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EXM-21

D/A Converter Module

Hardware Reference

RadiSys® Corporation

15025 S.W. Koll Parkway

Beaverton OR 97006

(503) 646-1800

FAX: (503) 646-1850

07-0150-01 August 1993

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March 1993

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1. Product Description

This manual contains the information required to install and use the EXM-21 digital-to-analog converter expansion module.

The EXM-21 is a dual, 12-bit digital-to-analog (D/A) EXM expansion interface card. It contains an EXM expansion interface, two 12-bit D/A converters, output amplifiers, and a reference generator. The output stages of the EXM-21 provide unipolar or bipolar outputs up to ±10V, and a 4-20mA current loop. A DC-DC converter is provided for +5V only operation.

The EXM-21 is software- and output-compatible with the Keithley Metrabyte DAC-02 card (with the exception of calibration procedures -- refer to Chapter 3). The EXM-21 contains a female DB-25 connector on the face plate, along with four trimpots accessible through the front panel.

WARNING!

DO NOT PLUG IN ANY CABLE OR CONNECTOR INTO THE FRONT PANE CONNECTORS WHILE THE EXM-21 IS POWERED UP. THIS SYSTEM IS N DESIGNED FOR "HOT INSERTION" WHILE THE SYSTEM IS POWERED UP, AND IS NOT DESIGNED TO WITHSTAND POTENTIAL DAMAGE THAT COULD ARISE FROM FLUCTUATIONS IN POWER. NEVER PLUG IN A SERIAL OR PARALLEL DEVICE, KEYBOARD, TRANSCEIVER, OR OTHER COMPONENT WHILE THE SYSTEM IS ON.

1 1

Specifications

The following tables define the specifications of the EXM-21.

Characteristic		Value
Environmental		
Temperature	operating	0° to 60° C (* see below)
	storage	-40° to 125° C
Humidity	operating	0 to 95% (non-condensing)
	storage	0 to 95% (non-condensing)
Vibration	operating	.015"PP 2.5g (max) 5 to 2000 Hz
	storage	.030"PP 5g (max) 5 to 2000 Hz
Shock	operating	30g 11 msec duration
	storage	50g 11 msec duration
Electrical		
Current	maximum	+5V @ 600 mA
	typical	+5V @ 400 mA
10V Reference Generator	initial accuracy	± 10.5 mV
	temperature coefficient	3 ppm typical, 50 ppm max
	LT stability	15 ppm typical
5V Reference Generator	initial accuracy	± 7.5 mV
	temperature coefficient	3 ppm typical, 50 ppm max
	LT stability	15 ppm typical
Fuse	External +5V	Schurter OMF 2A (socketed)

Table 1. EXM-21 Environmental and Electrical Specifications.

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

Refer to Table 2 below for output range specifications.

Description		Specification
System		
Channels		2
Resolution		12 bit (1 part in 4096)
I/O Address		Software-configured on any 8-bit boundary
Relative Accuracy		1/2 LSB (0.01% of output voltage) maximum
Current Loop		4 mA to 20 mA
Differential Linearity		1/2 LSB maximum
Output Ranges when using Internal -5V Reference		Unipolar: 0V to +5V Bipolar: -5V to +5V
Output Ranges when using Internal -10V Reference		Unipolar: 0V to +10V Bipolar: -10V to +10V
Reference		
DC Reference Input Range		0 maximum to -10V minimum
Variable Reference Input Range		± 10V maximum
Reference input resistance		7 K Ohm minimum 11 K Ohm typical 20 K Ohm maximum
Output		
Output Amplifiers Offset	unipolar	< 50 uV unipolar @ 25 °C < 120 uV unipolar 0° to 60 °C
	bipolar	< 100 uV bipolar @ 25 °C < 240 uV bipolar 0° to 60 °C
Voltage output impedance		0.1 ohm maximum
Voltage output drive current		± 5 mA minimum
Current Loop		
Current Loop Compliance Voltage		8V to 36V
AC Reference		
AC Reference Operation		± 10V, 2-quadrant and 4-quadrant
Feed through		5 mV @ 10 KHz, ± 5V Reference typical

Accuracy/Frequency	12 bit (0-1 KHz Reference)

Table 2. Output Specifications

NOTES



2. Installation

2 2

Before installing the EXM-21, 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-21, 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

Remove a blank EXM panel from the carrier (by unscrewing the thumb-screws) and insert the EXM-21 into the card guides. Firmly press the EXM-21 front panel to ensure that the module is properly seated in the subplane and secure it with the thumbscrews. Do not over-tighten 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.**

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

2 2

Configuring the BIOS Setup

Once the EXM-21 has been installed and the system has been booted, configure the BIOS setup. The EXM configuration data in the EPC 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. EPC system configuration procedures differ slightly depending on BIOS versions.

Enabling the EXM module

Once in the BIOS setup program, a menu displays specifying which function keys are available for further configuration. Press the **F2** function key to invoke the EXM setup screen. A screen similar to the following displays:

```
          ID OB1 OB2
Slot 0    FF  00  00
     1    DB  C1  00
     2    DA  93  00
     3    DE  00  39
     4    F5  05  00
     5    DC  F5  00
```

Figure 1. EXM Setup Screen

This 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. These are defined as follows:

SLOT — indicates the slot in which the EXM is installed. See the diagram below to determine which slot the EXM occupies.

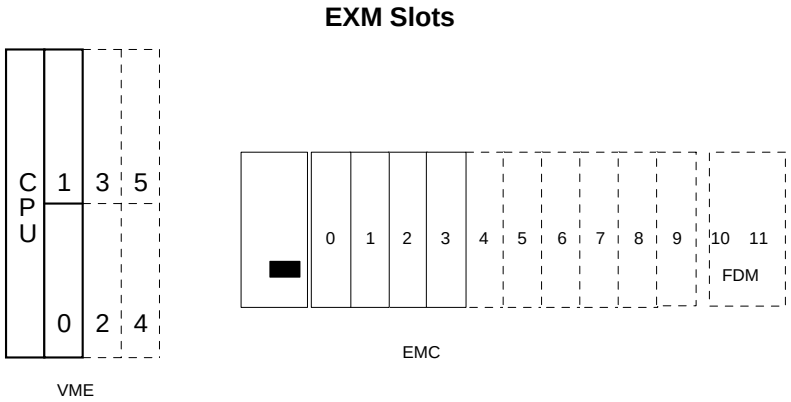


Figure 2. EXM Slot Numbering

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-21 should be set to **DA**.

2 2

OB1

OB1 is a hexadecimal value derived by combining the following:

Base I/O Address (bits 7-1)	Card Enable (bit 0)
Refer to Table 4.	0 - Card Disabled 1 - Card Enabled

Table 3. OB1 Register

Base I/O Address - Use these bits to set the value for the base I/O address of the EXM-21 programming registers. The base I/O address is a single setting large enough for a four-address range, four bytes in total length. The Base I/O address must be in the range 100h-3FCh, and is the sum of the bit values for each set bit as shown below:

bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1
200h	100h	80h	40h	20h	10h	8h

Table 4. Base Address Conversion

For example, a typical address setting for bits 7-1 might be 1001001, so that the base address equals the following:

200h + 40h + 8h = 248h.

Make sure that the base I/O address chosen for the EXM-21 does not conflict with any other modules that use a base I/O address (or range). Some common base I/O address ranges to avoid are the following:

1F0-1FF	IDE disk controller
278-27F	Parallel port (LPT2)
2E8-2EF	Serial port (COM4)
2F8-2FF	Serial port (COM2)
378-37F	Parallel port (LPT1)
3E8-3EF	Serial port (COM3)
3F0-3F7	Floppy disk controller
3F8-3FF	Serial port (COM1)

Card enable - This bit determines whether the EXM-21 is enabled or disabled at power-up. The default is 1, which enables the card.

Thus, a typical OB1 value is **93**h, indicating the card is using address 248h and the card is enabled.



OB2

OB2 is not used by the EXM-21 and should be set to **00**.

NOTES

3. Theory of Operation

Basics of EXM-21 Operation

The EXM-21 uses Analog Devices AD7548 D/A converters (or compatible). The inputs to the A/D converter are a negative reference voltage (Vref) and a digital value between 0 and 4096. The A/D converter outputs a voltage between 0 volts and -(Vref) volts, proportional to the digital value programmed.

Typically, a DC voltage is used as a reference to generate a single DC output voltage for each digital value programmed into the D/A converter. An AC reference may also be used to generate a variable output voltage for each digital value. One use of this is in synchro-digital and resolver applications for sine/cosine generation. Specific applications of an AC reference are beyond the scope of this manual.

The amplifier section of the EXM-21 buffers the output of the D/A converter and provides conversions to the bipolar or current loop outputs. When using an AC Reference, the outputs are termed 2-Quadrant (unipolar output) and 4-Quadrant (bipolar output). Figure 3 shows that a 2-Quadrant signal is made by varying the reference voltage between positive and negative voltages, and by keeping the programmed value positive. When using the 4-Quadrant (Bipolar) output, the programmed value can be programmed to be a negative value as well.

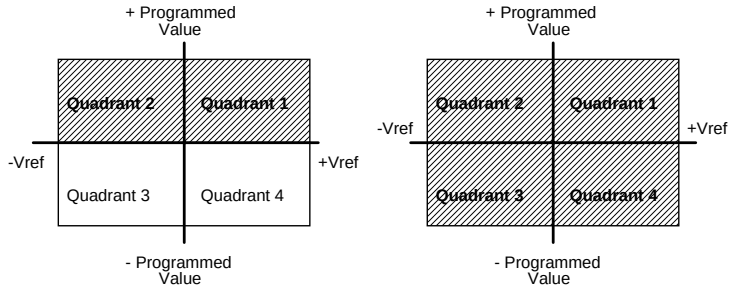


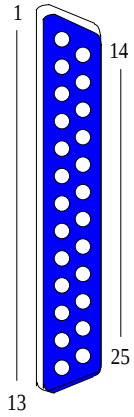
Figure 3. Two-quadrant and Four-quadrant operation.

Each D/A converter of the EXM-21 is calibrated separately, and must be re-calibrated for each new reference source or reference voltage used.

External Connections to the EXM-21

Front Panel Connector

The front panel of the EXM-21 has a DB-25 connector which is compatible with the Keithly Metrabyte DAC-02 connector.



Pin	Signal	Pin	Signal
1	Digital ground	14	-10V Reference
2	Analog ground	15	-5V Reference
3	Analog ground	16	D/A #1 Ref Input
4	Analog ground	17	D/A #1 Bipolar Output
5	Analog ground	18	D/A #1 Unipolar Output
6	Analog ground	19	D/A #1 4-20 mA Output
7	Analog ground	20	-10V Reference
8	Analog ground	21	-5V Reference
9	Analog ground	22	D/A #0 Reference Input
10	Analog ground	23	D/A #0 Bipolar Output
11	Analog ground	24	D/A #0 Unipolar Output
12	Analog ground	25	D/A #0 4-20 mA Output
13	Fused +5V		

Table 5. DB-25 Pin-out

Reference Voltages

The Reference voltage for each D/A converter is supplied through the front panel connector and may be connected to one of the internal references supplied on pins 14 & 15 and pins 20 & 21, or to an external reference source.

When using the current loop output, the internal -5V reference must be used.

The internal reference generators produce stable -5V and -10V reference voltages from a laser-trimmed -10V source.

Analog Outputs

Three types of analog outputs are provided for each D/A converter: unipolar, bipolar and current loop. The unipolar output has a range between 0V and -(Vref). The bipolar output has a range between (Vref) and -(Vref). The current loop has a range between 4mA and 20mA.

When using the current loop output, an external voltage source must be supplied to source the current. Two typical current loop configurations are shown in Figure 4. In each configuration, the current is measured by measuring the voltage across the resistor R. Note that when using the current loop output, a minimum of 8 volts relative to the EXM-21 analog ground must be present at the current loop output pin at all times.

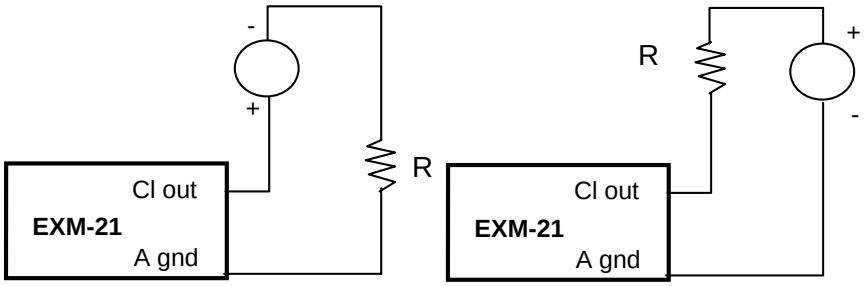


Figure 4. Typical Current Loop Configurations.

When using an AC reference, a 2-Quadrant output may be taken from the unipolar output, or a 4-Quadrant output may be taken from the bipolar output.

The following tables summarize all output ranges which use the internal EXM-21 references, as well as formulas for external reference voltages.

					Output		
D/A	Output Mode	Out-put Pin	Int Vref	Int Vref Conn	Min	Max	Step Size (1LSB)
D/A #0	Unipolar 0-5V	24	-5V	21-22	0.00V	4.99878V	1.221 mV
D/A #1	Unipolar 0-5V	18	-5V	15-16	0.00V	4.99878V	1.221 mV
D/A #0	Unipolar 0-10V	24	-10V	20-22	0.00V	9.99756V	2.441 mV
D/A #1	Unipolar 0-10V	18	-10V	14-16	0.00V	9.99756V	2.441 mV
D/A #0	Bipolar ± 5V	23	-5V	21-22	-4.99756V	5V	2.441 mV
D/A #1	Bipolar ± 5V	17	-5V	15-16	-4.99756V	5V	2.441 mV
D/A #0	Bipolar ± 10V	23	-10V	20-22	-9.99512V	10V	4.883 mV
D/A #1	Bipolar ± 10V	17	-10V	14-16	-9.99512V	10V	4.883 mV
D/A #0	Current Loop	25	-5V	21-22	4 mA	19.996 mA	3.906 µA
D/A #1	Current Loop	19	-5V	15-16	4 mA	19.996 mA	3.906 µA

Table 6. Output Ranges for Internal References.

Output Mode	Vref	Min	Max	Step Size (1LSB)
Unipolar	Ext	0.00V (when DAC value = 0)	-Vref * (4095 / 4096) (when DAC value = 4095)	-Vref /4096
Bipolar	Ext	Vref * (2047/ 2048) (when DAC value = 4095)	-Vref (when DAC value = 0)	-Vref /2048
2 Quadrant	AC	0.00V	-Vref * (4095 / 4096)	-
4 Quadrant	AC	Vref * (2047/2048)	-Vref	-

Table 7. Output Ranges for External References.

EXM-21 Programming Interface

Registers

The EXM-21 is programmable at the register level using I/O (Input/Output) instructions.

Data format for the D/A registers is as follows:

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Low Byte (Least Significant Byte):								
Base + 0 or 2	B3	B2	B1	B0	x	x	x	x
High Byte (Most Significant Byte):								
Base + 1 or 3	B11	B10	B9	B8	B7	B6	B5	B4

Table 8. D/A Registers Data Format

Registers *Base+0* and *Base+1* are for D/A #0 and registers *Base+2* and *Base +3* are for D/A #1. These registers are write-only and cannot be read. The low byte is written first (*Base+0* or *Base+2* register) followed by the high byte (*Base+1* or *Base+3* register). When the low byte is written, the data is stored in an intermediate register. When the high byte is written, the entire 12 bit word is loaded into the D/A converter and the output voltage changes.

Note that for unipolar and current loop outputs, the output voltage or current is proportional to the programmed value. However, for the bipolar output, the voltage is inversely proportional to the programmed value. For example, if a programmed value of 0 is written to the D/A converter, the resulting bipolar output voltage would be the maximum positive voltage. If 2048 is written, the resulting bipolar output voltage would be 0.00 volts. If 4095 is written, the resulting bipolar output voltage would be the maximum negative voltage.

3 3

Programming Example

The following programming example is written in Microsoft *C*. The only command which is dependent on the Microsoft version is the `outp` command which writes a byte to an I/O port. The syntax of this command is:

```
int outp( unsigned port_adrs, int value);
```

Descriptions of each function of the example are included in the comments before the functions.

```
/*
 * Function:    Set_DAC
 *
 * Description: Writes a 12bit value to the D/A converter specified.
 *
 * Parameters:  exm21_base      Base address of the EXM-21
 *              dac             EXM-21 D/A Converter to use (0 or 1)
 *              count           Digital value to write (0 to 4095)
 *
 */
void
Set_DAC( unsigned int exm21_base,
         unsigned short dac,
         unsigned short count )
{
        outp((exm21_base + 2 * dac), (count << 4));
        outp((exm21_base + 2 * dac + 1), (count >> 4));
}

/*
 * Function:    Set_DAC_Volts
 *
 * Description: Writes a value to the D/A converter specified to
 *              generate a given voltage.
 *
 * Parameters:  exm21_base      Base address of the EXM-21
 *              dac             EXM-21 D/A Converter to use (0 or 1)
 *              volts           Output voltage specified (in volts).
 *              vref            Reference voltage connected to
 *                              D/A converter.
 *              unipolar        TRUE if Unipolar output,
 *                              FALSE if Bipolar.
 */
void
Set_DAC_Volts( unsigned int exm21_base,
               unsigned short dac,
               double volts,
               double vref,
               unsigned short unipolar )
{
        unsigned short count;

        if( unipolar ){
```

```
                count = -(double) 4096 * volts / vref;
                Set_DAC( exm21_base, dac, count);
        } else {
                count = -(double) 2048 *( (double)1 + volts/vref);
                Set_DAC( exm21_base, dac, count);
        }
}

/*
 * Function:    Set_DAC_CL
 *
 * Description: Writes a value to the D/A converter specified to
 *              generate a given current at the Current Loop output.
 *
 * Parameters:  exm21_base      Base address of the EXM-21
 *              dac             EXM-21 D/A Converter to use (0 or 1)
 *              mamps           Output current specified (in mA)
 *                              (4mA to 20mA)
 */
void
Set_DAC_CL(    unsigned int exm21_base,
               unsigned short dac,
               double mamps )
{
        unsigned short count;

        count = (double) 256 * mamps - (double)1024;
        Set_DAC( exm21_base, dac, count);
}
```



Calibration

Calibration of the EXM-21 should be performed periodically to maintain the highest accuracy, or whenever a new reference voltage or reference source is used. The EXM-21 is calibrated at the factory using the internal -10V reference for the unipolar and bipolar outputs.

For laboratory environments, the EXM-21 should be re-calibrated at a six-month to one year interval. For more rigorous conditions where extremes of temperature, vibration or humidity are encountered, a three-month interval is recommended.

The location of the trimpots used during calibration is shown in Figure 5.

3 3

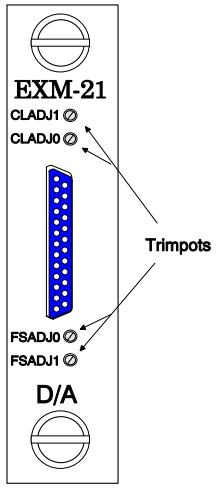


Figure 5. Trimpot Locations

Calibration Procedure

Note: This calibration procedure assumes the use of and familiarity with MS-DOS commands, especially the `DEBUG` utility provided with MS-DOS. If this is not available, please contact RadiSys Customer Service for additional MS-DOS software which may be used to calibrate the EXM-21.

Equipment Required:

- RadiSys EMC or EPC system including CPU, video adapter, monitor, keyboard and disk drive
- Non-metallic slotted calibration tool
- Male DB-25 connector with connections to internal or external references as required by the specific application. For AC reference applications, the AC source should be used with the input set to its peak output voltage that will be used. (See Selecting Output Ranges, page 14)
- Digital Volt Meter (DVM) and Digital Current Meter (DCM) accurate to 5 digits
- Voltage source capable of sourcing up to 10mA at 8V or greater.
- MS-DOS and DOS `DEBUG` utility.

Procedure:

Vref0 = Reference voltage for DAC#0
Vref1 = Reference voltage for DAC#1

1. Install the EXM-21 into the RadiSys computer system and configure the BIOS setup screen. (See Chapter 2).

   (All DEBUG programming examples will assume the EXM-21 base address is at 248h.)

   Install the Male DB-25 connector with application references attached.

2. Power up the RadiSys computer system and boot to DOS. At the DOS prompt, type DEBUG.

3. Program DAC #0 and DAC #1 to 4095. In debug, type:
   ```
   -o 248 ff
   -o 249 ff
   -o 25a ff
   -o 25b ff
   ```

4. Connect the DVM (+) lead to the DB-25 at pin 24. Connect the DVM (-) lead to the DB-25 at pin 2.

5. Calculate the calibration voltage for channel 0 as follows; write the result in the space provided.
   V0cal = -Vref0 * 0.999756 = _____

6. Adjust FSAJ0 on the EXM-21 front panel until the DVM matches the value calculated in step 5.

7. Connect the DVM (+) lead to the DB-25 at pin 18. Connect the DVM (-) lead to the DB-25 at pin 2.

8. Calculate the calibration voltage for channel 1 as follows; write the result in the space provided.
   V1cal = -Vref1 * 0.999756 = _____

9. Adjust FSAJ1 on the EXM-21 front panel until the DVM matches the value calculated in step 8.

If your application is not using current loop outputs, the EXM-21 is now calibrated for your application. To use the current loop outputs, the -5V internal reference must be used. Continue with step 10.

10. Program DAC #0 and DAC #1 to 0. In debug, type:

```
-o 248 0
-o 249 0
-o 25a 0
-o 25b 0
```

11. Connect the DCM (+) lead to the Voltage source output.
    Connect the DCM (-) lead to the DB-25 at pin 25.
    Connect the Voltage source ground to the DB-25 at pin 2.

12. Adjust CLAJ0 on the EXM-21 front panel until the DVM reads 4.000 mA.

13. Connect the DCM (+) lead to the Voltage source output.
    Connect the DCM (-) lead to the DB-25 at pin 19.
    Connect the Voltage source ground to the DB-25 at pin 2.

14. Adjust CLAJ1 on the EXM-21 front panel until the DVM reads 4.000 mA.

The EXM-21 is now calibrated.

4. 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 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.

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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. 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

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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