MOORE INDUSTRIES

DRM/DTM

Data Recorder Module
Data Transfer Module

USER'S MANUAL

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DRM/DTM

Introduction

Moore Industries' Data Recorder Module (DRM) is a battery-powered, programmable, signal recorder designed to digitally store a process current or voltage.

The input signals applied to the DRM are stored in random access memory (RAM). This data is viewed (interrogated) with an IBM-PC®, or compatible computer, or transferred to the Data Transfer Module (DTM) for interrogation at a later time and more convenient location. The DRM is user-programmable using special DRM software and an IBM-compatible computer.

This manual contains programming, installation, and operation information for the DRM and DTM. Notes and Cautions are provided throughout this manual to help the user avoid minor inconveniences and equipment damage.

Description

The DRM is a microprocessor-based device designed to collect, process, and store current readings in the range of 0-20 mA or voltage readings in the range of 0-1, 0-5 or 0-10 Vdc.

To retrieve stored data, the DRM must be connected to a computer or to a DTM. The DTM is used to extract data stored in DRM's and transfer it to an IBM-PC, or compatible computer, for *interrogation*. The DTM has enough internal RAM that it can retrieve data from as many as 15 DRM's before requiring a complete transfer to a computer.

The DRM Support Software (supplied with the unit) provides a user-friendly interface by which the user retrieves stored data and programs the DRM. Some of the programmable items include: the DRM ID code, time and date, recording rate, alarm logging, and type statistical data to be recorded. To effectively utilize the DRM Support Software, the user must be familiar with the general operating procedures used in the MS-DOS® operating system for the IBM-PC family of personal computers. *(Refer to your system documentation for specific operating details on MS-DOS.)*

Data retrieved from a DRM, or the DTM, is interogated using the support software. This software performs the necessary computations to display graphs, print data, and store recorded data on disks.

A miniature, 9-pin, D-type connector on the front of the DRM is used to interface it to the computer (using a special RS-232C cable) or to a DTM.

The DRM has separate connections for the input signal, external power source (optional), and a relay output that indicates fault conditions. The input, power, and relay output connections are made to removable terminal blocks at the front of the DRM. Each block facilitates two wire connections and is 'keyed' to seat in only one orientation. Current input models feature a Removable Terminal Block with Diode (RTBD), which allows removal of the DRM while maintaining loop continuity.

The DRM is packaged in a compact, all-aluminum, DIN-style housing that snaps directly onto standard DIN rails. This housing style is ideal for high-density installations.

Both the DRM and the DTM are battery-powered devices, but only the DRM can use an optional external power source, which prolongs the life of the internal batteries. Using an external power source is especially beneficial when the DRM is interfaced to a computer, because the communications mode consumes battery power rapidly.

Table 1 contains the DRM specifications, including information on power requirements, input signal characteristics, and environmental conditions. Table 2 contains the DTM specifications.

Serial Number. Moore Industries maintains a complete history on every unit it sells and services. This information is keyed to the serial number. When service information is required on the DRM or DTM, you must provide the factory with the serial number of the unit(s) in question. The DRM serial number is on a label affixed to the left-side panel of the unit. The DTM serial number is on a label affixed to the bottom end-plate of the unit, which is visible by removing the rubber end-cap.

Table 1. DRM Specifications

Characteristic	Specification
Input	Specific range configured via DRM Support Software **Current: 0-20 mA** (will withstand up to 35 mA without damage) *Input Impedance:* 50Ω nominal; *Voltage Drop:* 1 volt nominal for 20 mA input **Voltage: 0-1, 0-5, or 0-10 Vdc** *Input Impedance:* 1 MΩ, nominal
Output	**RS-232C** compatible serial communication interface *Bit Format:* 1 start, 8 data, 1 stop *Baud Rate:* 300, 1200 or 9600; auto selected (unit automatically adapts to host computer) *Connector:* 9-pin, miniature, D-type receptacle connector
Power	**External: 9-42 Vdc**; 5 mA, typical (45 mW, nominal) **Internal Power:** Two 3.5-Vdc, 1.7-Ah, replaceable Lithium batteries (SAFT LITHIUM LS6-BA, or equivalent) *Operating Life:* At 25 °C (77 °F), minimum of 3 years when unit is used exclusively for data gathering *Battery Shelf-life:* 5 years *Storage Capacitor:* A capacitor is included with the unit which allows 60 seconds to replace batteries without loss of data *Backup:* With external power applied, internal batteries are not used; when external power is removed, unit operates exclusively on internal power
Performance	**Storable Values:** Records any combination of minimum, maximum, and average values (which are user-selectable) from all samples taken over the recording interval **Memory Capacity:** Stores 1600, 3238, or 6500 values (user-selectable); maximum of 6100 values with alarm logging selected **Recording Interval:** Can range from once every second to once every eight hours (user-selectable); value chosen must divide evenly into 24 (hours) **Sample Rates:** Samples input once per second regardless of recording interval **Sample Accuracy:** *Current Units*, ±0.004% of span/°C for 0 to 50 °C (32 to 122 °F) ambient; *Voltage Units*, ±0.008% of span/°C; if below 0 °C (32 °F), slight degradation of accuracy will result; 0-10 Vdc Units, ±0.02% of span/°C **Resolution:** 0.1% (10 bits) **Isolation:** Output is opto-isolated from the case, power, and input; 500 Vac continuous **Common Mode Noise Rejection:** *Current Units;* 100 dB, with 100Ω unbalanced; *Voltage Units*, 75 dB; *Normal mode:* 30 dB at 60 Hz, 100Ω source **RFI/EMI Protection:** Less than ±0.1% of span change in any data value with field strengths of 10 volts per meter and frequencies from 20 to 500 MHz per SAMA Standard 33.1
Adjustments	Via internal potentiometers **Zero:** *Current Units*, ±1.5% of span, nominal; *Voltage Units*, ±1% of span, nominal **Span:** *Current Units*, ±2% of span, nominal; Voltage *Units*, ±1% of span, nominal
NOTE: Refer to the Installation Section of this manual for the unit's outline dimensions.	

Table 1. DRM Specifications (Continued)

Characteristic	Specification
Clock	**Accuracy:** 0.1% of total recording period **Programmable Clock:** Calendar clock in month/day/year and hour/minute/second is user-selectable via DRM Support Software; a separate stored clock value gives date and time of last user programming change
Alarm	**Type:** Low-power transistor (FET) switch *Maximum Voltage:* 30 Vdc *Maximum Current:* 100 mA *On/Off Impedance:* 15Ω/1 MΩ, nominal *Threshold:* Trip points for HI and/or LO alarms are user-selectable within entire input range with a resolution of eight bits (1 part in 256)
Environmental Ratings	**Operating:** –25 to 60 °C (–13 to 140 °F) **Storage:** –40 to 70 °C (–40 to 158 °F)
Weight	397 grams (14 oz), with cable; 312 grams (11 oz), without cable

Table 2. DTM Specifications

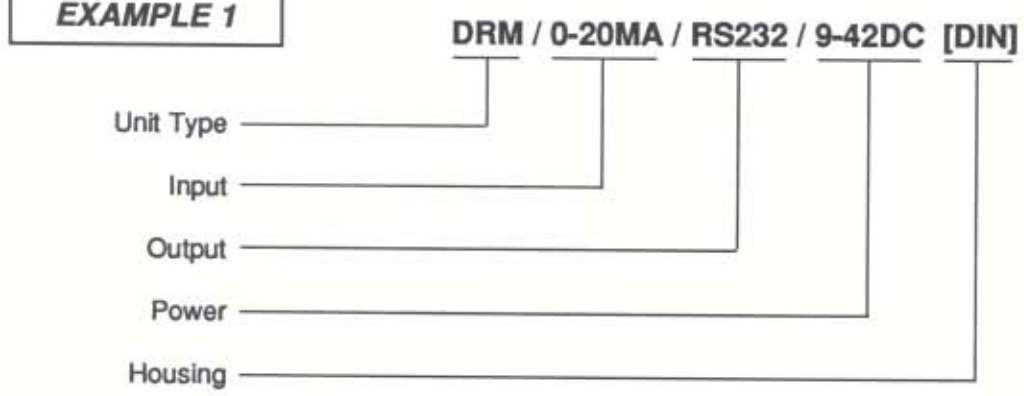
Characteristic	Specification
Input	**RS-232C** (from DRM)
Output	**RS-232C** compatible serial communication interface (to computer) *Bit Format:* 1 start, 8 data, 1 stop *Baud Rate:* 9600 *Cable Connectors:* DTM includes two permanently attached 9-pin, miniature, D-type connector cables; 30-inch cable connects to DRM and 6-inch cable connects to the DRM-to-computer interface cable for downloading the DTM
Power	**Battery**; Two 3.0-Vdc, 1-Ah, replaceable Lithium batteries (SANYO CR12600SE, or equivalent) *Operating Life:* At 25 °C (77 °F), internal power batteries will operate a minimum of 10,000 data transfers *Battery Shelf-life:* 5 years
Performance	**Data Storage:** Capacity, 128 Kbytes; equivalent DRM capacity, 97,680 values, such as 15 DRM contents with maximum of 6500 values or 60 DRM contents with maximum of 1600 values
Enviromental Ratings	Operating: –25 to 60 °C (–13 to 140 °F) Storage: –40 to 70 °C (–40 to 158 °F)
Weight	732 grams (25.8 oz)

DRM/DTM

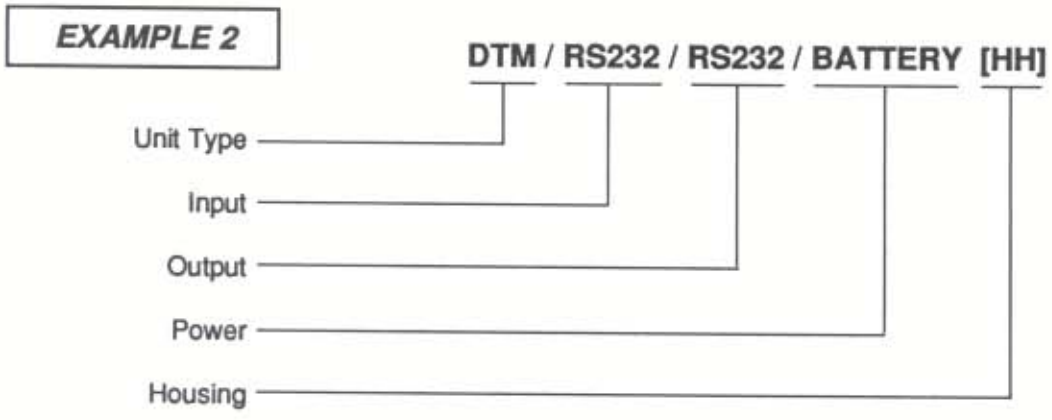
Model Number. Model numbers used on Moore Industries products identify the equipment type, functional characteristics and operating parameters of the unit. The model number for the DRM and DTM is on the same label as the serial number.

Each field of a model number identifies a specific aspect of the unit. The following examples identify the significance of each field of the DRM and DTM model numbers, respectively.

EXAMPLE 1



EXAMPLE 2



Calibration

Prior to shipment, every DRM is calibrated and checked at the factory. Before permanently installing the DRM, a bench check should be performed to verify that the proper relationship exists between the input signal and the recorded data values.

The value recorded by the DRM should be identical to the value of the input signal. For example, if the input signal at the time of sampling is 4 mA for a current input unit, the recorded value should be 4 mA. Likewise, if the input signal is 2.5 Vdc for a voltage input unit, the recorded value should be 2.5 Vdc. This holds true throughout the entire input range. *The recorded value is considered the output of the DRM.*

If the relationship between the input and the output are found to be identical, calibration is not required. However, should the relationship prove to be dissimilar, calibration is required. The only adjustments required to calibrate the DRM are the Zero and Span adjustments.

The Zero and Span Adjustments

The Zero and Span potentiometers are located on a printed circuit (PC) board inside the DRM. To access these potentiometers, the right-side panel of the unit must be removed. A Phillips-head screwdriver is required to remove the four screws securing the panel to the unit. Once the panel is removed, no further disassembly is required. Figure 1 shows the location of the Zero and Span potentiometers.

If the values input to the DRM are not identical to the values output by it, the output can be adjusted with the Zero and Span potentiometers to match the input. Turning these potentiometers clockwise decreases the output value, while turning them counterclockwise increases the output value.

Calibration Setup

Table 3 lists the equipment required to calibrate (or bench check) the DRM. Figure 2 shows the calibration hookup required to check and adjust the DRM output.

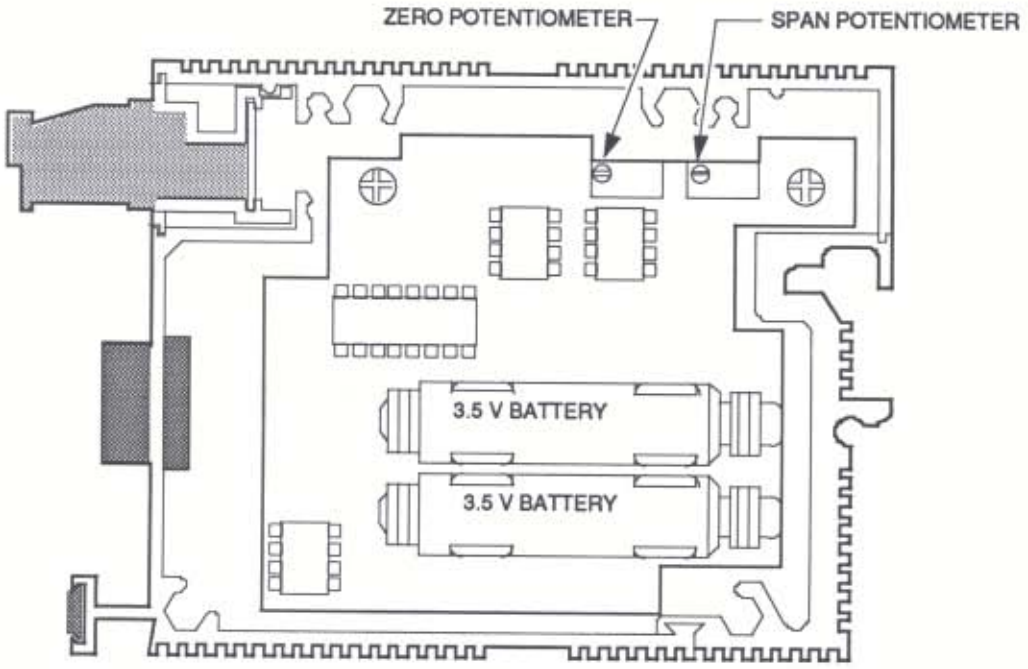


Figure 1. *Zero and Span Potentiometer Locations*

Table 3. DRM Calibration Equipment

Equipment	Description
Computer	IBM-PC/XT/AT or IBM-PS/2, or compatible, running MS-DOS, version 2.11 or later, and having at least 512 K of memory
Power Source	9-42 Vdc power source
Adjustable Input Source	*For current units*; 0-20 mA, accuracy of 0.05% or better *For voltage units*; 0-10 Vdc, accuracy of 0.05% or better
RS-232C Interface Cable	Moore Industries' P/N 801-838-26 or 801-839-26
DRM Support Software	Moore Industries' P/N 143-75001-01 or 143-75001-02
Screwdriver	Slotted-head, head width no greater that 2.54 mm (0.10 in)

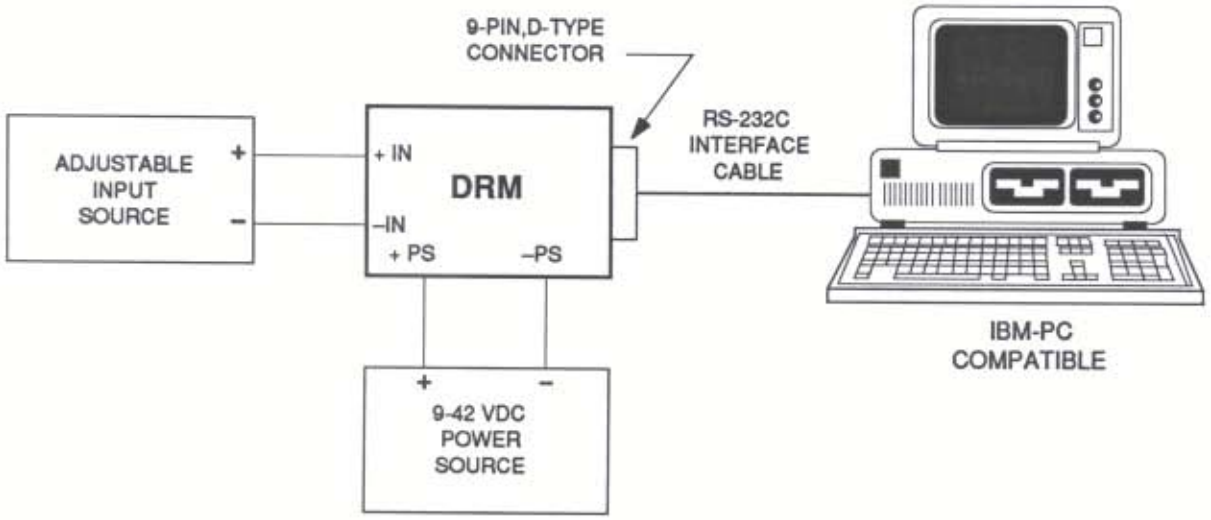


Figure 2. DRM Calibration Hookup

An adjustable input source is required so that various input values (current or voltage) may be checked. Also, for the computer to display real-time readings, the DRM must be configured (scaled) for the appropriate input type.

The procedure for *scaling* a DRM is contained in the DRM Programming Section of this manual. If the DRM is scaled for engineering units other than milliamps or volts, the relationship between the input and the output will require special calculations by the user.

Calibration Procedure

To calibrate a DRM, an IBM-PC (or IBM-compatible computer) and the DRM Support Software are required. The DRM Support Software is a menu-driven program. The DRM Programming Section of this manual contains the instructions for programming the DRM. The calibration procedure described here, however, contains only the software steps necessary to check and adjust the output of a DRM.

The DRM must be connected as shown in figure 2 to perform the calibration. The DRM Support Software must be installed in the appropriate disk drive. Also, the IBM-PC, or compatible, must be operating under MS-DOS to run the DRM Support Software.

NOTE

If the DRM being calibrated has been scaled to store input values in unique, user-specific units, the values output will not match the input. Refer to the DRM Programming Section for scaling information.

1. Set up DRM as shown in figure 2.
2. At computer keyboard, type DRM and press ENTER.

NOTE

On some computer keyboards, the ENTER key is labeled RETURN or it carries a return symbol. This manual uses the term ENTER for this key, but the function performed by this key is the same regardless of its labeling.

3. When entries for date appear, enter desired date and press ENTER. Repeat this step at time prompt.
4. When 'SELECT DEVICE TO INTERROGATE' selections appear, press F1 to interrogate the DRM. A prompt will advise you to connect RS-232C cable.
5. When 'DRM Main Menu' appears, press F1 to analyze recorder data.
6. When 'Analyze Recorder Data Menu' appears, press F3 to obtain current reading.
7. Output value should be equal to input value. If no input is supplied to the DRM, displayed reading should be a zero-percent reading (or the scaled equivalent).

NOTE

Since it is difficult to adjust for a zero-percent input, a small input value such as 1 percent of the input span is recommended for the zero output adjustment.

8. Set adjustable input source to appropriate zero-percent modified input value.
9. Check computer monitor for output value. If output is equal to input, no adjustment is required. Go to step 10.

9a. If output is not equal to input, remove right-side panel with a Phillips-head screwdriver and adjust Zero potentiometer to make output value equal to modified zero-percent input. (see figure 1)

NOTE

Since the DRM samples the applied input value present at the input terminals once every second, the output values change in a pulsing manner.

10. Set adjustable input source for appropriate full-scale input.

11. Check computer monitor for output value. If output reading is equal to input, no adjustment is required. Go to step 12.

11a. If output is not equal to input, remove right-side panel and adjust Span potentiometer to make output value equal to full-scale input value. (see figure 1)

12. Set adjustable input source to any desired value between zero-percent and full-scale. Output should be equal to input at all settings (new value may require a few seconds to settle).

13. Once zero and span adjustments are complete, disconnect adjustable input source and replace right-side panel (if needed).

14. Press F10 twice to return to Main Menu.

15. Press F3 to process next DRM or DTM.

16. Disconnect RS-232C cable from DRM. DRM is ready to be placed into service.

17. If another DRM is to be calibrated or checked, connect it to RS-232C cable and press F3 of Main Menu. Repeat steps 5 through 16.

18. If no other DRM is to be calibrated or checked, press F10 of Main Menu to exit DRM Support Software and return to MS-DOS.

19. Press SPACE BAR to acknowledge exiting DRM Support Software, or strike any other key to return to Main Menu.

DRM Support Software

The DRM Support Software is designed specifically for programming the DRM and interrogating its data. This software is also used to retrieve and interrogate data files from the DTM. The support software is provided by Moore Industries on either a 5.25-inch, double-sided, double-density floppy diskette, or a 3.5-inch diskette. The DRM Support Software DOES NOT contain the MS-DOS Operating System.

Procedures for operating the DTM are described in the Data Transfer Module Section of this manual. Included in those procedures are instructions for interfacing the DTM to the user's computer and to the DRM.

This section contains instructions for preparing the DRM for programming, using the IBM-PC (or compatible), and the DRM Support Software. First, IBM compatibility requirements are described; followed by a hardware listing; and finally, a step-by-step procedure on how to install and load the DRM Support Software are provided.

IBM Compatibility Requirements

To successfully run the DRM Support Software, your IBM-PC (or compatible system) must have at least 512 Kbytes of available memory. Also, one double-sided, double-density diskette, an IBM color graphics card (or equivalent) or Hercules graphics card (or equivalent), and a serial communications adapter card (RS-232C) configured as COM1 or COM2 are required.

In general, manufacturers have become very proficient at 'cloning' the IBM-PC. The key factor as to whether Moore Industries software will run or not is the graphics capability and the correct serial interface. Clones that are advertised as being 100-percent compatible will generally be adequate if they also have compatible graphics and a serial port.

Hardware Requirements

To program the DRM or interrogate recorded data, the following items are required:

- DRM Support Software (P/N 143-75001-01 or 143-75001-02)
- Moore Industries' DRM RS-232C interface cable (P/N 801-838-26 or 801-839-26)
- IBM-PC/XT/AT or IBM-PS/2, or compatible, running MS-DOS version 2.11 or later, and having at least 512 Kbytes of memory
- An IBM Color Graphics Adapter (CGA card), or equivalent; or a Hercules graphics card, or equivalent; and a compatible monitor
- Double-sided, double-density disk drive (two preferred)
- Optional IBM compatible graphics printer (connected to LPT1: parallel port)

Installing the DRM Support Software

To safeguard against damage to the original DRM Support Software, make a backup copy of the program before using it. Once a backup copy is made, either on hard disk or a separate floppy diskette, you should store the original diskette in a safe place away from magnetic fields, direct sun light, high temperatures, and excessive moisture.

The contents of the DRM Support Software is copied onto a new disk using the MS-DOS COPY command. For example, place the DRM Support Software disk in drive `A:` and place the new disk in drive `B:`, then type:

```
COPY A:*.* B:  <ENTER>
```

A copy of the DRM Support Software is copied on the new disk. The DRM Support Software consists of the following files:

DRM.BAT	Start-up batch file
DRM-01.EXE	Main program
LOGO.LOG	The logo
CONFIG.TLG	System configuration file
QBHERC.COM	Hercules graphics driver
DRM01.SCL	Scaling factor files (voltage)
DRM02.SCL	Scaling factor files (current)
UPDATE.DOC	This file contains any manual updates that may pertain to the latest software release (this file may not exist on your system)
LOGOHERC.LOG	The logo for the Hercules card

A subdirectory for the DRM Support Software may be created on the user's hard drive. The support software can then be run directly from this subdirectory. To set up a subdirectory on the hard disk, at the `C:` prompt in MS-DOS, type:

```
MD\DRM <ENTER>
```

NOTE

Either upper or lower case characters may be entered in MS-DOS.

Change to the newly created subdirectory by typing:

```
CD\DRM <ENTER>
```

Copy the files from the DRM Support Software diskette to the new subdirectory by typing:

```
COPY A:*.* <ENTER>
```

Now the DRM Support Software can be run directly from this new DRM subdirectory on the hard disk drive.

NOTE

If the DRM Support Software is going to be run from a different drive, you should configure the disk drives so that scaling files and data files are stored on the same drive. (Refer to Utilities Menu, F6.)

Loading the DRM Support Software

The DRM Support Software is a menu-driven program. A menu-driven program presents screens that contain a number of selections. By making the appropriate selection, the program either presents another menu or a screen that allows for keyboard entries. By making menu choices and entries as necessary, all available features of the support software can be utilized.

This subsection contains the procedures to bring up the main menu of the DRM Support Software. From the main menu, all available programming options can be accessed through a series of menu selections. (Procedures for using the main menu are described in the DRM Main Menu Section of this manual.)

The DRM Support Software may be used from either a bootable diskette or from the DRM subdirectory on the hard disk drive. Starting up the software allows the user to set the time and date of the system and to select either a DRM or a DTM to be interrogated.

If the DRM Support Software is on floppy diskette, the disk must be inserted in one of the system's disk drives, and the appropriate drive selected using MS-DOS commands. With the appropriate drive selected, typing DRM starts the Support Software program.

If the DRM Support Software is run from a subdirectory on the hard disk drive, typing `CD\DRM` and pressing ENTER after the `C:` prompt starts the DRM Support Software.

Once started, the monitor displays items like the copyright notice, the software version, and the Moore Industries' logo. After several seconds, the following display appears:

```
Input date (MM/DD/YY):  01/05/90

TO ACCEPT DISPLAYED DATE PRESS:  RETURN
```

Since the internal clock of the computer is used to reset the clock in the DRM, it is important that the date and time be entered correctly. If the displayed date is correct, just press ENTER; otherwise, enter the current date and press ENTER. After setting the date and pressing ENTER, the time is next to be set. The time is based on a 24-hour clock, and is set in the same manner as the date. The following type of display appears:

```
Input date (MM/DD/YY):  01/05/90
Input time (HH:MM:SS):  09:00:00

TO ACCEPT DISPLAYED TIME PRESS:  RETURN
```

A few seconds after entering the time and pressing ENTER, the SELECT DEVICE TO INTERROGATE menu appears. From these options, the user may select either the DRM (F1) or DTM (F2) to interrogate or go directly to the main menu. The following options are displayed:

```
   SELECT DEVICE TO INTERROGATE

F1:  DRM

F2:  Data Transfer Module (DTM)

F10: Go to Main Menu
```

Selecting F10 (Go to Main Menu), does not display Recorder Status information because no device was selected. Selecting the main menu directly does, however, allow access to other functions. Selecting F1 (DRM) generates a prompt that instructs you to connect the DRM to the computer.

The next section of this manual describes processing of the DRM ONLY. Processing of the DTM is described in the Data Transfer Module Section of this manual.

CAUTION

Communicating with a computer places a tremendous drain on the DRM's internal battery. Using an external power source for the DRM when it is connected to a computer for transfering or interrogating data is highly recommended.

At this point, the 9-pin, RS-232C port of the DRM must be connected to the serial port of the computer, using the DRM RS-232C interface cable. Once connected, pressing ENTER causes the computer to wake-up the DRM.

NOTE

Under typical operating conditions, the DRM is actually on less than 1 percent of the time; just long enough to take a reading once per second. The rest of its operating time, the DRM is in a low-power mode.

To retrieve data from a DRM, the computer must first wake it up by sending a special string of characters.

After communication is established between the computer and the DRM, the DRM stays on (awake) for at least 2 minutes, or until the computer tells the DRM to resume low-power operation. When ENTER is pressed during the previous display, the following display appears:

```
Reading Status, Please Wait

F10:  To Abort and go to MAIN MENU
```

This screen is displayed for several seconds while the computer establishes communication with the attached DRM. As soon as the computer and the DRM are communicating, the F10 message disappears. A few seconds after the F10 message disappears, the 'Reading Status, Please Wait' message disappears and the monitor displays the DRM Main Menu, including the Recorder Status, Select, and Quick Plot blocks for the attached DRM.

NOTE

If for some reason the F10 message does not disappear within 30 seconds, check the cable connections and try again. If problems still exist, make sure that the cable is connected to the proper communications port. Assignment of the communications port is made under the Utilities (F6) selection of the main menu, which is described in the DRM Programming Section of this manual.

DRM Main Menu

The DRM MAIN MENU allows you to perform programming functions and to interrogate recorded data. If a DRM is selected for interrogation, and one is connected to the computer, the Recorder Status information will be displayed in the top portion of the main menu. The lower half of the display consists of the main menu selections (lower left) and a Quick Plot graph (lower right). The Quick Plot is a graphic summary of the data retrieved from a DRM. After a DRM has been selected for interrogation, the main menu appears like the example shown in figure 3.

Recorder Status Block

The Recorder Status block of the main menu contains the status information for the currently attached DRM. The following paragraphs explain what each line of the Recorder Status block indicates. (Changing DRM status information is described in the DRM Programming Section of this manual.)

Line 1. The first line *(Type:, Range:, and Recorder ID:)* of the Recorder Status block indicates the type of recorder, the range of the recorder, and the recorder identification (ID) code.

The type of recorder will be V1 for 0-1 volt units, V5 for 0-5 V units, V10 for 0-10 V units, and mA20 for 0-20 mA units. You can change the span of the 0-20 mA unit to 4-20 mA from the Program Recorder Menu. When this change is made, the recorder type displayed will be 'mA20-C'.

DRM/DTM

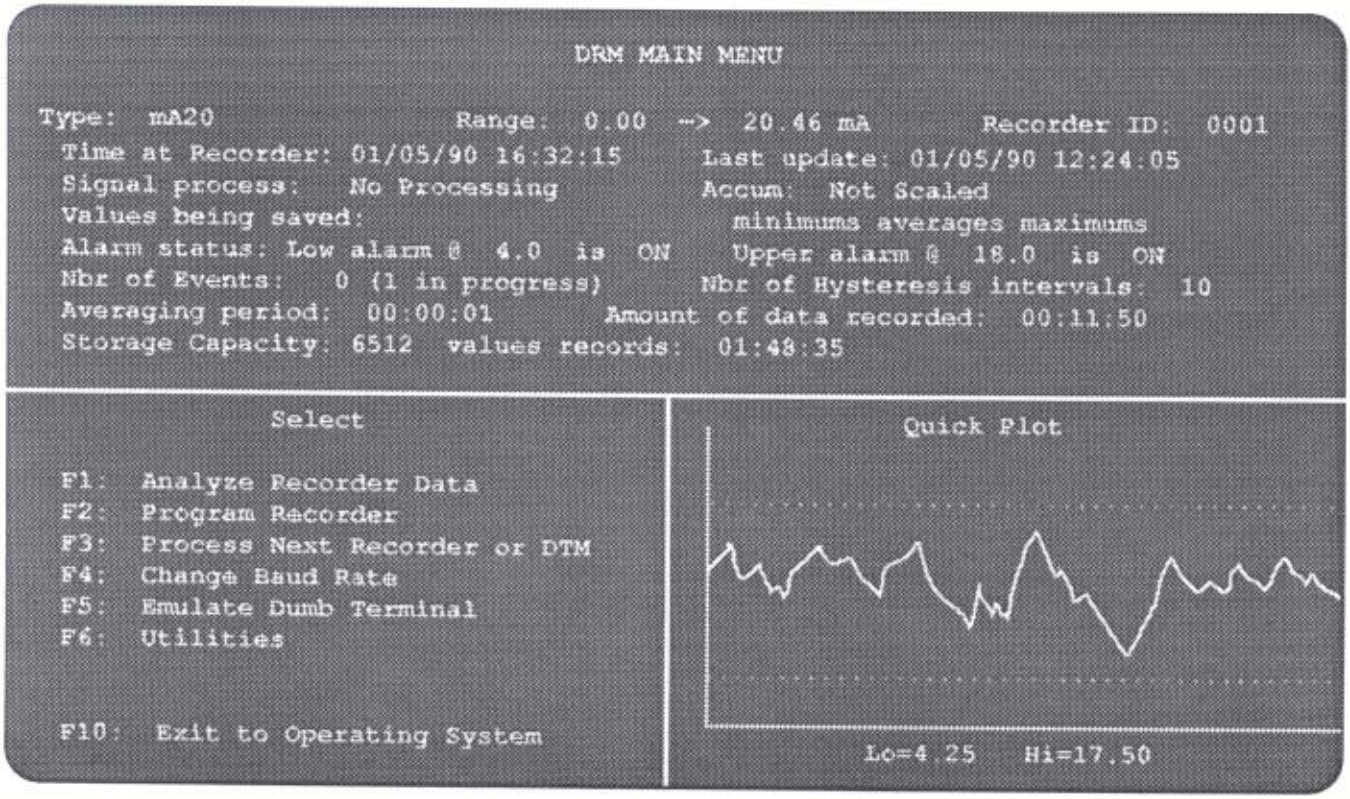


Figure 3 *The DRM Main Menu (Example)*

As mentioned in the previous paragraph, the range for current input units can be changed between 0-20 and 4-20 mA. For voltage input units, only the engineering units (units of measure) can be changed; the values are fixed. The range appears in the user-specified (scaled) units-of-measure. The ID code of the DRM is user-programmable. It is a combination of any four alphanumeric characters that you enter at the computer keyboard.

Line 2. The second line *(Time at Recorder: and Last Update:)* indicates the last time the DRM data was interrogated. This field is updated each time the computer reads the recorder status. If the time was initially set correctly, the time displayed will be very close to the current time of day. This time does not change on the screen, so when the Recorder Status is first displayed is when this time is closest to the actual time of day. The time displayed in the *Last Update* field represents the last time the DRM status was updated.

Depending on the desired accuracy, the time programmed in the DRM has to be reset approximately once every six months. It should be noted that the DRM and Support Software do not make corrections for Daylight Savings Time. Therefore, if the DRM is programmed for Standard Time, and data is interrogated during Daylight Savings Time, the recorder will appear to be inaccurate by one hour. The time can be programmed without affecting the stored data.

Line 3. The third line *(Signal process: and Accumulator:)* indicates if the DRM is programmed for square root extraction or basic signal processing, and shows the scaled accumulation totals.

The two signal processing options are indicated by the display of 'No Processing' or 'Square Root' in this field. 'No processing' means that the DRM takes readings each second and uses the results to determine which values to save without processing the signal any further. The 'Square Root' option means that the DRM takes readings each second and extracts the square root of the value and uses this value for all other processes. The square root signal is passed to the DRM Support Software as a percentage of full-scale.

When the 'Signal process' field is changed, the DRM data must be cleared for the change to be registered in the DRM. Changes in the 'Signal process' field are not confirmed until F1 is selected and you answer "Yes" to the prompt to clear the DRM data.

The accumulator keeps a running total of all input signal values. Each sampling is added to the accumulated total until the accumulator is cleared. The accumulator is reset when the clock is reset or the process signal type is changed. The accumulator is scalable to any meaningful engineering units in the Utilities Menu of the Main Menu.

Line 4. The fourth line *(Values being saved:)* of the Recorder Status block indicates which of the three available statistics (minimum, average, or maximum) are currently being saved. The DRM is user-programmed to compute and store any combination of the three statistics that occur during the user-programmed recording period.

Line 5. The fifth line *(Alarm status:)* indicates the user-programmable alarm levels and whether or not the external alarm signal will be activated when the input signal is beyond the alarm trip points.

When an alarm trip point is disabled ('OFF'), the alarm signal does not activate if the signal exceeds a trip point setting. If the alarm trip point is enabled ('ON'), the DRM activates the alarm switch whenever the input exceeds either trip point setting. A third option for the alarm status is the alarm LOGging option ('LOG'). This option activates the alarm switch, and records those values that exceed the specified trip point settings. The DRM alarm trip points are displayed in scaled engineering units, which are also user-selectable.

The alarm logging mode may be selected for either alarm trip point or for both. When either trip point is selected for alarm logging, the other can only be selected for alarm logging ('LOG') or turned off ('OFF'). Also, when alarm logging is selected for either trip point, the number of alarm events are tracked on the line displayed below the 'Alarm status' line. A hysteresis count is also made available for you to set if alarm logging is selected.

The alarm levels have a resolution of 1 part in 256. When enterring alarm levels, values entered are rounded to the nearest software trip point value. Therefore, it is possible that the software will round the trip point value you enter to the nearest available software trip point value.

Line 6. The sixth line *(Nbr of Events: and Nbr of Hysteresis intervals:)* of the Recorder Status block indicates the number of alarm events that have occurred since the last time the DRM data was cleared. The hysteresis intervals are a value that indicates the number of interval counts the DRM will continue to record after the input signal has returned to the non-alarm range.

Line 7. The seventh line *(Averaging period: and Amount of data recorded:)* of the Recorder Status block indicates the length of the programmed recording period, displayed in hours, minutes and seconds (HH:MM:SS), and the amount of data currently recorded.

The DRM stores sampled data at a rate indicated by the averaging period. Data is always sampled once per second and held in a temporary memory. However, calculations and storage of data occur at the rate indicated by this user-programmable time period. The amount of data recorded in the DRM is indicated in units of time.

Line 8. The eighth line *(Storage Capacity:)* of the Recorder Status block indicates the recording capacity of the attached DRM, both in the number of values that can be stored and the total amount of recording time (before the oldest recorded values are overwritten with the most recent data). The storage capacity is also user-programmable.

Quick Plot Block

The Quick Plot block is an unscaled graphic summary of the data contained in the DRM. It is displayed in the lower right corner of the DRM Main Menu. The Quick Plot block provides a convenient visual summary of the data contained in the DRM, without performing detailed analysis. More detailed data can be displayed using the Analyze Recorder Data selection (F1) of the main menu.

The upper and lower alarm levels are indicated by horizontal dotted lines. The numbers displayed at the bottom of the graph indicate the lowest (Lo) and highest (Hi) readings in the stored data set (with a resolution of 1 part in 256). For example, if the DRM is saving minimums, the displayed numbers are the lowest and highest minimums saved.

Select Block

The Select block of the DRM Main Menu is where selections are made to program various elements of the DRM and to interrogate DRM data. The function keys on the computer keyboard are used to initiate selections from the various menus. When the function key is pressed for a particular selection, either a new menu appears or a prompt requiring some type of keyboard entry appears. The Select block contains the following selections:

```
F1:   Analyze Recorder Data
F2:   Program Recorder
F3:   Process next recorder or DTM
F4:   Change baud rate
F5:   Emulate dumb terminal
F6:   Utilities

F10:  Exit to Operating System
```

Each of the above selections is described briefly in the following paragraphs and in greater detail in the DRM Programming Section of this manual.

F1: Analyze Recorder Data – allows you to view the data, manipulate graphed data, change compression factors, print of data, display the current scaled values being stored, store DRM data to disk, and retrieve stored data from disk.

F2: Program Recorder – allows you to clear (erase) DRM data, change and save DRM configuration parameters, and retrieve stored DRM configuration parameters.

F3: Process next recorder or DTM – allows you to select a subsequent DRM or a DTM for processing.

F4: Change Baud Rate – allows you to seletect either 300, 1200, or 9600 baud rate.

F5: Emulate Dumb Terminal – allows you to use the computer keyboard to "talk" to modems for remote interrogation of DRM's, and may be used for some system troubleshooting.

F6: Utilities – allows you to assign disk drives for storing data files, configuration files, and scaling factors; allows for the assignment of the DRM communication port; and allows for the setting of the engineering units to be displayed in the DRM data (scaling). Allows the user to select the printer and display type.

F10: Exit to Operating System – returns the computer to MS-DOS operating system.

The procedures for interrogating data and programming the DRM from the main menu are described in the following section.

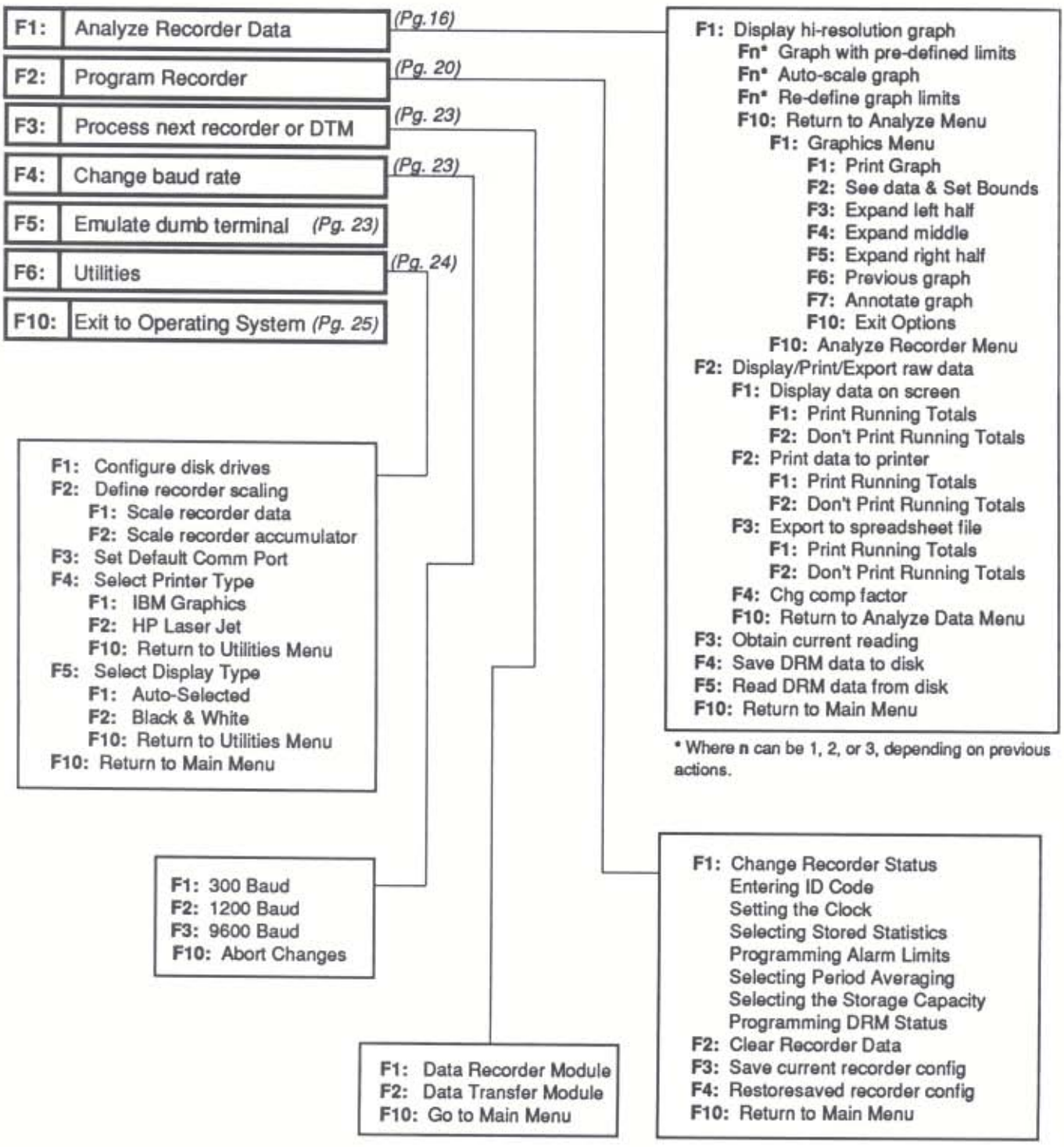


Figure 4. *DRM Quick-Reference Programming Guide*

DRM Programming

After loading the DRM Support Software and bringing up the main menu, you may select from a number of options for interrogating and programming a DRM. Data stored in the DTM is also interrogated with the DRM Support Software. However, the DTM is not programmable. This section focuses on the interrogation and programming of the DRM from the main menu of the DRM Support Software.

When a DRM is attached to the proper communication port of the computer, Recorder Status, Quick Plot, and Select blocks are all displayed as shown in figure 3. The Select block is the area in which most programming selections are made. The following paragraphs contain the procedures for using the Select block to interrogate DRM data and to program the unit.

Figure 4 is a quick-reference guide for programming the DRM.

Analyze Recorder Data (F1)

F1 of the DRM Main Menu Select block allows you to view, print, and manipulate DRM recorded data. After pressing F1, the display retains the form of the main menu. That is, the Recorder Status and Quick Plot blocks remain the same. But, the heading of the menu changes and displays the following selections:

```
F1:  Display Hi-resolution Graph
F2:  Display/Print/Export raw data
F3:  Obtain current reading
F4:  Save recorder data to disk
F5:  Read recorder data from disk

F10:  Return to Main Menu
```

This menu allows you to view and manipulate recorded data. The following paragraphs describe the submenu selections of F1, Analyze Recorder Data.

F1: Display hi-resolution graph. This option begins the process of displaying a high-resolution graph. When F1 is pressed, the computer reads the data from the DRM. The rate of data transfer is dependent on the baud rate programmed in the computer. The higher the baud rate, the faster the transfer. With the DRM connected directly to the computer, a baud rate of 9600 provides the fastest transfer. (To change the baud rate, select F4 of the Select block.)

Once the data transfer is complete, the program provides three graph scaling options: *Graph with predefined limits, Auto-scale graph,* and *Re-define graph limits* (or *Define graph limits*).

The first option, *Graph with predefined limits,* only appears if graph limits were previously defined for the attached graph DRM. By selecting this option, the program uses the graph limits that were stored during a previous session.

The second option, *Auto-scale graph,* automatically determines the proper vertical scaling, The advantages of auto-scaling are that it is fast, and it always captures the entire data set on the screen. In addition, when certain sections of the graph are expanded (as explained in subsequent paragraphs), the graph is again auto-scaled to expand the vertical resolution to match the displayed data.

The third option, *Redefine graph limits* (or *Define graph limits*), allows for entry of a low and high limit (in engineering units) used by the graphing routine. After the upper and lower limits are entered, a decision must be made to make these limits permanent. If "Y", for yes, is selected, the program saves the new limits. These limits are accessible the next time data is graphed. The saved limits become the first option, *Graph with predefined limits.* If defined limits are not saved, the *Redefine graph limits* option described above will not be available when data from this particular DRM is graphed at a later time.

Figure 5 is an example of a DRM data graph for a current input unit.

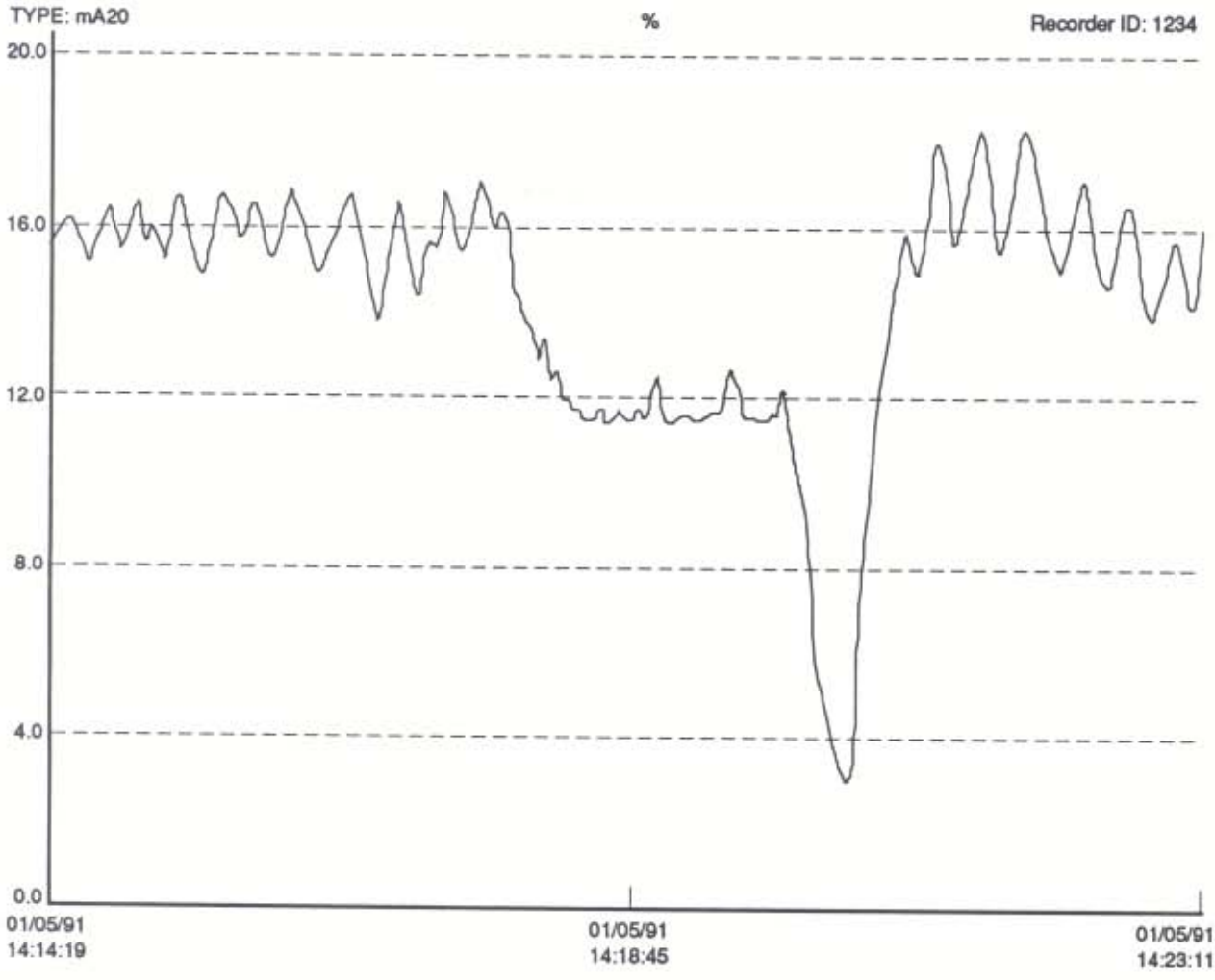


Figure 5. *DRM Data Graph (Example)*

For computers with a color graphics card, the graph will appear in color. All maximum values are displayed in red, all average values are green, and all minimum values are blue.

After the graph is displayed, there are a number of options available for further analysis. These options are displayed on the screen by selecting F1 for Graphics Menu. These options are displayed in the upper right corner of the displayed graph and appear as follows:

```
Graphics Options: SELECT
F1:  Print Graph
F2:  See data & Set Bounds
F3:  Expand left half
F4:  Expand middle
F5:  Expand right half
F6:  Previous graph
F7:  Annotate graph

F10: Exit Options
```

If an IBM-compatible printer is connected to the computer, and the computer has a graphics card, the F1 option of this menu generates a printout of the displayed graph.

The F2 option provides a means for the user to set the start and stop times for use in the Display/Print Raw Data (F2) option of the Analyze Recorder Data Menu, and to view the data on the screen. The start and stop times are set by moving the vertical line on the display with the left or right arrow keys to the desired time. Once at the desired time, press the respective function key (F1 or F2) to set these times. Holding down the Control (CTRL) key, while pressing the left or right arrow key, causes the vertical line to move 25 times faster than normal. The Home and End keys of the keyboard move the line across the screen. Ordinarily, the line moves one time interval at a time.

The F3 through F5 options expand or contract the graph by a factor of two from the selected graph section. Graphs can be expanded up to six times. The computer beeps when no further expansions are allowed. After expansion, the previously displayed graph is viewed by pressing F6.

The F7 option, Annotate Graph, allows for keyboard entries to be made to the displayed graph. A flashing cursor indicates where the entries are being made. The up and down arrow keys and the Home and End keys move the cursor to the desired location of the graph. Entries that are made to a displayed graph are not stored with the data. So, before storing the data, a hardcopy must be printed to retain a record of the annotated data.

F2: Display/Print/Export raw data. A high-resolution graph provides a good visual indication of what the recorded data looks like. However, viewing the actual numbers that have been plotted may be more useful. The F2 option of the Analyze Recorder Data Menu displays or prints the recorded data. It allows for the storing of data onto disk in a spreadsheet format.

The DRM can store up to 6500 data points (6100 when alarm logging is selected). The number of points displayed or printed is controlled by a user-programmable compression factor. The compression factor determines how many data points are compared to produce a single line or interval output. For example, if a compression factor of 10 were selected, the computer would display a single line for every 10 lines of recorder data intervals. DRM's programmed to record averages use the average of the number of data points specified by the compression factor. DRM's that are programmed to record minimums compare the number of data points specified by the compression factor and use the most minimum reading. DRM's programmed to record maximums compare the number of data points specified by the compression factor and use the greatest maximum reading.

Compressing the data saves time and paper. For example, if a compression factor of one were selected and a printout requested, roughly 100 pages would be printed if only one type of value is recorded (averages, minimums, or maximums). However, a compression factor of one does produce a complete record of the raw data.

Figure 6 is an example of the printout of raw data for a current input unit. This data appears in the same form on the computer monitor.

DRM STATUS

Type: mA20 Range: 0.00 -> 20.00 mA Recorder ID: 0001
Time at Recorder: 01/05/90 16:32:15 Last update: 01/05/90 12:24:05
Signal process: No Processing Accum: Not Scaled
Values being saved: minimums averages maximums
Alarm status: Low alarm @ 4.0 is ON Upper alarm @ 18.0 is ON
Nbr of Events: 0 (1 in progress) Nbr of Hysteresis intervals: 10
Averaging period: 00:00:01 Amount of data recorded: 00:11:50
Storage Capacity: 6500 values records: 01:48:35

Output compressed by a factor of 15

Date	Time	Min	Avg	Max
01/05/90	14:14:19	9.04	11.95	16.68
01/05/90	14:14:34	6.46	7.42	8.64
01/05/90	14:14:49	9.06	11.68	13.48
01/05/90	14:15:04	9.40	12.74	14.40
01/05/90	14:15:19	3.12	5.04	8.82
01/05/90	14:15:34	0.70	1.83	2.84
01/05/90	14:15:49	2.98	4.31	5.64
01/05/90	14:16:04	5.66	7.59	8.92
01/05/90	14:16:19	8.92	10.03	11.58
01/05/90	14:16:34	11.98	13.90	15.40
01/05/90	14:16:49	13.04	14.45	16.04
01/05/90	14:17:04	12.86	14.17	15.46
01/05/90	14:17:19	12.32	13.58	14.80
01/05/90	14:17:34	12.22	14.40	16.28
01/05/90	14:17:49	14.66	15.52	16.46
01/05/90	14:18:04	14.76	15.43	16.02
01/05/90	14:18:19	15.04	15.76	16.24
01/05/90	14:18:34	13.90	15.22	16.30
01/05/90	14:18:49	13.30	13.43	13.72
01/05/90	14:19:04	11.68	12.67	13.30
01/05/90	14:19:19	8.52	9.99	11.48
01/05/90	14:19:34	6.04	6.90	8.34
01/05/90	14:19:49	4.40	5.56	6.04
01/05/90	14:20:04	0.68	2.15	4.00
01/05/90	14:20:19	1.18	2.92	4.18
01/05/90	14:20:34	4.20	4.81	5.08
01/05/90	14:20:49	5.10	5.97	6.82
01/05/90	14:21:04	6.88	7.10	7.40
01/05/90	14:21:19	7.54	8.17	9.10
01/05/90	14:21:34	0.66	3.58	7.48
01/05/90	14:21:49	0.00	0.09	0.68
01/05/90	14:22:04	0.00	0.00	0.00

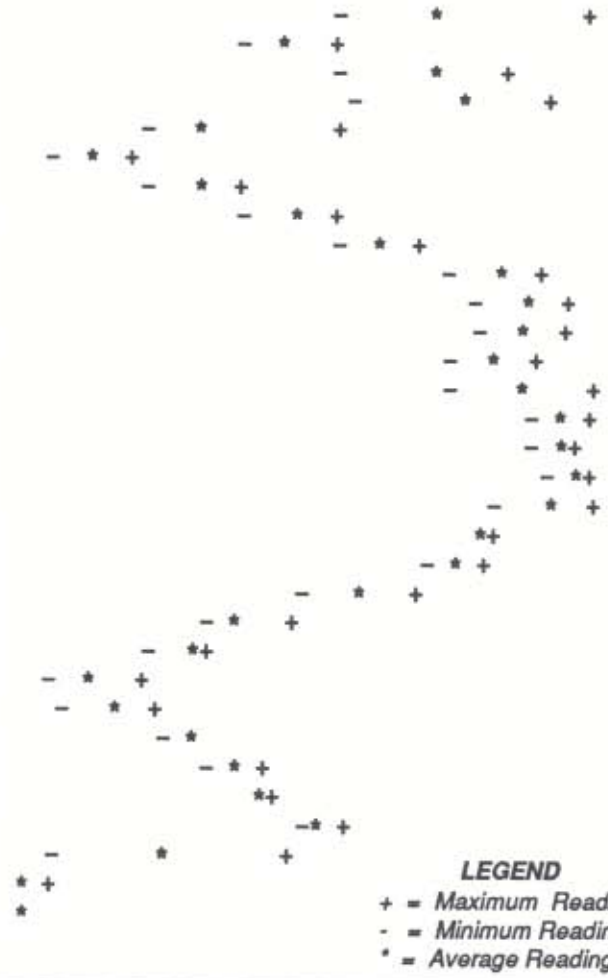


Figure 6. Raw Data Printout (Example)

F3: Obtain current reading. The F3 selection of the Analyze Recorder Data Menu displays the readings currently being input to the DRM. If the input varies, this signal will vary accordingly. The units are displayed in scaled engineering units programmed in the DRM. If the unit is not scaled, the readings are displayed in milliamps (mA). Depending on the baud rate, the readings are updated approximately once per second. This operation requires additional use of the internal battery of the DRM. Therefore, to conserve battery power, external power should be used.

F4: Save recorder data to disk. Data files are stored with the F4 selection of the Analyze Recorder Data Menu. Data from the currently attached DRM is saved with this selection.

When F4 is pressed, the computer reads the data of the attached DRM. While reading the data, a message appears in the middle of the display indicating that this is taking place, and to please wait. When the message disappears, a prompt appears requesting a filename. Up to eight characters may be used for the filename (using MS-DOS file naming conventions).

This filename is the name under which the currently displayed data will be filed. Entering the filename and pressing ENTER saves the file. An extension of .D02 is automatically attached to the filename that was entered by the user. If a file exists with the same name as the filename just entered, a different filename must be selected.

The data is saved to the default disk drive. The drive designation can be changed via the Utilities (F6) menu. However, an alternate drive may be assigned on a file-by-file basis by indicating the drive designator before the filename. For example, entering B:FILE1 would result in a file named FILE1.D02, existing on drive B. After the desired data is stored, the software returns to the Analyze Recorder Data Menu.

Storing data from recorders with 8 Kbytes of memory requires roughly 9 Kbytes of disk space. Therefore, a 360-Kbytes disk can hold up to 40 data files.

F5: Read recorder data from disk. Data is recalled from disk with the F5 option of the Analyze Recorder Data Menu. The monitor displays a directory of all .D02 files contained on the default disk drive. To select a stored data file, use the up, down, right, and left arrow keys to highlight the desired file, then press ENTER, or enter the desired filename (with extension) in the space provided. Simply begin typing and the characters appear. Up to 12 characters may be entered, including the .D02 extension. For example, to recall the file named FILE1, enter FILE1.D02 and then press ENTER. If a different disk drive is required, enter the drive designator first (e.g., B:FILE1.D02). Once the data file is read into memory, a high-resolution graph can be displayed or a printout of the data may be made using F1 or F2 of the Analyze Recorder Data Menu, respectively.

After a data file is read from a disk, the software returns to the Analyze Recorder Data Menu. Pressing F10 in the Analyze Recorder Data Menu returns the software to the main menu.

Program Recorder (F2)

F2 of the DRM Main Menu Select block is used to program various configuration parameters of the DRM. The parameters of an attached DRM may be changed, cleared, or saved. Also, recorded parameters may be recalled for the attached DRM.

Depending on which parameter is being programmed, the stored data in the DRM may need to be cleared. Programming the recording rate, synchronizing the recorder clock, changing DRM statistics, and recording capacity require that recorder data be cleared.

A prompt appears asking for confirmation to clear the recorder data. When programming other parameters, clearing the recorder data is not required.

The Program Recorder Menu contains the following selections:

```
F1:  Change Recorder Status
F2:  Clear Recorder Data
F3:  Save current recorder config
F4:  Restore saved recorder config

F10:  Return to MAIN MENU
```

F1: Change Recorder Status. When F1 of the Program Recorder Menu is pressed, Recorder Status information is displayed with highlights in the programmable fields. A set of arrows pointing inward indicate the current field to be programmed. Prompts at mid-screen show the types of input expected for each field. The up and down keys move the indicator arrows to the desired field to be programmed. The following paragraphs describe how to set each field.

Entering the ID Code. Each DRM can be uniquely identified by entering a user-selected identification code. Any four alphanumeric characters may be used for the ID code. To enter the ID code, ensure the Recorder ID field is highlighted, then type in the desired code. The left and right arrow keys move the cursor so entries may be edited. Use the up or down arrow keys to select another field, if necessary.

Setting the Clock. When the clock field is highlighted, each press of the SPACE BAR toggles this field through three messages; 'OK', "Reset" and 'Sync'. With 'OK' displayed, if the current parameters are stored, the existing clock setting is maintained. With 'Reset' displayed, if the current parameters are stored, the clock is reset to the current time. With 'Sync' displayed, if the current parameters are stored, the DRM recording intervals are synchronized to the calendar clock of the computer. For example, if programming is in one-minute intervals by synchronizing the recorder clock, the recording intervals start on whole-minute boundaries. When the DRM clock is not synchronized, intervals start at the time of programming the DRM. Synchronizing the clock must be done with recording intervals that are at least 5 seconds long.

Synchronization of the DRM clock requires that its data be cleared. Note that a synchronized DRM can be 'reset' without clearing data, but to synchronize a DRM, data must be cleared.

Signal Process. Samples can be stored as square root values or as non-processed values. With this field highlighted, pressing the SPACE BAR toggles it between readings of 'Square Root' or 'No Processing'.

Selecting Values to be Saved. The stored statistics can be the minimum, average, and maximum interval readings. With this field highlighted, pressing the SPACE BAR changes the field to various combinations of these three statistics. Any one statistic or any combination of the three may be recorded. For example, if the DRM is programmed for a recording rate of 10 seconds and the statistics being recorded are the lowest and highest, then every 10 seconds the DRM records the minimum and maximum values measured during the previous 10 seconds.

The user-programmable Storage Capacity, shown on line 7 of the Recorder Status block, identifies the amount of recording time the recorder can log data before the oldest data begins to be overwritten.

Programming Alarm Limits and Status. On the Alarm Status line, line 4, the lower and upper limits and the on/off/log condition of the alarms are set. Pressing the SPACE BAR toggles the alarm status for each trip point between 'ON', 'OFF', and 'LOG'.

The lower alarm trip point value must always be less than the upper alarm trip point. (The prompt line provides this reminder.) The DRM Support Software does not allow invalid values for the alarm trip points.

The alarm feature works as follows: once every second, the DRM checks to see if an alarm trip point is enabled or disabled. If it is disabled ('NO'), the alarm switch is turned off. If an alarm trip point is enabled ('ON'), the DRM compares the trip point with the input reading; if the current reading is out of range, the alarm switch is turned on. The alarm switch stays on until either the signal returns to the non-alarm range, or the alarm trip point is disabled.

If alarm logging ('LOG') is selected, the DRM compares the trip point setting with the input reading and records all values that exceed the specified trip point setting. If only one trip point is chosen for logging, the DRM will only record values that exceed that particular trip point setting.

Alarm logging also includes an event counter, which records up to 48 alarm events, and a hysteresis counter, which can be set between 1 and 255 counts. The number of events recorded is displayed on the line directly below the 'Alarm status' line. This data is stored in a first-in-first-out buffer (FIFO), so the oldest information is discarded first when space is needed to record the latest event (not to exceed 48). The hysteresis counter identifies the number of intervals that you want the alarm log to record after the input has returned to the non-alarm range.

Select Averaging Period. The Averaging period is used to set the time period for the DRM to perform calculations and store data in memory. For example, if a two-minute recording period is selected, the DRM samples data once every second. At the end of a two-minute period, the DRM calculates the values to be stored in memory. After storing the selected values, the DRM begins sampling for the next two-minute period.

Selecting the Storage Capacity. The DRM offers three different memory storage capacities; 2, 4, or 8 K. These three storage values are capable of storing 1600, 3236 or 6500 data samples, respectively. The Storage Capacity field, on line 7 of the Recorder Status block, reflects the data samples value. If changes are made to storage capacity, the Values Being Saved field (line 3) changes accordingly.

Programming DRM Status. By pressing F1, the computer sends the latest status information to the DRM. If there are changes in the status information that necessitates clearing the memory, a prompt will ask for verification of the changes before the memory is cleared. After the DRM has been programmed, the new status information is displayed along with the Program Recorder Menu.

F2: Clear Recorder Data. Pressing F2 of the Program Recorder Menu clears the data stored in the attached DRM. That is, all stored data in the DRM is erased from memory when this function is selected. However, a prompt verifying this selection is displayed before the data is actually erased. Press "Y" for yes or "N" for no in response to this prompt. If "Y" is pressed, all data in the attached DRM is erased. When its memory is full, the DRM automatically overwrites the oldest data with the most recent data. Thus, the Clear Recorder Data option need only be used when starting a new test. After clearing memory, the recorder status is updated and the F2, Program Recorder Menu is displayed.

F3: Save current recorder config. The F3 option of the Program Recorder Menu allows for the saving of configuration parameters of the currently attached DRM.

Saving the DRM configuration is convenient if a large number of DRMs are to be programmed with similar parameters. After saving the configuration parameters with the F3 option, connect the next DRM and select the F4 option, Restore Saved Recorder Config. The same parameters stored in the first DRM can now be programmed into any subsequently attached DRM(s).

After selecting F3, a prompt asks for a filename where the configuration data is to be stored. Enter any valid MS-DOS filename. A file extension of .C02 is automatically added to the filename. The file is saved to the disk drive designated by the F1 option of the Utilities Menu (F6). This designation can be overridden by assigning a different drive designation. For example, entering B:DEMO stores the configuration file on disk drive B:, regardless of the option selected in the Utilities Menu (F6).

The programmed parameters that are saved on disk are: the DRM ID, clock synchronization, signal processing status, values being saved, alarm status, the averaging period, and scale factors.

F4: Restore saved recorder config. The F4 option of the Program Recorder Menu allows for the retrieval of configuration files from disk. These files are loaded into the attached DRM and consist of the values saved, the alarm status, the averaging period, and scaling factors. In addition, the date and time are automatically updated to the current time as indicated by the internal real-time clock of the computer.

Prior to restoring the DRM status, a prompt asks for the ID code to be programmed with the restored configuration. If the ID code shown in the prompt is acceptable, just press ENTER and the file information will be loaded into the DRM. If a different ID code is desired, enter the new code and press ENTER. The recorded information will be transferred to the DRM and will have the new ID code.

Once a stored file is restored to the DRM, the display returns to the Program Recorder Menu. Press F10 to return to the Main Menu.

Process Next Recorder or DTM (F3)

F3 of the DRM Main Menu Select Block is selected to interrogate another DRM or DTM.

Pressing F3 informs the computer that another device is to be processed. The computer sends the proper commands to terminate its communication link with the currently attached recorder, or DTM, if one is attached.

To process another DTM, refer to the Data Transfer Module Section of this manual for procedures. To process the next DRM, perform the following steps:

1. Press the F3 key of the Main Menu.
2. Wait until software automatically disconnects the old recorder.
3. Press F1 to select the DRM for interrogation.
4. Connect the new DRM to the RS-232C Interface Cable.
5. Press ENTER to start communications with DRM.

Change Baud Rate (F4)

F4 of the DRM Main Menu Select Block allows for the selection of one of three baud rates: 300, 1200, or 9600 baud. The baud rate determines how quickly data is transferred between the DRM and the computer. The higher the baud rate, the faster the transfers. Therefore, 9600 baud provides the fastest transfers. However, 300 and 1200 baud may be required for other types of communications.

After selecting the desired baud rate, the ENTER key must be pressed. When the ENTER key is pressed, the baud rate selection is stored in the CONFIG.TLG file of the DRM Support Software. After pressing ENTER, the computer returns to the Main Menu.

Communications between the DTM and the computer always takes place at 9600 baud and is not user-selectable.

Emulate Dumb Terminal (F5)

F5 of the DRM Main Menu Select Block turns the computer keyboard and monitor into a dumb terminal.

After pressing F5, the display is cleared, with the exception of the "F10: Return to Main Menu" message shown at the bottom of the screen. While in the dumb terminal mode, the computer is used to send keyboarded characters out its COM port at the currently programmed baud rate. The monitor displays characters received through the COM port from remote devices.

The dumb terminal mode may be used to send commands to an attached modem to communicate with DRMs in the field. This allows access to the DRMs for remote interrogation.

Utilities (F6)

F6 of the DRM Main Menu Select Block is used to configure certain elements of the system and to set the scaling units of the DRM to user-selectable engineering values. After pressing F6, the following Utilities Menu is displayed:

```
F1:  Configure disk drives
F2:  Define recorder scaling
F3:  Set Default Comm Port
F4:  Select Printer Type
F5:  Select Display Type

F10:  Return to Main Menu
```

F1: Configure disk drives. The F1 option of the Utilities Menu allows the user to define the disk drive designator for the storage and retrieval of data files, configuration files, and scaling factors. Prompts appear in sequence, asking for the drive designations for the location of the three files. Drive A, B, or C may be designated for any or all of the files.

After entering the disk drive designations, the software returns to the Utilities Menu.

F2: Define recorder scaling. The F2 option of the Utilities Menu is used to scale the attached DRM for user-selectable engineering units. By scaling a DRM, the recorded data is stored in units such as volts, milliamps, Deg F, etc. Also, a unique unit of measure appropriate for a specific application may be user-assigned.

Once entered, the scaling factors required to convert the DRM units into the desired engineering units are stored on disk in the 02REF.SCL files. When the computer first communicates with a DRM, it scans the scale factor files for an ID code that corresponds to the attached DRM and retrieves the assigned scale factors. If a DRM is not scaled, the units of measure default to milliamps for current input units, and volts for voltage input units.

When the F2 option of the Utilities Menu is pressed, the following options appear:

```
F1:  Scale recorder data
F2:  Scale recorder accumulator
```

This options allow you to select the area you wish to scale. For either option, the following prompt appears:

```
Units and scaling to be entered for
recorder ID:  XXXX. Enter up to eight
characters for YOUR units: _______
```

The recorder ID displayed corresponds to the attached DRM. After entering the desired units of measure in eight characters or less, pressing the ENTER key adds the following to the display:

```
A slope and offset will be computed
from 2 points entered by you.
Enter pt. #1 _______ mAmps
```

Enter here the lower value machine units that will correspond to the units of measure you desire (e.g., 0 mA). After entering a value for this prompt and pressing ENTER, the prompt asks for a value that represents the corresponding user units. After entering the first set of values, a second set of values for the upper reference is also required to complete the scaling process. After each entry, the ENTER key must be pressed for the value entered to be accepted.

For example, if the output of a DRM needs to be in Fahrenheit, the following is one way that the prompts may be responded to:

```
Units and scaling to be entered for
recorder ID: 0001.  Enter up to eight
characters for YOUR units:  Deg F
A slope and offset will be computed
from 2 points entered by you.
Enter pt. #1 ____0____ mAmps
          = ___32____ Deg F
Enter pt. #2 ___20____ mAmps
          = __212____ Deg F
```

After entering values like those in the above example, all displayed and recorded values are in degrees Fahrenheit (Deg F). Once the last value is entered and ENTER is pressed, the program returns to the Utilities Menu and the recorder status information is updated to reflect the new units of measure. The DRM Support Software automatically performs the necessary calculations to produce the corresponding values for a varying current input.

To reset a DRM to its factory settings, enter 0 mA = 0 mA for the first set of points and 20 mA = 20 mA for the second set of points.

Scaling the accumulator is very similar to scaling the data. The same displays are used to enter scaling values for the accumulator function. The difference between the two is how you arrive at the values to enter.

The accumulator keeps a running total of the amount of input applied to the DRM, and displays it in user-specified units. For example, if you were measuring a flow process, the DRM accumulator could be scaled to track the rate in gallons per day, gallons per hour, or gallons per minute. Regardless of which engineering units are used for the data, the accumulator will add to its total once per second by the amount and in the units you specify.

Ordinarily the lower scaling value will equal zero. This means that for a zero-percent input, the accumulator adds zero to its total when the input is sampled. Any input value greater than zero-percent when sampled will be added to the accumulator total and the new total displayed in the selected units of measure. The amount added to the total is dependent on the upper value selected.

To set the upper scaling value, the rate must be computed for a 'per second' rate. If you are measuring a flow in 'gallons', you need to determine the maximum number of gallons that will pass a particular point in one second. This maximum rate represents a full-scale input value to the DRM. For example, if you know the daily total flow is 5 million gallons, you can compute the per second rate by dividing the total amount of flow in a day by the number of seconds in a day (5,000,000/86,400 = 57.8704). The upper value for scaling the accumulator for this application would be 57.8704 gallons. This entry is made after entering the full-scale input configuration of the DRM (e.g., 20 mA = 57.8704 gal, 10 V = 57.8704 gal, 1 V = 57.8704 gal).

The reason you must compute the rate in seconds is because the DRM samples its input once every second. It takes this sample, converts it to a value proportional to the scaling values selected, and adds it to the accumulator total.

F3: Set Default Com Port. The F3 option of the Utilities Menu is used to set the default communications port to either communications port 1 (COM1) or communications port 2 (COM2). The selected communications port is used to communicate between the computer and the DRM and DTM. If only one communications port exists, the system must be configured for COM1.

After entering number 1 or 2 and pressing the ENTER key, the program returns to the Utilities Menu. Pressing F10 of the Utilities Menu returns the program to the Main Menu.

F4: Select Printer Type. The F4 option of the Utilities Menu is used to select either an HP LaserJet or IBM Graphics printer for printing. Printers compatible with either of these two printers are supported by the software. The current configuration of the unit is also shown. After entering F1 or F2, the program returns to the Utilities Menu. Pressing F10 of the Utilities Menu returns the program to the Main Menu.

F5, Select Display Type. The F5 option of the Utilities Menu is used to select display types. The choice for black and white should be used for LCD displays ONLY. Choose Auto-select for any other type of display. Current configuration is also displayed. After entering F1 or F2, the program returns to the Utilities Menu. Pressing F10 of the Utilities Menu returns the program to the Main Menu.

Exit To Operating System (F10)

This is the last option in the Main Menu Select Block. This option is used to return your system to the MS-DOS command level.

Installation

Installation of the DRM is divided into two phases, mounting and the electrical connections. In most cases, it is easier to mount the DRM before completing the electrical connections.

The DTM is a hand-held device and requires no mounting. Its electrically connections are described in the Data Transfer Module (DTM) Section later in this manual.

Mounting the DRM

The DRM is packaged in a DIN-style housing, which is designed for mounting on standard G-type, DIN rails. The DIN-style housing is ideal for high-density installations where various types of devices, also in DIN-style housing, are mounted immediately adjacent to one another.

The installation site should be free of excessive dust, moisture, and corrosive elements. These elements can effect the performance of the DRM if it is not well protected inside an additional enclosure.

Figure 7 shows the outline mounting dimensions of the DRM.

Making the DRM Electrical Connections

The electrical connections for the DRM are made at the front panel of the unit to six labeled terminals. Two terminals each are provided for the input, external power, and the relay output terminals.

The input terminals are labeled "+IN" and "–IN". The external power source terminals are labeled "+PS" and "–PS". The relay output terminals are labeled with a contact closure symbol. Although there are no special wire type requirements, using a twisted-pair for the input signal is recommended to avoid picking up stray transients from neighboring conductors.

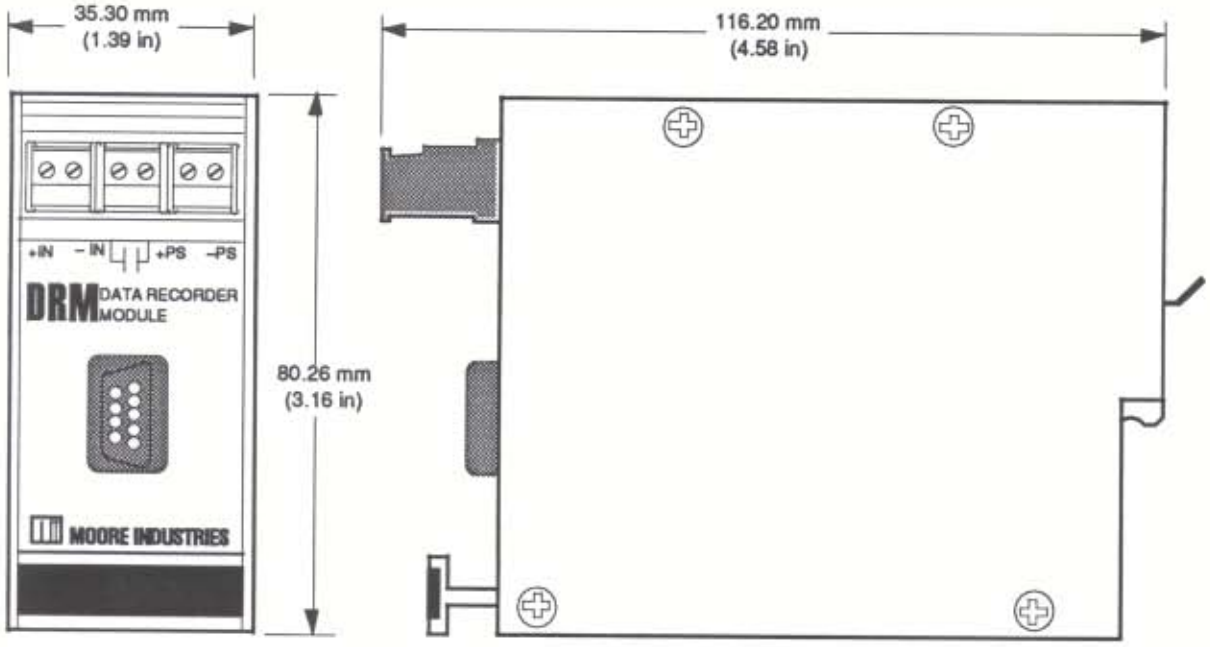


Figure 7. DRM Outline Dimensions

For normal operation, an external power source may be used, but is not required. However, during data transfers to a computer, using an external power source is highly recommended. When external power is used, it is connected to the +PS and –PS terminals.

NOTE

The DRM has no case ground connection. When possible, avoid mounting the DRM in any known electrical fields, and secure the case to a good conductor at zero potential.

Removable terminal blocks are used to connect electrical wires to the DRM terminals. Each wire is secured to its terminal block with a slotted-head compression screw. Three terminal blocks are provided with each unit.

The RTBD. The *current input* version DRM has a special terminal block called the Removable Terminal Block with Diode (RTBD), which is used for the input signal and allows the DRM to be removed from a process loop without interrupting loop continuity.

The input wires are connected to this RTBD terminal block by prying open the spring loaded clamp in the block. Figure 8 shows the two methods for opening the clamp to connect wires. Prying the clamp open from the front using leverage is the recommended method whenever the RTBD is plugged into the DRM.

To perform a data transfer, the RS-232C connector on the DRM is used to connect it to the DTM or the computer. Table 4 lists the pin-outs required to connect an RS-232C connector to the DRM and the computer. IBM-compatible computers may be equipped with 9-pin connectors, 25- pin connectors, or both. Use the appropriate column for your system.

Figure 9 illustrates a typical installation hookup for recording process signals with the DRM.

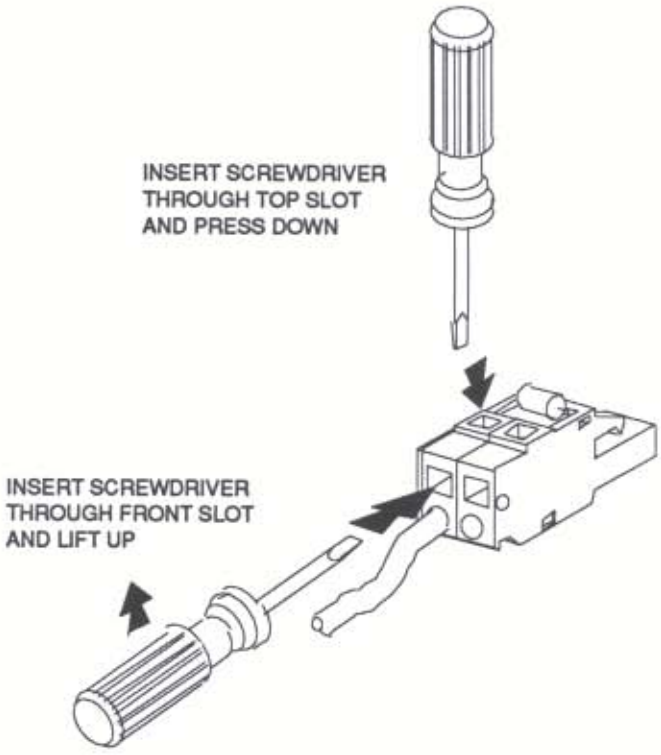
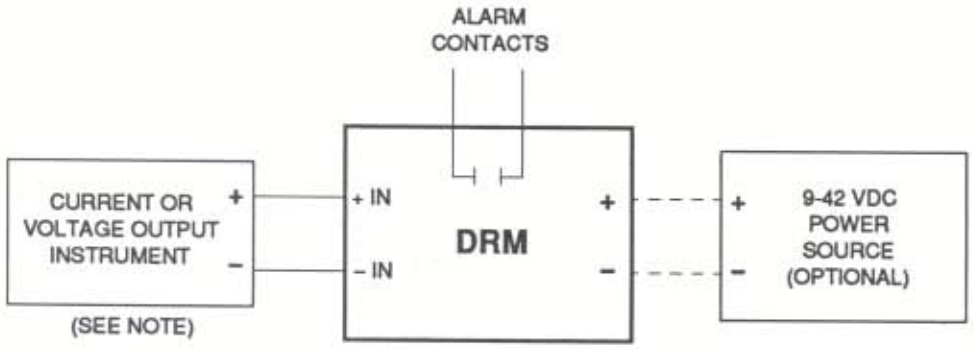


Figure 8. *RTBD Wire Connections*

Table 4. *RS-232C Connector Pin Assignments*

Signal	RS-232C Connector		
	9-pin at DRM	9-pin at PC	25-pin at PC
Data Carrier Detect	1	1	1
Serial Transmit Data	2	2	3
Serial Receive Data	3	3	2
Clear to Send	5	7	4
Ground	7	5	7



NOTE: Refer to table 1 for DRM input specifications.

Figure 9. *Typical Installation Hookup*

Operation

Once the DRM is calibrated, programmed, and installed, it operates unattended, except for instances when recorded data needs to be extracted for interrogation.

There are no visual indicators on the DRM and the only controls are the Zero and Span potentiometers, which after initial adjustment require no further attention.

When data needs to be extracted for interrogation, the RS-232C port on the front of the DRM is used to interface it to the DTM or an IBM-compatible computer. The procedures for extracting and interrogating data are contained in DRM Main Menu and DRM Programming Sections of this manual.

The DRM is designed to operate on its internal batteries. These batteries will last for years if they are used only for data recording. When the DRM is hooked directly to a computer to transfer data, use of an external power source eliminates consumption of power from the internal batteries and saves them solely for data recording.

Also, the DRM's performance should be verified by removing it from service and bench checking it at regular intervals. You must decide what the most appropriate bench-check intervals are for your particular application and facility maintenance philosophy. This help to ensure the operational performance of the DRM your expectations.

Data Transfer Module (DTM)

The DTM is designed to transfer data from DRM's to an IBM-compatible computer. Data stored in DRM's, typically installed a great distance from a computer, is extracted and temporarily stored in the DTM for transfer to a computer for interrogation. Unlike the DRM, the DTM is not programmable.

The DTM is capable of storing data from up to 15 DRM's when each DRM is programmed to record 6512 data points. With DRM's programmed for 3236 data points, the DTM can store the data from up to 30 DRM's. With DRM's programmed for 1600 data points, the DTM can store data from up to 60 DRM's.

The DTM is a hand-held device with one pushbutton, one dual-colored LED (red and green), and two cables with connectors. One of the cables is noticeably longer than the other. This long cable connects directly to the 9-pin connector on the DRM. The shorter cable connects the DTM to the computer via the DRM RS-232C interface cable.

The DTM has three operational modes: (1) collects data from the DRM, (2) transfers data from the DTM to the computer, (3) indicates the proportional amount of memory remaining in the DTM.

Modes 1 and 3 are activated by pressing and releasing the DTM pushbutton, which turns on the DTM. When the button is released, the dual-colored LED on the DTM illuminates green for several seconds. During this time, the DTM is attempting to communicate with the DRM. For the communication to be successful, the long cable of the DTM must be connected to a DRM. If a DRM is detected, the DTM sends the required commands to collect its data. While data is being transferred, the LED flashes green rapidly and then extinguishes.

If a DRM is not detected after approximately 10 seconds, the DTM enters Mode 3. Mode 3 indicates the current memory status by flashing the LED red for a certain percentage of time, followed by the LED flashing green for a certain percentage of time. The ratio of red to green indicates how much storage space is occupied with recorder data.

After data is collected with the DTM, it can be interrogated by a computer using the DRM Support Software.

To process a DTM, select F3 of the main menu. The following display appears:

```
SELECT DEVICE TO INTERROGATE

F1:   Data Recorder Module (DRM)

F2:   Data Transfer Module (DTM)

F10:  Go to Main Menu
```

Press F2. The following display appears:

```
Connect DTM to RS-232  COMM Port

of Computer Using DRM Interface Cable

Press RETURN to continue

F10:  Go to MAIN MENU if no DTM attached
```

After making the cable connection, press ENTER.

NOTE

Do not press the DTM pushbutton; this will cause the DTM to enter Mode 1 or Mode 3, and it will not communicate properly with the computer.

The following display appears:

```
Reading Status, Please Wait

F10: To Abort and go to Main Menu
```

This screen is displayed for several seconds while the computer establishes communications with the attached DTM. As soon as the computer and the DTM are communicating, the F10 message disappears. A few seconds after the F10 message disappears, the 'Reading Status, Please Wait' Message disappears and the following display appears:

```
MAKE YOUR SELECTION

F1:  Automatically process DTM data
F2:  Selectively process DTM data
F3:  Clear attached DTM's memory
F4:  Process another DTM or recorder

F10: Go to Main Menu
```

NOTE

If for some reason, the F10 message does not disappear within 30 seconds, check the cable connections and try again. If problems still exist, make sure that the cable is connected to the proper communications port. The assignment of the communications port is made under the Utilities (F6) selection in the main menu Select Block, which is described in the DRM Programming Section of this manual.

The 'XX' in the DTM menu indicates how many DRM data sets are contained within the attached DTM. Normally, either F1 or F2 of this menu is selected to automatically or selectively process the DTM.

For automatic processing (F1), the software offers filename prompting. If desired, you may have the computer automatically generate data files by answering "no" to the prompt. The computer uses the currently programmed date as a filename root, to which two digits are appended. This will guarantee unique filenames for up to 100 data files per day. However, the filenames generated are not very descriptive.

On the other hand, the user may elect to name the files with something more meaningful; this can be done by answering "yes" to the prompt. A prompt will appear requesting a filename after the intermediate processing of data sets of each DRM.

Using automatic processing, the computer will generate separate data files for the stored data sets of each DRM. These data files can be analyzed at a later time in a manner identical to data files stored from individual DRM's.

Once F1 is selected, the program processes ALL data files in the DTM. This involves generating new files on the disk designated for data files for EACH file in the DTM. There is no stopping this process once it is begun. When complete with auto process, the program returns to the previous display.

'Selectively process DTM data' (F2) lets the user choose which data set to interrogate. Up and down arrows are used to highlight the desired data file, and ENTER is pressed to select the file. Press F3 of the main menu to select another file for interrogation or press F10 to return to the previous screen.

The functions available for selective analysis are identical to those available when interrogating data stored on disk. However, these files are not on disk and must be stored individually.

If 'Clear attached DTM's memory' (F3) is selected, the DTM is cleared, making it ready for use in the next data transfer application. A prompt will ask for confirmation of this selection before the memory of the DTM is cleared.

Press F4 in the 'MAKE YOUR SELECTION' menu to process another DTM or DRM.

Maintenance

Maintenance of the DRM is primarily limited to keeping the input and output terminals clean and tight. The DRM has two 3.5-V Lithium batteries. These batteries have a shelf-life of 5 years.

If the batteries are used to power the unit in data-gathering mode ONLY (e.g., no data transfers), the batteries will power the unit for at least 3 years.

The DTM has two 3-V Lithium batteries. These batteries also have a shelf-life of 5 years. When used in the DTM, the batteries will power the DTM for a minimum of 10,000 data transfers.

Refer to Battery and DTM Problems in the Troubleshooting Section of this manual for addition information regarding battery performance.

Changing the DRM Batteries

To change the DRM batteries, you must first remove the right-side panel by removing the four Philips-head screw securing it to the housing frame.

CAUTION
To retain the latest programming information, the batteries must be changed in less than 60 seconds.

Using a small slotted-head screwdriver, pry the old batteries out of the battery holders. Replace the old batteries with suitable replacement batteries. Ensure that the designated polarity is maintained.

The internal clock of the DRM will be delayed by the amount of time that it takes to change the batteries.

Changing DTM Batteries

To replace the DTM batteries, you must remove the two rubber end-caps. Removing the end-caps allows access to the two rear panel screws. Loosen these two Phillips-head screws to remove the rear panel.

Using a small slotted-head screwdriver, pry the old batteries out of the battery holders. Replace the old batteries with suitable replacement batteries. Ensure that the correct polarity is maintained.

CAUTION
Transfer all data stored in the DTM before replacing batteries. Data will be lost if the batteries are removed while data resides in the unit.

Troubleshooting

Should a DRM malfunction, one or more possible problems may exist. The source of the problem may be pinpointed by checking some specific items. The following is a list of items that the user should check if a malfunction occurs:

- Cable/wiring connections
- Computer compatibility/configuration
- DRM configuration
- Improper disconnect
- Using dumb terminal mode
- Battery and DTM problems

Cable/Wiring Connections

Depending on the type malfunction, it is always wise to check electrical connections to ensure proper continuity exists for data signals. Connections made to the DRM in the field should be checked to ensure that the input readings are getting to the unit. Also, the cable connections between the DRM and the computer and/or DTM must be verified to ensure that adequate contact exists for the exchange of data.

If a communication link is established for the DRM, and recording or transferring problems are detected, the communition link through the modem should be verified before proceeding with any other troubleshooting procedures.

Computer Compatibility/Configuration

The computer used to program and to access the DRM data must be an IBM-PC, or compatible, capable of running the DRM Support Software.

The configuration of a computer system should be established so that all users of the DRM Support Software are aware of the location of the DRM data files. If one user configures the system so that the data files are stored on the floppy disk drive while others assume files are on the hard drive, the system will try to find stored data files on a non-existent drive. Also, configuration of communications ports must be clearly understood to use the DRM successfully. If the computer has only one communications port, it must be configured as COM1:.

Many IBM compatibles are sold with various graphics display options. The DRM Support Software requires the use of an IBM color graphics adapter (CGA) or a Hercules-compatible graphics card.

DRM Configuration

If the DRM Support Software is displaying incorrectly scaled engineering units, it may have inadvertently deleted or modified some of the 02REF.SCL files that were used when the recorder was last pro-

grammed. The Support Software maintains recorder scaling information on disk (not in the DRM). Thus, if the disk on which scaling information has been stored is not available, the displayed scaling information will not be what you expect. The solution is to use the disk that was used during the last programming session or to reprogram your units using the F2 option of the Utilities Menu.

Improper Disconnect

If you accidentally disconnect the DRM from the computer while the software is communicating with the DRM, you should be able to immediately reconnect the cable without causing any problems. If you leave the recorder disconnected for too long, however, it is possible for communications to fail.

The DRM stays on for 2 minutes after receipt of the last character from the computer. If the DRM stops communicating with the computer, it should be disconnected from the computer for at least two minutes. This allows the DRM to reset itself. You should then reconnect the DRM and try to re-establish communications.

If the support software appears to hang-up, first try pressing the ESC or F10 key. If this does not cure the problem, halt the program by pressing CTRL-Alt-Del. Then, restart the program.

Using Dumb Terminal Mode

There may be occasions in which you wish to establish communications using the Emulate Dumb Terminal (F5) option.

Make the necessary cable connections between the DRM and the computer. Before entering the dumb terminal mode, you must also change your baud rate (F4 of the Main Menu) to 300 or 1200 baud. Then, you may enter the dumb terminal mode via F5 of the Main Menu. At this point, your IBM-PC, or compatible, will behave just like a dumb terminal. All keys that you press are sent to the DRM.

To wake up the DRM (which is normally in a low power mode), the proper character sequence must be sent— a string of CTRL-H characters. Hold down the CTRL key and the H key at the same time. The DRM should respond within 60 seconds by sending a string of "OK's", at which time, F10 may be pressed to return to the main menu. If the DRM status is not displayed on the top half of screen, press F3 to inform the software that another DRM is to be processed.

If the wakeup is not successful, the DRM may communicate with the DTM. If the DRM and DTM communicate, the DRM is functioning properly. You should then attempt to communicate between your computer and the DTM. If the computer does not communicate with the DTM, a configuration or compatibility problem still exists.

Battery and DTM Problems

Problems encountered when transferring data from a DRM to the DTM and from the DTM to a computer are generally caused by marginal batteries — either in the DRM or the DTM.

Battery voltages in the DRM can be checked by removing the right-side panel of the DRM to gain access to the batteries. DRM battery voltages must be at least 2.8 volts per battery for the unit to operate properly.

Battery voltages can be checked in the DTM by removing both end-caps and loosening the two Phillips-head captive screws in the back cover and then it. DTM battery voltages should be at least 2.7 volts (with the DTM turned off).

RETURN PROCEDURES

To return equipment to Moore Industries for repair, follow these four steps:

1. Call Moore Industries and request a Returned Material Authorization (RMA) number.

   Warranty Repair –
   If you are unsure if your unit is still under warranty, we can use the unit's serial number to verify the warranty status for you over the phone. Be sure to include the RMA number on all documentation.

   Non-Warranty Repair –
   If your unit is out of warranty, be prepared to give us a Purchase Order number when you call. In most cases, we will be able to quote you the repair costs at that time. The repair price you are quoted will be a "Not To Exceed" price, which means that the actual repair costs may be less than the quote. Be sure to include the RMA number on all documentation.

2. Provide us with the following documentation:
   a) A note listing the symptoms that indicate the unit needs repair
   b) Complete shipping information for return of the equipment after repair
   c) The name and phone number of the person to contact if questions arise at the factory

3. Use sufficient packing material and carefully pack the equipment in a sturdy shipping container.

4. Ship the equipment to the Moore Industries location nearest you.

The returned equipment will be inspected and tested at the factory. A Moore Industries representative will contact the person designated on your documentation if more information is needed. The repaired equipment, or its replacement, will be returned to you in accordance with the shipping instructions furnished in your documentation.

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