EK-DMP11-TM-001

DMP11 Synchronous Controller Technical Manual

digital

EK-DMP11-TM-001

DMP11 Synchronous Controller Technical Manual

Prepared by Educational Services
of
Digital Equipment Corporation

1st Edition, September 1981

Printed in U.S.A.

This document was set on DIGITAL's DECset-8000 computerized typesetting system.

CONTENTS

CONTENTS (Cont)

CONTENTS (Cont)

CONTENTS (Cont)

CONTENTS (Cont)

FIGURES

FIGURES (Cont)

TABLES

PREFACE

This manual describes in detail the installation requirements, programming considerations, and servicing procedures, including diagnostic support, for the DMP11 Synchronous Controller. Appendices are also provided as an addition to the above.

Other publications which support the DMP11 Synchronous Controller are:

- *M8207 Microprocessor Technical Manual* (EK-M8207-TM)
- *M8203 Line Unit Technical Manual* (EK-M8203-TM)
- *DMP11 Print Set* (MP-00795)
- Electronic Industries Association (EIA) specifications

CHAPTER 1
SYSTEM OVERVIEW

1.1 INTRODUCTION
The multipoint DDCMP-DMP11 intelligent communications line controller is a general purpose device designed to manage efficient, high-speed, synchronous, multipoint networks using VAX or PDP-11 systems as control and tributary station hosts. This device is designed to be managed by a VAX or PDP-11 system with minimum demand on system resources.

NOTE
This manual should be used with the M8207 Microprocessor Technical Manual (EK-M8207-TM) and the M8203 Line Unit Technical Manual (EK-M8203-TM).

1.2 SYSTEM CONCEPT
DMP11 operation is based on a high-speed microprocessor that is optimized for multipoint networks. In multipoint networks, a DMP11 can operate as either a control or a tributary station. When operating as a control station, a DMP11 can control up to 32 other tributary stations. These tributary stations can consist of additional DMP11s or devices compatible with Digital Data Communications Message Protocol (DDCMP).

A DMP11 can be configured to operate with both half-duplex and full-duplex communications lines. For full-duplex lines, line speeds can range up to 500K bits per second (b/s). For half-duplex lines, line speeds can range up to 1M b/s.

Operation of each DMP11 in a multipoint network is managed by an internal microprogram that includes a dynamic polling algorithm. This polling algorithm changes the polling frequency at each tributary in order to accommodate the actual resource needs of that tributary. This polling frequency change is based upon the response history. Because system resources are allocated as the need arises, overall network efficiency is increased.

DMP11 communications line control and data transfer activity is directed by a user program through a command/response structure.

NOTE
In this manual, the term user program is synonymous with device driver.

Using this command/response structure, a user program can manage data traffic between a control station and selected tributaries. Also, with this command/response structure, the user program can control protocol operation, tributary polling priorities, transmit and receive buffer assignments, and network status and error recording and reporting.

The multipoint DDCMP-DMP11 intelligent communications line controller is made up of two devices: the M8207 microprocessor and the M8203 line unit. The communications functions performed by the DMP11 are carried out by a microprogram contained in ROM and executed by the M8207 microprocessor. Physically, a DMP11 includes two standard-height, hex boards inserted in a standard UNIBUS hex SPC slot. A simplified block diagram of the DMP11 is shown in Figure 1-1.

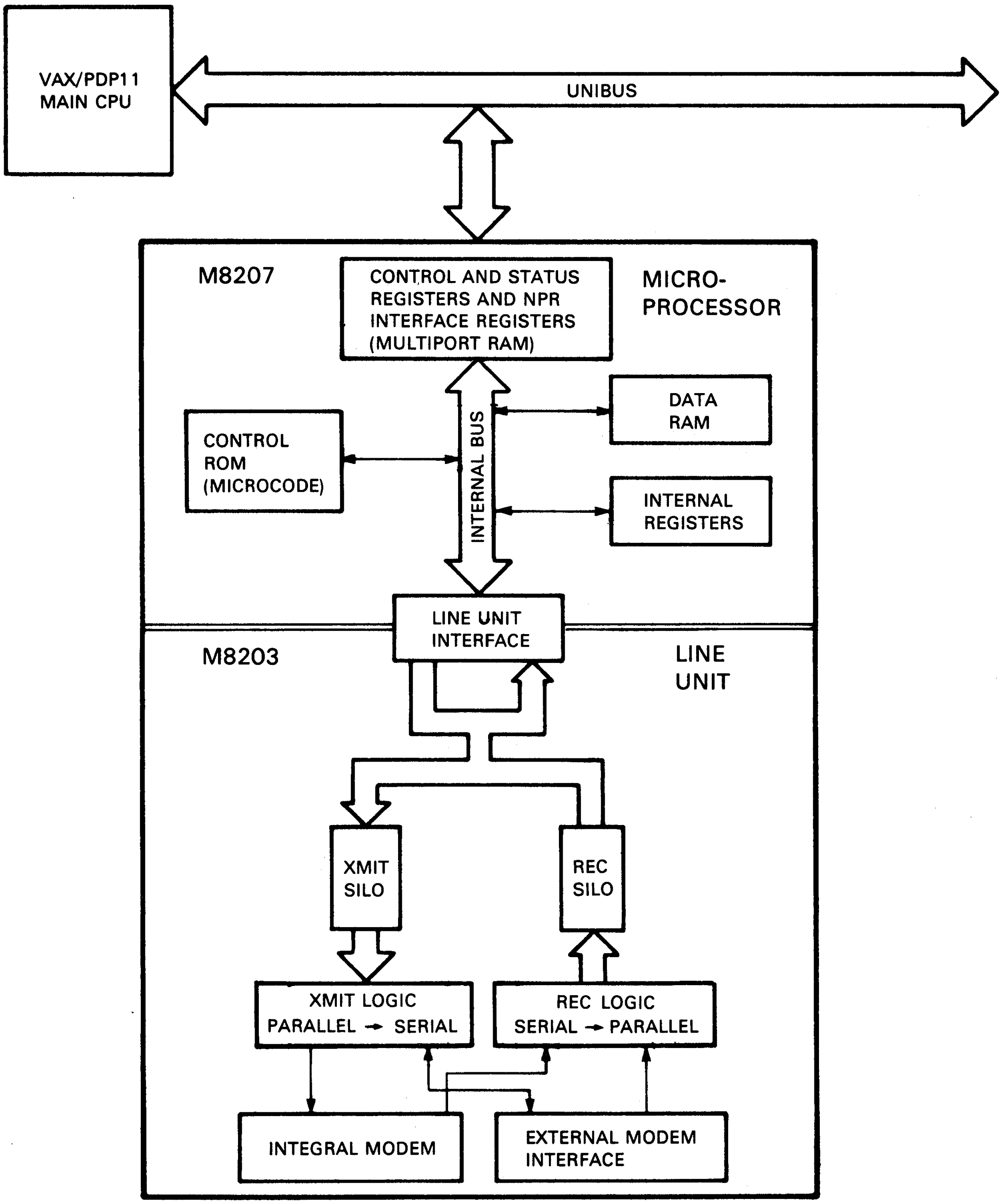


Figure 1-1 Simplified Block Diagram

1.2.1 The M8207 Microprocessor

The M8207 microprocessor is designed to support networks formed by VAX and PDP-11 systems. It operates in parallel with the associated system and has an architecture optimized for data movement, character processing, performing address arithmetic, and other functions necessary to controlling I/O devices, formatting data, and carrying out protocol operation. The DMP11 resides as a non-processor request (NPR) device on both the VAX and PDP-11 UNIBUS.

Operation of the DMP11 as an intelligent multipoint or point-to-point network controller is managed by a ROM-based microprogram executed by the M8207 microprocessor. User-defined parameters controlling the dynamic aspects of DMP11 operation are in the microprocessor data memory.

Data transfers by the microprocessor are performed under link control of DDCMP over synchronous multipoint or point-to-point networks. In multipoint networks, tributary addresses can be switch-selected at installation time or software-assigned by the user program during actual operation. The microprocessor has an 8-bit internal data path, a 4K, 8-bit random access data memory, and a control ROM having a maximum addressable storage capacity of 6K, 16-bit micro-instructions.

1.2.2 The M8203 Line Unit

Functionally, the M8203 line unit serves as an interface between the M8207 microprocessor and the physical communications line. In this role, the line unit provides the user with a variety of operational options. For example, line speeds from 56K to 1M b/s can be selected through the line unit integral modem. Alternatively, the line unit can be configured to connect the microprocessor to the communications line through an external modem. Also, both the integral and external modem interfaces can accommodate both full-duplex and half-duplex communications lines.

A major advantage of the M8203 line unit is that it connects directly to the communications line, bypassing the UNIBUS. As a consequence, communications activity handled through the DMP11 has little impact on UNIBUS bandwidth.

Data silos within the line unit provide for the buffering of transmit and receive messages. The buffering capacity of these silos is optimized to eliminate, as much data overrun as is possible under normal operating conditions.

1.2.3 DMP11 Microcode

The DMP11 microcode is a 6K, 16-bit, ROM-encoded microprogram executed by the M8207 microprocessor. This microprogram is supported by a 4K, 8-bit, data RAM that stores user-defined communications and protocol parameters as well as the internal data base. These parameters, along with the internal data base, allow the DMP11 to manage data traffic between stations and to respond dynamically to changing communications line activity.

In addition to handling all transmit and receive message processing under DDCMP, the DMP11 microcode manages buffer assignments and the storage and retrieval of messages in main memory, maintains the internal data base, and performs a wide range of error/event surveillance, detection, reporting, and recovery activities.

A major feature of the microcode involves the ability to down-line load a remote main CPU through the DMP11 at an associated multipoint or point-to-point station, and to initiate execution of the loaded program. As a result, the operational integrity of network stations at inaccessible locations can be readily maintained. The only restriction on this process is that the main CPU at the remote station must be in the PDP-11 family. However, the main CPU at the control station can be one of either the VAX or PDP-11 family.

The operational efficiency of DMP11-implemented multipoint networks is substantially increased by the dynamic polling algorithm contained in the DMP11 microcode. This algorithm adjusts the current polling priority of a tributary according to the past polling response history of that tributary. The relative priority of each tributary at the three polling activity levels (active, inactive, and unresponsive) can be established through user specified parameters. In addition, the user program can change the priority of a tributary and its polling state during actual operation.

1.3 DMP11-VAX/PDP-11 INTERFACE

Communication between the user program and the DMP11 is accomplished over the VAX/PDP-11 UNIBUS through four control and status registers (CSRs). These four 16-bit registers serve as a bidirectional port to pass user program commands to the DMP11 and DMP11 responses to the user program. Each of these registers is byte and word addressable by the user program.

In this group of four CSRs, the first two have a fixed format that serves as a preface to all user program issued commands and DMP11 resonses. The format of the second two registers is variable and determined by the specific command or response. Functionally, the four CSRs form a port for the exchange of commands and responses between the user program and the DMP11. The actual content of the data port is specified by an identification field in the fixed format portion. Other fields in the fixed format portion provide for system initialization, interrupt enabling, reading and execution of maintenance instructions, line unit maintenance, data transfer set up and execution, and tributary addressing.

A user program issues a command to the DMP11 by transferring the command to the CSRs. Specific bits in the fixed format portion of the command alert the DMP11 to the existence of the command and its identity. The DMP11 then performs the functions specified by the command. If a response is required, the DMP11 stores the appropriate response in the CSRs and informs the user program that a response is pending.

Message data received or transmitted by the DMP11 is respectively written into or read from user program allocated buffers in main memory. These buffers are accessed by the DMP11 through execution of NPRs to the UNIBUS address of the buffer. A UNIBUS address is defined as an 18-bit address used by an NPR device to access a device on the UNIBUS or a location in main memory.

1.4 SUMMARY OF DMP11 COMMAND AND RESPONSE STRUCTURES

A user program can issue four types of commands to be executed by the DMP11. In general, the DMP11 replies to these commands with three types of responses. Figure 1-2 provides a general summary of the functions performed by the DMP11 command/response structure. The functions performed by DMP11 commands and responses are described in detail in Chapter 3.

1.4.1 User Program Commands

The four types of commands issued by a user program permit the program to control all necessary aspects of DMP11 operation. These are:

1. The microprocessor control command,
2. The mode definition command,
3. The control command, and
4. The buffer address/character count command.

The general functions performed by these commands are described in the sections that follow.

1.4.1.1 Microprocessor Control Command – This command has two functions, one operational and one diagnostic. For the operational function, the microprocessor control command is used to clear all condition-sensitive logic in the DMP11. At startup time this command is the first issued by the user program in order to place the DMP11 in the run state in preparation for system initialization.

On receiving this command, the DMP11 executes an internal diagnostic microprogram to verify its operational state. When the diagnostic has executed, the user program is notified of success or failure through a code in the CSRs. If successful, the DMP11 is placed in an operational state.

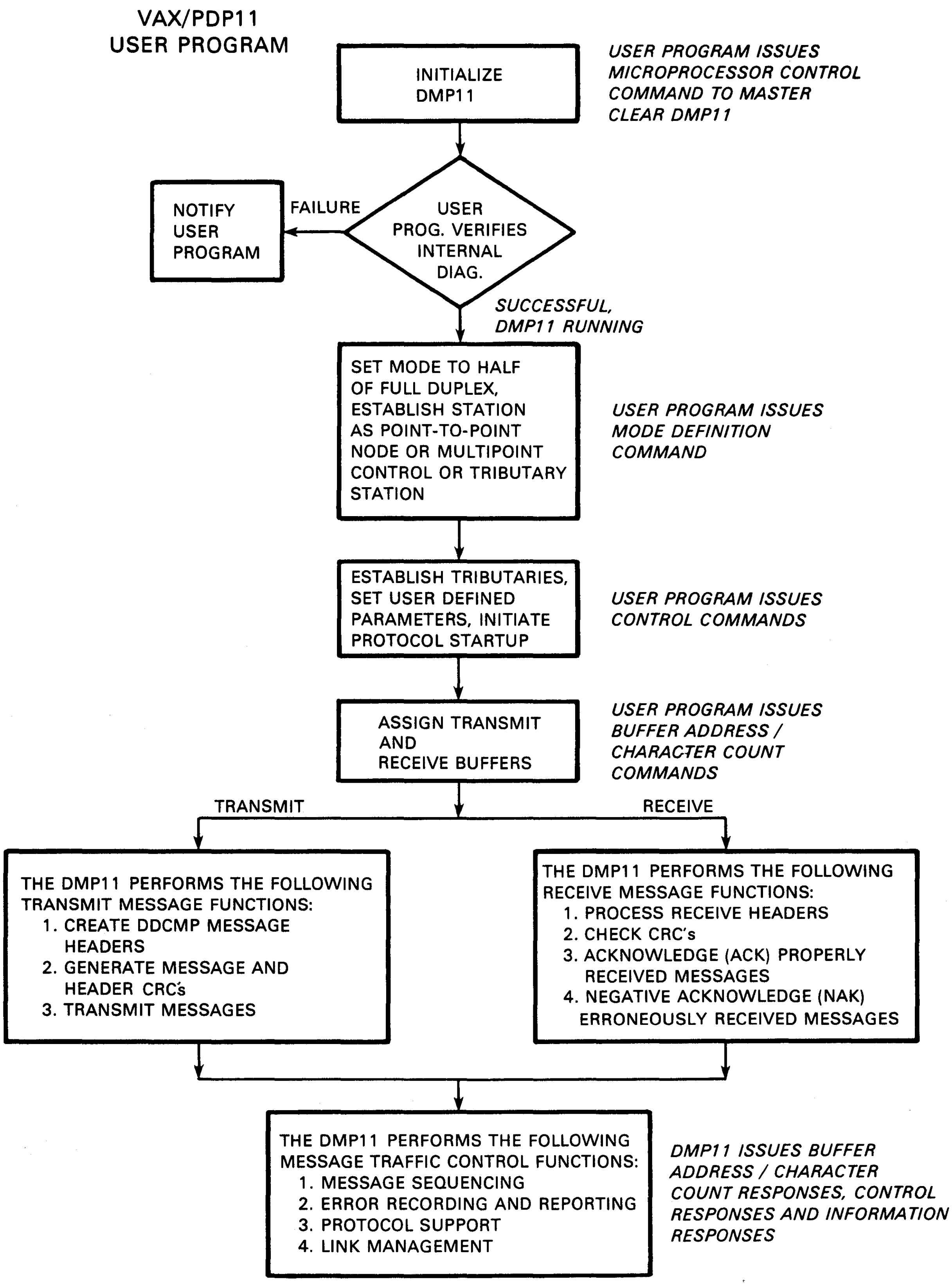


Figure 1-2 General Summary of DMP11 Command Response Structure

For diagnostic purposes, the microprocessor control command permits the execution of maintenance instructions, the single stepping of both the microprocessor and the line unit, and operation of the line unit in loopback mode. This microprocessor control command function is normally used when the DMP11 is not connected to the communications line.

1.4.1.2 Mode Definition Command – A user program issues this command to an associated DMP11 once at system startup time to initialize the DMP11 and define the operational state of that device. For a DMP11, this command defines its function as that of either a control or tributary station in a multipoint network or as a station in a point-to-point network. It also serves to define the station as full- or half-duplex. This command can also provide DMP11/DMC11 line compatibility when these devices are connected point-to-point.

1.4.1.3 Control Command – This command allows the user program to structure the internal data base, specify user-defined parameters, and initiate protocol operation. In addition, the control command provides the user program with access to the status, statistical, and error information maintained in the internal data base by the DMP11.

With this command, the user program at a control station can change the protocol state of an associated tributary. Tributaries can also be established and deleted with this command.

Various aspects of dynamic polling, as implemented by the DMP11 polling algorithm, can also be controlled by the user program through this command. For example, dynamic polling for individual tributaries can be enabled and disabled and polling parameters can be selectively modified.

1.4.1.4 Buffer Address/Character Count Command – This command has two forms, one for initiating transmission of a message, and one for assigning a buffer for anticipated message reception.
The form for initiating a transmission directs the DMP11 to transmit a message having a specified character count from a main memory buffer identified by a designated UNIBUS address to the tributary addressed by the command. If the DMP11 is a control station, the tributary address identifies the tributary that is to receive the message. If the transmitting DMP11 is a tributary station, the tributary address in the command serves to identify the sending tributary to the receiving control station.

The form for allocating buffers for received messages directs the DMP11 to store an expected receive message from a specified tributary in the main memory buffer of designated length at the memory location pointed to by the UNIBUS address contained in the command.

1.4.2 DMP11 Responses

A DMP11 provides three response messages to the user program arising from message traffic initiated by the user program. The role of responses in the operation of a DMP11-implemented network is summarized in Figure 1-2. The three responses posted to the user program are:

1. The buffer disposition count response,
2. The control response, and
3. The information response

The general nature of these responses is described in the sections that follow.

1.4.2.1 Buffer Disposition Count Response – This DMP11 response provides the user program with information on the disposition of messages transmitted and received by the DMP11. For example, when a message is successfully transmitted and the receipt is acknowledged by the receiving station, the DMP11 issues this response to inform the user program of that fact.

Similarly, when a message is received and stored in the assigned buffer, this response informs the user program of the buffer completion and identifies the received message. Other forms of this response are used to inform the user program of unacknowledged transmissions and of transmissions and receptions not completed because the logical link was disconnected.

1.4.2.2 Control Response – This response message is issued by the DMP11 to report system events and error conditions encountered during transmission, reception, and diagnostic operations. It is generally unsolicited. The types of events and error conditions reported include system and protocol events, and network and procedural errors.

1.4.2.3 Information Response – Specific actions requested by control commands require responses from the DMP11 confirming that the requested action has been performed. The DMP11 returns such responses to the user program by issuing an information response containing the confirming response. For example, when the user program requests, through a control command, that the contents of a specific error or statistical counter be read, the contents of that counter is returned by an information response.

In most cases, the DMP11 issues an information response in reply to a control command issued by the user program. However, the DMP11 microcode can issue unsolicited information responses to the user program when the state of the protocol changes. In such cases, the DMP11 generally returns all unused buffers and issues appropriate information responses to the user program to inform it of the action taken.

1.5 PROTOCOL SUPPORT

In DMP11 implemented multipoint and point-to-point networks, all message-data transfers between stations are conducted under the control of DDCMP. Although knowledge of DDCMP is not necessary to using the DMP11, it is helpful in understanding events and error conditions related to data traffic in a DMP11-implemented network. A brief summary of DDCMP is presented in Appendix A.

The DMP11 microcode handles all aspects of DDCMP processing including data messages, control messages, and maintenance messages. At the user program level, message handling involves only passing buffers to the DMP11 for transmission and accepting buffers from the DMP11 containing received messages.

There are no file structure restraints on message data transmitted and received over DMP11-implemented networks. In addition, all data is transmitted and received in transparent form so that there are no restrictions on the type of data that can be transmitted or received under DDCMP.

In multipoint networks, the control station polls each tributary by sending a valid DDCMP message having the select bit set (see Appendix A). In response to a poll, a tributary can only send a valid DDCMP data message to the control station. The nature of a multipoint network is such that a tributary can only transmit to the control station. As a result, any communication between tributary stations must go through the control station.

1.6 SYSTEM APPLICATIONS

As previously stated, the multipoint DDCMP DMP11 intelligent controller is a general-purpose device designed primarily for implementing high-speed multipoint and point-to-point networks. A point-to-point network can be considered as a multipoint network formed by one control station and one tributary station where the two stations alternately serve as control station and tributary station. In a half-duplex, point-to-point network, the transmitter is the control station and the receiver is the tributary. When the line turns around, the roles reverse. In a full-duplex, point-to-point network, each station simultaneously serves as both a control station and a tributary station.

Because the DMP11 is a general-purpose device, detailing specific applications is not as helpful as actually describing a network configuration. Therefore, this section outlines some multipoint network configurations that can be implemented with the DMP11.

A DMP11 is equipped with a group of switches that permit the device to be configured for a wide range of application situations. One set of switches in this group allows a DMP11 to be assigned a single tributary address. In this case, a specific set of switches define the numerical value of the tributary address. Switch assigned tributary addresses have the advantage of data transfer security because a tributary address, once established in the device switches, cannot be changed by the attendant software.

Figure 1-3 illustrates a multipoint network where each DMP11 in the network is a single tributary station. The tributary address at these stations can be either software-assigned or switch-assigned.

Figure 1-4 illustrates a multipoint network where the DMP11 at each station supports software-assigned multiple tributary addresses. Multiple tributary addressing is advantageous when network resources are distributed throughout a limited physical area. This 32-tributary limit is imposed by the availability of storage in the microprocessor data memory.

Figure 1-4 also illustrates the tributary status slot (TSS) structures as part of the DMP11 data base. In multipoint networks, these TSS structures are established by the user program as part of the control and tributary station data bases. TSS structures are maintained at each tributary station with a separate TSS for each tributary maintained at the control station.

A major capability of DMP11-implemented multipoint networks lies in the ability of the main CPU at the control station to down-line load programs to tributary stations and execute those programs without human intervention. As a result, DMP11-implemented multipoint networks are particularly suited for installation at remote locations that are inaccessible under most circumstances. For example, DMP11s could be placed in difficult to reach locations, such as weather stations at sea, and in environments that are hazardous to humans.

Note that in Figure 1-3, the blocks representing external modems are shown in dotted lines. This representation refers to the ability of a DMP11 to connect to the physical communications line through the integral modem or through an external modem. In general, an external modem is used when the communications line is a low to medium speed long-distance leased or dial-up line. The integral modem is used when the communications line is a short distance (up to 16000 feet) high speed line (up to 1M b/s).

1.7 APPLICABLE DOCUMENTS

1. *M8207 Microprocessor Technical Manual* (EK-M8207-TM)
2. *M8203 Line Unit Technical Manual* (EK-M8203-TM)
3. *DMP11 Print Set* (MP-00795)
4. *Digital Data Communications Message Protocol (DDCMP) Specification,* Version 4.0 (AA-D599A-TC)
5. *Maintenance Operation Protocol (MOP) Specification*, Version 2.0 (AA-D602A-TC)
6. Electronic Industries Association (EIA) specifications

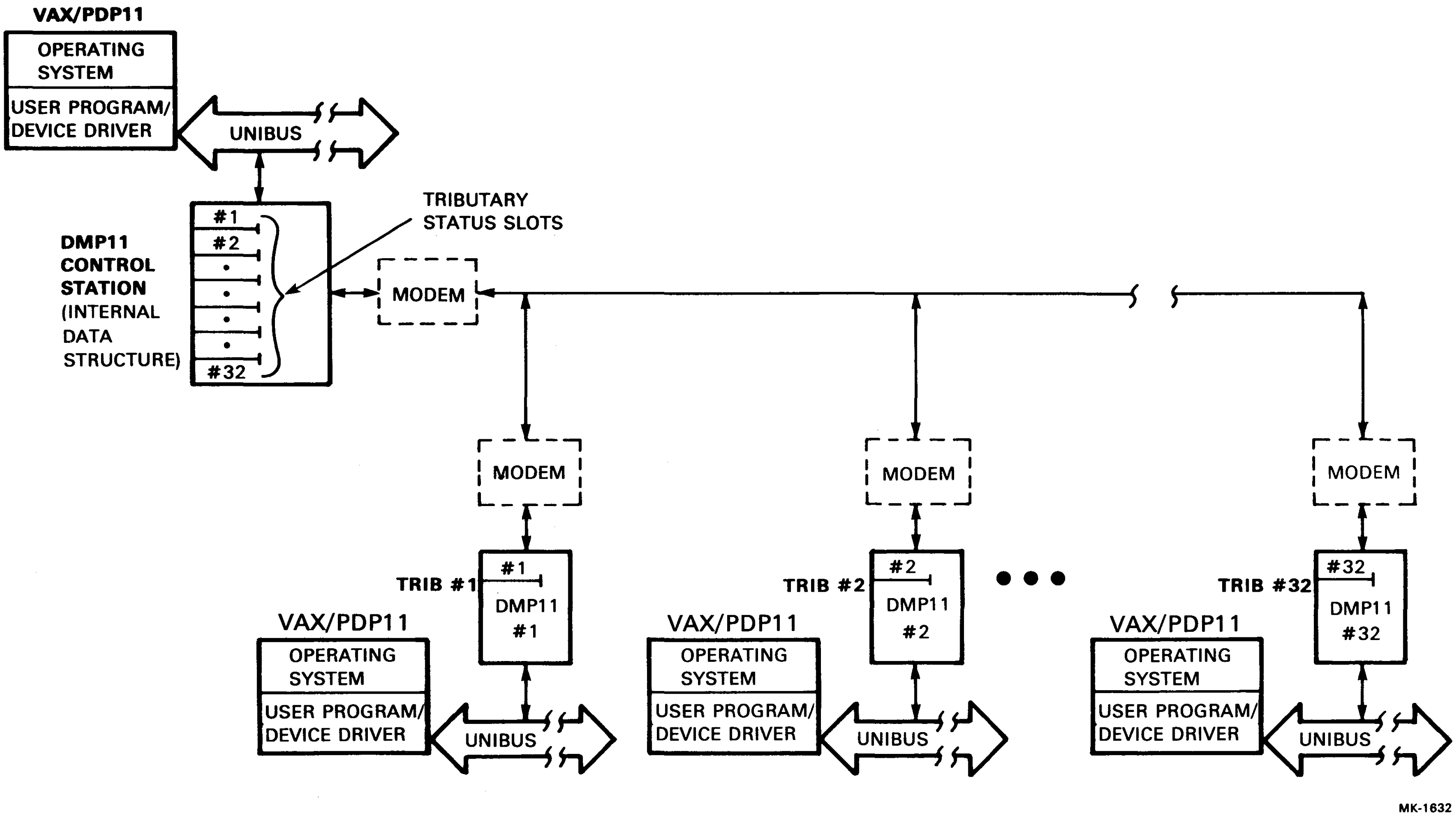


Figure 1-3 Block Diagram of a Multipoint Network with Single Assigned Addresses

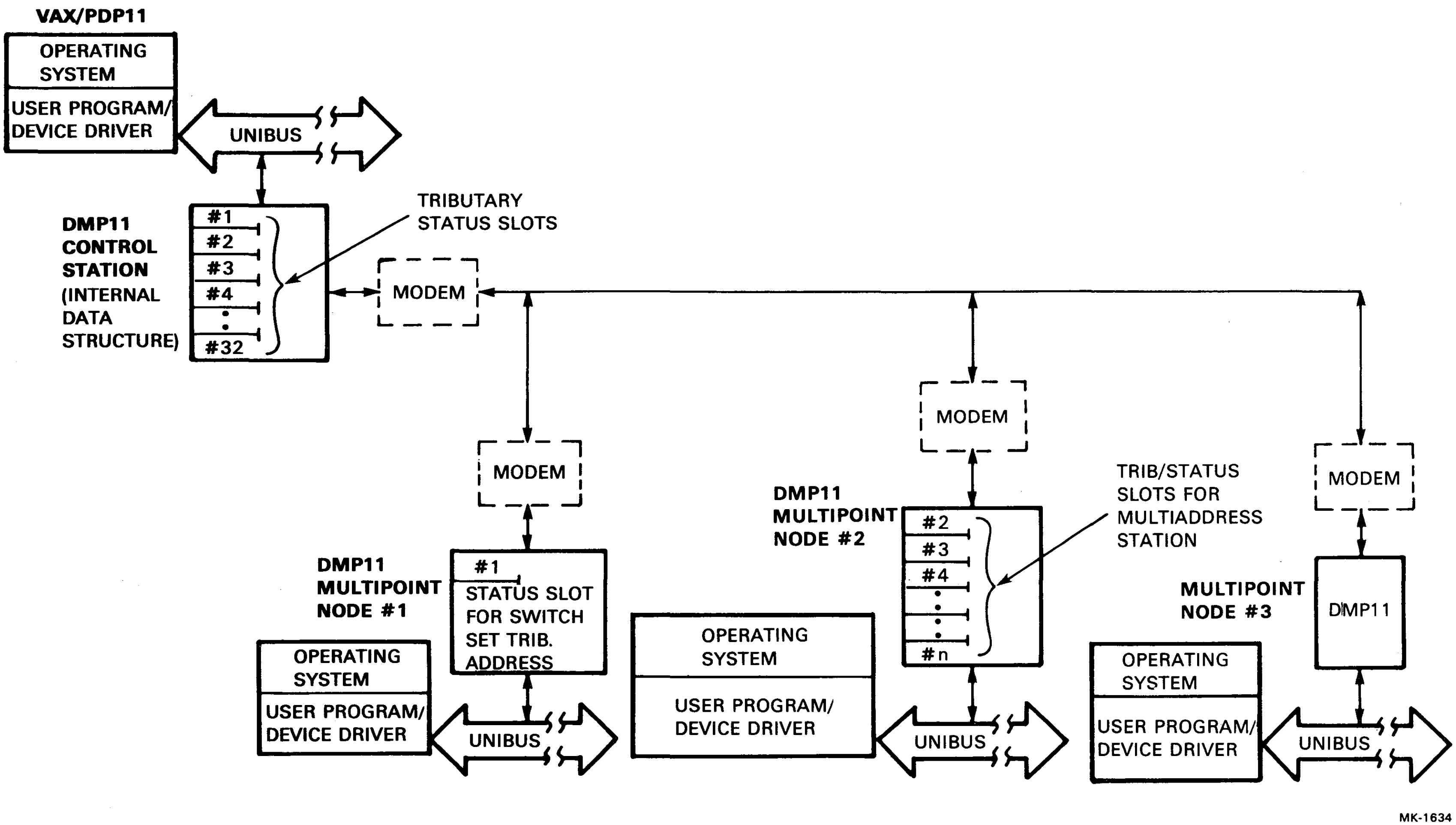


Figure 1-4 Block Diagram of a Multipoint Network with Multiple Tributary Addresses

CHAPTER 2
INSTALLATION

2.1 SCOPE
This chapter provides all the necessary information for installing and testing the DMP11 microprocessor subsystem. A checklist, which can be used to check the installation process, is also included.

2.2 UNPACKING AND INSPECTION
The DMP11 is packed according to standard packing practices. When unpacking, remove all packing material and check the equipment against the shipping list (Table 2-1 contains a list of supplied items for each configuration). Examine all parts and carefully check the module for cracks, loose components, and separations in the etched paths. Report damages or shortages to the shipper and inform the DIGITAL representative.

2.3 INSTALLATION CONSIDERATIONS
Installation of the DMP11 microprocessor/line unit subsystem should be done in four phases:

- Phase I – Preinstallation Considerations

  Verify system requirements, system placement, and configuration requirements.

  Network Topology Chart

  For multipoint networks, it is absolutely necessary to know the configuration of the DMP (that is, control tributary, HDX, FDX, etc.), locations of tributaries (w/address), and where in the network they are connected (control, Trib 187, Trib 98, Trib 208), or else troubleshooting will be impossible.

- Phase II – Microprocessor Installation

  Configure, install, and verify the microprocessor module via the appropriate diagnostics.

- Phase III – Line Unit Installation

  Configure the line unit module for the customer application and install, cable, and verify it via appropriate diagnostics.

- Phase IV – DMP11 System Testing

  Verify the DMP11 microprocessor subsystem operation with the functional diagnostics and system exerciser programs.

Table 2-1 DMR11 Option Packing List

Option	Parts List	Description
DMP11-AD		DMP11 basic subsystem unit containing:
	M8203	Line unit module
	M8207-YA	Microprocessor module with DMP11 microcode ROMS
	BC08S-1	Module connection cable
	H3254	V.35 and integral test connector
	H3255	RS-232-C/RS-422-A/RS-423-A module test connector
	EK-DMP11-UG	*DMP11 User's Guide*
	MP-00795	Customer print set
	ZJ-289-RB	Diagnostic set
DMP11-AA		RS-232-C/RS-423 interface configuration containing:
	DMP11-AD	Basic DMP11 unit
	BC55C-10	EIA RS-232-C/RS-423-A cable
	H3251	Cable turnaround test connector
	H325	Cable turnaround test connector
DMP11-AB		CCITT V.35 interface configuration containing:
	DMP11-AD	Basic DMP11 unit
	BC05Z-25	CCITT V.35 cable
	H3250	Cable turnaround test connector
DMP11-AC		Integral modem interface configuration containing:
	DMP11-AD	Basic DMP11 unit
	BC55A-10	Integral modem cable
	H3257/H3258	BC55A terminators
DMP11-AE		RS-422-A interface configuration containing:
	DMP11-AD	Basic DMP11 unit
	BC55B-10	RS-422-A cable
	H3251	Cable turnaround test connector

It is strongly recommended that a topology diagram be drawn at installation time and maintained throughout the life of the installation. The topology diagram should provide the information shown below. Figure 2-1 shows a local network topology and Figure 2-2 shows a remote network topology.

Cable routing	Shows the actual physical location of the cable trough and indicate any equipment which may cause interference, such as an X-ray room.
Machine type	Shows whether the CPU is a PDP-11/70, PDP11/34, VAX-11/780, etc.
Type of station	Identifies whether the station is a control or tributary station.
Physical address	DDCMP address can range from 1-255.
Location	Shows by room number, or other appropriate means, the actual location of the equipment.
Node name	The name given to the tributary if applicable.
Operating system and version	The name of the software operating system, such as RSX-11M V3.2.
DECnet version	DECnet software version, such as DECnet-11M V3.0.
Transmit and recieve	Shows transmit and receive lines. Shows end nodes and terminations. If a patch panel is used, it shows the line numbers between patch panels.

NOTE

The use of patch panels and the numbering of the lines is recommended.

2.4 PREINSTALLATION CONSIDERATIONS

Table 2-1 should be considered prior to ordering a DMP11 communications interface to ensure that the system can accept the DMP11 and that it can be installed correctly. Sections 2.4.1 through 2.4.2 should also be verified at installation time.

2.4.1 System and Device Placement

2.4.1.1 System Placement – On systems that contain many high-speed, direct memory access (DMA) devices, there is a chance of adverse bus latency. To help prevent this, the closer the physical placement of the DMP11 to the processor, the higher the DMA device priority. Customer applications using speeds greater than 250K bits per second (b/s) require UNIBUS placement before all UNIBUS repeaters and before all devices that have a lower NPR rate on the UNIBUS.

2.4.1.2 Device Placement – The DMP11 requires two hex-height, small peripheral controller (SPC) backplane slots (preferably two adjacent slots). Any SPC backplane [DD11-B (REV E) or later] can accept the DMP11. The DD11-D can accommodate a maximum physical configuration of three DMP11s (see CAUTION).

CAUTION

Each DMP11 requires approximately 8.5 amperes from the +5 volt source. For example, three DMP11s in a DD11-D can overload the H744 supply. Therefore, there is a restriction to 2 per DD11-D with each supply providing 24 amps of +5 V. The H7441 supply, however, can supply 32 amperes.

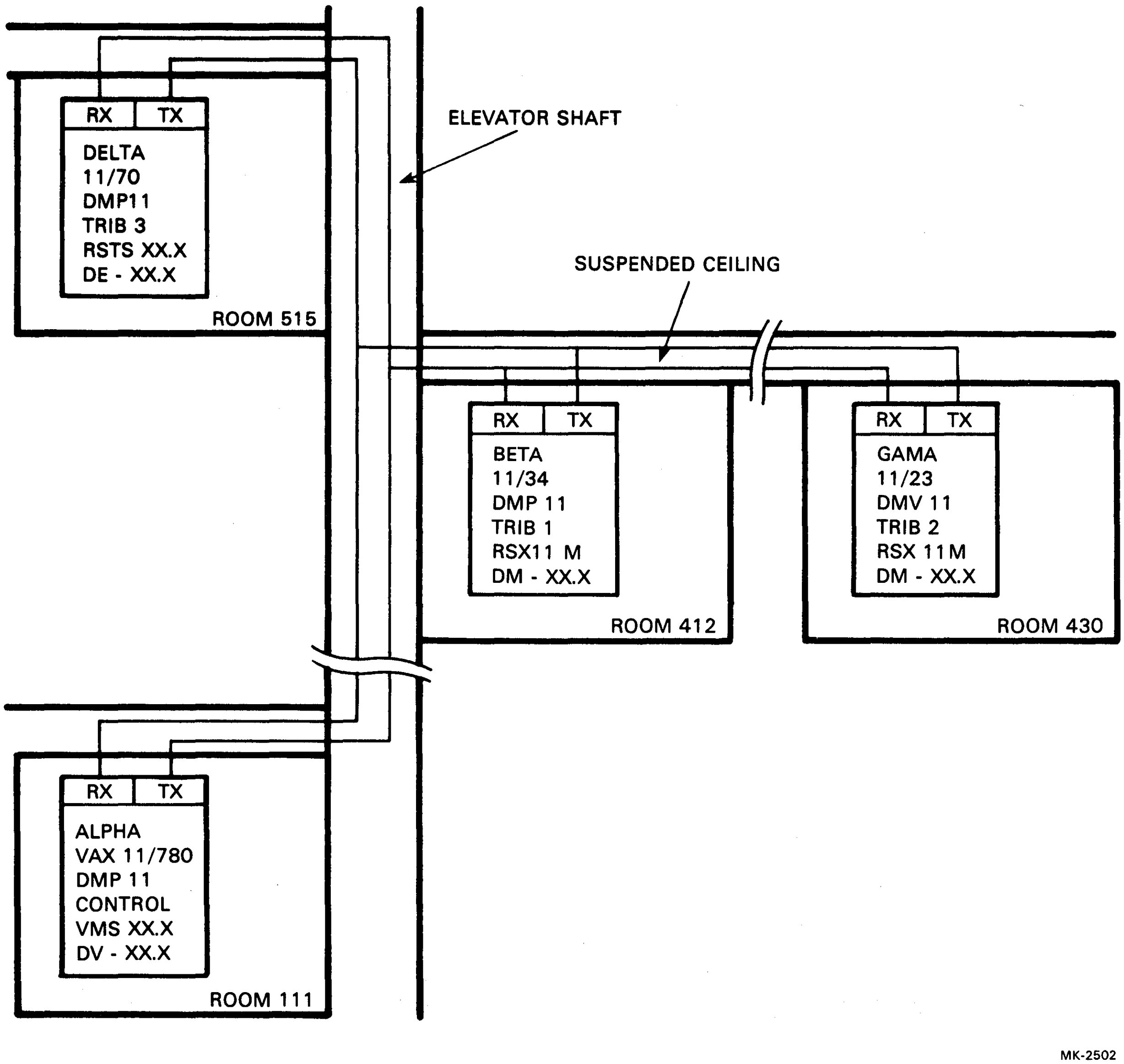


Figure 2-1 Example of a Topology Diagram for a Local Multipoint Network

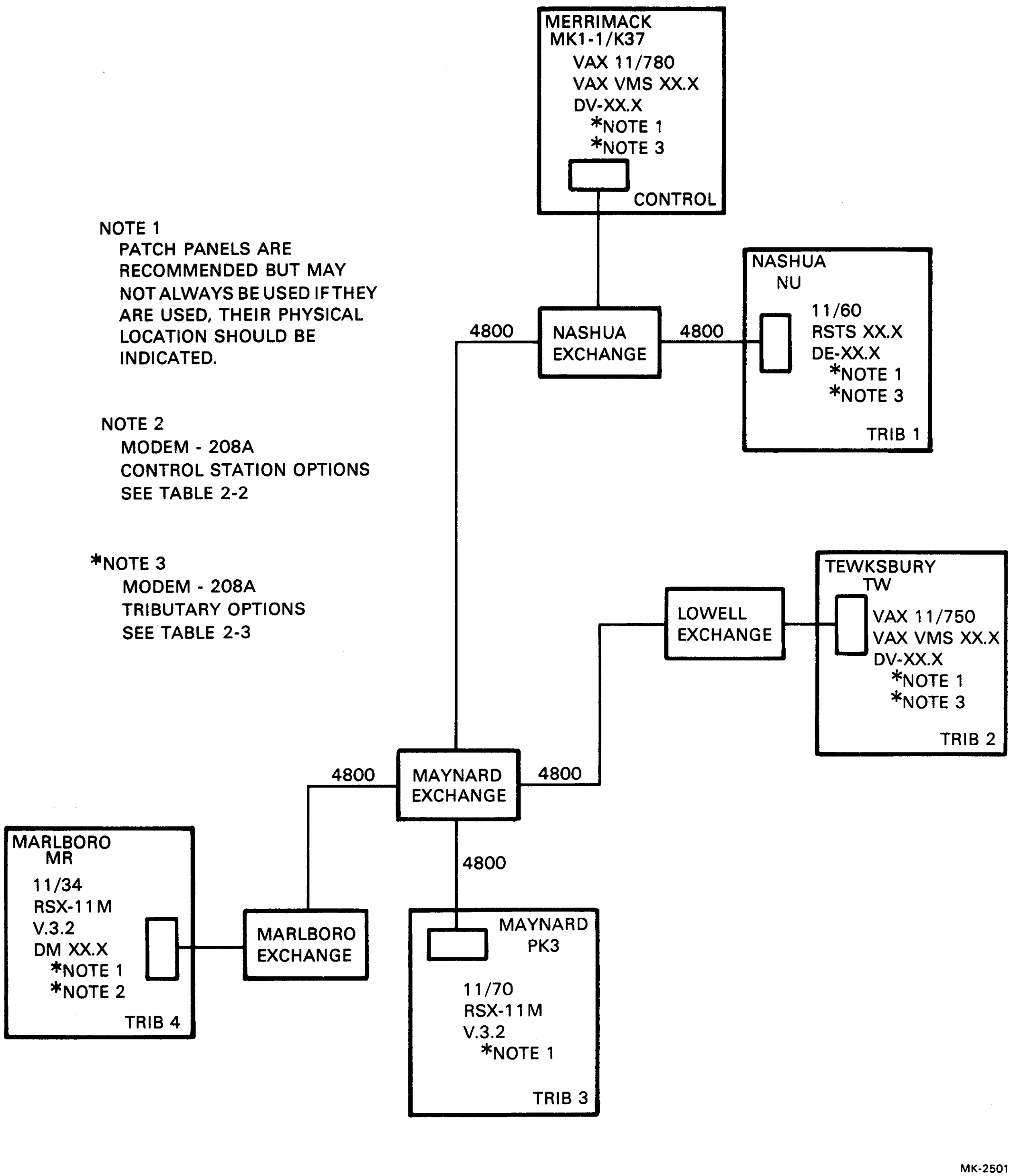


Figure 2-2 Example of a Topology Diagram for a Remote Multipoint Network

Table 2-2 Typical Control Station Options of a Bell 208A Compatible Data Set (4800 b/s) Full-Duplex Operation

Data Set Options	DEC Recommended Settings
Transmitter Timing Provided	Data set (internal)
Carrier Control	Continuous
Request-to-Send Operation in Continuous Carrier Mode	Continuous (CB constantly on)
One Second Holdover at Receiver on Line Dropouts	Not provided
New Sync Option to Squelch Receiver Clock	Not used – NS is strapped OFF within the data set
Data Set Ready Lead Option for Analog Loopback Testing by Data Terminal	CC is on when the AL button (only) is pressed
Grounding Option	AB connected to AA

Table 2-3 Typical Tributary Options of a Bell 208A or Compatible Data Set (4800 b/s) Full-Duplex Operation

Data Set Options	DEC Recommended Settings
Transmitter Timing Provided	Data set (internal)
Carrier Control	Switched (48.5 ms CA-CB delay)
Request-to-Send Operation in Continuous Carrier Mode	Continuous (CB constantly on) N/A Switched (8.5 ms CA-CB delay) N/A
One Second Holdover at Receiver on Line Dropouts	Not provided
New Sync Option to Squelch Receiver Clock	Not used – NS is strapped off within the data set
Data Set Ready Lead Option for Analog Loopback Testing by Data Terminal	CC is on when the AL button (only) is pressed
Grounding Option	AB connected to AA

2.4.2 System Requirements

1. UNIBUS Loading (Recommended)

   M8207-YA microprocessor

   1 UNIBUS dc load
   5 UNIBUS ac loads

   M8203 line unit

   No UNIBUS loads

2. Power Requirements

   Check the power supply before and after installation to ensure against overloading. The microprocessor/line unit total current requirement for the +5 volt supply is approximately 8.5 amperes. Additionally, the unit requires ±15 volts for the silos, level conversion logic, and integral modem. Power requirements for the microprocessor/line units are listed in Table 2-4.

Table 2-4 DMR11 Voltage Chart

Module	Voltage Rating (Approximate Values)	Maximum Voltage	Minimum Voltage	Back Plane Pin
M8207-YA	+ 5 Volts @ 5.0 A	+ 5.25	+ 5.0	C1A2
M8203	+ 5 Volts @ 3.5 A	+ 5.25	+ 5.0	C1A2
	+15 Volts @ .1 A	+15.75	+14.25	C1U1
	−15 Volts @ .2 A	−15.75	−14.25	C1B2

3. Interrupt Priority

   The interrupt priority is selected by priority plug E77 on the M8207-YA microprocessor module. This plug is preset to select priority five (BR5). This corresponds to IPL 21 on VAX systems. Refer to Figure 2-3 for the priority plug location.

4. Device Address Assignment

   The DMP11 is in the floating address space of the input/output (I/O) page of memory.

   The selection of the device address is accomplished by switch pack E127 on the M8207-YA microprocessor module. Refer to Figure 2-3 for the switch pack placement. The DMP11 has a ranking of 21 in the floating list.

   Refer to Appendix B if more information is needed on the floating address allocation.

5. Device Vector Address Assignment

   The DMP11 is in the floating vector space of the reserved vector area of memory. The ranking assignment of the DMP11 is ranking number 42. The selection of the device vector address is accomplished by switch pack E28 on the M8207-YA microprocessor module. Refer to Figure 2-3 for the location of the switch pack. Appendix B contains more information on floating vector allocation.

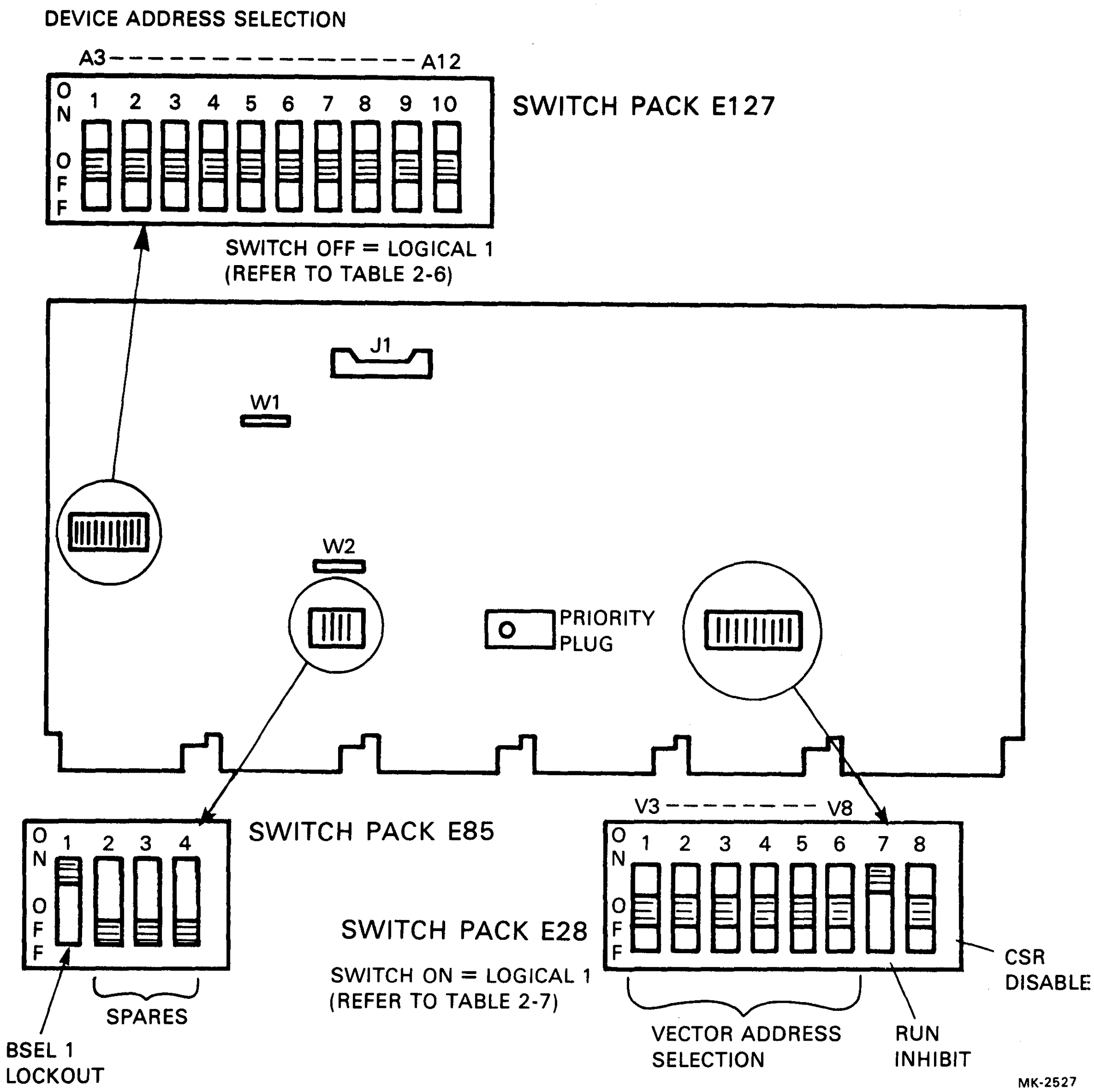


Figure 2-3 M8207-YA Microprocessor Switch/Jumper Locations

6. Customer Application Considerations

   The DMP11 is configured according to the customer's application and configuration requirements. Ask the customer to determine these requirements for the DMP11 being installed (refer to Tables 2-5 through 2-8).

Table 2-5 M8207-YA DMP11 Jumper Chart

Jumper Number	Normal Configuration	Function
W1	Always In	Microprocessor Clock Enable – When removed it disables the microprocessor clock. Removed only for automatic module testing at the factory.
W2	Always In	Bus ac Low Enable – When removed it disables a program asserted ac low signal passed onto the UNIBUS.

Table 2-6 Switch Pack E127 Selections

Switches	Function
1-10	Device Address Selection:

MSB / LSB

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	1	SWITCH PACK E127										0	0	0

SWITCH NUMBER	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	DEVICE ADDRESS
										OFF	760010
									OFF		760020
									OFF	OFF	760030
								OFF			760040
								OFF		OFF	760050
								OFF	OFF		760060
								OFF	OFF	OFF	760070
							OFF				760100

						OFF					760200

						OFF	OFF				760300

					OFF						760400

					OFF		OFF				760500

					OFF	OFF					760600

					OFF	OFF	OFF				760700

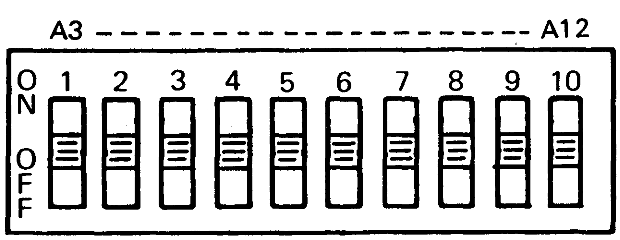
				OFF							761000

			OFF								762000

			OFF	OFF							763000
											--
		OFF									764000

NOTE: SWITCH OFF RESPONDS TO LOGICAL ONE ON THE UNIBUS.

SWITCH PACK E127
DEVICE ADDRESS
SELECTION



Switch Pack
E127

Table 2-7 Switch Pack E28 Selections

Switches	Function
	NOTE **Switch ON equals a logical one (1) on the UNIBUS.**
1-6	Vector Address Selection:

MSB … LSB

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	SWITCH PACK E28						1/0	0	0

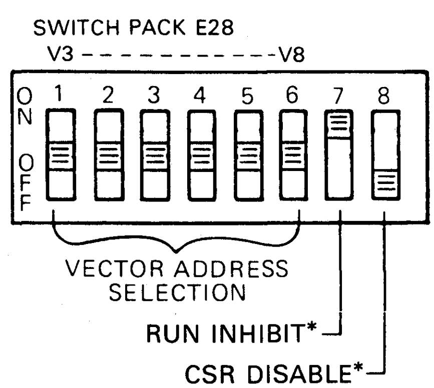
SWITCH NUMBER	S6	S5	S4	S3	S2	S1	VECTOR ADDRESS
		ON	ON				300
		ON	ON			ON	310
		ON	ON		ON		320
		ON	ON		ON	ON	330
		ON	ON	ON			340
		ON	ON	ON		ON	350
		ON	ON	ON	ON		360
		ON	ON	ON	ON	ON	370
	ON						400

	ON		ON				500

	ON	ON					600

	ON	ON	ON				700

NOTE: SWITCH ON PRODUCES LOGICAL ONE ON THE UNIBUS.



*Refer to Table 2-6 for switch functions.

Table 2-8 Switch Selectable Features

Switch Location and Number	Normal Configuration	Function
E28 Switch 7	ON	Run Inhibit – Under normal conditions, (switch ON) the initialization of the microprocessor directly sets the run flip-flop which allows the microcode to begin execution immediately. If an internal malfunction or execution of erroneous microcode occurs during power up, it is possible for the microprocessor to hang the UNIBUS. Placing the run inhibit switch in the OFF position clears the run flip-flop and allows the diagnostics to be loaded to determine the fault. Once diagnostics have been executed and the problem corrected, the run switch must be returned to the ON position.
E28 Switch 8	OFF	CSR Disable – When the switch is ON it keeps the device from responding to its address. Used in special applications on other options.
E85 Switch 1	ON	BSEL 1 Lockout – When the switch is OFF, it inhibits the use of all maintenance test features and keeps the run bit asserted at all times. This allows the DMP11 microcode to run with the ability to detect a boot request message at all times. This is used at unattended computer sites. This switch must be ON to execute all diagnostics.
NOTE **Although BSEL 1 maintenance functions are inhibited, master clear (bit 6) is still functional.**		
E85 Switches 2, 3, 4, and 5	OFF	Not Used (see note in Table 2-6)

2.5 MICROPROCESSOR INSTALLATION

2.5.1 Backplane Considerations

Perform the following on the SPC slot that will contain the DMP11 M8207-YA microprocessor module (selected at preinstallation).

1. Verify that the backplane voltages are within the specified tolerances listed in Table 2-4.

2. Turn system power off and remove the NPR grant (NPG) wire that runs between CA1 and CB1 on that backplane slot for the M8207-YA module.

NOTE

Be sure to replace this jumper if the microprocessor is removed from the system.

3. Perform resistance checks on the backplane voltage sources to ground to ensure that no short circuit conditions exist. Refer to Table 2-4 for backplane pin assignments.

2.5.2 M8207-YA Considerations
Perform the following on the DMP11 M8207-YA microprocessor module.

1. Ensure that the module version number is an M8207-YA, which shows DMP11 microcode.

2. Verify that M8207-YA jumpers W1 and W2 are installed correctly (refer to Table 2-5).

3. Configure switch pack E127 to implement the correct device address for the DMP11, as determined from the floating address allocation. Refer to Table 2-6 for the correlation between switch number and address bit. A switch OFF (open) responds to a logical one on the UNIBUS. Refer to Appendix B for additional information on floating address allocation.

4. Configure switch pack E28 to implement the correct vector address for the DMP11 as determined from the floating vector allocation. Refer to Table 2-7 for the correlation between switch number and vector bit. A switch ON (closed) responds to a logical one on the UNIBUS. Refer to Appendix B for additional information on floating vector allocation.

5. Verify that the switch selectable features of the M8207-YA are configured as follows (Table 2-8 provides a summary of switch selectable features):

   - Run Inhibit – Switch pack E28, switch 7; always ON.

   - CSR Inhibit – Swtich pack E28, switch 8; always OFF.

   - Byte Select/Lockout – Switch pack E85, switch 1; normally ON (allows all functions in BSEL 1 to be used). If the switch is OFF, the Run bit is always asserted and will not allow diagnostic testing.

   NOTE
   For switch pack E85, only switch 1 is used.

6. Verify that the priority plug is a BR5 and is installed correctly in location E77.

2.5.3 M8207-YA Insertion
Carefully insert the M8207-YA microprocessor module into the selected SPC slot and perform the following tests:

1. Perform resistance checks on the backplane voltage sources to ground to ensure that no short circuit conditions exist on the module. Refer to Table 2-4 for backplane pin assignments.

2. Turn system power ON and verify that the backplane voltages are within the specified tolerances listed in Table 2-4.

3. Load and execute the M8207 static diagnostics, parts one and two (no test connectors are required). See Table 2-9.

   On obtaining a minimum of five error free end passes, proceed to the M8203 line unit installation section.

2.6 M8203 LINE UNIT INSTALLATION
The M8203 line unit is a universal module with various types of interface capabilities. The M8203 line unit does not present any ac or dc loads to the UNIBUS and only draws power from the backplane slot in which it is. All data and control signals flow into and out of the line unit via a berg port to the microprocessor. Because of the various M8203 applications, the configurations for each may be differ-

ent and are selected via switches, jumpers, and different cables. To provide a better understanding of these variations, a number of tables describing each switch pack, jumper, and cable function (as listed below) has been created for reference. Table 2-10 lists the normal M8203 line unit configurations for the different types of DMP11 options. Also, refer to the following:

NOTE
Modem interface signal jumpers are included on the BC55C panel and, therefore, do not have to be configured on the M8203 module.

- Table 2-11 Jumper Functions – These jumpers are used to select various interface standard parameters and modem interface signals, depending on application and modem type. Additional jumpers are available on the BC55C (panel) cable for additional interface signal selection.

- Table 2-12 Switch Pack E39 Functions – This switch pack allows proper selection of interface driver and receiver control logic and different line speeds for various applications.

Table 2-9 DMP11 Diagnostics

PDP-11 Diagnostic	Description
CZDMP**	M8207 microprocessor static diagnostic 1
CZDMQ**	M8207 microprocessor static diagnostic 2
CZDMR**	M8203 line unit static diagnostic 1
CZDMS**	M8203 line unit static diagnostic 2
CZDMT**	DMP11 functional diagnostic
CZCLM**	DMP11 DCLT program
CXDMD**	DMP11 DEC/X11 master module
CXDME**	DMP11 DEC/X11 slave module
VAX-11 Diagnostic	**Description**
EVDXA REV 3.0 and Above	COMM microprocessor repair level diagnostics (Level 3)
EVDMA REV *.*	M8203 line unit repair level diagnostics
EVDMB REV *.*	VAX DMP11 functional diagnostic

Table 2-10 Normal M8203 Configuration

M8203 Configuration	Option Type:	DMR11-AA EIA RS-232-C or RS-423-A	DMR11-AB CCITT V.35	DMR11-AE EIA RS-422-A	DMR11-AC Integral Modem 56K b/s	DMR11-AC Integral Modem 1 MEG b/s	DMR11-AA Null Modem Clock 9.6K b/s
Jumper Configuration* (refer to Table 2-11)	W1-W6, W11 W14-W17	OUT	OUT	OUT	OUT	OUT	OUT
	W7-W10 W12,W13	IN	IN	IN	IN	IN	IN
Switch Pack E39 (refer to Table 2-12)	S1-4	OFF	OFF	OFF	OFF	OFF	OFF
	S5	OFF	ON	OFF	OFF	OFF	OFF
	S6	OFF	OFF	OFF	OFF	OFF	OFF
	S7	OFF	OFF	ON	OFF	OFF	OFF
	S8	ON	ON	ON	OFF	ON	OFF
	S9	ON	ON	ON	OFF	ON	ON
	S10	OFF	OFF	OFF	ON	ON	OFF
Switch Pack E121 † (refer to Table 2-13)	S1-4	Unit Number Selection					
	S5-7	Mode Definition Selection					
	S8	Mode Enable					
	S9	Remote Load Detect					
	S10	Power On Boot					
Switch Pack E134 † (refer to Table 2-14)	S1-8	Tributary Address/Password					
	S9	Not Used					
	S10	High Speed/Low Speed					
Cables Required (refer to Figure 2-6)		BC55C-10* and BC05D-25	BC05Z-25	BC55B-10 and BC55D-33	BC55A-10 and Twinax Cables	BC55A-10 and Triax Cables	BC55C-10* and Null Modem
Module Turnaround Test Connector (refer to Figure 2-7)		H3255 IN J2	H3254 IN J1	H3255 IN J2	H3254 IN J1	H3254 IN J1	H3254 IN J2
Cable Turnaround Test Connector (refer to Figure 2-7)		EIA RS-232-C H325 EIA RS-423-A H3251	H3250	H3251	Half-duplex Switch ON and Cables Removed	Half-duplex Switch ON and Cables Removed	EIA RS-232-C H325 EIA RS-423-A H3251

*Modem variable
†Customer application variable (there is no normal setting for these switches)

Table 2-11 M8203 Jumper Functions

Jumper	Normal Configuration	Function
W1	OUT	Clear to send EIA/V.35
W2	OUT	Data mode EIA/V.35
W3	OUT	Receive data EIA
W4	OUT	Receive clock EIA
W5	OUT	Receive ready EIA
W6	OUT	Transmit clock EIA

NOTE

These jumper positions can be used to insert capacitors or resistors, depending on interface standard.

- **RS-423-A – Capacitors can be inserted in noisy environments. Refer to RS-423-A Standard, Section 4.1.6, Wave Shaping, for capacitor selection.**
- **RS-422-A – Resistors are required to properly terminate the receivers in order to obtain distances of 1219.2 meters (4000 feet). Unterminated receivers only obtain distances of 12.2 meters (40 feet). For ease of installation, these terminating resistors (100 ohms) have been installed in the RS-422-A cable BC55B-10.**

Jumper	Normal Configuration	Function
W7	IN	Signal Rate Indicator – When removed, opens signal to interface in RS-422-A/423-A and RS-232-C configurations. Remove when a BC05C-XX* cable is used as this signal is presented to cinch pin nine, which has a positive test voltage on some modems.
W8	IN	Data Mode (Data Set Ready) – When removed, opens signal to interface in RS-422-A/423-A configurations. It has no effect in RS-232-C. Remove when a BC05C-XX* cable is used, as the signal is presented to cinch pin 18, which is dibit clock on some modems.
W9	IN	Null Modem Clock – When removed the signal amplitude is lowered below the interface standards so as not to create interference in some modems.

*DMP11 does not support the use of a BC05C-XX cable.

Table 2-11 M8203 Jumper Functions (Cont)

Jumper	Normal Configuration	Function
W10	IN	Terminal Ready – When removed, it opens the signal to modem in RS-422-A/423-A configurations. Remove when a BC05C-XX* cable is used, as this signal is presented to cinch pin 10, which is negative test voltage on some modems.
W11	OUT	Receiver Ready (Carrier Detect) – When installed, it allows this signal to be on at all times. This could cause a problem with the microcode since the Universal Synchronous Receiver/Transmitter (USYRT) will be enabled all the time.
W12	IN	Terminal in Service (Make Busy) – When removed, it opens this signal to the modem. Some modems will not answer the phone and will be put in analog loopback when this signal is asserted. When a BC05C-XX* cable is used, this signal is presented at cinch pin 25.
W13	IN	Oscillator Enable – To be removed only for factory automatic testing. Jumper should always be installed in the field.
W14 and W15	OUT OUT	56K Bandpass Filter Enable – With these jumpers installed, the bandpass filter is limited to 56K b/s. Used in special applications only.
W16	OUT	Switched RTS-CTS Enable – When jumper is installed, it enables the request to send and clear to send interlock in the M8203 line unit which inhibits asserting RTS, until CTS is dropped. This jumper should never be installed when the DMP11 is operating with a modem that has the constant CTS option installed.
W17	OUT	Half-Duplex Lockout Enable – When this jumper is installed, it enables the M8203 line unit half-duplex lockout feature when half-duplex mode is selected. The lockout feature disables the transmitter or receiver when the other is active. This jumper applies only to half-duplex applications. It must not be installed for full-duplex applications.

NOTE

Jumpers W16 and W17 are mutually exclusive. Only one or the other may be installed, not both. Also, these jumpers are provided only on M8203 modules REV E or higher. For modules up to REV D, refer to ECO-M8203-MK-007 for details of similar jumpers.

*DMP11 does not support the use of a BC05C-XX cable.

Table 2-12 Switch Pack E39 Selections

NOTE
Switch off equals a logical one (1).

Switches	Function
1-4	Not used in DMP11.
5-7	Interface Selection – Selects proper drivers and receivers for each interface type: • SW5, 6, and 7 all OFF — Selects EIA RS-232-C and RS-423-A interface logics which are single-ended (unbalanced) drivers and receivers. The integral modem logic is selected with the BC55A-10 cable when installed in J1 of the M8203. • SW5 ON — Selects V.35 interface logic which has balanced drivers and receivers. • SW6 ON — Reserved. • SW7 ON — Selects EIA RS-422-A interface logic with balanced drivers and receivers.

Interface Type	SW5	SW6	SW7
RS-232-C, RS-423-A, Integral Modem*	OFF	OFF	OFF
V.35	ON	OFF	OFF
RS-422-A	OFF	OFF	ON

Switches	Function
(Switches 8-10)	Line Speed Selection – Selects modem speed for integral modem applications, null modem applications, and diagnostic testing.

	Switch				Switch		
Speed	**8**	**9**	**10**	**Speed**	**8**	**9**	**10**
1 MEG	ON	ON	ON	19.2K†	ON	ON	OFF
500K	OFF	ON	ON	9.6K	OFF	ON	OFF
250K	ON	OFF	ON	4.8K	ON	OFF	OFF
56K	OFF	OFF	ON	2.4K	OFF	OFF	OFF

*Integral modem is selected by BC55A cable when installed in J1 of the M8203 line unit. Module connector J2 must not have a cable or test connector installed.

†Normal switch setting unless the integral modem or null modem clock features are used.

- Table 2-13 Switch Pack E121 Functions – This switch pack is provided for the selection of the mode of operation of the DMP11 (for example, Pt-to-Pt, multipoint control, trib, etc.) and for various microcode features. See Table 2-11 for details.

- Table 2-14 Switch Pack E134 Functions – This switch pack is provided for the selection of the tributary address and remote load detect password. See Table 2-7 for details.

- Table 2-15 Cable Description – This table lists the functions and uses of each cable used with the DMP11.

- Figure 2-4 shows the jumper and switch pack placements on the M8203 line unit.

- Figure 2-5 shows the jumper and switch pack placement on the M8203 line unit.

- Figure 2-6 shows the outline drawings of DDMP11 cables.

2.6.1 M8203 Considerations

Configure all appropriate switch settings and jumpers on the M8203 line unit module according to the recommendations in Table 2-15.

NOTE

If the customer has additional requirements because of modem restrictions or a bootstrapping feature, be sure to configure the line unit to these requirements using the information contained in Tables 2-11 through 2-14.

2.6.2 M8203 Insertion

With system power OFF, carefully insert the M8203 line unit module into the proper backplane slot (usually adjacent to the microprocessor) and perform the following:

1. Connect the line unit and the microprocessor using the BC08S-1 cable. One end of the cable is connected to J1 of the M8207-YA microprocessor module and the other end to J3 of the M8203 line unit module. Carefully fold the cable back to the right, tightly against the component side of either the microprocessor or line unit module, so as to fit it into the mounting box. Refer to Figure 2-5 for connector layouts.

2. Insert the appropriate module test connector into the correct line unit connector as specified in Table 2-10. Be sure to insert with "SIDE 1" (etched on the test connector) visible from the component side of the line unit. See Figure 2-5 for test connector orientation.

   Schematics and outline drawings of each test connector used with the DMP11 are provided in Figure 2-7.

3. Turn system power ON and perform voltage checks on the line unit backplane slot. Ensure that the voltages are within the specified tolerances as listed in Table 2-4.

4. Load and execute the M8203 static diagnostics, parts one and two, with external maintenance mode selected. (See Table 2-9.)

   Chapter 6 provides detailed information on these diagnostic routines. Upon obtaining a minimum of five error free end passes, with the module turnaround test connector installed, proceed with step 5.

5. Remove the module turnaround test connector and connect the appropriate cable (see Table 2-10) to the proper berg connector for the DMP11 option selected. Refer to Table 2-15 for detailed information on cable requirements.

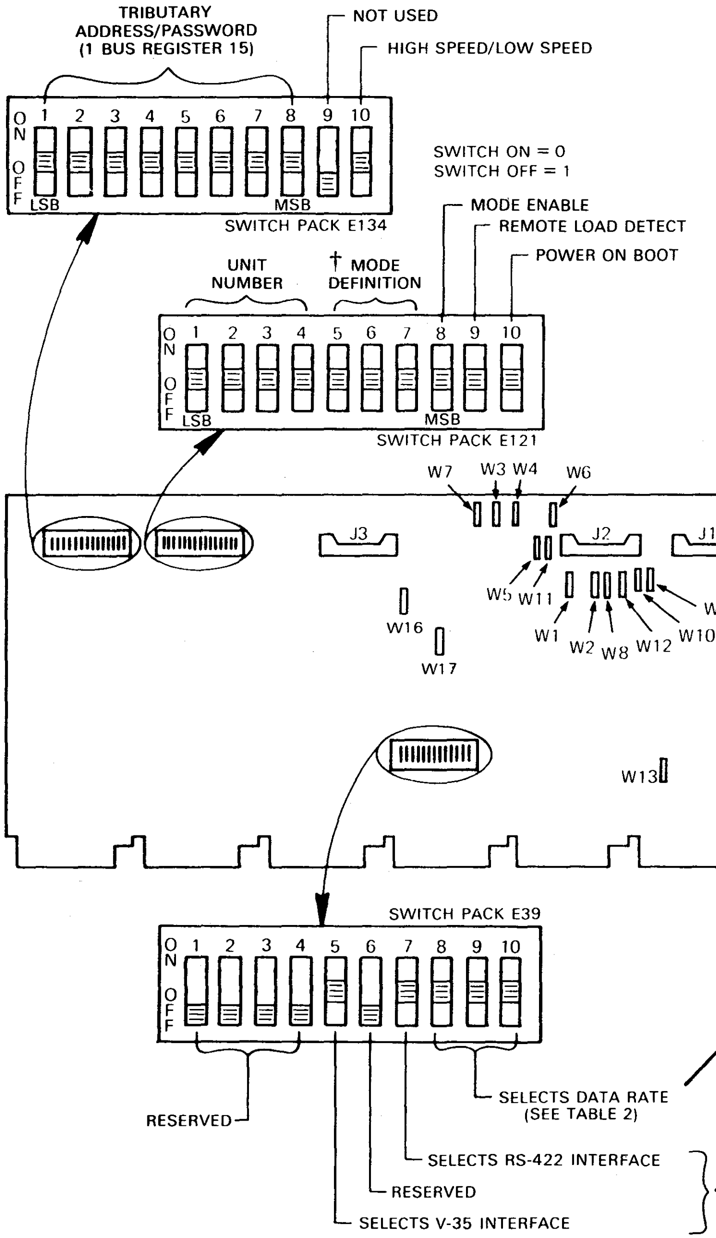
Table 2-13 Switch Pack E121 Selections

Switch	Function
	NOTE **Switch off equals a logical one (1).**
1-4	Unit Number Selection – These switches are physically connected to IBUS register 16 Bits 0-3 with switch 1 being the least significant bit (LSB) and switch 4 the most significant bit (MSB). The unit number is used to identify each unique DMP11 if several are installed on the same system. This is particularly important for systems utilizing the remote load detect and boot features of the DMP11. The boot program must know which of the DMP11s in the floating address space is performing the down line load.
5-7	Mode Definition Selection – These switches are physically connected to IBUS register 16 Bits 4-6, and are used in conjunction with switch 8 to define the mode of operation for the DMP11.

MODE	SWITCH 5	6	7
HDX PT-TO-PT/DMC Line Compatible	ON	ON	ON
FDX PT-TO-PT/DMC Line Compatible	OFF	ON	ON
HDX PT-TO-PT*	ON	OFF	ON
FDX PT-TO-PT*	OFF	OFF	ON
HDX MULTIPOINT CONTROL STATION*	ON	ON	OFF
FDX MULTIPOINT CONTROL STATION*	OFF	ON	OFF
HDX MULTIPOINT TRIBUTARY*	ON	OFF	OFF
FDX MULTIPOINT TRIBUTARY*	OFF	OFF	OFF

*DDCMP V4.0

Switch	Function
8	Mode Enable – This switch is physically connected to IBUS register 16 bit 7, and is used to indicate that the mode definition is actually selected in switches 5-7. Switch in off Position: Mode defined in switches Switch in on Position: Mode not defined in switches defined by software (overridden by software.
9	Remote Load Detect – This switch is physically connected to IBUS register 11 bit 2, and is used to enable the remote load detect feature of the DMP11. Switch in off Position: Enables Switch in on Position: Disables
10	Power on Boot – This switch physically connected to IBUS register 11 bit 1, and is used to enable or disable the power ON boot feature of the DMP11. Switch in off Position: Disables Switch in on Position: Enables **NOTE** **If the remote load detect and power on boot features are used, then switches 1 through 10 must be appropriately set. Remote load detect and power on boot features are only applicable to PDP-11 processors and do not apply to VAX-11 processors.**



† MODE DEFINITION	SWITCH 5	SWITCH 6	SWITCH 7
HDX PT-TO-PT/DMC LINE COMPATIBLE	ON	ON	ON
FDX PT-TO-PT/DMC LINE COMPATIBLE	OFF	ON	ON
HDX PT-TO-PT*	ON	OFF	ON
FDX FT-TO-PT*	OFF	OFF	ON
HDX MULTIPOINT CONTROL STATION*	ON	ON	OFF
FDX MULTIPOINT CONTROL STATION*	OFF	ON	OFF
HDX MULTIPOINT TRIBUTARY*	ON	OFF	OFF
FDX MULTIPOINT TRIBUTARY*	OFF	OFF	OFF

*DDCMP V4.0

SPEED	SWITCH 8	SWITCH 9	SWITCH 10
1MEG	ON	ON	ON
500K	OFF	ON	ON
250K	ON	OFF	ON
56K	OFF	OFF	ON
*19.2K	ON	ON	OFF
9.6K	OFF	ON	OFF
4.8K	ON	OFF	OFF
2.4K	OFF	OFF	OFF

* NORMAL SWITCH SETTING UNLESS THE INTEGRAL MODEM OR NULL MODEM CLOCK FEATURES ARE USED.

	SW5	SW6	SW7
RS-232-C OR RS-423-A OR INTEGRAL**	OFF	OFF	OFF
V.35	ON	OFF	OFF
RS-422	OFF	OFF	ON

** INTEGRAL MODEM IS SELECTED BY BC55A CABLE WHEN INSTALLED IN J1 OF THE M8203 LINE UNIT. MODULE CONNECTOR J2 MUST NOT HAVE ANY CABLE OR TEST CONNECTOR INSTALLED.

MK-2524

Figure 2-4 M8203 Switch and Jumper Locations

Table 2-14 Switch Pack E134 Selections

Switch	Function
	NOTE **Switch off equals a logical one (1).**
1-8	Tributary Address/Password – These switches are physically connected to IBUS register 15 bits 0-7, with switch 1 being the least significant bit (LSB) and switch 8 the most significant bit (MSB). The tributary address switches allow the user to define the address in switches which the device will respond to, for message traffic over the communication link. Valid addresses are: 1 for PT-to-PT stations, and 1 through 255 for multipoint tributary stations; address of zero is illegal. If the power on boot and remote load detect features are used, these switches must be set to the tributary address. In addition, for remote load detect this address also serves as a password for the maintenance message ENTER MOP MODE. (Tributory address and Password must be equal.
9	Not used in DMP11 – Switch is physically connected to IBUS register 11, bit 3.
10	High Speed/Low Speed – This switch is physically connected to IBUS register 11, bit 5. The setting of this switch indicates to the microcode whether the data rate over the communication line is greater or less than 250K b/s. Switch in off Position: High speed (250K b/s) Switch in on Position: Low speed (<250K b/s)

NOTE
If the boot feature is selected, it is mandatory that the switches in switch packs E121 and E134 be appropriately configured according to the following charts:

	LSB			MSB						
E121	1 OFF	2 OFF	3 ON	4 ON	5 OFF	6 OFF	7 OFF	8 OFF	9 ON	10 ON

EXAMPLE: UNIT NUMBER = 3, MODE = FDX TRIB.

MK-2731

	LSB							MSB		
E134	1 OFF	2 OFF	3 ON	4 OFF	5 OFF	6 OFF	7 OFF	8 ON	9 X	10 X (HIGH/LOW SPEED)

X = DON'T CARE

EXAMPLE: TRIB ADDR = 123 (DECIMAL), MUST BE SET IN OCTAL REPRESENTATION ($123_{10} = 173_8$)

MK-2732

Table 2-14 Switch Pack E134 Selections (Cont)

LSB (switch 1) — MSB (switch 4)

	1	2	3	4	5	6	7	8	9	10
E121	ON	ON	OFF	ON	ON	OFF	OFF	OFF	OFF	OFF

EXAMPLE: UNIT NUMBER = 4, MODE = HDX TRIB.

MK-2733

LSB (switch 1) — MSB (switch 8)

	1	2	3	4	5	6	7	8	9	10
E134	OFF	OFF	ON	OFF	OFF	OFF	OFF	ON	X	X

X = DON'T CARE.

HIGH/LOW SPEED (switch 10)

EXAMPLE: TRIB ADDRESS AND PASSWORD = 123 (DECIMAL), MUST BE SET IN OCTAL REPRESENTATION ($123_{10} = 173_8$)

MK-2734

Table 2-15 Cable Description

Interface	Description
RS-232-C	
• Cable Assembly: BC55C-10 (Refer to Figure 2-6A) • M8203 Connector: J2 • Test Connector: H325	A 3M (10 feet) cable with a 40 pin, berg connector at one end which is installed into J2 of the M8203 so that the ribbed side of the cable faces out. This creates a half twist in the cable and is required for proper pin connections. The other end has a panel bracket that includes three different cinch connectors, J1, J2, and J3. Connector J2 is used for RS-232-C and is connected to the modem with external cable BC05D-25. The bracket must be mounted on the rear mounting rail of the cabinet to ensure proper grounding and for easy access to external cable connections. The BC55C panel has several jumpers. Depending on the modem option selected, certain jumpers must be installed. Refer to Table 2-13 for detailed jumper configurations.
External Cable	
• BC05D-25 (Refer to Figure 2-6E)	A 7.5 M (25 feet) external cable that connects J2 of the BC55C panel to an RS-232-C modem.

Table 2-15 Cable Description (Cont)

Interface	Description
• Test Connector: H325	
RS-422-A	
• Cable Assembly: BC55B-10 (Refer to Figure 2-6B)	A 3m (10 feet) cable with a 40 pin, berg connector at one end which is installed into J2 of the M8203 so that the ribbed side of the cable faces out. This creates a half twist in the cable and is required for proper pin connections. This cable is similar to the BC55C in that it has a panel bracket at the other end. There is, however, only one connector on the panel (J2) that is used with cable BC55D-33 for external connection to the modem. The bracket must be mounted on the rear mounting rail of the cabinet to ensure proper grounding and easy access to external cable connections. The BC55B panel has two jumpers (W1 & W2) for shield grounding connections. Normally, W1 is always out (special application only) and W2 normally in. For RS-449 applications, W2 can be removed to place a 100 ohm resistor between circuit ground and frame ground to dissipate ground currents.
External Cable	
• BC55D-33 (Refer to Figure 2-6F)	A 10 m (33 feet) external cable that connects J2 of the BC55B panel to an RS-422-A modem.
• Test Connector: H3251	
RS-423-A	
• Cable Assembly: BC55C-10 (Refer to Figure 2-6A)	Same cable as used for RS-232-C except that panel connector J1 is used with external cable BC55D-33 for connection to the modem. The bracket must be mounted on the rear mounting rail of the cabinet to ensure proper grounding and easy access to external cable connections. The BC55C panel contains several jumpers. Depending on the modem selected, certain jumpers must be installed. Refer to Table 2-13 for detailed jumper configurations.

Table 2-15 Cable Description (Cont)

Interface	Description
External Cable	
• BC55D-33 (Refer to Figure 2-6F)	A 10 m (33 feet) external cable that connects J1 of the BC55C panel to an RS-423-A modem.
• Test Connector: H3251	
V.35	
• Cable Assembly: BC05Z-25 (Refer to Figure 2-6G • Test Connector: H3250	A 7.5 m (25 feet) modem cable with a 40 pin, berg connector at one end that connects to J1 of the M8203. A 37 pin, Data Phone Digital Service (DDS) connector is installed at the other end and connects to the modem.
Integral Modem	
• Cable Assembly: BC55A-10 (Refer to Figure 2-6C) • M8203 Connector: J1 • Test Connector: NONE (Place panel HDX Position for turnaround)	A 3 m (10 feet) cable with a 40 pin, berg connector at one end that plugs into J1 of the M8203 with the cable strain relief tab facing out. A BC55A connector panel is installed at the other end. This panel contains four connectors, two female and two male. The panel also switch to includes a toggle switch to select either full-duplex or half-duplex. The panel is mounted on the rear mounting rail of the cabinet to ensure easy access to external connections and for proper grounding. Appropriate terminator connectors H3257 or H3258 must be used. See Figures 2-7 and 2-8.

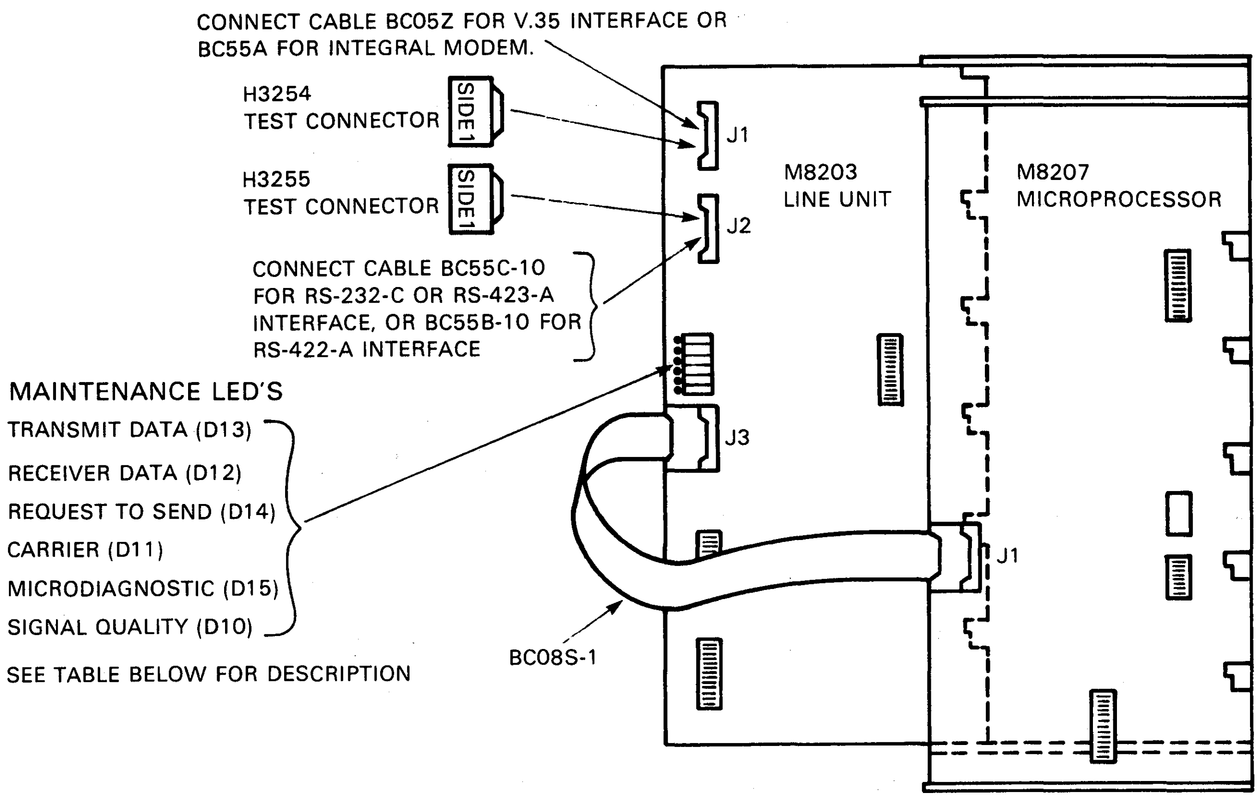
NOTE

Ensure that all cables mounted in the M8207 and M8203 are properly installed and seated in the berg connectors.

Interface	Description
External Cables	
• BC55N-98 (Refer to Figure 2-6D) • Test Connector: NONE	A 29.4 m (98 feet) external twinax cable used to connect a DMC11 to a DMR11 or a DMR11 to a DMR11 for a selected data rate of 56K b/s.
• BC55M-98 (Refer to Figure 2-41)	A 29.4 m (98 feet) external triaxial cable used for the same purpose as the BC55N, but for data rates above 56K b/s.

Table 2-15 Cable Description (Cont)

Interface	Description
• Test Connector: NONE	For full-duplex, connect the male end of one BC55N or BC55M cable to the receive out of the connector panel. Connect the female end of the same cable to the transmit in of the connector panel at the other station. Connect the male end of the other cable (BC55N or BC55M) to the transmit out and the female end to receive in at the other station. For half-duplex, connect the male end of the cable (BC55N or m) to the receive out and connect the other end of this cable to the receive in at the other station.

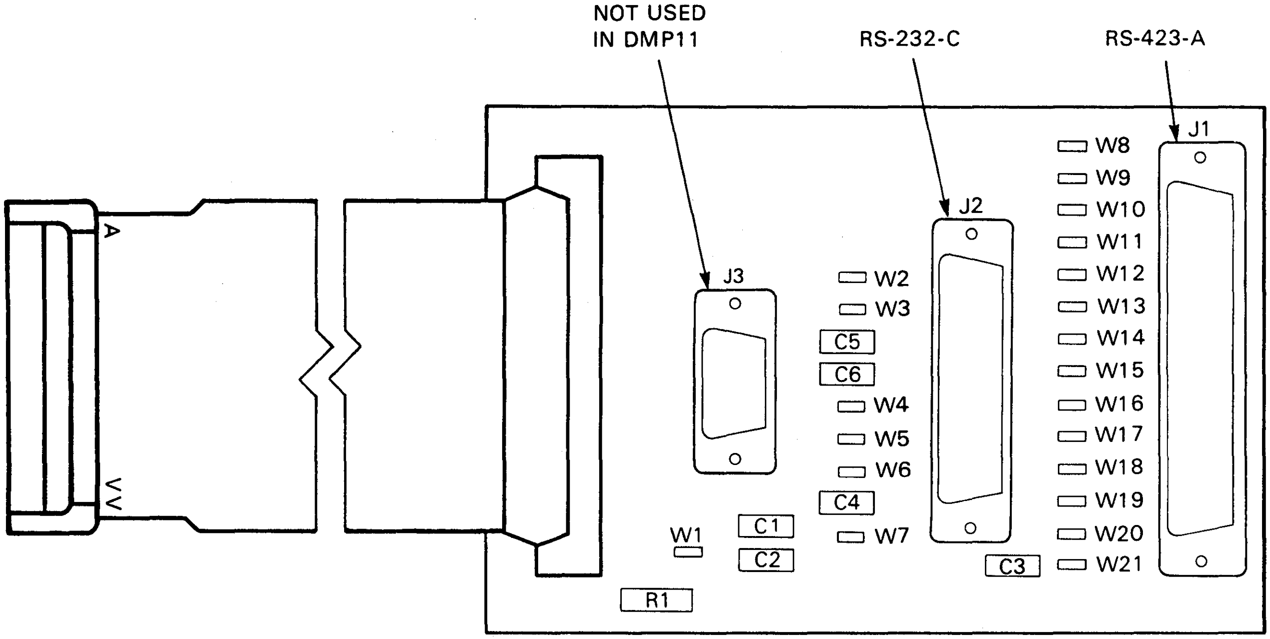


DESIGNATION	DESCRIPTION
D13	ON INDICATES DMP11 IS TRANSMITTING A STEADY STREAM OF 1's.
D12	ON INDICATES DMP11 IS RECEIVING A STEADY STREAM OF 1's.
D14	ON INDICATES THE USYRT IS READY TO TRANSMIT WHEN CTS IS DETECTED.
D11	ON INDICATES CARRIER IS PRESENT AT THE RECEIVER.
D15	ON FOR EXECUTION OF MICRODIAGNOSTICS
D10	ON INDICATES CARRIER PRESENCE AND OFF INDICATES CARRIER ABSENCE.

MK-1570

Figure 2-5 Microprocessor/Line Unit Installation

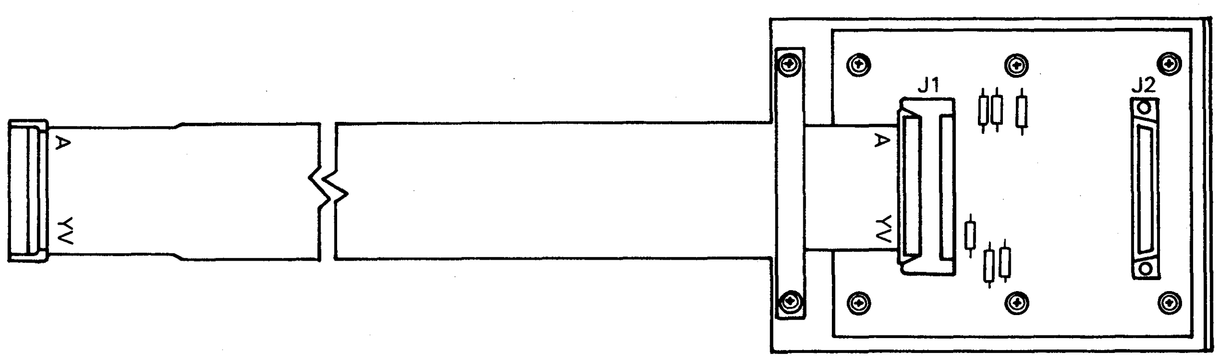
VIEW A



BC55C-10(RS-232-C/RS-423-A) INTERFACE PANEL CABLE

MK-1571

VIEW B

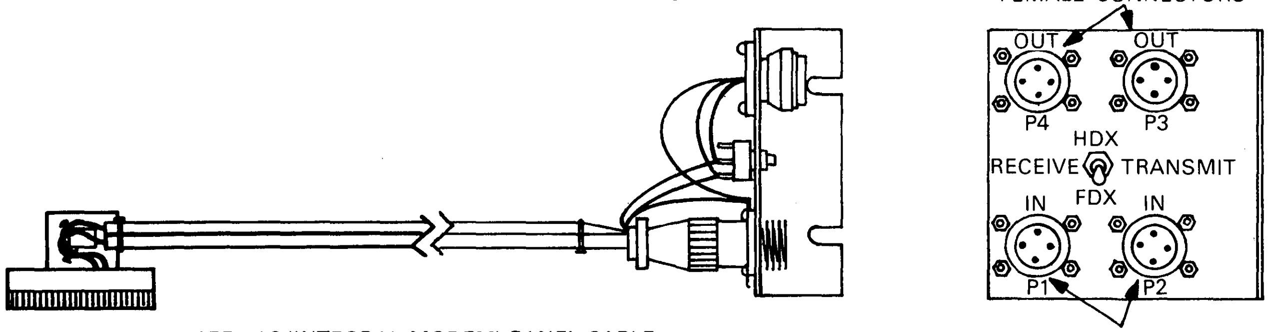


BC55B-10 (RS-422-A INTERFACE) PANEL CABLE

MK-2136

Figure 2-6 DMP11 Cable Drawings (Sheet 1 of 3)

VIEW C



BC55A-10 (INTEGRAL MODEM) PANEL CABLE

MALE CONNECTORS

CONNECTOR PANEL
(FRONT VIEW)

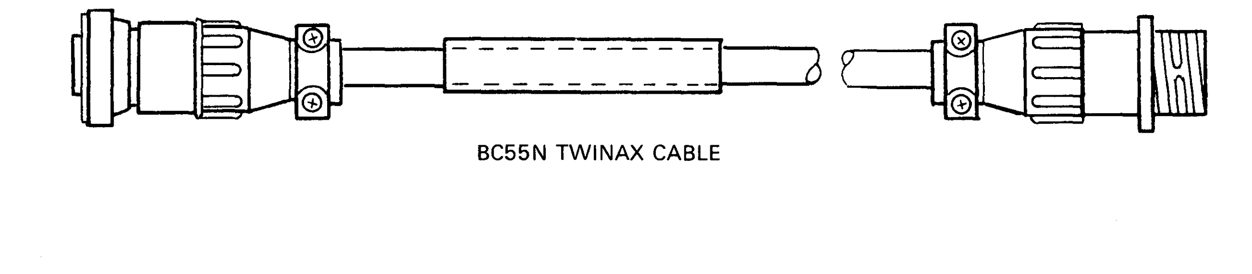
MK-2137

H3258
TERMINATOR

H3257
TERMINATOR

MK-2244

VIEW D

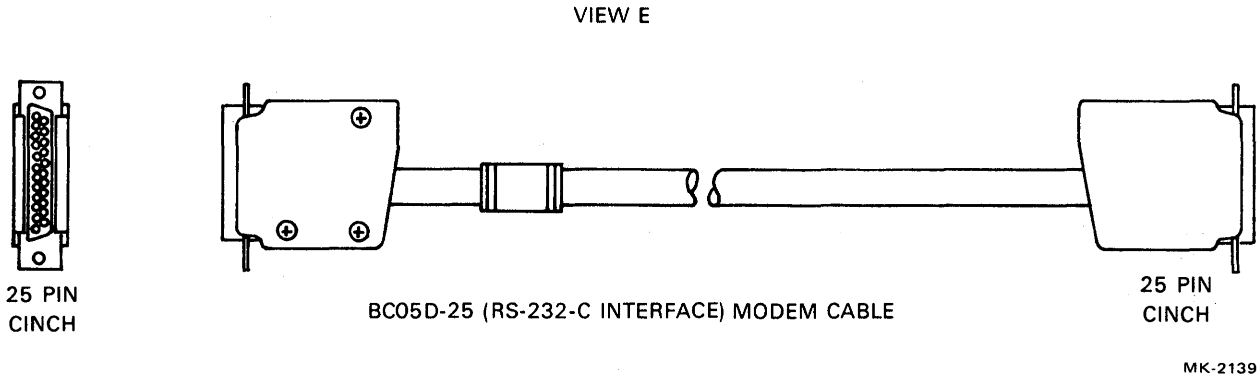


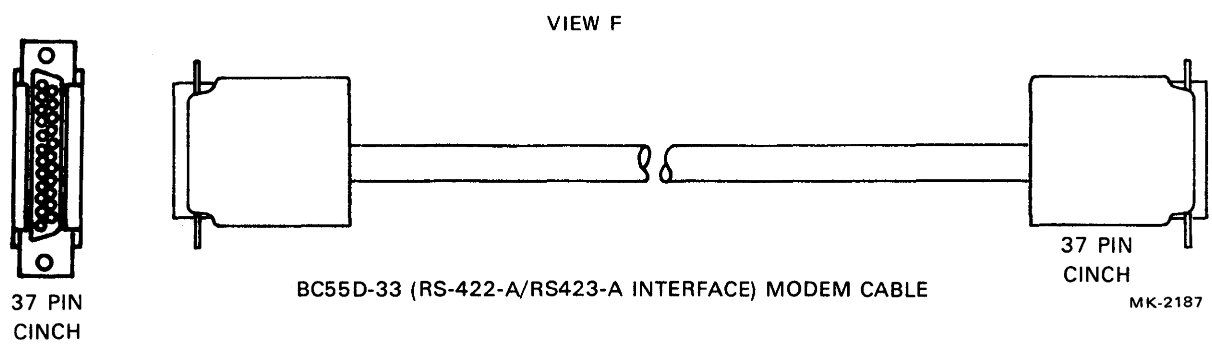
BC55N TWINAX CABLE

BC55M TRIAX CABLE

MK-2168

Figure 2-6 DMP11 Cable Drawings (Sheet 2 of 3)





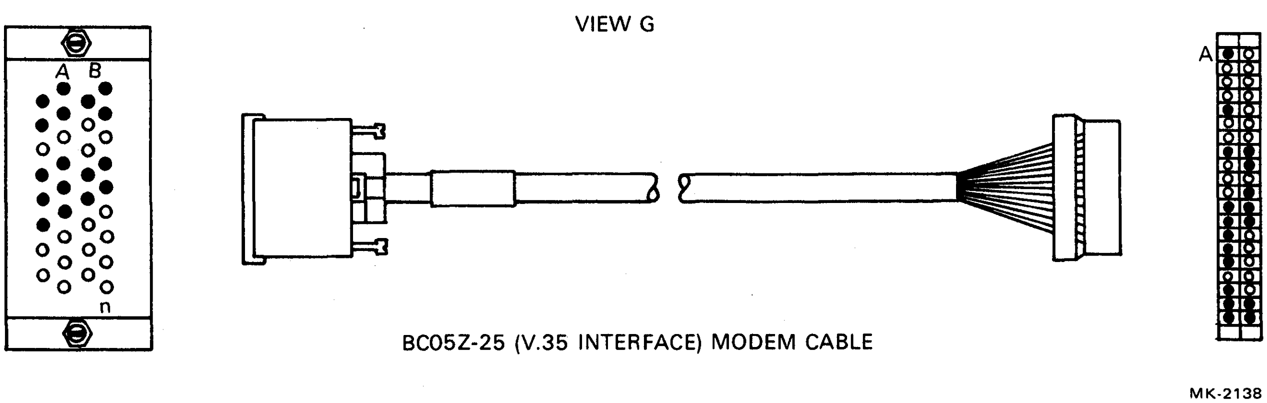
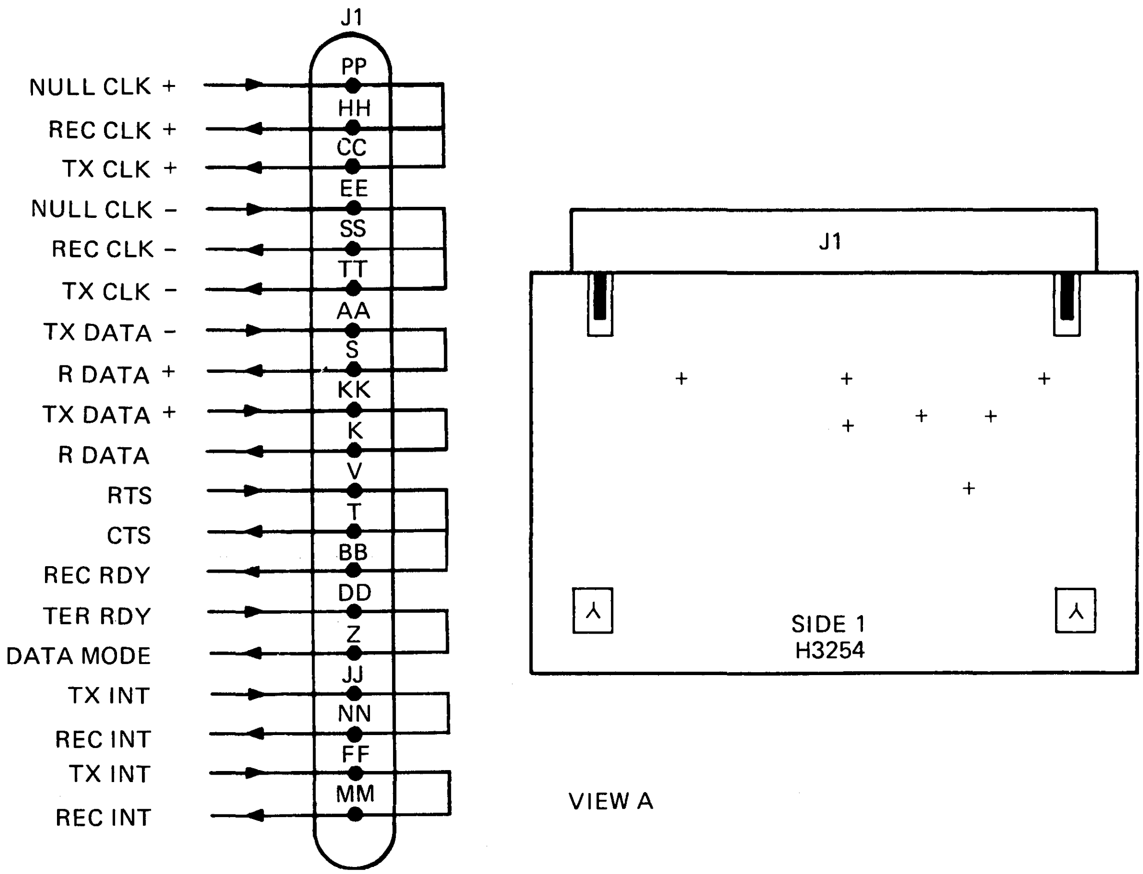


Figure 2-6 DMP11 Cable Drawings (Sheet 3 of 3)



H3254 MODULE TEST CONNECTOR (J1 ON M8203)

MK-2143

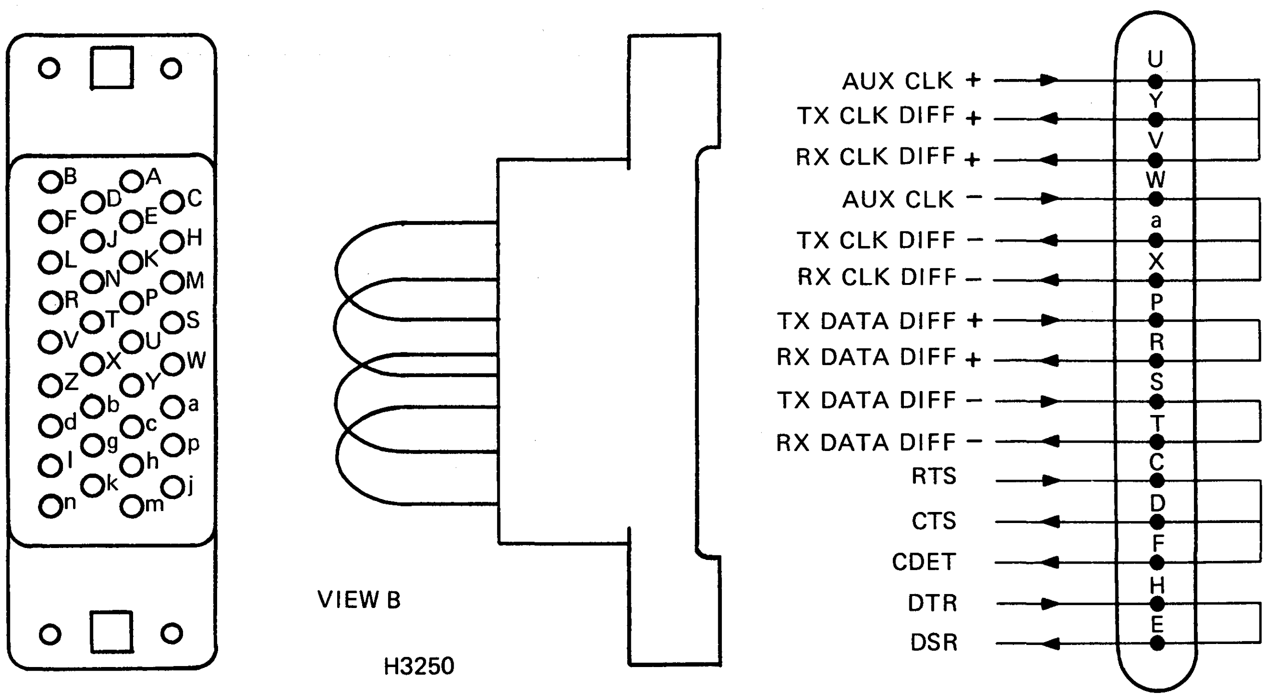
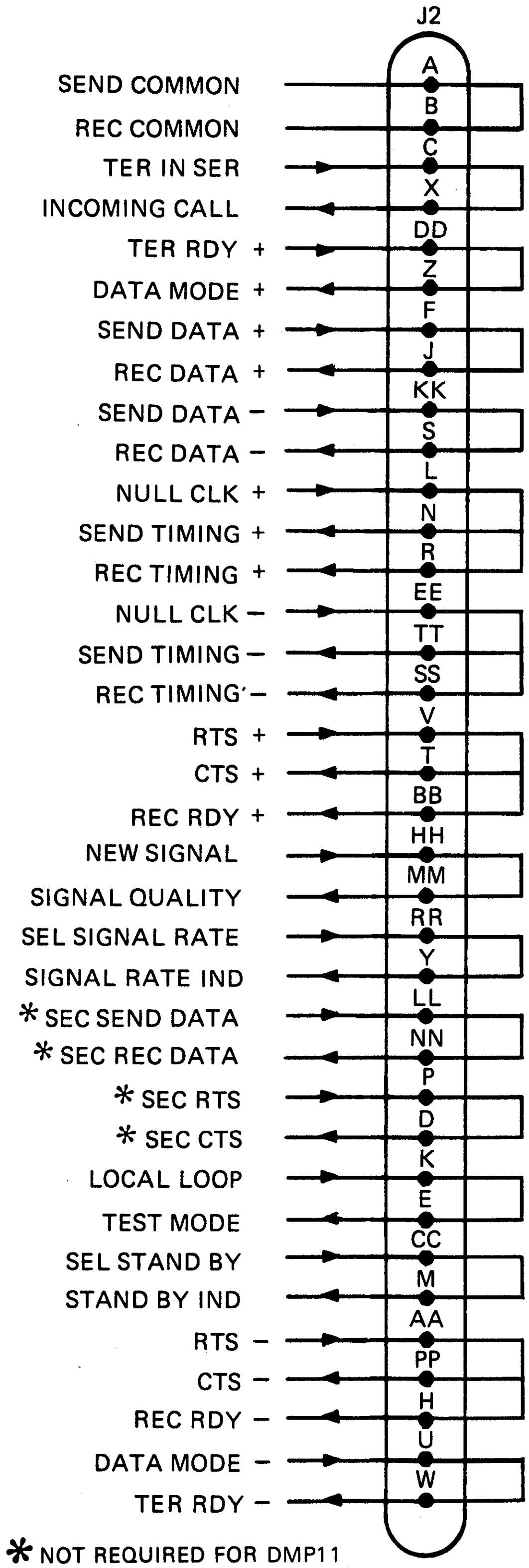
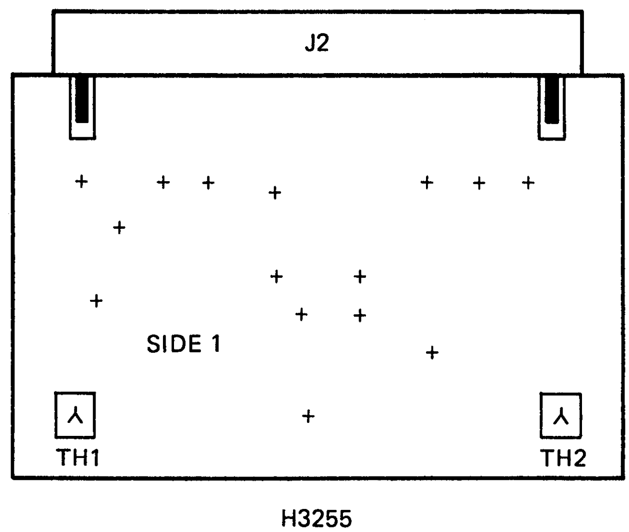


Figure 2-7 DMP11 Turnaround Test Connectors (Sheet 1 of 4)

MK-2123





VIEW C

H3255 MODULE TEST CONNECTOR (J2 ON M8203)

MK-2122

Figure 2-7 DMP11 Turnaround Test Connectors (Sheet 2 of 4)

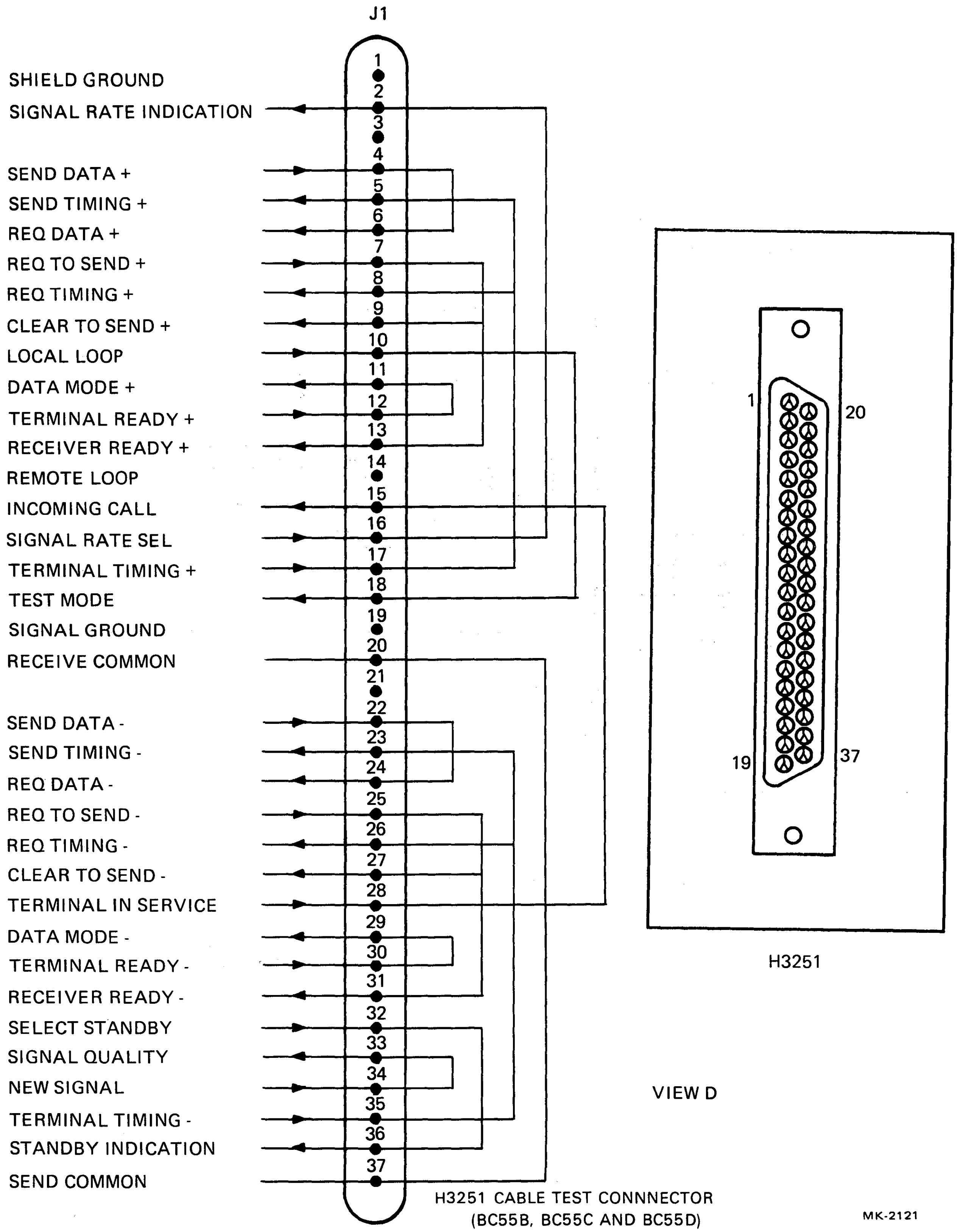


Figure 2-7 DMP11 Turnaround Test Connectors (Sheet 3 of 4)

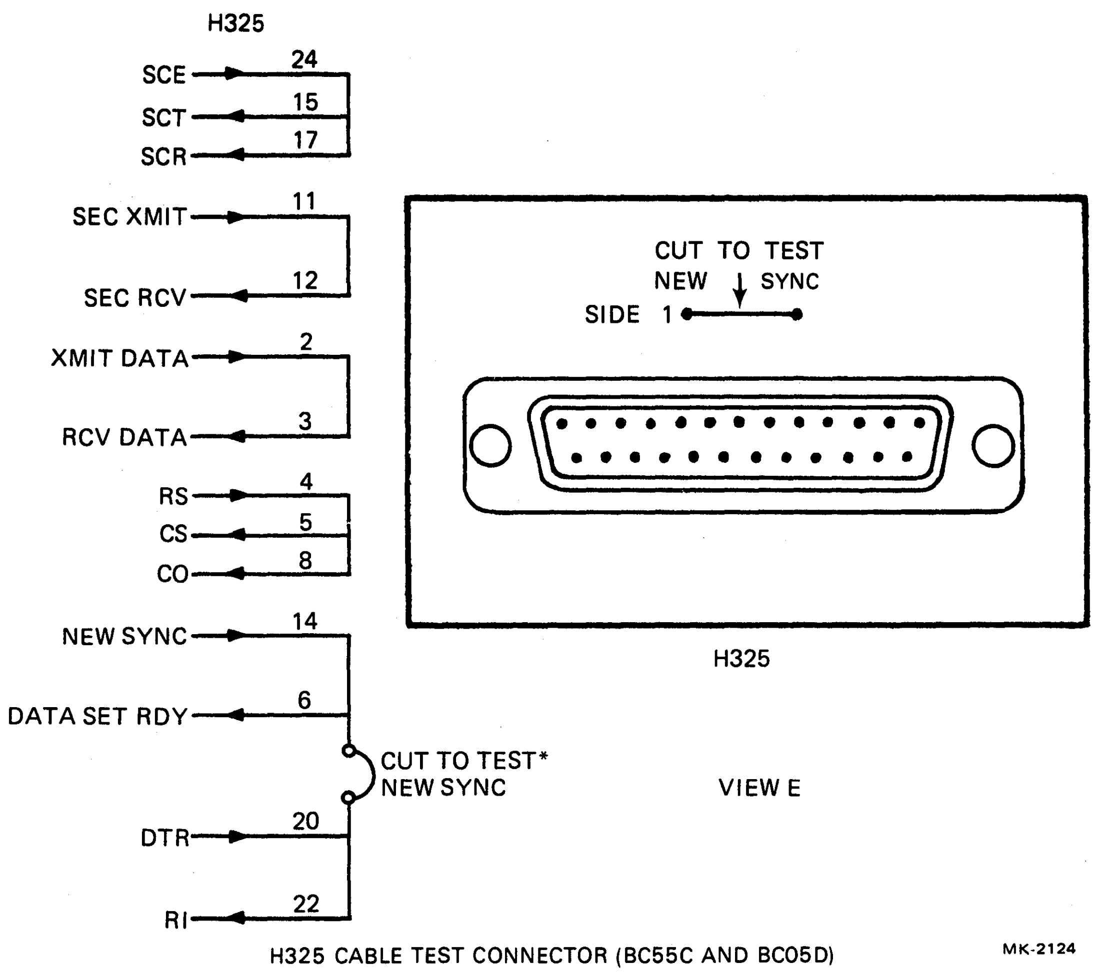


Figure 2-7 DMP11 Turnaround Test Connectors (Sheet 4 of 4)

NOTE
When installing panel cables BC55A, BC55B, or BC55C, it is important that the panel be properly mounted on the rear mounting rail of the cabinet to ensure adequate grounding.

When connecting integral modem options, check the BC55A connector panel to verify that the appropriate modem jumpers on the panel are properly configured for the option selected. Table 2-16 lists each of these options and required jumper configurations.

Table 2-16 Modem Option Jumper Functions

J2 Pin	Jumper	RS-232C	Bell 208B	Bell 209	Data 2400	Datel 4800	CCITT V.23	CCITT V.26 BIS	CCITT V.27 TER	ISO 2110-1972	Future D	EIA RS-232	EIA RS-449	CCITT V.24
1	W1	IN	IN	IN	IN	IN				IN		AA		101
	W7													
2												BA	SD	103
3												BB	RD	104
4	W19	IN	IN	IN	IN	IN	IN	IN	IN	IN		CA	RS	105
5												CB	CS	106
6												CC	DM	107
7												AB	SG	102
8												CF	RR	109
9														
10														
11	W14									IN†			SF	126
12	W3	IN			IN	IN	IN	IN	IN	IN		SCF	SRR	122
13	W2	IN			IN		IN	IN	IN	IN		SCB	SCS	121
14	W6	IN			IN	IN	IN	IN	IN	IN		SBA	SSD	110
15	W20	IN	IN	IN	IN	IN	IN	IN	IN	IN		DB	ST	114
16	W5	IN			IN	IN	IN	IN	IN	IN		SBB	SRD	119
17	W18	IN	IN	IN	IN	IN	IN	IN	IN	IN		DD	RT	115
18	W17												LL	141
19	W4	IN			IN	IN	IN	IN	IN	IN		SCA	SRS	120
20												CD	TR	108
21	W16	IN		IN								CG	SQ	110
	W13												RL	140
22												CE	IC	125
23	W21	IN*			IN	IN	IN	IN	IN	IN		CH	SR	111
	W12	*										CI	SF	112
24	W15				IN								SS	116
	W10	IN	IN	IN		IN		IN	IN			DA	TT	113
25	W11				IN								SB	117
	W9												TM	142
	W8											Make Busy		

*RS-232-C defines both signals for this pin
† CCITT modem A only

Integral modem options require that a 75 ohm terminator be connected to end each transmit line (BC55A panel) at each end of a full-duplex and a half-duplex network. The terminators are used to prevent reflections at the end of a transmission line. These terminators are available in both male (H3257) and female (H3258) types to accommodate different integral modem cabling. Selection of the appropriate terminator type is dependent upon which type of unused panel connector is available on the receive line at the BC55A-10 panel. Refer to Figure 2-8 for DMP11 to DMR11/DMC11 cabling and to Figure 2-9 for DMP11 to DMP11/DMR11 cabling. Various multipoint cabling examples are shown in Figures 2-10, 2-11, and 2-12.

6. Insert the appropriate cable turnaround test connector in the end of the cable. Refer to Table 2-10 for the specific test connector. Load and execute the M8203 static diagnostics specified in step 4 using the external maintenance mode selected to verify the module and cable. Upon obtaining a minimum of five error free passes, proceed to the DMP11 system test procedures, Section 2.7. Figure 2-7 shows the various test connectors used in the DMP11.

2.7 DMP11 SYSTEM TESTING

The final step in the installation of a DMP11 subsystem is to exercise the microprocessor and line unit, as one complete unit, on the UNIBUS and over the communications link. This is the first testing that will use the DMP11 microcode.

2.7.1 Functional Diagnostic Testing

Ensure that the specific cable turnaround test connector for the selected DMP11 option is still installed at the end of the cable. Load and execute the DMP11 functional diagnostics with the external mode selected.

A. PDP-11 Systems

   CZDMT** DMP11 Functional Diagnostics

B. VAX-11 Systems

   EVDMB
   REV *.* - VAX DMP11 Functional Diagnostic

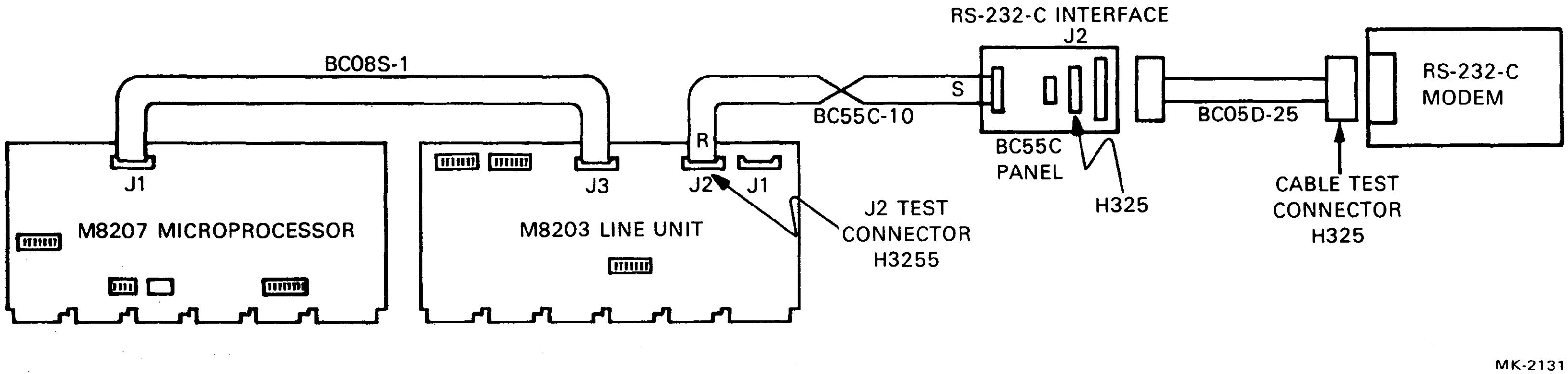
On obtaining a minimum of five error free end passes, proceed to Section 2.7.2.

2.7.2 DECX11 System Exerciser

There are two DEC/X11 modules for the DMP11: DMD* and DME*. Together these two modules can operate:

- Up to 16 DMP11 devices in loopback, or in point-to-point.
- A single DMP11 configured as a multipoint control station communicating with up to 32 tributaries.
- Up to 16 devices configured as multipoint tributaries on the same PDP-11 UNIBUS.

These modules transmit, receive, and check 32 data messages of 1024 bytes each on a given physical link. By default, this involves a single PDP-11 system with one or more devices operated in internal or external loopback mode. By operator selection of nondefault modes, however, actual point-to-point or multipoint operation is possible. See Chapter 6 for more detail.



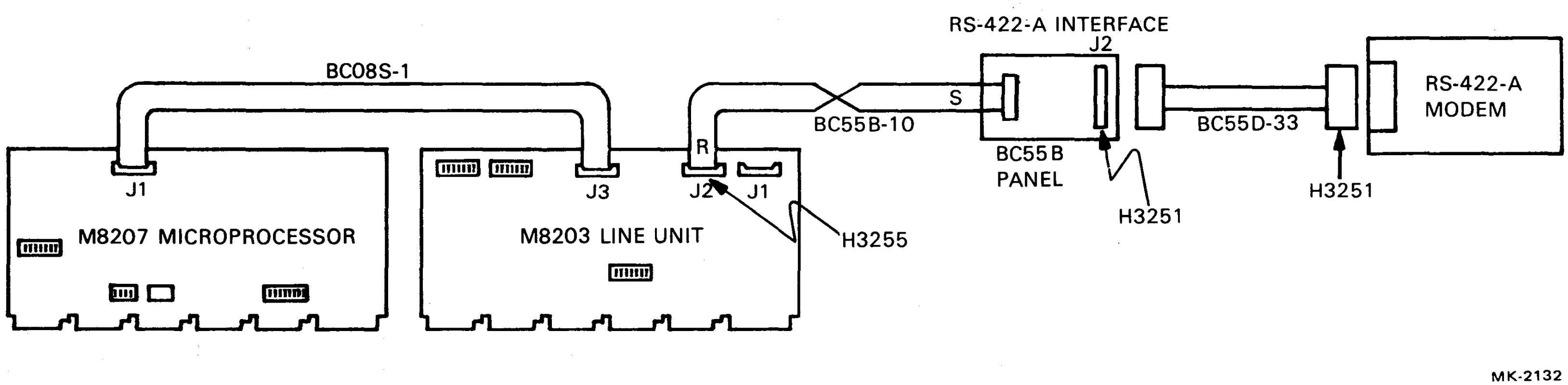


Figure 2-8 DMP11 Remote System Cabling Diagram (Sheet 1 of 2)

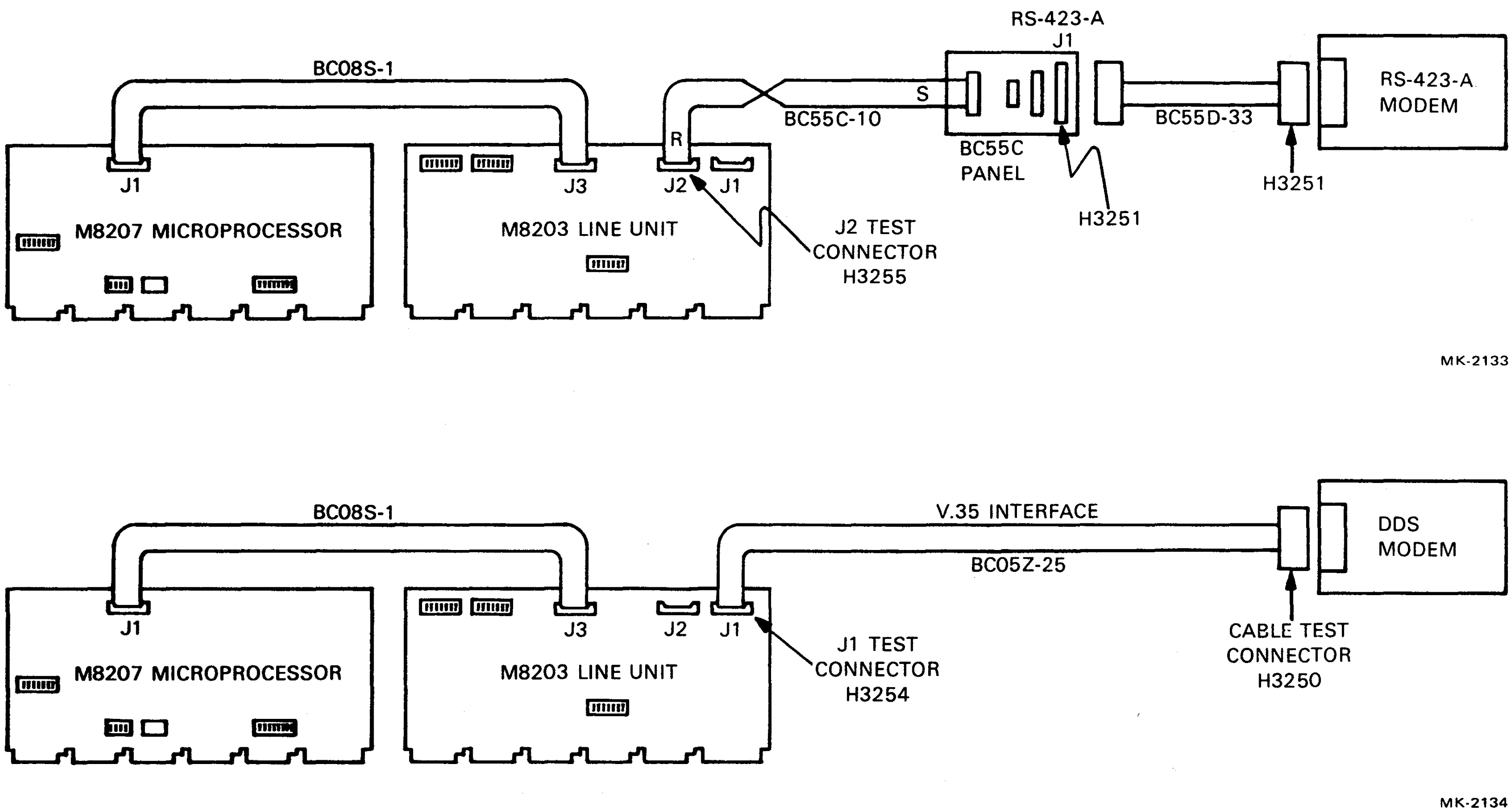
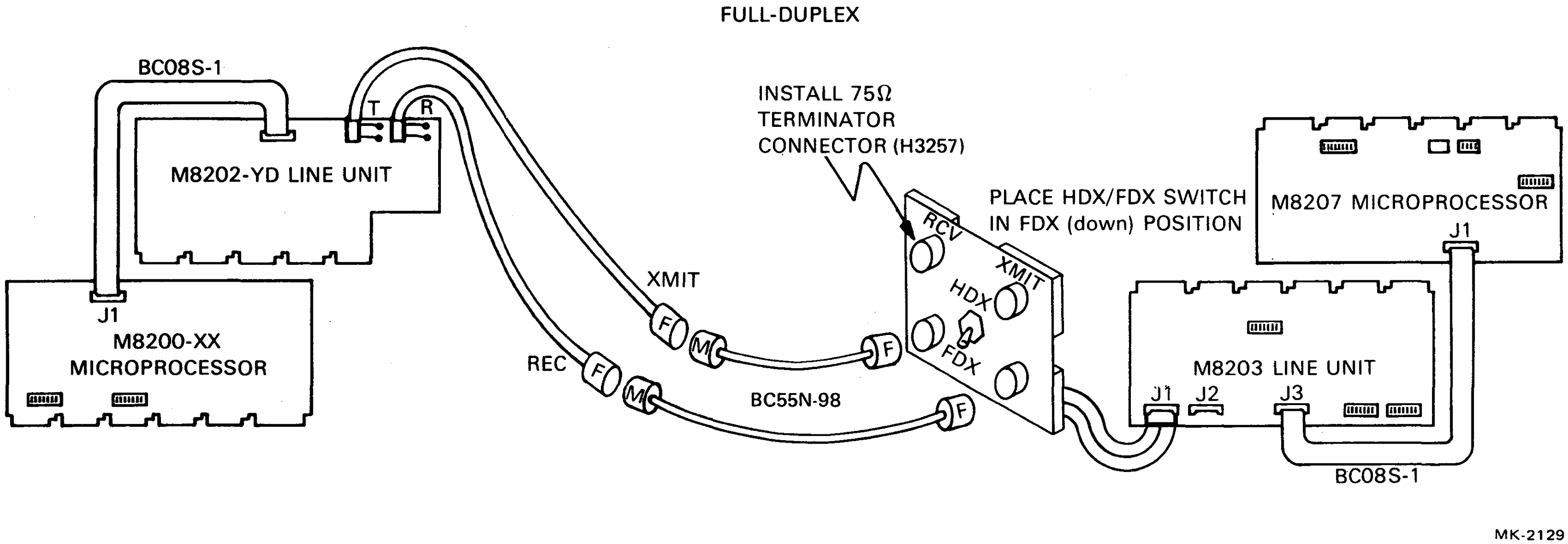


Figure 2-8 DMP11 Remote System Cabling Diagram (Sheet 2 of 2)

Figure 2-8 DMP11 Remote System Cabling Diagram (Sheet 2 of 2)



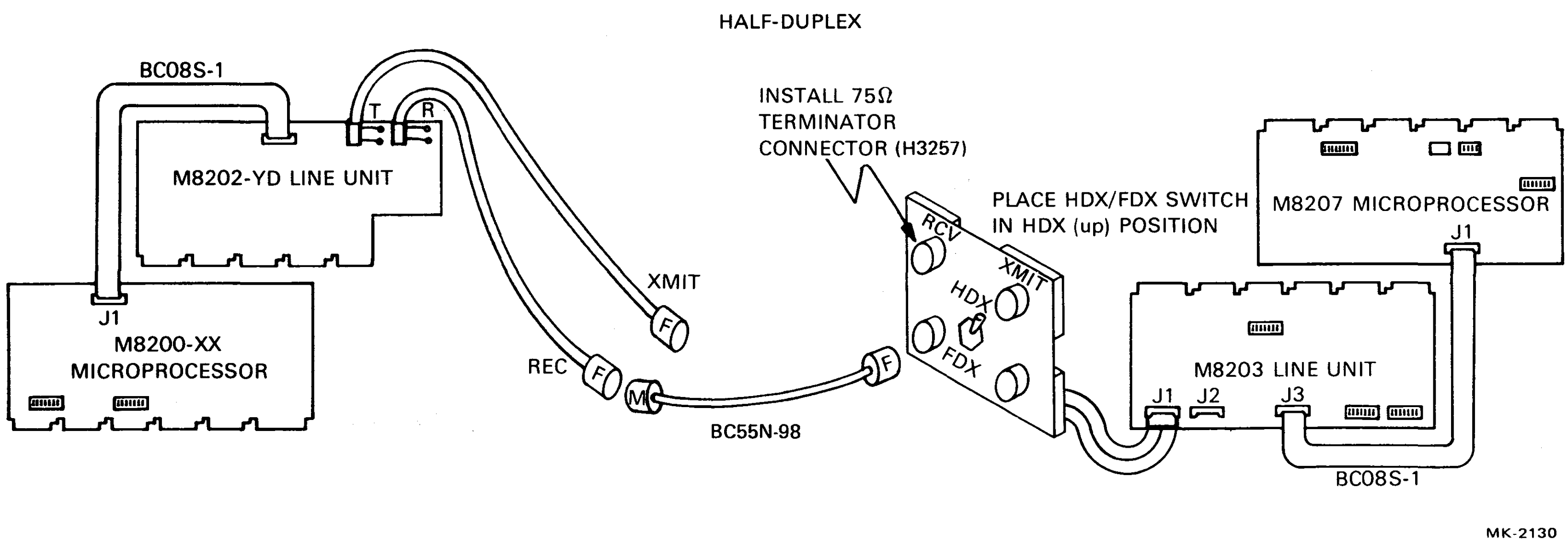


Figure 2-9 DMC11 to DMP11 Integral (Local) Modem Cabling Diagram for Point-to-Point Network

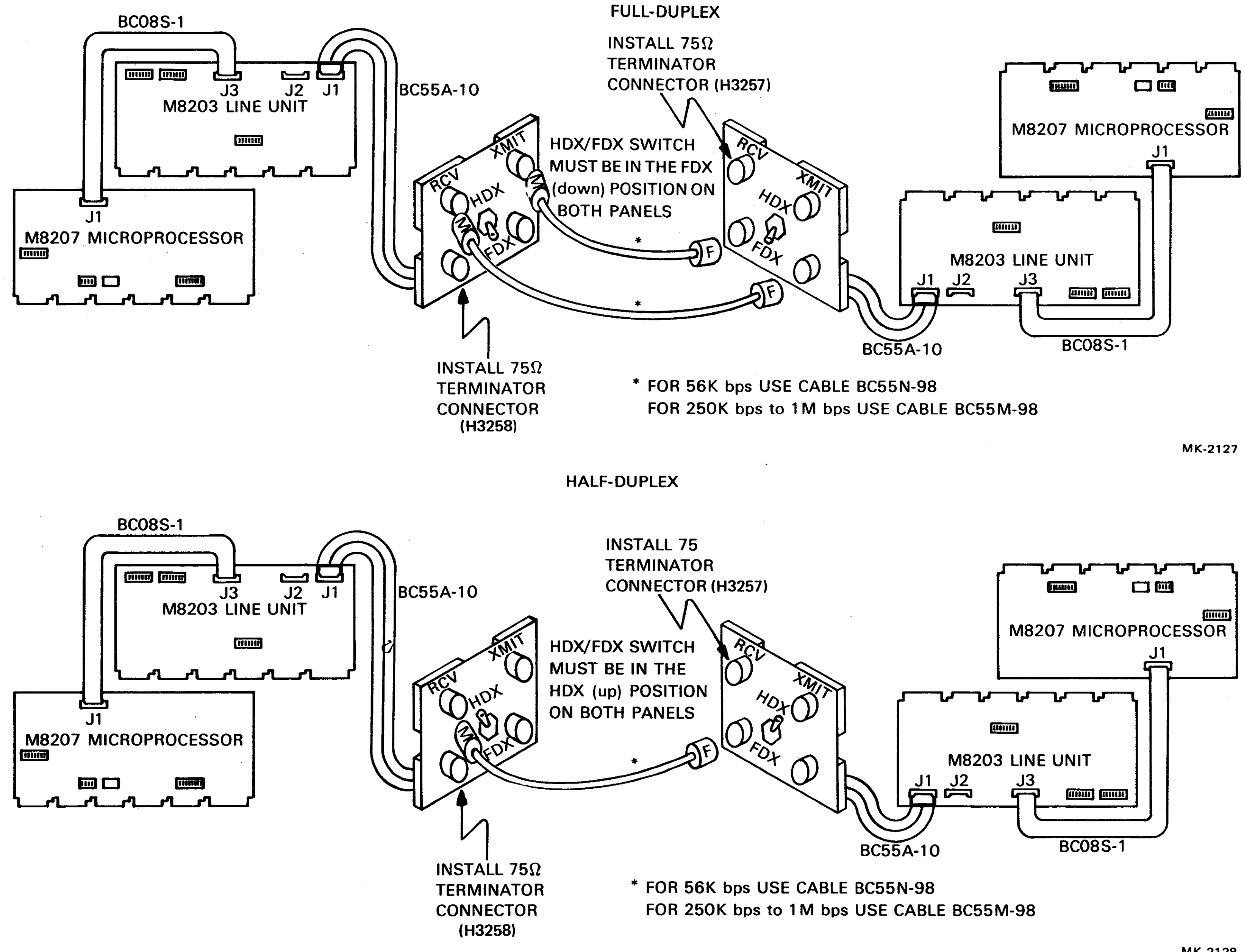


Figure 2-10 Multipoint Cable Routing Example Half-Duplex

HDX NETWORK

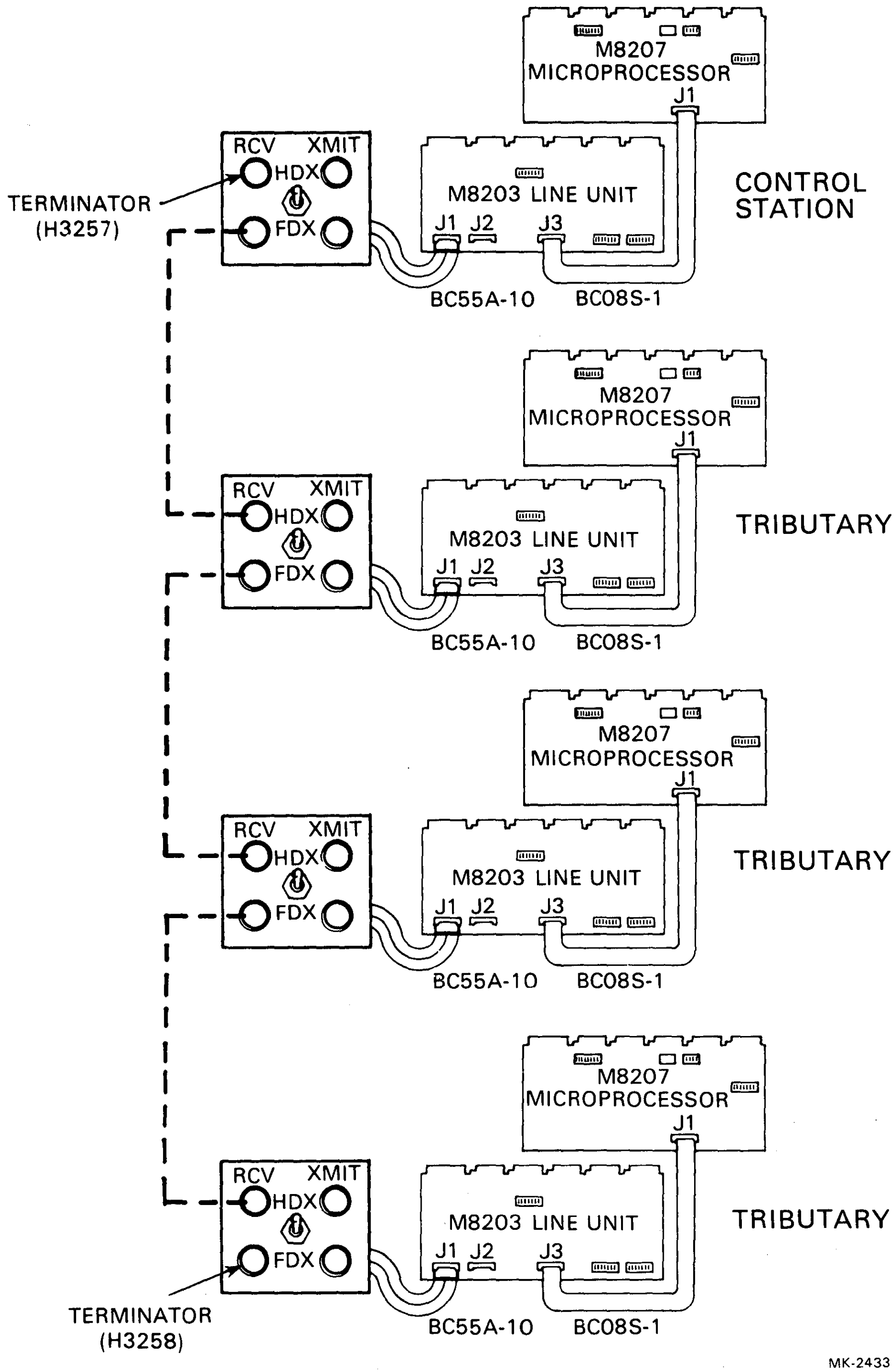


Figure 2-11 Multipoint Cable Routing Example
Full-Duplex Control Station End Node

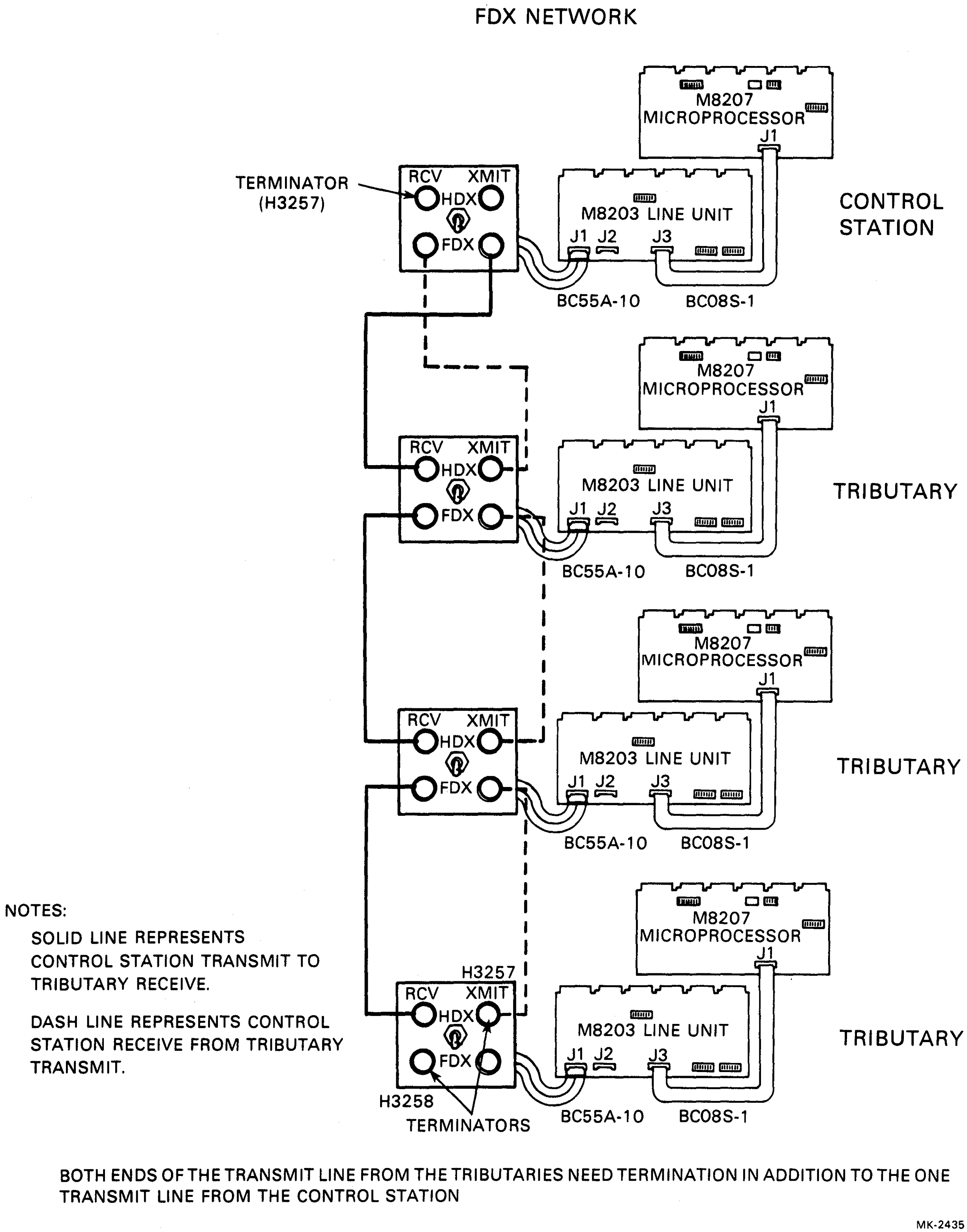


Figure 2-12 Multipoint Cable Routing Example Full-Duplex Control Station End Node

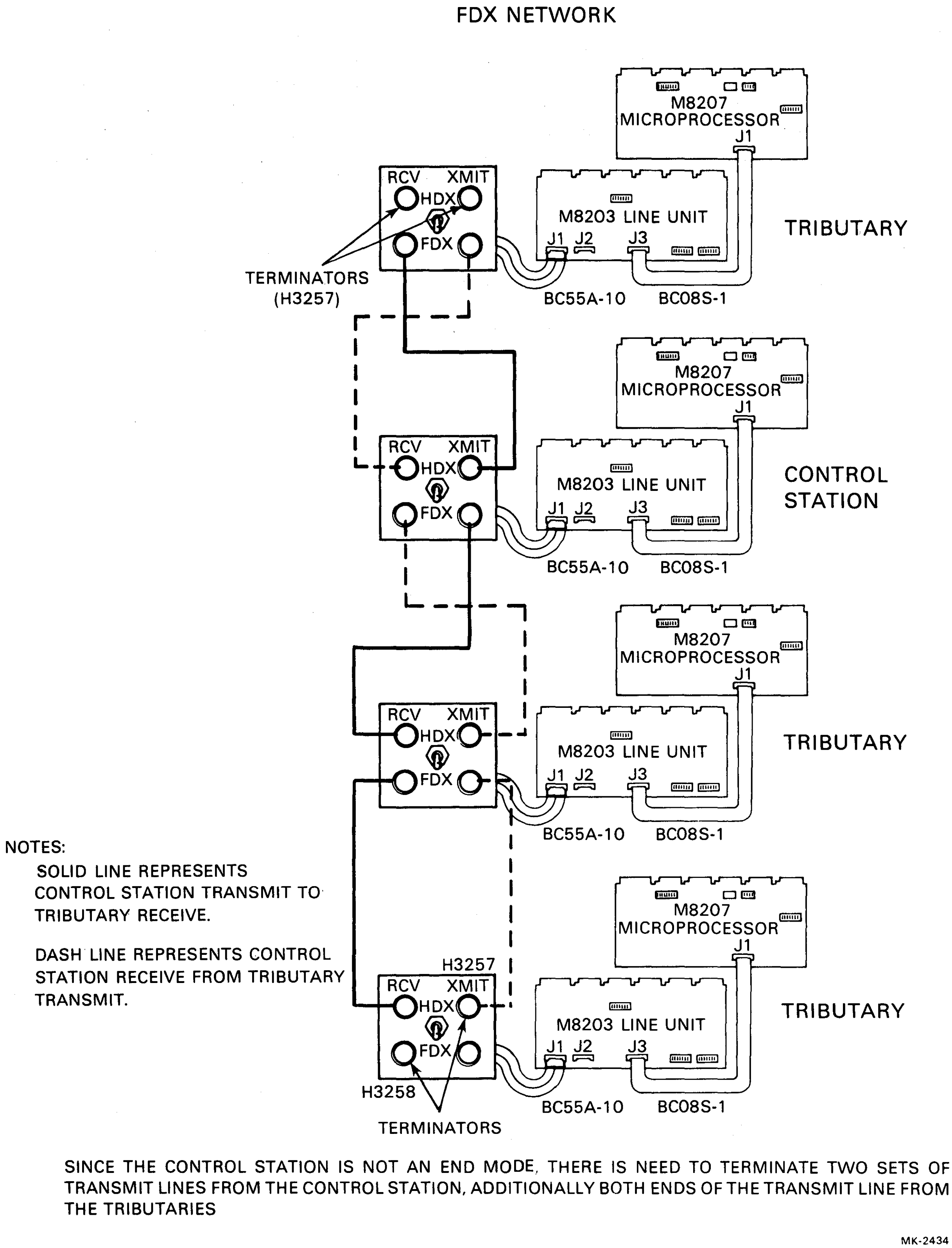


Figure 2-13 Multipoint Cable Routing Example Full-Duplex Tributary Station End Nodes

2.7.3 Final Cable Connections

The final step in the installation process is to return the DMP11 to its normal cable connections, either to the appropriate modem or to the distribution panel. Cable Routing instructions are included for each cable in the description column of Table 2-15. The DMP11 system cable routing diagrams in Figures 2-8, 2-9, and 2-13, have been included to help show overall cable routing for the various DMP11-XX options. References to specified locations of the various test connectors during diagnostic testing are also included. After the cables are connected to the appropriate modem or distribution panel, it is suggested that the data communications link test program (DCLT) be exercised.

2.7.4 DMP11 Link Testing

The DMP11 can be exercised over a communications link by the data communications link test (DCLT). It is suggested that DCLT be configured to run first on a cable test connector and then on a modem with the modem analog loopback test feature selected, if the modem includes this feature. Next, the overall communications link should be exercised with the remote computer systems that contain DMP11s and/or DMR11s or a DMC11.

PDP-11 DCLT is CZCLM**
VAX DCLT is EVDMD**

CHAPTER 3
COMMAND AND RESPONSE STRUCTURES

3.1 INTRODUCTION

The interaction between a user program and a DMP11 includes the issuing of commands to the DMP11 and the processing of responses from the DMP11. Specific DMP11 responses are solicited by issuing commands. Other DMP11 responses are unsolicited and result from the detection of various hardware and software events and error conditions and changes to the operational status of tributaries.

Each DMP11 command and response has a highly structured format, where the issuing of commands by the user program and responses by the DMP11 requires that a specific programming sequence be followed. This chapter defines these formats in detail and describes the relationship of commands and responses to the operation of a DMP11 in the network environment.

3.2 COMMAND/RESPONSE STRUCTURE

The DMP11 is a nonprocessor request (NPR) device residing on a VAX/PDP-11 UNIBUS. Communication between a DMP11 and the user program is done through the UNIBUS control and status registers (CSRs). DMP11 CSRs are assigned the symbolic byte addresses BSEL0 through BSEL7, and the four symbolic word addresses SEL0, SEL2, SEL4, and SEL6. Table 3-1 lists the symbolic byte and word addresses assigned in the VAX/PDP-11 input/output (I/O), page floating address space along with the octal addresses.

NOTE

Each letter x in the I/O page addresses listed in Table 3-1 represents an octal value that is switch assigned at each DMP11 in a network at installation time.

The relationship between the symbolic byte and word addresses for DMP11 CSRs and the actual CSR layout is shown in Figure 3-1. Figure 3-2 shows the fields in CSR bytes BSEL0, BSEL2, and BSEL3 that make up the fixed format portion of both user program commands and DMP11 responses. This fixed format portion serves to identify the command/response type, the tributary address that the command/response applies to, and to coordinate ownership of the CSRs between the DMP11 and the user program.

The four bytes that make up SEL4 and SEL6 contain the fields pertinent to each user program command and DMP11 response. In-depth descriptions of the SEL4 and SEL6 fields making up each user program command and DMP11 response are presented in the sections which follow.

3.3 USER PROGRAM COMMANDS

A user program has a set of four commands that it can issue to a DMP11 for execution by that device. These are:

1. Microprocessor control,
2. Mode definition,
3. Control, and
4. Buffer address/character count

Table 3-1 Symbolic Byte and Word Address

Symbolic Address	Octal Value
SEL0	76xxx0
BSEL0	76xxx0
BSEL1	76xxx1
SEL2	76xxx2
BSEL2	76xxx2
BSEL3	76xxx3
SEL4	76xxx4
BSEL6	76xxx4
BSEL5	76xxx5
SEL6	76xxx6
BSEL6	76xxx6
BSEL7	76xxx7

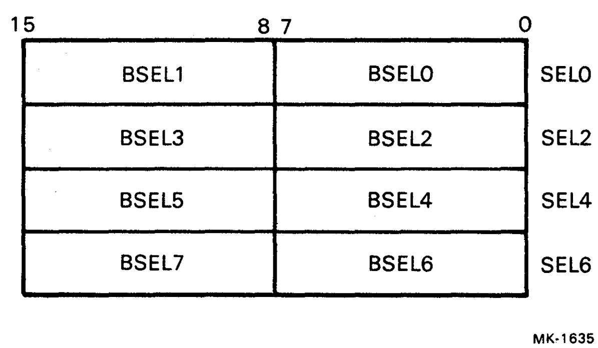


Figure 3-1 Relationship Between DMP11 CSR's Byte and Word Symbolic Addresses

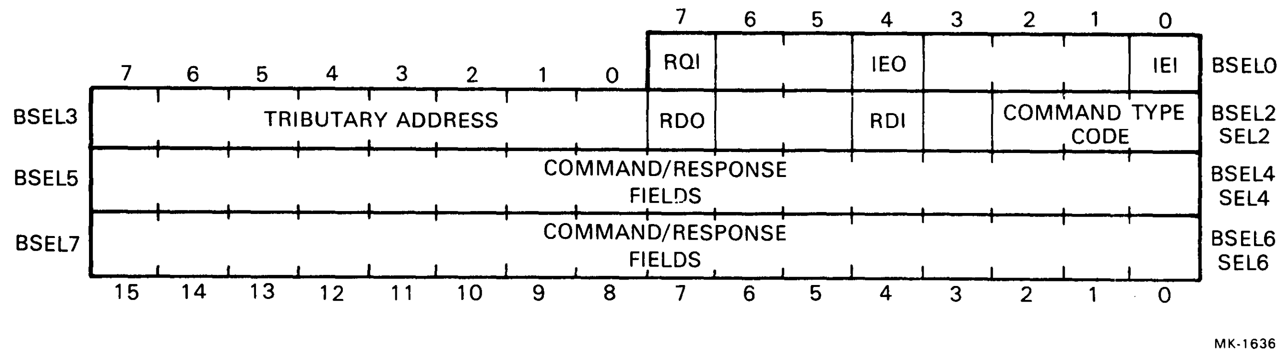


Figure 3-2 Command and Response Fixed and Variable Formats

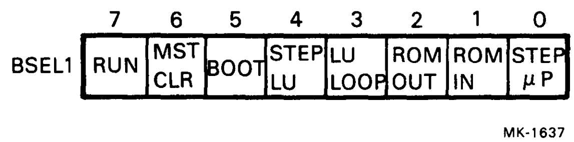


Figure 3-3 Bit Layout of Initialization Register

With the exception of the microprocessor control command, which is used to set up the DMP11 initialization register and involves only BSEL1 of the CSRs, user program commands need an identification code in the first three bits of BSEL2 (see Figure 3-2). These codes identify each command and are listed in Table 3-2.

3.3.1 Microprocessor Control Command

This single-byte command has two functions:

1. To initialize and start the DMP11 running, and
2. To execute the maintenance functions implemented by the DMP11.

At startup time, under typical operating conditions, this command is the first issued by the user program.

The format for the DMP11 initialization register (BSEL1) is shown in Figure 3-3. To set the master clear bit and start the DMP11 running, the user program moves a byte having an octal value of 100 to BSEL1. As a result, all condition sensitive logic in the DMP11 is reset for startup and the internal startup diagnostic is executed. The internal startup diagnostic indicates the result of execution by placing a code in BSEL4 and BSEL6 of the CSRs to be read by the user program. The codes returned by the internal diagnostic are listed and defined in Table 3-3.

When the diagnostic completes successfully, as indicated by the value 77 in BSEL4 and 305 in BSEL6, the Run bit in BSEL1 is set to one.

Figure 3-4 presents a flowchart describing how to set master clear. A timeout counter is set to avoid an endless loop catching the user program in the event that the internal diagnostic does not complete successfully. A timeout counter is necessary because this process does not generate an interrupt. This timeout counter should be set to a value that results in a delay of from one-half to one second.

Table 3-2 User Program Command Codes

Command Name	Binary Code
Mode Definition	010
Control Command	001
Buffer Address/Character Count Command (Receive Buffer)	000
Buffer Address/Character Count Command (Transmit Buffer)	100

Table 3-3 DMP11 Internal Diagnostic Execution Codes (Octal)

BSEL4	BSEL6	Meaning
77	305	The internal diagnostic executed successfully.
(Random)	143	The internal register test failed; the microcode is in a loop.
100	135	The microprocessor data RAM test failed; the microcode is in a loop.
100	125	The microprocessor ALU test failed; the microcode is in a loop.
100	264	The line unit test failed; the microcode is in a loop.
100	305	The line unit test failed; however, the microprocessor is running. When returned, this code usually indicates that the electrical cable connecting the line unit to the microprocessor disconnected. In this circumstance, the microprocessor must be running in order to troubleshoot the line unit.

As shown in Figure 3-3, bits zero through four of BSEL1 are used to perform maintenance and diagnostic functions on the M8207 microprocessor and the M8203 line unit. When these maintenance bits are used by a programmer through the main CPU console or by a system diagnostic running in the main CPU, both the run bit and the master clear bit must be set to zero. The only exception to this is the LU loop bit which is not affected by the state of the run bit.

3.3.1.1 Microprocessor Control Command Field Descriptions – Figure 3-3 shows that the DMP11 initialization register (BSEL1) has eight one-bit control fields, with three used for startup in normal operation and five for microcode diagnostic and maintenance purposes. These five bits are used by diagnostic programmers and generally have no use in the development and operation of DMP11 user programs.

One of the switch controlled features of the DMP11 is the enabling and disabling of the five diagnostic/maintenance bits by the BSEL1 lockout switch (see Section 2.5.2). When the BSEL1 lockout switch is ON, the various maintenance bits can be used for diagnostic and maintenance purposes. When OFF, all diagnostic and maintenance functions performed by these bits are disabled. The functions performed by each of the BSEL1 single bit fields are described in detail below.

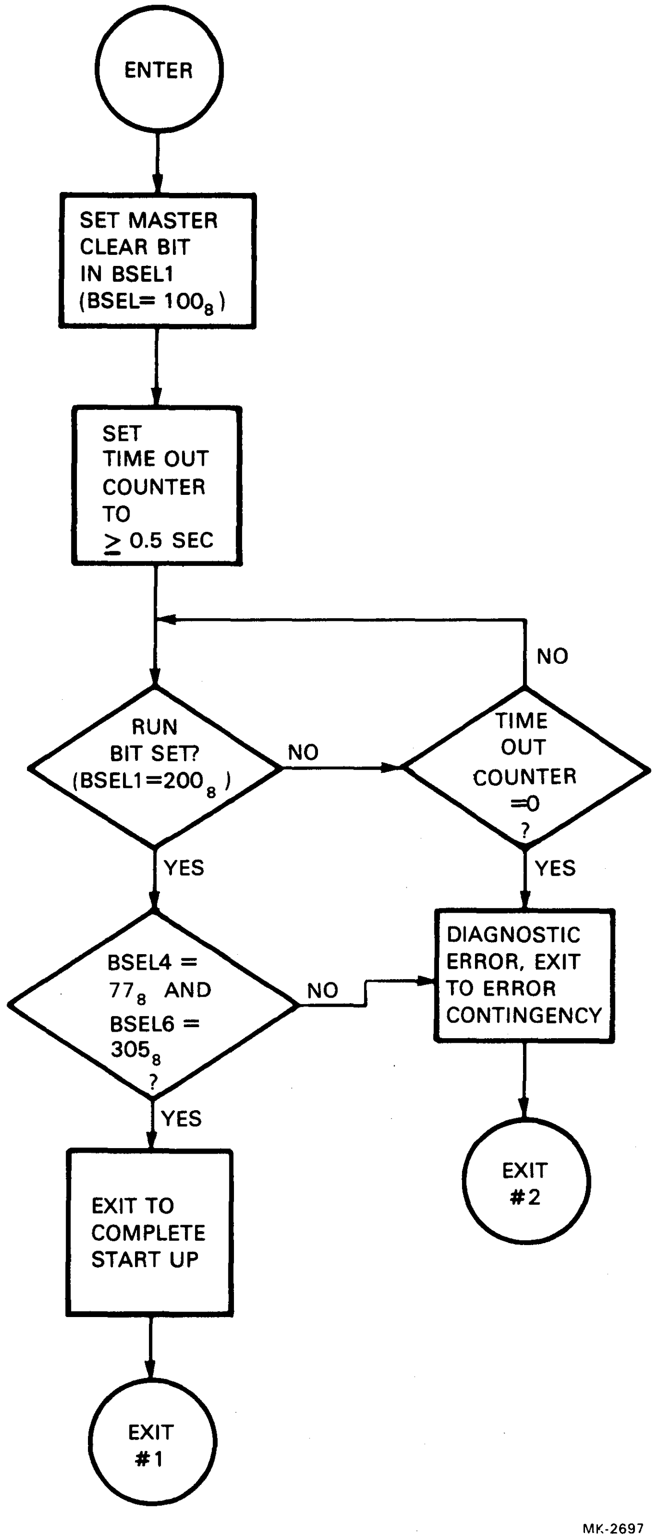


Figure 3-4 Flowchart for a Routine to Initialize the DMP11

Master Clear (Bit Six of BSEL1)

This bit controls the DMP11 initialization process. When set by the user program, all condition sensitive logic in the microprocessor and the line unit is cleared. In addition, the microprocessor program counter is cleared, the microprocessor clock is enabled, and the microprocessor starts to run and begins to execute the internal diagnostic. Since master clear is a write-only bit, the user program can only set this bit.

In addition, when the BSEL1 lockout switch (see Section 2.5.2) is in the OFF position, the master clear bit is the only bit in BSEL1 that can be set by the user program. This feature prevents an inadvertent setting of the maintenance/diagnostic bits by the user program.

Run (Bit Seven of BSEL1)

Run is a flag bit that serves to inform the user program that the DMP11 is ready for configuration and normal operation. Execution of the internal diagnostic routine is started by setting master clear. When the internal diagnostic routine successfully executes, it sets the run bit, clears the master clear bit, and sets BSEL4 and BSEL6 to the code for successful completion (see Table 3-3). At this point, the microcode is running and the DMP11 is ready to accept startup and operational commands and to issue responses.

In normal operation, the run bit serves to flag only the transition of the microprocessor from off to the running state, not from running to off. With the BSEL1 lockout switch OFF, the run bit can only be read. However, with this switch ON, the run bit can be set and cleared by the user program.

NOTE

Clearing the run bit halts the M8207 microprocessor.

Step Microprocessor (Step MP, Bit Zero, BSEL1)

Setting the step microprocessor bit causes the microprocessor to perform one instruction cycle to execute the CROM microinstruction addressed by the program counter. To use this bit, the BSEL1 lockout switch must be on. The step microprocessor function is useful only for maintenance and diagnostic operations.

Control ROM Input (ROM I, Bit One, BSEL1)

This bit permits a microinstruction to be entered through the CSRs for execution by the microprocessor. In actual practice, the ROM I bit is set and the microinstruction is placed in SEL6 of the CSRs (see Figure 3-2,). Step MP is then set and the instruction in SEL6 is executed as if it were a microinstruction in the M8207 control ROM.

If the microinstruction entered in SEL6 is a move class instruction, the microprocessor program counter is increased by one. However, if the microinstruction executed is a branch class instruction, the program counter is set to the CROM address branched to by the microinstruction.

NOTE

It is good programming practice to clear the ROM I bit immediately after the microinstruction in SEL6 is executed.

To use this bit, the BSEL1 lockout switch must be ON. The function performed by the ROM I bit is useful only for maintenance/diagnostic operations.

Control ROM Output (ROM O, Bit Two, BSEL1)

Setting this bit places the contents of the CROM location addressed by the program counter in SEL6 of the CSRs. The contents of any CROM location can be examined in SEL6 by using the ROM O bit and by executing an unconditional branch instruction to the desired location using the ROM I bit. This sets the microprocessor program counter to address this location. Then, by setting the ROM O bit, the contents of that location are moved to SEL6 for examination.

The general sequence listed below describes the use of the ROM I and ROM O bits for examining CROM locations:

1. Set ROM I;
2. Move the appropriate branch class instruction to CSR SEL6;
3. Clear ROM I; (If an additional microinstruction is needed to set the program counter to the desired CROM address, repeat steps one to three.);
4. Set ROM O;
5. Read information from CSR SEL6; and
6. Clear ROM O.

To use these bits, the BSEL1 lockout switch must be ON. The function performed by the ROM I and ROM O bits is useful only for maintenance and diagnostic operations.

Line Unit Loop (LU Loop, Bit Three, BSEL1)

This bit is used to implement internal loopback testing without the necessity for a loopback cable or connectors. Serial output prior to the transmitter level conversion logic is fed back to the receiver serial-to-parallel conversion logic so that internal logic levels are maintained throughout the feedback loop.

When the LU loop bit is set in conjunction with the run bit being cleared, data is clocked through the transmit/receive loop at the rate the step LU bit is toggled. However, if the LU loop bit is set in conjunction with run being set, data is clocked through the transmit/receive loop at the internal maintenance clock rate which is 48K b/s. Clearing the LU loop bit halts the internal loopback process.

To use this bit the BSEL1 lockout switch must be ON. The functions performed by the LU loop bit are useful only during maintenance/diagnostic operations.

Step Line Unit (Step LU, Bit Four, BSEL1)

Step LU is used in conjunction with the LU loop bit to single-step through the transmit/receive loop. With the LU loop bit set, and the run bit cleared, each setting of step LU causes one transmit bit to be shifted for loopback. In the same manner, each clearing of step LU shifts the transmitted bit for reception. By alternately setting and clearing this bit, a succession of bits can be transmitted and looped back, one at a time, for reception.

Invoke Primary MOP Mode (BOOT, Bit Five, BSEL1)

When set to one, this bit causes the DMP11 at this multipoint station to request that the control station start the primary maintenance operation protocol (MOP) boot procedure. In point-to-point networks, a DMP11 with this bit set requests the other station to start the primary MOP boot procedure.

NOTE
Master clear must be set at the requesting DMP11 in order to use the primary MOP boot procedure.

3.3.2 Mode Definition Command

The mode definition command is used to create both the hierarchy of a network and the characteristics of the communications line serving that network. As shown in Figure 3-5, the mode definition command has two fields: the command type code field in BSEL2 (which is common to all DMP11 commands) and the mode field in BSEL6 (which contains a code defining the function to be performed by the command).

With the mode definition command, the user program can name a DMP11 as a control tributary station in a multipoint network or as a station in a point-to-point network. In addition, the characteristics of the physical communications line connecting a network can be defined.

The actual mode field codes and the functions implemented by each code are listed in Table 3-4.

Under typical operating conditions, the mode definition command is issued by the user program at startup time after the internal diagnostics are executed successfully (see Table 3-3) and the run bit is set. Network discipline needs the user program associated with each DMP11 in the network to issue a mode definition command. For example, in a half-duplex multipoint network compiled solely of DMP11s:

1. The user program at the control station issues a mode definition command having the mode field set to four (control station half-duplex).

2. The user program at each tributary station issues a mode definition command with the mode field set to six (tributary station half-duplex).

This network discipline also applies to DMP11s operating in point-to-point networks with other DMP11s or DMC11s.

The functions performed by the mode definition command can also be implemented by the mode selection switches on the DMP11 line unit module (see Section 2.6). The mode definition function at a tributary station having a switch-assigned tributary address must be done using these switches. However, when tributary addresses are software assigned, the mode definition command must be used at the control and tributary stations to configure the network and assign line characteristics. The switch settings for performing the mode definition functions compare with the BSEL6 codes listed in Table 3-4 (see Section 2.6 and Table 2-10).

3.3.3 Control Command

This command provides the primary device for controlling the operation of DMP11-implemented networks. The format for the control command is shown in Figure 3-6. At startup time, after issuing the microprocessor control and the mode definition commands, the user program at the control station DMP11 must issue a control command for each tributary address supported in the multipoint network. Also, the user program at each tributary station must issue a control command for each tributary to be established at that station. At a control station, these commands result in the creation of a tributary status slot (TSS) in the microprocessor data memory for each tributary address in the network. At a tributary station one TSS is created for each tributary address created at that station.

The DMP11s at the control station and at all tributary stations use these TSS structures to coordinate protocol operation over the network between the control station and a tributary. User programs at control and tributary stations access these structures to obtain functional information, such as counts of messages transmitted and received, selection interval counts and timeouts, reply timeouts, and pertinent error counts.

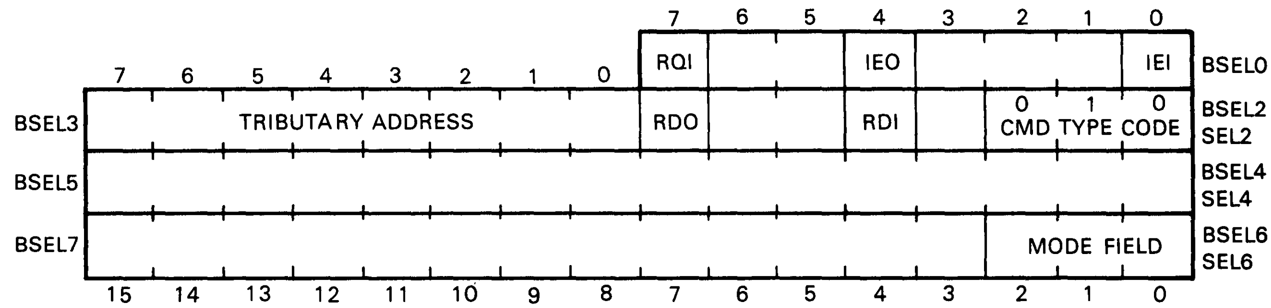


Figure 3-5 Mode Definition Command Format

Table 3-4 Mode Field Codes and Functions

BSEL6 Bit Positions 2 1 0	Line Characteristics	Network Configuration	DMC11 Compatibility
0 0 0	Half-Duplex	Point-to-Point	Yes
0 0 1	Full-Duplex	Point-to-Point	Yes
0 1 0	Half-Duplex	Point-to-Point	No
0 1 1	Full-Duplex	Point-to-Point	No
1 0 0	Half-Duplex	Control Station	N/A
1 0 1	Full-Duplex	Control Station	N/A
1 1 0	Half-Duplex	Tributary Station	N/A
1 1 1	Full-Duplex	Tributary Station	N/A

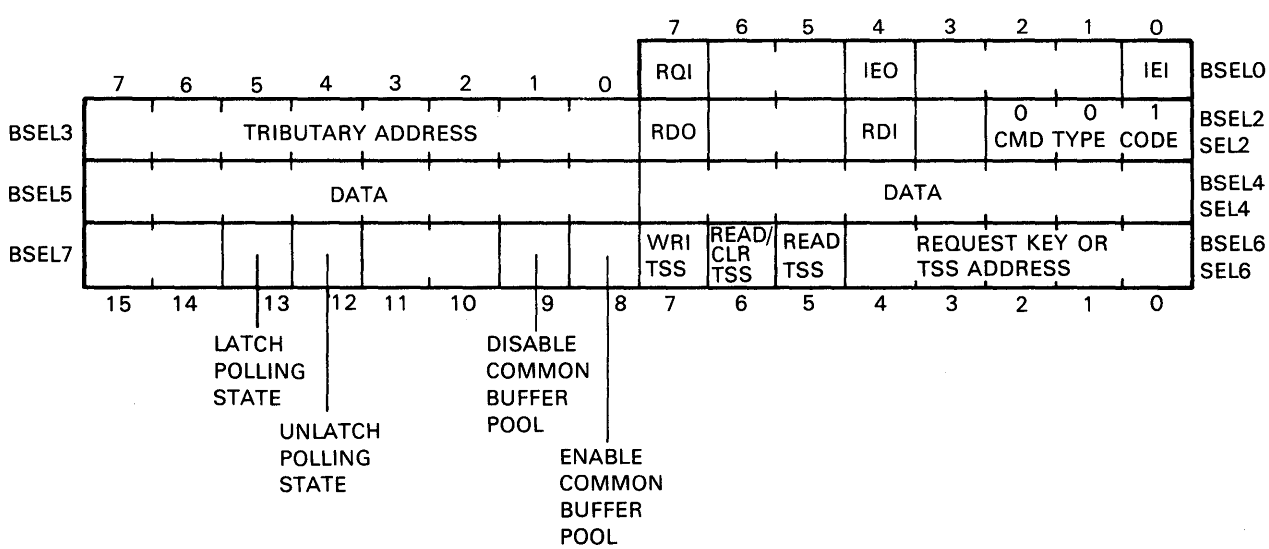


Figure 3-6 Control Command Format

At the startup of tributary stations having multiple software-assigned tributary addresses, the user program at each station issues as many control commands as there are tributaries created at that station. However, in networks where tributary addresses are switch-assigned, only one control command specifying the switch-assigned address need be issued as part of the startup sequence. Also, at a tributary station with the tributary address assigned by means of switches, any non-zero tributary address in a control command is overridden by the switches.

In point-to-point networks, a control command having the tributary address field set to one must be issued at both stations. This results in the creation of a single TSS structure at each station.

The user program at the control station has access to parameters for controlling the operation of the polling algorithm. It also has the option of specifying a unique set of polling parameters for each tributary in the network by issuing control commands.

During a typical operation, the control station, through the polling algorithm, determines the polling level of any tributary in the network and adjust the polling frequency of that tributary as necessary (see Section 5.2). Based on the short-term polling response history of a given tributary, that tributary can be placed in one of four polling frequency levels:

1. Active – a tributary is active when it responds to most polls with data messages.

2. Inactive – a tributary becomes inactive when it responds to a consecutive number of polls with control messages instead of data messages. This number is a user-defined parameter referred to as the number of no-data messages needed to go to inactive (NDM-INACT).

3. Unresponsive – a tributary becomes unresponsive when it does not respond to a consecutive number of polls. This number is a user-defined parameter referred to as the number of timeouts to go unresponsive (TO-UNRESP).

4. Dead – a tributary becomes dead when it continues to be unresponsive for a consecutive number of polls after a TO-UNRESP timeout. This number is a user-defined parameter referred to as the number of timeouts to go to dead (TO-DEAD). All dead tributaries are polled at a rate designated by the user-defined polling parameter DEAD T (see Section 5.2.3.4).

3.3.3.1 Control Command Field Descriptions – The Control Command permits the user program to perform a number of control functions using a single command format. In general, each function implemented by this command needs the issuing of a single correctly formatted control command. Exceptions to this are identified in the descriptions for the field or fields implementing each command function. These fields are described in detail in the sections that follow.

Enable/Disable Common Pool Buffers (Bits 0 and 1 of BSEL7)

In multipoint networks, user programs at control and tributary stations have the ability to set up a common pool of receive buffers and to selectively enable and disable access to buffers in this pool. Buffers in this common pool are allocated on a quota basis with each tributary assigned a specific quota. A common buffer pool is created by the user program through the buffer address/character count command (see Section 3.3.4). These control bits apply only to multipoint networks.

Enable Common Pool	When set to one, this control bit enables the use of receive buffers from the common buffer pool for the tributary designated by the address in BSEL3. In addition, the quota for that tributary is set by the octal value in BSEL4. If the enable common pool bit is set and the value in BSEL4 is zero, the effect of setting this bit is nullified.

If the octal value placed in BSEL3 is 377, the buffer quota available to the tributary is without a limit. During network operation, when a common pool receive buffer is completed by a tributary, the quota for that tributary is decremented by one. The user program can increase the quota for a tributary by issuing a control command with the enable common pool bit set and a value in BSEL4. However, in this event, the value in BSEL4 is added to the current quota to establish the new quota for that tributary. If the increase causes the quota for that tributary to equal or exceed the octal value 377, the quota is reset to 376 and a procedural error is posted to the user program (see Section 3.4.2.4).

Disable Common Pool — When set to one, this bit disables the use of common pool receive buffers by the tributary addressed by BSEL3. In addition, the quota previously created for that tributary is reduced to zero.

Latch/Unlatch Polling State (Bits 4 and 5 of BSEL7)

In DMP11-implemented multipoint networks, the control station DMP11 uses the microcode polling algorithm to automatically poll each tributary at a frequency determined by the current polling level and user-defined polling parameters. In addition to specifying polling parameters for each tributary by means of the control command (see the write TSS function), the user program at the control station can also change the polling level of a given tributary. That tributary then stays at the designated polling level, regardless of its ongoing response history, until the user program returns polling control of that tributary to the polling algorithm.

Latch Polling State — When set to one, this bit causes the polling level of the tributary addressed by BSEL3 to be set according the binary code specified by bits 0 and 1 of BSEL4. The relation between the coded value of these bits and polling levels is defined in Table 3-5.

Unlatch Polling State — When set to one, this bit causes the polling level of the tributary addressed by BSEL3 to be restored to polling algorithm control at the active level. During operations which follow, the polling algorithm adjusts the tributary to a polling level determined by its short-term response history.

Table 3-5 Correspondence Between Polling Levels and the Binary Code in BSEL4, Bits 0 and 1

Polling Level	Binary Code
Active	00
Inactive	01
Unresponsive	10
Dead	11

Request Key Field (Bits 0 to 4 of BSEL6)
The codes in the request key field provide for the control functions related to the startup and operation of DMP11s by the user programs at all stations. When the request key field is used, bits five through seven of BSEL6 must be cleared. The octal code for each control function is listed in Table 3-6. Each of the control functions listed in Table 3-6 are defined in detail below.

No Request

This code allows the issuing of a null control command for the purpose of returning control of the CSRs to the DMP11 when RDI is set and there is no command to issue. The effect of using this request key is to issue a NOP command. Note that the enable/disable common pool and latch/unlatch polling state bits can be used with this request key.

Establish Tributary

This control function allows user programs at all stations to start creation of the tributary status slot (TSS) data structure. To establish tributary addresses in a multipoint network the user programs at both the control and tributary stations must issue one establish tributary control command for each tributary supported. In these commands, the establish tributary code must be set in the request key field, with the correct tributary address set in BSEL3.

NOTE
In a point-to-point network, this control command, with a tributary address of one in BSEL3, should be issued at each station to create the needed TSS.

At the control station, the user program can create a TSS structure for up to 32 tributary addresses. In addition, the total number of tributary addresses created and maintained by a multipoint control station at any given time cannot exceed 32. Correct network discipline states that tributary addresses created at the control station also be created at the tributary stations.

As a result of creating one or more tributary addresses at a station, the DMP11 automatically creates a global status slot (GSS) as part of the internal data structure at that station. The GSS maintains the status of DMP11 operation and specific data that is global to the device. The GSS is accessible to the user program by specifying a tributary address of zero in BSEL3 of the accessing control command.

NOTE
This control command function can also be used during the typical operation of a multipoint network to recreate previously deleted tributaries. In such events, the tributary address must be reestablished at both the control station and the pertinent tributary station.

Delete Tributary

This control command function allows the user programs at both control and tributary stations to remove a tributary from functional status by deleting the TSS. Prior to issuing this command, the user program must first halt the tributary being deleted (see request key request halt state). Although a DMP11-implemented multipoint

Table 3-6 Octal Codes for Request Key Control Functions

Control Function	Octal Code
No Request	00
Establish Tributary	01
Delete Tributary	02
Request Startup State	03
Request Maintenance State	04
Request Halt State	05
Reserved	06
.	.
.	.
.	.
Reserved	17
Read Modem Control	20
Write Modem Control	21
Run Interface Diagnostic	22
Write Modem Test Register	23
Reserved	24
.	.
.	.
.	.
Reserved	37

network can support a maximum of 32 tributary addresses, the tributary address space provided by the DMP11 CSR BSEL3 allows up to 255 tributary addresses. As a result, it is possible for the tributary stations in a network to support more than 32 tributary addresses, with the restriction that a maximum of 32 tributaries can be created at any one time.

Request Startup State

This control function initializes the tributary addressed by BSEL3 and starts the the DDCMP startup sequence for that tributary (see Appendix A). The user program is informed by a control response when the startup sequence is complete (see Section 3.4.2.2). When the control response, tributary in run state, is received by the user programs at both the control and tributary stations, then message traffic can start between the control station and that tributary. Before issuing a control command with this request key to an assigned tributary, the tributary must be in the DDCMP halt state. If this command is issued to a tributary not in the halt state, a procedural error occurs (see Section 3.4.2.4). A control command with this function can be issued by the user program at any time after the tributary is established.

NOTE
The enable/disable common pool and/or the latch/unlatch polling state bits in BSEL7 can be combined with this control function in a single control command.

Request Maintenance State

This control function places the tributary addressed by BSEL3 into the DDCMP maintenance state. A tributary placed in this state can only transmit and receive maintenance messages. In order for maintenance message traffic to occur between a control station and a tributary, the control and tributary station must be in the maintenance state. Issuing a control command with this control function initializes the TSS for the pertinent tributary. Before issuing a control command with this request key the tributary must be in the DDCMP halt state. To return to the usual operation from the maintenance state, a tributary must first be in the halt state. Then the request startup state control command can be issued.

NOTE
The enable/disable common pool and/or the latch/unlatch polling state bits in BSEL7 can be combined with this control function in a single control command.

Request Halt State

This control command function places the tributary addressed in BSEL3 into the DDCMP halt state. When a tributary is halted at the control station, that tributary is no longer polled. When a tributary is halted at the tributary station, that tributary no longer responds to polls transmitted from the control station. In the process of halting a tributary at both the control and tributary stations, all private receive buffers allocated to that tributary are returned.

However, the TSS for that tributary at both control and tributary stations remains the same. A tributary in the halt state can be restarted by issuing a control command containing the request key for request startup state.

NOTE
The request key request halt state can be used globally to return all common pool buffers at the control and tributary stations. However, the common buffer pool quota assigned to each tributary remains the same. The user programs at the control and tributary stations must issue Control commands with the code for request halt state (05) with a tributary address of zero in BSEL3. If a common pool buffer is in use when this global command is issued, a procedural error results (see Section 3.4.2.4). If the common buffer pool is empty when this command is issued, no buffers are returned.

Read Modem Control — The user program issues this control function to read the contents of the DMP11 line unit registers 13 and 17. The DMP11 responds to this command by issuing an information response with the contents of line unit registers 13 and 17 in SEL4 (see Section 3.4.3 and Appendix C). The functions of the eight bits comprising each of these registers are described in detail in Appendix C.

Write Modem Control — The user program issues this control function to write the contents of BSEL4 (modem control information) into the DMP11 extended line unit register 13 (see Appendix C).

Run Interface Diagnostic — This control function starts execution of the DMP11 interface diagnostics. These diagnostics test the CSR interface and related data paths between the DMP11 and the user program. These routines, which are designed for use with a cooperating diagnostic program executed out of main memory, are detailed in Appendix E. (This request key is designed for diagnostic use only.)

Write Modem Test Register — The diagnostic programmer issues this control function to write the contents of BSEL4 (modem test information) into the extended line unit register AX3-15. This register is a single byte register (See Appendix C). (This request key is designed for diagnostic use only.)

Access Tributary Status Slot and Global Status Slot (BSEL6)

Figure 3-6 shows that the control command field defined by bits zero to four of BSEL6 have either a request key code or provide the user program with access to TSS and GSS locations. Using this field in a control command for implementing a request key control function needs bits five through seven of BSEL6 cleared to zero. However, when using BSEL6 in a control command to access a specific TSS or GSS location, one of the BSEL6 bits five through seven must be set to one. These bits specify the type of TSS/GSS access.

These bits specify that the TSS/GSS location addressed by BSEL6, bits zero to four, be either written into, read from, or be read and cleared. The TSS accessed through these control command fields is defined by the tributary address in BSEL3. The GSS is accessed in the same way except that a tributary address of zero is used. Both the TSS and GSS are addressed on word boundaries so that each access results in two bytes being read or written. The detailed functions performed by the BSEL6 control bits five through seven along with the name and octal address of the specific TSS/GSS locations accessed are shown below.

NOTE

TSS and GSS addresses are specified in octal with all data to be written. Also, data read from a TSS or GSS is in octal.

Write TSS/GSS — This bit (bit seven, BSEL6), when set to one, enables the user programs at all stations to write into the TSS or GSS locations addressed by bits zero to four of BSEL6. The control command to write into a TSS or GSS location must have the octal address of that location in bits zero to four of BSEL6. The address of the tributary whose TSS is being accessed is included in BSEL3 of the command. When writing into a GSS, the contents of BSEL3 (tributary address) must be zero. In both events, the data to be written is in BSEL4 and BSEL5 of the control command. There are 13 TSS parameters that can be written by a control command (see Table 4-1).

NOTE
Some parameters are eight bits in length with two included in a single TSS location.

If the user program tries to write into any other TSS location, a procedural error is generated (see Section 3.4.2.4). The names of these parameters, the TSS octal addresses, and the octal values of BSEL6 are listed below:

1. Transmit delay timer (XDT) preset value: address = 30 and the value of BSEL6 = 230.

2. Initial polling urgency (Q) and polling rate (R) for active state: address = 31 and the value of BSEL6 = 232.

3. Initial polling urgency (Q) and polling rate (R) for inactive state: address = 32 and the value of BSEL6 = 232.

4. Initial polling urgency (Q) and polling rate (R) for unresponsive state: octal address = 33 and the octal value of BSEL6 = 234.

5. Number of selection intervals during which no data messages were received, causing a tributary to go inactive (NDM-INACT) and number of timeouts to go unresponsive (TO-UNRESP): address = 34 and the value of BSEL6 = 234.

6. Number of timeouts to go dead (TO-DEAD) and maximum message count: address = 35 and the value of BSEL6 = 235.

7. Selection interval timing counter: address = 36 and the value of BSEL6 = 236.

8. Babbling tributary timing counter: address = 37 and the value of BSEL6 = 237.

There are five GSS parameters that can be written by a control command (see Section 4.3.2. and Table 4-2). If the user program tries to write into any other GSS location, a procedural error occurs (see Section 3.4.2.4). The names of these parameters, the GSS octal addresses, and the octal values of BSEL6 are listed below:

1. Number of sync characters to precede non-abutting messages (NUM SYNC): address = 33 and the value of BSEL6 = 233.
2. Preset value for carrier with timing counter: address = 34 and the value of BSEL6 = 234.
3. Polling urgency update interval (DELTA T): address = 35 and the value of BSEL6 = 235.
4. Polling rate for dead tributaries (DEAD T): address = 36 and the value of BSEL6 = 236.
5. Poll delay timer (POLL DELAY): address = 37 and the value of BSEL6 = 237.

Read and Clear TSS/GSS

This bit (bit six of BSEL6), when set to one, allows the user programs at all stations to read and clear specific locations in a TSS and GSS. If a user program tries to read and clear any other than the specified TSS and GSS locations, a procedural error is generated (see Section 3.4.2.4). The control command to read and clear a TSS or GSS location must include the octal address of the location within the TSS or GSS being accessed in bits zero to four of BSEL6. The address of the tributary assigned to the TSS is in BSEL3. However, if a GSS location is to be read and cleared, the contents of the tributary address field, BSEL3, must be zero. When the DMP11 receives a control command to read and clear a TSS or GSS location, it passes the information is passed, not the request to the user program through an Information response. The TSS and GSS locations accessible to the user program for reading and clearing are made up of local and global error counters and supporting statistics. For the TSS, the names of these counts, the octal addresses, and the octal values of BSEL6 are listed below:

1. Number of data messages transmitted: address = 07 and the value of BSEL6 = 107.
2. Number of data messages received: address = 10 and the value of BSEL6 = 110.
3. Number of selection intervals completed: address = 11 and the value of BSEL6 = 111.
4. Number of data errors outbound and associated error types: address = 12 and the value of BSEL6 = 112.
5. Number of data errors inbound and associated error types: address = 13 and the value of BSEL6 = 113.
6. Number of local buffer errors and associated error types: address = 14 and the value of BSEL6 = 114.
7. Number of remote buffer errors and associated error types: address = 15 and the value of BSEL6 = 115.
8. Number of selection interval timeouts and associated error types: address = 16 and the value of BSEL6 = 116.
9. Number of local reply timeouts and associated error types: address = 17 and the value of BSEL6 = 117.

There are four station error counts maintained in the GSS that can be read and cleared through a control command and each of these is described in detail in Section 5.3.1.3. The names of these counts, the GSS octal addresses, and the octal values of BSEL6 are listed below:

1. Remote station error counter and associated error types: address = 15 and the value of BSEL6 = 115.
2. Local station error counter and associated error types: address = 16 and the value of BSEL6 = 116.

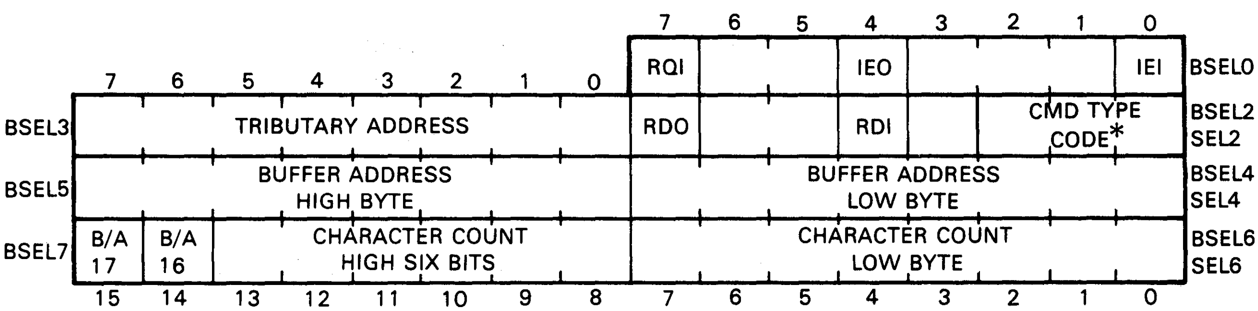
3. Global header block-check error count and maintenance data field block-check error count: address = 17 and value of BSEL6 = 117.

Read TSS/GSS

When set, this bit (bit five of BSEL6) permits user programs at all stations to read any location in either the TSS or the GSS. The control command to read a TSS or GSS location must contain the octal address of the location within the TSS or GSS in bits zero to four of BSEL6. The address of the tributary with the TSS being accessed is in the tributary address field (BSEL3). However, if a GSS location is to be read, the contents of BSEL3 must be zero. When the DMP11 receives a control command to read a TSS or GSS location, it passes the information to the user program through an information response (see Section 3.4.3). The word boundary octal addresses for TSS and GSS locations are in the range 0 to 37. The corresponding octal values for BSEL6 of a control command to read these TSS and GSS locations range from 40 for location zero to 77 for location 37.

3.3.4 Buffer Address/Character Count Command

In DMP11-implemented networks, user programs at all stations control the allocation of transmit and receive buffers through the buffer address/character count command. This command has two forms to help separate management of transmit and receive buffers. These two forms are identified by the type code in bits zero to two of BSEL2. The format for the buffer address/character count command is shown in Figure 3-7.



*TYPE CODES
BUFFER ADDRESS/CHARACTER COUNT COMMAND - RECEIVE = 000
BUFFER ADDRESS/CHARACTER COUNT COMMAND - TRANSMIT = 100

Figure 3-7 Buffer Address/Character Count Command Format

The type code for commands to allocate receive buffers is zero, and for commands to allocate transmit buffers, the type code is four. Except for the type code field, the command formats for allocating receive and transmit buffers are exactly the same.

When a user program has a message to transmit, it issues a buffer address/character count command to inform the DMP11 of the address and size of the message buffer to be transmitted, with the tributary address of the receiving station. For a DMP11 in a point-to-point network, the receiving station address is always one. In all networks, a zero in the tributary address field (BSEL3) of a buffer address/character count command for a transmit buffer will result in a procedural error (see Section 3.4.2.4).

In multipoint networks, user programs at both the control and tributary stations can handle the allocation of receive buffers in two ways:

1. The first method is the allocation of receive buffers from a common pool of buffers. With the common buffer pool enabled (see Section 3.3.3.1), receive buffers are assigned to the pool through the buffer address/character count command, based on one buffer for each command issued. Each buffer address/character count command used to assign a buffer to the common pool must have a zero in BSEL3. Although this command assigns buffers to a common pool, actual allocation to a tributary is done through the control command by enabling access to the pool and assigning quotas (see Section 3.3.3.1).

2. With the second method, the user program can directly allocate private receive buffers based on expected message traffic using one buffer address/character count command for each private buffer allocated. In this way, a private buffer is defined as a receive buffer assigned to a specific tributary for its exclusive use. In all events, the address of that tributary must be in BSEL3 of the assigning command.

Private buffers and buffers from a common pool can be used together at control and tributary stations in a multipoint networks. Under these conditions, the benefits provided by both methods are available to the user program. For example, common pool buffers can be set up for messages that are not expected and/or for large messages, although private buffers can be allocated for expected receive message traffic and/or receive messages of optimum size.

3.3.4.1 Buffer Address/Character Count Command Field Descriptions – Figure 3-7 shows that the value of the type code field (bits zero through two of BSEL2) serves to identify the transmit and receive buffer address/character count commands. Except for the type code field, the other fields are identical for both command types. These fields are described in detail below.

Buffer Address (BSEL4, BSEL5, and Bits Six and Seven of BSEL7)
The four fields (two bytes and two bits) make up the 18-bit buffer address used by a DMP11 to transfer data to or from a location in main memory through non-processor request execution. BSEL4 forms the low-order eight bits of the buffer address with BSEL5 the next eight higher-order bits. Finally, the two high-order bits 16 and 17 of the buffer address are created by bits six and seven of BSEL7.

Character Count (BSEL6 and Bits Zero through Five of BSEL7)
The two fields that make up the 14-bit character count provide for a maximum buffer size of 16,383 bytes. The eight low-order bits of the character count is in BSEL6, with the six high-order bits in bits zero to five of BSEL7. A character count is always in positive binary notation. If any other notation is used, the results are undefined. In addition, a character count of zero results in a procedural error (see Section 3.4.2.4).

3.4 DMP11 RESPONSES

The DMP11 has a set of three response structures that it can use to respond to specific user program commands as well as to inform the user program of functional events and error conditions. These responses are:

1. Buffer disposition response,
2. Control response, and
3. Information response.

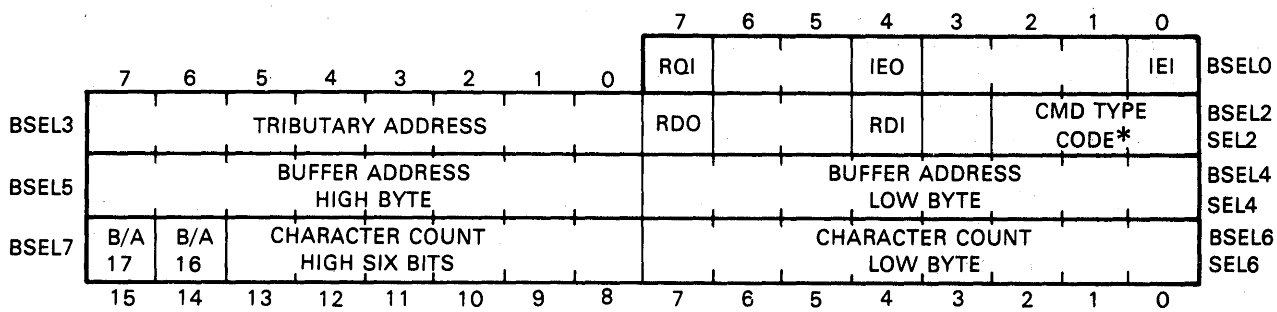
Although a one-to-one communication does not exist between user program commands executed by the DMP11 and responses issued to the user program, commands often get responses. For example, the disposition of transmit and receive messages is specified by the buffer disposition response. Information requested through control commands for TSS, GSS, and request key data is provided by the information response. However, error messages and messages about functional events, which are generally unsolicited, are returned to the user program through the control response. Like user-program commands, DMP11 responses are identified by a type code in bits zero through two of BSEL2.

NOTE

In multipoint networks, each response issued includes the address of the tributary that the response concerns in the tributary address field (BSEL3). However, in point-to-point networks equivalent responses always have a one in BSEL3.

3.4.1 Buffer Disposition Response

Management of transmit and receive buffer completions uses five different types of buffer disposition – three for transmit buffers and two for receive buffers. As shown in Figure 3-8, the format for these responses is the same for all transmit and receive buffer dispositions. However, the types of transmit and receive buffer dispositions are identified by the type code in bits zero through two of BSEL2. A summary of the relationship of buffer disposition to type code is found in Table 3-7.



* BUFFER DISPOSITION RESPONSE TYPE CODES:
1. RECEIVE BUFFER COMPLETE = 000
2. RECEIVE BUFFER UNUSED = 011
3. TRANSMIT BUFFER COMPLETE = 100
4. TRANSMIT BUFFER SENT NOT ACK'd = 110
5. TRANSMIT BUFFER NOT SENT = 111

MK-2509

Figure 3-8 Buffer Disposition Response Format

Receive Buffer Completed

When a message is successfully received and stored in the assigned main memory buffer, the DMP11 informs the user program of this successful completion by issuing a buffer disposition response with the type code for receive message completed. Data in a receive buffer is not valid until such a response is given for that buffer. This response is issued for both receive buffers from the common pool and for private buffers.

Receive Buffer Unused

When the protocol at the control or tributary station is halted for a specified tributary, the DMP11 automatically returns all private receive buffers allocated to that tributary whether used or not. Also included are buffers for messages received but not acknowledged when the protocol was halted. As a result, unacknowledged message buffers could have been written into, and have invalid information. The DMP11 issues one buffer disposition response for each buffer returned.

When the user program at the control or tributary station issues a control command having the request halt state request key, with the tributary address field (BSEL3) set to zero, the DMP11 returns all common pool buffers. The DMP11 returns these buffers by issuing one buffer disposition response having the receive buffer unused type code for each common pool buffer left unused. When all common pool buffers are returned, the DMP11 issues an information response indicating that the completion process is at an end. If the common buffer pool is empty when the request halt state control command is issued, the DMP11 issues the same information response (see Section 3.4.3).

Table 3-7 Buffer Disposition Response Type Codes

Buffer Disposition	Binary Code
Receive Buffer Completed	000
Receive Buffer Unused	011
Transmit Buffer Completed	100
Transmit Buffer Sent But Not Acknowledged	110
Transmit Buffer Not Sent	111

Transmit Buffer Completed
A Buffer Disposition Response having the type code for transmit buffer completed serves to inform a user program that the message from the specified buffer has been successfully transmitted to the designated tributary. Successful transmission means that the receiving station has acknowledged receiving the message through the protocol.

Transmit Buffer Sent but not Acknowledged
When the protocol for a tributary is halted, either at a control or tributary station, the DMP11 automatically returns all transmit buffers being processed by that tributary to the user program. For each transmit message sent but not acknowledged at the time the protocol was halted, the DMP11 issues one buffer disposition response having the tributary address and this type code.

NOTE

During protocol operation, after seven unacknowledged transmissions of a message, the transmit threshold error is exceeded and the DMP11 issues a control response indicating this error (see Section 3.4.2). The DMP11 continues to transmit the message and responsibility for terminating the transmission belongs to the user program.

Transmit Buffer Not Sent
At both the control station and at tributary stations, the DMP11 handles transmit message traffic by maintaining a queue of buffers to be transmitted for each tributary address created in the network. When the protocol for a given tributary is halted at the control or tributary station, the DMP11 automatically returns all unused buffers allocated to that tributary to the user program. The DMP11 issues one buffer disposition response having the tributary address and this type code for each transmit buffer staying in the queue of transmit buffers.

The protocol can be halted for a tributary in one of three ways:

1. The user program issues a control command halting the tributary.
2. A DDCMP STRT message is received while the tributary is in the RUN state.
3. A DDCMP maintenance message is received, temporarily halting the protocol, while receive buffers are being returned.

3.4.1.1 Buffer Disposition Response Field Descriptions – Except for the type code field, whose function has been defined in the preceding section, this response has six other fields that apply equally to all five response changes. These fields, which serve to name the size and main memory address of the buffer being completed are described in detail below.

Buffer Address (BSEL4, BSEL5, and Bits Six and Seven of BSEL7)
These four fields (two bytes and two bits) make up the 18-bit buffer address used by a DMP11 to transfer data to or from a location in main memory through NPR execution. BSEL4 forms the eight low-order bits of the buffer address with BSEL5 the next eight higher-order bits. Finally, the two high-order bits 16 and 17 of a buffer address are created by bits six and seven, of BSEL7.

Character Count (BSEL6 and Bits Zero Through Five of BSEL7)
The two fields which make up the 14-bit character count provide a count of the actual number of bytes which make up the message having in the buffer being returned. The eight low-order bits of the character count is in BSEL6, with the six-high order bits in bits zero to five of BSEL7. A character count is always in positive binary notation.

3.4.2 Control Response

A control response is an unsolicited response issued by the DMP11 when an error is detected or when certain functional events occur that need the user program be notified. There are four types of information passed to the user program by control responses:

1. System events,
2. Protocol events,
3. Network errors, and
4. Procedural errors.

The format for the control response is shown in Figure 3-9. Figure 3-9 shows that except for the tributary address and type code fields, a control response has five information fields. Four of these fields are used to include the 18-bit UNIBUS address. The fifth field is dedicated to the error/event code.

The UNIBUS address fields, which are used to identify undersize buffers and non-existent memory locations, are pertinent only to certain error conditions. The event/error code is in BSEL6 of a control response and is an octal number in the range of two through 376. The name of each event/error and the corresponding octal code are listed in Table 3-8. Procedural errors are listed in Table 3-9.

NOTE
The event/error octal codes are all even values to make the use of these codes for dispatch table entry easier.

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
									RQI			IEO				IEI	BSEL0
BSEL3	TRIBUTARY ADDRESS								RDO			RDI		0 (CMD TYPE CODE)	0	1	BSEL2 SEL2
BSEL5	*BUFFER ADDRESS OR CHARACTER COUNT HIGH BYTE								*BUFFER ADDRESS OR CHARACTER COUNT LOW BYTE								BSEL4 SEL4
BSEL7	B/A 17	B/A 16							EVENT/ERROR CODE								BSEL6 SEL6

*ONLY APPLICABLE FOR NON-EXISTENT MEMORY AND BUFFER TOO SMALL ERRORS

Figure 3-9 Control Response Format

Table 3-8 Event/Error Names, Categories, and Corresponding Codes (in Octal)

Event/Error	Information Category	Code
Receive Threshold Error	Network Error	2
Transmit Threshold Error	Network Error	4
Select Threshold Error	Network Error	6
Start Message Received While Running	Protocol Event	10
Maintenance Message Received While Running	Protocol Event	12
Maintenance Message Received While Halted	Protocol Event	14
Start Message Received While in Maintenance Mode	Protocol Event	16
Reserved	N/A	20
Tributary Polling State Changed to Dead	System Event	22
Tributary in Run State	Protocol Event	24
Babbling Tributary	Network Error	26
Streaming Tributary	Network Error	30
Modem Ring Detect	System Event	32
Reserved	N/A	34
.	.	.
.		.
.	.	.
Reserved	N/A	76
Procedural Errors	(See Table 3-1)	100
.	.	.
.	.	.
.	.	.
Procedural Errors	(See Table 3-9)	302

Table 3-8 Event/Error Names, Categories, and Corresponding Codes (in Octal) (Cont)

Event/Error	Information Category	Code
Modem Disconnect	System Event	304
Queue Overflow	System Event	306
Modem Carrier Loss	System Event	310
Reserved	N/A	312
.	.	.
.	.	.
.	.	.
Reserved	N/A	376

Table 3-9 DMP11 Procedural Errors and Corresponding Codes (in Octal)

Octal Code	Procedural Error
100	A command other than a mode definition command is issued before the mode created. (See Section 3.3.2.)
102	Invalid type code used in a command.
104	Invalid mode change (for example the mode of a tributary station is changed to point-to-point).
106	A non-global command is issued to a tributary which has not been created.
110	A non-global command is issued with a tributary address of zero.
112	Try to delete or place an unhalted tributory in the start or maintenance protocol state.
114	Try to create more than 32 tributaries.
116	Try to create a tributary that is currently created.
122	An invalid request key is used in a control command.
124	Try to assign a buffer to a halted tributary.
126	Try to assign a buffer with a byte count of zero.
130	Try to assign a transmit buffer with the tributary address field (BSEL3) set to zero.

Table 3-9 DMP11 Procedural Errors and Corresponding Codes (in Octal) (Cont)

Octal Code	Procedural Error
132	Try to read and clear or write into a reserved section of a TSS or GSS.
134	Try to use the reserved bits in BSEL7 of a control command.
136	Try to retrieve common pool buffers while the common pool is in use.
140	Try to raise the common pool buffer quota to a value higher than 376 octal (see Section 3.3.3.1).
142	Reserved
.	.
.	.
.	.
276	Reserved
300	Buffer too small – recovery from this error condition is detailed in Section 4.6.2.2
302	Non-existent memory error – recovery from this error condition is detailed in Section 4.6.2.1.

In general, the functional events and errors described in this section apply to all stations. Exceptions to this are identified where applicable.

The meaning of each system and protocol event reported by a control response, with a description of each error condition recorded, are detailed in the sections that follow. The function of the UNIBUS address fields in specific error reports are defined in the descriptions of those errors.

3.4.2.1 System Events – There are five system events reported by control responses. These concern the functional state of tributaries and the state of the local modem.

Tributary Polling State Changed to Dead

This control response code informs the user program at a multipoint network control station that the polling level of the tributary addressed by BSEL3 has been changed to the dead state by the polling algorithm. A tributary can be removed from the dead state by the user program through a control command implementing the latch/unlatch polling function. Also, if a dead tributary responds, the polling algorithm automatically places the tributary in the active state (see Section 5.2.1). This control response has no meaning in point-to-point networks.

Modem Ring Detected

This control response code informs the user program at all stations that an off-to-on transition of the EIA signal ring, continuing for at least one millisecond, was detected by the local modem. When detected, this signal indicates that a remote station is requesting connection of the physical communications line. Modem ring detect applies only to networks connected by a switched line and is not used in networks based on a dedicated line. Because this is a global response, the contents of BSEL3 are zero.

Queue Overflow

This control response informs the user program at all stations when the free linked list is empty (see Section 5.4). Often, this response indicates that operational conditions are creating responses faster than the DMP11 can process them. Because this condition is a global response, the contents of BSEL3 are zero. Once this response is issued, the user program has three seconds to recover the next response from the CSRs (three seconds per pending response) before the CSRs are cleared by the internal microdiagnostics. To restore the DMP11 to operation, the complete startup sequence must be executed (see Section 4.3).

NOTE

This is a fatal error. The DMP11 will reinitialize itself for subsequent startup.

Modem Disconnected

This control response code informs the user programs at all stations that an on-to-off transition of the EIA signal data set ready (DSR), continuing for at least one millisecond, was detected. Such a transition of DSR indicates that the local modem is diconnecting from the physical communications line. Because this is a global response, the contents of BSEL3 are zero. This response is also posted to user programs in point-to-point networks when there is a failure to connect to the other station. In this event, the response serves as a notification to dial again.

Modem Carrier Loss

This control response code informs the user program that the EIA signal carrier detect has gone from on to off while the DMP11 was in the process of receiving a message. Because this is a global response, the contents of BSEL3 is always zero.

3.4.2.2 Protocol Events – A DMP11 uses the control response to report five different protocol events to the user program. These reports serve to inform the user program of the state of protocol operations associated with the tributary specified by the address in BSEL3.

STRT Message Received While Running

This control response informs the user program at a control or tributary station that a DDCMP STRT message was received by a tributary while that tributary was in the DDCMP run state. In the usual operation, the control station DMP11 issues a DDCMP STRT message to inform a tributary that the user program at the control station has started protocol operation for that tributary. A DDCMP STRT message is also used to resynchronize the logical link between the control station and a tributary because of conditions, such as threshold errors or receive and transmit overruns, that inhibit efficient message traffic. In this event, the user program at the control station (after the tributary is halted at the control station) issues a request startup state control command causing the associated DMP11 to send DDCMP STRT messages to the tributary being resynchronized. As a result, the protocol at that tributary is halted and the DMP11 at that station sends a control response to its user program having the code for STRT message received while running. All buffers are then returned through a buffer disposition response for receive buffers unused. At this point the tributary user program has the option of restoring the logical link by issuing a request startup mode control command to the halted tributary. As a result of this action, the protocol becomes functional at that tributary, allowing it to respond the next time it is polled.

Maintenance Message Received While Running

This control response informs the user program at the control or tributary station that a DDCMP maintenance message was received by a tributary while that tributary was in the DDCMP run state. As a result, the tributary at the receiving station is halted and all buffers (used and unused) are returned to the user program. When all buffers are returned, the DMP11 informs the user program of this by issuing an information response (see Section 3.4.3) and then places the tributary in the maintenance state. Once in the maintenance state, the tributary is ready to perform the functions implemented by the maintenance operation protocol (MOP). The actual maintenance message that caused this event is not returned to the user program.

Maintenance Message Received While Halted

This control response informs the user program that at a control or tributary station a DDCMP maintenance message was received by a tributary while it was in the DDCMP HALT state. After receiving a maintenance message under these conditions, the tributary is placed in the DDCMP maintenance state ready to operate under MOP. The actual maintenance message that caused this event is not returned to the user program.

STRT Message Received in Maintenance State

This control response informs the user program at a control or tributary station that a DDCMP STRT message was received by a tributary while it was in the DDCMP maintenance state. After informing the user program of this event, the DMP11 does not take any further action. Any action taken in response to this protocol event is up to the user program.

DDCMP RUN State Entered

This control response code informs the user program at the control or tributary station or at a point-to-point station that the tributary addressed by BSEL3 has entered the DDCMP RUN state. The DMP11 issues this response as an answer to a request startup state control command from the user program. When this response is received, the user program is informed that the protocol is functional for the tributary or station and that message traffic can begin (see Section 3.3.3.1).

3.4.2.3 Network Errors – The DMP11 provides control responses for five different network error conditions. All network errors, whether pertaining to a tributary or point-to-point station, are capable of being recovered.

Receive Threshold Exceeded — When the number of consecutive receive errors recorded for a given station equals seven, this network error is reported to the user program by a control response. Each time a receive threshold exceeded error is reported, the receive threshold error counter is reset to zero.

Transmit Threshold Exceeded — When the number of consecutive transmit errors recorded for a given station equals seven, this network error is reported to the user program by a control response. Each time a transmit threshold exceeded error is reported, the transmit threshold error counter is reset to zero.

Select Threshold Exceeded — When the selection interval timeout counter has timed out seven consecutive times, this network error is reported to the user program at a multipoint control station, or a half-duplex, point-to-point station by a control response. Each time a select threshold exceeded error is reported, the counter is reset to zero. The programmable selection interval period is the time allocated to a tributary for responding to a poll, or to a station for responding to a transmission. A selection interval is terminated either by a timeout of the counter resulting in this error condition or by a message which has the selection bit set.

NOTE

For further details on threshold counters see Section 5.3.1.2.

Babbling Tributary Detected — When the babbling tributary timeout period is exceeded, this network error is reported to the user program at a multipoint control station or a half-duplex, point-to-point station by a control response. A babbling tributary is a tributary that continues to transmit valid DDCMP messages without deselecting itself until the programmable babbling tributary timeout counter expires. Detection of this error condition usually indicates that the transmitting station is malfunctioning, or that the period of the babbling tributary timeout counter is too short (see Section 4.4.2). Recovery from this error condition usually requires human intervention at the remote station.

Streaming Tributary Detected — When the streaming tributary timeout period is exceeded, this network error is reported to a user program at a multipoint control station or a half-duplex, point-to-point station by a control response. A streaming tributary is a tributary or point-to-point station that has failed to relinquish the physical communications line at the end of the selection interval for that station. The streaming tributary timeout period, which is determined by the programmable streaming tributary timer, starts at the end of the selection interval. Detection of this error condition usually indicates that the modem at the remote station has malfunctioned, or that the period of the streaming tributary timer is too short (see Section 4.4.3). Recovery from this error usually requires human intervention at the remote station.

3.4.2.4 Procedural Errors – Procedural errors are those errors generated when the user program violates the procedures used to interface with the DMP11. With three exceptions (see Table 3-9, error codes 140, 300, and 302), these errors, when detected, are placed at the beginning of the DMP11 internal response queue and passed immediately to the user program as control responses. Also, with one exception (see Table 3-9 error code 302), these errors are not fatal.

NOTE
For this, a fatal error is an error that results in protocol shutdown.

Octal codes contained in BSEL6, in the range 100 to 144 and 300 and 302, serve to define the specific procedural violations. The name of each procedural error and its corresponding octal code are listed in Table 3-9.

One of the exceptions to immediate posting of procedural errors by the DMP11 is that of raising the common buffer pool quota for a tributary to a value higher than 376 (procedural error code 140). In this event, the DMP11 automatically resets the quota to 376. There is no urgency to the posting of this error. A control response with this error code is queued for reporting in the same manner as all other control responses.

NOTE
With the exception of the buffer too small and nonexistent memory errors, the only control response fields used by the DMP11 when posting a procedural error are type code field in BSEL2 and output code field in BSEL6. All other fields stay as set by the user program in the command that originally generated the procedural error (see Figure 3-9).

A buffer-too-small error occurs when the size of the buffer allocated to a receive message is not large enough to store the message. As shown in Figure 3-9, the control response returned when this error occurs has the character count of the message that caused the error. The DMP11 does not look for a buffer large enough. Instead, it requests retransmission of the message and expects that the user program will provide a correct buffer. Recovery from this error is detailed in Section 4.6.2.2.

A non-existent memory procedural error is reported to a user program by a control response when the DMP11 tries to access a main memory location that does not exist. As shown in Figure 3-9, the UNIBUS address that causes the error is returned to the user program in BSEL4, BSEL5, and BSEL7 of the reporting control response. This error can be fatal to the tributary or point-to-point station that initiated the memory access causing the error. Section 4.6.2.1 describes a recommended procedure for recovering from this error.

3.4.3 Information Response
Information responses are issued by the DMP11 in direct response to a request for information by the user program. As described in Section 3.3.3.1, an information response can be generated by control commands having specific request key codes. Also, buffer return complete responses caused by certain protocol events reported by control responses (see Section 3.4.2.2) are passed to the user program by means of the information response. The format for the information response is shown in Figure 3-10.

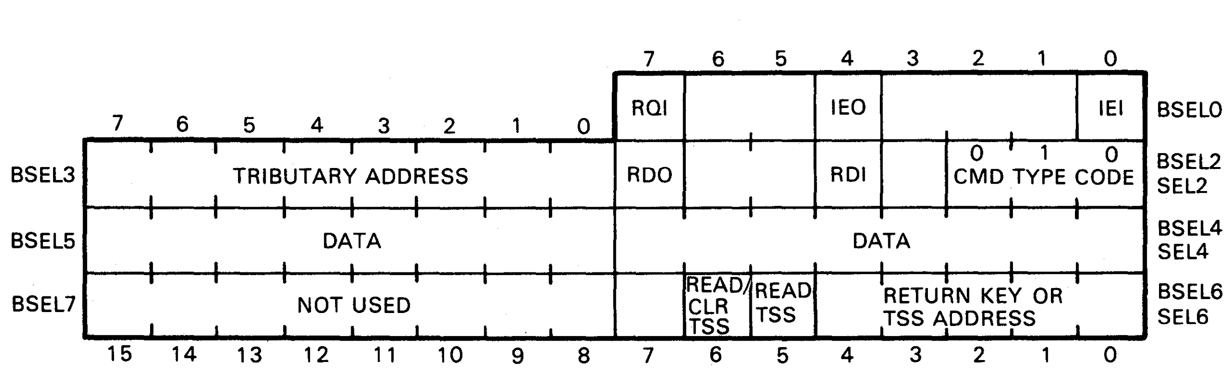


Figure 3-10 Information Response Format

3.4.3.1 Information Response Field Descriptions – Figure 3-10 shows that the data passed to the user program is contained in BSEL4 and BSEL5, with the fields in BSEL6 naming the type of data. BSEL3 contains the address of the tributary associated with the data in BSEL4 and BSEL5. However, if the Information response is returning data retrieved from a GSS, BSEL3 has a zero.

Return Key Codes
As shown in Figure 3-10, bits zero to four of BSEL6 of an information response can have either a return key code or a TSS/GSS address, with the nature of the TSS/GSS access defined by bits five and six of BSEL6. The return key codes are detailed below:

Return Modem Status (octal code = 10)
: An information response with this return key code in bits zero to four of BSEL6 has the contents of line unit register 13 and 17 in BSEL4 and BSEL5. This information response is returned when the user program issues a control command with the request key read modem control. The format and data content of line unit registers 13 and 17 are described in Appendix C.

Buffer Return Complete (octal code = 20)
: An information response with this return key code in bits zero to four of BSEL6 informs the user program that the process of returning buffers has been completed. This buffer returning process is started under the following circumstances:

1. The protocol event STRT message received while running occurred. This causes all private buffers assigned to the tributary defined by the address in BSEL3 to be returned.

2. The protocol event maintenance message received while running occurred. This causes all private buffers assigned to the tributary defined by the address in BSEL3 to be returned.

3. The user program issued a control command with the request key request halt state. This causes all private buffers assigned the tributary defined by the address in BSEL3 to be returned.

4. The user program issued a global control command (BSEL3 = zero) with the request key request halt state. This causes all unused common pool buffers to be returned.

Information responses with the return key code for buffer return complete always have zeros in BSEL4 and BSEL5.

TSS/GSS Access
When a user program accesses a TSS or a GSS through a control command, the DMP11 reads the defined location and passes the data to the user program by means of an information response. Reading a TSS or a GSS location stores two bytes of data from that location in BSEL4 and BSEL5 of the information response, with the lower-order byte in BSEL4 and the high-order byte in BSEL5. If a TSS is read, BSEL3 in the information response has the associated tributary address. However, data read from a GSS passes to the user program through an information response having a zero in BSEL3.

As described in Section 3.3.3.1, any TSS or GSS location can be read and specific locations can be read and cleared. With the TSS/GSS address, BSEL6 in an information response also has two single bit fields that indicate a read or a read and clear TSS/GSS. These information response fields are described in detail below:

TSS/GSS Address	This field (BSEL6, bits zero to four) has the octal address of the TSS/GSS location from which the data in BSEL4 and BSEL5 was read.
Read TSS/GSS	When set, this bit (BSEL6, bit five) designates that BSEL4 and BSEL5 have the data requested by the read TSS/GSS control command.
Read and Clear TSS/GSS	When set, this bit (BSEL6, bit six) designates that BSEL4 and BSEL5 have the data requested by the read and clear TSS/GSS control command. In addition to reading the requested TSS/GSS location, the DMP11 also clears that location.

NOTE

The TSS/GSS locations accessible for writing, reading, and reading and clearing are listed and described in Section 3.3.3.1.

CHAPTER 4
PROGRAMMING METHODS

4.1 INTRODUCTION

The design of user programs to control the operation of a DMP11 needs attention to a number of programming subjects specific to the user program/DMP11 interface. These subjects are listed below and are detailed in the separate sections referenced.

1. Control and status register (CSR) interface discipline (Section 4.2)

2. Configuration and startup (Section 4.3)

3. Criteria for determining user-defined parameters (Section 4.4)

4. Error counter access (Section 4.5)

5. Error recovery procedures (Section 4.6)

6. Booting a remote station (Section 4.7)

4.2 CSR INTERFACE DISCIPLINE

The command/response interface between a DMP11 and the user program is the eight-byte DMP11 CSRs that are addressed through the CPU I/O page. Because the DMP11 microprocessor runs in a multiprocessing mode with the PDP-11/VAX-11, the passing of commands and responses through this interface must be disciplined in order to remove the possibility of a race condition.

NOTE

A race condition results when the user program sets control bits in the CSRs after the microprocessor has read those bits).

This interface discipline demands that the user program to follow two separate procedures: one for issuing commands and one for retrieving responses.

Figure 4-1 shows the control bits in the CSR interface discipline. These bits are located in the DMP11 CSRs BSEL0 and BSEL2. Figure 4-1 shows that BSEL0 has two control bits named interrupt enable in (IEI) and interrupt enable out (IEO), bits zero and four. These bits, when set, enable the M8207 microprocessor to interrupt the main CPU under two circumstances. These are:

1. The CSRs become available to the user program for the issuing of a command (IEI) when the ready in bit (RDI) is set by the DMP11.

2. A response is to be read from the CSRs by the user program (IEO) when the DMP11 sets the ready out bit (RDO).

A DMP11 is capable of operating in both an interrupt and a non-interrupt mode.

7	6	5	4	3	2	1	0	
RQI			IEO				IEI	BSEL0
RDO			RDI					BSEL2

MK-2390

Figure 4-1 CSR Interface Control Bits

NOTE

For the best system performance, it is recommended that all system operation be conducted in the interrupt mode with the IEI and IEO bits set to one.

The procedures defining CSR interface discipline, which are described in the sections that follow, are based on operation in the interrupt mode. As a result, the interrupt enable bits, IEI and IEO, should be set by the user program before using the CSR interface.

4.2.1 Issuing Commands

A user program issues commands to a DMP11 in four steps:

1. The user program sets the request in (RQI) bit (bit seven of BSEL0, see Figure 4-1). When the DMP11 sets the RDI bit it also interrupts the main CPU if IEI is set.

2. If a single command is to be issued, the user program clears RQI. If a series of commands are to be issued, RQI can stay set until immediately before initiating step three for the last command issued. By leaving RQI set while issuing a series of commands, the user program is assured that it will have access to the CSRs after the next response.

3. The user program loads the command into the CSRs BSEL3, SEL4, and SEL6.

4. The user program sets the command type code in bits zero to two of BSEL2 and clears RDI. Clearing RDI informs the DMP11 that the CSRs have a command to be read.

4.2.2 Reading Responses

When the DMP11 has a response for the user program, it sets the CSR control bit RDO. When the IEO bit is set, it interrupts the main CPU. This action results in the DMP11 giving CSR read access to the user program.

With the response read, the user program clears the RDO bit. This action results in control of the CSRs being passed back to the DMP11. Note that the complete response must be read from the CSRs before clearing RDO because user program control of the CSRs is given up once RDO is cleared. In addition, to make the operation efficient requires that control of the CSRs by the user program, be kept to a minimum and all processing of responses must be done after RDO is cleared.

4.2.3 CSR Interface Interactions

User program access to the CSRs is under complete control of the DMP11. Access to the CSRs is given on request when the user program has a command to issue or when the DMP11 has a response for the user program. Figure 4-2 shows the type of access window available to the user program operating under interrupt control when issuing a command or reading a response.

As previously indicated, the user program sets RQI to request use of the CSRs for the purpose of issuing a command. The DMP11 makes the CSRs available for issuing a command – only when it is not using them – by setting RDI and interrupting the user program through the floating vector XX0. As a result, the time between the setting of RQI by the user program and the access to the CSRs through an interrupt cannot be determined.

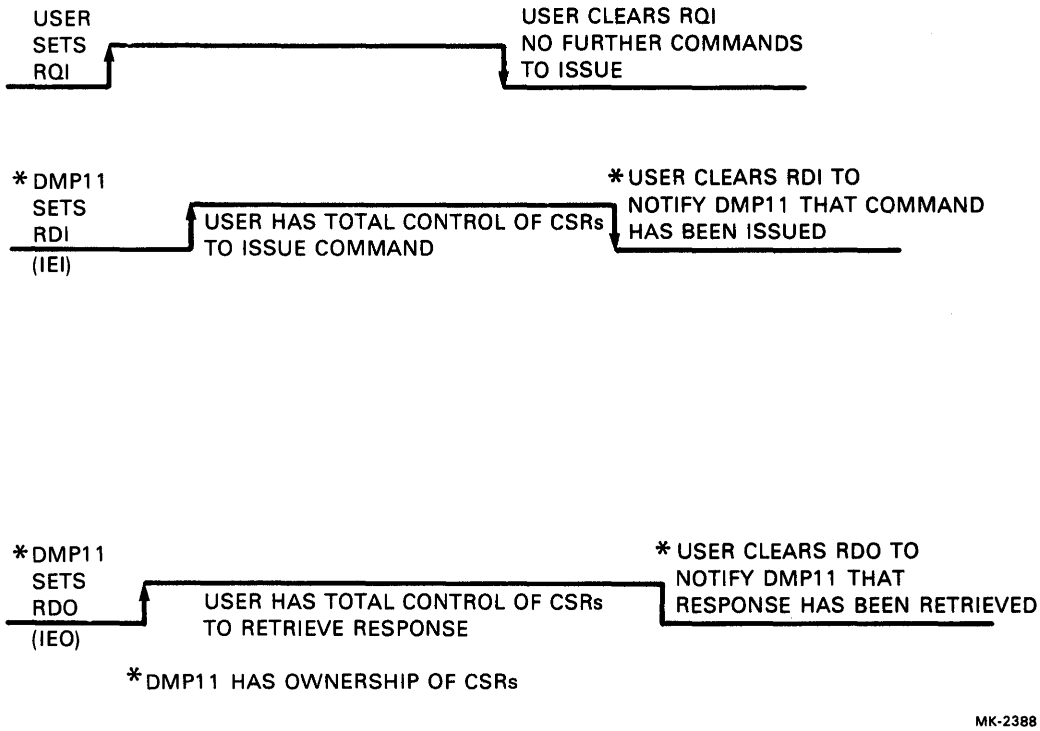


Figure 4-2 CSR Access Window

When commands are continuing to issue from a queue and the last command is issued with the user program owner of the CSRs (RDI is set), there is a way for the user program to return control of the CSRs to the DMP11. In such events, the user program can issue a control command with the code for no request in the request key field, informing the DMP11 to ignore the contents of the CSRs. In this way, the possible reading of incorrect data by the DMP11 is avoided.

If the user program is to issue a single command to the CSRs, RQI should be cleared before the command is issued, as indicated in Figure 4-2. However, if a series of commands are to be issued, the user program can leave RQI set. In this way, when a command is issued and RDI is cleared, the DMP11 will give up the CSRs to the user program after the next response. The time between the clearing RDI by the user program after completing one command and the access to the CSRs for the next command, also cannot be determined.

When the DMP11 has a response to be passed to the user program, it sets RDO and interrupts the main CPU through the floating vector XX4. At this point, the user program is the owner of the CSRs and can proceed by reading the response. Once the response is read from the CSRs, the user program should immediately clear the RDO bit. User program routines responsible for issuing commands and recovering responses should be designed to limit CSR access time to that time needed to load a command or recover a response.

4.3 DMP11 CONFIGURATION AND STARTUP

When starting a DMP11, the user program needs to perform a series of steps that form three procedures; one to configure the DMP11 to operate within the network, one to create user-defined parameters, and one to start protocol operations.

4.3.1 Configuration Procedure

The sequence to configure a control and tributary station DMP11 for network operation includes the following steps:

1. Set the master clear bit and wait for the run bit to be set (see Section 3.3.1 and Figure 3-4).

2. On detecting that the Run bit is set, read BSEL4 and BSEL6.

3. The DMP11 is functional when the contents of BSEL4 equals 77 and BSEL6 equals 305 (octal), indicating that the startup microdiagnostics have executed successfully. Any other values in BSEL4 and BSEL6 indicate that an error condition was detected by the startup microdiagnostics. (The values and meanings of these diagnostic error codes are listed in Table 3-3.)

4. If the DMP11 mode is software defined, set the mode for that device by issuing the correct mode command (see Section 3.3.2). If the mode for a DMP11 was setup by internal switches, this step can be ignored (see Section 2.6).

5. Setup the tributary addresses for the DMP11 by issuing one control command having the request key establish tributary for each tributary address to be established at this DMP11 (see Section 3.3.3.1).

6. If the DMP11 is a station in a point-to-point network, issue a control command to create a tributary address of one for that station.

4.3.2 Specifying User-Defined Parameters

After a DMP11 is configured, the user-defined parameters can be specified. User-defined parameters include parameters used by the polling algorithm and those specific to protocol operations. As described in Section 3.3.3.1, user-defined parameters are specified through control commands configured to address a tributary status slot (TSS) or a global status slot (GSS). When setting polling and protocol parameters, the user program has the option of accepting the default for a parameter or setting the parameter to some predetermined value. The criteria for determining, the best values for the different polling parameters are detailed in Section 5.2.3. Criteria for the rest of the parameters, which generally concern the operation of the communications link, are described in Section 4.4.

NOTE

Although most of the user-defined parameters are 16 bits in length, some are single-byte parameters. If the user program is to accept the default for one parameter and set the other to a unique value, then both the default value and the unique value must be written. This is necessary because both TSS and GSS user-defined parameters are written on two byte boundaries.

The process of specifying user-defined parameters includes two basic types:

1. Parameters for control and tributary station TSS structures

2. Parameters for the control and tributary station GSS

4.3.2.1 Specifying TSS Parameters – TSS parameters that can be specified by the user program are listed in Table 4-1 by name, BSEL6 address, size, and default value. A functional summary of of each parameter is also given.

NOTE

The octal values listed in Table 4-1 under the heading "TSS Address (octal value of BSEL6") are based on the setting of bit seven in BSEL6 to start a write TSS.

Table 4-1 User-Defined TSS Parameters

Name	TSS Address (Octal value of BSEL6)	Size (Bits)	Default Value (Octal)	Description
XDT PRESET	230	16	0 (no delay)	Preset value for the transmit delay timer. This parameter provides a fixed delay between transmissions of data and maintenance messages to the tributary.
Q (active)	231	8	377	The initial polling urgency (U) for tributary (i). The TSS for a tributary (i) must be assigned a value for each of the three polling levels: active, inactive, and unresponsive. This parameter is applicable only to TSS structures at the control station.
Q (inactive	232	8	0	
Q (unresponsive)	233	8	0	
R (active)	231	8	0	The rate (R) by which urgency (U) is increased for tributary (i). The TSS for tributary (i) must be assigned a value for R for each of the three polling levels: active, inactive, and unresponsive. Both the Q and R values for a given tributary are created through a single control command. Therefore, if one parameter is to be set to a unique value and the default is to be accepted for the other, both the default value and the unique value must be written. This parameter is applicable only to the TSS structures at the multipoint control station.
R (inactive)	232	8	100	
R (unresponsive)	233	8	20	
NDM-INACT	234	8	10	Number of no data messages needed to go inactive. This parameter specifies the number of consecutive polls to be made to a tributary without any data messages being received, before changing to polling state from active to inactive. This parameter applies only to TSS structures at a multipoint control station.
TO-UNRSP	234	8	2	Number of timeouts to go unresponsive. This parameter specifies the number of consecutive times a tributary will be polled with no response being received (consecutive selection timeouts) before the polling state is changed from active or inactive to unresponsive. Values for NDM-INACT and TO-UNRSP can be specified with a single control command.

Table 4-1 User-Defined TSS Parameter (Cont)

Name	TSS Address (Octal value of BSEL6)	Size (Bits)	Default Value (Octal)	Description
				If one parameter is to be set to a unique value and the default is to be accepted for the other, both the default value and the unique value must be written. This parameter applies only to the TSS structures at a multipoint control station.
TO-READ	235	8	20	The number of timeouts to go dead. This parameter specifies the number of consecutive polls to be made to an unresponsive tributary (consecutive selection timeouts) before the polling state is changed from unresponsive to dead. This parameter applies only the TSS structures at a multipoint control station.
MXMC	235	8	4	Maximum transmitted message count. This parameter specifies the count of the maximum number of abutting data messages to be transmitted by a station before deselecting itself. This count applies to the TSS structures at both control and tributary stations in multipoint networks as well as point-to-point stations. Both TO-DEAD and MXMC for a given tributary are created through a single control command. Therefore, at the multipoint control station, when one parameter is to be set to a unique value and the default is to be accepted for the other, both the default value and the unique value must be written. At tributary and point-to-point stations, the polling parameter TO-DEAD is ignored.
SEL TIMER	236	16	3 (sec.) (5670 octal)	Selection interval timer. This timer is started when a message is transmitted with the select flag set and halted when a valid response is received or the line is resynchronized. The selection timer is used as a reply timer for full-duplex, point-to-point networks and as a selection timer at multipoint control stations and half-duplex, point-to-point stations. This counter counts in milliseconds, from one to 65,535 milliseconds.

Table 4-1 User-Defined TSS Parameter (Cont)

Name	TSS Address (Octal value of BSEL6)	Size (Bits)	Default Value (Octal)	Description
BAD TIMER	237	16	6 (sec.) (13560 octal)	Babbling tributary timer. This timer is used to detect a babling tributary (see Section 3.4.2.3). In a multipoint network, this parameter applies only to the control station. However, this parameter applies to both stations in point-to-point networks operating in half-duplex mode.

The actual order for specifying TSS parameters is arbitrary. The complete command series to specify these parameters for TSS structures at a multipoint control station are listed below:

1. Issue a series of control commands to setup the preset value for the transmit delay timer.
2. Issue a series of control commands to create the polling parameters initial polling urgency (Q) and polling rate (R) for the three polling levels.
3. Issue a series of control commands to specify values for the active, inactive, unresponsive, and dead polling state-change parameters.
4. Issue a series of control commands to specify values for the maximum transmitted message count.
5. Issue a series of control commands to set the selection timers for tributaries (or issue a single command to set the point-to-point station reply timer).
6. Issue a series of control commands to set the babbling tributary timers.

4.3.2.2 Specifying GSS Parameters – As previously indicated, when one or more tributary addresses are setup at a DMP11, the microcode automatically creates a GSS for that control or tributary station. The GSS parameters that can be specified by a user program are listed in Table 4-2 by name, BSEL6 address, size, and default value. A functional summary of each parameter is also given.

The sequence of control commands necessary to specify GSS parameters for a multipoint control station are listed below:

1. Issue a control command to specify the number of sync characters (NUM SYNC) that are to precede non-abutting transmit messages.
2. Issue a control command to set the streaming tributary timer (STREAM TRIB).
3. Issue three control commands to assign values for the global polling parameters delta time (DELTA T), dead tributary (DEAD T), and poll delay.

NOTE

The octal values listed in Table 4-2 under the heading "GSS Address (octal value of BSEL6)" are based on the setting of bit seven of BSEL6 to start a write GSS. Also, when specifying a user-defined GSS parameter, BSEL3 in the pertinent control command has a zero.

Specific user-defined TSS and GSS parameters are common to both control and tributary stations. Note that control commands specifying TSS parameters must have the address of the tributary associated with the TSS in BSEL3. Similarly, each control command specifying a GSS parameter must have BSEL3 set to zero.

Table 4-2 User-Defined GSS Parameters

Name	GSS Address (Octal value of BSEL6)	Size (Bits)	Default Value (Octal)	Decription
NUM SYNC	233	16	10 (low speed) 15 (high speed)	Number of sync characters. This global value specifies the number of sync characters that are to precede non-abutting transmitted messages. This parameter applies to all stations. Low speed is defined as less than 250K b/s, and high speed as equal to or larger than 250K b/s.
STREAM TRIB	234	16	6 (sec.) (1350 octal)	Streaming tributary timer. This timer is used to detect a streaming tributary (see Section 3.4.2.3). In a multipoint network, this parameter applies only to the control station. However, in half-duplex, point-to-point networks, this parameter is applicable to both stations.
DELTA T	235	16	50 (ms) (62 octal)	Delta time. This parameter creates the polling urgency update interval. This global parameter, which applies only to multipoint network control stations, is used by the polling algorithm to compute polling urgency for each tributary (see Section 5.2.2). This interval is also used for the updating of the transmit delay timer. The default value of 50 ms is the minimum value for this parameter.
DEAD T	236	16	10 (sec.) (23420 octal)	Dead tributary. This parameter specifies the interval between polls for dead tributaries. This global parameter applies only to multipoint control stations.
POLL DELAY	237	16	0 (no delay)	This parameter provides for a fixed delay between polls for all tributaries in a network. If the default is accepted, the next poll for any tributary will occur immediately following completion of the current poll.

Previous steps have covered specifying user-defined TSS and GSS parameters (see Table 4-1 and 4-2) at the control station. The two steps listed below cover the parameter specifying process at the tributary stations:

1. Issue a series of control commands at each tributary station to set the maximum transmitted message count (MXMC) for each assigned TSS at a tributary station. Note that the 8-bit value for MXMC must be placed in BSEL5 of each command (the tributary station DMP11 ignores BSEL4 in these commands). The procedure for determining the best value for this parameter for tributary stations is the same as that used for for control stations (see Section 4.4.2).

2. Issue a single control command at each tributary station to set a value for the number of sync characters (NUM SYNC) that are to precede non-abutted transmit messages. The procedure for determining the best value for this parameter for tributary stations is the same as used for control stations.

4.3.3 Protocol Operation

At this point, the DMP11 has been configured for operation in the network and is ready for protocol operation. The steps needed to start protocol operation are:

1. Place assigned tributaries in the ISTRT state by issuing one Control command having the request key request ISTRT state for each tributary address.

2. If the DMP11 is a station in a point-to-point network, one control command must be issued having the request ISTRT state request key with a tributary address of one in BSEL3.

3. The DMP11 confirms that the protocol is functional at each tributary by issuing a control response having the protocol event code for DDCMP RUN state entered, one for each control command issued.

When the protocol is running at the control station and at all tributary stations, data traffic on the network can start.

4.4 CRITERIA FOR DETERMINING USER-DEFINED PARAMETERS

User-defined TSS and GSS parameters are in two categories:

1. Polling parameters that provide for user program control over the dynamic activity of the polling algorithm end.

2. Communications line parameters that provide the user program with the ability to control data traffic over the physical communications line.

Polling parameters are described in detail in Section 5.2.3. Communications line parameters include:

1. Selection interval timer,
2. Number of sync characters,
3. Babbling tributary timer,
4. Maximum transmitted message count,
5. Streaming tributary timer, and
6. XDT preset.

The values for the selection interval timer and the number of sync characters are related as are the values for the babbling tributary timer and the maximum transmitted message count. As a result, these related parameters are described in Section 4.4.1. Setting the Selection Interval Timer and in Section 4.4.2, Setting the Babbling Tributary Timer.

4.4.1 Setting the Selection Interval Timer

The function performed by the selection interval timer at a DMP11 depends on the mode selected for that DMP11. In full-duplex, point-to-point networks, this timer is used as a reply timer for the purpose of message accountability. This timer operates as a selection interval timer when the mode for the DMP11 is one of the following:

1. A full-duplex control station,
2. A half-duplex control station, or
3. A half-duplex point-to-point station.

In this capacity, it performs the link management function as well as providing for message accountability.

Link management is the process of controlling the transmission and reception of data over networks where there are two or more transmitter/receiver devices connected to the same physical communications link. This applies to half- and full-duplex, multipoint networks as well as to half-duplex, point-to-point links. On half-duplex links, only one transmitter can be active at any time and on full-duplex links, only one tributary transmitter can be active at a time.

A station on such links can transmit when it has been selected or given the link. Link ownership is passed through use of the select flag in the DDCMP message header. Detecting a select flag in a received message allows the receiving station to transmit after message reception is completed. Sending the select flag also means that this station stops transmitting after the current message is sent.

A selection timer detects the loss of a select flag by timing the interval needed to receive the longest message from a station. A timer is started when a station is selected and reset when a valid message is received at that station. When the timer interval is exceeded at the sending station (indicating that a message was not received during the period of the timer) it is assumed that messages with the select flag set were either transmitted or received in error.

At this point, the station that sent the messages with the select flag set owns the communications line and continues transmitting as if it had received a valid select return.

The values assigned to select interval timers at stations in half-duplex point-to-point networks should be different at both stations to prevent a possible deadlock condition where both stations become synchronized in timing out. For both multipoint control stations and half-duplex, point-to-point stations, the criteria for determining the value for a select timer include such elements as:

1. Maximum message length,
2. Number of synch characters,
3. Line speed,
4. Line turnaround time, and
5. Message processing delays.

As indicated in Table 4-2, the GSS parameter number of sync characters has two defaults – one for low-speed operation (10) and one for high-speed operation (15). The functional speed range of a DMP11 is specified by the line unit high speed/low speed switch. This switch is placed in the correct position when the DMP11 is installed (see Section 2.6). In the low speed position, the DMP11 can operate at line speeds below 250K b/s. In the high speed position, the device line speed can range from 250K b/s up to 1M b/s. It is recommended that the default for the correct line speed range be taken for this parameter.

Some recommended values for a selection interval timer are detailed in Table 4-3.

The formula used to find the values listed in Table 4-3 is:

$$\frac{\text{8 bits per byte}}{\text{data rate (bits per second)}} \times \text{348 bytes per message} + \text{RTS/CTS delay} = \text{Timer (in seconds)}$$

NOTE

Most modems include an RTS/CTS delay that must be included in the computation of the value for the selection interval timer. When operating with an external (EIA) modem, the typical delay used is 150 milliseconds. The delay used when operating with the integral modem is 100 microseconds. In networks where traffic involves messages of 40 bytes or less, two RTS/CTS delays must be used. The added delay is necessary because a complete message of this length can fit into the line unit transmit silo causing the selection interval timer to be started before any characters are transmitted.

The values listed in Table 4-3 represent absolute minimums. In most events specific applications need added delay time to prevent a timeout during reception of a valid message. Requirements for added delay time can be caused by processing delays that occur when receiving from a non-DMP11 device or by line delays found with satellite stations. When determining this value, the value chosen for the selection interval timer should represent the time that the system can reasonably expend waiting for a response from another station.

When used as a reply timer, the selection interval timer sets the maximum waiting period between sending a message and receiving an acknowledgement (ACK) before taking error recovery actions. This timeout is necessary to recover from power outages and to prevent the protocol from becoming deadlocked.

The same criteria used to determine a value for a selection interval timer in multipoint networks are also used to determine a value when this timer is used as a reply timer. As shown in Table 4-3, the default value for both uses is 3 seconds.

Table 4-3 Recommended Selection Interval Timer Values

Bits Per Second	Computed Timer Value for a 256-Byte Message	
4800	580 ms + 150 ms = 730 ms	→ 800 ms
9600	290 ms + 150 ms = 440 ms	→ 500 ms
56K	49.7 ms + 0.1 ms = 49.8 ms	→ 50 ms
250K	11.1 ms + 0.1 ms = 11.2 ms	→ 12 ms

The figures shown in Table 4-3 include the following overhead elements:

256 bytes of data.
28 bytes of header, sync, and pad characters.
64 bytes of extra overhead to allow for the emptying of the transmit silo.

Total 348 bytes

4.4.2 Setting the Babbling Tributary Timer

This user parameter is compatible with half-duplex and full-duplex, multipoint network control stations. A babbling tributary is a tributary that continues to transmit valid DDCMP messages after an implementation dependent timeout, thereby taking control of the communications line and denying equal access to other tributaries in the network. This situation is controlled by the babbling tributary timer which monitors the total time a tributary continuously transmits without giving up the communications line. When this period exceeds the timeout period of the babbling tributary timer, the user program is informed through a control response having the code for a babbling tributary and the identification of the offending tributary. When a babbling tributary is detected, the control station takes no action beyond this indication.

A main consideration in determining a value for the babbling tributary timer is the total time interval that a given tributary will need to end a selection interval. Determining the value for this timer is similar to that for the selection interval timer in that the same range of elements are used as criteria for computing the value. The main difference in the two decisions is that the total number of message bytes should be used in babbling tributary timer parameter computations rather than the number of bytes in the longest message.

A value for the maximum transmitted message count parameter must also be considered with the parameter for the babbling tributary timer. The user-defined parameter to set this counter places a limit on the number of messages that a tributary can transmit during the period of the selection interval counter. This is done by forcing the select flag (terminating the selection interval) when the count of messages sent by a tributary equals the setting of the maximum transmitted message count. This count relieves the user program from having to limit the number of messages queued for transmission in order to avoid a babbling tributary condition.

In any event, the period set for the timeout of a babbling tributary timer should be long enough to be certain that timer expiration indicates a definite error condition. In addition, the parameter assigned to the maximum transmitted message count should also be considered when setting the period of the babbling tributary counter.

4.4.3 Setting the Streaming Tributary Timer

A streaming tributary is a tributary station on a multipoint line (or point-to-point station) that continues to assert the carrier signal on the link after it has given up the link. In normal operation, the link is returned to the control station when it receives a select flag or when the period of the selection interval timer is exceeded. A timeout of the streaming tributary timer indicates a potential jamming of the link by a defective tributary station, a defective point-to-point station, or a malfunctioning modem.

The streaming tributary timer is started when the link is returned to the control station by the remote station and stopped when the carrier is dropped by that station. When a streaming tributary is detected, when the streaming tributary timer expires, the user program is informed in the same manner as a babbling tributary. No further action is taken by the control station DMP11.

Determining a value for the streaming tributary timer needs consideration of such elements as modem delays and settling time of the communications line. As with determining periods for the selection interval timer and the babbling tributary timer, the period specified for this timer should be long enough to prevent an early running out of the timer. For most network applications the default of one second will be enough.

4.4.4 Criteria for Determining a Value for XDT Preset

This user-defined parameter provides for a fixed delay between the transmission of each data or maintenance message from the control station to a tributary, causing data and maintenance message traffic delays in one direction only. It has no effect on the polling rate for a tributary when the tributary is polled using DDCMP control messages. DDCMP control messages are not subject to the XDT preset delay, and tributaries usually respond immediately to a poll.

This delay is valuable in states where the remote station is a character-interrupt device (such as a DUP11) needing added processing time between receive messages or where the remote station has limited receive buffer resources.

NOTE

When selecting a value for this parameter, the user should consider that this delay timer is incremented by the value of the user-defined parameter DELTA T, not by the system clock (a one millisecond timer).

The default value for this parameter is zero.

4.5 ERROR COUNTER ACCESS

As described in Section 5.3, the DMP11 has a large complement of error counters designed to isolate a wide range of error conditions. The TSS for each assigned tributary has seven error counters with three statistical counters that provide background information for error analysis. In addition, the GSS at each station has four error counters that tabulate global errors. The three TSS statistical counters are 16 bits long, and the threshold error counters are three bits long. The rest of the TSS/GSS error counters are eight bits long.

4.5.1 Reading the Counters

Both TSS and GSS counters are accessed through the correct control command. The contents of the counter or counters returned through an information response (see Sections 3.3.3 and 3.4.3). Through the control command, the user program has the option of either reading or both reading and clearing the counters. When doing error analysis, it is recommended that a user program read and clear these counters to be certain of a zero-base for sampling of the counters. If copies of the counters are maintained in main memory, it is also recommended that counters be read and cleared.

NOTE

The three-bit threshold error counters are automatically reset when the maximum count is reached. Access to these counters is limited to reading only (see Section 5.3.1.2).

The DMP11 error and statistical counter structure is designed to be a complete unit. As an example of this structure, consider the data errors inbound counter and the data messages received statistical counter. The data errors inbound counter tabulates the errors related to the validity of message reception such as block check errors. The data messages received counter records the total number of messages received. A ratio of message reception errors to total number of messages received can be taken from these two counters.

4.5.2 Counter Skew

When performing error analysis, there is a potential of skew between counts because of read time delays and the requirement that counters be read one at a time. The chance of skew between counts is a function of line speed: the higher the line speed, the greater the probability of a skew condition. An example of this potential skewing is the possible difference between the number of selection intervals and the number of selection timeouts. A skew can result from added selection timeouts occurring while the counters are being read.

If there is a requirement that error/statistical counters be read without the potential for skew, this can be done by halting the protocol at the tributary. With the protocol halted, the contents of the error/statistical counters in a TSS and in the GSS are frozen at the counts recorded when the protocol was halted. The counters can then be read without the problem of skew because of read time delays.

4.6 ERROR RECOVERY PROCEDURES

Within a DMP11-implemented network, there are three basic levels of error recovery including the user program:

1. Procedural violations where the user program is only informed.
2. Recovery from errors that ask the user program to initiate protocol shutdown.
3. Fatal errors resulting in system shutdown with a minimum of notice to the user program.

As shown in Table 3-8, procedural error codes from 100 to 140 are reported to the user program with no recovery needed. The last two procedural errors (codes 300 and 302) include error recovery levels two and three. All network errors need recovery through protocol shutdown. However, after receiving the control response, queue overflow can result in a network shutdown (see Table 3-7).

4.6.1 Recovery from Network Errors

In order to recover from network errors, the protocol must be halted at the tributary or station recording the error. Two similar but separate procedures are recommended for recovery from threshold errors and babbling and streaming tributary errors. These recovery procedures are described in the sections that follow.

4.6.1.1 Recovery from Threshold Errors – DMP11 threshold errors are detailed in Section 3.4.2.3. and 5.3.1.2. The recommended recovery procedure that should be started by the user program at the station recording the errors is listed below:

1. Halt the protocol (see Section 3.3.3.1).
2. Read the error counters to determine the type and cause of the threshold error condition. If the error results from a lack of receive buffers, correct the condition. If the transmit or selection threshold is exceeded, check the functional condition of the remote station.
3. When the conditions causing the errors are cleared, restart the protocol (see Section 4.3.3).

4.6.1.2 Recovery from Babbling and Streaming Tributary Errors – These errors result when the user-defined parameter (or default) specifying the period of the correct timer is exceeded. Therefore, a time-out can result from an actual error condition or from the period of the timer being too short for the type of message activity on the line (see Sections 4.4.2 and 4.4.3). A recommended recovery procedure to be used when finding these conditions is:

1. Halt the protocol (see Section 3.3.3.1).
2. Check the value of the timer parameters and increase if the value is not correct.
3. Restart the protocol (see Section 4.3.3).
4. If this error condition continues, reconfigure the station as specified by Section 4.3.1.
5. When the cause of the timeout is at the remotestation, action must be taken at the remote station to determine and correct the fault. The local station is at fault only if the values of the timer parameters are not correct.

4.6.2 Recovery from Procedural Errors

The two procedural errors that need a recovery procedure are:

1. Non-existent memory error, and
2. Buffer too small error.

The recovery procedure for each of these errors is detailed in the sections that follow.

4.6.2.1 Recovery from a Non-Existent Memory Error – Non-existent memory errors occur when the DMP11 tries to access an allocated receive or transmit buffer having an invalid UNIBUS address. When this error is detected, the DMP11 sends a control response to the user program with the invalid address (see Section 3.4.2.4). It is up to the user program to determine whether the non-existent address is in a transmit or receive buffer.

NOTE
Depending on microcode processing situations, the non-existent memory address returned to the user program could have been incremented to the next sequential location.

The recommended recovery procedure for this error is as follows:

1. Halt the protocol for the tributary or station that records this error in order to start the return of all outstanding buffers (see Section 3.3.3.1).

2. If the error is in a buffer from the common pool, the user program should issue the global halt command to start the return of all outstanding receive buffers from the common pool.

3. Restart the protocol and reallocate buffers as necessary. If this error occurs again, a possible main CPU or DMP11 malfunction may be present.

NOTE
If the network line speed is more than 56K b/s, the requests for retransmission generated by a non-existent memory address can result in the overflow of the DMP11 response queue causing a fatal system error (see Section 4.6.2.3).

4.6.2.2 Recovery from a Receive Buffer too Small Error – When the DMP11 receives a message, it first checks to see if a buffer from the common buffer pool linked list is available. If one is available, it uses that buffer. If the common buffer pool is empty, has a quota of zero, or is not enabled, the private buffer linked list is checked. If a private buffer is not available, the receiving station NAKs the incoming message. The steps taken by the DMP11 microcode in this process are listed below:

1. Is the message number in sequence? Yes, continue; no, ignore message.

2. Is the common buffer pool enabled? Yes, continue; no, go to step 6.

3. Does the common buffer pool quota = 0? Yes, go to step 6; no, continue.

4. Is a common pool buffer available? Yes, continue; no, go to step 6.

5. Is the common pool buffer too small? Yes, go to step 8; no, use this buffer.

6. Is a private buffer available? Yes, continue; no send NAK – buffer temporarily not available.

7. Is private buffer too small? Yes, send NAK – buffer too small; no, use this buffer.

8. Is private buffer available? Yes, go to step 7; no, send NAK – buffer too small.

NOTE
The DMP11 does not scan the common pool or private linked list structures looking for a buffer of acceptable size. Instead, it uses the next available buffer from the list.

Buffer too small errors apply only to receive buffers. The procedure for recovery from this error depends on whether the allocated buffer is from the common pool or is a private buffer. The recovery procedures are detailed below:

A. Common pool buffer too small:

   1. Assign a private buffer of acceptable size to the receiving tributary through a buffer address/character count command (see Section 3.3.4).

B. Both private and common pool buffers too small:

   1. Halt the protocol for the affected tributary in order to start the return of all outstanding private buffers.

   2. Restart the protocol.

   3. Assign a private buffer of acceptable size to the receiving tributary through a buffer address/character count command (see Section 3.3.4).

C. Private buffer too small and common pool not enabled

   1. If buffers from the common pool are available to other tributaries and are of acceptable size, enable common pool buffers for this tributary (see Section 3.3.3).

   2. If the common buffer pool is not in use for other tributaries, follow recovery procedure B.

4.6.2.3 Recovery from a Queue Overflow Error – This error is always fatal to the DMP11 that recorded the error because it forces automatic shutdown of the device. The basic cause of this error is that the link blocks from the free linked list are not available (see Section 5.4.1.1). Usually, this error results when the internal response queue overflows because the DMP11 generates responses faster than the user program can recover responses from the queue. This error can also occur if a large number of receive buffers are allocated. An example of the cause of the response queue running over is the occurrence of continuous running over non-existent memory errors in high-speed networks (see Section 4.6.2.1).

When this error occurs, the DMP11 lists the most current entry in the response queue to the user program. The user program then has three seconds after being interrupted to read the response. If it is read during this three-second interval, the next response is listed, and the user program again has three seconds to read the next response. As long as the user program reads each response within three seconds, the process can continue until the internal response queue is empty. These responses can then be studied to determine the cause of the queue overflow.

After the last response is listed, or the three-second response period ends, the DMP11 shuts itself down. At this point, to return the DMP11 to functional status, the startup procedure must be started from the beginning (see Section 4.3).

4.7 BOOTING A REMOTE STATION

DMP11-implemented networks provide the user program at the multipoint control station or point-to-point station with the ability to boot the main CPU at a remote station that has been shutdown because of a power outage or software malfunction. There are three ways this boot function can be performed:

1. Remote load detect: the control station starts the primary maintenance operation protocol (MOP) boot procedure for a remote station. See Section 1.7 for the name, version, and order number of the MOP specification.

2. Power on boot: the first poll received after power-up at the remote station causes the DMP11 at that station to ask the control station to start the primary MOP boot procedure.

3. Invoke primary MOP: the user program at the remote station causes, the DMP11 to ask that the control station start the primary MOP boot procedure.

NOTE

These procedures apply only to tributary stations in PDP-11-based multipoint networks and to one node in a PDP-11-based point-to-point link. VAX-11 systems cannot be booted using these DMP11 procedures.

Primary MOP boot procedures need the DMP11 line unit switch-configured in the way specified in this section. The steps taking place at the remote station and over the communications line leading to each of the three primary MOP boot functions are shown in the sections that follow.

4.7.1 Steps Leading to a Remote Load Detect Boot

The steps taking place at the remote DMP11 and the host PDP-11 in response to an Enter MOP Mode message from the control station are:

1. The DMP11 NPRs a tight loop routine into main memory.

2. The DMP11 transfers control to the routine through the ac low vector. This routine removes the CPU from the active state to prevent any intervention during the NPR process.

3. The DMP11 then sends a primary MOP Request program message to the control station. The control station responds in turn with a primary MOP Memory load with transfer address message with the boot or related program to be loaded into the remote station main memory.

4. The DMP11 NPRs that program into main memory and starts executing the program.

5. At this point, the remote station is operating in the way planned by the down-line loaded program.

The steps occurring over the communications line during a remote load detect boot are:

1. The control station sends an enter MOP mode message to a remote tributary station.

2. The remote station identifies the address and password in the message and then removes the main CPU from the active state.

3. The remote station then responds with a primary MOP request program message.

4. The control station responds to this message with a primary MOP memory load with transfer address message having the boot or related program to be loaded into the host PDP-11 at the remote station.

4.7.2 Steps Leading to a Power On Boot

When power is restored after a shutdown at a remote station, the DMP11 performs the same steps performed during a remote load detect boot. However, the first two steps performed over the communications line are omitted and the tributary station responds to the first poll from the control station with a MOP mode request program message, the tributary station then continues the same sequence used in the remote load detect boot procedure.

4.7.3 Steps Leading to an Invoke Primary MOP Boot

This boot operation starts when a user at a tributary or point-to-point station sets the boot and master clear bits in the DMP11 initialization register (see Section 3.3.1.1). The steps taken by the DMP11 are the same as with a power-on boot.

4.7.4 Line Unit Switch Settings for the Boot Functions

At remote stations in networks supporting the primary MOP boot functions, the line unit switches must be configured in a specific way to correctly perform the boot functions (see Section 2.6).

NOTE

The switch setting procedures described below apply only to tributary stations in a multipoint network and to one node in a point-to-point network.

The four-bit unit number of each DMP11 must be set in the line unit switches. This unit number allows the boot program, once loaded into the host PDP-11, to identify the specific DMP11 that is booting. The line unit number is placed in switch pack E121 with switch number 1 the LSB and switch number 4 the MSB.

As described in Section 3.3.2, the operating mode of a DMP11 can be created through the mode definition command or by specific settings of the line unit switches.

NOTE

When primary MOP booting is supported in a network, the operating mode of each tributary station must be set in the line unit switches instead of through the mode definition command.

The operating mode of a DMP11 is specified by setting the mode enable switch, switch number 8 of switch pack E121, to one (OFF) and by setting switch numbers 5, 6, and 7 of switch pack E121 to the needed operating mode. The settings for these line unit switches are listed in Table 4-4.

4.7.4.1 Switch Settings for the Power On Boot Function – To enable the power on boot function at a remote tributary station, switch number 10 of the line unit switch pack E121 (power-on-boot) must be set to zero (ON). In addition, the tributary address of this station must be set into line unit switch pack E134. For the tributary address, switch number 1 is the LSB and switch number 8 is the MSB. If the mode is point-to-point, the address switches can be ignored.

4.7.4.2 Switch Settings for the Invoke Primary MOP Boot Function – Line unit switch settings for the invoke primary MOP boot function are exactly the same as those for the power-on boot function. To perform this boot function, the user program at the remote station must set the boot and master clear bits in the DMP11 initialization register (see Section 3.3.1.1).

4.7.4.3 Switch Settings for the Remote Load Detect Boot Function – To enable the remote load detect boot function at a remote tributary station, switch number 9 of line unit switch pack E121 (remote load detect) must be set to one (OFF). For the remote load detect boot function, the switch-assigned tributary address, which is included in the enter MOP mode message, also serves as the password. When using the remote load detect boot function in point-to-point networks, the line unit tributary address switches, for protection purposes, can be set to a unique value because the address of a point-to-point node is always one.

Table 4-4 Mode Switch Settings

Mode Switches	Line Characteristics	Network Configuration	DMC11 Line Compatibility
5 6 7			
ON ON ON	Half-Duplex	Point-to-Point	Yes
OFF ON ON	Full-Duplex	Point-to-Point	Yes
ON OFF ON	Half-Duplex	Point-to-Point	No
OFF OFF ON	Full-Duplex	Point-to-point	No
ON ON OFF	Half-Duplex	Multipoint Control Station	N/A
OFF ON OFF	Full-Duplex	Multipoint Control Station	N/A
ON OFF OFF	Half-Duplex	Multipoint Tributary Station	N/A
OFF OFF OFF	Full-Duplex	Multipoint Tributary Station	N/A

CHAPTER 5
ASPECTS OF DMP11
MICROCODE OPERATION

5.1 INTRODUCTION
There are a number of aspects of the DMP11 microcode operation that interface with a user program and must be carefully considered in the design and operation of such a program. These include:

1. Operation and use of the dynamic polling algorithm,

2. Error and statistical information recorded by the DMP11 microcode for user analysis, and

3. Structure of the DMP11 internal data base.

Each of these is detailed in the sections that follow.

5.2 DMP11 DYNAMIC POLLING ALGORITHM
In multipoint networks implemented by two or more DMP11 intelligent communications line controllers, polling frequency and priority for each assigned tributary are determined automatically by the microcode polling algorithm and applied dynamically. The polling algorithm uses the following information to determine these elements:

1. A tributary's poll response history,
2. A tributary's user-defined parameters, and
3. A tributary's protocol state.

The multipoint network control station polls all assigned tributaries that are not in the DDCMP halt state. The protocol state of every assigned tributary is maintained in the TSS by the control station. When a tributary is available for polling, all transmit messages for that tributary are sent as the poll, up to the limit set by the maximum transmitted message count. If no transmit messages are available for a tributary, the DMP11 automatically transmits the correct DDCMP control message.

The DMP11 polling algorithm determines which tributary is to be polled next, based on each tributary's polling urgency level. The DMP11 polling algorithm uses the user-defined TSS and GSS polling parameters for categorizing tributaries into polling levels and determining the rate at which polling urgency is increased within each polling level. A tributary's polling level is based on its response history. This classification device, combined with a regular incrementing of polling urgency, results in the most active tributaries being polled most often.

5.2.1 Polling States
As indicated in Section 3.3.3, the control station maintains the poll response history for a tributary by continuously monitoring its polling activity and assigning it to a state correct to its response rate. These states are:

1. Active – the polling algorithm maintains a tributary as active when it responds to polls with data messages.

2. Inactive – the polling state of an active tributary changes to inactive when it responds to a consecutive number of polls with non-data DDCMP messages. The count of consecutive non-data messages received from a tributary in the active state is defined by the user-defined parameter NDM-INACT (number of no-data messages needed to go inactive).

3. Unresponsive – a tributary, either active or inactive, is placed in the unresponsive state when it fails to respond in any way to a consecutive number of polls. (Each poll results in a selection timeout.) The count of consecutive polls without responses is defined by the user-defined parameter TO-UNRESP (number of timeouts to go unresponsive).

4. Dead – an unresponsive tributary continues to be unresponsive to consecutive polls until the number of selection interval timeouts defined by the user-defined parameter TO-DEAD (number of timeouts to go dead) is exceeded. Different from tributaries in the other polling states, dead tributaries are always polled on a round-robin basis with the period between polls determined by the user-defined global parameter DEAD-T (dead timer).

When specifying the parameters controlling polling levels, the user has the option of accepting the defaults (see Table 4-3 and 4-4) or selecting specific values in place of these defaults. As described in Section 3.3.3.1, the user program can set the polling state of a tributary to any state at any time by issuing a latch polling state control command. The polling state set by a control command stays in effect, regardless of tributary performance, until polling control is given back to the polling algorithm by the user program. This is done by issuing an unlatch polling state control command.

Figure 5-1 shows a state diagram describing the changes between polling states. The actual changes depend on the particular polling parameters (see Section 4.3.2).

NOTE

A tributary in the inactive, unresponsive, or dead polling state is immediately returned to the active state when it responds to a poll with a valid data message or when the user program allocates a transmit buffer to that tributary.

5.2.2 Computation of Urgency

Computation of a tributary's urgency is based on three user-defined polling parameters:

1. Q – the starting value of polling urgency (U) for a tributary,

2. R – the rate by which urgency (U) is increased for a tributary, and

3. DELTA T – the polling algorithm global update interval

Figure 5-2 graphs the relation between these three parameters. This graph shows the effect of Q = 0, R = 6, and DELTA T = 50 ms for a tributary. Figure 5-2 shows that the value of the urgency (U) axis ranges from zero to 255. In addition, three base lines are shown having values for U of 127, 128, and 255. The values of these base lines have the following meaning:

1. Zero to 127 – A tributary with an urgency in this range is never polled until its value of U reaches 128.

2. 128 – This is the threshold level at which a tributary becomes acceptable for polling.

3. 129 to 254 – The tributary is available for polling when in this range. Within a group of tributaries the tributary to be polled next is the tributary with the highest value of U.

4. 255 – This value of U represents the highest polling urgency. A group of tributaries all having the maximum value of U would be polled on a round-robin basis.

During each DELTA T time period, the control station polling algorithm updates the urgency of each functional tributary by adding the value of R for the correct polling state (dead) to the urgency value of each tributary. This updating sequence is performed on the TSS data base in the order in which tributaries were created at the control station. When the polling algorithm determines that the next poll is to be sent, it selects the tributary to be polled by scanning the TSS data base (in the order the tributaries were assigned starting at the TSS following the last tributary polled. In this process, the tributary with the highest value of U from among active, inactive, and unresponsive tributaries is selected as the next tributary to be polled.

If an urgency of 255 is detected during the process of scanning the TSS data base for the tributary with the highest value of U, the scan process halts and that tributary is immediately selected for polling. Once the selected tributary is polled, its urgency goes back to the assigned value of Q for its polling level.

As previously stated, dead tributaries are polled at a rate determined by the user-defined parameter DEAD T. One dead tributary is polled at each running out of the DEAD T timer, and the scan of dead tributaries is resumed from the last dead tributary polled.

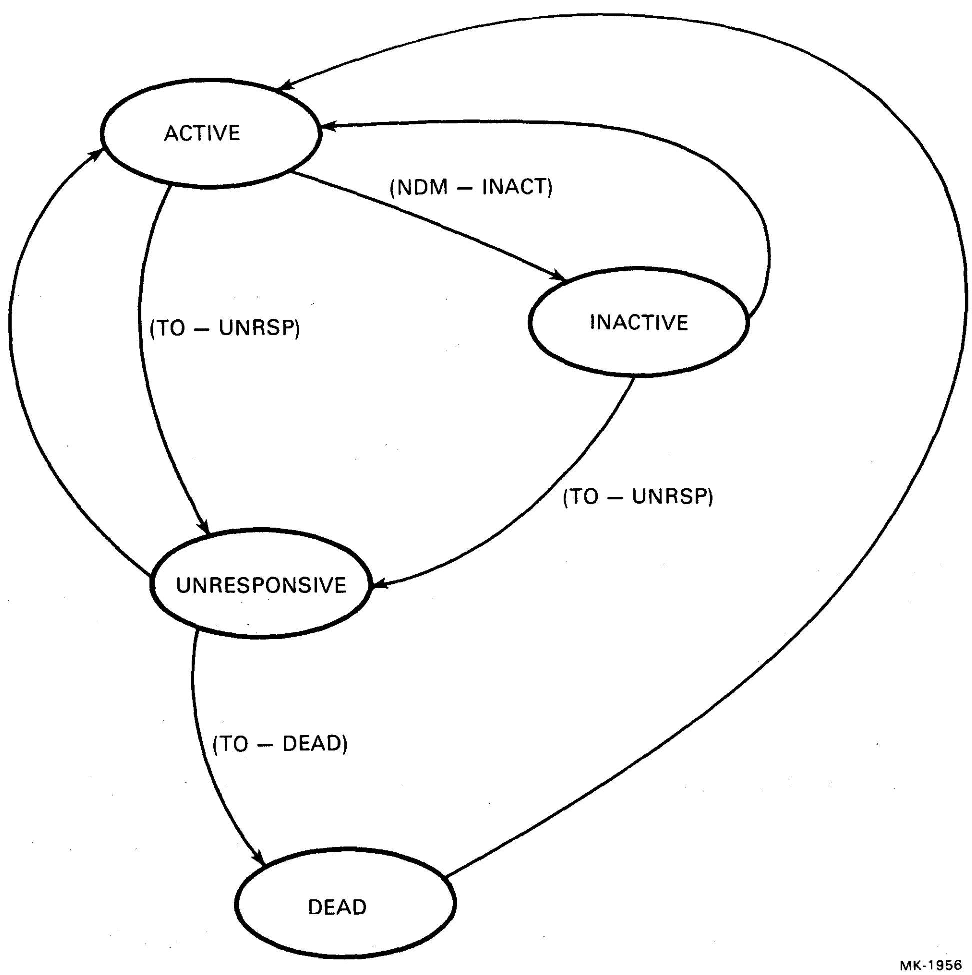


Figure 5-1 State Diagram of Polling State Transitions

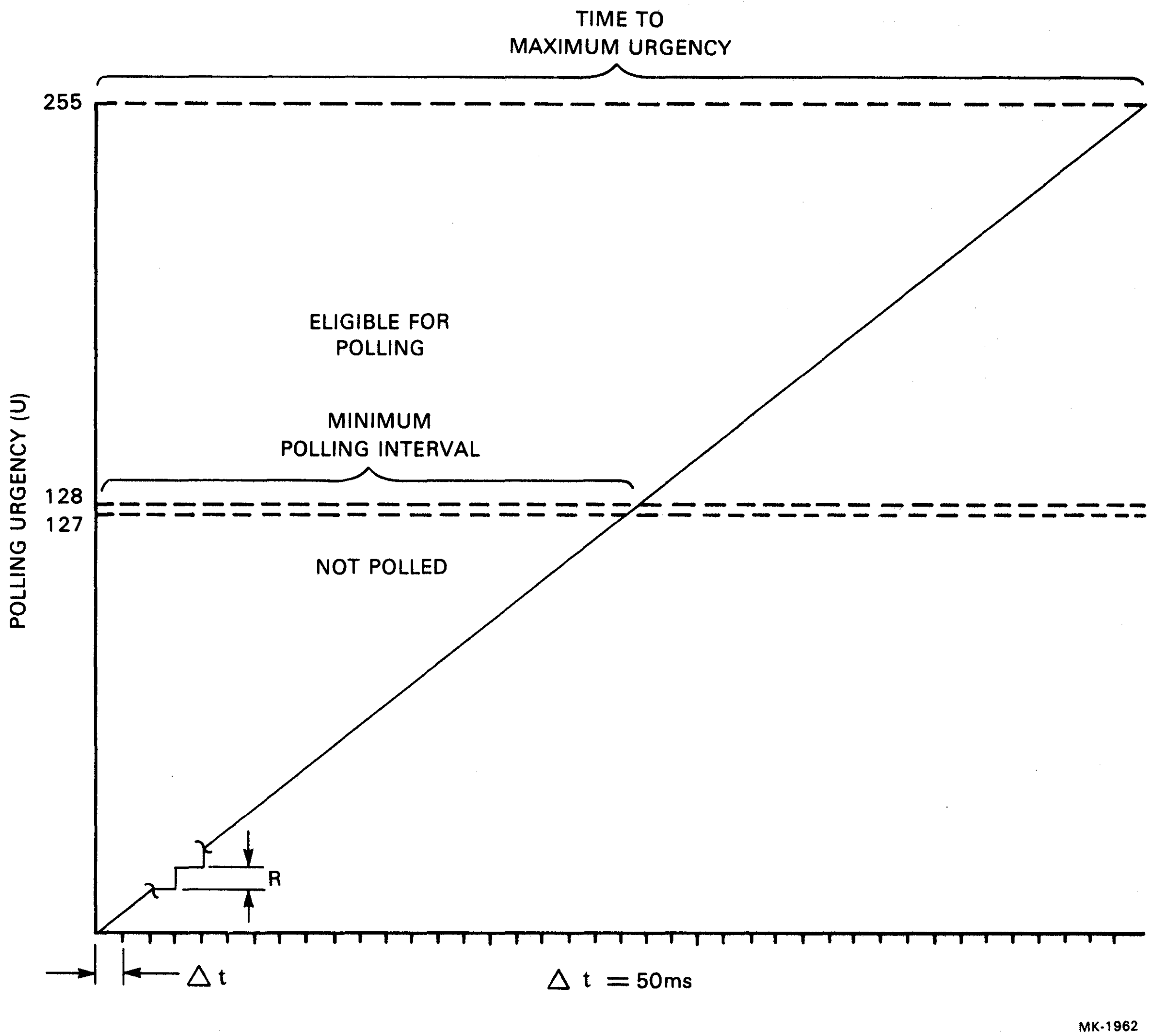


Figure 5-2 Relationship Between Polling Parameters Q, R, and Delta T

5.2.3 Criteria for Determining Polling Parameters

Although there are no absolute rules for determining specific values for the polling parameters, there are general rules that provide a basis for getting acceptable values for these parameters. The user-defined polling parameters include the following:

1. DELTA T – the GSS parameter for specifying the rate of urgency updating.

2. Q and R – the TSS parameters used in the computation of polling urgency.

3. POLL DELAY – the GSS parameter that specifies the delay to be used between sequential polls.

4. DEAD T – the GSS parameter that specifies polling rate for dead tributaries.

Details for determining the values of these parameters are described in the sections that follow.

5.2.3.1 Criteria for Determining DELTA T – The 50 ms default value for DELTA T provides for minimum polling intervals which range from 50 ms (Q = 0, R = the threshold value 128) to 6.4 seconds (Q = 0, r = 1). The default value of 50 ms is the smallest acceptable value for DELTA T and represents the actual time needed for the polling algorithm to update the urgencies of 32 tributaries.

NOTE

The minimum polling interval defines the time needed for a tributary to reach the urgency threshold value of 128 and is the absolute minimum time period needed to become acceptable for polling. The maximum polling interval for a tributary cannot be determined because it is a function of such variables as line speed, message traffic, the number of tributaries in a network, and the polling states of those tributaries. In addition, these variables prevent the determining of the point in time at which any tributary in a network will be polled.

For almost all multipoint network applications, the default value of 50 ms for DELTA T is not enough. However, in specific instances (for example, a network formed by low traffic devices), a higher value of DELTA T may be recommended.

5.2.3.2 Criteria for Determining Values of Q and R – For a given value of DELTA T, the minimum polling interval is a function of the user-defined parameters Q and R. For example, if a minimum polling interval of 0.8 second is needed for a tributary (assuming a DELTA T of 50 ms), the parameters Q = 0 and R = 8 fills this requirement (see Figure 5-3). As shown in Figure 5-3, the time to reach maximum polling urgency for these values of Q and R is 1.6 seconds. Figure 5-3 also shows that for R = 4, the value of Q = 64 causes the minimum polling interval to stay at 0.8 second, but needs a correspondingly longer time (2.4 seconds) to reach maximum polling urgency.

NOTE

Reaching maximum polling urgency does not guarantee that a tributary will be polled. Instead, it represents maximum acceptance for polling.

When determining values of Q and R for tributaries in a multipoint network, a minimum polling interval and a time to maximum urgency must be determined for each tributary in each of the polling states (active, inactive, and unresponsive). In each state, these values are a function of the total amount of data traffic expected from a tributary while in a specific polling state. The primary goal when determining the values of Q and R for each tributary should be to make sure that the tributary having the most regular data message response rate during past polling activity will be the tributary most often polled.

Default values for the parameters Q and R are based on line speeds in the one megabyte range. The characteristics of the defaults are very short minimum polling intervals (0 to 0.3 second) and times to maximum urgency (50 ms to 0.65 second).

Figure 5-4 graphs the relationship between the default values of Q and R for each of the three polling states. When all tributaries in a network have the default value for Q and R and all tributaries are in the active polling state, polling is round-robin.

5.2.3.3 Determining a Value for Poll Delay – The user-defined global parameter, poll delay sets a fixed delay between control station polls, providing a device for message traffic without changing the values of Q and R for individual tributaries. During this delay, transmission from the control station to

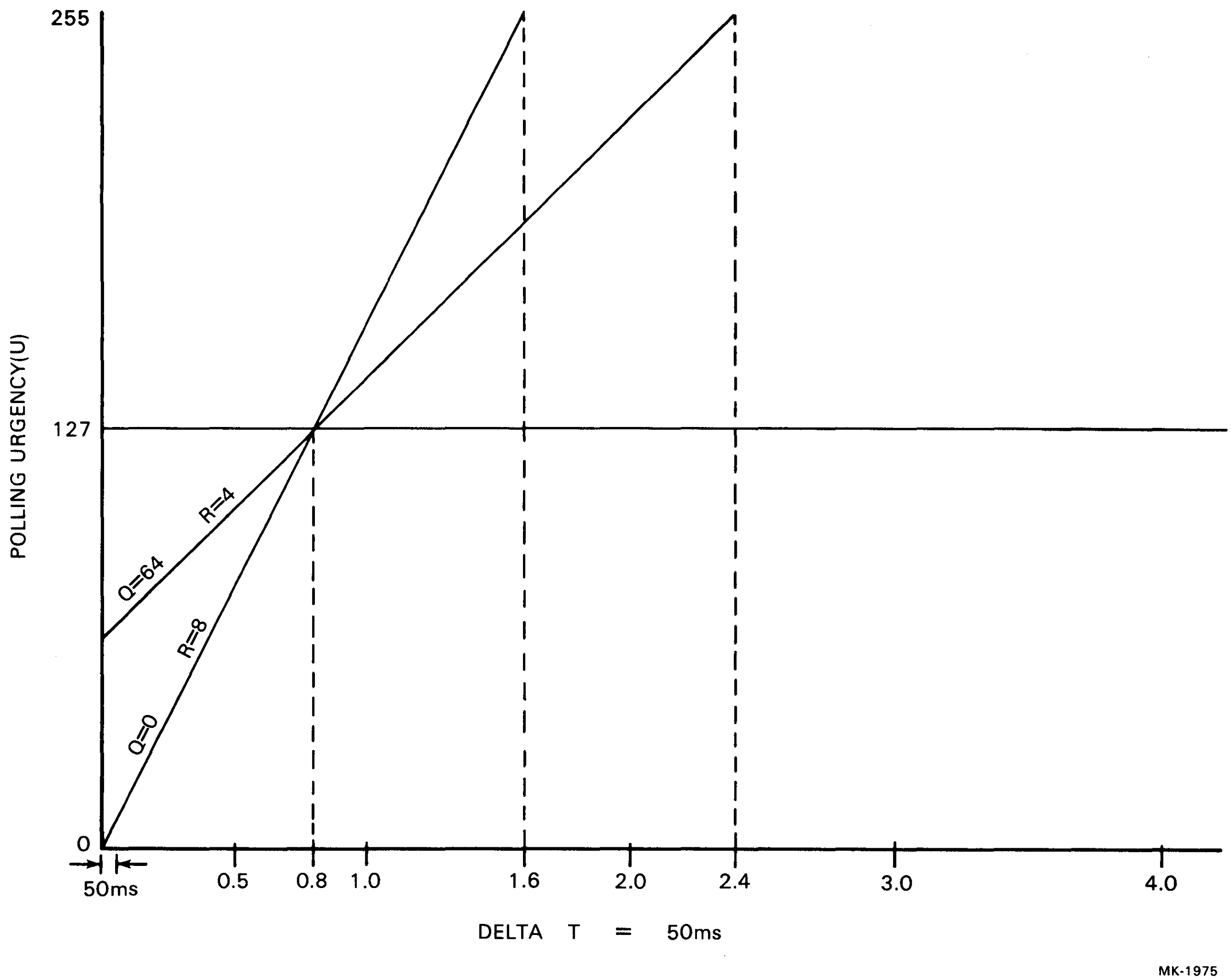


Figure 5-3 Relationship Between Polling Parameters Q, R, and the Minimum Polling Interval

tributary stations is halted for the interval defined by the poll delay timer. This interval starts when the tributary polled deselects itself.

The ability to control message traffic through a single parameter is valuable in multipoint networks where DMP11s are configured together with slower character interrupt communication devices, such as the DUP11. The value selected for poll delay in these instances is a function of character handling rates of the non-DMP11 devices.

In remote multipoint networks where the distance between the control station and each differs tributary station differs significantly, the resulting differences in communication line settling time can increase transmission and reception errors. In such instances, the settling time for the most distance tributary station should be used for determining a value for this parameter.

For DMP11-implemented, high-speed, local networks, this parameter is not necessary. In such instances, the default value for POLL DELAY, which is zero, should be accepted.

5.2.3.4 Determining a Value for DEAD T – This global parameter (which is the period of the dead tributary timer) sets the rate at which dead tributaries are polled. Dead tributaries are polled on a round-robin basis, with one tributary polled at each termination of the dead tributary timer.

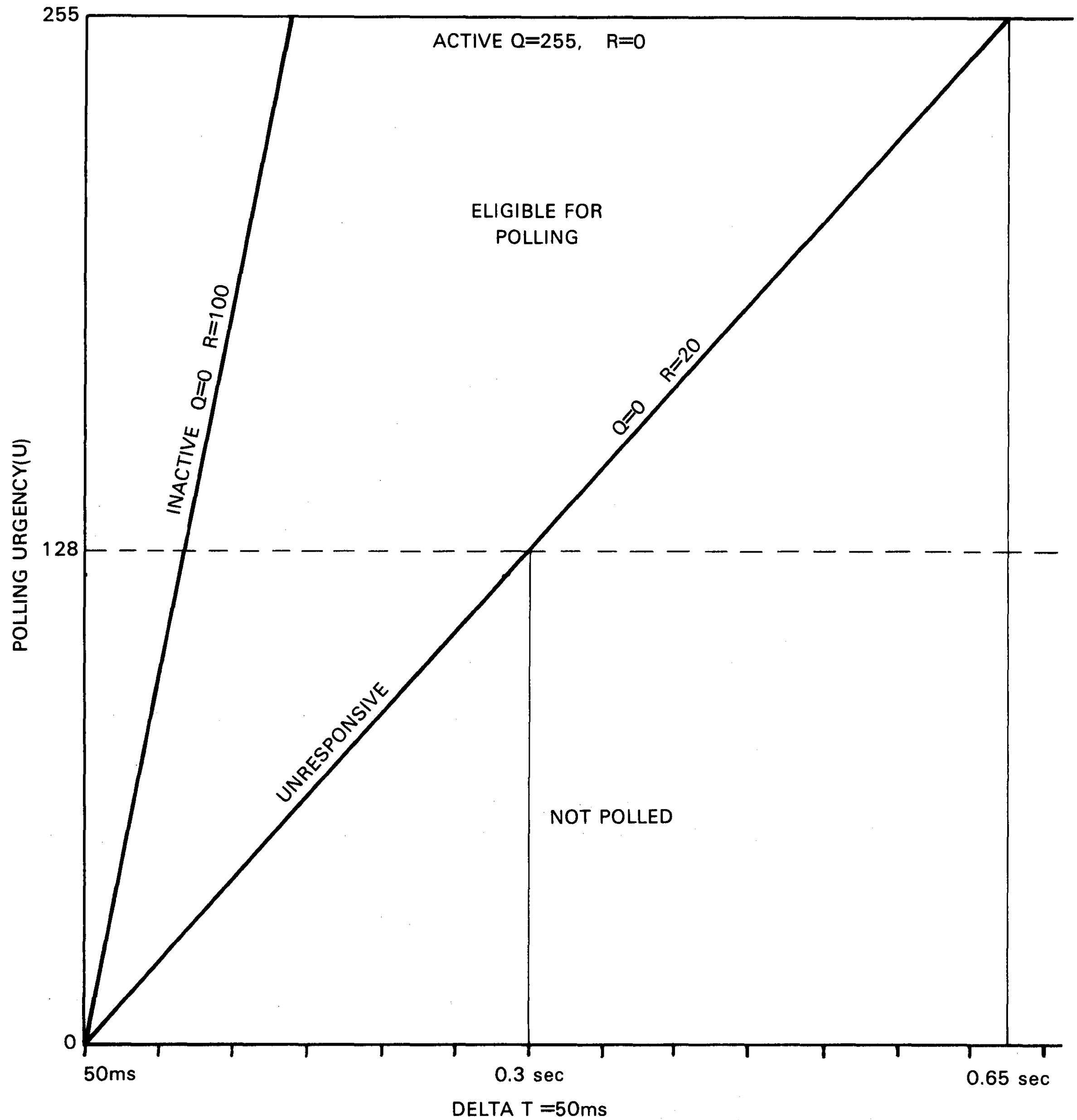


Figure 5-4 Relationship Between the Default Values for Q and R for the Three Polling Levels

Polling dead tributaries can include a significant impact on network line use. In general, the shorter the period of this timer, the larger the impact on line use. Also, for a given value of DEAD T, the impact on line use will drop as system line speed increases. In determining a value for this parameter, the primary goal should be to limit the impact of dead tributary polling on network line use.

Although the best rate of dead tributary polling will differ from application to application, the value determined for DEAD T should be based on the period of the selection interval timer for the specific application. For example, if the period of the dead tributary timer is equal to that of the selection interval timer, only dead tributaries are polled. For most system applications, it is recommended that the period of the dead tributary timer be three to 10 times larger that of the selection interval timer, depending on system line speed. The default value for DEAD T is 10 seconds. This is approximately three times larger than the default value for the selection interval timer.

5.3 ERROR RECORDING

Error recording by the DMP11 is based on the use of a standard set of DDCMP counters built so that specific subsets of these counters apply directly to the cause of specific error conditions. The complete set of counters include counters specific to tributary error conditions, counters for recording global errors, and counters that provide a statistical base for conducting error analysis.

In a multipoint network, errors are recorded by these counters at the control station for all assigned tributaries in the network. Identical sets of counters are maintained at tributary stations, one set for each tributary assigned at a station. As a result, user programs at any DMP11 in a network can detect a malfunction and determine total error rates by accessing the correct TSS error counters.

When a station detects an error in a received message, it updates the counter and transmits a DDCMP negative acknowledge message (NAK) to the transmitting station to inform it of the error. A NAK has tributary address and reason code fields that identify the source and the reason for the NAK.

In general, NAKs are sent by data receivers to data senders when the data message transmitted by the sender was received in error. By recording both NAKs sent and received, each station in a network is capable of compiling error statistics on its tributaries. For more detail on NAKs, NAK reason codes, and DDCMP message types, see Appendix A.

5.3.1 Error Counter Structures

There are three types of error counters maintained by the DMP11:

1. Data link error counters – These counters record errors about the physical communications line on a control/tributary station pair basis.

2. Threshold error counters – These counters record the presence of continuous errors that are reported when a specific threshold has been exceeded. These counters also apply to a control/tributary station pair.

3. Station error counters – These global counters record errors specific to the physical communications line.

Statistical information is recorded for each tributary for use in studying error counts. Three counters provide this information:

1. Data messages transmitted counter,
2. Data messages received counter, and
3. Selection interval counter.

Figure 5-5 shows a map of both error and statistical counters as they appear in a TSS structure. Figure 5-5 shows that certain counters report a classification of errors of a single type of error and that flags for these counters record the occurrence of the specific errors within the class. Each of these counters can be considered a group counter that records each occurrence of the errors defined by the flags. The function of the flags is to provide an indication of the type of errors recorded by the group counter. Through the use of sampling methods (for example, reading and clearing a group counter and flags at a specific frequency) it is possible to solve errors recorded by the group counter to a specific error type within the class.

Reading or reading and clearing a counter is done through the read and read and clear TSS/GSS control commands (see Section 3.3.3.1). These commands access the TSS/GSS locations shown in Figures 5-5 and 5-6 on word boundaries only. The content of the TSS/GSS location is returned to the user program through an information response (see Section 3.4.3).

TRIBUTARY STATUS SLOT (TSS) ADDRESS (OCTAL)				
5	RESERVED			
	RECEIVE THRESHOLD ERRORS			
6	TRANSMIT THRESHOLD ERRORS			
	SELECTION THRESHOLD ERRORS			
7	DATA MESSAGES TRANSMITTED			
10	DATA MESSAGES RECEIVED			
11	SELECTION INTERVALS			
12	DATA ERRORS OUTBOUND			
	RESERVED	OREP	ODBCC	OHBCC
13	DATA ERRORS INBOUND			
	RESERVED	IREP	IDBCC	IHBCC
14	LOCAL BUFFER ERRORS			
	RESERVED		LBTS	LBTU
15	REMOTE BUFFER ERRORS			
	RESERVED		RBTS	RBTU
16	SELECTION TIMEOUTS			
	RESERVED		IRTS	NRTS
17	LOCAL REPLY TIMEOUTS			
	REMOTE REPLY TIMEOUTS			

MK-1960

Figure 5-5 TSS Map of Error and Statistical Counters

GLOBAL STATUS SLOT (GSS)
ADDRESS (OCTAL)

15	REMOTE STATION ERRORS				
		RSTR	RSEL	RMHFE	ROVRN
16	LOCAL STATION ERRORS				
		LOVR	LUNDR	LMHFE	LOVRN
17	GLOBAL HEADER BLOCK CHECK ERRORS				
	MAINT. DATA BLOCK CHECK ERRORS				

MK-1959

Figure 5-6 GSS Memory Map

NOTE

Except for the clearing action that results from a read and clear control command, TSS and GSS counters are cleared when the user program master clears a DMP11. Also, when a tributary is created, the TSS counters for that tributary are cleared. However, placing a tributary in the DDCMP HALT or ISTRT states has no effect on these counters.

5.3.1.1 Data Link Error Counters – Counters in this class record physical communications line errors using message traffic between a control and tributary station pair (or two point-to-point stations). Data link error counters are eight-bit counters which, if not cleared, latch at the maximum count of 255. All counters in this class can be read or read and cleared by the user program by means of the control command and information response. The errors recorded by the seven counters in this class are:

1. Data errors outbound,
2. Data errors inbound,
3. Local buffer errors,
4. Remote buffer errors,
5. Selection timeout errors,
6. Local reply timeout errors, and
7. Remote reply timeout errors.

The counters that record these errors are described in detail under the headings that follow.

Data Errors Outbound Counter

This group counter records communications line errors for message traffic outbound from this station. The three flag bits for this counter indicate the types of outbound errors being recorded.

OHBCC – Outbound Header Block-Check Error. This flag is set when a NAK specifying a data or control message header block-check error is received.

OBDCC – Outbound Data Field Block-Check Error. This flag is set when a NAK specifying a data field block-check error is received.

OREP – Outbound REP Response. This flag is set when a NAK is received in response to a DDCMP REP message sent from this station (see Appendix A).

Data Errors Inbound Counter
This group counter records communications line errors for message traffic inbound to this station. The three flags for this counter indicate the types of inbound errors being recorded.

IHBCC – Inbound Header Block-Check Error. This flag is set, while in the DDCMP run state, when a message with a header block-check error is received at this station. When this error occurs, the receiving station transmits a NAK to the sending station. If an error of this type occurs when this station is in a protocol state other than run, the error is recorded as a global header block-check error (see Section 5.3.1.3). Point-to-point stations in the run state also record this error. Multipoint control stations record this error for the selected tributary, regardless of the address field in the receive message. Multipoint tributary stations record this error only if the address field matches their station address.

IDBCC – Inbound Data Field Block-Check Error. This flag is set when a data message with a data field block-check error is received at this station. The receiving station transmits a NAK to the sending station each time this error occurs.

IREP – Inbound REP Response. This flag is set when a NAK is sent in response to a REP message received by this station (see Appendix A).

Local Buffer Errors
This group counter records each failure of the user program at this station to allocate receive buffers of acceptable size or quantity to store data messages from the remote station. The two flags for this counter report the type of buffer allocation error recorded.

LBTU – Local Buffer Temporarily Unavailable. This flag is set when a buffer is not available for a message received by this station. This condition results in a NAK being transmitted by this station to the sending station.

LBTS – Local Buffer Too Small. This flag is set when a message is received by this station and the available receive buffer is too small to store the message. This condition results in a NAK being transmitted by this station to the sending station.

Remote Buffer Errors
This group counter records each failure of the user program at the remote station to allocate buffers of acceptable size or quantity to store data messages sent by this station. The two flags for this counter report the type of buffer allocation error recorded.

RBTU – Remote Buffer Temporarily Unavailable. This is set when a NAK is received indicating that a buffer is not available at the remote station for a data message sent by this station.

RBTS – Remote Buffer Too Small. This flag is set when a NAK is received indicating that the buffer at the remote station is too small for a data message sent by this station.

Selection Timeout Counter
At multipoint control stations and half-duplex point-to-point stations, this group counter records each selection timeout incurred by the tributary (see Appendix A). It is not necessary for multipoint tributary stations to maintain selection timeout counters. In addition, the two stations in a full-duplex, point-to-point network are continuously selected, ending the need for this counter. The two flags associated with this counter report the type of selection timeout error recorded.

NRTS – No Reply To Select. This flag is set to record the running out of the selection timer without the receipt of a valid message or header, or without the detection of an attempted transmission.

NOTE
The DMP11 detects attempted transmissions by monitoring the modem signal carrier detect or through receiving a DDCMP synchronization sequence.

IRTS – Incomplete Reply To Select. This flag is set when a selection interval timeout occurs, preceded by receiving a valid message header not having the select bit set, or the detection of an attempted transmission from the remote station.

NOTE
At full-duplex, point-to-point stations, the selection interval timer is used as a reply timer. Therefore, at these stations this counter is not used.

Local Reply Timeouts
This counter records the sending of a DDCMP REP message to a remote station following the timeout of the reply interval at this station. A REP message is sent when data messages transmitted to the remote station are not acknowledged (ACKed).

Remote Reply Timeouts
This counter records the transmission of ACKs sent in response to a REP message received. NAKs sent in response to REP messages received are recorded as data errors inbound. A remote station sends REP messages to this station to indicate that it did not receive ACKs for data messages sent. This station received the messages, but the sending station did not receive the ACK sent in response to the data or REP messages.

5.3.1.2 Threshold Error Counters – Threshold error counters provide a user program with information on consecutive or continuous errors occurring on the physical communications line or at remote stations. Figure 5-5 shows a map of these counters as they exist in a TSS structure. The three-bit threshold counters record the following error conditions:

1. A message is transmitted but not acknowledged (transmit threshold counter).

2. A message is received incorrectly and NAKed (receive threshold counter).

3. A selection interval timer runs out (selection interval threshold counter).

When a threshold counter collects a consecutive count of seven, a control response is sent to the user program with information that the specific threshold error and the counter are cleared. This action provides the user program with information on error conditions that interrupt data transmission.

At multipoint network control stations, all three counters are maintained in the TSS structure for each assigned tributary. At tributary stations, only the transmit and receive threshold counters are maintained. In point-to-point networks, one set of threshold counters is maintained at each station. The functions of the three error counters in this class are described under the headings that follow.

Transmit Threshold Counter
Transmit threshold errors recorded by this counter differ, based on the protocol state of the tributary or station. At a control or tributary station, the detection of any consecutive combination of the following conditions increments this counter:

1. This station is in the ISTRT state and it sends a STRT message.

2. This station is in the ASTRT state and it sends a STACK message.

3. While in the run state, a NAK is received at this station with a reason code other than 3 (see Appendix A).

4. While in the run state this station sends a REP message.

This counter is cleared when this station or tributary enters the ASTRT, ISTRT, or run state. When in the run state, this counter clears before reaching a count of seven for the following reasons:

1. On successful transmission of a message.

2. On receipt of an acknowledgement when no messages are left.

Receive Threshold Counter
In the RUN state, the receive threshold counter records the sequential occurrence of receive message errors for its tributary up to a maximum count of seven. This counter is incremented when a NAK is sent for any one of the following reasons:

1. A message header block-check error.

2. A message data field block-check error.

3. A NAK response to a REP message.

4. A buffer is temporarily not available.

5. A receive message overrun.

6. A message is too long for the available buffer.

7. A message header format error.

NOTE
These receive error conditions agree with DDCMP NAK reason codes.

There are three instances that cause this counter to be cleared before reaching a count of seven:

1. The ISTRT, ASTRT, or run state is entered

2. A valid control message is received

3. A valid data message is received in the RUN state

Selection Threshold Counter
This counter records each consecutive end of the selection interval timer. In multipoint networks, this counter is implemented only at the control station, one for each assigned tributary. For half-duplex, point-to-point networks, one counter is implemented at each station. This counter is cleared when a valid message is received having the select bit set.

5.3.1.3 Station Error Counters – Station error counters are 8-bit global counters that record the following types of general error conditions:

1. A hardware or software fault at a remote station.

2. A hardware or software fault at the local station.

3. Data errors occurring on the physical communication line that are not detected by a header block-check.

The names of the counters that record these error conditions are:

1. Remote station error counter,
2. Local station error counter,
3. Global header block-check error counter, and
4. Maintenance message data field block-check error counter.

Figure 5-6 is a memory map showing the location of these counters in the GSS. All station counters are eight-bit counters which if not cleared, latch at the maximum value of 255. Figure 5-6 shows that the local and remote station error counters are group counters configured with sets of error flags. The group counters and flags record errors in the same way as data link error counters and can be use in a similar way for error analysis (see Section 5.3.1).

Station error counters are found in the global status slot (GSS) at each DMP11. The user program has the option of either reading or reading and clearing these counters using the control commands read GSS or read and clear GSS with a tributary address of zero. Accessing GSS locations is done on two-byte boundaries.

Remote Station Error Counter
This group counter records errors caused by a fault at a remote station or by data errors not seen on the communications line inbound to this station. The specific errors recorded and the functions of the error flags are described below.

ROVRN – Remote Receive Overrun. This flag is set when a NAK is received indicating that a receive overrun occurred at the remote station.

RMHFE – Remote Message Header Format Error. This flag is set when this station detects a header format error in a message from a remote station. The remote station is informed of this error by a NAK sent from this station.

RSEL – Remote Selection Address Error. This flag is set only at multipoint control stations. It records receiving a message containing an address that does not match the address of the tributary selected.

RSTR – Remote Streaming Tributary. This flag is set only at multipoint control stations and half-duplex, point-to-point-stations. It records the occurrence of one of the following events:

1. The communications line not released by the remote station after the babbling tributary timer ran out (see Section 4.3.2).

2. The communications line not released by the remote station at the end of the selection interval (see Section 4.3.2).

When this flag is set, a control response having the correct error condition code is passed to the user program (see Section 3.4.2).

Local Station Errors
This group counter records global errors caused by a fault at this station or by a data error not seen on the communications line outbound from this station. The specific errors recorded and the functions of the error flags are described below.

LOVRN – Local Receive Overrun NAK Sent. This flag is set when a receiver overrun occurs at this station while in the DDCMP run state. A NAK is sent to inform the remote station of the error.

LOVR – Local Receive Overrun, NAK Not Sent. This flag is set when a receive overrun occurs at this station and is not NAKed. Failure to NAK a receive overrun at the local station can be caused by:

1. A receive overrun at this station while it is receiving a message header or,

2. A station that is not in the DDCMP run state

LUNDR – Local Transmit Underrun. This flag is set when a transmit underrun occurs at this station.

LMHFE – Local Message Header Format Error. This flag is set when a NAK is received at this station indicating a message header format error.

Global Header Block-Check Error Counter
This counter records the occurrence of header block-check errors at all stations not in the DDCMP run state. This counter records header block-check errors for maintenance messages and for messages that are received with a station address that does not match the address of this station. If these types of errors occur when the station is in the DDCMP RUN state, they are recorded as inbound header block-check errors.

Global Maintenance Data Field Block-Check Error Counter
This counter records data field block-check errors occurring in maintenance messages and provides the mechanism for detecting maintenance message data fields, which are not valid, during operations in the DDCMP maintenance state.

5.3.1.4 Statistical Counters – These Counters provide statistical information for evaluating the error counts recorded by the DMP11. They are maintained in the TSS for each assigned tributary as well as in the single TSS at each point-to-point station. All statistical counters are 16 bits wide and, if not reset, will latch at the maximum value of 65,535. The statistical counters are:

Data Messages Transmitted Counter
This counter records data messages transmitted by this station following protocol startup. The count can be used as a statistical base when evaluating the number of data errors outbound, local reply timeouts, and remote buffer errors. This counter records the total number of messages transmitted since startup while in the run state. This count does not include attempts to retransmit messages.

Data Messages Received Counter
This counter records the total number of data and maintenance messages received by this station following protocol startup while operating in the DDCMP run and maintenance states. The count can be used as a statistical base when evaluating the number of data errors inbound, remote reply timeouts, and local buffer errors.

Selection Interval Counter
At multipoint control and point-to-point stations, this counter records the number of messages transmitted with the select bit set. This count is maintained in all states of network operation and includes all

valid DDCMP messages transmitted with the select bit set. The counter can be used as a statistical base to determine the ratio of selection timeouts to the total number of selections made. Also, for a multipoint control station, this counter records each poll made.

5.4 STRUCTURE OF THE DMP11 INTERNAL DATA BASE

The DMP11 internal data base provides the device for controlling the assignment and completion of transmit and receive buffers, queuing of DMP11 responses, and assignment of TSS structures to assigned tributaries for the storage and maintenance of tributary and global status information. A map of this data base, which is maintained in the 4K-byte data memory, is shown in Figure 5-7.

This internal data base is implemented by three basic structures:

1. Linked lists,
2. Slot mapping Table, and
3. TSS and GSS structures.

Each of these data base structures are described in the sections that follow.

5.4.1 Linked Lists

A linked list is an open-ended data list made up of fixed length blocks linked by pointers. Figure 5-8 shows the standard format for DMP11 linked list structures. Each of these blocks, called link blocks, have seven bytes of data and a one byte pointer to the next link block in the list. The pointer is in the last block in the list and is a terminator.

The DMP11 linked list structure is made up of three types of linked lists. These are:

1. The free linked list – The free linked list is a list of empty link blocks used by the DMP11 microcode to form the types of linked lists left.

2. The response linked list – Responses for the user program are queued on this list for posting.

3. Buffer linked lists – These lists have the accessing information for each receive and transmit buffer allocated, based on one link block per allocated buffer.

Each type of linked list is described in detail in the sections that follow.

5.4.1.1 The Free Linked List – The free linked list is the source from which all other linked lists get link blocks. The addition of a link block to the receive, transmit, or the common pool buffer linked list is started by the user program through a buffer address/character count command (see Section 3.3.4). Also, the addition of a link block to the response linked list is started by the DMP11 when a response is posted to the user program (see Section 3.4).

Access to a linked list is controlled by two list pointers: one pointing to the start of the list and one pointing to the end of the list. When a link block is removed from the free linked list, the start of list pointer is changed to point to the next available link block in the free linked list. When a link block is completed by one of the functional linked lists, it is added to the end of the free linked list. The start and end of the list pointers for the free linked list are maintained in the station GSS.

The 1720 bytes allocated to the free linked list translate into a total of 215 link blocks available for use by the functional linked lists. As a result, the free linked list functions as a finite resource for the functional linked lists. When the last link block is removed from the free linked list, the start of list pointer is set to the terminator value of octal 377 in order to indicate that there are no more link blocks available. In this instance, the next request by the response linked list for a link block generates the fatal error queue overflow. Given a fatal error condition, the buffer allocation plan for a user program should be designed to be certain that enough link blocks are always available for use by the response linked list maintained at the station controlled by that program (see Section 3.4.2.1).

5.4.1.2 The Response Linked List – This linked list functions as a queue of buffer completion, control, and information responses to be posted to the user program. When preparing a link block to conduct a control or information response, the DMP11 clears all bit position that are not used in the link block to zero. However, link blocks restored to the free linked list stay the same. The start and end of the list pointers for the response linked list are maintained in the GSS for the station.

5.4.1.3 Buffer Linked Lists – A buffer linked list is provided for each type of message buffer allocated by a user program. These are:

1. Common pool receive buffers,
2. Private receive buffers, and
3. Transmit buffers.

Each link block in a buffer linked list provides the location and size of a buffer in main memory.

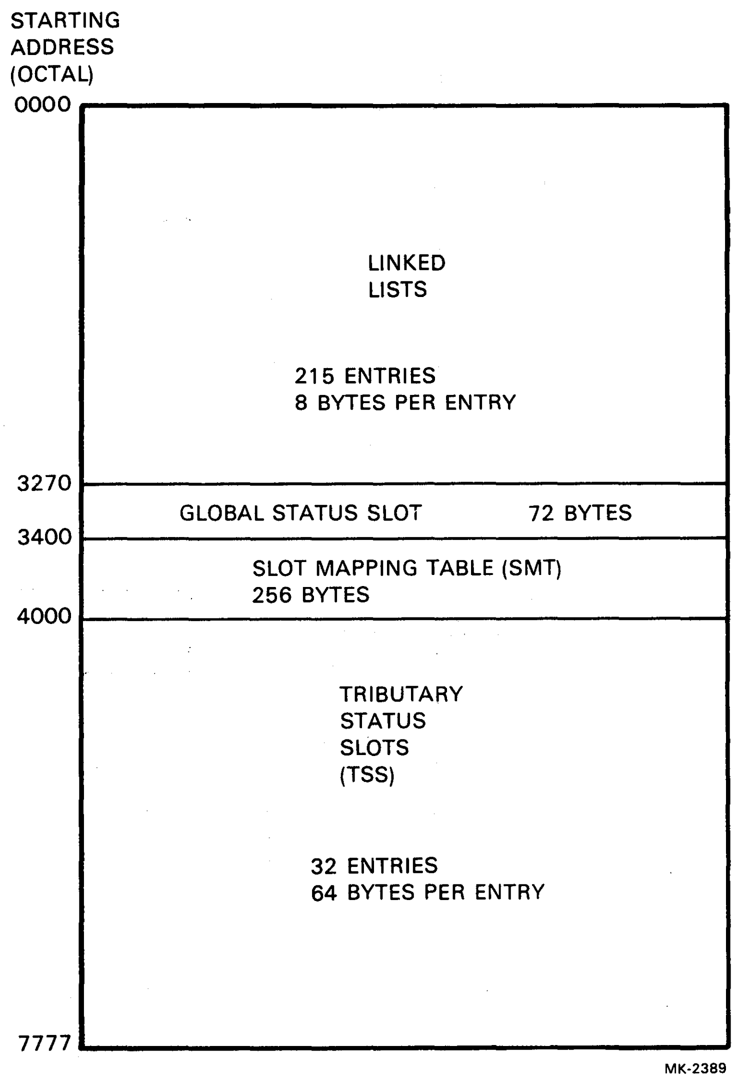


Figure 5-7 Map of DMP11 Data Memory

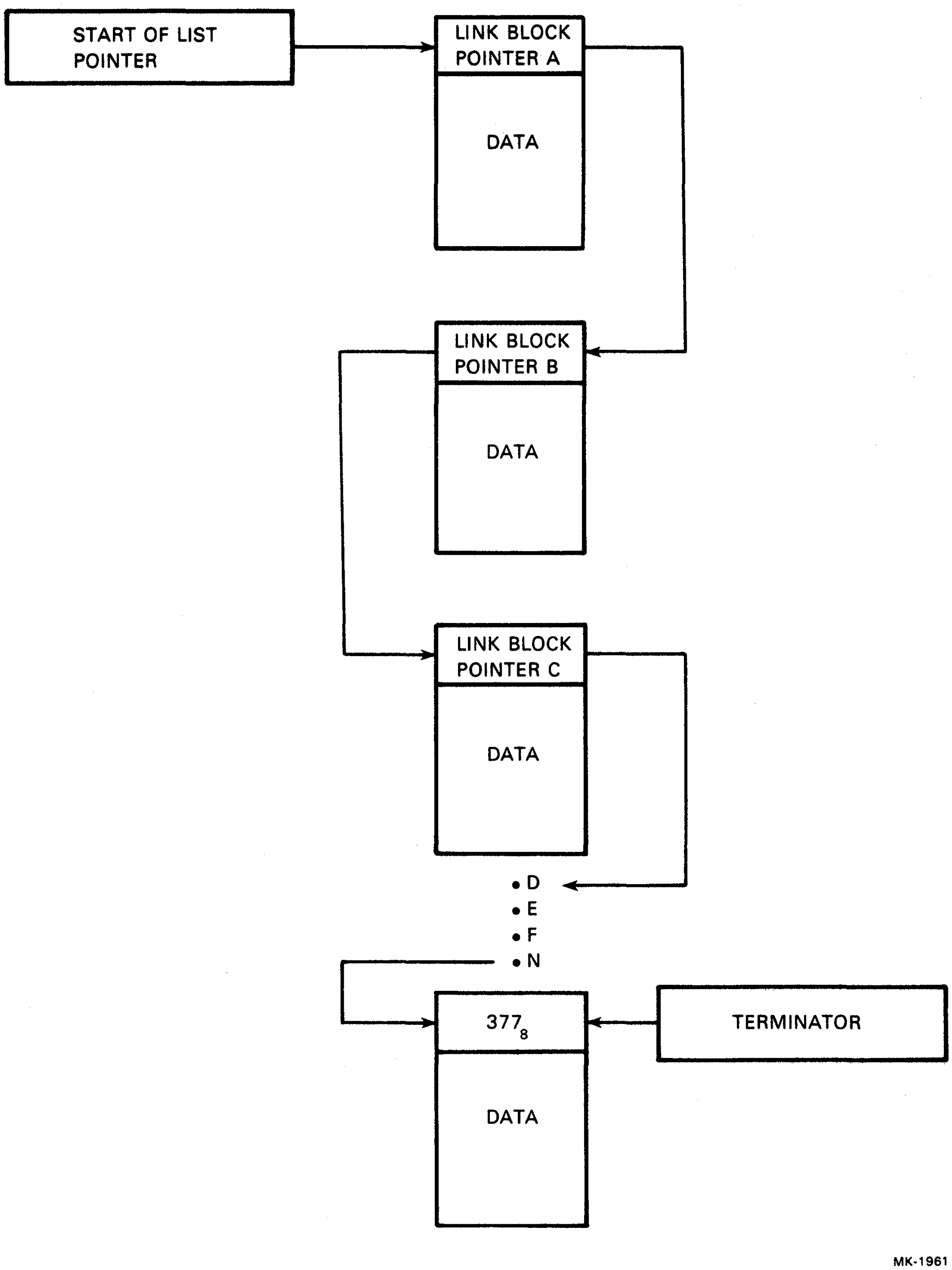


Figure 5-8 DMP11 Linked List Structure Format

Common Pool Buffer Linked List
Controlling receive messages through a common pool of buffers provides an efficient method of controlling buffer allocation. The common pool buffer linked list provides a queue of receive buffers available to all assigned tributaries according to the quota assigned to each tributary.

Common pool buffers are assigned through the buffer address/character count command and enabled with tributary quota assignments through the control command (see Sections 3.3.4 and 3.3.3). The start-of-list and end-of-list pointers for this linked list are maintained in the station GSS.

Receive Buffer Linked List
This linked list operates as a queue of private receive buffers with a separate list maintained for each tributary assigned on a multipoint network. For point-to-point stations using private receive buffers, one list is maintained at each station. The start-of-list and end-of-list pointers for each receive buffer linked list are maintained in the tributary's (or station's) TSS structure.

Transmit Buffer Linked Lists
This list functions as a queue of transmit buffers, with one list maintained for each tributary assigned on a multipoint network. For point-to-point stations, one list is maintained at each station. The start-of-list and end-of-list pointers for each transmit buffer linked list are maintained in the tributary's (or station's) TSS structure.

A unique feature of the link block for this list is that it has a message number field. The number in this field is the DDCMP message sequence number from the header of the message transmitted out of the buffer described by the specific link block. The DMP11 microcode uses this field to find the buffer for a message that has been NAKed (and therefore must be sent again).

5.4.2 Slot Mapping Table
Under DDCMP, the 8-bit message header address field permits no more than 255 unique tributary addresses in a multipoint network. However, the DMP11 limits the number of assigned tributaries to 32. In order to implement DDCMP, a tributary in a DMP11-implemented multipoint network can have a TSS address in the range of one to 255 (zero is reserved to address the GSS).

TSS addresses are assigned at both control and tributary stations through the slot mapping table (SMT). As shown in Figure 5-7, this table occupies 256 (octal 400) locations in DMP11 data memory, with one location for each of the 255 potential tributary addresses.

The function of the SMT is to map an eight-bit tributary address into one of the 32 available TSS structures. When a tributary is deleted, (see Section 3.3.3.1), its TSS and SMT entry is available for assignment again. Also, when 32 tributaries are assigned and a try is made to create a 33rd, a procedural error is posted to the user program (see Section 3.4.2.4).

5.4.3 TSS and GSS Structures
Figure 5-7 shows that the TSS and GSS structures occupy separate sections of the DMP11 data memory. The GSS is a single 72-byte structure and the 32 TSS structures are made up of 64 bytes each. Together, the TSS and GSS structures occupy a little over half of the DMP11 data memory. These structures are described in the sections that follow.

5.4.3.1 The Global Status Slot – A detailed map of the GSS is shown in Appendix F. This map shows that 64 of the 72 bytes in this slot have global control and status information with the other eight bytes used as a storage area for subroutine vectors.

The GSS is used to maintain control and status information specific to the operation of the DMP11 microcode, to record event counts and error conditions that are global and to store global parameters. Most of the GSS is reserved for microcode control and status information.

Access to the GSS is done on two-byte boundaries. With the exception of an eight-byte storage area, a user program can read any GSS location at will through the control command, with the contents of the addressed location returned to the user program through an information response (see Sections 3.3.3.1 and 3.3.4.1). A user program can read and clear only the GSS station error counters (see Section 5.3.1.3) through the control command and information response. Through the control command, a user program can write the five global parameters (see Table 4-4) into GSS octal locations 33 through 37.

5.4.3.2 Tributary Status Slots – At a multipoint control station, a separate TSS is maintained for each assigned tributary in the network. At a tributary station, a separate TSS is maintained for each tributary assigned at that station. In a point-to-point network, one TSS is maintained at each station. When a tributary is deleted, its TSS is available for assignment again. However, when the protocol is halted at a tributary, or placed in the maintenance, ISTRT or ASTRT protocol states, the TSS stays complete.

Through use of the control command, all TSS locations can be read by the user program and specific locations can be written into or read and cleared. When a location is to be read or read and cleared, the data read is posted to the user program through an information response (see Sections 3.3.3.1 and 3.3.4.1).

A detailed map of a TSS is presented in Appendix G. This map shows that a TSS has four general types of tributary-specific information:

1. Protocol and tributary status,
2. Error and statistical counters,
3. Message exchange variables, and
4. Polling parameters.

A description of each of these types is given in the sections that follow. In addition, the information types that apply to a user program are referenced to that section of the manual where the topic is explained in detail.

Protocol and Tributary Status
This type includes information on the tributaries protocol state, its status with relation to the communications line, its protocol status, and its polling status. Tributary polling status is maintained only at a multipoint network control station. Because this information is only related to and used by the DMP11 microcode, it can be read by a user program.

Error and Statistical Counters
These counters provide the user program with a wide range of error counts and a set of statistical counts that permit analysis of the relation of specific error counts. These counters can be read and cleared by the user program. The function of each of these counters are described in detail in Section 5.3.

Message Exchange Variables
This type includes a range of variables maintained and used by the DMP11 microcode to control the sequential exchange of message data. Each TSS also maintains a group of timers that can be set to a specific timeout value by the user program. This group of timers directly affect message traffic conducted over the communications line. These timers are:

1. Transmit delay timer,
2. Selection interval timer,
3. Maximum transmit message count, and
4. Babbling tributary timer.

The link management functions performed by these timers is detailed in Section 4.3.2. Note that a timeout value for the selection interval timer is stored in each tributary's TSS. The actual timer is maintained in the GSS.

Polling Parameters
These parameters are user-defined values used by the polling algorithm in conducting dynamic polling activity in multipoint networks. The functions performed by the DMP11 polling algorithm and the criteria for determining the values for each parameter are described in detail in Section 5.2.

CHAPTER 6
SERVICE

6.1 SCOPE

This chapter provides information for servicing the DMP11. It includes the maintenance philosophy, maintenance functions, troubleshooting methods in a multipoint environment, preventive maintenance, and corrective maintenance. The section on troubleshooting in a multipoint environment includes:

- The general approach to multipoint troubleshooting.
- Some common problems with different multipoint network configurations.
- The use of error counters and other information for isolating problems to a specific part of the physical link.

The corrective maintenance section has short descriptions of the diagnostics associated with the DMP11 for VAX-11 and PDP-11 systems.

6.2 MAINTENANCE PHILOSOPHY

The field replaceable unit (FRU) for the DMP11 is either a defective module (M8207-YA microprocessor or M8203 line unit) or cable. Training of field service personnel is applied to functional and application troubleshooting, using diagnostics for fault isolation to the FRU. Also, spare parts for module repair are not stored in the field. Finally, typical applications of the DMP11 do not permit long troubleshooting sessions and component troubleshooting/repair needs, at least, a 16-channel logic analyzer.

CAUTION

When inserting or removing the M8207-YA microprocessor module, be sure not to move the priority plug or control read-only memories (CROMs).

Always make sure that the CROMs are set firmly and in the correct socket. Otherwise, erratic operation of the DMP11 may result.

6.3 TROUBLESHOOTING METHODS FOR MULTIPOINT

Some complex multipoint network configurations have a potential for wasting valuable time when trying to isolate a problem. For this reason, troubleshooting techniques for multipoint networks differ from those for point-to-point networks.

The following sections describe these troubleshooting techniques for:

- Approach
- Error counters

6.3.1 Approach

Before trying any corrective measures, it is important to get some basic information about the network configuration and the type of problem. This information can be found by asking the user and by referring to the topography diagram for the network. The topography diagram is generated at installation time and is maintained by the field service representative. The flowchart (Figure 6-1) shows a typical approach to troubleshooting from the time a service call is placed until corrective maintenance starts. This procedure should be followed to help isolate a failing tributary before a technician is sent to a site.

6.3.2 Error Counters

In multipoint networks, many tributaries tie to the same transmission line. Because of this it is more difficult to determine which link, if any, is causing errors. To aid in troubleshooting, the DMP11 uses error counters. Every DMP11 in the network (the control station and each tributary) uses error counters to record errors. This allows user programs at any DMP11 in the network to determine error rates and detect a malfunctioning link.

The main way in which errors are indicated to the DMP11 is by DDCMP negative acknowledge messages (NAKs). Each NAK has an address field and a reason code that identifies the source and reason for the NAK. In general, NAKs are sent by the station receiving a message to the station which sent the message when an error is detected in the received message. By recording NAKs sent and NAKs received, each point or tributary in the network can compile statistics on the condition of the link created between the two stations. DDCMP has been designed so that even if one of the stations on the link cannot record errors, the other station may be used to record errors for all communications in both directions on the link.

There are three main categories of error counters used by the DMP11: data link counters, station counters, and threshold counters. Data link counters and threshold counters are maintained for each tributary/control station pair on a physical link. These counters are found in the tributary status slots of the data memory (Figures 6-2 and 6-3). Station counters are maintained for the complete physical link and are found in the global status slot of the data memory (Figure 6-4).

The information found by checking error counters may help in identifying a problem area. For detailed information on error counters, refer to Chapter 3.

6.3.2.1. Data Link Counters – Data link counters are of two types: cumulative and background. The cumulative counters are 8-bit registers which latch at 255_{10}. The background counters are 16-bit registers which latch at 65535_{10}. The cumulative data link counters record and total occurrences of an error and group them into the following classes:

- Data errors outbound,
- Data errors inbound,
- Local reply timeouts,
- Remote reply timeouts,
- Local buffer errors,
- Remote buffer errors, and
- Selection timeouts.

Background data link counters are used to provide a statistical base for the cumulative error counters and therefore record:

- The number of data messages transmitted,
- The number of data messages received, and
- The number of selection intervals.

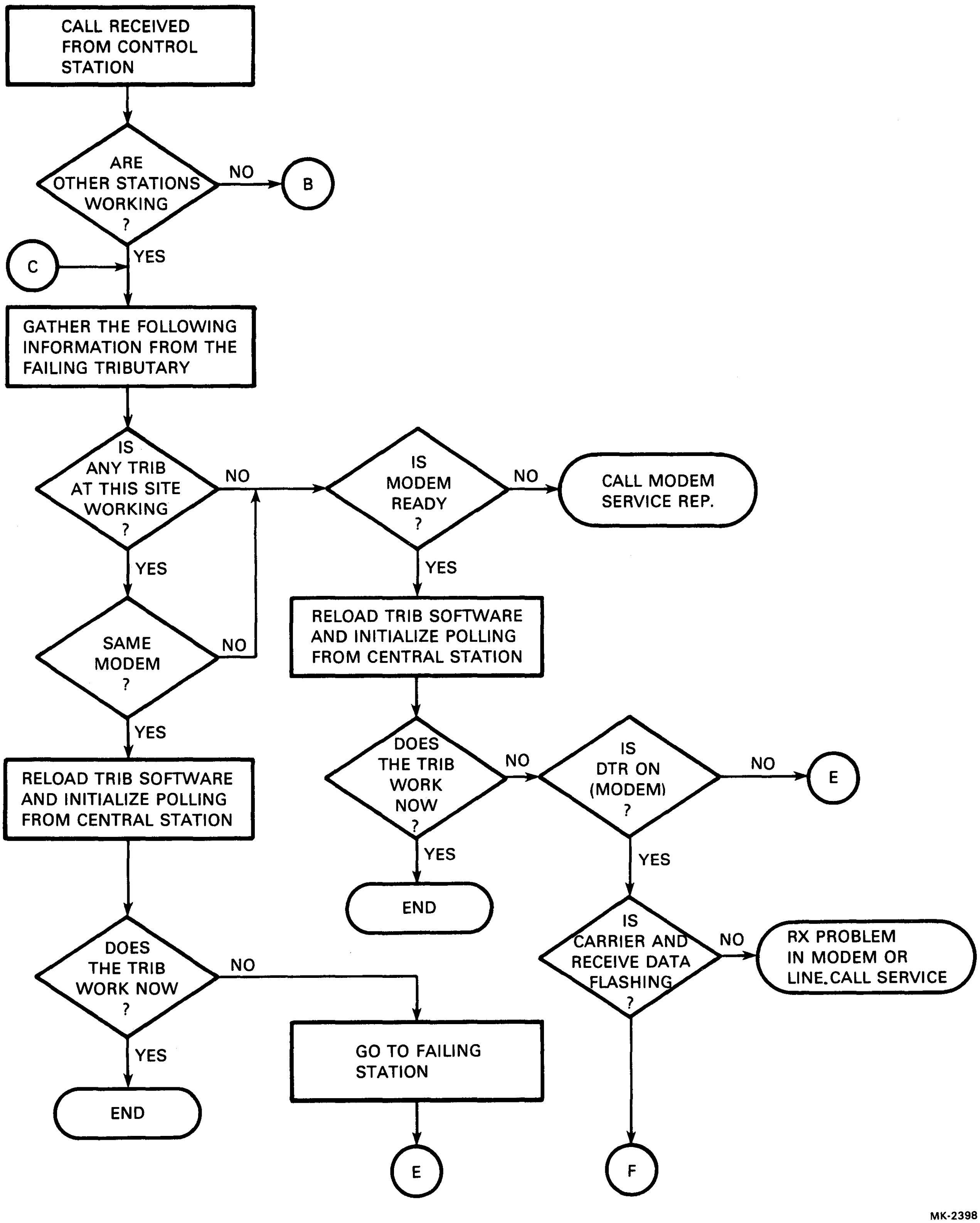


Figure 6-1 Typical Isolation Troubleshooting Flowchart (Sheet 1 of 5)

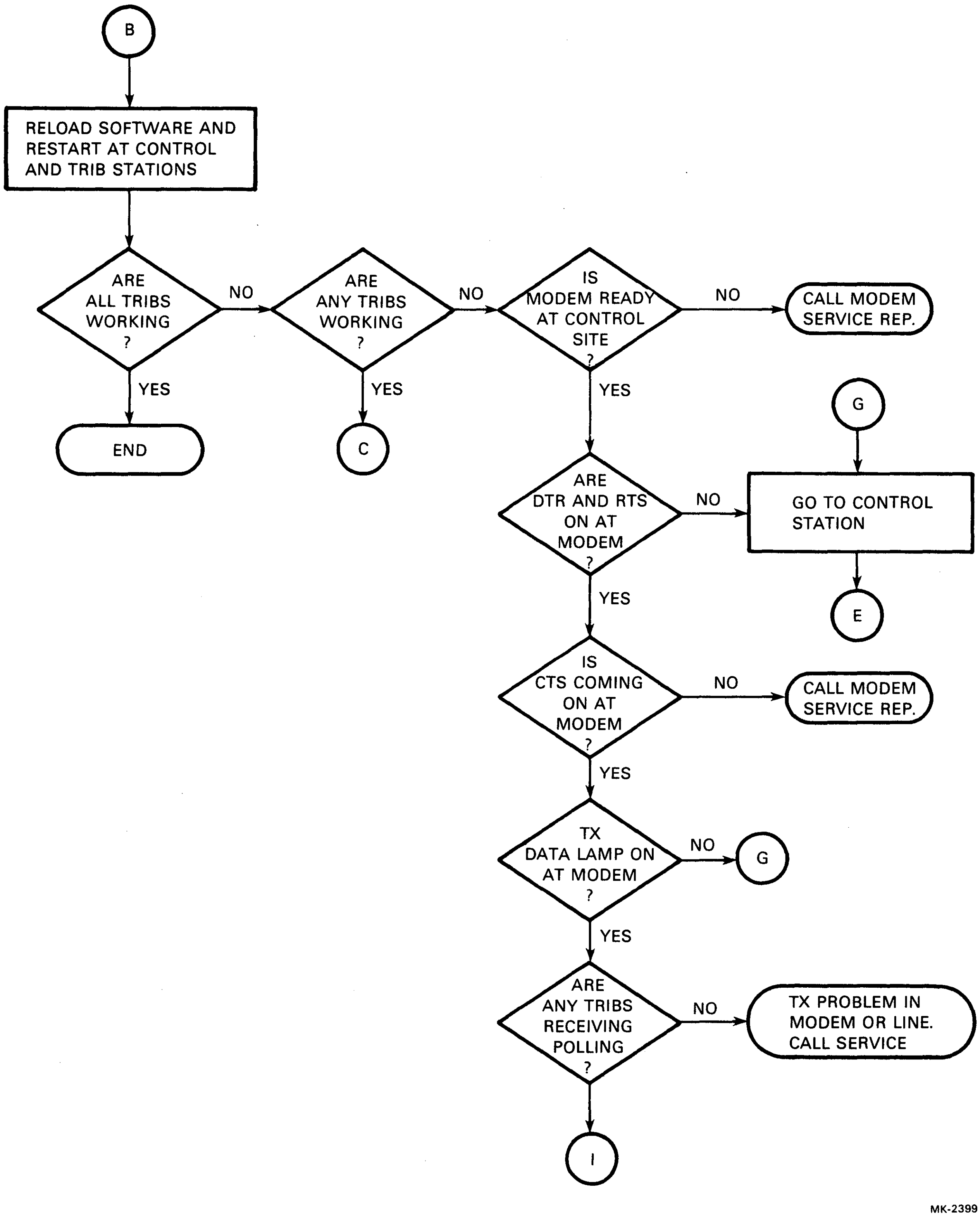


Figure 6-1 Typical Isolation Troubleshooting Flowchart (Sheet 2 of 5)

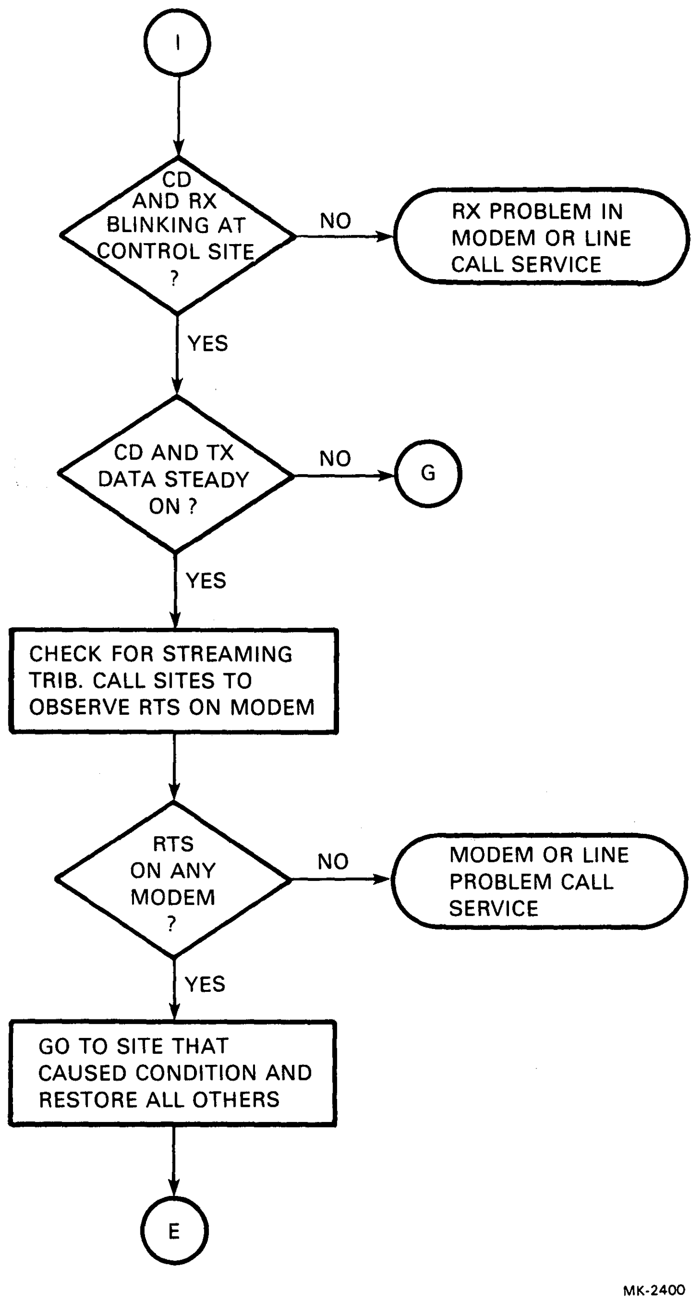


Figure 6-1 Typical Isolation Troubleshooting Flowchart (Sheet 3 of 5)

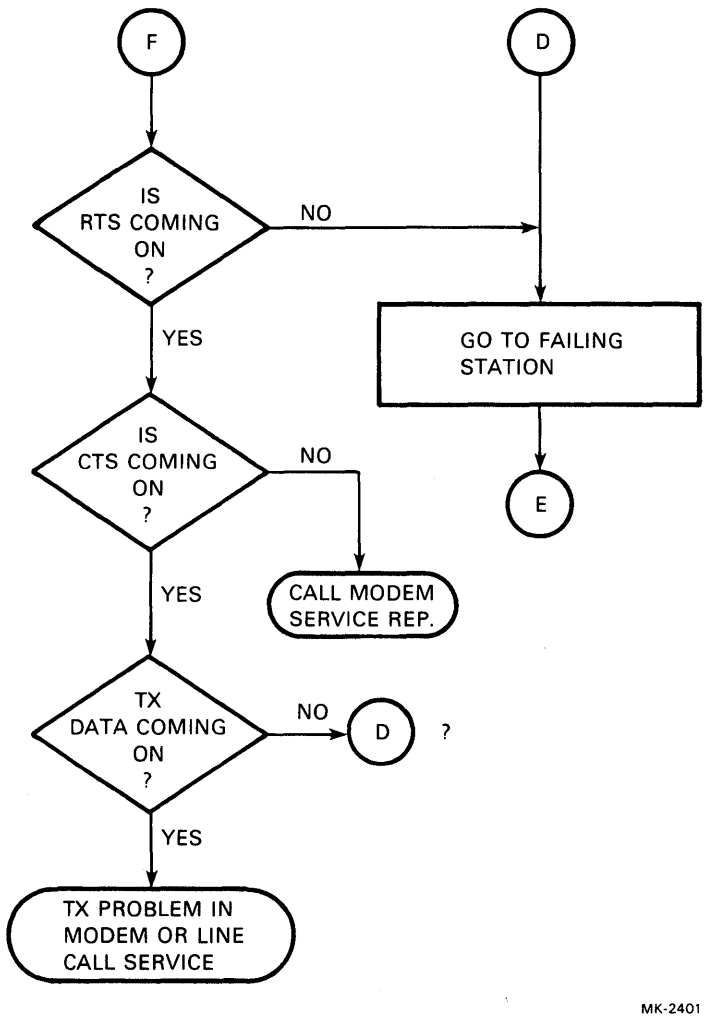


Figure 6-1 Typical Isolation Troubleshooting Flowchart (Sheet 4 of 5)

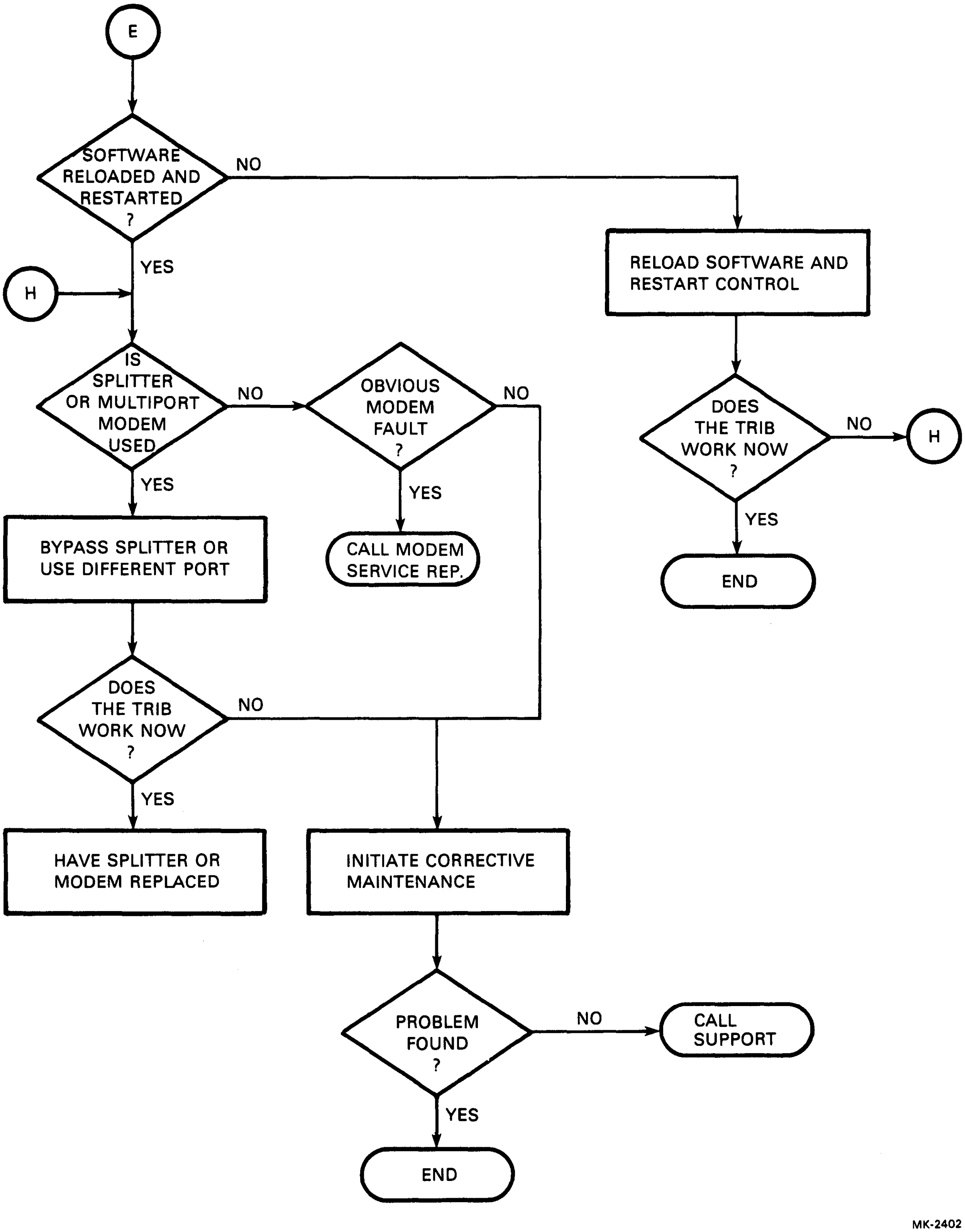


Figure 6-1 Typical Isolation Troubleshooting Flowchart (Sheet 5 of 5)

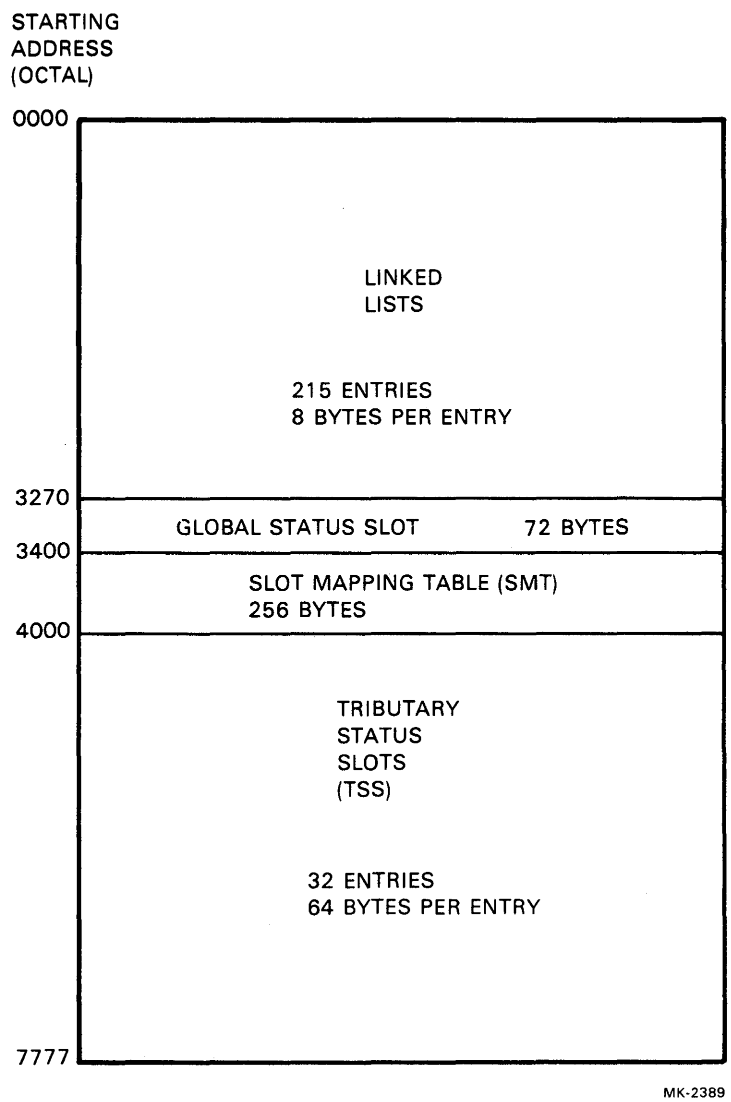


Figure 6-2 Data Memory

TRIBUTARY STATUS SLOT (TSS)
ADDRESS (OCTAL)

Address				
5	RESERVED			
	RECEIVE THRESHOLD ERRORS			
6	TRANSMIT THRESHOLD ERRORS			
	SELECTION THRESHOLD ERRORS			
7	DATA MESSAGES TRANSMITTED			
10	DATA MESSAGES RECEIVED			
11	SELECTION INTERVALS			
12	DATA ERRORS OUTBOUND			
	RESERVED	OREP	ODBCC	OHBCC
13	DATA ERRORS INBOUND			
	RESERVED	IREP	IDBCC	IHBCC
14	LOCAL BUFFER ERRORS			
	RESERVED		LBTS	LBTU
15	REMOTE BUFFER ERRORS			
	RESERVED		RBTS	RBTU
16	SELECTION TIMEOUTS			
	RESERVED		IRTS	NRTS
17	LOCAL REPLY TIMEOUTS			
	REMOTE REPLY TIMEOUTS			

MK-1960

Figure 6-3 Tributary Error Counters

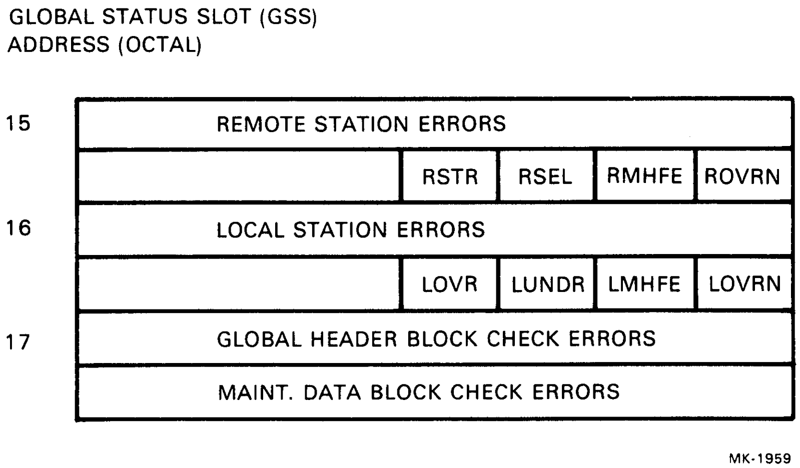


Figure 6-4 Station Error Counters

A point-to-point station maintains a single set of data link counters. Multipoint stations (control and tributary) maintain a separate set of data link counters for each created tributary. Data link counters are cleared by:

- A master clear of the DMP11,
- A control-in command to establish the tributary, or
- A user issued control-in command to RD/CLR error counters.

Data Errors Outbound – This eight-bit group counter records NAKs received for data errors occurring on the communications channel outbound from this station. There are three types of outbound errors for which this counter records NAKs received: header blockcheck (OHBCC), data field blockcheck (OBDCC), and reply response (OREP). Three separate flag bits indicate which type of outbound error is being counted.

OHBCC (outbound header blockcheck) is set when a NAK with a reason code of one is received for a header block check error for either data or control messages.

OBDCC (outbound data field blockcheck) is set when a NAK with a reason code of two is received for a data field block check error.

OREP (outbound reply response) is set when a NAK with a reason code of three is received for a reply response.

Data Errors Inbound – This eight-bit group counter records occurrences which usually result from data errors on the communications channel inbound to this station. Three separate bits indicate specific error types connected to this counter.

IHBCC (inbound header blockcheck) is set when messages having header blockcheck errors are received. When this error occurs, point-to-point stations and multipoint control stations send a NAK with a reason code of one. A multipoint control station records this error for the selected tributary regardless of the address field in the received message. A multipoint tributary records this error only if the address field matches its station address.

IDBCC (inbound data field blockcheck) is set when NAKs with a reason code of two are to be sent for data field blockcheck errors.

IREP (inbound reply response) is set when NAKs with a reason code of three are to be sent for reply response.

Local Reply Timeouts – This eight-bit counter records occurrences which result from:

- The loss of communication between two stations while the one recording this error has data to transmit, or
- The choice of an unacceptable value for the reply timer.

Specifically, this error counter records the sending of a REP message.

Remote Reply Timeouts – This eight-bit counter records occurrences which result from:

- The loss of communications between two stations while the remote station has data to transmit, or
- The choice of an unacceptable value for the remote station reply timer.

Specifically, this counter records ACKs sent in response to a REP. The remote station sent a REP because it received no acknowledgement for messages it previously sent. The local station received those messages, but the remote station never received the acknowledgement.

Local Buffer Errors – This eight-bit counter records the fact that the user program at this station failed to correctly allocate receive buffers at this station to data messages from the remote station. Two separate bits indicate the specific errors for this counter.

LBTU (local buffer temporarily unavailable) is set when a buffer is temporarily unavailable. This condition indicates that a NAK with a reason code of eight is to be sent.

LBTS (local buffer too small) is set when a local buffer is too small for the incoming message. This condition indicates that a NAK with a reason code of 16 is to be sent.

Remote Buffer Errors – This eight-bit counter records the fact that the user program at the remote station failed to correctly allocate receive buffers to data messages from the user program at this station. Two separate bits indicate the specific errors for this counter.

RBTU (remote receive buffer temporarily unavailable) is set when a NAK with a reason code of eight is received.

RBTS (remote receive buffer too small) is set when a NAK with a reason code of 16 is received.

Selection Timeouts – This eight bit counter records the occurrences which result from:

- Loss of communications with a remote station,
- Data errors on the communication channel to or from the remote station, and
- The choice of an unacceptable value for this stations select timer.

This counter is used only by point-to-point, half-duplex, or multipoint control stations. Two separate bits indicate the specific errors for this counter.

NRTS (no reply to select) is used to record selection intervals in which no transmission is received from the tributary, and no transmit try is detected. Specifically, it records the expiration of the select timer without the receipt of a valid control message or header, or the detection of a tried transmission.

IRTS (incomplete reply to select) is used by point-to-point, half-duplex, and multipoint control stations to record selection intervals which were not correctly terminated. Specifically, it records the expiration of the select timer preceded by the receipt of a valid control message, receipt of a valid header, or detection of a transmission. A tried transmission is indicated by:

1. A carrier signal,
2. A DDCMP synchronization sequence, and
3. An SOH, ENQ, or DLE.

Data Messages Transmitted – This 16-bit counter records messages transmitted by this station, and latches at a count of 65535. It can be used as a statistical base when evaluating data errors outbound, local reply timeouts, and remote buffer errors.

Data Messages Received – This 16-bit counter records messages received by this station, and latches at a count of 65535. It can be used as a statistical base when evaluating data errors inbound, remote reply timeouts, and local buffer errors.

Selection Intervals – This 16-bit counter records the number of times this station selects the other station. It also latches at a count of 65535. Specifically, it records the number of messages transmitted with the select flag on. It is only used by point-to-point, half-duplex, and multipoint control stations. It can be used as a statistical base when evaluating the number of selection timeouts.

6.3.2.2 Station Counters – Station counters are eight-bit counters which latch at 255 and record unusual occurrences. These occurrences may be the result of :

- A hardware or software fault at this station
- A hardware or software fault at a remote station
- A data error on the communication channel not seen by the header blockcheck field.

A single set of these counters is used for all tributaries on a multipoint link.

There are four types of station counters:

1. Remote station errors,
2. Local station errors,
3. Global header blockcheck errors, and
4. Maintenance data field blockcheck errors.

Station Counters are cleared by:

- A master clear of the DMP11 or
- A user issued control-in command to RD/CLR the counter.

Remote Station Errors – This eight-bit counter records occurrences caused by a fault in a remote station or by a data error on the channel inbound to this station which is not found. Four separate bits which is not seen indicate the specific errors for this error counter.

ROVRN (remote receive overrun) is set when a NAK with a reason code of nine is received for a receive overrun.

RMHFE (remote message header format errors) is set when a message header has a format error. This condition indicates that a NAK with a reason code of 17 is to be sent.

RSEL (remote selection address error) is set when a multipoint control station receives a message having an address field which does not match the address of the selected tributary. RSEL is a flag used only by multipoint control stations.

RSTR (remote streaming tributaries) is set by either one of two events: 1) an implementation, which depnds on the maximum transmission interval, is exceeded without letting go of the channel (babbling tributary), or 2) the channel is not let go following the end of a selection interval.

Local Station Errors – This eight-bit counter records occurrences caused by a fault in this station or by a data error on the channel outbound from this station which is not found. Four separate bits indicate the specific errors for this error counter.

LOVRN (local receive overrun, NAK sent) is set for local station receive overruns. This condition indicates a NAK with a reason code of nine is to be sent.

LOVR (local receive overrun, NAK not sent) is set by a receive overrun when a NAK is not sent. For a multipoint tributary, this occurs if an overrun occurs while receiving a header. For other stations, this occurs when the station is not in the DDCMP run state.

LUNDR (local transmit underruns) is set when a transmit underrun occurs.

LMHFE (local message header format error) is set when a NAK with a reason code of 17 is received to indicate a message header format error.

Global Header Blockcheck Errors – This eight-bit counter records the occurrences of header blockcheck errors that are not recorded on a per tributary basis. Specifically, it counts header blockcheck errors for maintenance messages and for messages to tributaries where the address field does not match the station address.

Maintenance Data Field Block Check Errors – This eight-bit counter records the occurrences of data field blockcheck errors for maintenance messages.

6.3.2.3 Threshold Error Counters – Threshold error counters are used to determine if a continuous fault is present. A continuous fault is one which occurs seven times. When a threshold counter reaches its maximum value (7), the user program is informed by a control response.

In the DDCMP run state, threshold counters are cleared when the user is informed. In this way, the user is always informed of a continuous fault. In the DDCMP ISTRT and ASTRT states, threshold counters are not cleared when the user is informed. In this way, the user is not continuously informed of a remote station which is not operating.

A point-to-point station maintains a single set of threshold counters. A multipoint control station maintains a separate set for each tributary. A multipoint tributary maintains a single set unless it supports multiple tributary addresses, in which event it maintains a single set for each tributary address.

There are three types of threshold error counters: transmit, receive, and selection.

Transmit Threshold Errors – This three bit counter is incremented (if it is less than 7) in the following ways.

1. The DMP11 is in the ISTRT state when a STRT message is sent.

2. The DMP11 is in the ASTRT state when a STACK message is sent

3. The DMP11 is in the running state and a NAK with a reason code other than three (REP response) is received, or when sending a REP message.

The Transmit Threshold Error counter is cleared:

- On entering the ISTRT, ASTRT, or run states.
- While in the run state and one of the following occurs:
  1. A transmit threshold error is reported.
  2. A NAK, ACK, or data message is received acknowledging a new message.
  3. A NAK, ACK, or data message is received when no messages are outstanding.

Receive Threshold Errors – This three bit counter is incremented (if less than 7) when a NAK with one of the following reason codes is sent.

Reason Code	Description
1	Header blockcheck error.
2	Data field blockcheck error.
3	REP response.
8	Buffer temporarily not available.
9	Receive overrun.
16	Message header format error.

This counter is cleared when:

- Entering the ISTRT, ASTRT, or run states,
- A control message with a correct header blockcheck is received without a header format error,
- A data message with correct header and data field blockchecks is received without a header format error, and
- In the run state, a receive threshold error is reported.

Selection Threshold Errors – This three-bit counter is only used by multipoint control stations and half-duplex, point-to-point stations. It is incremented (if less than 7) when a selection timeout occurs.

It is cleared when a message is received which has the select bit set, or while in the running state and a selection threshold error is reported.

6.3.3 Error Counter Analysis

The software operating system records all the error counters but does not try to study or take any specific action as a result of any specific errors. The system manager or another operator instructs the software to recover the counters. The counters are studied by the operator or system manager and then the software is instructed to perform a specific function relative to the counter indications.

For information on recovering the counters, refer to the system specific DECnet system managers guide or the network manager. Also, refer to Section 6.6.5 for a description of OCLT, which allows access to the error counters.

The following example shows how the counters can be used in diagnosing a system failure. Refer to Figure 6-5.

Assume that a full-duplex, multipoint network is made up of seven tributaries and a control station, as shown in Figure 6-5. The type of electrical interface (EIA RS-121/RS-449, V.35, integral modem), is not important in this example. The system manager at the control station sees that data transfers over the network appear to be slow. Some standard file transfers are taking a longer time than usual to complete. (Note that in some events this can be caused by a sudden increase in traffic on the network.) The problem appears to be intermittent because no threshold errors have occurred and data is being transferred between all tributaries. The system manager examines the error counters at the control station for tributary 7. They are as follows:

ERROR COUNTERS FOR TRIBUTARY SEVEN (AT THE CONTROL STATION)

DATA ERRORS OUTBOUND = 0
DATA ERRORS INBOUND = 255 (IREP, IDBCC, IHBCC)
LOCAL REPLY TIMEOUTS = 40
REMOTE REPLY TIMEOUTS = 0
LOCAL BUFFER ERRORS = 0
REMOTE BUFFER ERRORS = 0
SELECTION TIMEOUTS = 50 (IRTS)
DATA MESSAGES TRANSMITTED = 420
DATA MESSAGES RECEIVED = 310
SELECTION INTERVALS = 212

The DATA ERRORS INBOUND counter (which is latched) indicates that NAKS have been sent:

- For header BCC errors (IHBCC),
- For data BCC errors (IDBCC), and
- In response to receiving a REP (IREP).

Local reply timeouts show that REP messages have been sent to the tributary because acknowledgements for messages have not been received. Selection timeouts have also occurred where the tributary received a poll and transmitted (raised carrier) but did not deselect itself (incomplete reply to select – IRTS). From the information provided so far, there appears to be a problem on the link between the tributary's transmitter and the control station's receiver. This is enforced again by the fact that there are no data errors outbound, indicating that no NAKs have been received from the tributary. The problem can be in the control stations' receiver hardware (M8203 line unit, modem, etc.), the cable to the tributary, or the tributary's transmitter hardware (M8203 line unit, modem, etc.). The next logical step is to examine the error counters at the control station for the other tributaries. On doing this, the system manager sees that tributary six has the same type and relative number of errors as tributary seven. This indicates that the problem is in the control station's receiver or the cable from tributaries six and seven. (It can be that both tributaries six and seven have tranmsitter problems, but this is not probable.) Examination of the error counters for the tributaries that are left shows very few errors. This rules out the control station hardware.

NOTE

If failures occur at the control station they are indicated by the fact that in most events all stations are affected.

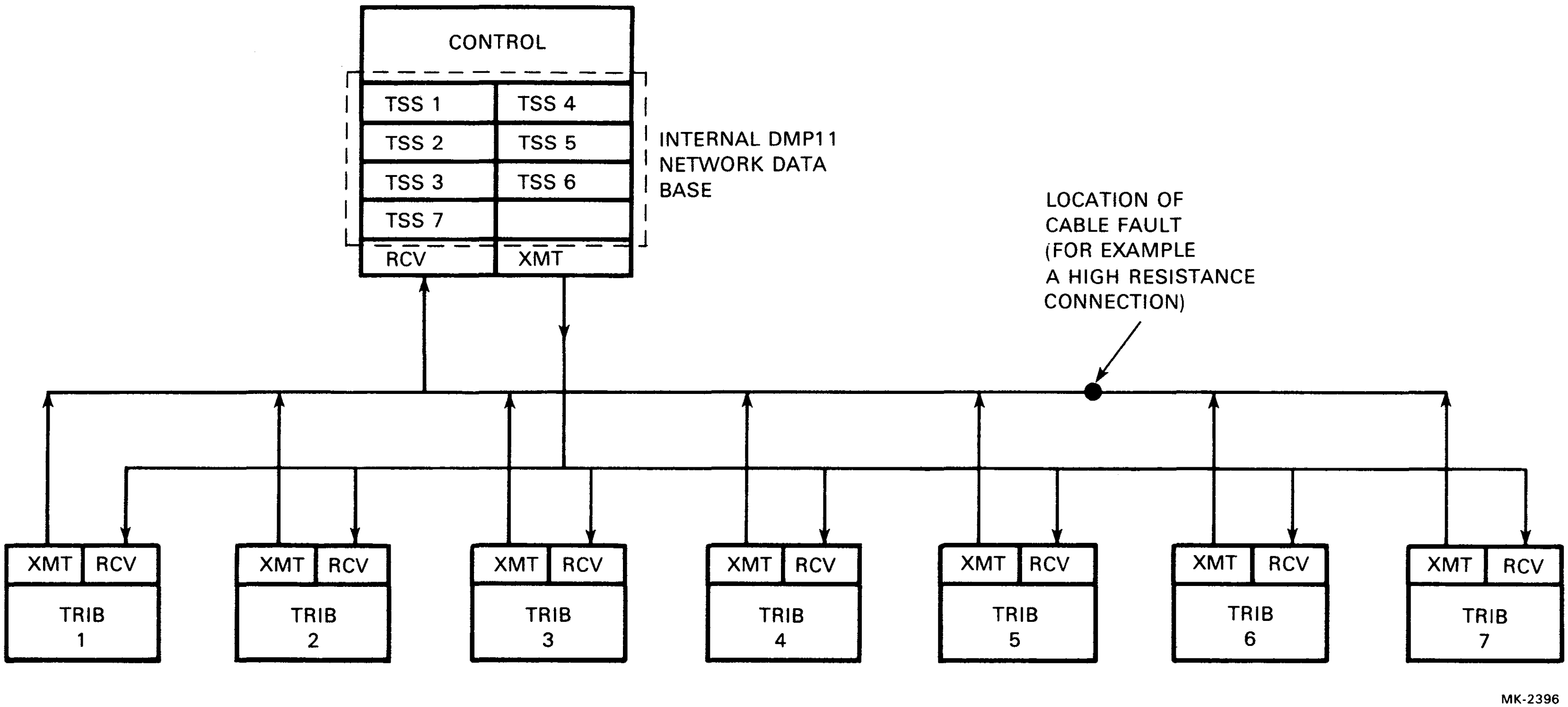


Figure 6-5 Full-Duplex Seven Tributory Multipoint Network

The problem appears to be an intermittent cable fault on the control station's receive line (tributaries transmit line) between tributaries five and six. (Note that this can be a modem related problem if tributaries six and seven share the same modem by using a modem splitter.) More information about the problem can be found by examining the error counters at the tributary end of the link.

ERROR COUNTERS FOR TRIBUTARY SEVEN (AT THE TRIBUTARY STATION)

DATA ERRORS OUTBOUND = 255 (IREP, IDBCC, IHBCC)
DATA ERRORS INBOUND = 0
LOCAL REPLY TIMEOUTS = 23
REMOTE REPLY TIMEOUTS = 40
LOCAL BUFFER ERRORS = 0
REMOTE BUFFER ERRORS = 0
SELECTION TIMEOUTS = N/A
DATA MESSAGES TRANSMITTED = 310
DATA MESSAGES RECEIVED = 420
SELECTION TIMEOUTS = N/A

Note that these error counters provide the same type of information as the control station error counters. The errors all appear to be in one direction; that is, outbound. Note also that the number of data messages transmitted and received match those at the control station. Because data transfer is occurring, the chance of a hard error in the hardware is low.

NOTE
Hard errors at the control or tributary stations usually are discovered during the start-up sequence.

Examination of the remainder of the tributary's error counters shows that tributary six has errors similar to tributary seven and the other tributaries have very few errors. The slow running of the network is because of the:

- Timeouts that occur from time-to-time when polling tributaries six and seven and
- A number of retransmissions that occur in order to get the data transferred.

These timeouts and retransmissions of data are the result of a cable fault between tributary five and six, as indicated in Figure 6-5.

NOTES

1. **If failures occur at the control station, they are indicated by the fact that in most events all stations are affected.**
2. **Hard errors at the control or tributary stations usually are discovered during the start-up sequence.**

6.4 MAINTENANCE FUNCTIONS/MAINTENANCE MODES

The maintenance functions are available to the DMP11 via the maintenance control and status register (CSR) (BSEL 1).

6.4.1 Microprocessor Control Command Register

This register is in the high byte of address 76XXX0. A description of the CSR byte is provided in the system programming chapter (Chapter 3). The byte format and bit descriptions are in the following sections.

BSEL1 has all maintenance functions, including master clear, and is not for typical user communications between the user program and the microprocessor. These functions override all other control functions. All bits are read/write. Only master clear is functional if the BSEL1 lock out switch is set (refer to Chapter 2). Table 6-1 describes the bit functions of BSEL1. More details are available in Section 3.3.1.1.

6.4.2 Maintenance Modes

The DMP11 microprocessor can be tested by two basic modes:

- Maintenance and
- System test (free-running).

The DMP11 line unit can be tested by three basic modes:

- Single step internal maintenance,
- System test internal maintenance, and
- External maintenance.

6.4.2.1 Maintenance Mode – The maintenance mode can be invoked using selected bits of BSEL1. These can be used to halt the microprocessor (clear bit 15), step the microprocessor (set bit 8), examine the current CROM location (assert bit 10 and examine SEL6), and override the current CROM instruction with a different instruction and execute that new instruction (load SEL6 with the new instruction and assert bits 8 and 9). Refer to the *M8207 Maintenance Manual* for more information.

NOTE

1. **Be sure that BSEL1 lock out BST switch 1, E85 is ON to allow access to the maintenance bits in BSEL1.**

2. **With the BST switch OFF, it is possible to master clear the microprocessor by setting bit 14 of BSEL1.**

6.4.2.2 System Test – System test mode tests the performance of the microprocessor and line unit while running at full speed and using the control ROM.

NOTE

Run inhibit switch 7, E28 must be ON to use this mode and confirm typical operating conditions.

6.4.2.3 Single Step Internal Maintenance Mode – The user program selects this mode by setting LU loop bit 11 and clearing run bit 15 of SEL0. This allows for checking most of the line unit without disconnecting the M8203 from the modem or from the triaxial cable. Line unit signal D8 LPBKL is set to keep the transmitter output active, looping the output back at TTL levels to become the receiver input. Line unit request to send (RTS) and data terminal ready (DTR) signals are held cleared. The clocking source is the D16 step LU signal from the microprocessor, which becomes D1 step LU at the line unit. The user program generates the clock signal which toggles step line unit bit 12 of SEL0.

6.4.2.4 System Test Internal Maintenance Mode – The user program selects this mode by setting line unit loop bit 11 and run bit 15 of SEL0. This mode allows the program to perform an off-line system test by free-running the DMP11 and checking the line unit without disconnecting the M8203 from the modem or from the triaxial cable. The transmitter output is looped back at the TTL level to become the receiver input. The clock source is the DMP11 maintenance clock, which is 48K b/s.

Table 6-1 BSEL 1 Bit Descriptions

Bit	Name	Description
0	Step μP (Step Microprocessor)	When set, moves the microprocessor through one instruction cycle which is usually made up of three, 60 ns pulses. The run bit should be cleared before executing this control function.
1	ROM In	When set, routes the contents of SEL6 as the next microinstruction to be executed by the microprocessor when step μP or run is set.
2	ROM Out	When set, modifies the source paths for SEL6 to have the contents of the addressed CROM. If ROM out and step μP are set, then the contents of the next CROM address will output to SEL6. The PC points to the address of the CROM.
3	LU Loop (Line Unit Loop)	When set, connects the line unit's serial line OUT, back to its serial line IN. This loopback is done at the TTL level before level conversion. When the LU loop bit is set and the run bit (bit 7) is cleared, the step LU clock is the only one available for shifting data in or out. When the LU loop bit is set and the run bit is set, data is clocked at 24K b/s by the maintenance clock. If the LU loop bit is cleared and the run bit set, the loopback test connector is needed in order to perform loopback testing.

LU Loop	Run	Clock Source	Mode
Set	Clear	Step LU (bit 12 via program)	Single step internal maintenance
Set	Set	Maintenance clock @ 24K b/s	System test internal maintenance
Clear	Set	Maintenance clock determined by rate select SWs	External maintenance

Table 6-1 BSEL 1 Bit Descriptions (Cont)

Bit	Name	Description
		NOTE **The DMP11 must be set up in full-duplex mode to run in any loopback maintenance mode. For external loopback mode, cable test connectors H3250 or H3251 or module test connectors H3254 or H3255 are needed.**
4	Step LU (Step Line Receiver)	With the run bit cleared and bit 4 set, the transmitter shifts; when bit 4 is cleared, the receiver shifts. This control function is used with LU loop bit 11 to assume transmit and receive clocks for line unit maintenance in single step maintenance mode.
5	Boot	When set, this bit causes the DMP11 at a remote multipoint station to request the control station to invoke the primary MOP boot procedure after that station has been shut down or as a result of a software failure. In point-to-point networks, the DMP11 having the boot bit set requests the other station to start the procedure.
6	MCLR (Master Clear)	When bit 6 is set, MCLR initializes both the microprocessor and the line unit. This bit is self clearing. The microprocessor clock is enabled and the run bit is set, placing the DMP11 in the initialized state. The microprocessors program counter is also temporarily cleared by MCLR.
7	Run	Run controls the microprocessor clock; bit 7 is set by BUS initialization or master clear, which enables the microprocessor clock. Run can be cleared for maintenance by the run inhibit switch (E28). See D16 of the *M8207-YA Print Set*. The BST switch is provided to prevent run from being cleared by a runaway microcode program when the microprocessor malfunctions. Detailed discussion of the run inhibit switch is in Chapter 2.

6.4.2.5 External Maintenance Mode – The user program selects the external maintenance mode placing the DMP11 in the usual running mode (bit 11 clear and bit 15 set). The cable is terminated with a test connector based on the use of DMP11 option. The termination may be made at the BC55* panel or at the modem end of the external cable (See Figure 2-6).

The DMP11 options are configured as follows:

1. DMP11-AA (for RS-232-C; RS-423-A)

   - The modem must be disconnected and the test connector must be attached to the cable. This may be done at the BC55C panel or at the modem end of the external cable.

	Test Connector	Interface Cable	Modem Cable
RS-232-C	H325	BC55C-10	BC05D-25
RS-423-A	H3251	BC55C-10	BC55D-33

- Data rate switches (switches 8, 9, and 10 of E39) select the clock rate. This clock signal is looped back in the test connector to simulate modem transmit and receive clocks. The data rate for this application must not exceed 56K b/s.

- Modem control signals are tested for correct level conversion and cable paths. These signals are looped back in the test connector as shown in the signal flow of Figure 2-5E.

2. DMP11-AB (CCITT V.35/DDS)

   - The modem must be disconnected and the H3250 test connector must be attached to the BC05Z-25 cable.

   - Data rate switches (8, 9, and 10 of E39) select the clock rate. This clock signal is looped back in H3250 to assume modem transmit and receive clocks.

   - Modem control signals are tested for correct level conversion and cable paths. These signals are looped in the H3250 as shown in the signal flow of Figure 2-5B.

3. DMP11-AC (for integral modem local use)

   - The local link connections of the BC55A connector panel are disconnected at the local panel and the FDX switch on the BC55A connector panel is switched to half-duplex to do the external loopback.

   CAUTION
   If the DMP11 is connected to another running DMP11, disconnect the cable at the BC55A connector panel during diagnostic execution.

   - Data rate switches (8, 9, and 10 of E39) select the clock rate. This data is looped back through the BC55A connector panel to test, transmit, and receive data. The data rate for this application must not be less than 56K b/s.

4. DMP11-AE (for RS-422-A interface)

   - The modem is disconnected and an H3251 test connector is attached to the BC55D-33 cable or the BC55B panel.

   - Data rate switches (8, 9, and 10 of E39) select the clock rate. This signal is looped back through the H3251 to assume modem transmit and receive clocks.

   - Modem control signals are tested for correct level conversion and cable paths. These signals are looped in the H3251 as shown in the signal flow of Figure 2-5D.

6.4.3 Maintenance (LED) Indicators

Six light-emitting diodes (LEDs) are installed on the M8203 line unit to permit a visual check of certain conditions. Five of these apply specifically to modem conditions. The other LED (D15) relates to functional conditions of the DMP11. Table 6-2 provides a description of each LED while Figure 6-6 identifies the physical locations.

6.5 PREVENTIVE MAINTENANCE (PM)

There is no specific DMP11 PM schedule. A general check of voltages and connections should be done when system PM is performed. After checking DMP11 modules or cables, a complete checkout of the device, by running all diagnostics and, if possible, the interprocessor test, is needed. Special attention must be given for the following reasons:

- The DMP11 can have seating problems and
- CROM (control ROM) chips installed in sockets are easily moved during removal and replacement of the M8207-YA module or adjacent modules. The CROM chips may accidentally come in contact with the etch side of the adjacent module.

6.6 CORRECTIVE MAINTENANCE ON A PDP-11 PROCESSOR

Because the FRU is either a module or cable, all corrective diagnosis should be directed towards isolating the failing FRU. DMP11 diagnostics are designed to help in the isolation process and should be run starting with the M8207 microprocessor test and continuing to the DEC/XII program. The correct sequence of diagnostics is as follows:

Diagnostic	Description
CZDMP*	M8207 Microprocessor Static Diagnostic 1
CZDMQ*	M8207 Microprocessor Static Diagnostic 2
CZDMR*	M8203 Microprocessor Static Diagnostic 1
CZDMS*	M8203 Microprocessor Static Diagnostic 2
CZDMT*	DMP11 Microprocessor Functional Diagnostic
CZCLM*	DMP11 DCLT program
CXDMD*	DMP11 DEC/XII Master Module
CXDME*	DMP11 DEC/XII Slave Module

Table 6-2 Maintenance Indicators

Designation	Name	Description
D10	Signal Quality	A signal from the modem that indicates the presence or absence of the carrier. When this signal is ON it indicates the presence of the carrier and OFF indicates an absence of the carrier.
D11	Carrier	Indicates that the carrier is present at the receiver.
D12	Receiver Data	When ON, indicates that a steady stream of ls are being received.
D13	Transmit Data	When ON, indicates that a steady stream of ls are being transmitted.
D14	Request to Send	When ON, indicates that the USYRT is ready to start transmitting as soon as clear to send is detected.
D15	Diagnostics	When ON, indicates microdiagnostics are running. When the microdiagnostics complete successfully, this indicator goes off.

*Indicates the revision level

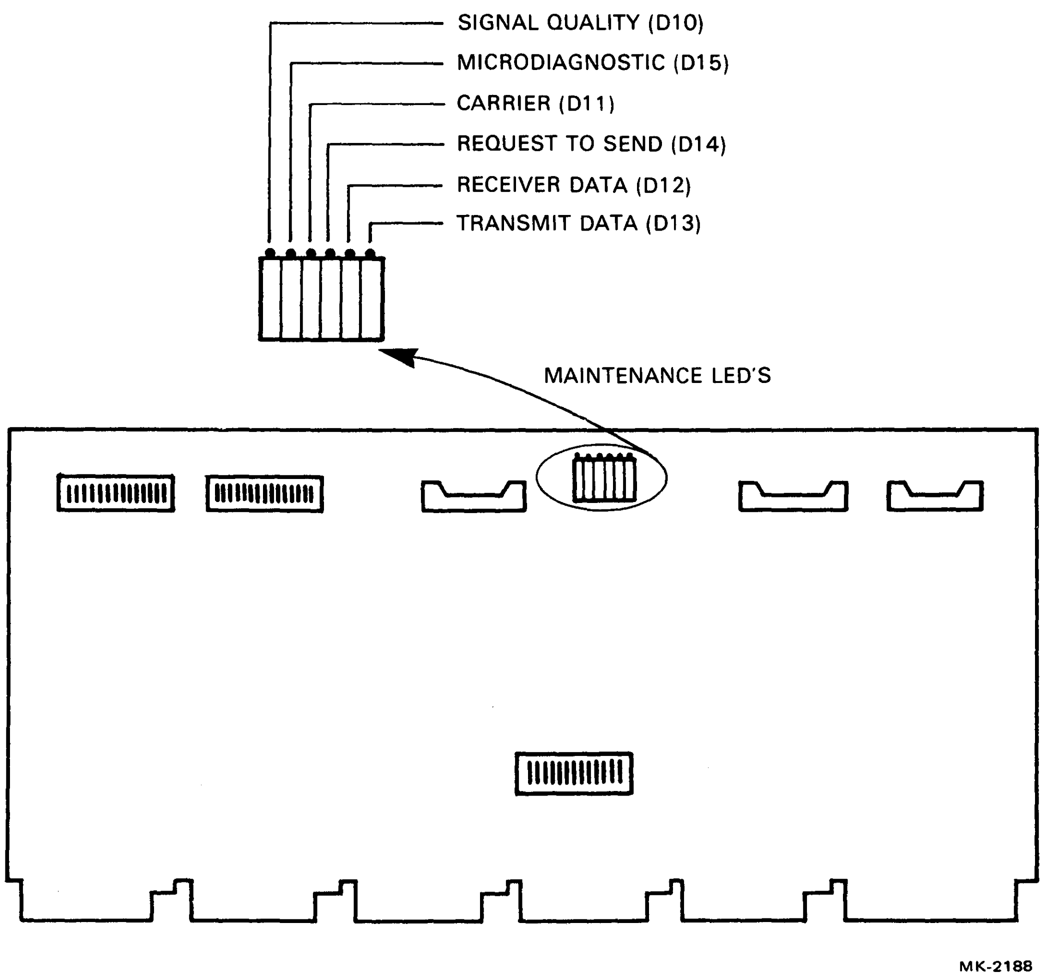


Figure 6-6 M8203 Maintenance LED Locations

6.6.1 CZDMP*/CZDMQ*

These diagnostics test the M8207-YA microprocessor in two parts. Through dialogue with the operator and by using the diagnostic supervisor (DS), the program allows for the adjustment of device parameters, such as the UNIBUS address, vector address, and processor type.

This program is compatible with the stand-alone diagnostic supervisor and does not exceed 16K of memory. Refer to Appendix C for details on the diagnostic supervisor.

The total time needed to run M8207 static tests is approximately from 30 seconds to 2 minutes per pass, depending on the CPU type.

CZDMP* and CZDMQ* are compatible with XXDP+, ACT/SLIDE, and APT. XXDP+ and ACT/SLIDE may be run in dump or chain modes. APT can be run in program or script modes.

Memory management is not used in this program and, if installed, it is disabled. If parity memory is installed, memory parity traps are disabled.

A summary of the tests performed are listed in Tables 6-3 and 6-4. All tests support the DMC11, KMC11-A, DMR11, and DMP11. However, some tests listed in Table 6-4 are not executed on certain devices. Refer to Table 6-4 for these exceptions. For more detail, refer to the diagnostic listings.

6.6.2 CZDMR*/CZDMS*

These diagnostics perform static tests of all M8203 logic. These include line unit register addressing, USYRT addressing, static bit interaction and read/write logic tests, basic transmitter/receiver sequencing and data buffering, and static operations in character and bit-stuffing modes. In addition, data messages are sent on the line unit at TTL level, or through an external test connector with a specific modem interface selected.

Static logic tests provide troubleshooting capabilities such as tight scope loops, switch options, and the ability to lock on intermittent errors. Added tests provide fault isolation to allow for replacement of the smallest field replaceable unit.

These programs conform to the stand-alone version of the diagnostic supervisor and are compatible with ACT, APT, XXDP+, and SLIDE. Through dialogue with the operator, the programs permit modifications of device parameters such as the UNIBUS address, vector addresses, and device priority. The operator can specify specific tests to be run and a number of looping, running, and reporting modes. Refer to Appendix C for details on the diagnostic supervisor.

Device errors are reported as they occur. The report includes the test number and error description, good and bad test data, and allowable device register contents.

A summary of the tests performed are listed in Tables 6-5 and 6-6. For more detail, refer to the diagnostic listings.

6.6.3 CZDMT*

The CZDMT* diagnostic performs testing on the DMP11 option in a functional way to verify its correct operation under microcode controlled use of the DDCMP. This includes a ROM CRC/CCITT check, microdiagnostic, command use, and error generation.

This functional test provides troubleshooting capabilities such as tight scope loops, switch options, and the ability to lock on intermittant errors. Also, this program conforms to the stand-alone version of the diagnostic supervisor and is compatible with APT, ACT, XXDPT, and SLIDE. Refer to Appendix C for details on the diagnostic supervisor.

Table 6-3 CZDMP* Diagnostic Summary

Test Number	Description
1	Verifies that referencing UNIBUS device registers does not cause a T/O trap
2	Verifies that run can be cleared
3	UNIBUS register word, dual addressing test
4-8	Control status register write/read tests
9	Port 4 register write/read test
10	Port 6 register write/read test
11	UNIBUS register byte, dual addressing test
12	Maintenance instruction register test
13	Microprocessor test
14-27	Microprocessor IBUS/IBUS* register write/read tests
28	Microprocessor IBUS/IBUS* dual address test
29	Microprocessor BR register test
30	Scratchpad test
31	Scratchpad dual addressing test
32,33	Interrupt tests
34,35	Priority interrupt tests
36-38	NPR tests
39,40	Test of extended address (EA) bits 16 and 17
41,42	NPR non-existent memory test
43	NPR test
44	ALU C-bit test
45-76	ALU tests

Table 6-4 DZDMQ* Diagnostic Summary

Test Number	(M8200) DMC11	(M8204) KMC11-A	(M8207) DMR11 DMP11	Description
1				Verifies that referencing UNIBUS device registers does not cause a timeout.
2				BR right shift test
3,4	S		S	IOP CRAM write/read test
5	S		S	IOP CRAM dual addressing test
6,7				IOP main memory test
8				IOP main memory dual addressing test
9	S	S		IOP MAR test (4K main memory)
10	S		S	IOP (CRAM) ODT bits test
11	S		S	CRAM tests of jump(i)
12-24	S		S	CRAM tests of jump(i)
25	S	S		4K Main memory page dual address test
26	S	S		Jump field, page test
27,28	S	S		Jump test
29	S	S		Z bit test
30	S	S		C bit test

Table 6-4 DZDMQ* Diagnostic Summary (Cont)

Test Number	(M8200) DMC11	(M8204) KMC11-A	(M8207) DMR11 DMP11	Description
31				Program clock bit test
32				Force power fail test
33				Microprocessor noise test
34				NODST instruction test
35	S	S	S	Extended CRAM test (M8206 only)
36	S	S	S	Microcode test (M8206 only)
37				Negative address test
38				Byte addressing test
39	S	S		PC register test
40	S	S		Branch field H test
41				Scratchpad 0 (SP0) selection test
42	S	S		MOV INST H signal test
43				Master clear test

*S = Test Skipped

Table 6-5 CZDMR* Diagnostic Summary

Test Number	Description
1	Microprocessor CSR addressing test (SEL 0)
2	INBUS/OUTBUS register 14 initialization test
3	INBUS/OUTBUS register 14 read/write bit test
4	Register 14 master clear test
5	Register 14 UNIBUS reset (INIT) test
6	Line unit false selection test
7	Inbus register master clear test
8	Register 10-17 addressing test
9	Register 11 read/write bit test
10	Register 12 read/write bit test
11	Register 13 read/write bit test
12	Register 17 read/write bit test
13	Maintenance clock bit test
14	Extended register master clear test
15	Extended register addressing test
16	Registers 15, 16/AX2-15, AX2-16 read/write bit test
17	AX0-15, AX0-16 read/write bit test
18	AX1-15, AX1-16 read/write bit test
19	AX3-15, AX3-16 read/write bit test
20	Register 17 AX2-16 read/write, master clear test
21	Transmitter buffer data test
22	Transmitter buffer sequencing test
23	TX MSG timing test, character mode with CRC
24	TX MSG timing test, bit mode with CRC
25	TX MSG timing test, character mode with no CRC
26	TX underrun set and clear test, character mode
27	TX character length timing test, character mode with CRC
28	TX character length timing test, bit mode with CRC

Table 6-5 DZDMR* Diagnostic Summary (Cont)

Test Number	Description
29	TXDATA bit test, character mode with no CRC
30	USYRT RCV MSG test, character mode with CRC
31	USYRT RCV MSG test, bit mode with CRC
32	USYRT RCV MSG test, character mode with no CRC
33	USYRT RCV MSG test, bit mode with no CRC
34	Silo-disabled transmitter load test
35	Silo-disabled MSG test, bit mode with no CRC
36	RCV buffer test, character mode with CRC
37	RCV character length timing test, character mode with no CRC
38	RCV character length timing test, bit mode with no CRC
39	TX underrun error, idle marking character mode with no CRC
40	MSG termination with go ahead (GA) characters, bit mode with no CRC
41	Idle sync test, character mode
42	Strip sync test

Table 6-6 CZDMS* Diagnostic Summary

Test Number	Description
1	Bit stuffing test
2	RCV overrun error, set and clear test
3	Abort sequence test
4	Abort and idle flags test
5	TX underrun error, idle abort characters, bit mode
6	RCV disable test
7	Assembled bit count test
8	Secondary station address bit test
9	All parties address bit (RDALL) test
10	Insert error bit (IERR) test, character mode with no CRC
11	Switch pack printout and test
12	Register AX3-15 printout
13	CRC generation test
14	CRC error detection test
15	VCR parity generation test
16	VCR error detection test
17	Integral modem interface test, character mode with CRC
18	V.35 modem interface test, character mode with CRC
19	RS-232-C and RS-423-A modem interface test, character mode with CRC
20	RS-422-A modem interface test, character mode with CRC
21	Half-duplex bit (HALF DUPX) test
22	Half-duplex RCV disabled test, with silos disabled
23	Interaction of modem control bits
24	Data test, bit mode with no error detection
25	Data test, character mode with no error detection
26	Data test, bit mode with CRC-CCITT-1 error detection
27	Data test, bit mode with CRC-CCITT-0 error detection
28	Data test, character mode with CRC-16 error detection
29	Data test, character mode with odd VRC error detection
30	Data test, character mode with even VRC error detection
31	Contiguous ones in secondary station address mode, bit mode
32	DDCMP MSG test, character mode

Through dialogue with the operator, the program permits modification of device parameters such as the UNIBUS address, vector addresses, and device priority. The operator can specify certain tests to be run and a number of looping, running, and reporting modes.

A summary of the tests performed are listed in Table 6-7. For more detail, refer to the diagnostics listings.

6.6.4 DMP11 Microdiagnostic Error Reporting

The microdiagnostics for the DMP11 are made up of two microprograms: internal diagnostics and interface diagnostics.

Internal diagnostics test registers and data paths that are internal to the microprocessor. These diagnostic routines run automatically on a master clear and must complete successfully before regular interaction with the PDP-11/VAX-11 can take place.

The user program is informed of the results by way of the CSRs. Table 6-8 is a summary of the possible results.

Interface diagnostics test registers and data paths used for transfer of information between the PDP-11/VAX-11 and the microprocessor. These routines run on request by the user program and exercise the datapaths in the multiport RAM from the microprocessor side.

The interface microdiagnostics are a set of diagnostics that run with external diagnostics. The interface microdiagnostics are started by a command from the external diagnostics to the DMP11 microde. These microdiagnostics can only be run in this way and will neither detect nor report errors. It is the responsibility of the external diagnostics to monitor and interpret test results.

The microdiagnostics perform six tests:

1. Window register test #1 – This test writes all ones to the window registers (BSEL0 and BSEL2-BSEL7). The external diagnostics must read and verify that the registers were written correctly.

2. Window register test #2 – This test writes all zeros to the window registers. The external diagnostics must read and verify the registers.

3. Interrupt test #1 – This test causes the micro-CPU to interrupt to vector xx0.

4. Interrupt test #2 – This test causes the micro-CPU to interrupt vector xx4.

5. NPR data transfer test – This test performs one NPR in and one NPR out. The external diagnostics provide the input and output addresses and request a number of these transfers before the test is exited.

6. "Hog bit" test – This test, when requested by the external diagnostics, does 256 NPRs in with the "not last transfer" bit set. This takes the UNIBUS for a minimum of 100 microseconds. After the NPRs are complete, an interrupt to vector xx0 is made.

   The external diagnostic must set up a count register and vector xx0 before starting the "Hog bit" test. When started, the test enters a count loop. If the test is successful the final count is less than five.

NOTE

Refer to the diagnostic listings for detailed operating procedures of CZDMP*, CZDMQ*, CZDMR*, CZDMS*, and CZDMT*.

Table 6-7 CZDMT* Diagnostic Summary

Test Number	Description
1	Address Test – Verifies all CSR addresses.
2-7	ROM Verification Test – Verifies that all ROMs are in place and that the contents are correct.
8-9	Not used on DMP11.
10	Initialization Test – Does master clear and waits for completion of microdiagnostics.
11	Interface Diagnostic – Runs additional microdiagnostic code to verify interrupt and NPR logic.
12	RDI Remains Set Test – Verifies that RDI sets and remains set.
13	RDO Sets Test – Verifies that RDO sets when a control-in command of "read modem" is issued.
14	Procedure Error 100 Test – Verifies that a procedure error of 100 (non-mode definition command after a master clear) can be generated.
15	Procedure Error 104 Test – Verifies that a procedure error of 104 (illegal mode change) can be generated.
16	Mode Change of Duplex Portion Test – Verifies that no procedure error occurs when changing full-duplex to half-duplex.
17	Maximum Tributaries Test – Verifies that maximum tributaries can be assigned and that a procedure error of 114 results when one more than maximum tributaries is tried. Verifies that a procedure error of 116 results when a try is made to assign an already assigned tributary.
18	Read/Write Tributary Status Slot Test – Verifies that each TSS can be written and read correctly.
19-20	Procedure Error 132 Test – Verifies that a procedure Error of 132 (try to write into a reserved area of the TSS) is produced.
21	Read/Clear Command Test – Verifies that the read/clear command operates correctly.
22	Global Status Slots Test – Verifies the GSS for read and write operations.
23	Halt Tributary Command Tests – Verifies the halt tributary command.
24	Kill Tributary Command Test – Verifies proper operation of the kill tribitary command.
25	Procedure Error 102 Test – Verifies that a procedure error of 102 (illegal type code used in an input command) can be produced.
26	Procedure Error 110 Test – Verifies that a procedure error of 110 can be produced. (Try to perform a non-global command for tributary address of 0.)
27	Procedure Error 120 Test – Verifies that a procedure error of 120 (illegal request key on control-in).
28	Procedure Error 134 Test – Verifies that a procedure error of 134 (try to use reserved bit is BSEL7 on control-in).
29	Latch/Unlatch Poll Check – Verifies that the latch and unlatch poll commands operate correctly.
30	Short Message Sending Test – Verifies that receive buffers returned and data is correct for short messages.
31	Procedure Error 122 Test – Verifies that a procedure error of 122 (try to assign a buffer for a not assigned tributary) can be produced.
32	Procedure Error 124 Test – Verifies that a procedure error of 124 (try to assign a buffer for a halted tributary) can be produced.
33	Procedure Error 126 Test – Verifies that a procedure error of 126 (try to assign a buffer with a byte count of 0) can be produced.

Table 6-7 CZDMT* Diagnostic Summary (Cont)

Test Number	Description
34	Procedure Error 130 Test – Verifies that a procedure error of 130 (try to assign or transmit buffer for tributary 0) can be produced.
35	Point-to-Point DDCMP Transmit/Receive Test – Verifies that 256 bytes can be transmitted and received correctly using point-to-point full-duplex.
36	Multipoint DDCMP Transmit/Receive Test – Verifies that 255 bytes can be transmitted and received correctly using multipoint full-duplex.
37	Modem Register Read/Write Test – Verifies that the modem registers be written and read correctly.
38-40	Memory Extension Bits Test – Verifies that transfers can be made to user memory if it exists. Transfers are made using bit 16, bit 17, and bits 16 and 17.
41	Point-to-Point Transmit/Receive Starting at Odd Byte – Verifies that transfers can be made starting at an odd byte boundary using DDCMP point-to-point.
42	One Byte Odd to Even Transmit/Receive Test – Verifies that transfers can be made from an odd transmit buffer to an even receiver buffer using multipoint.
43	Polling State Tests – Verifies that polling state degrades from active to inactive, to potentially dead to dead.

Table 6-8 Internal Diagnostic Results

BSEL 6	BSEL 4	Indication
143	Random	The internal register test failed. The microcode is in a loop.
135	100	The data RAM test failed. The microcode is in a loop.
125	100	The ALU test failed. The microcode is in a loop.
264	100	The line unit test failed. The microcode is in a loop.
305	100	The line unit test failed. The microcode will interact with the PDP-11/VAX-11. This code usually indicates that a line unit is not connected to the microprocessor.
305	77	The microdiagnostics completed with no errors.

6.6.5 Data Communications Link Test CZCLM* (DCLT)

DCLT is a communications equipment maintenance tool designed to verify DMP11 to DMP11 communication links. The DCLT program provides the coverage necessary to isolate the following faults:

- Communications interface program functionality,
- Communication modem,
- Communication cable routing and installation, and
- Physical link/network.

DCLT programs allow testing between modes with different hardware interfaces implementing the same or compatible protocol. The DCLT program can be exercised under normal maintenance loopback tests:

- Internal TTL loopback,
- Hardware loopbacks:
  - Module test connectors or,
  - Cable test connectors,
- Manual controlled local modem analog and digital loopback functions (full-duplex mode)
- Programmable controlled local modem analog loopback (full-duplex mode),
- Programmable controlled remote modem digital loopback (full-duplex mode).

The main goal of DLCT is to test the communications link and therefore assumes that the CPUs, clocks, and DMP11s at each end of the link have previously been tested and found to be in the correct working order.

Before studying any data, the user must have a complete understanding of the protocol formats for the system under test.

DCLT may be used to access DMP11 error counters or other information by using the print command. The print command invokes a DCLT level called report within which the following commands are available.

Command	**Description**
HELP or ?	Prints help information for RPT>
TSS NNN/SW	Shows tributary status slot information where NNN is the decimal tributary and ADDR and SW are one of the following switches
ERROR	Indicates only error slots are to be printed
FULL	Indicates all tributary status slots are to be printed
OFFSET = NN	Indicates the tributary status slot whose offset is NN is to be printed
GSS/SW	Prints the global status information. Switches are the same as for TSS
LOG	Dumps the event log
EXIT	Exits back to the command level that you entered from. [DCLT> or DP>]

DCLT is XXDP+ or APT compatible and runs under control of the diagnostic supervisor (DS). It needs 24K of memory. For more information on DCLT, refer to CZCLM* document.

6.6.6 DEC/X11 DMP11 Modules

There are two DEC/X11 modules for the DMP11: DMD* and DME*. Together these two modules can operate:

- Up to 16 DMP11 devices in point-to-point links.

- A single DMP11 configured as a multipoint control station communicating with up to 32 tributaries.
- Up to 16 devices configured as multipoint tributaries on the same PDP-11 UNIBUS.

These modules transmit, receive, and check 32 data messages of 1024 bytes each on a given physical link. By default, this involves a single PDP-11 system with one or more devices operated in internal or external loopback mode. By operator selection of non-default modes, however, actual point-to-point or multipoint operation is possible.

6.6.6.1 DMD* – DMD* is the master module. It can operate up to 16 DMP11 devices in looped back, point-to-point modes or a single device in multipoint control mode. DMD* can be self-sufficient or it can communicate with slave modules on the same or another processor.

A separate DMD* module is needed for each group of looped back DMP11 devices, each control station, or each group of point-to-point devices.

The actual operating mode for each DMD* module is selected by software switch registers for that module. The DMD* module uses switch registers SR1-SR3 as follows:

SR1 has three values: 0, 1, or 2

When SR1 = 0:

- All selected DMP11s run in point-to-point, full-duplex mode, with internal or external loopback on all devices.
- SR2 has the following meaning:

  If SR2=0, internal loopback is provided by the program. This is done using TTL-level loopback on the line unit. SR2=0 is the default mode of operation.

  If SR2=1, external loopback is provided by H3254 or H3255 test connnectors on each device. In this case the modem interface must be selected for testing by using SR3.

  - V.35 is selected when SR3=0 (Default)
  - Integral modem is selected when SR3=10
  - V.35 is selected when SR3=20
  - RS-449/RS-232-C/RS-423-A is selected when SR3=100
  - RS-422-A is selected when SR3=200

If SR2=2, cable loopback is provided by the H3250 or H3251 test connectors.

When SR1=1:

- All selected DMP11s run in point-to-point, full- or half-duplex, without loopback.
- The DMD* module communicates with DME* (slave) modules on the same or other PDP-11 systems.
- Other software switch registers are not used.

When SR1=2:

- Only one DMP11 is selected

- The selected DMP11 runs in multipoint control, full- or half-duplex mode, without loopback.
- The DMD* module communicates with DME* (slave) modules on the same or other PDP-11 systems.
- SR2 = the total number of tributaries on this multipoint link. The range is from 1 to 40_8.
- SR3 = the starting tributary address. The program uses this starting address to compute the other addresses. The address range is from 1 to 377_8 and they may wraparound (377 to 1) if necessary.

6.6.6.2 DME* – DME* is the slave module. It can operate up to 16 DMP11 devices in point-to-point slave or multipoint tributary modes. A separate DME* module is needed for each group of point-to-point slaves or multipoint tributaries on a system.

As with the DMD* module, the actual operating mode for each DME* module is selected by software switch registers for that module. The DME* module uses software switch registers SR1-SR3 as follows.

SR1 has two values: 0 and 1

When SR1 = 0:

- All selected DMP11 devices run in point-to-point slave, full- or half-duplex mode, without loopback.
- The DME* module communicates with the DMD* (master) modules on the same or other PDP-11 systems.
- SR2, SR3, and SR4 are not used.

When SR1 = 1:

- All selected DMP11 devices run in multipoint tributary, full- or half-duplex mode, without loopback.
- The DME* module communicates with a DMD* (master) module on the same or another PDP-11 system.
- SR2 = the total number of tributaries on the multipoint link on this CPU. The range is from 1 to 40_8.
- SR3 = the starting tributary address. The program uses this starting address to compute the other addresses. The address range is from 1 to 377_8 and they may wraparound (377 to 1) if necessary.

NOTE

If the DMP11 DEC/XII modules are configured to run in link mode, it is recommended that the exerciser be started in run lock mode. If this is not done, the exerciser may hang.

6.6.7 Soft Error Reports Under DEC/X11

Soft errors indicate errors which occurr causing a message retransmission. The DMD* module requests data errors inbound and outbound for each pass. If any errors are present, they are reported as soft errors. The soft error report may be used in the isolation of certain DMP11 failures from UNIBUS loading or data late problems.

The DMP has no data late bit or capabilities for detecting the fact that it did not get bus mastership in time to service the synchronous line. The DMP11 sees such a condition as an error in the synchronous data stream (a BCC error, transmitter underrun, or receiver overrun) and DDCMP causes the message to be retransmitted. This causes error counters in DMP11 RAM memory to increase. A process of elimination must be used to determine whether soft errors (BCC) are caused by bus latency or failing DMP11 hardware.

Usually, the DMP11 should show no errors when running in a local loopback mode. This is usually a noise-free circuit. Therefore, any soft error reports should be examined and the cause isolated.

If soft errors are reported while running a DMP11 on a completely loaded system (other devices being exercised), they may be because of bus latency. This may be verified by running only the DMD*DEC/X11 module with only one DMP11 enabled. If the soft errors discontinue, a latency condition is indicated.

If soft errors continue while running only the DMD*DEC/X11 module, the DMP11 device diagnostics should be run. The problem can be a faulty DMP11 or cable.

SR1 and SR2 (bit 0) may be used in the isolation process. If SR1=0 and SR2=1, DEC/X11 does not set line unit loopback but it uses an external turnaround. By running with SR1=0 and SR2=0, a TTL loopback is performed. This proves that the ending cable/turnaround connector is not faulty.

TTL loopback eliminates the level converters and the integral modem. The bit rate selected is 48K b/s using the maintenance clock.

6.7 CORRECTIVE MAINTENANCE ON A VAX-11/780

Because the FRU is either a module or cable, all corrective diagnosis should be directed to isolating the faulty FRU. DMP11 diagnostics are designed to help in the isolation process and should be run starting with the basic microprocessor test. The correct diagnostics sequence is as follows:

Diagnostic	Description
EVDXA REV 3.0 and Above	COMM Microprocessor Repair Level Diagnostics (Level 3)
EVDMA REV *.*	M8203 Line Unit Repair Level Diagnostics
EVDMB REV *.*	VAX DMP11 Functional Diagnostic

6.7.1 EVDXA *.* COMM Microprocessor Repair Level Diagnostics

This diagnostic performs tests on the M8207-YA microprocessor. It includes device initialization, register and RAM addressing, read/write testing, interrupt generation and priority, NPR operation and addressing, ALU functions and the microprocessor instruction set, and INBUS/INBUS* and OUTBUS/OUTBUS* testing. This program performs many of the tests in maintenance mode by moving the microprocessor through several instruction sequences. This program will be run at VAX Level 3, which is a stand-alone repair level.

6.7.2 EVDMA REV *.* M8203 Line Unit Repair Level Diagnostics

This diagnostic performs register and USYRT addressing tests, static bit-interaction and read/write logic tests, basic transmitter and receiver sequencing tests, and static operation in character and bit-stuffing mode tests. This program performs many of the tests in Internal Loopback Mode using the USYRT maintenance bit and the line unit loopback features. In external loopback mode it uses a turn-around connector. This program is implemented as a separate VAX diagnostic, which runs at Level 3.

6.7.3 EVDMB* VAX-11/780 DMP11 Functional Diagnostic (Level 2)
The DMP11 functional diagnostic verifies the operation of a VAX/DMP11 in both point-to-point and multipoint modes.

The point-to-point configuration includes two DMP11s located on the same VAX host system or on two separate VAX systems. EVDMB supports up to 32 VAX/DMP11 based tributaries in multipoint mode.

There are eight sections in the program which include:

Maintenance Wrap – This section uses the maintenance loopback feature for testing full-duplex, point-to-point configurations. Data is looped back by the DMP11. The clock is provided. This is the default section because it needs no manual intervention.

Cable Wrap – This section effects data loopback using the H3250, H3251, H3254, H3255, or identical turnaround connector. The clock is provided by the DMP11.

Modem Wrap – This section allows data to be looped back at the modem. Depending on the specific modem in question, it supports local and remote loopback in either manual or programmable mode. The modem supplies the clock. This section supports the standard interfaces: RS-232-C, RS-423-A, RS-422-A, RS-449, and V.35.

Point-To-Point Transmitter – This section is the starter of the system to system test. It supports system to system data communications between two VAX systems. It is used with the point-to-point receiver.

Point-To-Point Receiver – This section supports system to system data communications between two VAX systems. It is used with the point-to-point transmitter.

Multipoint – This section supports a data communications link between multiple VAX/DMP11 systems in a multipoint configuration.

Functional Test – This section exercises the basic functionality of the DMP11 within the limits set by the VMS/DMP11 device driver. The tests that make up this section are a selected subset of the CZDMT* DMP11 functional tests.

Manufacturing Test – This section is made up of those tests which support the manufacturing process.

6.7.4 EVDMD* VAX DMP11 DCLT Program
DCLT is a communications equipment maintenance tool for isolating failures to either the interface, the telephone communications line, or the modem. It exercises DMP11 to DMP11 links.

DCLT runs under the control of the VAX diagnostic supervisor and needs 256K bytes of memory.

APPENDIX A
DDCMP IN A NUTSHELL

A.1 DDCMP

The Digital Data Communications Message Protocol (DDCMP) provides a data link control procedure that ensures a reliable data communication path between communication devices connected by data links. DDCMP has been designed to operate over full- and half-duplex synchronous and asynchronous channels in both point-to-point and multipoint modes. It can be used in a variety of applications such as distributed computer networks, host front-end processors, remote terminal concentrators, and remote job entry-exit systems.

A.1.1 Controlling Data Transfers

The DDCMP message format is shown in Figure A-1. Three control characters are provided in DDCMP to differentiate between the three possible types of messages:

SOH – data message follows
ENQ – control message follows
DLE – maintenance message follows

Note that the use of a fixed-length header and message size declaration obviates the requirement for extensive message and header delimiter codes.

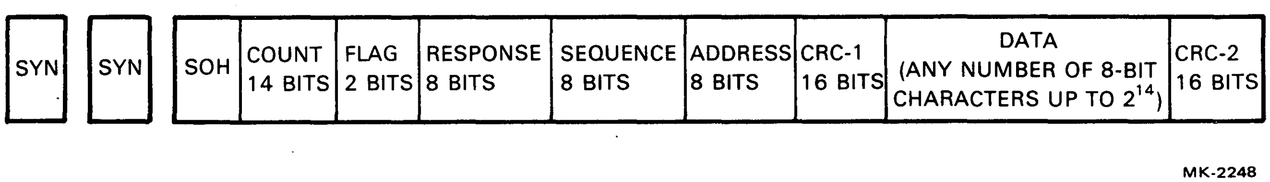


Figure A-1 DDCMP Data Message Format

A.1.2 Error Checking and Recovery

DDCMP uses a 16-bit cycle redundency check (CRC-16) for detecting transmission errors. When an error occurs, DDCMP sends a separate negative acknowledge (NAK) message. DDCMP does not require an acknowledgement message for all data messages. The number in the response field of a normal header or in either the special NAK or acknowledge (ACK) control message specifies the sequence number of the last good message received. For example, if messages 4, 5, and 6 have been received since the last time an acknowledgement was sent and message 6 is bad, the NAK message specifies number 5 which says "messages 4 and 5 are good and 6 is bad." When DDCMP operates in full-duplex mode, the line does not have to be turned around; the NAK is simply added to the sequence of messages for the transmitter.

When a sequence error occurs in DDCMP, the receiving station does not respond to the message. The transmitting station detects, from the response field of the messages it receives (or via timeout), that the receiving station is still looking for a certain message and sends it again. For example, if the next message the receiver expects to receive is 5, but receives 6 instead, the receiver will not change the response field (which contains a 4) of its data messages. The receiver will say, "I accept all messages up through message 4 and I am still looking for message 5."

A.1.3 Character Coding

DDCMP uses ASCII control characters for SYN, SOH, ENQ and DLE. The remainder of the message, including the header, is transparent.

A.1.4 Data Transparency

DDCMP defines transparency by use of a count field in the header. The header is of a fixed length. The count in the header determines the length of the transparent information field, which can be from 1 to 16,383 bytes long. To validate the header and count field, it is followed by a CRC-16 field; all header characters are included in the CRC calculation. Once validated, the count is used to receive the data and to locate the second CRC-16, which is calculated on the data field. Therefore, character stuffing is avoided.

A.1.5 Data Channel Utilization

DDCMP uses either full-duplex or half-duplex circuits at optimum efficiency. In the full-duplex mode, DDCMP operates as two independent one-way channels, each containing its own data stream. The only dependency is the acknowledgements, which must be sent in the data stream in the opposite direction.

Separate ACK messages are unnecessary, reducing the control overhead. Acknowledgements are simply placed in the response field of the next data message for the opposite direction. If several data messages are received correctly before the terminal is able to send a message, all of them can be acknowledged by one response. Only when a transmission error occurs, or when traffic in the opposite direction is light (no data message to send), is it necessary to send a special NAK or ACK message.

In summary, DDCMP data channel utilization features include:

1. The ability to run on full-duplex or half-duplex data channel facilities,

2. Low control character overhead,

3. No character stuffing,

4. No separate ACKs when traffic is heavy; this saves on extra SYN characters and inter-message gaps,

5. Multiple acknowledgements (up to 255) with one ACK, and

6. The ability to support point-to-point and multipoint lines.

A.2 PROTOCOL DESCRIPTION

DDCMP is a very general protocol; it can be used on synchronous or asynchronous, half-duplex or full-duplex, serial or parallel, and point-to-point or multipoint systems. Most applications involving protocols are half-duplex or full-duplex transmission in a serial synchronous mode; that operating environment will therefore be emphasized in this description.

The header is the most important part of the message because it contains the message sequence numbering information and the character count, the two most important features of DDCMP. Because of the importance of the header information, it merits its own CRC blockcheck, indicated in Figure A-2 as

CRC-1. Messages that contain data, rather than just control information, have a second section which contains any number of 8-bit characters (up to a maximum of 16,383) and a second CRC (indicated in Figure A-2 as CRC-2).

Before the message format is discussed in greater detail, the message sequencing system should be explained because most of the header information is directly or indirectly related to the sequencing operation.

In DDCMP, any pair of stations that exchange messages with each other number those messages sequentially starting with message number one. Each successive data message is numbered using the next number in sequence, to modulo 256. Thus, a long sequence of messages would be numbered 1, 2, 3,...254, 255, 0, 1,... The numbering applies to each direction separately. For example, station A might be sending its messages 6, 7, and 8 to station B, while station B is sending its messages 5, 6, and 7 to station A. Thus, in a multipoint configuration where a control station is engaged in two-way communication with 10 tributary stations, there are 20 different message number sequences involved – one sequence for messages from each of the 10 tributaries to the control station and one sequence for messages from the control station to each of the 10 tributaries.

Whenever a station transmits a message to another station, it assigns its next sequential message number to that message and places that number in the sequence field of the message header. In addition to maintaining a counter for the sequentially numbered messages which it sends, the station also maintains a counter of the message numbers received from the other station. It updates that counter whenever a message is received with a message number exactly one higher than the previously received message number. The contents of the received message counter are included in the response field of the message being sent, to indicate to the other station the highest sequenced message that has been received.

When a station receives a message containing an error, that station sends a negative acknowledge (NAK) message back to the transmitting station. DDCMP does not require an acknowledgement for each message, as the number in the response field of a normal header (or in either the special NAK or positive acknowledgement message ACK), specifies the sequence number of the last good message received.

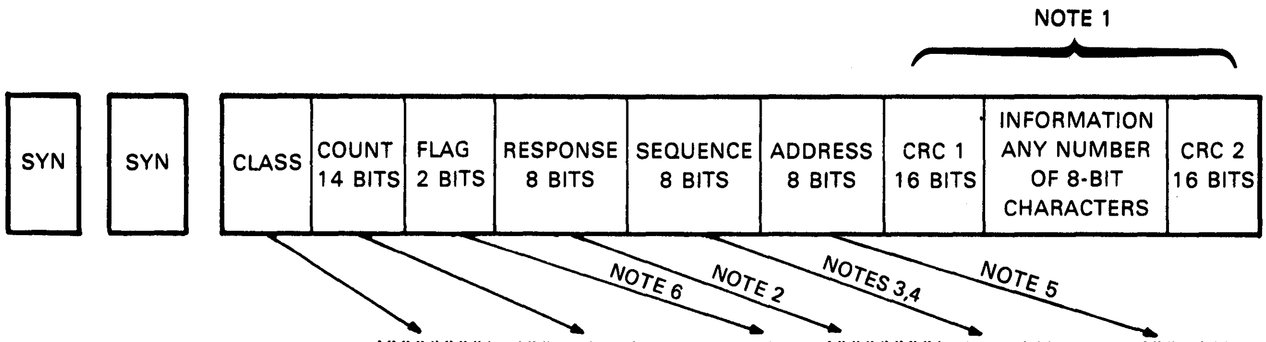
When a station receives a message that is out of sequence, it does not respond to that message. The transmitting station detects this from the response field of the messages which it receives; if the reply interval expires before the transmitting station receives an acknowledgement, the transmitting station sends a reply (REP) message. The REP message contains the sequence number of the most recent unacknowledged message sent to the remote station. If the receiving station has correctly received the message referred to in the REP message (as well as the messages preceding it), it replies to the REP by sending an ACK. If it has not received the message referred to in sequence, it sends a NAK containing the number of the last message that it did receive correctly. The transmitting station then retransmits all data messages after the message specified in the NAK.

The numbering system for DDCMP messages permits up to 255 unacknowledged messages outstanding, a useful feature when working on high-delay circuits, such as those using satellites.

However, the DMP11 limits the maximum number of unacknowledged messages outstanding to be 127.

A.3 MESSAGE FORMAT

With the above background, it is now time to explore the various DDCMP message formats in full detail, as shown in Figure A-2. The first character of the message is the class of message indicator, represented in ASCII with even parity. There are three classes of messages; data, control, and maintenance. These are indicated by class of message indicators SOH, ENQ, and DLE. The next two characters of the message are broken into a 14-bit field and a 2-bit field. The 14-bit field is used in data and maintenance messages to indicate the number of characters that will follow the header CRC field and



	CLASS	COUNT	FLAG	RESPONSE	SEQUENCE	ADDRESS
	XXXXXXXX	XXXXXXXXXXXXXX	XX	XXXXXXXX	XXXXXXXX	XXXXXXXX
SOH – DATA MESSAGES	10000001	CHARACTER COUNT	QS	RESP #	MESSAGE#	ADDRESS
ENQ { ACKNOWLEDGEMENT	00000101	00000001000000	QS	RESP #	00000000	ADDRESS
ENQ { NEGATIVE ACKNOWLEDGE	00000101	00000010--------	QS	RESP #	00000000	ADDRESS

REASONS:

BCC HEADER ERROR	000001
BCC DATA ERROR	000010
REP RESPONSE	000011
BUFFER UNAVAILABLE	001000
RECEIVER OVERRUN	001001
MESSAGE TOO LONG	010000
HEADER FORMAT ERROR	010001

ENQ { REPLY MESSAGE	00000101	00000011000000	QS	00000000	LSTMESS#	ADDRESS
ENQ { START MESSAGE	00000101	00000110000000	11	00000000	00000000	ADDRESS
ENQ { START ACKNOWLEDGEMENT	00000101	00000111000000	11	00000000	00000000	ADDRESS
DLE MAINTENANCE MESSAGE	10010000	CHARACTER COUNT	11	00000000	00000000	ADDRESS

NOTES:

1. ONLY THE DATA MESSAGE AND THE MAINTENANCE MESSAGE HAVE CHARACTER COUNTS, SO ONLY THESE MESSAGES HAVE THE INFORMATION AND CRC2 FIELDS SHOWN IN THE MESSAGE FORMAT DIAGRAM ABOVE.

2. "RESP #" REFERS TO RESPONSE NUMBER. THIS IS THE NUMBER OF THE LAST MESSAGE RECEIVED CORRECTLY. WHEN USED IN A NEGATIVE ACKNOWLEDGE MESSAGE, IT IS ASSUMED THAT THE NEXT HIGHER NUMBERED MESSAGE WAS NOT RECEIVED, WAS RECEIVED WITH ERRORS, OR WAS UNACCEPTED FOR SOME OTHER REASON. SEE "REASONS."

3. "MESSAGE#" IS THE SEQUENTIALLY ASSIGNED NUMBER OF THIS MESSAGE. NUMBERS ARE ASSIGNED BY THE TRANSMITTING STATION MODULO 256; I.E., MESSAGE 000 FOLLOWS 255.

4. "LSTMESS#" IS THE NUMBER OF THE LAST MESSAGE TRANSMITTED BY THE STATION. SEE THE TEXT DISCUSSION OF REP MESSAGES.

5. " ADDRESS" IS THE ADDRESS OF THE TRIBUTARY STATION IN MULTIPOINT SYSTEMS AND IS USED IN MESSAGES BOTH TO AND FROM THE TRIBUTARY. IN POINT TO POINT OPERATION, A STATION SENDS THE ADDRESS "1" BUT IGNORES THE ADDRESS FIELD ON RECEPTION.

6. "Q" AND "S" REFER TO THE QUICK SYNC FLAG BIT AND THE SELECT BIT. SEE TEXT.

MK-2249

Figure A-2 DDCMP Message Format in Detail form the information part of the message. In control messages, the first 8 bits of the 14-bit field are used to designate what type of control message it is; the last 6 bits are generally filled with zeros. The exception is in NAK messages where the last six bits are used to specify the reason for the NAK. The 2-bit field contains the quick sync and select flags.

The quick sync flag is used to inform the receiving station that the message will be followed by sync characters; the receiver may wish to set its associated synchronous receiver hardware into sync search mode and sync strip mode. This will re-establish synchronization and syncs will be discarded until the first character of the next message arrives. The purpose of this is to permit the receiving station to engage any hardware sync-stripping logic it might have and prevent it from filling its buffers with sync characters. The select flag is used to control link management in half-duplex or multipoint configurations, where transmitters need to get turned on and off.

Link management is the process of controlling the transmission and reception of data on links where there may be two or more transmitters and/or receivers actively connected to the same signal channels. This will be true of half-duplex, point-to-point links, as well as full- and half-duplex multipoint links. On half-duplex links, only one transmitter may be active at a time; on full-duplex links, only one slave transmitter may be active on the link at a time.

A station on such a link may transmit when it has been selected or granted ownership of the link. This ownership is passed by use of the select flag existing in all messages. A select flag set in a received message allows the addressed station to transmit after completing reception of the message. The select flag also means that the transmitter will cease transmitting after the message is sent.

The response field contains the number of the last message correctly received. This field is used in data messages and in the positive and negative acknowledge types of control message. Its function should be evident from the preceding discussion of sequence control.

The sequence field is used in data messages and in the REP type of control message. In a data message, it contains the sequence number of the message as assigned by the transmitting station. In a REP message, it is used as part of the question, "Have you received all messages up through message number (specify) correctly?"

The address field is used to identify the tributary station in multipoint networks and is used in messages both to and from the tributary. In point-to-point operation, each station uses an address of 1.

In addition to the positive and negative acknowledgement and REP types of control message, there are also start and start acknowledge control messages. These are used to place the station which receives them in a known state. In particular, they initialize the message counters, timers, and other counters. The start acknowledge message indicates that this has been accomplished.

Figure A-2 also shows the maintenance message. This is typically a bootstrap message containing load programs in the information field. A complete treatment of maintenance messages and start up procedures is beyond the scope of this book.

NOTE

Refer to the DDCMP Specification Order AA-D599A-TC for a complete detailed description of DDCMP.

APPENDIX B
FLOATING DEVICE ADDRESSES AND VECTORS

B.1 FLOATING DEVICE ADDRESSES

UNIBUS addresses starting at 760010 and continuing through 763776 are designated as floating device addresses (see Figure B-1). These are used as register addresses for communications (and other) devices interfacing with the PDP-11 and VAX-11 Systems.

NOTE

Some devices are not supported by VAX-11, however, the same scheme applies; that is, gaps are provided as appropriate. The convention for assigning these addresses is as follows:

A gap of 10_8 must be left between the last address of one device type and the first address of the next device type. The first address of the next device type must start on a modulo 10_8 boundary. The gap of 10_8 must also be left for devices that are not installed but are skipped over in the priority ranking list. Multiple devices of the same type must be assigned contiguous addresses. Reassignment of device types already in the system may be required to make room for additional ones.

B.2 FLOATING VECTOR ADDRESSES

Vector addresses, starting at 300 and proceeding upward to 777, are designated as floating vectors. These are used for communications (and other) devices that interface with the PDP-11 and VAX-11.

NOTE

Some devices are not supported by VAX-11, however, the same scheme applies. Vector size is determined by the device type.

There are no gaps in floating vectors unless required by physical hardware restrictions (in data communications devices, the receive vector must be on a zero boundary and the transmit vector must be on a 4_8 boundary).

Multiple devices of the same type are assigned vectors sequentially.

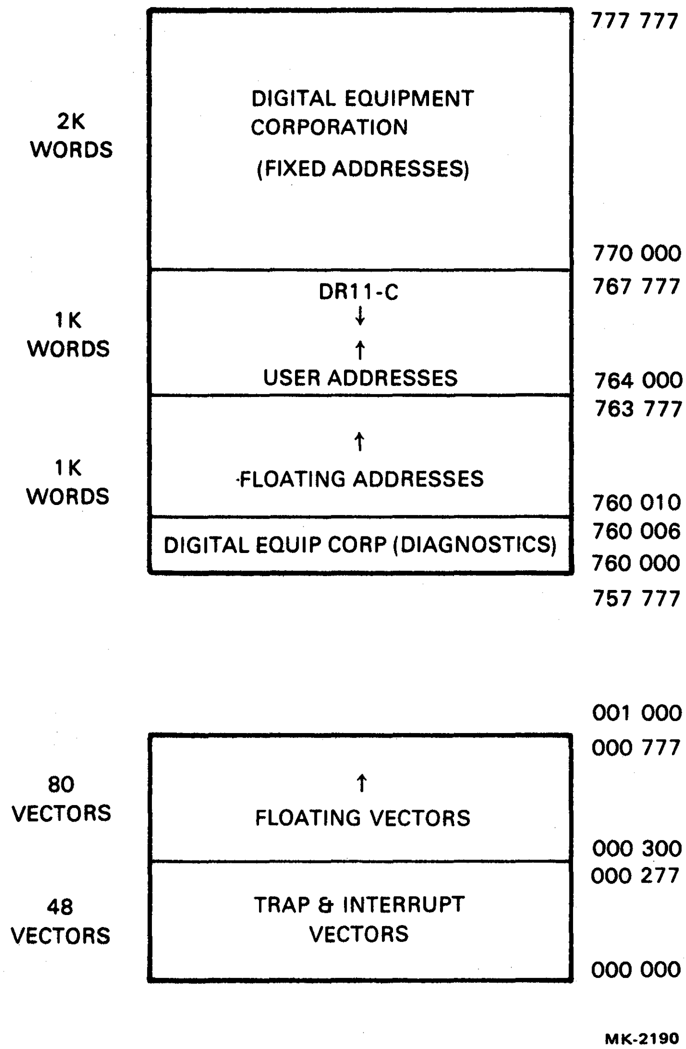


Figure B-1 UNIBUS Address Map

Floating CSR Address Devices

Rank	Option	Decimal Size	Octal Modulus
1	DJ11	4	10
2	DH11	8	20†
3	DQ11	4	10
4	DU11	4	10
5	DUP11	4	10
6	LK11A	4	10
7	DMC11/DMR11	4	10
8	DZ11* and DZV11/DZ32	4	10
9	KMC11	4	10
10	LPP11	4	10
11	VMV21	4	10
12	VMV31	8	20†
13	DWR70	4	10
14	RL11 and RLV11	4	10 (extra only)
15	LPA11-K	8	20 (extra only)
16	KW11-C	4	10
17	Reserved	4	10
18	RX11	4	10 (extra only)
19	DR11-W	4	10
20	DR11-B	4	10 (After second)
21	DMP11-AD	4	10
22	DPV11	4	10
23	ISB11	4	10
24	DMV11-AD	8	20

*DZ11-E and DZ11-F are dual DZ11s and are treated by the algorithm as two DZ11s.

†Starting CSR ADDRESS must be an even multiple of 20 (octal).

Floating Interrupt Vector Devices

Rank	Option	Decimal Size	Octal Modulus
1	DC11	4	10
2	KL11 (extra)	4	10*
2	DL11-A (extra)	4	10*
2	DL11-B (extra)	4	10
3	DP11	4	10
4	DM11-A	4	10
5	DN11	2	4
6	DM11-BB	2	4
7	DH11 modem control	2	4
8	DR11-A	4	10*
9	DR11-C	4	10*
10	PA611 (reader & Punch)	8	10*
11	LPD11	4	10
12	DT11	4	10*
13	DX11	4	10*
14	DL11-C	4	10*
14	DL11-D	4	10*
14	DL11-E	4	10*
15	DJ11	4	10*
16	DH11	4	10†
17	GT40	8	10
18	LPS11	12	30*
19	DQ11	4	10†
20	KW11-W	4	10
21	DU11	4	10*
22	DUP11	4	10*
23	DV and modem control	6	10
24	LK11-A	4	10
25	DWUN	4	10
26	DMC11/DMR11	4	10*
27	DZ11/DZ32	4	10*
28	KMC11	4	10
29	LPP11	4	10
30	VMV21	4	10
31	VMV31	4	10
32	VTV01	4	10
33	DWR70	4	10*
34	RL11/RLV11	2	4
35	RX02	2	4
36	TS11	2	4 (after the first)
37	LPA11-K	4	10
38	IP11/IP300	2	4
39	KW11-C	4	10
40	RX11	2	4 (after the first)
41	DR11-W	2	4
42	DR11-B	2	4 (after the first)
43	DMDP11-AD	4	10
44	DPV11	4	10
45	ML11	2	4 (MASSBUS device)
46	ISB11	4	10
47	DMV11-AD	4	10

*The vector for the device of this type must always be on a 10_8 boundary.

† These devices can have either a M7820 or M7821 interrupt control module. However, it should always be on a 10_8 boundary.

B.3 EXAMPLES OF DEVICE AND VECTOR ADDRESS ASSIGNMENT

Example 1 VAX-11

The first device requiring address assignment in this example is a DMC11 (number 7 in the device address assignment sequence; number 26 in the vector address assignment sequence).

The only devices used are:

1 DMC11
1 DZ32
1 DMP11

Device (Option)	Device Address	Vector Address	Comment
	760010		Gap left for DJ11
	760020		Gap left for DH11
	760030		Gap left for DQ11
	760040		Gap left for DU11
	760050		Gap left for DUP11
	760060		Gap left for LK11A
DMC11	760070	300	First DMC11
	760100		Gap left between DMC11 and next device
DX32	760110	310	First DZ32
	760120		Gap left between DZ32 and next device
	760130		Gap left for KMC11
	760140		Gap left for LPP11
	760150		Gap left for VMV21
	760160		Gap left for VMV31
	760170		Gap left for DWR70
	760200		Gap left for RL11
	760210		Gap left for LPA11-K
	760220		Gap left for KW11-C
	760230		Gap left for reserved device
	760240		Gap left for RX11
	760250		Gap left for DR11-W
	760260		Gap left for DR11-B
DMP11	760270		FIRST DMP11
	760300		Gap left after last device, in this case the DMP11, to indicate that none follow.

Example 2 PDP-11

The first device requiring address assignment in this example is a DMR11 (Number 7 in the device address assignment sequence; Number 26 in the vector address assignment sequence.)

The only devices used are:

1 DMR11
2 DZ11s
2 DMP11s

Device (Option)	**Device Address**	**Vector Address**	**Comment**
	760010		Gap left for DJ11
	760020		Gap left for DH11
	760030		Gap left for DQ11
	760040		Gap left for DU11
	760050		Gap left for DUP11
	760060		Gap left for LK11A
DMR11	760070	300	First DMR11
	760100		Gap left between DMR11 and next device
DZ11	760110	310	First DZ11
DZ11	760120	320	Second DZ11
	760130		Gap left between DZ11 and next device
	760140		Gap left for KMC11
	760150		Gap left for LPP11
	760160		Gap left for VMV21
	760170		Gap left for VMV31
	760200		Gap left for DWR70
	760210		Gap left for RL11
	760220		Gap left for LPA11-K
	760230		Gap left for KW11-C
	760240		Gap left for reserved device
	760250		Gap left for RX11
	760260		Gap left for DR11-W
	760270		Gap left for DR11-B
DMP11	760300	330	First DMP11
	760310	340	
	760320		Gap left after last device, in this case the DMP11, to indicate that none follow.

APPENDIX C
LINE UNIT AND MODEM CONTROL REGISTER FORMATS

C.1 LINE UNIT AND MODEM CONTROL REGISTER FORMATS

The modem signals made available by the M8203 line unit can be examined or modified by the user program if needed. This supplies the flexibility needed to meet the different modem interface requirements of different countries. The bits for these signals are in registers 13 and 17. The user program can read registers 13 and 17 and write into register 13 through control commands.

To read registers 13 and 17, the user program sets the code read modem control in the request key and the contents of registers 13 and 17 are returned to the user by an information response. The contents of register 13 appear in BSEL4 and the contents of register 17 appear in BSEL5. To write into register 13, the user program issues a control command having the request key write modem control and the new value of register 13 in BSEL4.

Another line unit register that can be written into by the user is the extended register 3-15. The main purpose of writing into this register is to select the correct interface when test connectors are used. The user writes into this register with the write modem test register request key.

NOTE

Extended register 3-145 is used for diagnostic purposes only

Read Register 13

Bit	Name	Description
0	CARRIER	Received line signal detector, usually referred to as carrier detect, indicates that there is an audio tone being received from the remote modem. Usually, in full-duplex applications, it is on when the communications line is intact and the remote modem has the signal request to send asserted (the modem is transmitting). In half-duplex applications, carrier detect is on whenever the carrier (audio tone) is on the line and request to send at the local modem is off. This signal is also acceptable to the DMP11 integral modem.
1	STANDBY	This signal, when asserted, shows that the indicator local modem is in condition to operate with the typical or standby communications facilities. An on condition indicates that the local modem is conditioned to operate in its standby mode with the usual facilities replaced by the predetermined standby facilities. The off condition indicates that the local modem is conditioned to operate in its usual mode. This signal applies only to modems that support this feature.

2	CLEAR TO SEND	This signal is generated by the local modem to indicate whether or not it is ready to transmit data. This signal has a slightly different meaning with differnt modems. With some modems it indicates that the carrier is being received from the remote modem and, therefore, is an indication that an acceptable communication channel exists. In others, it is only a delayed version of request to send. In this case clear to send is "probably" clear to send.
3	MODEM READY	This signal shows that the modem is ready to operate. The on condition indicates that the local modem is connected to the communications line and is ready to swap control signals with the DMP11. The off condition indicates that the local modem is not ready to operate. This signal, where implemented, is used by the DMP11 to detect either a power off condition or a cable-related modem malfunction.
4	HALF-DUPLEX	This signal, when asserted, shows that the M8203 line unit is in the half-duplex mode. This means that the DMP11 is connected to a communications line designed for transmission in either direction, but not in both directions at the same time. When cleared, it implies full-duplex operation, which is two-way independent transmission in both directions.
5	REQUEST TO SEND	This signal controls the data channel transmit function of the local modem, and on a half-duplex channel, to control the direction of data transmission of the local modem. On a full-duplex channel, the on condition maintains the modem in the transmit mode and the off condition maintains the modem in the nontransmit mode. On a half-duplex channel, the on condition maintains the modem in the transmit mode and prevents the receive mode. The off condition maintains the modem in the receive mode. A transition from off to on instructs the modem to enter the transmit mode. The modem responds by taking such action as may be necessary and shows completion of such actions by asserting clear to send, thereby indicating to the DMP11 that data may be transferred across the communications channel. A transition from on to off instructs the modem to complete the transmission of all data that was previously transferred to the modem and then assume a non-transmit or receive mode, whichever is correct. The modem responds to this instruction by turning off the clear to send signal when it is again prepared to respond to an on condition of request to send.
6	DATA TERMINAL READY	This signal controls the switching of the local modem to and from the communications line. When asserted, this signal serves to inform the local modem that the DMP11 is ready to operate. This signal also prepares the modem for connection to the communication line and maintains this connection as long as it is on. When turned off, this signal causes the local modem to disconnect after all data previously transferred to the modem has been transmitted. This signal can be used by the local modem to detect a power off condition in the DMP11 or a cable-related modem malfunction.
7	RING	This signal indicates whether an incoming call signal is being received by the local modem. When on, this signal indicates that an

incoming call (ringing) signal is being received by the local modem. The on state of ring must appear approximately at the same time as the on segment of the ringing cycle (during rings) on the communications line. The off condition must be maintained during the off segment of the ringing cycle (between rings) and at all other times that ringing is not being received. This signal is not affected by the state of data terminal ready.

Read Register 17

Bit	Name	Description
0	MODE	This bit indicates the functional mode of the line unit. A one indicates character oriented protocol operation and a zero indicates bit oriented protocol operation. The M8203 line unit initializes this bit to one.
1	ECS	This is the maintenance clock (24K Hz).
2	TEST MODE	This signal indicates whether or not the local modem is in a test condition. (This signal applies only to modems that support this feature.) When in the on condition, this signal indicates to the DMP11 that the local modem has been placed in a test condition. The on state of this signal is in response to the on condition of the signal maintenance mode 1 or maintenance mode 2 and indicates that the test condition is assigned. The on condition can also be in response to either local or remote execution by means of any modem test condition. Activation of a telecommunications network test condition (for example, facility loopback) that is known to the modem can also cause this signal to be on. In the off condition, this signal indicates that the modem is not in the test mode and is available for typical operation.
3	IN COMPOSITE READY	This bit indicates that the receive silos are ready to receive another character (M8203 maintenance function only).
4	OUT COMPOSITE READY	This bit indicates that data is present at the bottom of the transmit silo ready for transfer to the USYRT (M8203 maintenance function only).
5	TX DATA	This bit indicates that a data bit is present on the output of the USYRT serial data stream (M8203 maintenance function only).
6	SIGNAL QUALITY	This signal indicates whether or not there is a chance of an error in the receive data. When on, this signal indicates that there is a chance that no error has occured. An off condition indicates a high chance of an error. The criterion for this is created by the modem manufacturer. For example, this signal may indicate the quality of the receive data based on the recovery of the carrier, recovery of bit timing, or distortion of the eye pattern in the demodulator. Signal quality may also be based on the state of the equalizer for those modems equipped with equalizers.

Bit	Name	Description
7	SIGNAL RATE	This signal is used to indicate one of the two data signaling rates of a dual-rate synchronous modem or one of the two signal rate ranges of an asynchronous modem. The on condition indicates the higher data signaling rate or range of rates and the off condition indicates the lower data signaling rate or range of rates. The rate of timing signals, if included in the interface, can be controlled by the signal, as correct.

Write Register 13

Bit	Name	Description
0	NOT USED	
1	SELECT STANDBY	This signal is used to select normal or standby communications facilities. An off to on transition instructs the local modem to replace the usual facilities with predetermined standby facilities. This signal is maintained in the on state when the standby facilities are needed. An on-to-off transition of this signal instructs the local modem to replace the standby facilities with the normal facilities. This signal is maintained in the off state when the usual facilities are needed for use.
2	MAINTENANCE MODE 2	This signal is used to control the remote loopback (remote loopback) test condition at the remote modem. When asserted, this signal causes the local modem to signal the creation of the remote loopback test condition at the remote modem. After asserting this signal and detecting a test mode on condition, the local modem can operate in full-duplex mode to exercise both the local and remote modem. In the off condition, this causes the local modem to signal the release of the remote loopback test condition. The remote loopback test condition places the communication system out of service to the DMP11 connected to the modem. When the remote loopback test condition is started, the remote modem indicates an off condition to data mode and an on condition to test mode. If the remote loopback test condition at the remote modem is started from the local modem through manual means or by means of the remote loopback test condition, the local modem allows data mode to respond as usual and maintain test mode in the on state.
3	MAINTENANCE MODE 1	This signal is used to control the local loopback (local loopback) test condition at the local modem. In the on condition, the output of the local modem transmitter is transferred to the input of its receiver. After creating the local loopback test condition, the local modem asserts the test mode center. With test mode in the on state, the local modem can operate in full-duplex to exercise the interface. When this signal is in the off state, the modem is released from the local loopback test condition. The local loopback test condition does not prevent an incoming call through the signal ring.
4	HALF-DUPLEX	The DMP11 uses this bit to place the line unit into the half-duplex mode. The user program cannot set or clear this bit. The DMP11

can change line characteristics only through the the mode command. The M8203 line unit has a hardware interlock that prevents simultaneous transmission and reception when in the half-duplex mode. While the receiver is actively receiving, or carrier detect is asserted, the data loaded into the transmit silo will not be loaded into the USYRT for transmission and, therefore, request to send will not be shown to the modem. Similarly, while the transmitter is transmitting, the receiver is disabled from receiving data.

5	SELECT FREQUENCY	This signal is used to select the transmit and receive frequency bands of a modem. In the on condition, the higher frequency band is selected for transmission to the communications channel and the lower frequency band is selected for reception from the communications channel. When off, the lower frequency band is selected for transmission to the communications channel and the higher frequency band is selected for reception from the communications channel.
6	DATA TERMINAL READY	This signal controls switching of the local modem to and from the communications line. When asserted, this signal informs the local modem that the DMP11 is ready to operate. This signal also prepares the modem for connection to the communication line and maintains this connection as long as it is on. When turned off, this signal causes the local modem to disconnect after all data previously transferred to the modem has been transmitted. This signal can be used by the local modem to detect a power off condition at the DMP11 or a cable-related modem malfunction.
7	POLLING	This signal determines whether or not the local modem will quickly respond to new data on the communications line. This signal is used at control stations in multipoint networks where the remote modems operate in switched carrier mode. This incoming signal to the control station appears as a series of short message bursts transmitted by each tributary, as it responds to the poll from the control station. In order to allow rapid accommodation to signals from many tributaries appearing in fast order, the control station informs the local modem when a new signal is about to start by asserting polling for a short interval. For synchronous systems, clock timing on the incoming message varies from message to message because the remote modems are in no way synchronized to each other. If the time interval between messages is too short, the clock holdover after the end of one message may preclude rapid synchronization on the following message. The use of this signal allows the control station to reset the modem receiver timing recovery circuit enabling it to respond much faster to the line signal present after polling has been turned off. This signal applies only to modems that support polling.

Write Extended Register 3-15

Bit	Name	Description
0	SELM	This bit is a select interface bit. When set, the modem interface is selected by the other bits in the register.

1	RESERVED	
2	EN C32	This is reserved for CRC-32 enable.
3	INT	Setting this bit (when bit 0 is set) selects the integral modem, but does not select the speed or the filter for the integral modem. The correct cable or test connector must be used with the corresponding data rate that is selected.
4	V.35	This bit indicates that the V.35 interface is selected.
5	BCC 32	This bit is reserved for the BCC match of CRC-32.
6	XYZ	This bit indicates that the EIA single ended interface. This includes RS-232-C and RS-423. This is the default when Bit 0 is not set.
7	422	This bit indicates that RS-422 is to be selected. This is a differential interface and must be switch selected in normal mode.

C.2 RS-449 VERSUS RS-232-C

The most common interface standard in use during the last few years is RS-232-C. However, when used in modern communications systems, it has critical limitations. The most serious of these is speed and distance.

For this reason, interface standard RS-449 was developed to replace RS-232-C. This standard maintains a degree of compatibility with RS-232-C, to make an upward transition to RS-449 easier.

The most significant difference between RS-449 and RS-232-C is the electrical characteristics of signals used between the data communications equipment (DCE) and the data terminal equipment (DTE). The RS-232-C standard specifies only unbalanced circuits, whereas RS-449 specifies both balanced and unbalanced circuits. The specifications for these two circuit types supported by RS-449 are in EIA Standards RS-422-A for balanced circuits and RS-423-A for unbalanced circuits. These new standards permit increased transmission speeds and allow an increased distance between the DTE and DCE.

The maximum transmission speeds supported by RS-422-A and RS-423-A specified circuits vary with circuit length. The usual transmission speed limits are 20K b/s for RS-423-A at 200 feet and 2M b/s for RS-422-A also at 200 feet. These usual transmission speeds can be changed by tradeoffs between speed and distance.

Another major difference between RS-449 and RS-232-C is the specification of two new connectors to make the leads needed to support added circuit functions and the balanced interface circuits easier. One connector is a 37-pin cinch used to make the majority of data communications applications. The other is a nine-pin cinch for applications needing secondary channel functions. Some of the new circuits implemented by RS-449 support local and remote loopback testing and standby channel selection.

The transition from RS-232-C to RS-449 will not happen immediately. Therefore, applications that need connection between RS-232-C and RS-449 interfaces must follow the limitations of RS-232-C, which specifies a transmission speed of 20K b/s at a maximum distance of 50 feet.

APPENDIX D
MODEM CONTROL

D.1 MODEM CONTROL

There are two levels of modem control available to the DMP11. The first level is provided by the M8203 line unit, and the second by the DMP11 microcode.

D.1.1 Line Unit Modem Control

The M8203 line unit provides the following modem control functions:

1. Modem ready lockout of request to send, and

2. Prevention of simultaneous transmission and reception in half-duplex mode.

D.1.1.1 Modem Ready Lockout of RTS – The lockout function automatically inhibits the setting of request to send until modem ready is asserted. This feature relieves the DMP11 of having to check the functional state of the modem each time the communications line is connected.

D.1.1.2 Half-Duplex Mode – When set, half-duplex (bit 4 of line unit register 13) specifies that the line unit is in the half-duplex mode. In half-duplex mode, a hardware interlock prevents the line unit from transmitting and receiving at the same time. During reception (carrier detect asserted), data loaded into the line unit transmit silo does not move to the USYRT for transmission. Therefore, request to send does not display to the modem. Similarly, during transmission, reception is disabled.

NOTE

This hardware lockout prevents the M8203 line unit from being used in the half-duplex mode on a full-duplex modem with the continuous carrier option installed.

D.1.2 Modem Control Implemented by the DMP11 Microcode

The main modem signal monitored by the DMP11 is modem ready. Once this signal becomes true, the DMP11 reports any transition from on-to-off to the user program by issuing a control response with the code for the system event modem disconnect. Transmission is inhibited by the line unit by interlocking the signals modem ready and request to send.

NOTE

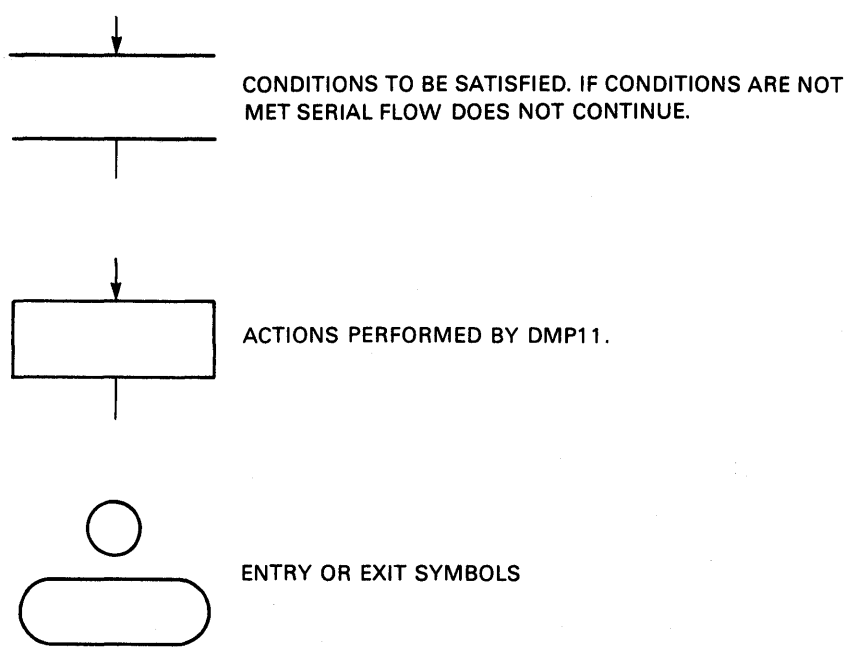
Modem ready is examined at one millisecond intervals, therefore, transitions smaller than one millisecond, depending on when they occur, may or may not be detected by the DMP11.

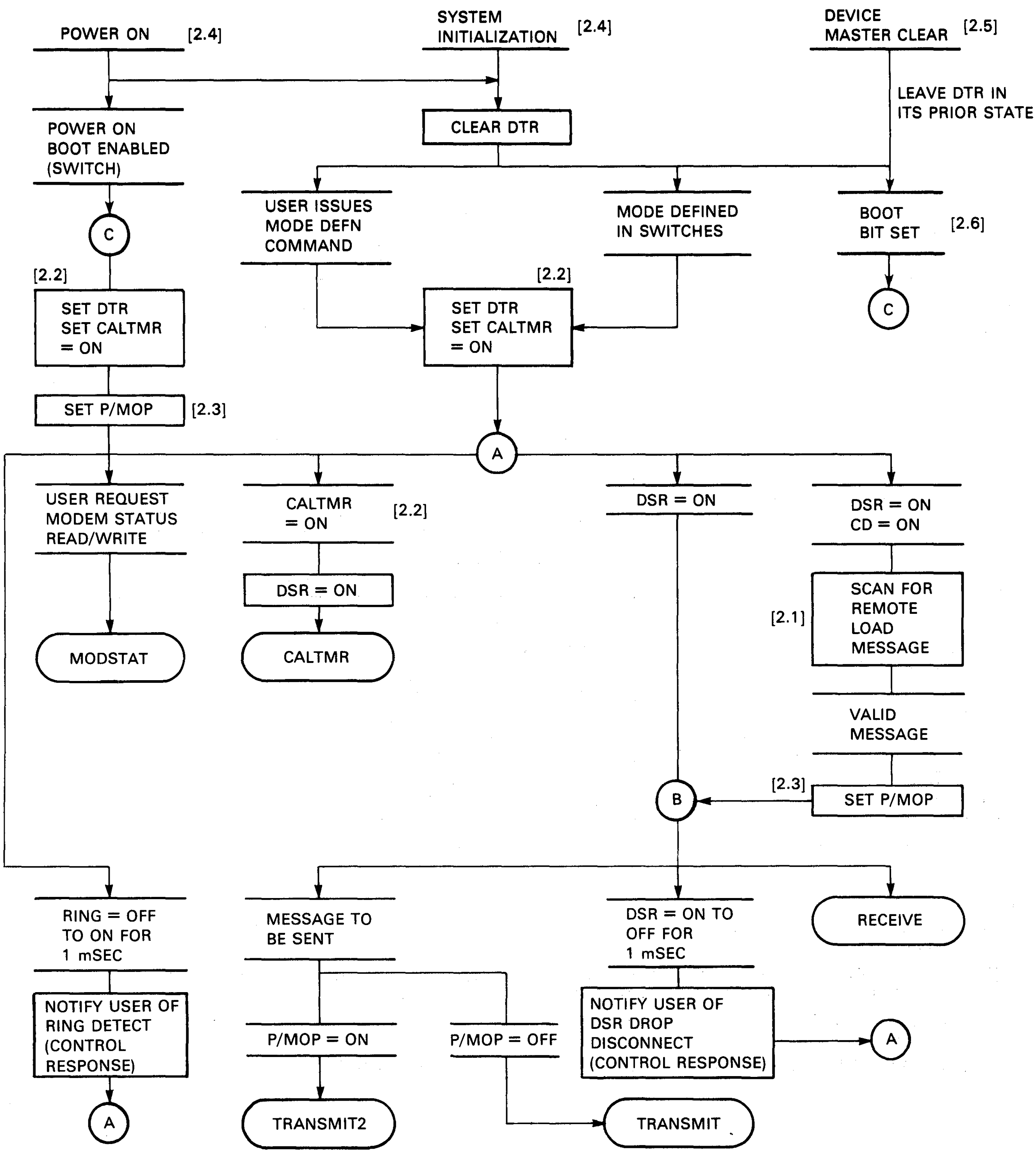
Another modem signal monitored by the DMP11 is ring detect. In this event, a transition from off-to-on is reported to the user program as long as this signal stays high for at least one millisecond. The DMP11 reports this through a control response with the code for the system event modem ring detect.

When the signal carrier detect is dropped by the modem for longer than 128 milliseconds, the user program is informed by a control response with the code for the system event modem carrier loss.

When modem ready is asserted at a point-to-point station, a special timer, referred to as the call timer, is started. The call timer runs until a valid DDCMP header is received or the timer expires (65 seconds). When the counter expires, the DMP11 clears data terminal ready and posts a control response to the user program for the system event modem disconnect. The system then waits three seconds and reinitializes. The purpose of the call timer is to disconnect the line when an incoming call cannot communicate with the DMP11. This condition can be caused by a noisy telephone connection or a wrong number.

The flow shown by the diagrams that follow desribe the processing of EIA modem control signals by the DMP11. Each diagram represents a serial flow for a specific modem control function. However, the functions performed, as represented by each diagram, are performed in parallel. The readable and writeable modem signals listed on the diagram for modem status can be read and written through the control command using the request keys read modem test register and write mode control. The symbols used in these diagrams are defined below.





NOTES:

[2.1] REMOTE LOAD DETECT IS A MAINT. DDCMP MESSAGE INITIATING A DOWN LINE LOAD.

[2.2] CALTMR - (CALL TIMER): USED TO DETERMINE IF VALID MESSAGE IS RECEIVED. "ON" INDICATES TIMER RUNNING.

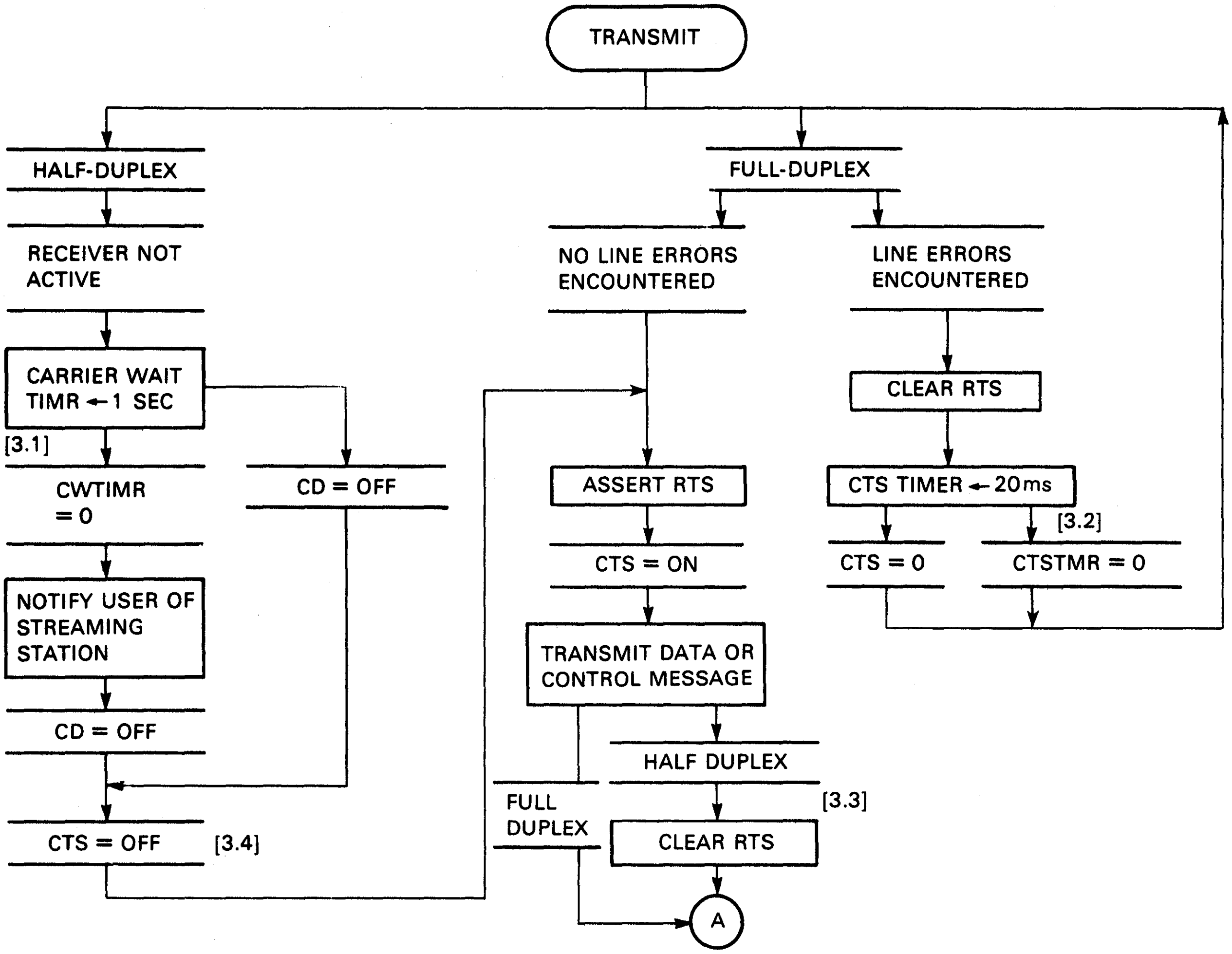
[2.3] P/MOP - PRIMARY MAINTENANCE OPERATION PROTOCOL, REQUESTING REMOTE LOAD.

[2.4] RUN COMPLETE MICRODIAGNOSTICS (MICROPROCESSOR AND LINE UNIT)

[2.5] RUN PARTIAL MICRODIAGNOSTICS – MICROPROCESSOR ONLY

[2.6] INVOKE PRIMARY MOP BOOT (BIT FIVE, BSEL 1)

MK-1974



NOTES:

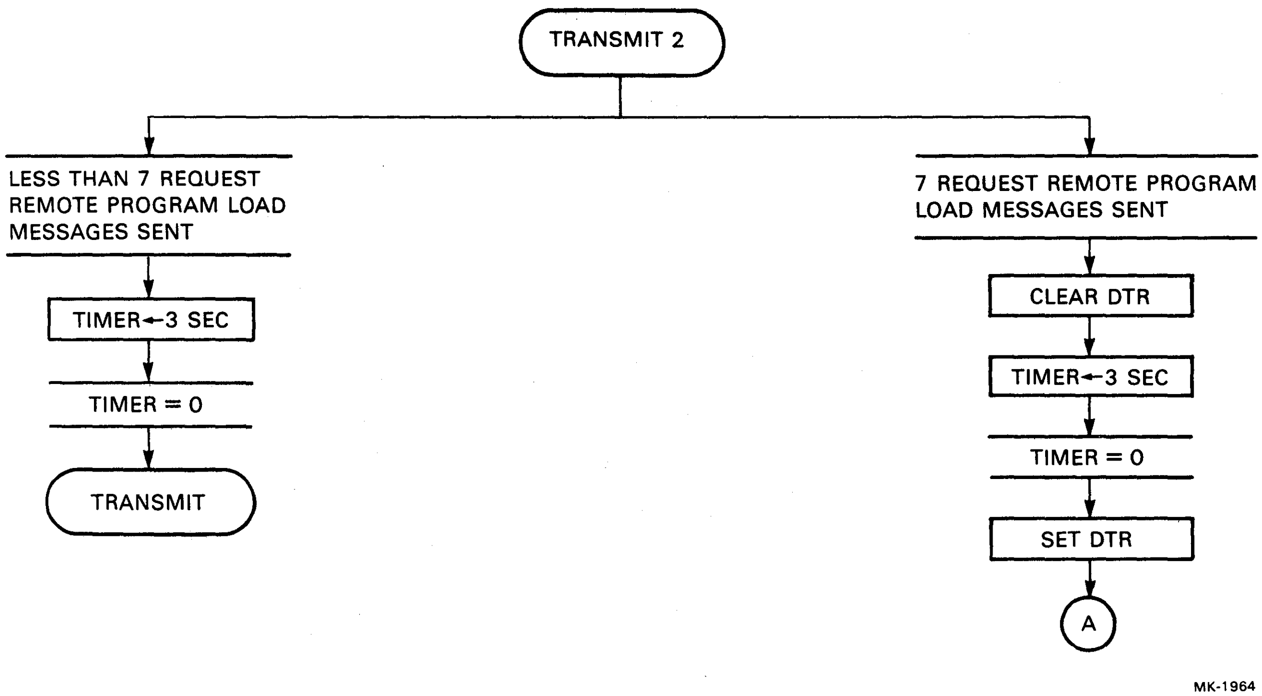
[3.1] CWTIMR -- CARRIER WAIT TIMER. IT DETECTS THE CONDITION WHERE THE LINK WAS NOT RELINQUISHED IN TIME BY THE REMOTE END.

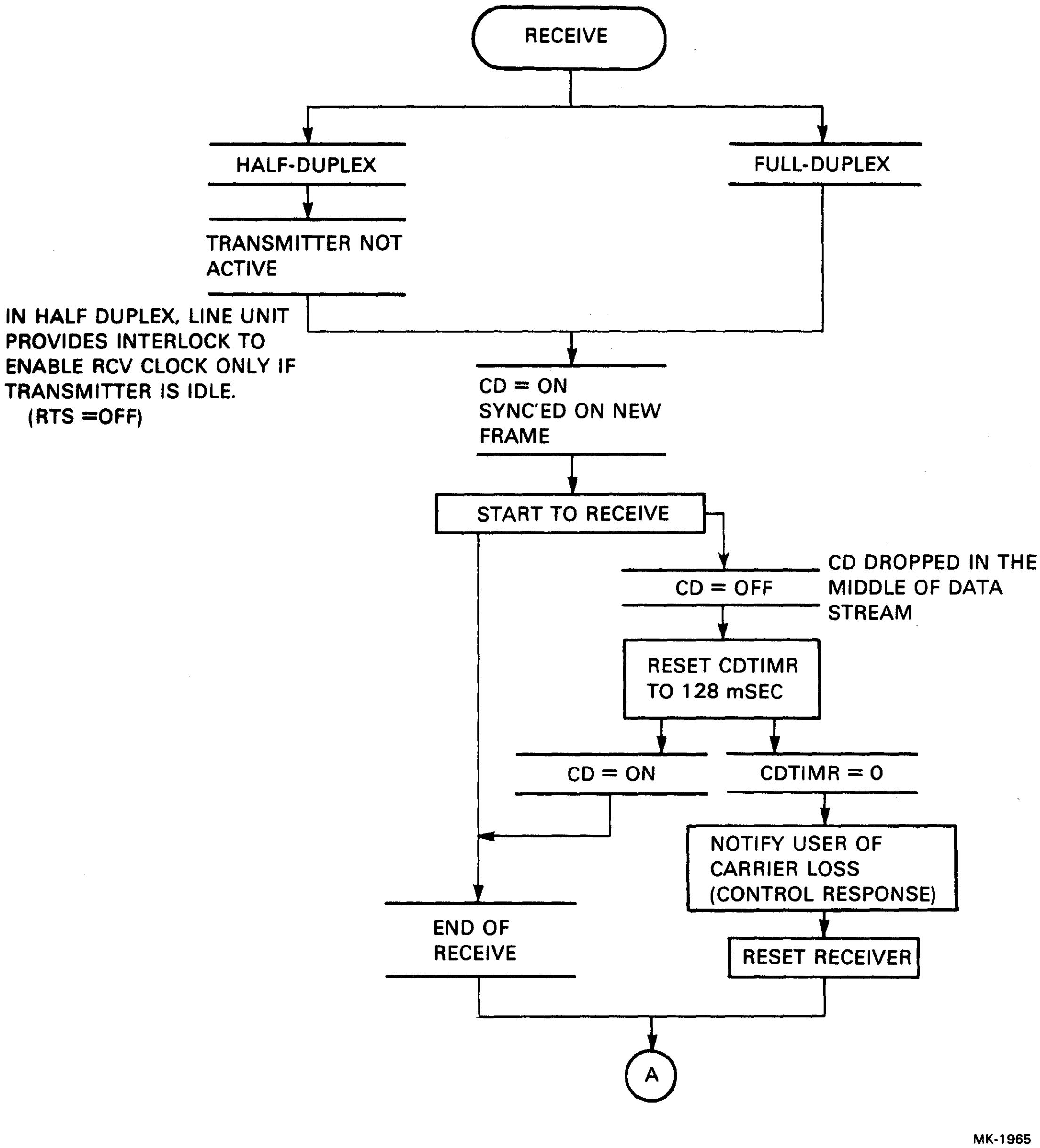
[3.2] CTSTMR -- CLEAR TO SEND TIMER. TIME CLEAR TO SEND GOING AWAY WHEN DROPPING RTS BECAUSE OF LINE ERRORS. FALL-OUT COVERS CONDITION OF CONSTANT CTS MODEMS.

[3.3] IN FULL DUPLEX MODE -- DMP11 ASSERTS RTS CONSTANTLY. RTS IS DROPPED ONLY WHEN THERE ARE LINE ERRORS.

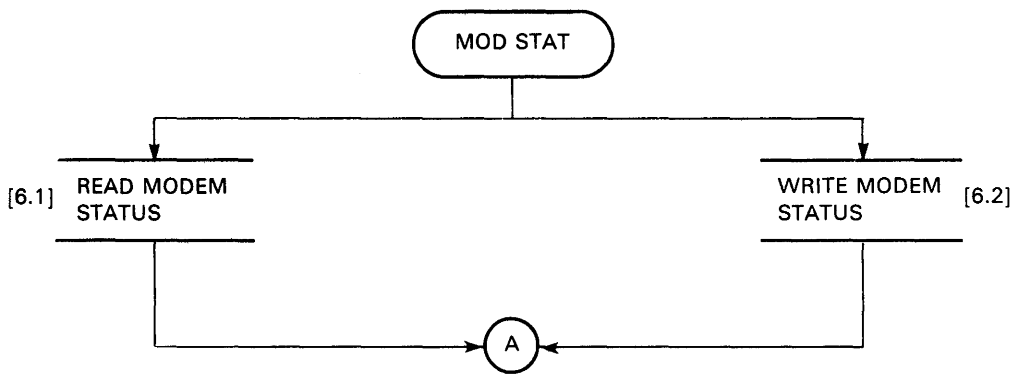
[3.4] SOFTWARE INTERLOCK - CONDITION IS SWITCH SELECTABLE FOR CONSTANT CTS MODEMS.

MK-1963


TRANSMIT 2
LESS THAN 7 REQUEST REMOTE PROGRAM LOAD MESSAGES SENT
TIMER←3 SEC
TIMER = 0
TRANSMIT
7 REQUEST REMOTE PROGRAM LOAD MESSAGES SENT
CLEAR DTR
TIMER←3 SEC
TIMER = 0
SET DTR
A
MK-1964



RECEIVE
HALF-DUPLEX
FULL-DUPLEX
TRANSMITTER NOT ACTIVE
IN HALF DUPLEX, LINE UNIT PROVIDES INTERLOCK TO ENABLE RCV CLOCK ONLY IF TRANSMITTER IS IDLE. (RTS =OFF)
CD = ON SYNC'ED ON NEW FRAME
START TO RECEIVE
CD = OFF
CD DROPPED IN THE MIDDLE OF DATA STREAM
RESET CDTIMR TO 128 mSEC
CD = ON
CDTIMR = 0
NOTIFY USER OF CARRIER LOSS (CONTROL RESPONSE)
END OF RECEIVE
RESET RECEIVER
A
MK-1965



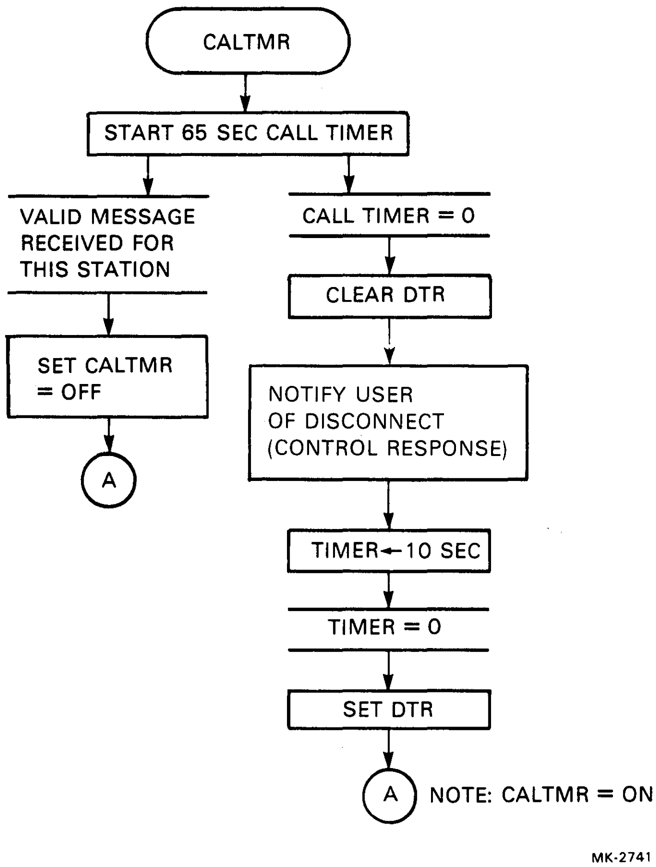
[6.1]
READABLE MODEM SIGNALS:

CARRIER
CLEAR TO SEND
MODEM READY (DSR)
HALF DUPLEX
REQUEST TO SEND
DATA TERMINAL READY
RING
TEST MODE

[6.2]
WRITEABLE MODEM SIGNALS:

DATA TERMINAL READY
SELECT STANDBY
REMOTE MODEM LOOPBACK
LOCAL MODEM LOOPBACK
NEW (POLLING) SIGNAL
SELECT FREQUENCY

MK-1966


CALTMR
START 65 SEC CALL TIMER
VALID MESSAGE RECEIVED FOR THIS STATION
SET CALTMR = OFF
A
CALL TIMER = 0
CLEAR DTR
NOTIFY USER OF DISCONNECT (CONTROL RESPONSE)
TIMER←10 SEC
TIMER = 0
SET DTR
A
NOTE: CALTMR = ON
MK-2741

APPENDIX E
INTERFACE DIAGNOSTIC COMMAND FLOWCHARTS

The DMP11 interface diagnostic command permits a user program to test the data paths from the DMP11 through the CSRs to the main CPU. A typical use of this command is to include a routine capable of issuing this command and evaluating diagnostic results as part of the user program. This routine, then, is executed as part of the system initialization process. Such a routine can also be part of a system diagnostic package running in the main CPU.

This command performs the following tests with results available for evaluation by the main CPU diagnostic routine:

1. Set the CSRs (except BSEL1) to all ones.

2. Set the CSRs (except BSEL1) to all zeros. The main CPU diagnostic routine has the option of looping back to perform test 1 again.

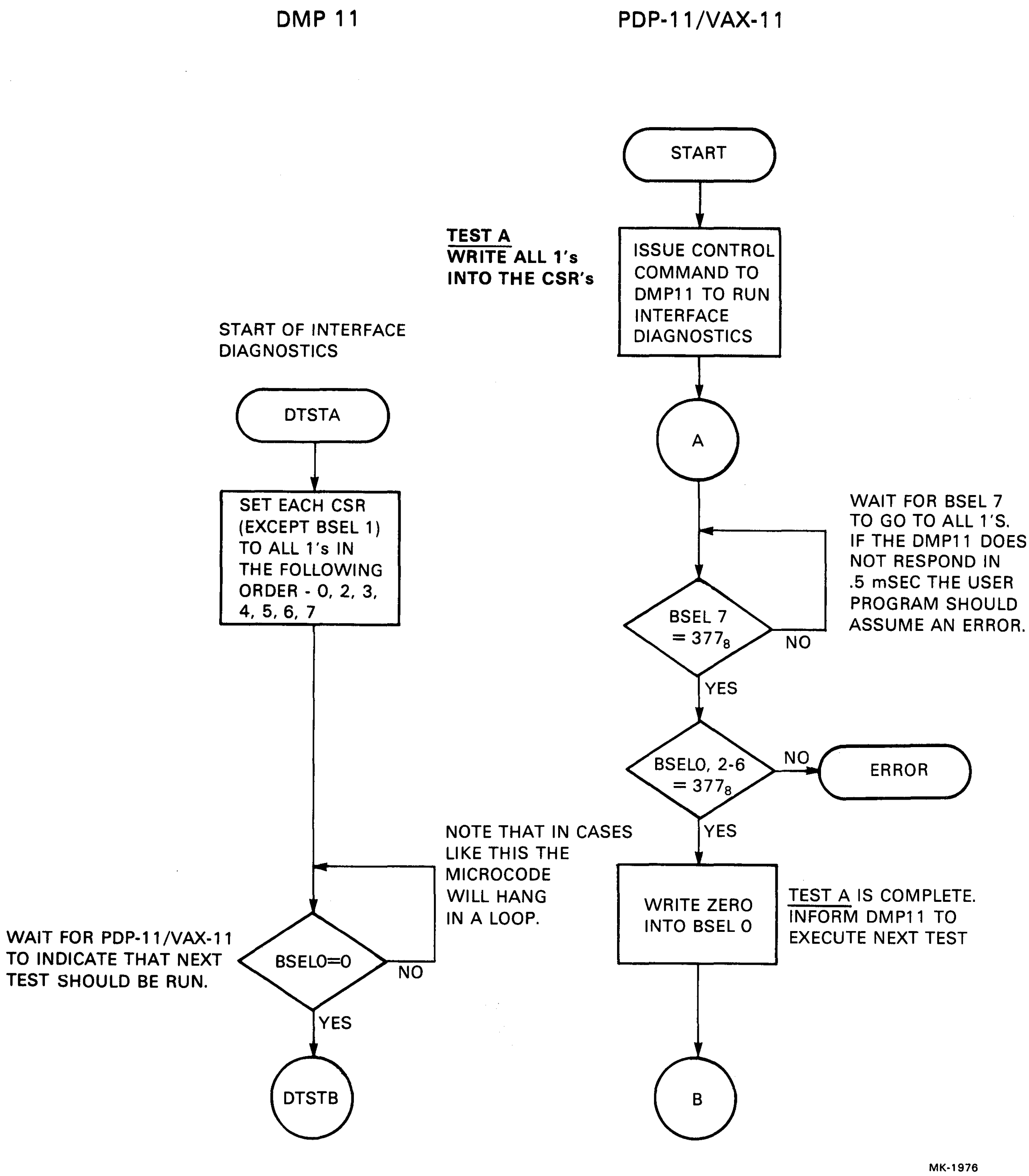
3. Test input interrupt vector (XX0).

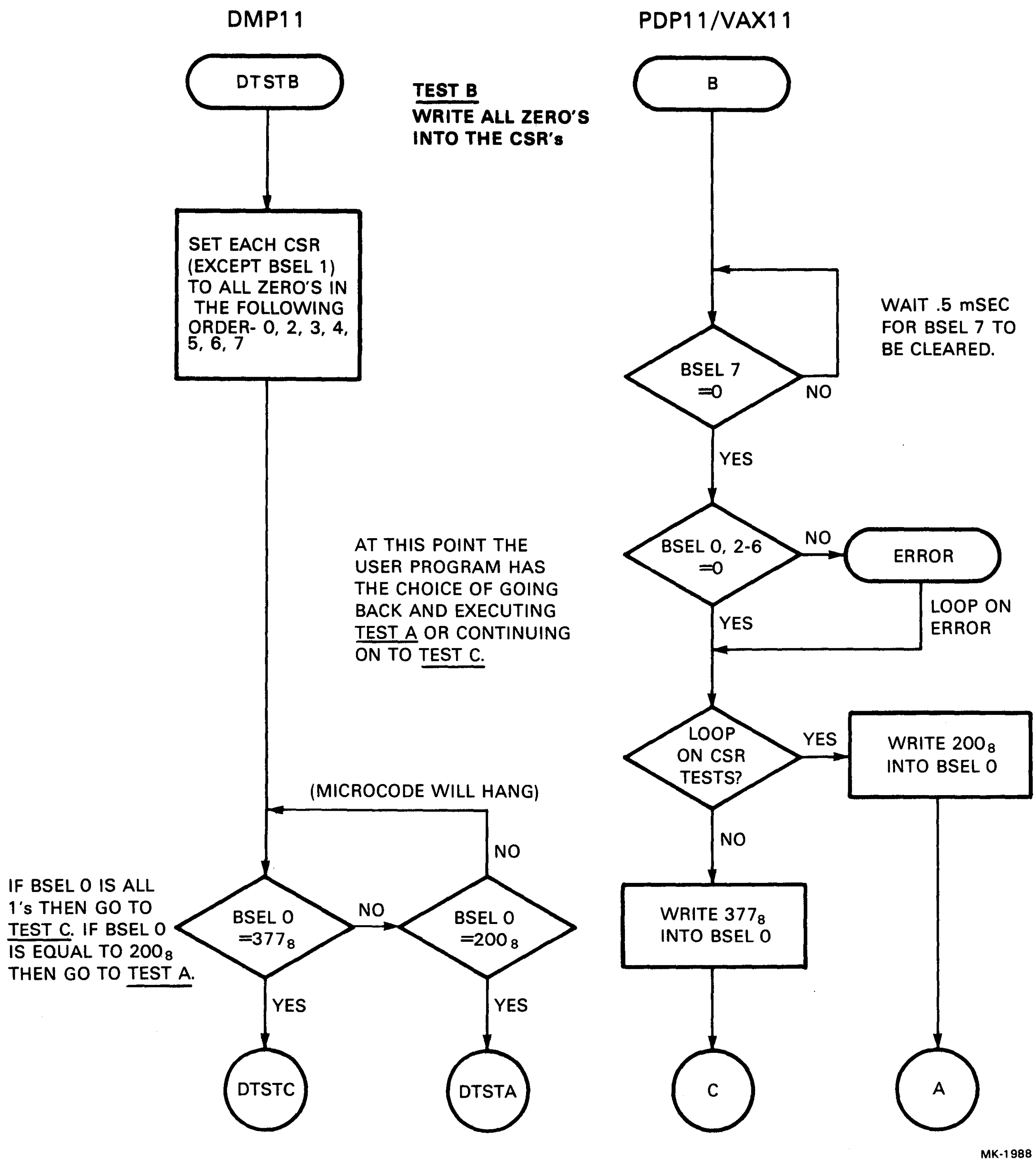
4. Test output interrupt vector (XX4).

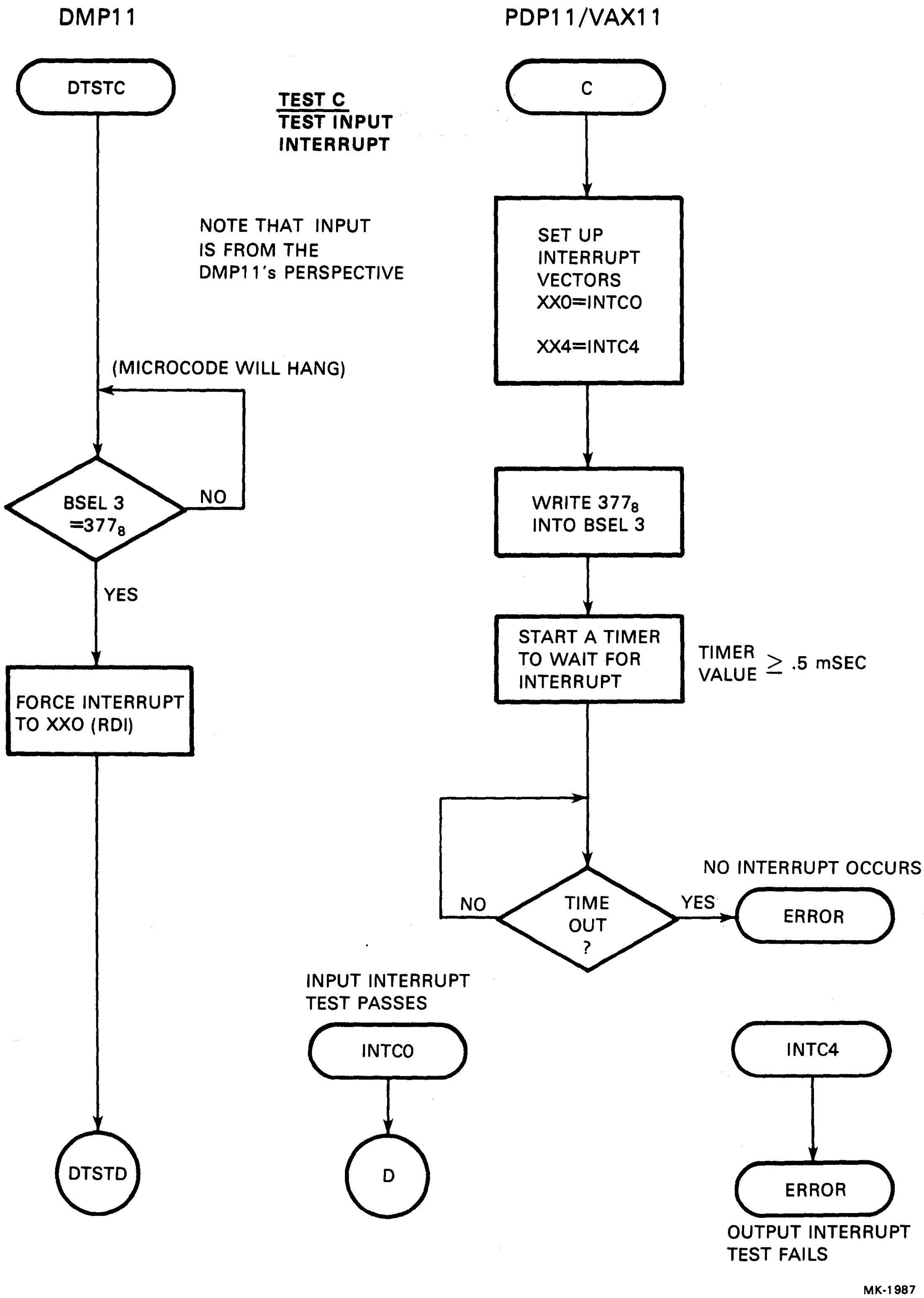
5. NPR the content of one main CPU location to another. Block NPRs can be done by incrementing the NPR in and NPR out addresses.

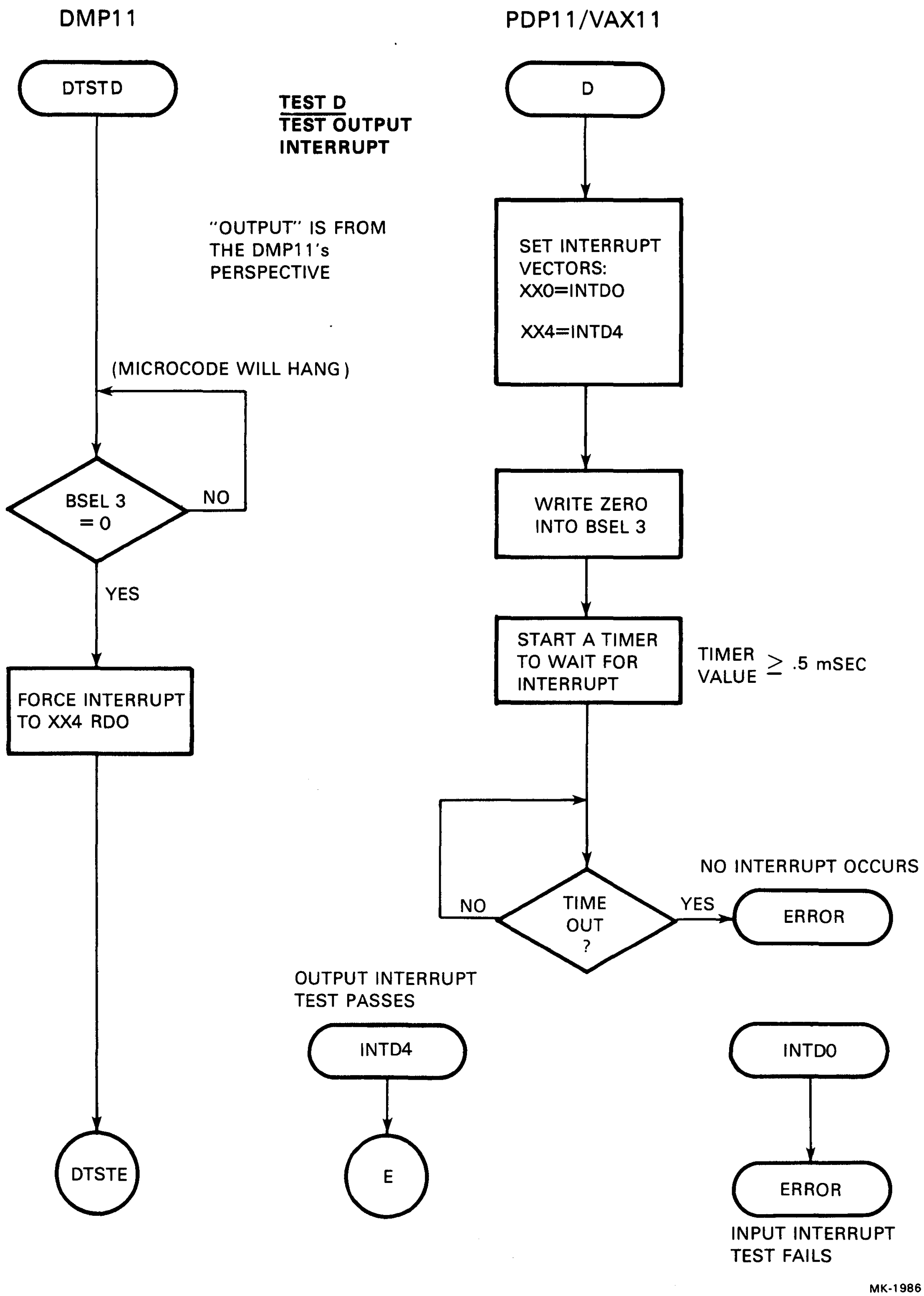
To perform these tests, the startup procedure detailed in Section 4.3 should be completed up to and including the mode definition command. At this point a control command with the run interface diagnostic request key can be issued to perform the tests listed above and detailed in the flowcharts that follow.

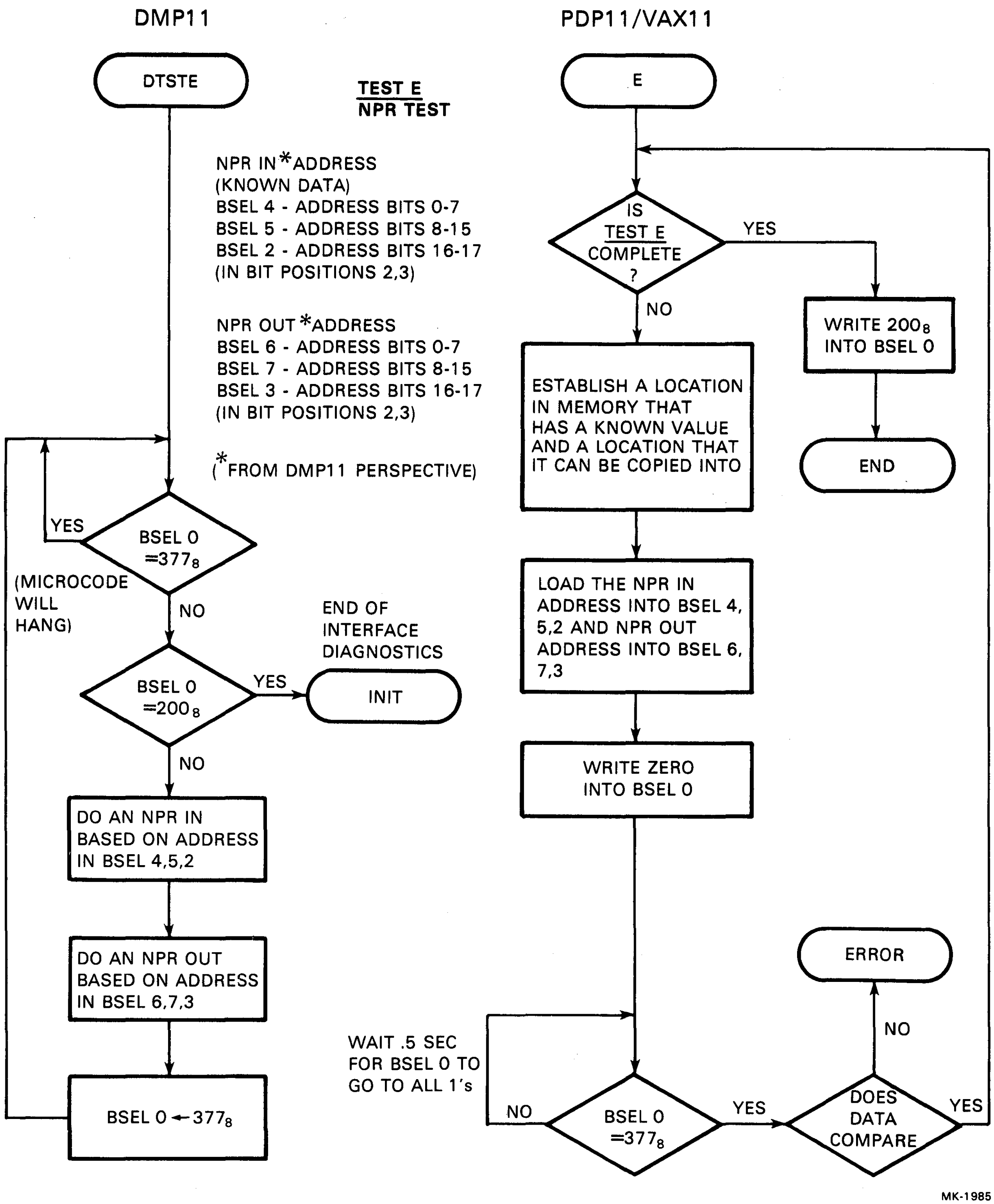
NOTE
When these tests have completed successfully, the mode, if software selected, must be re-established in order to continue system configuration.


DMP 11
PDP-11/VAX-11
START
TEST A
WRITE ALL 1's
INTO THE CSR's
ISSUE CONTROL
COMMAND TO
DMP11 TO RUN
INTERFACE
DIAGNOSTICS
START OF INTERFACE
DIAGNOSTICS
DTSTA
A
SET EACH CSR
(EXCEPT BSEL 1)
TO ALL 1's IN
THE FOLLOWING
ORDER - 0, 2, 3,
4, 5, 6, 7
WAIT FOR BSEL 7
TO GO TO ALL 1'S.
IF THE DMP11 DOES
NOT RESPOND IN
.5 mSEC THE USER
PROGRAM SHOULD
ASSUME AN ERROR.
BSEL 7
= 377_8
NO
YES
BSEL0, 2-6
= 377_8
NO
ERROR
YES
NOTE THAT IN CASES
LIKE THIS THE
MICROCODE
WILL HANG
IN A LOOP.
WRITE ZERO
INTO BSEL 0
TEST A IS COMPLETE.
INFORM DMP11 TO
EXECUTE NEXT TEST
WAIT FOR PDP-11/VAX-11
TO INDICATE THAT NEXT
TEST SHOULD BE RUN.
BSEL0=0
NO
YES
DTSTB
B
MK-1976


DMP11
PDP11/VAX11
DTSTB
TEST B
WRITE ALL ZERO'S
INTO THE CSR's
B
SET EACH CSR (EXCEPT BSEL 1) TO ALL ZERO'S IN THE FOLLOWING ORDER- 0, 2, 3, 4, 5, 6, 7
WAIT .5 mSEC FOR BSEL 7 TO BE CLEARED.
BSEL 7 =0
NO
YES
AT THIS POINT THE USER PROGRAM HAS THE CHOICE OF GOING BACK AND EXECUTING TEST A OR CONTINUING ON TO TEST C.
BSEL 0, 2-6 =0
NO
ERROR
YES
LOOP ON ERROR
LOOP ON CSR TESTS?
YES
WRITE 200₈ INTO BSEL 0
(MICROCODE WILL HANG)
NO
NO
IF BSEL 0 IS ALL 1's THEN GO TO TEST C. IF BSEL 0 IS EQUAL TO 200₈ THEN GO TO TEST A.
BSEL 0 =377₈
NO
BSEL 0 =200₈
WRITE 377₈ INTO BSEL 0
YES
YES
DTSTC
DTSTA
C
A
MK-1988


DMP11
PDP11/VAX11
DTSTC
TEST C
TEST INPUT
INTERRUPT
C
NOTE THAT INPUT
IS FROM THE
DMP11's PERSPECTIVE
SET UP
INTERRUPT
VECTORS
XX0=INTC0
XX4=INTC4
(MICROCODE WILL HANG)
BSEL 3
=377$_8$
NO
WRITE 377$_8$
INTO BSEL 3
YES
START A TIMER
TO WAIT FOR
INTERRUPT
TIMER
VALUE ≥ .5 mSEC
FORCE INTERRUPT
TO XXO (RDI)
NO INTERRUPT OCCURS
NO
TIME
OUT
?
YES
ERROR
INPUT INTERRUPT
TEST PASSES
INTC0
INTC4
DTSTD
D
ERROR
OUTPUT INTERRUPT
TEST FAILS
MK-1987


DMP11
PDP11/VAX11
DTSTD
D
TEST D
TEST OUTPUT
INTERRUPT
"OUTPUT" IS FROM
THE DMP11's
PERSPECTIVE
SET INTERRUPT
VECTORS:
XX0=INTD0
XX4=INTD4
(MICROCODE WILL HANG)
BSEL 3
= 0
NO
YES
WRITE ZERO
INTO BSEL 3
START A TIMER
TO WAIT FOR
INTERRUPT
TIMER
VALUE ≥ .5 mSEC
FORCE INTERRUPT
TO XX4 RDO
NO INTERRUPT OCCURS
NO
TIME
OUT
?
YES
ERROR
OUTPUT INTERRUPT
TEST PASSES
INTD4
INTD0
DTSTE
E
ERROR
INPUT INTERRUPT
TEST FAILS
MK-1986


DMP11
PDP11/VAX11
DTSTE
TEST E
NPR TEST
E
NPR IN*ADDRESS
(KNOWN DATA)
BSEL 4 - ADDRESS BITS 0-7
BSEL 5 - ADDRESS BITS 8-15
BSEL 2 - ADDRESS BITS 16-17
(IN BIT POSITIONS 2,3)
NPR OUT*ADDRESS
BSEL 6 - ADDRESS BITS 0-7
BSEL 7 - ADDRESS BITS 8-15
BSEL 3 - ADDRESS BITS 16-17
(IN BIT POSITIONS 2,3)
(*FROM DMP11 PERSPECTIVE)
IS TEST E COMPLETE ?
YES
NO
WRITE 200₈ INTO BSEL 0
END
ESTABLISH A LOCATION IN MEMORY THAT HAS A KNOWN VALUE AND A LOCATION THAT IT CAN BE COPIED INTO
YES
BSEL 0 =377₈
(MICROCODE WILL HANG)
NO
END OF INTERFACE DIAGNOSTICS
BSEL 0 =200₈
YES
INIT
NO
LOAD THE NPR IN ADDRESS INTO BSEL 4, 5,2 AND NPR OUT ADDRESS INTO BSEL 6, 7,3
WRITE ZERO INTO BSEL 0
DO AN NPR IN BASED ON ADDRESS IN BSEL 4,5,2
DO AN NPR OUT BASED ON ADDRESS IN BSEL 6,7,3
ERROR
NO
WAIT .5 SEC FOR BSEL 0 TO GO TO ALL 1's
BSEL 0 ← 377₈
NO
BSEL 0 =377₈
YES
DOES DATA COMPARE
YES
MK-1985

DMP11 SYNCHRONOUS CONTROLLER TECHNICAL MANUAL
EK-DMP11-TM-001

Reader's Comments

Your comments and suggestions will help us in our continuous effort to improve the quality and usefulness of our publications.

What is your general reaction to this manual? In your judgement is it complete, accurate, well organized, well written, etc? Is it easy to use? ______

What features are most useful? ______

What faults or errors have you found in the manual? ______

Does this manual satisfy the need you think it was intended to satisfy? ______

Does it satisfy *your* needs? ______ Why? ______

☐ Please send me the current copy of the *Technical Documentation Catalog*, which contains information on the remainder of DIGITAL's technical documentation.

Name ______ Street ______
Title ______ City ______
Company ______ State/Country ______
Department ______ Zip ______

Additional copies of this document are available from:

Digital Equipment Corporation
444 Whitney Street
Northboro, MA 01532

Attention: Printing and Circulation Services (NR2/M15)
Customer Services Section

Order No. EK-DMP11-TM-001

Fold Here

Do Not Tear – Fold Here and Staple

digital

No Postage Necessary if Mailed in the United States

BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO. 33 MERRIMACK, NH

POSTAGE WILL BE PAID BY ADDRESSEE

Digital Equipment Corporation
Educational Services Department & Publishing
Continental Blvd. (MK1/2M26)
Merrimack, N.H. 03054

Digital Equipment Corporation • Bedford, MA 01730