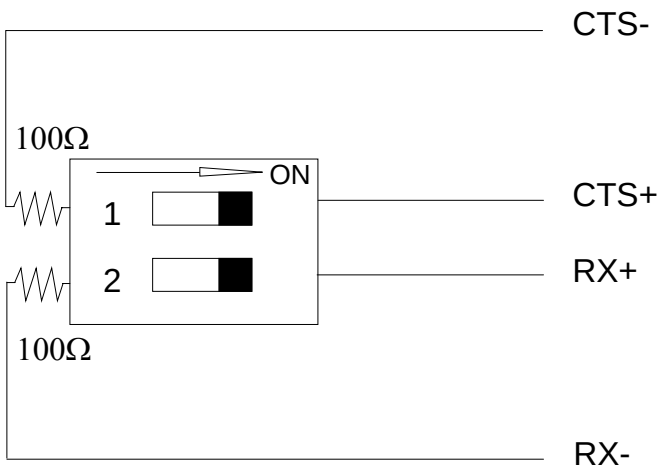


Figure 5. Signal Termination.

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.

5 5

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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