DFM Series Intelligent Communications Processor User Guide

digital	DECwriter	RSX
	DIBOL	Scholar
DEC	MASSBUS	ULTRIX
DECmate	PDP	UNIBUS
DECset	P/OS	VAX
DECsystem-10	Professional	VMS
DECSYSTEM-20	Rainbow	VT
DECUS	RSTS	Work Processor

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FIGURES

EXAMPLES

This manual provides technical information that allows the user to install, test, program, and operate the DFM Intelligent Communications Processor.

Chapter 1 provides a general description of the important features of the DFM unit and summarizes a variety of DFM applications and configurations.

Chapter 2 contains procedures for proper site setup and preinstallation planning. Important link considerations and unit cabling requirements are covered.

Chapter 3 describes the physical features of the DFM unit and details the different controls and indicators of each module that mounts in the DFM enclosure. This chapter also includes a comprehensive preinstallation benchtest that verifies system and link operation, and allows the operator to become familiar with some of the features and functions of the DFM unit.

Chapter 4 provides typical examples of DFM configurations and the steps necessary to program the DFM unit properly to implement those configurations.

Chapter 5 contains detailed descriptions of each DFM command, where used, and the command line format for executing each command. Examples are provided for each command.

Chapter 6 describes the many configuration options that are available with the DFM unit to set up system, channel, and link parameters.

Chapter 7 identifies actions that should be taken when service is required. A systematic troubleshooting procedure using various DFM test features is provided to isolate problems with the hardware or telephone facilities.

Appendices A through F include a variety of material from specifications, details of all possible link modems, cables, a blank Configuration Worksheet, signal characteristics, and release notes.

This manual uses red and blue color highlighting to bring attention to certain features, operator interactions, and conditions. Many of the examples in this manual show how the operator must interact with the DFM unit to program certain operational characteristics. In these examples, operator input is highlighted in red, while expected system responses are printed in blue.

Other areas of this manual are printed in blue to emphasize the importance of certain information.

1.1 MULTIPLEXING

A multiplexer allows multiple terminals to share a pair of modems and a telephone line.

Each multiplexer controls the incoming data flow from local channels by combining it into a single stream of data for transmission to the other unit. Likewise, each unit receives a stream of data from the other unit, determines channel destinations, and forwards the data to the individual local channel destinations.

The original method for linking several devices at one site to a computer at another site is shown in Figure 1-1. Each device requires its own telephone line and two modems, one at each location. In the illustration, a total of ten modems and five separate telephone lines are required. Phone line usage is inefficient and costly in terms of monthly charges. Also, the large number of modems represent a high purchase or monthly rental expense.

Multiplexers solve the cost problem of multiple modems and phone lines otherwise required to connect several remotely located terminals to long distance or local area networks.

The DFM system can replace the configuration of Figure 1-1 with both reduced costs and greater efficiency. Two DFM units, two modems, and one high-speed telephone line (Figure 1-2) can service multiple terminals as well as provide other valuable network management benefits.

The DFM unit monitors the usage and performance of each channel as well as the concentrated link. It can print or display error counts and statistics on utilization for each channel or the link.

Additional cost savings and efficiency are realized because the DFM Intelligent Communications Processor (ICP) is an intelligent interfacing device. The DFM unit connects previously incompatible devices, provides automatic error correction, and manages the entire network from one location.

Aggregate baud rate of devices connected to the DFM unit can typically be two to four times the concentrated link speed. In some applications, baud rates up to eight or ten times the concentrated link speed can be achieved.
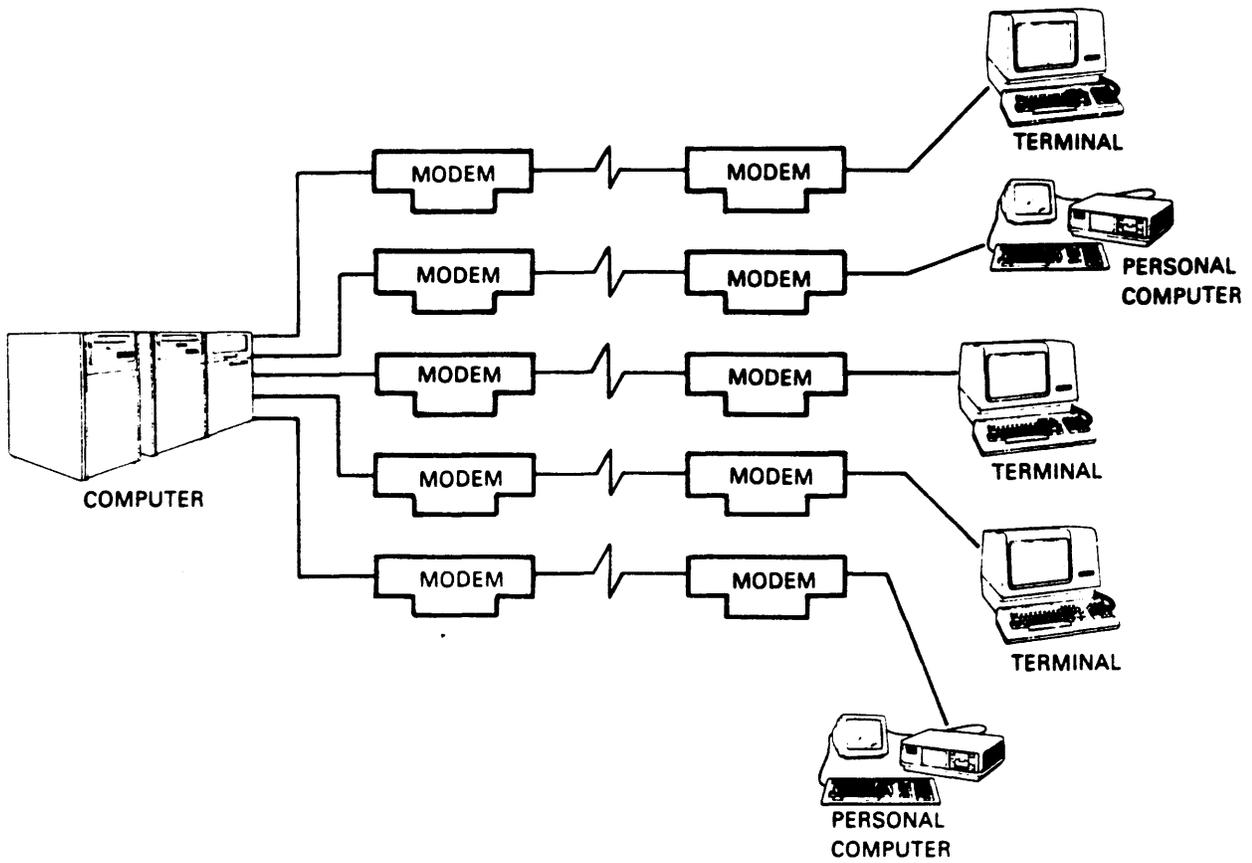
TK-10651

Figure 1-1   Traditional Remote Communication Network
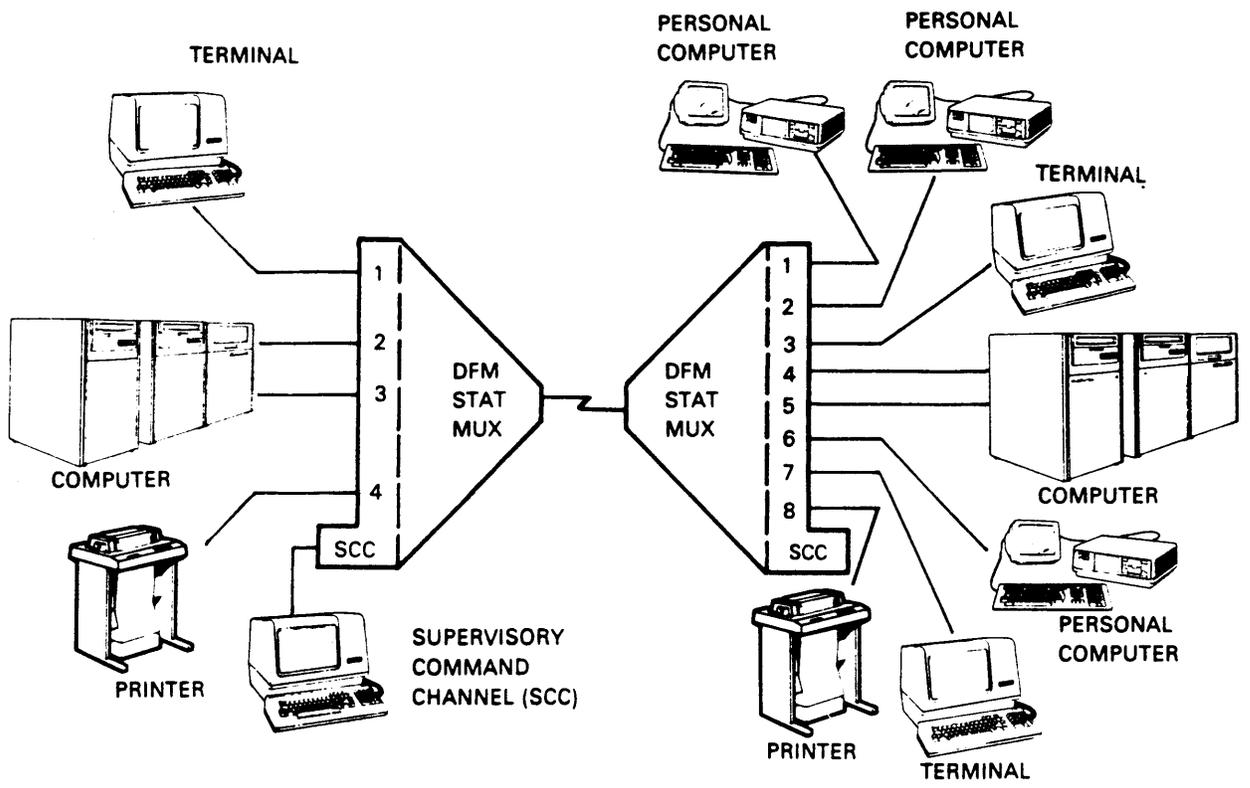
Figure 1-2 DFM ICP Communication Network

TK-10056

1.2 DFM FEATURES

A conventional multiplexer channel can communicate only with devices attached to the same channel on the remote unit. This type of operation is called dedicated. Other devices cannot access a dedicated channel even when it is inactive.

The DFM ICP eliminates the limitation of dedicated channels by allowing any channel in the network to be connected to any other channel. Multiple channels at one location can contend for a limited number of computer ports or other facilities at the other end of the system. Channel switching and port contention provide the flexibility that is required in today's rapidly changing communications environment.

The modular design permits quick and easy removal or insertion of modules into the backplane. No tools are required, which speeds troubleshooting, simplifies field upgrades, and decreases down time for maintenance.

DFM flexibility is a key feature. Programmable configuration options adapt the units to most types of data communications requirements and independent channel configurations allow the units to interface between nearly any type of bit serial devices. The DFM unit supports both synchronous and asynchronous communications traffic. Two out of every group of four channels can support either Digital Equipment Corporation's DDCMP or other synchronous protocols. Synchronous protocols other than DDCMP are handled in a transparent mode.

1.2.1 Channel Switching and Port Contention

DFM handling of switched channels allocates valuable computer ports more efficiently, services a greater range of hardware facilities, and provides easy expansion to support additional users.

Switched channel ends are treated independently. A device connected to a switched channel on the local unit may communicate with any device connected to the local or remote unit. If a selected channel or all channels assigned to a group are busy, the request for connection is queued. The connection is made as soon as the requested channel or any other channel assigned to the same group is available.

The contention feature of switched channels enables sharing of a limited number of computer ports or other facilities among a variety of users. This feature allows a 16-channel unit to be connected to a unit with fewer ports, with channels at one end contending for connections on a first come, first served basis.

Channel switching and contention includes an automatic disconnect feature for channels when there has been no activity within a time-out period defined by the system manager.

1.2.2 Network Management and Control

Management of the DFM system is accomplished through interactive commands that are entered to the system through the supervisory channel. Programming, diagnostic testing, and monitoring of the system are accomplished by the supervisory command program, which is directly accessed by the supervisory channel. If desired, the supervisory channel can be dialed into from a remote location.

Nondisruptive, current data information can be displayed or printed by the supervisory channel using the monitor capabilities for channel, link, or system. Monitored information for channels includes four types of error counters, EIA signal status, the last characters transmitted and received by the terminal, and transmit/receive utilization statistics.

Monitor information for the link and system includes link error counters, EIA signals, link transmit/receive utilization, and system status indicators.

This vital information enables the user to analyze data traffic trends and potential congestion points. It also isolates the location and nature of error conditions. For example, widely fluctuating link statistics can provide an early warning of telephone line failure. When telephone line performance is questionable, link categories can be monitored (and printed out) over time to help define a link problem before it causes the system to go down. A full range of diagnostic tests quickly isolates malfunctioning components to replaceable modules.

Supervisory Channel

> The supervisory channel provides direct access to the supervisory command program, which processes DFM interactive commands. The supervisory command program may also be accessed from the data channels once they are enabled to do so by the system manager. Supervisory channel output takes full advantage of CRT display capabilities, displaying a full screen of system information on request.

Down-line Loading of Parameters

> When units are reset, reinitialized, or reconnected, channel parameters are checked for consistency and down-line loaded, if necessary. This not only ensures parameter compatibility between units, but also speeds the initial configuration process. Channel parameters need to be entered on only one unit, and then sent down-line to the other.

Selective Modem Control

The integral modem module permits switch selectable modem control and single source support of the DFM system. When the front panel signal quality monitor indicates signal deterioration, the user may manually initiate a fallback in transmission speed.

Parameter Protect

The front panel parameter protect switch protects current configuration of parameters from being changed either by command or down-line loading. This prevents either accidental or deliberate tampering with system parameters from a remote location once the system is set up.

Simple Programming Dialog

Interactive commands make supervisory functions easy. DFM command structure includes prompting that helps first-time users through each step of a complete command. Experienced users can use abbreviated commands to speed the process.

Nonvolatile Storage

DFM option settings are stored in NVROM (nonvolatile read only memory), which is not disturbed by loss of power. Thus, units do not have to be reprogrammed if a power interruption occurs.

Password Secured Access

Passwords assigned and changed only by the system manager limit the use of supervisory and data channel command modes to authorized users only. There are two levels of password access: user and system manager.

The USER level allows access to noncritical functions such as monitoring status, displaying configuration parameters, executing limited test functions, and normal data channel usage via the CONNECT/DISCONNECT commands. The SYSTEM MANAGER level allows access to all command functions.

Autodisconnect

Switched channel connections can be automatically disconnected if there has been no data activity within a timeout period defined by the system manager. Releasing inactive computer ports permits existing hardware facilities to be more efficiently allocated.

1.2.3 Intelligent Interfacing

Channels may operate synchronously or asynchronously using 5-, 6-, 7-, or 8-bit data with even, odd, or no parity, and any one of thirteen flow control conventions. In addition, the DFM unit provides the following for each channel:

Speed Conversion

Channel ends may be programmed for different speeds allowing terminal devices to communicate with one another, regardless of differences in speed. This is especially convenient in applications using switched channels.

Flow Control Conversion

Flow control conventions are separately programmed for each channel end. The intelligent interface provided by the DFM unit automatically translates flow control types between ends. Incompatible devices now can be connected by taking advantage of this feature. For example, a computer using XON-XOFF flow control can be connected to a printer that uses DSR-DTR, and the DFM system ensures that data is stopped and started as required by either device.

Autobaud

Autobaud automatically adjusts the multiplexer data rate to match the speed of the connected terminal. It does this by determining the speed of the first character received (expected to be a RETURN). This feature is a necessity when DFM channels are connected to dial-up modems since the transmit speed of the terminal may be an uncertainty. Autobaud also may be used on channels directly connected to terminals.

Break Character Control

Break characters are accepted by the DFM unit and reproduced at the other channel end. Accuracy is crucial because some data terminals have functions associated with break characters of different lengths.

Flyback (Fill) Character Delay

A specified number of NUL characters is transmitted following a RETURN on DFM channels. Some terminal devices (especially printers) require additional time for the print head or cursor to return to the starting point for the next line of data. Use of this feature prevents loss of data.

1.2.4 Comprehensive Diagnostics

Pinpointing failures is made easy by the automatic self-tests and diagnostic tests available to data channel operators or the system manager.

Power-up Self-test

> Built-in self-test diagnostics are executed when the units are powered on or restarted from the supervisory channel. They detect most hardware failures. LED error codes identify the failure and location.

System Manager Level Tests

> Diagnostic test capabilities including Channel Loopback, Link Loopback, Remote Echo, Local Echo, and Pattern tests are available to the system manager. Tests are executed from either the supervisory channel or any properly enabled data channel.

Data Channel Level Tests

> Data channel command mode allows a limited subset of tests to be run without having to enter a password. Local Echo, Remote Echo, Channel Loopback, and Pattern tests may be run on any channel that is in command mode.

Manual Maintenance Mode

> When the supervisory channel is inoperative or not available, a subset of testing features may still be run by using the two maintenance pushbuttons (M1 and M2) on the control module. Front panel LEDs indicate test results.

1.2.5 Expansion Capability

Modular Design

> Simplicity of design enables tool-free access and module change by quick removal and reinsertion into the backplane. Failures are quickly isolated to a replaceable module. All LEDs and pushbutton switches are readily accessible on the front panel.

Expansion Line Modules

> Channel capacity can be increased in 4-channel increments, up to a maximum of 16 channels. Of each 4-channel group, two channels can support synchronous or DDCMP operation.

Integral Modem Module

For complete system independence and single-source support, Digital Equipment Corporation provides several integral modem modules available in 2400 bits/s, 4800 bits/s, or 9600 bits/s. Modem control, testing, and monitoring are made easy by the use of front panel switches and LEDs.

1.2.6 Maximized Throughput

DFM design and functions optimize both response time and link utilization (throughput):

Multi-microprocessor Design

The DFM unit has up to four microprocessors that perform a variety of independent processing tasks. The control module, channel modules, and integral modem module have their own microprocessor(s). This distributes the workload and optimizes microprocessor time, which maximizes throughput and performance.

Internal Direct Memory Access (DMA) Data Transfer

Control board logic transfers data directly between channel and link, relieving the processor of this task. This increases overall processing capability and provides exceptional throughput and response time.

Channel Input and Output Buffers

Each DFM channel has input and output buffers. Each buffer has a capacity of 4K bytes for synchronous channels and 2K bytes for asynchronous and switched channels. Separation of buffering, aids link throughput and minimizes the possibility of buffer overflow.

Error Correction

The DFM system provides automatic correction of errors that occur during data transmission. A cyclic redundancy check (CRC) is run on each block of data as it is transmitted and received. Any discrepancy results in an automatic request for retransmission. The CRC method guarantees an undetected error rate of about one in one trillion.

1.3 APPLICATIONS AND CONFIGURATIONS

The versatility of the DFM units enable them to support a large variety of applications. Computers can be used at either or both ends of the link, as well as any mix of printers, terminals, personal computers, or modems. Switching and contention features permit a single unit to be used as a local equipment allocation device. Configurations of the DFM system include support for:

- Channel switching and port contention

- Single-unit use of switching functions

- Tail circuits (either dial-up or dedicated modems connected to a remote DFM port)

- Dial-up computer timesharing

- Communications via satellite

- Both asynchronous and synchronous traffic

- Multiple DFM configurations

1.3.1 Switching and Contention

Channel switching and contention features provide the flexibility required in the rapidly changing data communications environment. Any switched channel end can be connected to any other, if allowed by the security feature. This makes it possible for a user to have immediate access to all authorized company facilities (see Figure 1-3).

The channel contention feature allows a unit at one end of the network to be connected to a unit with fewer channels at the other end. Terminals at one end contend for connections on a first come, first served basis. Inactivity for a time period selected by the system manager results in an automatic disconnect, freeing unused computer facilities.

The contention feature allows a limited number of computer ports or other facilities to be shared among a variety of users. By minimizing the need for additional computer ports, this feature obtains maximum performance from existing hardware facilities.
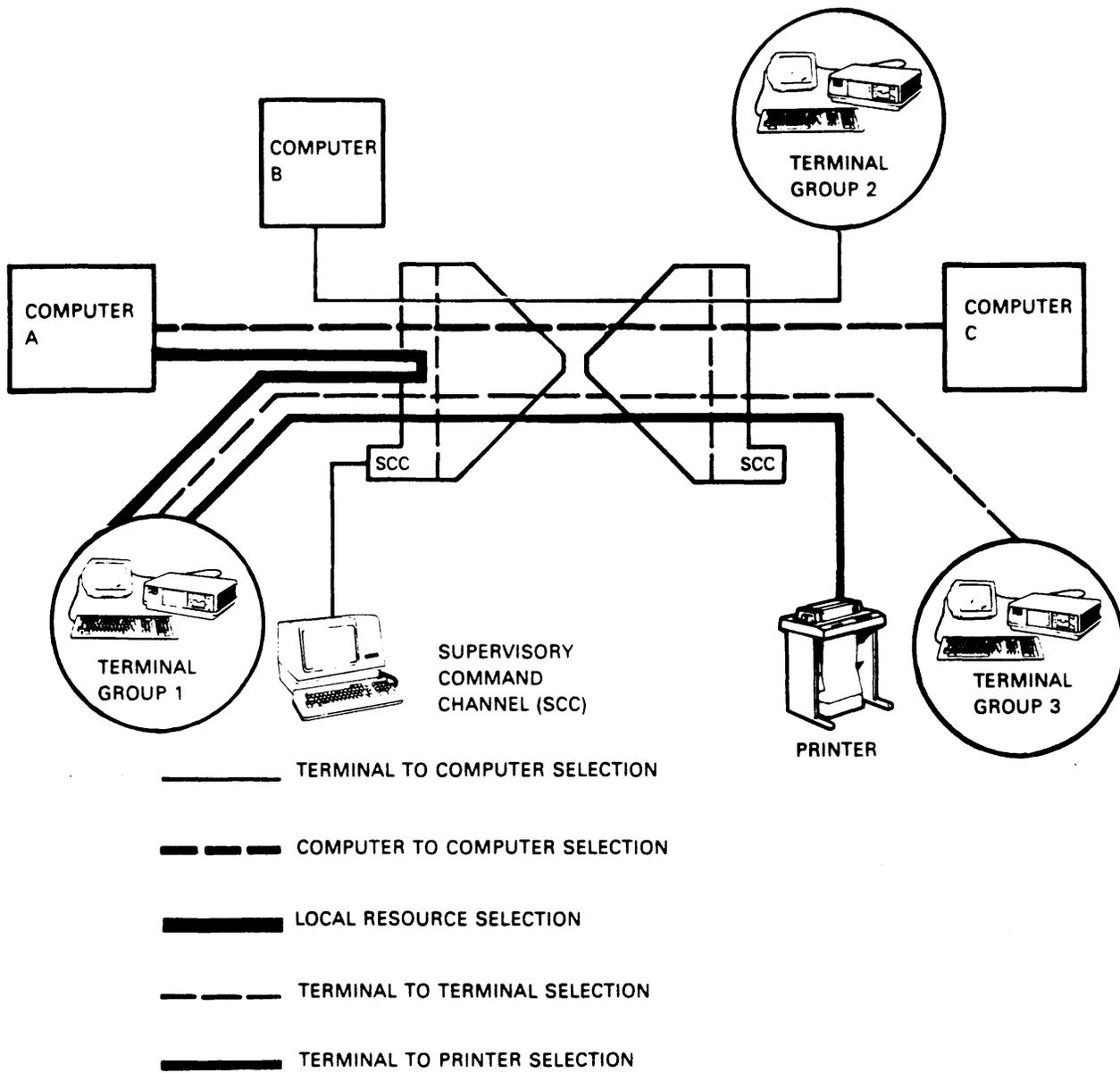
Figure 1-3 Switching and Contention Configuration

There are circumstances in which a large number of users require connection to a variety of in-plant facilities, or a limited number of computer ports need to be shared locally by many users. In such an application, a single unit may be used as a local switch (see Figure 1-4). By using the simple CONNECT command, users are either connected or queued for connection to the desired facility.
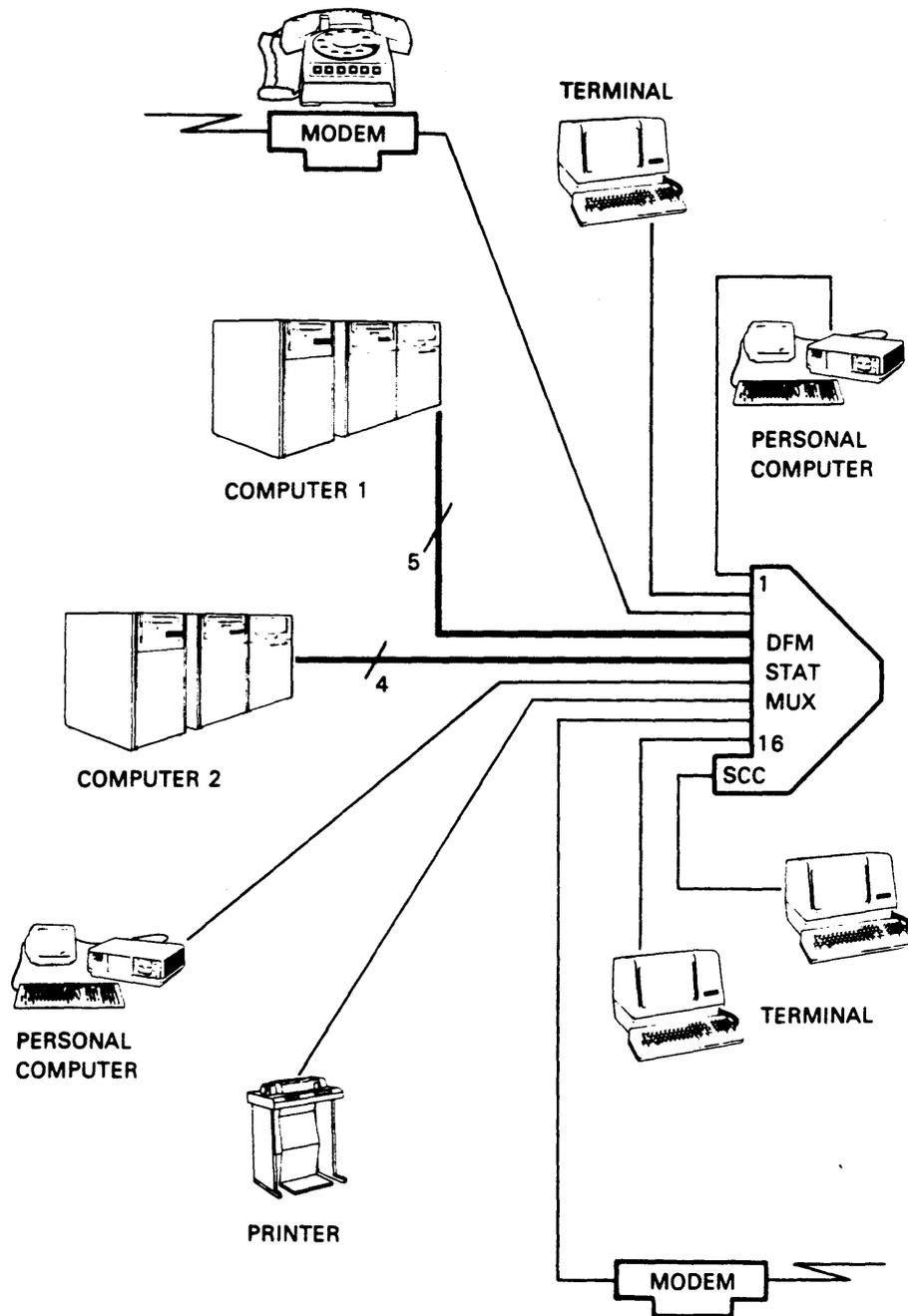
Figure 1-4 Single-Unit Switching Functions

1.3.2 Tail Circuits

Figure 1-5 illustrates a network configuration with DFM sites in Boston and Chicago, each having a substation (called a tail circuit). Each tail circuit connects to the DFM unit by modems using either public switched telephone facilities or private leased lines. Notice in Figure 1-5 that each DFM site has a variety of channel devices.
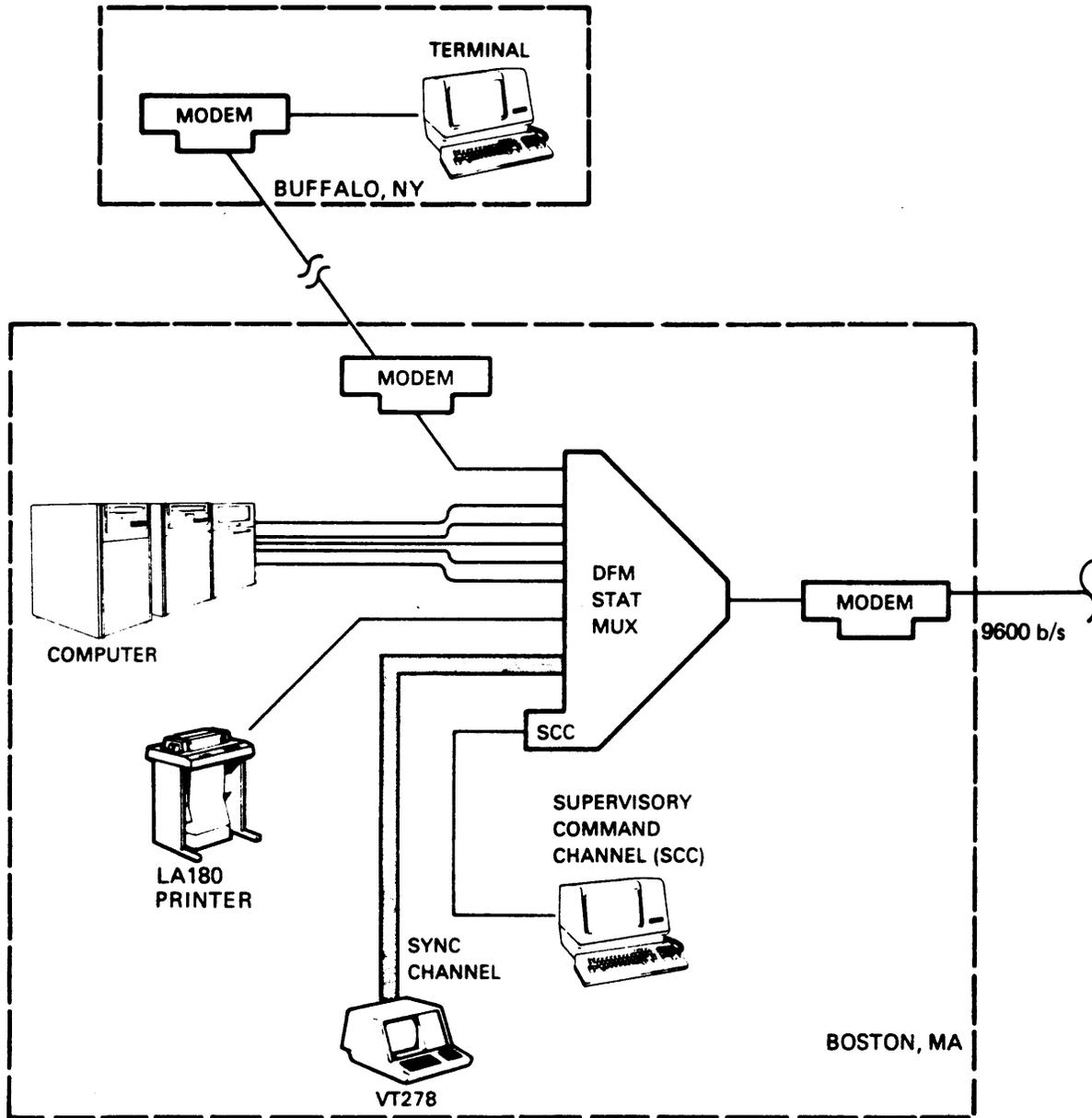
MKV84-0576

Figure 1-5   Distributed DFM Network with Dial-up Remotes
(Sheet 1 of 2)
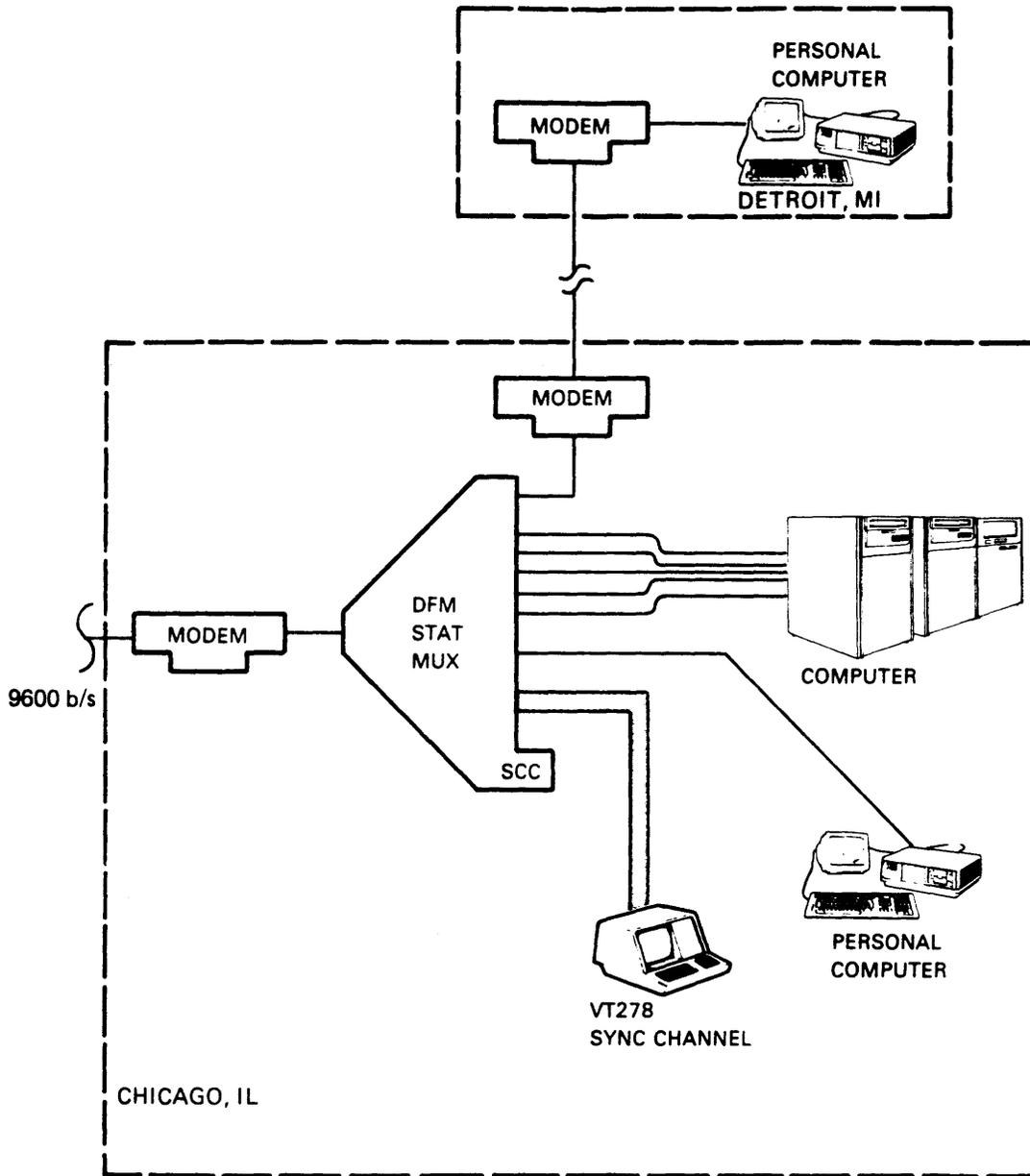
Figure 1-5   Distributed DFM Network with Dial-up Remotes
(Sheet 2 of 2)

The number of tail circuits is limited only by the number of DFM
channels. The configuration in Figure 1-6 allows a business in one
city to provide computer time to customers in another. In this
type of application, all channels on the remote unit are connected
to dial-up modems, allowing customers to access the remotely
located computer by a local phone call.
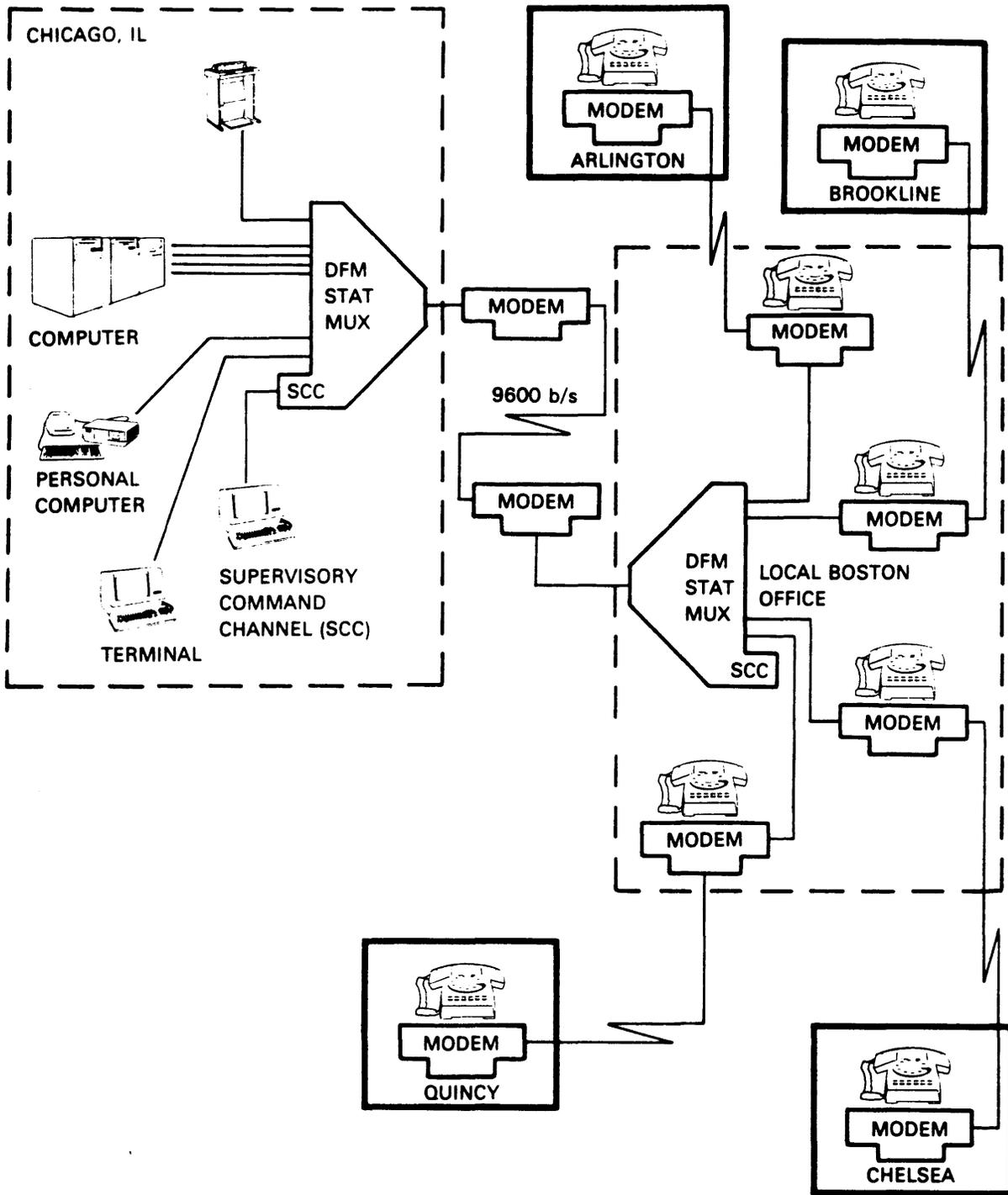
Figure 1-6 Dial-up Computer Timesharing

1.3.3 Satellite Links

DFM network configurations are not limited to conventional terrestrial link facilities. Concentrated link facilities can include microwave, fiber-optic, or satellite components. Figure 1-7 illustrates the use of a satellite link instead of a telephone line.
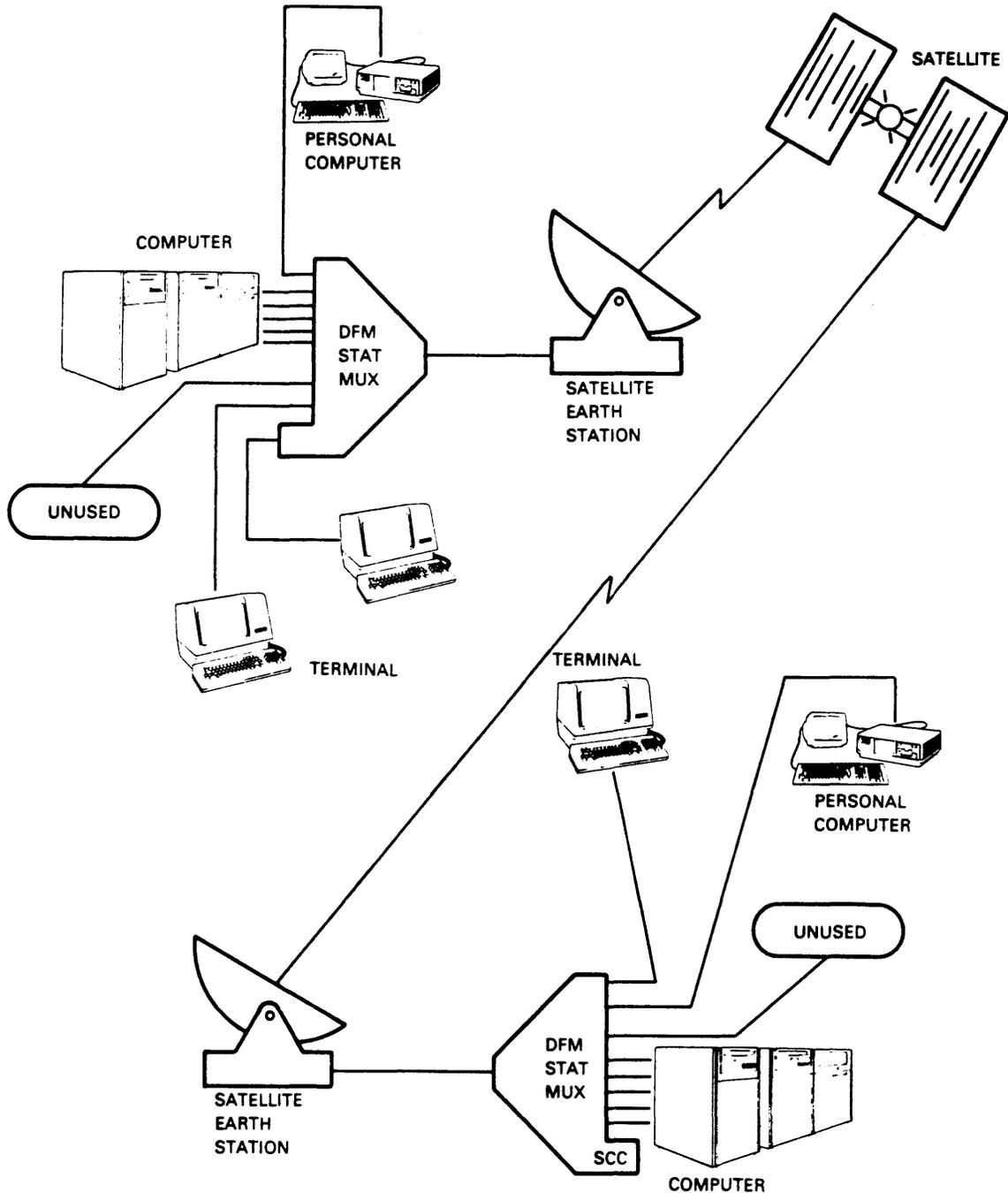
Figure 1-7 DFM System Using Satellite Link

1.3.4 Synchronous Channels

The DFM unit handles synchronous data traffic on up to one-half its channels. Each of these channels can be configured separately to support various data speeds and block sizes. All synchronous data channels that use EIA flow control have data statistically multiplexed to provide maximum throughput. In addition, special control for Digital Equipment Corporation's DDCMP protocol is provided by monitoring the incoming data for control, maintenance, and data messages. When detected, messages are relayed immediately. See Figure 1-8 for synchronous channel configurations.
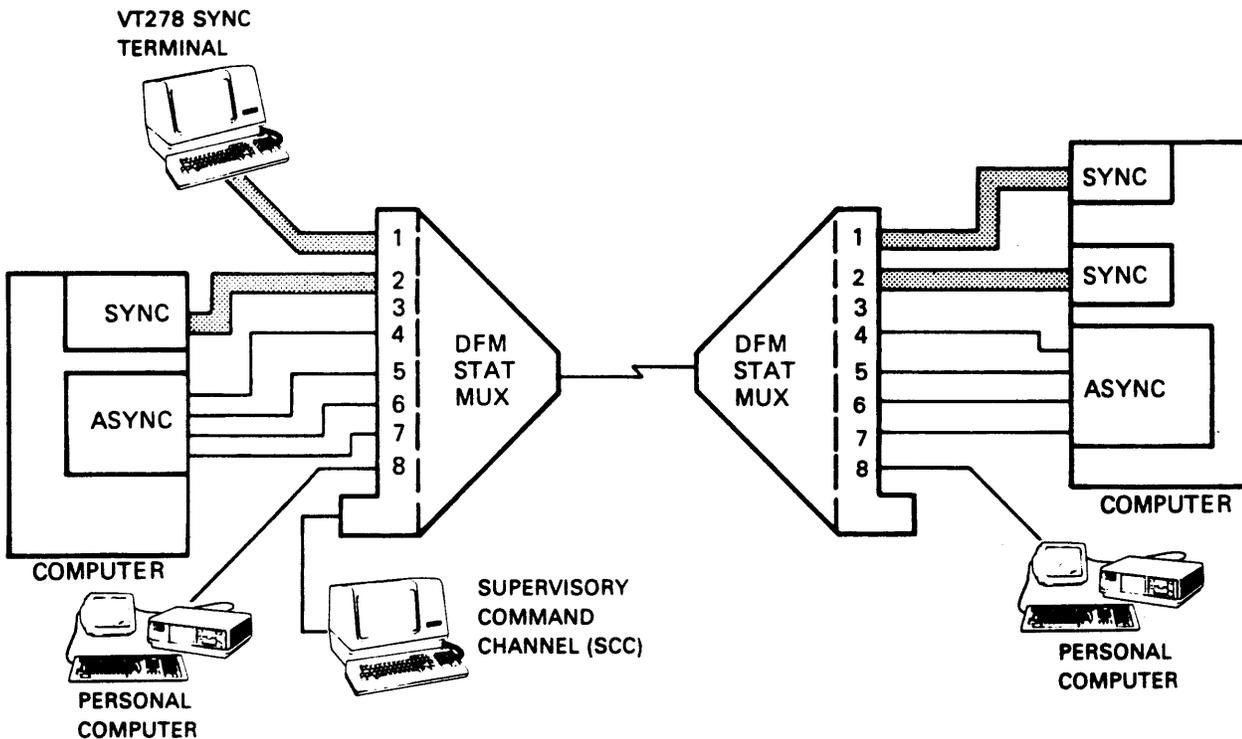
Figure 1-8   Synchronous Channel Configuration

1.3.5 Multiple DFM Configuration

By taking advantage of synchronous channel capability, two pairs of DFM units can service a multiple DFM application (see Figure 1-9). In this configuration, channels from two separate locations use the same concentrated link. This configuration is particularly economical when one site is significantly farther away from the other two (for example; sites in Boston, New York, and Denver). Again, a channel at any of the sites may also be dialed into or connected to dedicated modems.

1-18

DENVER

COMPUTER

DFM
STAT
MUX

SCC

4

DFM
STAT
MUX

1

SCC

MODEM

9600 b/s

SUPERVISORY
COMMAND
CHANNEL (SCC)

BOSTON

TERMINAL

PERSONAL
COMPUTER

TERMINAL

MODEM

4

DFM
STAT
MUX

1

SCC

MODEM

PERSONAL
COMPUTER

TERMINAL

DFM
STAT
MUX

SCC

MODEM

PERSONAL
COMPUTER

TERMINAL

NEW YORK

MKV84-0287
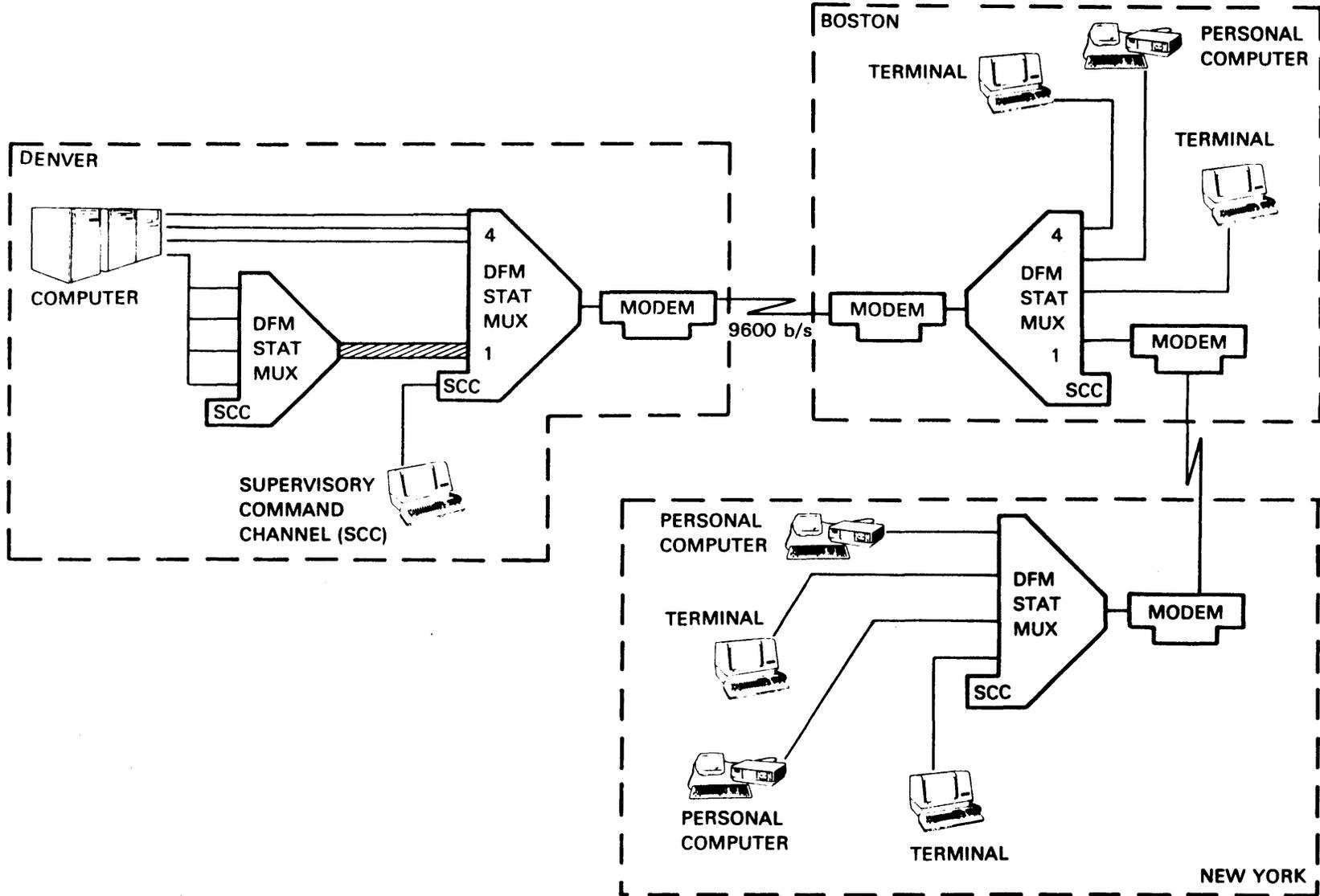
Figure 1-9   Multiple DFM

2.1 GENERAL

This chapter provides guideline information for planning DFM installations. This information is to help determine what additional equipment will be required to satisfy your application requirements. The latter portion of the chapter provides cross-reference data for determining placement of the units, cabling, and other requirements.

2.2 SUPERVISORY CHANNEL

Use of the independent supervisory command channel (SCC) is required during initial installation to set up the system parameters, which are described in Chapter 6. Once the system is set up, the terminal may be moved to a data channel where it may alternatively be used for supervisory purposes. In most cases, once the system is set up, there is little need for supervisory access.

The SCC terminal should be located within 15.24 m (50 ft) of the DFM unit for a direct connection. For distances greater than 15.24 m (50 ft), line drivers, modems, or a dial-up connection may be used.

Terminals connected to the supervisory port must be asynchronous, and set to some combination of the following:

- Seven or eight bits
- Parity of even, odd, or none
- One stopbit
- Flow control of either XON-XOFF or none
- Speed of 150, 300, 600, 1200, 2400, 4800, or 9600 bits/s

The supervisory channel is equipped with an autobaud mechanism that allows it to adjust to the current speed setting of a terminal when it is connected. Autobaud can detect speeds of 150, 300, 600, 1200, 2400, 4800, or 9600 bits/s.

Setting up the system is done via interactive commands: commands that the system prompts for, and responds to in English. After initial programming, other supervisory functions may be done from either the supervisory channel or from data channels. Both provide password protected ability to set parameters, monitor data flow, and test the DFM system. Except for setting a few link and system parameters, all input may be made at one end of the system.

There are three levels of system control:

- Supervisory Level -- This level is the highest level of system control and requires a password. The supervisory level password allows the system manager total supervisory capability. This level displays a SYS> prompt.

- User Level -- This level also requires a password, but is more restrictive, not allowing parameter changes or test functions. This level displays a USR> prompt.

- Channel Operator Level -- This level allows channel users to perform tasks necessary for their channels only, without a password. This level is available only to channels that have been enabled via the supervisory level. This level displays a SEL> prompt.

2.3 CHANNEL CONSIDERATIONS

2.3.1 Channel Type
Channel type parameter allows the DFM unit to support the communications protocol of devices connected to the selected channel. Choices are:

- Asynchronous,
- Switched,
- DDCMP,
- Synchronous, and
- Unused.

2.3.1.1 Asynchronous Channels -- Asynchronous channel types operate with asynchronous protocol, and are dedicated. For example, a device connected to Channel 1 on the local unit can only communicate with whatever device is connected to Channel 1 on the remote unit.

2.3.1.2 Switched Channels -- Switched channel types operate with asynchronous protocol, but can be connected to any other switched channel via the CONNECT command (see Chapter 5). Switched channels are completely independent; Channel 1 on the local unit may be connected to any other switched channel on the local unit as well as any switched channel on the remote unit (see Channel ID and Group Access Options, Chapter 6).

The switched channel "contention" feature allows a limited number of computer ports or other hardware facilities to be shared among a variety of users. This enables, for example, a 16-channel unit to be connected to a unit with fewer ports. Channel contention operates on a first come, first served basis. Suppose that Channel 1 on the local unit requests connection to Channel 3 on the remote unit. If Channel 3 on the remote unit is already connected to another switched channel, the request is queued.

If Channel 1's request is the first one queued, it will be connected as soon as Channel 3's current connection is terminated. Otherwise, it must wait until prior requests for connection are satisfied. Channels requesting connection to busy channels or groups remain queued until either a connection is made, or the request is withdrawn with the DISCONNECT command.

2.3.1.3 Synchronous Channels -- Synchronous channels are defined as either DDCMP or sync channel types. DDCMP is Digital Equipment Corporation's proprietary protocol used primarily with systems joined by DECnet facilities. Synchronous channel types support any type of synchronous communications protocol in a transparent manner (that is, the DFM unit does not look at or interpret data on the channel). Because of internal buffering, however, some delay in the data transfer may be experienced.

Since constant communication between devices is a part of most synchronous protocols, synchronous channels have a big impact on link utilization. Data rate calculations for the link must include 120% of the combined data rates for full-duplex synchronous channels. For DDCMP and half-duplex synchronous operation, the link calculations must include 50% of aggregate input.

Half-duplex operation is recommended whenever possible for synchronous (non-DDCMP) channel types. Half-duplex operation is selected by CTS-RTS flow control.

DFM handling of the DDCMP protocol eliminates the need for flow control or half-duplex operation. In DDCMP protocol, when the DFM unit detects an "idle" frame (no data present), it does not transmit it. This saves concentrated link bandwidth for frames with data.

Synchronous channel loading must be spread evenly among channel modules. For this reason, the DFM unit only supports synchronous or DDCMP operation on two out of every group of four channels (Channels 1 and 2, 5 and 6, 9 and 10, and 13 and 14). The load should be spread as evenly as possible. For example, if 3 synchronous channels are required on a 12-channel unit, they should be assigned to Channels 1, 5, and 9.

Since synchronous communications protocols typically include their own error detection and retransmission schemes, the DFM unit does not provide error correction on synchronous and DDCMP channel types.

Section 2.4.2 covers link speed calculations, including synchronous channel considerations.

2.3.1.4 Unused Channels -- Channels not currently in use may be set to a channel type of unused. This prevents the channel from being serviced by the DFM unit, reduces system overhead, and improves service to the remaining channels. Channels may be changed from one of the other types to unused and then back, without losing parameter settings.

2.3.2 Connecting a DFM Channel to a Modem
Either dial-up or dedicated modems may be connected to a DFM channel. For 1200 bits/s dial-up capability, the 212A compatible DF112 modem is available. For 2400 bits/s operation, the DF124 or DF224 modems are available.

A crossover cable (BC22M cable or equivalent) must be used to connect a modem to a DFM channel. When a dial-up modem is used, it is possible to have the host computer or the DFM unit manage the handshaking sequence. (See Section 6.7.2 for more information.)

Synchronous and DDCMP channels can be dialed into only if a modem with an auto-answer feature is used; carrier detect (CD), data terminal ready (DTR), and clear to send (CTS) are always asserted on synchronous and DDCMP channels.

2.3.3 Channel Cabling
Regardless of the channel type setting, straight-through cables are used for connection directly to terminals, and crossover cables are required when a DFM channel is connected to a modem. Further information on DFM cables is found in Table 2-1. Cable wiring diagrams are found in Appendix C.

2.4 LINK CONSIDERATIONS
The first consideration for the link is to determine what type of facility will be used. The following sections discuss link types, then suggest a procedure for determining link speed. Having determined the required data rate for the link, it is possible to determine requirements for direct or modem connections. This, in turn, establishes cabling requirements.

2.4.1 Type of Link
A communications link can be any one of the following:

- Dial-up phone line with modems;

- A leased (or dedicated) line with modems;

- Microwave or satellite transmission service (typically accessed through phone connections); or

- Direct, short-haul connection via line drivers or fiber-optic media.

With dial-up phone lines, data is sent through the telephone company's regular voice grade lines and intermediate switching circuits. At times, noise and interruptions on these lines can make effective data communications difficult, if not impossible.

Leased lines are physically separate circuits that are not shared with other users. A leased line is available at all times and can achieve high-speed transmission in both directions simultaneously by employing a 4-wire circuit. In addition, the monthly charge for leased lines does not vary with hours of usage as it does with dial-up lines. Under some circumstances, however, even dedicated leased lines experience noise interruptions and line "hits," which may lead to garbled data transmissions.

Two other forms of transmission media are becoming increasingly popular:

- Microwave, and
- Satellite.

Both provide high-speed, high-volume data communication. Microwave links are particularly effective for intracity applications, satellite links offer effective overseas and intercity connections.

When data communications capabilities are needed for more than a few hours each business day, a dedicated phone line is usually the most economical solution, even for one terminal. If there are several terminals in use at the same time and location, the user will need a dedicated line to take advantage of the cost savings of multiplexing with the DFM unit.

All cables used as part of the concentrated link should be of high quality construction, preferably shielded twisted pairs. Specifications for cables used as part of the concentrated link are described in Appendix C. The characteristics of the signals on the concentrated link as well as channel lines are covered in Appendix E.

2.4.2 Data Rate for the Link
The proper data rate (speed) of the concentrated link in any application is an important factor in achieving optimum performance from the DFM system. The speed must be great enough to handle the anticipated data traffic, but no greater than that because of the increased cost of higher speed communications facilities.

Link speed is determined by:

1.   Dividing channel devices into categories

     a.   Asynchronous CRTs with flow control
     b.   Asynchronous CRTs without flow control
     c.   Asynchronous block mode CRTs
     d.   Printers
     e.   DDCMP or half-duplex synchronous devices
     f.   Full-duplex synchronous devices

2.   Estimating a "required bandwidth factor" for each
     category

     a.   Async with flow control   = .15
     b.   Async without flow control   = .25
     c.   Async block mode CRTs   = .30
     d.   Printers   = .35 to .6
     e.   DDCMP, half-duplex sync   = .50
     f.   Full-duplex synch   = 1.2

3.   Multiplying the combined baud rates of each category
     times the required bandwidth factor

     For example, suppose there are four asynchronous CRTs
     (using flow control) operating at 4800 bits/s:

          Combined baud rates = 4800 X 4 = 19,200 bits/s
          19,200 X .15 = 2880 bits/s

     Thus, 2880 bits/s of link speed is required for these
     devices. Suppose there are also two DDCMP channels
     operating at 2400 bits/s:

          Combined baud rates = 2400 X 2 = 4800 bits/s
          4800 X .5 = 2400 bits/s

     2400 bits/s of link speed is required for these two
     devices.

     Final link speed is calculated by adding the totals for
     each category. In this example, 2880 bits/s + 2400
     bits/s, or at least 5280 bits/s of link speed are needed.

The bandwidth factors listed are estimates only, based on average conditions and usage. Additional factors may require that these estimates be revised either upward or downward. For example, if an asynchronous terminal using flow control is planned for a very light usage application (one or two hours a day) the required bandwidth factor for that device may be lowered to .10.

On the other hand, if the same terminal is to have an unusually heavy application, it is advisable to increase the bandwidth factor to .20.

In general, bandwidth factors should not vary much from the preceding figures. In the case of printers, however, the amount of usage can significantly alter the estimate given.

When a printer receives data at full capacity, it will tend to monopolize the link for the duration of the job. Thus, if a printer will be running for more than 10 or 15 minutes each hour, a factor of .6 (or greater) may be warranted. If it is going to be running only a few minutes each hour, a factor of .35 to .4 probably will be sufficient.

For asynchronous block mode terminals, the factor to be used is dependent on the size of the block, even when flow control is in use. This is because the CPU usually will not respond to flow control except between blocks of data. If the size of the blocks is not too big (for example, fewer than 1000 bytes), the suggested factor of .30 should be adequate. Otherwise, like a printer, terminals will monopolize the link for the duration of the block, and the factor required should be increased proportionately.

Flow control usually increases the response time to remote devices. Since the DFM units regulate the flow of data, however, data will not be lost. Without flow control, as the speed of the concentrated link is reduced, the chance of buffer overflow and subsequent loss of data is increased.

When an error is detected, the DFM unit automatically retransmits data. Thus, a higher error rate directly reduces the effective throughput of the concentrated link. If phone lines are known to be troublesome, the estimated link speed should be increased accordingly. In general, the larger the network, the more conservative the estimate of link speed should be.

Once an estimate of required link speed is reached, the result is adjusted upward to achieve a faster response, assure a better echo of data, or to anticipate a high error rate.

2.5 LINK MODEMS

The DFM unit can operate with either a variety of standalone external modems such as the DF100 series or a variety of optional integral modem modules.

2.5.1 Optional Integral Modem

The DFM enclosure supports an optional integral modem module of either 9600, 4800, or 2400 bits/s, allowing complete system independence and single-source support of the DFM system.

While the DFM unit can work in conjunction with nearly any type of modem, the DFM integral modem is the ideal match. The integral modem is a self-equalizing, synchronous modem designed for point-to-point applications. Self-equalization allows them to adjust automatically to changing line conditions, which means that they operate effectively over standard, unconditioned voice grade lines (type 3002).

2.5.2 External Link Modems or Line Drivers

If external modems are used, they must meet two primary criteria:

- They must handle control signals in a way that allows the DFM units to detect an interruption to communications (for example, by dropping CTS).

- They must be data transparent; that is, they must not be dependent on the communications traffic being in character format.

The DFM unit can operate with synchronous modems of any speed up to 19.2K bits/s. The only asynchronous link speed that is supported, however, is 9600 bits/s. Currently, the only type of asynchronous modem that is as fast as 9600 bits/s is a short haul modem.

If DFM units are to be a maximum of 15 to 20 miles apart, it may be possible to utilize short haul, asynchronous modems operating at 9600 bits/s. Check manufacturer's requirements for distance, and other requirements such as conditioning of the telephone line.

For interplant applications, the DFM units may be either directly connected, or connected with line drivers. Digital Equipment Corporation recommends a maximum of 15.24 m (50 ft), in accordance with EIA standards, for units to be directly connected. With high quality cable and the absence of any electrical interference, it may be possible to go farther than 15.24 m (50 ft).

Line drivers are used in conjunction with in-plant cables up to approximately 1524 m (5000 ft). They amplify the input digital signal so that longer distances can be covered without signal deterioration. Check manufacturer's requirements for distances and types of cables required.

Table 2-1 summarizes cable types and usage in conjunction with the various kinds of communication facilities.

2.6 OPERATING CONDITIONS FOR THE DFM UNIT

The DFM unit is designed to operate in a clean and dry environment such as a computer room or office area. It is lightweight and can be placed on any solid, unheated surface such as a shelf or desktop. Do not place the unit on top of a cabinet that generates heat. The DFM unit may also be located in the H9646 communications cabinet on an optional louvered shelf. Clearance on the sides of the unit is not important. Avoiding obstruction of the bottom and top ventilation holes, however, is very important.

CAUTION
Do not block top or bottom ventilation holes. Convection is the only method of cooling the unit. If ventilation is restricted, damage will result.

About 10.16 cm (4 inches) of clearance at the rear is required for cable connection and routing. The front of the unit should be in a position that makes the front panel LED indicators clearly visible.

2.6.1 Environment

The DFM unit operates within temperatures ranging from $0°$ to $40°$C $(32°$ to $104°$F) and relative humidity ranging from 0% to 95% noncondensing up to an altitude of 2438 m (8000 ft). Storage (nonoperating) temperatures are from $-35°$ to $71°$C $(-30°$ to $160°$F).

2.6.2 Power Requirements

Nominal power required for the DFM unit is 115 Vac (230 Vac optional) within the 50 to 60 Hz frequency range at 92 W. The DFM unit is Underwriter's Laboratory (UL) listed and Canadian Standards Association (CSA) approved. The power cord is 2.1 m (7 ft) long.

2.7 PREINSTALLATION TEST AND FAMILIARIZATION

A preinstallation benchtest (Chapter 3) is recommended for each pair of DFM units prior to installation at local and remote sites. The purpose is both to ensure that the units are functioning properly, and to familiarize operators with their use. For this reason, it is strongly recommended that both DFM units be sent to the same site.

When integral modems are purchased, units are connected for the test with a piece of phone wire or any other compatible 4-wire cable. If integral modems are not purchased, Digital Equipment Corporation recommends purchasing a BC22L cable, or obtaining another cable that conforms to null modem specifications in Appendix C. The BC22L cable crosses receive and transmit pins and loops back other signals so that DFM units can communicate without modems between them.

2.8 DFM CABLES

Figure 2-1 shows the locations of the various cables required with the DFM system. Table 2-1 provides cable descriptions and order numbers.

Each channel presents a DCE interface which can be directly connected to a terminal (DTE), in which case, a straight-through cable is used. If a channel is connected to a modem (DCE), a crossover cable must be used.

The link (connector J18) presents a DTE interface, expecting to be connected to a modem (DCE). If units are to be directly connected (DTE to DTE), a crossover cable must be used.
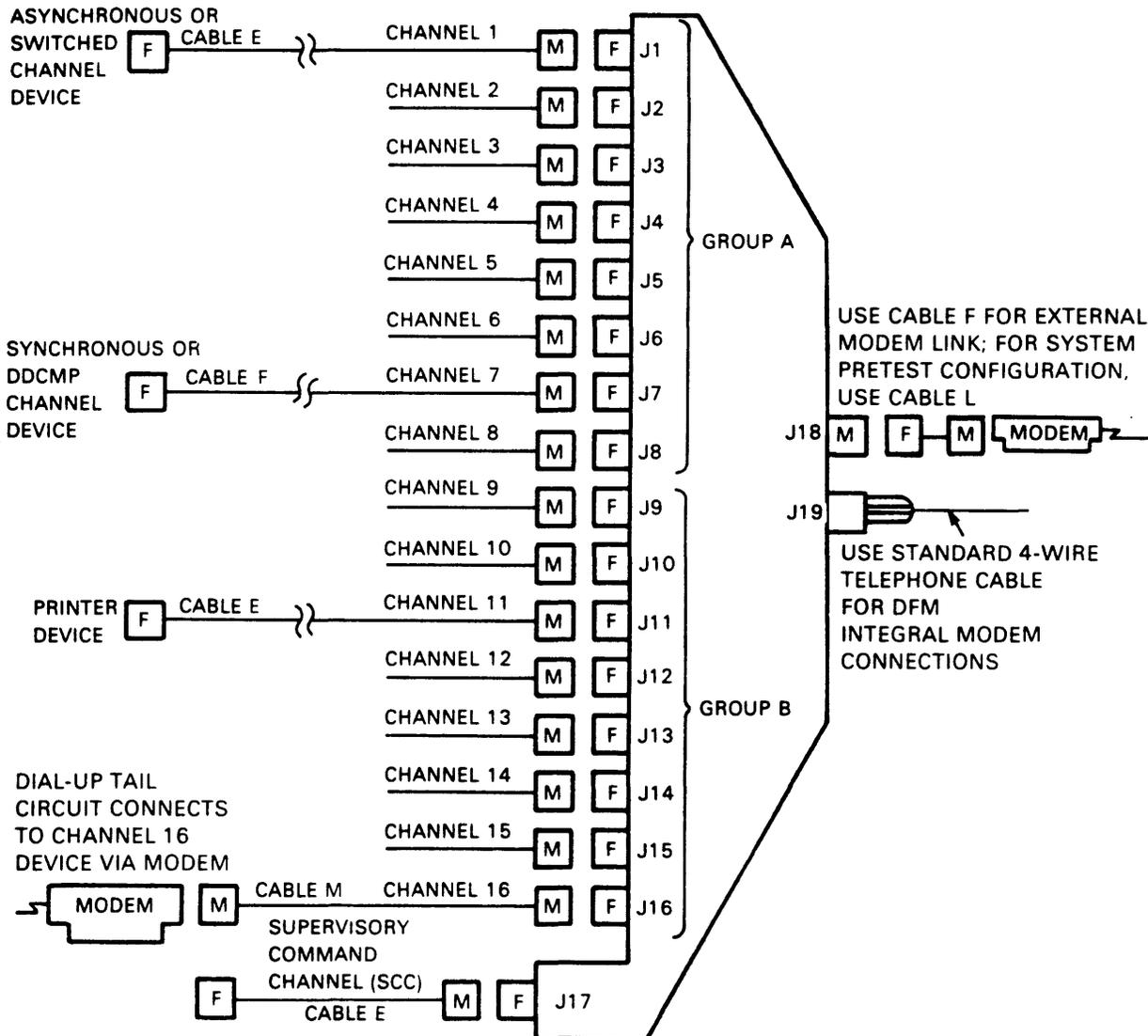
MKV85-2000

Figure 2-1 DFM Cable Connections

2-10

Table 2-1 Cable Descriptions and Order Numbers

Cable	Description	Order No.
Cable F	Straight-through cable with male to female connectors for connection of synchronous DTE to DFM channel, or the connection of a modem to the link or the link connection of one DFM unit to the channel connection of another DFM unit.	BC22F-XX
Cable E	Straight-through cable with male to female connectors for connection of asynchronous DTE to the DFM unit.	BC22E-XX
Cable M	Crossover cable with male to male connectors for connection of DCE to DCE (modem to DFM channel), or for the route-through applications in which channels of two DFM units are connected together.	BC22M-XX
Cable L	Null modem cable with female to female connectors. Recommended for preinstallation test with units having no integral modems.	BC22L-XX
Cable T	Special loopback test cable.	See Appendix C

NOTE
The XX suffix on order numbers indicates
the length of cable (for example,
BC22L-10 is a 10 ft null modem cable).

2.9 PREINSTALLATION EQUIPMENT SELECTION

An inventory of current and planned equipment to be supported by the DFM unit is important for proper selection of DFM units, cables, and accessories.

Figure 2-2 is a guide for planning a DFM installation. It covers selection of the proper size DFM units, cables, and other communication facilities. Make copies of the guide for use as worksheets. Examples that illustrate its use are provided in the following sections.

LOCAL							REMOTE						
TERM DEV	CABLE	MODEM	PHONE LINE	MODEM	CABLE	DFM CHANN	DFM CHANN	CABLE	MODEM	PHONE LINE	MODEM	CABLE	TERM DEV
						1	1						
						2	2						
						3	3						
						4	4						
						5	5						
						6	6						
						7	7						
						8	8						
						9	9						
						10	10						
						11	11						
						12	12						
						13	13						
						14	14						
						15	15						
						16	16						

SUPERVISORY CHANNEL EQUIPMENT

TERM DEV	CABLE	MODEM	PHONE LINE	MODEM	CABLE	DFM CHANN	DFM CHANN	CABLE	MODEM	PHONE LINE	MODEM	CABLE	TERM DEV

LINK EQUIPMENT

DFM DEV	CABLE	MODEM	LINK PHONE LINE	MODEM	CABLE	DFM DEV

MKV85-2001

Figure 2-2   Hardware Selection Guide

2.9.1 Using the Hardware Selection Guide

The following examples illustrate how the hardware selection guide may be used to determine additional hardware required for DFM data channels, the supervisory channel, and the concentrated link.

Example 2-1: Channel Connections -- Refer to Figure 2-3 for a sample of how to fill in the hardware selection guide for the following configurations.

Channel 1 is connected to the host computer at the local end. The remote channel end is connected to a VT100 through a dial-up modem. A 7.6 m (25 ft) cable is required at the local end. At the remote end, a 3.0 m (10 ft) crossover cable is required between the DFM unit and its 212A modem. A phone line connects the remote DFM unit's 212A modem to a dial-up 212A modem, which is attached to a VT100 terminal via a 3.0 m (10 ft) straight-through cable.

Channel 2 connects a synchronous terminal to the host computer via crossover cables at both DFM units.

> **NOTE**
> Synchronous and DDCMP devices can be operated only on Channels 1, 2, 5, 6, 9, 10, 13, and 14. This ensures that synchronous channel load is spread evenly among four channel groups.

Local channels 4, 5, and 8, and remote channels 3, 4, 5, 6, and 7 are switched (asynchronous) channels. All are connected to the DFM unit by straight-through cables.

Local channels 6 and 7, and remote channel 8 are unused.

LOCAL							REMOTE						
TERM DEV	CABLE	MODEM	PHONE LINE	MODEM	CABLE	DFM CHANN	DFM CHANN	CABLE	MODEM	PHONE LINE	MODEM	CABLE	TERM DEV
VAX	─────────────────────────►				E-25	1	1	M-10	212A	DIALUP	212A	E-10	VT100
VAX	─────────────────────────►				F-25	2	2	F-25 ──────────────────────►					SYNC TERM.
VAX	─────────────────────────►				E-25	3	3	E-25 ──────────────────────►					VT102
VAX	─────────────────────────►				E-25	4	4	E-25 ──────────────────────►					VT102
VAX	─────────────────────────►				E-25	5	5	E-25 ──────────────────────►					VT102
UNUSED						6	6	E-25 ──────────────────────►					VT100
UNUSED						7	7	E-25 ──────────────────────►					VT202
VT100	─────────────────────────►				E-25	8	8						UNUSED
					:	:	:		:				
					:	16	16						

MKV85-2002

Figure 2-3   Hardware Selection Guide for Example 2-1

Example 2-2: Supervisory Command Channel (SCC) Connections --
Refer to Figure 2-4 for a sample of how to fill in the hardware
selection guide for the following configuration. The local SCC is
to be directly connected to the DFM unit via a 7.6 m (25 ft)
straight-through cable. The remote SCC is shown connected via a
3.0 m (10 ft) crossover cable to a dial-up modem, allowing the
system to be managed from a remote location. A VT202 terminal is
connected to a modem at the other end of the phone link via a 7.6
m (25 ft) straight-through cable. Care must be taken to ensure
that proper modem control signals (such as DTR) are asserted for
the remote SCC.

LOCAL							REMOTE					
TERM DEV	CABLE	MODEM	PHONE LINE	MODEM	CABLE	DFM CHANN	DFM CHANN	CABLE	MODEM	PHONE LINE	MODEM	CABLE	TERM DEV
VT202						→E-25	SUPV	SUPV	M-10	212A	LEASED	212A	E-25	VT202

MKV85-2003

Figure 2-4   Hardware Selection Guide for Example 2-2

Example 2-3: Direct Link Connections (No Modems) -- Refer to
Figure 2-5 for a sample of how to fill in the hardware selection
guide for the following configuration. This example illustrates a
direct connection using a null modem cable. The AA suffix on the
DFM serial numbers indicates that there are no integral modems
installed. The 08 code indicates that the DFM unit has 8-channel
capability. The null modem cable is connected to connector J18 on
the DFM units.

DFM DEV	CABLE	MODEM	LINK PHONE LINE	MODEM	CABLE	DFM DEV
08-AA ← L-10					→	08-AA

MKV85-2004

Figure 2-5   Hardware Selection Guide for Example 2-3

Example 2-4: Link Connections with Integral Modems -- Refer to
Figure 2-6 for a sample of how to fill in the hardware selection
guide for the following configuration. This configuration uses
integral modems installed with a data rate of 9600 bits/s as
indicated by the AC suffix on the DFM model number. The units have
12-channel capability. A dedicated phone line is used for the link
and attached directly to the J19 connector on both units.

DFM DEV	CABLE	MODEM	LINK	MODEM	CABLE	DFM DEV
12-AC ◄			————DEDICATED PHONE LINE————			► 12-AC
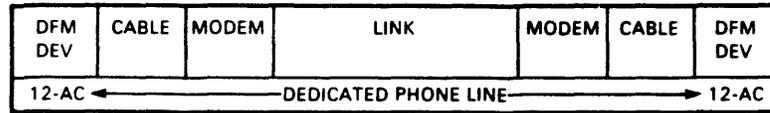
MKV85-2005

Figure 2-6   Hardware Selection Guide for Example 2-4

Example 2-5: Link Connections with External Modems -- Refer to
Figure 2-7 for a sample of how to fill in the hardware selection
guide for the following configuration. This configuration uses a
16-channel unit with no integral modems, as indicated by the
DFM-16-AA model number. The external modems are attached to the
DFM units with 7.6 m (25 ft) straight-through cables. The modems
are linked by a dedicated phone line.

DFM DEV	CABLE	MODEM	LINK	MODEM	CABLE	DFM DEV
16-AA	F-25	209A	◄—— DEDICATED PHONE LINE ——►	209A	F-25	08-AA
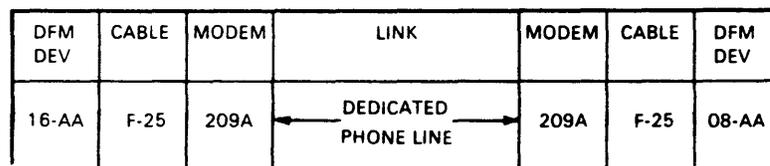
MKV85-2006

Figure 2-7   Hardware Selection Guide for Example 2-5

2-15

2.9.2 Determining DFM Size

Asynchronous devices may be connected to any channel. Synchronous channel operation must be distributed among 4-channel groups. Only Channels 1-2, 5-6, 9-10, and 13-14 can support synchronous operation. If your system must support three synchronous channels, therefore, at least an 8-channel unit is needed. For five synchronous channels, at least a 12-channel unit is needed (see Figure 2-8).

```
┌────────────────────────────────────────────────────────────────────────────────┐
│ DFM16-AC                                                                         │
│ DFM12-AC                                                                         │
│ DFM08-AC                                                                         │
│ DFM04-AC                                                                         │
│ CHANNEL NUMBERS          1 2 3 4      5 6 7 8       9 10 11 12     13 14 15 16    │
│ SYNCHRONOUS/DDCMP ONLY   S S          S S           S S            S  S          │
├────────────────────────────────────────────────────────────────────────────────┤
│ DFM(XX) IS THE MODEL NUMBER. XX = NUMBER OF CHANNELS IN THE UNIT.                 │
│                                                                                  │
│ THE SUFFIX CONTAINING TWO ALPHABETIC CHARACTERS AFTER THE DFM SIZE MEANS:         │
│                                                                                  │
│   AA = NO MODEMS                                                                  │
│   AB = INTEGRAL MODEM V.27 4800 BITS/S                                            │
│   AC = INTEGRAL MODEM V.29 9600 BITS/S                                            │
└────────────────────────────────────────────────────────────────────────────────┘
```

MKV85-2007

Figure 2-8 DFM Sizing Aid

2.10 INVENTORY AND REQUIREMENTS FORM

With the information presented so far, the Inventory and Requirements Form of Figure 2-9 can be used to help in making final requisitions.

REQUIRED ITEMS	DESCRIPTION	QTY AVAIL.	QTY RQD	ORDER QTY
DFM04-AA	4-CHANNEL ICP W/O INTEGRAL MODEM			
DFM04-AB	4-CHANNEL ICP INTEGRAL MODEM V.27			
DFM04-AC	4-CHANNEL ICP INTEGRAL MODEM V.29			
DFM08-AA	8-CHANNEL ICP W/O INTEGRAL MODEM			
DFM08-AB	8-CHANNEL ICP INTEGRAL MODEM V.27			
DFM08-AC	8-CHANNEL ICP INTEGRAL MODEM V.29			
DFM12-AA	12-CHANNEL ICP W/O INTEGRAL MODEM			
DFM12-AB	12-CHANNEL ICP INTEGRAL MODEM V.27			
DFM12-AC	12-CHANNEL ICP INTEGRAL MODEM V.29			
DFM16-AA	16-CHANNEL ICP W/O INTEGRAL MODEM			
DFM16-AB	16-CHANNEL ICP INTEGRAL MODEM V.27			
DFM16-AC	16-CHANNEL ICP INTEGRAL MODEM V.29			
TERMINALS				
ASYNCHRONOUS				
SWITCHED				
PRINTERS				
SYNCHRONOUS				
PERS COMPUTER				
OTHERS				
CABLES				
BC22E-10	ASYNCHRONOUS DTE-TO-DCE STRAIGHT THROUGH			
BC22E-25	ASYNCHRONOUS DTE-TO-DCE STRAIGHT THROUGH			
BC22F-10	SYNCHRONOUS DTE-TO-DCE – SHIELDED			
BC22F-25	SYNCHRONOUS DTE-TO-DCE – SHIELDED			
BC22L-05	SPECIAL DIRECT LINK – SYSTEM PRETEST			
BC22L-10	SPECIAL DIRECT LINK – SYSTEM PRETEST			
BC22L-25	SPECIAL DIRECT LINK – SYSTEM PRETEST			
BC22M-10	SPECIAL DCE-TO-DCE CROSSOVER SHIELDED			
BC22M-25	SPECIAL DCE-TO-DCE CROSSOVER SHIELDED			
4-WIRE LINE	TELEPHONE CABLE OR EQUIVALENT			
COM LINES				
LEASED LINES				
DIAL-UP LINES				
LINE DRIVERS				
MODEMS				
SHORT HAUL				
ASYNCHRONOUS				
SYNCHRONOUS				

MKV85-2008

Figure 2-9   Inventory and Requirements Form

3.1 GENERAL
This chapter covers the unpacking and inspection, the descriptions of the DFM modules controls and indicators, and the installation process of the DFM system. Part of that process is a preinstallation benchtest, which is designed to verify that the units are functioning properly and to familiarize operators with their use prior to installation at local and remote sites.

3.2 UNPACKING AND INSPECTION
The DFM units and the user manual are shipped in one container. Cables are shipped separately. Since problems usually can be isolated to one of the replaceable modules, the original containers need not be saved.

CAUTION
Do not try to carry the unit by the front bezel. Handle the DFM unit by the main portion of the enclosure only. The front bezel of the DFM enclosure is secured only by magnetic latches.

Inspect the unit and cables for dents, broken pieces, damaged connectors/pins, damaged wires, and so forth. Verify that the correct system components were shipped by comparing them to the packing list.

Any damage should be reported to the shipper and Digital Equipment Corporation at once. Inform the original sales person by telephone of any shortages in the shipment.

3.3 VISUAL INSPECTION
Figure 3-1 shows the front of the DFM unit with the front bezel both on and off. It also shows module placement and location of the identification decal.

3.3.1 Removing the Bezel
The front bezel is held in place by four heavy duty, magnetic latches (two on either side). To remove it, grasp it by the front window area with one hand and hold the enclosure with the other hand. The magnetic latches are quite strong, requiring a firm pull on the bezel.

3.3.2 Checking the Identification Decal
The identification decal is located on the bottom right of the unit (see Figure 3-1). It lists the serial and model numbers.

SLOT 1
INTEGRAL
MODEM

SLOT 2
SPARE – FOR
FUTURE USE

SLOT 4
4- OR 8-CHANNEL
EXPANDER MODULE

SLOT 3
CONTROL
MODULE

SLOT 5
4-OR 8-CHANNEL
EXPANDER MODULE

SLOT 4 MUST CONTAIN AN 8-
CHANNEL MODULE BEFORE
EXPANDING TO SLOT 5

SLOT 6
POWER SUPPLY
MODULE

digital™   S

MODEL DFMXX – YY
SER. NO. AAA NNNN
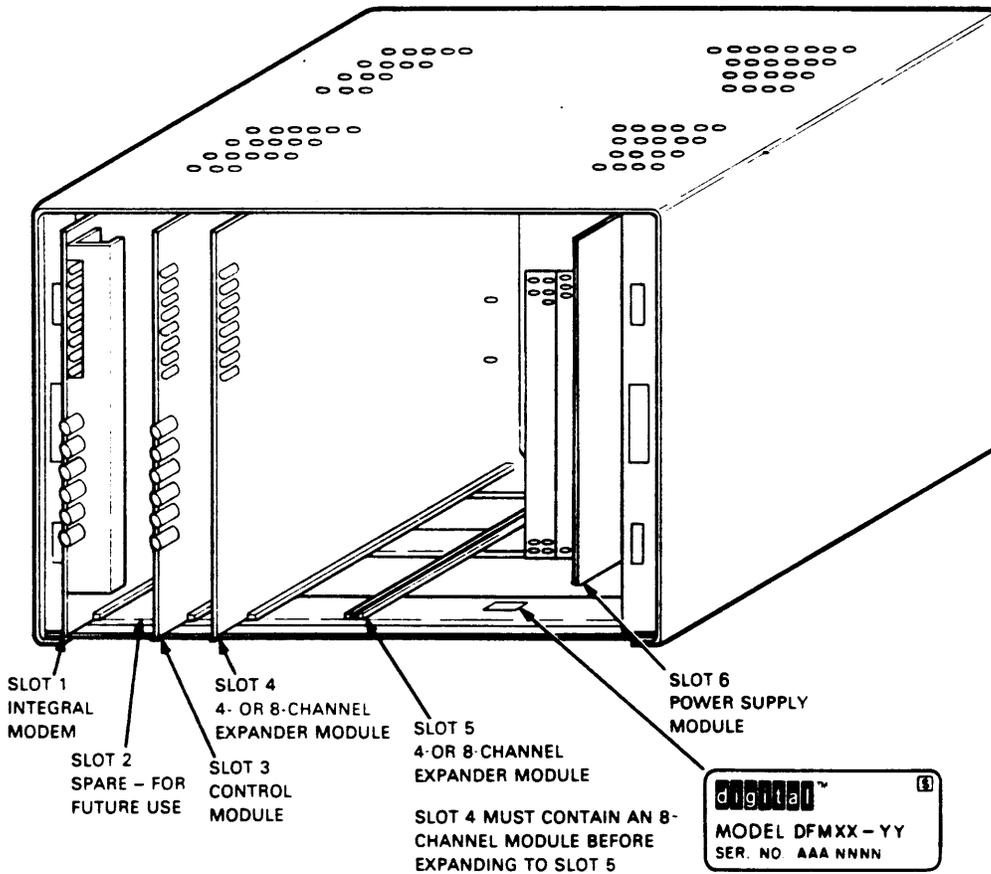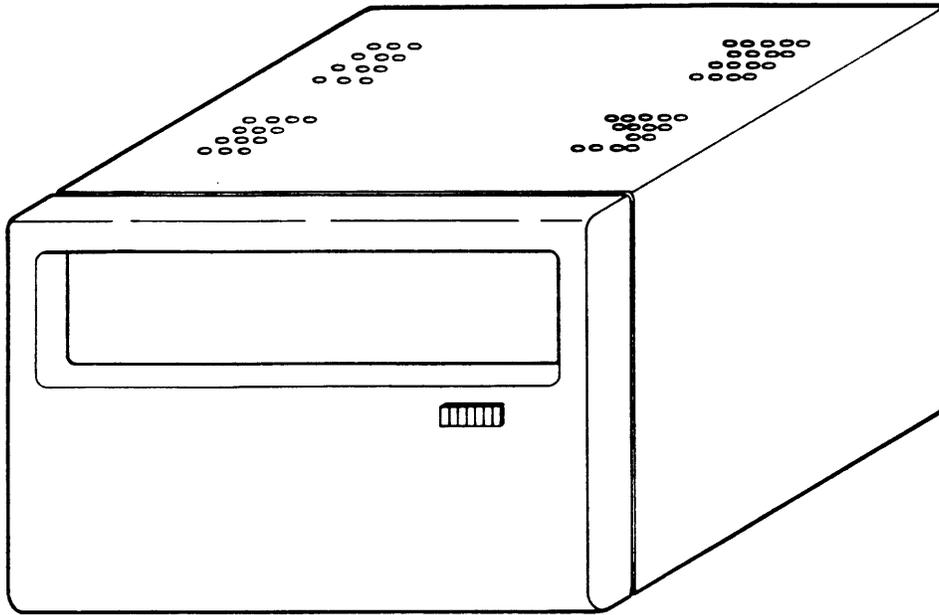
MKV85-2009

Figure 3-1   DFM Enclosure, Module Placement, and ID Decal

The serial number has seven characters: the first three are alphabetical and the last four are numerical (for example, BCA1234). The serial number uniquely identifies each DFM unit.

The model number defines the number of channels and whether or not a modem module is present:

Model Number Format

    DFM-XX-YY

    DFM = The series of the intelligent communications processor

    XX = The number of channels, where XX can be 04, 08, 12, or 16

    YY = The type of modem, where:

        AA = No integral modem installed
        AB = V.27 bis/4800 bits/s integral modem
        AC = V.29/9600 bits/s integral modem

3.3.3 Checking the Modules

Figure 3-1 shows the proper location of DFM modules. Verify that the correct modules are installed.

Slot 1 -- Integral modem module. It is the only module with six pushbutton switches and eight LEDs. Refer to Appendix B for information on the integral modem.

Slot 2 -- Spare. This slot should be empty because it is intended for future use.

Slot 3 -- Control module. It is the only module with four pushbutton switches and eight LEDs.

Slot 4 -- Channel module. Either a 4-channel expansion module (identified by LED labeling C1 through C4) or an 8-channel expansion module (identified by LED labeling C1 through C8) must be located in this slot.

Slot 5 -- Channel expansion module. Either a 4-channel expansion module (identified by LED labeling C1 through C4) or an 8-channel expansion module (identified by LED labeling C1 through C8) may be used in slot 5. Slot 4 must contain an 8-channel module before expanding to slot 5. See Table 3-1 for slot/channel combinations.

Slot 6 -- Power supply module. It is identified by the perforated screen mesh that surrounds all the components on the module.

Table 3-1   Slot/Channel Combinations

Module Size & Location		Front Bezel Indications	
Slot 4	Slot 5	Group A	Group B
4	--	1 -- 4	--
8	--	1 -- 8	--
8	4	1 -- 8	9 -- 12
8	8	1 -- 8	9 -- 16

3.3.4   Rear Panel Connectors

Figure 3-2 illustrates the location, function, and identification of each rear panel connector. These locations, are also marked on the rear panel of the unit.

Power Connector and Line Fuse	The power connector and line fuse (5 A 250 V) are on the left-hand side of the unit. There is no power switch. When the power cord is plugged into the wall socket, power is applied to the unit. Subsequently, if power is lost and then restored, the unit is automatically back ON.
Connectors J1-J16	Data channel connectors. Group A corresponds to the module located in slot 4, with J1 through J8 being Channels 1 through 8. Group B corresponds to slot 5. Connectors J9 through J16 are for Channels 9 through 16.
Connector J17	Supervisory command channel (SCC) connector. Initial programming of the system must be done from the supervisory channel. After data channels are enabled to enter command mode, all supervisory functions may be performed from a data channel (if desired).
Connector J18	Link connector used for either a BC22L null modem cable (direct connection to the other DFM unit), or connection to an external modem (which is then connected to the telephone line).
Connector J19	Link connector used when the integral modem module is installed. It provides for direct connection to the phone line.

GROUP B   GROUP A

J9   J1
J10   J2
J11   J3
J12   J4
J13   J5
J14   J6
J15   J7
J16   J8

SUPERVISORY
COMMAND
CHANNEL (SCC)
CONNECTOR J17(F)

POWER CONNECTOR

PRIVATE
LINE
CONNECTOR J19

FUSE

LINK
CONNECTOR J18(M)
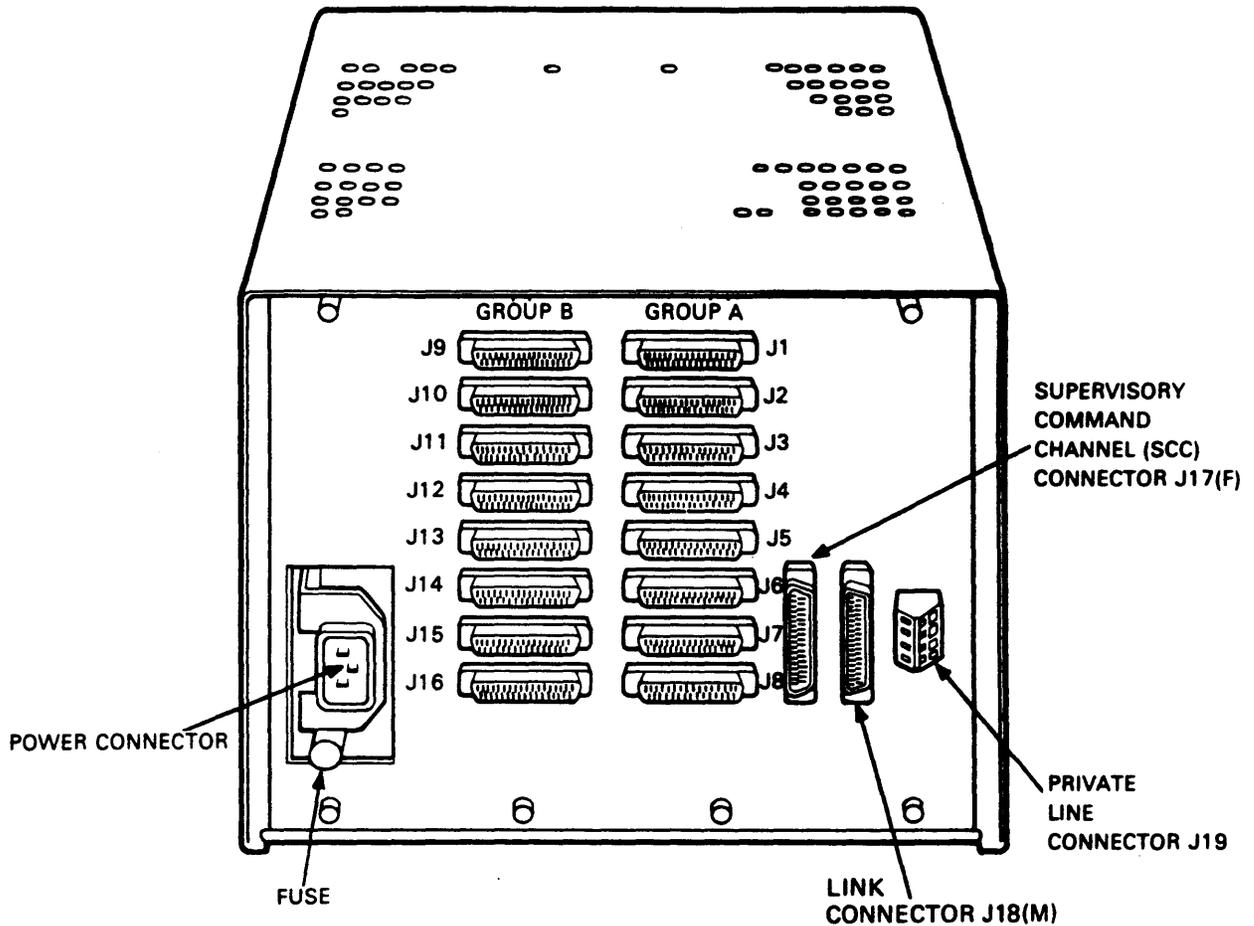
GROUP B CONNECTORS (F) = SECOND
4-OR 8- CHANNEL EXPANDER LINE
MODULE IN SLOT 5

J9 = CHANNEL 9
J10 = CHANNEL 10   } DFM12
J11 = CHANNEL 11
J12 = CHANNEL 12   } DFM16
J13 = CHANNEL 13
J14 = CHANNEL 14
J15 = CHANNEL 15
J16 = CHANNEL 16

GROUP A CONNECTORS (F) = FIRST
4-OR 8- CHANNEL LINE MODULE IN
SLOT 4

J1 = CHANNEL 1
J2 = CHANNEL 2   } DFM04
J3 = CHANNEL 3
J4 = CHANNEL 4   } DFM08
J5 = CHANNEL 5
J6 = CHANNEL 6
J7 = CHANNEL 7
J8 = CHANNEL 8

NOTE
  1. SLOT 4 MUST CONTAIN AN
     8-CHANNEL MODULE BEFORE
     EXPANDING TO SLOT 5
  2. M = MALE CONNECTORS
     F = FEMALE CONNECTORS

MKV85-2010

Figure 3-2   DFM Rear Panel Connectors

3.4 CONTROLS AND INDICATORS

Front panel LEDs on all modules blink as the units run the power-up self-test. The LED pattern corresponds to the individual hardware tests that are being run. Depending on the size of the units (number of channels), this test cycle can take up to 10 or 15 seconds.

When the power-up tests are complete, only DR, NR, and CD should be ON. If the link is not up (connected and ready), CD and/or NR may not be ON. Chapter 7 describes the power-up test sequence in detail.

3.4.1 Control Module

Control module pushbutton positions and functions are described in Table 3-2. Control module LED indicator functions are described in Table 3-3. Figure 3-3 shows the location of these pushbuttons and indicators.

3.4.2 Channel Expansion Module

The channel expansion module does not contain any pushbutton switches. LED indicators are described in Table 3-4 and Figure 3-4 shows their locations.

3.4.3 Integral Modem Module

The front panel of Digital Equipment Corporation's link modems contain eight LED indicators and six pushbutton switches. The LEDs display activity status, operating mode, or error conditions in the modem. Front panel switches are used to initiate tests and control speed. See Figure 3-5 for locations of modem module controls and indicators.

Functions of front panel switches and indicators are different, depending on the type of link modem being used. Table 3-5 lists the functions of front panel switches and LEDs, and identifies which ones are available on which modems. Tables 3-6 and 3-7 describe all switches and indicators.

Table 3-2 Control Module Pushbutton Controls

Pushbutton Switch	Description
Maintenance 1 (M1) Maintenance 2 (M2)	These switches are used for manual mainte-nance purposes when there is no supervisory terminal attached to the DFM unit or the supervisory channel is inoperative.

M1	M2	Test Function
OUT	OUT	Normal operations
OUT	IN	Configuration option is forced to invalid. (Chapter 6 describes configuration option.) With only M2 IN, the unit's operating parameters are down-line loaded from the other unit when the unit is reset or reinitialized.
IN	OUT	Continuous self-test. When only M1 is IN, pressing the system reset (SR) switch or applying unit power causes the DFM unit to continually repeat self-test. Only these two methods can start a continuously looping self-test. Chapter 7 details unit self-tests, system reset, and reinitialization procedures.
IN	IN	Link loopback. When both switches are IN, the LBACK test for the link is initiated. Chapter 7 describes LBACK testing. When the unit is in manual LBACK mode, both the SD and RD LEDs should be ON, indicating that the unit is continuously sending and receiving data. Errors are indicated by blinking SA and RA LEDs. The supervisory channel cannot be used on a unit when this test is running. The following message is returned: SUPERVISORY CHANNEL NOT AVAILABLE: LBACK TEST ACTIVE The data channel on the other unit may be used for all supervisory functions except initiating Link LBACK tests.

Table 3-2 Control Module Pushbutton Controls (Cont)

Pushbutton Switch	Description
Parameter Protect (PP)	PP is pressed IN to protect parameter settings stored in NVROM (nonvolatile read only memory). When the PP switch is pressed IN, it takes effect only after the unit is either reset (by means of the SR switch) or reinitialized. When parameter protect is in effect, system, link, or channel parameters may be changed, but the new values are not stored in NVROM. This means that when units are either reset or reinitialized, any parameters changed when the PP switch was in effect return to the original setting. When a parameter is changed and the PP switch is in effect, the following message is returned to the supervisory terminal: <302> ERROR IN COMMAND 'COMMAND LINE': UNIT LOCKED
System Reset (SR)	This switch performs three functions: 1. During normal operation, when pressed IN, the power-up test cycle is run, which clears the status, date, and time counters, flushes channel buffers, and logs the operator out of the supervisory command handler. THIS ACTION INTERRUPTS DATA TRAFFIC. Parameter settings are NOT affected. 2. System reset allows the unit to recognize that the PP switch has been pressed IN. 3. In manual maintenance mode, the SR switch starts looping self-tests or the LBACK tests.

Table 3-3   Control Module LED Indicators

LED Indicator	Description
Send Data (SD)	ON indicates that the DFM unit is transmitting data on the link.
Receive Data (RD)	ON indicates that the DFM unit is receiving data on the link.
Carrier Detect (CD)	ON indicates that the modem connected to the DFM unit (whether integral or external) is detecting a carrier signal on the link (CD signal raised by the modem). CD is also ON when the units are directly connected (no modems), and the link connection has been verified.
Send ARQ (SA)	ON indicates that the unit has not received acknowledgement of a frame and is resending it.
Receive ARQ (RA)	ON indicates that the unit has detected a data error and will not acknowledge the frame.
Channel Data Error (CE)	If the CE LED is either ON or BLINKING, data has been lost on at least one channel. Blinking indicates that a framing error or parity error has occurred on one of the channels. When it remains ON, a data overrun or buffer overflow has occurred. Channel errors may be cleared either individually by means of the CLEAR command or all at once (along with system and link counters) with the SR switch.
Network Ready (NR)	ON indicates that both DFM units are ready, communication is established (link is up), and parameters are compatible. OFF indicates that the units are not communicating.

Table 3-3 Control Module LED Indicators (Cont)

LED Indicator	Description
	The NR LED blinks to indicate one of the following:
	1. The unit has received no communication from the other DFM unit for at least 5 seconds,
	2. The unit has retransmitted a frame at least 10 times with no acknowledgement from the other unit, or
	3. The CTS signal has been lost on the link for at least 5 seconds.
	Each of the above generates an alarm message <110> (see Table 6-7). After either one minute of NR blinking or 100 unsuccessful retransmits, whichever comes first, the unit automatically repowers.
Device Ready (DR)	ON indicates that the DFM unit has passed self-test diagnostics and is ready.
	After the unit has completed self-tests, DR never should be OFF.
	The DR LED blinks to indicate one of the following:
	1. Both units are set to either master or slave,
	2. Both units are set to invalid, or
	3. There has been an error reading parameter settings from the the NVROM (nonvolatile read only memory).
	Each of the above generates an alarm message <311>. See Table 6-7.

LEDS

SD (SEND DATA)
RD (RECEIVE DATA)
CD (CARRIER DETECT)
SA (SEND ARQ)
RA (RECEIVE ARQ)
CE (CHANNEL DATA ERROR)
NR (NETWORK READY)
DR (DEVICE READY)

PUSHBUTTON SWITCHES

M1 (MAINTENANCE 1)
M2 (MAINTENANCE 2)
PP (PARAMETER PROTECT)
SR (SYSTEM RESET)

CONTROL MODULE
(LOCATION SLOT 3)
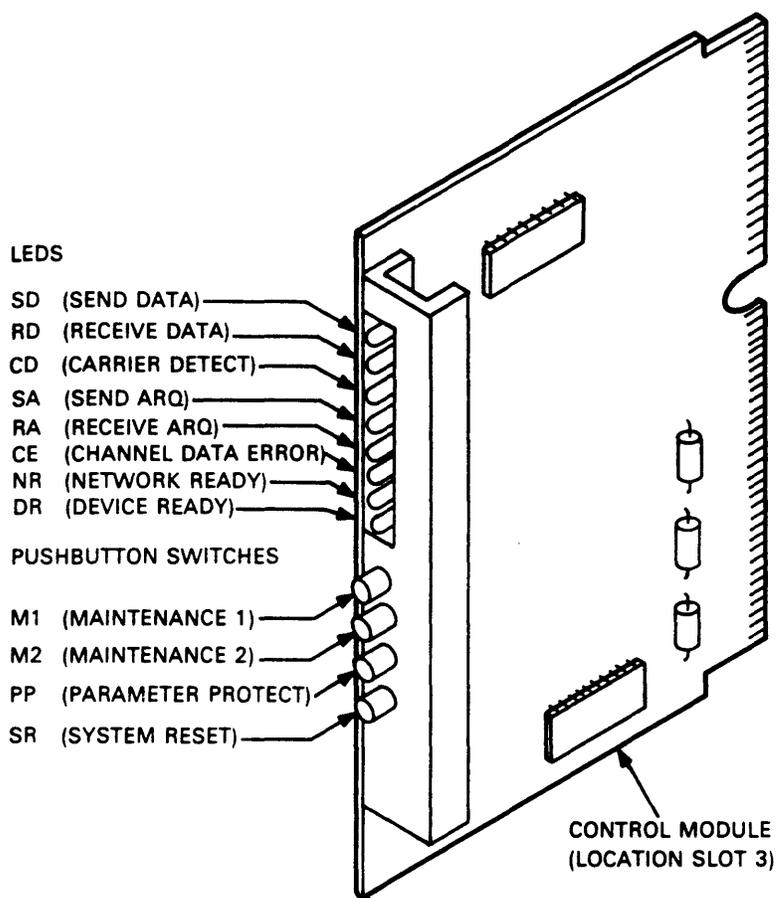
TK-10660

Figure 3-3 Control Module Pushbuttons and LEDs

Table 3-4 Channel Module LED Indicators

LED Indicator	Description
Channels 1 -- 8 Channels 9 -- 16	Any of these LEDs ON indicates data activity (either transmit or receive) on the corresponding channel number.
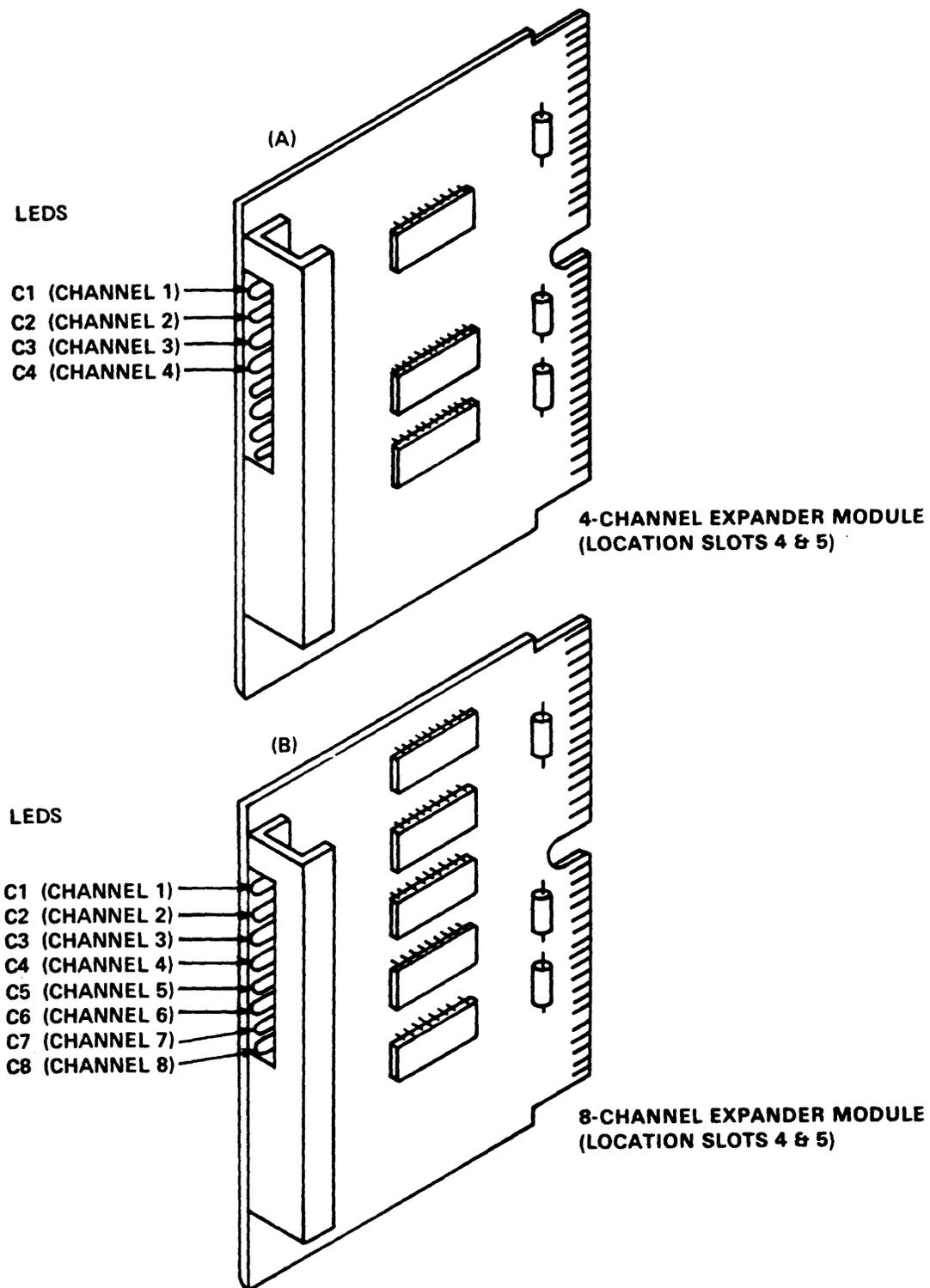
Figure 3-4   Line Module Indicators

DF127/DF129
MODEM MODULE

SEND DATA   SD
RECEIVE DATA   RD
CARRIER DETECT   CD
CLEAR TO SEND   CS   LEDS
REQUEST TO SEND   RS
SIGNAL QUALITY   SQ
FALLBACK   FB
TEST MODE   TM

LOCAL LOOP   LL
TEST PATTERN   TP
REMOTE LOOP   RL   PUSHBUTTONS
DIGITAL LOOP   DL
FALLBACK   FB
FALLBACK SPEED   FS

                             SERIAL
                             NUMBER
                             LABLE

DF124 MODEM
MODULE

SEND DATA   SD
RECEIVE DATA   RD
CARRIER DETECT   CD
DATA TERMINAL READY TR
MODEM READY   MR   LEDS
OFF HOOK   OH
HIGH SPEED   HS
TEST MODE   TM

LOCAL LOOP   LL
SELF TEST   ST
REMOTE LOOP   RL   PUSHBUTTONS
DIGITAL LOOP   DL
HIGH SPEED   HS
DATA/TALK   D/T

                             SERIAL
                             NUMBER
                             LABEL

DF126 MODEM
MODULE

SEND DATA   SD
RECEIVE DATA   RD
CARRIER DETECT   CD
DATA TERMINAL READY TR
MODEM READY   MR   LEDS
CLEAR TO SEND   CS
REQUEST TO SEND   RS
TEST MODE   TM

LOCOAL LOOP   LL
SELF-TEST   ST
REMOTE LOOP   RL   PUSHBUTTONS
DISABLE MODEM   DM
FALLBACK   FB
DATA/TALK   D/T

                             SERIAL
                             NUMBER
                             LABEL

                             TELEPHONE RJ11C
                             TEST JACK J1

MKV85-2032

Figure 3-5   Modem Module Pushbuttons and LEDs

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Table 3-5   Link Modem Front Panel Switches/LED Matrix

Function	DF124	DF126	DF127	DF129
LEDs				
Send Data (SD)	X	X	X	X
Receive Data (RD)	X	X	X	X
Carrier Detect (CD)	X	X	X	X
Clear to Send (CS)		X	X	X
Request to Send (RS)		X	X	X
Signal Quality (SQ)			X	X
Fallback (FB)			X	X
Test Mode (TM)	X	X	X	X
Terminal Ready (TR)	X	X		
Modem Ready (MR)	X	X		
Off Hook (OH)	X			
High Speed (HS)	X			
Switches				
Local Loop (LL)	X	X	X	X
Test Pattern (TP)			X	X
Remote Loop (RL)	X	X	X	X
Digital Loop (DL)	X		X	X
Fallback (FB)		X	X	X
Fallback Speed (FS)			X	X
Self-Test (ST)	X	X		
Disable Modem (DM)		X		
Data/Talk (D/T)	X	X		
High Speed (HS)	X			

Table 3-6 Link Modem Front Panel LED Indicators

LED Indicator	Indicator Status	
	ON	OFF
Send Data (SD)	Modem is transmitting data.	Modem is not transmitting data.
Receive Data (RD)	Modem is receiving data. When blinking on the DF124 or DF126 modem, it indicates that errors are being detected when self-test loopback tests are run.	Modem is not receiving data.
Carrier Detect (CD)	Audio carrier from a remote modem is present.	Carrier from a remote modem is not present.
Clear to Send (CS)	Modem is ready to accept data from the DTE.	Modem is not ready to accept data from the DTE.
Request to Send (RS)	DTE has data to send.	DTE does not have any data to send.
Signal Quality (SQ)	When continuously ON, signal quality is poor. When blinking, signal quality is marginal.	Signal quality is satisfactory.
Fallback (FB)	Modem is operating at fallback speed.	Modem is operating at normal speed.
Data Terminal Ready (TR)	Data terminal equipment (DTE) is ready to send or receive data.	Data terminal equipment is not ready to send or receive data.
Modem Ready (MR)	Modem is ready to send or receive data.	Modem is not ready to send or receive data.
Off Hook (OH)	Modem is connected to a dial-up telephone line and the handset is off hook.	Telephone handset is not off hook.

Table 3-6 Link Modem Front Panel LED Indicators (Cont)

LED Indicator	Indicator Status	
	ON	OFF
High Speed (HS)	Modem is prepared to operate at high speed.	Modem is prepared to operate at low speed.
Test Mode (TM)	Modem is in test mode.	Modem is not in test mode.
	When blinking on the DF127 or DF129 modem, it indicates that errors are being detected when self-test loopback tests are run.	
	Power-up self-test failures on DF127 or DF129 modems are indicated by TM and SQ blinking together.	

Table 3-7 Link Modem Front Panel Pushbutton Controls

| | Pushbutton Position | |
Pushbutton Switch	IN	OUT
Local Loop (LL)	Modem is placed in analog loopback test mode.	Normal position. Analog loopback is disabled.
Self-Test (ST) or Test Pattern (TP)	Modem is placed in test mode sending a test pattern.	Normal position. Test pattern is disabled.
Remote Digital Loop (RL)	Remote modem is placed in digital loopback mode. For DF126 modem, applies to private line only.	Normal position. Remote digital loop is disabled.
Digital Loop (DL)	Modem is disabled (out of service) and placed in local digital loopback mode.	Normal position. Local digital loopback is disabled.
High Speed (HS)	DF124 modem is conditioned to operate at 1200 bits/s instead of the normal 2400 bits/s.	DF124 modem is conditioned to operate at the normal speed of 2400 bits/s.
DATA/TALK (D/T)	Conditions the DF124 modem for voice communications.	Conditions the DF124 modem for serial binary data communications.
Disable Modem (DM)	The DF126 modem is disabled (out of service) and is forced OFF HOOK, presenting a busy condition to the line.	The DF126 modem is enabled for normal operation.
Fallback (FB)	Modem is conditioned to operate at the lower (fallback) speed.	Modem is conditioned to operate at the higher (normal) speed.
Fallback Speed (FS)	Selects the lower fallback speed for DF127/ DF129 modems.	Selects the higher fallback speed for DF127/DF129 modems.

3.5 PREINSTALLATION BENCHTEST AND OPERATOR FAMILIARIZATION

The preinstallation benchtest and familiarization procedure is designed to familiarize operators with the use of a DFM unit prior to installation at local and remote sites. This procedure ensures that the DFM units are functioning properly after shipment. The procedure is divided into four parts.

- Logging on with USER and SYSTEM MANAGER passwords

- Setting system parameters

- Enabling a data channel to enter command mode

- Demonstrating switched channel operation

The preinstallation test configuration consists of:

- A pair of DFM units.

- Either a piece of phone wire (or other compatible 4-wire cable) if integral modems are used, or a null modem cable (BC22L cable or equivalent, see Appendix C).

- An asynchronous terminal (for example, VT100) and associated cable (BC22E cable or equivalent).

An asynchronous terminal is used for this test procedure. The test procedure assumes a speed of 1200 bits/s and data format of 8-NONE (8 bits, no parity). If another speed or data format is used, appropriate DFM channel settings must be made in the procedure.

The preinstallation test procedure includes entering commands (first on one unit, then on the other) before the units are linked together.

3.5.1 Logging on with USER and SYSTEM MANAGER Level Passwords

STEP 1 POWER-UP SELF-TEST
Plug both units into wall outlets. LEDs on all modules flash as the power-up test sequence is executed. When the self-test is complete, only the device ready (DR) LED on both control modules will be ON.

STEP 2 CONNECTING TO SUPERVISORY COMMAND CHANNEL
Using the BC22E cable or equivalent, connect an asynchronous terminal to the supervisory command channel connector (J17) on one of the units. Press the RETURN key several times. The DFM password prompt appears on the terminal screen:

LOGON:
PASSWORD?>

STEP 3   USER LEVEL LOGON
          All DFM units come from the factory with passwords set to
          "SUPER" for SYSTEM MANAGER level and "USER" for the USER
          level. At the password prompt enter USER followed by
          <RETURN>. The standard header line and USER level prompt
          (USR>) appears:

          4-15-84 12:00   DFM Series - ICP " "   Level 1.1
          USR>

STEP 4   USER LEVEL COMMANDS
          Press the RETURN key. The system displays the limited set
          of commands that are accessible via the USER password:

          LOGOUT MONITOR REPEAT SHOW   (or ^Y)

          "Users" can display current settings (SHOW command),
          monitor error counts and other statistics, repeat
          selected commands, or simply logout.

STEP 5   USER LEVEL LOGOUT
          Enter LOGOUT followed by <RETURN>. (It is necessary to
          log out of one privilege level before entering another.)

STEP 6   SUPERVISORY LEVEL LOGON
          After pressing a few more RETURNS to display the logon
          password prompt, enter SUPER, followed by a <RETURN> and
          then another <RETURN> at the SYS> prompt. The system
          displays the full range of commands available to the
          system manager.

          Valid Entries: BROADCAST CANCEL CLEAR COPY DISCONNECT
          CONNECT LOGOUT MONITOR REPEAT RESTART SET SHOW TEST
          (or ^Y)

          These commands are used to SET (program), MONITOR, or
          TEST various channel, system, or link categories as well
          as BROADCAST messages to data channels, COPY one
          channel's configuration to another, CONNECT or DISCONNECT
          switched channels, and so on. Chapter 5 describes each
          command in detail. Control Y is used to abort any partial
          command or system output.

3.5.2 Setting System Parameters

STEP 1   SET SYSTEM DEFAULT
The system is programmed (that is, parameters are set to specific values) with the SET command. To assure a known starting point for all parameters, enter the following on whichever unit will be the master.

SYS> set system default <RETURN>

This command sets all system, link, and channel parameters to their default settings (see Table 6-4). The DFM unit reinitializes as it stores the default parameter settings. Because this would interrupt current data traffic, the system warns the user with:

WARNING ---- COMMAND MAY RESTART SYSTEM

    USE (CONTROL Y) TO ABORT COMMAND
    <CR> TO CONTINUE

This response appears with all commands that reset or reinitialize the system. Continue by pressing RETURN.

<RETURN>
Re-initializing the unit.

The unit goes through a standard power-on procedure with the LEDs cycling until the DR LED comes ON. To continue, press two RETURNS to display the available options again.

STEP 2   SET LINK SPEED
If the units contain integral modem modules, go to Step 3. Before two units can communicate, they have to be set to the same link speed. The default setting for link speed is sync, which is appropriate when the units are connected via synchronous modems.

For the units to be directly connected (via null modem cable -- BC22L-XX) the link speed must be set to async as shown below.

SYS> set link speed async <RETURN>

Setting the link speed also causes system reinitialization.

STEP 3   SET SYSTEM TYPE
          The default (factory) setting for all system types is
          master. Before two units can communicate, one of the
          units must be set to slave. Disconnect the terminal cable
          from J17 on the master unit, connect it to J17 on the
          slave unit, and logon using the SUPER password. From the
          SYS> prompt enter:

          SYS> set system type slave <RETURN>

STEP 4   SET SYSTEM CONFIGURATION
          The default setting for the system configuration option
          is valid. Before two units can communicate, one must be
          changed to invalid. The purpose of this option is
          explained in Section 6.5.3. On the slave unit, enter:

          SYS> set system config invalid <RETURN>

          Setting the configuration option also causes system
          reinitialization.

STEP 5   SET SLAVE LINK SPEED
          If using the integral modems, go to Step 6. If units are
          going to be connected with the null modem cable, set the
          link speed on the slave unit to async as in Step 2.

STEP 6   LOGOUT ON SLAVE, CONNECT TO MASTER
          Enter LOGOUT on the slave unit, disconnect the terminal
          cable from the slave unit, and connect the cable to the
          master. One or two RETURNS should display valid entries.
          The DR (device ready) LED should still be ON at both
          control modules.

STEP 7   CONNECTING THE UNITS
          If the null modem cable is used, it is plugged into
          connector J18 on both units. If integral modems are being
          used, the units are connected with a piece of telephone
          wire (or any other compatible 4-wire cable) to connector
          J19 on both units. Figure 3-6 shows how units with
          integral modems are connected.

          The inset in Figure 3-6 shows the connector slots to
          insert a small screwdriver to open the connecting points
          of connector J19. To open the spring clip, insert and
          twist the small screwdriver until the points open. Hold
          until the correct wire is inserted, release the
          screwdriver, and the connection is made.

          Once connected, the device ready (DR), network ready (NR)
          and carrier detect (CD) LEDs of both DFM units should be
          ON. These indicate that each device is ready, the link
          is up, and a carrier signal is being detected.
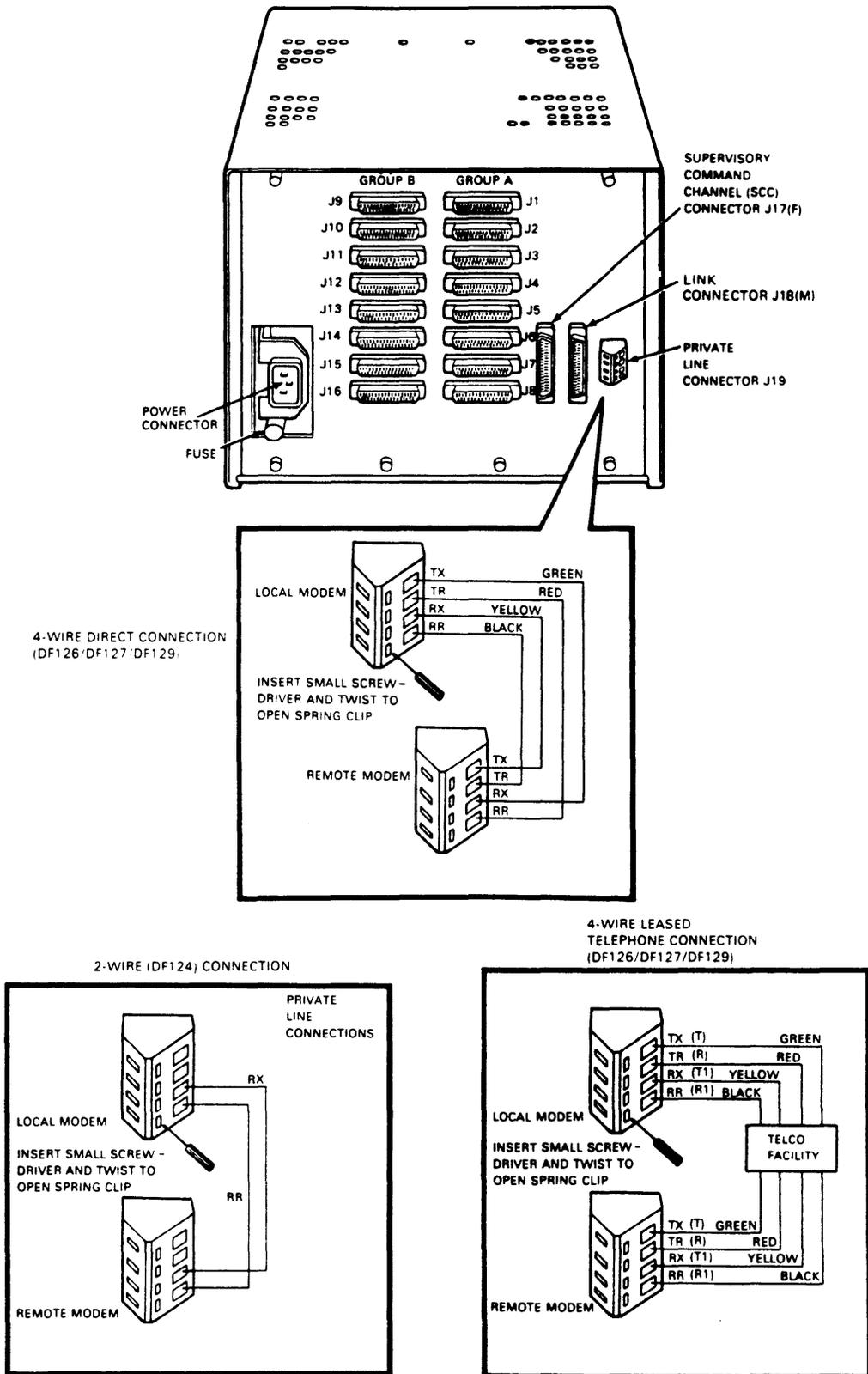
Figure 3-6   Integral Modem Link Connections

STEP 8   SET SYSTEM PARAMETERS
          Set the following system parameters.

          SYS> set time <current time: 00:00 to 24:00> <RETURN>

          SYS> set date <current date: mm-dd-yy> <RETURN>

          The unit responds with each new setting when RETURN is
          pressed. Notice that the new settings are entered in the
          standard header line when a RETURN is entered.

          12-31-83   12:00   DFM SERIES-ICP " "   Level 1.1
          SYS>

STEP 9   DISPLAY SYSTEM PARAMETERS
          Display system parameters by entering the following
          command.

          SYS> show system <RETURN>

          The system displays all system parameters as shown below.

          System parameters:
            NAME   = " "
            TYPE   =MASTER   AUTODISC   =20 SW-DATAPAR =8-NONE
            CONFIG =VALID   SW-STOPBITS =1 SW-SIGNALS =ASSERT
            COMCHAR =1C1C
            CHANNELS=8

          Notice the value for the COMCHAR (command character)
          option. This option can be set to any one or two hex
          characters ranging from 00 to 1F. The default (factory)
          setting for the COMCHAR is two characters (1C1C in
          hexadecimal). On Digital Equipment Corporation terminals,
          1C corresponds to a CONTROL/BACKSLASH. This allows a data
          channel operator to switch from data mode to command mode
          by pressing CONTROL/BACKSLASH twice.

                                  NOTE
                  For non-Digital Equipment Corporation
                  terminals, determine which key sequence
                  corresponds to the hex 1C character (see
                  Table 6-3).

3.5.3 Entering Data Channel Command Mode

STEP 1   SHOW CHANNEL 1 PARAMETERS
Display the current settings for Channel 1 by entering the following command.

SYS> show channel 1 <RETURN>

System response is:

Channel parameters:

```
1 TYPE    =ASYNC L-SPEED =1200   R-SPEED =1200 L-FLOW   =NONE
  R-FLOW  =NONE  DATAPAR =8-NONE STOPBITS=1    SIGNALS =ASSERT
  FILLCHAR=0     PRIORITY=NORMAL ECHO    =NONE MESSAGES=NONE
  COMTERM =NONE  COMECHO =NONE
```

STEP 2   ENABLE CHANNEL 1 TO ENTER COMMAND MODE
The channel parameters that must be changed are COMTERM (command terminal) and COMECHO (command echo); they must be set to local. Also, FLOW (flow control) must be set to a value consistent with the terminal being used for the test. The commands are shown below. Also, following each command, the unit responds with "Parameter Saved".

SYS> set channel 1 comterm local <RETURN>
SYS> set channel 1 comecho local <RETURN>
SYS> set channel 1 L-flow xon-T <RETURN>

STEP 3   SUPERVISOR LOGOUT
Enter LOGOUT at the SYS> prompt. Both the supervisory channel and a data channel cannot be logged into the supervisory command program at the same time.

STEP 4   CONNECT TO USER CHANNEL 1
Move the terminal cable from the SCC to Channel 1 (connector J1) on the same unit. Press the RETURN key to display the data channel command prompt as shown below.

DFM Series-ICP " "   Level:1.1   Channel:1
    Data Channel Command Selection

SEL>

The SEL> prompt indicates that the data channel is in command mode at the operator level. No password is required. Pressing RETURN displays valid data channel operator commands as shown below.

SUPERVISOR TERMTEST EXIT

Supervisor   -- Allows an operator to access the supervisory
                      channel from a data channel when the correct
                      password is entered.

Termtest   -- Allows an operator to start Pattern or Echo
                      tests for that channel, without a password.
                      These tests do not interfere with other
                      channels.

Exit   -- Returns the channel to data mode.

STEP 5   LOGON TO USER CHANNEL AS SUPERVISOR
          Enter SUPERVISOR at the SEL> prompt. The system prompts
          for a password. Entering the USER or SYSTEM MANAGER
          password puts the operator in the same command mode
          described in Section 3.5.1.

3.5.4 Switched Channel Operation

STEP 1   CONNECT AND LOGON TO SUPERVISORY COMMAND CHANNEL
          Return the channel to data mode by entering EXIT followed
          by pressing the RETURN key. Reconnect the terminal cable
          to the supervisory channel (connector J17). Since you
          logged out from the supervisory channel earlier, enter
          several RETURNS for the system to again prompt for a
          password.

STEP 2   SET CHANNEL 1 PARAMETERS
          The remainder of the benchtest demonstrates switched
          channel operation. All channels will be set to channel
          type = switched. This is done in two steps; first,
          enter:

          SYS> set channel 1 type switched <RETURN>

          Next, copy this channel type to the remaining channels by
          using the following command:

          SYS> copy 1 all <RETURN>

STEP 3   **SHOW CHANNEL 1 SWITCHED PARAMETERS**
To verify that the channel type was correctly changed
from asynchronous to switched, execute a SHOW CHANNEL
command.

SYS>show channel 1 <RETURN>

1   TYPE =SWITCHED

LOCAL:
```
    SPEED =1200      FLOW     =NONE      FILLCHAR=0    PRIORITY=NORMAL
    ECHO  =DISABLED MESSAGES=DISABLED   COMTERM=DISABLED
    ID    =(A)      GROUPACCESS=(A)
    SIGNALS=PASS    COMECHO =DISABLED   AUTODISC=DISABLED
```

REMOTE:
```
    SPEED =1200      FLOW     =NONE      FILLCHAR=0    PRIORITY=NORMAL
    ECHO  =DISABLED MESSAGES=DISABLED   COMTERM=DISABLED
    ID    =(A)      GROUPACCESS=(A)
    SIGNALS=PASS    COMECHO =DISABLED   AUTODISC=DISABLED
```

Notice the settings for COMTERM, COMECHO, and FLOW
options. Proceed to the next step.

STEP 4   **SET OTHER CHANNEL 1 PARAMETERS**
Notice the difference in channel parameters between async
(see Section 3.5.3) and switched channel types. Local and
remote switched channels are treated independently by the
DFM unit. Also, since channel type has changed, all
parameters are set to their default values for switched
channels. To enable a switched channel to enter command
mode, COMTERM and COMECHO must be enabled. In addition,
FLOW (flow control) must be set to a value consistent
with the terminal being used for the test. Execute the
following commands to set these features.

SYS>set channel 1 local comterm enabled <RETURN>

SYS>set channel 1 local comecho enabled <RETURN>

SYS>set channel 1 local flow xon-t <RETURN> (for DIGITAL
terminals)

STEP 5   COPY CHANNEL 1 TO ALL CHANNELS
          To make all channels the same as Channel 1, use the COPY
          command as shown below.

          SYS>copy 1 all <RETURN>

          The system responds with:

          Channel 1 copied to 1
          Channel 1 copied to 2
          Channel 1 copied to 3
          Channel 1 copied to 4
          Channel 1 copied to 5
          Channel 1 copied to 6
          Channel 1 copied to 7
          Channel 1 copied to 8

STEP 6   DISCONNECT FROM SUPERVISORY COMMAND CHANNEL AND CONNECT
          TO USER CHANNEL 1
          LOGOUT from the supervisory channel and reconnect the
          terminal cable to Channel 1 (connector J1). Press the
          RETURN key to display the SEL> data channel command
          prompt. Press RETURN again (at the SEL> prompt) to
          display the commands that are available in this mode.
          They are:

          CONNECT DISCONNECT SUPERVISOR TERMTEST STATUS EXIT(OR ^Y)

          Notice CONNECT, DISCONNECT, and STATUS. These are addi-
          tional commands that are available on switched channels.
          They are not available on asynchronous channels. Enter:

          SEL> connect 2 remote <RETURN>

          The system response is:

          Connected to Remote Channel 2

          This indicates that Channel 1 on the local unit is now
          connected through the link to Channel 2 on the remote
          unit. As soon as a switched channel is connected to
          another, it is put directly into data mode. Whenever a
          channel is in data mode, normal data transfer between
          the two channel ends is possible.   To verify the
          connection, enter data on the terminal keyboard and
          observe both channel LEDs (Channel 1 local and Channel 2
          remote).   Whenever a key is pressed, both channel LEDs
          light.

STEP 7   SHOW SWITCHED CHANNEL STATUS
To change from data mode to command mode, use the COMCHAR. Press the CONTROL/BACKSLASH keys twice to reenter command mode. At the SEL> prompt, enter:

```
SEL> status <RETURN>
```

A message showing the connection is displayed:

```
Connected to Channel 2 Remote
SEL>
```

STEP 8   DISCONNECT SWITCHED CHANNELS
To disconnect from remote Channel 2, enter:

```
SEL> disconnect <RETURN>
```

A message appears indicating the disconnect.

```
Disconnected From Channel R:2
SEL>
```

When a switched data channel is not connected to another channel, it cannot be put into data mode. Thus, users cannot EXIT from the SEL> prompt until they are connected to another switched channel.

STEP 9   SETTING UNITS BACK TO DEFAULT
To simplify later configuration of the units, set them both to the default settings. This is done by reconnecting the terminal cable to J17 (on both units), logging on with the SUPER password, and entering:

```
SYS> set system default <RETURN>
```

This finishes the preinstallation test and familiarization process. For detailed information on each of the DFM commands, refer to Chapters 5 and 6.

3.6   INSTALLATION
After the pretest and familiarization process, the two DFM units may be placed at the planned local and remote locations. These locations may be relatively close to where the pretest was performed or they may be miles away. Once they reach the final destination, remove the front bezel and verify that all modules are firmly seated in both units before power is applied.

There are three DFM configurations using:

- Integral modems,

- External link modems (no integral modems), and

- Direct connections (null modem cable).

DFM units with an integral modem module connect to the telephone
line via connector J19 on the back of the unit. Figure 3-6
illustrates how units with integral modems are connected to either
end of the phone line.

The inset in Figure 3-6 shows the points of insertion for a small
screwdriver to open the connecting points of connector J19. To
open the spring clip, insert and twist the small screwdriver until
the points open. Hold until the correct wire is inserted, release
the screwdriver, and the connection is made.

DFM units without an integral modem connect to an external
standalone modem by means of a BC22F cable and connector J18 on
the back of the unit. Refer to modem manufacturer's instructions
for installation instructions.

Null modem DFM units (no modems) use a BC22L cable or equivalent
to directly connect at J18.

Before two DFM units can communicate, the following parameters
must be set:

- Link speed (on both units) is set to sync for use with
  synchronous modems (including the integral modem, if
  installed), and async for use with either asynchronous
  modems or a direct connection.

- System type on one unit must be set to slave.

- If the configuration of each unit is not identical, then
  the configuration option on one unit must be set to
  invalid.

Once these parameters have been set, and the units are properly
connected, LEDs DR (device ready), NR (network ready), and CD
(carrier detect) should be ON. If not, refer to Chapter 7.

3.6.1 DFM Cabling
Refer to Section 2.8 for a list of system cables and a description
of cabling requirements.

3.6.2 Installing Module Options
There are two possible module options that can be user installed:

- An integral modem, and

- A channel expansion module.

When installing a module, it is necessary to power down the unit
by unplugging the power cord before inserting the module.

Before powering the system down, it is important to notify all active users that the system is to be powered down for maintenance purposes. The first consideration in upgrading the DFM system is proper planning and user notification in advance of the event. Notification can be given by using the BROADCAST command with a message "SYSTEM WILL BE DOWN FOR 30 MINUTES 3/21/86 AT 6 P.M." Note that only channels with the message option enabled will get this message.

Once the system is powered down, remove the front bezel and insert the expansion module in the correct slot (see Figure 3-1), making sure the module snaps firmly into the backplane connector.

3.6.2.1 Installing Integral Modems -- Guidelines for installing the integral modem module are listed below.

- Disconnect the current link connection; that is, remove the cable attached to J18 (at both DFM units), and

- Reconnect the link using connector J19* (at both DFM units). See Figure 3-6 for connections.

The DFM series integral modem is installed in Slot 1 of the DFM enclosure (see Figure 3-1). The DF127 or DF129 modem is typically used as the integral modem. The DFM unit is available with these modules already installed in the DFM enclosure (DFMXX-AB includes DF127, or DFMXX-AC includes DF129) or modem modules may be shipped separately and installed later. Other modem modules may be used as the integral modem, as discussed in Appendix B, but they must be ordered and installed separately.

It is necessary to verify that the modem options are configured correctly to operate with the DFM unit. DFM integral modem module options are set at the factory for general purpose use. These factory selections may not be correct for use with the DFM unit. The module must be checked, therefore, and changed to the correct option selections, if necessary (see Appendix B for selections).

---

* This, of course, assumes that an integral modem module is being installed at both ends. In remote area configurations it is possible, although unlikely, to install an integral modem module at one end and have the other end connected to a compatible external modem.

3.6.2.2 Installing Channel Expansion Modules -- Guidelines for installing the channel expansion module are listed below.

- The first channel line module position (Slot 4) must be equipped with an 8-channel module before expanding to Slot 5 with a 4- or 8-channel line module. A user cannot expand to Slot 5 if Slot 4 contains a 4-channel module.

- It is not necessary to install an expansion line module at both DFM units. The units are not required to have an equal number of channels. This is the main advantage of the DFM unit's contention feature.

- Cabling for the additional channels must be correctly installed.

- Once the expansion channel line module is installed and the DFM unit repowered, the new channels must be programmed to the desired parameters.

- The Configuration Worksheet (see Chapter 6) should be updated and redistributed.

When the units are powered ON, the LEDs on the new module will sequence ON/OFF during the self-test routine.

4.1 INTRODUCTION
This chapter examines a few typical DFM configurations with various types of hardware components and the steps required to set up the DFM unit to accommodate the different characteristics of the hardware.

Emphasis is placed on switched channel capabilities because of its complexity and flexibility.

Before continuing with this chapter, it is necessary to fully understand the commands and how to use them (see Chapter 5) and to understand how the DFM unit works (see Section 3.5).

4.2 UNSWITCHED CHANNELS
Asynchronous, synchronous, and DDCMP channel types do not have switching capability. This means that the device on the local channel always communicates with the device connected to its corresponding remote channel end. For example, Channel 1 on the local end can only communicate with Channel 1 on the remote end. When a device is powered ON, it is automatically connected to the device at the other end, provided it is also powered ON. No commands are needed to establish a connection.
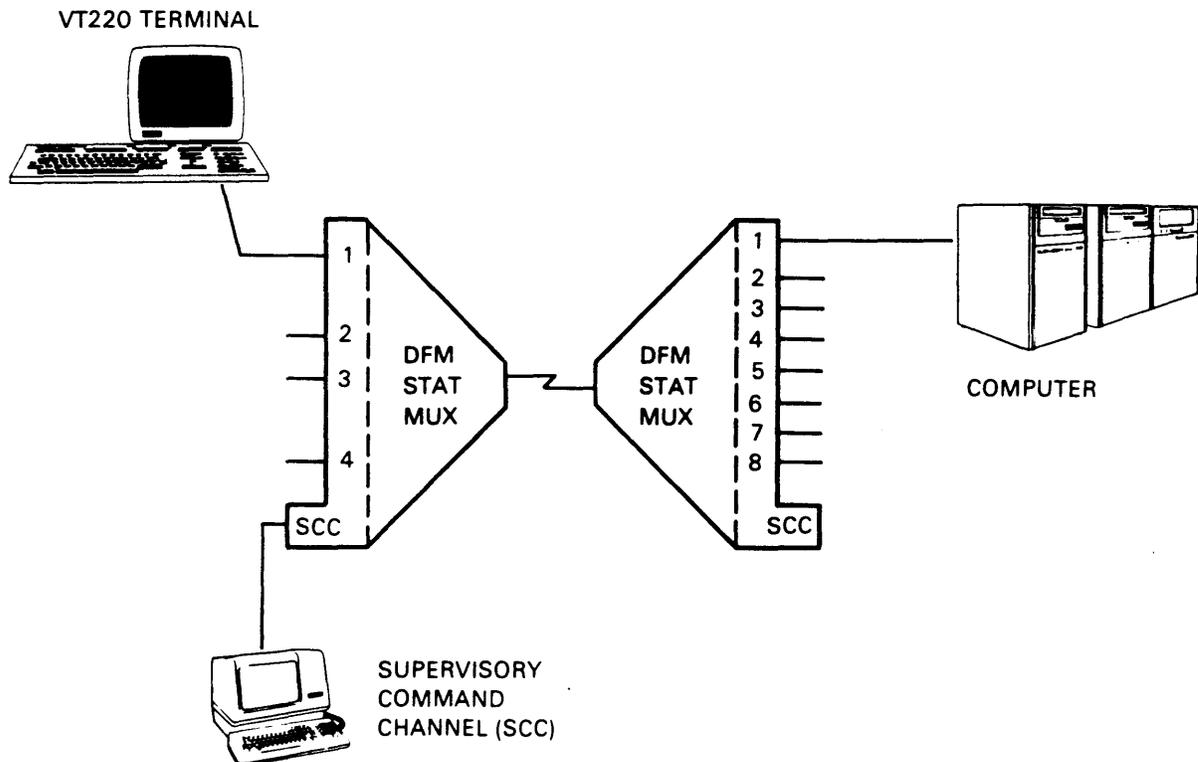
MKV85-2012

Figure 4-1 Typical Asynchronous Configuration

Figure 4-1 is an example of an unswitched type of configuration. A VT220 terminal is connected to a local site and needs a dedicated connection to a VAX computer at the remote site. Channel 1 is programmed as an asynchronous channel type. In this example, the VT220 terminal is able to log on to the VAX computer as soon as it is powered ON.

Asynchronous channel types can be programmed to enter command mode to access the supervisory channel. Synchronous and DDCMP channel types cannot access command mode.

4.3 SWITCHED CHANNELS
A switched channel can communicate with any other switched channel provided that the devices are asynchronous and the security feature allows the connection. Synchronous devices cannot be connected to switched channels.

Switching can occur locally (such as two terminals sharing one printer in the same office) or switching can occur remotely (such as two terminals at one site sharing a VAX port at the other site).

Each end of the switched channel must be programmed separately. When the supervisory channel is being used to program the DFM unit and a SHOW CHANNEL command is entered, both local and remote parameters are shown. The local parameters are those that apply to the channel end from which the supervisory channel is being used. The remote parameters apply to the same channel at the other DFM unit. Both switched channel ends can be programmed from one DFM unit.

4.3.1 Remote Switching Application
The configuration of Figure 4-2 shows how a DECmate system and a Rainbow system at one location can share a VAX port at another location. An LN03 printer is also shared at the terminal site so that the output of the VAX computer can be printed. The following procedure demonstrates what steps are necessary to program this configuration.
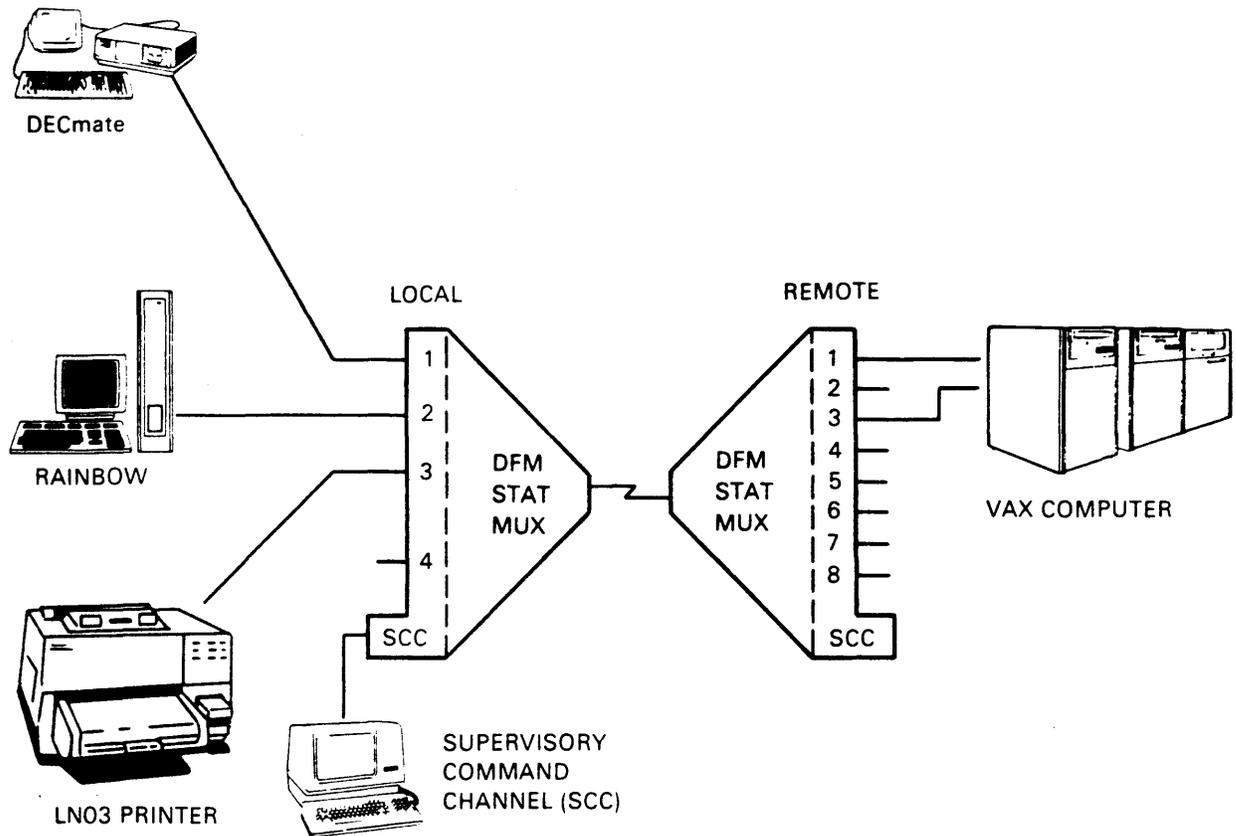
MKV85-2013

Figure 4-2   Typical Remote Switched Configuration

STEP 1   Connect the DECmate to the supervisory channel. Connect
          the Rainbow to Channel 2 and the printer to Channel 3 at
          the local DFM unit.

STEP 2   At the remote DFM unit, connect a VAX port to Channel 1
          and another VAX port to Channel 3.

STEP 3   Use the WPS CX communications program on the DECmate to
          access the DFM supervisory channel. Set up system and
          link parameters as described in Section 3.5.2 making the
          local DFM unit the master and the remote DFM unit the
          slave.

STEP 4   Assigning group IDs

At the DECmate, enter the following.

SYS>Set group D DECMT,R RNBOW,V VAX <RET>

SYS>Show group <RET>   The DFM unit responds with the
following:

Current Group Names are:

        D = DECMT
        R = RNBOW
        V = VAX

STEP 5   Setting Channel Parameters

The channel type is set to switched. Channel speed,
flow control, and ID must be set accordingly. Group
access is set by listing the IDs of the devices that
each switched channel is allowed to access. Set the
channel parameters as follows.

For the DECmate on local Channel 1:

    SYS>Set channel 1 type switched <RET>
    Parameter saved.

    SYS>Set channel 1 local speed 9600, flow Xon*-B,
    comecho enable, comterm enable <RET>
    Parameter saved.
    Parameter saved.
    Parameter saved.
    Parameter saved.

    SYS>Set channel 1 local id D, groupaccess RV <RET>
    Parameter saved.
    Parameter saved.

For the VAX port on remote Channel 1:

    SYS>Set channel 1 remote speed 9600, flow Xon*-b,
    signals assert* <RET>
    Parameter saved.
    Parameter saved.
    Parameter saved.

    SYS>Set channel 1 remote id V <RET>
    Parameter saved.

For the Rainbow on local Channel 2:

    SYS>Copy 1 2 <RET>
    Channel 1 copied to 2

    SYS>Set channel 2 local id R, groupaccess DV <RET>
    Parameter saved.
    Parameter saved.

For the LN03 printer and VAX computer on Channel 3:

    SYS>Set channel 3 type async, l-speed 9600, r-speed
    9600 <RET>
    Parameter saved.
    Parameter saved.
    Parameter saved.

    SYS>Set channel 3 l-flow xon-t, r-flow xon-c <RET>
    Parameter saved.
    Parameter saved.

                        NOTE
    The VAX system manager must designate
    the LN03 printer as a "spool" device.

Set the remaining channels to unused:

    SYS>Set channel 4 type unused <RET>
    Parameter saved.

    SYS> copy 4 5 <RET>
    Channel 4 copied to 5

    SYS> copy 5 6 <RET>
    Channel 5 copied to 6

    SYS> copy 6 7 <RET>
    Channel 6 copied to 7

    SYS> copy 7 8 <RET>
    Channel 7 copied to 8

To verifiy that all of the channel parameters have been
correctly programmed, execute a SHOW CHANNEL ALL command
as shown below.

SYS>show channel all <RET>

The DFM unit responds with the following:

```
1   TYPE  =SWITCHED

LOCAL:
     SPEED =9600       FLOW     =XON*-B    FILLCHAR=0    PRIORITY=NORMAL
     ECHO  =DISABLED MESSAGES=DISABLED   COMTERM=ENABLED
     ID    =(D)        GROUPACCESS=(RV)
     SIGNALS=NONE      COMECHO =ENABLED   AUTODISC=DISABLED

REMOTE:
     SPEED =9600       FLOW     =XON*-B    FILLCHAR=0    PRIORITY=NORMAL
     ECHO  =DISABLED MESSAGES=DISABLED   COMTERM=DISABLED
     ID    =(V)        GROUPACCESS=(A)
     SIGNALS=ASSERT* COMECHO =DISABLED   AUTODISC=DISABLED

2   TYPE  =SWITCHED

LOCAL:
     SPEED =9600       FLOW     =XON*-B    FILLCHAR=0    PRIORITY=NORMAL
     ECHO  =DISABLED MESSAGES=DISABLED   COMTERM=ENABLED
     ID    =(D)        GROUPACCESS=(RV)
     SIGNALS=NONE      COMECHO =ENABLED   AUTODISC=DISABLED

REMOTE:
     SPEED =9600       FLOW     =XON*-B    FILLCHAR=0    PRIORITY=NORMAL
     ECHO  =DISABLED MESSAGES=DISABLED   COMTERM=DISABLED
     ID    =(V)        GROUPACCESS=(A)
     SIGNALS=ASSERT* COMECHO =DISABLED   AUTODISC=DISABLED

3   TYPE  =ASYNC   L-SPEED =9600       R-SPEED =9600 L-FLOW  =XON-T
    R-FLOW=XON-C  DATAPAR =8-NONE      STOPBITS=1     SIGNALS =ASSERT
    FILLCHAR=0    PRIORITY=NORMAL      ECHO    =NONE MESSAGES=NONE
    COMTERM =NONE COMECHO =NONE

4 U TYPE  =UNUSED              (Was ASYNC)

5 U TYPE  =UNUSED              (Was ASYNC)

6 U TYPE  =UNUSED              (Was ASYNC)

7 U TYPE  =UNUSED              (Was ASYNC)

8 U TYPE  =UNUSED              (Was ASYNC)
```

STEP 6   Logging Out

          After all channel parameters are set correctly, enter
          LOGOUT at the SYS> prompt.

              SYS>logout <RET>

          The DFM unit responds with:

              Logged Out

              LOGON:
              PASSWORD?>

STEP 7   Disconnect the DECmate from the supervisory channel and
          connect it to Channel 1. Load communications for the
          DECmate (refer to DECmate user's documentation). Press
          RETURN to display the command channel prompt (SEL>).

STEP 8   AT the SEL> prompt, enter C (for CONNECT) followed by
          RETURN.

              SEL>C <RET>

          The DFM unit responds with the menu for selecting
          switched channels:

              Valid Entries: <A to Z> or <1 to 16> (or ^Y)
                             D = DECMT
                             R = RNBOW
                             V = VAX

              CONNECT>

STEP 9   Enter V at the displayed connect prompt.

              CONNECT>V <RET>

          The DFM unit responds with a message indicating the
          connection:

              SEL>Connected to Remote Channel 1

          The DECmate is now connected to the VAX computer. Press
          RETURN and log on to the VAX computer.

STEP 10   Enter terminal mode on the Rainbow, press RETURN once or
          twice to display the SEL> prompt, and repeat Steps 8 and
          9 from the Rainbow. When request for the VAX computer
          is made (V), the DFM unit responds with:

              SEL>REQUEST FOR GROUP V QUEUED

STEP 11   Log out of the VAX computer from the DECmate, then press
           CONTROL/BACKSLASH twice to recall the SEL> prompt. At
           the SEL> prompt, enter d (for DISCONNECT) followed by
           RETURN.

               SEL>d <RET>

           The DFM unit responds with:

               Disconnected From Channel R:1
               SEL>

           As soon as the DECmate disconnects from the VAX
           computer, the queued Rainbow on local Channel 2 is
           automatically connected to the VAX computer. The user
           on the Rainbow can now log on.

           There can be more than one VAX port assigned through
           switched channnels. Each port is assigned the same
           group ID of V. When a terminal user wants to connect to
           a VAX computer and C is entered, followed by V,
           connection is made to any free VAX port in the V group.

4.3.2 Local Switching Application

The configuration of Figure 4-3 shows how two personal computers
can share a letter quality printer and an asynchronous modem
through one DFM unit. The following procedure demonstrates that
the DFM unit can be used as a PC switch so that common peripherals
can be shared. The steps necessary to program this configuration
are as follows.

STEP 1   Connect a Rainbow to the supervisory channel. Connect a
           DECmate to Channel 2 and the printer to Channel 3 at the
           DFM unit. Connect an asynchronous modem to Channel 4.
           Refer to Table 2-1 for required cables.

STEP 2   Enter terminal mode by typing T at the main screen of
           the Rainbow. Press RETURN several times to access the
           supervisory channel.

STEP 3   At the logon password prompt, enter:

               LOGON:
               PASSWORD>super <RET>

           The DFM unit responds with:

               SYS>
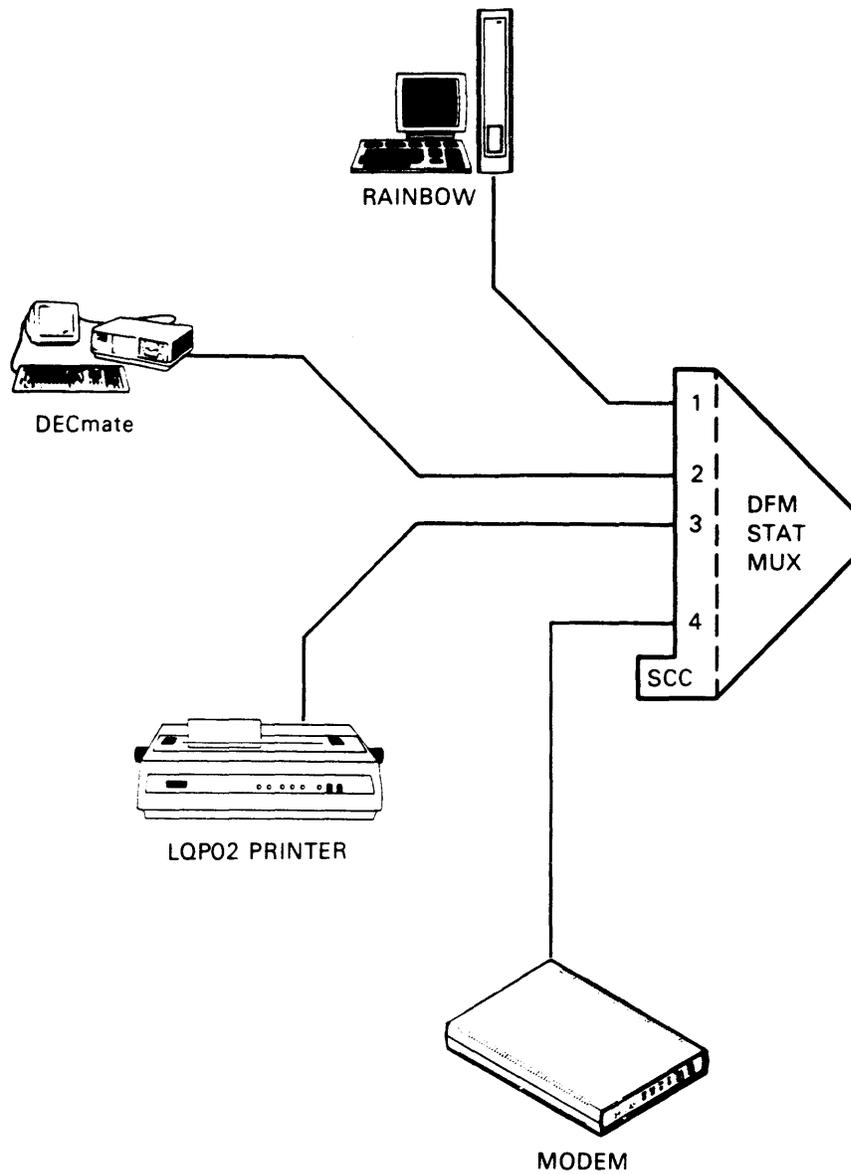
Figure 4-3 Local Switching Application

STEP 4   Reinitialize the DFM unit

At the SYS> prompt, enter:

SYS>set system default <RET>

The DFM unit responds with the warning message.

WARNING ---- COMMAND MAY RESTART SYSTEM

USE (CONTROL Y) TO ABORT COMMAND
<CR> TO CONTINUE

STEP 5   Assigning group IDs

          At the SYS prompt, enter the following.

          SYS>Set group D DECMT, L LQPØ2, R RNBOW, M MODEM <RET>
          Parameter saved.
          Parameter saved.
          Parameter saved.
          Parameter saved.

          SYS>Show group <RET>   The DFM unit responds with the
          following:

          Current Group Names are:

                    D = DECMT
                    L = LQPØ2
                    R = RNBOW
                    M = MODEM

STEP 6   Setting Channel Parameters

          All channel types are set to switched. Channel speed,
          flow control, and ID must be set accordingly on the
          local DFM unit only. Group access is set by listing the
          IDs of the devices that each switched channel is allowed
          to access. Set the channel parameters as follows.

          For the Rainbow on local Channel 1:

              SYS>Set channel 1 type switched, comecho enable,
              comterm enable <RET>
              Parameter saved.
              Parameter saved.
              Parameter saved.

              SYS>Set channel 1 local speed 9600, flow Xon-B <RET>
              Parameter saved.
              Parameter saved.

              SYS>Set channel 1 local id R, groupaccess LM <RET>
              Parameter saved.
              Parameter saved.

          For the DECmate on local Channel 2:

              SYS>Copy 1 2 <RET>
              Channel 1 copied to 2

              SYS>Set channel 2 local id D, <RET>
              Parameter saved.

4-1Ø

For the LQP02 printer on local Channel 3:

```
SYS>Copy 1 3 <RET>
Channel 1 copied to 3

SYS>Set channel 3 local id L, groupaccess RD <RET>
Parameter saved.
Parameter saved.
```

For the modem on local Channel 4:

```
SYS>Copy 3 4 <RET>
Channel 3 copied to 4

SYS>Set channel 4 local id M, 1-speed 1200, signals
dial* <RET>
Parameter saved.
Parameter saved.
Parameter saved.
```

To verify that all of the channel parameters have been correctly programmed, execute a SHOW CHANNEL ALL command to display parameters.

STEP 7   Logging Out

After all channel parameters are set correctly, enter LOGOUT at the SYS> prompt.

```
SYS>logout <RET>
```

The DFM unit responds with:

```
Logged Out

LOGON:
PASSWORD?>
```

STEP 8   Disconnect the Rainbow from the supervisory channel and connect it to Channel 1. The Rainbow must use MS^{tm}-DOS Version 2.11 or above for this application (poly-COM^{tm} communication software can also be used).

STEP 9   Enter terminal mode from the Rainbow by typing T at the main screen. Press RETURN a few times to display the command channel prompt (SEL>).

MS-DOS is a trademark of Microsoft Corporation.
poly-COM is a trademark of Polygon Associates, Inc.

STEP 10   At the SEL> prompt, enter C (for CONNECT) followed by RETURN.

　　　　　　SEL> C <RET>

The DFM unit responds with the menu for selecting switched channels:

Valid Entries: <A to Z> or <1 to 16> (or ^Y)
　　　　　　　　D = DECMT
　　　　　　　　L = LQP02
　　　　　　　　R = RNBOW
　　　　　　　　M = MODEM

　　　　　　CONNECT>

STEP 11   Enter L at the displayed connect prompt.

　　　　　　CONNECT> L <RET>

The DFM unit responds with a message indicating the connection:

　　　　　　SEL>Connected to Local Channel 3

The Rainbow on Channel 1 is now connected to the printer.

STEP 12   To print a document, return to the main screen of the Rainbow and select the drive containing the MS-DOS operating system. Use the SETPORT command at the MS-DOS prompt to set the communications port characteristics. Use the XMODE command to redirect printer output to the communications port. Refer to the MS-DOS user's documentation for more details.

STEP 13   Print the document using the MS-DOS PRINT command.

STEP 14   When the print routine is completed, return to command mode by typing the command character. Then enter DISCONNECT at the SEL> prompt to release the printer.

To allow the DECmate on Channel 2 to access the printer, the following steps would be used.

STEP 1   The DECmate must have WPS operating system Version 2.1 or above for this application.

Enter CX at the main menu of the DECmate, then press RETURN a few times to access the command channel prompt <SEL>.

STEP 2   To connect to the printer on Channel 3, enter the following at the <SEL> prompt:

          SEL>C L <RET>

          The DFM unit responds with a message indicating the connection:

          SEL>Connected to Local Channel 3

STEP 3   Return to the main menu at the DECmate and set the communications port characteristics using the SO and CC commands.

STEP 4   At the main menu, select the document to be printed. Redirect the printer output to the communication port by changing the document destination code to CLQP and proceed to print the document.

To connect to the modem on Channel 4, the following steps would be used.

STEP 1   At the SEL> prompt, enter:

          SEL>C M <RET>

          The DFM unit responds with a message indicating the connection:

          SEL>Connected to Local Channel 4

          The DECmate or Rainbow is now connected to the modem, which allows the user to dial a remote device.

STEP 2   To dial a number, refer to the modem user's documentation.

The examples in this chapter show two very simple switched configurations. In complex configurations using eight or more channels, it is important to use the Configuation Worksheet (see Section 6.2). Without hard-copy diagrams of the configuration, programming a large configuration could be confusing and complicated.

5.1 GENERAL

This chapter provides detailed descriptions of each DFM command, including where used, command line format (syntax), and one or more examples of each. Commands are listed in alphabetical order.

5.2 SUPERVISORY COMMAND HANDLER

The supervisory command handler processes commands entered on the supervisory channel. Either the USER or SYSTEM MANAGER password is required to log onto it. The type of password that is entered determines which commands can be entered.

Only one user can log into the supervisory command handler at any one time. It is directly accessed via the supervisory channel (connector J17) on the back of the unit.

The supervisory command handler may also be indirectly accessed from data channels when the channel is in data channel command mode (see Section 5.3).

PASSWORD LEVELS
Before any supervisory command can be entered, the password prompt appears:

        LOGON:
        PASSWORD?>

Supervisory commands are divided into two categories: those available with the USER password, and those available with the SYSTEM MANAGER password.

The default settings for USER and SYSTEM MANAGER level passwords are USER and SUPER, respectively. Passwords may be changed with the SET command. After either password is entered, the system indicates the privilege level by the prompt that is given:

    USR> for "user" level privileges

    SYS> for "system manager" privileges

A third level of commands, Data Channel Operator commands, is available to channel operators. This level requires no password. The operator command level is indicated by the SEL> prompt.

5.3 DATA CHANNEL COMMAND MODE

In addition to data mode, asynchronous and switched channel types can operate in command mode if enabled to do so (synchronous channels cannot enter command mode).

Asynchronous and switched channels are enabled to enter command mode by the following options:

- COMTERM Option (command terminal) -- For asynchronous channels, COMTERM must be set to local, remote, or both to enable command mode.

  For switched channels, there is a separate COMTERM option for each end, which must be set to enabled.

- COMECHO Option (command echo) -- This option determines whether command input is echoed by the DFM unit or not. Like the COMTERM option, it must be set to local, remote, or both for asynchronous channels, and enabled for a switched channel end.

- COMCHAR Option (command character) -- This option is set to the same value for all channels at the system level. When entered, the command character(s) enable a data channel to communicate with the DFM unit via supervisory commands. For the COMCHAR to be recognized, however, the COMTERM option must be set appropriately. The default value for the COMCHAR option is two hex 1C characters. Hex 1C corresponds to a control-backslash sequence on Digital Equipment Corporation's terminals. For other terminals, verify the key sequence that corresponds to hex 1C.

Refer to Section 3.5.3 (part of the preinstallation benchtest), for a description of "Enabling a Data Channel to Enter Command Mode".

5.4 DFM COMMAND STRUCTURE

5.4.1 Command Levels
DFM commands are divided into the following levels of access or system control. Also provided are the commands that are available at each level.

- Data Channel Operator commands (no password required)

  Asynchronous type channel:
  SUPERVISOR TERMTEST EXIT

  Switched type channel:
  CONNECT DISCONNECT STATUS SUPERVISOR TERMTEST EXIT

- USER Password Level commands

  LOGOUT MONITOR REPEAT SHOW (or^Y)

- SYSTEM MANAGER Password Level commands

  BROADCAST CANCEL CLEAR COPY DISCONNECT CONNECT LOGOUT MONITOR REPEAT RESTART SET SHOW TEST (or^Y)

When a data channel enters command mode, Data Channel Operator commands can be executed without having to enter a password. To access the broader range of commands, the supervisor command must be entered. The DFM unit then prompts for a password.

The USER or SYSTEM MANAGER password is required at logon before any other commands can be entered.

5.4.2 DFM Command Prompting

DFM command structure allows inexperienced users to step through complete command strings, one step at a time. Before anything is entered, or at any point of an incomplete command, a RETURN can be entered and the DFM unit prompts for "Valid command, Entries".

When an incomplete or otherwise erroneous command is entered, the system responds with the partial command that was accepted, and prompts the user for the next valid entry. Notice in the example the partial commands appearing instead of the SYS> prompt:

EXAMPLE 5-1: USING RETURN AT THE SYS> PROMPT

Command Input: SYS> <RETURN>

Unit Response: Valid   Entries: BROADCAST   CANCEL   CLEAR   COPY
               DISCONNECT CONNECT LOGOUT MONITOR REPEAT RESTART
               SET SHOW TEST (or^Y)

                    (Date) (Time) DFM Series - ICP " " Level: (REV)
               SYS>

EXAMPLE 5-2: USING RETURN AFTER THE FIRST VALID ENTRY

Command Input: SYS> set <RETURN>

Unit Response: Valid Entries: SYSTEM CHANNEL LINK (or^Y)
               SET>

EXAMPLE 5-3: USING RETURN AFTER THE SECOND VALID ENTRY

Command Input: SET> link <RETURN>

Unit Response: Valid Entries: SPEED DELAY (or^Y)
               SET LINK>

EXAMPLE 5-4: USING RETURN AFTER THE THIRD VALID ENTRY

Command Input: SET LINK> speed <RETURN>

Unit Response: Valid Entries: SYNC ASYNC (or^Y)
                SET LINK SPEED>

EXAMPLE 5-5: USING RETURN AFTER THE FOURTH VALID ENTRY

Command Input: SET LINK SPEED> sync <RETURN>

Unit Response: WARNING ---- COMMAND MAY RESTART SYSTEM

                    USE (CTRL Y) TO ABORT COMMAND
                    <CR> TO CONTINUE

Control Y (^Y) can be entered to abort the SET command, which results in the following unit response.

            (Date) (Time) DFM Series - ICP " " Level: (REV)
        SYS>

Entering a RETURN causes the unit to reinitialize, resulting in the following response:

        Parameter saved.

        SYS>

5.5 DFM COMMAND DESCRIPTIONS

This section provides detailed descriptions of all the commands that are available with the DFM unit. The command descriptions are in alphabetical order. These descriptions include privilege level usage, definitions, the correct command string format, and one or more examples.

BROADCAST

PRIVILEGE LEVEL:

    Data Channel Operator   [ ]
    User Password   [ ]
    System Manager Password   [X]

DEFINITION: The BROADCAST command is used by the system manager to send any desired message to data channels at both ends of the system. Only channel ends with the message option enabled receive broadcast messages.

When sent from the supervisory channel, a message may consist of 256 characters (about 4 lines), but each line must be separated by a backslash (\).

When sent from a data channel enabled for supervisory commands, a message can only be a maximum of 74 characters (1 line).

EXAMPLE 5-6: BROADCAST MESSAGE

Command Input:

    SYS>Broadcast System will be down tonight from 7:00 to 8:00 p.m.
        <RETURN>

Unit Response:

    Message sent.

    SYS>

CANCEL

PRIVILEGE LEVEL:

    Data Channel Operator   [ ]
    User Password   [ ]
    System Manager Password   [X]

DEFINITION: The CANCEL command is used to terminate either a test function or any command that is being repeated (using the REPEAT command). When CANCEL is entered, the DFM unit returns to the system manager prompt.

NOTE
Control Y (^Y) or a return <RETURN> have the same effect as CANCEL.

EXAMPLE 5-7: CANCELING A TEST SEQUENCE

To cancel a test sequence, first initiate a test sequence.

START TEST

Command Input: SYS>test channel 1 pattern <RETURN>

Unit Response: Test initiated.

            TEST CHANNEL 1 PATTERN>

CANCEL TEST

Command Input: TEST CHANNEL 1 PATTERN> cancel <RETURN>

Unit Response: Test terminated.

            SYS>

CLEAR

PRIVILEGE LEVEL:

Data Channel Operator	[ ]
User Password	[ ]
System Manager Password	[X]

DEFINITION: The CLEAR command is used to reset error counters back to zero. It allows the system manager to clear either individual counters or groups of counters as specified in the command line. When system is selected, all counters (channels and link) are cleared.

FORMAT:

COMMAND	CATEGORY	OPTION	VALUE
Clear	SYS	None	None
	LINK	ACtivity	XMitutil, RECVutil, ALL
		STats	TRansmit,RECEive, LINKDrop, ALL
	CHannel<No. or ALL>	L-Stats,	FRamerr, PARerr, R-Stats, BUFrovrf, DATAOvrn, ALL

NOTE
Allowed abbreviations for entries are
shown in capital letters.

EXAMPLE 5-8: USING THE CLEAR COMMAND

Command Input: SYS>clear channel all r-stats parerr <RETURN>

Unit Response: Cleared.

        SYS>

CONNECT

PRIVILEGE LEVEL:

Data Channel Operator	[X]
User Password	[ ]
System Manager Password	[X]

DEFINITION: The CONNECT command is used to connect one switched channel to another. It may be used from either the supervisory channel (system manager password) or a switched channel that is in data channel command mode. From switched channels, no password is required for use.

A switched channel end may be connected to any other switched channel (either local or remote) provided access is granted by the group access option for each channel. (See Channel ID/Group Access Options, Section 6.8.3.10, for a description of switched channel access and identification).

Switched channels are disconnected by either the DISCONNECT command or the automatic disconnect feature (see AUTODISC Option, Section 6.5.4).

CONNECTING TO A GROUP

If a channel group name is specified in the CONNECT command string, the group name (a single letter) must be a valid entry as determined by the group access option or the connection will be denied. Each channel can be assigned to one or more groups using the SET command to specify those groups in the group access option. If access is authorized, connection will be made to the first available channel (not busy) in that group. If all channels in a group are busy, the request is queued, and the requesting channel will be connected to the first available channel in that group.

Explicit channel number and channel end may also be specified in the CONNECT command, but group access is still checked by the system. Whether a group or explicit channel is specified, channel connections are made on a first come, first served basis. Requests remain queued until either a connection is made or the request is withdrawn via the DISCONNECT command.

CONNECT (CONT)

EXAMPLE 5-9: CONNECTING FROM A SWITCHED DATA CHANNEL

Specifying explicit channel number and channel end:

    Command Input: SEL> connect 3 remote <RETURN>

    Unit Response: SEL> Connected to Remote Channel 3

Specifying a Group ID:

    Command Input: SEL> connect a <RETURN>

    Unit Response: Connected to Local Channel 2. (Connection is
                             made to the first available channel in group
                             a)

When the CONNECT command is followed by a RETURN, the DFM unit
prompts for valid entries and displays group "names". A group name
is a descriptive name (up to five characters) for a group that is
represented by a letter when used with the CONNECT command. (See
the SET command description for information on how to set group
names.)

EXAMPLE 5-10: CONNECTING FROM THE SUPERVISORY CHANNEL

Specifying explicit channel number and channel end:

    Command Input: SYS> connect 2 local 3 local <RETURN>

    Unit Response: Connection completed.

Specifying a Group ID:

    Command Input: SYS> connect 2 local a <RETURN>

    Unit Response: Connection completed.

Whether a connection is attempted from a data channel or the
supervisory channel, if the requesting channel does not have
access to the specified channel or group (that is, the channel ID
or group letter does NOT appear in that channel's group access
assignment), the following message is returned:

    ILLEGAL: SECURITY VIOLATION; ACCESS DENIED.

CONNECT (CONT)

If an attempt is made to connect to a different channel while a previous request is still pending or the channel is connected, the following responses are displayed.

EXAMPLE 5-11: CONNECTING FROM THE SUPERVISORY CHANNEL
(Channel Busy)

Command Input: SYS> connect 7 local 1 remote <RETURN>

Unit Response: Channel 7 not disconnected
                This response appears if the busy channel (Channel 7) is at the same end as the supervisory channel being used,

                or

                Channel Busy, Request Denied
                This response appears if the busy channel (Channel 1) is at the other end of the supervisory channel being used.

EXAMPLE 5-12: CONNECTING FROM A SWITCHED DATA CHANNEL
(Channel Queued or Busy)

Command Input: SEL> connect 1 local <RETURN>

Unit Response: Inuse: Already Requesting Channel 8 Local
(if queued)   SEL>

Unit Response: Inuse: Already Connected to Channel 8 Local
(if connected) SEL>

If two remote channel ends are specified by the supervisory channel of the local unit (or vice versa), the system responds with:

    Request forwarded to Remote Unit.

In this case, it is necessary to execute a SHOW SWITCHED command to see if the connection has been made or is queued.

When a connection has taken place, channels are placed in normal data mode. Entering the COMCHAR sequence returns the terminal to the command mode, where the operator can execute one of the other commands, for example, DISCONNECT.

5-10

COPY

PRIVILEGE LEVEL:

Data Channel Operator	[ ]
User Password	[ ]
System Manager Password	[X]

DEFINITION: The COPY command is used to copy one channel's configuration (parameters) to another. It allows the system manager to copy the entire parameter configuration of one channel to another selected channel or to all channels.

When identical or even similar configurations are planned for several channels, the COPY command can greatly speed the programming process. Enter the parameters in one channel and then copy its configuration to the channels that are similar. Minor changes for individual channels can then be programmed.

FORMAT:

COPY <source channel no.> <destination channel no. (or ALL)>

NOTE
Specify only the channel number. Do not
enter the word "channel."

EXAMPLE 5-13: COPY ONE CHANNEL TO ALL CHANNELS

Command Input: SYS> copy 2 all <RETURN>

Unit Response: Channel 2 copied to 1
                 Channel 2 copied to 2
                 Channel 2 copied to 3
                 Channel 2 copied to 4
                 Channel 2 copied to 5
                 Channel 2 copied to 6
                 Channel 2 copied to 7
                 Channel 2 copied to 8

                 SYS>

DISCONNECT

PRIVILEGE LEVEL:

Data Channel Operator   [X]
User Password   [ ]
System Manager Password   [X]

DEFINITION: The DISCONNECT command is used to terminate a connection between two switched channels. It may be issued either from a data channel (in command mode) or from the supervisory channel. A data channel operator can only disconnect that channel's current connection by entering DISCONNECT at the SEL> prompt (no password required).

The system manager can disconnect any current connection by specifying a channel number and channel end (that is; local or remote). For example, assume local Channel 2 is connected to remote Channel 5. The connection can be disconnected by the system manager specifying either "disconnect 2 local" or "disconnect 5 remote".

Whether a disconnect is performed from a data channel or the supervisory channel, a message indicating the disconnection is sent to both ends of the connection.

EXAMPLE 5-14: DISCONNECTING FROM SWITCHED DATA CHANNELS

Command Input: SEL> disconnect <RETURN>

Unit Response: Disconnected From Channel R:2
              SEL>

              or

              Channel Not Connected: No Disconnect Necessary
              SEL>

DISCONNECT (CONT)

EXAMPLE 5-15: DISCONNECTING A LOCAL CHANNEL USING THE SUPERVISORY CHANNEL

Command Input: SYS> disconnect 2 local <RETURN>

Unit Response: Channel 2 disconnected.

        or if Channel 2 was not connected;

        Channel 2 Not Connected, No Disconnect Necessary.

EXAMPLE 5-16: DISCONNECTING A LOCAL CHANNEL USING THE SUPERVISORY CHANNEL

Command Input: SEL> disconnect 5 remote <RETURN>

Unit Response: Request forwarded to Remote Unit.

If the DISCONNECT command is entered on the local unit for disconnection of a remote channel end(s), the request is forwarded. A SHOW SWITCHED command displays current switched connections and must be entered to see if the DISCONNECT command was successful.

EXIT

PRIVILEGE LEVEL:

Data Channel Operator   [X]
User Password   [ ]
System Manager Password   [ ]

DEFINITION: The EXIT command is used to exit from data channel
command mode and return to normal data mode. On
switched channels, however, if there is no current
data connection, there is no data mode (thus no reason
to exit). Entering EXIT in this situation just returns
the operator to the SEL> prompt.

Entering data channel command mode with the COMCHAR
sequence allows a temporary break in communication
without disconnecting a switched connection. When the
command activity at the SEL> prompt is completed, the
EXIT command is entered at the SEL> prompt to return
the channel to data mode.

LOGOUT

PRIVILEGE LEVEL:

Data Channel Operator	[ ]
User Password	[X]
System Manager Password	[X]

DEFINITION: When the LOGOUT command is entered, the operator or system manager is logged out of the supervisory command handler. The supervisory command handler can only be logged into from one location at a time (data channels or supervisory channel).

Entering LOGOUT on a terminal connected to the supervisory channel returns the channel to an idle state and the password prompt. Entering LOGOUT at the data channel USER or SYSTEM MANAGER password level, returns the data channel to the operator (no password) command level (SEL>). Entering EXIT at the SEL> prompt, returns the channel to data mode.

EXAMPLE 5-17: LOGGING OUT

Command Input: SYS> logout <RETURN>

Unit Response: Logged Out

LOGON:
PASSWORD>

MONITOR

PRIVILEGE LEVEL:

    Data Channel Operator   [ ]
    User Password   [X]
    System Manager Password   [X]

DEFINITION: This command displays the MONITOR information for
system, channel, or link categories. Using the REPEAT
function with the MONITOR command provides a periodic
update of the information being monitored (see REPEAT
command).

FORMAT:

    MONITOR SYSTEM
            LINK
            CHANNEL <channel number or "all">

EXAMPLE 5-18: MONITOR SYSTEM

Command Input: SYS> monitor system <RETURN>

Unit Response:

SYSTEM

    DEVICE STATUS=READY
    NETWORK STATUS=READY
    CHANNEL ACTIVITY:
    1   Xmt=185   Avg Xmt=180   Rcv=192   Avg Rcv=285   (chars/min)
    2   Xmt=192   Avg Xmt=175   Rcv=199   Avg Rcv=278   (chars/min)
    3   Xmt=175   Avg Xmt=265   Rcv=180   Avg Rcv=274   (chars/min)
    4   Xmt=7260 Avg Xmt=645   Rcv=0   Avg Rcv=0   (chars/min)

LINK ACTIVITY:
XMITUTIL= 84% RECVUTIL= 48%

Channel and link activity are explained in Examples 5-19 and 5-20.

NETWORK STATUS: Either reads "READY" or one of the following:
                *PROBLEM: LINK DOWN
                *PROBLEM: NO CTS (on the link)
                *PROBLEM: NO RECEIVE
                *PROBLEM: TRANSMIT RETRIES

Each of these problems causes the NR LED on the control module to
blink. Refer to Table 3-3 for a description of each problem.

MONITOR (CONT)

DEVICE STATUS: Either reads "READY" or one of the following:
                         *PROBLEM: NVROM BAD/DISABLED
                         *PROBLEM: BOTH UNITS INVALID
                         *PROBLEM: BOTH UNITS MASTER
                         *PROBLEM: BOTH UNITS SLAVE

Each of these problems causes the DR LED on the control module to blink. Refer to Table 3-3 for a description of each problem.

EXAMPLE 5-19: MONITOR LINK

Command Input: SYS> monitor link <RETURN>

Unit Response:

<u>Link TRANSMIT RECEIVE LINKDROP total</u>

```
 1      0        0       0        0
XMITUTIL= 92%  EIA Signals= CAR XCK RNG RCK DSR DTR CTS RTS
RECVUTIL= 84%              0   0   0   0   0   1   0   1
```

Link counters are cleared automatically when the system is reset.

TRANSMIT: Number of transmit errors for the local unit since link counter was last cleared.

RECEIVE: Number of errors received by the unit since the counter was last cleared.

LINKDROP: A linkdrop occurs when there is a severe enough interruption in communication between two units for the DFM unit to automatically reinitialize.

                The front panel NR LED blinks for one minute prior to reinitialization. See Table 3-3 for a description of conditions that interrupt communication and cause the NR LED blink.

XMITUTIL: Transmit utilization of the link is the number of characters transmitted on the link divided by link capacity multiplied by 100. The calculation for this figure is made every 15 seconds, which is then added to the the previous total, and the sum is divided by 2. Thus, this figure is heavily weighted toward recent utilization.

MONITOR (CONT)

RECVUTIL: Receive utilization of the link is defined in a
          fashion corresponding to XMITUTIL (previous page).

EIA Signals: Indicated ON by a 1 and OFF by a 0. The link presents
             a DTE interface, so the DFM outputs DTR and RTS on
             the link. CAR, DSR, and CTS are input signals.

XCK/RCK: Transmit clock/receive clock. When link speed is set
         to async, receive and transmit clocks are generated
         by the DFM units. When link speed is set to sync, the
         connected modem must generate clock signals. Both
         clocks should always be indicated ON when the units
         are transmitting and receiving data.

EXAMPLE 5-20: MONITOR CHANNEL

Command Input: SYS> monitor channel 1 <RETURN>

Unit Response:

```
Chan    FRAMERR     PARERR      BUFROVRF     DATAOVRN        subtotal      total
-------L-----R----L-----R----L-----R-----L------R--------L-----R---------
 1      0     0    0     0    0     0     0      0        0     0        0
XMITDATA=NUL 00h                  EIA Signals= CAR RCA RNG RRI DSR DTR CTS RTS
RECVDATA= ''  > 3Eh                           1   0   0   0   1   0   1   0
ACTIVITY:   Xmt=93     Avg Xmt=82       Rcv=101    Avg Rcv=80   (chars/min)
```

XMITDATA, RECVDATA, ACTIVITY and EIA Signals appear only when a
single channel is monitored. This information is on-line data,
which means it can change while it is being monitored.

XMITDATA: The last character transmitted on the monitored
          channel.

RECVDATA: The last character received on the monitored channel.

ACTIVITY: Xmt = number of characters transmitted (by terminal)
          over the last minute. Avg Xmt = average number of
          characters transmitted per minute for the last 20
          minutes.

          Rcv = number of characters received by terminal in
          last minute. Avg Rcv = average number of characters
          received per minute for the last 20 minutes.

EIA Signals: Indicated ON by a 1 and OFF by a 0. Channels present
             a DCE interface, so the DFM unit outputs CAR, RNG,
             DSR, and CTS to the terminal. The DFM unit receives
             RCA, RRI, DTR, and RTS from the terminal.

MONITOR (CONT)

When DDCMP and synchronous channels are monitored, only buffer overflow errors are displayed. Framing, parity, and data overrun errors do not apply to synchronous channel operation.

For DDCMP channels only, header CRC errors are counted and appear in the parity columns.

XMITDATA, RECVDATA, ACTIVITY, and EIA Signals categories apply to both synchronous and asynchronous channels. When the DFM unit reads characters appearing on synchronous channels, however, it is possible that the register will be bit-shifted. This means that XMITDATA and RECVDATA values (appearing in hex) may not accurately reflect the character actually transmitted or received.

REPEAT

PRIVILEGE LEVEL:

Data Channel Operator	[ ]
User Password	[X]
System Manager Password	[X]

DEFINITION: The REPEAT command allows the system to repeat certain commands at specified intervals for a specified number of repetitions. Whenever REPEAT or any two commands are entered on one line, they are separated by a semicolon (;).

The repeat command allows the operator to specify the number of times, and the time interval in seconds for a selected command to be repeated. A REPEAT function may run indefinitely by entering an asterisk (*) in the repetitions field.

When used with the BROADCAST command, it must be the first command because any data following the BROADCAST command is considered text. A repeating command is terminated by pressing RETURN or entering any other command.

FORMAT:

```
Monitor link; REPEAT <repetitions>: <interval in seconds>
                     (1 to 65,535)    (1 to 65,535)
```

EXAMPLE 5-21: REPEAT MONITORING A CHANNEL

Command Input: SYS>MONITOR CHANNEL 1; REPEAT 4:5 <RETURN>

Unit Response: The following response is updated and displayed four times at five second intervals.

Chan	FRAMERR		PARERR		BUFROVRF		DATAOVRN		subtotal		total
	L	R	L	R	L	R	L	R	L	R	
1	0	0	0	0	0	0	0	0	0	0	0

```
XMITDATA=NUL 00h          EIA Signals= CAR RCA RNG RRI DSR DTR CTS RTS
RECVDATA='' > 3Eh                       1   0   0   0   1   0   1   0
ACTIVITY:    Xmt=93    Avg Xmt=82    Rcv=99    Avg Rcv=79   (chars/min)
```

RESTART

PRIVILEGE LEVEL:

    Data Channel Operator   [ ]
    User Password   [ ]
    System Manager Password   [X]

DEFINITION: The RESTART command is used to reinitialize the system while retaining the link error counters and supervisory channel log-on condition. Parameters are down-line loaded, channel buffers are cleared, and the units are resynchronized with the RESTART command.

When a channel type is changed, the new parameter is automatically down-line loaded. It is recommended that a RESTART command still be issued for resynchronization. Other major parameter changes, like link speed, automatically restart the system.

Refer to Section 7.2 for a complete description of self-tests and reinitialization.

EXAMPLE 5-22: SYSTEM RESTART

Command Input: SYS> restart <RETURN>

Unit Response: Reinitializing the unit

The front panel LEDs sequence through the self-test routine when reinitialization takes place. When it is finished, pressing RETURN twice displays the SYS> prompt.

SET

PRIVILEGE LEVEL:

Data Channel Operator	[ ]
User Password	[ ]
System Manager Password	[X]

DEFINITION: The SET command is used to select (program) system, link, and channel parameters, as well as, general categories of date, time, alarm, and password. Chapter 6 details the use of the SET command to select options and values, and explains each programmable option for system, link, and channel categories.

Other general categories used with the SET command are shown below.

FORMAT:

SET	TIME	<00:00 to 23:59>
	DATE	<mm-dd-yy>
	ALARM	Disabled or Enabled (default is disabled)
	PASSWORD	<user or super> <any eight characters>
	GROUP	<group ID> <any five character name> (? ; , not allowed)

EXAMPLE 5-23: SETTING TIME

The time appears in DFM header lines; thus any printout of supervisory channel output is automatically stamped with the time.

Command Input: SYS> set time 13:15 <RETURN>

Unit Response: Time set: 13:15

SET (CONT)

EXAMPLE 5-24: SETTING DATE

The date also appears in DFM header lines and the printout of supervisory channel output.

Command Input: SYS> set date Ø8-22-85 <RETURN>

Unit Response: Date set: 8-22-85   13:18

EXAMPLE 5-25: SETTING ALARM

Alarm is set either enabled or disabled. When enabled, the supervisory channel receives automatic system alarm messages. Note that this option corresponds to the messages option for data channels.

Command Input: SYS> set alarm enabled <RETURN>

Unit Response: Alarm set: Enabled

The new time, date, and alarm appear in the header line. The word "ALARM" indicates that the supervisory channel is enabled to receive alarm messages generated by the DFM unit. Table 6-7 lists each alarm message.

EXAMPLE 5-26: SETTING NEW PASSWORDS

Passwords may be changed with the SET command for both USER and SYSTEM MANAGER levels. The default passwords for these privilege levels are USER and SUPER, respectively.

Command Input: SYS> set password system Smith <RETURN>

Unit Response: Parameter Saved.

        or

Command Input: SYS> set password user Brown <RETURN>

Unit Response: Parameter Saved.

Passwords may be set to any combination of eight ASCII alphanumeric characters, with the exception of question mark (?), semicolon (;), comma (,), and a blank space. Entering any of the exceptions in this field will have unpredictable results.

SET (CONT)

EXAMPLE 5-27: ASSIGNING GROUP NAMES

Five character descriptive "names" are assigned to groups identified by a letter. Switched channel users may then be prompted with group names as an aid to access the correct group: For example, group A may be assigned to engineering resources only. Thus, it would be appropriate to assign the name of ENG-1 to group A. A list of group names is displayed by the DFM unit whenever a SHOW GROUP command is entered or the CONNECT command is entered followed by a RETURN. The only ASCII characters that cannot be entered in this field are question mark (?), semicolon (;), comma (,) or a blank space. A maximum of seven groups can be specified.

This example assigns several channels connected to the accounting microcomputer to a group identified by the letter A.

Command Input: SYS> set group a acctg <RETURN>

Unit Response: Parameter Saved.

Group A has now been assigned the name "ACCTG" (that is, "accounting").

Group names are listed when:

1. A CONNECT command, followed by a RETURN is entered on a switched channel in command mode.

    Command Input: SEL> connect <RETURN>

    Unit Response: Valid Entries:<A to Z> or <1 to 16> (or^Y)

                          A = ACCTG
                          E = ENG

2. A CONNECT command from the supervisory channel is incomplete.

    Command Input: SYS> connect 1 local <RETURN>

    Unit Response: Valid Entries:<A to Z> or <1 to 16> (or^Y)

                          A = ACCTG
                          E = ENG

3. A SHOW GROUP command is entered on a supervisory channel.

    Command Input: SYS> show group <RETURN>

    Unit Resopnse: Current Group Names are:

                          A = ACCTG
                          E = ENG

SHOW

PRIVILEGE LEVEL:

Data Channel Operator   [ ]
User Password   [X]
System Manager Password   [X]

DEFINITION: The SHOW command is used to display parameter
             settings. It allows the operator to display the
             current settings of all system, channel, or link
             parameters. When the channel category is selected,
             either one channel or all channels may be specified.

             Also, with the SHOW SWITCHED command, the operator
             can display all switched connections throughout the
             system.

             Response messages for show channel and show link
             include special symbols called "state indicators"
             that provide information on status. See Examples 5-29
             and 5-30 for descriptions of state indicators.

FORMAT:

    SHOW SYSTEM
         LINK
         CHANNEL <No. or "all">
         SWITCHED
         GROUP

EXAMPLE 5-28: SHOW SYSTEM

Command Input: SYS> show system <RETURN>

Unit Response: System Parameters:
                NAME="DECMUX"   AUTODISC=20   SW-DATAPAR=8-NONE
                TYPE=MASTER   SW-STOPBITS=1 SW-SIGNALS=ASSERT
                CONFIG=VALID
                COMCHAR=1C1C
                CHANNELS=8

SHOW (CONT)

EXAMPLE 5-29: SHOW LINK

Command Input: SYS> show link <RETURN>

Unit Response: Link Parameters:
        1 E SPEED=SYNC: 19200 DELAY=NORMAL

NOTE
The letter E is a link state indicator.
See Table 5-1 for a description of link
state indicators.

If the link speed is set to sync, but no clocking signal is
detected, the response reads SPEED=SYNC: NO CLOCK. This indicates
that either the link modem is malfunctioning or that a proper
connection to the modem has not been made.

The link speed is checked during system reset or reinitialization
for response purposes only. Thus, if modem speed has fallen back
since last reset, the speed that is displayed in the response will
reflect the previous setting.

EXAMPLE 5-30: SHOW CHANNEL

Command Input: SYS> show channel 1 <RETURN>

Unit Response:

```
Channel parameters:
1 E TYPE     =ASYNC L-SPEED =1200   R=SPEED =1200   L-FLOW    =NONE
    R-FLOW  =NONE   DATAPAR =8-NONE STOPBITS=1       SIGNALS   =ASSERT
    FILLCHAR=0      PRIORITY=NORMAL ECHO     =NONE   MESSAGES =NONE
    COMTERM =NONE   COMECHO =NONE
```

NOTE
The letter E is a channel state indica-
tor. See Table 5-2 for a description of
channel state indicators.

Regardless of the size of the DFM unit, the operator can set and
show channels up to channel number 16. This is because a
16-channel unit can be connected to a unit with fewer ports to
take advantage of port contention functions. Because a larger unit
may be at the other end of the network, it is necessary to provide
the capability of programming a channel end that does not exist on
the local unit. This is the reason for channel state indicators
(L, R, and B) that show when a channel end "does not exist" at one
or both ends.

SHOW (CONT)

Also, when the channel type is changed to unused, and a SHOW channel is executed, the response indicates that the channel is currently unused, as well as what the channel type <u>was</u> before it was set to unused. This allows the channel type to be changed from either sync, async, or switched to unused, and then back, and still retain the original parameter settings. If channel type is set to unused, and then to a new type, all channel parameters go to their default values of the new selection (see Table 6-4).

EXAMPLE 5-31: SHOW SWITCHED

Command Input: SYS> show switched <RETURN>

Unit Response: CONNECTIONS:

Channel	Channel
L:2	L:8
L:3	L:1
L:4	L:6
L:5	SUPV CHAN

REQUESTS

Channel	Channel
L:5	L:8

EXAMPLE 5-32: SHOW GROUP

Command Input: SYS> show group <RETURN>

Unit Response: Current Group Names are:
A = ACCTG
E = ENG
P = PERS

NOTE
Refer to the SET command for information
on how to set group names.

Table 5-1 Link State Indicators

E = One or more of the error counters for the link is incremented.

R = DFM unit is responding to a Link Loopback command issued by the other DFM unit.

Table 5-2 Channel State Indicators

E = One or more of the error counters for the channel has been incremented.

S = Synchronous channel being displayed.

U = Channel type set to unused.

L = Local channel end is either not functioning or nonexistent.

R = Remote channel end is either not functioning or nonexistent.

B = Both channel ends are either not functioning or nonexistent.

\> = Unit has received a "stop data" flow control signal on the link.

< = Unit has sent a "stop data" flow control signal on the link.

\# = Unit has received and sent a "stop data" flow control signal on the link.

STATUS

PRIVILEGE LEVEL:

Data Channel Operator   [X]
User Password   [ ]
System Manager Password   [ ]

DEFINITION: The STATUS command is used for a switched data
             channel only. Its function is to show whether or not
             the channel is currently connected to another
             switched channel.

             If there is a connection, the unit response shows
             which channel (by number) it is connected to and the
             location (local or remote). If the channel is not
             connected, a response message indicating no
             connection is displayed.

EXAMPLE 5-33: SWITCHED CHANNEL STATUS

Command Input: SEL> status <RETURN>

Unit Response: Not Busy

          or

          Connected To Channel (1-16) (Local or Remote)
          (if there is a connection)

SUPERVISOR

PRIVILEGE LEVEL:

```
Data Channel Operator          [X]
User Password                  [ ]
System Manager Password        [ ]
```

DEFINITION: Entering the SUPERVISOR command at the data channel
SEL> prompt causes the log-on/password prompt to
appear. This allows the operator to access commands
that are available via the USER or SYSTEM MANAGER
passwords. The operator must enter the correct USER or
SYSTEM MANAGER password to continue, otherwise, a
Control Y must be used to abort the process.

There is a maximum time limit of two minutes to enter
a password, after which, a message is displayed that
indicates a timeout.

EXAMPLE 5-34: USING THE DATA CHANNEL SUPERVISORY COMMAND

Command Input: SEL> supervisor <RETURN>

Unit Response: LOGON:
               PASSWORD?>

Entering the correct password, followed by RETURN, causes the
appropriate password prompt (either USER> or SYS>) to appear.

TERMTEST

PRIVILEGE LEVEL:

Data Channel Operator	[X]
User Password	[ ]
System Manager Password	[ ]

DEFINITION: The TERMTEST command is used by data channel operators to run a limited set of terminal tests. Tests that can be executed without a password are:

- Pattern test,
- Local Echo test, and
- Remote Echo test.

Once a test is running, it is terminated by pressing the BREAK key. Chapter 7 provides a complete description of each test function.

FORMAT:

```
SEL> termtest pattern,
             l-echo, or
             r-echo  <RETURN>
```

or

```
SEL> termtest <RETURN>
```

Valid Entries: PATTERN L-ECHO R-ECHO (or ^Y)
TERMTEST>

EXAMPLE 5-35: USING THE TERMTEST PATTERN TEST

Command Input: SEL> termtest pattern <RETURN>

Unit Response: The response for the Pattern test is the complete ASCII character set as shown below.

```
!"#$%'()*+,--./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\\] \n|
 'abcdefghijklmnopqrstuvwxyz{{|}}~
T"#$%'()*+,--./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\\] \n|
_'abcdefghijklmnopqrstuvwxyz{{|}}~
```

(BREAK key pressed)

END TEST
SEL>

TEST

PRIVILEGE LEVEL:

    Data Channel Operator   [ ]
    User Password   [ ]
    System Manager Password   [X]

DEFINITION: The TEST command allows the system manager to initi-
              ate a system, channel, or link test. The TEST command
              must be used with caution because some of the tests
              interfere with data activity on all channels.

              Refer to Chapter 7 for a complete description of the
              function and scope of each test, as well as warnings
              about the degree of interference from each test. When
              the TEST command is used, tests run until terminated
              with either a RETURN or the CANCEL command. Notice
              that the data channel TERMTEST command is terminated
              with the BREAK key, whereas, the system manager's
              test functions are terminated with either a RETURN or
              the CANCEL command.

FORMAT:

    TEST   SYSTEM   POWERUP
              LINK   SIGNALS, LBACK
              CHANNEL <no.>   SIGNALS, L-ECHO, R-ECHO,
                                  PATTERN, LBACK

TEST (CONT)

EXAMPLE 5-36: USING THE LINK LBACK TEST

Command Input: SYS> test link lback <RETURN>

Unit Response: Test initiated.

```
                TEST LINK LBack>
                (8-22-85 12:04) LINK 1 LBACK: NO ERRORS
```

For demonstration purposes, the link cable is disconnected to simulate a link failure. The output below indicates a linkdrop.

```
(8-22-85 12:06) LINK 1 LBACK: NO LOOP
TEST LINK LBACK>
```

When reconnected, error counts are indicated:

```
(8-22-85 12:12) LINK 1 LBACK: TRANSMIT=271/49% RECEIVE=67/20% LINKDROP=1
```

```
        TEST LINK LBACK> cancel <RETURN>
        TEST TERMINATED.

        4-28-83 10:26 System:"11/70-B (local)" Level:0B0
        SYS>
```

This chapter describes each programmable configuration option of the DFM system and guidelines on using the SET command to select these options. In addition, the Configuration Worksheet is provided. Fill out a copy after deciding what option settings your application requires.

The Configuration Worksheet is designed to be a guide for the programming process, as well as a permanent record of configuration/reconfiguration activity. In the event of any type of system problems or accidental reset to default, such a record is very important to reprogram the system.

6.1 DFM CONFIGURATION OPTIONS
Configuration options for the DFM Intelligent Communications Processor are divided into the following categories.

- General -- These are options of a general nature, such as time, date, password, and so forth.

- System -- Options set at the system level are:

  -- Parameters which distinguish DFM units from one another (for example, name).

  -- Certain switched channel parameters (for example, STOPBITS, DATAPAR) that are set at the system level to ensure compatibility among all switched channels.

  -- Other system-wide parameters for all channels (for example, the command character sequence (COMCHAR) used by data channels to enter command mode).

- Link -- Link options are speed and delay.

- Channel -- Channel options define the operating characteristics of each channel. Depending on the type of channel selected, the options vary.

The types of options that can be selected by the SET command are listed in Table 6-1.

6.2 THE CONFIGURATION WORKSHEET
Programming the DFM system is a two-step process.

- Fill out the Configuration Worksheet as you follow along in this chapter, selecting the proper settings as each option is explained. Figure 6-1 is a typical configuration diagram and Figure 6-2 is a sample filled-in Configuration Worksheet.

- Using the SET command, program the units according to the information on the worksheet. Section 6.3 provides guidelines on using the SET command, while Sections 6.4 through 6.8 detail option descriptions.

A blank Configuration Worksheet for photocopying purposes is located in Appendix D.

Table 6-1 Configuration Options

GENERAL:	TIME DATE ALARM PASSWORD GROUP (descriptive name)
SYSTEM:	NAME TYPE CONFIGURATION AUTODISCONNECT COMCHAR SW-DATAPAR SW-STOPBITS SW-SIGNALS DEFAULT
LINK:	SPEED DELAY
CHANNEL:	Asynchronous Channel: TYPE SPEED FLOW SIGNALS FILLCHARACTER PRIORITY ECHO MESSAGES COMTERM COMECHO DATAPAR STOPBITS
	Switched Channel: TYPE SPEED FLOW FILLCHARACTER PRIORITY ECHO MESSAGES COMTERM COMECHO ID GROUP ACCESS SIGNALS AUTODISCONNECT
	Synchronous/DDCMP Channel: SPEED FLOW BLOCKSIZE (non-DDCMP only) SYNFILL (DDCMP only)

The DFM ICP is a very powerful and flexible networking device and must be correctly programmed. To help in the programming process, it is important to use the Configuration Worksheet. It is equally important to draw a diagram of the configuration similar to the one shown in Figure 6-1. Figure 6-1 is used with the Configuration Worksheet of Figure 6-2 to provide an example of how to fill in the worksheet. The example is a typical switching and contention application utilizing multiple resources. Some of the most important features, such as network security, synchronous and asynchronous communication, and system management are covered.

6.2.1 Network Security
To restrict terminal users from unauthorized resources, the channels are assigned a unique group access list containing only the ID codes of resources that the terminal user is allowed to use. In Figure 6-1, the DECmate user on remote Channel 10 cannot access the data PBX or the VAX-11/780 system at the local site because the ID for those facilities are not included in the group access list for Channel 10. Refer to Chart 2B of Figure 6-2 for remote Channel 10 option selections.

6.2.2 System Management
A system manager is generally assigned to maintain network integrity of such a complex system as shown in Figure 6-1. Initial programming of the DFM unit is done from the supervisory command

channel (SCC). Once programming is complete and the network link
is established, the system manager may choose to program his user
channel for supervisory command mode. This allows the system
manager to participate as both terminal user and system manager
from the same terminal. In the example, local Channel 1 is
selected for the system manager.

The group access list for remote Channels 7 and 8 include the
letter "S" (system manager) which allows Channels 7 and 8 to
communicate with the system manager on Channel 1 to report any
network problems.

6.2.3 Synchronous/DDCMP Support
Channel 5 is established as a DDCMP link between the local and
remote VAX system. This type of configuration is suitable for
applications requiring file transfers over DECnet facilities. See
Figure 6-2, Chart 3, for option selections.

6.2.4 Modem Tail Circuits
Local Channel 8 and remote Channel 11 are programmed for modem
application to allow terminal users to dial in or dial out of the
DFM network.

6.2.5 Data PBX Facility
The DFM supports a wide variety of data communications equipment.
Local Channels 2 and 3 are connected to a PBX (Private Branch
Exchange) to allow terminal users to access resources not directly
connected with the DFM network.

6.2.6 Asynchronous Channel Support
Channel 4 is the only channel programmed for asynchronous use.
Asynchronous applications are the most common type in statistical
multiplexer networks, however, asynchronous terminal users are
limited to a single resource. The terminal user on local Channel 4
can only communicate with the VAX system on remote Channel 4.
Refer to Figure 6-2, Chart 2A, for Channel 4 programming.

6.2.7 Host Systems
Local Channels 2, 3, 6, and 7, and remote Channels 1, 2, and 3 are
programmed as switched channels and are connected to host systems.
These channels have been assigned IDs of X for the PBX, A (Alpha)
for the VAX 8600, and B (Beta) for the VAX-11/780 (refer to the
switched only section of Figure 6-2, Chart 2A). The group access
for the above system channel ends must be considered very
carefully. The selection should be a unique letter that has not
yet been assigned. In the example configuration, the letter Z is
assigned for the group access on these system channel ends. This
restricts access to the system devices to those terminal users
that have the letters A, B, or X in their group access list.

PBX
ID = X
ACC = Z

VT220
ID = R
ACC = ABMXS

DECmate
ID = R
ACC = ABMP

RAINBOW
ID = S
ACC = ABMXR

VAX 8600
ID = A
ACC = Z

SYNC

NEW YORK MUX 1
(LOCAL)
DFM08-AC

BOSTON MUX 3
REMOTE
DFM12-AC

DECmate

VAX-11/780
ID = B
ACC = Z

SYNC

9600 BITS/S

RAINBOW
ID = R
ACC = ABPXS

LN03 PRINTER
ID = P
ACC = R

MODEM #2

ID = M
ACC = RS

DECmate
ID = R
ACC = AMP

MODEM #1

ID = M
ACC = RS

UNUSED

CHANNEL CONFIGURATION CHART

CHANNEL TYPE	CHANNEL NUMBER
SWITCHED	1, 2, 3, 6, 7, 8 9, 10, AND 11
UNUSED	12
ASYNCHRONOUS	4
SYNCHRONOUS (DDCMP)	5

LEGEND
ID   = GROUP ID
ACC = GROUP ACCESS
SCC = SUPERVISOR COMMAND CHANNEL

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Figure 6-1   Sample Configuration Diagram

CHART 1

INTELLIGENT COMMUNICATION PROCESSOR WORKSHEET

LOCAL:	REMOTE:
LOCATION *NEW YORK*	LOCATION *BOSTON*
MODEL # *DFM∅8-AC*	MODEL # *DFM 12-AC*
SERIAL # *NQ ∅5∅4*	SERIAL # *NQ 14∅9*

SYSTEM PARAMETERS:	SYSTEM PARAMETERS:
NAME: *NEW YORK-MUX 1*	NAME: *BOSTON-MUX 3*
16 CHARACTERS (MAX)	16 CHARACTERS (MAX)
TYPE: MASTER ☒	TYPE: MASTER ☐
SLAVE ☐	SLAVE ☒
*CONFIGURATION: VALID ☒	*CONFIGURATION: VALID ☒
AUTODISCONNECT: TIMEOUT [*8C*]	AUTODISCONNECT: TIMEOUT [*8C*]
(1 to 225 SEC)	(1 to 225 SEC)

SWITCHED PARAMETERS:	SWITCHED PARAMETERS:
SW DATAPAR:	SW DATAPAR:
DATA: 8 ☒ PARITY: NONE ☒	DATA: 8 ☒ PARITY: NONE ☒
7 ☐ ODD ☐	7 ☐ ODD ☐
6 ☐ EVEN ☐	6 ☐ EVEN ☐
5 ☐	5 ☐
SW STOPBITS: 1 ☒	SW STOPBITS: 1 ☒
1.5 ☐	1.5 ☐
2 ☐	2 ☐
SW SIGNALS: ASSERT ☒	SW SIGNALS: ASSERT ☒
PASS ☐	PASS ☐
COMMAND CHARACTER: [1][C] [1][C]	COMMAND CHARACTER: [1][C] [1][C]
(HEX 00 TO 1F) HEX HEX	(HEX 00 to 1F) HEX HEX
GROUP NAMES: *B=BETA, A=ALPHA, M=MOD#2, R=RTERM, X=PBX*	GROUP NAMES: *A=ALPHA, B=BETA, M=MOD#1, P=PRINT, S=SYMGR, X=PBX, R=RTERM*

LINK PARAMETERS:

SPEED:	SYNC ☒	DELAY:	NORMAL ☒
	ASYNC ☐		SATELLITE ☐

LINK CHARACTERISTICS MUST BE SET THE SAME AT BOTH ENDS

*CONFIGURATION IS VERY CRITICAL. REFER TO SECTION 6.5.3.

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Figure 6-2   Sample of Completed Configuration Worksheet
(Sheet 1 of 4)

CHART 2A

LOCAL

CHANNELS			1	2	3	4	5	6	7	8
TYPE	U=UNUSED									
	S=SYNC SEE CHART 3				▨	▨	S	▨	▨	▨
	A=ASYNC					A				
	SW=SWITCHED		SW	SW	SW			SW	SW	SW

ASYNC ONLY	STOPBITS	1, 1.5, 2	⌇	⌇	⌇	1	⌇	⌇	⌇	⌇
	SIGNALS	A = ASSERT / L = L-DIAL / R = R-DIAL / B = 2-DIAL / P = PASS	⌇	⌇	⌇	A	⌇	⌇	⌇	⌇
	DATAPAR	N = NONE / O = ODD / E = EVEN	⌇	⌇	⌇	N	⌇	⌇	⌇	⌇

ASYNC & SWITCH	SPEED	1200					⌇			X
		2400					⌇			
		4800		X	X		⌇		X	
		9600	X				⌇	X		
		AUTOBAUD					⌇			
		OTHER①					⌇			
	FLOW	NONE					⌇			
		XON⁎B	X	X	X	X	⌇	X	X	
		XON⁎C					⌇			
		XON⁎T					⌇			
		CTS-RTS					⌇			
		OTHER②					⌇			1
	FILLCHAR	(0-255)	Ø	Ø	Ø	Ø	⌇	Ø	Ø	Ø
	PRIORITY	L=LOW / N=NORMAL / H=HIGH	H	N	N	L	⌇	N	N	N
	ECHO	SWITCHED: E = ENABLE	D	D	D	N	⌇	D	D	D
	MESSAGES	D = DISABLE ASYNC:	E	E	E	R	⌇	D	D	E
	COMTERM	N = NONE / L = LOCAL	E	E	E	R	⌇	D	D	E
	COMECHO	R = REMOTE / B = BOTH	E	E	E	R	⌇	D	D	E

SWITCH ONLY	AUTODISC	E = ENABLE / D = DISABLE	E	E	E	⌇	⌇	E	E	E
	CHANNEL ID	A TO Z	S	X	X	⌇	⌇	B	B	M
	GROUP ACCESS	ID-LIST	3	Z	Z	⌇	⌇	Z	Z	RS
	SIGNALS	N = NONE / D = DIAL / D⁎ = DIAL⁎ / A = ASSERT / A⁎ = ASSERT⁎	N	N	N	⌇	⌇	A⁎	A⁎	D⁎

REMOTE

CHANNELS			1	2	3	4	5	6	7	8
TYPE	U=UNUSED									
	S=SYNC SEE CHART 3				▨	▨	S	▨	▨	▨
	A=ASYNC					A				
	SW=SWITCHED		SW	SW	SW			SW	SW	SW

ASYNC & SWITCH	SPEED	1200				X	⌇			
		2400					⌇			
		4800		X	X	X	⌇		X	X
		9600	X				⌇	X		
		AUTOBAUD					⌇			
		OTHER①					⌇			
	FLOW	NONE					⌇			
		XON⁎B	X	X	X	X	⌇	X	X	X
		XON⁎C					⌇			
		XON⁎T					⌇			
		CTS-RTS					⌇			
		OTHER②					⌇			
	FILLCHAR	(0-255)	Ø	Ø	Ø	Ø	⌇	Ø	Ø	Ø
	PRIORITY	L=LOW / N=NORMAL / H=HIGH	H	N	N	L	⌇	N	N	N
	ECHO	SWITCHED: E = ENABLE	D	D	D	N	⌇	D	D	D
	MESSAGES	D = DISABLE ASYNC:	D	D	D	L	⌇	E	E	E
	COMTERM	N = NONE / L = LOCAL	D	D	D	L	⌇	E	E	E
	COMECHO	R = REMOTE / B = BOTH	D	D	D	L	⌇	E	E	E

SWITCH ONLY	AUTODISC	E = ENABLE / D = DISABLE	E	E	E	⌇	⌇	E	E	E
	CHANNEL ID	A TO Z	A	A	A	⌇	⌇	R	R	R
	GROUP ACCESS	ID-LIST	Z	Z	Z	⌇	⌇	28	4	5
	SIGNALS	N = NONE / D = DIAL / D⁎ = DIAL⁎ / A = ASSERT / A⁎ = ASSERT⁎	A⁎	A⁎	A⁎	⌇	⌇	N	N	N

① OTHER SPEED SELECTIONS:
1=50, 2=75, 3=110, 4=134.5, 5=150,
6=300, 7=600, (ASYNC ONLY S=SAMEBAUD)

SPLIT-SPEED 8=75/1200, 9=1200/75,
10=150/2400, 11=2400/150.

3=ABMXR
4=ABMXS
5=ABPXS

② OTHER FLOW SELECTIONS:
1=XON-B, 2=XON-C, 3=XON-T,
4=DSR-DTR, 5=CTSH-RLSH,
6=CTSH-RLSL, 7=CTSL-RLSH,
8=CTSL-RLSL.

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Figure 6-2 Sample of Completed Configuration Worksheet
(Sheet 2 of 4)

CHART 2B

			LOCAL 9	10	11	12	13	14	15	16		REMOTE 9	10	11	12	13	14	15	16

CHANNELS

TYPE			9	10	11	12	13	14	15	16		9	10	11	12	13	14	15	16
	U=UNUSED														U				
	S=SYNC SEE CHART 3																		
	A=ASYNC																		
	SW=SWITCHED											SW	SW	SW					

ASYNC ONLY

	STOPBITS	1, 1.5, 2									
	SIGNALS	A = ASSERT / L = L-DIAL / R = R-DIAL / B = 2-DIAL / P = PASS									
	DATAPAR	N = NONE / O = ODD / E = EVEN									

ASYNC & SWITCH

	SPEED	1200												X					
		2400																	
		4800										X	X						
		9600																	
		AUTOBAUD																	
		OTHER①																	
	FLOW	NONE																	
		XON*-B										X	X						
		XON*-C																	
		XON*-T																	
		CTS-RTS																	
		OTHER②												1					
	FILLCHAR	(0-255)										¢	¢	¢					
	PRIORITY	L=LOW / N=NORMAL / H=HIGH										N	N	N					
	ECHO	SWITCHED: / E = ENABLE										D	D	D					
	MESSAGES	D = DISABLE / ASYNC:										E	E	E					
	COMTERM	N = NONE / L = LOCAL										D	E	E					
	COMECHO	R = REMOTE / B = BOTH										D	E	E					

SWITCH ONLY

	AUTODISC	E = ENABLE / D = DISABLE										E	E	E					
	CHANNEL ID	A TO Z										P	R	M					
	GROUP ACCESS	ID-LIST										R	PM B	MRS					
	SIGNALS	N = NONE / D = DIAL / D* = DIAL* / A = ASSERT / A* = ASSERT*										N	N	D*					

① OTHER SPEED SELECTIONS:
1=50, 2=75, 3=110, 4=134.5, 5=150,
6=300, 7=600, (ASYNC ONLY S=SAMEBAUD)

SPLIT-SPEED 8=75/1200, 9=1200/75,
10=150/2400, 11=2400/150.

② OTHER FLOW SELECTIONS:
1=XON-B, 2=XON-C, 3=XON-T,
4=DSR-DTR, 5=CTSH-RLSH,
6=CTSH-RLSL, 7=CTSL-RLSH,
8=CTSL-RLSL.

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Figure 6-2   Sample of Completed Configuration Worksheet
(Sheet 3 of 4)

CHART 3

TYPE	CHANNELS		LOCAL 1	2	5	6	9	10	13	14		REMOTE 1	2	5	6	9	10	13	14
	S = SYNC D = DDCMP				D									D					

SYNC & DDCMP

			LOCAL 1	2	5	6	9	10	13	14		REMOTE 1	2	5	6	9	10	13	14
SPEED	INT 1200																		
	INT 1800																		
	INT 2400				X									X					
	INT 4800																		
	INT 7200																		
	INT 9600																		
	INT 1200																		
	INT 1800																		
	INT 2400																		
	INT 4800																		
	INT 7200																		
	INT 9600																		
FLOW	NONE																		
	CTS-RTS				X									X					

SYNC ONLY

			LOCAL 1	2	5	6	9	10	13	14		REMOTE 1	2	5	6	9	10	13	14
BLOCKSIZE	512				X									X					
	1024																		
	2048																		
	4096																		

DDCMP ONLY

		LOCAL 1	2	5	6	9	10	13	14		REMOTE 1	2	5	6	9	10	13	14
SYNFILL	2,4,6			6									6					

CHART 4

GENERAL PARAMETERS:

TIME: 00:00 to 23:59
        3:45

DATE: MM-DD-YY
        12-2-86

		LOCAL	REMOTE
ALARM:	ENABLED	☐	☒
	DISABLED	☒	☐

PASSWORD: (8 CHARACTERS MAX.)
USER: *USER*
SYSTEM: *SUPER*

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Figure 6-2   Sample of Completed Configuration Worksheet
(Sheet 4 of 4)

6.3 PROGRAMMING GUIDELINES

System and link parameters must be programmed separately on both local and remote DFM units. Once the units are communicating, the channel parameters entered on one unit can be down-line loaded to the other unit. Down-line loading makes the programming process easier and faster. The following sequence of steps is used to program the DFM system after the units are powered up at local and remote sites.

- Decide which unit will be the "master".

- Enter the "SET SYSTEM DEFAULT" command on the master unit to ensure a known starting point for channel configurations (this also sets system and link parameters to their default values listed in Table 6-4).

- Set link speed on the master unit (sync when connected to synchronous modems; otherwise async).

- On the other unit (so two units can communicate):

  -- Change the type to "slave"
  -- Set the link speed the same as the master unit

- Connect units (via phone line or other facility).

- After the power-up test cycle, the units should come up with the CD, NR, and DR LEDs all ON (it may be necessary to press the SR switch once). If not, refer to Chapter 7.

- Enter channel parameter selections on the master unit.

- Set the configuration option on the slave unit to "invalid".

- The invalid set of parameters is automatically replaced by the valid set, with the exception of system type, name, and link speed (as well as date, time, and alarm).

6.3.1 Configuration Rules

During network configuration the following rules apply.

- Both units cannot be master or slave. [Device Ready LED (DR) blinks]

- Both units cannot be invalid. [Device Ready LED (DR) blinks]

- If both units are valid, the master unit downloads to the slave unit.

6.3.2 Using the SET Command

Table 6-2 is a complete listing of DFM options that are programmed with the SET command.

In addition to system, channel, and link parameters, other general categories selected with the SET command are:

Time: Appears in DFM header lines; thus any printout of supervisory channel output is automatically stamped with the time.

Date: Also appears in DFM header lines and the printout of the supervisory channel output.

Alarm: Is set either enabled or disabled. When enabled, the word "ALARM" appears in the supervisory channel header lines and the supervisory channel receives automatic system alarm messages.   Note that this option corresponds to the messages option for data channels.

Password: May be changed with the SET command for both USER and SYSTEM MANAGER levels. The default passwords for these privilege levels are USER and SUPER, respectively.

Group: Five-character descriptive "names" are assigned to groups identified by a letter. Switched channel users may then be prompted with group names as an aid to access the correct group. For example, Group A may be assigned to engineering resources only. Thus, it would be appropriate to assign the name of ENG-1 to Group A. A list of group names is displayed by the DFM unit whenever a SHOW GROUP command is entered or the CONNECT command is entered followed by a RETURN. A group name can be any combination of five characters or numbers with the exception of a question mark (?), a semicolon (;), a comma (,), or a blank space.

6.3.2.1 Setting Multiple Options -- When several options in the same category (system, link, or channel) are programmed, options may be separated by a comma and entered on the same command line. The number of options that can be programmed with the same line is limited by a maximum of 76 characters that can appear on one line.

When a comma is the last item entered on a command line, the DFM unit prompts for the next option to be programmed (see Example 6-1).

EXAMPLE 6-1: SETTING MULTIPLE OPTIONS

Command Input: SYS>set channel 1 1-speed 4800, r-speed 4800,
             1-flow xon-t, r-flow xon-c,<RETURN>

Unit Response:

    Parameter saved.
    Parameter saved.
    Parameter saved.
    Parameter saved.

Because a comma was the last character on the line, the DFM unit
prompts the operator to program the next option (DATAPAR) for
Channel 1:

    <Next Option?> (or ^Y)

    SET CHANNEL 1 DATAPAR>

6.3.2.2 Abbreviations -- All commands, options, and values may be
abbreviated when entered into the system. All that is required is
to supply enough letters to uniquely identify the input. For
example, SET SYSTEM TYPE SLAVE may be abbreviated as SE SYS TY SL.
Notice that system requires three letters, because SY does not
clearly define system; there is also SYnc and SYnf.

6.3.2.3 "Channel All" Programming -- To select all channels to
the same type (asynchronous, switched, or unused) the CHANNEL ALL
command can be specified. The "channel all" feature can only be
used to select channel type and asynchronous channel parameters.
It cannot be used to select switched channel parameters. Switched
channel parameters must be selected on a per channel basis and
then duplicated, if necessary, using the COPY command.

EXAMPLE 6-2: SET CHANNEL ALL

Command Input: SYS> set channel all type switched <RETURN>

Unit Response: Parameter saved.

Because synchronous and DDCMP channel types are only possible on
certain channels, "channel all" programming is not allowed when
setting options on these channel types.

6.3.2.4 COPY Command -- With the COPY command, an operator can copy the configuration of one channel to another channel, or to all other channels. If identical or similar channel configurations are planned for several channels, this command can greatly speed the programming process.

EXAMPLE 6-3: PROGRAMMING WITH THE COPY COMMAND
(For eight-channel unit)

Command Input: SYS> copy 1 all <RETURN>

Unit Response: Channel 1 copied to Channel 2
Channel 1 copied to Channel 3
Channel 1 copied to Channel 4
Channel 1 copied to Channel 5
Channel 1 copied to Channel 6
Channel 1 copied to Channel 7
Channel 1 copied to Channel 8

Some configurations cannot be copied to certain channels, however. Synchronous and DDCMP channel configurations are allowed only on Channels 1 and 2, 5 and 6, 9 and 10, and 13 and 14. Trying to copy a synchronous channel configuration to a channel without synchronous capability results in an error message.

6.4 DFM OPTIONS AND VALUES
Table 6-2 lists all of the options and the values that can be selected. Valid abbreviations appear in capital letters.

Table 6-2   Configuration Options and Values

Function	Option	Parameter Value
GENERAL		
	TIme	(24 hour clock:hours:minutes) (∅∅:∅∅ to 23:59)
	DATE	(MM-DD-YY)
	ALArm	Either DISAbled or ENabled
	PASSWord	(Any eight characters) Defaults are USer and SUPER.
	GROUP Access	(Five-character descriptive name.)
SYStem	NAme	Up to 16-character name
	TYpe	MAster or SLave
	CONFIguration	INvalid or VALId
	AUTODisconnect	Time period from 1 to 255 minutes
	SWItched DATA Parity (SW-D)	5-E 6-E 7-E 8-E 5-O 6-O 7-E 8-O 5-N 6-N 7-N 8-N
	SWitched STOpbits	1, 1.5, 2
	SWitched SIgnals	ASSert, PASS
	DEFault	Pressing RETURN after entering default sets all applicable parameters to default values.
	COMmand Character (COMC)	One- or two-character sequence (hex value from ∅∅ to 1F).
LINK	SPeed	ASYnc, SYNC
	DELay	NORmal or SATellite
CHannel	TYpe	UNUsed, ASYnchronous, SWItched, SYNChronous, or DDCMP

Table 6-2   Configuration Options and Values (Cont)

Function	Option	Parameter Value
ASYNC Channel Options:		
	Local-SPeed (L-SP) Remote-SPeed (R-SP)	50, 75, 110, 134.5, 150, 300, 600, 1200, 2400, 4800, 9600, AUTOBaud, SAMebaud, or Split-Speed at 75-1200, 1200-75, 150-2400, or 2400-150.
	LOCA1-FLow Control REMote-FLow Control	NONe, XON*-B, XON*-C, XON*-T, XON-B, XON-C, XON-T, CTS-RTS, DSR-DTR, CTSH-RLSH, CTSH-RLSL, CTSL-RLSH, CTSL-RLSL
	DATA Parity	5-E 6-E 7-E 8-E 5-O 6-O 7-O 8-O 5-N 6-N 7-N 8-N
	STOpbits	1, 1.5, 2
	SIgnals	ASSert, L-Dial (L-D), R-Dial (R-D), 2-Dial (2-D), or PASS
	FILlcharacter	Number of null characters from 0 to 255.
	PRiority	LOW, NORmal, HIgh
	ECho	NONe, LOCAl Unit, REMote Unit, or BOth
	Messages	NONe, LOCAl Unit, REMote Unit, or BOth
	COMmand Terminal	NONe, LOCAl Unit, REMote Unit, or BOth
	COMmand Echo	NONe, LOCAl Unit, REMote Unit, or BOth
SWITCHED Channel Options:		
	SPeed	50, 75, 110, 134.5, 150, 300, 600, 1200, 2400, 4800, 9600, AUTOBaud, or Split-Speed at 75-1200, 1200-75, 150-2400, or 2400-150.

Table 6-2 Configuration Options and Values (Cont)

Function	Option	Parameter Value
	FLow	NONe, XON*-B, XON*-C, XON*-T, XON-B, XON-C, XON-T, CTS-RTS, DSR-DTR, CTSH-RLSH, CTSH-RLSL, CTSL-RLSH, CTSL-RLSL
	SIgnals	NONe, PASS, ASSERT, ASSERT*, DIAL, DIAL*
	FILlcharacter	0 to 255
	PRiority	NORmal, LOW, HIgh
	ECho MEssages COMmand Terminal COMmand Echo AUTODisconnect	All of these options for SWItched CHannels are either ENabled or DISAbled.
	GROUP Access	Specifies which group(s) channel is allowed access to. \<ID List, ALL\>
	CHannel Identification	\< A to Z\>

SYNCHRONOUS and DDCMP Channel Options:

Function	Option	Parameter Value
	L-SPeed R-SPeed	INT1200, INT1800, INT2400, INT4800, INT7200, INT9600, EXT1200, EXT1800, EXT2400, EXT4800, EXT7200, EXT9600.
	FLow Control	NONe, CTS-RTS
	BLocksize (Synchronous Only)	512, 1024, 2048, 4096
	SYNFill (DDCMP Only)	2, 4, 6 SYNC Characters

6.5 SETTING SYSTEM OPTIONS
This section details each system option.

6.5.1 Name Option
The name option for a DFM unit is a cosmetic feature that appears in quotes on all header lines. It provides a unique identity for each DFM unit in a system. The unit name can be set to any combination of 16 alphanumeric characters.

The unit name is part of the header line that appears with all supervisory channel outputs. If a printing terminal is connected to the supervisory channel, this option provides a way for the information that is output to be stamped with the identity of the unit:

    4-28-84 12:15   DFM Series - ICP "11/70-B" Level: 1.1

6.5.2 Type Option

Values: MASTER, SLAVE

Default: MASTER

Before two DFM units can communicate, one must be named master and the other slave. This option is for identity purposes, and combined with the configuration option (below), establishes a working basis for down-line loading.

(See "Down-Line Loading", under configuration option, below).

6.5.3 Configuration Option

Values: VALID, INVALID

Default: VALID

This option flags the entire set of parameters of one unit as either valid or invalid. Invalid sets of parameters are replaced by valid ones when down-line loading occurs.

DOWN-LINE LOADING OF OPERATING PARAMETERS
All parameters with the exception of system type and name; link speed; and date, time, and alarm are exchanged between units according to the following rules.

- Parameters in units with an invalid configuration option are replaced by those from a unit with a valid configuration option. The invalid configuration option is then changed to valid.

- If parameters differ on two units, but the configuration option of both is set to valid, then parameters from the master unit replace those of the slave.

- If both units are invalid, master, or slave, the Device Ready LED on both units blink until one unit is changed. Data cannot be transmitted until this condition is cleared.

Down-line loading of parameters ensures consistency of parameter settings and also allows a DFM unit to be automatically configured. When installing two units or adding a new unit to a system, once parameters have been entered on one unit, the other unit is automatically configured with the same parameters by setting its configuration option to invalid. Before two units can communicate, one unit must be set to slave, and proper link speed must be selected for each unit.

Down-line loading occurs whenever the units are either reset or reinitialized.

Units are reset whenever:

- Power is applied to the unit

- The power-up test is initiated, either via:

    -- The TEST SYSTEM POWERUP command, or

    -- The System Reset switch (SR)

Units reinitialize whenever:

- The current setting is changed for system type or configuration, as well as link speed or delay.

- The RESTART command is executed.

- The link is lost for a period of at least one minute .

System reset involves the full set of power-up diagnostic tests. System reinitialization is primarily a resynchronization of units.

Refer to Section 7.2 for a complete description of self-tests and initialization procedures.

6.5.4 System Autodisconnect (AUTODISC) Option

Values: From 1 to 255 minutes

Default: 20

The AUTODISC option has system and channel level settings. At the SYSTEM level, a timeout period (in minutes) is defined. Switched channels are automatically disconnected if there has been no data activity within the defined timeout period.

At the channel level, the AUTODISC option applies to switched channels and may be set to either enabled or disabled. To activate the switched channel AUTODISC timeout period, the channel option must be set to enabled.

6.5.5 Switched-Data Parity (DATAPAR) Option

Values: 5, 6, 7, or 8 bits/character with parity of odd, even, or none.

Default: 8-NONE

The switched-DATAPAR option selects data size and parity settings for all switched channels. This is done at the system level to ensure that all devices connected to switched channels use the same data/parity parameters.

6.5.6 Switched-Stopbits Option

Values: 1, 1.5, or 2

Default: 1

The number of stopbits for use on all switched channels is also selected at the system level to ensure consistency. Equipment operating at 150 bits/s or less generally requires 1.5 or 2 stopbits. For speeds above 150 bits/s, 1 stopbit is sufficient.

6.5.7 Switched-Signals Option

Values: ASSERT, PASS

Default: ASSERT

Refer to Section 6.7.1 for considerations of "EIA Signals on DFM Channels".

This system level option allows the signals option for all switched channels to be set to either assert or pass.

Each switched channel end also has a signals option. The setting at the channel level overrides the system level selection when it is set to other than none. At the channel level the default is none, which means that unless another value is entered, the system level setting applies to the channel.

At the channel level, additional values of dial or dial* (the asterisk is part of the selection and is NOT a reference to a footnote) may be entered to allow the channel end to handle the dial-up handshake with a connected modem.

With the assert value set, carrier, data set ready, and clear to send are output continuously on the switched channel end. Other EIA signals are not passed between channel ends. The DFM unit operates most efficiently when it does not have to relay EIA signal changes between ends. Assert is the recommended setting unless there is a particular reason to relay EIA signals between channel ends.

With the pass value, the DFM unit relays the toggling of EIA signals between channel ends. This setting is recommended only in the situation where it is important to see an EIA transition at either end (that is, there is a special CPU function that is associated with the toggling of an EIA signal).

The signals option setting affects DFM operation when a modem is connected to a channel end. Refer to Section 6.7.2 for more information on how the channel signals option affects dial-up operation.

6.5.8 Command Character (COMCHAR) Option

Values: One or two characters -- any combination of hex values from 00 to 1F.

Default: 1C1C

This option defines one or two characters that enable data channels to enter command mode. When entered on a data terminal, the supervisory command program is accessed, and supervisory functions may be executed.

Hex 1C corresponds to a control-backslash sequence on DIGITAL terminals. For non-DIGITAL terminals, verify which key sequence corresponds to hex 1C. If 1C is undesirable or not possible, alter the COMCHAR for each data channel via the supervisory port.

The COMCHAR setting applies to async and switched channels only. Synchronous and DDCMP channels cannot enter command mode. When the COMCHAR selection is entered on an enabled data channel, the DFM responds with the command mode prompt. For the COMCHAR to be recognized, however, COMTERM and COMECHO channel options must be enabled on the selected data channel.

Table 6-3 lists valid command character (COMCHAR) selections and what control key function is required.

EXAMPLES: ASCII   HEX

                     ESC   1B
                     ENQ   Ø5
                     DC2   12

                              CAUTION
Select a combination of one or two
characters that are NOT likely to be
transmitted as part of any data message
because it will inadvertently place the
channel in command mode.

Table 6-3 Command Character Selections

Key Pressed with CTRL Key	Hex Code Transmitted	Function Mnemonic
Space Bar	ØØ	NUL
A	Ø1	SOH
B	Ø2	STX
C	Ø3	ETX
D	Ø4	EOT
E	Ø5	ENQ
F	Ø6	ACK
G	Ø7	BELL
H	Ø8	BS
I	Ø9	HT
J	ØA	LF
K	ØB	VT
L	ØC	FF
M	ØD	CR
N	ØE	SO
O	ØF	SI
P	1Ø	DLE
Q	11	DC1 or XON
R	12	DC2
S	13	DC3 or XOFF
T	14	DC4
U	15	NAK
V	16	SYN
W	17	ETB
X	18	CAN
Y	19	EM
Z	1A	SUB
[	1B	ESC
\	1C	FS
]	1D	GS
~	1E	RS
?	1F	US

6.5.9 Default Option

The SET SYSTEM DEFAULT <RETURN> command line sets all system, channel, and link options to their default values. The default values for each programming option are shown in Table 6-4.

When channel type is changed to switched, synchronous, or DDCMP for the first time, options for these channel types are at their default values.

Table 6-4 Option Default Values

SYSTEM OPTIONS	DEFAULT
Name	NONE
Type	MASTER
Configuration	VALID
Autodisconnect	20
SW-Data Parity (DATAPAR)	8-NONE
SW-Stopbits	1
SW-Signals	ASSERT
Command Character (COMCHAR)	1C1C
LINK OPTIONS	
Speed	SYNC
Delay	NORMAL
CHANNEL OPTIONS	
Type	ASYNC
L-Speed	1200
R-Speed	1200
L-Flow	NONE
R-Flow	NONE
Data-Parity (DATA-PAR)	8-NONE
Stopbits	1
Signals	ASSERT
Fillcharacter	ZERO
Priority	NORMAL
Echo	NONE
Messages	NONE
Command Terminal (COMTERM)	NONE
Command Echo (COMECHO)	NONE

Table 6-4 Option Default Values (Cont)

	DEFAULT
SWITCHED CHANNEL OPTIONS	
Speed	1200
Flow	NONE
Signals	NONE
Fill Character	ZERO
Priority	NORMAL
Echo	DISABLED
Messages	DISABLED
Command Terminal (COMTERM)	DISABLED
Command Echo (COMECHO)	DISABLED
Channel ID	A
Group Access	A
Autodisconnect	DISABLED
DDCMP CHANNEL OPTIONS	
Speed	EXT1200
Flow Control	NONE
Synfill Characters	6
SYNCHRONOUS CHANNEL OPTIONS	
Speed	EXT1200
Flow Control	NONE
Blocksize	512

6.6 SETTING LINK OPTIONS
This section details each link option.

6.6.1 Link Speed Option

Values: SYNC or ASYNC

Default: SYNC

Sync is the required setting for this option when the DFM unit is connected to synchronous modems (either the integral modem module or external synchronous modems). This setting permits link speeds up to 19.2K bits/s to be clocked by the connected modem.

The async setting is required when the units are either directly connected (using a BA22L cable) or connected via asynchronous modems. This setting allows the DFM unit to operate only at 9600 bits/s asynchronous (NRZI) speed (the DFM unit supplies the clock).

Link parameters are displayed with the SHOW LINK command. When set to sync, either the detected speed or the fact that "no clock" has been detected is displayed. "No clock" indicates that either the DFM unit is not properly connected to the modem, or that the modem is malfunctioning.

6.6.2 Link Delay Option

Values: NORMAL or SATELLITE

Default: NORMAL

If the DFM network is to utilize a satellite link, this option must be set to satellite. Satellite links have longer delay times than normal land links. This must be expected by the DFM unit or it will initiate retransmission of data that is not acknowledged within the normal timeout period.

> **NOTE**
> A satellite link may not be used if a
> DFM unit containing software level 1.0
> is to be connected to a unit with a
> later software release.

6.7 IMPORTANT CHANNEL CONSIDERATIONS

Before describing channel options, it is important to discuss some major factors associated with channel configuration. Channel signals and flow control option settings, as well as considerations for connecting modems to DFM channels, merit particular attention.

6.7.1 EIA Signals on DFM Channels

The setting for the channel signals option determines whether EIA signals are asserted or relayed between channel ends. Signals should be asserted unless there is a particular reason why signals must be relayed to the other channel end.

For asynchronous channels, setting the signals option to assert causes the DFM unit to constantly assert CAR, DSR, and CTS to devices connected to the channel. In addition to assert, switched channels may be set to assert*. This causes CAR, DSR, and CTS to be dropped briefly when a switching disconnection occurs.

If there is a special CPU function that is associated with a change in EIA signals, it may be necessary to relay EIA signal changes from one end to the other. This is accomplished by setting the signals option to pass. DIGITAL computers typically do not have such special functions.

EIA signals are always asserted on synchronous channels.

6.7.2 Connecting Modems to DFM Channels

When a channel port is connected to a modem (either point-to-point or dial-up), a "crossover" cable must be used. Various types of modems have different strapping options recommended for optimum performance when connected to a multiplexer. Check manufacturer's documentation for additional installation requirements.

When dedicated (not dial-up) modems are used, the recommended setting for the signals option is assert for asynchronous channels and assert* for switched channels. Synchronous channels do not have a signals option; carrier, data set ready, and clear to send are always asserted to devices connected to synchronous channels.

When dial-up modems are connected to either asynchronous or switched channels, either the CPU or the DFM unit can manage the dial-up handshake and establish communication with the connected device. When the signals option is set to pass, EIA signals are relayed between the modem and CPU and the computer handles the handshake sequence.

The DFM unit works most efficiently when it handles the dial-up handshake. This allows the unit to flush channel buffers and keep track of channel status, as well as disconnect a switched channel connection between DFM units when a hangup occurs.

For the DFM unit to manage the dial-up handshake on an asynchronous channel, the signals option must be set to either R-dial or L-dial. These values correspond to either the local or remote DFM unit, and indicate only a point of reference with respect to the unit being programmed. For example, if programming the local unit, and the remote unit is connected to the modem, then R-dial is the appropriate setting. If the unit connected to the modem is being programmed, then L-dial must be used. Only the unit connected to the modem can handle the handshake sequence.

Switched channel ends may be set to either dial or dial* for the DFM unit to handle the handshake with the connected dial-up modem. Dial* permits a modem connected to a DFM channel to initiate an outgoing call.

Since terminals connected via dial-up modems can transmit at any speed up to that of the modems, terminal speed in dial-up applications may be an uncertainty. The channel speed setting of "autobaud" allows the DFM unit to automatically adjust to the speed of a connected terminal by sensing the data rate of the first character received (expected to be a RETURN).

Autobaud may be utilized whether the DFM unit or the host computer handles the dial-up handshake.

6.7.3 Flow Control on DFM Channels

The sum of the data rates of the external devices attached to a DFM unit usually exceeds the data rate of the concentrated link. Inherent in this situation is the possibility of buffer overflow and the resultant data loss when heavy use occurs over an extended period of time. Although the DFM unit can buffer bursts of heavy traffic, sustained heavy loads can result in buffer overflow and loss of data.

Buffer overflow is prevented (without increasing the speed of the concentrated link) by the use of flow control. DFM flow control signals the connected terminal or CPU to stop sending data when buffer space available for that channel approaches capacity. When channel buffer space is available, a signal is issued to resume sending data.

Terminal devices also stop and start the flow of data. Flow control is used most often by CRTs and printers that cannot receive data as fast as the host computer can transmit it. If the host computer is busy running a program, it may not be able to accept data for a few moments and must also be able to control the flow of data.

DFM flow control selections for channel ends must be set to a convention that the connected device can recognize. For asynchronous and switched channels, local flow and remote flow are programmed independently and may be set to different values.

There are two basic types of flow control:

- In-band
- Out-of-band

The "in-band" types work by inserting special characters into the data stream (for example, X-ON X-OFF). This type of flow control is generally used with all DIGITAL computers and terminals.

The "out-of-band" types work by raising or lowering the voltage on selected EIA pin connections. This type of flow control is primarily used with non-DIGITAL equipment.

Table 6-5 shows which category each of the DFM flow control selections fit into.

Table 6-5   DFM Flow Control Selections

OUT-OF-BAND	IN-BAND
Async/Switched:	Async/Switched:
DSR-DTR	XON*-B
CTS-RTS	XON-B
CTSH-RLSH	
CTSH-RLSL	
CTSL-RLSH	Async/Switched Asymmetric:
CTSL-RLSL	
	XON*-C
Sync/DDCMP:	XON*-T
	XON-C
CTS-RTS	XON-T

6.7.3.1 Out-of-Band Flow Control -- For DSR-DTR flow control, the DFM unit raises DSR when data can be received, and expects to see DTR high on a channel when the terminal can accept data.

CTS flow controls include CTS-RTS (for synchronous channels) and CTS(x)-RLS(x) for asynchronous and switched channels. For both types, CTS is the signal output by the DFM unit. With CTS-RTS, the DFM unit raises CTS when data can be received, and expects the synchronous device to have RTS raised when it can receive data.

CTS(x)-RLS(x) flow control types use CTS (clear to send) for the DFM unit to signal terminals and RLS (reverse carrier) for terminals to signal the DFM unit.

CTS(x)-RLS(x) flow control names define the send data (as opposed to stop data) conventions. For example, CTSH-RLSH indicates that the DFM unit has CTS high when data can be received (thus lower it for data to be stopped), and expects the terminal will have reverse carrier high when it can receive data.   CTSH-RLSL indicates that the DFM unit has CTS high when data can be received, and expects the terminal to have RLS low when it can receive data.

The total CTS(x)-RLS(x) set of flow controls consists of:

CTSH-RLSH	CTSH-RLSL
CTSL-RLSH	CTSL-RLSL

Appendix E covers the pin assignments for each of the EIA signals, for the link as well as DFM channels.

6.7.3.2 In-Band Flow Control -- The XON-B type flow control must be set the same for both ends. XON-B type flow control may be used with switched or asynchronous channels connected either to a terminal or computer port. This type of flow control is sufficient for most applications. XON-B causes the DFM unit to act on received XON and XOFF characters from channel devices. XON-B type flow control generates XON and XOFF characters to channel devices when appropriate.

The XON-C and XON-T flow controls are used when it is necessary to have different flow control settings for terminal and computer channel ends. The "C" denotes connections to computers and the "T" is for connections to terminals. These types of flow controls should be used only as required by the manufacturer's recommendations. The matrix chart of Table 6-6 shows when certain types of flow controls would be used with what types of equipment.

With XON-C, the DFM unit generates an XON or XOFF to the computer, but does not respond to either of these characters coming from the computer.

With XON-T, the DFM unit does not send an XON or XOFF to the terminal device, but acts on these characters when received from the terminal device.

All XON flow control types send a DC1 (11 hex) for XON and a DC3 (13 hex) for XOFF.

The XON* type of flow control provides periodically an automatic transmission of XON to "prompt" the attached device in case it missed an initial XON. The XON* flow control also provides an automatic retransmission of XOFF after the initial XON if it continues to receive data.

Note that XON* selections are NOT desirable in some applications. Problems may occur in applications where a channel device either autobauds on the first character received (expected to be a CR) or initiates other functions, expecting data to immediately follow an XON.

Table 6-6   DFM Flow Control Selection Chart

Channel Type	Terminal End Devices*	Terminal End Selection	DIGITAL Computer End Selection
Asynchronous or Switched	DIGITAL Asynchronous Terminals	XON-B or XON*-B	XON-B or XON*-B
	DIGITAL Personal Computers Emulating a Terminal	XON-B or XON*-B	XON-B or XON*-B
	DIGITAL Serial Printers	XON-T	XON-C
	Dial-Up Asynchronous Modems	XON-B	XON-B
	Tektronics Type Terminals	CTS-RTS	XON-B
Synchronous	Synchronous Terminals	CTS-RTS	CTS-RTS

* The DFM unit supports flow control for all DIGITAL computers acting as CPU end devices. For non-DIGITAL computers and terminals, see manufacturer's specifications.

6.8   SETTING CHANNEL OPTIONS

Each channel type has a unique set of other options. After channel types are explained below, options for each type of channel are explained separately beginning with Section 6.8.2.

6.8.1   Channel Type Option

Values: ASYNCHRONOUS, SWITCHED, SYNCHRONOUS, DDCMP, or UNUSED.

Default: ASYNCHRONOUS

The channel type option is used to program the DFM unit to support the communications protocol of devices connected to the selected channel. When a channel is changed from one type to another, execution of a RESTART command is recommended.

- Asynchronous Channels -- Asynchronous channels operate with asynchronous protocol, and are dedicated. That is, a device connected to Channel 1 on the local unit can only communicate with whatever device is connected to Channel 1 on the remote unit.

- Switched Channels -- Switched channels operate with asynchronous protocol, but can be connected to any other switched channel (via the CONNECT command, see Chapter 5). Switched channel ends are completely independent. Channel 1 on the local unit may be connected to any other channel on the local unit, as well as any channel on the remote unit. (See Channel ID/Group Access options; Section 6.8.3.10).

  The switched channel contention feature allows a limited number of computer ports or other terminal facilities to be shared among a variety of users. This enables, for example, a 16-channel unit to be connected to a unit with fewer ports.

  Channel contention operates on a first come, first served basis. For example, suppose Channel 1 on the local unit is to be connected to Channel 3 on the remote unit. If Channel 3 on the remote unit is already connected to another switched channel, the request is queued. If the request from Channel 1 is the first one queued, it will be connected as soon as the current connection on Channel 3 is terminated. Otherwise, it must wait until prior requests for connection are satisfied.

- Synchronous Channels -- Synchronous channels are defined as either DDCMP or synchronous channel types. DDCMP is Digital Equipment Corporation's proprietary protocol used with systems joined by DECnet facilities. Synchronous channel types support any type of synchronous communications protocol in a transparent manner. That is, the DFM unit does not look at or interpret data on the channel.

  In the absence of CTS-RTS flow control, synchronous channels operate full-duplex. CTS-RTS flow control selects half-duplex operation.

Since constant communication between devices is a part of most synchronous protocols, synchronous channels have a big impact on link utilization. Data rate calculations for the link must include 120% of the combined data rates for full-duplex synchronous channels. For DDCMP and half-duplex synchronous operation, the link calculations must include 50% of aggregate input.

Half-duplex operation is recommended whenever possible for synchronous (non-DDCMP) channel types. Half-duplex operation is selected by CTS-RTS flow control.

DFM handling of the DDCMP protocol eliminates the need for flow control or half-duplex operation. In DDCMP protocol, when the DFM unit detects an idle frame (no data present), it does not transmit it across the link. This saves concentrated link bandwidth for frames with data. The maximum blocksize that can be handled by the DFM unit on DDCMP channels is 4K bytes. For optimum performance, the DECnet setting of 576 bytes is recommended.

Synchronous channel load must be spread evenly among channel modules. The DFM unit can support synchronous or DDCMP operation only on two channels out of every four channel group (Channels 1 and 2, 5 and 6, 9 and 10, and 13 and 14). The load should still be spread as evenly as possible among these channels. For example, if 3 synchronous channels are required on a 12-channel unit, they should be assigned to Channels 1, 5, and 9.

Synchronous communications protocols typically include their own error detection and retransmission schemes. The DFM unit does not provide error correction on synchronous and DDCMP channel types.

Section 2.4.2 covers link speed calculations, including synchronous channel considerations.

● "Unused" Channels -- Channels not currently in use may be set to a channel type called unused. This prevents the channel from being serviced by the DFM unit, reduces system overhead, and improves service to the remaining channels. Channels may be changed from one of the other types to unused, and then back again, without losing original parameter settings.

6.8.2 Asynchronous Channel Options

6.8.2.1 Asynchronous Speed -- Asynchronous channel speed is set independently for either end with L-speed (local) and R-speed (remote) options.

Values: 50, 75, 110, 134.5, 150, 300, 600, 1200, 2400, 4800, 9600, Autobaud, Samebaud. **Split-Speeds:** 1200/75, 75/1200, 2400/150, 150/2400

Default: 1200

With the autobaud value, the DFM unit senses the speed of the first received character (expected to be a RETURN) and sets channel speed to the appropriate value. Data rates of 150, 300, 600, 1200, 2400, 4800, and 9600 bits/s can be sensed by autobaud.

The split-speed values allow a terminal to transmit and receive at different speeds. For example, the 75/1200 value sets the transmit speed to 75 bits/s and the receive speed to 1200 bits/s. Transmit speed is the first number in all split-speed values. A split-speed value at one end of a channel does not affect the speed setting for the other end.

The samebaud value for the speed option sets the speed of an asynchronous channel end to match the speed of the other end of the channel; it is usually (but not necessarily) used in conjunction with autobaud. The samebaud value can be used only at one end of an asynchronous channel.

6.8.2.2 Asynchronous Flow Control --

Values: NONE, DSR-DTR, CTS-RTS, CTSH-RLSH, CTSH-RLSL CTSL-RLSH, CTSL-RLSL, XON*-B, XON*-C, XON*-T, XON-B, XON-C, XON-T

Default: NONE

Considerations for channel flow control settings are covered in Section 6.7.3.

6.8.2.3 Asynchronous Data Parity --

Values: 8-NONE, 8-EVEN, 8-ODD, 7-NONE, 7-EVEN, 7-ODD, 6-NONE, 6-EVEN, 6-ODD, 5-NONE, 5-EVEN, 5-ODD.

Default: 8-NONE

Both character size and the type of parity used are selected with this option. The general format is n-NONE, n-EVEN, or n-ODD where n is the number of data bits in the character with even, odd, or no parity bit attached.

6.8.2.4 Asynchronous Stopbits --

Values: 1, 1.5, 2

Default: 1

The stopbits option selects the number of stopbits used in asynchronous communication. Equipment operating at 150 bits/s or less normally use 1.5 or 2 stopbits. For equipment operating at higher speeds, 1 stopbit is sufficient.

6.8.2.5 Asynchronous Signals --

Values: ASSERT, PASS, L-DIAL, R-DIAL, 2-DIAL

Default: ASSERT

> **NOTE**
> When a modem (either dial-up or dedicated) is connected to a DFM channel, a crossover cable (BC22M) must be used.

Refer to Section 6.7.1 for considerations of "EIA Signals on DFM Channels".

- ASSERT -- Carrier, data set ready, and clear to send are asserted continuously by the DFM unit. Other EIA signals are not relayed between channel ends. The DFM system operates most efficiently when it does not have to relay EIA signal changes. Assert is the recommended setting unless a dial-up modem is connected to the channel (see the dial values, below), or there is some other CPU function associated with EIA signal changes.

- PASS -- With the pass value, the DFM unit relays the toggling of all EIA signals between channel ends. This setting is recommended only in the situation where it is important to see an EIA transition at one end or the other. This is generally the case only if the host computer has a special function associated with an EIA signal transition, or if the operator wants the host computer to handle the dial-up handshake with a modem connected to a DFM channel.

- L-DIAL, R-DIAL, 2-DIAL -- These values enable the DFM unit to handle the dial-up handshake when an asynchronous channel is connected to a dial-up modem. "L", "R", and "2" correspond to the local, remote, or both ends of an asynchronous channel. This option must be set to the value that corresponds to the unit that is connected to the modem.

For example, if connected to the supervisory channel on the local unit, and the remote unit is connected to a dial-up modem, signals must be set to R-dial. If you are on the supervisory channel of the unit that is connected to the modem, the L-dial value is used. 2-dial is used in the event that both ends of an asynchronous channel are connected to dial-up modems.

Refer to Section 6.7.2 for more information on "Connecting Modems to DFM Channels".

6.8.2.6 Asynchronous Fillcharacter --

Values: 0 to 255

Default: 2

The fillcharacter option defines the number of null characters that are transmitted after a RETURN, before the DFM unit sends the next valid data.

Null characters following a RETURN provide a time period for the cursor or the print head on terminal devices to return to the starting point for the next line. Some of the older CRTs and printers require such a pause to prevent data loss between lines or page advances.

For the majority of newer devices, this option may be set to 0.

6.8.2.7 Asynchronous Priority --

Values: NORMAL, HIGH, LOW

Default: NORMAL

Channel settings for priority take effect only when the concentrated link between DFM units is backed up, that is, data is buffered and waiting to be sent across the link.

Each setting corresponds to the size of the frame (therefore, the amount of data) that can be sent at each channel's opportunity. Normal channel priority throughput is about three times that of low priority channels; high priority channels have about four times the throughput of low priority channels. A priority setting of "low" reduces link efficiency.

6.8.2.8 Asynchronous Echo --

Values: NONE, L-UNIT, R-UNIT or BOTH

Default: NONE

The ECHO option enables either the local, remote, or both DFM units to echo data characters back to terminals rather than the host computer. In some applications (that is, when a satellite link is used) it is desirable to let the DFM unit do the echoing because of the additional delay involved with CPU echo.

The general rule is to let the computer do the echoing of characters which assures that it is receiving the data. If both the CPU and DFM unit echo the character, it appears twice on the terminal screen.

6.8.2.9 Asynchronous Messages --

Values: LOCAL, REMOTE, BOTH, or NONE

Default: NONE

This option allows neither, either, or both ends of a channel to receive automatic system error messages, or messages that are broadcast from a command channel.

> CAUTION
> Error and broadcast messages must NOT be
> sent out on channel ends connected to
> intelligent devices. Unsolicited input
> to the host computer, personal compu-
> ters, or intelligent terminals may cause
> problems.

Table 6-7 is a list of automatic system alarm messages and their meanings.

Table 6-7 Alarm Messages

<108>**CONCENTRATED LINK JUST WENT DOWN
Link communication is interrupted, initialization to follow.

<109>**CONCENTRATED LINK IS DOWN
Notification to the dial-in user that the link is currently inoperable.

<110>**CONCENTRATED LINK NETWORK-READY PROBLEM
One of the following has occurred: no CTS on the link, no data received on the link, or transmit retries are failing. Also, NR LED blinks; Table 3-3 describes each problem.

<200>**MUX LOST DATA TO TERMINAL:FRAMING ERR
A framing error on an output character has occurred.

Table 6-7 Alarm Messages (Cont)

<201>**MUX LOST DATA TO TERMINAL:PARITY
A parity error occurred.

<202>**LOST DATA TO TERMINAL:BUF OVFL
One or more output characters are lost due to buffer overflow.

<203>**MUX LOST DATA TO TERMINAL:OVERRUN
One or more output characters are lost due to data overrun.

<204>**MUX LOST DATA FROM TERMINAL:FRAMING ERR
A framing error on an input character has occurred.

<205>**MUX LOST DATA FROM TERMINAL:PARITY
A parity error on an input character has occurred.

<206>**MUX LOST DATA FROM TERMINAL:BUF OVFL
One or more input characters are lost due to buffer overflow.

<207>**MUX LOST DATA FROM TERMINAL:OVERRUN
One or more input characters are lost due to data overrun.

<301>**PARAMETER STORAGE FAILURE
Parameter protect PP switch feature is engaged.

<302>**ERROR IN COMMAND, 'text-of-command': 'kind-of error'
The 'text-of-command' displays the incorrect command sent.

The 'kind-of-error' displays one of three possible messages;
"Locked" when the Parameter Protect switch is IN, "Conflict" when
the attempted command is incompatible with current configuration,
and "Value" when the value selected is not acceptable.

<311>**SYSTEM DEVICE-READY PROBLEM
One of the following is occurring: The NVROM is bad or disabled,
or both units are invalid, masters, or slaves. Also, DR LED
blinks; see Table 3-3.

6.8.2.10 Asynchronous Command Terminal (COMTERM) --

Values: LOCAL, REMOTE, BOTH, or NONE

Default: NONE

The COMTERM option enables a channel end to enter command mode.
Unless it is enabled for the appropriate channel end, command
character (COMCHAR) is not recognized when entered on the
terminal. (Refer to the system option of COMCHAR.)

6.8.2.11 Asynchronous Command Echo (COMECHO) --

Values: NONE, LOCAL, REMOTE, or BOTH

Default: NONE

This option enables the DFM unit to echo supervisory commands that are entered on a data channel so that they appear on the terminal screen. DFM echoing is not normally used for channels in data mode, but is necessary for input to the supervisory command handler. Self-echoing terminals do not need to use this option.

6.8.3 Switched Channel Options
Switched channel options are set separately for each channel end.

Switched channel data parity and stopbits options are set at the system level to ensure that all switched channel devices use the same data, parity, and stopbit parameters.

The signals option for all switched channels may be set simultaneously to either assert or pass under the system level option of SW-signals. Each switched channel also has a signals option that overrides the setting at the system level. At the channel level, additional values of dial and dial* may be entered to allow the channel end to handle the dial-up handshake with a connected modem. If the signals option at the channel level is left at the default value of NONE, the setting for the system SW-signals option takes effect.

6.8.3.1 Switched Speed --

Values: 50, 75, 110, 134.5, 150, 300, 600, 1200, 2400, 4800,
         9600, Autobaud.   Split-Speeds: 1200/75, 75/1200,
         2400/150, 150/2400

Default: 1200

The autobaud value is useful when a channel end is connected to a dial-up modem. The DFM unit senses the speed of the first received character (usually a RETURN) and sets channel end speed to the same value. Data rates of 150, 300, 600, 1200, 2400, 4800, and 9600 bits/s can be sensed when the autobaud value is in effect.

The split-speed values allow terminals to transmit and receive at different speeds. For example, the 75/1200 value sets the transmit speed to 75 bits/s and the receive speed to 1200 bits/s. Transmit speed is the first number in all split-speed values. A split-speed value at one end of a channel does not affect the speed setting for the other end.

6.8.3.2 Switched Flow Control --

Values: NONE, DSR-DTR, CTS-RTS, CTSH-RLSH, CTSH-RLSL, CTSL-RLSH, CTSL-RLSL, XON*-B, XON*-C, XON*-T, XON-B, XON-C, XON-T

Default: NONE

Considerations for channel flow control settings are covered in Section 6.7.3.

6.8.3.3 Switched Signals --

Values: NONE, PASS, ASSERT, ASSERT*, DIAL, DIAL*

Default: NONE

> **NOTE**
> Whenever a DFM port is connected to a
> modem (either dial-up or dedicated), a
> crossover cable (BC22M) must be used.

- **NONE** -- Outgoing signals are either passed or asserted, based on the value of the system SW-signals option.

- **ASSERT** -- The DFM unit outputs carrier, data set ready, and clear to send continuously on the switched channel end. Other EIA signals are not passed between channel ends of a switched connection. The DFM unit operates most efficiently when it does not have to relay EIA signal changes between ends. Assert is the recommended setting unless there is a particular reason to relay EIA signals between channel ends.

- **PASS** -- The DFM unit relays the toggling of EIA signals between channel ends. This setting is recommended only in the situation where it is important to see an EIA transition at either end (for example, there is a special CPU function that is associated with the toggling of an EIA signal, or if an operator wishes the CPU to handle the handshake with a dial-up modem connected to a remote DFM channel).

- **ASSERT*** -- Carrier, data set ready, and clear to send are always asserted, except when a switched channel connection between DFM units is terminated. When the disconnect occurs, these signals are dropped at both channel ends for four seconds. This feature can be utilized to cause a logoff on the CPU when a switched connection is terminated.

Also, in this mode, DTR is monitored. When DTR is dropped by the terminal or CPU at either end of a switched connection, the switched connection between units is terminated. Many CPU types can be set to lower DTR momentarily when a logout occurs. (On a VAX CPU, the SET TERM/MODEM/HANGUP command causes DTR to be dropped briefly on logout.)

This can be useful in applications where the DFM unit is used to contend for CPU ports or other resources. Since a logoff by a user disconnects the switched connection between DFM units, the resource connected to the DFM channel is released for use by another person. A terminal or personal computer also drops DTR when it is turned OFF, so this automatically terminates a switched connection.

- DIAL -- This value allows the DFM unit to perform the dial-up handshake with a connected modem, enabling the modem to answer a call when ring indicator is seen.

- DIAL*-- Dial* allows an outgoing call to be initiated by a modem that is connected to a DFM channel. If a modem with an autodial feature is used, dial* allows communications to be initiated by either a ring indicator on the modem (incoming call) or by connecting to the dial* channel from another switched channel (outgoing call). For incoming calls, the modem handshake is handled just as it is with the dial setting. Connecting to a dial* channel from another switched channel, however, causes DTR and RTS to be raised, which puts the modem on-line. Now, the modem can be instructed to dial an outgoing call. When a call is successful, and communication is established with another modem, the modem raises DSR and CAR. The DFM unit monitors these signals, and if they drop for more than five seconds (indicating that the modem has stopped communicating with the other modem), the switched connection is terminated and DTR and RTS are dropped, forcing the modem off-line.

If the modem is communicating with another modem, and the switched connection is terminated, the DFM unit drops RTS and DTR, which causes the modem to go off-line (hang up the phone line).

Although a channel speed setting of autobaud can be set on a dial* channel, it is not recommended because on an outgoing call autobaud cannot take place, and channel speed will be undetermined.

Additional information on EIA signal characteristics in dial, dial*, and assert* modes is found in Appendix E.

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RECOMMENDED SETTINGS FOR THE SIGNALS OPTION ON SWITCHED CHANNELS

The pass setting does not provide any of the DFM functions that are associated with the other settings of the signals option (for example, automatic logout at the CPU or automatic disconnection of a switching connection). For this reason, the pass setting is recommended only in applications where there is either a special CPU function associated with the toggling of an EIA signal, or an operator wishes the CPU to handle the dial-up handshake with a modem connected to the DFM unit.

When a switched channel end is connected to a DIGITAL CPU, (and especially when the DFM unit is used to contend for channel resources), the channel should be set to assert*. Only assert* provides automatic termination of switched channel connections upon logoff, as well as automatic logoff from the CPU upon disconnection of a switched channel connection.

When connected to a terminal or personal computer, the signals option may be set to either assert or assert*. Only assert* causes a switched channel connection to be automatically terminated when the terminal device is powered off. This in turn causes a logoff at the CPU.

When a switched channel end is connected to a modem with dial-out capabilities, it must be set to dial* to initiate an outgoing call. This setting also provides automatic hang-up on a switched channel disconnection, as well as automatic switched channel disconnection upon modem hang-up. If dialing into a channel set to dial*, only one switched connection can be made per phone call. This is because when the switched connection is terminated, the modem is forced off-line.

When connected to a modem that does not have dial-out capabilities, use the dial setting. This setting provides automatic disconnection upon hang-up, but the modem does not hang up the phone line when a switched channel connection is terminated.

6.8.3.4 Switched Fillcharacter --

Values: 0 to 255

Default: Zero

The fillcharacter option defines the number of null characters to be transmitted following a RETURN.

Null characters following a RETURN provide a time period for the cursor or the print head on terminal devices to return to the starting point for the next line. Some of the older CRTs and printers require such a pause to prevent data loss between lines or page advances.

For the majority of newer devices, this option may be set to 0.

6.8.3.5 Switched Priority --

Values: NORMAL, HIGH, LOW

Default: NORMAL

Channel settings for priority take effect only when the concentrated link between DFM units is backed up, that is, data is buffered and waiting to be sent across the link.

The various settings correspond to the size of the frame (therefore, the amount of data) that can be sent at each channel's opportunity. Normal channel priority throughput is about three times that of low priority channels; high priority channels have about four times the throughput of low priority channels. A priority setting of "low" reduces link efficiency.

6.8.3.6 Switched Echo --

Values: ENABLED, DISABLED

Default: DISABLED

When enabled, the echo option instructs the local DFM unit to echo data characters back to terminals. In some applications (that is, when a satellite link is used) it is desirable to let the DFM unit do the echoing because of the additional delay involved with CPU echo.

The general rule is to let the computer do the echoing of characters which assures that it is receiving the data. If both the CPU and DFM unit echo the character, it appears twice on the terminal screen.

6.8.3.7 Switched Messages --

Values: ENABLED, DISABLED

Default: DISABLED

This option enables a channel device to receive automatic system error messages, or messages that are broadcast from a command channel.

> CAUTION
> Error and broadcast messages must NOT be
> sent out on channel ends connected to
> intelligent devices. Unsolicited input
> to the host computer, personal compu-
> ters, or intelligent terminals may cause
> problems.

A list of alarm messages and their meanings is listed in Table 6-7.

6.8.3.8 Switched Command Terminal (COMTERM) --

Values: ENABLED, DISABLED

Default: DISABLED

The COMTERM option enables a channel end to enter command mode. Unless this option is set enabled for a particular channel, the command character sequence (COMCHAR) is not recognized when entered on the terminal, and the data channel cannot enter command mode.

<div align="center">

CAUTION

Select a combination of one or two characters that are NOT likely to be transmitted as part of any data message because it will inadvertently place the channel in command mode.

</div>

6.8.3.9 Switched Command Echo (COMECHO) --

Values: ENABLED, DISABLED

Default: DISABLED

This option allows the DFM unit to echo commands so that they appear on the terminal screen as they are entered. DFM echoing is not normally used for channels in data mode, but is necessary for input to the supervisory command handler. Self-echoing terminals do not need to use this option.

6.8.3.10 Switched Channel ID/Group Access --

ID Values: Any single letter.

Group Access Values: Any combination of channel IDs.

Default (for both): A

Switched channel ends are assigned a channel ID, which is a letter, and a group access value, which is a combination of other channel IDs. The group access value for a channel specifies the IDs of other channels that it can be connected to. A "group" is formed when more than one channel end is assigned the same ID.

For example, suppose the local end of Channel 1 has a channel ID of C and a group access of AXY. This means that it can be connected only to channels that have an ID of A, X, or Y. Other channels wishing to connect to the local end of Channel 1 must have the letter C in their group access values.

"A" is the default setting for both the ID and group access options for all switched channels. This means that any switched channel can be connected to any other channel because they are all in the same group.

A group is formed by assigning the same ID (letter) to more than one channel end. It is appropriate, therefore, to assign the same ID to all channels that access the same facilities. For example, assume four channel ends are connected to a microcomputer that contains all the accounting information. If only these four channel ends are assigned to group A, then whenever a user needs to access accounting information, all that needs to be entered is "CONNECT A". If all channels in group A are busy, the request is queued until any one of the channels is disconnected.

In the above example, the channel end that wishes to be connected to group A must have the letter A in its group access assignment or the connection will be denied. In this way, groups of channels that are connected to certain facilities are protected from being accessed by an unauthorized user.

Each group can also be assigned a "name", which is a five-character descriptive title for the group (for example, A = ACCTG). Group names are assigned with the SET command. They are useful because the DFM unit prompts with group IDs and names (for identification purposes) when a CONNECT command is entered.

EXAMPLE 6-4: SETTING GROUP ID/ACCESS

Command Input: SYS> set chann 1 local id b <RETURN>

Unit Response: Parameter Saved.

Command Input: SYS> set channel 1 local groupaccess abc <RETURN>

Unit Response: Parameter Saved.

Local Channel 1 can now access any other switched channel that has an ID of A, B, or C. For any other channel to access local Channel 1, the letter B must appear in its group access assignment.

In Example 6-5, a group is defined by setting the IDs of several channel ends to the same value. The group is then assigned a name, and the use of the name is illustrated.

EXAMPLE 6-5: ASSIGNING GROUP NAME

Command Input: SYS> set channel 1 local id e <RETURN>

Unit Response: Parameter Saved.

Command Input: SYS> set channel 2 local id e <RETURN>

Unit Response: Parameter Saved.

Command Input: SYS> set group e eng-1 <RETURN>

Unit Response: Parameter Saved.

Channels 1 and 2 are now in group E, and the group has been
assigned the name "ENG-1" (that is, "engineering one"). Group
names are listed when:

- A CONNECT command, followed by a RETURN is entered on a
  switched channel in command mode:

  SEL> connect <RETURN>
  Valid Entries: <A to Z> <1 - 16> (or ^Y)

          A = ACCTG
          E = ENG-1

- From the supervisory channel, a CONNECT command is not
  completed:

  SYS> connect 1 local <RETURN>
  Valid Entries: <A to Z> <1 - 16> (or ^Y)

          A = ACCTG
          E = ENG-1

- A SHOW GROUP command is entered on a supervisory channel:

  SYS> show group <RETURN>

  Current Group Names are:

          A = ACCTG
          E = ENG-1

6.8.3.11 Switched Automatic Disconnect (AUTODISC) --

Values: ENABLED or DISABLED

Default: DISABLED

When enabled for a switched channel end, this option permits the current switched connection to be automatically disconnected if there has been no activity for a specified time period. The timeout period is the same for all switched channels, and is defined by the system level AUTODISC option.

6.8.4 Synchronous and DDCMP Channel Options
There are three types of synchronous channel operation:

- Synchronous CTS-RTS Mode
- Synchronous Bandsplit Mode
- DDCMP Mode

"Synchronous" channel types can support any type of synchronous protocol. With CTS-RTS flow control, synchronous channels operate in half-duplex mode.

When no flow control is selected for a synchronous channel, it operates in full-duplex "bandsplit" mode.

"DDCMP" channel types support Digital Equipment Corporation's proprietary synchronous protocol (DDCMP), used primarily by systems connected with DECnet facilities. The maximum blocksize that can be handled by the DFM unit on DDCMP channels is 4K bytes. For optimum performance, a blocksize of 576 bytes (as a DECnet parameter) is recommended.

Synchronous channel types have a large impact on the determination of link speed. For information on this and other important synchronous channel considerations, refer to Section 6.8.1 (channel type option).

6.8.4.1 Synchronous Speed -- Speed is set independently for either end of synchronous channels with L-speed and R-speed options.

Values: INT1200, INT1800, INT2400, INT4800, INT7200, INT9600,
         EXT1200, EXT1800, EXT2400, EXT4800, EXT7200, EXT9600

Default: EXT1200

INT and EXT preceding each speed indicate either internal or external clocking.

External settings are for synchronous or DDCMP channels connected to modems or self-clocking terminals. Indicate the speed of the device that is to be connected.

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With internal speed settings, the DFM unit provides clocking for the channel. When terminals without self-clocking are connected directly to the DFM unit, channel speed must be clocked by the DFM unit.

6.8.4.2 Synchronous Flow Control --

Values: NONE, CTS-RTS

Default: NONE

CTS-RTS flow control for a synchronous channel selects half-duplex (one direction at a time) operation. Due to link bandwidth considerations, half-duplex operation for synchronous channels is recommended whenever possible.

Refer to Section 6.8.1 (channel type option) for more information on link speed and other considerations for synchronous channels.

6.8.4.3 Synchronous Blocksize -- This option applies to non-DDCMP channels only.

Values: 512, 1024, 2048, 4096

Default: 512

This option informs the DFM unit of the size of data blocks to be used by the synchronous protocol on the selected channel.

6.8.4.4 Synchronous SYNFILL -- Applies to DDCMP channels only.

Values: 2, 4, or 6

Default: 6

This option selects the number of sync characters that will precede each block of data transmitted on DDCMP channels. The recommended setting is 6.

7.1 GENERAL

This chapter provides a systematic approach of using the various test features of the DFM unit and associated modems to isolate problems with the hardware or telephone facilities.

The DFM unit provides two commands (see Chapter 5) to aid in the troubleshooting process:

- The MONITOR command is available to provide a variety of statistics concerning system, channel, and link conditions. From these statistics and reports, certain decisions can be made as to the next logical step or corrective action.

- The TEST command is provided to allow a variety of channel and link tests to determine if data transmissions are clean or contain errors.

The DFM unit also has two maintenance pushbutton switches located on the control module. These switches allow a limited set of tests to be executed manually should the supervisory channel be unavailable or inoperative. See Table 3-2 for a description of the use of these two switches. Refer to Tables 3-6 and 3-7 for descriptions of modem controls and indicators.

There are a number of places in a communications system where a problem can occur that will either cause numerous errors (SA and/or RA LEDs on control module blinking frequently) or cause communication to fail entirely (NR LED not ON). Problems occur when:

- One of the modem modules may be malfunctioning.

- One of the control modules may be malfunctioning.

- The quality of the telephone line connecting the units may have degraded.

- There may be an incompatibility in the operating parameters of the two units (that is, link speed or system type).

When experiencing trouble with the system (numerous errors or the NR LED not ON), make sure that no switches are IN except for those that control modem speed (high speed or fallback).

Next, check the CD LEDs. There are two on each unit; one on the modem module and one on the control module. If none of the CD LEDs are ON, the fault is most likely in one of the modems or in the telephone line (refer to the section 7.4.1).

If the control module CD is not ON in one unit, the fault is most likely in that DFM unit).

Basically, troubleshooting the DFM unit can be divided into two areas; channel and link.

Channel considerations are:

- DFM channel input/output (I/O) circuits

- Channel cables and connections

- Channel devices (terminals, CPUs, printers, modems, and so forth)

Link considerations are:

- DFM link I/O circuits

- Link modes (integral and standalone)

- Link cables and connections

- Telephone lines

Whenever a problem is experienced, it is very important to document all of the circumstances and symptoms concerning the problem. If it should become necessary to consult with a DIGITAL Field Engineer, a history of the type and sequence of problems experienced allows Field Service personnel to get a better idea of where to begin.

7.2 AUTOMATIC SELF-TESTS
Automatic self-tests check hardware components that are not a part of the channel or link circuits. Special LED error codes identify the failure and location.

DFM self-testing occurs whenever the units are either "reset" or "reinitialized".

Units are reset when:

- Power is applied to the unit,

- The TEST SYSTEM POWERUP command is issued, or

- The System Reset switch (SR) is pressed.

Units are reinitialized when:

- The current setting for system type or configuration, as well as link speed or delay, is changed, or

- The RESTART command is executed, or

- The link is lost for a period of greater than one minute.

System reset executes the full self-test diagnostic. All buffers are cleared, all counters set back to zero, and the logon state of the supervisory channel is cleared (it is necessary to log back onto the supervisory channel).

System reinitialization is primarily a resynchronization of units and executes only a limited set of self-test diagnostics. Channel counters and buffers are cleared, but link counters and the supervisory channel logon state are retained.

Down-line loading of channel parameters occurs with both system reset and reinitialization. When reset and reinitialization are complete, control module LEDs indicate system status.

The following is a summary of initial system conditions and LED status associated with the self-test. Disregard modem indicators during self-test. Modem indicators are only significant in LBACK testing.

Condition   Control Module LED Status

                                   SD   RD   CD   SA   RA   CE   NR   DR

Condition	SD	RD	CD	SA	RA	CE	NR	DR
DFM does not pass self-test ①	X	X	O	X	X	X	O	O
DFM passes self-test, link not connected ②	O	O	O	O	X	O	O	●
DFM units connected, link not operational ③	O	O	☼	O	O	O	☼	O
DFM units connected, link operational ④	O	O	●	O	O	O	●	●

Legend

X   =   Don't Care (ON or OFF)

O   =   OFF

●   =   ON

☼   =   Blinking

NOTES

① Refer to Section 7.3 for additional LED status indications.

② If a cable is installed to either connector J18 or J19, check cables and/or connections. Install cable if necessary.

③ Refer to link testing, Section 7.4

④ Even if the link is operational, data transmissions could still experience errors. Refer to Section 7.4 for link testing.

7.3 DFM UNIT FAILS AUTOMATIC SELF-TEST

When the self-test is completed, the DR LED will come ON indicating that the DFM unit passed the tests. If the DR LED does not come ON when the test appears to be finished (about 15 seconds), then the DFM unit has failed the self-test. When this happens, other LEDs on the control module and channel module(s) light to indicate a certain type of failure, as explained below.

The DFM automatic self-test routine checks the control module memory first. If a problem is detected in the memory test, one of the following LED status conditions will be displayed for a period of about five seconds, and then the unit will try again until this series of test is passed. No other LEDs on any other modules should be ON if a memory failure occurs. Automatic self-tests cannot continue until memory error conditions are cleared.

The bottom two LEDs on the control module (labeled NR and DR) are used to display memory error status as indicated below.

Condition	Control Module LED Status							
	SD	RD	CD	SA	RA	CE	NR	DR
Problem with RAM autosize	O	O	O	O	O	O	O	O
Problem with ROM checksum	O	O	O	O	O	O	●	O
Problem with host memory	O	O	O	O	O	O	●	●

Legend

O = OFF

● = ON

After memory tests pass, the control module continues with the rest of the automatic self-tests. The bottom two LEDs (NR and DR) stay ON throughout the rest of these tests. As the units continue the tests, the front panel LEDs light in a particular sequence, (indicating which test is being run), and stay lit (indicating the test has been passed) according to the following list. The LEDs light from the bottom to the top. If an error is detected, the sequence stops and all LEDs lit to that point flash. The last flashing LED indicates the nature of the failure according to the descriptions below.

SD	O	Stays on during diagnostics
RD	O	Unused (off)
CD	O	Hardware configuration (memory or SCCs)
SA	O	Host SCC
RA	O	DMA (host)
CE	O	Host interrupts/timer
NR	O	Stays on during diagnostics
DR	O	Stays on during diagnostics

The channel line module LEDs also play a part in reporting self-test diagnostic failures. During self-test, these LEDs perform a sequence of ON/OFF conditions (simultaneously for two channel modules) from the bottom up to the top.

The Channel 3 activity LED corresponds to a point in the diagnostic routine where expansion memory is tested. At this point, all eight LEDs go through another cycle where the Expansion Board Memory Test Code (next page) applies.

After the expansion memory is checked, the LEDs are again interpreted by the Expansion Board Test Code listed below. Errors are indicated by the code flashing ON and OFF rapidly. The last LED lit indicates which test has detected the error.

Expansion Board Test Code

C1	O	The top two LEDs designate the board number: C2 lit
C2	O	for Channel board No. 1; C1 and C2 lit for Channel board No. 2
C3	O	Unused (off)
C4	O	Expansion memory
C5	O	[The bottom four LEDs apply to expansion SCCs
C6	O	Note: As long as one SCC in board No. 1 is
C7	O	operational, the unit can function and will come up.
C8	O	These LEDs indicate how many SCCs are functioning.]

Expansion Board Memory Test Code

The various expansion memory tests check hardware integrity of the related data and addressing lines in the following manner.

C1	O	Off
C2	O	Walking 0s
C3	O	Walking 1s
C4	O	Addressing, high
C5	O	Too low
C6	O	Addressing, low
C7	O	Too high
C8	O	On

If the automatic (power-up) self-test appears to be failing, repeat it by pressing the System Reset (SR) switch.

Failure of this self-test cycle is a fatal error for the DFM unit. If it continues to fail, DIGITAL Field Service must be called.

7.4 LINK OR CHANNEL COMPONENTS

When a problem occurs, the first thing is to determine whether link or channel hardware (or configuration) is causing problems. If the DR (device ready), CD (carrier detect), and NR (network ready) LEDs are ON (not blinking), then the link is operational. Even though the link may be operational, however, there still could be other link problems such as data errors. It is important that problems with the link be eliminated before proceeding to Channel Troubleshooting.

The status of the DR, CD, and NR control module indicators can give some indication of a link problem.

- Blinking DR indicator -- If the DR LED is blinking after the unit has passed power-up, it is due to one of the following:

    -- Both units are set to type = master or type = slave,

    -- Both units set to INVALID,

    -- NVROM defaulted due to data storage failure (all parameters for system, channel, and link are set to default values due to an error in writing to nonvolatile read only memory).

- CD indicator OFF -- When the link speed is set to async, the carrier signal is generated by the DFM unit. If synchronous modems are used in the concentrated link, link speed must be clocked by the modem. This means that link speed must be set to sync. When link speed is set to sync, the modem must generate the carrier signal. If the link speed is set properly, a lack of carrier indication (CD OFF) is probably due to one of the following:

    -- A loose, broken, or dirty connector,
    -- A malfunctioning modem,
    -- A bad telephone line.

    After cables, connectors, or other obvious possibilities are checked, isolate the telephone line from the modems. This can be accomplished by systematic use of the LBACK test as described in Section 7.4.1.

- NR indicator OFF -- The most common cause of failure to obtain LINK READY is an improper configuration of link speeds. When synchronous modems are used, the link should be set to sync. When asynchronous modems are used, or the BC22L cable is used, or the DFM unit is used as a local data switching device, the link should be set to async.

    If link speed configuration is not the problem, one of the link components is failing.

7.4.1 Isolating and Testing Link Components

The LBACK (Link Loopback) test is used to determine the performance of the concentrated link by determining the number and type of errors that occur. A data pattern is generated and checked by the local unit after it is looped back by the remote DFM unit. Test results show figures for transmit, receive, or linkdrop errors. Normal data traffic must be discontinued while running the LBACK test.

The LBACK test can be used to check the entire link or parts of the link by placing the modems in different modes of loopback. Modem loopback capabilities differ from modem to modem. Table 7-1 provides a matrix of loopback features associated with the recommended modems from Digital Equipment Corporation. For other modems, refer to manufacturer's documentation for loopback features. Obviously, if a particular loopback feature is not available, then some of the various loopback tests described in this section may not apply.

Table 7-1   Link Modem Loopback Test Matrix

Test Function	DF124	DF126	DF127 ①	DF129 ①
Analog Loopback	X	X	X	X
Analog Loopback Self-Test	X	X	X	X
Digital Loopback			X ②	X ②
Digital Loopback Self-Test			X ②	X ②
Remote Digital Loopback	X	X ③	X	X
Remote Digital Loopback Self-Test	X	X ③	X	X
End-to-End Self-Test	X	X	X	X

① Has special unidirectional/bidirectional loopback feature.

② Not local digital loopback, but a variation of remote digital loopback.

③ Available with private line configurations only.

The test pattern generated during the LBACK test may be looped back to the originating DFM unit by one of the following ways.

1. Remote DFM.

2. Remote modem in loopback mode.

3. Local modem in loopback mode.

4. Special loopback test cable.

As an alternate to using the LBACK test pattern, most modems have a self-test feature that allows the modem to supply the test pattern. In any case, after testing is completed, the SR switch on the control module should be pushed to reset the multiplexer. This is necessary to resume normal operation.

Link loopback testing generally isolates most problems. The Link Signals test described in Section 7.4.1.8 is rarely needed. The Link Signals test also requires the use of a special cable which is not provided as a standard item and, therefore, must be fabricated as specified in Section C.6.

7.4.1.1 End-to-End LBACK Test -- This procedure checks the entire link facility at full capacity (see figure 7-1). statistics on the number and type of errors that are detected are returned to the supervisory terminal when the test is initiated from the supervisory channel.

The remote multiplexer automatically responds to a LINKLOOP test that is generated at the local multiplexer.
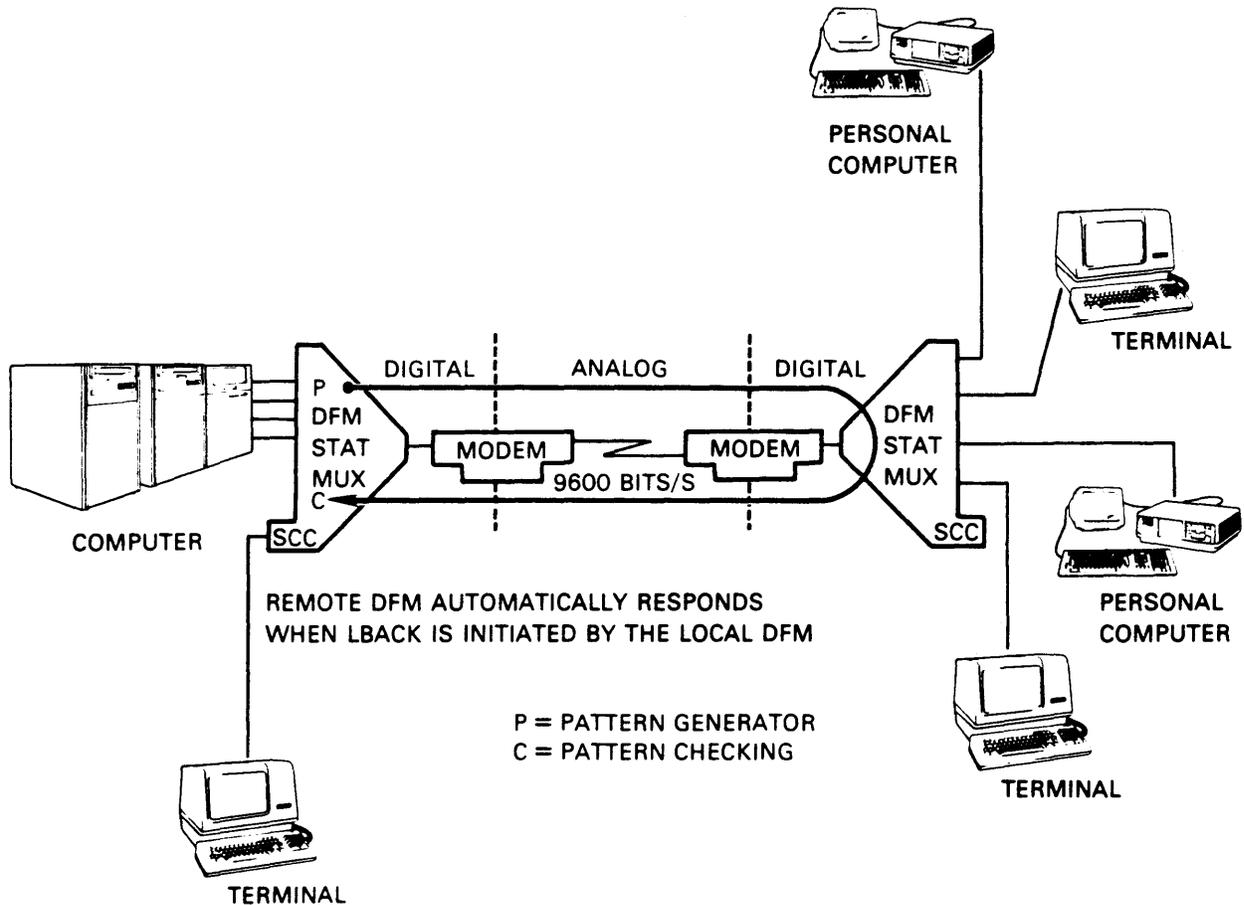
MKV85-2015

Figure 7-1   End-to-End Link Loop Configuration

The LBACK test pattern may be initiated in two ways:

- From the supervisory channel (as described in Example 7-1).

- From the front of the control module by pressing IN the M1 and M2 switches, and then pressing the SR switch.

Execute the LBACK test from the supervisory channel. Indicators should be as shown below when the LBACK test is initiated from the supervisory channel. Modem module indicators vary depending on the module used and whether local or remote. The chart below shows all four recommended modem modules. Errors are reported to the supervisory terminal as shown in Example 7-1.

When manual LBACK test is used (control module switches M1 and M2 pressed IN), indicator status is slightly different than shown below. The NR indicator on the control module where the manual test is initiated is OFF. Errors are indicated by blinking SA or RA instead of being displayed at the terminal.

Also, the FB indicator on DF127/DF129 modem modules will be ON and the HS indicator on the DF124 modem will be OFF if the tests are executed at the lower speed(s).

Control Module	SD	RD	CD	SA	RA	CE	NR	DR
Local	☀	☀	●	X	X	X	●	●
Remote	☀	☀	●	X	X	X	●	●

DF124 Modem Module	SD	RD	CD	TR	MR	OH	HS	TM
Local	☀	☀	●	●	●	O	●	O
Remote	☀	☀	●	●	●	O	●	O

DF126 Modem Module	SD	RD	CD	TR	MR	CS	RS	TM
Local	☀	☀	●	●	●	●	●	O
Remote	☀	☀	●	●	●	●	●	O

DF127/DF129 Modem Module	SD	RD	CD	CS	RS	SQ	FB	TM
Local	☀	☀	●	●	●	X	X	O
Remote	☀	☀	●	●	●	X	X	O

Legend

X   =   Don't Care (ON or OFF)

O   =   OFF

●   =   ON

☀   =   ON or Blinking

EXAMPLE 7-1: RUNNING LBACK FROM THE SUPERVISORY CHANNEL

The LBACK test runs continuously, until terminated. The DFM unit samples the test data periodically and sends the following messages indicating test results.

Command Input: SYS> test link lback <RET>

Unit Response: Test Initiated.

(response with no errors)

```
    TEST LINK LBACK>
    (12-1-83  12:41) LINK 1 LBACK: NO ERRORS
```

(as errors occur)

```
    TEST LINK LBACK>
    (12-1-83   12:42) LINK 1 LBACK:TRANSMIT  29/2%  RECEIVE  12/1%
    LINKDROP=0

    TEST LINK LBACK>
    (12-1-83   12:43) LINK 1 LBACK:TRANSMIT  40/4%  RECEIVE  12/1%
    LINKDROP=0

    TEST LINK LBACK>
    (12-1-83   12:44) LINK 1 LBACK:TRANSMIT  40/2%  RECEIVE  12/1%
    LINKDROP=1
```

Errors are counted from the beginning of the test. In this example, the first report indicates that 29 transmit errors were detected, which represents 2% of the test data transmitted at that time. The second report indicates that 40 transmit errors were detected, which is 4% of the test data transmitted at that time. The third report shows that no additional errors were detected since the last report, so the percentage of errors for the amount of test data sent dropped to 2%. The third report also shows that a linkdrop was detected, that is, the link connection was momentarily lost. The information on received test data is interpreted the same way.

The LBACK test is terminated by pressing RETURN.

7.4.1.2 Remote Modem Digital Loopback (Using DFM Pattern) -- This test removes the remote multiplexer from the test circuit (see Figure 7-2).

The first step is to put the remote modem into digital loopback mode. This can be accomplished by pressing the RL switch IN on the local modem. Pressing RL causes the system to reinitialize (about 45 seconds).

After reinitialization, the LBACK test is initiated at the local DFM unit by using either the TEST command at the supervisory channel as in Example 7-1, or using the manual feature (M1 and M2). The following indications should be displayed on the LEDs.
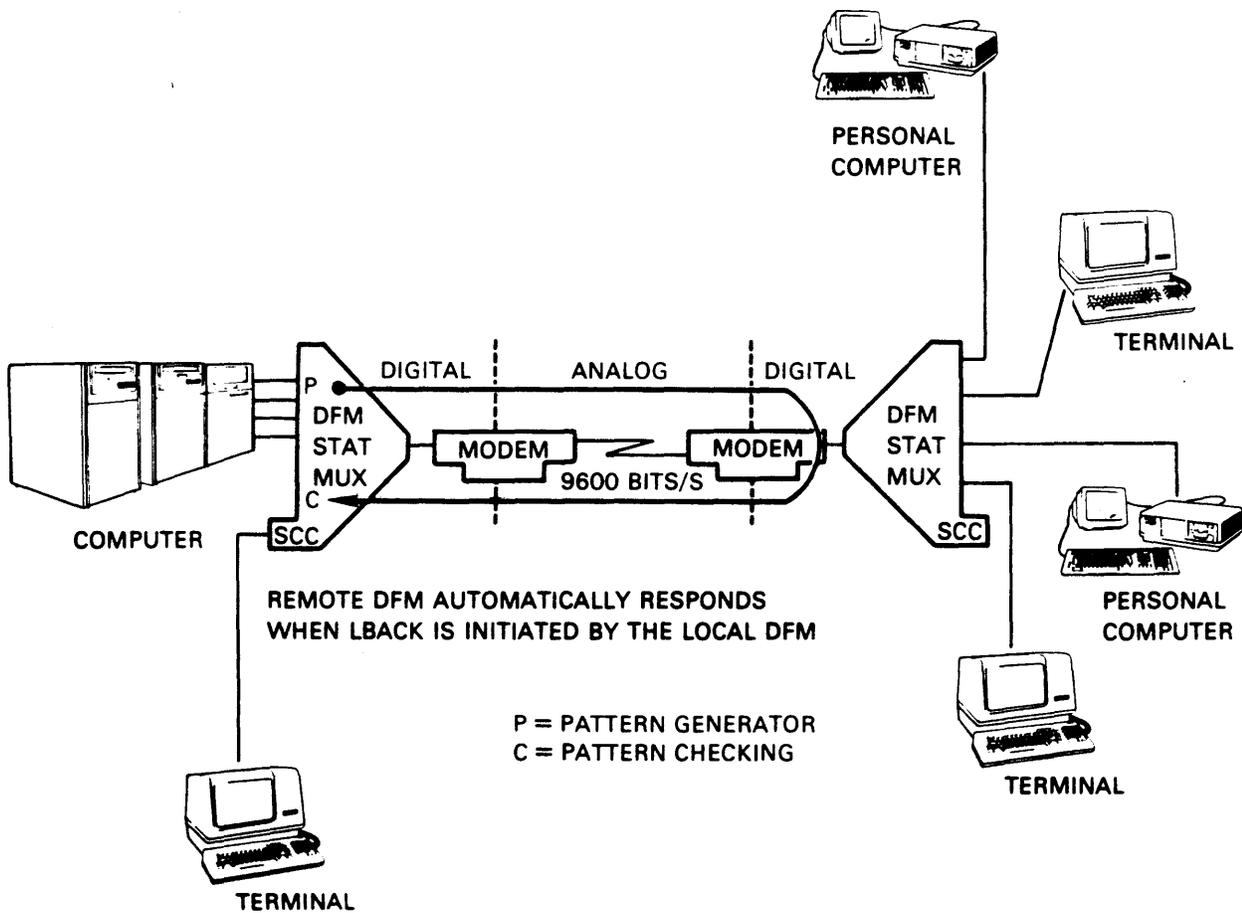
MKV85-2016

Figure 7-2 Remote Digital Loopback (Using DFM Pattern)

Control Module	SD	RD	CD	SA	RA	CE	NR	DR
Local	★	★	●	X	X	●*	O	★
Remote	X	X	X	X	X	X	X	X

DF124 Modem Module	SD	RD	CD	TR	MR	OH	HS	TM
Local	★	★	●	●	●	O	●	●
Remote	★	O	●	●	O	O	●	●

DF126 Modem Module	SD	RD	CD	TR	MR	CS	RS	TM
Local	★	★	●	●	●	●	●	●
Remote	★	★	●	●	●	●	●	O

| DF127/DF129 Modem Module	SD	RD	CD	CS	RS	SQ	FB	TM
Local	★	★	●	●	●	X	X	●
Remote	★	★	●	O	●	X	X	●

Legend

X = Don't Care (ON or OFF)

O = OFF

● = ON

★ = ON or Blinking

* The CE indicator on the local control module is OFF for this test when DF126 modems are used.

If the LED display is not as shown above, there may be a malfunction in one of the modem modules, the local control module, or the telephone line may be bad.

7.4.1.3 Remote Modem Digital Loopback (Using Modem Pattern) --
This test removes local and remote DFM units from the test circuit
(see Figure 7-3).

The first step is to put the remote modem into digital loopback
mode. This can be accomplished by pressing the RL switch IN on the
local modem. Pressing RL causes the system to reinitialize (about
45 seconds).

After reinitialization, a test pattern is generated and checked by
pressing the TP (Test Pattern) or ST (Self-Test) switch IN on the
local modem module (depends on the modem being used).

NOTE
The same circuit can be tested by simply
pressing the TP or ST switch IN on both
modem modules. (LED indications are
identical).
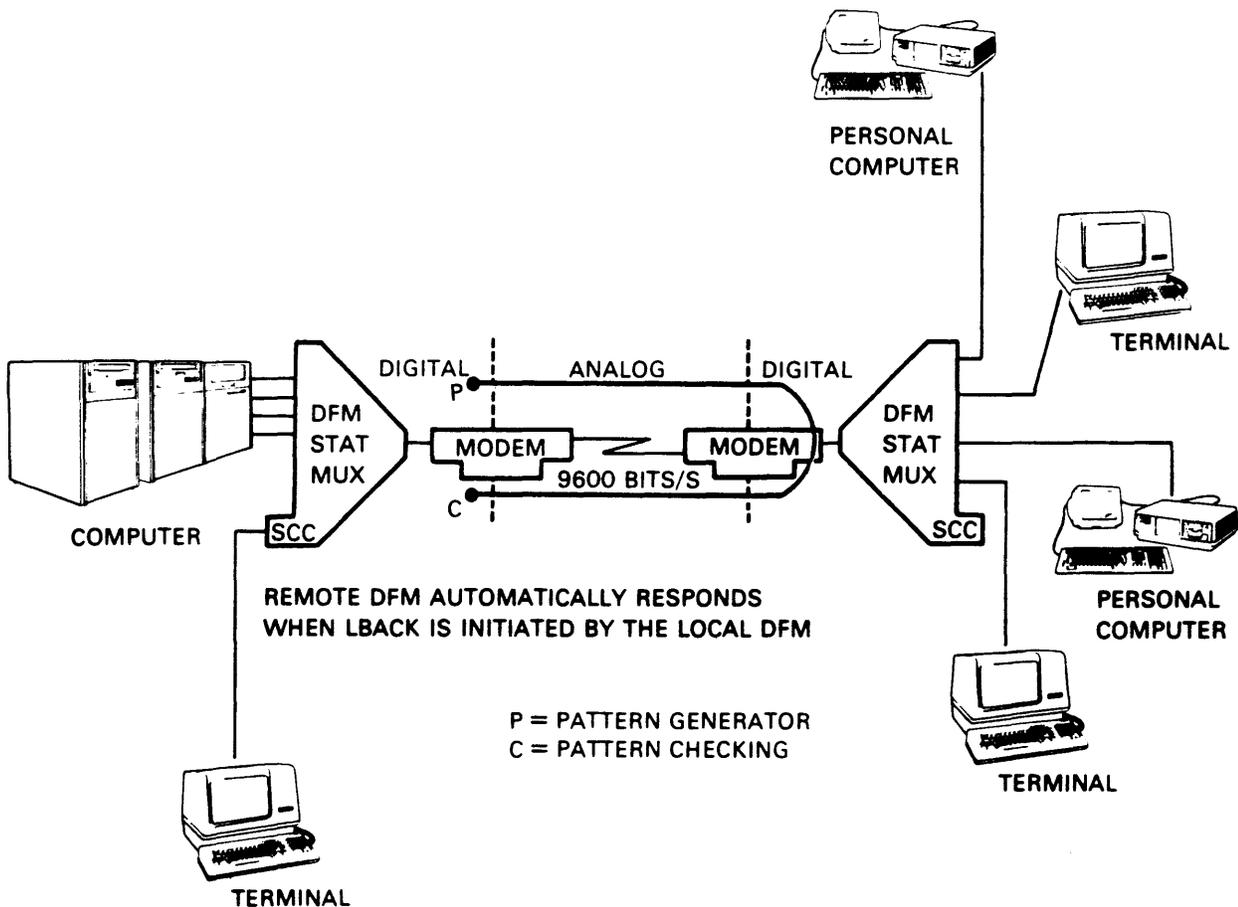
MKV85-2017

Figure 7-3   Remote Digital Loopback (Using Modem Pattern)

LED indicators on either control module (local or remote) are not relevant to this test.

DF124 Modem Module	SD	RD	CD	TR	MR	OH	HS	TM
Local	☀	O	●	●	●	O	●	●
Remote	☀	O	●	●	O	O	●	●

DF126 Modem Module	SD	RD	CD	TR	MR	CS	RS	TM
Local	☀	☀	●	●	O	O	●	●
Remote	☀	☀	●	●	●	●	●	O

| DF127/DF129 Modem Module	SD	RD	CD	CS	RS	SQ	FB	TM
Local	☀	☀	●	O	●	X	X	●
Remote	☀	☀	●	O	●	X	X	●

Legend

X = Don't Care (ON or OFF)

O = OFF

● = ON

☀ = ON or Blinking

If the LED display is not as shown above, one of the modems may be malfunctioning or the telephone line may be bad.

7.4.1.4 Remote Modem Analog Loopback (Using DFM Pattern) -- This test only applies to DF127/DF129 modem configurations; it cannot be executed with DF124 or DF126 modems. This test removes the remote multiplexer as well as the digital portion of the remote modem from the test circuit (see Figure 7-4).

This test requires that the bidirectional loopback option on DF127 or DF129 modems be enabled at the remote unit modem. Press the LL switch IN on the remote unit modem. Pressing LL causes the system to reinitialize (about 45 seconds).

After reinitialization, initiate the LBACK test at the local DFM unit using either supervisory channel or manual (M1 and M2) method.
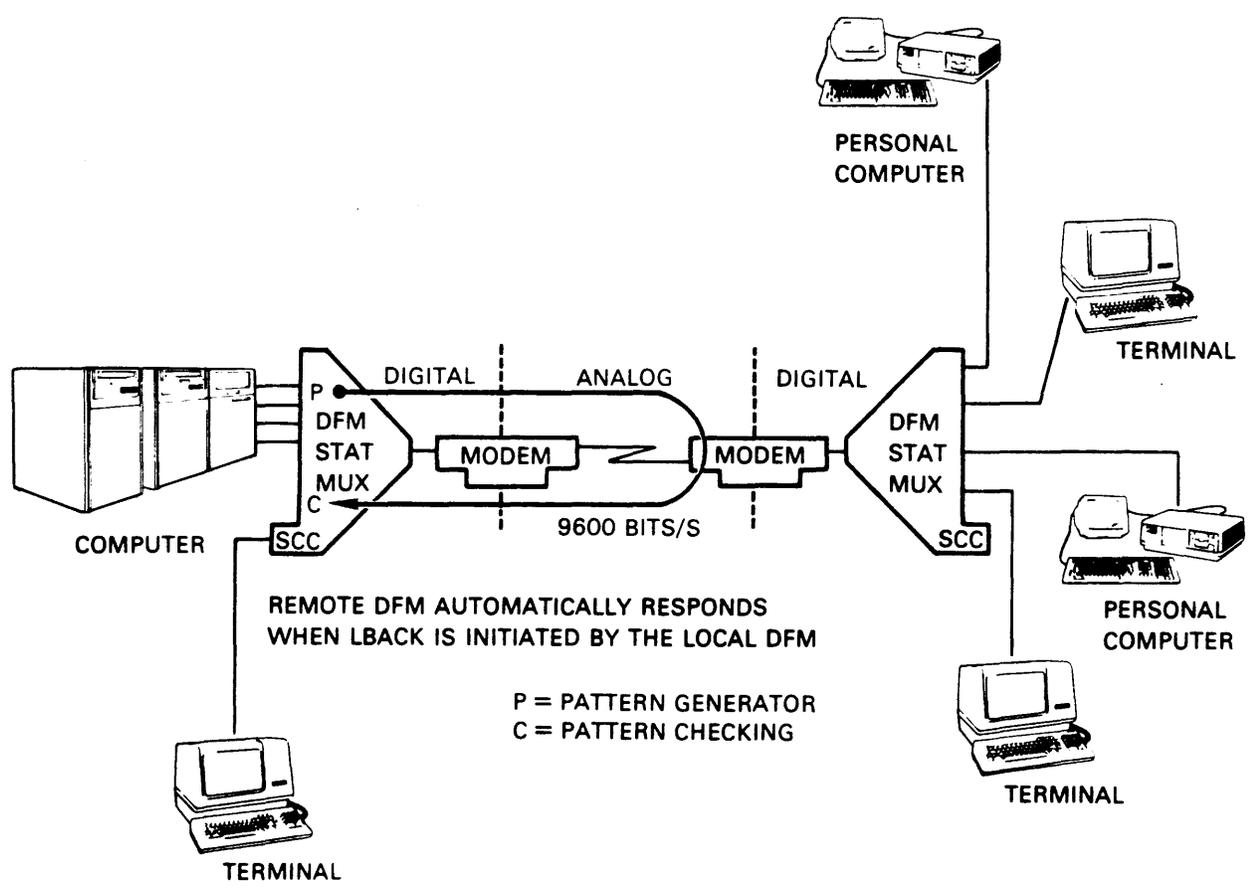
MKV85-2018

Figure 7-4 Remote Analog Loopback (Using DFM Pattern)

| Control Module		SD	RD	CD	SA	RA	CE	NR	DR
Local		☀	☀	●	X	X	●	O	●
Remote		X	X	X	X	X	X	X	X
DF127/DF129 Modem Module		SD	RD	CD	CS	RS	SQ	FB	TM
Local		☀	☀	●	●	●	X	X	O
Remote		☀	☀	●	●	●	X	X	●

Legend

X = Don't Care (ON or OFF)

O = OFF

● = ON

☀ = ON or Blinking

If the LED display is not as shown above, there may be a malfunction in the local modem module, the local control module, or the telephone line may be bad. There is a small possibility that the remote unit modem is malfunctioning.

7.4.1.5 Remote Modem Analog Loopback (Using Modem Pattern) -- The
test circuit for this procedure includes the local modem, the
link, and the analog portion of the remote modem (see Figure 7-5).
This test applies only to DF127 and DF129 configurations.

This test requires that the bidirectional loopback option on DF127
or DF129 modems be enabled on the remote modem. Press the LL
switch IN on the remote modem. Pressing LL causes the system to
reinitialize (about 45 seconds).

After reinitialization, a test pattern is generated and checked by
pressing the TP (Test Pattern) or ST (Self-Test) switch IN on the
local modem module (depends on the modem being used).
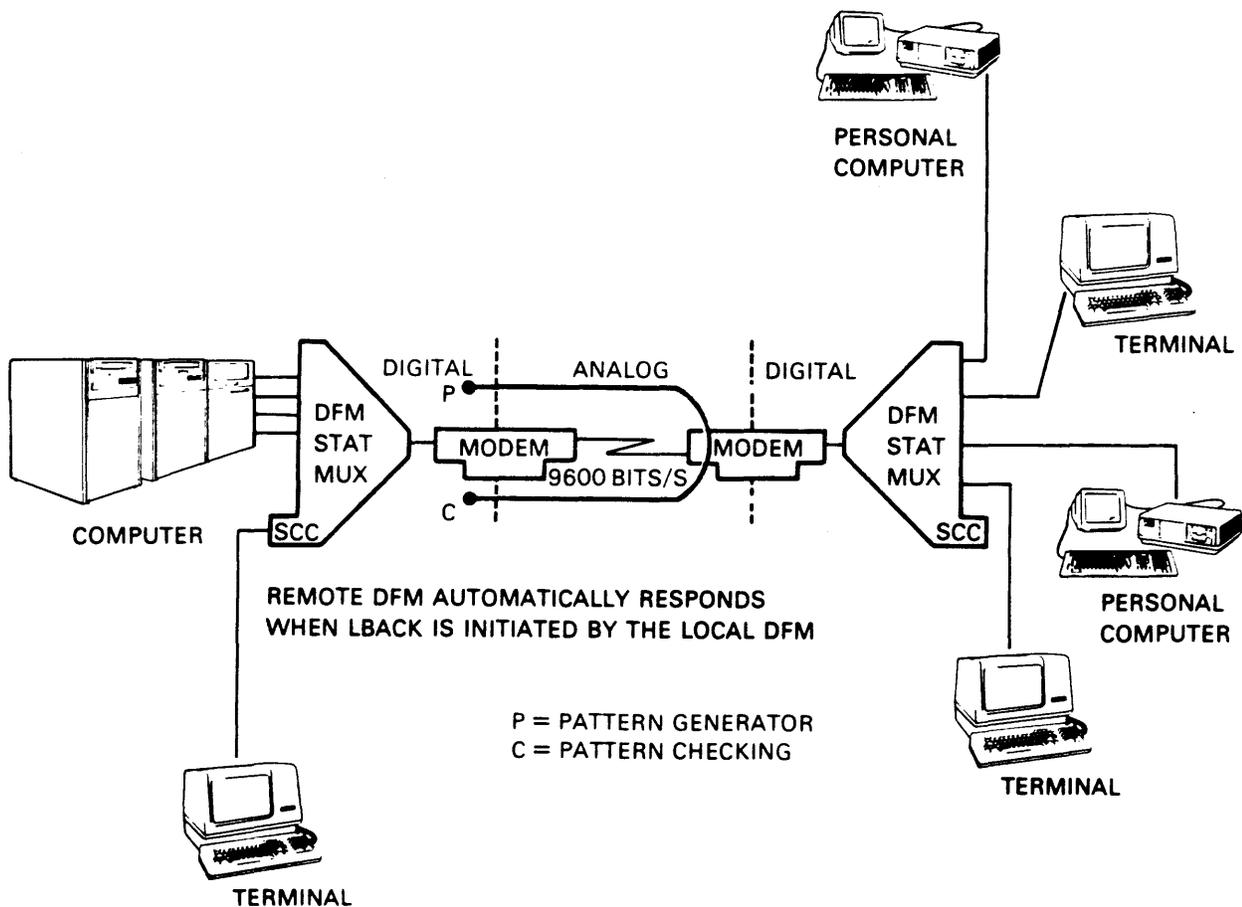
MKV85-2019

Figure 7-5 Remote Analog Loopback (Using Modem Pattern)

LED indicators on either control module (local or remote) are not relevant to this test.

| DF127/DF129 Modem Module	SD	RD	CD	CS	RS	SQ	FB	TM
Local	☀	☀	●	O	●	X	X	●
Remote	☀	☀	●	●	●	X	X	●

Legend

X = Don't Care (ON or OFF)

O = OFF

● = ON

☀ = ON or Blinking

If the LED display is not as shown above, the local modem may be malfunctioning or the telephone line may be bad. There is a small possibility that the remote modem is malfunctioning.

7.4.1.6 Local Analog Loopback (Using DFM Pattern) -- This test verifies the local modem and DFM unit up to the link RS-232-C interface (see Figure 7-6). Press the LL switch IN on the local modem. Pressing LL causes the system to reinitialize (about 45 seconds).

After reinitialization, initiate the LBACK test on the local DFM unit using either the supervisory channel or manual (M1 and M2) method.

LOCAL ANALOG LOOP AT BOTH ENDS
ISOLATES THE TELEPHONE LINE

P = PATTERN GENERATOR
C = PATTERN CHECKING
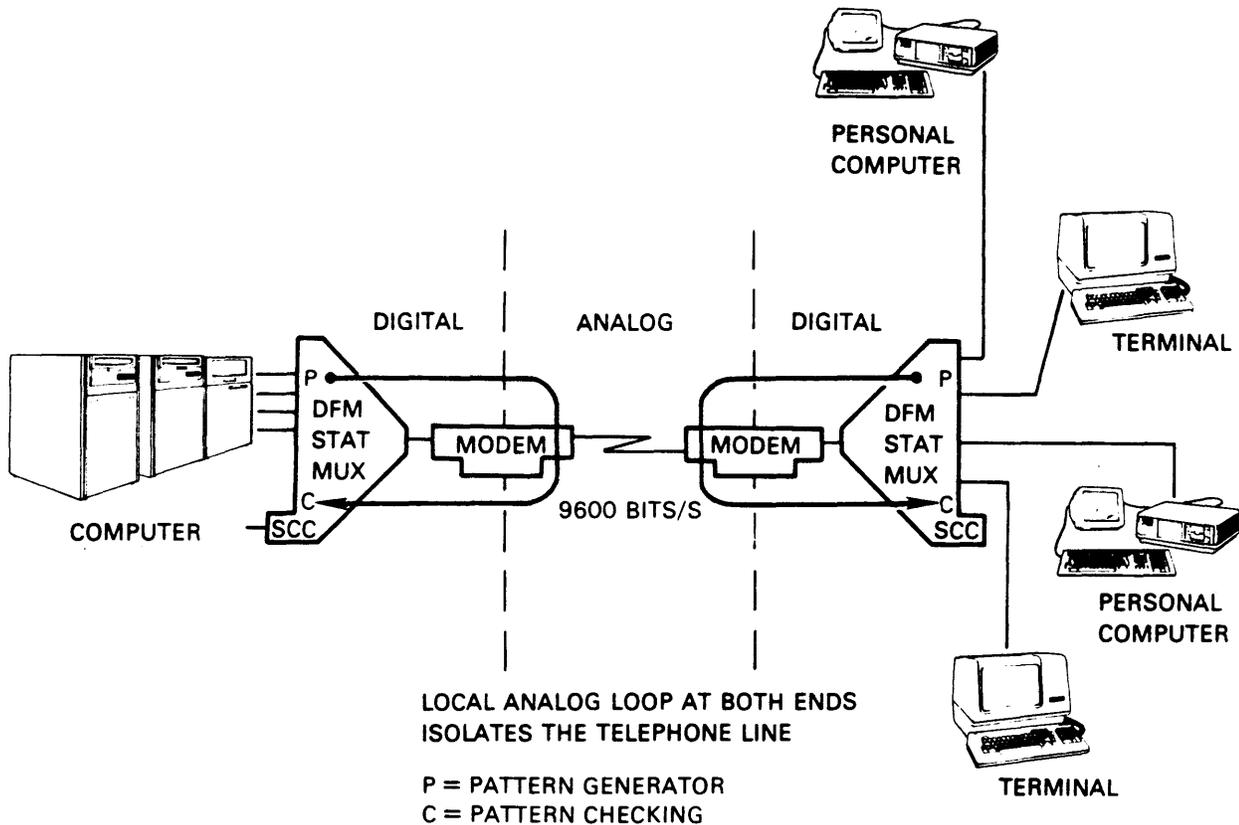
MKV85-2020

Figure 7-6   Local Analog Loopback (Using DFM Pattern)

| Control Module	SD	RD	CD	SA	RA	CE	NR	DR
Local	☀	☀	●	X	X	●	●*	☀
Remote	X	X	X	X	X	X	X	X
DF124 Modem Module	SD	RD	CD	TR	MR	OH	HS	TM
Local	☀	●	●	●	●	●	●	●
Remote	X	X	X	X	X	X	X	X
DF126 Modem Module	SD	RD	CD	TR	MR	CS	RS	TM
Local	☀	☀	●	●	●	●	●	●
Remote	X	X	X	X	X	X	X	X
DF127/DF129 Modem Module	SD	RD	CD	CS	RS	SQ	FB	TM
Local	☀	☀	●	●	●	X	X	●
Remote	X	X	X	X	X	X	X	X

Legend

X = Don't Care (ON or OFF)

O = OFF

● = ON

☀ = ON or Blinking

* The NR indicator on the local control module is OFF for this
  test when DF124 or DF126 modems are used. The NR indicator on
  the local control module is ON for this test when DF127 or DF129
  modems are used.

If the LED display is not as shown above, there may be a
malfunction in the local modem module or the local control module.

7.4.1.7 Local Analog Loopback (Using Modem Pattern) -- This test verifies only the local modem module (see Figure 7-7). Press the LL switch IN on the local modem. Pressing LL causes the system to reinitialize (about 45 seconds).

After reinitialization, a test pattern is generated and checked by pressing the TP (Test Pattern) or ST (Self-Test) switch IN on the local modem module (depends on the modem being used).

LOCAL ANALOG LOOP AT BOTH ENDS
ISOLATES THE TELEPHONE LINE

P = PATTERN GENERATOR
C = PATTERN CHECKING
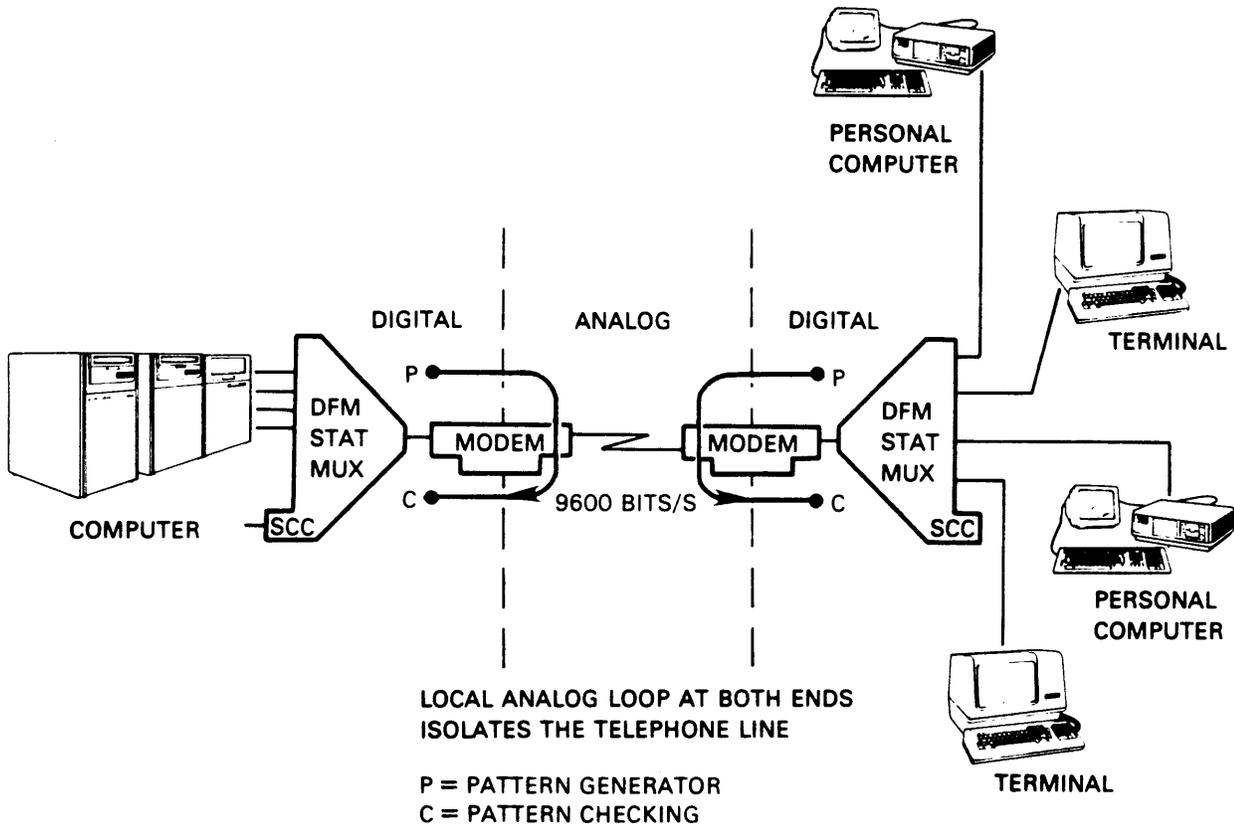
MKV85-2021

Figure 7-7   Local Analog Loopback (Using Modem Pattern)

LED indicators on either control module (local or remote) are not relevant to this test.

DF124 Modem Module	SD	RD*	CD	TR	MR	OH	HS	TM
Local	☀	O	●	●	●	●	●	●
Remote	X	X	X	X	X	X	X	X
DF126 Modem Module	SD	RD*	CD	TR	MR	CS	RS	TM
Local	☀	●	●	●	O	O	●	●
Remote	X	X	X	X	X	X	X	X
DF127/DF129 Modem Module	SD	RD	CD	CS	RS	SQ	FB	TM*
Local	☀	☀	●	O	●	X	X	●
Remote	X	X	X	X	X	X	X	X

Legend

X = Don't Care (ON or OFF)

O = OFF

● = ON

☀ = ON or Blinking

* If these indicators blink during the test, the modem is detecting errors.

If the LED display is not as shown above, the modem is malfunctioning.

7.4.1.8 Link Signals Test -- The purpose of this test is to verify concentrated link EIA signal toggle capabilities. The special loopback test cable loops back all control signal pairs (for example, DSR-DTR) while the unit raises and lowers voltages. Passing this test ensures that none of the link EIA signals are stuck high or low.

NOTE
The Link Signals test interferes with
data traffic on ALL channels because the
link cable must be disconnected.

A special loopback test cable, not available as a standard item, is required for this test. This cable must be fabricated as specified in Section C.6.

Refer to Figure 7-8 for the following test procedure.

1.   Unplug cables from Channel 4 and the link.

2.   Plug the male end of the special loopback test cable into Channel 4.

3.   Plug the female end of the special loopback test cable into the link connector.

4.   Enter TEST LINK SIGNALS command line on supervisory channel followed by a RETURN <RET>. The test begins. Pressing RETURN after this test starts terminates the test.

5.   Following the test, the special loopback test cable must be removed, link and Channel 4 cables reattached, and the unit repowered to restore full operational capability.

CONDITIONS:
1. LINK DISCONNECTED
2. MAINTENANCE CABLE
   CONNECTED TO
   LINK AND CHANNEL 4.

SIGNALS TOGGLED AT LINK
ARE CHECKED BY CHANNEL 4
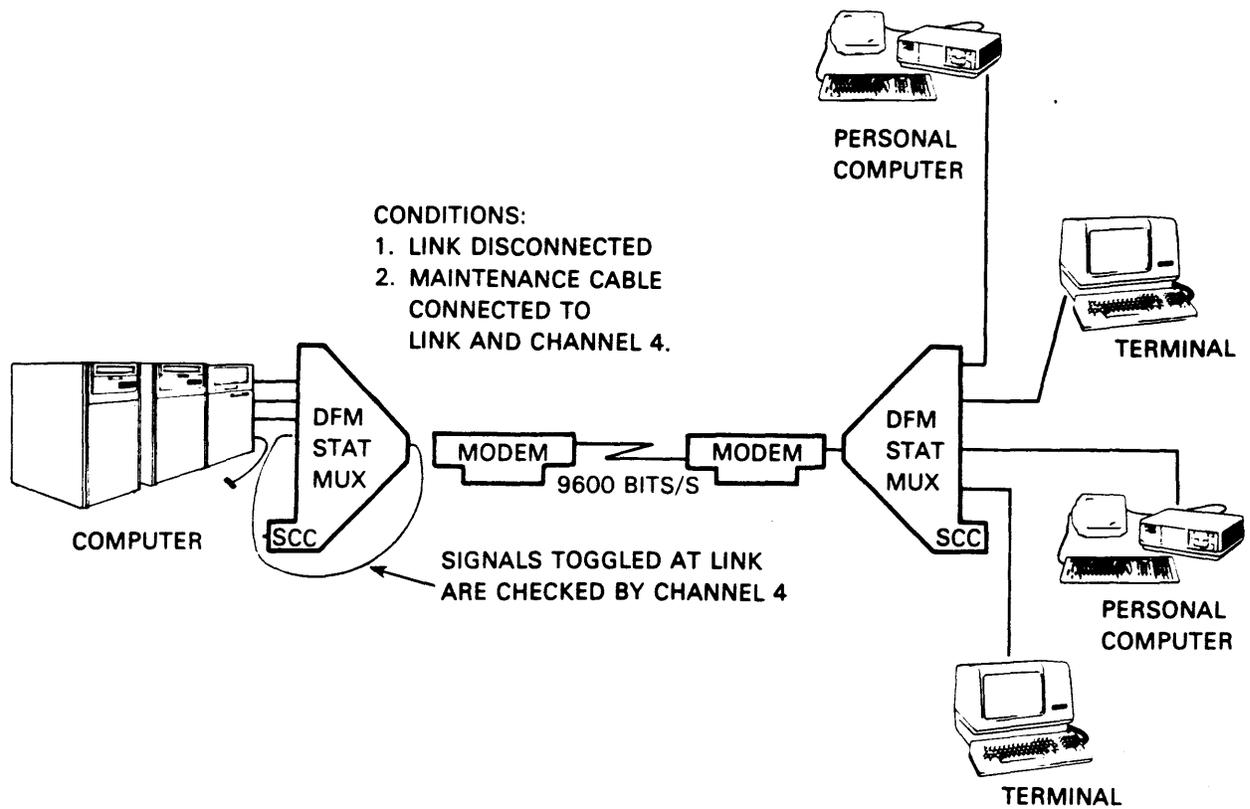
MKV84-0295

Figure 7-8   Link Signals Test Configuration

7.4.2 Isolating and Testing Channel Components

The following is a list of some considerations for problems associated with channel operations.

1. Obvious Causes

   a. Loose or broken connectors
   b. Connectors being pulled out by weight of cable

2. Channel Configuration Pitfalls

   a. TYPE -- set to UNUSED?
   b. FLOW CONTROL -- must be consistent with terminal and CPU
   c. SIGNALS -- set to other than ASSERT?
   d. DATAPAR consistent with both terminal and CPU?

3. Isolate channel failure with:

   a. MONITOR Information

      1) Xmitdata, Recvdata, and Signals readouts
      2) Framerr, Bufovrf, Parerr, and Dataovrn figures

   b. TEST Facilities

      1) Echo tests, Local and Remote
      2) Pattern test
      3) Signals (special loopback cable required. See Section C.6 for fabrication of test cable.)

7.4.2.1 Channel Configuration Pitfalls -- The following options can impair channel operation unless configured properly.

- Type Option. Often the type option is mistakenly set to value of unused. This results in the channel being disabled.

- Flow Control Option. This function is very important and is difficult for some users to understand. Flow control must be set to values consistent with the CPU and/or terminal that are connected to that channel.

- Signals Option. Should be set to pass only when it is important to allow changing the EIA signals at the other end of the computer channel (that is, so the computer can log off a user after a dial-up connection has been terminated.)

- Data Size and Parity Options. Must be set to values consistent with CPU and terminal.

7.4.2.2 Channel Monitoring Facilities -- Refer to the MONITOR command, Chapter 5, for monitor procedures. Only the systematic use of the available functions is explained here.

When transmission is not continuous, the XMITDATA and RECVDATA values show the last characters transmitted and received by the terminal on the monitored channel.

If there is no terminal response or returned characters are garbled, trace the data path to determine how far the data is being correctly transmitted and received in the following manner.

- Enter a character on a terminal connected to the local unit.

- Look at the XMITDATA value for that channel on the local unit to verify that the character is transmitted properly.

- Look at the RECVDATA value on the remote unit to verify that the character is correctly received by the unit and sent to the channel.

- Look at the XMITDATA value on the remote unit to see if the character has been echoed by the CPU and transmitted back by the remote unit.

- Look at the RECVDATA value on the local unit to see if the echoed character is received by the unit and sent to the terminal correctly.

NOTE
Sometimes channels can be locked up by a jammed flow control character. DC3 (13 hex) is an XOFF. Look for other control characters that may be jammed and inhibiting channel operation.

7.4.2.3 Channel Errors -- Alone, error indications listed below, cannot pinpoint channel malfunctions, but they can help to identify the problem.

- Framing Errors: Possible causes of a significant number of framing errors could be:

  -- A mismatch in CPU, terminal, or multiplexer settings for data size, parity, or speed.

  -- A failing input/output device (chip) in the channel port.

  -- A failing I/O device on the computer.

- Buffer Overflow: Buffer overflows always imply a flow control problem. Either flow control is not in use or it has been set to an improper value.

- Parity Errors: Parity errors usually indicate an improper setting for data parity at the terminal, computer, or multiplexer.

- Data Overrun: Data overrun is caused by more data being received on a port than the microprocessor can handle. Typically, a significant number of framing errors will also be present.

7.4.2.4 Local and Remote Echo Tests -- The purpose of the Local Echo test is to verify the functioning of the channel cables and the RS-232-C interface. The Remote Echo test verifies the integrity of channel cables as well as the concentrated link. If a terminal device is suspected faulty, either test verifies that the terminal is sending, receiving, and properly displaying characters (see Figure 7-9).

NOTE
Echo tests do not interfere with data
traffic on other channels. Channel
transmit and receive speeds must agree.

If the channel echo configuration option for the channel being tested is set to local, characters echoed back to the terminal appear twice.

NOTE
Both Local and Remote Echo tests, as
well as Channel Pattern test, may also
be activated from terminals connected to
data channels once they are in command
mode.

Refer to the description of the TEST and TERMTEST commands in Chapter 5 for examples on executing echo tests.

PERSONAL
COMPUTER

LOCAL
DATA IS LOOPED BACK
BY LOCAL DFM

TERMINAL

DFM
STAT
MUX

SCC

COMPUTER

MODEM

MODEM

9600 BITS/S

DFM
STAT
MUX

SCC

PERSONAL
COMPUTER

REMOTE
DATA IS LOOPED BACK
BY REMOTE DFM
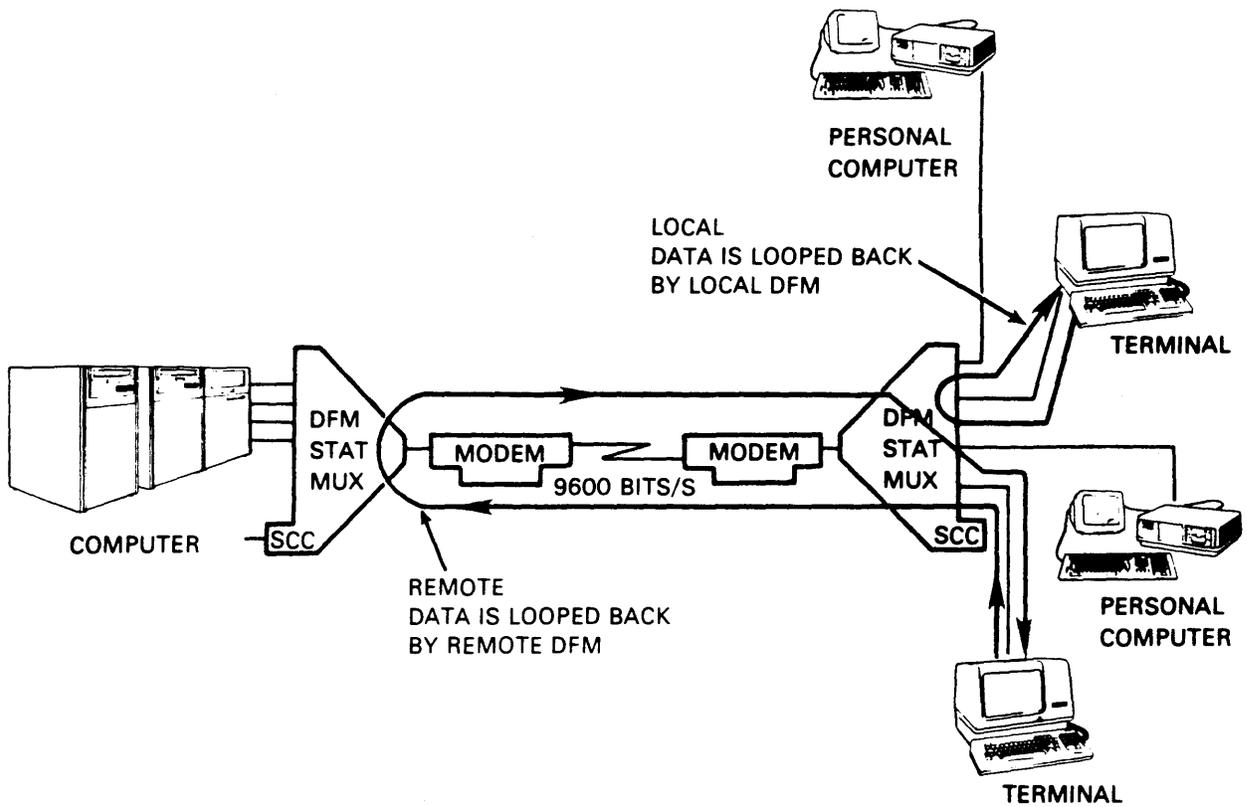
TERMINAL

MKV85-2022

Figure 7-9   Channel Echo Test Configuration

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7.4.2.5 Channel Pattern Test -- The purpose of this test is to verify channel hardware between the terminal and the DFM unit. The DFM unit repeats the ASCII character set on the specified channel until the test is terminated. The test is terminated by pressing RETURN if at the supervisory channel or by pressing the BREAK key if at the data channel (see Figure 7-10).

NOTE
The Channel Pattern test does not interfere with data traffic on any other channel.

Garbled characters or a disrupted pattern on the terminal screen indicates a hardware problem somewhere in the data path. In most instances this type of problem is caused by loose or dirty connectors or wrong speeds.

Refer to the description of the TEST and TERMTEST commands in Chapter 5 for examples on executing pattern tests.
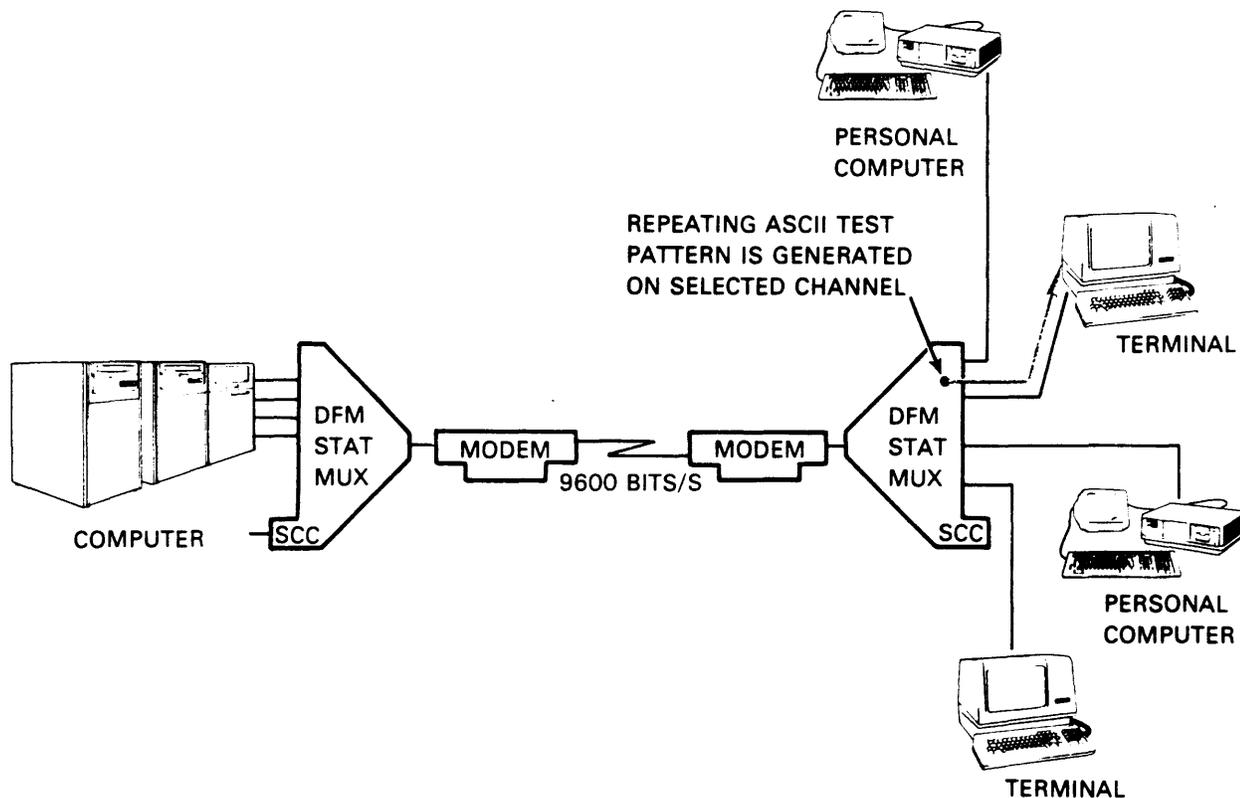
MKV84-0293

Figure 7-10 Channel Pattern Test Configuration

7.4.2.6 Channel Signals Test -- The purpose of this test is to verify channel EIA signal toggle capabilities. The special loopback test cable loops back all control signal pairs (for example, DSR-DTR) while the unit raises and lowers voltages. Passing this test ensures that none of the channel EIA signals are stuck high or low (see Figure 7-11).

Echo and Pattern testing generally isolates most problems. The Channel Signals test described on the next page is rarely needed. The Channel Signals test also requires the use of a special cable which is not provided as a standard item and, therefore, must be fabricated as specified in Section C.6.

NOTE
The Channel Signals test interferes with data traffic on ALL ports because all channel cables must be disconnected.
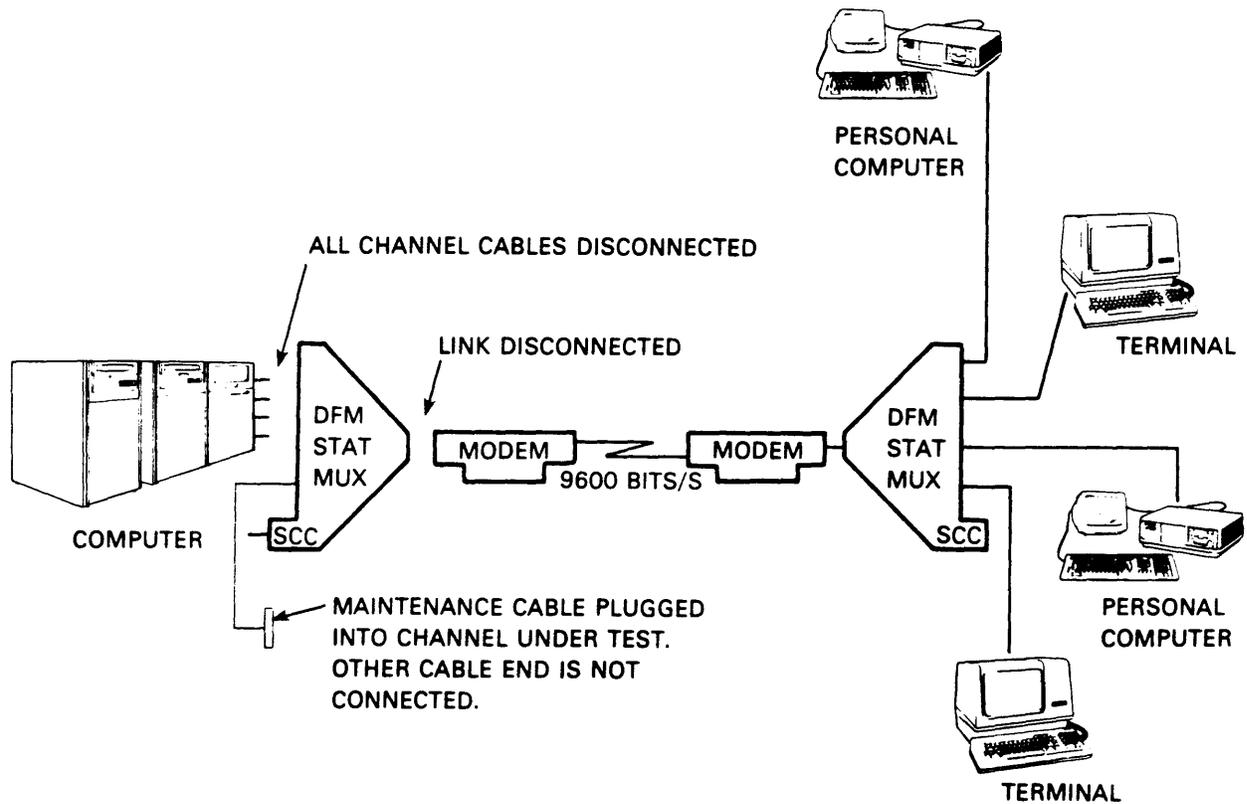

MKV84-0289

Figure 7-11   Channel Signals Test Configuration

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Test Procedure:

1. Unplug cables from all channels and from the link port.

2. Plug the male end of the special loopback test cable into the appropriate channel port connector. (The female end of the special loopback test cable is not connected during the Channel Signals test.)

3. Select and execute the Channel Signals test for the desired channel.

4. As other channels are tested, the special loopback test cable is plugged into the appropriate channel port and the test sequence is repeated.

5. When the Channel Signals test is complete, the unit must be repowered after all cables have been replaced. This restores full operational capability.

The DFM Channel Signals test consists of five separate tests performed continuously and in sequence on the channel specified. The Channel Signals test runs until terminated. The test is terminated by pressing RETURN if at the supervisory channel or by pressing the BREAK key if at the data channel. The output of each step in the test is assigned a code.

Test 1 = Output code 00: No output signals asserted; none should be received.

Test 2 = Output code 03: Only CTS asserted; only RTS should be received.

Test 3 = Output code 0C: Only DSR asserted; only DTR should be received.

Test 4 = Output code 30: Only RI asserted; only RRI should be received.

Test 5 = Output code C0: Only CAR asserted; only RCA should be received.

The test results are not only displayed as a message on the originating terminal, but are also displayed as a coded message on the control module LEDs.

The Channel Signals test runs continuously until terminated from the initiating terminal. As the unit passes the first sequence, all LEDs on the control module light, and the following message is displayed on the terminal.

TEST CHANNEL 1 SIGNALS> Passed

This message is displayed until either the test is terminated or an error occurs. An error detected in any of the five tests results in:

- A message to the initiating terminal in the following format.

TEST CHANNEL 1 SIGNALS> FAILED: output=(03) input=(00000030)

- Control module LEDs displaying the output code of the failed test (see the following LED outputs).

Control module LEDs correspond to the "output=xx" portion of the displayed message. This allows the result of the test to be determined via the front panel (visually) as well as from the displayed message. Error indications (both terminal and LEDs) remain on display until either another (different) error occurs or the test is terminated.

During the Channel Signals test, each of the LEDs on the control
module represent one of the EIA signals.

```
LED 1 (SD) = CAR
LED 2 (RD) = RCA
LED 3 (CD) = RI
LED 4 (SA) = RRI
LED 5 (RA) = DSR
LED 6 (CE) = DTR
LED 7 (NR) = CTS
LED 8 (DR) = RTS
```

TEST RESULTS (LED READINGS) ARE:

Test 1	Test 2	Test 3
Output = 00:	Output = 03:	Output = 0C:
(SD) Off	(SD) Off	(SD) Off
(RD) Off	(RD) Off	(RD) Off
(CD) Off	(CD) Off	(CD) Off
(SA) Off	(SA) Off	(SA) Off
(RA) Off	(RA) Off	(RA) On
(CE) Off	(CE) Off	(CE) On
(NR) Off	(NR) On	(NR) Off
(DR) Off	(DR) On	(DR) Off

Test 4	Test 5
Output = 30:	Output = C0:
(SD) Off	(SD) On
(RD) Off	(RD) On
(CD) On	(CD) Off
(SA) On	(SA) Off
(RA) Off	(RA) Off
(CE) Off	(CE) Off
(NR) Off	(NR) Off
(DR) Off	(DR) Off

These codes display what is expected to be received as well as
what is output for each step of the test.

GENERAL SPECIFICATIONS

MULTIPLEXING TECHNIQUE
Statistical time division, dynamic bandwidth allocation with variable block length.

MULTIPLEXING EFFICIENCY
To 800%, depending on application. Typically 300% to 500%.

SYSTEM DESIGN
Multi-microprocessor design with internal DMA bus structure.

SYSTEM CONFIGURATION
Configuration of system parameters can be done by using either the supervisory channel or enabled data channels with simple-to-use commands that are similar to DIGITAL VAX/VMS command structure.

SUPERVISORY COMMAND CHANNEL
A special terminal connection that allows the system manager to issue program, monitor, and test commands to the DFM system. Access to command level is password protected. The supervisory command channel program can also be accessed from any data channel if program is not in use.

NETWORK CONTROL
All network functions (programming, monitoring, and diagnostic tests) are performed by the supervisory command program. Diagnostic capabilities include system, channel, and link testing. Broadcast messages can be issued by the system manager.

NETWORK MONITORING
The MONITOR command permits the system manager to display status and/or error conditions for system, channel, and link categories. All error counters can be cleared by a separate command.

PARAMETER MEMORY
All configuration parameters are stored in nonvolatile, power independent memory.

DFM FUNCTIONAL SPECIFICATIONS

AGGREGATE SPEED

Maximum aggregate speed of 153.6K bits/s which is 9600 bits/s on all channels simultaneously.

CHANNEL END-TO-END DELAY

Varies with speed of channel and link, from 16 ms to 140 ms (typically, less than 60 ms).

CHANNEL SPECIFICATIONS

CAPACITY

4-, 8-, 12- and 16-channel models.

ASYNCHRONOUS CHANNELS

All channels may operate in asynchronous mode (4, 8, 12 and 16). These channels can be operated as either dedicated or switched.

SYNCHRONOUS CHANNELS

Synchronous mode supported on one-half the channels (1, 2, 5, 6, 9, 10, 13, and 14). Each sync channel can support message blocks of 512, 1024, 2048, or 4098 bytes.

SYNCHRONOUS PROTOCOL

Multiplexes all synchronous data when RTS-CTS flow control is selected (independent of protocol). Handles all protocol NOT using RTS-CTS flow control in transparent mode. Special handling is included for Digital Equipment Corporation's DDCMP protocol. No ARQ is performed on synchronous data channels.

SWITCHING

Asynchronous switched channels provide users with the ability to select any other switched channel using simple commands.

CONTENTION

Asynchronous switched channels can contend for available switched channels. Users are queued for busy channels.

SECURITY

Switched channels have "group access" codes to restrict users from protected channels.

GROUP SELECTION

When switched channel users request a particular channel group, the DFM searches for the first available channel and establishes the connection.

PARAMETER INTERMIX

There are no intermix restrictions.

AUTOMATIC PARAMETER UPGRADE

Channel parameter changes at either end of the network are transferred to the other end automatically with up-line/down-line load.

NON-INTERFERING

Channel programming does not interfere with other active channels.

SPEEDS

50, 75, 110, 134.5, 150, 300, 600, 1200, 2400, 4800, 9600 bits/s; autobaud 150 to 9600 bits/s using CR character; samebaud; split speeds of 1200/75, 2400/150, 75/1200, or 150/2400 bits/s. Synchronous 1200 to 9600 bits/s (internal or external clocks).

SPEED CONVERSION

Channel speeds may be set to different values for either end of a channel. The DFM unit provides automatic conversion of speeds between ends.

DATA FORMAT

Async data: 5-, 6-, 7-, or 8-bit data with even, odd, or no parity; 1, 1.5, or 2 stop bits. All switched async channels must have the same data format selections. Sync channels support 8-bit ASCII or EBCDIC with 2, 4, or 6 SYN characters.

FLOW CONTROL

X-ON/X-OFF, CTS-RTS, CTS-RLS, DSR-DTR, and EIA modem control RTS-CTS.

FLOW CONTROL CONVERSION

Flow control conventions may be set to different values for either end of a channel. The DFM unit provides automatic translation of conventions between ends.

FILL CHARACTER BUFFERING

Allows a number of NUL characters to be selected by the user for transmission following a CR character (asynchronous and switched channels only).

ECHOPLEX

Local echo selection at either or both ends of a channel.

PRIORITY

Three levels of priority for each channel provide variable message frames. High is for large data requirements; low is for background/noncritical data; and normal is for typical data requirements in full-duplex configurations.

EIA DIAL-UP CONTROL

Programmable EIA dial-up modem control allows the DFM unit to control automatic answer and call disconnect at either or both ends of a channel.

INTERFACE

EIA RS-232-C/CCITT V.24/V.28; 25-pin female connector.

EIA SIGNALS

Four full-duplex EIA control signals per channel in each direction.

STATUS/INDICATORS

Channel activity LED for each channel; channel utilization statistics; channel error LED and error statistics.

MESSAGES

Allows either or both ends of the channel to receive broadcast and automatic system error messages.

CONCENTRATED LINK SPECIFICATIONS

CAPACITY

Single concentrated link, either synchronous or NRZI asynchronous.

SPEEDS

Synchronous 1200 to 19,200 bits/s; NRZI asynchronous 9600 bits/s only.

PROTOCOL

Conforms to ADCCP ANSI Standard X3.66. Protocol is a superset of X.25 Level II, SDLC, and HDLC.

ERROR DETECTION/CORRECTION

ARQ error correction with 16-bit CRC (asynchronous data only).

SATELLITE DELAY

Link protocol functions are enhanced for satellite networks of one hop.

INTERFACE

EIA RS-232-C/CCITT V.24/V.28; 25-pin male connector.

INTEGRAL MODEM

The DFM enclosure provides space to install a DIGITAL modem module. This option is field installable.

PHYSICAL SPECIFICATIONS

DIMENSIONS
     22.5 cm H X 31.5 cm W X 31 cm D (8.87 inches X 12.37 inches
     X 12.25 inches).

WEIGHT
     6.8 kg (15 lbs) to 8.6 kg (19 lbs), depending on the
     configuration.

MOUNTING
     Shelf/tabletop mounting only.

ENVIRONMENTAL REQUIREMENTS

TEMPERATURE
     Operating: 0° to 40°C (32° to 104°F).

HUMIDITY, ALTITUDE
     0 to 95% noncondensing up to 2438 meters (8,000 feet).

FCC
     Meets FCC Rules, Part 15J -- Class A operation.

POWER
     115 or 230 Vac; 50/60 Hz; 92 W
     UL listed and CSA approved.

OPTIONS

INTEGRAL MODEMS
     4800 bits/s V.27 private line modem and 9600 bits/s V.29
     private line modem.

B.1 LINK MODEM OVERVIEW

The composite link output of the DFM ICP can use a standalone modem or an internal integral modem module that fits into Slot 1 of the DFM enclosure. There are several Digital Equipment Corporation modems (both standalone and integral) that are available for use with the DFM unit. Table B-1 lists each of these modems by their speed characteristics and by model designation.

This appendix provides a brief description of the various user-selectable options that are available with each modem and how each selection is made. Each modem module is shipped from the factory with the various options preset to select the most popular configurations. For use with the DFM unit, however, some factory options must be changed. The tables in this appendix show what options must be selected when the modem is used with the DFM unit. These options are printed in blue for easy reference. It is not within the scope of this appendix to provide a description of each option. Detailed information on each of these modems, and descriptions of modem options, is available by referring to separate user's guides for each modem. Part numbers for the user's guides are listed in Table B-1. Refer to Chapter 3 for descriptions of modem front panel controls and indicators.

Table B-1   DFM Link Modems

Speed	Integral (Private Line)	Standalone Dial-Up	Section Reference	User Guide Part Number
1200 or 2400 bits/s	DF124-AM (2-wire)	DF124-AA (2-wire)	B.3	EK-DF124-UG
1200 or 2400 bits/s	DF126-AM (4-wire)	N/A	B.4	EK-DF126-UG
2400 or 4800 bits/s	DF127-AM (4-wire)	N/A	B.5	EK-DF127-UG
4800/7200 or 9600 bits/s	DF129-AM (4-wire)	N/A	B.6	EK-DF129-UG

B.2 LINK MODEM CONFIGURATIONS WITH THE DFM UNIT

Standalone modems connect to the DFM link connector J18 using a standard straight-through cable such as BC22F or equivalent (see Figure B-1).

Integral modem modules are plugged into Slot 1 of the DFM enclosure as detailed in Chapter 3. Integral modem link connections are made at connector J19 as shown in Figure B-2. Connections to J19 differ depending on the type of modem module used and whether a 2- or 4-wire private telephone network is used. The inserts of Figure B-2 show these differences.
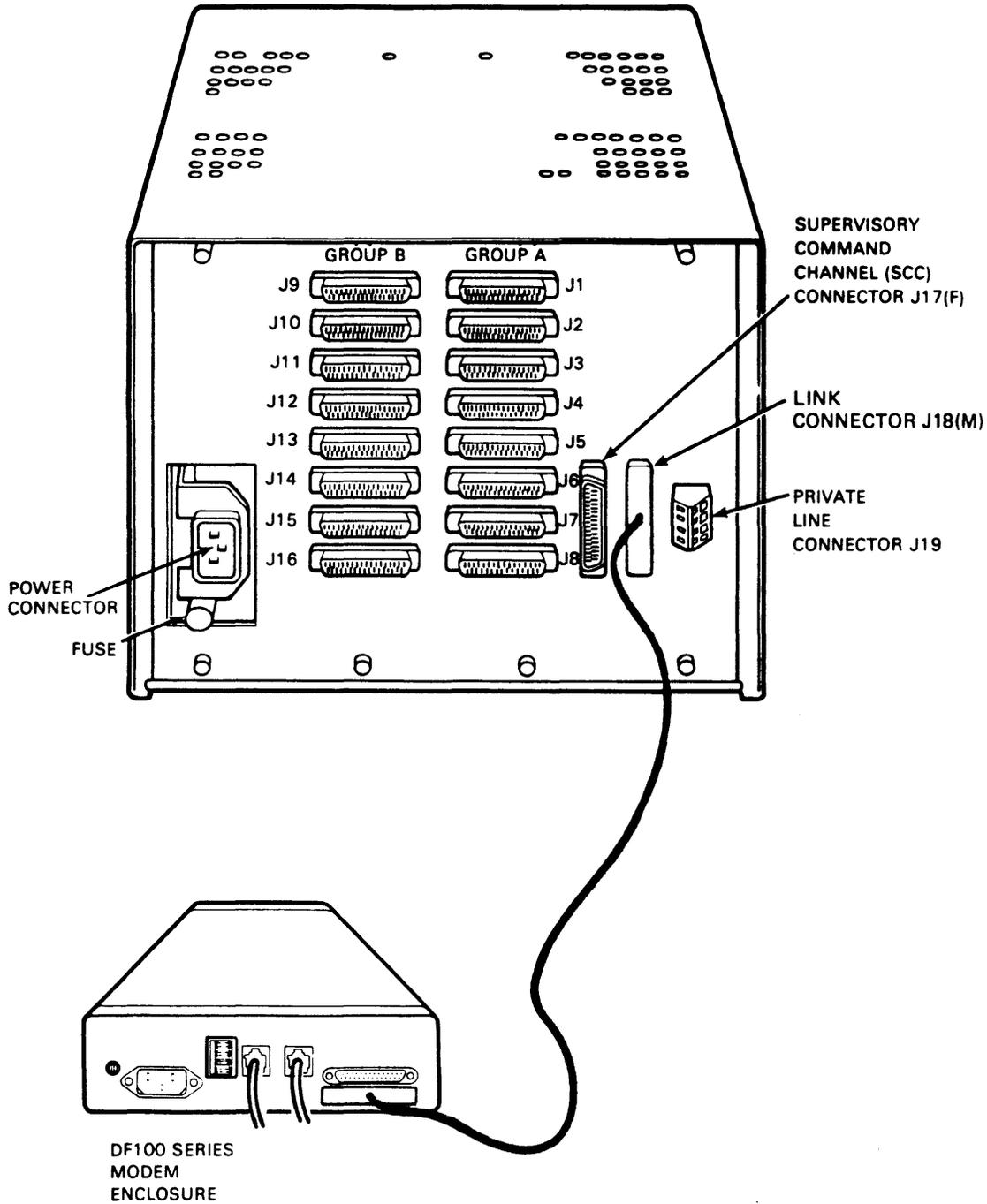

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Figure B-1   Standalone Link Modem Connections
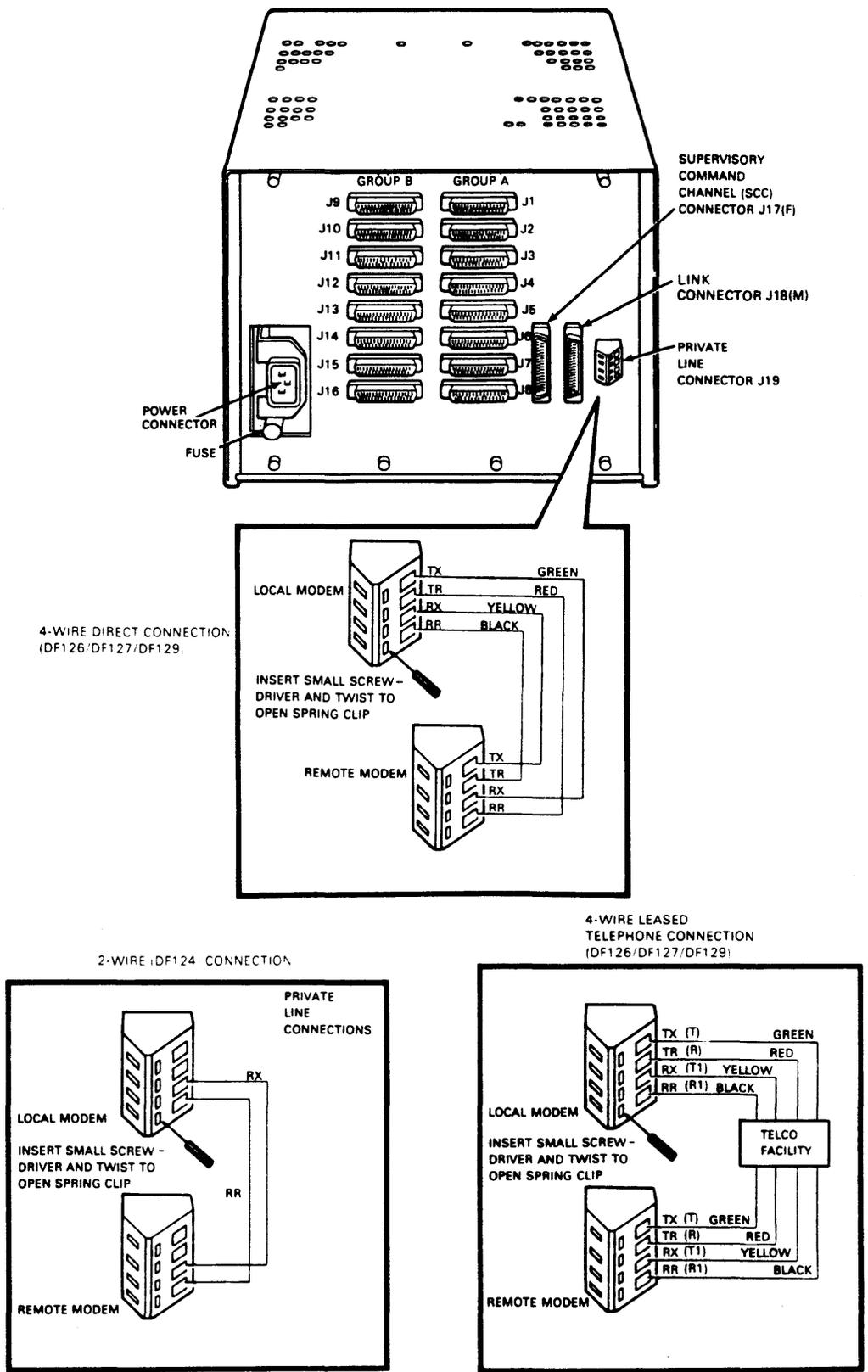
Figure B-2   Integral Modem Link Connections

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B.3 THE DF124 LINK MODEM

Whether using the DF124 modem as an integral or standalone modem with the DFM unit, certain modem options must be correctly selected. Figure B-3 shows the location of switchpacks, while Tables B-2 through B-5 indentify which options are required with the DFM unit and the switch positions necessary to select those options.
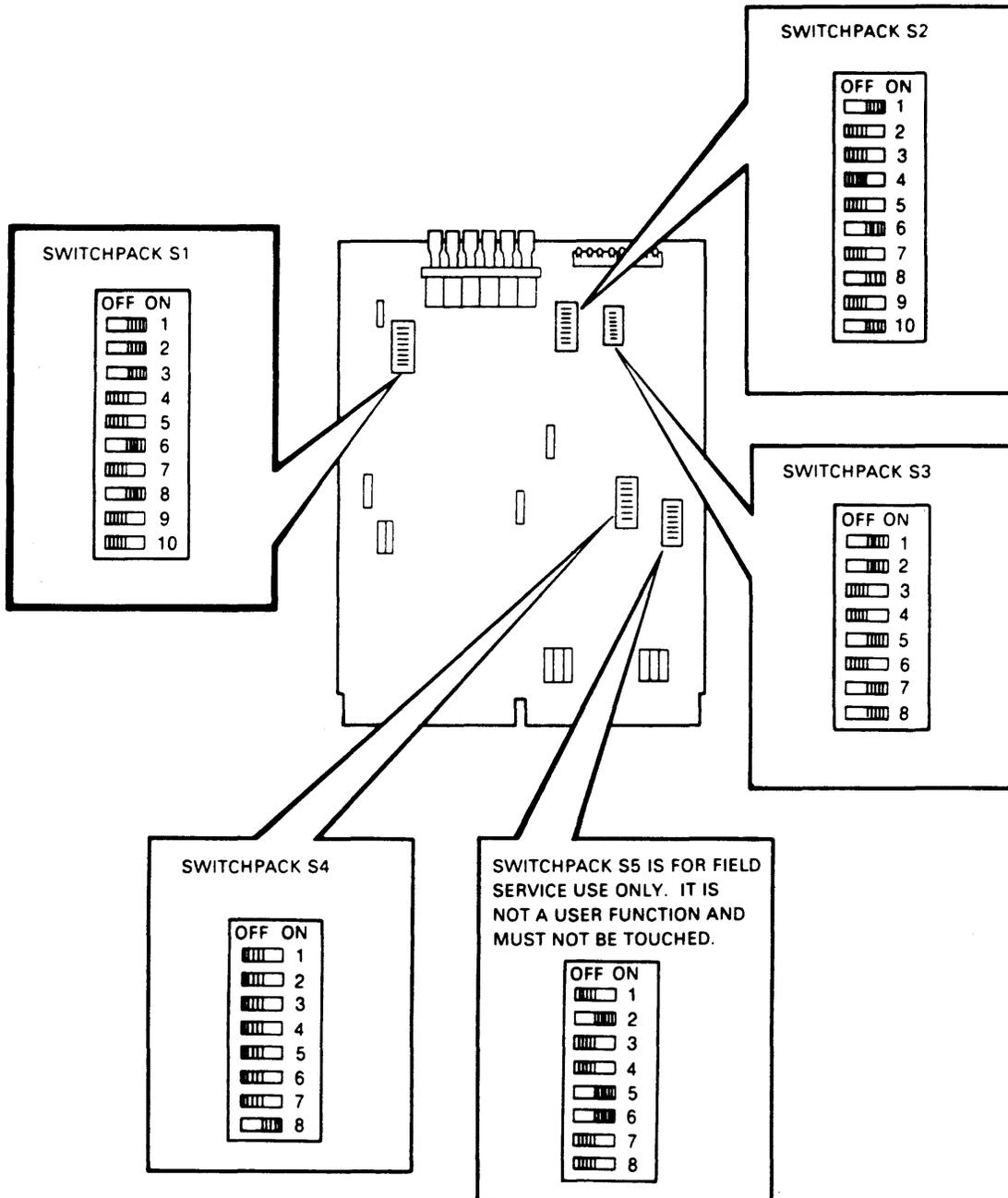
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Figure B-3   DF124-AM Module Layout and Switchpack Locations

The DF124-AM module also includes one additional switchpack (S5) which is provided solely for manufacring and Field Service use. These switches should not be touched by the user. They are mentioned here for information only.

Table B-2   DF124-AM Switchpack 1 Selections

Option	Selection	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
Long Space Disconnect	Enabled	OFF									
	Disabled	ON									
Loss of Carrier Disconnect	Enabled		OFF								
	Disabled		ON								
Answer or Originate	Ans			OFF							
	Orig			ON							
Slave Clock	Receive				ON						
	External				OFF						
Master Clock	Internal					OFF					
	External					ON					
Remote Loopback	V.54						OFF				
	V.22						ON				
Parity Select	Parity							ON			
	No Parity							OFF			
Local Echo	Enabled								ON		
	Disabled								OFF		
Parity Type	Odd									ON	
	Even									OFF	
Fallback Select	CCITT										ON
	BELL										OFF

Table B-3   DF124-AM Switchpack 2 Selections

Option	Selection	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
Character	8 Bits	ON		ON							
Length	9 Bits	OFF		ON							
	10 Bits	ON		OFF							
	11 Bits	OFF		OFF							
Async	Basic		ON								
Rate	Extended		OFF								
Mode	Sync				OFF						
Select	Async				ON						
Response	Long					OFF					
Message	Short					ON					
MI	Enabled						OFF				
	Disabled						ON				
Auto	Manual							ON			
Answer	Auto							OFF			
PSTN or	PSTN								OFF		
PLTN	PLTN								ON		
Signal	-49 dBm									OFF	
Detector	-37 dBm									ON	
Threshold											
Retrain	Enabled										ON
	Disabled										OFF

Table B-4   DF124-AM Switchpack 3 Selections

Option	Selection	S1	S2	S3	S4	S5	S6	S7	S8
Abort Timer	Enabled	ON							
	Disabled	**OFF**							
DTR	External		ON						
	Forced ON		**OFF**						
RTS	**External**			**ON**					
	Forced ON			OFF					
Interface Rate Select Control	**Enabled**				**ON**				
	Disabled				OFF				
Guard Tone Select	**Enabled**					**OFF**			
	Disabled					ON			
Pulse Dialing Duty Cycle	**60%**						**OFF**		
	67%						**ON**		
Interface Local Loop Control	Enabled							ON	
	Disabled							**OFF**	
Interface Remote Digital Loop Control	Enabled								ON
	Disabled								**OFF**

Table B-5 DF124-AM Switchpack 4 Selections

Option	Selection	S1	S2	S3	S4	S5	S6	S7	S8
PSTN Xmit Level	- 2 dBm	These switches are							
	- 3 dBm	disabled for U.S.							
	- 4 dBm	and Canadian instal-							
	- 5 dBm	lations. The option							
	- 6 dBm	is hard-wired to							
	- 7 dBm	select -10 dBm.							
	- 8 dBm								
	- 9 dBm								
	-10 dBm								
	-11 dBm								
	-12 dBm								
	-13 dBm								
	-14 dBm								
	-15 dBm								
	-16 dBm								
	-17 dBm								
PLTN Xmit Level	- 2 dBm					OFF	OFF	OFF	OFF
	- 3 dBm					ON	OFF	OFF	OFF
	- 4 dBm					OFF	ON	OFF	OFF
	- 5 dBm					ON	ON	OFF	OFF
	- 6 dBm					OFF	OFF	ON	OFF
	- 7 dBm					ON	OFF	ON	OFF
	- 8 dBm					OFF	ON	ON	OFF
	- 9 dBm					ON	ON	ON	OFF
	-10 dBm					OFF	OFF	OFF	ON
	-11 dBm					ON	OFF	OFF	ON
	-12 dBm					OFF	ON	OFF	ON
	-13 dBm					ON	ON	OFF	ON
	-14 dBm					OFF	OFF	ON	ON
	-15 dBm					ON	OFF	ON	ON
	-16 dBm					OFF	ON	ON	ON
	-17 dBm					ON	ON	ON	ON

B.4 THE DF126 LINK MODEM

Whether using the DF126 modem as an integral or standalone modem with the DFM unit, certain modem options must be correctly selected. Figure B-4 shows the location of switchpacks, while Tables B-6 through B-11 indentify which options are required with the DFM unit and the switch positions necessary to select those options.
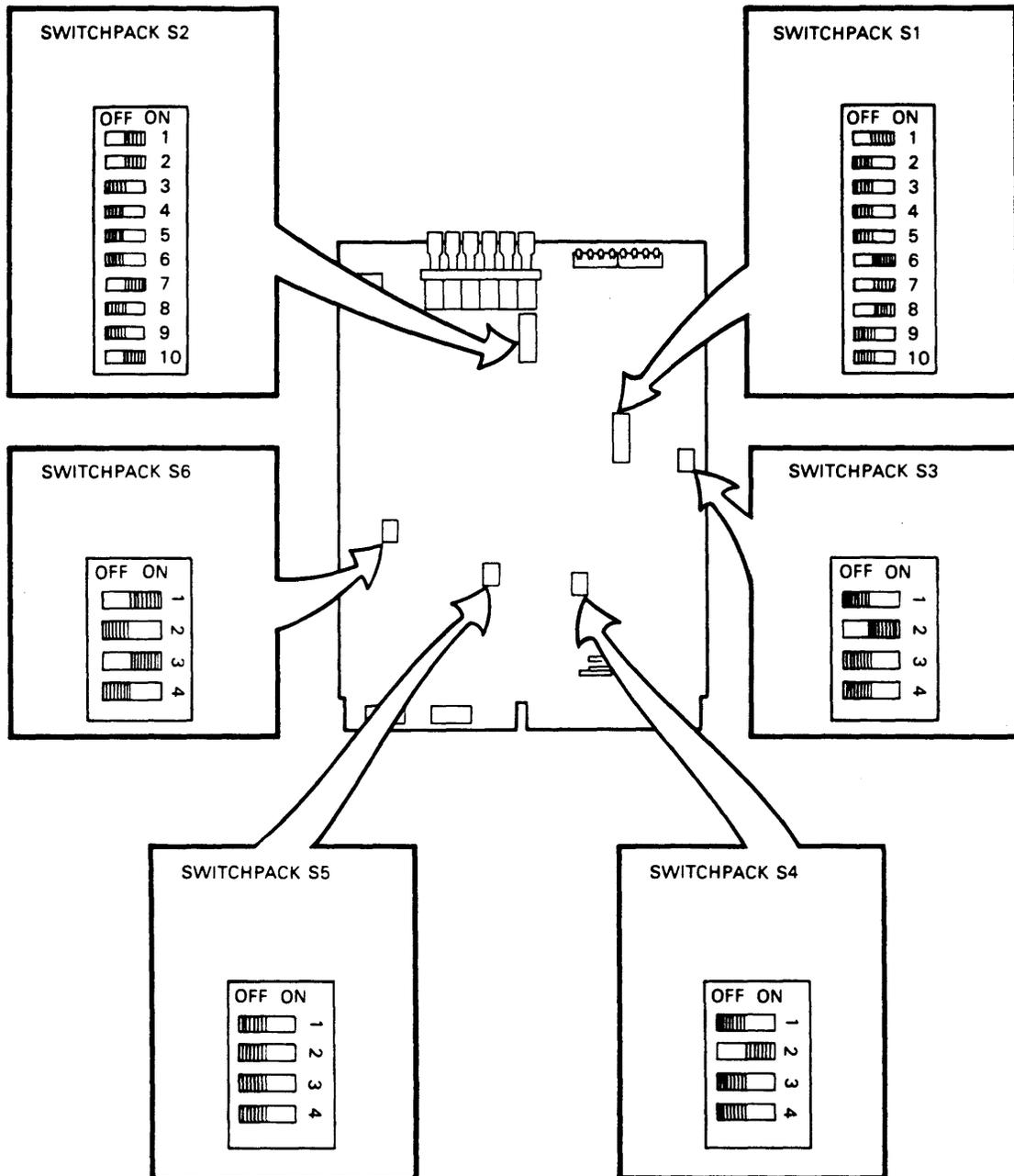

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Figure B-4   DF126-AM Module Layout and Switchpack Locations

Table B-6 DF126-AM Switchpack 1 Selections

Option	Selection	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
Scrambler	Enabled	ON									
	Disabled	OFF									
Terminal Timing	Enabled		ON								
	Disabled		OFF								
Slave Timing	Enabled			ON							
	Disabled			OFF							
Coding Option	A Coding				ON						
	B Coding				OFF						
CTS Delay	147-154 ms					ON	ON				
	8.5-9.35 ms					ON	OFF				
	0 ms					OFF	ON				
	24.9-26.4 ms					OFF	OFF				
Constant Carrier	Enabled							ON			
	Disabled							OFF			
Speed Indicate/ Select	Indicate								ON		
	Select								OFF		
Receiver Squelch	Maximum									ON	
	Minimum									OFF	
Reserved											NOT USED

Table B-7   DF126-AM Switchpack 2 Selections

Option	Selection	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
Abort Timer	Disabled	OFF									
	Enabled	ON									
Remote Loopback Initiate	Disabled		OFF								
	Enabled		ON								
PSTN or PLTN	PSTN			ON							
	PLTN			OFF							
Mode Select	Sync				OFF						
	Async				ON						
Response Message	Long					OFF					
	Short					ON					
Auto-Answer	Auto						OFF				
	Manual						ON				
Character Length	11 Bits							OFF	OFF		
	10 Bits							ON	OFF		
	9 Bits							OFF	ON		
	8 Bits							ON	ON		
Parity Select	Parity									ON	
	No Parity									OFF	
Local Echo	Disabled										OFF
	Enabled										ON

Table B-8   DF126-AM Switchpack 3 Selections

Option	Selection	S1	S2	S3	S4
Parity Type	Odd Even	ON OFF			
Secondary Data Port	Enabled Disabled		ON OFF		
Reserved				NOT USED	NOT USED

Table B-9   DF126-AM Switchpack 4 Selections

Option	Selection	S1	S2	S3	S4
PR/PC*	Permissive Programmed	OFF ON	ON OFF		
Reserved				NOT USED	
MI	Disabled Enabled				OFF ON

* Only one may be ON, the other must be OFF. Permissive is used with RJ11C/CA11A service and programmed is used with RJ41S/RJ45S/CA41A/CA45A type service.

Table B-10 DF126-AM Switchpack 5 Selections

Option	Selection	S1	S2	S3	S4
Private Line	0 dBm	OFF	OFF	OFF	OFF
Xmit	- 1 dBm	ON	OFF	OFF	OFF
Level	- 2 dBm	OFF	ON	OFF	OFF
	- 3 dBm	ON	ON	OFF	OFF
	- 4 dBm	OFF	OFF	OFF	ON
	- 5 dBm	ON	OFF	OFF	ON
	- 6 dBm	OFF	ON	OFF	ON
	- 7 dBm	ON	ON	OFF	ON
	- 8 dBm	OFF	OFF	ON	OFF
	- 9 dBm	ON	OFF	ON	OFF
	-10 dBm	OFF	ON	ON	OFF
	-11 dBm	ON	ON	ON	OFF
	-12 dBm	OFF	OFF	ON	ON
	-13 dBm	ON	OFF	ON	ON
	-14 dBm	OFF	ON	ON	ON
	-15 dBm	ON	ON	ON	ON

Table B-11 DF126-AM Switchpack 6 Selections

Option	Selection	S1	S2	S3	S4
Carrier	-43 dBm	OFF			
Detect	-33 dBm	ON			
Level					
Reserved			NOT USED		
Equalizer*	In			OFF	ON
	Out			ON	OFF

*Only one may be ON, the other must be OFF.

B.5 THE DF127 LINK MODEM

Whether using the DF127 modem as an integral or standalone modem with the DFM unit, certain modem options must be correctly selected. There are three versions of the DF127 modem module that can be used with the DFM unit. The early version (below serial number NQ01800) can only be used as an integral modem. It cannot be used in the DF100 series standalone enclosure.

Version 2 of the DF127 modem modules can be used in both integral or standalone configurations and consists of modules between serial number NQ01800 and NQ03000.

Version 3 (above serial number NQ03000) is similar to Version 2 and has been redesigned to take advantage of new state-of-the-art technology and components. Modem options offered on Versions 2 and 3 are the same, however, component layout and placement of switchpacks are different than Version 2. Modem options and switch selections on Version 1 are completely different than Versions 2 and 3. Figures B-5, B-6, and B-7 show each of the DF127 versions.

Each modem module must be removed from the DFM enclosure to access the switches.

CAUTION
Disconnect power to the unit before removing the integral modem module from Slot 1 for switchpack reconfiguration.

B.5.1 DF127 Version 1 Configuration Options

There are two types of switch selections on the DF127 Version 1 module: a 10-position raised rocker switchpack that selects modem options and a 16-position slide switch that adjusts the analog output level. Refer to Figure B-5 for the locations of switchpack and analog output level adjustments on the modem. Refer to Tables B-12 and B-13 for DF127 Version 1 option selections.
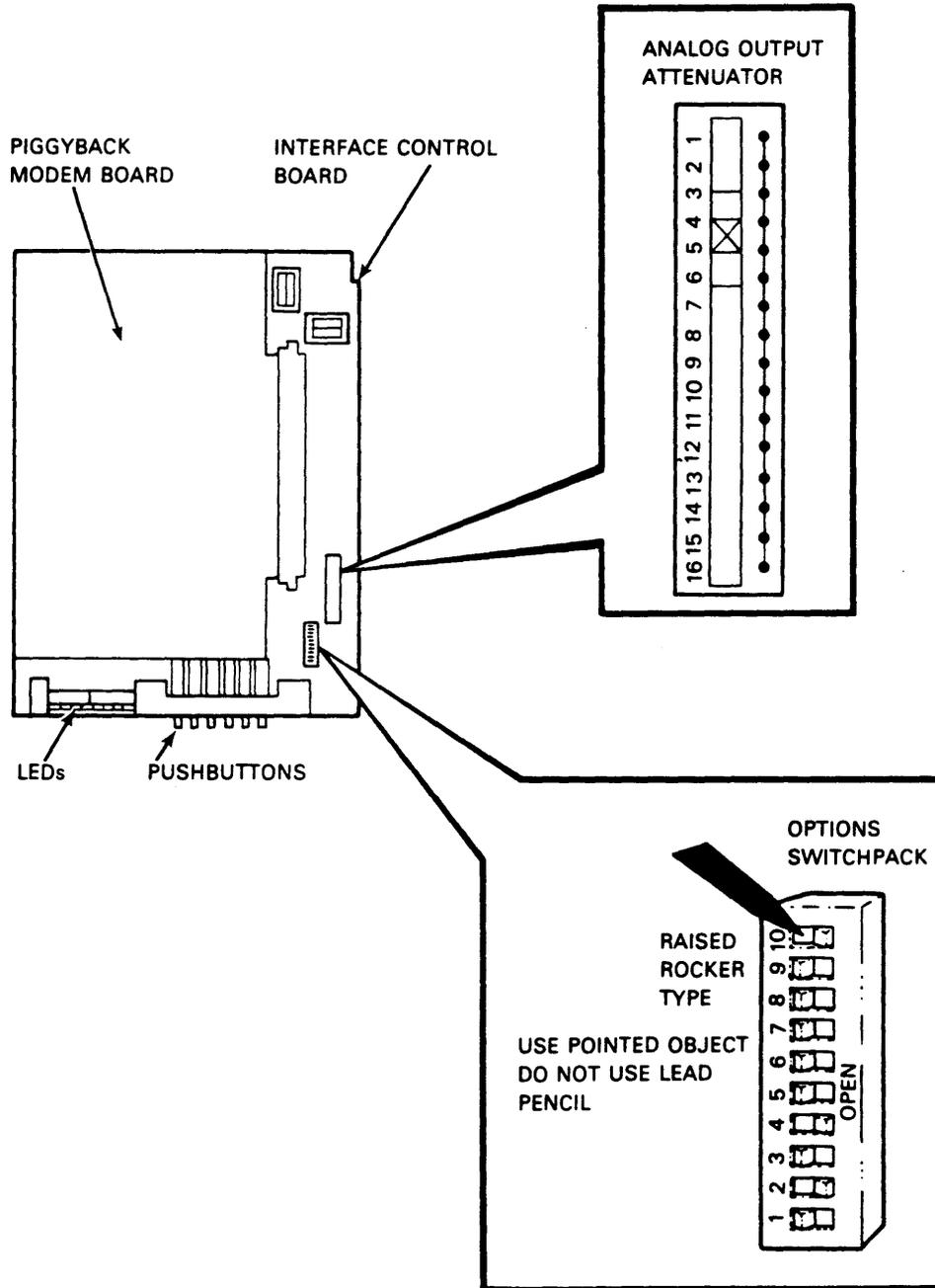
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Figure B-5   DF127-AM Module (Version 1) Layout and Switchpack Locations

Table B-12 Switchpack Options

Switch Number	Function	Switch Position Closed	Open
1	Transmitter Clock	External Clock	Internal Clock
2	Equalizer Sampling Period	T	T/2
3	Carrier Control	RTS Controlled	Continuous
4	Loopback Control	Bi-Directional	Uni-Directional
5	SPARE - Not Used		
6	Data Set Ready (DSR) Control	Normal Data	Power-up
7	Threshold Level Select	-26 dBm	-43 dBm
8	SPARE - Not Used		
9	Automatic Fallback	Disabled	Enabled
10	Remote Loopback	Disabled	Enabled

Table B-13   Analog Output Attenuation

Position	Attenuation
1	0 dBm
2	- 1 dBm
3	- 2 dBm
4	- 3 dBm
5	- 4 dBm
6	- 5 dBm
7	- 6 dBm
8	- 7 dBm
9	- 8 dBm
10	- 9 dBm
11	-10 dBm
12	-11 dBm
13	-12 dBm
14	-13 dBm
15	-14 dBm
16	-15 dBm

B.5.2 DF127 Version 2 and 3 Configuration Options

Versions 2 and 3 of the DF127 modem module contain three switch-packs and several jumpers to select modem options. See Figure B-6 for Version 2 jumper/switchpack layout and Figure B-7 for Version 3 jumper/switchpack layout. Option selections are the same for Versions 2 and 3 (see Tables B-14 and B-15 for jumpers, and B-16 through B-19 for switches). Switchpack locations, however, are different.
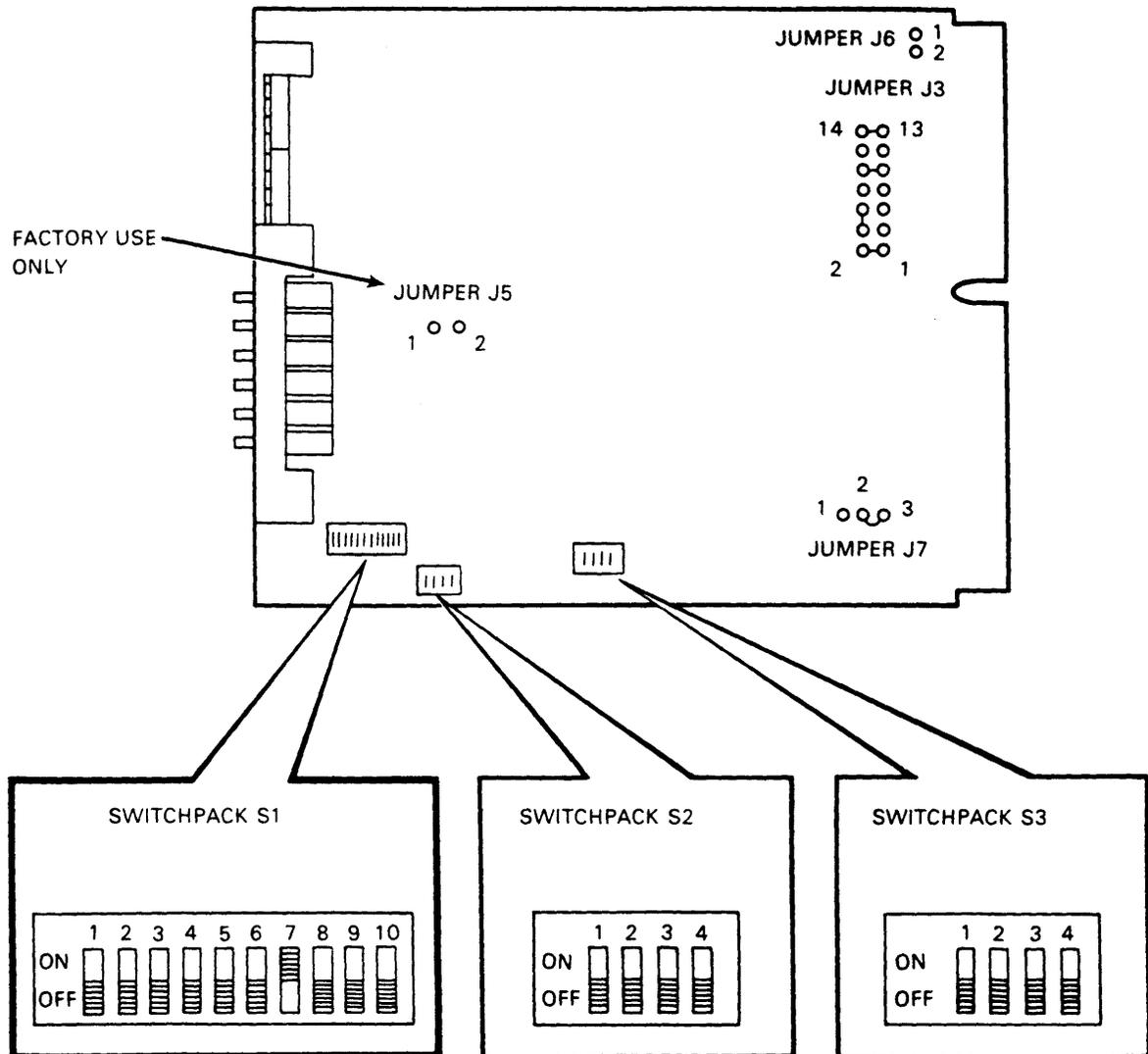
Figure B-6   DF127-AM Module (Version 2) Layout and Switchpack Locations

Figure B-7   DF127-AM Module (Version 3) Layout and
Switchpack Locations

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Table B-14   Jumper Selections for Version 2

Option	Selection	Jumpers* J3 1-2	3-4	4-6	7-8	9-10	11-12	13-14	J6 1-2	J7 1-2	2-3
Speed Indicate/ Select	Indicate	IN	OUT	IN							
	Select	OUT	IN	OUT							
Interface Local Loop Control	Enabled				IN	OUT					
	Disabled				OUT	IN					
Interface Remote Digital Loop Control	Enabled						IN	OUT			
	Disabled						OUT	IN			
Protective Ground to Modem Ground	Enabled								IN		
	Disabled								OUT		
2- or 4- Wire Private Line	2-Wire									IN	OUT
	4-Wire									OUT	IN

* Jumpers on J4 are used for special maintenance testing and jumper J5 is for factory use only. Each of these are not user functions.

Table B-15   Jumper Selections for Version 3

| Option | Selection | J5 | | | | | | | J8 | J6 | |
		1-2	3-4	5-6	7-8	9-11	11-12	13-14	1-2	1-3	2-4
Speed Indicate/ Select	Indicate					IN	OUT	IN			
	Select					OUT	IN	OUT			
Interface Local Loop Control	Enabled			OUT	IN						
	Disabled			IN	OUT						
Interface Remote Digital Loop Control	Enabled	OUT	IN								
	Disabled	IN	OUT								
Protective Ground to Modem Ground	Enabled								IN		
	Disabled								OUT		
2- or 4-Wire Private Line	2-Wire									IN	OUT
	4-Wire									OUT	IN

* Jumpers on J2 are used for special maintenance testing and jumper J3 is for factory use only. Each of these are not user functions.

Table B-16 DF127-AM Switchpack 1 Selections for Version 2

Option	Selection	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
Transmit Clock 1	External Internal	ON OFF									
Equalizer Sampling	T T/2 ①		ON OFF								
Carrier Control	RS Continuous ①			ON OFF							
Loopback Control	Bi-Direction Uni-Direction				ON OFF						
Squelch	Enabled Disabled ①					ON OFF					
Transmit Clock 2	Slave Independent ②						ON OFF				
Carrier Threshold	-26 dBm -43 dBm							ON OFF			
Data Qual Threshold	10^{-4} 10^{-3} ③								ON OFF		
RS to CS	<15 ms Training ① & ④									ON OFF	
Remote Loopback	Disabled Enabled										ON OFF

NOTES:

① These options must be set to OFF when the DF127 modem is used with the DFM unit.

② This option only applies when the Transmit Clock 1 is set to internal.

③ This option is enabled or disabled by switchpack 2, switch 1. When enabled, retraining occurs when the error rate reaches the data quality threshold selected by switchpack 1, switch 8.

④ When this switch is OFF, the training period varies with modem speed and the selection of switchpack 2, switch 3. This option is valid only in continuous carrier mode.

Table B-17 DF127-AM Switchpack 1 Selections for Version 3

Option	Selection	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
Transmit Clock 1	External	ON									
	Internal	OFF									
Equalizer Sampling	T		ON								
	T/2 ①		OFF								
Carrier Control	RS			ON							
	Continuous ①			OFF							
Loopback Control	Bi-Direction				ON						
	Uni-Direction				OFF						
Squelch	Enabled					ON					
	Disabled ①					OFF					
Transmit Clock 2	Slave						ON				
	Independent ②						OFF				
Carrier Threshold	-26 dBm							ON			
	-43 dBm							OFF			
Data Qual Threshold	10^{-4}								ON		
	10^{-3} ③								OFF		
RS to CS	<3 ms									ON	
	50 ms ① & ④									OFF	
Remote Loopback	Disabled										ON
	Enabled										OFF

NOTES:

① These options must be set to OFF when the DF127 modem is used with the DFM unit.

② This option only applies when the Transmit Clock 1 is set to internal.

③ This option is enabled or disabled by switchpack 2, switch 1. When enabled, retraining occurs when the error rate reaches the data quality threshold selected by switchpack 1, switch 8.

④ This option is valid only in continuous carrier mode (switchpack 1, switch 3 = ON) when the modems are already trained. In RS controlled carrier mode (switchpack 1, switch 3 = OFF) switch 9 has no effect. In this mode RS to CS delay is dependent on modem speed and the training interval selection of switchpack 2, switch 3.

Table B-18 DF127-AM Switchpack 2 Selections (Versions 2 and 3)

Option	Selection	S1	S2	S3	S4
Data Quality Retrain	Disabled Enabled ① & ②	ON OFF			
Round Robin Retrain	Disabled Enabled ③		ON OFF		
Training Interval	Short Long ② & ④			ON OFF	
Reserved					NOT USED

NOTES:

① This switch works together with switchpack 1, switch 8.

② These options must be set to OFF when the DF127 modem is used with the DFM unit.

③ This switch is valid only in RS controlled carrier mode. In continuous carrier mode, the round-robin feature is always enabled, regardless of the position of this switch.

④ This switch selects the training interval (see chart below) when switchpack 1, switch 9 is set to OFF.

Speed	Long Interval (Switch 3 OFF)	Short Interval (Switch 3 ON)
Normal (4800 bits/s)	708 ms	50 ms
Fallback (2400 bits/s)	943 ms	66 ms

Table B-19 DF127-AM Switchpack 3 Selections (Versions 2 and 3)

Option	Selection	S1	S2	S3	S4
PLTN	Ø dBm	OFF	OFF	OFF	OFF
Xmit Level	- 1 dBm	ON	OFF	OFF	OFF
Attenuation	- 2 dBm	OFF	ON	OFF	OFF
	- 3 dBm	ON	ON	OFF	OFF
	- 4 dBm	OFF	OFF	ON	OFF
	- 5 dBm	ON	OFF	ON	OFF
	- 6 dBm	OFF	ON	ON	OFF
	- 7 dBm	ON	ON	ON	OFF
	- 8 dBm	OFF	OFF	OFF	ON
	- 9 dBm	ON	OFF	OFF	ON
	-1Ø dBm	OFF	ON	OFF	ON
	-11 dBm	ON	ON	OFF	ON
	-12 dBm	OFF	OFF	ON	ON
	-13 dBm	ON	OFF	ON	ON
	-14 dBm	OFF	ON	ON	ON
	-15 dBm	ON	ON	ON	ON

B.6 THE DF129 LINK MODEM

Whether using the DF129 modem as an integral or standalone modem with the DFM unit, certain modem options must be correctly selected. Like the DF127 modem, there are three versions of the DF129 modem module that can be used with the DFM unit. The early version (below serial number NQ001700) can only be used as an integral modem. It cannot be used in the DF100 series standalone enclosure.

DF129 Version 2 can be used in both integral or standalone configurations and consists of modules between serial number NQ001700 and NQ004000.

Version 3 (above serial number NQ004000) is a similar to Version 2 and has been redesigned to take advantage of new state-of-the-art technology and components. Modem options offered on Versions 2 and 3 are the same, however, component layout and placement of switchpacks are different than Version 2. Modem options and switch selections on Version 1 are completely different than Versions 2 and 3. Figures B-8, B-9, and B-10 show each of the DF129 versions.

Each modem module must be removed from the DFM enclosure to access the switches.

CAUTION
Disconnect power to the unit before removing the integral modem module from Slot 1 for switchpack reconfiguration.

B.6.1 DF129 Version 1 Configuration Options

There are two types of switch selections on the DF129 Version 1 module: a 10-position raised rocker switchpack that selects modem options and a 16-position slide switch that adjusts the analog output level. Refer to Figure B-8 for the locations of switchpack and analog output level adjustments on the modem. Refer to Tables B-20 and B-21 for DF129 Version 1 option selections.
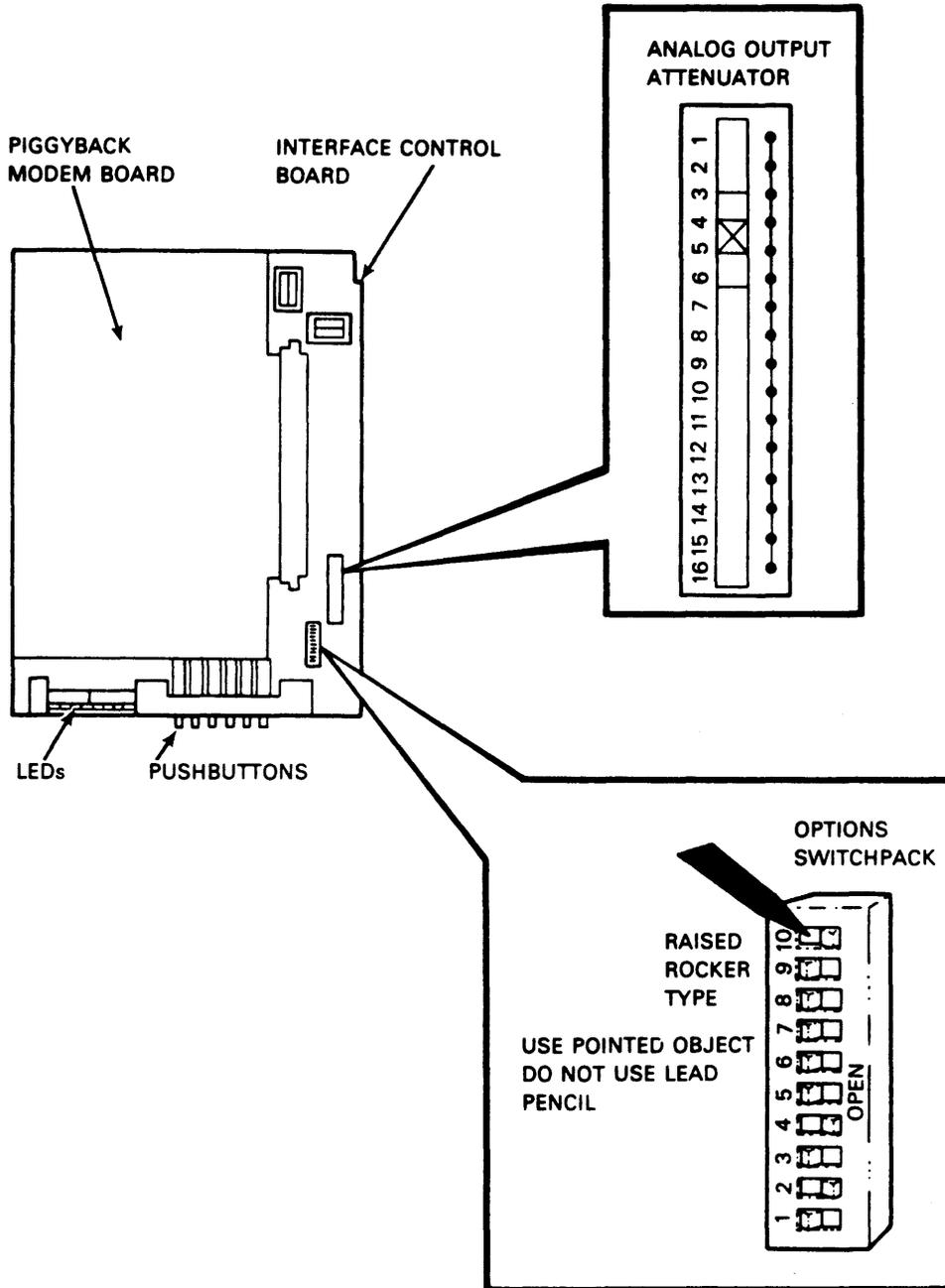
MKV84-0296

Figure B-8 DF129-AM Module (Version 1) Layout and Switchpack Locations

Table B-2Ø   Switchpack Options

Switch Number	Function	Switch Position Closed	Open
1	Transmitter Clock	External Clock	Internal Clock
2	Equalizer Sampling Period	T	T/2
3	Carrier Control	RTS Controlled	Continuous
4	Loopback Control	Bi-Directional	Uni-Directional
5	SPARE - Not Used		
6	Data Set Ready (DSR) Control	Normal Data	Power-up
7	Threshold Level Select	-26 dBm	-43 dBm
8	SPARE - Not Used		
9	Automatic Fallback	Disabled	Enabled
1Ø	Remote Loopback	Disabled	Enabled

Table B-21   Analog Output Attenuation

Position	Attenuation
1	Ø dBm
2	- 1 dBm
3	- 2 dBm
4	- 3 dBm
5	- 4 dBm
6	- 5 dBm
7	- 6 dBm
8	- 7 dBm
9	- 8 dBm
1Ø	- 9 dBm
11	-1Ø dBm
12	-11 dBm
13	-12 dBm
14	-13 dBm
15	-14 dBm
16	-15 dBm

B.6.2 DF129 Version 2 and 3 Configuration Options

Versions 2 and 3 of the DF129 modem module contain three switch-packs and several jumpers to select modem options. See Figure B-9 for Version 2 jumper/switchpack layout and Figure B-10 for Version 3 jumper/switchpack layout. Option selections are the same for Versions 2 and 3 (see Tables B-22 and B-23 for jumpers, and B-24, B-25, and B-26 for switches). Switchpack locations, however, are different.
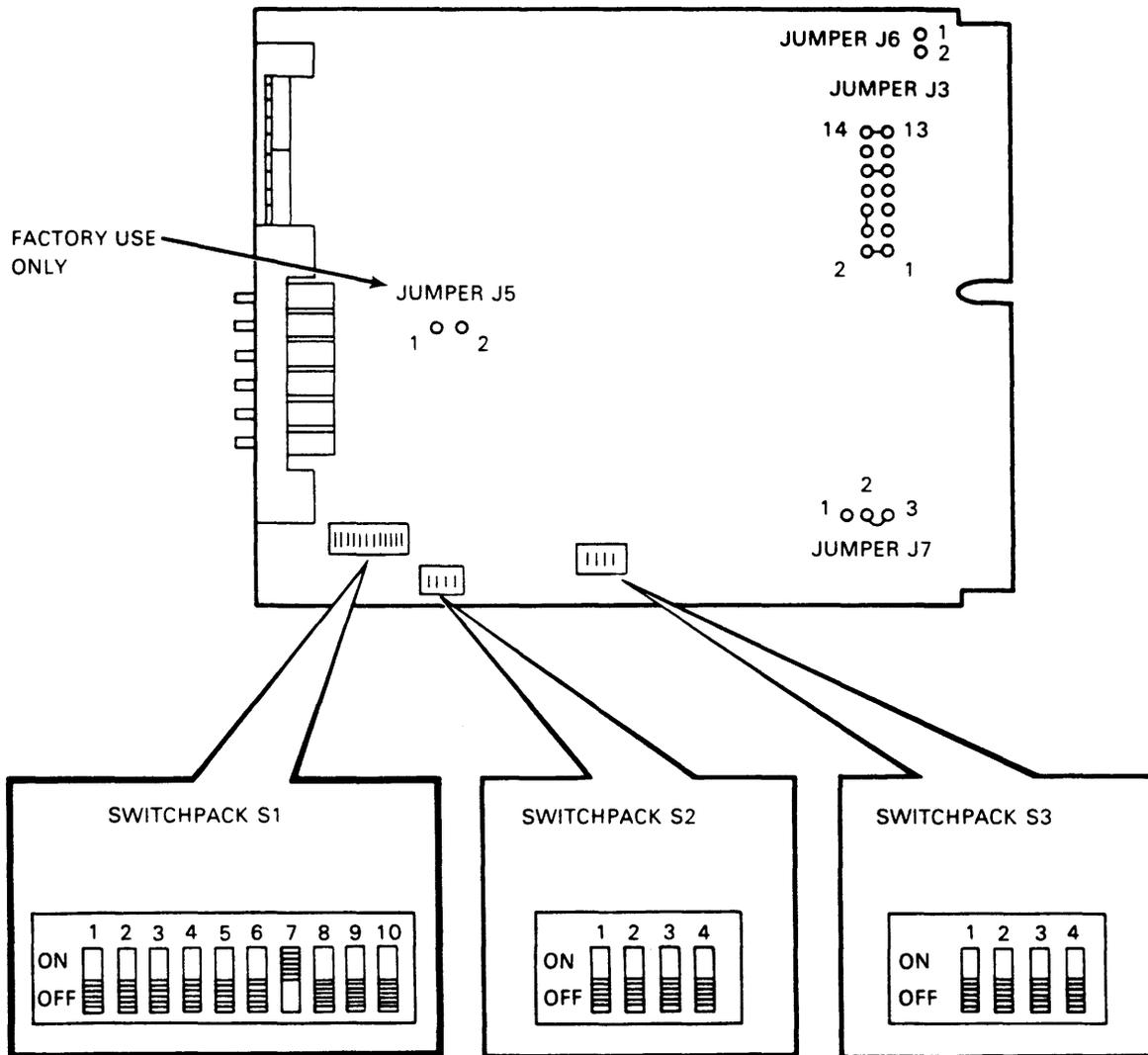
MKV85-2025

Figure B-9   DF129-AM Module (Version 2) Layout and Switchpack Locations
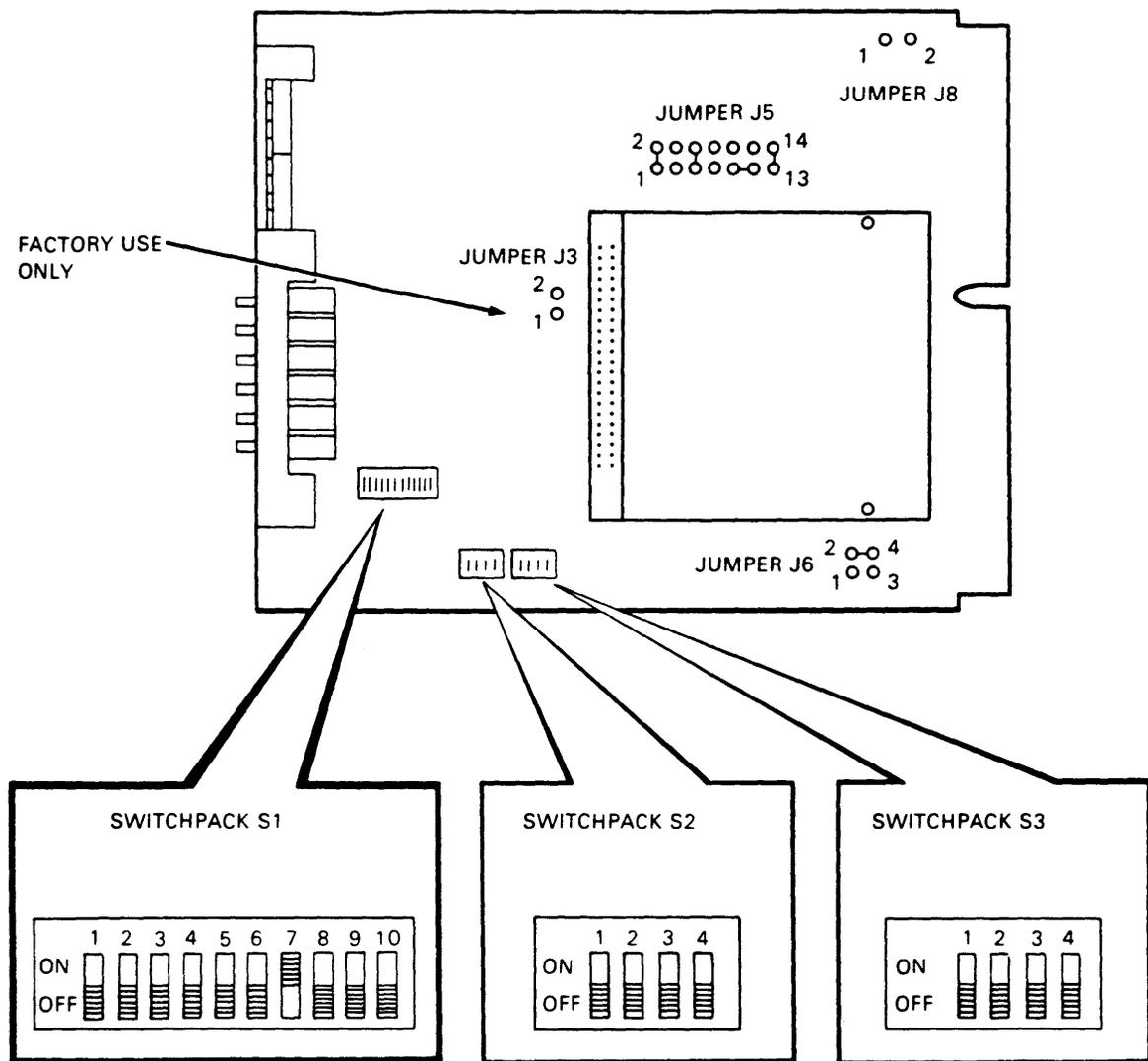
Figure B-10   DF129-AM Module (Version 3) Layout and
Switchpack Locations

Table B-22   Jumper Selections for Version 2

Option	Selection	Jumpers*									
		J3							J6	J7	
		1-2	3-4	4-6	7-8	9-10	11-12	13-14	1-2	1-2	2-3
Speed Indicate/ Select	Indicate	IN	OUT	IN							
	Select	OUT	IN	OUT							
Interface Local Loop Control	Enabled				IN	OUT					
	Disabled				OUT	IN					
Interface Remote Digital Loop Control	Enabled						IN	OUT			
	Disabled						OUT	IN			
Protective Ground to Modem Ground	Enabled								IN		
	Disabled								OUT		
2- or 4- Wire Private Line	2-Wire ①									IN	OUT
	4-Wire									OUT	IN

① Does not apply to DF129 modem.

* Jumpers on J4 are used for special maintenance testing and jumper J5 is for factory use only. Each of these are not user functions.

Table B-23   Jumper Selections for Version 3

Option	Selection	1-2	3-4	5-6	7-8	9-11	11-12	13-14	J8 1-2	J6 1-3	J6 2-4
Speed Indicate/ Select	Indicate					IN	OUT	IN			
	Select					OUT	IN	OUT			
Interface Local Loop Control	Enabled			OUT	IN						
	Disabled			IN	OUT						
Interface Remote Digital Loop Control	Enabled	OUT	IN								
	Disabled	IN	OUT								
Protective Ground to Modem Ground	Enabled								IN		
	Disabled								OUT		
2- or 4-Wire Private Line	2-Wire ①									IN	OUT
	4-Wire									OUT	IN

① Does not apply to DF129 modem.

* Jumpers on J2 are used for special maintenance testing and jumper J3 is for factory use only. Each of these are not user functions.

B-31

Table B-24 DF129-AM Switchpack 1 Selections

Option	Selection	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
Transmit Clock 1	External	ON									
	Internal	OFF									
Equalizer Sampling	T		ON								
	T/2 ①		OFF								
Carrier Control	RS			ON							
	Continuous ①			OFF							
Loopback Control	Bi-Direction				ON						
	Uni-Direction				OFF						
Squelch	Enabled					ON					
	Disabled ①					OFF					
Transmit Clock 2	Slave						ON				
	Independent ②						OFF				
Carrier Threshold	-26 dBm							ON			
	-43 dBm							OFF			
Data Qual Threshold	10^{-4}								ON		
	10^{-3} ③								OFF		
RS to CS	<15 ms									ON	
	253 ms ① & ④									OFF	
Remote Loopback	Disabled										ON
	Enabled										OFF

NOTES:

① These options must be set to OFF when the DF129 modem is used with the DFM unit.

② This option only applies when the Transmit Clock 1 is set to internal.

③ This option is enabled or disabled by switchpack 2, switch 1. When enabled, retraining occurs when the error rate reaches the data quality threshold selected by switchpack 1, switch 8.

④ This option is valid only in continuous carrier mode.

Table B-25 DF129-AM Switchpack 2 Selections

Option	Selection	S1	S2	S3	S4
Data Quality Retrain	Disabled Enabled ① & ②	ON OFF			
Round Robin Retrain	Disabled Enabled ③		ON OFF		
Not Used On DF129				NOT USED	
Reserved					NOT USED

NOTES:

① This switch works together with switchpack 1, switch 8.

② These options must be set to OFF when the DF129 modem is used with the DFM unit.

③ This switch is valid only in RS controlled carrier mode. In continuous carrier mode, the round-robin feature is always enabled, regardless of the position of this switch.

Table B-26 DF129-AM Switchpack 3 Selections

Option	Selection	S1	S2	S3	S4
PLTN	Ø dBm	OFF	OFF	OFF	OFF
Xmit Level	− 1 dBm	ON	OFF	OFF	OFF
Attenuation	− 2 dBm	OFF	ON	OFF	OFF
	− 3 dBm	ON	ON	OFF	OFF
	− 4 dBm	OFF	OFF	ON	OFF
	− 5 dBm	ON	OFF	ON	OFF
	− 6 dBm	OFF	ON	ON	OFF
	− 7 dBm	ON	ON	ON	OFF
	− 8 dBm	OFF	OFF	OFF	ON
	− 9 dBm	ON	OFF	OFF	ON
	−1Ø dBm	OFF	ON	OFF	ON
	−11 dBm	ON	ON	OFF	ON
	−12 dBm	OFF	OFF	ON	ON
	−13 dBm	ON	OFF	ON	ON
	−14 dBm	OFF	ON	ON	ON
	−15 dBm	ON	ON	ON	ON

C.1 GENERAL

This appendix outlines pin connections and EIA signal assignments for the cables used with the DFM system. For more information on cables and connections, see Section 2.8.

SIGNAL ABBREVIATIONS

Abbreviations used in the wiring tables are listed below. Unidentified pin connections are not used.

```
CTS -- Clear to send
DCE -- Data communications equipment
DSR -- Data set ready
DTE -- Data terminal equipment
DTR -- Data terminal ready
ERC -- External receive clock
ETC -- External transmit clock
CD  -- Carrier detect
PG  -- Protective ground
RC  -- Receive clock
RD  -- Received data
RI  -- Ring
RLS -- Reverse carrier (reverse CD)
RRI -- Reverse ring (busy out)
RTS -- Request to send
SG  -- Signal ground
TC  -- Transmit clock
TD  -- Transmitted data
```

C.2 CABLE E (BC22E) DFM TO ASYNCHRONOUS DTE

The BC22E cable is used for connecting an asynchronous DTE to a DFM channel. (The DFM unit presents a DCE interface on channel ports.)

The BC22E cable is not symmetrical (see Figure C-1). The male connector must be attached to the DFM unit.

```
PG    1 O————————————————————O 1
TD    2 O————————————————————O 2
RD    3 O————————————————————O 3
RTS   4 O————————————————————O 4
CTS   5 O————————————————————O 5
DSR   6 O————————————————————O 6
SG    7 O————————————————————O 7
CD    8 O————————————————————O 8
RLS  11 O————————————————————O 11
     12 O————————————————————O 12
     18 O————————————————————O 18
     19 O————————————————————O 19
DTR  20 O————————————————————O 20
RI   22 O————————————————————O 22
     23 O————————————————————O 23
RRI  25 O————————————————————O 25
```
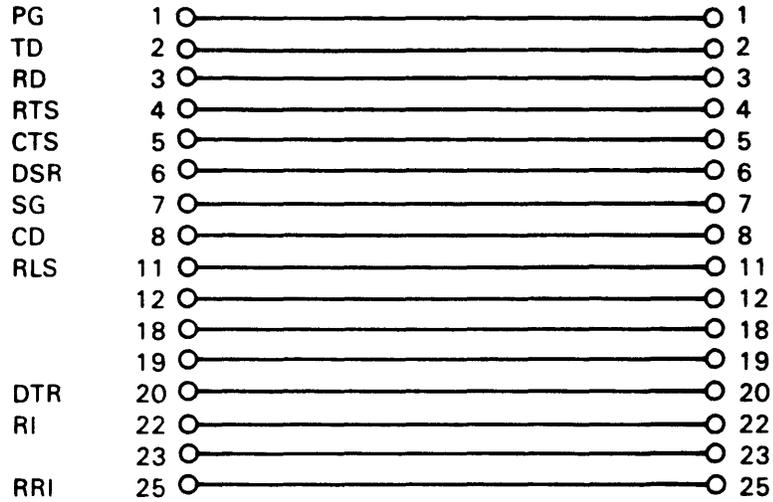
MKV85-2027

Figure C-1 BC22E Cable -- DFM to Asynchronous DTE

C.3 CABLE F (BC22F) DFM TO SYNCHRONOUS DTE

The BC22F cable is used to connect the DFM link port to an external modem. It is also used to connect a DFM synchronous channel to a synchronous or DDCMP device.

The BC22F cable is symmetrical (see Figure C-2).

```
PG     1  O─────────────────────O  1
TD     2  O─────────────────────O  2
RD     3  O─────────────────────O  3
RTS    4  O─────────────────────O  4
CTS    5  O─────────────────────O  5
DSR    6  O─────────────────────O  6
SG     7  O─────────────────────O  7
CD     8  O─────────────────────O  8
ERC    9  O─────────────────────O  9
ETC   10  O─────────────────────O 10
RLS   11  O─────────────────────O 11
      12  O─────────────────────O 12
      13  O─────────────────────O 13
      14  O─────────────────────O 14
TC    15  O─────────────────────O 15
      16  O─────────────────────O 16
RC    17  O─────────────────────O 17
      18  O─────────────────────O 18
      19  O─────────────────────O 19
DTR   20  O─────────────────────O 20
      21  O─────────────────────O 21
RI    22  O─────────────────────O 22
      23  O─────────────────────O 23
      24  O─────────────────────O 24
RRI   25  O─────────────────────O 25
```
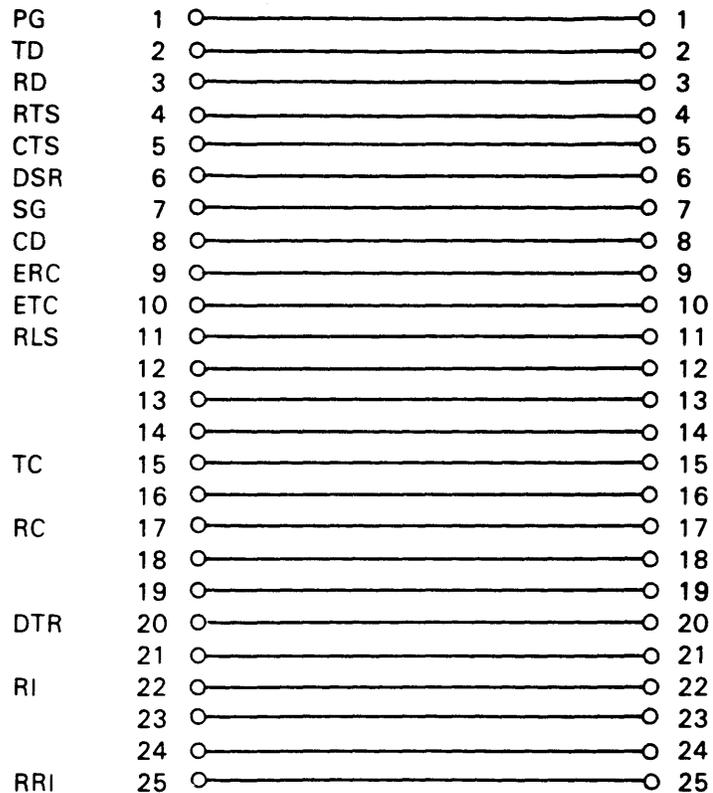
MKV85-2028

Figure C-2   BC22F Cable -- DFM to Synchronous DTE

C.4 CABLE L (BC22L) SPECIAL DIRECT LINK
The BC22L cable is used to directly connect two DFM units (no modems in between) by means of connector J18 on both units. The link speed selection must be set to async on both DFM units when using the direct link configuration. In accordance with EIA standards, a maximum distance of 15.24 m (50 ft) between units is recommended.

The BC22L cable may also be used to connect the units for the preinstallation benchtest when integral modems are not purchased (see Chapter 3). The BC22L cable is symmetrical (see Figure C-3).

```
TD      2 O————————————⨉————————————O 2
RD      3 O————————————⨉————————————O 3
RTS     4 O——————┐          ┌——————O 4
CTS     5 O——————┘          └——————O 5
DSR     6 O————————┐      ┌————————O 6
SG      7 O————————┼——————┼————————O 7
CD      8 O————————●——⨉——●————————O 8
DTR    20 O——————————⨉——————————————O 20
```
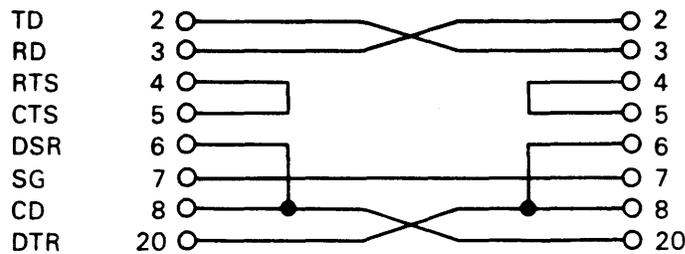
MKV85-2029

Figure C-3   BC22L Cable -- Direct Link

C.5 CABLE M (BC22M) DCE TO DCE CROSSOVER

The BC22M cable is used to connect a DFM channel to a modem. This cable is frequently called a "crosspatch" or "crossover" cable because it crosses EIA signals inside the cable. By using the BC22M cable and the proper software parameter settings to handle a channel to modem connection, the DFM unit passes the four EIA signals (CTS, DSR, CD, and RI) through to the device connected at the corresponding remote-end device. The RTS and DTR from the remote-end device are passed through to the modem. This is accomplished by crossing CTS with RTS, DSR with DTR, connecting RC and TC from modem to external clocks on the DFM unit, and connecting RI pins to RRI at the DFM unit for a busy signal.

The BC22M cable is not a symmetrical cable. It has two male ends. P1 must be connected to the DFM unit (see Figure C-4).

```
              P1                                      P2

TD      2 O------------------\    /------------------O 2
RD      3 O------------------ \  / ------------------O 3
RTS     4 O----------------\   \/   ----------------O 4
CTS     5 O----------------  \ /\  /----------------O 5
DSR     6 O-----------       \/  \/                 O 6
SG      7 O-----------       /\                      O 7
                                                     O 8

ERC     9 O--------|
ETC    10 O--------|
CD     11 O--------|
                                                     O 15
                                                     O 17
DTR    20 O------------------                        O 20
RI     22 O--------●---------                        O 22
       24 O--------|                                 O 24
RRI    25 O--------|
```
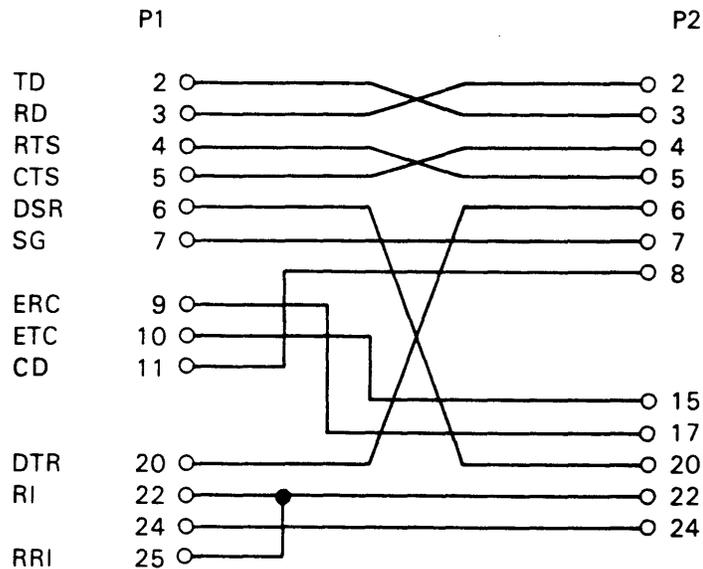
MKV85-2030

Figure C-4 BC22M Cable -- DCE to DCE Crossover (Shielded)

C.6 CABLE T SPECIAL LOOPBACK TEST CABLE
This special cable is required to run the Signals test for the link and DFM channels. This cable is NOT available as a standard item and must be fabricated according to the connections shown in Figure C-5.

MALE   FEMALE

TD   2
RD   3
RTS   4
CTS   5
DSR   6
SG   7
CD   8
RLS   11

                                        2
                                        3
                                        4
                                        5
                                        6
                                        7
                                        8
                                        15 XMIT CLOCK
                                        17 RECV CLOCK

DTR   20   20
RI   22   22
RRI   25
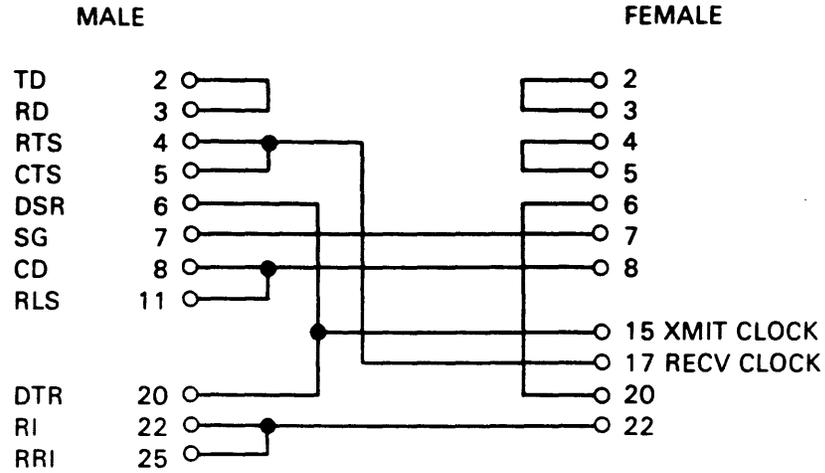
MKV85-2031

Figure C-5   Special Signals Loopback Test Cable

GENERAL

The Configuration Worksheet provides a hard-copy reference of the network configuration. It shows the location and mix of terminals and computers connected by the DFM system as well as the operating parameters of each device.

It is recommended that copies of the filled-in worksheet be distributed to data channel users. Information on the worksheet is necessary for switched channel operators to use the system effectively. Each operator must know which channels are switched, the associated channel IDs, and the group access assignments.

Refer to Figure 6-2 for an example of how to fill out the Configuration Worksheet. Use copies of the blanks provided here in this appendix when reconfiguring the system.

CHART 1

INTELLIGENT COMMUNICATION PROCESSOR WORKSHEET

LOCAL:	REMOTE:
LOCATION _____	LOCATION _____
MODEL # _____	MODEL # _____
SERIAL # _____	SERIAL # _____

SYSTEM PARAMETERS	SYSTEM PARAMETERS
NAME _____ 16 CHARACTERS (MAX) TYPE: MASTER ☐ SLAVE ☐ *CONFIGURATION: VALID ☐ AUTODISCONNECT: TIMEOUT [_____] (1 to 225 SEC)	NAME _____ 16 CHARACTERS (MAX) TYPE: MASTER ☐ SLAVE ☐ *CONFIGURATION: VALID ☐ AUTODISCONNECT: TIMEOUT [_____] (1 to 225 SEC)

SWITCHED PARAMETERS:	SWITCHED PARAMETERS:
SW DATAPAR DATA: 8 ☐ PARITY: NONE ☐ 7 ☐ ODD ☐ 6 ☐ EVEN ☐ 5 ☐ SW STOPBITS: 1 ☐ 1.5 ☐ 2 ☐ SW SIGNALS: ASSERT ☐ PASS ☐ COMMAND CHARACTER: ☐☐ ☐☐ (HEX 00 TO 1F) HEX HEX GROUP NAMES:	SW DATAPAR: DATA: 8 ☐ PARITY: NONE ☐ 7 ☐ ODD ☐ 6 ☐ EVEN ☐ 5 ☐ SW STOPBITS: 1 ☐ 1.5 ☐ 2 ☐ SW SIGNALS: ASSERT ☐ PASS ☐ COMMAND CHARACTER: ☐☐ ☐☐ (HEX 00 to 1F) HEX HEX GROUP NAMES:

LINK PARAMETERS:

SPEED	SYNC ☐	DELAY:	NORMAL ☐
	ASYNC ☐		SATELLITE ☐

LINK CHARACTERISTICS MUST BE SET THE SAME AT BOTH ENDS

*CONFIGURATION IS VERY CRITICAL. REFER TO SECTION 6.5.3.

LOCAL

TYPE			1	2	3	4	5	6	7	8
TYPE		U=UNUSED								
		S=SYNC SEE CHART 3								
		A=ASYNC								
		SW=SWITCHED								

ASYNC ONLY

		1	2	3	4	5	6	7	8
STOPBITS	1, 1.5, 2								
SIGNALS	A = ASSERT L = L-DIAL R = R-DIAL B = 2-DIAL P = PASS								
DATAPAR	N = NONE O = ODD E = EVEN								

ASYNC & SWITCH

		1	2	3	4	5	6	7	8
SPEED	1200								
	2400								
	4800								
	9600								
	AUTOBAUD								
	OTHER①								
FLOW	NONE								
	XON*B								
	XON*C								
	XON*T								
	CTS-RTS								
	OTHER②								
FILLCHAR	(0-255)								
PRIORITY	L=LOW N=NORMAL H=HIGH								
ECHO	SWITCHED: E = ENABLE								
MESSAGES	D = DISABLE ASYNC:								
COMTERM	N = NONE L = LOCAL								
COMECHO	R = REMOTE B = BOTH								

SWITCH ONLY

		1	2	3	4	5	6	7	8
AUTODISC	E = ENABLE D = DISABLE								
CHANNEL ID	A TO Z								
GROUP ACCESS	ID-LIST								
SIGNALS	N = NONE D = DIAL D* = DIAL* A = ASSERT A* = ASSERT*								

REMOTE

Channels 1–8 (grids, no values)

① OTHER SPEED SELECTIONS:
1=50, 2=75, 3=110, 4=134.5, 5=150,
6=300, 7=600, (ASYNC ONLY S=SAMEBAUD)

SPLIT-SPEED 8=75/1200, 9=1200/75,
10=150/2400, 11=2400/150

② OTHER FLOW SELECTIONS:
1=XON-B, 2=XON-C, 3=XON-T,
4=DSR-DTR, 5=CTSH-RLSH,
6=CTSH-RLSL, 7=CTSL-RLSH,
8=CTSL-RLSL.

CHART 2B

			LOCAL								REMOTE							
CHANNELS			9	10	11	12	13	14	15	16	9	10	11	12	13	14	15	16
TYPE		U=UNUSED																
		S=SYNC SEE CHART 3																
		A=ASYNC																
		SW =SWITCHED																
ASYNC ONLY	STOPBITS	1, 1.5, 2																
	SIGNALS	A = ASSERT L = L-DIAL R = R-DIAL B = 2-DIAL P = PASS																
	DATAPAR	N = NONE O = ODD E = EVEN																
ASYNC & SWITCH	SPEED	1200																
		2400																
		4800																
		9600																
		AUTOBAUD																
		OTHER①																
	FLOW	NONE																
		XON*.B																
		XON*.C																
		XON*.T																
		CTS-RTS																
		OTHER②																
	FILLCHAR	(0-255)																
	PRIORITY	L=LOW N=NORMAL H=HIGH																
	ECHO	SWITCHED: E = ENABLE																
	MESSAGES	D = DISABLE ASYNC:																
	COMTERM	N = NONE L = LOCAL																
	COMECHO	R = REMOTE B = BOTH																
SWITCH ONLY	AUTODISC	E = ENABLE D = DISABLE																
	CHANNEL ID	A TO Z																
	GROUP ACCESS	ID-LIST																
	SIGNALS	N = NONE D = DIAL D* = DIAL* A = ASSERT A* = ASSERT*																

---

① OTHER SPEED SELECTIONS:
1=50, 2=75, 3=110, 4=134.5, 5=150,
6=300, 7=600, (ASYNC ONLY S=SAMEBAUD)

SPLIT-SPEED 8=75/1200 9=1200/75
10=150/2400 11=2400/150

② OTHER FLOW SELECTIONS:
1=XON-B., 2=XON-C, 3=XON-T,
4=DSR-DTR, 5=CTSH-RLSH,
6=CTSH-RLSL, 7=CTSL-RLSH,
8=CTSL-RLSL.

CHART 3

TYPE	CHANNELS		LOCAL 1	2	5	6	9	10	13	14		REMOTE 1	2	5	6	9	10	13	14
	S = SYNC	D = DDCMP																	
SYNC & DDCMP	SPEED	INT 1200																	
		INT 1800																	
		INT 2400																	
		INT 4800																	
		INT 7200																	
		INT 9600																	
		INT 1200																	
		INT 1800																	
		INT 2400																	
		INT 4800																	
		INT 7200																	
		INT 9600																	
	FLOW	NONE																	
		CTS-RTS																	

TYPE			LOCAL									REMOTE							
SYNC ONLY	BLOCKSIZE	512																	
		1024																	
		2048																	
		4096																	

DDCMP ONLY

			LOCAL									REMOTE							
	SYNFILL	2,4,6																	

CHART 4

GENERAL PARAMETERS:

TIME: 00:00 to 23:59

DATE: MM-DD-YY

		LOCAL	REMOTE
ALARM:	ENABLED	☐	☐
	DISABLED	☐	☐

PASSWORD: (8 CHARACTERS MAX.)
USER: _____
SYSTEM: _____

E.1 INTRODUCTION
This appendix defines signal characteristics for concentrated link
and individual channels in a DFM system. Pin assignments,
associated signal names, and usage are covered. System
configurations and related signal characteristics are divided into
the following groups:

1.   Concentrated Link Signal Characteristics

2.   Channel Signal Interface Characteristics

    a. General

    b. Asynchronous and Switched Channels

        1) ASSERT Mode
        2) PASS Mode
        3) DIAL Mode
        4) DIAL* Mode
        5) ASSERT* Mode
        6) CTS-RTS Flow
        7) DSR-DTR Flow
        8) CTSx-RLSx Flow

    c. Synchronous and DDCMP Channels

        1) No Flow Control
        2) CTS-RTS Flow

E.2 CONCENTRATED LINK SIGNAL CHARACTERISTICS

The concentrated link between two DFM units may be either a leased line with modems at each end or a direct connection by means of a "null modem" crossover cable (BC22L or equivalent). When a configuration using modems is employed, a straight-through cable (BC22F or equivalent) should be used to connect the DFM unit to the modem. Appendix C outlines cable wiring. These cables are available from Digital Equipment Corporation.

When using synchronous modems, the link speed must be set to sync. When using asynchronous modems or a direct connection, the link speed must be set to async. The async link speed is 9600 bits/s asynchronous encoded NRZI, and will not work with data-sensitive asynchronous modems.

The concentrated link connector (see Table E-1) is a standard RS-232-C 25-pin DTE connector.

Table E-1 Concentrated Link Signal Characteristics

Pin	Direction	Signal Name and Usage
1	N/A	Protective ground (PG): connected to chassis ground.
2	From DFM	Transmitted data (TD): bit serial data transmitted by the DFM.
3	To DFM	Received data: bit serial data received by the DFM.
4	From DFM	Request to send (RTS): always asserted by the DFM during operation. When using a null modem cable (with link speed set to async), RTS is connected to CTS at each cable end to indicate a modem ready condition to the DFM.
5	To DFM	Clear to send (CTS): indicates that the modem is ready to accept data from the DFM. Loss of the CTS to the DFM for an extended period of time indicates to the DFM that concentrated link communication has been lost, and the DFM will attempt to reinitialize the link. When a BC22L null modem cable is used, RTS is looped back to assert CTS so that the modem ready condition will be present.
6	To DFM	Data set ready (DSR): not used by the DFM.
7	N/A	Signal ground (SG): ground reference for all other circuits except protective ground (pin 1).

Table E-1 Concentrated Link Signal Characteristics (Cont)

Pin	Direction	Signal Name and Usage
8	To DFM	Carrier detect (CAR): this signal, when asserted by a modem, indicates that the modem is successfully communicating with another modem. The DFM monitors this signal only to display the state of the signal on the display panel. When using a BC22L null modem cable, the signal DTR from each unit is crossed over to CAR at the other unit to provide the CAR indicator when a successful connection is achieved. If this LED is not lit on the front panel, there is not a successful connection between the two units.
15	To DFM	Transmitter signal element timing (TXC): a modem must supply the synchronous data clocks for the data on transmitted data, pin 2, when the DFM is set to link speed synchronous.
17	To DFM	Receiver signal element timing (RXC): a modem must supply the synchronous data clocks for the data on received data, pin 3, when the DFM link speed is set to synchronous.
20	From DFM	Data terminal ready (DTR): always asserted by the DFM during operation. When two DFM units are connected by a BC22L null modem cable, DTR at each unit is connected to CAR at the other unit to provide a positive indication on the front panel CD (carrier detect) LED when a successful connection is established between the units.

NOTE
If CTS is off for more than five seconds, network ready will flash on the front panel display. If the link is established, and CTS is OFF for more than one minute, the link will be considered lost. The DFM unit will then attempt to reinitialize and flush all buffers.

E.3 CHANNEL SIGNALS INTERFACE CHARACTERISTICS

DFM channels use a standard RS-232-C DCE interface connected by a 25-pin female D-shell connector. Channels are connected to a DTE terminal or CPU with a BC22E or BC22F straight-through cable. A channel is connected to a modem or another DCE interface device with a BC22M crossover cable. When a BC22M crossover cable is. utilized with the DFM unit, a DTE interface is presented. Appendix C contains cable configurations and descriptions.

Signals having characteristics that do not vary based on configuration, are described in this section. Signals with characteristics dependent on configuration are partially defined in Table E-2 with more explicit descriptions in the following sections.

Table E-2   Channel Signal Characteristics -- General

Pin	Direction	Signal Name and Usage
1	N/A	Protective ground (PG): connected to chassis ground.
2	To DFM	Transmitted data (TD): bit serial data from terminal or attached device to DFM.
3	From DFM	Received data (RD): bit serial data from DFM to terminal or attached device.
4	To DFM	Request to send (RTS): used for CTS-RTS flow control and pass signals option.
5	From DFM	Clear to send (CTS): used for CTS-RTS flow control; the four CTSx-RLSx flow control types; and assert, pass, assert*, dial, and dial* signal options.

<div align="center">

NOTE

In CTSx-RLSx, x may be either L for low or H for high.

</div>

Pin	Direction	Signal Name and Usage
6	From DFM	Data set ready (DSR): used for DSR-DTR flow control and assert, pass, assert*, dial, and dial* signal options.
7	N/A	Signal ground (SG): ground reference for all other signals except protective ground (pin 1).

Table E-2 Channel Signal Characteristics -- General (Cont)

Pin	Direction	Signal Name and Usage
8	From DFM	Carrier detect (CAR): used in CTS-RTS flow control for synchronous channels only, and used in assert, assert*, pass, dial, and dial* signal options.
9	To DFM	External transmit signal element timing (ETXC): when a synchronous modem or device is used with a channel configured in externally clocked mode (speed EXTxxxx), the device should supply the clocking for pin 2, transmitted data, on this pin.

<div align="center">NOTE
xxxx is the speed in bits per second (bits/s).</div>

Pin	Direction	Signal Name and Usage
1Ø	To DFM	External receive signal element timing (ERXC): when a synchronous modem or device is used with a channel configured in externally clocked mode (speed EXTxxxx), the device supplies the clocking for pin 3, received data, on this pin.
11	To DFM	Reverse carrier (RCA), also called reverse line sense (RLS): used for the four CTSx-RLSx flow control types, PASS, DIAL, and DIAL* signal options.
15	From DFM	Transmitter signal element timing (TXC): when a synchronous channel is configured in internally clocked mode (speed INTxxxx), the DFM supplies the clocking for pin 2, transmitted data, on this pin.
17	From DFM	Receiver signal element timing (RXC): when a synchronous channel is configured in internally clocked mode (speed INTxxxx), the DFM supplies the clocking for pin 3, received data, on this pin.
2Ø	To DFM	Data terminal ready (DTR): used for DSR-DTR flow control, and pass and assert* signal options.

Table E-2 Channel Signal Characteristics -- General (Cont)

Pin	Direction	Signal Name and Usage
22	From DFM	Ring indicator (RI): this signal is always deasserted except when the pass signals option is selected, or when a channel is programmed as "unused." When a channel is unused, this pin is asserted. A customer-supplied cable may be used to connect this pin 22 to pin 25 (busy) on a modem as a "busy out" indication for that channel.
25	To DFM	Reverse ring (RRI): used with the pass signals option.

NOTE

The minimum interface needed for a channel configured for asynchronous operation is transmitted data (pin 2), received data (pin 3), and signal ground (pin 7). More signals may be required depending on the type of flow control and signals option selected.

E.4 SIGNAL CHARACTERISTICS FOR ASYNCHRONOUS AND SWITCHED CHANNEL TYPES

E.4.1 Assert Mode

Table E-3 lists the signal characteristics for a channel when the signals option is set to assert. Flow control, if selected, overrides the assert characteristics of these signals.

Table E-3 Assert Mode Signal Characteristics

Pin	Direction	Signal Name and Usage
5	From DFM	Clear to send (CTS): CTS is always asserted in assert mode.
6	From DFM	Data set ready (DSR): DSR is always asserted in assert mode.
8	From DFM	Carrier detect (CAR): CAR is always asserted in assert mode.
22	From DFM	Ring indicator (RI): RI is always deasserted (logical false) in assert mode.

E.4.2 Pass Mode

Table E-4 lists the signal characteristics for a channel when the signals option is set to pass. Flow control, if selected, overrides the pass characteristics of these signals.

In the following description:

- For a switched channel, the "related" channel is the channel to which this channel is currently connected, and

- For an async channel, the "related" channel is the channel with the same number on the other DFM unit.

Setting dedicated channels to pass causes both ends to be in pass mode, and EIA signal changes are relayed in both directions.

Switched channel connections can result in signals being passed in only one direction.

Example:

Suppose a switched channel with the signal option set to pass is connected to another that is set to assert.

The assert channel end asserts signals to the connected DTE, but since it has also been notified (upon connection) that the related channel is set to pass, it will pass signal changes that are detected along to the connected channel.

The pass channel end passes signal changes along to the assert end, but the changes are not relayed to the connected DTE.

Table E-4   Pass Mode Signal Characteristics

Pin	Direction	Signal Name and Usage
4	To DFM	Request to send (RTS): if the related channel end is set to pass, the state of this signal appears as CTS on pin 5 of the related channel.
5	From DFM	Clear to send (CTS): the state of this signal on a channel end set to pass is determined by the state of RTS (pin 4) on the related channel. CTS is deasserted on a switched channel that is set to pass and is not currently connected to another channel.

Table E-4 Pass Mode Signal Characteristics (Cont)

Pin	Direction	Signal Name and Usage
6	From DFM	Data set ready (DSR): the state of this signal on a channel end set to pass is determined by the state of DTR (pin 20) on the related channel. DSR is deasserted on a switched channel that is set to pass and is not currently connected to another channel.
8	From DFM	Carrier detect (CAR): the state of this signal on a channel end set to pass is determined by the state of RCA (pin 11) on the related channel. CAR is deasserted on a switched channel that is set to pass and is not currently connected to another channel.
11	To DFM	Reverse carrier (RCA), (also known as reverse line sense (RLS): if the related channel is set to pass, the state of this signal is output as CAR (pin 8) of the related channel.
20	To DFM	Data terminal ready (DTR): if the related channel is set to pass, the state of this signal is output as DSR (pin 6) of the related channel.
22	From DFM	Ring indicator (RI): the state of this signal on a channel end set to pass is determined by the state of RRI (pin 25) on the related channel. RI is deasserted on a switched channel that is set to pass and is not currently connected to another channel.
25	To DFM	Reverse ring indicator (RRI): if the related channel is set to pass, the state of this signal is output as RI (pin 22) of the related channel.

NOTE
The characteristics of the input signals
(DTR, RTS, RRI, and RCA) are determined
by the signals option setting for the
other channel.

E.4.3 Dial Mode

Table E-5 lists the signal characteristics for a channel when the signals option is set to dial. Note that if any flow control is selected having conflicting usage for any of the signals, the result is unpredictable. For example, the dial mechanism may toggle a signal for a certain reason, only to have it changed by the flow control mechanism. In general, out-of-band flow control is not recommended on the channel with the signals option set to dial.

Table E-5   Dial Mode Signal Characteristics

Pin	Direction	Signal Name and Usage
5	From DFM	Clear to send (CTS): asserted by the DFM after the DFM detects RCA and DTR raised by the modem. Indicates to the modem that the DFM is now ready to begin normal data transmission. This signal appears as RTS, pin 4, at the modem end of the cable.
6	From DFM	Data set ready (DSR): asserted by the DFM after the DFM detects RI raised by the modem. It indicates that the modem should go "on-line." A timer is started and if RCA and DTR are not both raised within 15 seconds, the line is considered "off-line" and the DFM channel will go back to the idle (hung up) state. This signal appears as DTR, pin 20, at the modem end of the cable.
8	From DFM	Carrier detect (CAR): not supported in the BC22M cable. Always deasserted by the DFM when the dial signal option is selected.
11	To DFM	Reverse carrier detect (RCA): monitored by the DFM, and when asserted by the modem (along with DTR), indicates that the modem is "on-line." This signal originates on pin 8 (CAR) at the modem end of the cable. Loss of this signal during communications on a channel with the dial signal option selected will cause the DFM to force the modem "off-line."
20	To DFM	Data terminal ready (DTR): this signal is monitored by the DFM, and when asserted by the modem along with RCA, indicates that the modem is "on-line." This signal originates on pin 6 (DSR) at the modem end of the cable. Loss of this signal during communications on a channel with the dial signal option selected causes the DFM to force the modem "off-line."

Table E-5 Dial Mode Signal Characteristics (Cont)

Pin	Direction	Signal Name and Usage
25	To DFM	Reverse ring (RRI): this signal indicates to the DFM that the phone line connected to the modem is "ringing." The DFM then asserts DSR and waits 15 seconds for the modem to assert RCA and DTR to indicate that it has successfully gone "on-line." This signal originates on pin 22 (ring indicator) at the modem end of the cable.

E.4.4 Dial* Mode

Table E-6 lists the signal characteristics for a channel when the signals option is set to dial*. Note that if any flow control is selected having conflicting usage for any of the signals, the result will be unpredictable. Out-of-band flow control is not recommended for channels with the signals option set to dial*.

Table E-6 Dial* Mode Signal Characteristics

Pin	Direction	Signal Name and Usage
5	From DFM	Clear to send (CTS): this signal is asserted by the DFM after it detects RCA and DTR raised by the modem. It indicates to the modem that the DFM is ready to begin normal data transmission. It is also asserted by the DFM if a switched connection is made to this channel from another channel. The signal appears on pin 4 (request to send) at the modem end of the cable.
6	From DFM	Data set ready (DSR): this signal is asserted by the DFM after the DFM detects RI raised by the modem, and indicates that the modem should go "on-line." When DSR is asserted, a timer is started. If both RCA and DTR are not asserted within 15 seconds, the line is considered "off-line" and the DFM channel will go back to the idle (hung up) state. This signal is also raised by the DFM if a switched connection is made to this channel from another channel. This assertion will cause a dial-out modem to go "on-line" and wait for dial commands. Note that the DFM does not issue any dial commands to the modem because this is the responsibility of the user. The signal appears on pin 20 (DTR) at the modem end of the cable.
8	From DFM	Carrier detect (CAR): Not supported in BC22M cable. Always deasserted by the DFM when the dial* signal option is selected.
11	To DFM	Reverse carrier detect (RCA): this signal is monitored by the DFM, and when asserted by the modem along with DTR, indicates that the modem is "on-line." Loss of this signal during communications on a channel with the dial* signal option selected causes the DFM to force the modem "off-line." The signal originates on pin 8 (CAR) at the modem end of the cable.

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Table E-6 Dial* Mode Signal Characteristics (Cont)

Pin	Direction	Signal Name and Usage
20	To DFM	Data terminal ready (DTR): this signal is monitored by the DFM, and when raised by the modem along with RCA, indicates that the modem is "on-line." Loss of this signal during communications on a channel with the dial* signal option selected will cause the DFM to put the modem "off-line." This signal originates on pin 6 (DSR) at the modem end of the cable.
25	To DFM	Reverse ring (RRI): this signal indicates to the DFM that the phone line connected to the modem is "ringing." The DFM then asserts DSR and waits 15 seconds for the modem to assert RCA and DTR to indicate that it has successfully gone "on-line." It originates on pin 22 (RI) at the modem end of the cable.

E.4.5 Assert* Mode

Table E-7 lists the signal characteristics for a channel when the signals option is set to assert*. Note that if any flow control is selected having conflicting usage for any of the signals, the result will be unpredictable.

Table E-7 Assert* Mode Signal Characteristics

Pin	Direction	Signal Name and Usage
5	From DFM	Clear to send (CTS): CTS is always asserted, except for four seconds when a switched connection involving the channel is terminated. This deassertion indicates to the attached device that the connection no longer exists and that a logoff or other suitable action should be performed.
6	From DFM	Data set ready (DSR): DSR is always asserted, except for four seconds when a switched connection involving the channel is terminated. This deassertion indicates to the attached device that the connection no longer exists and that a logoff or other suitable action should be performed.
8	From DFM	Carrier detect (CAR): not supported in BC22M cable. CAR is always asserted, except for four seconds when a switched connection involving this channel is terminated. This deassertion indicates to the attached device that the connection no longer exists and that a logoff or other suitable action should be performed.
20	To DFM	Data terminal ready (DTR): monitored by the DFM, and when a loss of this signal (true to false transition) is detected, the DFM will terminate any switched connection in which this channel is involved. This mechanism may be used by the attached device to show that the device is no longer in use, and can be connected to another switched channel.
22	From DFM	Ring indicator (RI): RI is deasserted (logical false).

E.4.6 Asynchronous CTS-RTS Flow

Table E-8 lists the signal characteristics unique to the CTS-RTS flow control option for asynchronous channels. If the assert or pass channel signal option is selected, the usage for CTS-RTS flow will override the usage described under the signals option description. If any other channel signal option is selected along with CTS-RTS flow, the results are unpredictable.

Table E-8 Asynchronous CTS-RTS Signal Characteristics

Pin	Direction	Signal Name and Usage
4	To DFM	Request to send (RTS): the DFM interprets RTS high as an indication that the connected DTE can receive data. RTS low is interpreted as a STOP data signal.
5	From DFM	Clear to send (CTS): the DFM raises CTS to signal connected DTE that the DFM can receive data. The DFM lowers CTS to indicate to the attached device that it is not ready to receive data.

E.4.7 DSR-DTR Flow

Table E-9 lists the signal characteristics unique to the DSR-DTR flow control option. If the assert or pass channel signal option is selected, the usage for DSR-DTR flow will override the usage described under the signals option description. If any other channel signal option is selected along with DSR-DTR flow, the results are unpredictable.

Table E-9 DSR-DTR Signal Characteristics

Pin	Direction	Signal Name and Usage
6	From DFM	Data set ready (DSR): the DFM raises DTR to indicate to the attached device that it is ready to receive data. The DFM lowers DSR to indicate to the attached device that it is not ready to receive data.
20	To DFM	Data terminal ready (DTR): DTR high is interpreted by the DFM as an indication that the connected DTE is ready to receive data. DTR low is interpreted as a STOP data signal.

E.4.8 CTSx-RLSx Flow

Table E-10 lists the signal characteristics unique to the four CTSx-RLSx flow control options (x = L for low and H for high). If the assert or pass channel signal option is selected, the usage for CTSx-RLSx flow will override the usage described under the signals option description. If any other channel signal option is selected along with CTSx-RLSx flow, the results are unpredictable.

Table E-10 CTSx-RTSx Signal Characteristics

Pin	Direction	Signal Name and Usage
5	From DFM	Clear to send (CTS): CTSH-RLSH and CTSH-RLSL Types The DFM asserts CTS to indicate to the attached device that it is ready to receive data. The DFM deasserts CTS to indicate to the attached device that it cannot receive data. CTSL-RLSH and CTSL-RLSL Types The DFM asserts CTS to indicate to the attached device that it cannot receive data. The DFM deasserts CTS to indicate to the attached device that it is ready to receive data.
11	To DFM	Reverse line sense or reverse carrier (RLS): CTSH-RLSH and CTSL-RLSH Types The DFM interprets RLS high as an indication that the connected DTE is ready to receive data. The DFM interprets RLS low as an indication to stop sending data to the connected DTE. CTSH-RLSL and CTSL-RLSL Types The DFM interprets RLS high as an indication to stop sending data to the connected DTE. The DFM interprets RLS low as an indication that the attached device is ready to receive data.

E.5 SIGNAL CHARACTERISTICS FOR SYNCHRONOUS AND DDCMP CHANNEL TYPES

E.5.1 No Flow Control

Table E-11 lists the signal characteristics for no flow control when used with synchronous or DDCMP channels. No flow control establishes a full-duplex communication with synchronous devices.

Table E-11 Signal Characteristics Without Flow Control

Pin	Direction	Signal Name and Usage
5	From DFM	Clear to send (CTS): in synchronous mode, this signal is always asserted by the DFM.
		In DDCMP mode, this signal is always asserted unless there is not sufficient buffer space available to hold the frame. The DFM decodes the header portion of a frame to determine the size of a data frame. In DDCMP mode, CTS cannot be asserted by the DFM until the concentrated link to the remote unit has been established.
6	From DFM	Data set ready (DSR): DSR is always asserted by the DFM.
8	From DFM	Carrier detect (CAR): CAR is always asserted by the DFM.
22	From DFM	Ring indicator (RI): RI is always deasserted by the DFM.

E.5.2 Synchronous CTS-RTS Flow

Table E-12 lists the signal characteristics for CTS-RTS flow control when used with synchronous or DDCMP channels. CTS-RTS flow control establishes half-duplex communication with synchronous devices.

Table E-12   Synchronous CTS-RTS Signal Characteristics

Pin	Direction	Signal Name and Usage
4	To DFM	Request to send (RTS): RTS asserted by an attached device is interpreted by the DFM as meaning that the device has some data to transmit to the DFM. If there is empty buffer space for <BLOCKSIZE> characters (synchronous) or 32 characters (DDCMP), CTS will be raised to allow the device to transmit. The DFM does not transmit data to the attached device while RTS is asserted. Instead, it raises CTS and allows the device to transmit, after which the device should deassert RTS, allowing the DFM to transmit.
5	From DFM	Clear to send (CTS): CTS is asserted by the DFM to allow an attached device to transmit data to the DFM. It is normally deasserted, but will be asserted in response to the attached device asserting RTS. It will be deasserted when the attached device completes sending and drops RTS. The DFM will decode the header of a data frame to determine if there is sufficient space for the frame. If there is insufficient buffer space available for a frame or block, then CTS is deasserted. In DDCMP mode, CTS cannot be asserted by the DFM until the concentrated link to the remote unit has been established.
6	From DFM	Data set ready (DSR): DSR is always asserted by the DFM.
8	From DFM	Carrier detect (CAR): the DFM asserts this signal while it is transmitting data to the attached device. It is deasserted at all other times.
22	From DFM	Ring indicator (RI): RI is always deasserted by the DFM.

F.1 INTRODUCTION

DFM software releases subsequent to 1.0 contain features not available with the 1.0 level. The software release level that is present appears in the header line of DFM output to the supervisory terminal.

F.2 HALF-/FULL-DUPLEX DDCMP

Software level 1.0 runs only half-duplex DDCMP. Software level 1.1 can run either half- or full-duplex DDCMP. Half-duplex is selected by setting the flow control option for that channel to CTS-RTS; full-duplex is selected by a flow control of NONE for that channel.

If a unit with software level 1.0 is connected to another with software level 1.1, the software level 1.1 will check that all DDCMP channels have the flow control option set to CTS-RTS. It will change any channels with flow control set to NONE to be CTS-RTS.

With levels 1.0 and 1.1 connected, flow control for DDCMP channels cannot be set to NONE (selecting full-duplex operation) on either unit. When attempted, an error message is displayed.

F.3 SATELLITE DELAY

The link satellite delay option setting is handled differently by units with software level 1.0. Since the handling of frames on the link is crucial for compatibility of two units, when a software level 1.0 unit is connected to another unit with a different software level, the satellite option cannot be used.

F.4 MULTILINE BROADCAST MESSAGES

Only software levels subsequent to 1.0 have the ability to broadcast a message longer than one line from the supervisory channel. If a multiline broadcast message is sent from the supervisory channel of a software level 1.1 unit, only the first 80 characters (1 line) of that message will be sent to terminals connected to a software level 1.0 unit.

F.5 INDEFINITE REPEAT

With software level 1.1, an indefinite number of repetitions for the REPEAT command is invoked with the asterisk (*) in the repetitions field of the command line. Software level 1.0 units do not have this feature.

F.6   ABILITY TO SET A CHANNEL TYPE TO "UNUSED" WITHOUT LOSING PARAMETERS

Only software levels subsequent to 1.0 support this feature. On software level 1.0 units, when a channel type is set to unused, parameters immediately return to their default values.

With a software level 1.0/software level 1.1 combination, when a channel type is set to unused, channel parameters will be set to their defaults on both units. Thus, this feature only appears on a homogeneous software level 1.1 (or later release) system.

With the software level 1.1 unit in a software level 1.0/software level 1.1 combination, an unused channel always will display "UNUSED -- (was UNUSED)" to show that the previous parameters were not saved.

F.7   SWITCHED CONNECTION FROM SUPERVISORY CHANNEL

When a command is entered to connect a remote channel with another remote channel, the command is forwarded to the remote unit and executed there. A command to connect a remote channel to a group is also forwarded to the remote unit. All other CONNECT commands:

1.   Connect local channel to local port,

2.   Connect local port to group, and

3.   Connect local channel to remote channel (same as connect remote channel to local channel),

are executed by the local unit.

Software level 1.0 does not support the capability of connecting two switched channels from the supervisory channel. When a 1.0 unit is connected to a later release unit, and such a command is entered, it will succeed only if it is to be performed by the 1.1 (or later release) unit. Any command that must be forwarded to the 1.0 unit will not succeed, and the error message "Request Not Supported on Remote Unit" will be displayed.

F.8   GROUP "NAMES"

Only software levels subsequent to level 1.0 allow a five-character descriptive name to be assigned to switched channel groups (that are defined by a letter). Names can be neither entered or displayed on a software level 1.0 unit.

F.9   SYSTEM WARNING FOR COMMANDS THAT RESTART THE SYSTEM

Warning occurs only with software levels 1.1 and later.

F.10 ABILITY TO SET SPEEDS SEPARATELY FOR EITHER END FOR SYNCHRONOUS CHANNELS

With software level 1.1 and later releases, local and remote speeds are set independently (l-speed and r-speed options) for synchronous channels. With software level 1.0, only "speed" can be set for synchronous channels; this sets both local and remote ends of the channel.

When software level 1.0 is connected to a software level 1.1 unit, setting either the l-speed or r-speed option for a synchronous channel results in both options being set to the same value.

When the two units are first connected, the software level 1.1 unit will set all remote speeds on sync channels to the current setting for the l-speed option.

On a 1.0 and 1.1 combination, the full range of external speeds appears only on the 1.1 unit. Selecting any of them for either channel end results in both channel ends (since they are both set with a 1.0 and 1.1 combination) being set to "external."

F.11 ADDITIONAL ASYNCHRONOUS CHANNEL FLOW CONTROL SELECTIONS

Software levels 1.1 and later contain selections for flow control on asynchronous channels that are not available on 1.0 units.

When a software level 1.0 unit is connected to a software level 1.1 unit, the software level 1.1 unit will check all asynchronous channel flow types. If the flow is not "NONE," "XON-B," or "CTS/RTS" (1.0 selections), the unit will set the flow control option for that channel to "NONE."

When a unit with 1.0 software is connected to another with a later release, any attempt to set the flow control (on either unit) to a value other than those supported by the 1.0 unit will not succeed and an error message will be displayed.

F.12 SWITCHED CHANNEL "DIAL-UP" OPTION NOW CALLED "SIGNALS"

In addition to changing the name of the option, additional values are available with the 1.1 and later release software. The switched channel dial-up option for 1.0 units can only be set to either ENABLED or NONE. The signals option has additional values of assert, assert*, pass, dial, and dial*. (Dial corresponds to enabled.)

Thus, the signals option for switched channels may only be set to either DIAL or NONE when a 1.0 unit is connected to a unit with a later software release.

F.13 COMMAND CHARACTER (COMCHAR)
The command character sequence for 1.0 units is 1B1B (hex), and it is 1C1C (hex) for software level 1.1 and later. Hex 1C corresponds to the CONTROL/BACKSLASH sequence on DIGITAL terminals, and 1B is the ESCAPE key.

When a 1.0 unit is connected to a 1.1 or later revision, the first time down-line loading of parameters occurs, the valid or master unit will load its selection for this option on the other unit.

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